Essentials of
Prosthodontics

SH Soratur
BDS (Bombay), FICD (USA)
Reader (Retd), Rajiv Gandhi College of Dental Sciences, Bangalore
Formerly, House Surgeon at
University College Hospital, London and
Glasgow Royal Infirmary, Scotland
Dental Practitioner in London
Author of: (1) Essentials of Dental Materials
(2) Viva in Dental Materials, (3) Viva in Prosthodontics

JAYPEE BROTHERS
MEDICAL PUBLISHERS (P) LTD
New Delhi

Highdent laboratory

مرکز تخصصی پروتزهای دندانی

های دنت

طراحی و ساخت انواع پروتزهای دندانی بویژه ایمپلنت

برگزار کننده دوره های آموزشی تخصصی وجامع دندانسازی و...

با ما همراه باشید...

WWW.HIGHDENTLAB.COM

Published by

Jitendar P Vij
Jaypee Brothers Medical Publishers (P) Ltd
EMCA House, 23/23B Ansari Road, Daryaganj
New Delhi 110 002, India
Phones: +91-11-23272143, +91-11-23272703, +91-11-23282021, +91-11-23245672
Fax: +91-11-23276490, +91-11-23245683 e-mail: jaypee@jaypeebrothers.com
Visit our website: www.jaypeebrothers.com

Branches

- 2/B, Akruti Society, Jodhpur Gam Road Satellite
  Ahmedabad 380015, Phone: +91-079-30988717
- 202 Batavia Chambers, 8 Kumara Krupa Road, Kumara Park East
  Bangalore 560 001, Phones: +91-80-22285971, +91-80-22382956, +91-80-30614073
  Tele Fax: +91-80-22281761 e-mail: jaypeemedpubbgl@eth.net
- 282 IIIrd Floor, Khaleel Shirazi Estate, Fountain Plaza
  Pantheon Road, **Chennai** 600 008, Phones: +91-44-28262665, +91-44-28269897
  Fax: +91-44-28262331 e-mail: jpchen@eth.net
- 4-2-1067/1-3, Ist Floor, Balaji Building, Ramkote
  Cross Road, **Hyderabad** 500 095, Phones: +91-40-55610020, +91-40-24758498
  Fax: +91-40-24758499 e-mail: jpmedpub@rediffmail.com
- 1A Indian Mirror Street, Wellington Square
  Kolkata 700 013, Phones: +91-33-22456075, +91-33-22451926
  Fax: +91-33-22456075 e-mail: jpbcal@cal.vsnl.net.in
- 106 Amit Industrial Estate, 61 Dr SS Rao Road, Near MGM Hospital
  Parel, **Mumbai** 400 012, Phones: +91-22-24124863, +91-22-24104532,
  +91-22-30926896 Fax: +91-22-24160828 e-mail: jpmedpub@bom7.vsnl.net.in
- "KAMALPUSHPA" 38, Reshimbag Opp Mohota Science College,
  Umred Road, **Nagpur** 440 009 (MS), Phone: +91-712-3945220, +91-712-2704275
  e-mail: jpmednagpur@rediffmail.com

Essentials of Prosthodontics

First Edition: **2006**

ISBN 81-8061-697-5

Typeset at JPBMP typesetting unit
Printed at Gopsons Papers Ltd, A-14, Sector 60, Noida 201 301, India

Dedicated to

All of my teachers
from
Primary School (Shiragambi)
to
Postgraduate Level (London)

Foreword

I am happy to write a foreword to "*Essentials of Prosthodontics*" by Dr SH Soratur, whom I know since many years. This book has filled a vacuum felt for long in the field of prosthodontics, and the text is based on the long experience the author has had in teaching and clinical practice both in India and abroad.

The style of discussing a subject is simply wonderful because it goes to the root of the matter and by giving examples of everyday life, the mind-boggling aspects of the topics are made easily understood and interesting. A vast subject such as prosthodontics cannot be dealt in detail in a book of this size, but its essentials are well-narrated and illustrated touching all branches of the subject.

I am sure that the students and general dental practitioners will find this book valuable and useful to enhance one's knowledge.

Dr Prafulla Thumati
Principal
Bangalore Institute of
Dental Sciences and Hospital
Bangalore 560 029

Preface

This book is a product of my 40 years of private dental practice in India and abroad including 24 years of teaching experience in different dental colleges. It deals with basics and essentials of complete and partial dentures necessary for undergraduate students and general dental practitioners. At the same time it fulfills the university syllabus from examination point of view.

Simple step-by-step procedures explained in simple language will remove all confusions about the tricky work of making dentures.

The book is in five parts, part one deals with basics from the prosthodontic point of view, part two deals with laboratory procedures (Pre-clinical) involved in making complete dentures, part three deals with clinical procedures of complete denture construction, part four with partial dentures and finally part five with crowns, bridges, implant dentures, obturators, and maxillofacial-prosthesis very-very briefly.

Since “Good Dentures are a Thing of Beauty and Joy Forever,” I am of the opinion that sincerity and due attention to all stages is essential for the success of prosthodontic work. However, use of common sense and belief in “Practice makes perfect” equally holds good. The book is suitably-illustrated with plenty of drawings and photographs, which make it all the more interesting to read. I hope and wish that students and practitioners of dentistry will be immensely benefited by reading this book.

SH Soratur

Acknowledgements

I am thankful to:

- My son Dr Puneet Soratur for his painstaking correction of the script, proofreading and valuable suggestions.
- My another son Rajeev Soratur (Artist) and his wife Vidya for their attractively drawn diagrams and sketches.
- Dr Prafulla T, MDS (Prosthodontics), Principal, Bangalore Institute of Dental Sciences, Bangalore, for writing a foreword to this book.
- M/s Jaypee Brothers for publishing this attractive book.

Contents

Part 1
INTRODUCTION

Part 2
LABORATORY PROCEDURES FOR COMPLETE DENTURES

Part 3
CLINICAL PROCEDURES FOR COMPLETE DENTURES

PART 4
PARTIAL DENTURES

PART 5
CROWNS, BRIDGES, AND MISCELLANEOUS

PART 1 INTRODUCTION

1 Applied Anatomy and Physiology

The Skull

This is divided into;

a. Cranial part — Which contains and protects brain.
b. Facial part — Which contains eyes, nose and mouth.

Number of bones joined by sutures makeup the skull.

Bones of Cranium

a. Frontal bone is in the front above the eyes.
b. Parietal and temporal bones form the sidewalls of the skull above the ears.
c. Occipital bone forms the back of the skull.
d. Occipital bone, temporal bones, and sphenoid bones together form the under surface of the skull. There are numerous openings (foramina) in the base of the skull through which blood vessels and nerves pass (Fig. 1.1).

Facial Bones

This consist of:

a. Maxilla, upper jaw: This is made-up of two maxillary bones joined in the middle. This bone contributes to mouth cavity, nose cavity, and floor of the orbital cavities. Each maxilla has large air sinuses (maxillary sinus or antrum), which is connected, to the nose cavity. Antrum is above the roots of upper second premolar and molars.

Hard palate of maxilla forms the roof of the mouth; it is formed by two palatal processes of maxillary bone joining in the middle. If the two palatal processes fail to join during development, the result is cleft palate. Surgically untreated cleft palates are treated by prosthesis known as obturator.

The maxilla is firmly attached to the skull and so immovable. The maxilla carries maxillary teeth.

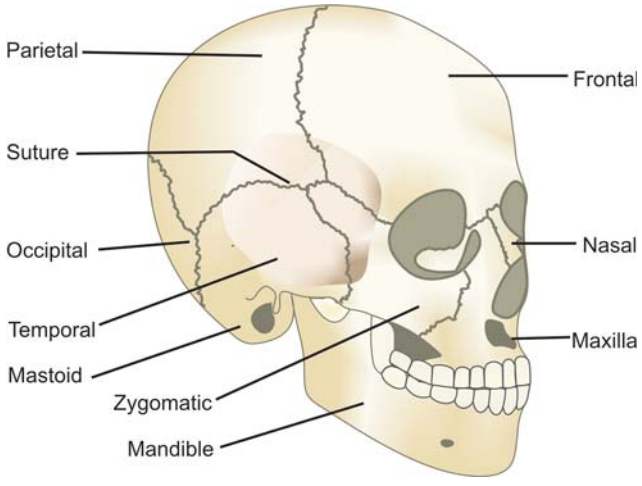


Fig. 1.1: Human skull

b. The palatine bones—These form the posterior parts of the hard palate and also side walls of nasal cavity.
c. Zygomatic (Malar) bones—also known as "Cheek bones" form the upper part of the cheeks- this and the process of temporal bone together form the Zygomatic arch at the side of the skull (Fig. 1.2).
d. Mandible – Lower jaw—This is a single bone of horse shoe shape attached to the base of the skull not by sutures but by two joints known as tempero-mandibular joints, situated just in front of the ears.

Parts of mandible:

i. **Alveolar process:** Lower teeth are socketed in this part and mucous membrane (gum) is attached to it.
ii. **Body of mandible**: This supports the alveolar process. Body has lower border forming the chin in the front and angle of the jaw at the back. On the outer surface of the body there is external oblique ridge to which buccinator muscle is attached. On the inner surface there is mylohyoid ridge (internal oblique ridge) to which mylohyoid muscle is attached. Also on the outer surface of the body of the mandible

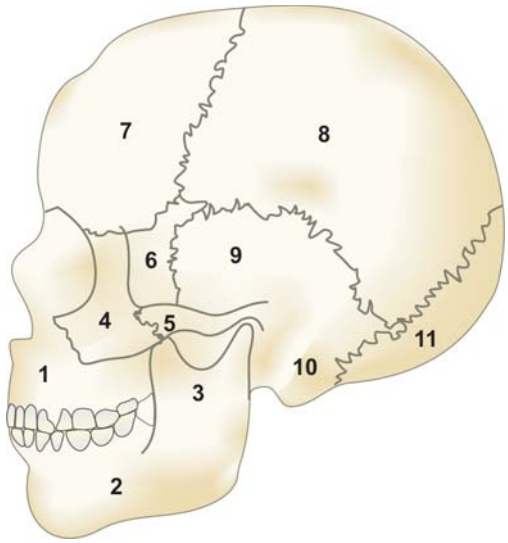


Fig. 1.2: Side of the skull
1. Maxilla, 2. Mandible, 3. Ramus of mandible, 4. Zygomatic bone, 5. Zygomatic arch, 6. Sphenoid process, 7. Frontal bone, 8. Parietal bone, 9. Temporal bone, 10. Mastoid process, 11. Occipital bone

below the premolar teeth there is the mental foremen from which nerves and blood vessels pass to the lower lip and gums in the incisor and canine region. Within the body of mandible there is the inferior dental canal through which inferior dental nerve and blood vessels travel. Body of the mandible is developed from Meckel's cartilage.

On the inner surface of the mandible in the midline there are genial tubercles (Fig. 1.3).

iii. **Mandibular ramus**: This is the vertical plate on the back of the body of the mandible.

The ramus has two processes; namely (a) Anterior coronoid process and (b) Posterior condyloid process. Between these processes is the sigmoid notch.

On the inner side of the ramus there is the posterior opening of the inferior dental (mandibular) canal through which nerve and blood vessels enter the body of the mandible. The tip of the coronid process gets attachment of temporal muscle. The upper most part of condyloid process is known as head of the condyle and fits into a hollow space (glenoid fossa) of the skull in front of the ear.

e. The other facial bones are Nasal bone, Lacrimal and Ethmoid bones.

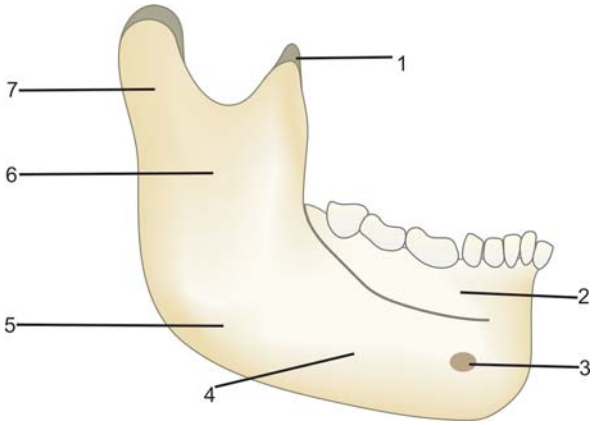


Fig.1.3: Outer surface of mandible
1. Coronoid process, 2. Alveolar process, 3. Mental foramen, 4. Body, 5. Angle, 6. Ramus, 7. Condyler process

ORAL CAVITY (MOUTH)

Boundaries

Anteriorly	—	Lips
Posteriorly	—	Pharynx
Laterally	—	Cheeks
Above	—	Roof of the mouth.
Below	—	Floor of the mouth (Fig. 1.4)

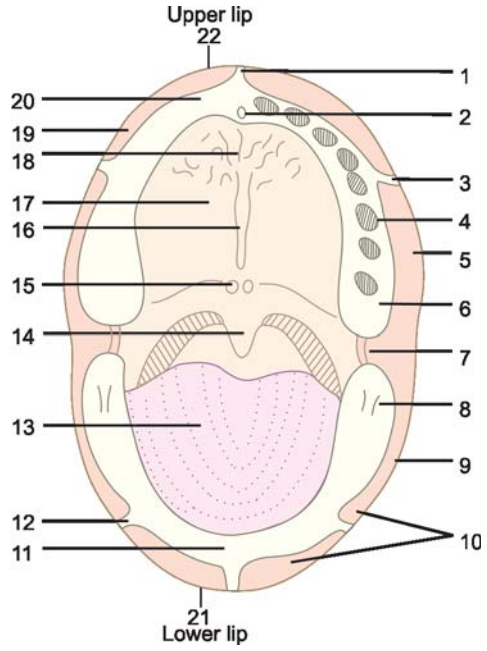


Fig 1.4: Oral cavity
1. Maxillary labial frenum, 2. Incisive papilla, 3. Maxillary buccal frenum, 4. Alveolar socket, 5. Cheek, 6. Tuberosity, 7. Hamular notch, 8. Retromolar pad, 9. Cheek, 10. Sulcus, 11. Mandibular alveolar ridge, 12. Mandibular buccal frenum, 13. Tongue, 14. Uvula, 15. Palatal fovea, 16. Palatal torus, 17. Hard palate, 18. Rugae, 19. Sulcus, 20. Maxillary alveolar ridge

The oral cavity is lined with mucous membrane, which is attached to the necks of teeth, to the alveolar bone and to the hard palate. In other areas, the mucous membrane covers the muscles of the lips, cheeks, soft palate and tongue. Histologically the mucous membrane has surface epithelial cells, and underlying connective tissue layer consisting of fibres, fibroblasts, small blood vessels; lymph vessels; nerve endings and nerves related to the sensation of pain, touch, hot, cold and taste.

The mucous membrane where it is firmly attached to the underlying bone is immovable and is used as a denture foundation. Where it is covering the muscles it is movable and is more sensitive. The reflexion of the mucous membrane from the alveolar bone to the lips and cheeks forms the vestibule of the mouth.

Contents of the Oral Cavity

a. Teeth in dentulous state.
b. Gum (ridge) in edentulous state.
c. Tongue
d. Salivary glands.
e. Frenal attachments.
f. Saliva (Fig. 1.5).

Permanent Teeth

These are 32 in number together in the upper and lower jaw- with 16 in each jaw and 8 on each side of the jaw, starting from the midline of the oral cavity. These teeth are represented as follows:

Patient's Right		Patient's Left
87654321	12345678	upper
87654321	12345678	lower

Description of Tooth

Root — Tooth part below the gum and covered by cementum.
Crown — Tooth part above the gum and covered by enamel.
Mesial — Tooth part nearest to the median line.
Distal — Tooth part away from the median line.
Labial — Tooth part of anterior tooth facing the lips.
Buccal — Tooth part of posterior tooth touching the cheek.
Incisal — Cutting surface of anterior tooth.
Occlusal — Chewing surface of posterior tooth.
Cervical — Tooth part at which root and crown meet.
Gingival — Tooth part which touches the gum or gingiva.
Lingual — Tooth part which is nearest to tongue.
Palatal — Tooth part that is nearest to the palate.
Proximal — Tooth part which is in close contact with another tooth (Fig. 1.6)
Cingulum — It is the lingual bulge at the base of the crown of anterior tooth.
Anterior teeth — These are the 12 teeth (front) (6 in the upper jaw and 6 in the lower) near the upper and lower lips.

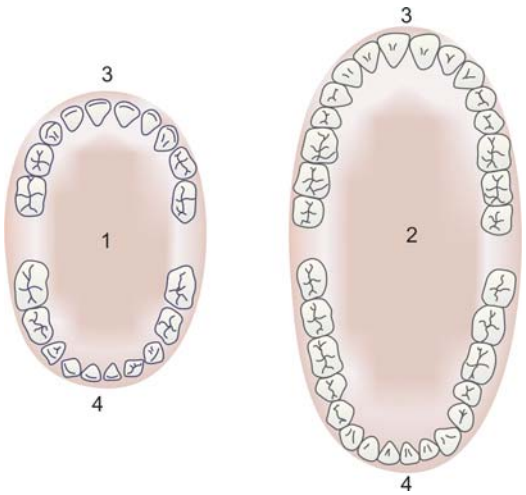


Fig. 1.5: Dental arches
1. Deciduous teeth, 2. Permanent teeth, 3. Maxillary, 4. Mandibular

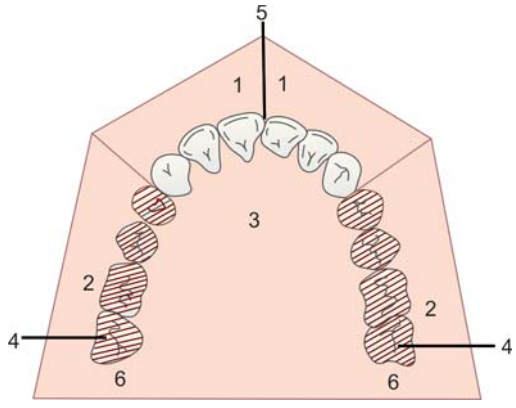


Fig 1.6: Dental arch
1. Labial, 2. Buccal, 3. Lingual or palatal, 4. Occlusal, 5. Mesial, 6. Distal

Part 1

Function—biting, tearing and shearing

Posterior teeth — These are 20 teeth (Back) (10 in the upper jaw and 10 in the lower situated behind the anteriors. **Function**—Chopping and grinding.)

Histology of Tooth

Tooth is made up of enamel, dentine, pulp and cementum. Root of the tooth is held in the alveolar bone of the main jawbone by means of periodontal membrane (Fig. 1.7).

1st Permanent Molar "Key of Occlusion"

These teeth erupt immediately behind the second deciduous molars usually at the age of six years, which is about one year before the first of the deciduous teeth, are shed.

Proper occlusion of these teeth, upper with lower and on both sides of the arch is one important step for the reasons of;

a. Proper mastication.
b. Growth and development of the lower half of face.
c. Facial expression.
d. Oral health and general health.

Because these four 1st molars in proper occlusion.

1. Hold the jaws in proper relation during the changing over period of deciduous teeth to permanent teeth.
2. Proper inter-digitations of upper and lower 1st molars prevent the future irregularities of occlusion. So this is called "Key of occlusion".
3. These four teeth support the jaws.

Then the eruption sequence of permanent teeth is as follows;

Central Incisor at	7 years of age
Lateral Incisor at	8 years of age
1st premolar at	10 years of age
2nd pre molar at	11 years of age
2nd molars and canines at	12 years of age
3rd molar at	18-20 years of age.

When all the permanent teeth are erupted to full occlusion.

a. Mesiodistal relation—Lower teeth cusps are little anterior to the corresponding cusps of the upper teeth.
b. Upper teeth overlap the lower teeth all around the arch.
c. Buccal cusps of uppers and lingual cusps of lowers show prominence which prevents cheek and tongue biting, by pushing the cheek and tongue aside during chewing (Fig. 1.8).

EDENTULOUS STATE

Denture Foundation "Denture-bearing Areas"

To support the denture, the area covered by the mucous membrane must have underlying bony support, called hard tissue area and this will firmly support the denture. The areas which take-up the main load of compression (of mastication) are the maxillary and mandibular alveolar ridges which are

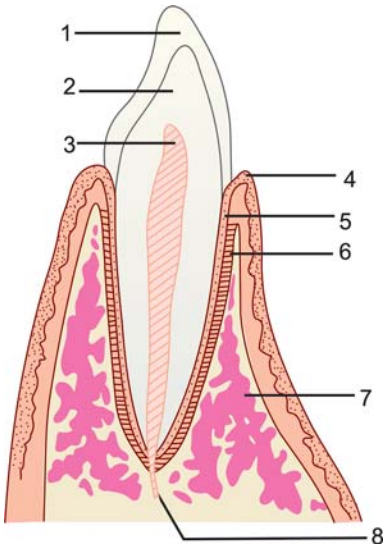


Fig 1.7: Structure of tooth
1. Enamel, 2. Dentin, 3. Pulp, 4. Gum (Gingiva), 5. Cementum, 6. Periodontal membrane, 7. Alveolar bone, 8. Apical foramen

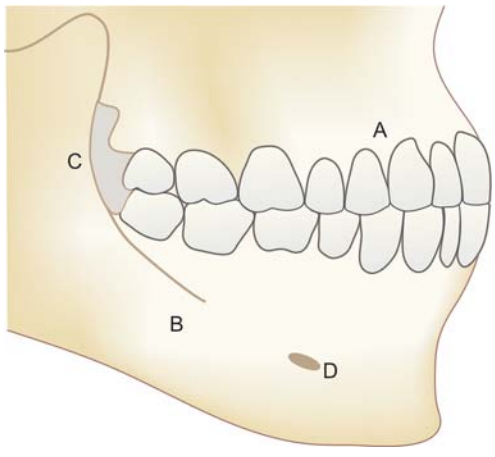


Fig 1.8: Occlusion of permanent teeth
A. Maxilla, B. Body of mandible, C. Ramus of mandible, D. Mental foramen

solid and unyielding, are known as **Main stress bearing areas**.

The palate is considered as **Secondary stress bearing area** because the bone underneath is thin and slightly flexible but it doesn't undergo resorption like alveolar ridges.

Bony prominences like torus palatinus and tuberosities should be suitably relieved to prevent pressure and pain.

The palatal rugea help in mixing the food into the taste buds of the tongue.

Palatal rugae should be sincerely copied on the fitting surface of the upper denture.

The tissue beyond the main and secondary stress bearing areas are the soft tissue areas, which are mobile and sensitive, are not the satisfactory denture foundation areas.

Denture coverage: Maxillary complete denture should cover the whole of the palate, labial and buccal aspects of alveolar ridge. The posterior border should be through the palatal fovea and completely cover the tuberosities.

Mandibular complete denture should cover the whole alveolar ridge right up to its full depth of sulcus. The posterior border should go over the flabby retromolar pads (Fig. 1.9).

Postdam: This is a raised lip on the posterior border of the fitting surface of the upper denture as a means of achieving perfect peripheral seal.

The Tongue

The tongue occupies the whole of the oral cavity when at rest with teeth occluded. It has a wonderful capacity to change its shape in so many ways during its many functional activities. It can be protruded, retracted, twisted and these are due to the combination of actions of intrinsic muscles of the tongue. Contraction of the intrinsic muscles shortens the tongue. These muscles are supplied by the hypoglossal (12th cranial) nerve.

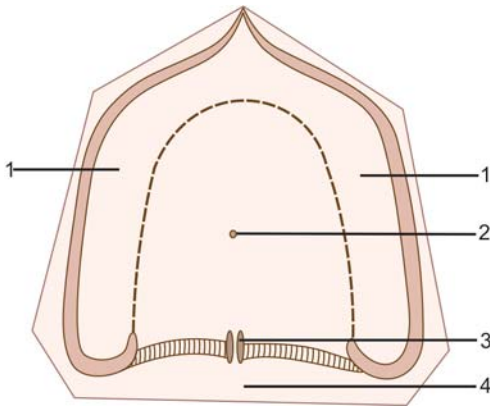


Fig 1.9: Maxillary denture foundation
1. Main stress-bearing area, 2. Subsidiary stress-bearing area, 3. Postdam area, 4. Soft tissue area

Parts of Tongue

Tongue is Divided into
a. Tip.
b. Dorsum (upper surface).
c. Right and left margin.
d. Undersurface.

Anterior 2/3 rd of the tongue only is visible by direct vision, but not the posterior 1/3rd.

The upper surface (Dorsum) and sides of the tongue has a mucous membrane with numerous small papillae (projections).

These are:
a. Filiform papillae
b. Fungiform papillae

At the junction of anterior 2/3rd and posterior 1/3rd in the center of the dorsum, there are circumvallate papillae.

These papillae give the tongue a rough surface to provide friction for the mastication of food.

Most taste buds are present in the epithelium of the tongue and some in the epithelium of soft palate, pharynx and epiglottis. The undersurface of the tongue is covered by smooth, thin, loosely attached mucous membrane and the mucous membrane is connected to the floor of the mouth by the midline frenum (lingual frenum).

The posterior part or root of the tongue is much more uneven and nodular due to rounded elevations with Central crypts. These are also called as lingual tonsils (Fig. 1.10).

Functions of Tongue

a. For mastication
b. For speech
c. For taste
d. To express emotions

Significance of Tongue

1. Tongue's movements, size and position should be taken into consideration while designing a denture.

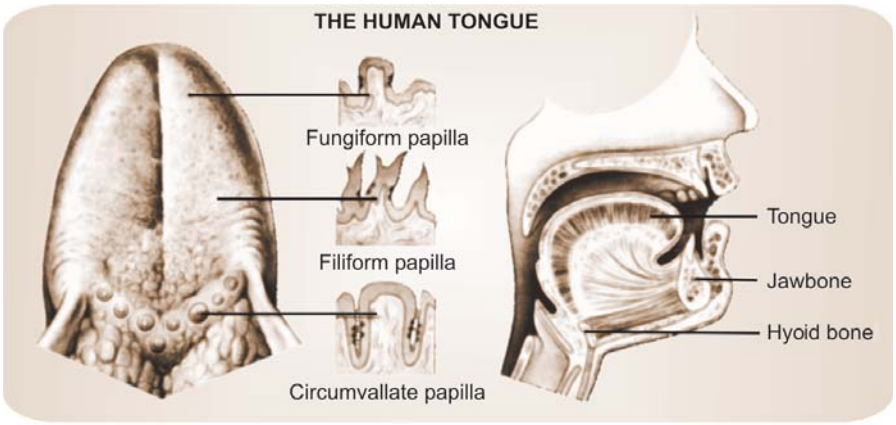


Fig 1.10: The human tongue
A. Upper surface, B. Side view (cut)

2. Ill-fitting denture or sharp, neglected tooth can cause irritation, ulcer or even cancer of tongue.
3. Help during registration of horizontal relation of mandible to maxilla—(i.e. centric Relation) – by asking the patient to put the tip of the tongue to the back of palate, the mandible is pulled back by tongue.

The Lips and Cheeks

These together form the anterior and lateral boundaries of the oral cavity. Their outer surface is covered by skin and inner surfaces by mucous membrane. They consist mainly of muscle tissue and collectively they are called "Muscles of Facial Expression" (Fig. 1.11).

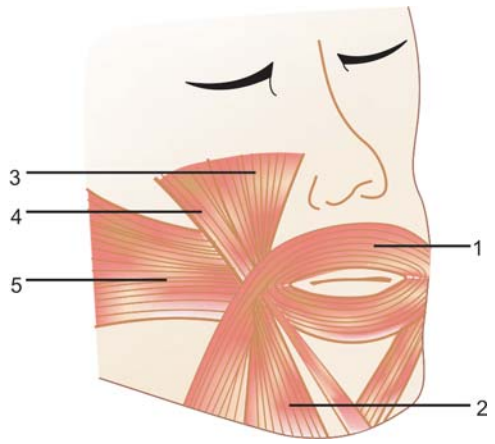


Fig. 1.11: Facial muscles
1. Orbicularis oris, 2. Triangularis, 3. Caninus, 4. Zygomaticus, 5. Buccinator

Muscles of the Lips

A. Closing muscles
Orbicularis oris—This forms the circular loop passing from one lip to the other around the corners of the mouth. When this muscle contracts the lips are drawn together and mouth is closed.
B. Opening muscles
Zygomaticus
Triangularis
Qudratus labi inferioris and superioris
Incisivus labi superioris and inferioris
Mentalis
Caninus

All these muscles enter the lips in a radial manner, and when they contract open the lips.

All these muscles together form the muscles of facial expression by their various reactions in the emotional states of joy, anger, sorrow and many others. These muscles are supplied by the facial nerve (7th cranial). Sensory impulses pass through buccinator and mental nerves.

All these muscles meet distal to the corners of the mouth to form a, Modiolus (meeting place). In the midline, upper lip and lower lip are connected to the gum by labial frenums. Upper labial frenum is better developed than lower labial frenum and both have to be relieved appropriately by the denture periphery.

Buccinator muscle is the main **Muscle of Cheek** and it takes its origin from the outer surface of the maxilla and is inserted in the mandible. At the posterior end it is attached to the pterygomandibular raphe. Its fibers run horizontally forward to continue into the orbicularis oris muscle, upper as well as lower

part. The buccinator is supplied by the branch of the facial nerve (7th cranial). The parotid duct pierces the buccinators to reach the buccal sulcus in the region of maxillary 2nd permanent molar tooth on each side of the face. The mucous membrane lining the cheeks is reflected on the alveolar bone of upper and lower jaws to form gums. The space between cheeks and lips on one side and gums and teeth on another side, is know as **Vestibule of the mouth** (Fig. 1.12).

Functions

With tongue on one side and lips and cheeks on another side keep the food on the occlusal surface of the teeth during mastication.

Significance

The area between tongue on one side, cheek and lips on other side is known as **"Neutral Zone"** as described by Sir William Kelsey Fry. And artificial teeth should be set-up in this neutral zone for the denture stability.

Roof of the mouth: Hard and soft palate

Hard and soft palates separate the oral cavity from the nasal cavity and nasopharynx. The bony part of the hard palate is made up by the palatal processes of the two maxilla and the horizontal process of the two palatal bones.

Anteriorly there is incisive foramen and posteriorly palatine foramena to transmit nerves and blood vessels.

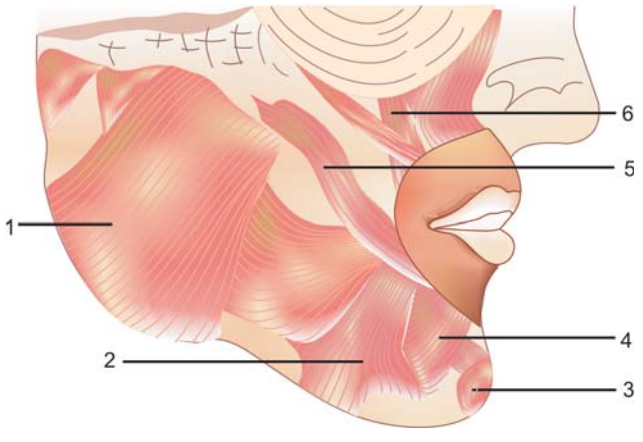


Fig. 1.12: Muscles of mastication and facial expression
1. Masseter, 2. Triangularis, 3. Mentalis, 4. Quadratus labi inferioris, 5. Zygomaticus, 6. Quadratus labi superioris

Soft Palate

This is continuous with the hard palate and ends posteriorly in a free margin. In the center of the free margin there is uvula. The sides of the soft palate has two folds (pillars)- namely, anterior pillar of the fauces formed by palato-glossal fold, and posterior pillar of the fauces formed by palato pharyngeal fold. Between the two pillars lies the lymphoid tissue called **Tonsil.**

The Muscles of Soft Palate

Levator veli palatini
Tensor veli palatini.
Uvula
Palato glossus
Palato pharyngeus.

Functions of Soft Palate

1. It is lifted up during swallowing and thus prevents food going into the nose.
2. At rest it forms a muscular seal by lying against the back of the tongue.

Floor of the Mouth

This is the area between the two horizontal rami of mandible and is occupied by tongue. The mucous membrane covering the floor of the mouth extends over the inner aspects of mandible to form labial and lingual gingivae and covers the under surface and lateral surface of tongue. Sublingual salivary glands are situated between the mylohyoid muscle and the mucosa of the floor of the mouth on both sides.

The right and left mylohyoid muscles are connected in the midline by a raphe. The muscles are attached anteriorly at the mylohyoid ridge of the mandible. Above the mylohyoid there are two geniohyoid muscles attached anteriorly to the genial tubercle and posteriorly to the hyoid bone. Also there is genioglossus muscle going into the tongue.

The submandibular salivary gland is situated in the floor of the mouth between the mandible and the tongue and under the mucous membrane towards the back of the oral cavity. The duct of each submandibular gland runs forward to open just behind the lower incisor teeth (Fig. 1.13).

Salivary glands: These are mainly 3 pairs
1. Parotid gland.
2. Submandibular gland
3. Sublingual gland.

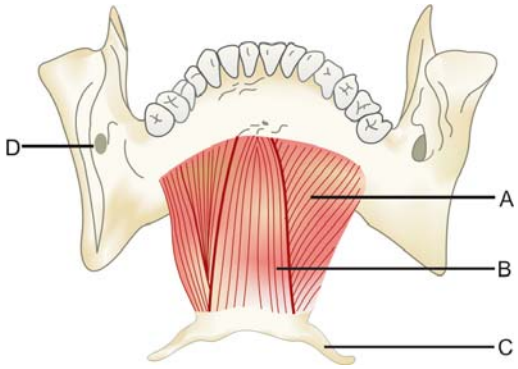


Fig. 1.13: Muscles of the floor of the mouth
A. Mylohyoid, B. Geniohyoid, C. Hyoid bone, D. Mandibular foramen

Parotid gland: This is situated below the ear and at the back of the mandible. Its duct (Stensen's duct) opens in the buccal vestibule in the region of maxillary second permanent molar tooth on each side.

Parotid gland is purely serous gland.

Submandibular gland is a mixed, serous and mucous gland.

Sublingual gland is almost entirely mucous gland.

Minor mucous glands are found in the palate, lips and cheeks and tongue.

Functions of Salivary Glands

To produce saliva and mucous.

Temperomandibular Joint—TMJ

This is a highly specialized joint and distinguished from most other joints by the fact the articulating surfaces are not covered by hyaline cartilage but by an avascular fibrous tissue. This is the joint on each side of the skull between the condyle of the mandible and the glenoid fossa and articular eminence of the temporal bone. This is a **Ginglymo arthrodial joint**. That means it has both hinge and sliding action.

Ginglimus = Hinge
Arthrotia = Joint

The mandible carries teeth, whose shape and position have a deciding influence upon the movement at the joints.

This is a bilateral articulation with the cranium and exerts a restricting influence on the movement of the mandible (Fig. 1.14).

The **Ligaments,** which assist the muscle in attaching the lower jaw to the skull, are;

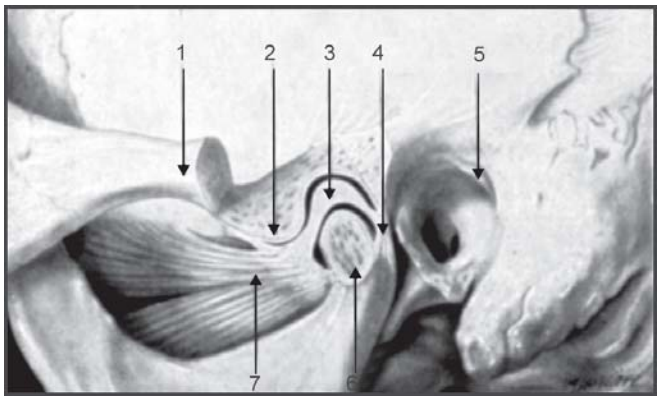


Fig. 1.14: Temperomandibular joint (Sagittal section)
1. Zygoma, 2. Articular eminence, 3. Articular Disc, 4. Capsular ligament, 5. Suprameatal spine, 6. Condylar process, 7. Lateral pterygoid muscle

1. Temperomandibular ligament.
2. Sphenomandibular—Spine to lingula
3. Stylo mandibular—Styloid process to posterior border of mandible (Fig. 1.15)
4. Pterygo mandibular - Hamulus to posterior end of mylohyoid ridge (Fig. 1.16).

Thus, the bony elements of the joint are united by a capsule and ligaments. Inside the capsule there is a joint cavity at which the movements between the bones take place. Each joint cavity is divided into upper and lower compartments by a horizontal articular disc or **Meniscus**. The disc is made up of interwoven bundle of connective tissue.

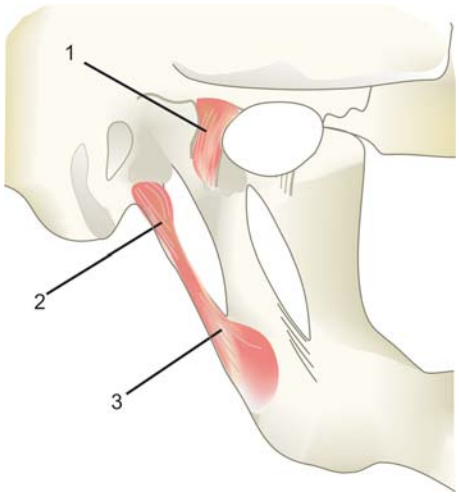


Fig. 1.15: Temperomandibular joint (outer view)
1. Temperomandibular ligament, 2. Styloid process, 3. Stylomandibular ligament

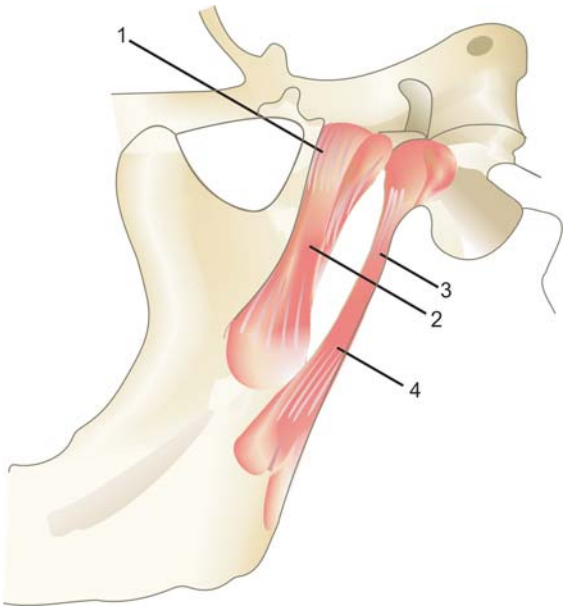


Fig. 1.16: Temperomandibular joint (Inner view)
1. Condyle, 2. Sphenomandibular ligament, 3. Styloid process, 4. Stylomandibular ligament

Posteriorly it forms a thick pad. Its central part is much thinner than the periphery.

The disc is attached medially and laterally to the condyle. This attachment is achieved by strong, short ligaments like the collateral ligaments of hinge joint.

The condyle is covered with dense fibrous tissue, so also the articulating surface of the temporal bone. In the fossa the covering is thin, becoming thick on the posterior slope and the articular eminence.

Synovial membrane as such does not cover the articular surface but there is a cellular layer at the peripheral boundaries of the joint—which is rich in cells and blood vessels and it is from these cells the synovial fluid is secreted and through this the bloodless tissues of the joint get their nutrition.

The temperomandibular ligament is a dense collagenous thickening of the capsular ligament on the lateral side of the joint passing downwards and backwards from the root of the Zygoma above, to the neck of the condyle below and behind. This is normally taut in all positions of the joint and thus keep condyle, disc and the temporal bone firmly opposed and prevent the backward displacement of condyle.

In the position of rest and normal occlusion, the head of the condyle is held balanced by the lateral pterygoid against the posterior slope of the eminentia and is not permitted to move back up into the depth of the glenoid fossa.

Muscles of Mastication

One of the main functions of mastication (chewing) is carried out by the teeth and jaws. The muscles directly involved in this process are called muscles of mastication.

1. *Masseter. It has two parts*
   a. Superficial part.
      Origin—Anteroir 2/3rd of Zygomatic arch
      Insertion—Lateral surface of the lower part of the ramus.
   b. Deeper part
      Origin—Whole length of the inner surface of the Zygomatic arch.
      Insertion—Lateral surface of the coronoid process and upper part of the ramus.
      Nerve supply—5th cranial nerve's mandibular division.
2. *Internal (Medial) Pterygoid*
   Origin—Medial surface of the lateral pterygoid plate and pyramidal process of the palatine bone.
   Insertion—Between the mylohyoid groove and angle of the jaw on the inner surface of the ramus
   Nerve supply—5th cranial nerve (Fig. 1.17).
3. *External (lateral) pterygoid*
   Origin—Infra temporal surface of the great wing of the sphenoid and the lateral surface of the lateral pterygoid lamina.
   Insertion—Anterior aspects of the neck of the condyle, the meniscus and capsule.
   Nerve supply-5th cranial nerve (Fig. 1.18).

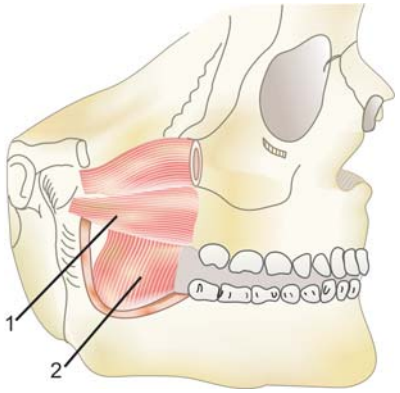


Fig. 1.17: Muscles of mastication (Outer view)
1. External (lateral) pterygoid, 2. Internal (Medial) pterygoid

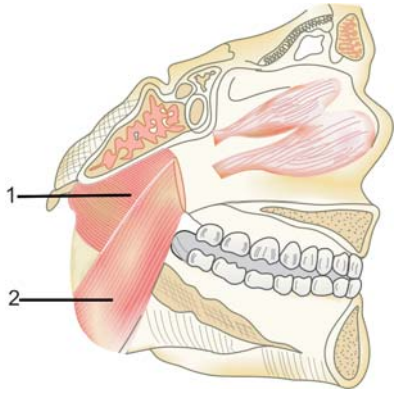


Fig. 1.18: Muscle of mastication (Inner view)
1. Lateral pterygoid, 2. Medial pterygoid

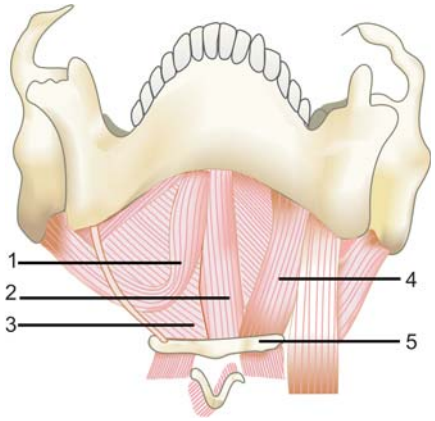


Fig. 1.20: Muscles of mastication
1. Digastric, 2. Geniohyoid, 3. Mylohyoid, 4. Hyoglossus, 5. Hyoid bone

4. *Temporalis*
   Origin—temporal fossa on the side of the skull
   Insertion—Apex and deep surface of the coronoid process and the anterior surface of the ramus as far forward as the last molar.
   Anterior fibers are vertical.
   Posterior fibers are horizontal.
   Nerve supply—5th cranial nerve (mandibular nerve) (Fig. 1.19).
5. *Digastric*. This has two bellies.
   Origin—Posterior belly from the mastoid notch of the temporal bone.
   Anterior belly from the digastric fossa in median line of the base of the mandible.
   Insertion—Both the bellies join by an intermediate tendon which attached to the hyoid bone Fig. 1.20.

Accessory Muscles of Mastication

i. Buccinator and lip muscles.
ii. Mylohyoid
iii. Geniohyoid
iv. Stylohyoid
v. Infrahyoid
vi. Tongue muscles (Fig. 1.21).

6. *Mylohyoid*
   Origin—Whole length of the mylohyoid ridge, which extends from the symphysis to the 3rd molar (Fig. 1.22).
   Insertion—Anterior aspects of the body of the hyoid bone and into the median raphe.

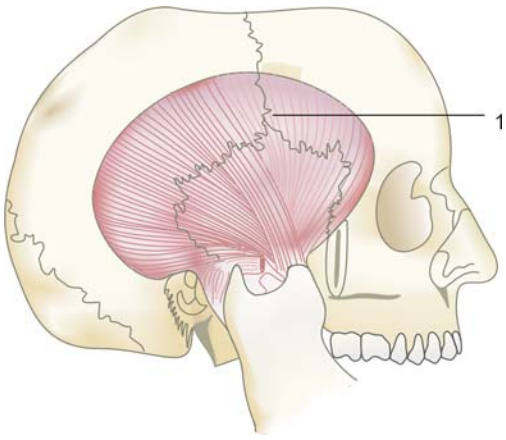


Fig. 1.19: Muscle of mastication
1. Temporalis

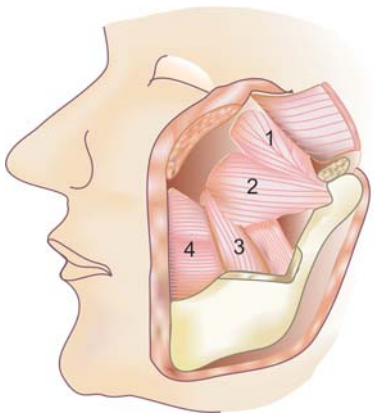


Fig. 1.21: Muscles
1. Temporalis, 2. Lateral pterygoid (upper head), 2. Lateral pterygoid (lower head), 3. Medial pterygoid (deep head), 3. Medial pterygoid (superficial head), 4. Buccinator

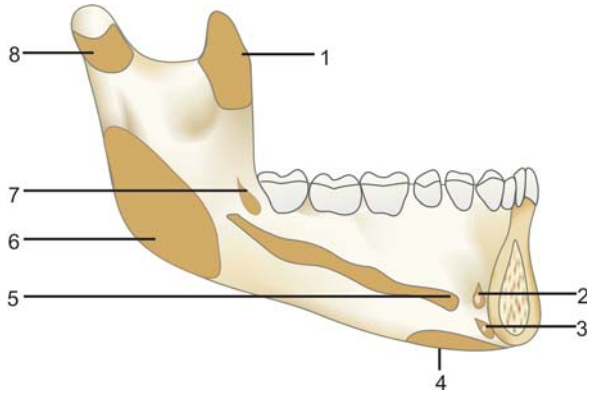


Fig. 1.22: Inner surface of mandible (Cross section)
1. Insertion of temporalis, 2. Origin of genioglossus, 3. Origin of geniohyoid, 4. Insertion of ant belly of digastric, 5. Origin of mylohyoid, 6. Insertion of medial pterygoid, 7. Insertion of buccinator, 8. Insertion of lateral pterygoid

7. *Geniohyoid*
   Origin—Inferior genial tubercle
   Insertion—Body of the hyoid bone (Fig 1.23).

Movements of the Mandible

The position of the mandible is maintained by the mandibular joint and the surrounding ligaments. The joint itself is peculiar because it is a double joint, like the knee joint, with a disc or meniscus between the head of the condyle and the glenoid fossa.
The movements are grouped as follows:
1. Opening movement—(Depression)
2. Closing movement—(Elevation)
3. Protrusive movement—(Forward)
4. Retrusive movement—(Backward)
5. Rotation movement—(Side to side)

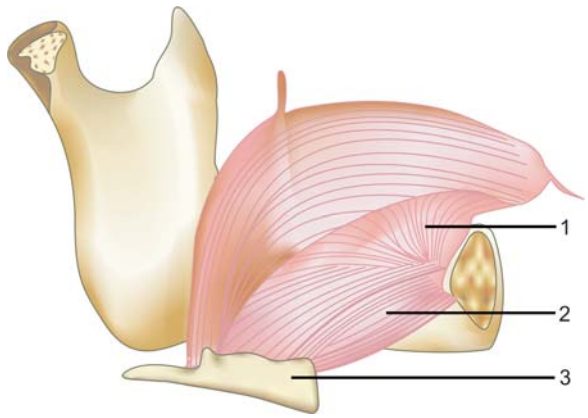


Fig. 1.23: Muscles of mastication
1. Geniohyoglossus, 2. Geniohyoid, 3. Hyoid bone

Movement	*Contracting muscle*	*Relaxing muscle*
Opening	Lateral ptreygoid Both bellies of digastric mylohyoid. Platysma.	Masseters, temporalis, medial pterygoid.
Closing	Masseters, temporalis.	Lateral pterygoids
Protrusion (with mouth not opened)	Lateral pterygoid	Posterior horizontal fibers of temporalis.
Retrusion (with mouth not opened)	Posterior fibres of temporalis	Lateral pterygoids.

The masseters, medial pterygoid and anterior fibers of temporalis do not relax but keep the teeth in contact during protrusion and retrusion.

Lateral Movement (Side to Side) Rotatory

	Contraction
On the side towards which jaw is moving	Posterior fibers of temporalis and all other muscles of that side.
On the opposite side	Lateral pterygoids.

For Example

If the jaw is moved to the right side, the right condyle remains stationary in the glenoid fossa but the left condyle alone moves forward and inward on the eminentia articularis, due to the contraction of left side lateral pterygoid muscle.

Then, if the jaw is moved to the left side, left condyle first moves backward into the glenoid fossa and the right condyle then moves forward on to the eminentia articularis.

Working side — Is the side towards which the jaw is moved.
Balancing side — Is the opposite side.

"Bennet Movement"

On the working side, although the condyle remains stationary, it rotates around a vertical axis, causing a slight backward and lateral movement due to the contraction of masseter and temporalis of that side. The result of this is little lateral shift of the whole mandible and this is Bennet movement (Fig. 1.24).

Christiansen Phenomena

Due to the downward and forward movement of condyle during protrusive and lateral movements, posterior teeth of artificial dentures or the posterior ends of the occlusal rims may not meet correctly; instead there will be a space between the two. This is due to changes that have taken place in the

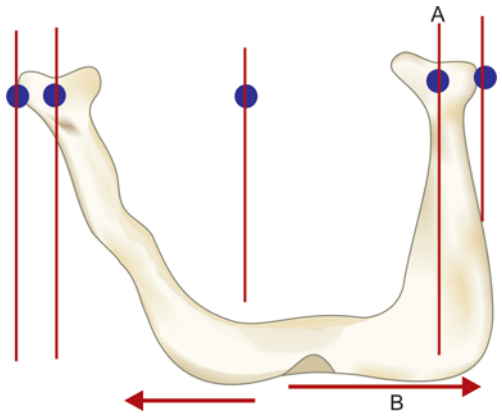


Fig. 1.24: Axis during mandibular movement (Lateral excursion)
A. Vertical axis, B. Bennet shift

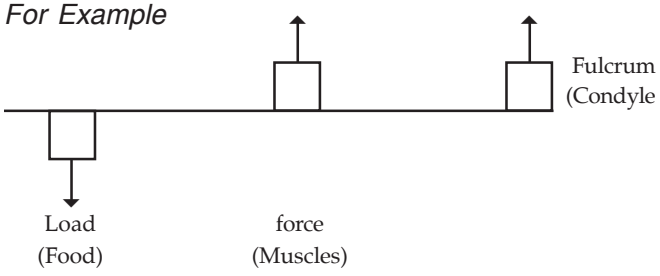
edentulous alveolar ridge. This is known as Christiansen phenomena, which has to be corrected if the dentures to have uniform contact of teeth throughout.

Opening Movement—Mechanism

Factor	*Action*	*Site*
Contracting muscles a. Anterior belly of digastric. gravity.	Rotation of condylar heads against stationary disc	Lower compartment of joint cavity (Hinge type)
b. Lateral and medial ptery-goids	Condyles and discs are drawn forward out of the glenoid fossa on to the emi-nentia articularis.	Upper compartment of joint cavity (sliding)
c. Postbelly of digastric and mylohyoids. *Relaxing muscles*, Masseters temporalis	Chin is pulled down and back, acting from hyoid bone, which is held stationary by other muscles.	

The temperomandibular joints, mandible and the muscles of mastication together act as double lever of class III.

For Example



Muscles of Mastication—Classification

1. Posterior group—attached to the ramus of mandible.
   Examples
   Masseters
   Temporalis
   Pterygoids—lateral and medial
2. Anterior group
   Attachment above—Body of mandible.
   Attachment below—Hyoid bone.
   Examples Mylohyoid
   Geniohyoid
   Anterior belly of digastric.

Muscles are also Classified by their Action

1. Elevators, e.g.
   Masseter
   Temporalis
   Medial pterygoid
2. Depressors. e.g.
   Platysma
   Digastric
   Mylohyoid
   Geniohyoid
3. Protrusors, e.g.
   Lateral pterygoid (Rotators)
   Medial pterygoid
4. Retrusors—Temporal (Fig. 1.25)
   Superior constrictor of pharynx (Fig 1.26)

Basic Movements of the Mandible

a. Rotary or hinge movement—in the lower compartment
b. Translatory or sliding movement—in the upper compartment (Fig 1.27)

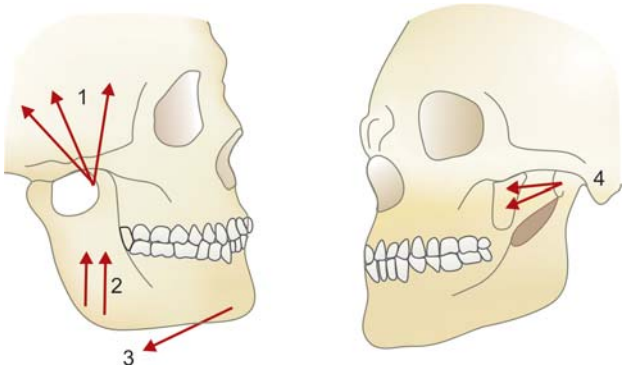


Fig. 1.25: Direction of the pull of muscles of mastication
1. Temporalis (Elevation), 2. Masseter (Elevation), 3. Geniohyoid and ant belly digastric (Depression), 4. Lateral pterygoid (Rotation)

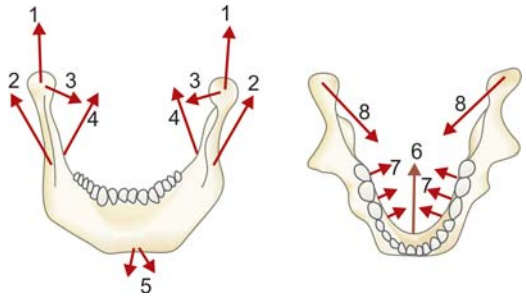


Fig. 1.26: Direction of the pull of muscles of mastication
1. Temporalis, 2. Masseter, 3. Lateral pterygoid, 4. Medial pterygoid, 5. Geniohyoid, 6. Geniohyoid and ant belly digastric, 7. Mylohyoid, 8. Lateral pterygoid

Functional Movements of Mandible

a. Opening and closing
b. Symmetrical protrusion and retrusion.
c. Asymmetrical lateral shift or rotation

Opening and Closing

Opening begins with almost pure rotatory or hinge movement and the mandible is depressed to slightly beyond rest position- means 2/3rd of opening has taken place. Then, for the remaining 1/3rd opening, both sliding and roratory components combine to produce a smooth, movement of opening fully. In the reverse process of closing, the first 2/3rd is translatory movement and remaining 1/3rd is combination of both translatory and rotatory movement until fully closed.

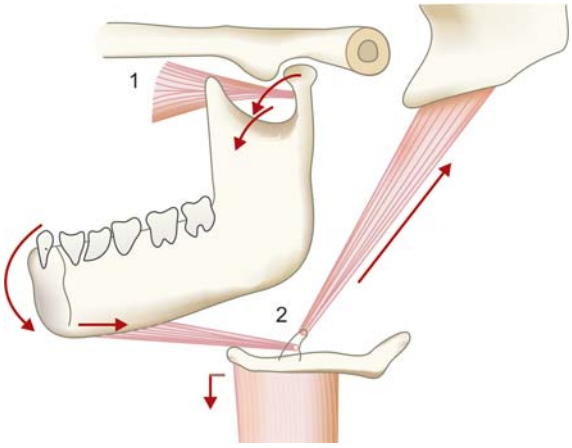


Fig. 1.27: Rotatory and translatory movements of mandible
1. Lateral pterygoid muscle, 2. Both the bellies of digastric muscle

Movements of Mandible can also be Classified as

a. Free movements—which starts from rest position, and end in rest position of the mandible.
b. Masticatory movements—(just described)
   – Cutting movements.
   – Grinding movements.

Positions of Mandible

1. *Rest position*: This is constant in each individual due to individually fixed and only slightly variable tonus of the masticatory muscles, which in their relaxation allows the mandible to drop slightly. Therefore rest position is not dependent on the presence of teeth or their shape or position but on the musculature and on the muscular balance only.
2. *Occlusal position*: it is that position of mandible in which teeth are in contact

Yet Another Classification of Mandibular Movement

1. Masticatory movements.
2. Swallowing movements.
3. Empty movement- for examples,
   During Bruxisum,
   i.e. Grinding of teeth in sleep

Axis During Jaw Movements

1. Horizontal axis—During opening and closing.
2. Vertical axis—During lateral movements (Fig 1.28). As pointed out by Bennet, the mandible moves bodily laterally and partially rotates during lateral excursions- and this is known as "*Bennet Movement*".

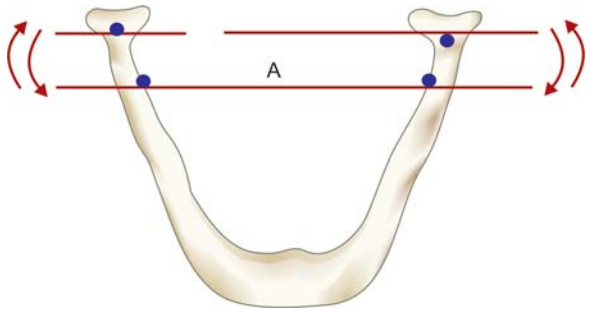


Fig. 1.28: Axis during mandibular movement
A. Horizontal axis during opening and closing

Saliva

It is a clear, colorless fluid secreted into the mouth by salivary glands.

Composition

Water 99 percent
Solid 1 percent ⟶ Coagulable proteins.
Mucin.
Inorganic ions of Na, K, and Ca
Chloride
Bicarbonate
Thiocynate
Urea.

Bacterias and its product: Food particles, epithelial cells, leucocytes. *Enzymes*- ptyalin. Water helps to dissolve food.

Mucin coats the food and acts as lubricant to make swallowing easy.

Ptyalin starts digestion of starch.

Functions of Saliva

1. Keeps the mouth moist.
2. Necessary for speech.
3. Helps in retention of complete dentures.
4. Maintains oral hygiene.
5. Digestion of starch.
6. Necessary for taste, chewing and swallowing.

Mastication (Chewing)

This is a complicated physiological process involving many structures like teeth, tongue, palate, muscles of mastication, nerves, saliva, TMJ etc; Teeth act as tool to cut, tear, and grind the food while it is getting mixed with saliva and made palatable before being swallowed. Powerful muscles of mastication apply force on the teeth, so that all kinds of food are properly cut and grinded. Incisors cut, canines tear and molars grind the food. Chewing begins with opening the jaw, and once the food is inside the mouth it is cut and torn into small pieces and taken back on to the molars to grind. All the while the mandible is making continuous opening and closing movements and lateral movements every now and then. Main and accessory muscles of mastication and tongue help in this process.

Proprioceptic afferent nerves from teeth, mucous membrane, periodontal membrane, tongue, TMJ and muscles etc; send the message to motor nuclei and accordingly the amount and direction of masticatory force is controlled by the muscles while chewing. Taste buds too react in deciding the acceptance or rejection of food and also the amount and nature of salivary secretion.

Significance: Patients wearing dentures has to learn the process of eating due to loss of periodontal membrane receptors.

The normal mechanism which induces chewing is purely reflex. Salivation, chewing and swallowing all are inter related and so the reflex mechanism controlling one will also control other two as well.

Types of Reflexes

a. *Isotonic reflex*: This is initiated by the introduction of any object (food) in the mouth, which stimulates the receptors in the mouth.
b. *Isometric reflex*: This is initiated by the movement of teeth in the sockets, which stimulates pressure receptors in the periodontal membrane. Thus, innervations of periodontal membrane act as a "protective structure" in determining the existence of any disturbance in either mastication or occlusion. This sensitivity and reflex mechanism together control the masticatory pattern (Fig 1.29).

Role of Tongue During Mastication

a. Direct crushing effect on food against the hard palate.

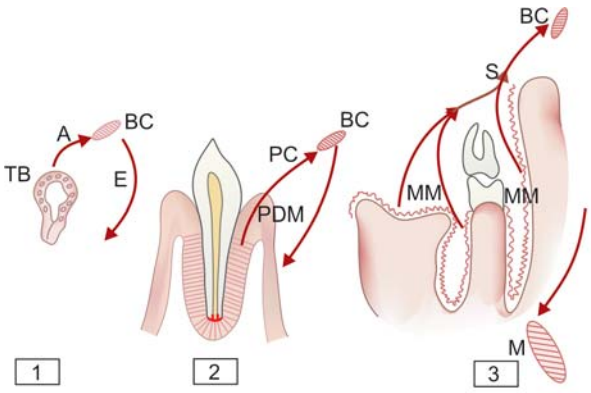


Fig. 1.29: Reflexes of masticatory process
BC—Barain centre, TB—Taste buds, PDM—Periodontal membrane, PC—Proprioceptive impulses, A—Afferent, E—Efferant, S—Sensory, M—Muscles of mastication, MM—Mucous membrane, 1—Control of saliva, 2—Control of amount and direction of force, 3—Control of muscles of mastication

b. Pushes the food on the occluding surfaces of teeth.
c. Help to mix the food in the saliva.
d. Separates chewed food from yet to be chewed food.
e. Cleaning effect.
f. Provides taste.

Extrinsic muscles move the tongue as a whole. Intrinsic muscles change the shape of the tongue.

Role of Hard Palate

This is sensitive to touch. Thus, harsh food is rejected by the palate.

Significance: Denture wearers loose this sensitivity.

Role of Cheeks and Lips

These are sensitive to touch and temperature and so control the temperature of food.

Prevent food and liquid going out of the mouth.

Factors Influencing the Strength of Bite

a. Strength of muscles of mastication.
b. Practice and Exercise.
c. Type of food.
d. Oral hygiene.
e. Distance between jaws.
f. Sensitivity of periodontal membrane.
g. Racial inheritance of powerful jaws.

Effects of Vigorous Mastication on Oral Tissues

i. Bone growth.
ii. Cleaning effect—Prevention of caries.
iii. Massaging action on gums.
iv. Periodontal effects—Extra bone deposition to compensate for the loss.
v. Soothing effect—Psychologically
For example "Chewing a gum" a modern fashion.

Swallowing

This is a co-ordinated activity of various muscles and nerves.

It occurs in 3 stages.

1st Stage: Oral Phase

This is voluntary. The masticated food is collected and made as bolus and kept on the dorsum of the tongue. Lips are closed. Teeth are brought together in occlusion. A mylohyoid muscle contracts, which pushes the tongue up against the palate and pushes the food backwards towards the pharynx. Soft palate is raised and thus allows the food to go into pharynx and at the same time prevents food going into nose.

2nd Stage: Pharyngeal Phase

This is involuntary. Food passes through the pharynx to the beginning of oesophagus.

At this time breathing stops temporarily and closure of nasopharynx occurs and larynx will be elevated. Thus laryngeal orifice is shut. At the same time oesophageal opening is raised up to a higher level to receive the descending bolus of food.

3rd Stage: Oesophageal Phase

This is also involuntary. The constrictor muscles of the pharynx contract from above downwards and push the bolus of food through the oesophagus into the stomach.

The Muscles taking Part in Swallowing

1. Muscles of mastication.
2. Mylohyoid.
3. Tongue muscle.
4. Lip muscles.
5. Hyoid muscles.
6. Elevating muscles of larynx.
7. Elevating muscles of soft palate.
8. Muscles closing the laryngeal inlet.
9. Pharyngeal muscles.

The mucous membrane of the mouth, pharynx, and esophagus through which food passes in swallowing is supplied by sensory fibers of the 5th, 9th and 10th cranial nerves. Then swallowing is the result of coordinated activity of number of reflex arcs involving 5th, 7th, 9th, 10th and 12th cranial nerves and upper spinal nerves and midbrain centers. The midbrain centers regulate and coordinate the reflex mechanism, so that once swallowing begins it cannot be stopped by any voluntary actions. Therefore one is not aware of entry of food into stomach.

CONCLUSION

Main Functions of Teeth—Natural or Artificial

1. *Eating*: Which involves opening the mouth, into which food is inserted and kept on the chewing

surface of teeth during chewing and then swallowed.

2. *Speaking*: Also involves opening of the mouth and movement of soft palate, tongue and lips. Proper speech demands correct vertical dimension; denture periphery, tongue space. Artificial teeth must be correctly positioned on the denture. Occlusal plane is suitably fixed, and the polished surfaces of denture are appropriately shaped, so that tongue, which plays a important role in speech feels natural environment in the mouth for its functions.
3. *Facial expression*: Involves contraction of muscles of facial expression and tongue.
4. *Appearance*: Depends on the scientific construction of dentures, especially with respect to vertical dimension, arrangement of teeth, and selection of teeth.

Artificial denture too should provide these fundamental functions of teeth.

2 Prosthodontics

DEFINITIONS

Prosthesis: This is an artificial appliance, constructed in the laboratory to replace a lost or missing natural part of the body.

For example: Artificial leg (Jaipur leg)

Prosthodontics: This is a branch of dentistry where scientifically and artistically designed artificial sets of teeth are made.

Word Origin and Meaning

"Pros" from Greek meaning 'To"
"These" from Greek meaning 'placing to"
"Odontos" from Greek meaning 'Tooth"
"Dens" or Dentis from Latin meaning 'Tooth"
Denture—This is a artificial set of teeth
Edentulous—Without teeth
Dentulous—With teeth

Abutment

Abut from French "Abuter" = to touch at the end = to end at = to end or lean upon

Abutment = An endwise meeting or junction.
= A limb of an arch which ends or rests against.
(In dentistry) = A tooth which abuts an edentulous space and which is used to support, retain or stabilize prosthesis.

Bridge: A compact, commonly fixed prosthesis replacing one or two teeth and is supported and retained mainly by inlays and crowns.

Clasp = From Middle English-claspe.
= Fastenings, to embrace: to grasp.
= To enclose and hold in the hand or arms.
(Dental) = A wrought or cast metallic arm attached to a partial denture which embraces natural tooth for retention. It will also provide bracing and support.

Crown- from French-Corone
Greek-Koronos = Curved
= A round head ornament – Worn by Kings and Queens.

Dental

1. That part of natural tooth above the gingiva and covered by enamel.
2. An artificial restoration placed on the prepared tooth above the gingiva.

Die- from old French "de"= given or cast
= A tool for shaping a thing.
Dental = A positive reproduction of tooth in a dental stone or die stone, for the purpose of making a inlay or crown.
Inlay = To insert.
= A pattern set into the surface.
Dental = A metallic or nonmetallic restortion constructed outside the mouth and later cemented in the tooth.

Pinlay - It is a inlay with pins for retention.

Onlay - This is a cast restoration placed on the tooth and held there with pins going into the dentin.

Dowel- From German- "Dobel" = A plug.
= A pin for fixing things together by fitting into a hole in both.
Dental = A pin, peg or post. Used during crown making.

Embrazure – The open space between the proximal surfaces of neighboring two teeth where they diverge buccally, labially or lingually from the point of contact.

Fossa = A pit or depression.

Jacket Crown

Jacket = A short coat especially of leather, A loose paper cover.
= Outer casing of a boiler.

Dental = A veneer (a thin layer) of porcelain or acrylic resin fitted to the crown preparation of natural tooth.

Key way—A locking device- groove or recess.

Mandrel—A bar of iron fitted to a turning lathe on which articles to be turned are fixed.

Pontic—From Latin Pons, Pontis = Bridge or connecting part.

Pons of brain—Where mass of fibers join the two hemispheres of brain.

Dental = It is that part of dental bridge which stands between the abutments and functions as an artificial tooth.

Reservoir = A small bulge on the sprue which provides reserves of liquid metal from which the casting may draw as it solidifies and cools.

Sprue = Dead end- A passage by which liquid metal runs into a mould and solidifies there.

Pickle = Pick- A small quantity.
= Acid used for cleaning a metal casting.

Crucible—A container in which metals are melted.

Cast—From old Norwegian- Kasta = To throw.
= A shape of a thing cast.
As an adjective – mould.

Casting—A thing cast in a metal

For example - Wheel, Axel etc.
= An act of moulding.

Dental—A model made from an impression.

Pier—From Middle English "Per"
= The mass of stonework between the openings in the wall of a building.
= The support of a bridge or arch.

Dental—It is the middle abutment in a bridge of three abutments.

Cantilever bridge—A fixed bridge with only one abutment at one end.

Thimble—From old English- " thymel"= Thumb.
= A cover for the finger used in sewing.

Chamfer—From French "Chamfrein" = to break the edge or side.
= A bevel or slope made by paring off the edge of anything originally right angled.
= A groove, channel or furrow.

Branches of Prosthodonties

1. Complete Dentures - C D
   a. Conventional.
   b. Immediate.
   c. Over denture.
   d. Implant (Fig. 2.1).
2. Partial denture: commonly reffered as Removable Partial Denture (RPD)
   Based on the support.
   a. Tissue borne—Acrylic.
   b. Tooth borne—Cast metal (Fig. 2.2).
   c. Disjunct denture—Combination of tooth borne and tissue borne (Fig. 2.3).
   Based on the purpose.
   a. Interim denture.
   b. Transitional denture.
   c. Treatment denture.
   Others
   a. Clasp-less denture.
   b. Spoon denture.
   c. Sectional denture.
   d. Every denture.
3. Bridges—Also called Fixed Partial Denture, (FPD)
   a. Fixed—fixed.

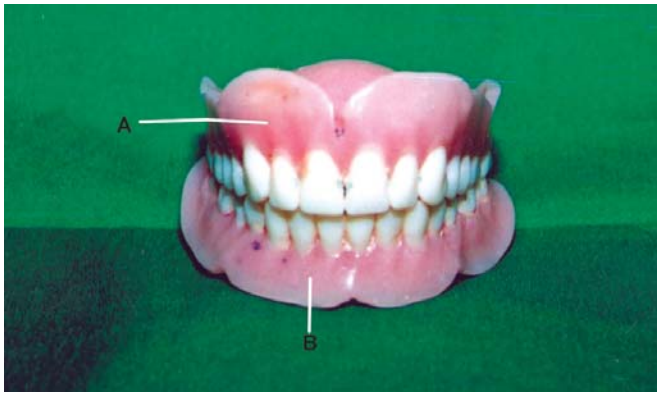


Fig. 2.1: Complete dentures (All acrylic)
A. Maxillary, B. Mandibular

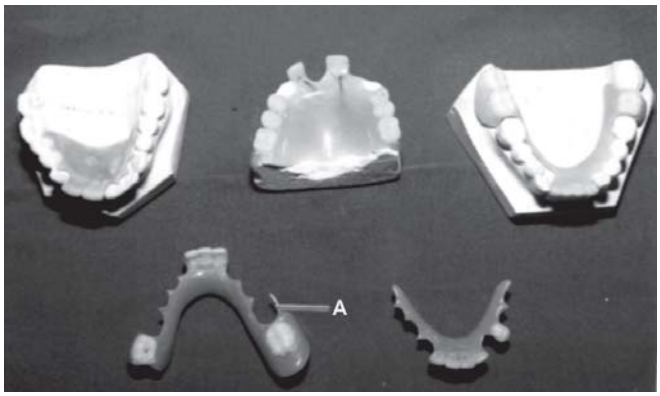


Fig. 2.2: Partial dentures (All acrylic)
A. Wrought wire clasp

b. Fixed movable
c. Plain cantilever
d. Spring cantilever (Fig. 2.4).

4. Maxillofacial prosthesis.
5. Others
   a. Obturator
   b. Gunning splint
6. Supporters and Retainers to prosthesis.
   a. Inlays
   b. Crowns
      – Full crowns
      ¾ Crowns
      i. Conventional
      ii. Pin-lay type
      iii. Pin-ledge type

Complete Dentures

Number of teeth replaced—All natural teeth.

Fig. 2.3: Assorted designs of cast RPDs

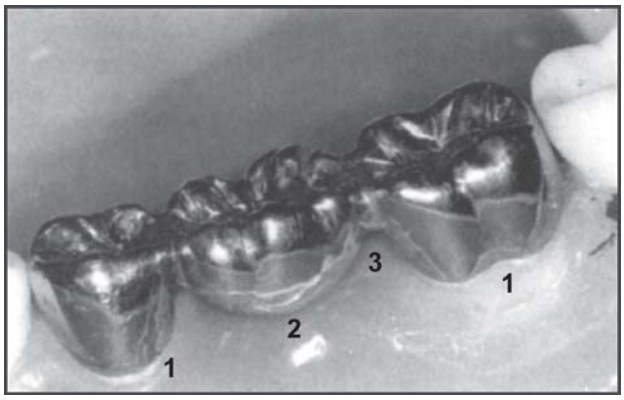


Fig. 2.4: Fixed-Fixed bridge
1. Full crowns (Retainers), 2. Pontic (Artificial tooth), 3. Soldered joint

Functions

Restores

1. Masticatory function.
2. Esthetics.
3. Speech.

Materials used to Make

a. Nonmetal Acrylic resin
b. Metallic chrome-cobalt.
c. Combination of metal and nonmetal (Fig. 2.5).

Requirements (Fig. 2.6)

a. Maximum coverage of denture foundation—to get;
   i. Maximum adhesion.
   ii. To spread masticatory load.
   iii. To reduce alveolar bone resorption.
b. Muscle attachments must be suitably relieved.

Fig. 2.5: Maxillary complete denture (View of fitting surface)
A. Chrome-Cobalt base, B. Arcylic flange

Part 1

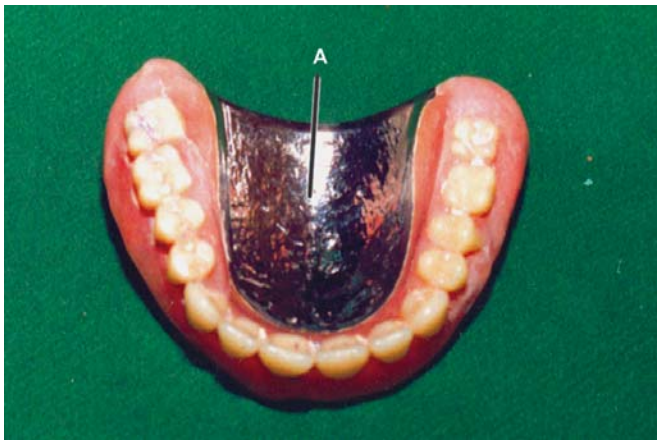


Fig. 2.6: Maxillary complete denture (occlusal view)
A. Chrome-cobalt base

c. Occlusion should be balanced.
d. Flanges shaped to help retention.

Partial Dentures

Number of teeth replaced—one or few

Functions

To Restore

1. Masticatory efficiency.
2. Esthetics.
3. Speech.
4. To protect the health of the remaining teeth.
5. To postpone edentulous state.

Requirements

a. Prior treatment plan and design
b. Proper mouth preparation
c. Providing proper support and retention.
d. Providing correct occlusal relations.
e. High technical skill and care.

Conventional Complete Dentures

These are constructed after extraction of all natural teeth on a completely healed-up alveolar ridge.

Immediate Denture

This denture is constructed before the extraction of teeth (some) and inserted immediately after extraction of those natural teeth.

These dentures can be complete or partial.

Over Denture

This is a complete denture and kept over the retained natural tooth- usually lower 3rd molar.

Implant Denture

This complete denture takes support from the stud like projections through the mucosa, which are the vertical components of metallic framework buried in the alveolar bone.

Tissue Borne Partial Denture

This denture is supported vertically only by the mucous membrane.

Tooth Borne Partial Denture

This denture is supported vertically only by the teeth.

Disjunct Denture

This is a two part partial denture, one part is tooth borne, and another part is tissue borne, both acting independently.

Interim Denture

This is a temporary partial denture worn by the patient while the permanent denture is getting ready.

Transitional Denture

This is a temporary denture worn by the patient and to which extra teeth are being added as the patient goes on loosing natural teeth.

Treatment Denture

This is a temporary partial denture worn by the patient as a part of treatment plan until the conditions are favorable for the construction of permanent partial denture.

Claspless Denture

This is a partial denture without clasp but retained by another arrangement, which engages the undercut on the proximal surfaces of abutment tooth next to the saddle.

Spoon Denture

This is a maxillary partial denture carrying one or two anterior teeth and a palatal spoon like section not in contact with the gingival margins of the teeth.

Sectional Denture

This is a two part partial denture, the path of insertion and removal for both the sections is not one and the same, but one section from behind and another section from front and then both gets locked-up.

Every Denture

This partial maxillary denture designed by Mr Every is completely tissue borne, makes use of full palatal coverage for support.

Maxillofacial Prosthesis

This is a prosthodontic appliance, which replaces any of the lost natural part of the human face (Nose, Ear, Eyeball, Skin of face, Bone, etc.) with or without artificial teeth attached to it, in order to rehabilitate a badly mutilated patient following a major surgery on the face.

Obturator

Is a dental appliance made to close a cleft (gap) in the hard and soft palate, to improve speech.

Word Origin and Meaning

From Latin- Obturare = To close, To stop.

Gunning Splint

This is an edentulous dental appliance in one or two parts, shaped like occlusal registration blocks but made of acrylic resin for the purpose of splinting fractured jaws until bone union takes place.

Full Crown

This is a entirely metal cast crown on premolars and molars, used as retainer to a bridge.

Three quarter crown—also known as Carmichael partial veneer crown is a shell crown, which covers all surfaces of tooth except labial or buccal because of esthetic reasons.

Pinlay Type 3/4th Crown

This crown makes use of additional pins, which fits, into holes drilled in the tooth parallel to the groove for retention.

Pinledge Type 3/4th Crown

This is a similar to pinlay type 3/4th crown except that pins are situated at the edge of tooth.

Difference between Appliance and Dental Prosthesis

Appliance has no teeth attached to it but it is used for some other purpose and is worn by the patient as a part of treatment.

For Example

Periodontal splint.
Cast metal cap splints
Orthodontic appliances.
Space maintainer.
Sports mouth guards, Night guards.
Appliance to stop habits like thumb sucking, snoring, etc.
Fluoride custom tray, Bleaching trays.
Dental prosthesis carries teeth on it and they are called dentures.
Nondental prosthesis are maxillofacial prosthesis, obturator.

Scope and Limitations of Prosthodontics

Prosthodontics is the major routine work undertaken by a dentist in everyday dental practice. In olden days public thought of dentist as a "Tooth puller and tooth maker". But a modern dentist does much more than that, and scientifically too. If one appreciates the importance of teeth for chewing a food and there by ones general health; for appearance and there by its impact on the morale of the patient, and for speech, it goes without saying that dentures are a must for a patient who has lost natural teeth.

Now a days it is very common for people to loose natural tooth for one reason or the other. Therefore demand for dentures will be more. Making a complete denture is a science as well as art. Making partial dentures is a skill. Both these involve clinical work (by dentist) and laboratory work (by technician) and both must be done with utmost care. All in all, scope for prosthodontics is widening day by day because of availability of better materials, instruments and techniques. Implant dentures are the latest in this widening scope of works. However there are limitations too as in all fields, because of conditions prevailing in the mouth which are not favourable, health of patient and lack of technical skill etc. However "*Good dentures are a thing of beauty and joy forever*".

3 Retention and Stability

(COMPLETE DENTURES)

DIFFERENCE BETWEEN NATURAL TEETH AND DENTURES (ARTIFICIAL SET OF TEETH)

Natural teeth	*Artificial sets (Denture)*
Roots are embedded in sockets of bone and there they stay firm.	There are no roots to teeth of dentures- so no embedding. The whole set as one unit just sits on the ridge.
Periodontal membrane is firmly attached between bone of alveolus and root of tooth and so there is no movement.	There is no attachment to bone- so the set is subjected to movement.
Dislodging forces do not affect teeth, situation is similar to a post dugged and erected in the ground.	Dislodging forces affect denture. Situation is like a post just made to stand upright on the ground without digging.
Main functions of natural teeth- e.g., mastication, esthetics and speech are done satisfactorily due to firm and stable teeth in the jaw.	Main functions of dentures too are similar to natural teeth- but it cannot be satisfactory if the dentures are not firm and stable over the jaw.

DEFINITIONS

Retention

1. Retention is the ability of the denture to remain in contact with its supporting tissues.
2. Retention is resistance to vertical displacement towards the occlusal surface.
3. Retention means a denture must stay foot where it is placed to rest.
4. Retention means denture must not be loose in the mouth.
5. Retention is that quality in denture that resists the forces of gravity, adhesiveness of foods and forces formed during opening the jaw.
6. Retention is resistance to displacing forces, which act on the denture, resulting in a movement towards the occlusal surface.

Stability

1. Stability is ability of the denture to remain stationary in relation to its bony support.
2. Stability is resistance to leverage and horizontal displacement.
3. Stability means the denture must not move sideways when in function.
4. Stability means the denture must not move about in the mouth.
5. Stability is the quality of denture to be constantly firm and steady and not subject to change of position when forces are applied.
6. Stability is an absence of movement of the denture in any direction other than towards the occlusal.

Retaining Forces on the Denture

1. Adhesion.
2. Cohesion.
3. Atmospheric pressure
4. Co-ordinated action of facial and tongue muscle.
5. Use of undercuts

Displacing Forces on the Denture

1. Force acting on the occlusal surfaces and incisal edges, e.g. Sticky food.
2. Muscular forces acting on the periphery or polished surface.
3. Extension of periphery into nonelastic mucosa.
4. Sudden entry of air between denture and oral supporting tissues.

Adhesion

This is attraction between dis-similar molecules (substances)

In the case of dentures- dis-similar molecules are

a. Denture fitting surface
b. Mucous membrane.

Part 1

These two different surfaces when in contact there will be adhesion.

To Increase Adhesion

a. Intimate and uniform contact of the denture against the tissues on which it rests. This in turn is brought about by good impression technique and close adaptation of denture base to the surface of the cast.
b. Wider the area of contact, better will be the adhesion. This in turn depends upon good impression, which registers all of denture foundation in detail. Greater the area coverage, greater will be the resistance to biting forces. In the case of maxilla it is good because of palate, but in the case of mandible it is not good because of its horseshoe shape.

Cohesion

Cohesion is attraction between similar molecules (substances).

When a displacing force acts on the denture, the cohesive force in the saliva acts to preserve the intact meniscus at the periphery. This reduces the fluid pressure within the saliva below atmospheric, and this difference in the displacing force and force in saliva, helps to retain the denture.

Intact Meniscus at the periphery brings about peripheral seal (Fig. 3.1).

Meniscus on the polishes surface of the denture brings about facial seal. (Meniscus from Greek-Maniskos, mene, meaning moon, which gets a crescent (curved) shape some time, just like a curved liquid surface in a test tube due to capillarity).

This peripheral seal must encircle the whole of fitting surface of the denture in order to get best of retention. This can be achieved by

a. Post dam at posterior border of maxillary denture.
b. Shaping the buccal and labial surface of dentures in such a way that they maintain an elastic contact with lip and cheek tissues.
c. By muco compressive impression technique.

POST DAM

This is done to compress the tissues of the soft palate immediately behind the posterior border of the hard palate. The posterior border of the upper denture should be just on the immovable part of the soft palate (Fig. 3.2).

Definition of peripheral seal: This is a close adaptation between sulcus reflexion and denture periphery. If this intimate contact is maintained the displacing forces will not disturb the denture and there by retention is secured.

Peripheral seal prevents the entry of air between the denture and tissues.

ATMOSPHERIC PRESSURE

Fauchard when he made his first denture he knew nothing of atmospheric pressure as a means of retention of maxillary denture. His upper denture was in the form of horseshoe shape just like mandibular denture and the dentures were retained by springs. Forty years after Fauchard's death, a satisfactory spring-less maxillary denture was made by James Gardette of Philadelphia in 1800 and he is known as the discoverer of the use of atmospheric pressure for the retention of maxillary denture.

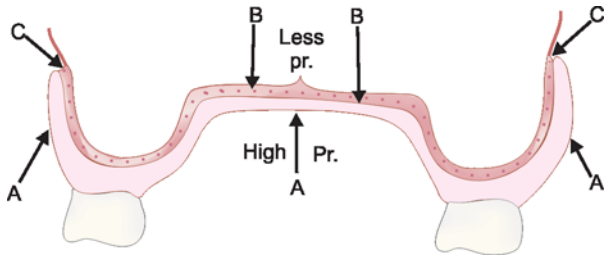


Fig. 3.1: Retention of maxillary complete denture
A. Atmospheric pressure (high) at the polished surface, B. Fitting surface with low pressure, C. Intact meniscus of slivary film

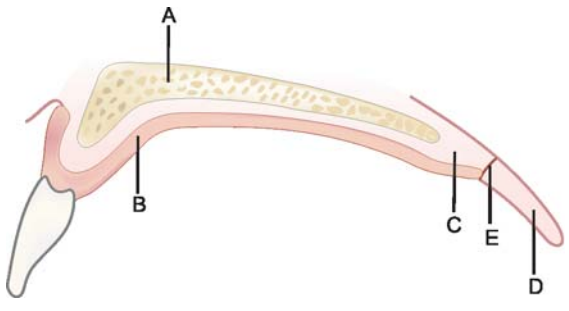


Fig. 3.2: Location of posterior border of maxillary denture
A. Hard palate, B. Maxillary denture, C. Soft palate (Im-movable), D. Soft palate (movable), E. Vibrating line

Part 1

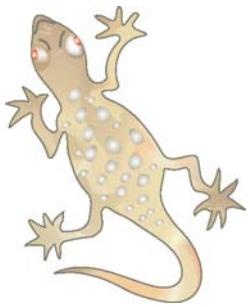


Fig. 3.3: Use of atmospheric pressure
E.g.: The lizard walks on the wall without falling down. When the lizard presses its feet on the wall, air is expelled from the fitting sides of its feet and becomes less pressure area. High atmospheric pressure on the external surface of feet keeps the lizard on the wall without falling down. This same principle is involved in how a maxillary complete denture stays on the upper jaw.

When the maxillary denture is in place on the palate, partial vacuum is formed on the fitting surface of denture due to the expulsion of air from there. The atmospheric pressure on the polished surface is more than the pressure on the fitting surface.

This imbalance in pressure holds the maxillary denture up in place in contact with the mucous membrane and thus retained. Cohesive forces in the saliva and adhesive forces between denture surface and mucous membrane also help in better retention of the maxillary denture against the force of gravity, etc (Fig. 3.3).

Other factors that help in the retention of denture are:

a. Balanced occlusion, which prevents rocking of dentures during function.
b. Muscular exercises done by patient.
c. Undercuts in tuberosity and lingual pouch areas.

However, the mandibular denture is retained almost entirely by mechanical forces.

Stability is Achieved by

1. Avoiding leverage.
   By placing the teeth in such a position relative to the ridge, which is most favourable to resist loading, i.e. by setting the posterior teeth over the ridges or by suitably tilting the occlusal plane. Set the posterior teeth in "Natural Zone". The area "Natural zone" was described by Sir William Kelsey Fry.
2. Resisting leverage.
   By adequate padding to prevent an air leak and by making flanges of proper depth.
3. Avoiding horizontal drag or inter cuspal locking.
   By balanced functional occlusions.
   Smooth cuspal clearance.
   Absence of locked bite.

In Short

Denture retention depends on closest adaptation or fit to the most effective shape of the denture foundation over the greatest possible area together with maximum reduction of dislodging forces.

CONCLUSION

For better retention and stability.

1. The denture base must cover the largest area possible.
2. The denture periphery must extend on the compressible tissues and must form a seal.
3. The tissue surface of denture must lie in continuous and intimate contact with the mucosa.

Thus

Impression surface of denture is retainer.
Occlusal surface of denture is balancer.
Polished surface of denture is stabilizer.

Therefore;

Most important steps are;

1. Accurate impression.
2. Correct jaw relation
3. Proper occlusion and finish.

4 Preprosthetic Surgery

DEFINITION

This is a surgical procedure undertaken before the construction of complete denture to convert unfavorable denture foundation into favorable one.
Contraindications to preprosthetic surgery.
1. Very old patient
2. Psychological patient.

Aim of Preprosthetic Surgery

1. To obtain reasonably satisfactory alveolar ridge-without undercuts.
2. To obtain uniformally covered mucous membrane.
3. To remove or reshape freni and other soft tissue interfering factors in the sulcus.
4. To get satisfactory depth of sulcus.

How to Avoid Some of the Surgical Procedures?

1. By carefully planning the extraction of teeth, because making of satisfactory artificial denture starts with the extraction of teeth.
2. Removing all sharp bony spicules at the time of extraction of teeth.
3. Avoiding bony undercuts.
4. By compressing the labial or buccal wall of the extraction sockets immediately after extraction of tooth with finger pressure.
5. Small tori mandibularis can be removed at the time of extraction.

Type of Surgical Procedures

1. On teeth.
2. On bone.
3. On soft tissues.

Surgical Procedures on Teeth

1. Buried retained roots are removed.
2. Impacted teeth are removed.
3. Over erupted, unopposed tooth is removed.

However, impacted maxillary 3rd molar, and maxillary canine are not removed if there is no other pathological conditions associated with them.

Surgical Procedures on Bone

This can be either;
a. Alveoloplasty—or reshaping the alveolar ridge.
b. Alveolectomy—or removing part of the alveolar bone.
These are done to,
Bony exostoces;
Knife-edge ridges;
Large Tuberosities,
Large Mylohyoid Ridge,
Undercut Ridge,
High Lower ridge in the anterior region,
Prominent premaxilla,
Maxillary tori.

Reduction of Large Maxillary Tuberosity

It may be only the soft tissue or soft tissue as well as bone to be removed, depending upon the clinical findings.

Two angulated incisions are made over the tuberosity; the width between the incisions depends upon the amount of tissue to be removed.

First, soft tissue between the incisions is removed and if necessary bone is removed with chisel. Remainder of the tuberosity is shaped with rongeurs or bone files (Fig. 4.1).

Resection of Mylohyoid Ridge

This is done to deepen the lingual sulcus. The procedure involves exposing the mylohyoid ridge by making two incisons; detaching the muscle from the bone and mylohyoid ridge is resected and its chipped part is removed; then bone is smoothened with vulcanite bur and finally suturing the flap.

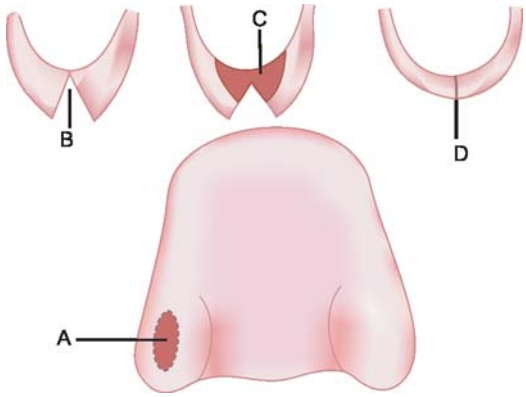


Fig. 4.1: Reduction of enlarged, fibrous maxillary tuberosity
A. Elliptical incision, B. Removal of wedge shaped tissue,
C. Undermining the mucosa, D. Suture

Prominent Genial Tubercles

These are dissected out by antero-posterior incision. After detaching the mucoperiosteum and muscle tendons, the flap is retracted forward and upward so that the projecting bone can be removed by burs and chisel. Bone files are then used to smooth the cut surface. The genioglossus muscle is re-transplanted above the geniohyoid muscle and held there with a suture passing below the lower border of the mandible to the chin.

Reduction of Prominent Maxilla

This can be done by two methods.

1. By inter cortical alveolectomy—done soon after extraction of teeth.
2. By labial alveolectomy—done after the gums have healed—in this method labial cortical bone is removed and the ridge is reshaped.

Inter Cortical Alveolectomy

The alveolar septa between the cortical plates are removed so that the outer cortical plate can be collapsed to reduce the protrusion of the alveolar process by bringing it into contact with the palatal plate.

Excision of Exostoses

This often occurs in multiple form and create undercuts in the ridge, which prevent proper denture construction.

After a suitable incision, the mucoperiosteum is detached and retracted to expose the bony projections, which are then removed with rongeurs.

Removal of Mandibular Torus

This is removed by the use of osteotome or sharp chisel. Usually one blow is sufficient.

Maxillary tori: Small tori are not removed but are relieved. Large torus is removed by an experienced oral surgeon because of the danger of perforating the hard palate (Fig. 4.2).

Surgical Procedures on Soft Tissues

Soft tissue abnormalities like;

a. Gingival hypertrophy—Causing folds.
b. Flabby ridges.
c. Wrong attachment of freni.
d. Palatal hypertrophy.
e. Papillomatosis.

Gingival Hypertrophy "Denture Granulomas"

These are excised by sharp dissection since these are pedenculated, the hypertrophied part is grasped with a pair of Allis forceps and pulled away from its attachment and excised. The wound left out, need not be sutured, but covered with base plate containg Zinc oxide eugenol paste. By suturing, the depth of sulcus will be lessened. These granulomas may be attached buccally, lingually or on the alveolar ridge. These are due to ill-fitting dentures and lack of oral hygiene.

Flabby Ridges

These are soft, movable gingival ridges without bony support. These are found mainly in the anterior part of the maxillary jaw due to excessive occlusal trauma which causes bone resorption (Fig. 4.3).

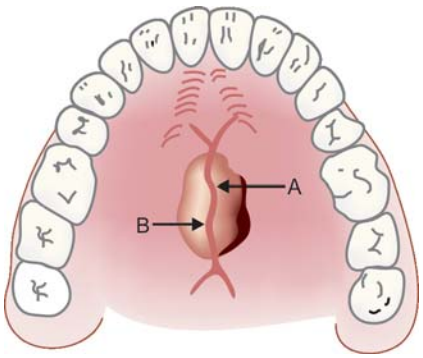


Fig. 4.2: Removing enlarged torus palatinus
A. Torus, B. Incision

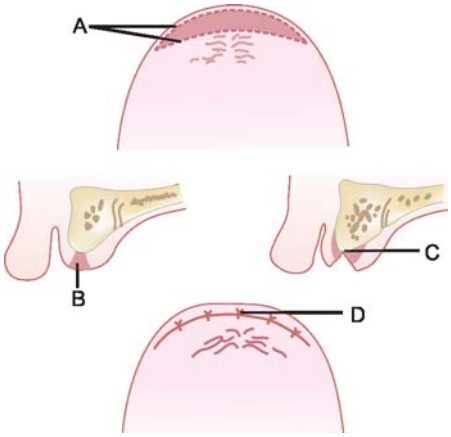


Fig. 4.3: Removing maxillary flabby fibrous tissue
A. Incisions, B. Fibrous tissue, C. Mucosa, D. Stitches

Removing Flabby Ridge

Make an incision on each side of the flabby fold extending from one side to the other. All that flabby tissue is dissected away. Then the gingival edges are sutured to close the wound (Fig. 4.4).

Frenoplasty: To correct low attachment of labial frenum.

Make two incisions on either side of the fibrous mucous membrane (not in periosteum) only. Then the central fibrous band is dissected out. Undercut the mucous membrane on either side and then mucous membrane is sutured to periosteum

Surgery—For Sulcus Extension

This procedure is necessary in cases where there is advanced atrophy of alveolar process resulting in no sulcus at all. Such condition presents great difficulty in denture construction. To over come this problem many methods have been suggested, like;

a. Reconstruct the alveolar ridge.
b. Replacing the lost bone.
c. Deepening the sulcus.

Sulcus Extention-(Deepening the Sulcus)

This is only possible if some alveolar bone remains or if the height of the basal bone is adequate. The problem is more in the case of mandible because it is flat on many occasions. Therefore careful clinical examination and X-ray study is necessary before the surgery.

Muscular attachments in both the jaws; position of the maxillary sinus, location of mandibular canal, mental foramen, all play a part in these surgical procedures. There are many surgical procedures named after the person who has done it.

Epithelial Inlay

This is yet another method of deepening the sulcus by skin grafts.

Principles of the method:
1. Skin graft is obtained from hairless area.
2. Thin graft is better than thick one.
3. There should be sufficient blood supply in the recipient area.
4. Infection should not occur.
5. Graft placed only when bleeding has completely stopped at the recipient area.
6. Graft is held and immobilized under pressure by a denture or by some other appliance.

Knife-edge-ridge-Smoothening

This condition occurs more often in the lower anterior region below the full lower denture. Patients complain of inability to use the denture due to soreness. To treat this condition, simple alveolectomy

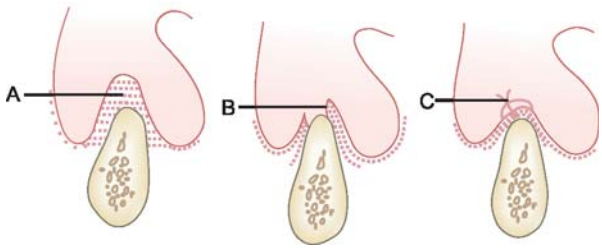


Fig. 4.4: Removing mandibular flabby fibrous tissue
A. Fibrous tissue, B. Area after removal, C. Stitch

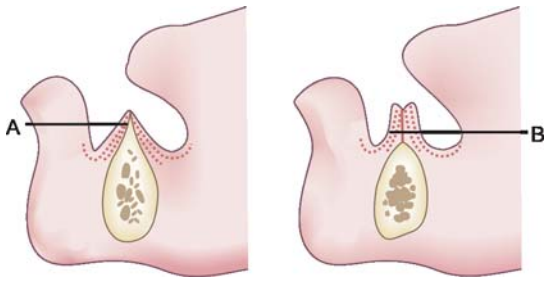


Fig. 4.5: Removing knife edged
(A) mandibular ridge and suturing (B)

is not advised, instead excision of the mucoperiostum over the ridge, smoothening the underlying bone gently and covering the mucous membrane graft (Fig. 4.5).

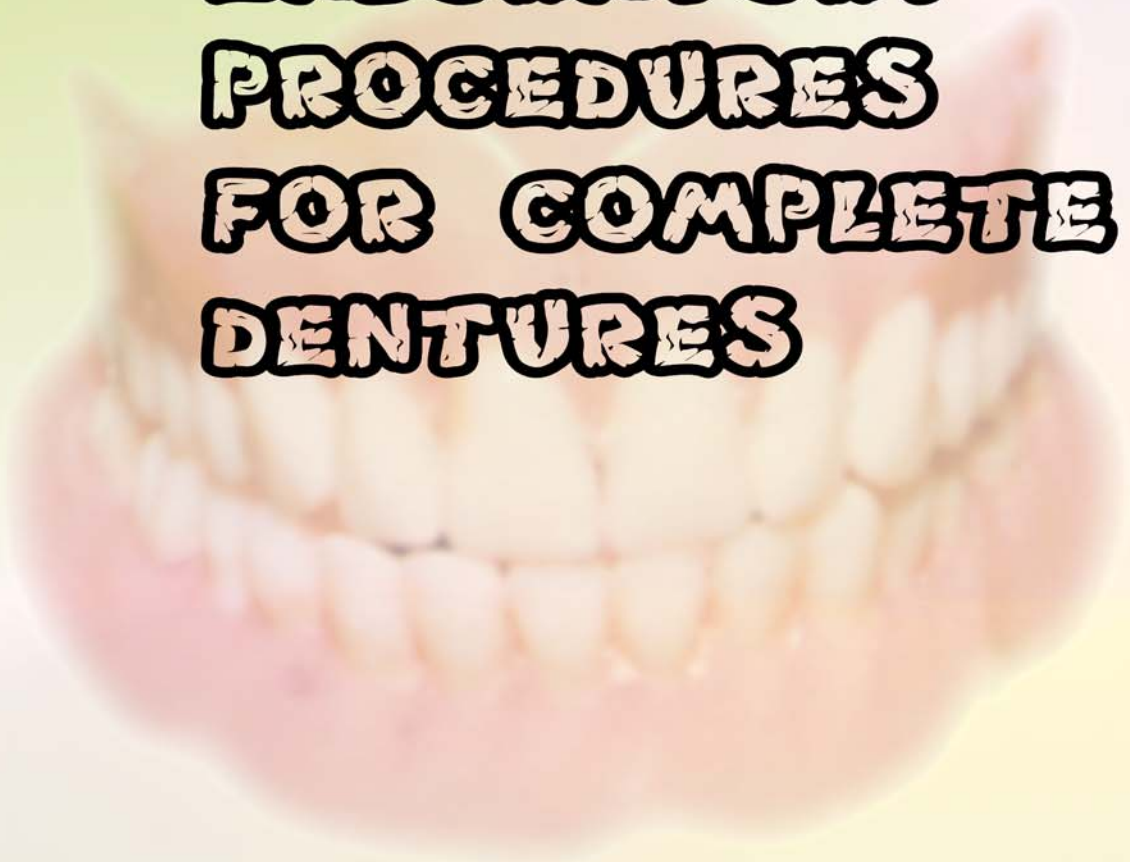
Frenectomy

This procedure is necessary in few patients with large frenum, which would interfere with upper denture fit. Best done several weeks before impressions are taken. After local anesthesia is given, upper lip is gently pulled away from the alveolar bone, and then clamp the frenum as far up as the reflection of the labial mucosa, with an artery forceps. Then wait a minute or so. Then the frenum is excised by cutting up on each side of the frenum while it is still clamped in the beaks of the forceps. Allow the lip to fallback. Undermine the mucosa over the alveolar ridge slightly. Suture the wound in the lip as well as the mucosa over the alveolar bone.

Remove the sutures after five days.

PART 2

LABORATORY PROCEDURES FOR COMPLETE DENTURES



5 Making of Cast and Model

DEFINITIONS

Cast is a positive, dimensionally accurate replica of oral soft and hard tissues of either the maxillary or mandibular jaws and used for the construction of dental appliances, which fit on the soft tissues of the oral cavity.

Model is a positive, dimensionally accurate replica of oral soft and hard tissues but used as study model, or for patient education or to demonstrate to the patient about the progress and out come of treatment as compared to the original condition.

TYPES OF CASTS/MODELS

Preliminary cast—Is one, which is made on preliminary impression and used to make special tray. This is constructed with plaster of Paris for economic reasons (Fig. 5.1).

Working cast—Is one, which is made on final impression and used to make denture. It is constructed with dental stone because it must be hard, strong and resistant to breakage and abrasion (Fig. 5.2).

Models can be as follows;
1. Model made at the beginning of treatment.
2. Model made at the end of treatment.

Fig. 5.1: Edentulous plaster casts (preliminary)
A. Mandibular, B. Maxillary

Most commonly used cast and model materials.
1. For dentures with nonmetallic denture base
   a. Plaster of Paris
   b. Dental stone.
2. For dentures with cast metal base.
   a. Investment
   b. Divestment.

IDEAL PROPERTIES OF CAST/MODEL MATERIALS

1. Should set to a very strong and hard mass.
2. Should maintain dimensional stability while and after setting.
3. Should not warp or distort.
4. Should produce all the finest details of impression.
5. Should have convenient setting time.
6. Should not break or get damaged during laboratory procedures.
7. Should be compatible with all types of impression materials.
8. Should have colour contrast so that it is not damaged during carving.
9. Should be resistant to surface abrasion and chipping.
10. Should be easy to manipulate and economic.

Fig. 5.2: Edentulous casts of dental stone (working casts)

NECESSITY OF CAST/MODEL

This represents the true parts of patients jaw or teeth and on these, dental appliances are fabricated in the laboratory in the absence of the patient, and fitted to the patients jaws at a later date. Therefore it is essential that cast must be accurate if the end product (denture) to be accurate.

Cast/Models are made from an impression of the oral tissues.

Accurate impression means accurate cast means accurate denture.

Impression making is a clinical procedure and the dentist must be skillful to do this. Cast making and denture fabrication is a laboratory procedure and the technician must be equally skillful to produce an accurate denture.

MAKING A CAST

Edentulous preliminary cast can be made entirely, i.e. impression part as well as base, with plaster of Paris. But dentulous and partially dentulous cast should be made with dental stone to prevent fracture of teeth. Similarly all working casts must also be made with dental stone.

However, impression area of cast with dental stone and base with plaster of Paris can be another choice if one desires.

PRELIMINARY BEFORE CASTING

All impressions coming from clinic should be carefully washed under room temperature tap water. Excess water on the surface of the impression is shaken off. If it is dentulous impression blow off air from teeth area. Keep the impression on the working bench with a support, one under the heel of the impression and another under the handle of the impression. For support one can use wooden end of plaster knife. Outer borders of impression must not be damaged.

Impressions of compound, ZOE paste, Alginate, and Elastomers do not require application of separating medium to the impression surface. But impression made with impression plaster of Paris must and should have separating medium applied to the impression surface to prevent adhesion of both impression plaster and casting plaster. Soap solution or 60 percent solution of sodium silicate in water can be used as separating medium. Now a days plaster impressions are rarely made.

Compound Impressions of Edentulous Jaws: Both the maxillary and mandibular impressions can be poured simultaneously if one is experienced; if not, one impression at a time should be poured and base made.

Mixing Plaster of Paris with Water—Tools required-
Clean, flexible, smooth rubber or plastic bowl.
Straight, broad, rigid stainless steel spatula,
Water measuring cup, or jar.

Balance or scale to weigh plaster powder Mixing bowl should not contain any traces of previous mix, if it does, it affects the setting time.

The water powder ratio for plaster of Paris for this purpose is 50 ml of water to 100 gm of plaster.

For pouring one impression at a time by Double pour method (Inverting method) 25 ml of water and 50 gm of powder is sufficient for the first mix. Therefore 25 ml of room temperature water is first taken in mixing bowl. Then 50 gm of plaster is added in increments to the water. Each increment of plaster is shifted into the water and one should wait for each increment to be soaked in water before adding next increment. Tap the bowl gently once or twice. Then start mixing, first by gentle stirring to wet all the powder particles and to break down the powder lumps. Then mix vigourously by rubbing against the side of the bowl for about a minute to a smooth, homogenous creamy mix. Removing air bubbles is very important during mixing and this can be done by tapping the bowl gently every now and then or by using automatic vibrator. Thus mixed mass should look shiny, glossy and cream like. "Whipping" action should not be employed while mixing.

Double Pour Technique or Inverting Method: Small amount of thus mixed plaster is first placed on the palatal vault area of maxillary impression or in the anterior region of the mandibular impression, and allowed to flow slowly into all areas of impression by mild vibration and by tilting the tray this side and that side. The tray is then inverted and tapped on the edges of the rubber bowl. This will ensure a thin and thorough coating of impression surface, which is free from air bubbles. This first layer of coating is very important and should be perfect because it is this what makes the future surface of a cast. This procedure can be repeated once more. Then the whole impression is filled to the level of its borders with plaster mix. Thus filled impression is laid aside with a support under the handle and at the heel of the tray with plaster looking up. Plaster

in the impression is allowed to set and when set, few criss-cross markings are made on it with wax knife (Fig. 5.3).

IInd Mix: This time 2 to 3 ml less water is used for the same 50 gm of plaster, in order to get rather thick mix. Place all that mix on a porcelain tile or glass slab and shape it into a square mass of about ½ an inch thick to make a base for the cast. Now invert the impression filled with previous mix on this square mass of second mix. Slowly shake the impression to and fro so that both the plasters come in contact evenly. While doing this, keep the impression level by holding the handle parallel to the porcelain tile. Then shape the sides all around the impression by using a spatula. As setting proceeds, the excess is removed with plaster knife. Allow for setting for 45 minutes to one hour (Fig. 5.4).

Separating the Cast from Impression

The whole unit, i.e. cast and impression along with tray is placed in hot water at a temperature required to soften the compound-say 55 to 60^0C. When the compound is soft, lift it up all along the buccal area and then palatal or lingual area. All this should be done very carefully without causing any damage to the cast. Don't try to remove the compound impression before it is softened. All traces of compound on the surface of cast should be removed carefully.

Fig. 5.3: Making of cast by double pour method

Making Working Cast

This is made following the final impression made by using a special tray with Zinc-oxide Eugenol impression paste. As usual, the procedure is basically same, except that this time dental stone is used to make a cast.

Wash the impression under tap water and shake off excess water. Mix dental stone with water powder ratio of 100 gm of stone to 30 ml of water. For 1st mix take 15 ml of water and 50 gm of stone.

No need of separating media to be applied to the impression surface. After filling the impression with dental stone of first mix, there is a choice for the 2nd mix; to make a base-one can use dental stone or else, plaster of Paris can be used.

Separating the cast from ZOE impression: The whole unit along with tray is immersed in near boiling water for few minutes. This will soften the paste, which makes it easy to separate the cast. While doing this, hold the whole unit with a towel and by using a round end of wax spatula, lift the impression try all along the outer periphery of the impression. All traces of ZOE paste left on the cast should be removed carefully.

Making a Dentulous or Partially Dentulous Cast

For this, impressions are usually made with Alginate, (IR-Reversible Hydrocolloid) whose main

Fig. 5.4: Making of cast by double pour (Inverting method)

disadvantage is distortion if not casted reasonably quickly. Impression shrinks due to drying and swells due to immersion in water. Both are bad. Therefore casting immediately is the best method. In case, if it is not possible to cast immediately or for some hours, then the impressions are wrapped in a damp cloth and kept in a polythene bag and seal the bag.

With these impressions also, there is no need of separating medium to be applied to the impression surface. Excess alginate beyond the posterior border of the maxillary impressions are cut away carefully with a sharp knife. Impression is washed under tap water, and excess water shaken off. Blow the air out of the teeth area of the impression.

Support the heel and handle of the impression, while being kept on the bench.

Once again Double pour/ Inverting method is employed to make a cast by using dental stone.

For the 1st mix 50 gm of Dental stone is mixed with 15 ml of water. For second mix to make a base 50 gm of stone is mixed with 12 ml of water to get rather thicker mix. While pouring the 1st mix, it is all the more important to ensure that the teeth areas are properly coated without entrapment of air. Remaining steps too should be done carefully because of the flexibility of the material.

Separating the Dentulous Cast from the Impression

The presence of teeth in the cast necessitates this step to be done with utmost care, to prevent fracture of teeth. Remove the excess stone all around the periphery of the impression. Holding the impression with the tray up looking, insert an instrument (e.g. straight end of wax spatula) between the tray and the alginate on either side of the impression and withdraw the instrument. This will separate the tray from the impression material. Separated tray is kept aside. Then the alginate material is lifted from the buccal and labial sides section-by-section and peeled off carefully without causing any damage to the underlying teeth.

Boxing an Impression to make a Cast

This is a method in which the impression is converted into a kind of box by attaching a strip of wax all around it and pouring plaster of Paris or dental stone into it. The advantage of this method is that it prevents pressure being fallen on impression while being casted and also base is made automatically.

Method: Bead or roll of carding wax is first attached just below the periphery of the impression all around. It is sealed with hot wax knife. The lingual space of mandibular impression is closed by a sheet of modelling wax and it is attached to the bead in that area. Than a sheet of modelling wax of about 4 cm in height is encircled around the impression and fastened to the bead of wax by hot wax knife. Seal the box properly and test it by placing some water into it. Water should not leak out. Impression of plaster of Paris, compound, ZOE paste can be easily boxed because wax beading will stick to the borders easily. Alginate and Elastomeric impression are not suitable for boxing since wax will not adhere to them. Once a properly boxed and sealed impression is ready, one time mixing of plaster or stone is done in sufficient quantity. At first small amount of mix is poured into the box and gently tapped or vibrated to make it flow into all areas of impression. This first coating must be smooth and uniform. Then the rest of the mix is poured into the box fully. Thus filled box of impression is allowed to set by placing a support at both ends of the impression. Once plaster or stone is set, peel off the strip of wax and the beading all around the impression (Figs 5.5 and 5.6).

Trimming Cast/Model

Method

a. Hand trimming.
b. By using model trimmer.

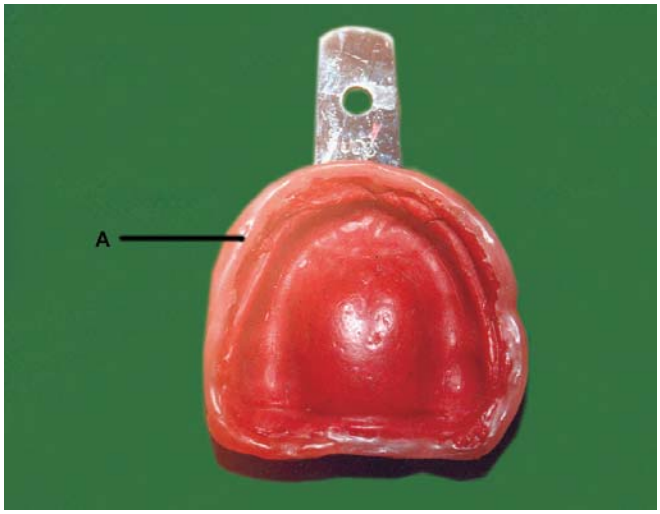


Fig. 5.5: Boxing an impression
A. Wax bead

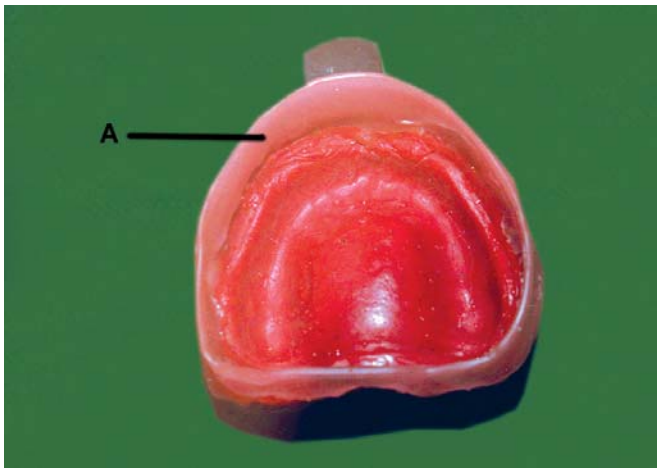


Fig. 5.6: Boxing an impression A. Boxing wax

Hand trimming must be done before the cast sets too hard. By using plaster knife with a palm grip and thumb support away from the sharp cutting edge of knife, buccal and labial excesses are removed without encroaching the full depth and width of sulci. Posterior border of the maxillary cast beyond the hammular notch and beyond the retromolar pad in case of mandibular cast are trimmed and made flat. On such a flat surface the cast should stand upright. Buccal and labial sides are made round. Tongue space of the mandibular cast is made flat and level from one side to another. Base also must be flat and level from side to side. Excess beyond the maxillary tuberosity and retromolar pad is removed. In any case sulcus and other anatomical features must not be damaged or reduced (Fig. 5.7).

Trimming by using model trimmer. Same principles as in hand trimming are to be followed. But the danger in this case is excess trimming due to improper control over the speed of the machine. Excess trimming especially at periphery of the cast must be avoided. Continuous water circulation is necessary during trimming.

TRIMMING STUDY MODELS

These models must be esthetic and made attractive. Therefore shape is given during trimming. Maxillary cast is pointed anteriorly and has 3 flat surfaces at the sides. Mandibular cast is made round in front and has two flat surfaces at the sides. Both casts have flat posterior surface, which is at right angle to the midline of the cast. Thus trimmed casts are dried and dusted with French chalk to make them smooth and attractive.

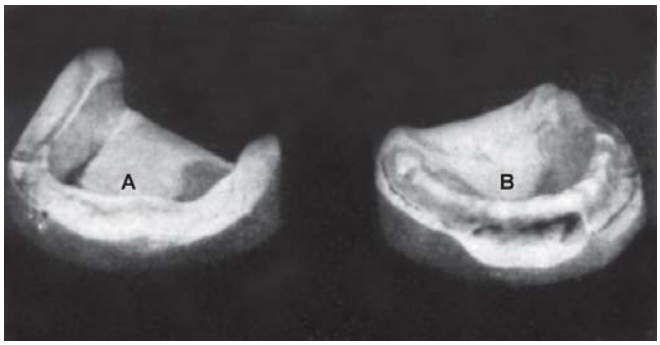


Fig. 5.7: Edentulous plaster casts
A. Mandibular, B. Maxillary

Duplication of Cast/Model

This is a method to make another cast/model without making another impression of mouth but by making an impression of the existing cast/model.

This is required for,

a. To save surgery time
b. Investment duplicate cast for cast metal work – i.e., cast partial denture construction
c. Record purpose.

Method: Select a suitable stock tray that fits accurately to the existing cast.

Soak the cast in cold water for 5 minute.
Tray must be perforated.
Mix alginate impression material.
Make impression of the cast.
Remove when set.
Wash under tap water.
Pour dental stone into this impression and make cast.
Separate the cast when stone is set
Trim the cast.

Materials to produce a rubber mould of cast. With which any number of cast can be made.

1. Latex rubber
2. PVC (Poly vinyl chloride)

CONCLUSION

Cast making is a skillful procedure and must be done carefully and slowly. Proper manipulation of gypsum products is essential.

Always make a base to all types of casts.

Take extra care while trimming to avoid fracture of base or teeth.

All impressions must be casted immediately or at least as early as possible.

6 Making Special Trays

These are also known as **Custom trays, Individualized trays, Tailor made trays.** Stock trays are necessary to make preliminary or 1st impression even though these impressions are not accurate. But there is no choice, because patient has come to us for the first time. Stock trays are like readymade shirts, which will fit to most people but are not exact. A special tray is like made-to-measure shirt, which will fit exact and to only one person for whom it is made.

Special tray is made on a cast obtained from preliminary impression of the patient.

Main use of Special Tray

To make secondary or final impression of the jaw.

Definition of special tray—It is a correctly fitting tray made on preliminary cast.

Requirement of Special Tray

1. Must be strong and rigid.
2. Must have smooth and round borders.
3. Must have provision to retain the impression material on its surface.
4. Its handle must be firmly attached and conveniently placed.
5. Must not distort during and after impression is made.
6. Flanges of the tray must not be adopted into undercuts.
7. Posterior border of maxillary tray must be 1/8 of an inch beyond the junction of hard and soft palate. And mandibular posterior border must cover retromolar pads.
8. Borders must not impinge on the muscle attachment and should have proper relief for frenal attachments.
9. Borders of tray should be little short of the peripheral out lines.
10. Borders must never be overextended.

Types of Special Trays

A. *Close fitting special tray*—This type of tray has not much room for the thickness of the impression materials. The impression material is in thin layer as in wash impression. ZOE paste gives such impression because of its thin viscosity (Fig. 6.1).

B. *Spacer special tray or loose fitting special tray*. These trays have space for thicker consistency impression material like alginate and thick consistency ZOE paste (Fig. 6.2).

What can be used as Spacer?

a. Modelling wax:
   One sheet thickness for thick consistency ZOE paste impression.
   Two sheet thickness for alginate impression.
b. Piece of thick canvas.

Materials for Making Special Tray

A. Nonmetallic
   1. Shellac base plate.
   2. Nonbrittle impression compound.
   3. Acrylic resin.
      i. Cold cured.
      ii. Heat cured.

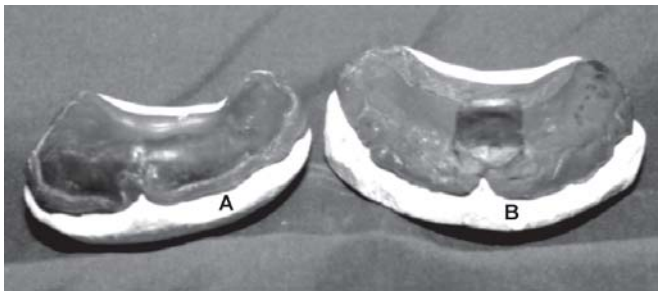


Fig. 6.1: Maxillary special tray (shellac)
A. Base plate adaption with rolled borders, B. Tray with handle

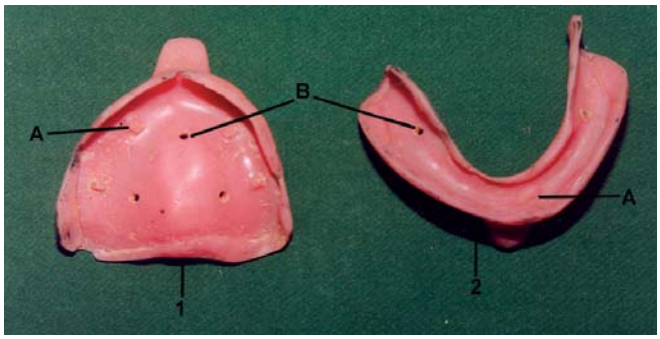


Fig. 6.2: Acrylic spacer special trays
1. Maxillary, 2. Mandibular (A. Occlusal stops, B. Perforations)

B. Metallic
1. Soft alloy of tin and lead.
2. Plumbers solder.

What can be used to make a handle to the tray?
a. Same material as the tray
b. Metal wire.

What can be used to retain the impression material in the tray?
a. Perforations
b. Special adhesive solution
c. Cotton wool threads spread over the surface of tray and fixed with sticky wax at 3to 4 points.

Shellac Special Tray

This can be made quickly and therefore commonly used as a special tray. But, because it is fragile and breakable one must handle this very carefully.
Types of Shellac
a. Plain
b. Alluminium filled (Fig. 6.3).

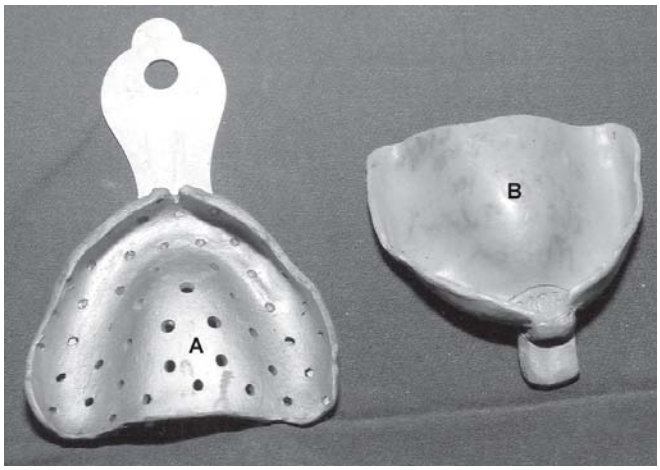


Fig. 6.3: Maxillary special trays
A. Made of alluminium filled shellac, B. Made of plain shellac

Method

Outline the periphery of the tray on the cast. Dust the cast with French chalk. Adapt one thickness of base plate wax to the cast and cut it little short of the peripheral outline (Two thickness wax sheet for Alginate impressions)

Dust the wax surface with French chalk. Soften the Shellac base plate over the flame uniformly and adapt it to the cast. In the case of an maxillary cast first adapt it at the palate with thumb pressure. In the case of lower cast adapt it over the ridge first. Resoften the unadapted areas of base plate section by section and thus complete the adaptation all over the ridge; buccal, labial and lingual areas of cast. Finger pressure is used to adapt the base plate.

Cut away the excess base plate beyond the sulcus and posterior border by sharp hot knife or by scissors or by using a narrow bladed fine teethed saw (Figs 6.4 and 6.5).

Resoften the borders and complete the adaptation.

File the borders to the peripheral outline of the cast.

Smoothen and make the borders round with sand paper. Lab hand piece can also be used for this. To make handle leftover pieces of Shellac are joined to one another to proper thickness and size of handle and shaped. One end of this is heated and attached to the adapted Shellac at a convenient place. Then the attached borders of the handle are sealed with hot wax spatula. When cooled the handle must be firm in place. Piece of impression compound also can be used to make handle. If one is using ZOE paste for final impressions it will adhere to the dry surface of the impression tray and so there is no need of

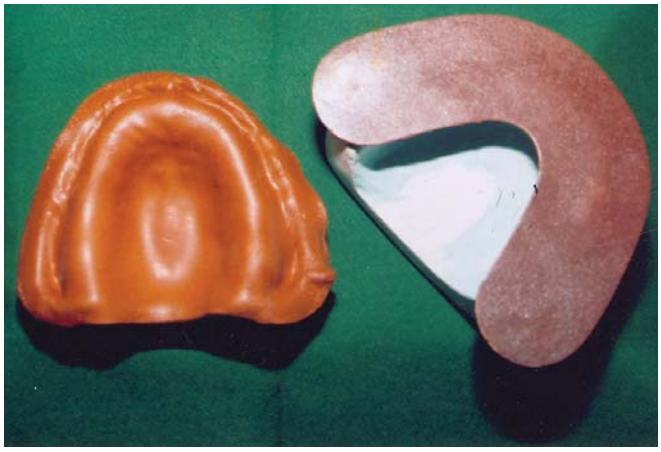


Fig. 6.4: Base plate (shellac) adaptation

Fig. 6.5: Base plate (shellac) adaptation (fitting surface)

perforations. On the other hand, if alginate is the final impression material, perforations (holes) are drilled into the base plate with a round bur or by piercing a hot instrument into the base plate (Fig. 6.6).

Spacer wax is removed only after border moulding but before the final impression material is loaded into the tray.

Close fitting shellac special tray (without spacer) can also be used while using ZOE paste as final impression material

Acrylic Resin Special Tray

Advantages—More rigid and strong, unbreakable, do not distort.

Self Cure (Cold Cure) Resin Tray

Methods
a. Sprinkler (salt and pepper) method
b. Dough method

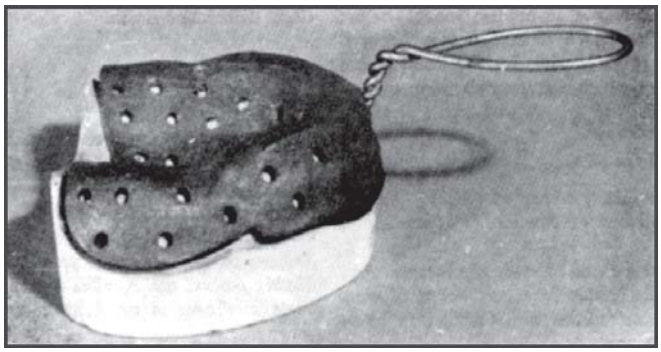


Fig. 6.6: Maxillary shellac special tray with perforations and wire handle

a. Sprinkler (Salt and Pepper) Method

Outline periphery of tray on the cast apply separating medium (cold mould seal) to the cast surface.

Wait for it to dry. Apply Vaseline to your fingers lightly. Adapt one or two thickness sheets of base plate wax as spacer over the cast to the required outline for basal seat area, i.e., over the crest of the ridge and little on to the buccal and lingual sides. Posterior palatal area and retromolar pad not covered. Apply separating medium again- this time to the surface of the spacer wax. Cut into the wax 2 to 3 mm square openings, one in the canine region and another in the molar region of both sides of the crest of the ridge. (These provide bumps in the tray and act as occlusal stops and space for the impression material to spread uniformly) Two dispensers, one containing acrylic self cure polymer whose flow from the opening can be controlled as desired; and another containing cold cure monomer liquid which can be dispensed in drops, are essential.

Start from the buccal self of maxillary tuberosity or retromolar buccal self of one side and continue to another side. First place a drop of monomer in the area, then immediately sprinkle some polymer over it. Repeat this sequence over and over again until 2-3 mm thickness of resin is formed, whole buccal and labial areas of both sides are covered with resin, which can be pressed lightly and smoothened with fingers before it polymerises.

Same process is carried on the lingual sides of the mandibular alveolar ridge and palatal area of maxillary ridge. Finally it is done on the crest of the ridge to join both the buccal and lingual resins. Important thing to observe in this technique is that there will be uniform thickness of 2-3 mm resin all over the tray.

b. Dough Method

Preliminaries like peripheral outline; use of separating medium, adapting wax spacer etc, are all-same as in salt and pepper method. Then adapting the acrylic dough can be done in different ways-

a. Mix monomer and polymer in small glass jar (Dappen glass) and wait a minute for dough consistency. Take the dough out of the jar in toto and adapt it to buccal self of the ridge and smoothen with fingers moistened with monomer. Clean the mixing jar. Once again mix monomer

and polymer; Wait a while and then adapt the dough in the labial self and again on the buccal self of the other side. This process is repeated until the whole area of tray including the palate is covered with thin layer (2-3 mm) of acrylic.

b. After usual preliminaries, acrylic dough is prepared, quantity suitable for the whole tray area, is rolled into flat sheet of even thickness and then immediately placed over the cast and adapted with fingers. In few minutes it becomes hard. Excess beyond the peripheral outline is cut away before the resin hardens.

c. Making Use of Template

How to make a template—Dental stone is mixed with water to a rather thick consistency and spread on the porcelain tile to make a square block of 4″× 4″ with 0.5″ thickness. Before the stone reaches its initial set, vaselined surface of either maxillary or mandibular shellac base plate is pressed flat into the stone and held there under light finger pressure. Little more than the whole thickness depth of base plate should be in the stone. When stone sets hard, shellac base plate is removed. The square block of set stone has now a shape, size and thickness of base plate on its surface. This is template—one for the maxillary and another for the mandibular.

After the customary preliminaries, templates are made use. Apply separating medium to the template.

Mix self-cure polymer and monomer in a jar. Pour this mix into the base plate area of template to cover the full area and thickness of template. Tap gently so that it spreads uniformly over the area. When the resin comes to dough stage after a minute or so lift it up from the template, spread it over the cast and adapt quickly with fingers moistened with monomer. Cut away the excess beyond the borders of the tray before the resin hardens. Advantage of using a template- uniform thickness is assured (Fig. 6.7).

Heat Cured Acrylic Special Tray

Outline the periphery of the tray on the cast.

Apply separating medium to the cast.

Adapt one or two sheets thickness of base plate wax over the cast. Cut the excess wax to the outline. Seal the edges all around. Make a suitable sized and shaped handle with base plate wax.

Fig. 6.7: Making of acrylic resin base
A. Mandibular template, B. Maxillary template

Attach the handle to the adapted wax on the cast in a convenient place.

Seal the handle to the wax base plate with hot knife.

Then all the steps of compression moulding technique are employed. Like, Flasking, Dewaxing; packing the heat cure acrylic dough; Curing; and Deflasking to obtain acrylic tray.

Trimming the acrylic special tray. When the resin is hard, its gross peripheral borders are first trimmed in a lathe and then by using a laboratory hand piece final finishing and rounding of borders is done. If necessary holes (perforations) are drilled into the resin. Contour the shape of the buccal and lingual flanges similar to the finished dentures.

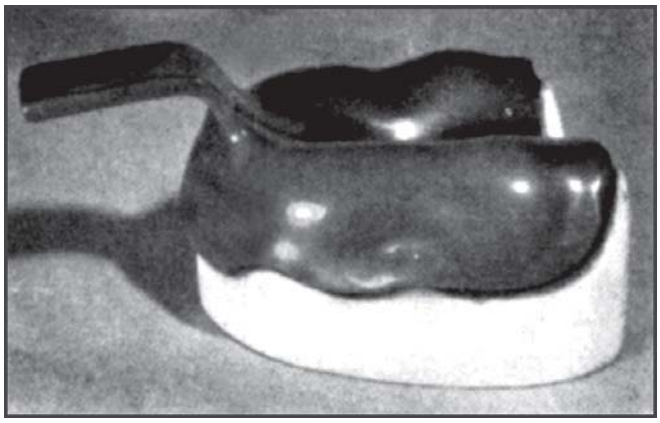


Fig. 6.8: Maxillary acrylic special tray

CONCLUSIONS (Fig. 6.8)

The borders of all trays must be smooth and round no sharpness felt anywhere.

The border should be little short of the peripheral outline to make room for the border-moulding compound.

All muscular attachments must be properly relived.

Handle of the tray must be firmly attached and placed in a convenient position so that it doesn't come in the way of making impressions.

Never over extend the borders.

Do not overheat the shellac base plate. Wax spacer is removed only after border moulding.

Make suitable provisions for the retention of impression material in the tray.

7 Making Jaw Registration Blocks

Also known as—Bite blocks; Occlusal blocks; Record Blocks, Occulsal rims.

DEFINITION

These are the devices with which correct positioning of the lower jaw in relation to upper jaw; occlusal plane, center of the face etc. can be recorded and accordingly artificial teeth are arranged

Parts of registration blocks are:

a. Base
b. Rim

Base Materials can be

a. Shellac sheet—routinely used
b. Modelling wax
c. Acrylic resin- cold cure or heat cure
d. Metal

} These are the temporary denture bases.

Rim Materials can be

a. Modelling wax—routinely used
b. Compound
c. Plaster—pumice combination

Making Registration Blocks with Shellac Base and Modelling Wax Rim for Edentulous Jaws

Preliminaries

Working stone casts of both maxillary and mandibular jaws are outlined to the anatomical landmark periphery with pencil. It is to the full depth of the sulcus. Dust the casts with French chalk. Block out any undercuts if present with modelling wax, especially in the maxillary tuberosity region and in the lingual pouch of the mandibular cast. And torus palatinous in the midline of palate if present it should be relieved with piece of tinfoil.

Adapting a Shellac Base Plate over the Cast

This is softened uniformly over a Bunsen burner flame (or a spirit lamp) and placed over the cast.

First the palatal area is adapted with thumb pressure and then over the ridges. Resoften the un-adapted areas of base plate section by section and in this way complete the adaptation all over the ridges, buccal, and labial areas of the sulcus. Borders in the sulcus must be adapted to the full depth and width of the sulcus. Posterior border should make contact with palatal surface of cast. There should not be any gap between the base plate and surface of the cast. Thoroughly adapted base plate will not rock when pressed on one side of the crest of the ridge, and vice versa. In other words, the adapting surface of base plate must make thorough contact to the cast surface including sulcus (This is how the future denture makes contact with patients soft tissues).

In the case of mandibular jaw, good adaptation in the lingual pouch area is very important for good retention of denture.

Shellac plate must not be over heated while adapting because over heating burns it and makes it weak. The edges of the base plate beyond the sulcus is cut away with sharp knife or with scissors while it is still soft and whole plate is once again resoftened at the borders and readapted. Then the excess left at beyond the outline is resoftened and folded back on to the base plate and sealed with heated instruments. This will create a thick and round border to the base, which also helps in retention. Also this makes the edges smooth. Posterior border of the maxillary base plate should not be folded; instead it is cut to finish at the junction of hard and soft palate. This border too should be made smooth and round by file or sand paper.

Test for any rocking of base plate at this stage—if it rocks, resoften it and readapt it.

Same procedure is followed to adapt base plate to the mandibular cast. In this case, borders are folded all around the sulcus including the retromolar pad region (Fig. 7.1).

Making wax rim: Wax to be used is a sheet of modelling wax. Take about 4″ long sheet of wax—approximate length of ridge from one end to another. Soften it length wise from one side and fold it 3 to 4 times to produce a roll of wax, which is 4″ long and 0.5″ wide.

Bend this roll of wax to the approximate shape of arch form of either maxilla or mandible.

Resoften one border of this bent roll of wax and place that heated end directly over the alveolar ridge from one end to another, but slightly buccally in the molar region. Press the wax roll lightly. Seal the joint between wax roll and base plate all along the ridge from one end to another both buccally and lingually, with hot instrument. Maintain the arch form of the wax roll all along—arch form in wax similar to the arch form of the underlying cast.

Forming and maintaining arch form at this stage is most important and essential.

Add strip of softened wax over the buccal aspect of the rim and fuse it to cover the naked base plate. Now place a glass slab or porcelain tile on the table. Put some water to cover its surface (Fig. 7.2).

Place the occlusal rim on to this surface with cast looking up.

Compress the wax rim in such a way that more pressure falls posteriorly than anteriorly keeping the cast surface parallel to the glass surface. This should be done slowly and up to a limit. The purpose of this act is to reduce the height of occlusal rim of maxillary cast.

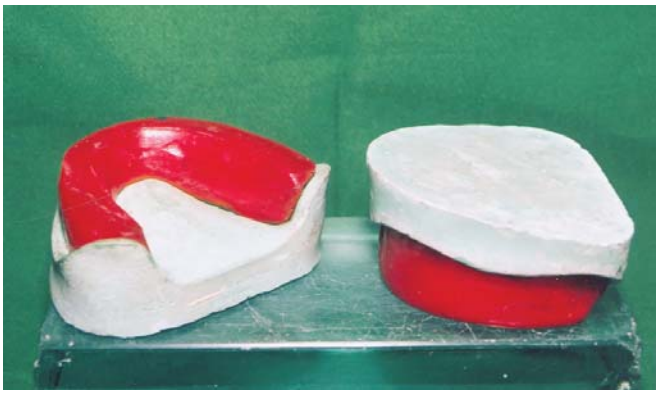


Fig. 7.2: Edentulous occlusal rims on casts

Excess wax that bulges out buccally is fused and made level up to the borders of the base plate. Similarly bulged wax lingually or palatally also fused and made level with that surface.

Height and width requirements of occlusal rims Maxillary rim—the height of the maxillary rim can be measured in two ways;

a. From the deepest part of the sulcus to the level of occlusal plane
   Or
b. From the crest of the ridge to the level of occlusal plane (Figs 7.3 and 7.4).

That means measuring from the sulcus includes height of the alveolar ridge and the wax rim height. Measuring from the crest of the ridge gives only the height of the wax rim.

The height of the alveolar ridge varies from patient to patient depending upon the amount and pattern of bone resorption. And also it is more pronounced in the mandibular ridge than in the maxillary ridge

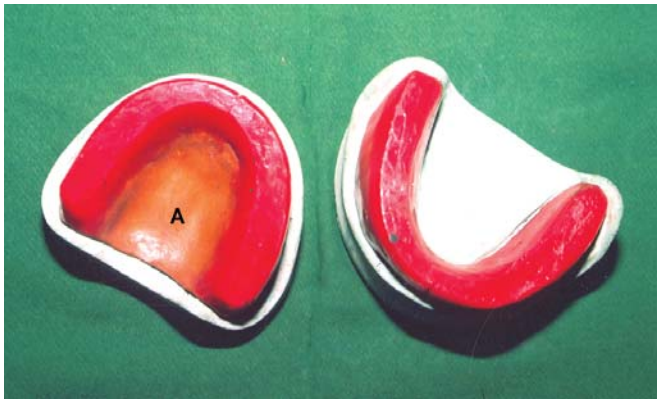


Fig. 7.1: Edentulous occlusal rims on casts
A. Shellac base

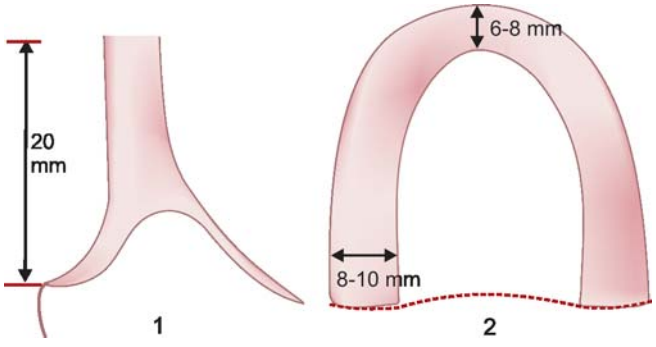


Fig. 7.3: Maxillary occlusal rim measurements
1. Height in the anterior region from the sulcus to occlusal surface.
2. Width in the Anterior and Posterior regions

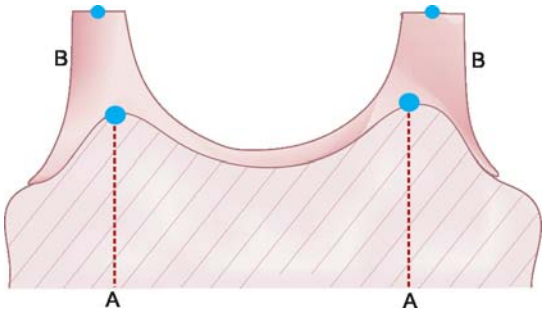


Fig. 7.4: Maxillary occlusal rim (Posteriorly)
A. Centre of the ridge, B. Rim slightly buccal to the center of the ridge

Relevance of rim height to occlusal plane: The inclination of occlusal plane is made parallel to the Ala-tragus line. To achieve this, the rim height has to be somewhat more in the anterior than in the posterior. As a general rule, rim heights are made to a certain measurements and these will be altered at the time of establishing jaw relations according to the needs of that particular patient. Thus, these standard measurements of maxillary occlusal rims are as follows.

Height as measured from the sulcus to occlusal level is,
Anteriorly—20 mm
In the first molar region -18 mm
In the tuberosity region -15 mm

These measurements makes the occlusal plane anterior to posterior with upward inclination coinciding with the Ala-tragus line.

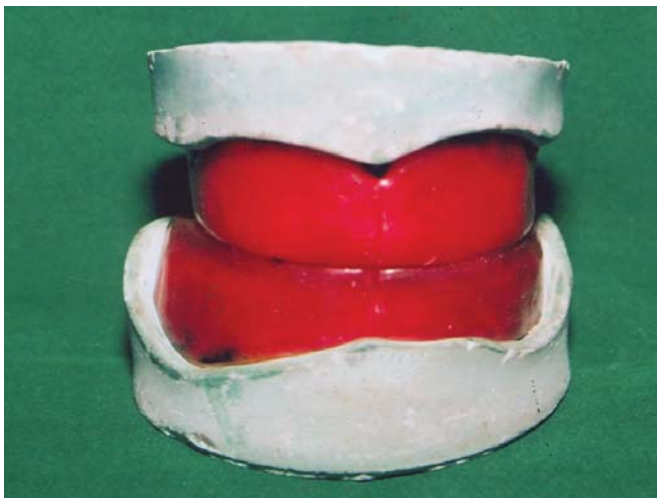


Fig. 7.5: Edentulous occlusal rims on the casts (front view)

Anterior measurement is made in the first incisor region, immediately next to the labial frenal attachment.

Width of the maxillary occlusal rim
Anterior—6-8 mm
Posterior—8-10 mm

Anterior width is less because it is to be occupied by incisors, which has incisal edges.

Posterior width is more because it is to be occupied by molars which has occlusal (wide) surface.

Having met the requirements with regard to height and width of the wax rim, other points to be attended to are; occlusal plane made level from one tuberosity to another.

Labial and buccal sides are made smooth and the whole surface from the border of the base plate to occlusal plane made as one, adding wax where necessary.

By holding the occlusal rim at the eye level, observe it from the front and from sides. It shouldn't have undue anterior protuberance or undue palatal inclination. Remove the excess wax from anterior palatal area. The wax surface and the palatal part of base plate should merge smooth as one surface. The whole palatal area should be available for unrestricted tongue movements. The Rim is made tapered to the base at the distal aspect of tuberosity to prevent contact with the ascending ramus of mandible. Finally all surfaces of rim should be made smooth with a small flame, and polish the wax in cold water with wet cotton.

To make mandibular base plate and wax rim: The same procedure as in maxillary rim is followed, the only

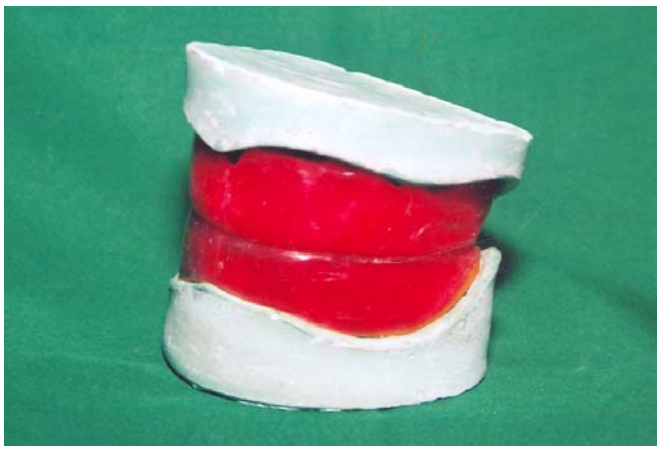


Fig. 7.6: Edentulous occlusal rims on the casts (side view)

Fig. 7.7: Making all wax occlusal rims (Base and rim)

difference is in measurements. Wax rim is placed directly over the ridge from anterior to posterior (Figs 7.5 and 7.6).

Height of mandibular occlusal rim as measured from the sulcus to the occlusal plane is as follows.

Fig. 7.8: Making all wax (Base and rim) occlusal rim

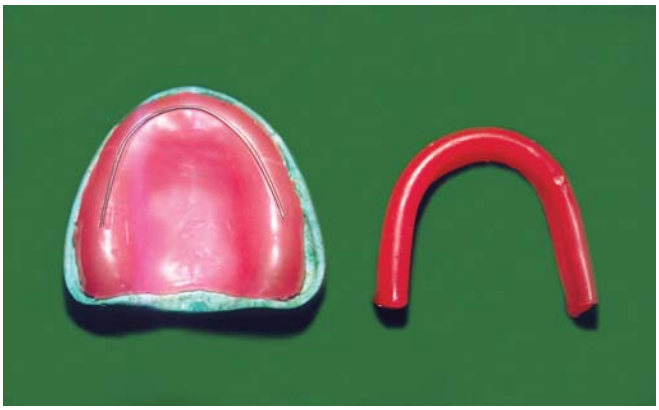


Fig. 7.9: All wax (Base and Rim) occlusal rim

Anteriorly—18 mm
Posteriorly—20 mm
Which is in other words reverse of maxillary rim measurements, and by doing this, both the occlusal rims make uniform contact from anterior to posterior when brought together

Width of the mandibular occlusal rim.
Anterior—4-6 mm
Posterior—6-8 mm

The posterior retromolar pad is taken as a reference point—the posterior level of occlusal plane should end up at a level two third the way upon the retromolar pad.

CONCLUSION (Figs 7.7 to 7.9)

Maintain the arch forms of both the maxillary and mandibular wax rims—which resemble the underling arch form of the stone cast. Wax rims are made to the stipulated measurements with regard to height and width.

Wax rims should not be bulky instead they should be slim and neat. Both the occlusal planes must be level and make even contact when put together. Base must not rock.

Clear all muscle attachments.

Rim should be firmly attached to the base.

Tongue space should not be encroached.

Rim should be placed directly over the underlying ridge.

If desired cold cure acrylic resin base and wax occlusal rims are made following the usual method.

8 Articulators and Mounting

DEFINITION

This is a device upon which dental casts along with occlusal rims are mounted in the same relationship obtained during establishing jaw relations.

Types of Articulators (Fig. 8.1)

1. Simple hinge or plane line articulator. This allows opening and closing movements only.
2. Anatomical Articulators.
   a. *Average movement articulator* also known as Fixed condylar path articulator or Free plane articulator (Fig. 8.2).
      This is also a hinged device but has inclined slot fixed at a certain angle, which allows basic average movement of Tempero mandibular joint, and the same is used for all patients. This also has fixed but sloped incisal table.
   b. *Fully adjustable articulator*:
      This has adjustable hinge; adjustable circular disc which allows condylar angles as recorded on the patient to be set; and also adjustable incisal table—all together allows individual jaw movements to be reproduced on the articulator.
      Examples of fully adjustable articulator
      Hanau
      Dentatus (Fig. 8.3).

Commonly used simple hinge articulator and free plane, average movement articulators are described here.

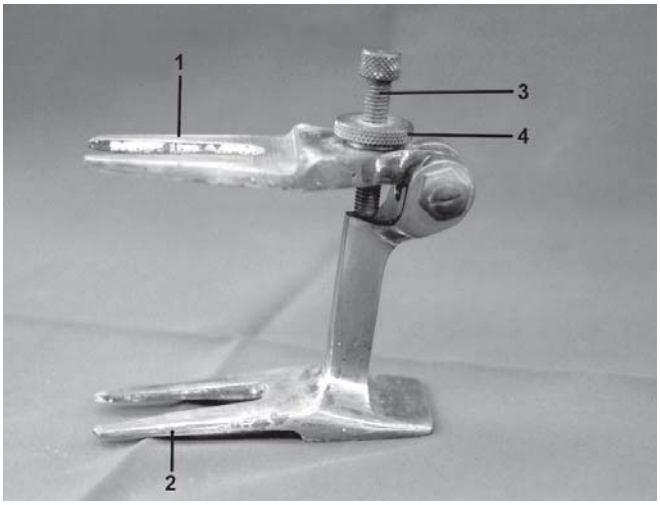


Fig. 8.1: Plane-line or simple hinge articulator
1. Upper arm, 2. Lower arm, 3. Set screw, 4. Screw tightening nut

Mounting on Simple Hinge Articulator

Preliminaries before Mounting

Casts must be properly and firmly seated on the base of occlusal rims. When both casts are placed in this way, if the casts make contact at the distal end it will prevent proper seating of the record blocks on the casts. In such a case distal contacting area of both casts are trimmed sufficiently to allow proper seating of blocks on the casts.

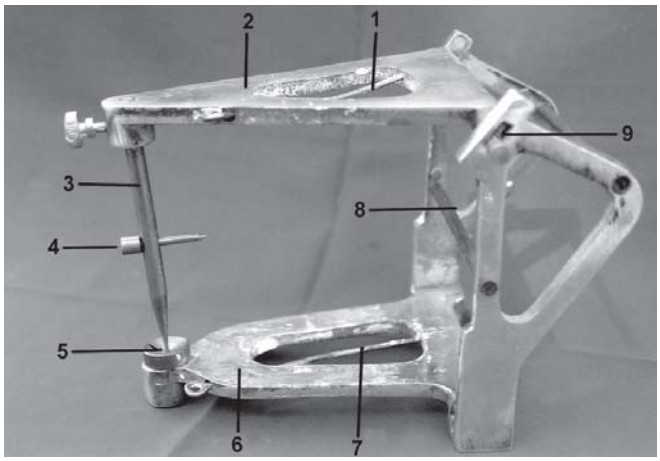


Fig. 8.2: Fixed condylar path articulator
1. Maxillary model securing wire, 2. Upper arm, 3. Incisal indicator pin, 4. Incisal Guidance pin, 5. Fixed incisal table of 10°, 6. Lower arm, 7. Mandibular model securing wire, 8. Posterior bar to guide occlusal plane, 9. Fixed, curved condylar path

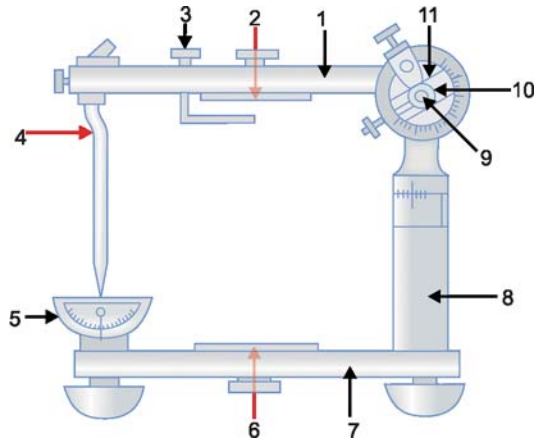


Fig. 8.3: Fully adjustable articulator
1. Upper arm, 2. Mounting plate (upper), 3. Orbital plane indicator, 4. Incisal guidance pin, 5. Incisal table, 6. Mounting plate (Lower), 7. Lower arm, 8. Condylar post, 9. Condylar axis, 10. Condylar sphere, 11. Condylar track

Hold the whole unit (both casts along with occlusal rims) in the space between upper and lower arms of the articulator to make sure there is sufficient space for the mounting plaster. If the bases of casts are too thick and comes in the way of mounting, the thickness of bases must be reduced to proper size.

Roughen the bases of casts with the point of plaster knife.

Soak the casts in water for few minutes.

Seal the casts to the base of the occlusal rims at the borders in 2 to 3 places with sticky wax or modelling wax.

Apply Vaseline to the articulator arm slightly. Adjust the screw on the articulator in such a way that the upper arm is parallel to the lower arm. This maintains the vertical dimension. Make a thick mix of plaster and water and put small amount of it on a flat smooth bench surface.

Position the lower arm of articulator in it. Put some more plaster over it. Lift the upper arm of the articulator. Position the whole mounting unit (i.e. both the casts along with occlusal blocks) over the lower arm and center it.

Make sure the occlusal plane is parallel to the bench surface when seen from front and sides. The centerline marked on the occlusal block should be perpendicular and vertical. This should be achieved before the plaster sets, it may be necessary to tilt the whole unit little bit this way or that to achieve this requirement.

Shape the sides of wet plaster and remove the excess. Allow the plaster to set.

Mounting the Upper Cast

Raise the upper arm of the articulator. Second mix of plaster and water is made. Place some amount of plaster mix on the base of upper cast and lower the upper arm of articulator into it. Cover with some more plaster mix. Flatten the upper surface and make the sides vertical.

Remove excess. Allow it to set. Trim with sand paper.

To set the vertical dimension maintaining screw loosen the locking nut. Adjust the screw by rotating it until its tip contacts the opposing arm of the articulator. Tighten the locking nut. This fixes the adjusting screw (Figs 8.4 and 8.5).

CONCLUSIONS

Check the articulator hinge before mounting. Lightly apply Vaseline to articulator arms. Occlusal plane must be horizontal to Central vertical line.

Symmetry of whole unit maintained. Thick bases of casts should be reduced in height before mounting. The whole unit must not move while mounting.

MOUNTING ON THE FREE PLANE ARTICULATOR

This articulator allows backward (i.e. in the patient forward) and lateral movements of the mandible.

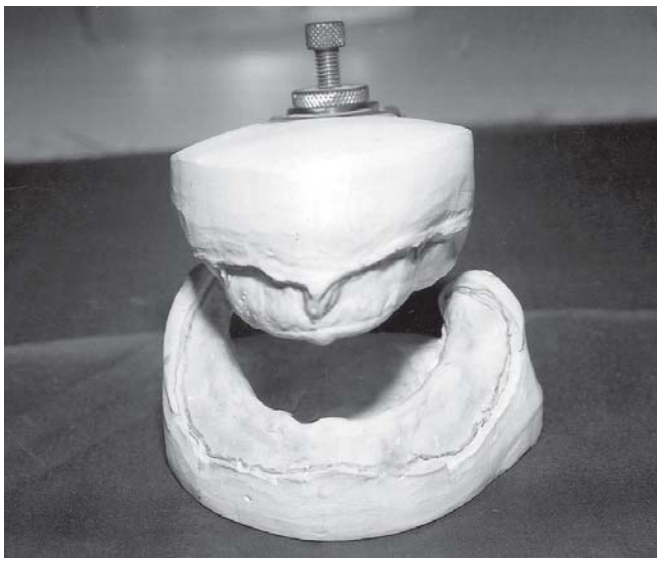


Fig. 8.4: Mounting on plane-line articulator showing denture space

Fig. 8.5: Mounting on plane-line articulator showing simple hinge

Fixed incisal angle helps in reducing incisal locking and fixed condylar guidance angle represents average condylar slopes of many patients.

Advantages of Using This Articulator

1. Helps in setting up of teeth to prevent cuspal interferance during mastication.
2. Multipoint contact of teeth around the arch during mandibular movements.
3. Such an arrangement of teeth helps in retention and stability of dentures.

Mounting Procedure (Fig. 8.6)

Reduce the bases of casts if thick.
Roughen the base of casts.
Soak the casts in water for few minutes.

Seal the casts to the base of occlusal rims at the borders in two to three places with sticky wax or modelling wax.

Apply Vaseline to the articulator arms lightly.

Incisal guidance pin is adjusted in such a way that its top end is flush with the top of the pin housing on the upper arm of the articulator. And its pointed end touches the incisal table.

Incisal indicator pin that is present in the incisal guidance pin pushed fully in the hole so that its head is firmly against the incisal guidance pin.

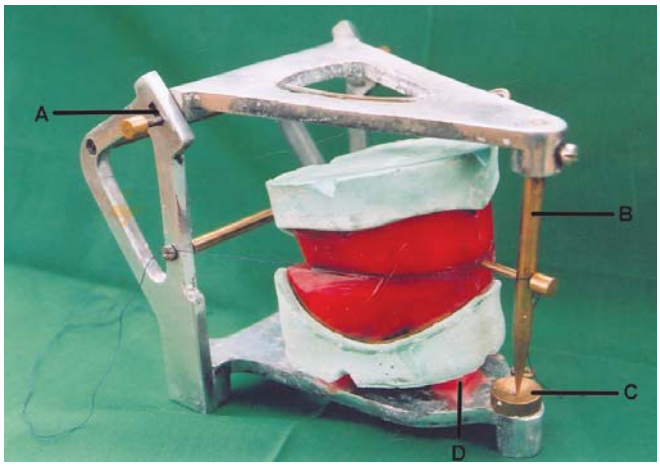


Fig. 8.6: Mounting on free plane articulator
A. Fixed condylar guidance, B. Incisal indicator pin, C. Incisal table, D. Wax tripods

Make three round balls of modelling wax, soften them and place them on the lower arm of the articulator in a triangular arrangement—one in the front and two at sides. Seal this wax ball to the arm with hot knife. Place the whole mounting unit on these wax balls.

First adjust the front wax ball by increasing or lowering its height in such a way that junction of the central line and occlusal plane of occlusal rims makes contact with the tip of the incisal guidance pin. Then the two side wax balls are adjusted by increasing or decreasing their heights in such a way that the posterior occlusal plane on either side lies coinciding with the imaginary line from the tip of incisal guidance pin to a horizontal bar on the posterior pillars of the articulator (Fig. 8.7).

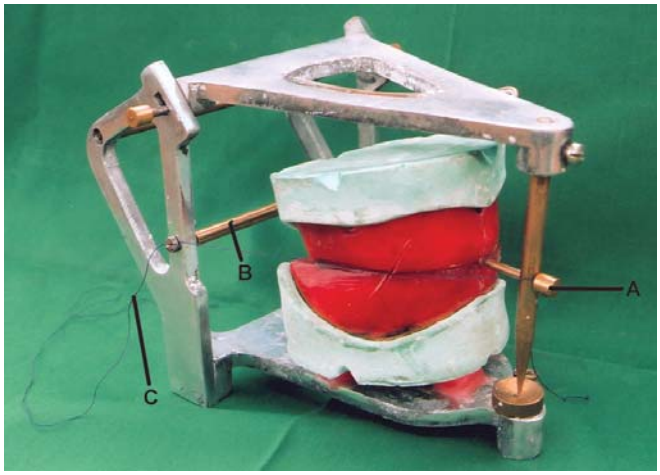


Fig. 8.7: Adjusting the occlusal rims on freeplane articulator
A. Incisal guidance pin, B. Posterior bar, C. Thread

A piece of thread held from the head of incisal guidance pin to the posterior bar will help to establish this adjustment.

Center the whole assembly of mounting in the center of the articulator space. Centerline marking on the wax rim coinciding with the center of the articulator etc are checked.

The whole assembly should not move at all until the upper cast is mounted. To ensure this, two wax strips are sealed between base of lower cast and articulator arm temporarily. Then withdraw the central incisal guidance pin from its housing.

Lift the upper arm of the articulator. Make a thicker mix of plaster and water. Place some amount of mix on the base of maxillary cast and lower the arm into it (Fig. 8.8).

Put some more plaster and shape it to a flat top and tapering sides before the plaster sets.

Remove the excess plaster and trim to shape. Allow the plaster to set.

When set, invert the articulator on the table with the upper arm down and lower arm up. Remove the wax balls. Lift the lower arm of articulator. Fresh mix of plaster is placed in the lower cast (Fig. 8.9).

Now lower the lower arm of articulator into the plaster mix and make sure the incisal indicator pin touches the incisal table. Put some more mix and shape to a flat bottom and tapering sides (Fig. 8.10).

Fig. 8.8: Mounting the maxillary cast and occlusal rim on freeplane articulator

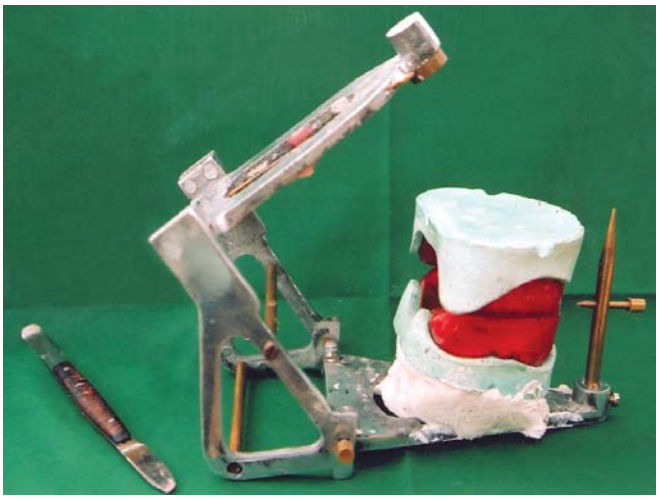


Fig. 8.9: Inverting the articulator to mount mandibular occlural rim and cast

Remove the excess and trim to shape. Allow the plaster to set. When set clean the articulator under tap water to remove all traces of plaster.

CONCLUSION

Adjust the articulator pins properly Apply Vaseline to articulator arms. If necessary reduce the thickness of bases of casts. Adjusting the occlusal plane in relation to anterior pin and posterior bar is essential. Once adjusted don't move the whole assembly until upper cast is mounted.

Fig. 8.10: Mounting the mandibular cast and occlusal rim on freeplane articulator

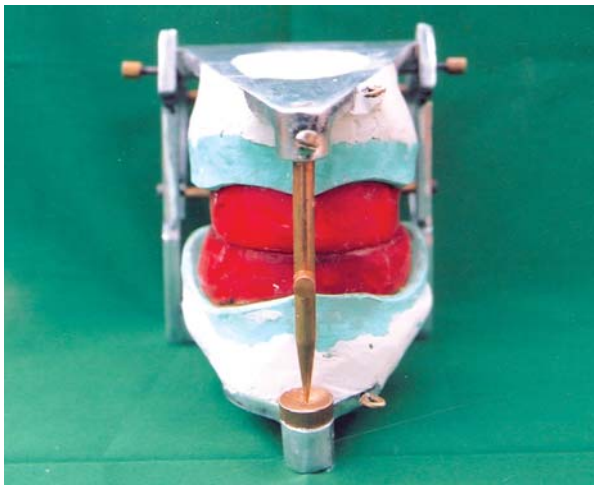


Fig. 8.11: Mounted occlusal rims on freeplane articulator (front view)

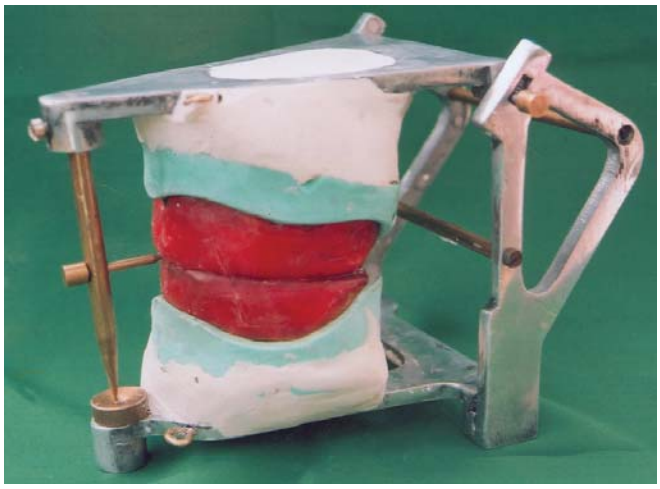


Fig. 8.12: Mounted occlusal rims on freeplane articulator (side view)

While lowering the lower arm make sure the tip of the incisal indicator pin touches the incisal table because this maintains the vertical dimension (Figs 8.11 and 8.12).

The mounted articulator is finished with sand paper to give a neat and smooth appearance.

MANDIBLE MOVEMENTS VERSES ARTICULATOR MOVEMENT

In Natural Condition

Maxilla (upper) is fixed to the skull
Mandible (lower) is movable

In the Articulator

Upper arm moves;
Lower arm fixed
Therefore-

Mandibular natural Movements	*Articulator movement*
Protrusive	Upper arm moves Backward
Right lateral	Upper arm moves to the left
Left lateral	Upper arm moves to the right

9 Setting-up of Teeth

Occlusion—Is just a static meeting of maxillary and mandibular teeth in any position.

Articulation—Is a dynamic change from one occlusion to another while the masticatory surfaces are in contact.

Centric occlusion—Is the occluson at which there is maximum contact of occluding surfaces of maxillary and mandibular teeth (i.e. intercuspidation or interdigitation) when the condyles are in their most retruded unstrained positions within the glenoid fossae.

That means, at centric occlusion 3 things are must
1. Maximum occlusal contact.
2. Deepest cuspal interpenetration.
3. Posterior functional condylar position.

After completing all the movements, mandible ultimately and certainly will go into only one position, i.e. to centric occlusion. This is the only possible foundation upon which artificial denture can be built. Upon relaxation of jaw muscles; the mandible drops down a little, there will be freeway space between teeth, this position of mandible is centric relation.

Centric relation—Is most retruded rest position of mandible from which lateral movements can be made.

Vertical dimension—Also known as "Height of the Bite".

When teeth present—It is the vertical distance between the jaws when teeth are in centric occlusion.

When teeth not present—It is the vertical distance between the upper and lower alveolar ridges after deducting the appropriate clearance for free way space.

Centerline—It is the center of patient's face

Normal lip line—Is the rest position of patients upper lip and it is about 2-3 mm higher than the occlusal plane.

Occlusal plane—It is the plane at which the occlusal surfaces of teeth meet.

Canine line—It is the position of the corner of the mouth.

SETTING-UP IN NORMAL OCCLUSION

Object of Set Up

1. To provide satisfactory appearance
2. To provide efficient masticatory function.
3. To maintain speech faculty in a normal pattern.
4. To contribute to retention and stability of dentures.

General Principles

Maxillary anterior teeth should always be set anterior to the alveolar ridge. How much anteriorly depends on the amount of bone resorption. Due to the pattern of bone resorption of alveolar ridges, the maxillary arch becomes somewhat narrower, especially on the labial aspect and the mandibular arch becomes wide in the molar regions.

While setting the anterior teeth normal lip position should not be altered. To help the technician to do this the dentist must trim the occlusal rims at the chair side so that the upper lip will neither fall inwards nor be stretched outwards.

Then the anterior teeth are set with the labial aspect of them parallel to and flush with the labial aspect of the trimmed rims. Thus lip profile will be maintained. Otherwise patient will have so called "*denture face*". Maxillary anterior teeth should be made some what prominent to give a bold look, If there is not much resorption of upper anterior ridge, teeth are set directly on the ridge and gum fitted.

The appearance of the face depends on the position of these six maxillary teeth that too of two central incisors.

If these teeth set too much forward, force of upper lip will displace the denture downward, there by retention of the denture is affected.

Incisal edge of maxillary occlusal rim should be adjusted by the dentist at the chair side, which will guide the technician to put incisal edges of anterior teeth to that level. Position of the lateral incisors gives the maxillary arch a square or spherical form. Canines are the corner stones of the dental arch. They are positioned at the corner of the mouth and play an important role in the set up. Thus appearance is given priority while setting maxillary anterior teeth. Although typical ideal setting arrangement will be described in the following pages many variations, irregularities can be done to enhance appearance.

Mandibular anterior teeth are placed directly over the ridge. They are positioned lingually to the maxillary anterior and slightly higher than the occlusal plane, to get the desired overbite and overjet.

Overbite or vertical overlap is the vertical distance that the maxillary anteriors overlap the mandibular anteriors.

Over jet or horizontal overlap is the horizontal distance that a maxillary anteriors overlap the mandibular anteriors (Fig. 9.1).

Both of these are in the range of 2-3 mm: normally over jet is more than overbite. The angle of inclination of incisal edges of upper anteriors and lower anteriors is related to the cuspal angle of posterior teeth and the angle of condylar slopes. The degree of over jet and over bite therefore depends on the posterior teeth, which are cuspless (flat) or cusped. Thus maxillary anteriors over lap the mandibular anteriors.

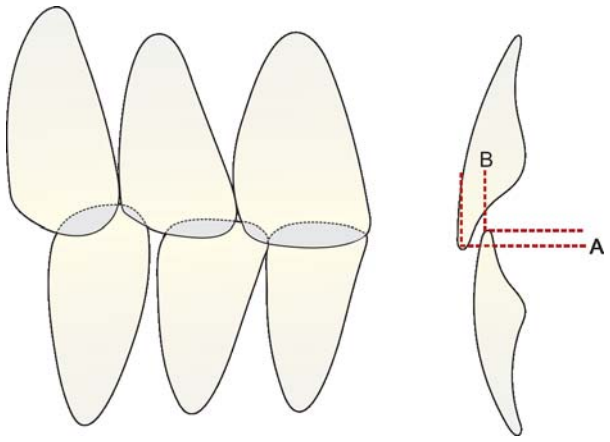


Fig. 9.1: Setting of maxillary and mandibular anteriors
A. Overbite, B. Over jet

Posterior teeth should be placed in the so-called "*neutral zone*". Neutral zone is the area of alveolar ridge where the forces exerted by tongue muscles and the facial muscles like cheeks and lips muscles are in equilibrium. The term is coined by Sir William Kelsey Fry. The pressures exerted by these muscles are equal and opposite. This is not so important with natural dentition because natural teeth are embedded in bone and do not move. But the dentures, which just sit on the alveolar ridge, are affected by these forces and can become unstable (move) due to wrong position of teeth. As the area of neutral zone reduces in size in edentulous patient, teeth which are narrower bucco-linugually should be used, esp., mandibular posteriors. Maxillary posteriors should be placed directly over the inter alveolar ridgeline or slightly out side the ridge (buccally) where bone resorption is excessive. Mandibular posteriors should be placed on the ridge coinciding with the line drawn from the crest in the canine region to the center of the retromolar pad. Lower posteriors should never encroach upon the tongue space. The buccal cusps of maxillary premolars and molars over lap the buccal cusps of mandibular molars and premolars and there is interdigitation of palatal cusps.

Level of horizontal occlusal plane—Normally this is midway between the maxillary and mandibular ridges. However this can be altered at the chair side by the dentist. The level of occlusal plane is related to retention and stability of dentures.

If the occlusal plane is more towards alveolar ridge, more stable the dentures are. This is especially important in the case of lower denture. In general, the occlusal plane should not be above the level of resting tongue.

Methods of Setting up of Teeth

1. By using simple hinge type of articulator. The teeth are set to normal occlusion without balanced occlusion. Later when the dentures are finished spot grinding of cusps of teeth is done to clear cuspal interferences in the mouth.
2. By using free plane, fixed condylar path, average movement articulator. Teeth are set to normal and balanced occlusion in all mandibular movements. Posterior teeth are set in a saucer like arrangement to resemble the compensating curves, which helps in bringing about multipoint contact of teeth during different mandibular movements.

3. By using fully adjustable articulator with face bow recording and angle of condylar path etc., teeth are set to a perfect balanced occlusion to meet the individual patients mandibular movements. This necessitates the use of complicated articulator and the dentist and the technician must have suitable training and skill to handle this.
4. Setting of teeth can also be done according to "functional theory of occlusion" for which patient is allowed to "chew-in" the occlusal surface record blocks made of plaster pumice combination.

Ideal Set-up in Normal Occlusion: Preliminaries before Starting of Set-up

Sealed occlusal blocks at the occlusal plane are unsealed. Occlusal plane made level and smooth with hot wax knife.

Dismantle the occlusal blocks from the casts if they are sealed. Mark the central line on the casts corresponding to the central line of the occlusal rims.

Draw a line along the crest of ridge with a pencil. Select suitable set of artificial teeth. Small, thin piece of glass slab kept handy. Other items like wax knife, lecrons carver, rubber bowl containing water and cotton wool are necessary. Bunsen burner flame is used to soften the wax.

Sequence of arrangement of teeth. Many methods can be followed but the method employed here is like this.

First maxillary anteriors.

Then mandibular anteriors.

Next maxillary posteriors.

Finally mandibular posteriors.

While setting the mandibular posteriors. First molar is first set because it is considered as "*key of occlusion*" Its correct positioning and occlusion with opposing maxillary teeth is important for the whole set-up. Before starting the set-up of maxillary anteriors, the strip containing artificial teeth is taken out from the box.

Keep it in front of you. Take out one tooth at a time. Important thing is right side and left side teeth should not be mixed up.

Individual Tooth Orientation

Reference planes used as guide and individual teeth are positioned in relation to these planes. They are-

1. *Vertical plane*—Imaginary vertical axis passing from the center of the articulator. Central line marked on the occlusal rim and on the cast is part of this vertical axis.
2. *Horizontal planes*—It is the occlusal plane passing antero-posteriorly.

Division of oral cavity—Since maxilla and mandible can be divided into right half and left half, all together it makes four quadrants in which teeth have to be set up. What is applicable to one half of maxilla is exactly same to the other half of maxilla. Similarly in the case of mandible

In one quadrant seven teeth are to be set. They are

1. One central incisor
2. One lateral incisor
3. One canine
4. One first premolar
5. One-second premolar
6. One first molar
7. One-second molar

Therefore one must understand the principles of arranging just seven maxillary teeth and just seven mandibular teeth in relation to vertical and horizontal axis. When the same arrangement is carried on the other half of jaws the whole set up is complete.

How to make use of glass slab? The glass slab represents the flat horizontal plane and shows the correct positioning of teeth. When the set tooth is placed on the slab one can see tooth's reflection (shadow) on the glass slab. With the help of this shadow one can ascertain whether the incisal edge is touching the slab (i.e. occlusal plane) or above it. Accordingly adjustments are made.

Glass slab also useful to see the simulated curves of Spee and Monson if the complete maxillary set up is placed on it.

Examples of some of the artificial teeth used for set up.

Manufacturer's Name Primadent

S*24MN1
S*24M2N
S*23M3D
S*24MS2

Procedure

Start setup with maxillary central incisor of one side-dig up just the quantity of wax from the occlusal rim on the region where central incisior is to be placed. Soften the remaining wax in the dugged up area and

place the tooth in it and orient it in relation to vertical and horizontal planes. Then follow the same procedure in this order—central incisor of other side, followed by lateral incisor of one side and followed by lateral incisor of other side, followed by canine of other side to be followed by canine of another side- thus completing the maxillary anterior setup. Set up of both central incisors, lateral incisors and canines makes a curve, which is the anterior arch form and presents a bold getup and look. Every tooth, once it is properly oriented it should be sealed around the neck. The whole labial surface of each tooth should be free of wax during and after setting. In other words set up must be clean and neat.

Maxillary Anteriors

Central Incisor

Front view—Long axis vertical or with slight distal inclination. Incisal edge horizontal and touching the occlusal plane (i.e. glass slab)

Side view—Incisal edge inclined forward slightly. Incisal edge parallel to and on the same level as the lower occlusal rim. Neck brought out a little.

Common mistake done while setting central incisors is mixing up the sides. This completely spoils the appearance. Identification points are; mesial incisal edge is at right angle. Distal incisal edge is round.

Lateral Incisor

Front view—Neck distally inclined slightly and somewhat depressed.

Side view—Incisal edge inclined forward slightly more than central.

Incisal edge—Not touching the occlusal rim (i.e glass slab) slightly above it.

Canine

Front view—Vertical and parallel to the vertical axis Neck out (Fig. 9.2).

Side view—Vertical.

Incisal point—Touching the occlusal plane (i.e. glass slab).

Mandibular Anteriors

Central Incisor

Front view—Slightly distal inclination at the neck. Long axis parallel to vertical axis.

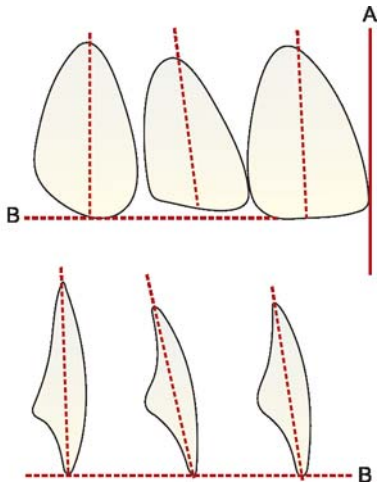


Fig. 9.2: Setting of maxillary anteriors
A. Vertical axis, B. Horizontal axis

Side view—Very slightly forward at the incisal edge
Incisal edge—About 2 mm above the occlusal plane.

Lateral Incisor

Front view—Same as central incisor.

Side view—Same as central incisor.

Incisal edge—Same as central incisor.

Canine

Front view—Slight distal inclination at the neck.

Side view—Slight lingual tilt at the incisal edge (Fig. 9.3).

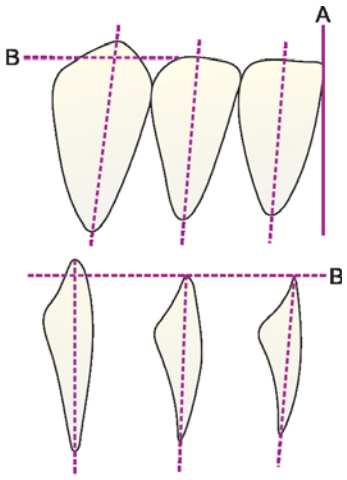


Fig. 9.3: Setting of mandibular anteriors
A. Vertical axis, B. Horizontal axis

Cusp little more than 2 mm above the horizontal plane, i.e. little above central and laterals.

Maxillary Posteriors

First Premolar

Front view and side view—long axis parallel to vertical axis.

Palatal cusp—Above horizontal plane.

Buccal cusp—Touching the lower occlusal rim, i.e. glass slab.

Second Premolar

Front view and side view—Long axis parallel to vertical axis.

Palatal cusp and buccal cusp—both touching the lower occlusal rim, i.e. glass slab.

First Molar (Fig. 9.4)

Front view—Long axis slopes buccally.

Side view—Long axis slope distally.

Mesiolingual cusp only touches the occlusal plane (i.e. glass slab). Both buccal cusps slightly higher than lingual cusps.

Second Molar

Front view—Long axis slopes buccally little more than first molar.

Side view—Long axis slope distally little more than first molar.

All four cusps do not touch the lower occlusal rim (i.e. glass slab) but the mesiolingual cusp is the nearest to the occlusal plane.

In case of first and second molar- distal cusps being higher than the mesial cusp, simulate the curve of Spee (antero-posterior curve) the buccal cusps being higher than the lingual cusps simulate the curve of Monson (lateral curve) (Fig. 9.5).

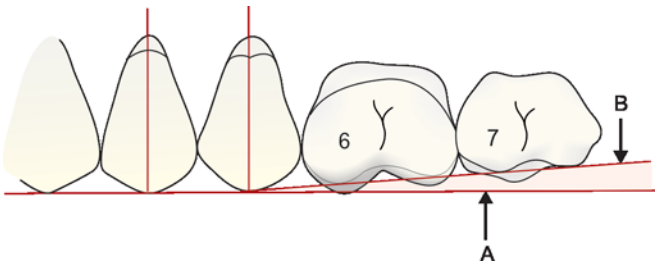


Fig. 9.4: Setting-up of maxillary posterior teeth
A. Occlusal plane, B. Buccal cusps of 6 and 7 above the occlusal plane

Mandibular Posteriors

First Molar

"Key of occlusion" Because this tooth plays a major role during balanced occlusion if set properly.

This tooth occludes with the distal slopes of cusps of maxillary second premolar and mesial 2/3 rd of maxillary first molar.

Front view—Long axis slopes lingually.

Side view—Long axis slopes mesially.

All the cusps are at a higher level than the occlusal plane, buccal and distal cusps higher than the mesial and lingual cusps. Proper occlusion and position of this tooth in relation to opposing tooth is very important.

Second Molar

This occludes with distal slopes of distal cusps of maxillary first molar and mesial 2/3 rd of maxillary second molar. All the inclination and cusps level are little more than that of first lower molar (Fig. 9.6).

Second Premolar

Front view and side view: long axis parallel to the vertical axis.

This tooth occludes with mesial slopes of cusps of maxillary second premolar and distal slopes of cusps of first premolar. Both the cusps are 2 mm above the horizontal plane.

Fig. 9.5: Setting of maxillary, anteriors and posteriors showing compensating curve in relation to molar set up

Fig. 9.6: Completed set-up (side view)

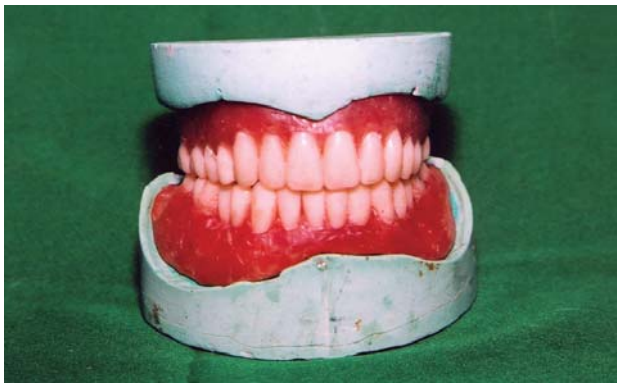


Fig. 9.8: Completed set-up (front view)

First Premolar (Fig. 9.7)

Front view and side view: long axis parallel to the vertical axis.

This tooth occludes with the mesial slopes of cusps of maxillary first premolar. Only the buccal cusp is above the horizontal plane by 2 mm (Fig. 9.8).

Balanced Occlusion

Why balanced occlusion setting of teeth to ideal normal setting deals only with the ideal positions of teeth to ensure occlusion. Occlusion however is a static relationship, but the oral cavity is dynamic and dynamic relationship between teeth is called articulation. This necessitates balanced articulation and occlusion

DEFINITIONS

Articulation—It is a relationship of the maxillary and mandibular teeth, which exists during mandibular movement from one occlusion to another. It is a dynamic relationship and it may be balanced or unbalanced.

Balanced articulation—It is a multipoint contact relationship of opposing teeth and they glide smoothly over each other during mandibular movement without causing dislodgement of dentures.

Balanced occlusion—Is a multipoint contact relationship of opposing teeth in a static condition.

Working side—It is that side of jaw where mastication takes place (Fig. 9.9).

Balancing side—It is that side of jaw where tooth-to-tooth contact is maintained to prevent tilt. It is other side of jaw (Fig. 9.10).

For Example

If mandible moves to the right, right side is working and left side is balancing side.

If mandible moves to the left, left side is the working side and right side the balancing side;

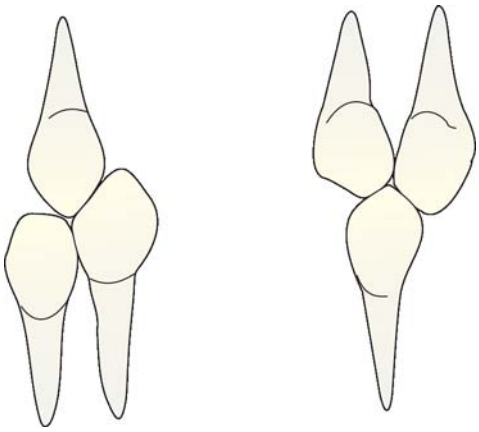


Fig. 9.7: Teeth interdigitation
Each tooth (except the maxillary 3rd molars) interdigitates with the two others in the opposite jaw.

Fig. 9.9: Working side occlusion

Part 2

Fig. 9.10: Balancing side occlusion

Advantages of Balanced Articulation

1. Improved masticatory efficiency.
2. Helps in retention and stability of dentures.
3. Wide distribution of occlusal load- thus reducing trauma to tissues.
4. Multipoint contacts of teeth (Fig. 9.11).

Factors Affecting Balanced Articulation

1. Condylar guidance—at TMJ.
2. Incisal guidance—at incisor overbite.
3. Occlusal plane.
4. Cuspal angles.
5. Compensating curves.

To remove confusion about balanced articulation simplification.

DEFINITIONS

Condyle—It is the rounded surface at the distal end of the ramus of the mandible, which fits into the glenoid fossa to form the temperomandibular joint.

Fig. 9.11: Protrusive relationship

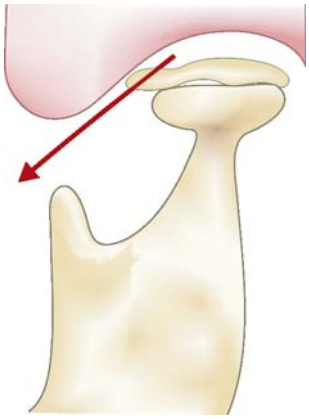


Fig. 9.12: Inclination of condylar path

Condylar path—It is the angulated path down which the condyle travels within the glenoid fossa (Fig. 9.12).

Condylar guidance—Is the arrangement or provision on the dental articulator, which reproduces the natural condylar path of patient along which the condyle travels during mandibular movement.

Incisal—means cutting edge of incisor teeth.

Incisal guidance—Is the guidance given to the mandibular movement in the anterior region by the relationship of maxillary and mandibular incisor teeth in contact during movement, i.e. extent of overbite (Fig. 9.13).

Occlusal plane—Is a horizontal anteroposterior plane at which occluding surfaces of maxillary and mandibular teeth meet.

Occlude—Means to close up or fit together.

Cuspal angle—It is the angle between the cusp slope and a line drawn across the base of cusp.

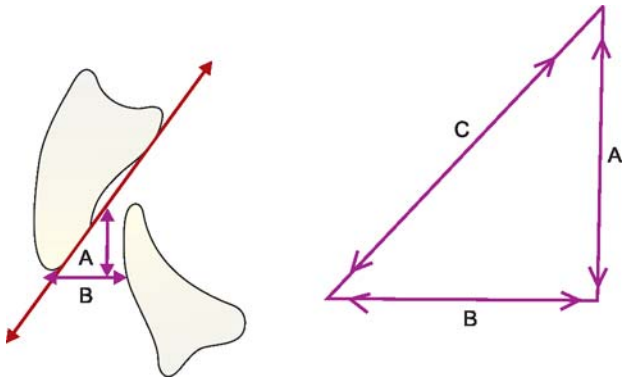


Fig. 9.13: Balancing the occlusion
A. Over-bite, B. Over-jet, C. Incisal guidance

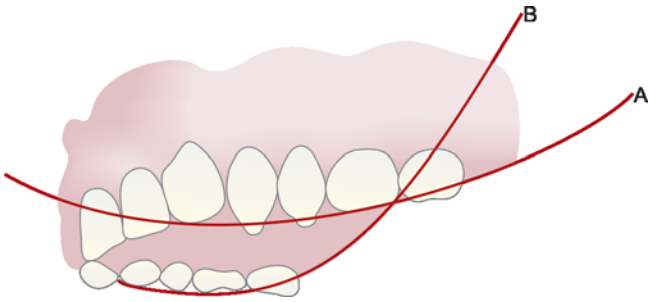


Fig. 9.14: Compensating curves
A. Antero-posterior curve similar to curve of spee, B. Lateral curve from right to left (i.e. side to side) is similar to curve of monson

Cusp height—Is the height of a cusp measured from its baseline. Cusp height increases with cusp angle.

Compensating curve—It is a saucer–like curve created in artificial teeth while setting-up to simulate the curve of Spee and Monson, as they exist in natural dentition. Flat cusp teeth require steeper curve. High cusp teeth require shallower curve. These curves are used to develop balanced occlusion (Fig. 9.14).

Curve of spee—It is an imaginary, anteroposterior curve line beginning at the tip of mandibular canine tooth and extending backward along the buccal cusps of premolar and molar to terminate in the anterior border of head of the condyle. This in natural dentition has center at the crista lacrimalis posterior and radius of 7 cm (Fig. 9.15).

Curve of monson—It is a side-to-side curve of occlusion (i.e. lateral curve). This in natural dentition has a center at glabella and 4 inches radius (Fig. 9.16).

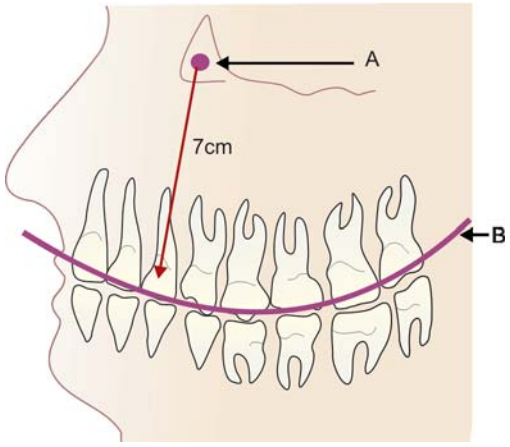


Fig. 9.15: Compensating curve
A. Crista lacrimalis posterior, B. Curve of spee

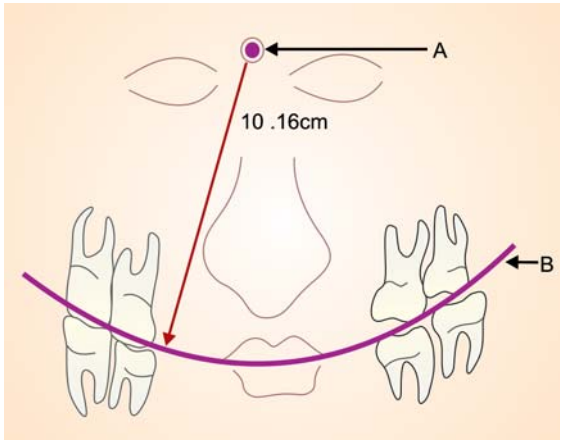


Fig. 9.16: Compensating curve
A. Glabella, B. Curve of monson

Incisal angle—Is the angle formed with the horizontal plane by drawing a line in the sagittal plane between incisal edges of the upper and lower central incisors when the teeth are in centric occlusion.

Mastication—It is chewing of food before swallowing. It makes use of jaws, teeth, supporting tissues, TMJ, muscles, tongue, lips, cheeks and soft tissues. This involves opening, closing, lateral and antero-posterior movements of lower jaw.

Masticatory cycle—Is the regime of movement of lower jaw starting from opening; followed by forward and lateral movements and finally closing.

Opening involves movement of both the condyles in their respective glenoid fossa and along the slope of eminentia articularis in forward and downward direction. The angle of this movement depends on the degree of slope of eminentia articularis. This movement in natural condition, (i.e. patients) is known as condylar path and in the articulator as condylar guidance. Thus this path is a curved path and the condyle has to travel along this curved path.

For example—Imagine a curved road. A car traveling on it has to follow the curvature of road.

The angle of condylar path varies from patient to patient and this can be recorded and transferred to an adjustable articulator (Fig. 9.17).

During *"grinding"* of food more protrusive and lateral movements of lower jaw takes place. In protrusive (forward) movement of lower jaw, lower front teeth have to pass across the incisal edges of upper anteriors as the condyles move downwards and forward. The degree of overbite and over jet is the deciding factor whether this passing over is

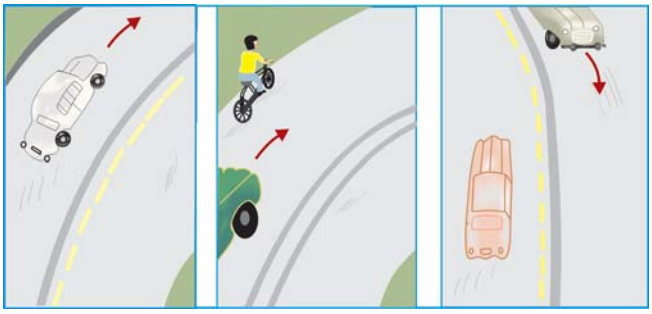


Fig. 9.17: Condylar guidance is similar to,
All vehicals following the curvature of the road

smooth or not. This is known as incisor path and incisal guidance. The angle of incisal guidance varies from patient to patient depending upon the amount of over bite. For example, imagine our same car travelling on a smooth road. Suddenly it comes across a road hump and it has to cross over it. Crossing over the hump and jolt one gets depends on the height of the hump. Higher the hump more will be the jolt felt. All those who travel on city bus services experience this.

In case of mandibular forward movement steep incisal angle puts the posterior teeth out of occlusion. During setting of teeth to balanced occlusion in edentulous patients suitable incisal angle has to be calculated and the incisal table set to that angle.

For example, first register the average condylar angle. Say 30 degrees. Then double the cuspal angle of posterior teeth. Say 20 degree X 2 = 40 degree.

Then subtract condylar angle in cuspal angle to arrive at incisal angle, i.e. 40 - 30 = 10 degree.

Lateral or Sideways Movement of Lower Jaw

On working side—Condyle rotates upon a vertical axis. And moves very slightly outwards and backwards. This is BENNET shift

On balancing side—Condyle moves forward and downward.

What is "BULL" Balanced articulation depends upon the cuspal angles being parallel to the path of movements of the mandible

Therefore, Buccal cusps of Upper posterior teeth and Lingual cusps of Lower posterior teeth should hormonize with the rotating movement and therefore are made parallel by grinding. Initial letter of this, namely, B of buccal, U of upper, L of lingual and L of lower—together make the word BULL (Fig. 9.18).

On the balancing side, lingual cusps of upper posteriors and buccal cusps of lower posteriors should not be grinded.

Thus teeth with a given cusp angle have been selected, balanced articulation and occlusion is obtained by adjusting the posterior teeth in such a way that cusp angles are in harmony with the rotating arc of the articulator, which automatically creates a compensating curve. Therefore the cusp angles should be parallel to the path followed by the mandible. Keep the overbite as small as possible. Set the incisal guidance table in such a way that during protrusive and right and left lateral movements the incisive edges of the maxillary and mandibular teeth just slide upon each other smoothly.

Teeth for Balanced Articulation

a. Cusped teeth are better.
b. Cuspless or inverted cusp or flat teeth.

Fully Adjustable Articulator

Records to be obtained at chairside:
1. Centric relation record.
2. Protrusive record.
3. Right and left lateral records.
4. Face bow record.

Face bow—It is a bow shaped frame, which fits over the face and registers the maxilla—condyles relationship. Then it is used to transfer this record

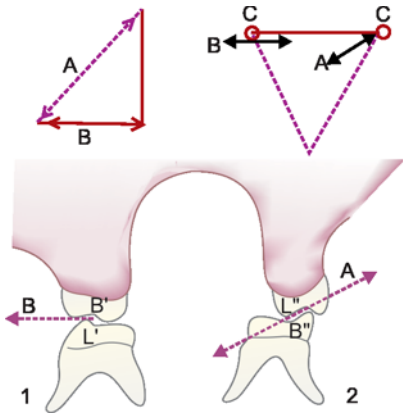


Fig. 9.18: Balancing the occlusion "BULL"
1. Working side, 2. Balancing side; A. Direction of movement on the balancing side, B. Direction of movement on working side, B'-Buccal cusp of upper posterior teeth, L'-Lingual cusp of lower posterior teeth, B". Buccal cusp of lower posterior teeth, L". Lingual cusp of upper posterior teeth, C. Condyles

on to a fully adjustable articulator while mounting the occlusal rims.

Handling of Face Bow

Movable rods at the end of the arms of the bow are positioned over the patient's condyles. Small u-shaped frame called bite fork is attached to the occlusal rim. Orbital pin is used to indicate the position of the orbital plane. ***Frankfurt plane*** – It is between eye and ear level.

Definition

It is a plane between the lower border of the orbital recess (eye socket) and the upper border of the auditory meatus (ear hole).

Preliminaries Before Mounting

1. Roughen the base of casts
2. Soak the bases of casts in cold water for 10 minutes
3. Set the articulator as follows:
   Condylar posts are set to 15 degree.
   Condylar tracks are set to 40 degree.
   Incisal guidance pin set to 0 degree.
   Incisal guidance table set to zero degree and kept horizontal.
   Orbital plane indicator is attached to the upper arm of the articulator.
   Condylar axis and its sphere are set to its basic central position.
   All locking screws are secured.
   Mounting discs are lightly lubricated with Vaseline.

Steps in Mounting

1. Mounting the upper occlusal rim with help of face bow records.
2. Mounting the lower occlusal rim with help of centric jaw relation record.
3. Adjusting the inclination of the condylar track from protrusive jaw relation record.
4. Adjusting right and left lateral movements by using lateral relation records.
5. Incisal guidance pin is lowered to the incisal table and locked.
   Attach face bow to the articulator and correctly center it.
   Place the upper occlusal rim together with the upper cast in place on the wax record of the face bow fork and secure it firmly with liquid wax.
   Raise or lower the front of the face bow until the occlusal surface of the occlusal rim is parallel with the base of the articulator.
   Support the face bow in this position and with plaster attach the upper cast to the upper member of articulator, which must also be parallel to the base.
   Adjust the hinge stop or incisal guide pin of articulator to maintain the upper arm parallel to the lower.
   Then remove the face bow.
   By using the centric occlusion wax record lower cast is attached to the base of the articulator with plaster.
   Adjust the condylar angle by using the right and left lateral movement wax records.
   Detailed description and setting to balanced articulation and occlusion is beyond the scope of this book. *However* if the patient is *chopper,* i.e. just makes up and down movements of lower jaw during eating-set his teeth on simple hinge articulator (Fig. 9.19).
   If the patient is a *Grinder,* i.e. produces all movements to mince the food- set his teeth on any of the movement articulators and try to achieve balanced articulation (Figs 9.20 and 9.21).

Understanding balanced articulation in easy way.

1. Example of chopper-cutting a piece of wood with axe (Fig. 9.22).
2. Example of grinder—cow chewing a cud (cud is regurgitated food from cow's first stomach) Observe cow's jaw movements during this act (Fig. 9.23).

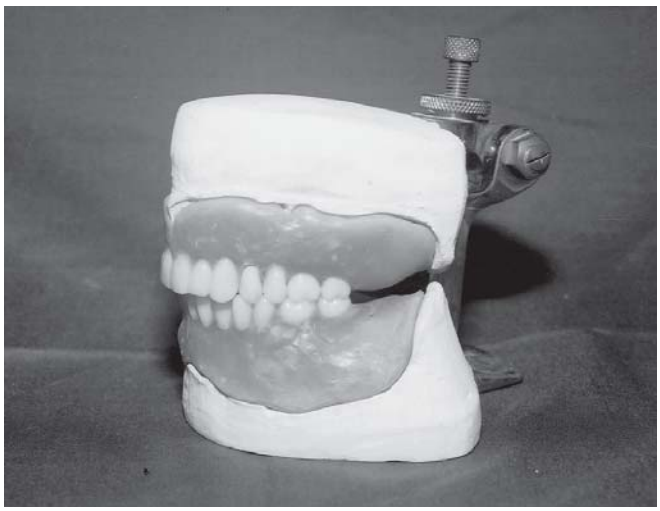


Fig. 9.19: Completed set-up on simple hinge articulator (side view)

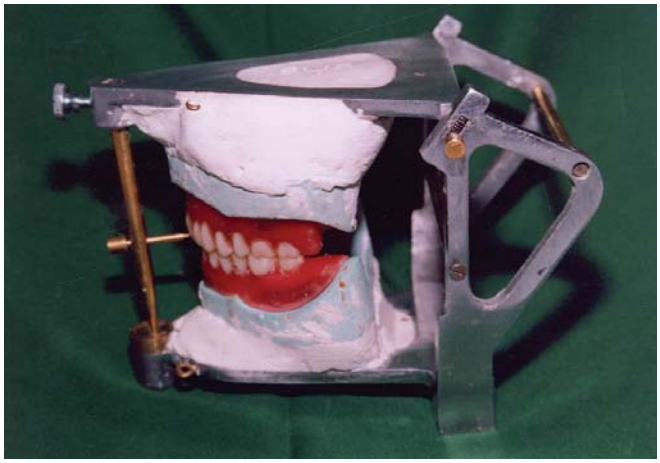


Fig. 9.20: Completed set-up on fixed condylar path articulator (side view)

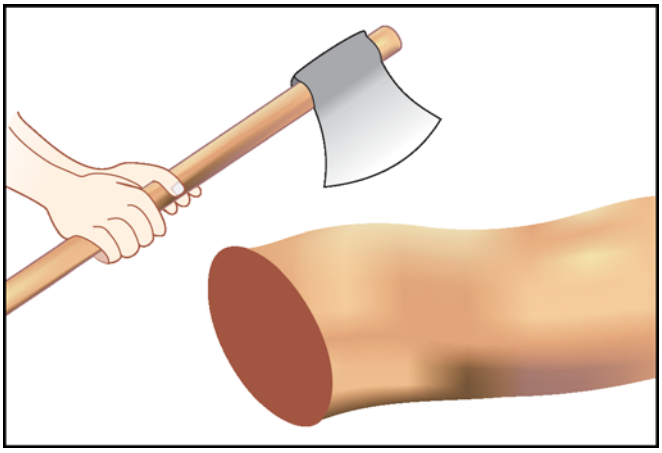


Fig. 9.22: Axe
Teeth set on plane line articulator simply chops food similar to axe which chops things (wood)

3. Acrobat walking on rope—he uses a long rod to balance himself and moves it to one side or another to prevent himself falling down (Fig. 9.24).
4. Balance used by vegetable vendor—vegetable on one side and weight on the other side must be equal in order to balance the arm. If there is difference, one or the other side goes up or down and the arm is not balanced (Fig. 9.25).

CONCLUSION

Unbalanced articulation with natural dentition matters little since teeth are embedded in bone. But unbalanced articulation with artificial dentures results in tilting and rocking of dentures. Therefore balanced articulation is preferred by using a movement articulator.

Waxing up: Carving and Polishing

It is important to realize that the polished surfaces of dentures act as stabilizers to dentures. Therefore this aspect of work should not be taken lightly.

How the polished surface acts as a stabilizer?—The muscles of cheek lips and tongue are in contact with the polished surface of dentures. During the movement of these muscles they should not displace the dentures, instead help in retaining the dentures in their intended area. Contouring these surfaces should harmonize with the position and movement of muscles (Figs 9.26 and 9.27).

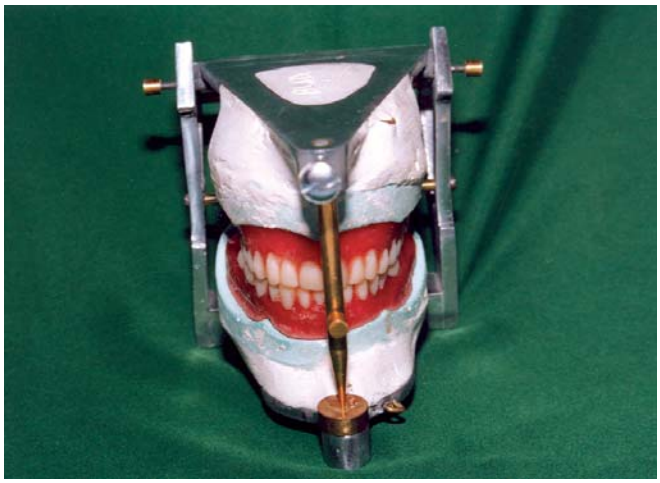


Fig. 9.21: Completed set-up on fixed condylar path articulator (front view)

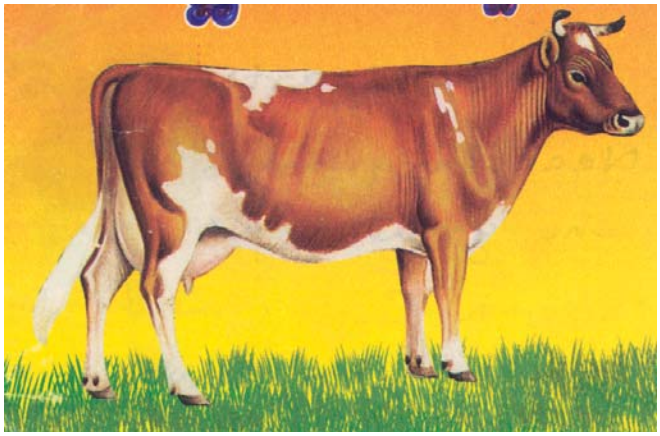


Fig. 9.23: Balanced articulation
Necessary for a person who grinds food just like a cow which chews its cud.

Fig. 9.24: Balanced articulation is similar to an acrobat walking on the rope who balances with the help of a rod

Methods of Adding Wax

1. Dripping a liquid wax from a roll of wax.
2. Adding cut slices of wax and melting it with hot wax knife.
3. Adding softened wax and pressing it to place.

Contouring

Is a method of waxing up to produce bulges on flanges to represent root prominences. After adding wax, hot wax knife is used to smoothen the whole area and to make the wax flow in between the teeth and up to the periphery. The thickness of wax added is 2 mm labially and 3 mm buccally.

However this can vary depending upon the individual requirements.

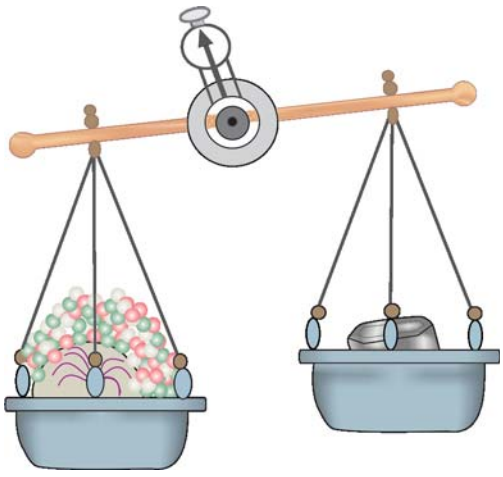


Fig. 9.25: Balancing the occlusion is similar to balancing things in a balance

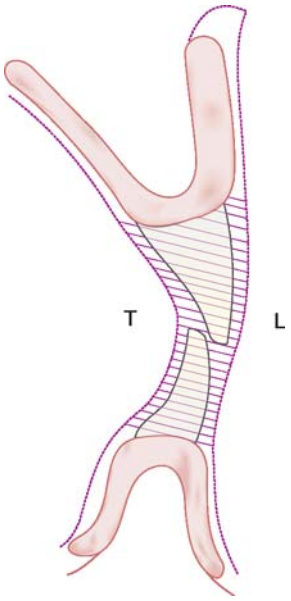


Fig. 9.26: Anterior neutral zone
T - Tongue on one side; L - Lips on another side

Trimming the wax to give shape to the surfaces and contouring.

Instruments used for carving-wax knife, lecron carver, wax spatula.

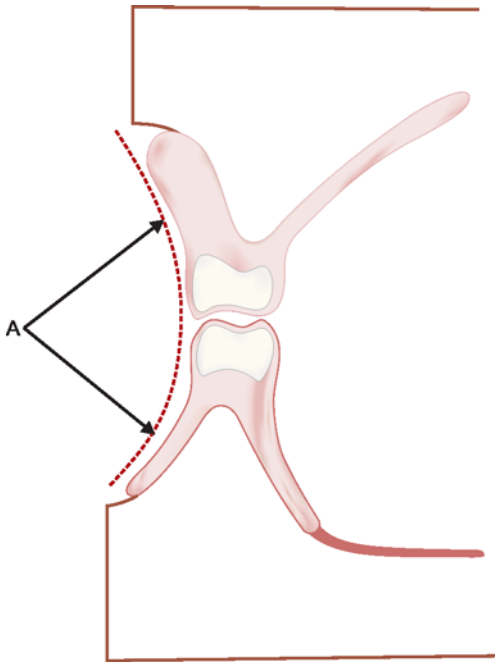


Fig. 9.27: Shaping the flanges of dentures in the buccal regions
A. Concave surfaces of the flanges

Neck trimming/carving—Wax must be hardened by placing in cold water before doing carving. By holding the carver in a pen grip it is passed all around the necks of teeth- tooth by tooth; removing wax without exposing edge of a tooth.

Same thing is done lingually as well. Upper labial surface is carved to support the lip and to give satisfactory look. Buccal flanges are made concave with the surface downwards and outwards facing. Labial surface of lower denture must not be thickly waxed. Buccal surface is made wide and thick with concavity.

Lingual surface with slight concavity is made to face inward and upward. Retromolar area is also covered with wax. Labial flange of the maxillary set is carved to give bony prominences over the roots and canine eminence with interdental depressions. For this, extra wax is added below the neck of each tooth during wax up stage. Then the set up is passed quickly over a blue flame of Bunsen burner section by section to produce the smooth surface and polished with wet cotton wool.

Stippling—It is a method of making a waxed surface finely pitted so that light is not evenly reflected from the surface. Stippling from Dutch word stip, stipple = small point or dot. This can be done by

1. Pressing a sponge on a softened wax.
2. Tapping clean tooth brush lightly on a not so softened wax.

Time spent on the waxed denture to produce a properly contoured, shaped, polished surface is worthwhile since it saves a lot of hard work on the finished dentures. It is a kind of skillful artistic work, which is perfected by repeated practice as the saying goes "Practice makes perfect".

Festooning—It is to reproduce the same curvature of gums around necks of denture teeth similar to natural teeth. Festoon from Latin Festum = Cosmetic, Beautifying.

Conclusion

The periphery should be thick, round and smooth but posterior border of maxillary denture should have knife like edge.

Palatal surface should be thinly waxed.

Produce root and canine eminences.

Completely expose teeth right up to but not the edges.

Don't heat the acrylic teeth while doing waxing-up and polishing.

Do not introduce air while waxing up.

During carving, wax must be hard.

Lingual walls of lower denture should not overhang.

Carving at the necks of teeth and in interdental areas should be such that finished dentures are self-cleansing.

No food packing occurs anywhere.

10 Acrylisation

Aim- It is to convert the waxed denture into hard acrylic resin.

In Short

1. The waxed denture is first invested (embedded) in a flask.
2. The flask is then heated to remove the wax.
3. Acrylic resin is prepared and when it is in a dough stage it is packed into one portion of the mould, the flask is closed. Excess removed by opening the flask and again closed and tightened with a clamp.
4. The flask is then again heated to cure (harden) the acrylic resin.
5. Flask is de-flasked. Denture recovered and finished.

Stages

1. Flasking.
2. De waxing.
3. Packing acrylic dough.
4. Curing.
5. De-flasking.
6. Finishing and polishing.

Preliminaries

1. Demount the articulator.
2. Reduce the thickness of cast base if necessary and also periphery of casts. Make sure the cast fit the flask properly. That means there must be at least 1/2" space all around the periphery of cast when it is placed in the centre of the bottom part of the flask. And also when the middle part of the flask is placed over the bottom part of the flask with waxed denture on the cast in side the flask there must be at least ½" space above the teeth level.
3. Soak the cast in cold water for 5 minutes.
4. Check the post damming on the upper model at the junction of hard and soft palate. *Post dam* is a method of scraping a shallow groove along the posterior border of the maxillary cast from tuberosity to tuberosity passing over the fovea palatane. It is about 4 mm wide and 1 mm deep. This creats a raised lip on the fitting surface at the posterior border which falls on the immovable part of soft palate and thus seals the posterior border.
5. Block under cuts if present, especially in maxillary tuberosity and lingual pouch areas of mandibular casts.
6. Relief and relieving – any prominent median raphae and protuberances in the midline of palate should be relieved. Such regions are covered with the soft metal of gauge 4 to give relief.
7. Check the wax–up once again.
8. Seal the periphery of denture neatly with the melted wax to prevent plaster going underneath the base plate.
9. Apply Vaseline to the inside surfaces of flask lightly to facilitate easy de- flasking.
10. Ensure all parts of the flask fit each other correctly to exert even pressure.

Flask

Is a metal container to embed the denture in plaster of Paris. The flask of suitable size to accommodate the cast should be used. Dental flask is in 3 or 4 parts. In the three-part flask, there is a shallower lower part, deeper middle part and a top lid. Inner surfaces of flask should be smooth. The flask is tapering in cross section. Base of the press and its attached plate on the thread must be parallel to ensure even pressure on the flask (Fig. 10.1).

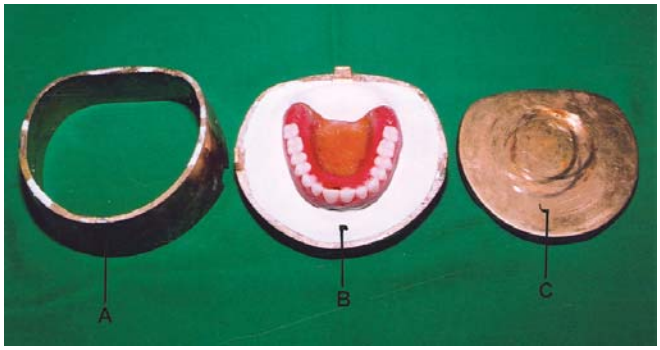


Fig. 10.1: Flasking
A. Middle part of flask, B. Maxillary set-up flasked in the lower part of the flask, C. Top lid of flask

Flasking Procedure

All three parts of the flask are separated. Plaster is mixed with water to a smooth rather thick consistency. Fill the shallower bottom part of the flask with plaster mix just a little short of its full depth. Keep the cast in the middle of the plaster, shake and press a little so that the plaster just reaches the edges. Plaster is manipulated to the just periphery of the wax. Remove gross excess of plaster. Shape the surface of plaster in such a way that it tapers from the denture border to the flask edges all around. Remove the plaster from metal edges of the flask. Plaster surface is smoothened; any roughness or undercuts if present are removed. Plaster is allowed to set. Apply separating medium (Vaseline) to the plaster surface. Keep the middle part of the flask over the bottom part. Mix plaster of Paris again – this time of rather thin consistency and it must be free from air bubbles. First put some amount of plaster over the teeth and wax and tilt the flask this way and that way to make the plaster flow all around. Tap the flask gently. Pour some more plaster into the flask and tap gently,the same is repeated until the whole of flask is filled. Put the top lid and press gently into its place, by fingers or under press. Put the whole flask assembly under pressure clamp. Put gentle pressure slowly and steadily until the lower two parts of the flask edges meet accurately. Wipe out the excess plaster coming out at these edges, see the flask edges. Tighten the clamp with hand pressure. Allow the plaster inside the flask to set. Wait for 15 minutes (Fig. 10.2).

De-waxing

The whole flask along with the clamp is placed in boiling water for 5 min. Take out the flask from

Fig. 10.2: Flasking of denture.
Pouring POP into middle section

boiling water. Remove the clamp. Separate the flask parts between shallow bottom part and deep middle part. Remove softened base plate. Pour boiling water over the cast to remove remaining traces of softened wax. Pour some more boiling water onto the part containing teeth for the same purpose. In any case, all traces of wax must be removed. Remove the plaster at the edges of flask. Remove loose pieces of plaster from between the teeth (Fig. 10.3).

Allow the flask to cool and become dry. Position the palatal reliefs if any.

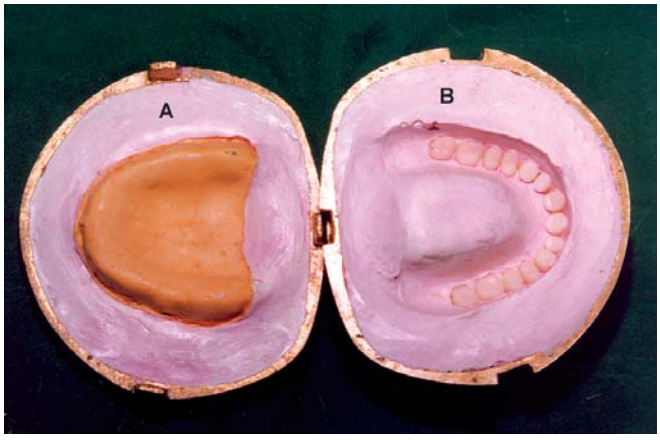


Fig. 10.3: Flask opened after De-waxing
A. Bottom part with cast, B. Middle part with teeth

Applying Separating Media

Cold mould seal is the separating medium to be used. Apply cold mould seal first to the middle part of the flask in which teeth are embedded with camel hairbrush. It is to be applied to the plaster surface only including the area in between the teeth but not to the teeth themselves. It must be applied thoroughly in sufficient quantity. Excess removed by a pellet of wet cotton wool. Allow the separating medium to become dry.

PACKING THE ACRYLIC DOUGH (Fig. 10.4)

Tools for Mixing

Clean porcelain or glass jar with neatly fitting lid. Stainless steel cement spatula or glass rod.

Proportion of monomer to polymer. It is about 1 to 3 ½. It means 6cc of monomer and 21cc of polymer by volume.

In practice one and half capfull of monomer bottle cap, one large capfull of polymer bottle cap is sufficient for one maxillary complete denture. May be little less for mandibular complete denture.

Fig. 10.4: Separating medium. Cold mould seal

Clean your hands thoroughly.

Place the required quantity of monomer in a mixing jar.

Take polymer in the cap of the bottle, sprinkle polymer into the monomer in a slow and steady stream until the excess appears on the surface (Figs 10.5 and 10.6).

Tap the jar gently to bring the free monomer to the surface.

Add little more polymer to be absorbed by the monomer.

Invert the jar to expel the surplus polymer.

Mix vigorously with a clean spatula for a minute or so. Replace the lid on the jar. The material in the jar immediately after mixing is like " **Wet sand**". Then after a minute or so it comes to "**stringy**" or cotton wool like stage, at this stage one can see actual threads when the material is pulled apart between fingers. It is also **sticky** now. Then the material passes into the dough stage. The time taken to arrive at dough stage from the beginning of mixing is dough-forming time. This varies from product to product but in general it is between 8 to 10 minutes (Figs 10.7 to 10.9).

The material in the dough stage is most suitable for packing into the mould and to compress it to take the shape of the mould. At this stage the dough is not sticky to touch, there are no threads when pulled apart; but it is soft and plastic. The material remains in this dough stage for as short as 5 minutes and it is essential that it must be packed and pressed within this time. Don't put your finger every now and then repeatedly to find out the different stages the material is in. Instead, wait for the stipulated time for forming dough. Mixing in warm jar will

Fig. 10.5: "Wet-sand" stage of acrylic denture base material

Fig. 10.6: Mixing acrylic resin "wet sand" stage

quicken the reaction and mixing in a cool jar will slowdown the reaction.

Acrylic dough is now removed from the mixing jar and kneaded between fingers (Fig. 10.10A and B).

Roll the dough into thick pencil shape and place it in the teeth containing part of flask directly over the teeth (Fig. 10.10A).

Put some extra dough over the vault area of palate in the case of maxillary denture.

Place a sheet of wet cellophane over the dough.

Assemble the flask and put it under pressure clamp or bench press.

Apply pressure slowly and steadily but intermittently until the excess material appears between the two halves of the flask at the edges.

Fig. 10.7: "Stringy and sticky" stage of acrylic denture base material

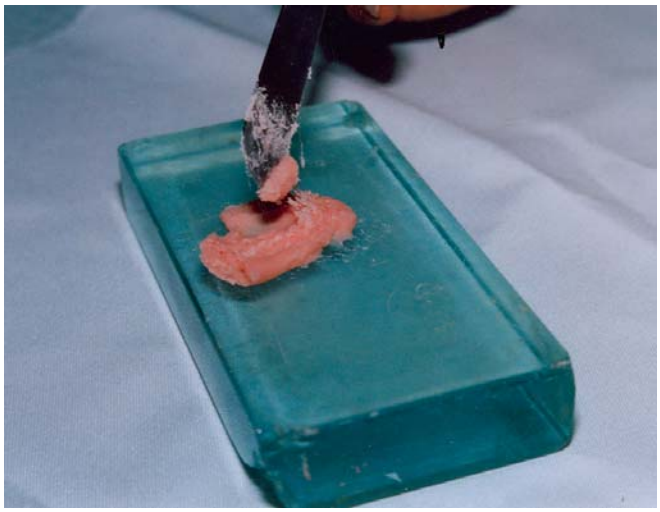


Fig. 10.8: "Stringy and sticky" stage of acrylic denture base material

Don't apply further pressure at this stage of **trial closure**- there is about 2 mm gap between the two halves of the flask (Fig. 10.11).

Then open the flask carefully.

Remove the cellophane sheet.

Remove the excess material known as **flash** with a sharp knife.

If under packed, add more dough where necessary and retry, until slight excess appears all around. Now cut away all excess (Fig. 10.12).

Purpose of cellophane sheet is that it will act as separating medium as well as producing a smooth fitting surface to the denture.

Apply cold mould seal once again to the plaster surface in both parts of the flask.

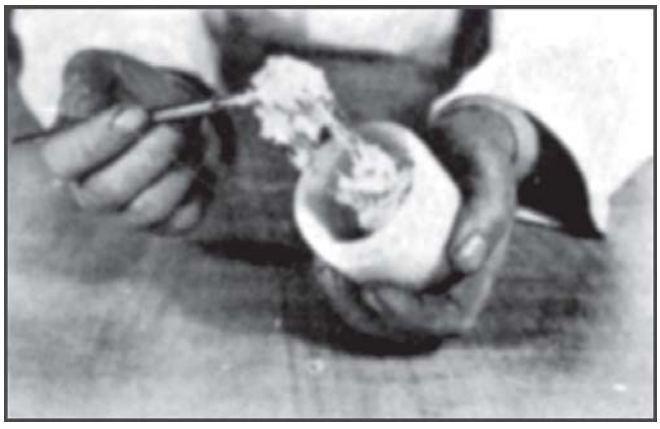


Fig. 10.9: "Stringy stage"

Fig. 10.10A: "Dough" stage

Allow the separating medium to dry. Close the flask **(Final closure)**.

Apply pressure slowly, steadily and intermittently under bench press or under clamp pressure until both halves of the flask make metal-to-metal contact at the edges (Fig. 10.13).

If the pressure is applied under bench pressure, transfer the flask to clamp pressure for curing

Leave the flask alone on the bench for 15 minute before curing.

CURING

This is a process, which converts the acrylic dough into a hard mass by a chemical reaction known as **polymerisation**.

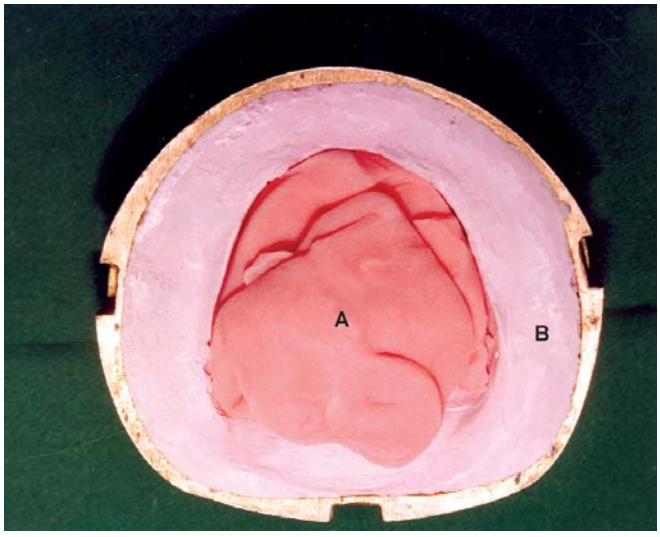


Fig. 10.10B: Packing. A. Acrylic dough packed in the, B. Teeth containing part of flask

Fig. 10.11: Denture curing flask showing flash after trial closure

Heat Cure Method

1. *One step method*: The packed flask along with pressure clamp is placed in water bath at a temperature of 74°C. The constant one temperature is maintained for 8-9 hours (overnight) and there is no terminal boiling.
   Since curing takes place at one constant temperature it is known as one step method.
2. *Two step method*: In this method there is stepwise rise in temperature involving two different temperature. Different patterns are;
   a. Start with cold water, bring it to 74°C and maintain the flask at this temperature for 2 hours and then raise the temperature to 100°C (boiling) and allow the flask be in it for another 1 hour. Total curing time is 3 hours.

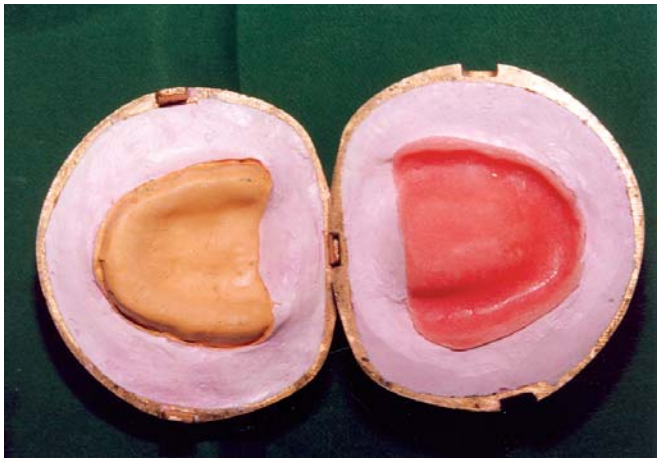


Fig. 10.12: Opened flask after trial closure and removal of flash

Fig. 10.13: Denture curing flask with clamp

b. Start with cold water, bring it to 70°C and maintain the flask at this temperature for 1 ½ hour and then raise to 100°C and maintain in it for another ½ hour. Total curing time is 2 hours.
c. Start with cold water, bring the temperature to 100°C in ½ hour and maintain in it for another ½ hour. Total curing time is 1 hour. It is a quick method.
d. Start with cold water, raise slowly to 60°C maintain at 60°C for ½ hour; raise to 70°C, maintain at 70°C for ½ hour, then bring to boil and maintain in boiling water for 1 hour. Total curing time is 2 to 2 ½ hour (Fig. 10.14).

Fig. 10.14: Acryliser

3. *Cardinal principles of curing*
   a. Accurate temperature control, i.e., Always start with cold water, slow rise in temperature and terminal boil of at least ½ hour, this will prevent gaseous porosities.
   b. Sufficient time for curing to ensure complete polymerisation.
   c. Just sufficient and sustained pressure throughout the whole period of curing to avoid contraction porosities (Fig. 10.15).

BENCH COOLING

After curing remove the flask from the hot water bath and keep it on the laboratory bench for cooling on its own slowly. This prevents internal stresses and strains developing in dentures. Never rush to open the flask immediately after curing.

DE-FLASKING

This is done to recover the cured denture out of the flask and has to be done very carefully to prevent fracture of the denture.

Gently tap the sides of the flask with a wooden mallet and remove the top lid. Investing plaster surrounding the denture is removed enbloc from flask. Make saw cuts into the plaster at equal distance all around, and remove each section by careful twist. Make saw cut into the cast as well and remove the cast piece by piece. Denture is taken out. Keep the denture in cold water until you start finishing and polishing (Fig. 10.16).

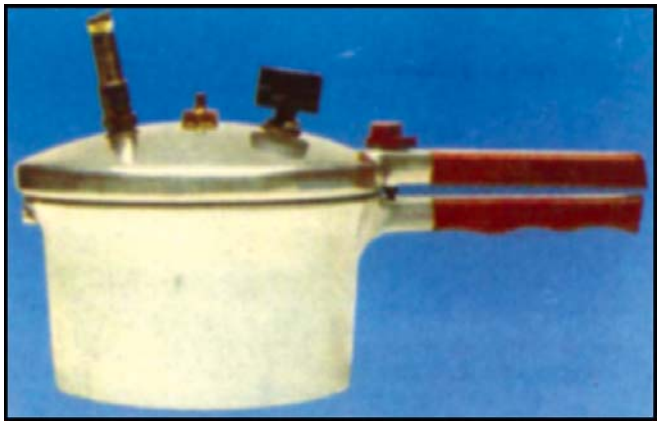


Fig. 10.15: Pneumatic polymerization tank

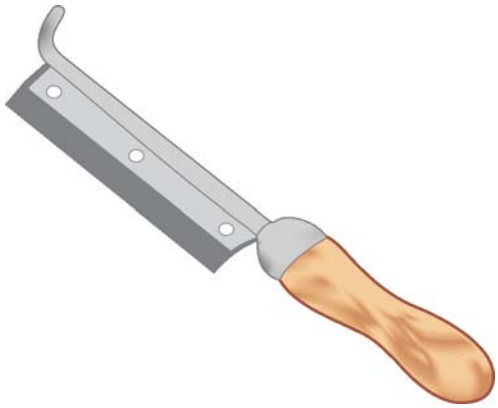


Fig. 10.16: De-flasking Hack-saw

Fig. 10.18: Polishing of denture with lathe

ROUGH FINISHING AND ABRADING

Machines required for this purpose are
a. Lathe on the table
b. Laboratory hand piece attached to hanging engine (Figs 10.17, 10.18 and 10.19).

First remove the flash (excess) by grinding on coarse lathe wheel. Shape the periphery by using a file and make it round.

Make the posterior border of the upper denture tapered.

Remove excess denture base from around each tooth with a suitable hand instrument.

Smoothen the palate and gum work with a suitably shaped abrasive stones on a hand piece.

Remove all pimples and plaster, etc. from fitting surface with hand instrument.

Sand papering: Cut strips of sand paper about ½ an inch by 2 inches and place it at right angle to and within the prongs of mandrel shaft, which has a slit along 3/4th of an inch of its length.

This mandrel shaft with sand paper is used on a hand piece or in the chuck on a lathe for sand papering all areas of denture satisfactorily. Thus first smoothen with a coarser abrasive followed by finer abrasive until scratches are no longer visible to the naked eye (Fig. 10.20).

Fig. 10.17: Denture finishing instruments
Laboratory straight handpiece
Assorted burs and stones

Fig. 10.19: Finishing of denture with hanging engine

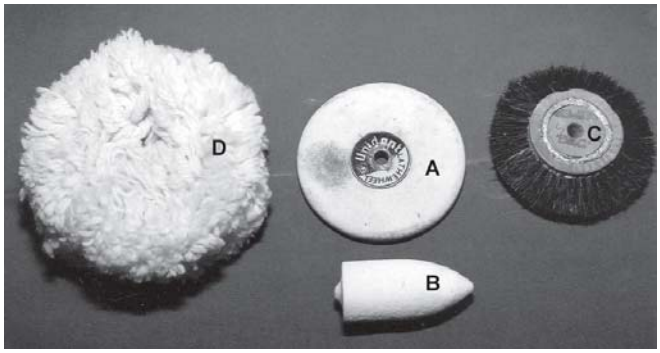


Fig. 10.20: Denture finishing and polishing instruments
A. Carborundum wheel, B. Felt cone, C. Black bristle brush, D. Cotton flannel wheel buff

Fig. 10.22: Acrylized, finished complete dentures (side view)

POLISHING

Pumice powder is mixed with water to a sticky, muddy consistency and apply this to the surface of denture. Attach black bristle brush on the lathe.

Set speed to 1500 RPM and start. Let the top of the brush revolve towards you; hold the denture firmly against the brush, move the denture in different directions on the brush.

Felt cone is used to polish the palatal surface and between teeth. Wash and scrub the denture with soap water. Mix whiting with water to a thin creamy consistency and apply to the denture.

Change the lathe speed to 2800 RPM. Attach cotton flannel brush to the lathe. Polish to achieve glossy appearance to the denture. Scrub with warm soapy water. Rinse in clean tap water. Use of rubber trough on the polishing side of lathe will prevent paste flying everywhere (Figs 10.21 and 10.22).

CONCLUSION

Keep the heels of casts low while flasking.

Fig. 10.21: Acrylized, finished complete dentures (front view)

Remove all traces of wax by boiling.

Apply cold mould seal thoroughly to the plaster surface.

Pack sufficient quantity of dough. During the final closure there must be metal-to-metal contact between the two halves of flasks to prevent raised bite. Strictly follow the principles of proper curing.

Thoroughly cool the flask after curing. Finish the borders round and smooth. Remove pimples from the fitting surface, but don't polish the fitting surface. Don't create heat while finishing and polishing. Store the polished denture in cold water (Figs 10.23 and 10.24)

ACRYLIC RESIN

This is a synthetic thermoplastic, translucent, organic solid resin, which is an ester of acrylic acid-polymethyl methacrylate.

This resin is supplied as;

A. Monomer—a clear, transparent liquid and it is methyl methacrylate.

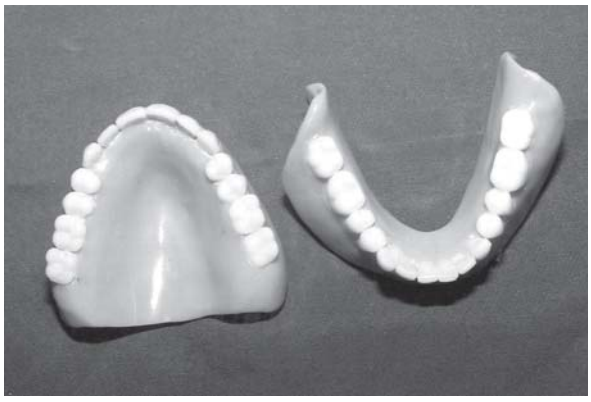


Fig. 10.23: Acrylized, maxillary and mandibular complete dentures (occlusal view)

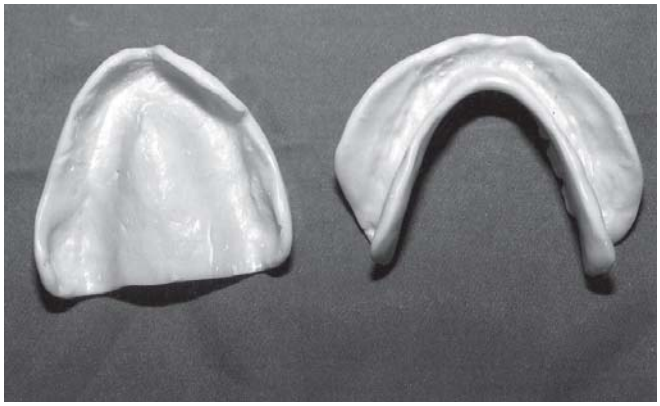


Fig. 10.24: Acrylized maxillary and mandibular complete dentures (Tissue surface)

B. Polymer—is a solid, or multiple molecular form of methyl methacrylate known as polymethyl methacrylate.

Polymerisation is an exothermic reaction brought about by heat, light, or chemical activators in which single molecules of monomer are linked up to form a long molecular chain- polymer, i.e.; Changing monomer (liquid) to polymer (solid) is polymerisation.

When monomer and polymer are mixed it forms dough, suitable for packing into a denture mould.

During curing monomer only changes into solid and already solid polymer remains as it is.

COMPOSITION OF HEAT CURE ACRYLIC RESIN

Polymer	*Monomer*
Polymethyl methacrylate.	Methyl methacrylate
Benzoil peroxide 0.5-1.5%	Hydroquinone 0.003- 0.1%
Dibutyle pthalate 8-10%	Dibutyle pthalate
Zinc or titanium oxide	Glycol dimethacrylate
Mercuric sulfide or Iron oxide	Co-monomers
Glass fibres or beads	
Nylon or Acrylic fibres	

Benzoil peroxide is a Initiator
Dibutyle pthalate is plastiazer
Zinc oxide is opacifier
Mercuric sulfide is pigment
Glass fibre increases stiffness
Nylon fibres simulate natural capillaries.
Hydroquinone is Inhibitor
Glycol dimethacrylate is cross-linking agents (Fig. 10.25).

Fig. 10.25: Acrylic heat-cure denture base material
A. Polymer, B. Monomer

COLD MOULD SEAL- (One Product's Trade Name –"Stellon")

Composition

Sodium alginate	-	2% by wt
Water	-	86% by wt
Di-sodium phosphate	-	7% by wt
Alcohol	-	7% by wt
Glycerin	-	4% by wt

HOW COULD MOULD SEAL WORKS

When this is applied to a dry plaster surface, sodium alginate reacts with calcium sulfate to form insoluble skin of calcium alginate on the surface of plaster, which in turn blocks the porosities on the surface of plaster. Thus, any other material that comes in contact with plaster will not adhere to it. In the case of acrylic dough which is packed in the denture mould, this separating medium prevents; a) Monomer of dough getting into plaster and b) water of plaster getting into acrylic dough.

DEFECTS IN HEAT CURED ACRYLIC DENTURES

1. Porosities
   a. Contraction porosity
   b. Gaseous porosity
   c. Granular porosity
2. Internal stresses and strains

3. Raised bite—is increase in vertical dimension.
4. Crazing—is development of fine crack.
5. Bleaching—is color instability

PREVENTION OF DEFECTS

Contraction porosity by applying just sufficient and sustained pressure during packing and curing

Gaseous porosity by proper control of curing temperature, i.e.; by slow rise in temperature. Monomer should not be made to boil.

Granular porosity by proper manipulation of monomer-, which should not be allowed to evaporate.

Internal stresses and strains by bench cooling. Raised bite by ensuring metal–to-metal contact of the two halves of the flask during final closure.

Crazing by making use of cross-linked resin and teeth.

Bleaching by giving careful attention to every details during acrylization.

Acrylic resin as denture base

	Advantages	*Disadvantages*
1.	Strength is adequate in normal case but not in patients with heavy bite	Can break
2.	Color satisfactory	Drying and wetting can affect dimensionally
3.	Manipulation easy	Poor thermal conductivity
4.	Light in weight	Radio lucent acrylic is not visible in X-rays
5.	Hygienic and easy to maintain	
6.	Easy to repair	
7.	Economic	
8.	Simple processing	
9.	Fit is good and comfortable	

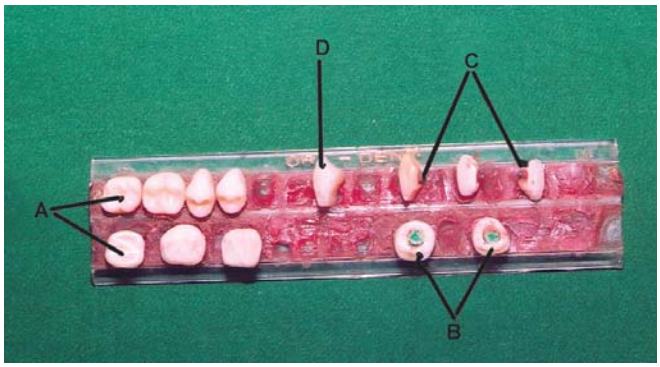


Fig. 10.26: Artificial teeth
A. Acrylic posteriors, B. Porcelain posteriors with under cuts, C. Porcelain- anteriors with pinhead, D. Acrylic anterior with no pinhead

Artificial teeth (Fig. 10.26)

Acrylic teeth	*Porcelain teeth*
Identification- nothing special on the back of tooth	Pinhead or undercutting on the back of tooth
Chemical union with base. No sound during contact, i.e.; silent touch.	Mechanical retention Clicking sound heard.
Tough	Brittle
Soft	Hard
Easy to grind and polish	Grinding spoils the tooth
Good appearance	Good appearance
Bring about loss of vertical dimension due to wear and tear	No loss of vertical dimension
Can be adjusted to any denture space	Can not be adjusted to limited denture space
Made of synthetic acrylic resin	Made of feldspathic ceramic
Routinely used these days	Occasionally used.

11 Repair, Relining, Rebasing, Etc.

Repairing Acrylic Denture

Why denture breaks-

1. Accidentally dropping the denture on to the floor.
2. Fatigue due to repeated stresses falling on denture.
3. Weak or thin acrylic resin.
4. Badly fitting denture.
5. Severely resorbed ridges.
6. Broken casts.
7. De-flasking while hot.
8. Tooth movement within the flask.
9. Setting of maxillary posteriors too much buccal to the aveolar ridge.
10. Un-balanced occlusion.
11. Wrong consistency dough.
12. Wrong curing.
13. Lack of bench cooling.
14. Heavy bite of patient.
15. Insufficient relief of upper denture in the mid line of palate.

Assessment Before Undertaking Repair

Study the nature and extent of fracture.

Find the cause of fracture.

In how many parts the denture is broken.

Try to realign the broken parts.

Whether a tooth also fractured or not.

Whether it is worthwhile to repair a badly broken denture.

How old is the denture and their fits, with all these factors taken into consideration, decide whether to under take repair or not (Fig. 11.1).

Procedure of repair- by using a cold cure acrylic resin.

The two broken parts of the denture are realigned in their correct position and fixed temporarily by applying sticky wax on the polished surface.

Mix dental stone with water.

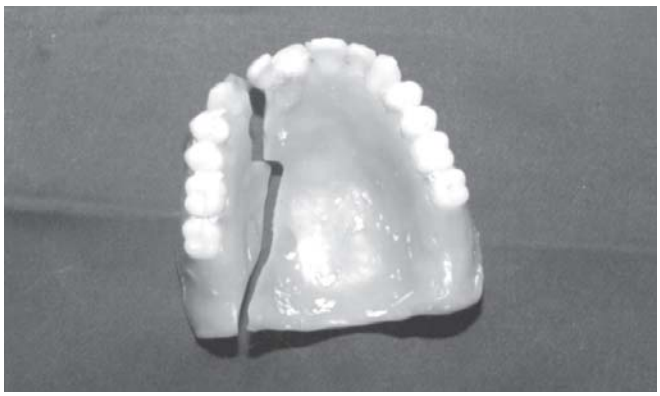


Fig. 11.1: Broken maxillary denture

Pour the stone mix on the fitting surface of the denture fully and finish to a flat level base.

Allow the stone to set.

Separate the cast from the denture.

Remove sticky wax.

Trim the fracture site of both parts of the broken denture to make room for the repair material. Make few Zig-Zag cut at the edges of the broken line on both sides.

If necessary make provision for placement of strengtheners like piece of wire at the fracture site (Fig. 11.2).

Remove all the dust produced during trimming.

Replace the trimmed parts on the cast and ascertain whether the space created is sufficient or not.

Remove the Parts from the Cast

Apply separating medium to the whole of cast on the fitting surface. Replace the denture parts on the cast. Cold cure repair material (acrylic resin) is now added to the broken area-either by (a) sprinkler method or by (b) flowing the fluidly mix into the area.

Fig. 11.2: Repairing acrylic denture

Gap is Slightly Overfilled

When the repair material is hard, remove the denture from the cast.

Finish and Polish as Usual

Store in cold water until delivery.

Adding a Tooth to Replace a Lost Tooth to the Denture

Roughen the site of lost tooth with a grinding stone and create some space. Select a suitable type and size of tooth and if necessary adjust it. Try the new tooth in the prepared site and check the suitability with respect to size, shape, occlusion, etc (Fig. 11.3).

Fig. 11.3: Loss of tooth from maxillary denture

Remove the Replacement Tooth

Apply cold cure acrylic resin fluidy mix to the site area.

Replace the tooth at the site and hold it in occlusion until the resin hardens.

Finish the borders at the repaired site and polish.

Relining an Acrylic Denture

Relining is a method of adding additional amount of new base material (Acrylic resin) to the fitting surface of denture to improve the fit of the denture.

Methods

1. Entirely chair side procedure
2. Chair side and laboratory steps combined.

1. *Entirely chair side procedure*—Done by Dentist
   Roughen the fitting surface of old denture. Remove undercuts if any.
   Apply Vaseline to the mucous membrane inside the patient's mouth.
   Mix cold cure acrylic resin to a fluidy consistency.
   Spread this fluid mix on the fitting surface of old denture.
   Insert the denture in the mouth.
   Ask the patient to close on the teeth, with the opposing set also in the mouth.
   Request the patient to tolerate the exothermic heat for a while.
   Remove the denture when material set. Trim the excess around the border. Fit the denture (Fig. 11.4).

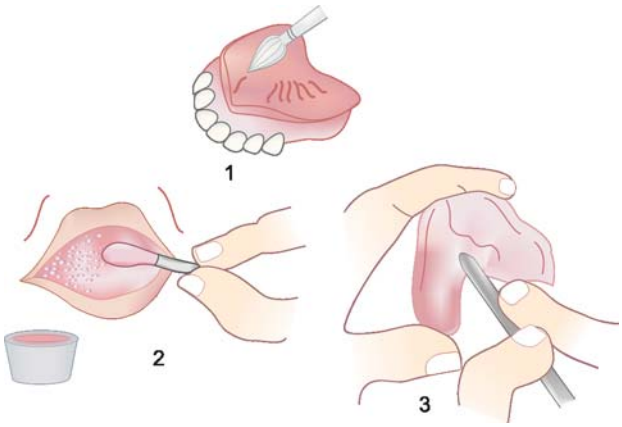


Fig. 11.4: Relining of denture
1. Reducing the fitting surface of a denture, 2. Applying vaseline to the mucous membrane, 3. Spreading the fluid mix of cold cure acrylic resin to the fitting surface before insertion into mouth

2. Chairside and laboratory steps combined (chair side steps done by Dentist and Laboratory steps done by technician)

Clinical Steps

Roughen the fitting surface of old denture.

Remove under cuts if any.

Border mould the periphery of old denture with green stick compund.

Mix Zincoxide-Eugenol impression paste.

Load on the fitting surface of old denture.

Make impression using loaded old denture as a tray.

Ask the patient to close on the teeth with the opposing set also in place.

Remove the denture when the ZOE paste is set. Gross excess of paste at the periphery removed.

Lab Steps

Stone cast is made from the impression. Invest the whole assembly (i.e. denture and cast together) in a denture flask. Separate the flask when plaster is set.

Remove all traces of ZOE paste by using hot water. Dry the surface of denture. Apply separating medium to the plaster surface. New denture base material, Heat cure acrylic or cold cure acrylic is mixed.

Apply some monomer to the fitting surface of old denture.

Pack the acrylic dough on the fitting surface of old denture.

Close the flasks.

Open the flask and remove the excess of dough around the periphery. Close the flask again.

Keep the flask for curing and this is done slowly.

Deflask, recover the denture.

Trim the borders smooth.

Polish the polished surface.

Store the denture in cold water until delivery.

Purpose of Relining

a. Improves fit.
b. Improves appearance.
c. Improves vertical dimension
d. Removes pain.

Composition of cold cure acrylic (Fig. 11.5)

Polymer	*Monomer*
Polymethyl methacrylate	Methyl methacrylate
Benzoil peroxide	Hydroquinone
Dibutyle phthalate	Dibutyl phthalate
Zinc oxide	Dimethyle- para- toluidine-(activator)
Coloring pigments and dyes.	

Fig. 11.5: Cold cure acrylic material
A. Polymer, B. Monomer

Immediate Denture Construction

Definition: This is a denture, which is fitted to the jaw immediately after extraction of natural teeth.

Method in short—Clinical step

Posterior teeth are extracted first.

Patient is asked to wait for 3 months for the gums to heal satisfactorily.

Final impression is made (Fig. 11.6).

Centric occlusion and relation registered on the posterior occlusal rims.

Posterior teeth are set.

Try the posterior set up in the mouth.

Fig. 11.6: Impression trays for immediate dentures

Laboratory Steps

Remaining natural teeth on the cast are removed.

Sockets prepared.

Full set-up completed by setting anterior teeth in the socket.

Wax up.

Acrylization, finishing and polishing.

Details of Lab Procedure of Socketed Denture

Mount the occlusal record block on the articulator.

Set-up posterior teeth and wax up.

Send to the clinic for try-in. Select suitable anterior teeth, which are little longer then the natural ones.

Remove the posterior set-up from the cast.

Draw round gingival margin of each anterior tooth on the cast with pointed pencil.

Draw long axis of tooth on both tooth and gum on the cast.

Measure the length of each tooth and mark this distance on the base of the cast for reference.

Cut off the central incisor with fine saw.

Level the stump to the gingival margin (Fig. 11.7).

Cut out the socket with fine rose- head bur or trimmer. The depth of socket should be 1/8th of an inch. Pencil mark around gingival margin remains as it is.

Fit the artificial tooth into this socket and adjust it to the long axis, incisal tip, dimension, labial shape etc; by grinding the tooth at neck.

Wax this tooth in position.

Repeat this method with all the remaining teeth individually.

Then place the already done posterior set-up on the cast.

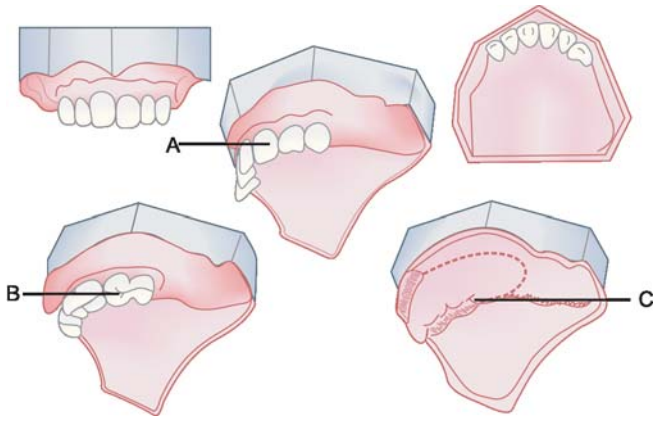


Fig. 11.7: Cast preparation for immediate denture
A. Standing teeth (maxillary), B. Teeth removed,
C. Ridge "Rounded off"

Seal the anterior set-up to the base plate of posterior set-up.

Check wax up and correct it wherever necessary.

Flasking- Invest in a suitable flask.

De-wax by boiling out. Remove all traces of wax.

Dry the mould.

Apply separating medium.

Mix heat cure acrylic resin.

Pack the dough.

Do trial closure and remove the excess dough. Remove cellophane paper. Apply separating medium.

Do final closure slowly until there is metal-to-metal contact of the two halves of the flask.

Curing done as usual, strictly following the principles of curing. Bench cool the flask.

De-flask carefully and remove the denture.

Finish and polish.

Store the denture in cold water until delivery.

Types of Immediate Dentures

1. Socketed
2. Flanged
   a. Without alveolectomy
   b. With alveolectomy

Contraindications for Immediate Dentures

1. Patients with poor physical general health.
2. Hemophilia patient
3. Very old age.
4. Economically poor patients.

Advantages of Socketed Immediate Dentures

1. No surgery (i.e; alveolectomy) needed.
2. Helps in retention because of socketed anterior dam.
3. Gives natural appearance, teeth growing from the gums.
4. Socketing itself allows for alveolar resorption and healing of soft tissues, thus fit is near normal.
5. Another set is done after a year.

Disadvantages

1. Labial flange may have to be made to upper denture at a later date.
2. Sometimes esthetics may suffer.
3. Denture foundation changes more quickly than after alveolectomy.

Advantages of Immediate Denture with Flange without Alveolectomy

1. Better retention and stability.
2. Relining can be postponed or even may not be necessary.
3. Protects the sockets during initial healing period.
4. Protects the blood clot.
5. Improvements and Adjustments to the anterior set-up possible during setting-up.

Main Advantage of any type of Immediate Denture

1. Appearance—Patient has always teeth- either his own natural or artificial teeth, psychologically very important factor.

Re-basing of Dentures

This is a procedure in which as much as possible of the denture base material is removed and replaced with new base material.

Acrylic teeth of denture are difficult to remove from the base because of excellent chemical union between the base and the teeth. Instead, as much as possible of the pink base is removed including that between the teeth in the inter dental spaces.

Procedure

At the chair side, impression with ZOE paste is made using old denture as a tray.

Make a stone cast from this impression.

Trim the cast, and mount on the articulator.

Make a plaster Register of teeth separately.

Remove the denture from the cast.

Remove as much as possible of the old denture base.

Replace on the plaster register.

Place a roll of soft wax on the remaining shallow strip of resin.

Close the articulator to the correct relationship. Complete the wax-up.

Invest, De-wax, pack the new resin, and cure, finish and polish.

Soft Lining of Dentures

Reasons for soft lining.

1. If the patient cannot tolerate the hard base of acrylic resin.
2. Repeated ulcers at the periphery and under the fitting surface of denture.
3. Knife-edged alveolar crest.
4. Thin mucous membrane at the crest of alveolar ridge.
5. Poor, greatly resorbed alveolar ridges.
6. In under cut areas.
7. If the patient is allergic to Acrylic resin.
8. In cleft palate cases.

Material for Soft Lining (Fig. 11.8)

Silicones

a. Heat cure-Laboratory procedure.
b. Cold cure- chair side procedure (Fig. 11.9)
Mode of supply- Main silicone Paste and Primer.

Laboratory Procedure

This lining can be applied,
a. While making a new denture
or
b. To the existing denture base.

Applying to the Existing Denture Base

Steps

Make a cast on the existing denture base.

- Remove the cast
- Adapt a wax spacer over the cast
- Put the denture back on the cast
- Seal at the periphery
- Flask the denture
- De-wax

Fig. 11.8: Silicone soft liner
A. Fitting surface of lower denture

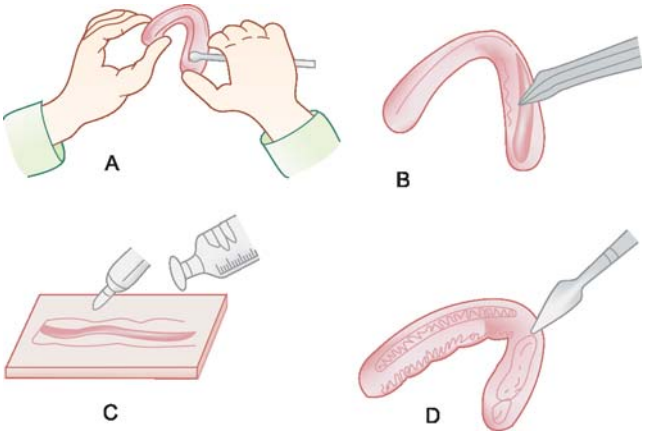
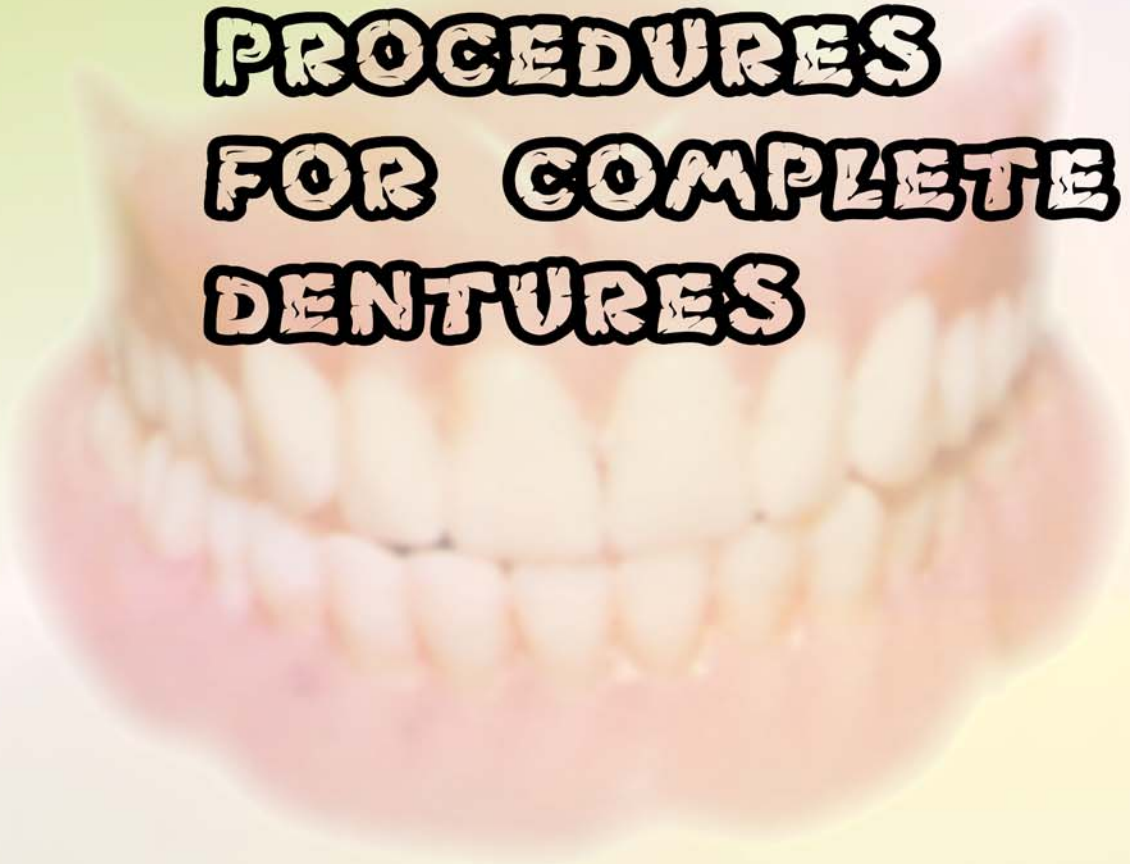


Fig. 11.9: Soft lining of denture
A. Roughening the fitting surface, B. Applying adhesive, C. Mixing soft liner, D. Applying soft liner to the fitting surface of the denture

- Open the flask
- Remove all traces of wax spacer by boiling water.
- Dry the cast
- Apply separating medium to the cast surface
- Apply primer of soft liner to the fitting surface of denture
- Wait for 10 minutes for the primer to dry
- Apply enough soft liner over the fitting surface of denture.
- Close the flask-make sure there is excess but excess is not removed.
- Cure for nine hours at 75°C.
- Open the flask and recover the denture.
- Trim the lining with scissors or fine abrasive stone or hot wax knife.

PART 3

CLINICAL PROCEDURES FOR COMPLETE DENTURES



12 Examination of Patient

Routine method of examining a patient in any hospital has a certain patterns—common to both medical and dental.
It is as follows:

A. Getting information.

1. Name of the patient.
2. Age of the patient.
3. Address of the patient and telephone number.
4. Occupation.
5. Sex.
6. Race.
7. Country of origin.

B. Medical History

General health, Systemic health—with special attention to Hereditary diseases, Blood Diseases, Muscular disabilities, Nutritional deficiencies, Allergy. For example: Poliomyelitis, Neurological problems.

C. Dental History

About extraction of natural teeth. Age at which extraction done, reasons for extraction.
About old dentures—If already present.
Mental attitude of patient.

1. Examination of patient

A. Inspection

a. *Extra-oral*

Facial features and personality.
Color of eyes and Skin.
Length of lips and texture of lips
Size of the orifice of mouth.
Angular cheilosis.

b. *Intra-oral*

Size and shape of alveolar ridges.
Arch form of both jaws.
Relationship of upper and lower arch.
Shape of hard palate
Protruberences on the palate and developmental defects.
Color of mucous membrane.
Depth of sulcus.
Size of tongue, its position and habits.
Frenal attachments.
Any bony promincess along the breadth and length of alveolar ridges.
Inter- ridge distance, i.e. Denture space
Any visible swelling or sinuses or roots of teeth.

B. Palpation: i.e. Examining by using fingers,

Alveolar ridges- firm or flabby.
Maxillary tuberosity, crest of ridges and tori if any and its extent.
Mylohyoid ridge and lingual pouch.
Depth of sulci all around the ridges.
Frenal attachment—High or low.
Any swellings.
Buried un-removed roots.
Any painfull area.
Any unusual findings—ulcer, sinuses, etc.
Floor of the mouth.
Under cuts of soft tissue or bony.
Quantity and quality of saliva.
Posterior junction of hard and soft palate.

The other two standard examination steps, like (a) Percussion and (b) Auscultation are not necessary for dental patient seeking dentures.

2. Radiological examination- (X Ray)

This is done to find out;

Any buried roots, or whole tooth.
The type of swelling.
Extent of sinus.
Basal bone and alveolar processes of edentulous ridges.
Size and relation of maxillary sinus.
Any painful area—its cause.

Results of these above methods of examination are a "*Sign*". "*Symptom*" is a complaint as told by the patient. *Special investigations* if necessary are.

1. Blood, bleeding and clotting time.

2. Blood sugar.
3. Urine examination.

Diagnosis: Is a final conclusion arrived at, about the disease or condition based on signs and symptoms and it gets a name.

Prognosis: Is assessing in advance about the success or failure of the treatment to be under-taken to alleviate the suffering of the patient.

Evaluation of Findings

Age of patient: Age as such is no bar to make dentures. In fact complete dentures are necessarily needed for old age patient. Teeth will help to improve their health by proper and efficient chewing of food. Patient's appearance and speech will improve; altogether boost the morale of the patient. However certain factors must be kept in mind while treating geriatric patients. First of all the condition of alveolar ridges, amount and nature of bone resorption.

This will vary from patient to patient. Many of the aged patients are malnourished and their tissues have lost the tonus and have become delicate. Badly resorbed ridge and delicate mucous membrane (more so in lower jaw) do not withstand the masticatory loads, and thereby patients develop ulcer under and at borders of dentures, which are very painful. Such patient's dentures must have soft lining at their fitting surfaces. Quantity and quality of saliva in aged patient also affects retention and stability of dentures. All life activities slow down as age advances. Patients muscular and joints movements and co-ordination lag behind. This will affect registration of jaw relations. Shaking of head and fingers will affect maintenance of denture's cleanliness and usefulness. This sign may indicate Parkinson's diseases.

Some of the aged female patients, especially those who are beauty conscious and fussy about everything are difficult to satisfy with their dental treatment. They expect too much out of artificial dentures, irrespective of the limitations. Menopause and its psychological effects should be taken into consideration while treating female patients. Other causes of disability in old age patient's are—Heart disease, High blood pressure, Tuberculosis, Diseases of bones and joints, Kidney problems, Diabetes, Cancer, Eye and Ear problems. Accidents and fracture of bones, which are already weak (osteoporosis) is common with old age. Facial skin of aged patients is wrinkled, supple, darker and dry. Same conditions prevail in oral mucous membrane.

Halitosis (Bad Odour/ Smell) May be due to poor oral hygiene of old dentures if present; respiratory disease, or oral infection. Acetone smell is felt with diabetic patients. Edentulous patients usually protrude their mandible when asked to open their mouth, which is to be corrected and is a difficult step during bite registration. Pain in the tongue, pain due to trigeminal neuralgia, and vague pain felt on the face by menopause reached females are related to age.

Aged patients suffer from dry mouth due to less salivary flow and also the saliva is more mucinous, thick and sticky, all this adversely affect denture retention and stability. Loss of teeth allows the tongue to relax and thus gives the impression of enlargement of the tongue.

Tongue may be hairy due to growth of fungus and yeast like organisms on the upper, back surface of tongue. White patches indicating leukoplakia may be seen on the tongue. Tongue may be smooth and glossy due to lack of consumption of vitamins. Similar white patches may be present in the buccal mucous (lichen planus). All these changes in the mucous covering the cheeks, floor of the mouth, palate and tongue should be investigated for carcinogenic changes.

Ill-fitting dentures worn by the patient cause mucosal inflammation, hyperplasia (over growth), ulcers and bad smell. These old, ill-fitting dentures may have over-extended or under-extended borders, rubber suction cups, worn out teeth, and faulty vertical dimension and articulation.

Residual Alveolar Ridges

After extraction of teeth, alveolar ridge, gradually reduce in size and shape. This is due to bone resorption. Normally jaws or ridge of maxilla and mandible is classified as:

Class I: (Considered as normal) – In which upper jaw or ridge is just 2-3 mm in front of or anterior to the lower jaw or ridge.

Class II: Superior protrusion in which maxillary jaw/ ridge is in much more than normal protrusion.

Class III: Inferior protrusion- in which mandibular jaw/ ridge is anterior to maxillary jaw/ridge (Fig. 12.1).

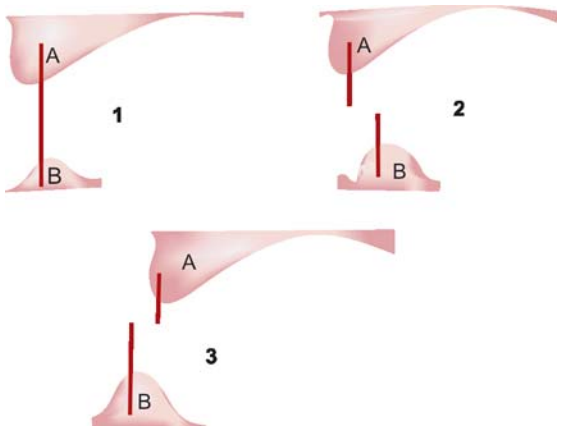


Fig. 12.1: Jaw (ridge) relationship
1. Normal, 2. Inferior retrusion (protruding maxilla), 3. Inferior protrusion (protruding mandible): A. Maxillary ridge, B. Mandibular ridge

Such jaw/ridge relation of maxilla to mandible changes due to bone resorption.

Degree and Pattern of Bone Resorption

The bone resorption chiefly affects the thinner of the two alveolar walls. In the mandible- labial wall in incisor and canine region. Lingual wall in molar region. In maxilla–labial and buccal walls.

Because of directional resorption of the alveolar ridge, the upper arch becomes somewhat narrower, especially on the labial aspect, and the lower arch retains its width but widens in molar region. This is the reason why artificial lower anterior and posteriors are placed directly over the ridge while the upper anteriors and posteriors are placed slightly outside the ridge, depending upon the degree of resorption that has taken place (Fig. 12.2).

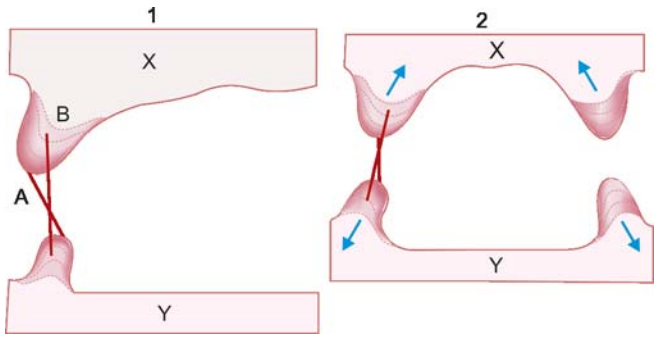


Fig. 12.2: Pattern of resorption of alveolar ridges
1. Side view, 2. Front view: A. Inter-ridge relation before resorption, B. Inter-ridge relation after resorption, X. Maxillary, Y. Mandibular

The Amount of Bone Loss of Alveolar Ridge Depends Upon

a. Bone lost before extraction of teeth may be due to periodontal diseases.
b. Bone lost or removed during extraction. Difficult extraction and impacted teeth removal requires bone loss.
c. Pre-prosthetic surgery undertaken, e.g. Alveolectomy.
d. Rate and degree of bone resorption after extraction.
e. Effect of old, ill-fitting dentures.

Arch form—is the form of alveolar ridge in horizontal plan, i.e. Occulusal plane (Fig. 12.3).

Ridge form—is the form of alveolar ridge in cross-section.

Parts of Denture Foundation

a. Bony foundation- Consists of alveolar ridge and covering mucosa, submucosa,and periosteum.
b. Peripheral border tissues- like sulcus, muscular attachments.

Suitable Arch Forms

1. Maxillary—Broad; Square, Well developed with palate of medium height.
2. Mandibular—same as maxillary but of mandibular shape.

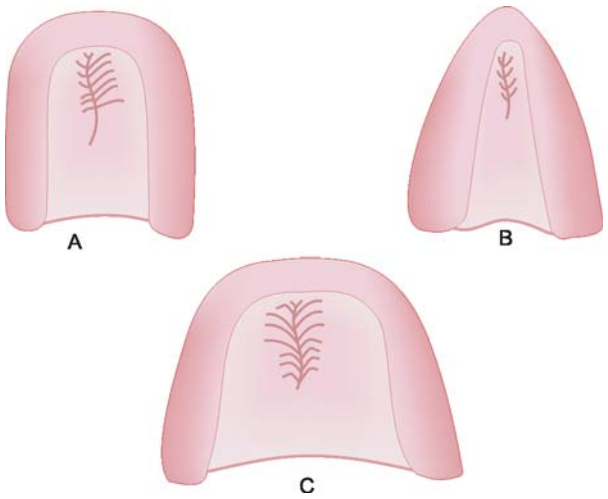


Fig. 12.3: Maxillary edentulous ridge (Arch forms)
A. U - shape, B. V - shape, C. Square

Ridge forms (Fig. 12.4)

	Maxillary	*Mandibular*
Suitable	Well developed but not bulky	Well developed, broad in section
Un-suitable	Flat, bulky, with undercut. V-shaped palate Small ridges Shallow sulcus	Flat, bulky, with undercut Collapsed, Narrow, Knife edged Shallow sulcus

Importance of Arch form and Ridge Form (Figs 12.5 and 12.6)

These are the main areas of denture foundation, which bear the major load of mastication and play a major role in denture retention and stability.

Well-developed ridges offer resistance to lateral displacement.

Broad ridge offer good resistance to vertical loading.

Flat ridge are good for vertical loading. But not good for lateral resistance.

Bulky ridges reduce the available denture space (inter ridge space) for teeth set-up.

Undercuts reduce the depth of flanges. Collapsed ridges produce undercuts.

Knife –edge like ridges are bad for vertical loading and cause pain (Figs 12.7 and 12.8).

Hard palate: High V-shaped palate is unfavorable for upper denture. Similarly, flat palate with small ridge and shallow sulcus is also not good.

Torus palatinus is a bony swelling in the midline of palate. Its size may vary small to large.

This area needs to be relieved during denture fabrication (Fig. 12.9).

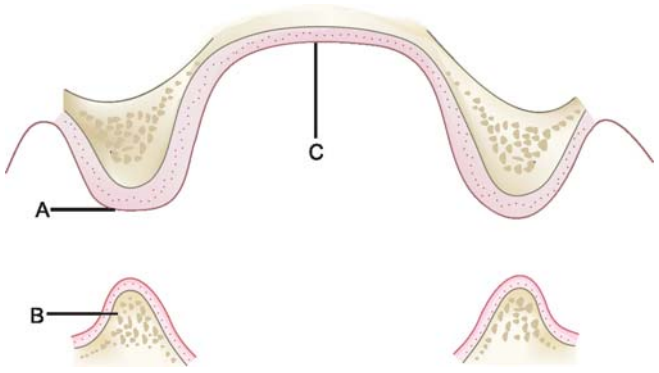


Fig. 12.4: Ideal denture foundation
A. Maxillary, B. Mandibular, C. Palate

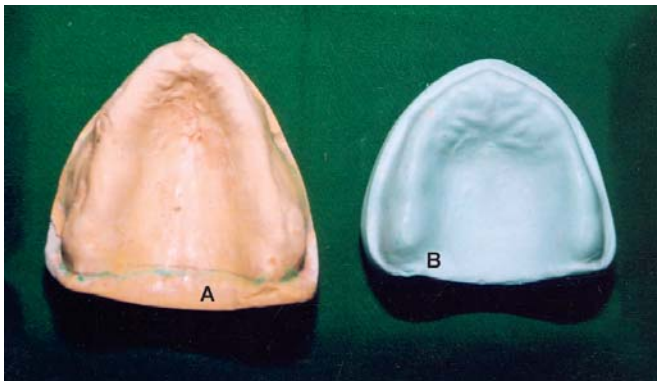


Fig. 12.5: Maxillary alveolar arch form.
A. Tapering (triangular), B. U-shape

Hard palate may be having a cleft, which was unsuccessfully closed leaving a hole in the middle of the palate and this needs to be covered.

Soft palate: The posterior border of maxillary complete denture should lie on non-moving tissue of soft palate, on a line from one side hamular notch to another side hamular notch, close to the fovea palatine. This is the site where post damming is done.

Palatal rugae: These if copied correctly on the impression and finally on the fitting surface of denture, are indicators of good fit of maxillary denture.

Maxillary tuberosities: These are helpful for the retention of maxillary full denture if they are large with deep sulcus in the area. But some time these are so large, they have to be surgically shaped. Maxillary tuberosity with one-side (buccal side) undercut is also very common. These undercuts need to be blocked before impression is made.

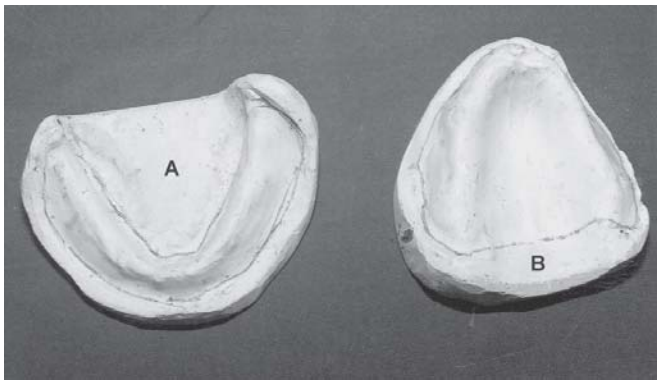


Fig. 12.6: Edentulous casts—Arch form
A. Mandibular, B. Maxillary- "V" shape

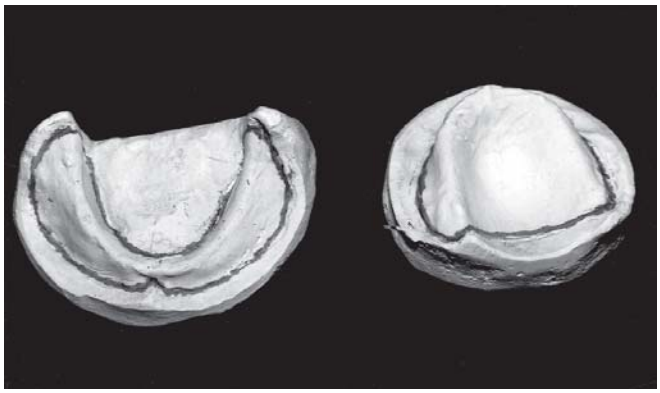


Fig. 12.7: Edentulous casts — Arch form
A. Mandibular, B. Maxillary- "U" shape

Hamular notch is the groove like depression just behind the maxillary tuberosities and this should be the posterior extension of maxillary full denture.

In the case of mandibular ridge, undercut is common in the lingual pouch area. This also needs to be blocked while making impression. Posterior border of the mandibular full denture should lie on retromolar pad. Undercuts are also common in the labial aspect of maxillary and mandibular anterior ridge.

Height of the alveolar ridge is responsible for the depth of sulcus. Deeper the sulcus better will be the retention of dentures. Sulci contain frenal attachments, one labial frenum in the anterior ridge and one or two in the buccal ridge. Lower anterior portion of ridge also has the lingual frenum in the floor of the mouth. All these frenal attachments must be suitably relieved so that their movements are not hampered when the denture is in place. Otherwise they cause displacement of dentures. On the other hand, very high attachment of maxillary labial frenum in the middle of the anterior ridge and relieved to its full depth may cause midline fracture of maxillary full denture. The full depth, width and contour of sulcus all around the ridges, labially and buccally is accurately registered at the time of border molding with greenstick compound just before the final impression is made. If this procedure is correctly done, one finds enough resistance to remove the special tray out of the mouth, and this gives the indication about the retention of finished denture. Good border molding brings about a seal around the periphery and sucks the denture into place. One can actually listen to this suction sound while removing the special tray.

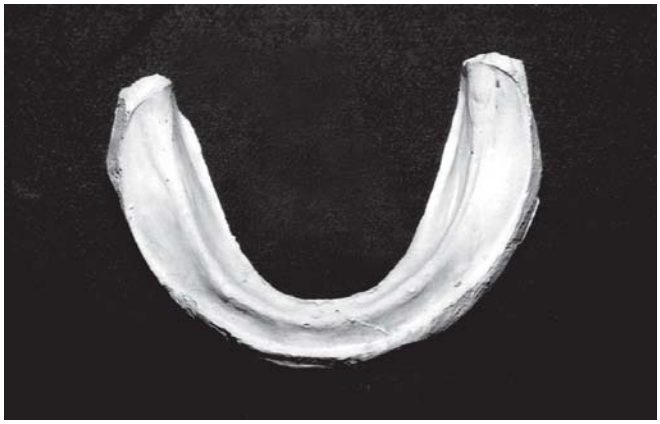


Fig. 12.8: Edentulous cast-mandibular
A. Very poor ridge (highly resorbed)

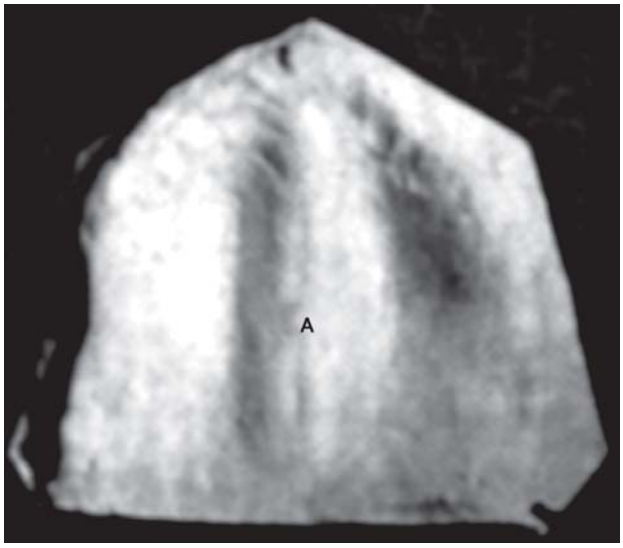


Fig. 12.9: Maxillary cast showing
A. Large torus palatinus

Thus alveolar ridge height and depth of the sulcus together form the flange of denture.

Ideal Depth of Flange

a. It must follow the maximum functional flexure line.
b. It must allow free movement of the border tissues within the limits of normal function.
c. It must provide efficient peripheral seal.
d. It must contact flexible, compressible tissues.
e. It must never terminate on rigid incompressible tissue anywhere.

Therefore, the peripheral outline of full denture is limited by the anatomical structures, which surround the denture bearing area, and is shaped to give full play to these structures in function.

Mucosa and Submucosa

Thickness of mucous membrane and submucosa varies over the different regions of denture foundation. Depending on this, it can be compressible or incompressible. For example, it is very thin in the middle of palate and moderately thick over the crest of the ridges, but very thick between these two areas of the palate (Fig. 12.10).

This uneven tissue compression can cause soreness, pain and also constant flexing of denture induces fatigue in the denture, which ultimately ends up in fracture of denture. Advanced periodontal diseases cause severe bone resorption leaving behind flabby soft tissue over the ridges. Chronic irritation due to ill-fitting dentures may cause hyperplasia of soft tissues. Thus the load bearing capacity of the tissues depend upon their consistency whether dense and firm, compressible or flabby.

This has a significance with respect to impression technique as well- If the whole of impression area were stone hard, only one impression material would have been sufficient for all types of impressions. But this is not the case. Because the denture foundation is deformable and compressible, several impressions can be made of the same area with several materials, all impressions being equally accurate yet all are different.

This lack of rigidity in the denture foundation is helpful since it helps in denture retention by providing closer peripheral seal owing to " give" of tissues. It also makes-up for any in- accuracies in the technique.

Ideally mucous membrane should be

i. Firmly attached to the under-lying bone.
ii. Slightly compressible.
iii. Of even thickness.

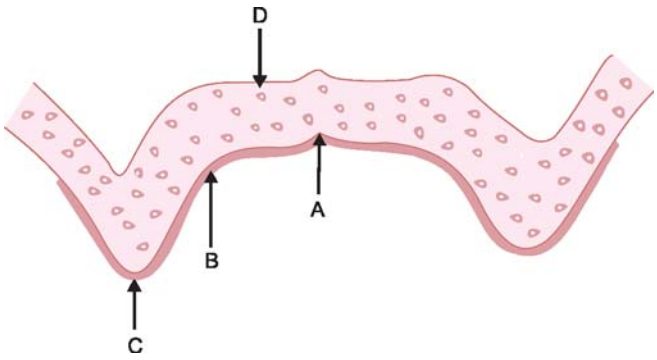


Fig. 12.10: Mucous membrane covering maxilla
A. Very thin in the midline, B. Very thick submucosa,
C. Moderatly thick at the crest of the ridge, D. Palate (bony)

Exostoses

In the mandible, this occurs with genial tubercle, which becomes enlarged. In the maxilla multiple exostoses occur on the buccal aspect of alveolar bone as hard nodules- these should be removed before undertaking denture construction.

Tongue: Its size, position, habits and movements has influence on the dentures especially mandibular. First of all, tongue movement must not be restricted by encroachment of dentures. If restricted, it will dislodge the mandibular denture out of place. Therefore posterior mandibular teeth must not overhang the side of the tongue.

Shape and contour of the lingual flange of the mandibular denture should slope slightly inwards from above downwards. Occlusal plane of the lower denture should be kept low, so that lateral borders of the resting tongue lie on the occlusal surfaces of the teeth. This will prevent displacement of lower denture also. Tongue should be trained not to make unwanted movements and patients should be told not to allow tongue to play with lower denture- a habit a denture wearer usually gets. On the contrary, patients should train the tongue movement to help retention and stability of dentures. Tongue can lift and press the upper denture up against the palate and press the lower denture towards the lower alveolar ridge.

Contact of the posterior edge of the upper denture with the back of tongue will cause retching and sensation of nausea.

Wrong arrangement of artificial teeth can cause tongue biting during mastication.

Unusual ulcers and swellings of the tongue should be noted down.

Denture Space or Inter Ridge Distance

If this is small and limited, acrylic artificial teeth have to be grinded sufficiently to accommodate them during set-up.

Any suspected buried roots or whole tooth, confirmed by X-ray examination should be removed before construction of denture.

Alveolectony of protruding ridges and trimming of bony spicules, and tuberosities should also be done before hand.

Special Investigations

If the patient is diabetic, blood and urine examinations are advised.

If any surgery is contemplated, bleeding time, clotting time and percent of hemoglobin and blood grouping are done.

If the patient is allergic to any of the dental materials that should be investigated and proper precautions taken.

Facial Features and Personality of a Patient

Face may be round, square or ovoid. Shape of the alveolar ridges usually confirms with the shape of face. This will help with selection of teeth.

Personality of patient; how well or badly dressed, her/his style of talking; manners, habits etc must be observed. All these will give some idea about his economic status, oral hygiene habits; education level; etc.

Color of eyes and skin also are taken into consideration while selecting artificial teeth.

Decreased vertical dimension of old dentures will cause fold at the angles of mouth, seeping of saliva at the corners of mouth which may get infected and result in angular cheilosis.

Lips: Size of the lips is important in relation to esthetics; how much of teeth are visible during normal speech or smiling. Lips may be long or short. Lips may be tight or relaxed.

Size of the orifice of mouth, if small and small tight lips together make impression making a difficult procedure.

Type of Patients

During the course of professional career one comes across all sorts of people, and they can be classified as;

1. Disciplined and demanding (Exacting).
2. Adjustable (philosophical).
3. Not-bothered (Indifferent).
4. Eccentric and unstable (hysterical)

With all these types of patients, the dentist must adopt a cool, calm and compromising attitude for the successful out come of denture construction.

Information about Previous/Existing Dentures

Number of previous sets and patient's opinion about them.

The reason for the new set.

Existing dentures should be examined for

a. Under extension or over extension of borders.
b. Fit of dentures – i.e.; Retention and stability.
c. Appearance
d. Vertical dimension.
e. Centric occlusion and centric relation.
f. If any suction plates.

If the Patient is seeking complete denture to be made for the first time, find out;

When was the last tooth extracted.

Has he/she worn partial denture before.

Why the natural teeth were extracted.

And examine; the residual ridges- state of healing and advice the patient if further waiting period is necessary.

If not; discuss with the patient.

a. About treatment plan and procedure
b. Expenses involved.
c. Expectations and limitations.
d. Duration of treatment.

CONCLUSION

Residual alveolar ridges are the main denture foundation- whose size, shape, texture etc; varies a great deal from patient to patient. By and large there is not much of a problem with maxillary ridges- it is the mandibular ridge that is problematic because of its peculiar shape, resorption of bone and muscular attachment. Many a times, the mandibular ridge is extremely poor and almost flat, unsuitable as a denture foundation. Un-even ridges, collapsed ridges, ridges with severe undercuts, bulky ridges, knife-edged ridges are also not uncommon.

Maxilla to mandibular relation whether class I, II, or III should be taken into consideration, because extreme cases of class II and III are also not uncommon. Buried roots, un-erupted tooth, infection and sinuses, should be treated appropriately before hand. Gums must be fully healed; waiting period of minimum of 6 to 8 weeks is a must.

Attitude of Patient

Occasionally one comes across a patient with couple of complete denture sets in his pocket- and seeking a third one. Such patient is never satisfied and one must be cautious about them. Not only that, these people go on doing shopping from one clinic to another. Therefore it is advisable to tell the patient realistically about the outcome of treatment.

However, dentist's thorough knowledge, skill, approach, self-confidence, and proper attention to all details of work are essential for the successful construction of complete dentures. Functionally and technically satisfactory dentures are a thing of beauty and joy forever. This should make the dentist happy more than the patient.

13 Making Impressions of Edentulous Jaws

INTRODUCTION

Definition

In General—Impression is an exact negative replica of any object being impressed upon.
For example; Thumb impression

Dental impression: It is an exact negative replica oral hard tissues (teeth and alveolar bone) and soft tissues (mucous membrane).

Purpose of making an impression: This is the first clinical step in the construction of complete dentures, the success or failure of the denture depends to a large extent, on this first step. Plaster of Paris or dental stone is poured on to this impression to get a cast, which represents the positive replica of oral hard and soft tissues.

In the absence of patient, denture fabrication is undertaken on the cast, stage by stage.

Aim

Complete denture is entirely tissue borne. Therefore distribution of masticatory load depends on the available surface coverage. (i.e. force per unit area). Greater the area coverage, greater will be the resistance to biting force or stress. This area coverage is not so bad in the case of maxillary denture because of presence of hard palate, as compared to mandibular complete denture, which is just limited, and horseshoe shaped. Fitting surface of the denture comes in contact with the oral soft tissues, and rests on the alveolar ridges and thus retains the denture in its intended area. Fitting surface of denture is nothing but the impression surface of impression. Thus fitting surface (Impression Surface) must cover as large area as possible of the denture foundation.

Complete denture has three surfaces:

1. Fitting Surface (i.e. Impression Surface)
2. Occlusal Surface
3. Polished Surface

All these surfaces take part in the success of complete denture.

Impression surface is a Retainer
Occlusal surface is a Balancer
Polished surface is a stabilizer.

In this respect Sir Wilfred Fish said; "The fundamental principle in the construction of complete dentures is that every part of every surface of the denture shall be modelled to fit some part of the patient's tissues or some part of the other denture".

Therefore impression surface must have wide coverage and close contact with tissues.

Ideal Impression

1. Has wide coverage of the denture foundation.
2. Registere all the details of the oral tissues.
3. Maintains dimensional stability until cast is made.
4. Has border, which has been correctly molded according to the anatomical boundary tissues and area.
5. Has no defect of any kind.

Denture Foundation

Within the area covered by maxillary and mandibular complete dentures are the alveolar ridges (of bone), which are only thinly covered by mucous membrane. These are known as hard tissue area and they will firmly support a denture placed upon them. If the tissue is muscle it is generally more mobile and sensitive. These are known as soft tissue areas and are not a satisfactory area to place a denture.

The maxillary and mandibular alveolar ridges which bear the main force of mastication (stress) are relatively solid and un-yielding. If these ridges are wide in cross section and square like in plan they are most suited to stress bearing. That's why these alveolar ridges are known as main stress bearing

areas. Palate is a subsidiary stress bearing area, and because the bone beneath it is thin and slightly flexible, it does not undergo resorption like alveolar ridges. The normal maxillary complete denture should cover the whole of the palate as well as the facial and buccal aspects of the ridge. The posterior border should be through the hamular notches thus completely covering the tuberosities and through the fovea palatine. The normal mandibular complete denture should cover the whole ridge including the retro molar pads. In both cases adequate relief must be given to muscle attachments.

Peripheral Border Tissues

The peripheral outline of the complete denture is limited by the anatomical structures which surround the denture bearing area and is shaped to give free play to these structures in function.

Maxillary Denture

Starting from the hamular notch of one side the periphery on the buccal side rises to the full depth of maxillary tuberosity in sulcus. Buccinator muscle attachment in this area should not be encroached. The periphery then takes a downward path until it reaches the root of the zygoma. At this point there is buccal frenum, which needs to be relieved. Then the periphery rises again to the full depth of the buccal sulcus and follows the curve (groove) of the sulcus until it drops down to the labial frenum in the centre of midline. During this coarse of periphery, maxillary incisive muscle attachment restricts its extension. Anteriorly the periphery should be relieved of labial frenum. The same is the peripheral border extension on the other side of the maxillary arch. The posterior border of the denture (posterior palatal seal) should lie on non-moving tissue of soft palate at the junction of hard and soft palate on a line from one hamular notch to another just in front of fovea palatinae. This is not a straight border; instead, it follows the curvature of posterior border of hard palate. Vibrating line of palate can be seen when the patient says "Ahhh" and is marked with a indelible pencil.

Peripheral outline of mandibular denture. Starting from the retromolar pad, the buccal side periphery runs downwards and outwards to the 1st molar region following the attachment of the buccinator muscle. The distal most part of this periphery is also influenced by the anterior border of masseter muscle. Another structure in this region is external oblique ridge, which should be taken into consideration. However, it is the facial contour that plays a major role in deciding the extension of the buccal flange in this area. Therefore, the polished buccal surface of the denture is made concave looking outwards and upwards so that the contracting buccinator presses the denture downwards.

Then the periphery runs forward up to the premolar area where the modiolus is situated and it is relieved. From now on, the periphery takes a curve of the sulcus passing over the canine region upto the midline where it is relieved for labial frenum. In the anterior region of the labial flange the mandibular incisive muscle attachment and attachment of mentalis muscle must not be enchroched upon, to avoid lifting-up of the mandibular denture by the contraction of these muscles.

Lingual periphery. (There is no palate here).

Starting from the crest of retro-molar pad, the periphery runs downward and forward in the lingual pouch area. Extension of periphery of mandibular denture in this region helps in retention and stability of lower denture. Sometime one comes across a deep undercut in this region. Palatoglossus muscle (Anterior piller of fauces) in this region limits the posterior edge of the periphery. The periphery then runs forward along the floor of the mouth above the attachment of mylohyoid muscle on the lingual aspect of the mandible. As the lingual periphery advances forward, with concavity looking downwards, it is actually over the sublingual salivary gland, which lies immediately underneath the mucous membrane of the floor of the mouth. Then the lingual periphery follows along the floor of the mouth, until it reaches the lingual frenum in the midline of the mandible. The periphery is cleared to relieve that frenum.

In summery the denture periphery should extend to the most effective shape of the foundation over the greatest possible area.

Impression Materials used During Complete Denture Construction

A. For preliminary Impressions
   a. Impression compound.
   b. Alginate based IR-Reversible hydrocolloid.
B. For Final Impressions
   a. Zinc oxide Eugenol Impression paste.
   b. Alginate based IR-Reversible hydrocolloid.

Ideal Properties of Impression Material

1. Should readily flow into all areas to be registered.
2. Setting time should be convenient to both patients as well as to the operator. Operator must have enough time for proper manipulation and at the same time patient must not unduly inconvenienced by lengthy setting time.
3. Should reproduce all the details of the oral hard and soft tissues accurately.
4. Should be easy to manipulate and to clean the instruments used for manipulation.
5. During removal from the mouth, it must not be broken. That means it must have certain amount of strength to resist tearing.
6. Should have elastic nature, so that the impression will come out of undercut areas intact and show elastic recovery after removal.
7. Should not distort or change its dimensions after removal from month.
8. Should have pleasant odor, taste and should not contain any harmful ingredients.
9. Should be easily separated from the model after casting and have compatibility with all cast materials.
10. Should have long self-life and economic.

Impression Compound

Definition: This is a mixture of various natural and / or synthetic resins.

Composition

Exact composition of impression compound is a trade secret. But, its main ingredients can be put under the following headings (Fig. 13.1).

Sl No	*Ingredients*	*Material*	*Function*
1.	Thermo-plastic materials	Paraffin wax	Soften upon heating and harden upon cooling
		Bees wax	
		Gutta percha	
		Stearin or Stearic Acid	
2.	Resins	Shellac	Increase hardness
		Copal Resin	
		Kauri Resin	
3.	Fillers	Pumice	Give bulk to the product and adds to proper consistency
		French Chalk	
4.	Coloring Agent	Rouge	

Fig. 13.1: Impression compound (cake form)

Probable Composition of Two Products

A.	Rosin	30 parts by wt
	Copal Resin	30 parts by wt
	Carnauba wax	10 parts by wt
	Stearic Acid	5 parts by wt
	Talc	75 parts by wt
B.	Dammer Resin	50 parts by wt
	Stearin	25 parts by wt
	Powdered soap stone	25 parts by wt

Disadvantages of Impression Compound

1. Not suitable if severe undercuts present.
2. Not Elastic.
3. Can Distort.
4. Not suitable for dentulous cases.
5. Thermal Conductivity is very low.

Advantages of Impression Compound

1. Can be reused.
2. Simple to use.
3. Can be corrected by reinsertion in the mouth.
4. Can be boxed for casting.
5. Separating medium not necessary.

Nature of Impression Compound Thermoplastic

i.e. Softens on Heating.
Hardens on Cooling.

Zinc-oxide Eugenol Impression Paste

Composition

A. Base paste - White in color
Zinc-oxide powder – Main
Olive oil or Mineral Oil – Plasticizer
B. Accelerator paste - Brown in color
Eugenol – Main

Kaolin or Talc—Filler
Rosin—For smoothness of mix.
Zinc Acetate
or Calcium Chloride } Accelerator for setting
Or Acetic Acid
Balsum—For flow.
Coloring agent (Fig. 13.2).

Setting Mechanism and Reaction

Sets by Autocatalytic process in which water (moisture) acts as a catalytic agent. Set material consists of un-reacted zinc oxide particles surrounded by a complex matrix of chelate compound known as Zinc Eugenolate.

Setting time - 4-5 minutes at mouth temperature.

Setting Reaction

$$\text{Zinc oxide} + \text{Water (moisture)} \xrightarrow{\text{Hydrolysis}} \text{Zinc Hydroxide}$$

$$\text{Zinc Hydroxide} + \text{Eugenol} \rightarrow \text{Zinc Eugenolate} + \text{Water}$$

Advantages of ZOE Paste

1. Accurate reproduction of all details.
2. Sticks to dry surface of impression tray.
3. Dimensionally stable provided the impression tray is stable.
4. No need of separating medium.
5. Can be reinserted in the mouth and faults can be corrected.
6. Can be boxed for casting
7. Easy to manipulate.
8. Minimum tissue distortion while making impression.

Disadvantages of ZOE Paste

1. Cannot be used if undercuts present
2. Burning sensation of eugenol is not tolerated by some patients.
3. Setting time has to be controlled
4. Difficult to clean because it is sticky.

Alginate Based IR-Reversible Hydrocolloid

Composition of Alginate powder (Fig. 13.3).

Ingredients	*% By wt*	*Functions*
Na/K alginate	15-20	Forms soluble alginate with water
Calcium Sulfate	14-16	Reactor-Reacts with Na/K alginate to form insoluble ca-alginate gel.
Sodium Phosphate	1-2	Retarder-reacts first with calcium ions- thus provides working time
Diatomaceous Earth Modifiers and Coloring agents	45-60	Filler

Mixing: According to the manufacturer's instructions.
Plastic cup/scoop for measuring powder
Plastic cylinder with markings for measuring water

Setting: by chemical reaction

Na/K Alginate + Calcium Sulfate → Calcium Alginate + Sodium Sulfate.

Fig. 13.2: ZOE impression paste with disposable paper pad and mixing spatula

Fig. 13.3: IR-reversible (Aliginate based) Hydrocolloid impression material with, Rubber bowl, Mixing spatula, Impression stock trays

Advantages of Alginate Impression Material

1. Elasticity – therefore suitable even in undercut areas.
2. Easy to manipulate with simple equipment.
3. Quick procedure.
4. Tolerated by patients.
5. Cheap.
6. Reproduction of details accurately.
7. Separating medium not necessary.

Disadvantages of Alginates

1. Subjected to syneresis (Shrinkage) and imbibition (Expansion)- that means distortion.
2. Must be casted immediately or at least as early as possible.
3. Boxing is difficult, but can be done
4. Can affect the hardness of stone cast
5. Does not adhere to the tray surface

Types of Impressions

A. *Mucostatic Impression*

Bone is a hard tissue, which cannot be compressed. But mucous membrane with its varying degree of submucosa is a soft tissue, which can be compressed. Normally, both hard and soft tissues are at rest and not compressed. But at function soft tissues are compressed.

While making impressions soft tissues can be compressed or not compressed depending upon the consistency of the impression material. While making impression, some amount of pressure has to be applied in order to register the surface details. However, thin consistency impression materials like plaster of Paris, thin consistency ZOE paste will not compress the tissues even under pressure. Such impression registers the tissues at normal, Rest condition. These impressions are called Mucostatic. Accordingly dentures made on such an impression will function better when the tissues are at rest, that is when teeth are apart.

B. *Muco-Compressive Impression*

Thick Consistency impression materials like Impression Compound, thick consistency ZOE paste, will compress and displace the tissues while making impression and such impression are called Muco-Compressive.

Dentures made on such impressions will fit better while the tissues are at function, that is while biting, eating etc. However; Common Aim of different techniques of making impressions is even distribution of pressure over the whole of fitting surface. Dentures made with such impressions function well both at rest and at use. The fit is better and they don't rock.

Impression Trays

These are the devices used to carry the impression materials into the mouth and hold it there until the material sets (Figs 13.4 and 13.5).

Requirements of Impression Tray

a. Proper size and shape.
b. Strong and Hard.
c. Smooth border.
d. Firm handle.

Classification of Trays

a. Stock trays or Ready-made tray.
b. Special tray also known as custom tray, Individualized tray, made to measure tray:
   - Close fitting tray.
   - Spacer tray.

Fig. 13.4: Assorted maxillary edentulous stock trays

Fig. 13.5: Assorted mandibular, Edentulous stock trays

Use of Impression Tray

1. Stock Trays - For Preliminary impressions
2. Special Tray - For Final impression.

Materials for Making Special Tray

a. Shellac base plate
b. Impression Compound – called Tray compound
c. Acrylic Resin
   1. Heat cure.
   2. Cold cure.
d. Metal – Soft metal like plumber's solder.

Types of Trays

a. Maxillary tray.
b. Mandibular tray.
c. Edentulous tray.
d. Dentulous or Box tray.
e. Perforated tray.
f. Non-perforated tray.
g. Rim lock tray.
h. Part tray.
i. Plastic tray – Nylon tray.
j. Tray with water circulating tubes at the under-surface of the tray (Fig. 13.6).

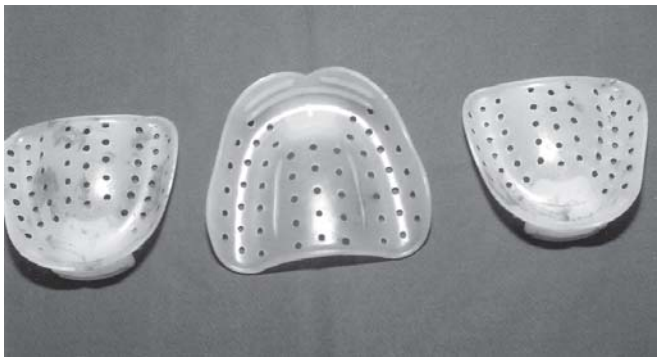


Fig. 13.6: Edentulous stock trays (Nylon)

Stock Trays

Stock trays are made of metal or plastic and are available in different sizes. These are numbered as 1,2,3,4 and so on and this indicates the size of human jaws. These figures (sizes) have been arrived at, by examining a large number of patient's jaws and finding an average size. This can be compared to a ready-made shirt, which is sold as small, medium, large and extra large. One can buy any one of these shirts according to one's approximate body size but they are not exact, instead only an approximate. When the patient's jaw impression has to be made for the first time, dentist has no choice but to use one of these ready-made stock trays, which will approximately fits that patient's jaw. This is why the stock tray is used to make the preliminary or first impression.

Special Tray

Just as stock trays can be compared to readymade shirts, special trays can be compared to a made to measure shirt. These special trays are made on the casts obtained by preliminary impressions made with stock trays.

These are special to that one and only patient and for no one else. These will fit exactly on the jaw of only one patient for whom it is specially made.

Use of Special Tray

For making second time, more accurate impression known as Final impression.

Close Fitting Special Tray

This is used when thin consistency impression material like ZOE Paste is used for final impression.

Spacer Special Tray or Loose Fitting Tray

This is used when some space is required for thicker consistency impression material like alginate is used for final impression.

Most suitable stock trays for edentulous jaws.

Casco Series

Number 3 for Maxillary Jaw
Number 7 for Mandibular Jaw (Fig. 13.7).

For other variations in jaw size and shape appropriate numbers are available. If the metal stock tray is not suited to a particular patient in size and shape, its size can be increased posteriorly by extending the flange with impression compound. Its shape can be altered by bending the flange this way or that with pliers (Fig. 13.8).

Patient's Version of Impression

Patients usually say " Doctor take the measurements". We don't measure the jaw with tapes and scales. Impression making is much more than measuring, although the basic idea is same.

Problems Met with Making Impressions

1. Fear and apprehension by the patient about a large amount of foreign material going into the mouth.
   Remedy—Patients fear removed by properly explaining to the patient about the material and procedure.
2. Nausea and Vomiting
   Remedy—Hold the patient's head tilted downward somewhat, while making the maxillary impression. Ask the patient to concentrate on breathing through the nose continuously. Don't overload the posterior border of the tray.

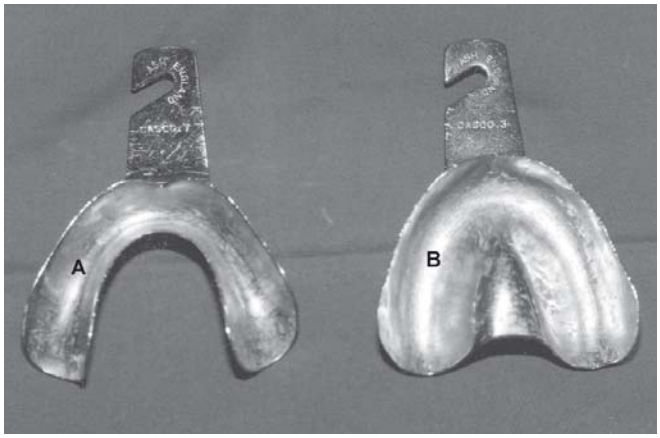


Fig. 13.7: Edentulous stock trays
A. Casco No. 7 (Mandibular), B. Casco No. 3 (Maxillary)

Fig. 13.8: Edentulous stock trays (small size)

Assure the patient that nothing serious is going to happen. In the worst case of actual vomiting, don't remove the impression; instead hold the kidney tray for the vomit.

Therefore, make the mandibular impression first and then only make the maxillary impression. By doing this, patient gains confidence and will cooperate subsequently. Patient is requested to wash the mouth thoroughly before making the impression.

Put a bip around patient's neck to protect his clothes.

In summary, "patient relaxed and Dentist confident".

Adjustment of Dental chair and dentist's positioning.

For lower impression: Up right chair, raised high to operators convenient level. Dentist standing in front of the patient, to one side of chair, patients head straight and held firm on the headrest (Fig. 13.9).

For Upper Impression

Chair still up-right and height adjusted so that dentist can put his one arm around patient's head. Dentist standing at the back, to one side of the chair.

Patients head held looking down a little, yet firm on the headrest (Fig. 13.10).

Fig. 13.9: Making impression of mandibular jaw

Fig. 13.10: Making impression of maxillary jaw

Tools Required for Making Impression

Impression Trays
Plier
Impression Materials – Concerned.
Hot and Cold Water
Mixing Spatula
Mixing slab or Paper pad
Border moulding compound
Spirit lamp
Wax knife or Lecron's carver
Rubber bowl,
Dispensers.
Vaseline.

PROCEDURES

Preliminary Impression

Mandibular Compound Impression

Selection of stock tray: Inspect the size and shape of lower ridge. Select a edentulous stock tray which approximates the lower ridge in size and shape.

Insert the tray in the mouth—first one corner of the tray entering the mouth and then rotating it inside the mouth. When the whole tray is inside the mouth, straighten it over the ridge. Center it in the oral cavity, place the tray over the ridge and assess its suitability—with respect to coverage of whole ridge; depth of buccal flange in the sulcus, Tray should go over the retro molar pads and lingual pouch. If necessary the borders of tray can be built-up with compound. For this, take a piece of softened compound and attach it to the required area and shape it.

With the tray over the ridge, there must be enough space between the tissues and tray to accommodate the impression compound, i.e. Between the trough of the tray and ridge. Patient is asked to raise the tongue and check the depth of lingual flange in the floor of the mouth. There should not be much disparity between the width of the ridge and width of the trough of the tray. In other words, the tray should cover the whole length and breadth of the alveolar ridge and to its full depth of the sulcus both buccally and lingually. Stock tray cannot be exact to the ridge but should be near enough. Casco No.7 fulfills these requirements in majority of normal sized and shaped lower ridges. Sometimes, tray flanges can be bent with plier wherever necessary.

For compound impression tray is not perforated.

Manipulation of Compound

Place a small piece of napkin inside the rubber bowl.

Pour hot water (60ºC) into the bowl.

Apply Vaseline to your fingers.

Place one full cake of impression compound into the bowl for softening.

Wait for 3 minutes.

Remove the softened compound and knead thoroughly with fingers. If necessary put the compound back in hot water and knead it again.

Take 3/4th of kneaded compound and roll it into a thick pencil shape. Warm the impression surface of the tray in hot water and dry it.

Place the roll of compound in the trough of the tray and shape it to the shape of tray.

Make a narrow trough in the roll of compound corresponding to the shape of tray.

Place the loaded tray into hot water, with compound surface down, just for a second or so.

Shake off the water from the tray.

Apply Vaseline lightly over the surface of compound.

Insert in the mouth; centre it directly over the ridge.

Apply downward and backward pressure uniformly from front to back.

Ask the patient to raise the tongue up and put it forward over the tray, and then to left and to right couple of times.

While holding the tray firm in the mouth with one hand, pull the cheek and lip of one side outward and then push inward over the border of the tray, and then same is repeated on the other side, to boarder mould the compound in the sulcus all around.

All tongue movement and muscle trimming on the labial and buccal side must be done while the compound is still soft. Hold the tray in the mouth with uniform light pressure for 2-3 minutes. Test the hardened compound with fingernail.

If no finger nail marks, remove the tray from the mouth.

Hold the tray under tap water.

Shake of water.

Inspect the impression for details.

CONCLUSION

Tray should be properly centered over the ridge—not in front or back of it. So also, not to one side or other side. That is, trough of the tray should lay directly over/under the ridge as the case may be.

Compound must be sufficiently soft so that it flows quickly under pressure.

Enough compound must be loaded in the tray.

Tongue movements and muscle trimming done quickly.

Full depth of lingual pouch area must be registered.

Maxillary Compound Impression

Selection of Stock Tray

Selection of maxillary stock tray is similar to the mandibular stock tray but with the following exceptions;

a. Maxillary edentulous tray must cover the palate, the posterior border falling at the junction of hard and soft palate.
b. Should cover the maxillary tuberosities and hamular notch.
c. The borders of labial and buccal flanges must cover the full depth of sulcus in those areas.
d. Tray must not rock on the palate.
e. Casco Number 3 fulfills the requirements of majority of normal size and shaped upper ridges.
f. In short, the tray should cover the whole length and breadth of the alveolar ridge, palate and to its full depth of the sulcus labially and buccally.

Manipulation of Impression Compound

This is also same as in the lower impression, but with following exceptions:

a. Full cake of compound is needed for the upper impression.
b. After kneading the softened compound it is made into a ball and placed on the palatal surface of tray and shaped to the tray shape.
c. More quantity of compound must be present in the palatal area.
d. After insertion and centering it in the mouth over the alveolar ridge pressure is applied upward and backwards—first in the anterior ridge so that the compound covers the anterior labial ridge and flows over it into labial sulcus. Then pressure is applied on the posterior part of ridge on both sides simultaneously muscle trim the border compound in the labial and buccal sulcus all around in the usual way.
e. Just sufficient pressure must be applied beyond the posterior palatal border of the tray.

CONCLUSION (Fig. 13.11)

Compound must flow right up to the vault of the palate and contact it all over.

Tray must be properly centered. Compound must flow over the tuberosities to the full depth of sulcus in that area.

Too much excess beyond the posterior palatal border gags the patient. While pressing on the anterior ridge, pull the upper lip outward and upward. One should actually see the compound flowing into the labial sulcus.

Precautions while Manipulating Impression Compound

a. Hot impression compound must be tempered (by waiting a while) and tested against the back of one's hand to prevent burning the patient's mouth.
b. Do not put too much pressure to make insufficiently softened compound to flow.
c. Do not use compound if there are too severe undercuts, especially in the maxillary tuberosity and lingual pouch area.
d. Do not soften impression compound in boiling water.
e. Sterilize the compound in autoclave.

Preliminary Impressions by using Alginate

Selection of Stock Trays

This is same as described under compound impressions, but with the following exceptions;

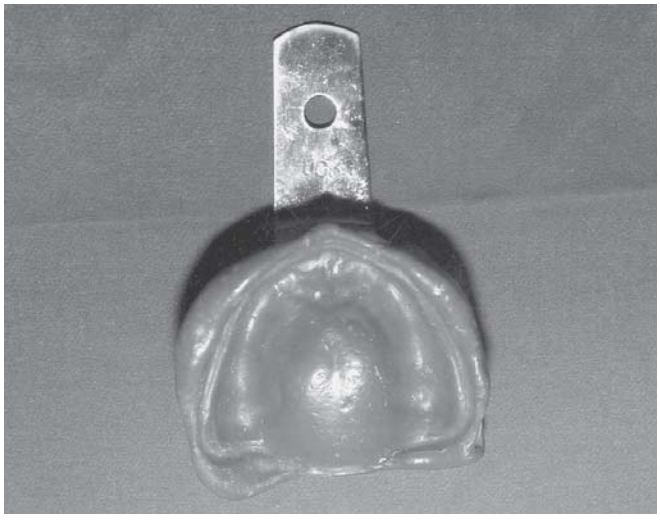


Fig. 13.11: Maxillary compound; Impression (preliminary)

a. Perforated tray is necessary.
If not, alter the surface of the non-perforated tray as under;
- Apply tray adhesive if available
or
- Spread the teased cotton wool (wisps) on the surface of impression tray and fix it with sticky wax at few spots.

All other points with respect to size, shape, border extension, area coverage etc. are same as in selection of stock tray for compound impressions.

The flanges of the tray can be bent with pliers to suite the requirements if necessary.

Manipulation of Alginate based impression Material—Steps

Instruments
1. Clean, Flexible rubber bowl.
2. Curved, rigid, stainless steel spatula.

Steps

1. Shake the can or packet to loosen the powder.
2. Wait a while for the dust to settle down before opening the lid.
3. Measure water according to the manufacturer's instructions by using the dispenser provided by them. For example water upto two markings on the water-measuring cup are sufficient for normal sized maxillary or mandibular tray.
4. Put this measured quantity of room temperature water into the bowl.
5. Measure the alginate powder by using a scoop provided by the manufacturer, usually 1 scoop of alginate powder for one I measure (i.e. 1 mark) of water. In this case take 2 scoops of alginate powder, sufficient for normal sized maxillary or mandibular edentulous tray.
6. Shift the powder into the water in the bowl.
7. Spatulation—First mix slowly by gentle stir to make all the powder wet with water.
Then mix vigorously by a Figure of "8" method, which is a to and fro method of rubbing the spatula against the side of the bowl. At the same time keep rotating the bowl in the palm of one hand. Mix for 1 minute. At the end of mixing, the mix should be smooth, uniformally homogeneous and creamy (Fig. 13.12).
8. Collect the mixed mass in one lump in the bowl with spatula.
9. Load the tray with the alginate mix by using a spatula, without incorporation of air into the mix.

Fig. 13.12: Correctly mixed IR-Reversible; Hydrocolloid (Alginate based), Impression material

10. Smoothen the surface of alginate with wet fingertips
11. If one is doing;
    Mandibular impression: Collect some quantity of mix from the remaining mix in the bowl with a fingertip, and place it at the lingual pouch (i.e retromylohyoid region) area on both sides of the lower jaw.
    Maxillary impression: Place in the vault of palate anteriorly and also at the buccal sulcus in the maxillary tuberosity on both sides.
12. *Making the impression*: Insert the loaded tray into the mouth, first through one corner of mouth and then rotate the tray inside the mouth. Once the whole tray is inside the mouth straighten it so that the tray handle is in line with patient's midline of the face. Trough of the tray should be over or under the alveolar ridge as the case may be.

Mandibular Impression

After centering the loaded tray in the mouth, press the tray downward and backward over the ridge by using both index fingers over the tray and both the thumbs below the lower jaw to support it.

Muscle trimming: Ask the patient to lift the tongue up and put it forward over the tray and then to the right side and to the left side of the mouth.

Hold the lower lip, pull it forward and outward and then push it inward and backward to mould the alginate in the labial sulcus. Then pull the cheek of one side outward and then pull it inward to mould the alginate in the buccal sulcus. Same is repeated on the other side cheek.

Maxillary Impression

Insert the loaded tray in the patient's mouth by rotating the tray into the mouth as explained with lower jaw impression. Center the tray over the ridge so that its handle is in line with the midline of the face, Then press the tray upward over the anterior ridge, at the same time retract the upper lip as the tray is seated to its place in the sulcus. Then press upwards on the back of the tray on both sides to seat the tray over the posterior parts of the ridge. As the tray is seated anteriorly, retracted upper lip is now pulled downward and inward so that anterior labial flange is molded in labial sulcus. Then the cheek of one side is pulled outward and then inward towards the flange to mould the buccal flange in the buccal sulcus. Same is repeated on the other side cheek. Instruct the patient to breathe through the nose continuously and hold his head slightly leaning down towards the chest, to prevent gagging.

13. Hold the tray steady while alginate is setting in the mouth. Alginate sets in 2-2½ minutes.
14. Removing the tray out of the mouth.
    Retract the corner of the mouth. Mandibular impression is removed with lifting upward motion. Jaw should be supported by thumbs under the mandible. Maxillary impression is removed with downward motion.
    In both cases, the impressions are removed with a sudden pull—upward or downward as the case may be.
    If difficulty is faced with removal of the impression because of the suction seal, put both the index fingers of both hands at the edge of the posterior flange in the buccal region on either side and break the seal by allowing the air to enter inside.
15. Rinse the impression under cool tap water; shake off excess water. Make arrangements to cast the impression immediately or at least as early as possible. If the impression has to be stored for few hours, cover it with wet cloth, put it in a polythene bag and seal it.

CONCLUSION

Alginate must be properly secured to the tray surface.
Mix must be uniformly homogenous.

Properly center the tray over the ridge.
Apply uniform pressure while setting.
Hold the tray without movement while setting.
Remove with sudden jerk when the alginate has set.

Do not forget to place some extra alginate mix on the palatal valult; in the retromylohyoid region and buccal sulcus of maxillary tuberosity regions. Because the material sets fast, the dentist has to be quick in his work.

Making Final Impression

Border Molding the Special Tray—Special tray is made of either, shellac base plate or Acrylic resin, with spacer in its fitting surface.

Check the Special Tray for

a. Peripheral extension—over extended or under extended in the sulcus. Place the tray in the mouth, lift the lip and pull the cheek outward and observe the border of the tray. If over extended at any area, reduce it by filing. If under extended it will be made good during border molding.
b. Test for frenal reliefs—Labial and buccal freni must have free movement and be properly relieved at their attachments in the vestibule.
c. Posterior border of the maxillary tray must end at the junction of hard and soft palate.
d. In the case of mandibular tray, the posterior end must cover the retro-molar pad and lingual pouch.
e. Check the tray for retention and stability.
f. Check the handle for its firm attachment and positioning.
g. Make sure there are suitable provision made for the retention of the impression material on the surface of the tray.
If ZOE paste is to be used—Dry surface will hold the material.
If Alginate is to be used, perforations are necessary.
h. Check the border of the tray for smoothness.

Instruments and Materials for Border Moulding

Bunsen burner or Spirit lamp
Hot and cold water in separate bowls
Wax knife
Vaseline
Green stick compound (Fig. 13.13).

Fig. 13.13: Green stick, border moulding; Peripheral tracing compound

Procedure

Lower Special Tray - with spacer intact. Apply Vaseline to your fingers and to patient's lips

Soften the green stick compound at one end by holding it well above the flame and rotating it between the fingers. Attach the softened compound at the crest of the border for a length of 3 cm starting from the posterior most borders on the buccal side.
Resoften the attached compo quickly.
Put it in hot water for a second.
Insert the tray in the mouth.
Pull the cheek out and then pull it inward couple of times to mould the compound in the buccal self-area.
Remove the tray out of the mouth.
Inspect the tracing.
Soften the compound once again as before, attach to further 3 cm of border of tray, resoften, put it in hot water, Insert in the mouth and border mould. This procedure is continued section by section until the whole border of the tray buccally labially and lingually is border moulded with green stick compound (Fig. 13.14).

Maxillary Special Tray

The procedure is exactly same as in the case of mandibular tray, but in the case of maxillary tray, its posterior border at the junction of hard and soft palate also is traced with green stick compound. While doing this posterior border tracing, patient is asked to make a sound "Ahhh" which make the soft palate to move up and down. Vibrating line marked earlier on the soft palate with indelible pencil makes

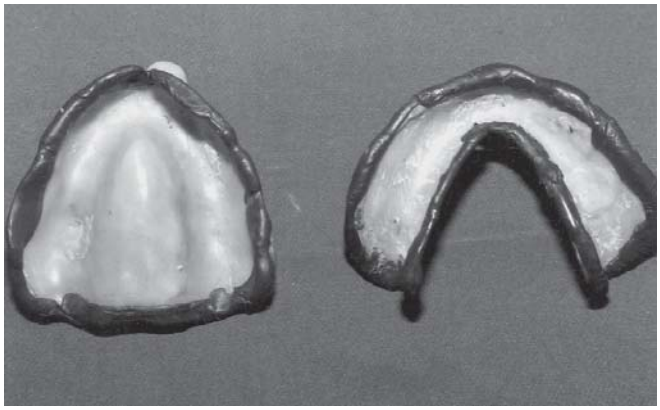


Fig. 13.14: Border moulded maxillary and mandibular special trays

a mark on the tracing compound and this helps to locate posterior border exactly just anterior to the vibrating line, but posterior to the hard palate.

Hamular notch areas are also traced with green stick compound.

Correctly and completely border moulded special tray is difficult to remove from the mouth. In-fact, this is a good indication and suggests a good fit of the future finished denture. However, to remove a tray form the mouth, suction seal has to be broken as explained earlier with alginate impressions.

After removing the tray it is washed under cool tap water.

Border moulding compound if it has been spread on the fitting surface of the tray anywhere is removed with hot wax knife.

Properly border moulded special tray shows a smooth, rolled edge form one end to another.

Remove the wax spacer from the fitting surface of the special tray. Make few escape holes.

Dry the surface.

Tray is now ready for final impression.

Final impression with ZOE Impression Paste

Manipulation of ZOE Paste

Tools Required
Thick cool Glass slab or oil impervious paper pad.
Broad bladed, flexible stainless steel spatula.
Vaseline.
ZOE impression paste.

Mixing

Squeeze out equal length and thickness of both the pastes side by side on the mixing glass slab or paper pad. About 3-4 inches long is sufficient for one full edentulous impression.

Apply Vaseline to your fingers and to patient's lips.

Mix both the pastes into one color and of uniform consistency by broad, sweeping strokes, covering the large area of glass slab or paper pad.

Mixing time is 1 minute and at the end of mixing, mix should be thin and creamy.

By using the same spatula, collect the material on to it and load the impression tray, spreading the whole impression surface uniformly, and thinly.

Insertion in the Mouth and Making Impression

This procedure is same as explained earlier in detail in connection with alginate and compound impressions.

Hold the tray in the mouth with light pressure until the paste sets in about 4-5 minutes.

Remove the Tray Out of the Mouth

Once again, if difficult to remove, adapt the same method explained earlier with alginate impressions and after border molding.

Wash the impression under tap water.

Shake off excess water.

Make a stone cast (Fig. 13.15).

CONCLUSION

Impression making is the first clinical step in making dentures. It must be just right for the success of finished denture. Impression surface acts as a retainer; closer the contact; wider the contact with natural tissues of the mouth and perfect seal around

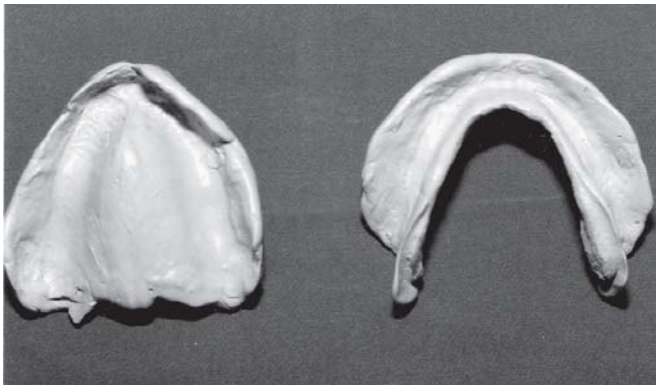


Fig. 13.15: Final impressions of maxillary and mandibular; Edentulous ridges made with Z O E impression paste

the periphery of denture, are essential for the fit and firmness of denture at rest and during function.

Every detail of each procedure should be strictly followed.

Manipulate the impression materials according to the manufacturer's instructions.

Make the cast immediately after impression is made.

Plan your work in such a way that you need not repeat the procedure.

Gain confidence of your patient by your calm and cool approach.

14 Jaw Relations

INTRODUCTION

This one topic is the most discussed, ill understood, and most controversial in the whole of prosthodontic dentistry. But, the final success or failure of any prosthodentic appliance depends entirely on this one step, more than anything else.

The subject can be simplified as follows:

The jaws concerned here are:

a. Maxilla—which is fixed to the skull and immovable
b. Mandible—which is movable and can be positioned at different levels.

Relation: This is a word, which describes the way in which one thing is connected with another. For example: We say, "He is my Relation" may be as brother, uncle, nephew etc. that means how one person is connected to another person.

In the same way, an object can be described with respect to distance.

For example: One house is 2 kilometers away from another house and the same house is 5 kilometers away from yet another house. Still, The same house can be described in another way:

The house is north to another house.

The house is south to another house.

The house is east to another house.

The house is west to another house.

Thus, the same one house can be related to another house in different way. Now applying this description to our maxilla and mandible;

Maxilla is fixed in one place—but the mandible can be related to maxilla differently—For example, it can be 1" down, or 2" down, or 3" down below the maxilla vertically.

This vertical distance between the upper jaw and lower jaw, which represents the length of the face, is vertical dimension.

With teeth present in both jaws, mandibular upward movement is restricted and it stops when the lower teeth touch the upper teeth. But in Edentulous mouth, there is no limiting factor for the upward movement of mandible. It can even move right upto the maxillary ridge. Downward movement of mandible is also restricted by muscles. Nature likes equilibrium. All the things that are there in nature are in equilibrium and at rest. The same applies to our mandible too. Mandible is suspended below the skull and stationed at a certain position where it is at rest. This equilibrium (i.e one thing is equal and opposite to another) of mandible is achieved by a balance between the muscles, which are trying to lift it up, and the muscles, which are trying to pull it down. That means, these elevator and depressor muscles have equal tonus in them; the position is balanced, (status quo) and the mandible is at Rest. This is known as physiologic Rest position of mandible. This distance between upper jaw and lower jaw when the mandible is at rest is the vertical dimension of rest position. When the natural teeth present in both jaws, teeth are not in contact with each other when the mandible is in this rest position. There is some gap (distance) between upper teeth and lower teeth. This gap or space is called *Freeway space*. In order to bring contact between lower teeth and upper teeth, the mandible has to move upward a little (2-3 mm); cross over that gap (free way space). This is normally felt when one clenches ones teeth.

In the clenched position, maxillary and mandibular teeth are in full inter-digitations. This is also another vertical dimension between upper jaw and lower jaw but when the teeth are in centric occlusion. In the clenched state of teeth, mandible cannot remain long; it gets tired soon and prefers to be at rest. Therefore it drops down (2-3 mm) to a resting position, in which there is a 2-3 mm of freeway space and the teeth are out of occlusion (Fig. 14.1).

In the edentulous condition, establishing this vertical dimension of rest position and of centric occlusion is vitally important and difficult. Establishing a satisfactory vertical dimension restores the normal appearance to the face. If not, face will be abnormal. With increased vertical dimension (*Height of bite*) face is long and strained. With decreased vertical dimension, face is sunken (shorter than normal) as if there are no teeth in the mouth. With the help of certain methods, and aids, satisfactory vertical dimension can be arrived at the stage of establishing jaw relations.

DEFINITIONS

Physiologic Rest Position

1. This is that position of lower jaw in which the elevator and depressor muscles are in balance.
2. It is that position of lower jaw in which the condyles are at rest in their most distal unstrained position in their respective glenoid fossae.

Vertical Dimension—Occlusal

It is the vertical distance between the jaws when the teeth are in normal occlusion. When there are no teeth, this distance is that of the denture space. This is also known as Height of the bite.

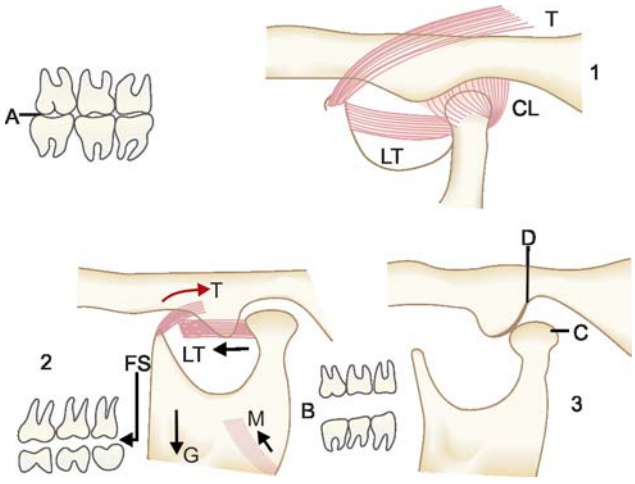


Fig. 14.1: Position of mandible: 1. Clenched, 2. Rest, 3. Open: A. Teeth in occlusion, B. Teeth out of occlusion, C. Condyle, D. Slope of eminentia articularis, T. Temporalis muscle, L. T - Lateral pterygoid muscle, CL. Capsular ligament, F. S. Freeway - space, M. Masseter, E. Gravity

Vertical Dimension—Postural

It is the vertical distance between the jaws when the facial muscles are relaxed. This dimension includes the free-way space.

Freeway Space or Interocclusal Clearance

This is a small space (2-3 mm) between upper and lower teeth when the facial muscles are at rest.

Results of Wrong Vertical Dimension (Fig. 14.2)

Raised bite or over opened bite	*Lowered bite or over closed bite*
Dentures less stable (like tall stool)	Dentures stable (short leged stool)
Large bulky dentures	Small, less bulky dentures
Lower teeth show too much	Teeth not visible
No free way space	Excessive Free-way space
Teeth clatter	Patient complaints are saying "can'nt Eat"
No room for food	Cheek biting
Patient complains of tiredness, discomfort and loose denture	Tongue biting
Jaws are kept too far apart	Pain in TMJ
Teeth meet pre-maturely while the elevators are still contracting.	Mandible has to move up more than usual to make contact with upper teeth.
Biting power is not drastically affected.	Biting power is not good. Patient cannot chew efficiently
Appearance—Long face, strained face	Appearance—Short face, Aged, sunken face
Distance between nose and chin is more than normal	Distance between nose and chin is less – thus closeness of nose and chin
Pain and ulcer under lower denture	Exaggerated folds around the mouth
Dentures not comfortable because of mouth full feeling	Angular cheilitis at the corners of mouth. Dentures comfortable.

Fig. 14.2: Results of wrong vertical dimension
1. High stool which is less stable, 2. Low stool which is more stable

Prothero said: "Build the dentures so that they don't come together except when the patient chews or swallows". Dentures should not hold the jaws too far apart. In other words don't over open the bite. Instead "restore the bite upto but never over" is a sound dictum. However bite can be lowered in cases of "5 Ds"

a. Deep bite.
b. Difficult inter ridge relation.
c. Difficult patient.
d. Doubtful prognosis.
e. Delicate, tender lower ridge.

Now let us go back to our house and compare it to mandible. Just as one house can be related to another house in different ways, the mandible too can be placed at different positions in relation to maxilla. Mandible can move upward, downward, forward, backward, to the right side and to the left side. All these movements start from one point, and at the end of all those movements, mandible returns to its original starting point. Whenever a mandible moves to another position it stays there momentarily for a certain purpose and then when that purpose is over, it returns to its original starting position where it can remain indefinitely. That starting point is the **centre or centric** – which can be defined as " a point towards which all things move "or "middle point of anything". These mandibular movements starting from one point and coming back to that point at the end of all movements can be explained by another simple example:

Imagine a tourist who has taken a room in a hotel. One morning he sets out to see the whole city. He goes to the North of the city, South of the city, East of the city, West of the city. He climbs the hill and goes down the valley during the course of sight seeing. At the end of the day, he is very much tired. He would like to rest and sleep. So then, he returns to his hotel room and relaxes. IN other words, our tourist after moving about everywhere in the city, he had to come back to the starting place – i.e. hotel, which is the center of his activities (Fig. 14.3).

Mandible too, at the end of all movements to ec-centric positions, it will definatly return to its centric position – which is called as position of Centric Relation. This position of centric relation of mandible exists irrespective of presence of teeth or not.

Centric Relation and Centric Occlusion coexists in a (i) child when the teeth are in contact in normal condition. (ii) Fully developed arches of un-worn, regular teeth and normal temperomandibular joint.

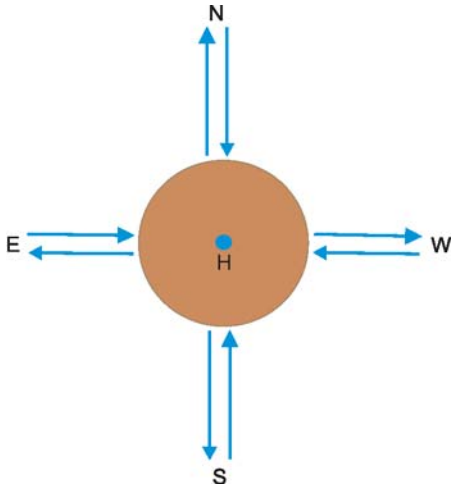


Fig. 14.3: Excursions of tourist compared to excursions of mandible H. Hotel room (centric), N. North (protrusion), S. South (retrusion), E. East (Left lateral), W. West (right lateral)

But, due to wear and tear changes take place and the two positions differ. Thus the concept of mandibular movement is centripetal and not centrifugal. That is towards and not away from centre.

In other words, whenever the mandible moves to one side or other, or moves forward, then ultimately it must and certainly will go into only one position which is known as centric occlusion if teeth are present, or to position of centric relation if teeth are not present. In no other position mandible can stay any longer than necessary.

Thus Centric occlusion or centric relation is the only possible foundation upon which artificial dentures can be built.

DEFINITIONS

Centric Relation

1. The mandible is in centric relation when both condyle heads rest in the sockets of the fossae irrespective of the jaw separation. (Hanau)
2. The most retruded rest position from which lateral movements can be made. (Sears)
3. It is the most posterior relation of the mandible to the maxilla at the established vertical relation. (Boucher)
4. The most retruded relation of the mandible to the maxilla when the condyles are in the most

posterior unstrained position in the glenoid fossae from which lateral movements can be made, at any degree of jaw separation. All other maxillo-mandibular relataions are to be considered as Ec- centric Relations.

Occlude – Means to close-up
Means to fit-together

Occlusion – Is a relationship between. Maxillary and mandibular teeth in contact. It is a static condition.

Centric Occlusion

Maximum contact of the occluding surfaces of the maxillary and mandibular teeth when the condyles are in their most retruded unstrained positions within the glenoid fossae. Cusped teeth can only inter-penetrate at spaced intervals like the cogs of a wheel. So then. Three things must be fulfilled for centric occlusion. They are

i. Maximum occlusal contact.
ii. Deepest cuspal interpenetration.
iii. Posterior functional position of condyles.

On the basis of other mandibular movements:

Lateral occlusion: Contact of the maxillary and mandibular teeth when the mandible is to the right or left of centric occlusion.

If to the right-Right lateral occlusion

If to the left-Left lateral occlusion.

Protrusive occlusion: Contact of the maxillary and mandibular teeth when the mandibular teeth are anterior to the centric occlusion.

Retrusive occlusion: Contact of the maxillary and mandibular teeth when the mandibular teeth are posterior to centric occlusion.

Occlusion plane: An imaginary clinical registration obtained by the use of occlusal blocks so that teeth can be set-up to a given plane.

Articulation: Is the change from one occlusion to another while the teeth are in contact. This is dynamic condition.

Crux of Jaw Relation

A. Mandible has to occupy a position vertically with respect to maxilla, where it is comfortable and restores the normal appearance to the edentulous patient.
This is establishing vertical dimensions, i.e. Adjusting mandible up or Down.

B. Mandible has to occupy a position antero-posteriorly (Horizontally) with respect to maxilla, where it is comfortable and restores the normal centric occlusion (when teeth are set) to the edentulous patient. This is establishing centric occlusion relation, i.e. Adjusting mandible forward or backward. Both these adjustments are difficult to achieve because mandible in an edentulous mouth behaves like a vagabond, with no control over its movements.

Guiding the Mandible

When teeth are present, movements of the mandible are guided by two things – One posteriorly situated and another anteriorly situated – viz – (i) *Condylar guidance* at the back. (ii) Incisal *guidance* at the front.

During opening of the jaw, lateral pterygoid muscle contracts and condyles of the mandible situated in their respective glenoid fossae at tempero-mandubular joint move along the slope of the eminentia articularis downward and forward because of the shape of eminentia articularis. (No choice).

This is similar to a car going along the curve of the road. Thus the movement of the mandible is guided by this posteriorly situated condylar guidance. At the same time cusps of back teeth and incisal edges of front teeth of mandible slide down the cuspal inclines of the maxillary teeth—this is anteriorly situated incisal guidance.

During closing movements, reverse route is followed along the same slope of eminentia articularis until the condyles go back to their glenoid fossae.

During other functional movements of the mandible the same mechanism is involved but with slight variation depending upon the type of movements—that is protrusive or lateral.

In any case, the mandible has to go back to its original starting point, which is dictated by interdigitation of cusps of posterior teeth.

But in an edentulous condition (No teeth at all) mandible has no urge to go back to its orginal starting point, because there are no teeth to be inter-digitated. Therefore mandible (i.e. condylar heads) occupies a somewhat anterior (forward) position in relation to maxilla. Over a period of time this becomes a habit to the patient. As a result, whenever he is asked to open a mouth, he protrudes the mandible, and when asked to close, mandible does'nt go back fully. This

has to be corrected if dentures have to be successful. However, rest position (relaxed) of the mandible remains unchanged, because it is dependant on the muscles, not teeth.

Therefore aim, during establishing jaw relation is to find out the position, which the mandible occupied with respect to maxilla when the natural teeth were present and transfer this knowledge to the occlusal rims, and then to the articulator. Plane line articulator provides only hinge movement, (i.e. opening and closing) and so teeth can be set up only to centric occlusion Anatomical articulators provide all the functional movements (Protrusive and Lateral) and so condylar guidance, incisor guidance can be recorded on the patient and transferred to articulator. Balanced occlusion can be achieved on the anatomical articulator, which is necessary for the stability of dentures Examples of balance (a) Wide apart legs of a stool (b) person cannot stand on one leg. This is where comes the use of facial bow, Gothic arch tracing etc. during establishing jaw relations.

With natural dentition, unbalanced occlusion doesn't matter much, because the teeth affected are only those making premature contact. But, unbalanced occlusion affects artificial dentures, because it affects all teeth since all are attached to the same one base, resulting in unseating of dentures.

In artificial complete dentures, balanced occlusion is essential for some patients, although not so necessary for others. While deciding whether a patients dentures should be balanced or not, find out what was patients mandibular movements while he had his own teeth.

If he was a grinder—Balance his dentures.

If he was a chopper—Don't balance.

Procedure of Establishing Jaw Relations

Stages

1. Testing each occlusal rims separately for—Fit, Stability, Fullness, Height, peripheral extension.
2. Determining the plane of occlusion
   i. Horizontal—Anteriorly (side to side)
   ii. Antero-posteriorly
3. Estimating Vertical Dimension, i.e. Vertical position of mandible.
4. Registering Centric Occlusion Relation, i.e. Horizontal, antero-posterior position of mandible
5. Recording other sundries like

   Centre line
   High lip line
   Corner line

   And sealing the occlusal rims together. At this stage, artificial teeth are selected to be used on the patient's dentures.

Details

Prerequisites: The whole atmosphere in the clinic must be of relaxed nature.

i. Patient is relaxed.
ii. Dentist is calm and confident.
iii. Systematic approach to work.

Maxillary occlusal rim is placed on the maxillary ridge and tested for fit, i.e. retention. It should remain firm on the ridge, and some resistance is felt while removing it. While in place it should not rock if pressed on one or other side.

Trimming the Maxillary Occlusal Rim

Labial fullness is assessed from the front and from the side. Upper lip should lie relaxed over the labial aspect of the occlusal rim. If lip is felt too full and outward, labial wax is removed. If lip is felt depressed and inward, wax is added to the labial aspect of the rim. At the end, lip must be relaxed and normal. With such a relaxed, and normal upper lip, the height of occlusal rim in the front is adjusted. 2-3 mm of occlusal rim should be visible below the lip line. To achieve this, wax is either added or removed to the anterior occlusal plane, from one corner of the mouth to another corner.

The anterior horizontal occlusal plane from one corner of the mouth to another corner is now made parallel to *inter-pupillary* line.

The buccal aspects of upper occlusal rim on both sides are assessed for fullness of cheeks. If necessary wax is either added or removed to get the normality. Make sure proper relief has been provided for the free movements of labial and buccal frenii. Horizontal occlusal plane antero posterioly from one corner of mouth to posterior end of the occlusal rim is made parallel to Naso-Auricular line (Fig. 14.4).

Naso-Auricular line is the line drawn from external auditory meatus to the lower border of the ala of nose. This is done on both sides of the occlusal rim. To achieve this, wax is either added or removed from the occlusal surface of occlusal rim, from corner of the mouth region to the posterior end of occlusal

Fig. 14.4: Determining occlusal plane

rim. At the end of all this, occlusal plane looks sloping upward from front to back. Peripheral border of upper base is checked for proper extension in the labial and buccal sulcus on both sides. Posterior palatal border of the maxillary base should be adjusted to lie on the compressible tissue just anterior to the vibrating line at the junction of hard and soft palate. Two small pits called foveae palatinae also lie on this vibrating line. By asking the patient to say "Ahh", this vibrating line can be seen and marked. Compressible tissue anterior to this vibrating line can be felt by pressing a round-ended instrument at the junction of hard and soft palate. Correct extension of this posterior border of the upper base is important for the retention of maxillary denture by way of seal all around.

Trimming the Mandibular Occlusal Rim

This is also tested just like the upper rim for

Labial fullness
Buccal fullness
Retention and Stability
Peripheral extension along outer and inner border.

And relief for freni.

Necessary adjustments are made if felt. Special attention should be given to retromolar pad and lingual pouch areas. Tongue movements should not be restricted. Remove both the occlusal blocks from the mouth. Ask the patient to wash his/her mouth.

Ask the patient to relax and be in normal state of mind.

Make one indelible pencil mark on the tip of the nose and another on the least movable part of the chin. Alternatively, small piece of adhesive tape can be stuck at the tip of nose and on the chin, and make a mark on this tape (Figs 14.5 and 14.6).

Measure the distance between these two pencil markings and note down the reading. Ask the patient to say "Em" and at the end of this lips are in a normal relaxed closed position—and now measure the distance between the said points again and note down. Ask the patient to moisten his lips and say "Em" again—when relaxed measure the distance again and note down. Now ask the patient to swallow his saliva, and at the end of it, let his lips be in relaxed closed condition.

Once again measure the distance between the said points and note down. Now study these different readings. If there are at least 3 constant readings, note down that reading for further reference. This constant reading refers to the rest position of the mandible. Now, insert the lower occlusal block in the mouth.

Adjust its height by adding or by removing the wax at the occlusal plane in such a way, with both upper and lower rims making even contact anteroposteriorly, the distance is measured now between the two pencil marks. This reading and the previous constant reading should be same. When this is achieved, remove further 2 to 3 mm of wax at the occlusal plane of lower occlusal rim to produce a free way space. Now, estimating vertical dimension is over. However, appearance of the face is the proper guide to assess vertical dimension. Experienced practitioners depend on this more than the measurement, and it is satisfactory for all practical purpose. However, other methods are available to help

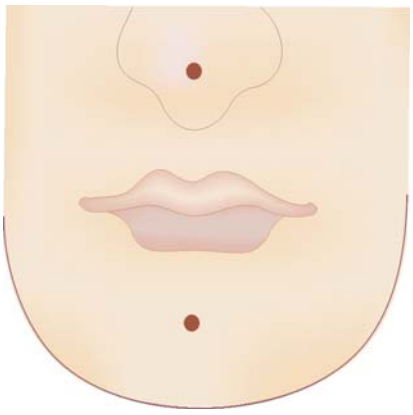


Fig. 14.5: Aid to obtain correct vertical dimension
A. Mark on tip of nose, B. Mark on chin

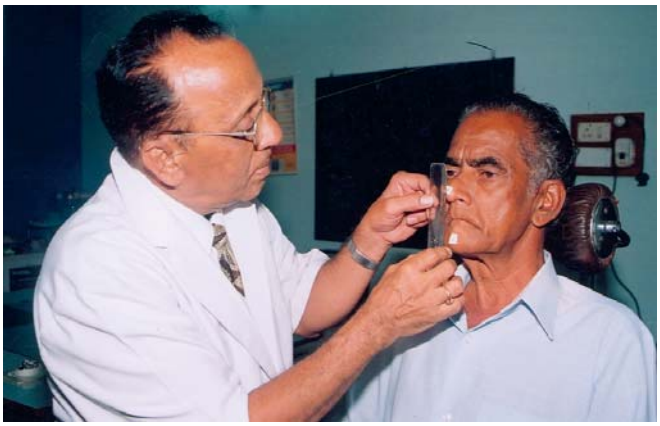


Fig. 14.6: Determining vertical dimension

arriving at correct vertical dimension – (1) Willis measurement-According to this: (Figs 14.7 to 14.10).

Distance form the lower border of the septum of the nose to the lower border of the chin is equal to distance from the upper canthus of the eye to the corner of the relaxed lips. This is the rest position of the mandible with teeth out of occlusion. (2) Use of pre-extraction records. This is possible if the same dentist has done the extractions and made certain recordings like profile tracing, articulated models, use of Willis's gauge etc.

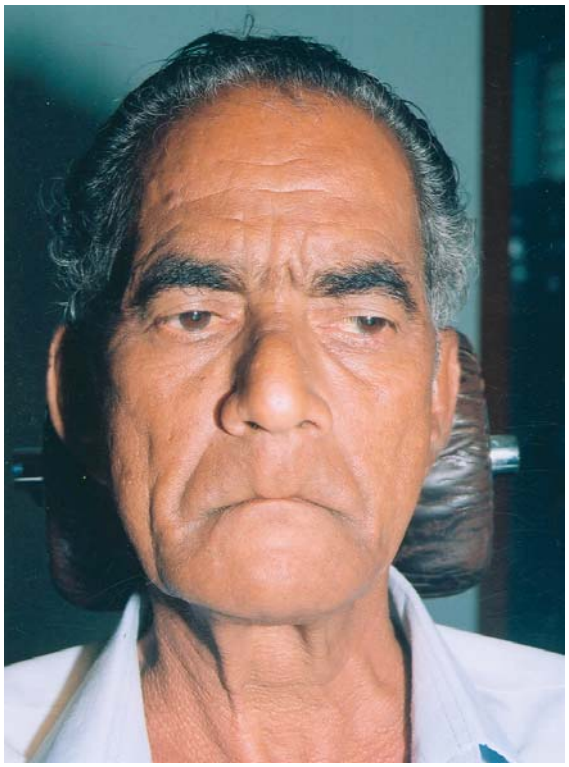


Fig. 14.7: Edentulous patient without dentures (front view)

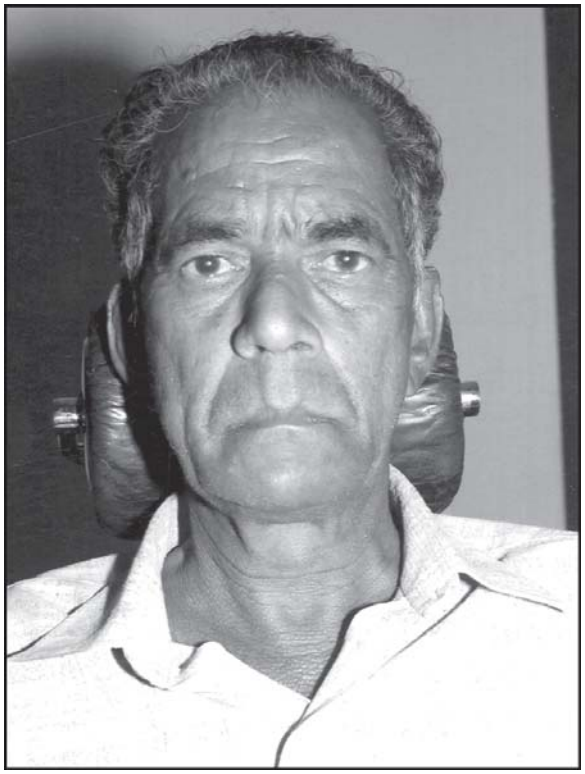


Fig. 14.8: Patient with complete dentures in the mouth (front view)

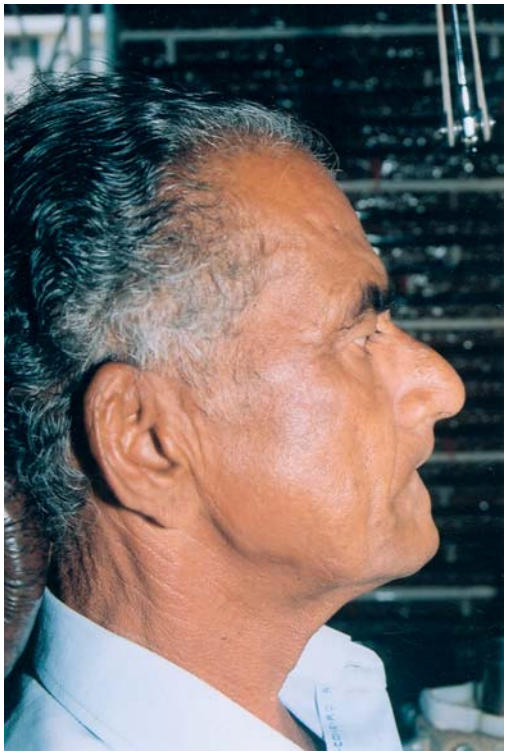


Fig. 14.9: Edentulous patient without dentures (side view)

Fig. 14.10: Patient with complete dentures in the mouth (side view)

Both occlused rims in the mouth, centre line of face, high lip line and corner lines are marked.

Registering the Position of Centric Relation

Once again patient is made to relax fully. He should divert his attention from what the dentist is doing. Start a general conversation with him/her for a while. Whole idea is to make the patient's lower jaw relaxed. Dentist should tell the patients to "Close" his/her mouth, not "Bite". Biting usually refers that mandible has to be protruded to bite on incisor teeth. Not only that, all edentulous patients gets the habit of putting the mandible forward without their knowledge.

What is required now is posterior (backward) position of mandible, not forward. To achieve this, patient is told to do the following:

a. Putting his tip of tongue to the back of palate few times.
b. Swallowing his own saliva.
c. Relax his lower jaw.

Now replace both the occlusal rims in the mouth. Ask the patient to relax. Ask him to swallow his saliva and close the rims together firmly. Separate the lips at the corner of mouth and mark a line with wax knife from upper rim to lower rim on both sides of the jaw—Strictly informing the patient not to open the mouth and not to move the lower jaw while doing this.

Patient is now asked to relax the lower jaw and wash the mouth. Repeat the above method once again and find out whether the patient closes to the previous markings on wax rims. If he does it is good. If not, reading is wrong. Try again. Now, ask the patient to put his tip of the tongue to the back of palate – as far back as possible and while the tongue in that position, close the occlusal rims.

Again check, the line markings on the occlusal rims. If both upper and lower rim markings are in line, the reading is correct and this is a final confirmation of that.

Finally, patient is once more asked to repeat the tongue movement as before and hold the jaws together firmly. Separate the lips at the corner of mouth and seal both the occlusal rims with hot wax knife at the occlusal level very carefully and quickly without causing any burn to the patient's lips. This sealing is done on both sides. All the while patient is holding the occlusal rims together firmly. Now patient is asked to open the mouth and push the occlusal rims out together in one unit.

Additional procedure (Not routinely Used) to register centric relation.

Gothic Arch Tracing

Principle

The word Gothic arch is related to old German style of architecture in churches with high pointed arches. Mandible from its retruded position moves forward (protrusion), and then to left and then to the right of the jaw and finally returns to its starting position of retrusion. If these movements of the mandible are traced by a pencil or by a pin attached to on the occlusal blocks, on a plate or paper, it will show a point, from which movement started and ended. Since this tracing resembles the German style of church architecture of highly pointed end, this method is called Gothic arch tracing (Fig. 14.11).

Starting form a retruded position, when the mandible moves to the right, the left condyle is drawn forwards down the eminentia articularis whilst the right condyle acts as a pivot, and vice-versa for the left lateral movement. If a tracing is done from a given point in the midline of the mouth, two lines will be formed which converge to a sharply pointed apex. Then during the forward movement

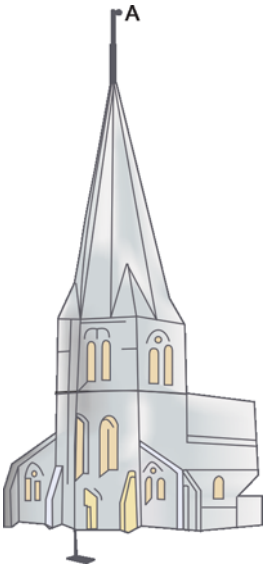


Fig. 14.11: Gothic arch
A. Pointed end of church building is based on gothic architecture of medieval Europe

of the mandible (protrusion) the tracing would also start and finish at this point, since it indicates the retruded position. Thus, this pointed point of tracing like an arrowhead is considered as retruded position of mandible. This method of tracing can be done inside the mouth (Intraoral tracing) or outside the mouth (extraoral tracing).

Tracing Device Attachment

Occlusal Rim	*Intraoral tracing*	*Extra oral tracing*
Upper	Tracing plate	Tracing Stylus
Lower	Tracing stylus	Tracing plate

CONCLUSION

Registering rest position, centric Relation, Centric occlusion position of mandible and free way space is absolutely necessary for the success of complete dentures. Wrong resistration, will end up with wrong occlusion, with no interdigitation of cusps in the finished dentures. Therefore it is essential for the dentist to realize the implications of this one step in denture making. One can visualize the meaning of these registrations on oneself as follows:

Imagine you are sitting comfortably with your mandible relaxed, both the lips in contact and relaxed. Throw your mind to your own teeth. Are they in contact? No, Maxillary and mandibular teeth are not in contact. Mandible is in physiological rest position. Now you clench your teeth. For this mandible moves up a little and mandibular teeth make contact with maxillary teeth, all this happening inside your closed mouth.

That contact of teeth with full interdigitation of cusps is the position of centric occlusion. The space through which mandible moved up to make contact with upper teeth, is freeway space. Now you stop clenching your teeth. Reverse process occurs. Mandible drops down to its rest position by passing over freeway space, once again all this is happening inside your closed mouth. That position of mandible, at which there is full interdigitation of cusps of posterior teeth is position of centric relation. With occlusal rims in the mouth, teeth of coarse are not there, but mandible can still be in position of centric relation if patient takes his mandible backward,(putting his tip of tongue to back of palate) and that is what is to be registered at the time of establishing jaw relations.

So then, what is important for this to be achieved – First and foremost the mandible must be fully relaxed and be in its physiologic rest position. Edentulous patient has already acquired a habit of putting his mandible forward. This he must stop doing. He should be told not to open the mouth too wide. His cheeks (lower jaw) tapped gently putts his mandible at rest position. Thus in establishing horizontal relation of mandible to maxilla (centric relation) patient plays a major role. His co-operation and effort are essential to take the mandible as far back as possible with respect to maxilla. On the other hand, in establishing vertical dimension (vertical relation) the dentist plays a major role, in assessing the normal appearance of face, providing freeway space, etc (Figs 14.12 to 14.15).

Records for Fully Adjustable Articulator

Recording the Condylar Angle

The slope of the condylar path is the path taken by the head of the condyle when moving up and down the eminentia articularais and is considered to be a straight line. The angle between this straight line and occlusal plane is condylar angle. The condylar path and condylar angle are constant and peculiar to each patient. These fixed factors are measured (recorded) and transferred to the fully adjustable articulator.

Fig. 14.12: Patient without complete denture in the mouth (front view)

Fig. 14.13: Patient with complete denture in the mouth (front view)

Fig. 14.14: Patient without complete dentures in the mouth (side view)

Fig. 14.15: Patient with complete denture in the mouth (side view)

Procedure

Apply Vaseline to the occlusal surfaces of both occlusal rims.

Place maxillary occlusal rim in the mouth. Soften a roll of wax and place it on the occlusal surface of lower occlusal rim. Now place the lower rim in the mouth. Ask the patient to protrude his lower jaw and close the mouth on the occlusal rims. Softened roll of wax will unite both the rims together.

Remove both the occlusal rims together and cool under tap water. Separate both the occlusal rims and take out the roll of wax placed in between them.

This roll of wax is the record, which has recorded the forward positions of both condyles at the same time.

If one wishes, right and left lateral positions can be recorded by separate roll of waxes.

Then, these roll of wax (Record) is used while mounting the occlusal rims on the articulator.

Recording the Relation of Maxilla to the Condylar Heads (i.e. Glenoid Fossae)

Device used - *Face bow*

Procedure

Frankfurt plane: It is a plane (line) between the lower border of eye socket and upper border of ear hole.

Marking the position of Glenoid fossa on the face:

1cm in front of the tragus of the ear on the Frankfurt line.

Calibrated condylar rods of the face bow are adjusted by placing them on the markings of glenoid fossae on the face, so that equal readings are obtained on both sides and note down the readings. Soften a roll of wax and attach it to the bite fork of the face bow.

Place both occlusal rims in the mouth. Place the bite fork in the mouth and ask the patient to close on the bite fork with attached soft wax. Make sure the bite fork's projecting rod is to one side of the midline of the face.

Then, place the face bow in position on the bite fork.

Adjust the calibrated condylar rods to the equal readings on both sides, noted down earlier and tighten the screws of these rods.

Tighten the screw of the bite fork's projecting rod.

Orbital indicator pin is positioned to the lower border of eye socket.

Tighten all the finger screws.

Remove the entire assembly out of the mouth.

Remove the face bow along with attached bite fork, containing wax record. This record is used while mounting on the articulator.

15 Selection of Artificial Teeth and Try-in

One of the main functions of teeth (Natural as well as Artificial) is appearance of face. To achieve this objective with artificial dentures, dentist must possess an esthetic sense in addition to scientific knowledge.

Anterior Teeth

Appearance of face is dependant on these anterior teeth to a large extent. The following Criteria should be taken into consideration with respect to anterior teeth.

A. Shape of Tooth – (Mould)
B. Size of Tooth
   a. Length
   b. Width.
C. Color of Tooth – (Shade)
D. Position of tooth in the arch
E. Age of the patient.

Mould (Shape)

Shape of Maxillary Central Incisor tooth is a representative of shape of tooth. Shape of this tooth represents the shape of underlying edentulous alveolar ridge, which in turn represents the shape of face.

Leon Williams's classification of face.

1. Square
2. Tapering
3. Ovoid (round) (Fig. 15.1)

Manufacturer produces anterior teeth on the basis of this classification, especially shape of central and lateral incisors. Accordingly tooth forms (mould) are:

A. Square
B. Tapering
C. Ovoid (round)

Generally-**Dentogenic concept**.

Square mould for the square face.

Tapering mould for the tapering face.

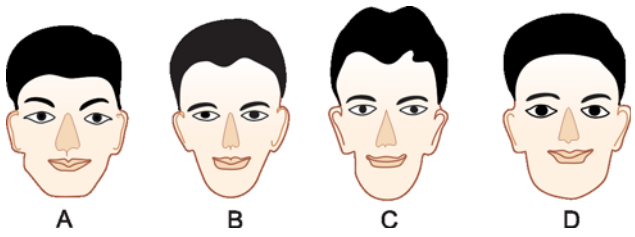


Fig. 15.1: Shape of face
A. Square, B. Tapering square, C. Tapering, D. Round (Ovoid)

Ovoid mould for a ovoid face—Is the criteria for the selection of mould. Other criteria like Age and Sex of the patient are also to be taken into account.

Male patients usually come under square or tapering form.

Female patients are of ovoid form. Square and tapering mould has straight sides with right-angled mesial corner and somewhat round distal corners. Ovoid form of central incisor has curved outline with rounded mesial and distal corners.

Males are generally vigorous and rugged and accordingly these front teeth should be bold with less convexity of labial surface and with ridges, grooves on it.

Females are generally delicate and so their 1st incisor tooth should have soft and smooth outline form with round corners.

Incisal edges of central incisors for older patients should be straight to give the effect of wear and tear.

Lateral incisor tooth usually resembles the central incisor in shape but to a smaller degree.

Normally, the maxillary anterior teeth are visible during normal talking but there again, Central incisors are more visible than others.

Size of anterior teeth should be with respect to length and width. Generally large face has large sized teeth. However length and mobility of upper lip should be noted while deciding the length of central incisors.

Incisors are usually set 2 mm below the relaxed lip line. If the length of upper lip is more, it is not possible to do this. Other factors that influence the length of anterior teeth are

a. Amount of resorption of alveolar ridges
b. Available inter ridge distance.

Male's teeth are larger than females. Upper line marked on the occlusal rim helps in selection of size of centrals. Upper lip line is the limit to which upper lip will retract during normal smiling and laughing. If the anterior tooth size is limited to this, denture base will not be visible during smiling and laughing. During tooth selection stage, one of the central incisor tooth is kept under the lip and assessed about its suitability with respect to length. One should never select too small teeth, which look artificial.

Width of central incisors alone is not to be considered, but the whole widths of the six anterior teeth occupy to the corner of the mouth at the canine eminence. Another landmark that can be used here is that, a line from the inner canthus of the eye and along the nasolabial fold will pass through the centre of canine tooth. Too narrow teeth will create gaps in between teeth. In general, there should be smooth blending of face size and tooth size. Small teeth with large face, and large teeth with small face will be unnatural. If suitable sized teeth are not found in one strip of artificial teeth, teeth can be exchanged from another strip to suit a particular patients dental arch (Fig. 15.2).

Color (shade): This factor in tooth selection is very important especially with lady patients. It is because they are more beauty conscious, they cannot decide by themselves; they go by others opinion, they change their mind, and they are difficult to satisfy. They always prefer white teeth, thinking that all natural teeth are white. Natural teeth are never pure white. They are either light yellow or deep yellow. Color of tooth should be in harmony with color of skin, eye and hair. All these should have smooth blending, not one thing conspicuous than other. Fair skinned people will have yellowish colored teeth, and dark skinned patient should have whiter teeth.

Aged patient should have darker shade teeth, and also male patients as compared to female patients.

Tooth of the shade guide is first moistened and held under the lip to decide the appropriate shade. Patients should be asked what color they would prefer. But, dentist can not always go by patients opinion, instead he should convince the patient what he thinks is the suitable shade after taking all the relevant factors into consideration.

While deciding the shade of the tooth, it is advisable to take the opinion of patient's friend or relation at the chair side (Fig. 15.3).

Posterior Teeth

Types

A. Cusped teeth – suitable for movement articulators
B. Shallow cusped teeth
C. Cuspless or flat or Inverted cusped teeth.

Flat teeth are not really flat and smooth; instead their surfaces are serrated by grooves or channels. Shallow cusped and cuspless teeth are used for setting on plane line hing articulator, where balanced articulation is not intended.

Cusped teeth with varing cusp angles and height are used to achieve balanced articulation on fully adjustable articulator. Balanced articulation is therefore easily obtained with cusped teeth. Such a condition is more efficient functionally.

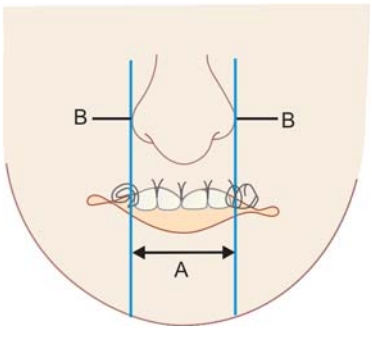


Fig. 15.2: Size of teeth
A. Width of four maxillary incisors and canines,
B. Outer corners of nose

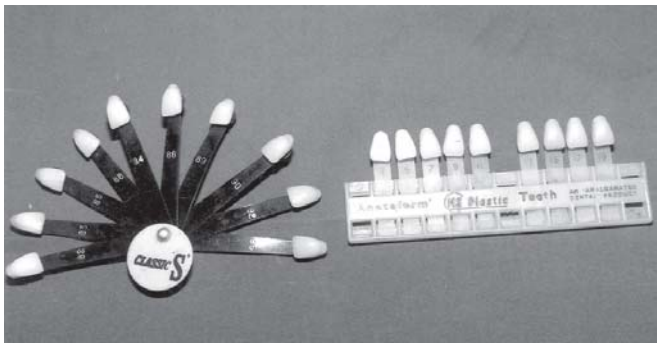


Fig. 15.3: Shade guides for artificial acrylic teeth

Size of Posterior Teeth

Height of the posterior teeth should be such that they will be accommodated in existing denture space without grinding. Acrylic teeth can be grinded to adjust for this.

Length of all posterior teeth together (Premolars and Molars) should fill the full length of alveolar ridge from canine backward. However teeth should not encroach the maxillary tuberosity and mandibular retro-molar pad. Generally two premolars and two molars occupy this space lengthwise.

Width of posterior teeth (i.e. bucco-lingual) especially mandibulars should be narrow so that tongue movements are not restricted.

Color (Shade) of posterior teeth is generally darker than anterior teeth.

Acrylic Teeth

Advantages	*Disadvantages*
Good appearance Chemical union to base No clicking sound Can be adjusted to limited denture space Light in weight	Wear and tear occurs - resulting in loss of vertical dimension and flat teeth.
Suitable for deep bite cases (Figs 15.4 and 15.5)	

Try-in

Try-in is the stage in the denture construction in which after setting up of teeth on a temporary base, the waxed up set is placed in the mouth and checked. This stage is important because, any alterations if necessary can be made now and patient's consent is sought before the denture is converted to a hard acrylic resin. One must impress upon the patient that once the denture is in acrylic resin it is highly impossible to do any alterations. This precautionary measure prevents any possible disputes between patient and dentist.

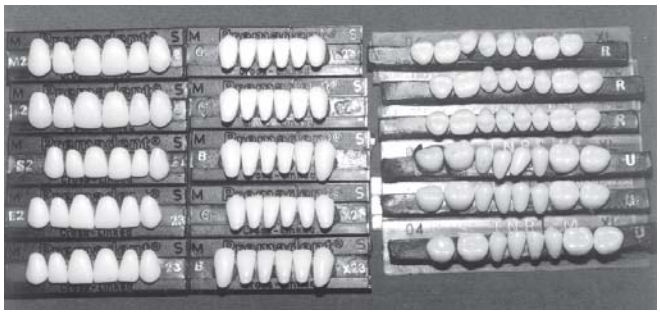


Fig. 15.4: Acrylic artificial teeth. Anterior and posterior

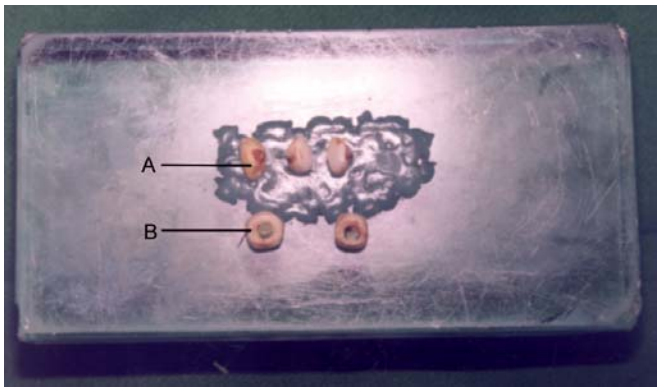


Fig. 15.5: Porcelain teeth
A. Anteriors with pin, B. Posteriors with undercut

Procedure

A. Place maxillary denture in the mouth, check its peripheral seal in the labial and buccal sulcus. Check the extension of the border for over or under extension and correct it if necessary. Check the posterior border for its seal against the palate and its extension. Correct it if necessary. Check the relief provided to labial and buccal freni. Check for retention and stability. If there is good fit, suction is felt and there will be some resistance during removal.

If pressed on one side of the denture, the other side should not rock and vice versa. This is an indication for good stability.

B. Take out the maxillary set place the mandibular set in the mouth. Once again check for,
   a. Peripheral extension and seal especially in lingual pouch area and retromoler pad
   Relief for labial and buccal freni. Correct if necessary.
   Check for rocking by pressing on one side at a time.
   Check retention and resistance felt during removal.
   Check the height of the occlusal plane. This is very important because it should not be too high up. Relaxed tongue should help to retain the denture in place, but should not dislodge it.

Tongue space—Tongue should not be cramped with denture in place. Tongue must have a free movement while talking and eating without causing any displacement of denture. Over

hanging molar teeth should be corrected. Premolars and molars should be directly over the alveolar ridge as far as possible. All the checking's on the mandibular set in place are done in a mouth which is not wide opened.

C. Replace the maxillary set back in the mouth.
With both the sets in the mouth, check for –
i. Vertical dimension.
ii. Free-way space.
iii. Centric relation position and centric occlusion.

Patient is asked to close on the back teeth after swallowing and check the occlusion.

Ask the patient to relax the mandible or say "leave the teeth apart". Check the free way space by separating the lip at the corner of the mouth. Ask the patient to put the tip of the tongue to the back of the palate and check the full inter-digitation of cusps of posterior teeth. If this is obvious every time a patient closes on back teeth it is a confirmation of centric relation and centric occlusion.

For correct vertical dimension, patient is asked to relax, moisten his lips and say "EM". Look at the patients face length from the front and from the side. Face should not look stretched, or sunken. This test is repeated once or twice. Dentist should be quite satisfied about the height of the face by applying his esthetic sense.

These two observations, like correct appearance and full interdigitation of cusps of posterior teeth when teeth are shut are the fundamentals for success of complete dentures. At this stage of try-in, corrections can be undertaken if necessary.

Check the overbite and over jet. Posterior teeth must meet evenly from 1st premolar to 2nd molar along the occlusal plane anteroposteriorly.

Check the teeth arrangement and position. Ask the patient to smile and see how much of teeth are visible, especially mandibular teeth. Lower teeth should be just visible while smiling.

Check the shape and size of anterior teeth and their suitability to the shape and size of face. Check the color of teeth. Regularity or irregularity of tooth arrangement can be corrected to enhance appearance. This is seen from the front and from the side.

Check the anterior occlusal plane from one corner of the mouth to another corner. It should be horizontal, not slanting to one side or other.

Check whether the centres of the face and central line (or midline of denture) of denture coincide or not. Maxillary labial frenum is taken to be in the middle of the face and other factors should follow it.

D. Check the wax-up and polished surfaces for -
Fullness of lips and cheeks.
Shape of polished surface – Convex or Concave
Check the anterior ach form and contour of labial surface. This should harmonize with face form.
Check the level of gingival margin of individual anterior teeth.
Check the carving around necks of teeth.
Labial flange should have root prominences, - more so with canines.
Stippling if done (i.e. minute pits) is also checked.

E. Check the balancing of articulation if this has been done on fully adjustable articulator.

F. Check the speech.
Patient is allowed to talk freely by engaging in conversation with matters of his/her family, friends, occupation, etc.
This will indicate about;
i. Vertical dimension – if dentures are made to correct vertical dimension they will not be loose while talking.
ii. Denture thickness and peripheral outline. Bulky dentures hinder smooth talking.
iii. Movement of tongue – with cramped tongue speech is not clear.
iv. Positioning of anterior teeth.
v. Level of occlusal plane.

Finally, Handover the face mirror to the patient and take his/ her opinion and consent about the appearance, color of teeth, etc. It is advisable that another person to be present while taking patient's consent as a witness, to avoid unnecessary disputes later.
Patient is requested to sign on consent form.

16 Fitting the Dentures and Teething Troubles

Preliminaries

A. Check the fitting surfaces. If there are any sharp spicules – remove them.

B. Check the entire periphery of both dentures. Extension and reliefs checked. It shall be smooth and round at the labial and buccal border of maxillary denture. Posterior border of maxillary denture is made smooth but not round. It is finished flat and thin.
Lingual; Labial and buccal flanges borders of lower denture also should be smooth and round. Only the posterior lingual border at the lingual pouch area should be thin but smooth.

C. Check all the polished surfaces of both dentures for smooth finish and polish.
Place both the sets in the mouth, check for (Fig. 16.1)
a. Retention, and Stability.
This is usually better in finished dentures than in try-in stage.
b. Appearance – i.e. Vertical dimension
c. Centric Relation and Centric Occlusion.
Ask the patient to close on the back teeth. Or putting his tip of tongue on back of palate – check the interdigitation of cusps (Fig. 16.2).

D. Check the freeway space while the mandible is at rest.
Ask the patient to swallow his saliva and close on back teeth.
Ask the patient to sip little water and close on back teeth.
Ask him to say "EM" and relax his mandible.
Ask him to moisten his/her lips and relax.

All these activities are done to familiarize the patient with dentures in the mouth. Patient is allowed to talk and chew on his teeth. If any of the dentures are hurting the mucous membrane find out what it is and correct it. Finally, demonstrate how to remove the dentures out of the mouth and replace back into the mouth (Fig. 16.3).

Identification of maxillary and mandibular dentures taught to the patient.

Identification of fitting surfaces of dentures. Let the patient remove and replace the dentures into the mouth all by himself/herself. Handover the face mirror to the patient to look at his face and teeth.

Fig. 16.1: Complete dentures (front view)

Fig. 16.2: Complete dentures (side view)

Fig. 16.3: Patient with complete dentures

Instructions to the Patient

1. For one reason or the other, you have lost all your natural teeth and facing a situation where there is no alternative but to use artificial dentures. To get used to this new situation you have to learn few things just like a child.
2. You cannot expect to get used to your new dentures overnight, it will take some time, and that depends on your perseverance, patience and determination.
3. Teething troubles.

   As with any new things, initial troubles will be there just like a new shoe, which hurts initially. But things will be all right gradually.

   Consult your dentist about these initial troubles and he will attend to them. Meanwhile you take out the hurting denture and do gargling twice or thrice a day with hot water mixed with pinch of table salt. Dentist will trim the rubbing part of the denture later.
4. With both the dentures in the mouth, you feel mouthful and that you need not worry how to talk and eat. Soon you will get accustomed to the new dentures and they become part of your mouth.
5. Control of dentures

   Natural teeth roots are embedded in the bone and so they are firm and immobile. Dentures on the other hand just sit on the gums what is left after loss of teeth. Better the gums, better the dentures stay in the mouth. Dentures move about in the mouth due to various reasons, and that you have to control. You should restrict your tongue's unnecessary movements. Anything foreign in the mouth, tongue will always play with it and try to get rid of it. On the contrary, you should train your tongue in such a way that it helps to retain the dentures in the mouth.

   If you sense that upper denture is coming down, let your tongue push it up. If the lower denture is moving up, let your tongue push it down to its place.
6. How long?

   This is dependant entirely on an individual – some will get used to the dentures in a very short time, others may take weeks or months. Generally, it is a gradual process of getting used to new dentures.
7. Eating

   Initially it may be difficult to eat but you must not be discouraged with that. Do not open your mouth too wide while eating and that too, insert little of food at a time in the mouth. Take your own time to finish the meal, without hurry. To start with, don't take sticky food, which might dislodge the sets.

   With practice, patience and persistence you will be able to eat normally. Lower denture generally is not as firm as the upper because of its shape and size but that too can be mastered. In the end you will learn to control the dentures by the muscles of the mouth while eating. In between meals, you practice sucking a sweet in the mouth. If you cannot eat stomach full of meal at a time, eat little at a time for few more times. If you feel embarrassed while eating in a company, you eat separately alone for sometime. Dentures are meant for chewing, which is necessary for proper nourishment and good health.
8. Wearing dentures at Night

   A denture should be constantly worn if the maximum degree of stability and efficiency is to be developed.

   However, initially, dentures may be removed and not worn at night but soon they can be worn both day and night. But, occasionally they should be removed to give rest to tissues.

   In any case, it is best left to patients wish and desire.

When not in use, dentures should be kept in cold water.

9. Hygiene of the mouth is of utmost importance to your well-being. Dentures should be cleaned at least twice a day, night and morning and preferably rinsed after each meal. The best and the simplest method is the use of a stiff brush, water and a good denture powder or paste. All adhered food particles, etc. must be removed, but care should be taken not to damage the fitting surface of the denture and the denture material itself.

   Dentures should always be cleaned over a basin containing water, to avoid damage if dropped.

   Never immerse or wash your acrylic dentures in very hot or boiling water. This will warp the dentures and ruin the fit. Use only cold or lukewarm water for cleaning and rinsing.
10. Don't go on asking others opinion about your dentures, regarding the appearance, color etc. If you are satisfied yourself, that should be the end of it.
11. However carefully the dentures have been made and fitted, minor problems are always there, for which you should accept and adapt.

    "If the dentures did not adjust to you, you adjust to the dentures" (Fig. 16.4).

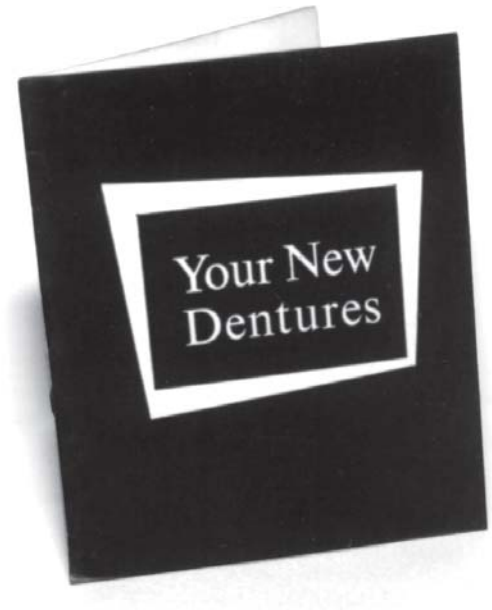


Fig. 16.4: Instructions to new denture wearers

Complaints Met with New Dentures (Teething Problems)

Complaint	*Causes*
Pain	Over extended periphery; undercut at the periphery; Rough periphery Rough fitting surface; Non-relief of hard areas; Sharp alveolar ridges, Uneven pressure on the denture, wrong jaw relations, Cusp-locking, Uneven alveolar ridges, Poorly fitting denture, Delicate patients, Delicate mucous membrane, Retained root in ridge, Allergy to denture base. Pressure on the frenum causing ulcer; cheek and tongue biting. Remedy – Remove the cause and adjust the dentures
Loose denture (Poor retention)	Poorly adapted base of a denture; Over extended or under extended border Lack of peripheral seal; Tight lips Cramped tongue; Poor alveolar ridges; Non-relief of hard areas; Improper contour of buccal and lingual surfaces. Wrong Jaw relations and teeth setup.
Moving denture (Instability)	Poor alveolar ridges; Distortion of denture base due to distortion of impression. Wrong Jaw Relation Large cusp angle Over bite Non-relief of hard areas. Cramped tongue.
Poor appearance	Wrong vertical dimension Wrong contour of labial and buccal flanges, Wrong color, shape, size of teeth, Wrong positioning of anterior teeth, Patient expecting too much, Teeth showing too much
Can't Eat	Over Closed bite Cusp less teeth Due to pain Cuspal interference Upper teeth out of ridge Cramped tongue Loose dentures
Can't talk properly	Loose dentures Cramped tongue Open bite Wrong position of anterior teeth. Patient not making effort to speak.
Teeth make noise	Porcelain teeth Increased Vertical dimension Cuspal Interference Lack of saliva
Nausea and Retching	Sensitive patient Moving, unstable dentures

Contd...

Contd...

Complaint	*Causes*
	Over extended posterior border of maxillary denture
General discomfort	Cramped tongue
	Wrong vertical dimension and occlusal plane.
Cheek and tongue biting	Reduced (over closed) vertical dimension
	Insufficient over jet
	Lack of tongue space
Food going under denture	Poor fit of dentures

Causes of Denture Failure

1. Poor Retention and Stability. Loose, moving sets.
2. Wrong jaw relations.
   - Wrong centric relation.
   - Wrong centric occlusion.
   - Wrong vertical dimension.
3. Cuspal interference.
4. Cramped tongue.
5. Poor alveolar ridges.
6. Un-cooperating patient.
7. Poor esthetics.
8. Technically inferior dentures.
9. Un-skilled dentist.
10. Incomplete flask closure and tooth movement during denture processing.

Abnormal Denture Foundation

Condition	*Remedy*
Flat lower ridge	Proper border adaptation
	Use of cusp less or shallow cusped teeth
	Balance the articulation
	Implant denture
	Heavy denture
Collapsed Lower ridge	Use short incisor teeth
Undercut ridges	Blocking out the undercut areas
	Trim the bone
	Use of hydrocolloid impression material
Shallow maxillary ridge	Proper peripheral adaptation
	Use cusp less teeth
	Balance the occlusion
Deep V-shaped Palate	Cast metal base in palate
	Proper border moulding
Knife edged Lower ridge	Trim the bone
	Use of soft lining to the base
	Implant denture
Large tuberosity	Trim the bone
	Block the undercut
	Flange height reduced

Contd...

Contd...

Condition	*Remedy*
Large torus palatinus	Suitable relief
	Cast metal palate
Sulcus not deep	Proper border moulding of impression
	Balanced articulation
Abnormal frenum	Cut it
Flabby ridge	Remove the flabby tissue
	Balanced occlusion
Protruding upper jaw	Gum fitting of anterior teeth
	Trim the bone
Class III Jaw Relation	Proper border moulding the impression
	Balanced articulation
	Give posterior cross-bite
	Make anteriors edge-to-edge.
Patient not giving correct centric relation record	Do Gothic arch tracing
Patient with large tongue	Thorough border moulding of the impression
	Occlusal plane kept low
	Use buccolingually narrow teeth
	Set the lower anteriors slightly anterior to the ridge.

Story of False Teeth

Tooth ache and tooth loss is as old as one can thing of. Prehistoric man, people of Asian civilization like Babylonians 5000 years before Christ, Ancient Egyptians, Etruscans, Greeks, Romans and right up to the modern man, all suffered with this problem. It was the desire to look better than chewing necessity that inspired false teeth. Greeks and Phoenicians used ligatures for tying artificial teeth to the neighboring natural teeth. Etruscans as early as 700 BC made dental appliances like partial dentures and fixed bridges. Romans probably learnt this skill from Etruscans and did some improvements. If at all, the ancient Romans did any full sets of false teeth, they were probably hinged. Teeth of bone, Ivory, Wood or of dead animals were used for replacing lost teeth. After the fall of Roman Empire, there were no improvements in dental skill for hundreds of years during the so-called Dark Age. In the 15th Century England, barber surgeons and chemists were doing extractions of teeth and they were called "Drawers of Teeth". This was a popular attraction at the market and fairs. In England of that time, use of artificial teeth was extremely rare. It can be substantiated by the fact, Queen Elizabeth the 1st who had lost her teeth, used a thick pad of fine clothes into her mouth to bring out the lips and cheeks whenever she appeared before the public. Similar

lip padding was used 200 years later by George Washington in America. In France *Pierre Fouchard* (1678-1761) made the first complete sets of false teeth with metal springs fixed at the posterior end of the sets for retention. He is known as the *"Father of Dentistry"* Ivory from hippopotamus or Walrus was used to make teeth and base. Base used to be of horseshoe shape without coverage of palate. Thus retention was a problem.

In England, dentistry did not progress much until the end of 17th Century. Because of lack of suitable impression material, full impressions were never done. Just by observing the mouth, the jaw size was noted, and measuring with compasses and calipers were the methods employed. Advertisements like "Dentures by Post" were common in newspapers. That means, patients were asked to mould a piece of soft wax into a horse-shoe shape and press it on to the jaw and then send it by post to the dentist. The dentist in turn used to send the finished dentures by post.

Phillip Pfaff (1756) a dentist to the King of Prussia is credited with having made the first plaster casts of the whole jaw from wax impressions. During 1790's a French Chemist Alexis Duchatean made porcelain teeth and another French dentist Nicholas Dubois De Chemant in 1792 made all porcelain (Base and teeth) sets and he himself wore it. Then this idea of making porcelain teeth sets spread to England, America and other European Countries.

Waterloo Teeth - Teeth extracted from dead soldiers of Waterloo War were also used for making artificial sets. However, porcelain because of its ability to match tooth color, shade and smooth surface was very popular for making teeth.

In America, a dental company called S.S White started production of porcelain teeth.

In England, Claudius Ash of London also perfected porcelain teeth of various shades and started manufacturing them. Ash was making ivory blocks also for denture base. Mr Claudius Ash was a Silver Smith in London at the beginning of 19th Century, became interested in teeth when a London dentist asked him to reproduce a dental appliance. His work involved riveting teeth of dead people to an ivory base.

Though he did his job perfectly, he hated handling of dead persons teeth. So he started experiments with porcelain and succeeded in it. Thus Claudius Ash was the first dental mechanic and also he started a world famous dental manufacturing company whose products are the best in quality (Fig. 16.5).

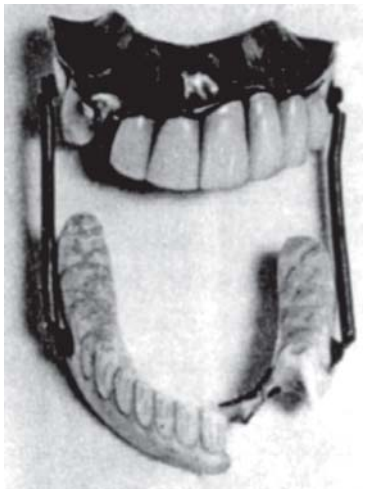


Fig. 16.5: Typical early victorian appliance

Whatever material was used as teeth and base, dentures had coil springs attached to them for retention of upper set and lower sets were made heavy for the same reason. It was Dr James Gardette of Philadelphia (1800) who is known as the discoverer of the use of atmospheric pressure for the retention of upper denture, made a spring-less denture, which covered the whole of palate. George Washington, the 1st President of America suffered a lot because he lost his many teeth during his early 40's, and did not have satisfactory artificial sets. Because of this, he suffered from indigestion, short temper and deafness. It even changed his shape of face, which made him reluctant to speak to the public. It is this changed shape of his face that we see every note of Dollar, a currency of America.

In 1839 Charles Good Year of America discovered Vulcanization technique, which converted soft rubber into a hard rubber. The product of this process, known as "Vulcanite" came to be used as denture base material and it was replaced by present day Acrylic Resin only in 1930's. Again in America, a Dentist by the name Horace Wells discovered anesthesia (Nitrous Oxide) and it was the beginning of painless extraction of teeth. With these two important discoveries, dentistry became closure to people, so mass extractions were done, and many false sets were made.

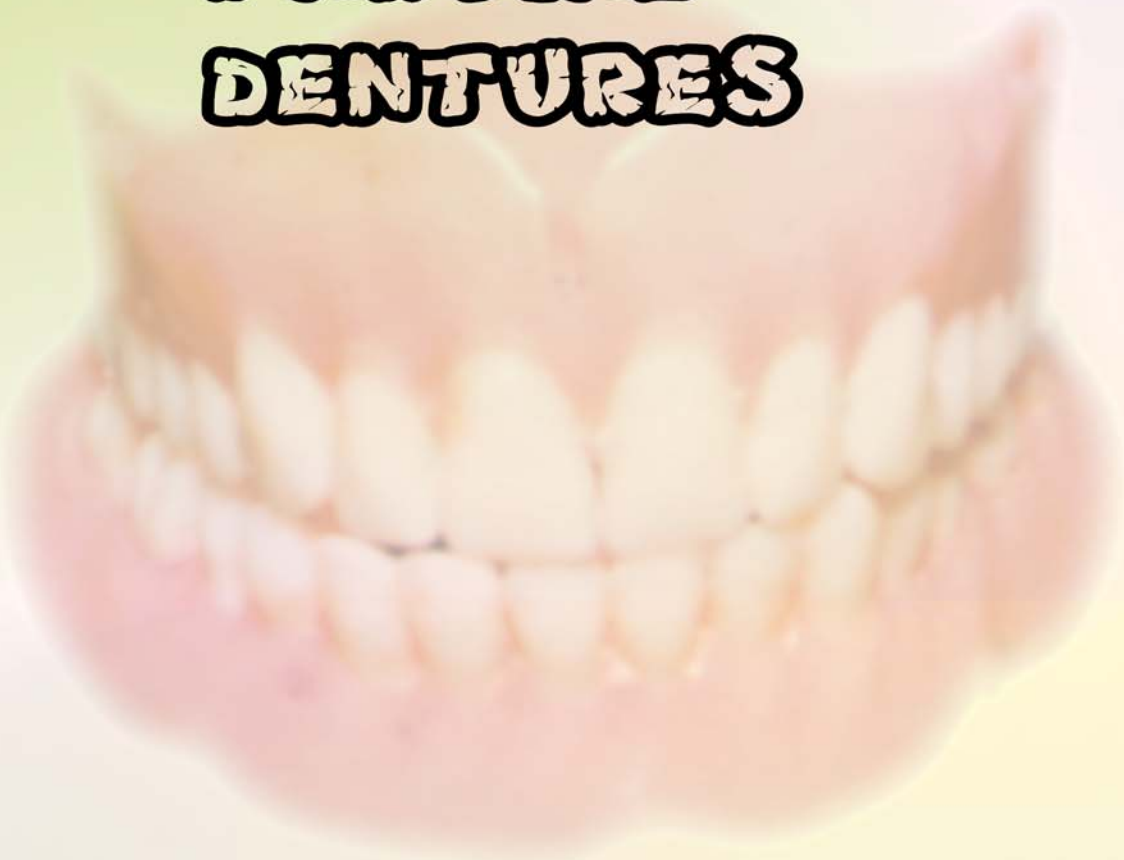
In 1869, celluloid was tried as a denture base material.

In 1924, Beckelite type of resin was also tried for denture base.

In 1934, Acrylic Resin was introduced to dentistry as denture base material.

PART 4

PARTIAL DENTURES



17 Classification

PARTIAL DENTURE

Definition: This is an appliance, which replaces one, or more lost natural teeth either in maxilla or mandible. The appliance can be removed by the patient.

Causes for Loss of Natural Tooth

a. Caries.
b. Periodontal disease.
c. Accident.
d. Intentional—To improve appearance or function.

Why Lost Natural Tooth to be Replaced

a. For appearance.
b. For masticatory efficiency.
c. For proper speech.
d. To preserve the health of the remaining teeth.
e. For prevention of tempero-mandibular joint dis-function.
f. To prevent occlusal disharmony.
g. To boost the morale of the patient.

Requirements for Good Partial Denture

1. Should fulfill the purpose for which it is made.
2. Should not cause further damage to remaining teeth and their supporting tissue.
3. Should be easily removable and reinserted by the patient.
4. Should be easy to clean.
5. Should be easy to repair.
6. Should be reasonably economic.
7. Should not be bulky.
8. Should be firm and immovable in the mouth.

What Happens if the Lost Natural Tooth is not Replaced

a. *Migration of teeth:* in dental arch. Tooth may tilt mesially or distally. As a result, there will be increase in free-way-space (inter-occlusal distance) and so the mandible has to move further up towards the skull to bring about contact between teeth.
b. *Depression of teeth*: Due to increased load on the remaining teeth, teeth may be depressed into the alveolar bone once again.
c. *Deviation of mandible laterally and antero-posteriorly*: This is the result of defect in cuspal relationship following the loss of teeth or it may be an attempt to secure the most efficient occlusal contact.
d. *Localized attrition*: This is due to more load falling on the remaining teeth.
e. *Marked disorientation of occluasl relationship*: For example "Over-eruption" of tooth may occur if the opposing tooth is not present. This will affect the function and dynamic relationship between mandible and maxilla.
f. *Loss of Alveolar bone*: This is the most damaging consequence of loss of teeth. There fore the *Aim of partial denture* should be;
   a. Preservation of alveolar bone and the avoidance of further loss of teeth. To state that "loss of teeth is followed by loss of alveolar bone", if the lost teeth are not replaced is equally true as " loss of alveolar bone is followed by loss of tooth" as it is happens in periodontal diseases.
   b. Postponement of edentulous state.

TYPES OF PARTIAL DENTURES

1. *Tooth borne*: If the occlusal load falling on denture is taken-up by remaining teeth and then to bone.
2. *Tissue borne*: If the occlusal load falling on denture is taken-up by mucous membrane and then to bone.

According to the material used for making a partial denture:
a. Nonmetallic-partial denture made with acrylic resin.
b. Metallic- made with cast chrome-cobalt alloy.

CLASSIFICATION

There are many methods and all are designated by the name of a person who suggested it.

1. *Kennedy classification (1923)*: This is the most popular method and the basis of classification is position of saddles.
   Firstly by the position of saddle or saddles and secondly by the number of extra saddle or spaces. There are four classes into which all type of partial dentures are grouped.
   Class I – Two free-end posterior saddles.
   Class II – One free-end posterior saddles.
   Class III – One non free-end posterior saddle.
   Class IV – One-antreior saddle (Figs 17.1 to 17.3).

Modifications

Class I, II, or III are modified when another saddle is present on the arch. For example,

Class I, modification 1: If there is one extra saddle; to class I.

Class I, modification 2: If there are two extra saddle; to class I.

Class I, modification 3: If there are three extra saddle; to class I.

Class I, modification 4: If there are four extra saddle; to class I (Figs 17.4 to 17.6).

Same formula applies to class II and III. But there are no modifications to class IV, because wherever a second saddle is present it is automatically becomes one of the other three classes.

2. *Cummer classification*: The basis of this classification is according to the position of direct retainers, i.e. Clasps.
   Class 1: Clasps (2 in number) diagonally (Diagonal claps) opposite to each other.
   Class 2: (Diametric claps)- Clasps (2 in number) diametrically opposite.

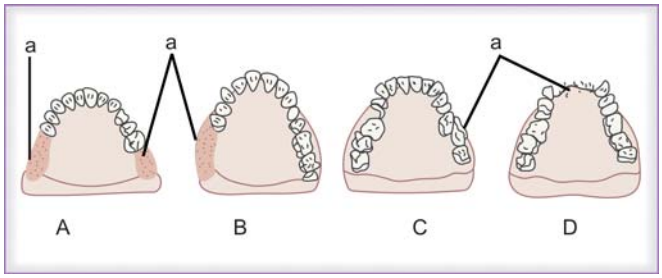


Fig. 17.1: Partial denture classification "Kennedy"
A. Class I (a- saddle area), B. Class II, C. Class III, D. Class IV

Fig. 17.2: Partial denture classification
A. Kennedy class I mod 1, B. Kennedy class II mod 2

Fig. 17.3: Partial denture classification
C. Kennedy class III, D. Kennedy class IV

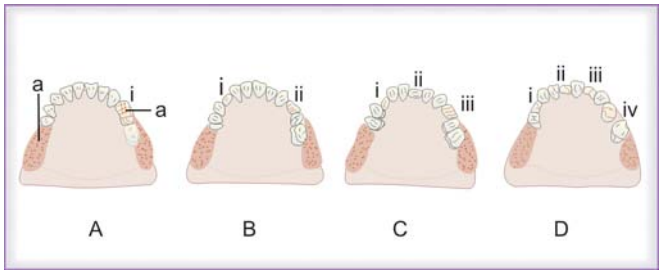


Fig. 17.4: Class I partial dentures
A. Modification 1 (a - Saddle), B. Modification 2
(a' - Modification i, ii, iii, iv), C. Modification 3, D. Modification 4

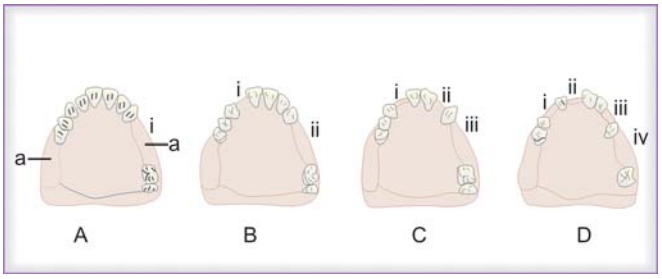


Fig. 17.5: Class II partial dentures
A. Modification 1 (a- Saddle), B. Modification 2
(a' - Modification i, ii, iii, iv), C. Modification 3, D. Modification 4

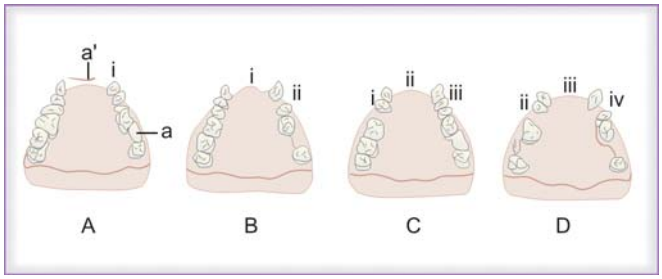


Fig. 17.6: Class III partial dentures
A. Modification 1 (a- Saddle), B. Modification 2
(a' - Modification i, ii, iii, iv), C. Modification 3, D. Modification 4

Class 3: (Unilateral claps)- Clasps (2 or more in number) on the same side.
Class 4: (Multilateral claps)- Clasps (3 or some time 4) in a triangular or quadrilateral relation.

3. *Beckett classification*: This is based on the load distribution of the individual saddle.
   Class 1: Saddles- Entirely tooth supported.
   Class 2: Saddles- Entirely mucosa supported free end or bounded.
   Class 3: Saddles- Bounded saddles with problems.
4. *Fried classification*: Based on the different functions of the saddles.
   a. Anterior saddle- With incisal function.
   b. Posterior saddle- Bounded with masticatory function.
   c. Posterior saddle- Cantilever or free-end with masticatory function.
5. *Applegate- Kennedy classification*: Based on the method of achieving support to the appliance.

Fig. 17.7: Chrome-cobalt casted frame work of RPD

Class I – Similar to Kennedy Class I
Class II – Similar to Kennedy Class II
Class III – Similar to Kennedy Class III
But bounded teeth are unable to bear support.
Class IV – Similar as Kennedy Class IV
Class V – Similar to Kennedy Class III.
But anterior boundary tooth is not suitable for support.
Class VI – Similar to Kennedy Class III but the bounded teeth are capable of support.

Names of persons who tried to classify partial dentures are – Bailyn; Skinner; Cummer; Godfrey; Swenson; Wilson; Friedman and Miller (Fig. 17.7).

18 Design of Cast Partial Dentures

Principles

All dentures are subject to vertical and lateral force, which may displace or retain the denture.

Retention: Is when the denture resists vertical displacement.

Stabilization: Is when the denture resists horizontal displacement.

OBJECTS OF DESIGN

1. To spread the load between the abutment teeth and the saddle areas as not to exceed the physiological limits.
2. Preservation of what is left (i.e. Teeth, alveolar bone) rather then perfect replacement of what is missing.
3. To achieve teeth support to denture and denture support to teeth- i.e." Mutual support"

How to Achieve the Aim

Attention must be given to;

a. Support, i.e. how the occlusal stresses are to be met.
b. Strength, i.e. how the denture itself will behave under loading.
c. Retention, i.e. how the denture is to be retained in place without causing damage.

Denture Support or Resistance to Loading

The design of partial denture must ensure that the functional loads are applied to the tissues best able bear them. These are

1. Natural teeth - Stands 1st in merit.
2. Palate - Stands 2nd in merit.
3. Edentulous Alveolar ridge - Stands 3rd in merit.

Tooth support: Ideally saddles should be tooth supported, i.e. rested on abutment tooth at each end. The more the natural teeth can be used for this purpose the better it will be because:

a. Tooth support is relatively rigid support.
b. Tooth support- makes tissue support largely unnecessary, thus there will be more scope for skeleton denture.

However the more skeleton the design, the weaker the denture, unless steps are taken to strengthen it. One must again consider, what is the nature of force, and how much of natural tissues are available to take-up these forces. That means, larger the area of occlusal surface of prosthesis greater will be the total force falling on it and so greater will be the demands on the natural tissues. In such a condition, the aim should be to re-distribute the forces. Therefore remaining natural teeth should be;

a. Strong.
b. In good position.
c. Healthy.
d. Sufficient in number.
e. Well distributed in the arch.

Canines and molars are the most satisfactory abutment teeth. In this respect, one can conclude partial denture must have stable environment and it functions as long as the abutments are good.

Magnitude of Force

The Masticatory muscles are the source of these forces, greater the resistance offered by the food mass, the greater will be the force exerted. Again, smaller the occluding surface, smaller the amount of food chewed and smaller will be the force exerted. Therefore if the supporting tissues are inadequate to bear the load, it is best to reduce the occlusal area.

Bone (Alveolar Bone)

The masticatory forces ultimately are taken up by alveolar bone whether it is via abutment teeth or via residual ridge.

Bone is a living tissue and so its ability to tolerate force is largely dependent upon the magnitude or

intensity of the force. Up to a point any increase in occlusal loading is met by the laying down of extra bone tissue, but thereafter any tendency to overload causes resorption. On the other hand, disuse atrophy occurs in edentulous spaces through lack of function when no denture is worn. This is the physiological tolerance limit of bone. Therefore the objective of partial denture design should be to spread the load between the abutment teeth and the saddle area as not to exceed this physiological limit. Not only that the potentially destructive forces must be minimized by proper design, location of components and by proper occlusion.

How does a partial denture cause damage to tissues. It is through;

a. Leverage.
b. Caries.
c. Periodontal disease.

A tooth tolerates vertically directed forces better than off vertical or near horizontal forces.

Types of Forces

A. *Vertical, occlusal*: These are the masticatory forces applied to the denture during function, and these forces must be resisted.

A fully tooth borne denture will resist the greatest of these loads and provide the most efficient mastication.

If the proposed partial denture is opposed by natural teeth- go for tooth borne design.

Molars and premolars are the most suitable teeth as abutment in a fully tooth borne partial denture. Occlusal rests take-up the masticatory load falling on the denture and transmits them to the abutment teeth. In order to do this properly, occlusal rests must be suitably designed and placed.

In extensive saddle cases, wider coverage of ridge is necessary to reduce the load applied per unit area.

B. *Lateral loads*. These are the forces met during the lateral movement of mandible during normal masticatory function. These forces are the most damaging and so their magnitude should be kept to minimum by the following methods.

a. Reduce the cusp angles of posterior teeth.
b. Reduce the occlusal table in the denture saddle.
c. Distribute the forces over the maximum number of natural teeth by use of clasps and continuous clasps.

C. *Antero- Posterior forces* (Fig. 18.1)

These forces act during the antero-posterior movement of mandible and because of this mandibular denture is likely to move backwards, and maxillary denture forwards.

To prevent these denture movements.

In the lower jaw- if there is already a standing natural posterior tooth, it will resist the backward movement of lower partial denture. If not, clasp the anterior teeth.

In the upper jaw

a. Clasp the posterior standing tooth.
b. Extend the saddle around the backside of the maxillary turberosity if standing posterior tooth is not present.
c. Standing anterior teeth themselves will prevent the forward movement of maxillary partial denture.

D. *Vertical dislodging forces*.

These forces are due to

a. Gravity – In the case of maxillary denture.
b. Sticky foods.
c. Tongue movement.

These forces must be met or contered in order that denture retention is not affected. This is done by;

a. Proper designing of clasps.
b. Making use of undercuts.
c. Large area coverage.
d. Making use of indirect retainers.
e. Providing proper occlusion.

Free-end saddle dentures, i.e. class I and II. The tissues covering the edentulous alveolar ridge can be deformed by pressure transmitted by the dentures in function and the distance the denture may move is greater than the distance through which natural

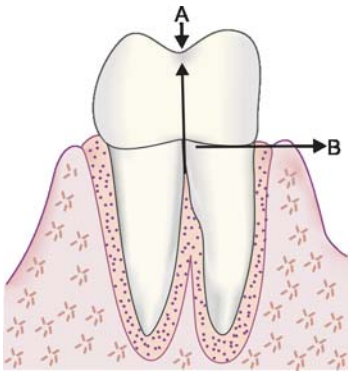


Fig. 18.1: Load on abutment
A. Vertical, B. Lateral

teeth move in their sockets under the same load. Thus the ridge-supported part of the denture will tend to be depressed into the tissues, and as a result, resorption of alveolar bone takes place. When this happens the denture is no longer in its original relationship to the natural teeth. This is more obvious in the lower jaw. In the upper jaw, the palate provides enlarged load bearing tissue.

But, difficulties of retention are greater in the upper jaws because the appliance is dislodged by gravity. In both jaws there is also an aesthetic problem, for the only teeth available to bear stress and stabilize the dentures are in the front of the mouth. An extension of dentures on these teeth is not advisable. In a typical free-end saddle case where only the six lower anterior teeth are present, the question of support is problematic, because of length of free-end saddle and abutment teeth are not strong enough. In such a situation, denture cannot be entirely tooth supported. In the same way it cannot be entirely tissue supported because the saddle area is not rigid due to the compressibility of soft tissues, and mouth is not stone hard and it is the "give" of the saddle area under load may damage the abutment teeth through leverage.

The possibility of damage to abutment teeth and/or saddle areas through overload and leverage can be avoided to some extent by; (Fig. 18.2)

a. Reducing overall load.
b. Sharing the load by stress-breaking,
   By using point contact clasps
   By adapting muco-compressive impression technique
   By anterior placement of occlusal rests.
c. Spreading the load- over several teeth
   Over maximum available saddle area
d. Use of rigid major connector. Thus making the denture both tooth and tissue supported.
e. Some kind of indirect retention.

In conclusion, the free-end saddle denture always presents difficulties. However if the standing teeth are sound and their retention is advisable, the correct design is one in which the teeth give maximum possible support, the rigidly and mesially attached saddle being extended as far as possible and occlusal surface reduced to the minimum.

In Short

1. Increase the rigidity of denture base.
2. Increase the extent of tooth support.
3. Increase effective clasping.
4. Increase area of soft tissue contact.
5. Decrease occlusal area.

ENTIRELY TOOTH SUPPORTED CLASS III PD (Fig. 18.3)

Denture base can be made of metal with connectors.

Cast clasps of either circumferential or bar type or a combination clasp can be used.

There is no need of indirect retention.

Normal impression procedure can be adapted.

Other Factors Influencing Design of Partial Dentures

1. Which arch; maxilla or mandible or both. The relationship of mandible to maxilla- whether it is class I II or III.
2. Type of major connectors indicated (Fig. 18.4).
3. Whether the partial denture is entirely tooth borne (Class III) or of one or both distal extension bases (class I and II) (Fig. 18.5).

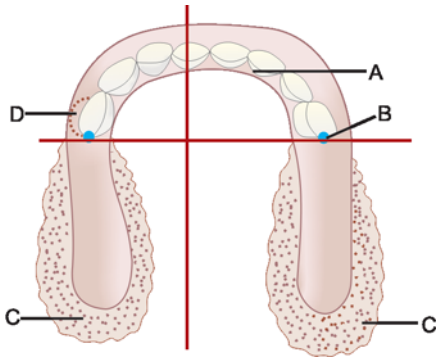


Fig. 18.2: Class I design (Tooth and Tissue borne)
A. Lingual plate, B. Occlusal rest, C. Saddles, D. Clasp

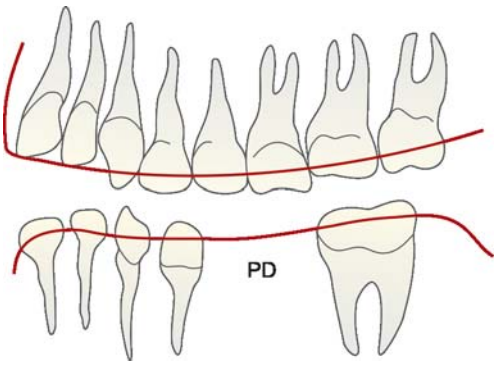


Fig. 18.3: Partial denture partial denture should be tooth borne because of opposing maxillary natural teeth

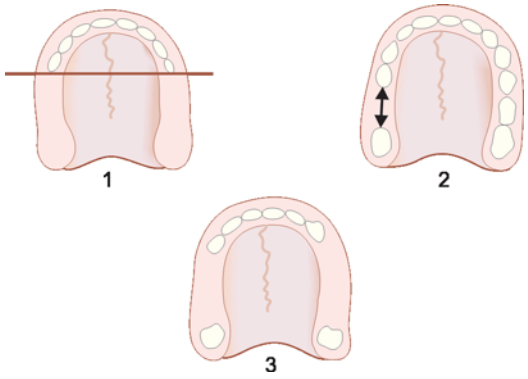


Fig. 18.4: Partial denture design
1. Class I. Both tooth and tissue supported, 2. Class III fully tooth borne because of short span, 3. Long span and unsuitable abutments necessitates tissue borne denture.

4. Material to be used- for the framework and for base.
5. Type of artificial teeth to be used.
6. Whether abutments are sound and healthy or needs some treatment.
7. Patient's attitude to oral hygiene (Fig. 18.6).
8. Periodontal condition of remaining teeth.
9. In case of lost single tooth or in case of anterior teeth consider the possibility of fixed bridge against removable PD.
10. Economic status of patient (Fig. 18.7).

Danger of Partial Denture

Removable partial denture is potentially dangerous device. It covers the tissues that should not be covered and an appliance, which is strong and stable, can become complex and difficult to clean.

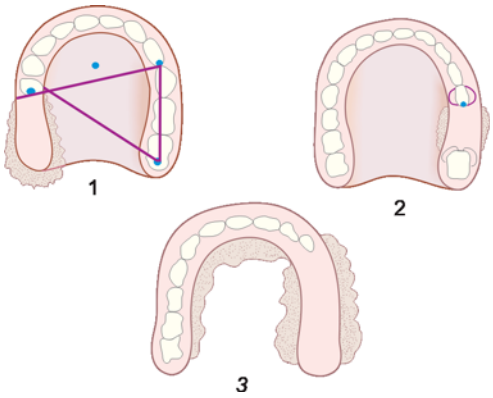


Fig. 18.5: Partial dentures
1. Class II using teeth placed wide apart for support and retention. 2. Class III with short span made on one side only. 3. Class III with long span made to extend to opposite side of the arch.

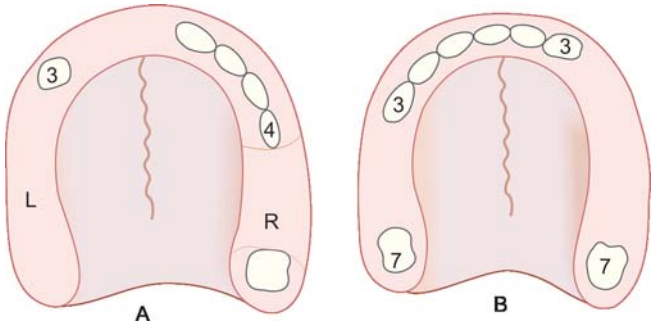


Fig. 18.6: Partial denture design
A. Tissue-borne on left side and tooth borne on right side. B. Tissue borne because of long spans and unsuitable abutments.

SURVEYING

Construction of cast metal removable denture involves careful planning. An early step in the planning is the surveying of the model, by using a model surveyor.

Why to survey a model—
1. To locate undercuts on teeth and tissue,
   Tool used is analyzing rod.
2. To mark points of widest contour on teeth and tissue.
   Tool used is carbon marker.
3. To make parallel the blocking-out material.
   Tool used is chisel.
4. To measure the depth of undercuts before clasping.
   Tool used is gauges.

Surveying a field by a civil engineer: This is to find out the ups and downs of area, boundary and other factors as necessary for which surveying is done.

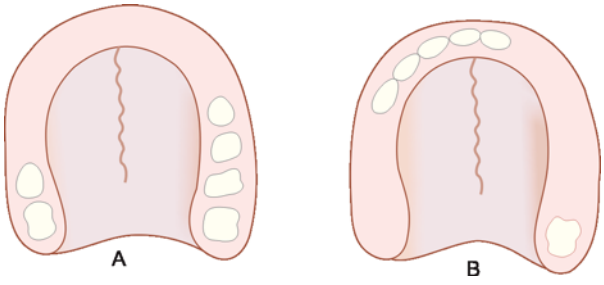


Fig. 18.7: Partial denture design
A and B. Both tissue-borne because of long spans

Origin and Meaning of the Word

Surveyor- From French—Survivor, Super = Over; Videre = to see

Definition of Surveyor

It is an instrument designed to locate undercuts on the selected teeth or tissue of the master model by circumscribing them with a carbon marker (Fig. 18.8).

Parts of Surveyor

1. Horizontal base or platform
2. Table to which cast is adjusted and which can be tilted.
3. Fixed vertical arm.
4. Horizontal arm from which the Vertical rod is suspended and this vertical rod can be raised or lowered.
5. Paralleling tool or guideline marker and carbon marker, e.g. Surveying blade or analyzing rod.
6. Mandrel for holding special tools like undercut gauges- → a. 0.75 mm gauge
   And Wax trimmer b. 0.50 mm gauge
   c. 0.25 mm gauge (Fig. 18.9)

In Short

Main parts of surveyor are;

a. Adjustable vertical rod of which the side can be applied to and mark the tooth being examined.

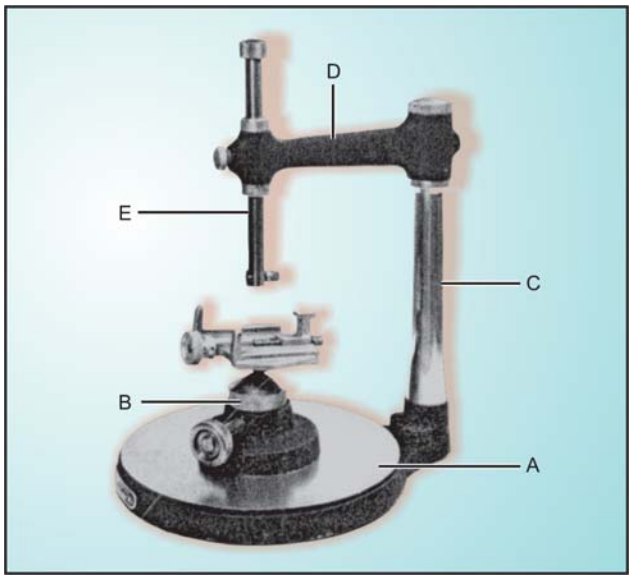


Fig. 18.8: Surveyor (Ney)
A. Horizontal base, B. Adjustable table, C. Fixed vertical arm, D. Horizontal arm, E. Vertical rod

Fig. 18.9: Undercut gauges
a. 0.75 mm gauge, b. 0.50 mm gauge, c. 0.25 mm gauge, d. Scraper

b. Adjustable table that holds the model in any selected relationship to the vertical rod, the rod itself being freely movable while remaining at right angle to the base. The tilt of the model represent that path of placement that the partial denture will ultimately take in the mouth. For example, imagine a box into which one would like to insert and remove something without any difficulty. This depends upon the angulation of the box (Fig. 18.10).

REASONS FOR SURVEYING

For direct retention of partial denture, clasps are used and these clasps make use of undercut area (wanted undercut) of both the teeth and tissues.

In order to make use of these undercuts it is necessary to know their precise limits, and this requires the use of a surveyor. The surveyor enables one to determine the size and severity of the various

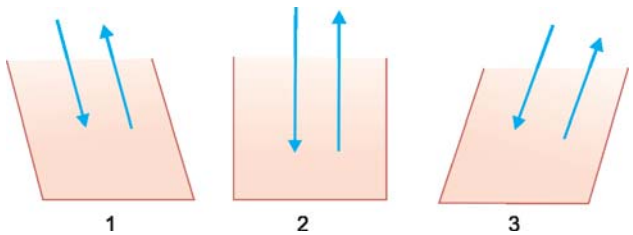


Fig. 18.10: Path of insertion and removal
1. From distal, 2. Vertical, 3. From mesial

undercuts by utilizing the analyzing rod together with the undercut gauge and to decide on the degree of tilting desirable whereby undercuts are transferred from one abutment to another.

Rigid denture base and rigid parts of clasps will not pass into undercut. Surveying identifies all the undercut areas relative to a given path of withdrawal. If the path of withdrawal can be controlled, then the use of undercut gauges permits the control of the extent of the lateral deflection of the clasps.

Paralleling the abutment sides with a chisel (after blocking out un-wanted undercuts) path of insertion common to all saddles can be found. Surveying helps in selecting the most suitable types of clasps. Surveyor marks the most bulbous part of a tooth, which is to carry a clasp, so that rigid part of the clasp can be placed above the undercut area and the flexible part of the clasp can be placed into the undercut area. Surveying will demonstrate undercut areas, which can be used for the retention of the denture. On the master model, on which denture is to be processed undercuts are blocked out with plaster.

Surveying enables those parts of the denture base, which fit against the crowns of teeth to be placed above the survey line, thus avoiding food lodging.

POSITION OF CAST ON SURVEYOR TABLE

a. Horizontal.
b. Anterior tilt.
c. Posterior tilt.
d. Lateral tilt.

RECORDING THE MOST ACCEPTABLE PATH OF INSERTION AND REMOVAL

The adjustable table may be tilted in relation to the vertical rod of the surveyor until a path that is suitable is found. For example;

a. A cast in a horizontal relationship to the vertical rod (No tilting) represent vertical path of insertion and removal.
b. A cast in tilted relationship represents a path of insertion towards the side of the cast that is tilted upward.

If the cast is tilted anteriorly (i.e.- Incisor area downward and posterior area upward)—then the path of insertion is from behind to forward.

If the cast is tilted posteriorly (i.e.- Incisor area up ward and posterior area down ward)-the path of insertion is from front to backward.

Thus cast position can be altered anteroposteriorly until the proximal surfaces are in parallel relation to one another or near enough so that they can be made parallel by disking. This will determine the antero-posterior tilt of the cast in relation to vertical rod of the surveyor. The end result of all this will provide the greatest area of parallel proximal surfaces that may act as guiding planes.

Thus antero-posterior tilt is mainly meant for finding out a suitable path of insertion and removal, where proximal surfaces of teeth are taken into account.

LATERAL TILT OF THE CAST

This is mainly concerned in finding out a suitable retentive area for clasps on buccal or lingual surfaces of abutment teeth. The cast position can be altered by tilting laterally to achieve reasonable uniformity of retention, the table holding the cast is rotated about an imaginary longitudinal axis without disturbing the previously established anteroposterior tilt.

The final position of the cast as result of all these different tilts provides suitable guiding planes for easy insertion and removal and suitable retention of clasps on the abutment teeth.

It is not much of a problem to clasp teeth that have parallel walls. Abutment teeth, in actual fact not only convex on this surfaces which comes in contact with denture, but also are always tilted in the vertical plane in relation to each other. Lower abutment teeth tilt towards each other and lean inward lingually. Upper abutment teeth also tilt towards each other but lean outwards buccally. These overall tilts can be readily changed in direction and made increased or decreased by tilting the plaster cast.

Then a survey line is marked.

On the other hand if several abutment teeth are present with different tilts, it becomes necessary to arrive at the compromise between their respective survey lines which will suite the most favorable path of insertion and removal and the most effective retention by clasping. Ideally however, the most favourable survey lines would be those traced with the occlusal surface at right angle to upright marker, for that would indicate horizontal path of insertion and removal of the denture.

GUIDING PLANES

These are two or more parallel, vertical, proximal surface of abutment teeth so shaped as to guide a

partial denture during insertion and removal. These are either found or created during surveying a model.

RETENTIVE AREAS

Flexible part of the clasp should be placed in an undercut area and the clasp must encircle more than half of the circumference of the tooth.

A clasp will retain only that part of the denture to which it is attached.

A clasp should always grasp the tooth, not mearly pressing against it. (Like holding something tight in one's hand) Clasp = Fastening. For a clasp to be retentive, its path of coming out of tooth must be different from that of denture itself. Clasp has to flex out (movement) and generate resistance while doing so, which is known as retention. To measure the retentive areas, and to locate the clasp terminals undercut gauges are used which are available in 0.75,0.50,0.25 mm sizes.

DEFINITION OF SURVEYING

This is a means of locating the height of maximum contour in relation to an acceptable path of and removal of a denture and retentive areas.

USE OF SURVEY LINES

1. Show non-undercut area of tooth or tissue.
2. Show under cut areas.
3. Suggest the type of clasp (Fig. 18.11)

USE OF UNDERCUTS

a. Indicate the amount of retention for clasps.
b. Indicate wanted and unwanted undercuts.
c. Accommodate the flexible part of the clasp arm.

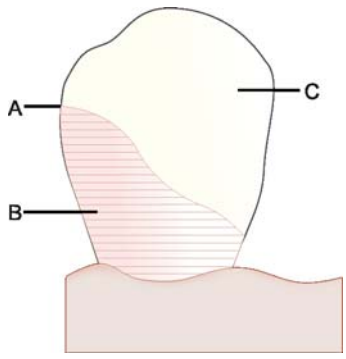


Fig. 18.11: Surveying
A. Survey line, B. Undercut area, C. Non-undercut area

TYPE OF SURVEY LINES

Class I — Low on clasping side of tooth
High on opposite side of tooth.
Class II — High on clasping side of tooth
Low on opposite side of tooth.
Class III — High on both side of tooth

OBJECT OF TILTING

Tilting the platform produces a different selection of survey line on the teeth from those obtained where the model is horizontal. Thus, areas of greater retentive value may be retained. For example, the survey lines for a posterior tilt may provide better clasping conditions than those for either an anterior tilt or when the model is horizontal. On the other hand, an anterior tilt or even a horizontal position may be more useful.

Factors Influencing the Tilt

a. Teeth.
b. Survey lines.
c. Clasps.
d. Path of insertion of denture.
e. Metal skeletal denture it self.

OBJECT OF SURVEYING THE DIAGNOSTIC CASTS

1. To find out the height of contour on abutment teeth, and to locate unwanted and wanted undercuts.
2. To find out suitable path of insertion and removal.
3. To find out proximal surfaces of teeth suitable for guiding planes by making them parallel.
4. To list the items for mouth preparation.
5. To record the cast position for future reference.

OBJECT OF SURVEYING MASTER CAST

1. For selecting the most suitable path of insertion and removal.
2. To use undercut gauges to measure the undercuts, to help locating the clasp terminal.
3. To find out the unwanted undercuts which needs to be blocked.
4. To trim block out material.

BLOCK OUT MATERIALS

1. Mixture of wax and clay.
2. Hard inlay wax.

3. Hard base plate wax.
4. Plasticine (artists modelling clay).
5. Plaster of Paris.
6. Dental cement.

ADVANTAGES OF PARTIAL DENTURE MADE AFTER SURVEYING THE MODEL

1. Patient can remove the denture easily out of the mouth and replace it back into the mouth easily.
2. Denture is firm and stable in the mouth, i.e. Good retention and stability.
3. Denture doesn't disturb appearance of patient.
4. Abutment teeth are not stressed beyond their physiologic limit.

USING SURVEYOR

Surveying is done by holding a vertical marking device such as graphite lead in contact with the crown of the tooth and moving either the model or the lead so that the side of the lead draws a line around the circumference of the crown and its point draws a line on the soft tissue aspects of model. The area lying between these two lines is a undercut (Fig. 18.12).

DETAILED SURVEYING PROCEDURE

Fix model to movable surveyor table.

Insert analyzing rod in surveyor rod.

Tilt table (i.e. Horizontal position) and lock it.

Circumscribe all the abutments with analyzing rod and note down the findings on paper. Select another tilt if necessary; survey again and note down the findings.

Make one more tilt if necessary and survey again.

Choose a path of insertion according to the findings on tilting.

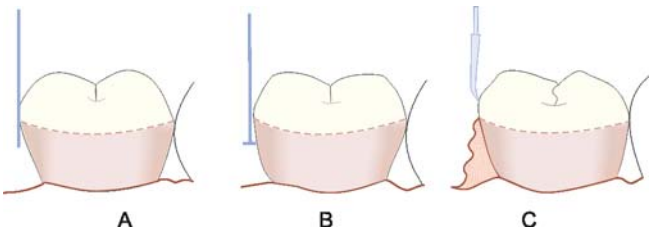


Fig. 18.12: Surveying
A. Carbon rod to mark widest part, B. Undercut gauge to measure undercut, C. Chisel to remove excess blocking out material

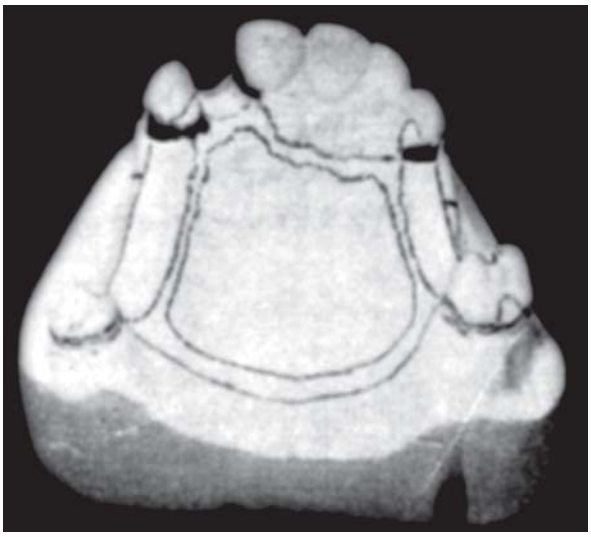


Fig. 18.13: Partial denture design on master model

Reset surveyor table to this selected tilt and make tracing on teeth with carbon marker.

Assess the severity of undercut by using an undercut gauge.

Design the plate and clasps with pencil without removing the model from the surveyor.

Mark the position of tilt (i.e. Model) on the sides and back of the model.

Remove the model from the table.

Soak the model in water.

Block out unwanted undercuts with plaster or hard wax. (Unwanted undercuts are those beneath the rigid portions of clasps)

Make sure the blocking-out material does not cover any portion of survey line. Fix the model on the surveyor table to its selected and marked position.

Insert paralleling chisel in the surveyor rod.

Position the 1st abutment beneath the chisel.

Lower the chisel until horizontal with the highest point of survey line and 1/8th of an inch away from it.

Move platform sideways, positioning chisel on the survey line.

Parallel the block-out areas by moving the paralleling tool vertically (Do not chisel the teeth surface) (Fig. 18.13).

MEANING OF WORDS

Abutment: That part of the end-wall of a bridge which supports the main beams or arch above.

Undercut: To cut under; To cut away under the surface so as to leave part over hanging.

19 Components of Cast Partial Denture

The Component Parts of Partial Denture

1. Saddles
2. Rests
3. Connectors
4. Direct retainers
5. In-direct retainers.

Saddles (Fig. 19.1)

Saddles carry the teeth and flanges, cover tissues and may be unilateral or multilateral. Tissue contact may be metal or resin.

Flanges give resistance to lateral, antero-posterior and distal movement.

Saddle should cover tuberosities and retromolar pads if possible.

Analogy of Word Saddle

Horse rider puts a saddle on the horse, which hangs on both sides of a horse back. Saddle of the horse carries the rider (Fig. 19.2).

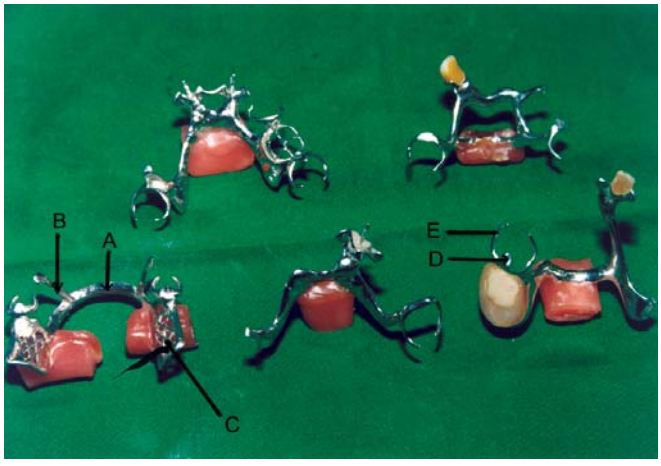


Fig. 19.1: Various designs of cast RPD
A. Major connector, B. Minor connector, C. Saddle, D. Occlusal rest, E. Clasp (Direct retainer)

Alveolar ridge is similar to horse back and the saddle of the denture hangs on both lingual and buccal sides of the ridge from above. Artificial teeth are attached to the saddle.

Saddles are basically denture bases.

FUNCTIONS OF SADDLES

a. Carries artificial teeth.
b. Takes up masticatory load and then transfer it to the underlying alveolar bone.
c. Visual part of saddle is usually made in acrylic resin, which gives natural appearance.
d. Underlying alveolar ridge gets stimulation from the base and there by its resorption is reduced
e. Prevents food getting under the base.
f. Supports the denture as in the case of class I and II partial denture.

REQUIREMENT OF IDEAL DENTURE BASE

1. Should be strong and rigid with high proportional limit and high modulus of elasticity,

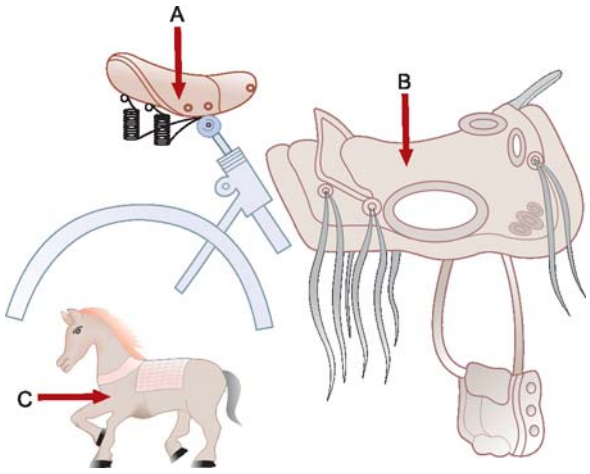


Fig. 19.2: Examples of saddle (General)
A. Saddle of a bicycle, B. Saddle for horse riding, C. Horse

so that it will withstand the normal masticatory stress, and also doesn't break.
2. Should have high thermal conductivity.
3. Should have low specific gravity- means light in weight.
4. Should be easy to clean.
5. Should be esthetic- Pink acrylic resin on the visible aspects of denture gives natural appearance.
6. Should be accurately adapted to the tissues.
7. Should not distort, warp or change in dimensions.
8. Should be biocompatible without causing irritation, allergy, etc.
9. Should have hard surface with good finish.
10. Should be economic.

MATERIALS USED FOR SADDLES

1. Chrome cobalt alloy.
2. Acrylic resin.

ADVANTAGES OF CHROME COBALT BASE

1. High strength, hence denture can be made skeleton in thin section.
2. Various designs are possible, so that denture occupies little area in the mouth. That means tissue coverage is less.
3. Hygienic—easy to clean and maintain.
4. Doesn't break easily
5. Doesn't distort.
6. Light in weight and less bulky, yet strong and rigid.
7. Thermal conductivity is good- thus the underlying tissues are kept in healthy condition.
8. Comes in intimate contact with the underlying tissues (i.e. good adaptation), which in turn helps retention.

DISADVANTAGES

1. Difficult to fabricate and time consuming.
2. Expensive on the whole.
3. Difficult to repair.
4. Difficult to rebase.
5. Color is unnatural.
6. Specially trained technician and special equipments are necessary to produce cast removable partial dentures.
7. As relining may be necessary at a later date, base made of acrylic resin is advisable in especially long span saddles.

METHODS OF ATTACHING ARTIFICIAL TEETH TO METAL BASE

a. Through medium of acrylic resin.
b. Connecting directly to metal base.
c. Processing directly to metal base.
d. By chemical bonding.

STRESS BREAKER DESIGN

(Stress equalizer/Articulated prosthesis.)

In partial denture design the objective must be to spread the load between the abutment teeth and the saddle areas, as not to exceed the physiological limit.

ORIGIN

The rigid attachment of the clasp to a denture has long been known to be potentially harmful to the clasped tooth. The first movable clasp was made by Evans of Paris in 1865. He was the first to recognize the necessity for movement in certain types of denture to prevent the attached tooth from becoming loosened. The type of denture he meant is now known as free-end saddle denture. This idea gave an impetus to develop stress broken design. However, stress can be reduced but not broken.

DEFINITION

It is a connector which reduces stress on abutment teeth by linking the saddle to the basic framework of a denture by means of non-rigid device such as bar; a hinge; a ball and socket or a slotted attachment.

Advantages of Stress Breaker Design

1. Mobility of abutment is prevented.
2. Alveolar bone resporption is prevented.
3. Relining of denture base may be eliminated.
4. Acts as a splint to weak teeth.

Disadvantages

1. Difficult to fabricate.
2. Indirect retainer becomes nonfunctional.
3. Food trapping.
4. Repair and maintenance difficult and costly.

Advantages of Rigid Design

1. Easy and Less costly to make.
2. Equal distribution of load between abutment and residual ridge.

3. Indirect retainer and other rigid components prevent rotational movement of the denture and there by provide horizontal stabilization.
4. Less danger of distortion.
5. Easy to clean and maintain.
6. Less frequent relining.

Disadvantages

1. Danger to abutment teeth if not properly designed.
2. If relining is not done when needed, the abutment tooth may be loosened due to continuous stress.
3. Wrought wire clasps may break.

Types of Stress Breakers

1. Those having a movable joint between the direct retainer and denture base. Hinges, sleeves, cylinder, or ball and socket devices, which provide movement.
2. Those having flexible connector between the direct retainer and denture base, e.g. split bar major connector.
3. Wrought wire connector.

RESTS

Definition

It is that part of the partial denture which rests upon the tooth surface and provides vertical support to the denture. (Fig. 19.3)

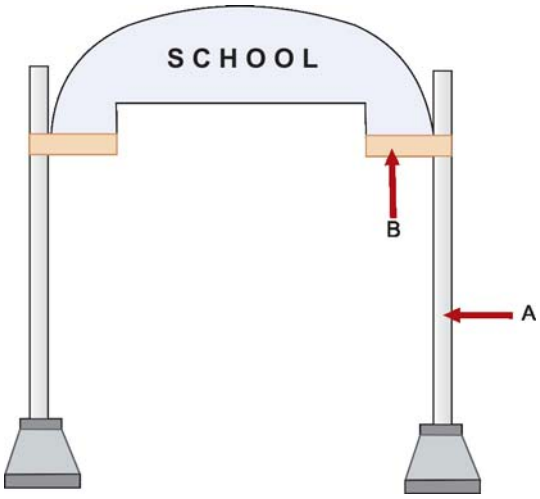


Fig. 19.3: Principles of occlusal rests and abutments
A. Abutment (of tooth), B. Occlusal rest (of tooth)

TYPES OF RESTS

1. Occlusal rest—On posterior teeth.
2. Lingual rest—On the lingual surface of anterior teeth.
3. Incisal rest—On the incisal edge of an anterior tooth.
4. Continuous clasp—This may act as a multiple rest.
5. Lingual and palatal plate—Which are basically major connectors, but rest on the cingulum of each tooth. This way helps to spread vertical load.
6. Onlays—These also can act as rest, although they are basically made to restore occlusion or vertical dimension.

FUNCTIONS OF RESTS

1. Prevent vertical displacement of the denture towards the soft tissues.
2. Transfer the load of the mastication to the natural teeth.
3. Prevent occlusal imbalance.
4. Retain clasps in their correct position.
5. Prevent food packing between denture and natural teeth.

PRINCIPLES OF REST DESIGN

A. Should be wide and thin.
B. Should be made hollow to receive the opposing tooth into occlusion.
C. Should be used along with clasps wherever possible.
D. "Seat" may be prepared to receive the rest.
E. Should transmit the load of mastication along the long axis of the abutment tooth.

OCCLUSAL REST AND REST SEAT

Location: Mesial or Distal fossa of molars or premolars.

Outline: Round or triangular shape with apex near the center of the tooth. Lower the marginal ridge by 1.5 mm. Floor of the seat concave or spoon shape with inclination towards the center of the tooth.

Preparation: Round Diamond bur or carborundum stone is used to reduce the enamel. Enamel however should not be penetrated.

Prior to this, disking of proximal surface should have done to provide guiding planes.

Requirement: Rest must fit tooth rest seat accurately to prevent food collection.

Should be strong to take-up load of mastication.

Should be at right angle or less (not more) to the long axis of the tooth.

Lingual Rests

Location: On canines and Incisors.
Indications
a. Where anterior tooth is the only abutment available for occlusal support.
b. To support indirect retainer.
c. As an extra rest.

Preparation

The proximal marginal ridge is reduced and the deepest part of the rest seat is made towards the center of the tooth. The floor of the rest is towards the cingulum.

Rest can also be made in cast crowns or inlay on these teeth.

Incisal Rests

Location: Mandibular incisors.

Preparation: As a round form at the incisal angle with deepest portion of the preparation towards the center of the tooth.

Connectors

Major connector joins one saddle to another and they should be rigid (Except in stress- broken design)
Minor connectors may be;
1. Occlusal rest extensions.
2. Continuous clasps.
3. Extended clasp arms (Fig. 19.4).

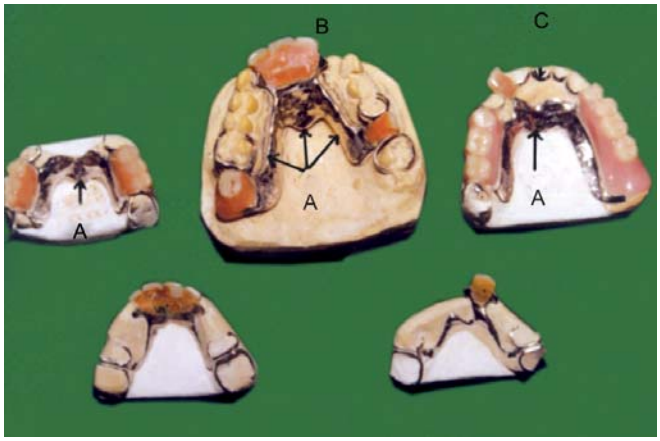


Fig. 19.4: Various design of cast RPD
A. Major connector, B. Cingulum rest, C. Continuous clasp (Indirect retainer)

Major Connectors

Requirements

1. Must be rigid (Not flexible)
2. *Location*: In a convenient position but without impingement of gingival tissues. The upper border of the mandibular lingual bar should be at least 4 mm below the gingival margin. The borders of the maxillary palatal connector should be minimum of 6 mm away from the gingival margin.
3. Adequate tissue relief should be provided under maxillary torus, raised palatal median suture line, exostoses.
4. Should not interfere with tongue movement.
5. Should not irritate the tongue.
6. Coverage of the tissues should be kept to minimum.
7. Should not trap food particles.
8. Should not impinge oral tissues.
9. Natural contour of the lingual aspect of mandibular ridge, or the palatal vault should be maintained.
10. Should prevent rotation of denture.

Mandibular Major Connectors

a. Lingual bar.
b. Lingual plate.
c. Labial bar.
d. Cingulum bar.
e. Lingual bar with cingulum bar.

Lingual Bar

Indication: Where sufficient space exists.

Location: Half pear shaped with bulkiest portion down.

Upper border should be tapered to soft tissues and at least 4 mm below the gingival margin.

Lower border is placed at the determined height of the alveolar lingual sulcus.

Proper tissue relief is provided.

Fabrication of Bar

a. Cast or
b. Wrought.

Contraindications

1. Lack of space.
2. Undercuts
3. Lingually inclined lower teeth.

Lingual plate: Also called *Lingual Apron.*

Indications

1. Lack of space, i.e. if the depth of lingual sulcus is not sufficient for the width of lingual bar.
2. Poor alveolar ridge, showing high resorption.
3. To stabilize periodontally weakened lower anterior teeth in addition to getting support to the denture.
4. In case addition to the plate is necessary if any of the incisors are lost.

Location

Half pear shaped with bulkiest portion placed down. Thin metal apron extending to contact cingula of anterior teeth and lingual surfaces of posterior teeth at the height of contour. Plate should extend inter proximally to the height of contact points- means inter proximal spaces are covered by the plate by scalloped contour of the plate inter proximally.

Lower border of the plate is kept at the determined height of alveolar lingual sulcus.

Lingual bar with cingulum bar- also known as *continuous clasp* or continuous bar retainer. This act as indirect retainer or rest in tooth borne dentures.

Advantage: Keeps the gingival margins free.

Disadvantage: Tongue doesn't tolerates it.

Maxillary Major Connectors

a. Single palatal bar
   a. Strap type.
   b. Broad type.
b. U shaped palatal connector
c. Anterior- Posterior Combination bar.
d. Full palatal coverage connector—palatal plate.

Palatal Bars

These are always made of metal. They are made in thin sections without loss of strength and fit accurately to the palatal tissues.

Therefore muco-compressive impression is necessary. Relief is given over the bony prominences covered by thin mucosa.

Location: Varies accordingly to the location of saddle area.

Placement

a. *Posterior third of palate*: It is most suitable because it doesn't bother the tongue. Acts as indirect retainer.
b. *Middle third of palate*: It can be made as single strap type of palatal major connector. Suitable for bilateral edentulous space of short span tooth borne denture.
c. *Anterior third of palate*: Act as indirect retainer and joins anterior saddle to an posterior saddle.

Single Broad Palatal Major Connector

Indications

a. Class I cases with good residual ridges.
b. V or U shaped palate.
c. Strong abutments.
d. Presence of more teeth in the arch.
e. If bony prominences are not present.

Anterior-Posterior Bar Combination

Indications

a. Class I and II cases with good abutments support and residual ridges.
b. Long edentulous spans with class III modification 1 cases.
c. Class IV cases.
d. Large bony prominences if present.
e. May be used in almost any type of maxillary partial denture because this is most rigid.

Nature and Location

Parallelogram shaped with opening in the central portion.

It is in the form of narrow (6-9 mm) anterior and posterior palatal straps.

It has lateral palatal straps of 5-6 mm broad and parallel to the curve of arch and 6 mm away from gingival margins of remaining teeth.

Anterior palatal strap is located in the area of palatal rugae.

Posterior palatal strap is located at the junction of hard and soft palate.

It extends to hamular notch areas on distal extensions.

Its shape is in the form of half oval in cross-section and 6-gauge thickness.

U Shaped Palatal Major Connector

Indication: Presence of large torus palatinus.

Disadvantage: Lack of rigidity causes gingival irritation, periodontal damage. It is a bad design.

Palatal Plate Type of Major Connector

Advantages

1. Because it is wide, can be made in thinner sections than bars.
2. Doesn't bother the tongue
3. Design copies the details of the rugae, etc, so adds to strength.
4. It will share the load of mastication with the palatal bone.
5. Makes the denture more firm in the mouth.

Disadvantage

Covers more tissue surface than a bar

Full Palatal Coverage Major Connector

Indications

1. In condition where only anterior teeth are present in the arch.
2. Class I arch where abutment teeth are not suitable for support and ridges are poor.
3. Class II with one or two modifications.
4. If palate has no bony proturbences.

Labial and buccal bars or plates as major connectors- not very popular because of their contact with lips. However, used when there is too much lingual inclination of lower anteriors and if there is excessive lingual undercuts.

Minor Connector

Minor connectors connect the major connector with other parts of the denture.

Function: Load sharing between the denture and abutments.

Requirements

Should be rigid and bulky.

Should be so shaped to be placed into inter dental spaces.

Should not come in the way of setting up of artificial teeth.

Location vertically in the inter dental space.

DIRECT RETAINER CLASP (EXTRA CORONAL)

Definition

It is a metallic component of a partial denture, which provides direct retention by engaging an undercut on a tooth.

Why Clasp is Necessary

Atmospheric pressure plays no part in the retention of a partial denture because the periphery in the absence of a continuous flange cannot be sealed against the ingress of air. Also the more skeleton the design the less effective is the forces of adhesion and cohesion. Therefore, the natural teeth are used for retention either by clasps or by frictional contact.

Clasp gives only local retention, and to be effective they must reciprocate with each other round the arch. Whenever possible, it is desirable to have tooth support in all quadrants and clasps in all quadrants of the arch. A clasp will retain only that part of the denture to which it is attached.

Another Definition of a Clasp

Clasp is a metallic component of a partial denture made in stainless steel (wrought) or chrome-cobalt (cast) alloy to provide (a) Mechanical retention by engaging the selected undercut on the surface of tooth, (b) to embrace the selected tooth and (c) to stabilize the denture.

Thus *functions* of clasp are:

1. Retention.
2. Bracing
3. Support (Fig. 19.5).

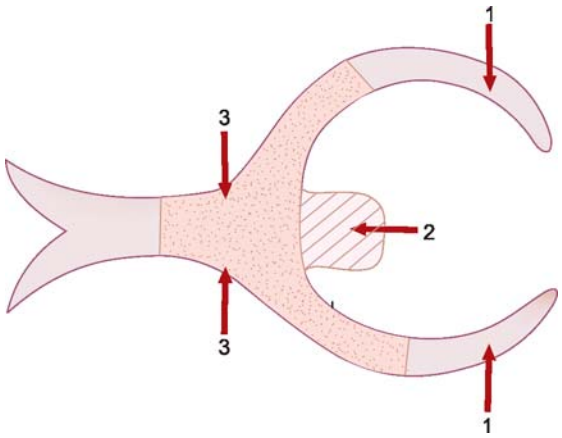


Fig. 19.5: Functions of clasp
1. Retention, 2. Support, 3. Bracing

Retention is obtained by placing the flexible portion of clasp in an undercut area, thus providing sufficient retention to resist dislodgement of the denture during mandibular movements. How much of an undercut is engaged by clasp depends on the material with which clasp is made.

Wrought wire clasp will enter an undercut to maximum of 2/3rd of its length.

Cast chrome-cobalt alloy clasp to 1/3rd of the length of undercut. This again depends on the severity of undercut and thickness of clasp arm. Bracing (or embracing) is obtained by the shoulder or rigid portion of the clasp embracing the tooth closely, thus preventing any lateral or horizontal movement of denture. This is stabilization. The rigid portion of the clasp must not be placed in an undercut area.

A clasp should grasp the tooth, not mearly pressing against it and wrongly designed clasp will kill the tooth. (Just like king Dhrutharastra wanted to kill Bhima by embracing him tightly with his arms, an episode in Mahabharatha). Support is obtained by a well fitting occlusal rest (which is a part of a clasp in association with abutment tooth), which takes-up the load of mastication, and then transfer that to abutment tooth.

REQUIREMENTS OF A CLASP

a. Should be strong (rigid) enough to resist permanent deformation in the mouth, but elastic enough to go back to their original shape when flexed.
b. Should be flexible enough to stretch out of the bulbous part of the tooth and springy enough to apply the force required to hold the denture in place.
c. Should be tapering, resilient and well fitting with a minimum contact area. Tapering towards the free-end.
d. Rigid portion must be in non-undercut area; flexible portion must be in undercut area.

PRINCIPLES OF CLASP DESIGN

1. Rigid portion must be on the occlusal side of the survey line (i.e. Nonundercut area)
2. Flexible portion must be in undercut area.
3. End portion of the clasp must remain in contact with the tooth.
4. Occlusal rest design should prevent movement of the clasp arm towards the neck of the tooth.
5. Clasp must not press on one side only of an unsupported tooth. If it does, tooth moves.
6. A tooth should never be clasped on one side only, unless supported by a plate or clasp arm on the opposite side (reciprocal arm). Reciprocal arm stabilizes the denture against the horizontal movements too.
7. Clasp should almost encircle the tooth (more than ½ the circumference of the tooth) to minimize tongue or cheek irritation.
8. Clasps should be so distributed on the denture that the clasping axis, a line drawn between the clasps, divides the denture equally, thus giving balanced clasping.
9. Clasps should be bilaterally opposed, i.e. Buccal retention on one side of the arch should be opposed by buccal retention on the other side of the arch and similarly on lingual side.
10. Bracing and retentive portions of the clasp should be placed at the junction of the gingival and middle thirds of the crown of an abutment tooth to resist horizontal and twisting forces falling on the tooth (Fig. 19.6).

HOW A CLASP WORKS

Clasp works on the principle of "Resistance of a metal to deformation".

While surveying the model; establish:
a. Guiding planes (i.e. parallel tooth surface)
b. Height of contour (also known as height of convexity; area of greatest convexity; guide line) This finding will show;
   1. Supra bulge or non-retentive area, i.e., area sloping occlusally- this is used to place non-retentive reciprocating or stabilizing component of clasp arm.

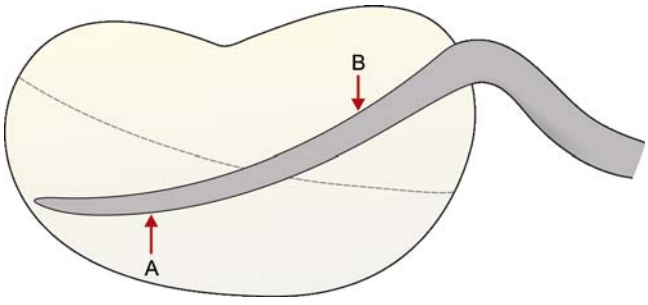


Fig. 19.6: Parts of clasp
A. Retentive part, B. Bracing part

2. Infra—bulge or retentive area—i.e., area sloping gingivally. This is used to place the retentive component of the clasp arm.

c. Suitable path of insertion and removal of denture (vertical rod of the surveyor represents the path of insertion and removal of denture).

d. Find out the size of angle of cervical convergence. Angle of cervical convergence is the angle below the height of the contour and it measures the degree of undercut. And then find out how far into the angle of cervical convergence the clasp terminal can be placed.

e. Determine the flexibility of clasp arms.

Flexibility of clasp arm is not uniform throughout its whole length. Instead, it is rigid at one end where it is attached to the denture. And the flexibility increases towards its tapering free end.

Then, flexibility depends also on; it's length, Diameter, Shape and the material with which it is made.

Longer the clasp arm, the more flexible it will be. Tapered clasp is twice as flexible as one without any taper; lesser the average diameter, more flexible it will be.

A clasp designed after taking into consideration all the above-mentioned factors, if placed in an undercut area of the tooth where it is forced to deform (i.e. flex out or stretch out) when vertical dislodging force is applied. It is this resistance to deformation that is known as retention and thus the denture stays firm in its place.

HOW MANY CLASPS FOR A DENTURE

A clasp will retain only that part of denture to which it is attached. Therefore clasps should be so placed as regularly as the particular case demands, round the periphery of denture, so that the resultant of their several forces falls as near the center of the denture as possible.

Tooth borne dentures of skeletal design require more clasps.

If a denture has a tendency to rock, about a line of two clasps, then a third clasp should be added and placed further away from the other two clasps.

(Just like legs of a stool, which are wide apart for stability of stool).

FACTORS AFFECTING THE SELECTION OF CLASP

1. Type of survey line.
2. Situation of tooth in the arch.
3. Occlusion of teeth of whole arch.
4. Appearance.

Which Teeth to Clasp

This depends on, shape, size, and strength of tooth. Order of suitability is as follows

1st Choice - Molars
2nd Choice - Premolars
3rd Choice - Cannies
4th Choice - Upper central incisors
5th Choice - Upper lateral incisors

All lower incisors are not suitable at all.

CLASSIFICATION OF CLASPS

1. Circumferential/Encircling/Occlusally approaching.
   i. Ring clasp
   ii. Two arm encircling clasp.
      a. Normal arm type
      b. Re-curved/reverse action/Hair-pin type.
   iii. One arm-encircling clasp
   iv. Back action clasp
   v. Embrasure/ Inter dental clasp.
   vi. Jackson crib.
   vii. Multiple clasps
   viii. Half and half clasp
2. Bar clasp/Projection/Gingivally approaching clasp.
3. Combination clasps.

Circumferential or Encircling Clasp

This clasp has two arms- one retentive and another bracing, two together encircle the tooth on opposite sides. Clasp is in contact with the whole length of the tooth, holding it at its extremities (Fig. 19.7).

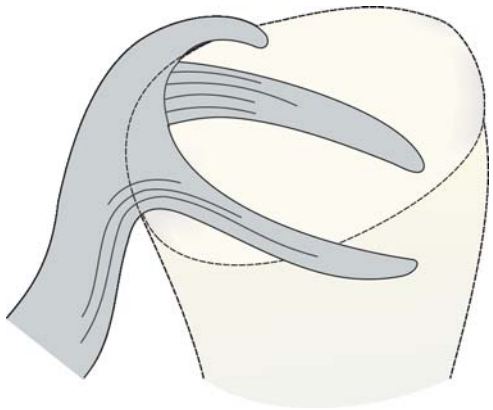


Fig. 19.7: Simple circumferential clasp

Disadvantages

a. More contact with tooth surface.
b. Adjustment is difficult.
c. Un-esthetic in the mandibular arch.

Advantages

a. Useful on all tooth borne dentures.
b. Good bracing against lateral movement.
c. Less food trapping.

Ring Clasp (Fig. 19.8)

This clasp encircles the tooth nearly fully and provides retention.

Its flexible arm is an extension of the reciprocal arm.

It is used on isolated lower molar with tilt.

It gives very good bracing and reduces leverage.

Back Action Clasp

This is a modification of ring clasp. It is attached to the denture by means of a rod placed anterior or posterior to the saddle on the lingual or palatal side.

If the rod is placed on the buccal side then it is called *reverse back action clasp*.

Being a bad design, not used much (Fig. 19.9).

Two Arm Encircling Clasp

Normal arm type: This clasp is conveniently placed adjacent to the edentulous space. Flexible part of the clasp covers a long distance in the undercut.

Reverse arm/Reverse action (hair pin clasp).

The length of the clasp arm is increased by curving it on itself.

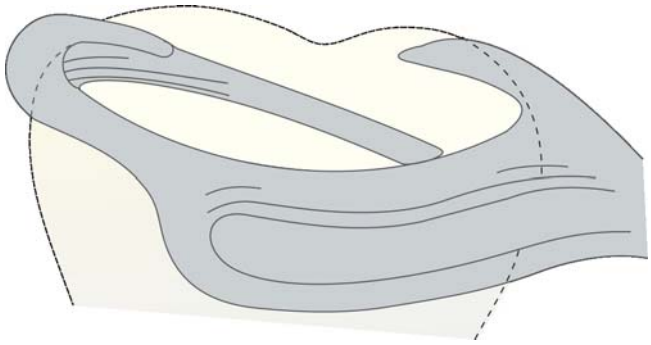


Fig. 19.8: Ring clasp

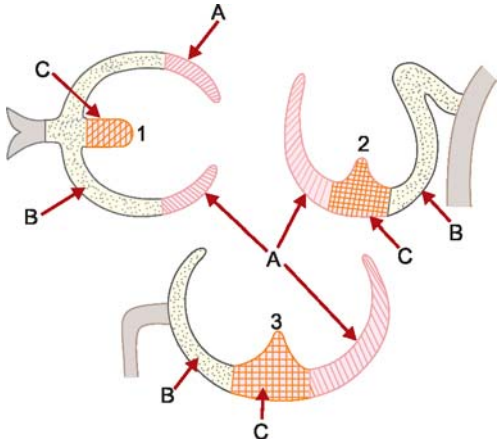


Fig. 19.9: Types of clasps
1. Ring clasp, 2. Back action clasp, 3. Reverse back action clasp
A. Retentive, B. Bracing, C. Support (occlusal rest)

Advantage

Good retention.
Reduces leverage.
Good bracing.

Disadvantage

Food packing where the arm takes a curve. Should be used if bar type retentive arm is contraindicated because of tissue undercut.

One Arm Clasp

This has only flexible (i.e. retentive) arm, and the other reciprocal arm is formed by an extension of the denture providing good bracing effect. Usually employed with acrylic based denture and easy to make. But retention is poor.

Embrasure/Inter Dental Clasp

Used in class II and III without modifications; (i.e. no edentulous space on the opposite of the arch, and full clasping of tooth not possible). This type of clasp should be used with double occlusal rests.

Should have two retentive clasp arms and two reciprocal clasp arms (Fig. 19.10).

JACKSON CRIB

This is a completely encircling clasp with no free flexible terminal. It is used when no edentulous space exist on either side of the tooth to be clasped.

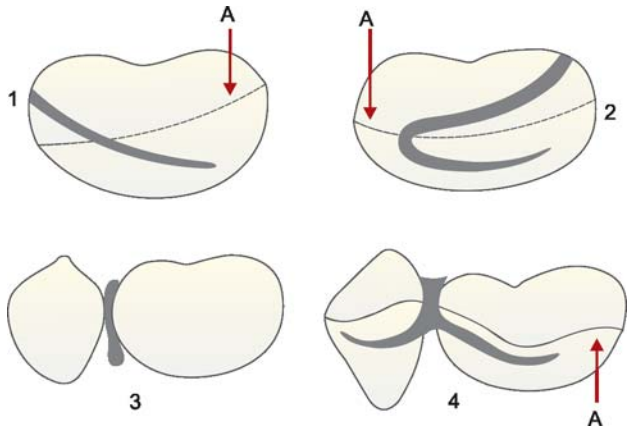


Fig. 19.10: Types of clasps
1. Normal arm encircling clasp, 2. Reverse action, Recurved arm, Hairpin clasp, 3 and 4. Embrasure, interdental clasp; A. Survey lines

Multiple Clasp

It is nothing but two opposing circumferential clasps joined at the terminal end of the two reciprocal arms.

Used when extra retention is needed.

Used when partial denture replaces the entire half of the arch

HALF AND HALF CLASP

This consists of one circumferential retentive arm coming from one side and reciprocal arm coming from another side, with or without another occlusal rest.

BAR CLASP/PROJECTING/GINGIVALLY APPROCHING (Fig. 19.11)

Also known as *ROACH clasp*.

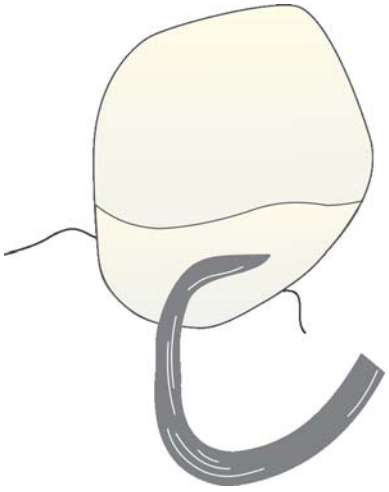


Fig. 19.11: Gingivally approaching clasp

These are classified accordingly to the shape of the retentive terminal.

T SHAPED

Used when the survey line indicates that no space exists for the rigid part of an encircling clasp and yet there is a large undercut area.

It is useful on canine and incisor teeth.

It is least visible.

U SHAPED

Useful when the survey line dips to the gingival margin on the buccal side of the tooth.

C SHAPED

Used when there is small undercut.

L SHAPED

Useful on premolar or canine when the area under the survey line is very very small and when no other type of clasp can be used.

Ball and Socket Type of Clasp (Fig. 19.12 and 19.13)

Used when the slope of tooth surface presents no undercut. Gives very good retention.

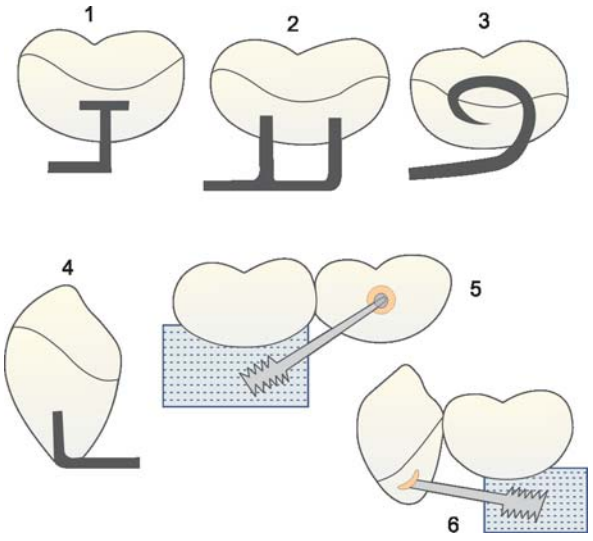


Fig. 19.12: Types of clasps
Bar; Projecting; Gingivally approaching, roach clasp
1. T-shaped, 2. U-shaped, 3. C-shaped, 4. L-shaped, 5. Ball and socket, 6. Infra- bulge clasp (De-van clasp)

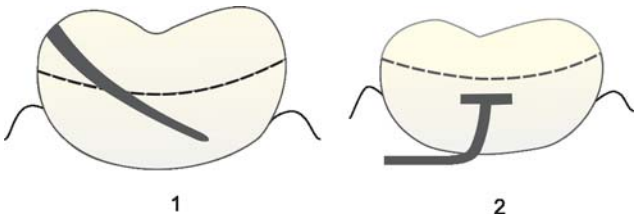


Fig. 19.13: Types of clasp
1. Occlusally approaching, 2. Gingivally approaching

Indications for Bar Type of Clasp

1. When a small undercut is present in the cervical third of the abutment tooth, which can be reached from gingival direction.
2. On abutment teeth when they support tooth borne partial denture.

CONTRAINDICATION

If there is deep cervical undercut.
If there is deep tissue undercut.

Advantages

1. Useful when encircling clasp cannot be used.
2. Less visible.
3. Can be placed in deep undercut area.
4. Acts as stress breaker

COMBINATION CLASPS

This clasp consists of wrought wire retentive arm and cast reciprocal arm.

Advantages

a. Flexibility.
b. Adjustability.
c. Appearance.
d. Minimum coverage of tooth surface.

Disadvantages

a. Can be easily distorted.
b. Extra step in making.

Indications

a. When maximum flexibility is required, i.e. on the abutment tooth adjacent to distal extension base.
b. If the abutment tooth is weak on which bar type of retainer is contraindicated.
c. For its esthetic value—i.e. less visible metal.

Survey lines

Blatterfeins classification (Fig. 19.14).

INDIRECT RETAINER

Definition

1. It is a component of removable partial denture extending beyond the fulcrum axis, which provides an anti-rotational stabilizing force.
   Indirect retainer does not engage undercuts.
   Why called indirect retainer.
   Because it retains in position some part of a denture remote from itself. It works on the principle of counter balance.
   (Just like remote hand control regulates the TV set)
2. Any extension of denture base, whether of metal or plastic that prevents rotation round a fulcrum axis will provide indirect retention.

Indications

a. In class I and II cases where distal extension bases are not totally tooth supported and not properly retained by the bounding abutment tooth.
b. In class III and IV cases where there is no adequate abutment support.

Contraindication

In a class III case which is entirely tooth borne.

Why- Movement of the base towards the edentulous ridge is prevented by occlusal rests on the abutment teeth. Movement of the base away from the ridge is prevented by the clasps.

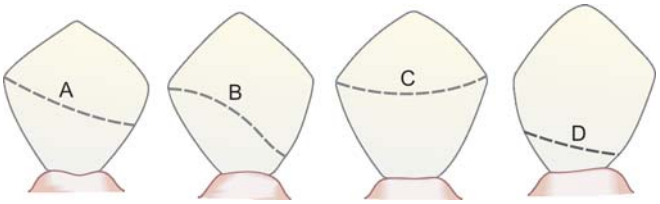


Fig. 19.14: Blatterfein's survey lines
A. Medium, B. Diagonal, C. High, D. Low

Horizontal and rotational movements are prevented by stabilizing components.

NATURE AND LOCATION

Indirect retainer retains the denture not entirely by itself but in conjunction (together) with direct retainer (i.e. clasp)

It works better if its position is away from the fulcrum line.

Indirect retainer must involve as many teeth as possible.

It must be placed on a firmly rooted tooth on a definite rest seat.

All connectors supporting the indirect retainer must be rigid.

Indirect retainer when placed on anterior teeth prevents their lingual movement, and settling of the lingual bar into the tissues.

TYPES OF INDIRECT RETAINER

1. Normal occlusal rest.
2. Extra occlusal rest.
3. Canine extension from occlusal rests.
4. Canine or Incisal rests.
5. Connector.
6. Saddle.
7. Continuous clasp.
8. Anterior and Posterior palatal bars.
9. Palatal rugae.
10. Onlay.
11. Direct indirect retention, i.e. when denture base itself can act as indirect retainer.

Intracoronal Direct Retainer-Precision Attachments

These are the internal attachments done to crown of the abutment, which interlocks with saddle.

More efficient retention is obtained by frictional resistance between the parts concerned.

How It works?

Female part of the attachment is a slot, which is embedded into metal. Inlay or crown done to the abutment tooth. Male part of attachment is a flange, which fits accurately into the slot and is attached to the saddle. Through this arrangement rigid connection is provided between saddle and abutment, which in turn provides retention by frictional contact between the parallel surfaces of the flange and slot. The mechanism also provides bracing and support.

Indication—Class III partial denture, (Fig. 19.15).

Precision Attachments

Advantages	*Disadvantages*
Appearance is not affected. Efficient retention. Direct lodging to abutment tooth. Better tolerated by patients. Posterior movement of denture in class I and II cases prevented	Extra work like inlay or crown to be fitted to abutment. Expensive and time consuming. Pulp can be at risk in deep preparations.

FULCRUM LINE (Fig. 19.16)

Definition

It is a point or axis upon which an object pivots.

Fulcrum line is an axis about which the denture will rotate when the base move toward the residual ridge. Example of various fulcrum lines.

Class I. The fulcrum line passes through the occlusal rest areas of the most posterior abutments.

Class II. The fulcrum line is diagonal passing through the occlusal rest areas of the abutment on the distal extension side and the most posterior abutment on the opposite side.

Rotation of tooth borne partial denture –e.g; Class III doesn't occur (Fig. 19.17).

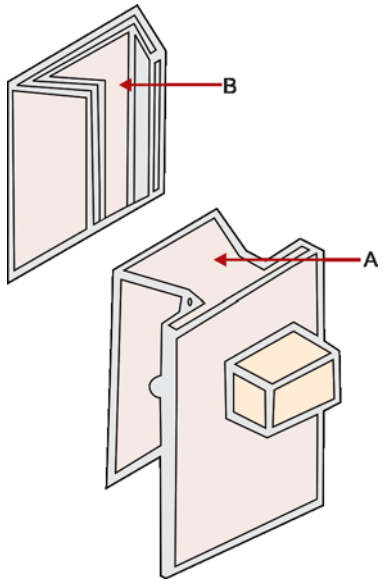


Fig. 19.15: "Crismani" prefabricated attachment showing three opposing guiding surfaces; A. Lug, B. Slot

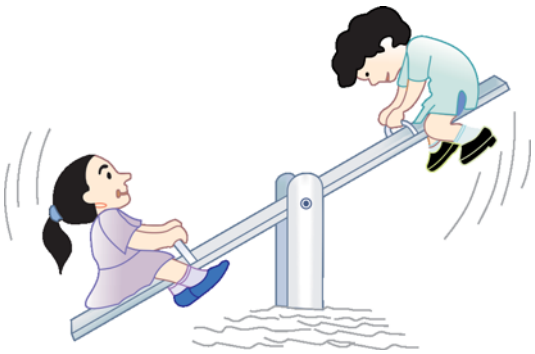


Fig. 19.16: See-saw effect
Rotation of partial denture around fulcrum line is similar to how a see-saw works

In class I and II cases as the fulcrum line shifts to more anteriorly placed rests, the base moves away from the ridges when the occlusal load is released.

Class IV: The fulcrum line passes through two abutment adjacent to the single edentulous space (Fig. 19.18).

STEPS IN DESIGNING

1. *Out lining the saddle areas*: Aim is to obtain maximum coverage but undercut areas must be taken into consideration.
   In free-end saddle cases (class I and II) full posterior extension into retromalar area (lower) and tuberosity (Upper) will prevent backward and forward movement of denture.
2. *Support the saddles*: Place occlusal rests/onlay in an appropriate locality, and spread this over as many natural teeth as possible, so that each individual tooth receives minimum force.

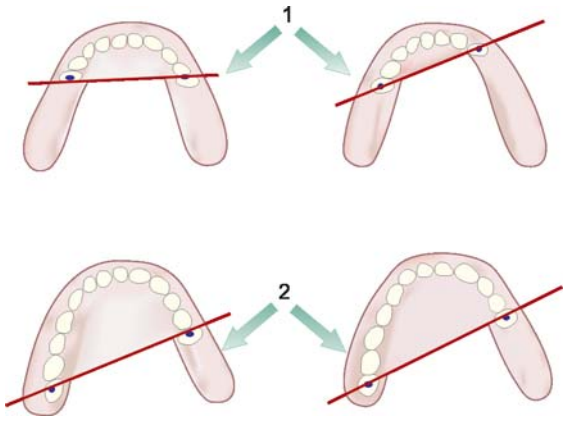


Fig. 19.17: Fulcrum lines
1. Class I, 2. Class II

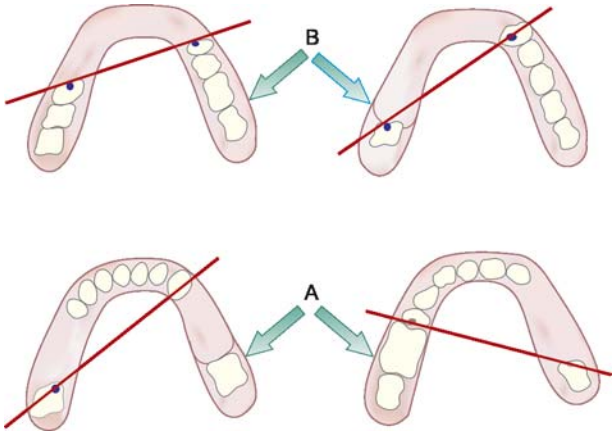


Fig. 19.18: Fulcrum lines
A. Class III, B. Class IV

Mucosal support is also considered- which is more in upper jaw because of palate as compared to lower jaw.

3. *Bracing the saddle*: This provides resistance to lateral movements. Measures employed are;
   a. Rigid clasp arms.
   b. Continuous clasp.
   c. Occlusal rests.
   d. Embrasure hooks.
   e. Reducing the steepness of cusp angle.
   f. Reducing the size of the occlusal table.
4. Resisting the antero-posterior movement of the saddles.
   Usually upper denture moves forward, lower denture moves backward.
   This is Achieved by;
   a. Natural tooth if present at the end.
   b. In class I and II cases;
      In lower jaw- high retromolar area
      In upper jaw- slope of hard palate.
   c. Encircling clasps.
   d. Embrasure hooks in the lower jaw.
   e. Full coverage of tubrosity in the upper jaw.
5. Providing retention.
   Mainly – By direct retainer- clasp, precision attachments.
   By Indirect retainers- Continuous clasp, occlusal rests, palatal bar.
   However, adhesion, cohesion, peripheral seal, balanced occlusion, shape of the denture also given consideration.
6. Connecting the saddles and retainers:
   By rigid connectors.

Summery: Mutual support, bracing, and resistance to antero- posterior movement is the object of designing so that the forces applied to the denture are distributed as widely as possible.

CONCLUSION

Partial denture is not just gap filler, but a replacement, which is integrated with the natural dental arch thus uniting the whole occlusion into one unit, ideally with both the denture articulation and the natural teeth in balance.

The damage, which a partial denture may cause, occurs through- leverage; caries and periodontal disease.

Every part of a partial denture should have a purpose and the design must represent the union of all the components in the simplest form.

Fixation is attachment of appliance to teeth for retention.

Anchorage is the site of delivery from which mechanical forces are exerted.

Ultimately; a partial denture design is a compromise between the requirements of hygiene; support; strength; and retention.

20 Clinical and Laboratory Procedures

Examination of Patient

A. History taking- Find out;
Why the patient is seeking partial dentures?
What is the main complaint with the existing condition of his mouth?
Has he worn partial dentures before – what is his /her experience with that?
Note down the age of the patient and Asses his/ her general health.

B. Clinical examination
a. Inspection
b. Palpation
Thorough clinical examination is aimed at finding.
Number of natural teeth present
Teeth affected by caries.
Restorations done on teeth.
Periodontal health- mobility, pockets, inflammation.
Which teeth are missing, i.e. Location of edentulous space.

Over Eruption and Under Eruption of Teeth

Over bite and Over jet.
Class of jaw relation.
Caries susceptibility.
Condition of ridge in edentulous spaces.
Tilts of teeth.
Oral mucos membrane status.
Size of tongue.
Bony prominence on the palate.
Exostoses on the alveolar ridge.
Retained roots showing through mucous membrane.
Occlusion of remaining teeth.
Movement of mandible in articulation
Any cuspal interferences to mandibular movements.
Oral hygiene habits.
How is patient's appearance, and masticatory function?
Un-erupted teeth, retained, buried roots.

C. Radiological examination (X-ray) to investigate.
Retained roots, Buried tooth, Impacted tooth, Incipient caries, Proximal caries, and extent of caries.
Apical infection and other pathological conditions.
Configuration of alveolar ridge, Bony prominences, Bony spicule, exostoses.
Restorations done on teeth.
Over hanging fillings.
Periodontal condition—condition of lamina dura, Bone resorption.
Alveolar support of abutment teeth.
Height of alveolar ridge.
Condition of crest of inter dental bone.
Root canal fillings
Condition and number of roots of abutment.

D. Impression of maxilla and mandible-to prepare diagnostic casts
Necessity of diagnostic cast.
1. To plan the treatment
2. To assess the proximal surfaces of teeth which can be used as guiding planes.
3. To locate the retentive and non-retentive areas of the teeth.
4. To find the suitable path of insertion and removal.
5. To educate the patient.
6. To prepare special trays.
7. As a record and for reference.

Mounting Diagnostic Casts on Adjustable Articulator

This is done with the help of face bow, which orients the maxillary cast to condyler axis- orbital plane (Frankfort horizontal plane) for the purpose of occlusal analysis.

Face bow is thus used to orient the maxillary cast on the articulator.

Face bow registration (Fig. 20.1).

Draw a line on the face of the patent extending from the upper margin of the external auditory meatus to the outer canthus of eye. Mark a point 11 to 13 mm anterior to the upper 1/3rd of the tragus of the ear. Mark another point at the lowest point on the inferior orbital margin.

Procedure

Soften a roll of wax and place it on the upper and lower surface of the face bow fork uniformly.

Then place the face bow fork in the patient's mouth and ask the patient to close the lower teeth in to the wax and hold it for a while.

Then remove the face bow fork from the mouth and cool the wax under tap water.

Replace the face bow fork into the patient's mouth again.

Attach the remaining assembly of the face bow to the face bow fork and adjust the calibrations on the shaft of the condylar rod, the two condylar rod tips positioned on the marking in front of the tragus of the ear. The shafts of the condylar rods are then locked in this bilaterally equal calibration.

Then adjust the infraorbital pointer, so that its tip touches the skin on the inferior orbital margin.

Then tighten all screws of the face bow.

Ask the patients to open the mouth.

Remove the entire face bow assembly intact.

Rinse under tap water.

Put it aside (Fig. 20.2).

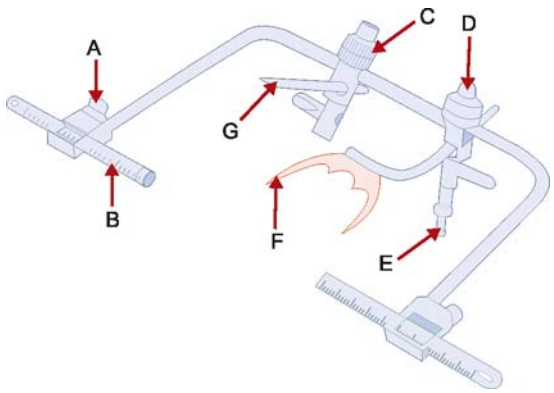


Fig. 20.1: Face bow
A. Set screw for calibrated condylar rod, B. Calibrated condylar rod, C. Lock clamp for orbital pointer pin, D. Lock clamp for bite fork, E. Anterior jack screw, F. Bite fork, G. Orbital pointer pin

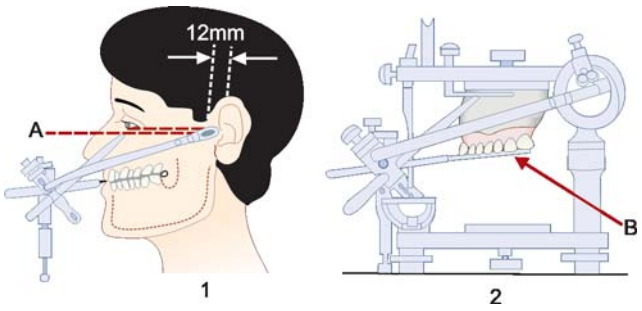


Fig. 20.2: Mounting models on adjustable articulator
1. Face bow registration, 2. Mounting the maxillary model; A. Frankfurt plane, B. Face- bow record

Thus face bow has registered the relationship of the maxilla to the condyles of the mandible.

Recording the Jaw Relations

This is to record the centric occlusion and centric relation (horizontal jaw relations) of the mandible to maxilla.

Centric occlusion is maximum inter digitations of maxillary and mandibular teeth.

Centric relation is most retruded position of the mandible to maxilla.

Both this records are registered with softened roll of wax.

For one record of centric occlusion and centric relation, place the roll of softened wax into the patients mouth and ask him/her to close the mouth on the posterior teeth where they fully inter-digitate. Wait for a while for the wax to harden. Ask the patient to open the mouth and remove the wax roll from the mouth. Cool it and put it aside.

For the other protrusive record soften another roll of wax. Ask the patient to protrude the lower jaw.

Place the softened wax roll on the lower teeth and ask the patient to close the mouth in that protruded position of the mandible.

Wait for a while for the wax to harden. Ask the patient to open the mouth.

Remove the wax record.

Cool it under tap water. Place it aside.

Mounting the Diagnostic Cast on the Articulator

Mounting the maxillary cast:

Roughen the base of the cast.

Soak the cast in water for 5 minutes. Dry the cast and apply vaseline lightly.

Center the face bow on the articulator—the calibration on the condylar rods of the face bow are adjusted to the same reading on both sides. Upper cast is placed into the indentations in the wax covering the bite fork. The face bow is now lowered or raised by means of a anterior jack screw until the orbital pointer pin touches the movable orbital axis plane indicator. The orbital axis plane indicator is placed at the same level as the condylar axis. This adjustment will make the upper jaw member parallel to the patient's orbital axis plane. Then remove the orbital plane indicator and pointer because it may interfere with placing the mounting plaster. Mix plaster of Paris to medium thick, creamy consistency.

Raise the upper arm of the articulator. Place some mass of plaster on the cast.

Lower the arm of articulator on the plaster. Build the plaster to cover upper plate of the articulator and trim. The plaster coming out through the opening in the mounting plate should be smoothed while still soft.

Mounting the Lower Cast (Fig. 20.3)

Roughen the base of the cast. Soak it in water for 5 minutes. Dry the cast and apply Vaseline lightly. Set the articulator to its basic settings. Condylar axis with its condylar spheres should be in the basic position.

Tighten the anterior setscrews.

Tighten the condylar lock screws.

Horizontal inclinations of the condylar tracks are set at 40°.

The condylar post is set at 15°.

Adjust the incisal pin, i.e. Lock the incisal pin with a reading of 2 to 3 mm opening (Depending upon the thickness of wax record) in its calibrations.

This is done to compensate for the thickness of the wax record, so that the arms of the articulator will again be parallel when the wax record is removed and the opposing casts meet.

Invert the articulator and support it. Place the centric jaw relation records between the upper and lower cast and make sure it fits accurately. Mix the plaster of Paris.

Mount the lower cast to the lower arm of the articulator, by closing the articulator.

Plaster is smoothened and trimmed. Lower cast can also be mounted without inverting the articulator in the following way- stand behind the articulator, place thumbs on the upper mounting plate, index and third finger underneath the lower cast. The articulator is now closed, bringing the lower cast into the soft plaster. The finger grips maintained until the initial setting of plaster.

Adjustment of the Horizontal Inclination of the Condylar Track from Protrusive Jaw Relation Record (Fig. 20.4)

The condylar spheres are unlocked by loosening the condylar lock nuts.

The incisal pin is lifted up.

The protrusive jaw relation record is placed between the teeth of the upper and lower casts.

By holding the articulator firmly against the chest, pressure is applied on the upper jaw member of the articulator above the center of wax record where it is held between the models. The setscrews for the condylar track inclinations are loosened and moved back and forth lightly.

Thus the inclination of the condylar tracks is adjusted until the upper and lower casts are in accurate and uniform contact with the protrusive wax record.

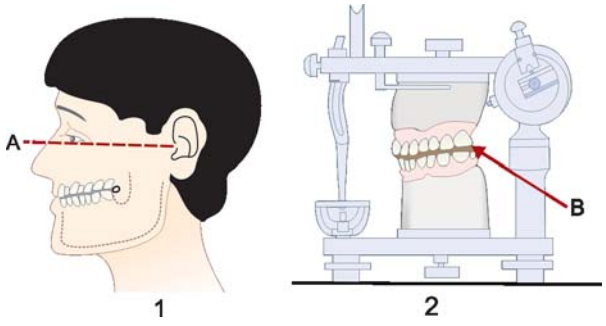


Fig. 20.3: Mounting models on adjustable articulator
1. Recording centric relation, 2. Mounting mandibular model;
A. Frankfurt plane, B. Centric relation record of wax

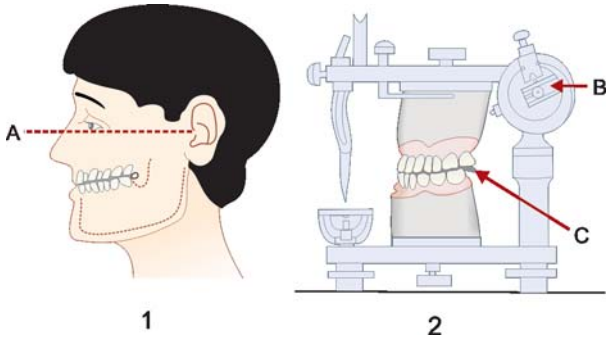


Fig. 20.4: Mounting models on adjustable articulator
1. Recording protrusive relation, 2. Setting the condylar track
A. Frankfurt plane, B. Condylar track, C. Protrusive wax record

MOUTH PREPARATION

In order to achieve the aim of providing the partial dentures- viz "not only replacing what is missing but also preserving what is left" the conditions in the mouth must be satisfactory. Mouth preparation is directed to fulfill these conditions.

This mouth preparation deals with,

1. Surgical preparation.
2. Periodontal preparation.
3. Abutment teeth preparation.

1. *Surgical preparations* of remaining natural teeth, it may be necessary to remove one or two if that helps for the success of partial denture in the opinion of the operator. Retaining these unfavorable teeth would complicate the matter in the end.

   Retained roots, impacted teeth, wrongly positioned tooth, Bony prominences like tori, exostoses, bony spicules etc; are surgically removed, and time is allowed for the gum to heal properly.

   Cysts, odontogenic tumors found in large X-rays are treated surgically.

   Polyps, Papillomas, Haemagiomas are excised.

   Mucous membrane if affected by hyperkeratoses, leukoplakia or ulcer are examined by biopsy and surgically removed by a specialist. Knife-edged alveolar ridges, ridges with sever undercuts are also surgically treated by bone trimming. Hyperplastic soft tissues like flabby ridges, folded tissues in the sulcus, are removed.

   Frenal attachment in the midline of upper lip and in the midline of floor of mouth if found high in attachment, they are surgically repositioned.

   Muscles like mylohyoid, buccinator, mentalis, genioglossus are found attached near the crest of the greatly resorbed alveolar ridge, are surgically treated to deepen the sulcus.

PERIODONTAL PREPARATION

The condition of the remaining teeth in the mouth is to a large extent depends on the conditions of tissues around the teeth. These teeth may be already affected by some of periodontal diseases or in the danger of being affected in the future. Therefore, one must first diagnose the condition of periodontal tissues, with respect to;

a. Inflammation
b. Pockets
c. Tooth mobility.

STAGES OF PERIODONTAL TREATMENT

1st stage: Thorough scaling and polishing including supra and sub gingival-curettage.

Strict instructions are given to the patient about oral hygiene and methods of brushing; massaging and cleaning and mouthwash etc.

Harmful habits like smoking, pan chewing etc; should be given-up.

Occlusal adjustments are made by selective grinding of teeth.

Mobile teeth are temporarily splinted

2nd stage: Even after this first line of treatment, it may be necessary to eliminate the pockets by gingivectomy or by flap operations.

Preparation of Abutment Teeth

Abutment teeth functions: These provide

1. Support.
2. Stability.
3. Bracing.
4. Retention.

Types of Abutments

1. Unprotected abutments are those, which do not need any restorations.
2. Protected abutments- are those on whom cast inlay or cast crown are done.

Restorations Done to Abutment

a. Cast inlay
b. Cast crown-full crown or ¾ crown.

Steps in Abutment Preparation

1. Proximal surfaces are disked- parallel to the path of insertion to form guiding planes.
   This is done with diamond points by using high-speed engine.
2. Reduce the excessive tooth contours on the buccal and lingual surfaces to lower the height of contour
   This will help proper designing of clasps
3. Preparing occlusal rests
   This can be done – on;
   i. Sound enamel
   ii. Cast inlay
   iii. Cast crown

Inlay Preparation on Abutment Tooth

This inlay is different from the conventional inlay because this is prepared mainly to support the occlusal rest.

The extent of inlay with respect of size, width, and depth are all-different. This inlay covers both proximal surface as well as occlusal surface- that means it is class II restoration. Inlay must be of sufficient width to accommodate the occlusal rest. The depth of inlay towards the pulp must not put the pulp at risk; however, adequate thickness of gold is necessary. After the cavity preparation; impression of the prepared tooth and overall impression is made by using elastomeric impression materials.

Die is made.

Inlay pattern is made on the die.

The pattern can even be contoured and paralleled with the help of model surveyor, and occlusal rest seat can be carved carefully on it.

Then pattern is invested and casted in gold alloy.

Crown Preparation on Abutment Tooth

Either full crown (ideal) or 3/4th crown is made on the abutment tooth.

Advantages of crown-

a. It protects the abutment.
b. It provides good contour for retention of clasps.
c. It is more suitable to give guiding planes.
d. Good occlusal rest- support can be achieved.

Procedure to make a gold crown is same as for cast gold inlays:

Namely
- Making a die
- Pattern
- Investing
- Boiling out
- Metal casting
- Finishing

GOLD INLAY/GOLD CROWN-CASTING

1. Preparing a die.
2. Making wax pattern on a die.
3. Spruing the pattern.
4. Investing the pattern.
5. Wax burn-out.
6. Casting liquid gold.
7. Cleaning the casting.
8. Finishing the casting.

METHOD EMPLOYED—"LOST WAX PROCESS"

This method involves surrounding of the wax pattern with a special investment material to produce a mould. When the investment is set, the wax pattern is melted and the wax is allowed to run out of mould. The process of eliminating the wax from the mould is called burnout. Then the liquid metal is poured into the space formerly occupied by the solid wax pattern. After the metal solidifies the mould is broken to recover the casting.

DIE

Definition

It is a positive, dimensionally accurate replica of prepared natural tooth and used for the construction of inlay or crown.

Most commonly used Die material is die stone (Fig. 20.5).

Master Die

Type IV and type V dental stones, (i.e. die stones) can be modified to increase their resistance to abrasion during carving of wax patterns and also their size can be slightly increased in order to accommodate the thin film of luting cement so that crown can be fully seated on the prepared tooth. Die altered to meet these requirements is known as master die.

To Increase Resistance to Abrasion

a. The surface of the die is applied with polymers like,
   Polymethyl methacrylate.
   Polyester
   Epoxy
b. Incorporation of wetting agent in the die stone composition ie; Lignosulfate.

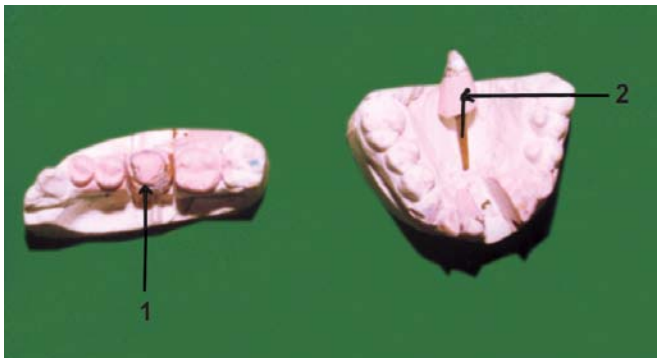


Fig. 20.5: Die
1. Of prepared molar tooth, 2. Of prepared incisor tooth

c. By using gypsum hardener like aqueous colloidal silica.

Die dimensions can be altered by using die spacers like:

Resins
Model paint
Colored nail polish.

These are applied to the surface of the die.

Method of Making a Removable Die

Double Pour Technique

Impression of the prepared tooth and overall impression made.

Clean the impression under tap water. Make two guidelines one on the buccal side and another on the lingual side of the impression at the site of prepared tooth with indelible pencil or pen.

Mix Die Stone

Fill the impression with die stone to above the level of the prepared tooth. Support the impression and level it on the bench.

Insert dowel pin in the site of impression where prepared tooth is, taking the help of pencil lines, to place the dowel pin centrally between and parallel to the pencil lines.

Allow the die stone to set.

Apply separating medium to the areas to be separated.

Cover the end of dowel pin with a piece of wax to relocate it later.

Mix dental stone now (of different color than the die stone).

Pour the remainder of the cast to make a base.

Remove the excess stone.

Allow setting and drying preferably overnight.

Separate the cast from the impression.

By using a jewelers fine saw blade in a saw frame, cut the cast throughout the inter proximal spaces next to the prepared tooth, down to the junction with the second pour of stone. Remove the wax at the tip of dowel pin. Gently remove the die (only) out of its seat in the cast (Fig. 20.6)

Trim the die to expose precise gingival margins.

Mark the gingival margin with pencil to help accurate waxing and later finishing.

Dowel pin = Pin in one part which fits into a hole in the other part.

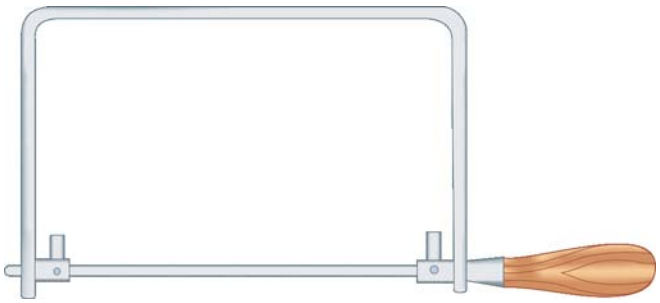


Fig. 20.6: Jewellar's fine saw

Making a Die from Copper Band Impression

Advantage- copper band impression is more accurate in recording sub-gingival areas- thus die margins are more precise.

Main Points

Contour the copper band.

Make a mark by scratching to indicate the buccal side, with a sharp instrument.

Fill the copper band with softened green stick compo.

Make the impression of prepared tooth in copper band.

Make overall impression with rubber base impression material.

Remove the impression.

Impression is poured in the die stone and dowel pin attached.

When set, soften the compo in hot water and separate the die.

Make a groove in the stone die below the preparation to act as key.

Replace the die in the overall impression and correctly seat it.

Cover the end of the dowel pin with a piece of wax.

Apply oil to the root of the die. Pour the overall impression with stone.

Remove the excess and make a base.

Allow to set.

Separate the die from the overall cast by cutting with a saw.

Remove the wax at the tip of dowel pin.

Gently push the tip of the dowel pin to remove the die from the cast.

Making Inlay Wax Pattern on a Die

(Indirect method) (Fig. 20.7)

Apply oil to the die.

Fill the cavity with soft inlay wax.

More soft wax is pressed with fingers to ensure perfect fit.

Carve the inlay and check the bite.

Scrape the proximal surface of adjoining teeth lightly, and apply oil in the contact areas of these surfaces.

Add more wax on the mesial and distal aspects of the pattern until they touch the adjoining teeth- this will ensure good contact points after polishing the inlay.

Make sure the edges of the inlay fit the edges of tooth preparation perfectly. Occlusal surface should not be deeply carved.

Attach a thick sprue or thin sprue with reservoir.

In Case of Crown Patterns (Fig. 20.8)

Apply oil to the die.

Dip the die in a liquid inlay wax (the temperature of the wax should be such that it is not far from the point of solidification).

Continue to build-up the crown either by dipping or by adding wax.

Carve correctly to crown shape mesiodistally, bucco-lingually and occlusally.

Make sure of contact points.

Occlusally, the cusps should resemble in shape and height of those of the adjoining natural teeth.

All molars have four cusps except the first lower which have five cusps.

The first lower premolar has a very small lingual cusp. Finish the marginal edge very carefully.

After carving polish the pattern with cotton wool using cold water.

Attach sprue.

SPRUING

Sprue former or sprue pin acts as a road, a channel or passage for entry of liquid metal into the mould in an invested ring. After wax elimination, sprue former or pin is removed as soon as investment has set. Sprue former can be made of metal, wax or resin.

Sprue former of suitable size should be selected according to the size of pattern.

For example-

- For small inlay — 1.5 mm diameter sprue former
- For larger inlay — 1.7 mm diameter sprue former
- For others — 2.1 mm diameter sprue former
- For large pattern — 2.6 mm diameter sprue former

The length of the sprue former depends on the length of the casting ring, that means, the pattern inside the ring is positioned about 1/4th" from the top of the ring. Proper positioning of the pattern in the ring helps the gases to escape out quickly before the liquid metal gets in. Otherwise porosity will occur.

Other requirements of sprue former are:

- Should be round in section to reduce turbulance.
- Should be smooth, especially at the junctions.
- Should be of adequate thickness to counter contraction.
- Should be short in length for the quick entry of liquid metal into the mould.

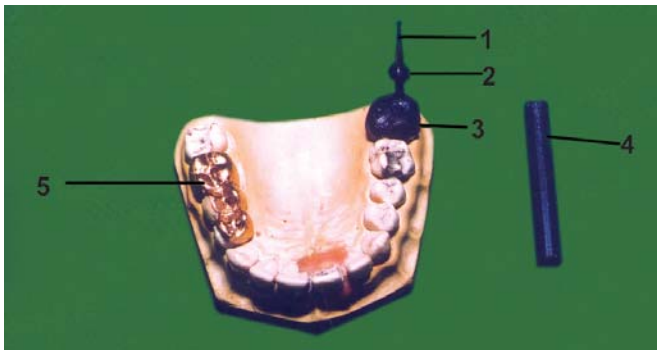


Fig. 20.7: Cast restoration:
1. Sprue former, 2. Reservoir, 3. Wax pattern, 4. Inlay wax, 5. Gold bridge

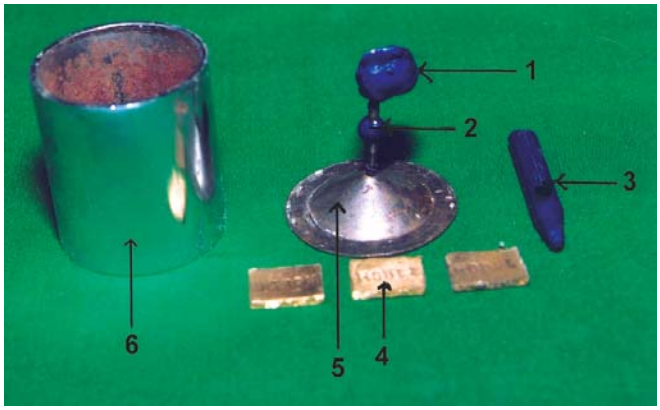


Fig. 20.8: Metal casting
1. Wax pattern, 2. Reservoir, 3. Inlay wax, 4. Gold alloy, 5. Crucible former, 6. Inlay ring

- Should be more than one in number in case of large patterns like MOD or partial denture framework.
- Should be placed on the pattern in such a way, that all the parts of mould are filled with liquid metal at one and the same time. The sprue pin is heated and attached to the pattern at the point of greatest bulk in the pattern and flared. Two sprue are attached for MOD pattern. The orientation of attachment of sprue former to the pattern is at an angle of 45° to the proximal wall, to prevent the impact of liquid metal on delicate areas of the mould, such as line angles.

Reservoir

Reservoir is a piece of wax attached to the sprue former approximately1mm (i.e. as close to the pattern as possible) from the pattern, as an added precaution to prevent localized shrinkage porosity. When the liquid metal in the mould solidifies first, and shrinks, the liquid metal in the reservoir will flow into the mould and thus overcomes the shrinkage. Reservoir is necessary only with sprue formers of very small diameter.

Removing the Wax Pattern from the Die

Sprue former can be used to remove the pattern. If not, the pattern is removed with a sharp probe or u-shaped stapler pin. Then the sprue former is attached to it. The pattern should be removed directly in line with principle axis of the tooth or prepared cavity. Any rotation of patterns will distort it. Hollow sprue pin is advisable because of its greater retention to the pattern.

Crucible Former

Also known as sprue base. It is like a stand to hold the sprue former along with a pattern within the casting ring while the pattern is being invested with investment material. The shape of the cricible former is such that when it is removed after the investment is set; it forms a funnal like shape, which is most suitable to pour liquid metal into it. Crucible former can be made of metal, rubber or resin.

Inlay ring: is a hollow tube fitted over the crucible former encircling the wax pattern to a height of ¼" or so above the edge of the pattern. The ring and the crucible former provide a seal and so the investment material can be poured inside the ring to surround the wax pattern and sprue former.

Casting ring liners: Traditionally, metal casting Ring or casting flask when used, must be lined with a liner of moistened paper made from glass fiber. This liner provides a cushion for the hardening investment material to expand into, during the setting reaction. The liner is moistened because a dry liner would absorb water from the investment and minimize the setting expansion. Previously, the liner material was made of asbestos, but its use has been abandoned because of its carcinogenic potential and could be a health hazard.

Todays ring liners are,

a. Cellulose paper.

b. Aluminium silicate glass fiber.

The liner is done in two layers inside the ring, and the thickness must be not less than 1 mm, so that ring can accommodate more expansion. The liner is placed some what short of the ends of the ring (about 3 mm) to enable the investment to obtain a grip and provide a seal. And this also restricts the longitudinal expansion (i.e. towards the open ends of the ring), so that a more uniform expansion takes place and less distortion of the wax pattern.

Size of the ring: It should be such, that places the wax pattern not more than one quarter of an inch from the top of the ring—thus hot air and gases trapped within the mould will escape out quickly as the molten metal rushes in. This way, backpressure porosity is prevented. A longer ring should be under filled for the same reason (Fig. 20.9).

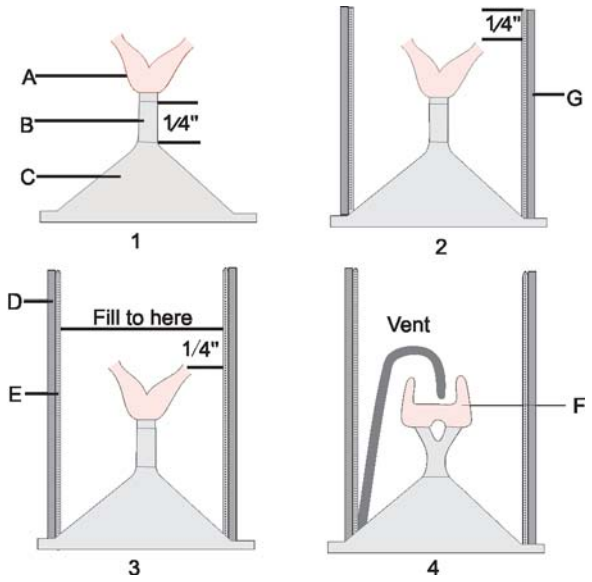


Fig. 20.9: Spruing (Principles)
A. Wax pattern, B. Sprue former, C. Crucible former, D. Inlay ring (large), E. Ring liner, F. MOD pattern, G. Inlay ring (small)

If split ring or flexible rubber ring is used, ring liner is not necessary, because such rings permit setting expansion of the investment.

Cleaning the pattern: The wax pattern is cleaned with mild soap solution to remove any debris, oil etc and then it is rinsed with room temperature water, and air-dried.

Since wax is water repellant, an agent, which reduces the surface tension of wax is applied to the pattern sparingly, and excess is blown off, such agent is known as "Wettax" and it is really a mild soap solution. By doing this, pattern surface will be properly and uniformally coated with investment.

Investing

Mixing investment with distilled water is done according to the manufacturer's ratio, in a clean, dry bowl, without entrapment of air into the mix.

Mixing methods:

a. Hand mixing and use of vibrator to remove air bubbles.
b. Vacuum-Mixing: This is better because it removes air bubbles as well as gases that are produced and thus produces a smoother mix.

Methods of Investing:

a. Hand Investing.
b. Vacuum investing.

Hand Investing

First, the mixed investment is applied on all the surfaces of the pattern with a soft brush. Blow off any excess investment gently, thus leaving a thin film of investment over the pattern. Then apply again.

Thus coated pattern can be invested by two methods:

1. Placing the pattern in the ring first and then filling the ring full with investment.
2. Filling the ring with investment first and then force the pattern through into it.

Vacuum Investing

Aim: To remove air bubbles from the investment.

To produce a smooth mix in contact with wax pattern thus finished casting will be free of surface defects and porosities will be less.

To increase the strength of investment.

Vacuum Investing Unit

This consists of a chamber of small cubic capacity from which air can be evacuated quickly and in which casting ring can be placed. Evacuation of air can be done by electrically or water driven vacuum pump.

Procedure: Ring filled with investment is placed in the vacuum chamber. Air entry tube is closed. Then vacuum applied. The investment will rise and froth vigorously for about 10 to 15 seconds and then settles back. This indicates that air has been extracted from the ring. The pressure is now restored to atmospheric by opening the air entry tap gradually at first and then more rapidly as the investment settles back around the pattern. Then the ring is removed from the chamber and the investment is allowed to set. Modern Vacuum investing unit does both mixing and investing under vacuum and is considered better than hand mixing and pouring.

Then, there are two alternatives to be followed depending upon which type of expansion is to be achieved in order to compensate for metal shrinkage. They are,

1. If *hygroscopic expansion* of investment is to be achieved, then immediately immerse the filled ring in water at a temperature of 37°C.
   Or
   Under "Controlled water adding technique". A soft flexible rubber ring is used instead of usual lined metal ring. Pattern is invested as usual. Then specified amount of water is added on the top of the investment in the rubber ring and the investment is allowed to set at room temperature. In this way only enough water is added to the investment to provide the desired expansion.
2. If *thermal expansion* of the investment is to be achieved, then investment is allowed to set by placing the ring on the bench for 1 hour or as recommended by the manufacturer.

Wax Burnout and Heating the Ring

After the investment has set hard, the crucible former and metal sprue former is removed carefully, and any loose particles at the opening of sprue hole are removed with small brush. The purpose of wax burn out is to make room for the liquid metal. The ring is placed in the oven (Furnace) at 250°C with the sprue end down, thus allowing the melted wax to flow out, for 30 minutes or even upto 60 minutes may be a good procedure to ensure complete elimination of wax and carbon (Fig. 20.10).

Heating the ring: The object is to create a mould of such dimension, condition and temperature so that

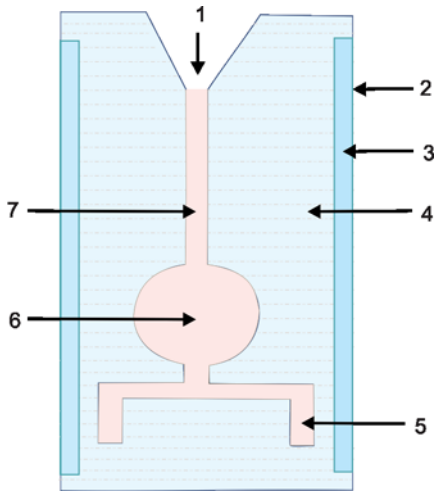


Fig. 20.10: Cross section through inlay casting mould after removal of crucible former, sprue former, and wax
1. Crucible, 2. Casting ring, 3. Ring liner, 4. Investment, 5. Inlay mould, 6. Reservoir, 7. Sprue

it is best suited to receive the hot liquid casting metal.

Casting Temperatures:

a. Hygroscopic Low Heat Technique:
After wax elimination the temperature of the same furnace can be set to a higher temperature for heating or else, the ring can be transferred to another furnace, which has already set to the higher temperature. In any case accurate temperature control is essential and therefore these furnaces have pyrometer and thermocouple arrangement. The ring is placed in the furnace with the sprue hole down and heated to 500°C and kept at this temperature for 1 hour.

In this low heat technique, the thermal expansion, obtained is less but together with the previously obtained hygroscopic expansion the total expansion amounts to 2.2 percent, which is slightly higher than what is required for gold alloys. Therefore the casting will fit rather loosely.

b. Thermal High Heat Technique:
Ideally, after wax elimination, the ring should be placed in a furnace, which is at room temperature and then the temperature is gradually raised, until it comes to 700°C in 1 hour. Then the ring is heat soaked at this temperature for another ½ hour. This slow rise in temperature is necessary to prevent cracking and decomposition of investment. The ring however should not be heated above 700°C, to prevent sulfur contamination and disintegration of investment leading to rough surface of finished casting.

Thus in this technique greater part of the compensation for metal shrinkage is by means of thermal expansion of investment (Fig. 20.11).

Setting expansion	.7%
Thermal expansion	1.25%
Total expansion	1.95%

The total heating time for larger castings can be upto 2 hours.

Casting the Metal

At the end of heating, if one were to look at the sprue hole, it will look cherry red. This means the ring is ready for metal casting and in fact it must be done immediately within one minute.

Casting machines:
1. Centrifugal casting machine.
2. Steam pressure machine—Solbrig machine.
3. Air pressure machine—Hereus.
4. Spring wound electrical resistance—melting furnace-casting machine.
5. Induction melting casting machine.

Centrifugal Casting Machine

This method makes use of centrifugal force to thrust the liquid metal into the mould. The aim is to force the liquid metal under sufficient pressure, so that

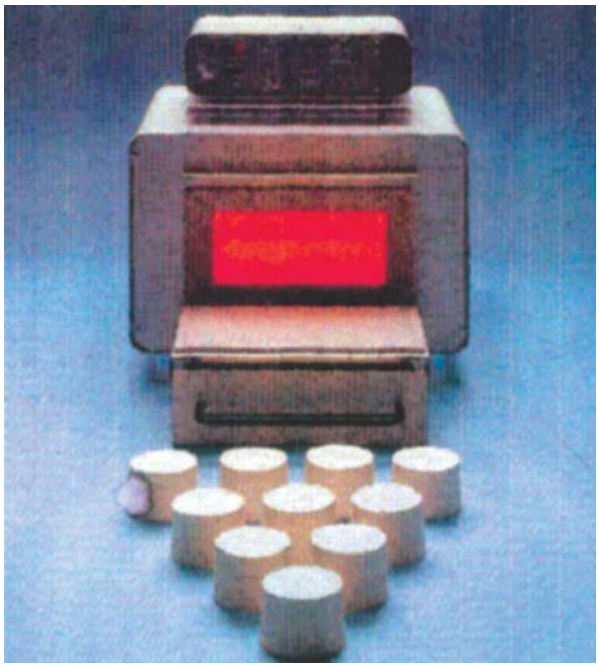


Fig. 20.11: Metal casting furnace

the pressure can be maintained for at least four seconds after the metal has been cast. Pressure is necessary because the liquid metal with high surface tension will not enter the mould on its own.

Centrifugal force – is a force generated by an object moving on a curved path. This force tends to pull the object away (out ward) from the centre of motion. Centripetal force – is an equal and opposite force to the centrifugal force. It is exerted by the restraining device that keeps the object on its curved path. Centripetal force tends to pull the object towards (in ward) the centre of the motion.

Thus in centrifugal casting, the liquid casting metal is poured into the mould as the mould is revolved (spinned) rapidly about its own axis. This spinning motion creates centrifugal force, which pushes the molten metal against the surface of the mould.

General application of centrifugal force:

1. Spin drier of a washing machine in which water is forced against the wall of a drum.
2. Cream separator used in dairy industry, which separates cream from milk.
3. Earth moving around the sun.
4. Electrons moving around the nucleus of an atom.

Centrifugal casting machine also known as "broken arm" casting machine has an arm, which is supported in the middle by a rotating spindle. One side of the arm has weights to balance the machine. Other side of the arm has a crucible to melt the metal and an arrangement to hold the casting ring. The spindle is spring-loaded and can be wound by hand, kept in this wounded position until the metal is melted. When the arm is released, it spins and throws the liquid metal outward into the investment mould inside the ring (Fig. 20.12).

Actual Procedure

1. The force exerted by the machine is adjusted by turning 3 or 4 turns of the arm to wound the spring and kept in that wounded position with the help of a stop rod.
2. Balancing the machine should have been done before the ring is heated, by placing the ring on the casting machine so that the arm is balanced to compensate for the weight of the ring and investment.
3. Pre-heating the alloy to its melting point by using reducing zone of the gas – air blowpipe flame. Use of reducing zone only is necessary to avoid Carburization of the metal, and because it is the hottest part of the flame. Reducing zone is blue in color. During heating the alloy, reducing flux such as borax is sprinkled over the alloy as soon as it is hot enough for the flux to adhere to it. Applying flux removes oxide skin on the surface of the alloy, and reduces its surface tension so that the liquid metal becomes very fluidy.
4. Then the ring is immediately taken out of the heating furnace and placed firmly against the back plate of the machine. Then the crucible is moved up against the sprue hole end of the ring. The crucible also has a hole in it. Thus both the holes (sprue hole and crucible hole) are up against each other.
5. The alloy is reheated again until it spins, and looks bright red-hot (1100°C) with shiny mirror like surface. This indicates its proper fusion.
6. At this stage blowpipe flame is removed, and arm of the machine is released by dropping the stop rod simultaneously.

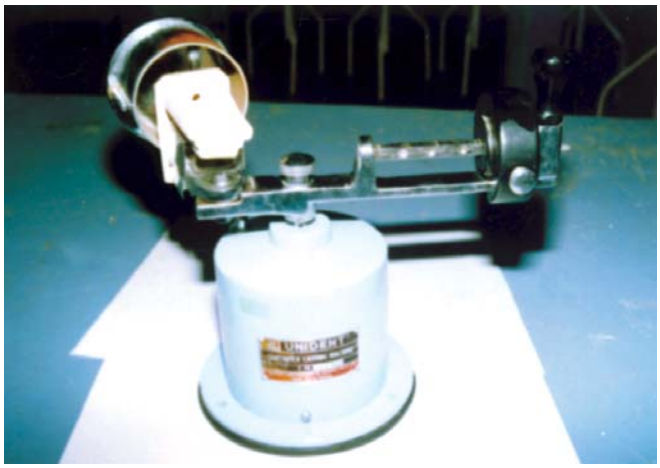


Fig. 20.12: Centrifugal casting machine (Broken-arm type)

The machine begins to spin and stops on its own. This act will throw (cast) the metal through the hole and directly through the sprue hole into the mould cavity in the investment material.

Two things are important during this final step—one is, metal must be in full liquid state, that means flame must be held at the metal until the arm of the machine is released.

Secondly, there must be enough rotational force to fill the mould cavity quickly before the metal solidifies in the sprue area.

Electrical Resistance—heated casting machine – In this, metal is automatically heated in a furnace (not by torch flame). Used with metal-ceramic restorations.

Induction melting casting machine—Metal is melted and forced by air pressure into the mould and used for casting base metal alloys.

Cleaning the Casting—Pickling

After completion of the casting, the hot ring is removed from the machine by holding with pair of tongs and placed on a heat resistant block to cool. When the visible part of the metal becomes dull red in color, it is immediately placed in cold water. This is quenching and causes the investment to crack which helps in separating the casting from the investment. Thus removed casting is cool enough and its sprue is removed from the restoration by using an abrasive disk mounted in a hand piece.

Then the casting is placed in a porcelain dish and 30 or 50 percent hydrochloric acid or sulfuric acid is poured to cover it. Acid removes the oxide coating on the surface of the casting and any residual investment. It may be necessary to heat the acid but it should not be boiled.

After pickling, casting is thoroughly cleaned under running water to remove all traces of acid. Ultrasonic devices are also available for cleaning the casting.

The commonly done method of heating the casting and then putting it into the pickling solution may damage the margins of the restoration and distort it and therefore should not be done. Metal-ceramic restorations and base metal alloys are not pickled.

Finishing and Polishing

Restoration may be stoned and polished on the external surfaces except at the edges, in the laboratory. Edges are finished in the clinic after cementing.

Finishing tools and polishers.
Mandrels, Abrasive disks.
Rubber cup polishers, Bristle brushes.
Pumice or Tripoli or Rouge.
Wool mop, etc.

Fitting to the Tooth

The cast metal restoration (e.g. Inlay) is finally cemented into the cavity prepared in a tooth, by using appropriate luting cement. When the cement has hardened, final finishing and polishing is done in the clinic (Fig. 20.13).

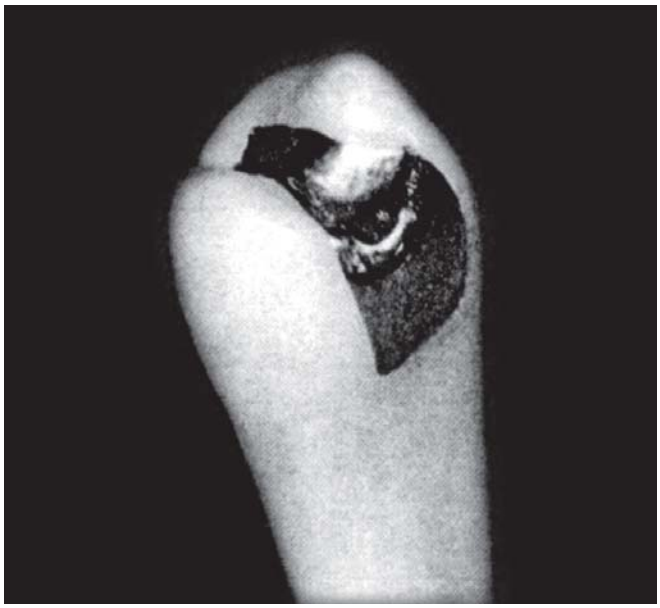


Fig. 20.13: Gold inlay casting on the die

BITE ANALYSIS

Over a period of many years, teeth wear, tilt, migrate and some are even lost and because of this, the mandible gradually takes a different, deflected position from that of centric relation. That means the condyles are in an abnormal relation to their respective glenoid fossae, and are not in their most posterior position. This ia an acquired disharmony between centric jaws relation and centric occlusion. The result of all this is premature cusp contact, deflection of mandible, joint dysfunction and breakdown of supporting structures of teeth. Bite analysis is an investigation of such deflection and causes.

BITE REHABILITATION

Aims at removing the causes so that mandible regains its proper position of centric relation and centric occlusion.

IMPRESSION FOR PARTIAL DENTURE

In class III partial dentures, which are entirely, tooth supported abutments are the main support for the denture. Any impression method that records these abutments in detail along with their surrounding structures and residual ridge is good enough.

But in the case class I and II which are distal extension types with no total tooth support, residual

ridge support also play a part in this function. Therefore special impression methods are necessary.

Impression in such cases must;
a. Record the tissues under load.
b. Distribute the load over as greater area as possible.

Residual ridge can take two positions;
1. Resting position- gives muco-static (without pressure) impression.
2. Functional position- gives muco-compressive (under load) or functional impression.

Resting position impression can be obtained by
- Plaster of Paris
- ZOE impression paste
- Rubber base
- Hydro colloides

} of suitable viscosity;

Functional Selective Tissue Displacement Impression Method

This is a combination of muco-static and muco-compressive methods.
Impression material used,
a. Border molding stick compound.
b. Rubber base impression material of addition silicone type for impression proper.

Tray: Special tray made with acrylic resin.

Method in Short

Acrylic special tray is made on duplicate diagnostic cast.

Special tray is border molded with attached partial denture cast framework.

Final impression is made with rubber base impression material by using the border moulded special tray along with attached framework.

Box the impression to get the altered Master cast.

Convectional Impression For Partial Denture

Material used—Addition silicone type
Tray used—Perforated stock tray (Fig. 20.14).

Method

Apply tray adhesive to all surfaces of inside of the tray.

Wait for 10 minutes.

Mix putty silicone (base and catalyst).

Knead with fingers and make a roll.

Load the tray (Fig. 20.15).

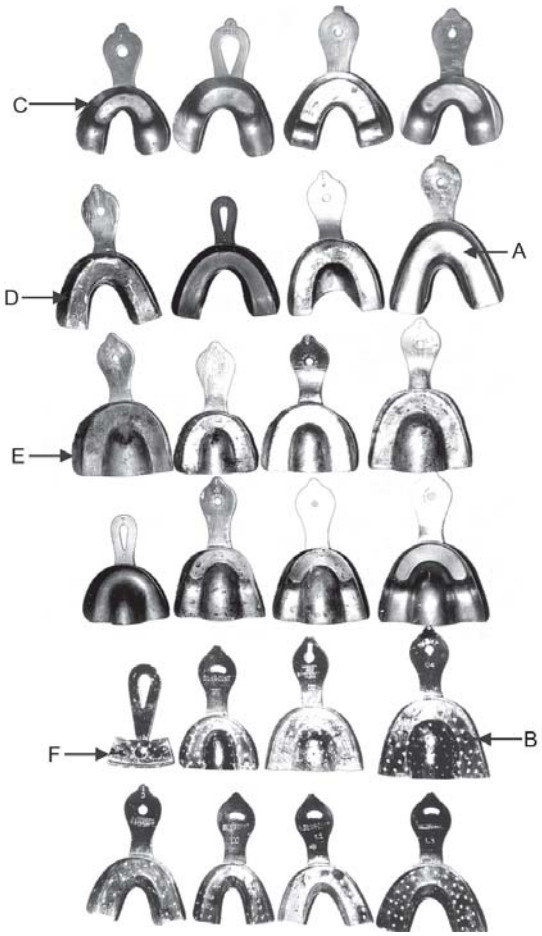


Fig. 20.14: Assorted dentulous impression trays
A. Non-perforated; B. Perforated; C. Combination tray (Edentulous and Dentulous); D. Mandibullar tray; E. Maxillary tray; F. Part (Sectional) tray

Fig. 20.15: Silicone elastomeric impression material with Base paste- blue; Accelerator paste- white; Glass slab; Spatula; Syringe

Mix the syringe material and load the syringe.

Inject the syringe material around the prepared tooth in the interproximal area, over the margins and occlusal surface. Place the tray immediately directly over the syringe material and make impression. (Figs 20.16 and 20.17).

Remove the tray with a quick snap.

Rinse the impression under tap water.

Make cast.

Addition silicones – also called,
Vinyl poly silioxane; poly vinyl silioxane,
Mode of supply-

1. Two paste system.
2. Gum and cartridge system with auto mixing.
3. Putty silicones.

Composition

Base paste	*Catalyst paste*
Polymethyl hydrogen siloxane	Divinyl poly dimethyl siloxane
Siloxane prepolymers	Siloxane prepolymers
Hybride silicone	Platinum salt reactor
Colloidal silica filler	Colloidal silica filler
Surfactant- soap	Alkyl silicate cross linking agent Fig. 20.18

Advantages

a. Clean to handle.
b. Most accurate.
c. No taste and smell.
d. Stable.
e. Good flow.
f. No by-product.

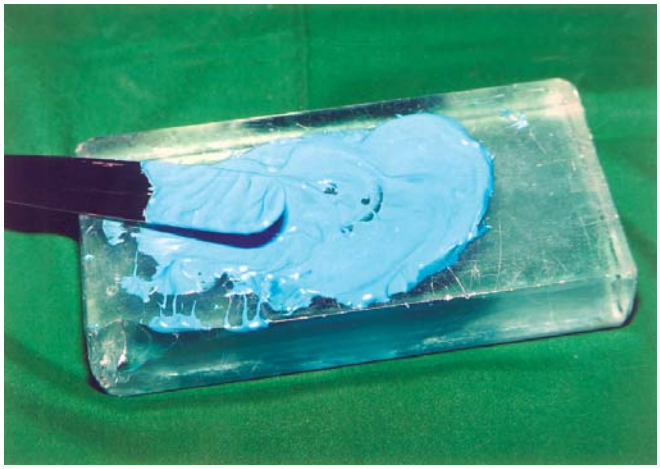


Fig. 20.16: Mixing of silicone elastomeric impression material

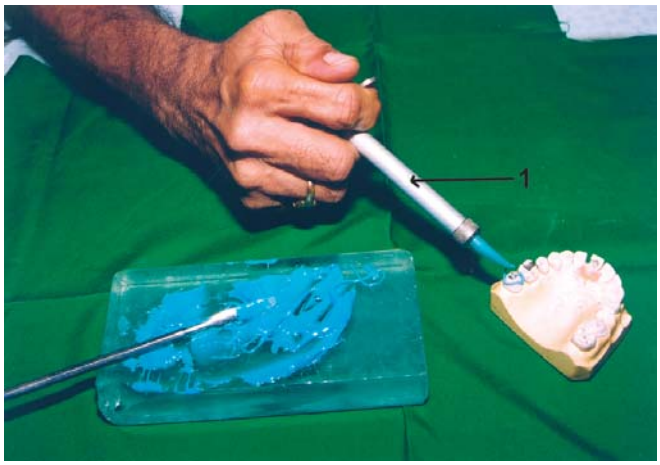


Fig. 20.17: Impression of prepared tooth
1. Injecting around prepared tooth

CONCLUSION

Mucostatic Impression

The impression material, which is fluid enough to register the denture bearing area without tissue displacement so that the denture fits best at rest- i.e. when the teeth are apart.

Mucocompressive Impression

The material is viscous enough to bring about controlled tissue displacement in the area so that the denture fits best in function, i.e. when biting, eating, etc;.

Fig. 20.18: Silicone elastomeric impression material with
Base plate } In a tube
Accelerator paste }
Glass slab
Spatula
Syringe

Part 4

Selective Tissue Displacement Impression

This method is a combination of pressure over certain areas and no pressure or little pressure over other areas.

The principle of this method is based on the fact that certain areas of mucosa withstand pressure better than the other areas.

Main requirement for this method is specially designed special tray.

Main objective of most of the techniques of making impression is, even distribution of load over the whole of the fitting surface.

Closed mouth impression: In order to mould the borders of the impression exactly to the position of vestibule of the mouth, patient is asked to close the mouth and do some muscular movements.

Casting chrome-cobalt as a denture base (Stellites)

COMPOSITION

Ingredient	*Percentage*	*Function*
Chromium	25-30	Provides resistance to corrosion
Cobalt	35-60	Gives strength and hardness
Nickel	0-30	Increases ductility
Molebdenum	5-6	Provides hardness
Beryllium	Trace	Reduce fusion temperature
Tungsten	0-5	Provides hardness
Carbon	0.2-0.4	Controls the hardness
Maganeses, Silicone, Iron	Trace	Acts as scavengers

Advantages	*Disadvantages*
High resistance to tarnish and corrosion	Complicated technique
Take and retains high polish	Need of expensive equipment
High hardness	High fusion temperature
More stiff and strong	Difficult to grind, adjust and polish
Light in weight	Not susceptible to heat treatment
Adequate mechanical properties	Low flexibility
Low cost as compared to gold	
Extremely resistant to abrasion	
Little galvanic action	

Investment Materials used for Chrome Cobalt Casting

1. Phosphate bonded investment. *Composition*-
   Refractory- Silica- 80 percent Quartz or cristobalite or combination of both.
   Binder—Magnesium oxide and ammonium phosphate—20 percent
   Mixing ratio- Powder—100 grams
   Water—14 ml
   Expected expansion
   Normal setting expansion – upto 1 percent
   Thermal expansion – upto 2 percent
2. Silica bonded investment. *Composition*-
   Refractory silica (Quartz or cristobalite)
   Binder – Ethyl silicate made into a special solution, also known as binder solution. Binder solution can also be purchased ready, as;
   One bottle containing Ethyl silicate.
   Another bottle containing dilute hydrochloric acid.
   Equal quantity from each bottle is mixed and allowed to stand for 12 to 24 hours.

Mixed Ratio

Investment powder—100 gm
Binder solution—22 ml
Expected thermal expansion – 1.8 to 2 percent

PROCEDURE

Duplicating the Master Model (Fig. 20.19)

Master model is surveyed, denture is designed, and unwanted undercuts are blocked out.

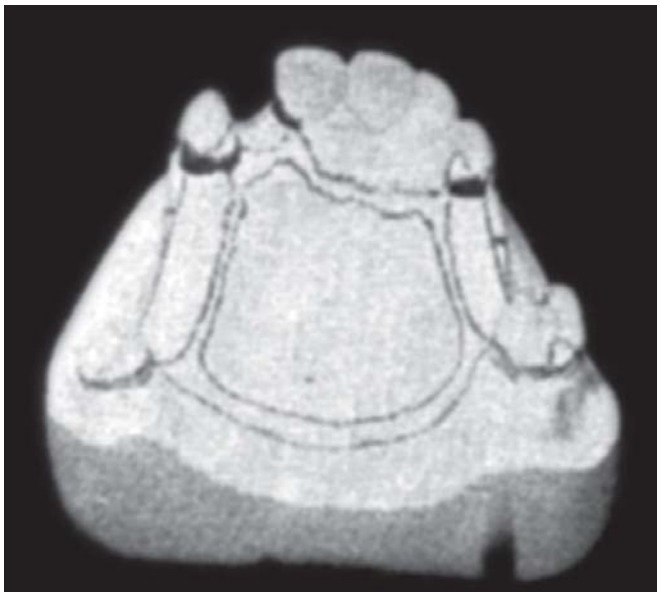


Fig. 20.19: Design of cast RPD on master model

Attach to sprue former with wax to the center of the wax pattern.

Soak the master model in lukewarm water for 20 minutes.

Assemble duplicating flask.

Prepare the duplicating material (reversible hydrocolloids) and pour over the master model in the duplicating flask. Irreversible hydrocolloid can also be used but not by pouring.

When set take out the master model.

Insert longest tapering sprue former in the hole in duplicating material left by the sprue former that was fixed to the master model.

Mix the investment material according to the manufacturers instructions. Cast this into the impression and vibrate.

Allow to set.

Remove the duplicating material by peeling.

Remove the sprue former.

Dry the model in an oven.

Wax Pattern

Use preformed plastic patterns to make the wax pattern. Clasps, bars and meshes etc; can be formed with this, to produce a neat pattern of uniform thickness. But make sure they adhere well to the model surface. Position the clasp, correctly—the flexible portion of the clasp should not go far below the survey line and for this undercut gauge ten thousands of an inch is used when designing clasps, sharp narrow corners should not be formed in the design, which are difficult to polish. At the end, seal the pattern everywhere at the edges including the clasps. Instead of preformed plastic patterns, ordinary casting wax (these too available in preformed form) can be used to form a denture pattern (Figs 20.20 and 20.21).

Spruing

The sprue is a channel through which the molten metal enters the mould. Requirement of the sprue are same as explained with gold casting. However multiple spures are attached in chrome-cobalt casting, although the methods of spruing are many and varied. While spruing from the palate, a hole is drilled in the palate about 1/4th of an inch in diameter to accommodate the main sprue and the pattern sealed. The pattern must be well fitted before spruing, and sprues must be firmly attached. Provide reservoirs

Fig. 20.20: Designing cast RPD with preformed wax patterns

for thick portions. Whenever possible, form a continuous flowline with the casting cone. Do not use long sprues.

Casting Ring

1. High heat casting ring.
2. Split casting ring.

High heat casting ring should be lined to allow for the expansion of investment. Split ring, which is removed before the investment is placed in the furnace, need not be lined.

Place the ring and seal it to the base with modeling wax.

Investing

Apply wetting agent (Household powdered or liquid soap) to the pattern. This will reduce the surface

Fig. 20.21: Ready shaped plastic patterns for designing cast RPD

Part 4

tension and allows proper coating of the pattern with investment so that finished casting will be smooth. Mix proper investment material, either phosphate bonded or silica bonded according to the manufacturers instructions.

Fill the casting ring slowly with investment, vibrating continuously

Allow to set.

Wax Elimination and Heating the Ring

Apply little heat to the sprue former and remove it with a slight twist.

Balance the casting machine by placing the ring over it.

Then keep the ring in a electric furnace and slowly raise the temperature to the casting temperature of 950 to 1050°C. Correct temperature is usually given by the manufacturer of the alloy.

Heat soak the ring at this temperature for at least 30 minutes to get maximum thermal expansion and to eliminate all gases.

Heat the crucible in furnace along with ring.

Casting

For casting chrome-cobalt—a centrifugal machine is used, which are of two types.

1. Spring operated and metal is melted with oxyacetylene flame.
2. Electric motor operated and metal is melted by a high frequency electric current known as "*induction melting*".

Preliminaries

Wind-up the centrifugal machine to the required tension.

Protect your eyes by anti-glare goggles.

Adjust the acetylene flame until a neutral slightly carburizing flame is obtained

Technique

Pull back the spring-loaded crucible holder.

Let another person take out the heated crucial from the furnace and place it on the holder.

Light the blowtorch.

Place piece of metal in the crucible.

Let other parson take the heated ring out of the furnace and place it on the machine in its place.

Then the metal is melted and cast.

Allow to cool slowly.

DE-FLASKING AND FINISHING

Tap the ring with small hammer to release the investment.

Cut the investment with hacksaw blade.

Sandblast it in a machine.

Cut the sprues with discs on a high-speed grinder.

Remove all roughness on fitting and non-fitting surfaces.

Polish electrolytically

Finish the non-fitting surface with rubber stone.

Do final polishing with felt wheel and green chromic oxide compound (Fig. 20.22).

Indications for Cast RPD

1. In Kennedy class I and II cases
2. In long span cases- where one can get retention and stability from the opposite side of arch- this is *Cross arch stabilization*.
3. In cases where denture will act as periodontal splint.
4. If many anterior teeth are missing.
5. Highly resorbed ridges.
6. Presence of sound abutment teeth.
7. Foe economic reasons- this is cheaper than bridge.
8. If the patient is careless about oral hygiene.

Why Cast RPD Fails

1. Due to improper assessment of the case.

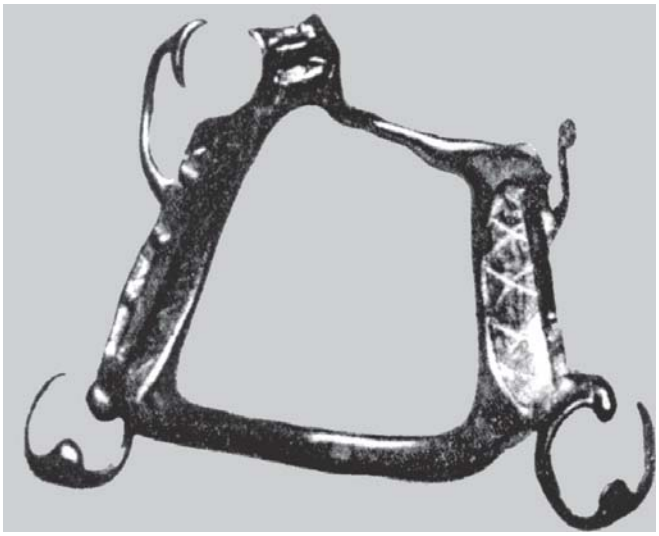


Fig. 20.22: Chrome-cobalt casting framework

2. Due to improper use of surveyor.
3. Due to incorrect design.
4. Due to wrong mouth prep.
5. Lack of tissue and tooth support.
6. Lack of proper occlusion,
7. More metal visible.
8. Non co-operative patient.
9. Damage to natural teeth and periodontal tissues.
10. Difference of opinion with the technician.

All acrylic RPD

This tissue-borne denture is unpopularly known as "Gum Stripper" because of repeated pressure applied to the ridge speeds up the resorption of under lying structure and ends up in loss of occlusal contact as a result of sinking denture. In due coarse of time the parts of the denture fitting around the gingival margins also apply pressure and in so doing strip the structures from around the teeth. The gingival margins become inflamed and susceptible to infection (Figs 20.23 and 20.24).

Fig. 20.23: Patient in need of partial denture

Fig. 20.24: Patient with partial denture inserted

Prevention of "Gum Stripping"

1. By making occlusal rests to prevent or to reduce tissue-wards movement of dentures.
2. By removing some of the collets from the denture to make it gingival free.

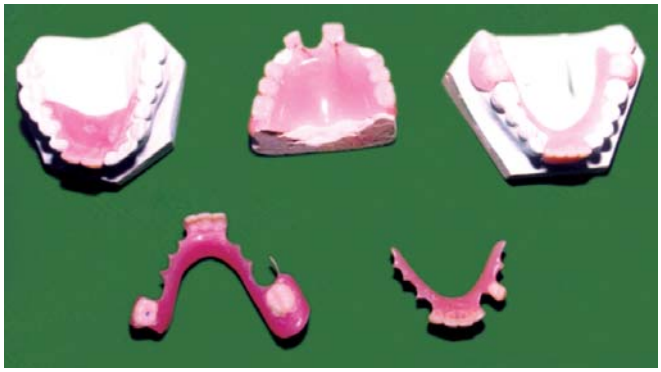


Fig. 20.25: All acrylic (tissue-borne) partial dentures

Retention of All Acrylic Partial Dentures

1. The denture must fit the teeth and tissue accurately to be retentive and stable.
2. Wrought wire clasps.
3. By flanges.
4. By collet- these are important components of partial denture.
   They give support to softer tissues.
   They spread the occlusal load.
   They help in stabilizing the denture in association with flanges and palate.

Collet must be trimmed on the fitting surface to remove the spike, which fits into the gingival margins.

Collet should be trimmed to maintain the contour of the tooth.

Collet must not become pressure points.

Collet must not entrap food (Fig. 20.25)

Spoon denture: This is a maxillary denture carrying one or two anterior teeth with a palatal spoon like part not in contact with the margin of the teeth, i.e. collets free. But with labial flange.

PART 5

CROWNS, BRIDGES, AND MISCELLANEOUS

21 Crowns

Word origin / meaning
Crown- French- Corone; Latin- Corona
= Curved
= A circular head ornament. For example: - that Worn by Kings and Queens.
Jacket – French- Jaquet
= outer covering
= Short coat of leather
= Outer covering of a boiler or pipe.
Ceramics – Greek – Keramicos
= Earthen
Porcelain – Portuguese – Porcelang
= "Little pigs"
= Cowrie shell (Shell of mollusca)
The shape of the cowrie shell and little pigs back are alike. The smoothness of cowrie shell and this earthen material are alike so the name porcelain.
Kaolin
= Chinese – Kao = High, Ling = Ridge.
= From mountain Kao-ling in china.
Veneer
= French- Fournir = to furnish.
= To overlay a thin sheet of fine wood or other substance.

Types of Crowns

1. According to the coverage.
   a. Full crowns } On posterior
   b. 3/4th crown, partial veneer } tooth
   c. Jacket crown } On anterior
   d. Post crown } tooth
2. According to the material
   a. Non-metal-
      i. Acrylic jacket crown
      ii. Porcelain jacket crown
   b. Metal
      i. Gold alloy crown
      ii. Nichrome crown
   c. Combination of metal and non-metal.
      Porcelain fused to metal (Fig. 21.1).

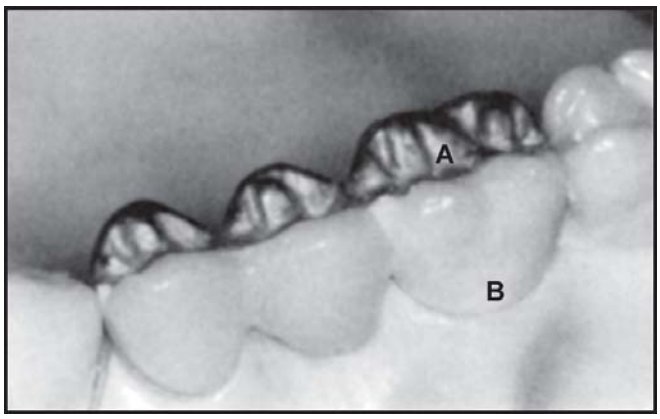


Fig. 21.1: Bridge with porcelain fused to metal
A. Metallic lingual aspect, B. Porcelain covered buccal aspect

3. Temporary crowns
   For example, Ready made- polycarbonate,
   Stainless steel/ Nichrome
   Celluloid
   Aluminum (Fig. 21.2 and 21.3).

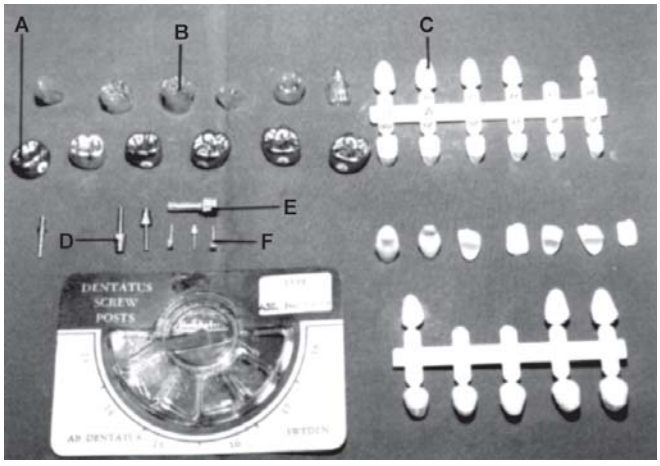


Fig. 21.2: Ready crowns and posts
A. Nichrome crown, B. Plastic, C. Polycarbonate, D. Charlton post, E. Post tightening spanner, F. Dentatus screw post

Fig. 21.3: Temporary crowns
Assorted polycarbonate crowns

Indications for Crowns

1. Badly damaged tooth
2. For esthetic reasons.
3. To improve occlusion.
4. As a retainer to bridge.
5. On the abutment of cast removable partial dentures.

Contraindications

1. Very young and very old.
2. Periodontally affected tooth.
3. Economic status
4. Mobile tooth.
5. Unfavourable occlusion

Definition

Crown: This is an artificial, constructed in the laboratory and fixed above the gingiva, and made of porcelain, acrylic resin or metal.

Jacket crown: This is a veneer of porcelain or acrylic resin fitted to the crown preparation of natural tooth.

Porcelain Jacket Crown PJC

Indication: To improve appearance—done on one or more of anterior teeth.

Tooth: Vital.
Age of patient- After 20 years.

Advantages

Excellent appearance.
Not harmfull to gingiva
Dimensionally stable
Color stability
Resistant to wear and tear.

Requirements

a. Skilled technician
b. Dust free laboratory
c. Dentist must have keen sense of color
d. Accuracy of work.

Crown Preparation: Of maxillary Central Incisor

Stage 1: Discing the Proximal Surfaces (Fig. 21.4)

This is done with safe sided carborundum disc. Disc cut should be in the direction of long axis of the line of withdrawl.

Start discing from the incisal edge and cut it straight through the enamel. Mesial and distal cuts are made converging palatally and swing the disc around the tooth labially and palatally and start forming the shoulder with the disc. Care should be taken not to cut patient's lip or tongue while doing this and also neighbouring tooth should not be damaged. Discguard and tongue guard can be used to prevent this, and firm grip of the hand piece is essential.

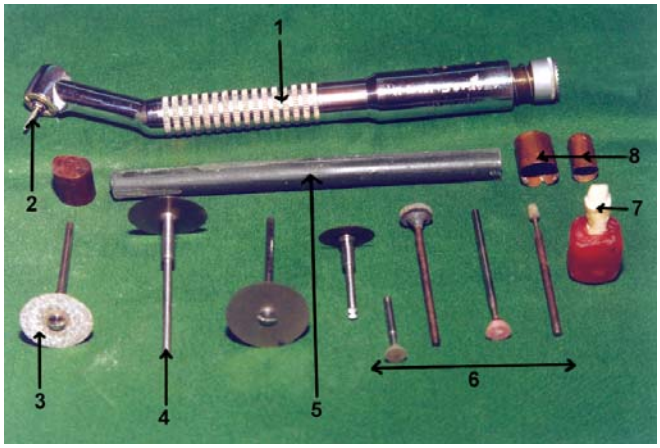


Fig. 21.4: Crown cutting instruments and materials
1. Contra angle hand piece; 2. Diamond bur; 3. Disc on short mandrel; 4. Disc on long mandrel; 5. Green stick compound; 6. Assorted stones; 7. Prepared crown for PJC; 8. Copper tubes

Stage 2: Incisal Reduction

This is done with wheel stone. After edge reduction it is given a 45° angle towards the palatal surface.

Stage 3: Reduction of Labial Surface

This can be done either by the wheel stone or by tapered stone. First reduce the incisal 2/3rd and then the gingival 1/3rd. Face cutting inverted stone is used to round off the labial shoulder.

Stage 4: Reduction of Palatal Surface

This surface is reduced in two planes. One gingival to the cingulum and this is made parallel to the gingival 1/3rd of the labial surface as far as possible. The instrument used for this is tapered fissure bur or stone.

Remainder of the palatal surface above the cingulum towards the incisal edge is reduced with a small size wheel stone with round edges and the surface is made concave.

This cancave surface above the cingulum and vertical surface below cingulum should meet in definite angle (corner) and this will help in retention of the crown. Palatal shoulder is prepared by using a face cutting inverted cone or tapered fissure stone on a contra angle hand piece. To ensure the full reduction of the entire surface of the palatal surface, it should be marked with a pencil before starting reduction, and then reduce until the whole pencil mark disappears.

Stage 5: Final Touch

Seven hundred tapered fissure stone or bur is used with light touch and it is moved all round the tooth, keeping the whole length of the bur in contact with the labial surface but not palatally. Shoulder hand file or end cutting fissure bur is used to go all round the shoulder. Finally round off the labial edge.

Main thing in the crown preparation is, there should not be undercuts.

There should be enough clearance on the palatal surface for the lower tooth (Figs 21.5 and 21.6).

Making the Impression of Crown Preparation

First copper ring impression with green stick compound.

Second overall impression

Third lower jaw impression

Fig. 21.5: Die
Die of prepared central incisors

First. Copper Ring Impression

Select a copper ring of suitable size, which will go just over the margins of the prepared tooth.

Shape the copper ring as that of tooth and pinch it on either side so that it doesn't touch the neighboring teeth. Cut a V-shape on the incisal edge of the labial surface of ring for the purpose of identification and help in locating the ring in the overall impression.

Trim the gingival edge of the ring according to the tooth shape.

As a trial, fill the ring with soft wax and push it over the tooth to test the proper trimming. If found excess anywhere trim the ring with wheel stone. Remove the soft wax and clean the ring by passing over the flame quickly.

Soften the greenstick compound over the bunsen flame, and fill the copper ring with it.

Apply Vaseline to your fingers.

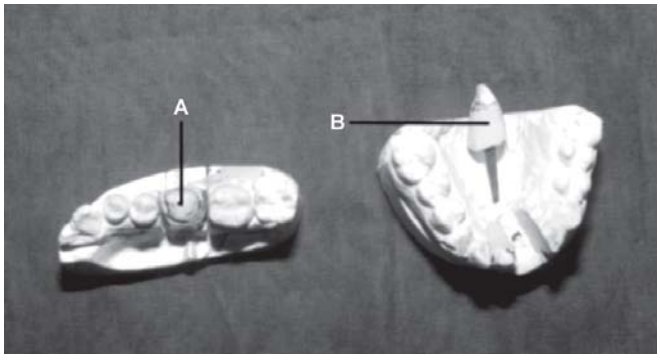


Fig. 21.6: Die
A. Molar tooth; B. Incisor tooth

Re-warm the ring by holding it well away from the flame.

Keep one finger over end of ring and push the ring over the prepared tooth and over the edges. Wriggle a bit. Cut V-shape in the compound, corresponding to V cut of the ring.

Remove extra compound.

Wait for compound to harden.

Second. Overall Impression

Select a perforated tray (even lower tray will do for the upper).

Mix silicone rubber base impression.

Apply tray adhesive and wait (this is done before mixing).

Load the tray and make overall impression.

When rubber is set remove the tray.

Then remove the copper ring.

Third. Lower Jaw Impression

This is done with alginate impression material.

Cast is poured in stone plaster.

Copper Plating the Green Stick Compound Impression in Copper Ring

Steps (Fig. 21.7)

1. Impression is cleaned with a detergent by using a brush.
2. Suitable length of soft wire (e.g. copper) is twisted around a copper tube.
3. Impression surface and edge of the copper tube is painted with colloidal graphite using a brush. The purpose is to make the surface of the impression electrically conductive. This step is called Metallizing. Allow to dry.
4. Insulation – ½" wide strip of wax is warmed and wrapped around the copper tube and also along the part of the twisted wire, in order to insulate these. The wax should protrude about 2 mm beyond the edge of the impression.
5. For the initial strike, sprinkle iron particles into the dry impression until full. Tip out and shake. Particles of iron should remain adhered to the surface. Fill the impression with electrolyte by using a pipette. Suck and fill several times until whole impression surface is light brown in color.
6. Thus prepared impression is made cathode (–ve electrode) of a plating bath, with an anode (+ve electrode) of copper. Impression is immersed in the electrolyte with the open end slightly tilted upwards and facing the copper rod. Negative lead is connected.
7. Current is switched on. Current of 5 to 50 milli Amp/Cm^2 of cathode surface is applied for 10 hours. This will cause slow dis-solution of anode and movement of copper ions from anode to cathode, thus plating the impression.
8. Electrolyte is an acid solution of copper sulfate – made up as follows
   Pure copper sulfate – 212 gm.
   Pure sulfuric acid – 31 cc.
   Potash of alum – 12 gm.
   Distilled water – 1000 cc.
9. Die stone is poured into the impression to obtain copper plated die.

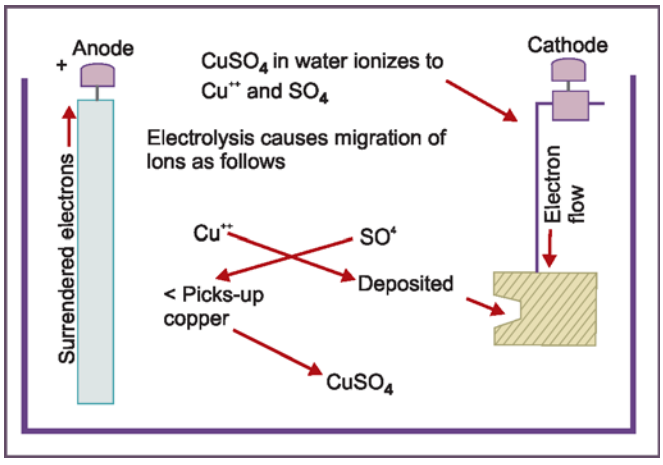


Fig. 21.7: Ionization of copper sulfate electrolyte Showing migration of ions and flow of electrons

Casting the Impression

After copper plating the ring impression, mix die stone and pour into the ring impression and make a tapered root with the help of pin and tube.

Soften the green stick compound.

Remove the die.

Relocate die in the overall impression in correct position and fix with sticky wax.

Apply oil to root of the die as a separating medium.

Now mix dental stone and pour into the rubber base over all impression.

Allow the stone plaster to set.

Remove the impression.

Trim the base of overall cast until tip of the tapered end of the die is seen.

Press the tip downward to remove the die from the cast.

Adapting Platinum Foil to the Die (Fig. 21.8)

Take a piece of platinum foil.

Platinum foil of gauge 1/1000 of an inch is used for this.

Make a tongue shape at one side of the foil.

Fold the tongue over the incisal edge and adapt. Then fold the foil from both sides over this already adapted tongue on the palatal surface. Adapt the foil thoroughly to the labial surface and to the both sides of the die, and then on the palatal surface.

Adaptation is done with fingers and by using a round burnisher.

Both the side folds meet at the palatal surface close to each other.

Reduce the height of one of this fold (where they meet) less than the other fold.

Cut a V-shaped portion of foil at the margin at the gingival end.

Fold the longer sheet over the shorter one and adapt together over the palatal surface thoroughly.

Cut away any excess at the incisal end of the die.

Cut the excess beyond the margin of the shoulder preparation, but leave 1/8th of an inch all round.

Burnish all areas above and below the margin thoroughly with a blunt instrument.

Building the Crown (Fig. 21.9)

Mix separately different shades of porcelain –like Body porcelain; Neck porcelain; and Incisal porcelains with distilled water to a creamy consistency in different dappen glasses.

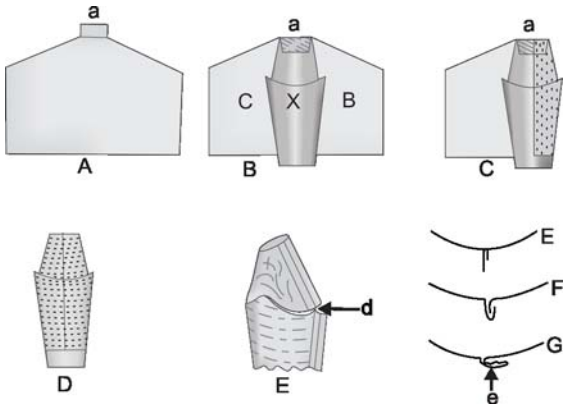


Fig. 21.8: Platinum foil adaptation to the die
A. Platinum foil cut to shape; B. Platinum foil placed on die (X)
a. Tongue of foil, b & c. Two folds of foil, d. V cut in the foil at the margin, e. Folding both the folds in the same direction

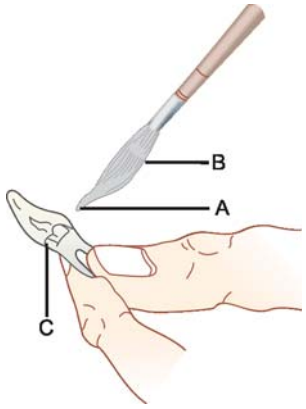


Fig. 21.9: Porcelain crown making
Application of porcelain slurry (A) to the platinum matrix (C) with brush (B)

Apply the wet mix to the platinum foil matrix over the die and blend the different shades as required, the application can be made with a fine camel hair brush or with a metal instrument.

Vibrate the die on an instrument, which will make the water of the mix to come to the surface (Fig. 21.10).

Remove this water with a blotting paper or with a nice linen piece of cloth.

Add further mix of porcelain and repeat the same again.

Build the crown to the required shape (Fig. 21.11).

Make the size little larger (side tooth on the cast as a guide) to allow for shrinkage on a baking.

Leave some excess beyond the shoulder as well.

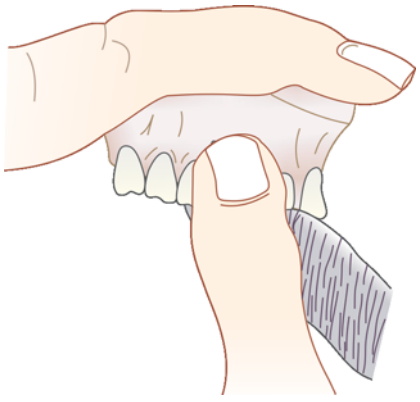


Fig. 21.10: Porcelain crown making
Drying the porcelain slurry and compressing

Fig. 21.11: Porcelain crown making
Carving the crown to shape

Baking the Crown

Remove the crown from the die (i.e. along with platinum foil)

Place it on a small ceramic stand. Open the door of a preheated furnace; keep the crown in front of the door of the furnace for drying for few minutes.

Then push the crown inside the furnace (Fig. 21.12).

Close the door of the furnace. Raise the temperature slowly to the fusing temperature of 950- 1050°C.

Open the door from time to time and examine the crown.

When the crown gets a matt (rough) finish remove it from furnace and cool it slowly under glass cover.

Then place the crown over the die to check the fit.

Fig. 21.12: Furnace for baking porcelain crown

Add some more porcelain mix to build the crown to the correct shape.

Over build the sides and incisal edge slightly to allow for contraction.

Put the crown back in furnace and fuse to a dull glaze.

Remove from the furnace and cool again.

Add glazing and staining porcelain mix to surface of the crown.

Place in the furnace.

Fuse to smooth glaze.

Take the crown out of furnace.

Cool it slowly. Vacuum firing produces good crown.

Try the crown with platinum matrix on the patients prepared tooth.

Alternations can be made if necessary.

If satisfactory, remove the platinum foil by stripping and with tweezers.

Fix the crown on the prepared tooth with appropriate luting cement.

Post Crown

This type of crown is made for the tooth in which pulp of the root has been removed and thus tooth is non-vital, (i.e. not living). This crown is usually made for the anterior tooth, which is very badly damaged by caries or by trauma.

Clinical Procedure

Remove the entire crown of the tooth.

Prepare the root canal, i.e. enlarge it and extend the length of the root canal – sufficient enough to hold the post.

Shape the root face- labially to below the gingiva and palatally according to the position of opposing lower tooth.

Posts can be;

1. Ready made- for example: Dentatus screw posts, Charlton smooth posts.
2. Metal casted.

Making Casted Post (Fig. 21.13)

This involves making an impression of the root canal with green stick compo in a copper ring, and then the overall impression.

First select a wire of suitable length, which fits correctly to the root canal. Soften wax or compound,

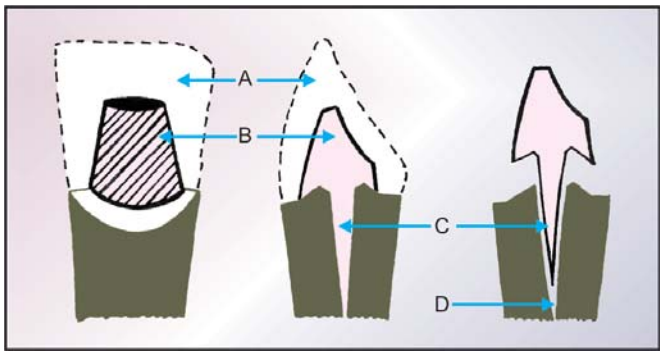


Fig. 21.13: Post crown
A. Porcelain jacket crown; B. Core (Metallic);
C. Post (Metallic); D. Root canal

shape it to the shape of root canal and push inside the root canal. Put pressure at the opening of the canal. Plug it a bit. Make a loop at one end of the selected wire.

Hold the wire with plier and heat the end, which is not looped.

Insert the wire in the root canal through the compound.

Remove the root impression for checking its fit and length.

Replace it back into the root canal.

Trim the suitable size copper ring to fit the root face.

Fill the copper ring with softened green stick compound and make an impression of the root face along with the wire.

Remove the copper ring with attached impression of root canal.

Fit another piece of wire as before into the root canal and make overall impression with silicone rubber base.

Copper plate the copper ring impression.

Make a die of root canal and root face; this die is now relocated into the rubber base overall impression.

Prepare a overall cast in stone plaster and split the die from it.

Next step is to make a cast metal post and core on this die of root canal.

Apply oil to the root canal and root face of the die.

Fill the root canal with liquid inlay wax.

Insert a warm piece of wire through the wax into the root canal.

This wire acts as a sprue.

Build the core with inlay wax around the wire over the root face.

Shape the core similar to jacket crown preparation.

By holding the wire projecting above the carved wax core, remove the pattern out from the root canal and root face.

Invest and cast with gold alloy as usual.

Now gold alloy post and core is ready.

Fit the casted post on the die.

Adapt platinum foil over the core of the post.

Prepare the porcelain jacket crown as described earlier.

Other Types of Crowns

A. *Richmond crown*: This is a single unit crown consisting of crown, core and post.
B. *Davis crown*: It is post crown in which porcelain tooth (not jacket) is cemented to the post core.

Dental Porcelain as a Material

Definitions

1. It is a glass-like ceramic material, which usually contains feldspar, Silica, Kaolin and Alumina.
2. It is a ceramic powder, which on a being subjected to a high temperature fuses to a hard smooth solid.
3. It is a refractory material made by heating a mixture of Kaolin, feldspar, quartz and metal oxides.

Composition (Fig. 21.14)

Ingredient	*Function*
Feldspar –75-80% $K_2O\ Al_2O$, $6SIO_2$ or (potaspar) Na_2O , Al_20_3 6 SIO_2 (Sodaspar)	Provides the amorphous glassy phase and holds the silicon mineral crystals together. Acts as basic glass lattice of SIO4 former. It acts as flux- ie Quartz and Kaolin will be dissolved into feldspar.
Quartz (silica) –15%	Provides crystalline phase. Gives stiffness, body and stability. Helps in retaining shape during fusing.
Kaolin (white china clay) 3-5%	Acts as a binder and unites with feldspar. Acts as opaquing agent. Improves the workability.
Potassium oxide Sodium oxide Calcium oxide	Acts as glass modifiers.
Various metallic oxides	Color pigments
Cerium oxide	Fluorescing agent
Zirconium oxide	Opacifing agent

Fig. 21.14: Porcelain jacket crown
1. Porcelain powder; 2. Baked crown

Types of Dental Porcelains

1. High fusing - Fusing at 1300°C
2. Medium fusing - Fusing at 1100-1300°C
3. Low fusing - Fusing at 850-1100°C
4. Ultra-low fusing - Fusing below 850°C

Compositions

Main Ingredient	*High fusing*	*Medium fusing*	*Low fusing*
Feldspar	80%	61%	60%
Quartz	15%	29%	25%
Kaolin	4%	Nil	Nil
Others	1%	Rest	Rest

Aluminous Porcelain

This type of porcelain contains high percentage of alumina as a filler to strengthen porcelain.

Alumina Content

In core powder - 50 percent
In dentin powder - 15-20 percent
In enamel powder - 5 percent

Methods of Condensation

a. Brush application method.
b. Gravitation.
c. Spatualation.
d. Whipping.
e. Vibration.

Stages of Baking

a. Low biscuit bake.
b. Medium biscuit bake.
c. High biscuit bake.
d. Glazing.

Metal Ceramics: Also called as

a. Porcelain fused to metal PFM
b. Porcelain bonded to metal PBM
c. Porcelain to metal PTM
d. Ceramic metal

This is a method in which low fusing porcelain is used as a veneer to the metal restorations.

Typical Composition of Alloy and Porcelain. Used in Metal Ceramics

Alloy (base metal)		*Porcelain (opaque porcelain)*	
Nickel 65%		Silica- SIO_2	48-59%
Chromium 17%		Alumina Al_2O_3	16-20%
Molebdenum 9%		Potash K_2O	8-10%
Beryllium 2%		Soda Na_2O	5-7%
Iron, Aluminum, Silicon	Trace	Calcium oxide	1.2-1.4%
		Boric oxide	1.2-1.4%
		Titania	2-3%
Copper, Manganese, Tin	Trace	Tin oxide	4-5%
		Zinc oxide	1-1.5%
		Ferric oxide, Fluorine	Trace

Advantages of Metal Ceramic

1. High strength- less fracture.
2. Improved fit.
3. Better esthetics if done well.

Disadvantages

1. Increased opacity and light reflectivity.
2. More difficult to create depth of translucency in a crown.
3. More difficult to get good esthetics.
4. Porcelain can devitrify and become cloudy
5. More bulk of metal necessary to provide rigidity.

Modern New Generation Dental Ceramics

1. Leucite Re-inforced porcelain (Optec- HSP)
2. Glass ceramic crown/ castable ceramic (Dicor)

3. CAD-CAM ceramic.
4. Injection molded Glass ceramic (IPS- Empress)
5. Glass infiltrated Alumina core Ceramic
   (In- Ceram)
   (In ceram spinell)

Cast Glass Ceramic Crown "DICOR"

This is a castable ceramic and made by lost wax process just like metal. This type of ceramic is similar to that used in cookware industry, and is basically composed of silica and therefore it is glassy and amorphous. So the name "Glass Ceramic"

Procedure

Crown Preparation

Wax pattern of prepared crown.

Investing the pattern with phosphate bonded investment.

Wax eliminated by heating.

Glassy, amorphous ceramic mix is poured into the mould to form the shape of the crown.

Remove the crown from investment.

Remove the sprue.

Heat to 1075°C for several hours

During baking, glassy, amorphous material changes into solid, crystalline material containing tiny thin sheets of crystalline mica. This transformation is known as "ceramming". Such a crystalline ceramic crown prevents propagation of crack and doesn't break.

Fit this crown now on the die.

Add surface porcelain, like enamel porcelain, neck porcelain etc, and finish to the final shape and appearance.

This is veneering.

Do the final baking and glazing.

Properties of Dicor

Strong,

Non-porous

Hard but do not abrade the opposing natural tooth.

Good appearance.

Advantages

1. Do not crack and break like other porcelains.
2. No need of metal coping.

Disadvantages

Not suitable for posterior teeth.

Partial Veneer Crown—Three Quarter Crown

(Carmichael crown) (Fig. 21.15)
This crown is made to cover all surfaces except labial or buccal surface of anterior or posterior teeth.

Use: As a bridge abutment.

Teeth on which it is made:
a. Incisors.
b. Canines.
c. Premolars.

Advantages

a. Good strength and stability.
b. Esthetically not bad.

Methods of Retention

a. By grooves cut in the side of the natural tooth.
b. By its 3/4th coverage of the tooth.
c. By cement

Variants of Basic Type

a. Pin lay
b. Pin ledge,
} which are retained, by additional pins inserted in the tooth.

Method of Construction: Usual Procedure like;

- Copper band impression.
- Over all impression.
- Making a copper plated die.
- Making a pattern.
- Spruing

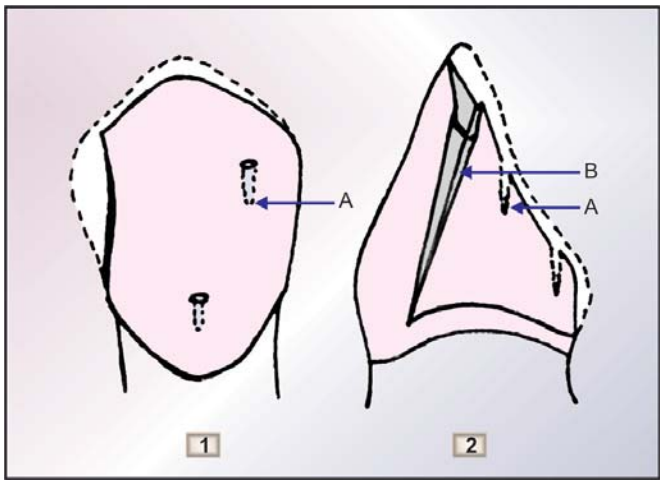


Fig. 21.15: 3/4th (Three quarter) crown
1. Palatal view; 2. Side view; A. Slots, B. Groove

Part 5

- Investing.
- Gold alloy casting.

Full Metal Crown (Full Veneer Crown)

This crown normally covers all the five surfaces of premolars and molars. For esthetic reasons, the buccal surfaces of premolars are covered with acrylic resin or porcelain.

Use

i. As a retainer to fixed bridge.
ii. To restore a badly damaged single tooth.
iii. As an abutment for removable cast partial denture.

Contraindication
a. Mobile tooth,
b. Large pulp chamber.

Principle of Tooth Preparation

a. Remove the undercuts from the surfaces.
b. Tapering towards the margin.
c. With shoulder or shoulderless prep.
d. Provide enough clearance on the occlusal surface.

Laboratory Procedure in Brief

Die is made, on which wax pattern is carved with inlay wax. Build the contact points and correctly shape all the surfaces. Occlusally the cusps should resemble the neighboring tooth in shape and height.

Attach a thick, short sprue.

Preferably vacuum invest the pattern.

Sufficient compensatory expansion should be obtained to over come the metal shrinkage.

Take care of contact points and margins while trimming and polishing the casted crown.

22 Bridges

Definition

Bridge is a compact, usually fixed prosthesis, which is supported and retained, mainly by inlays and crowns.

Types of Bridges

1. Fixed- Fixed
2. Fixed- Movable.
3. Plain cantilever.
4. Spring cantilever
5. Compound bridge- is combination of any two of above types.

Others

1. Temporary bridge- made entirely of acrylic resin and used to prevent tooth movement and damage while the permanent bridge is getting ready.
2. Maryland bridge-

Main Components of Bridge

1. Retainer—e.g. Inlay or crown
2. Pontic—artificial tooth
3. Connectors—Soldered joints, occlusal rest or slotted attachment.

Unit: Comprises Pointic and retainer.

Span: Describes the edentulous space that carries pontic or pontics.

Abutment tooth: This is the tooth to which retainers are cemented.

Definitions

Retainer: This is that part of the bridge which unites abutment tooth and pontic.

Connector: This is that part of the bridge which units retainer and pontic.

Pontic: This is that part of a bridge, which is between abutments and functions as artificial tooth – to replace the lost natural tooth.

Indications for Bridge

1. To prevent deterioration of the dental arch following the loss of one or more teeth.
2. To improve function.
3. To improve esthetics.
4. Abutment teeth on either side of edentulous space.

Contraindications for Bridge

1. Very long span.
2. Rampant caries.
3. Patient who is not bothered about oral hygiene.
4. Very old patient.
5. Severe gum recession.
6. Edentulous space with no abutment at one end.
7. Financial condition of patient.
8. If esthetic is affected in the anterior region.
9. Mobile abutments.
10. Many edentulous spaces on the arch.

Fixed—Fixed Bridge (Fig. 22.1)

This bridge has rigid, firm connections at both ends.

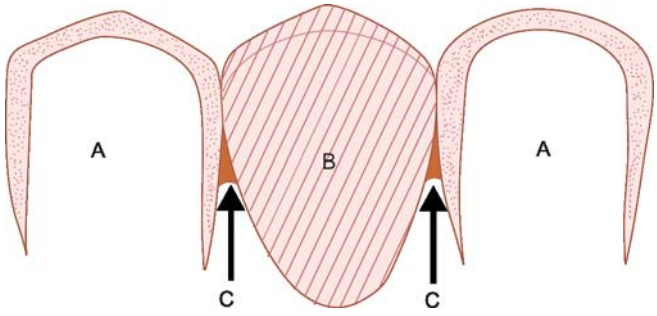


Fig. 22.1: Fixed-fixed bridge
A. Retainers; B. Pontic; C. Soldered joints

Its connectors are either a soldered joint or part of one-piece casting.

Advantage

Withstands masticatory loads better than other types of bridges.

Indications

a. In the posterior region of the arch.
b. Short span space.
c. If abutments are strong and large.

Construction

Cast the units of the bridge separately and then solder them together or cast as one-piece on one side and then solder the other side later.

Fixed Movable Bridge (Fig. 22.2)

This bridge has one rigid soldered joint at one end and less rigid connector at the other end.

Advantages

1. Allows slight movement between pontic and retainer- this is a stress breaking effect.
2. Stress on teeth is reduced.
3. Occlusal load is spread over other tooth.
4. Requires minimum tooth preparation.
5. Fixing cement of retainers will not get loosened.

Contraindication

Long span space.

Cantilever Bridge

This bridge has one retainer firmly fixed to an abutment tooth and has one pontic. It is completely unsupported at the other end (just like a portico or balcony of a house) (Fig. 22.3).

Indications

a. If the retainer tooth is large and firm.
b. If the edentulous space is small.
c. In non-stress bearing area.
d. More suitable to replace maxillary lateral incisor and canines.

Advantage

a. Good esthetics.
b. Only one retainer to be prepared, that too little.
c. Simple design.

Disadvantage

a. Bridge may rotate.
b. Abutment tooth may tilt under pressure.

Spring Cantilever Bridge (Fig. 22.4)

This bridge has a pontic away from the retainer, and there is palatal or lingual connector between the two. The connector is thin at the end where it is connected to the pontic and thick at the other end where it is connected to the retainer- this allows some flexibility and thereby reduces stress on the abutment tooth because load will be spread over a greater area. Two retainers are commonly used with this type of bridge.

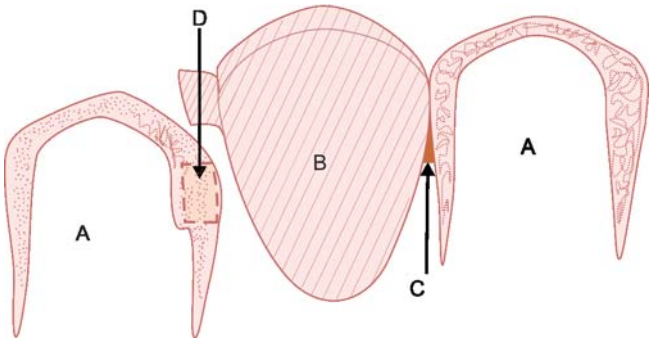


Fig. 22.2: Fixed movable bridge
A. Retainers; B. Pontic; C. Soldered joints; D. Movable joint

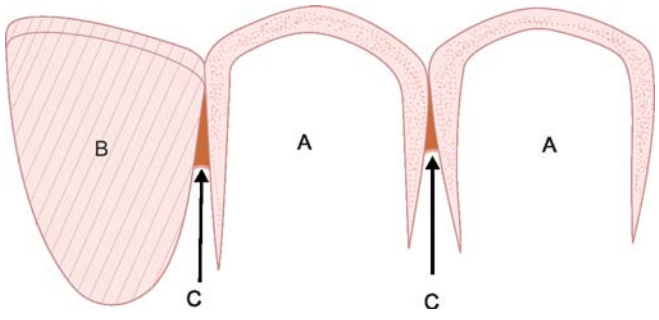


Fig. 22.3: Plain cantilever bridge
A. Retainers; B. Pontic; C. Soldered joints

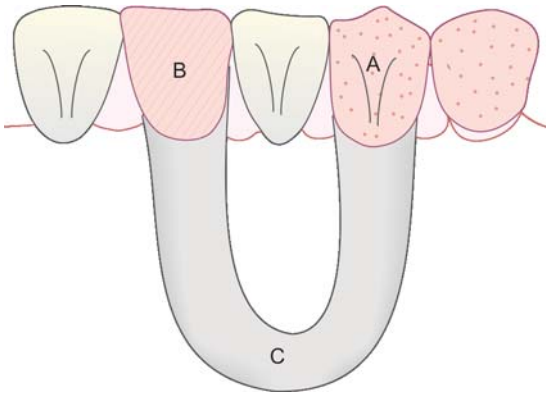


Fig. 22.4: Spring cantilever bridge
A. Retainers; B. Pontic; C. Connector

Indications

i. To replace a single anterior tooth. For example maxillary central incisor.
ii. In situations where there are unsuitable abutments.
iii. For esthetic reasons.

Contraindications

i. Not suitable for lower tooth.
ii. If palatal shape is not suitable.
iii. In very young patients.

Other Types of Bridges

A. *Maryland bridges* (resin bonded/retained bridges). Preparation of tooth is minimal, in the sense, enamel of lingual and proximal surfaces only removed but not of the labial surface.

Fitting surface of retainers is roughened by electrochemical etching and labial surface of prepared tooth is acid etched to provide mechanical retention to the resin cement.

Types

i. Rochette
ii. Sockwell
iii. Maryland.

B. *Temporary acrylic bridge.*

Pontics

Functions of pontics- same as natural tooth.
a. Masticatory
b. Aesthetics
c. Speech
d. Transferring occlusal load to abutment teeth.

Requirements of pontic.

i. Biological acceptability.
ii. Should not trap food.
iii. Sufficiently strong.
iv. Should be smooth.
v. Cusps should be covered with metal.
vi. Should touch the underlying soft tissues.
vii. Should be narrow towards the gingiva.
viii. Should maintain the contour of the arch.
ix. Must provide proper occlusion.
x. Bucco-lingual width and cusps should be properly designed to avoid cuspal interference during mandibular movements.

Materials for Pontic

1. Porcelain—most suitable.
2. Gold—next suitable.
3. Combination of porcelain and gold.
4. Combination of gold and acrylic.

Types and Shapes of Pontics

1. Ridge lap.
2. Spheroidal.
3. Conical.
4. Sanitary (Fig. 22.5).

Manufactured Pontics

1. Anterior ridge-lap pontic.
2. Posterior ridge-lap pontic.

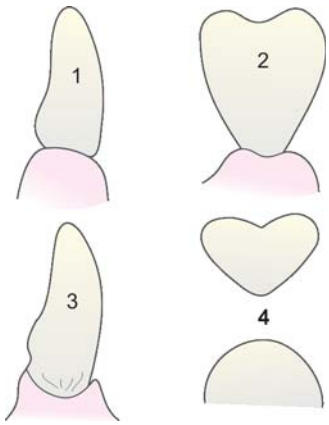


Fig. 22.5: Pontics
1. Ridge-lap; 2. Spheroidal; 3. Conical; 4. Sanitary

3. Molar dowel pontic.
4. Interchangeable –porcelain pontic.
5. Steel pontic (True pontic).
6. True pontic.
7. Pin facing pontic.
8. Reverse pin facing pontic.

Ridge Lap Pontics

This pontic overlaps or covers mainly the labial aspect of the ridge and therefore more suitable in the maxillary arch mainly because of appearance.

Less food trapping:

It is used posteriorly also.

Spheroidal Pontic

This is used in areas of depression of a fully healed ridge.

Pontic touches the crest of the ridge only.

More often used in lower posterior arch.

Conical Pontic

Not used on the posterior ridge.
More suitable as immediate replacement.

Sanitary Pontic

This is used only in the posterior region where there is excessive bone resorption.

Connector

These are the joints by which pontics are connected to the retainers.

Types

1. Rigid connectors.
   Example,
   One-piece casting.
   Soldered joint
   Link arm of spring cantilever bridge.
2. Non rigid connectors- Allow some movement.
   Example,
   Subocclusal slots.
   Ball and socket joint.
   Friction-sliding devices.

Factors Influencing the Length of Span of a Bridge

a. Load falling on bridge

If there are natural teeth in the opposing jaw, load is more.

Males put more load than females.

b. Condition of abutment teeth and their surrounding tissue.

Soldering a Bridge

Procedure

Assemble all the parts of a bridge and fix them with sticky wax.

Cover as much surface as possible with sticky wax.

Additional sprue or matchstick is placed across the joint area on the occlusal surface on all the three teeth,(two retainers and one pontic) and fixed with sticky wax to reinforce the joint.

Thoroughly cool the whole in air.

Carefully remove the whole assembly without making any movement.

Fill up the gaps with blue wax or carding wax.

Mix soldering investment to a rather thin consistency.

Cover the fitting surfaces of the retainers with investment.

Place the remaining investment on a piece of paper kept on the bench.

Place the whole unit on to this investment block on the bench.

Build up the investment on sides (do not cover lingual cusps).

Allow to set.

Trim the investment block and make it round all around.

Bridge

	Advantages	*Disadvantages*
1.	Patients prefer	More loss of natural structure of tooth due to tooth preparation.
2.	Patients feel more natural	Suitable only for short span.
3.	Take up more load.	Neighbouring teeth must be sound and firm.
4.	Tooth supported	Difficult to maintain cleanliness.
5.	Doesn't move in the mouth.	Difficult to repair.
6.	Quickly accepted to the oral environment.	Fabrication takes more time.
7.	No botheration of removing for cleaning	More expensive.
8.		Necessity of skilled technician.

Select a suitable solder-usually of highest carat gold.
Place flux at the joints.
Dry the investment block in oven.
It should be warm.
Remove the sticky wax by holding the assembly under hot water.
Keep the investment block in a cup shaped article.
Place the solder and flux at the joint.
Heat the investment block on both sides.
Heat it until the solder melts and flow into joints.
Quench.
Remove the unit from the investment block.
Wash under running water.
Do pickling in acid.
Wash in water.

23 Implant Denture

Word Meaning

Im- meaning "in"
Plant means, "To fix, To Insert, To Graft"

Implant: Is something that is inserted or grafted inside the living body tissues.

Dental implant: This is an implant placed/ buried in side the jaw but connected to the oral cavity through the mucosa. These external projections are used as a support for replacing a single tooth, or few teeth or even all teeth.

Implant denture: This is a denture constructed on the projections of implant inserted in the jaw. This may be a partial denture or complete denture (Fig. 23.1).

Indications for Implant Denture

1. Gross resorption of alveolar process causing problems of retention and stability.
2. Near exposure of inferior dental canal.
3. Hypersensitivity of mucous membrane.
4. High muscle attachments
5. Lingual or occlusal position of the mental foramen.
6. Mutilation of mouth due to injury or surgery.
7. Where fixed bridges are indicated in free- end saddle cases.
8. Where the patient requires greater biting and chewing power for health reasons.
9. When the patient is unable to tolerate conventional bridge or denture for psychological reasons.

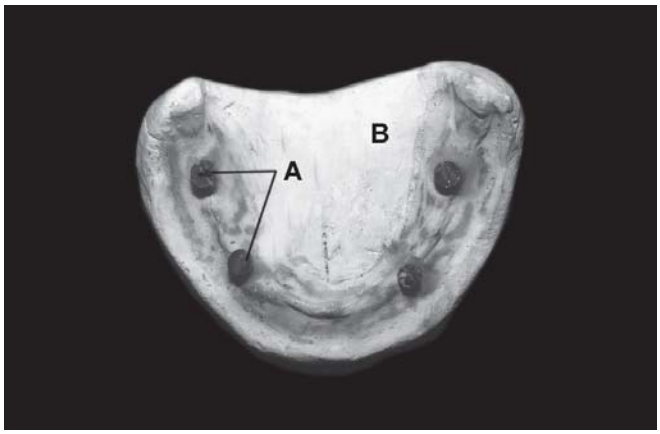


Fig. 23.1: Implants
A. Mandibular cast; B. Projections of implant on the alveolar ridge

Contraindications

1. Patients with systemic disease, e.g., Diabetes.
2. Patients who expects too much unrealistically.
3. Patients unable to maintain oral hygiene.

Considerations before Providing Implant Denture

1. Patient's general health and age. Patient must have sound health to withstand the various stages of implant technique.
2. Condition of the remaining alveolar bone should be healthy.
3. Biocompatibility of implant material.
4. Surgical procedure involved.
5. Nature, design and load distribution of implant.
6. Cost of treatment.
7. Attitude and psychology of patient.

Ideal Properties of Implant Material

1. Biocompatibility, Implant must not be rejected by the body.
   It must be nonirritating, nontoxic, nonallergic, noncarcinogenic.
   Ultimately this foreign material should be harmonious with living tissues and become part and parcel of it.
2. Should be Bioadhesive- means the implant should encourage the deposition of new bone and soft tissue around it so that its fixation is permanent, strong and immobile.
3. Should be chemically stable and inert.

4. Should have adequate strength.
5. Should be easy to fabricate and easy to manipulate.
6. Should be resistant to tarnish and corrosion.

Types of Dental Implants

1. Subperiosteal implant—Staple implant.
2. Transosteal implant—(Staple implant)
3. Endossecous implant (Tooth form).

Materials for Implants

1. Titanium—Either commercially pure titanium (CPT) or Alloy form.
2. Apatite coated titanium.

Subperiosteal Implant (Fig. 23.2)

The metal framework rests upon the alveolar ridge, but does not penetrate the bone.

The gingiva is reflected and the prefabricated implant is placed on the ridge with the projections for prosthesis protruding from holes in the gingiva after suturing.

This type of implant stays in place over the bone by the proliferation of periosteal fibers around the implant.

Disadvantage-

Less stable

Less successful

Infection may set up- leading to failure.

Doctor Dahl of Sweden did the first sub-periosteal implant in 1943 (Fig. 23.3).

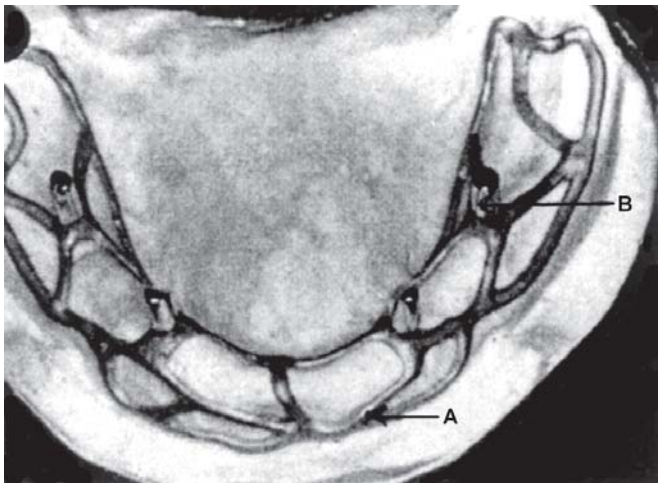


Fig. 23.2: Sub periosteal implant
A. Implant on the exposed bone; B. Projections of implant

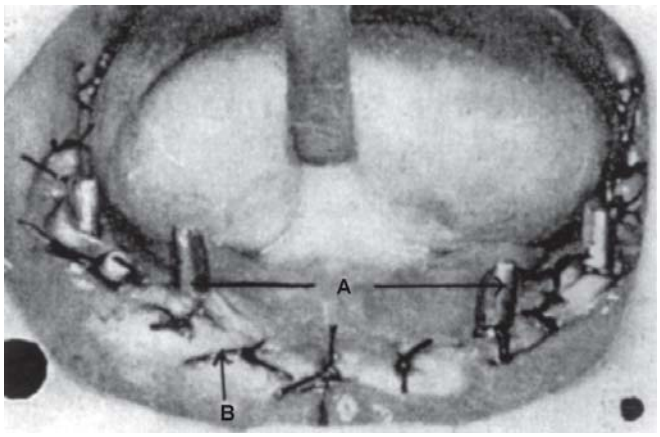


Fig. 23.3: Subperiosteal implant
A. Projections of implant through mucous membrane;
B. Sutures on mucous membrane

Transosteal Implant

This type of implant is suitable only for the mandible.

The implant penetrates completely through and through the mandible, the bottom plate lies on the under surface of the mandible.

The projections through the gingiva give support for the denture.

The success rate of this type of implant is better than subperiosteal implant.

Endosseous Implant

This type of implants are placed inside the bone and fixed to the bone by osseointegration, which allows direct apposition of new bone growth around the implant.

These are the most successful type of implants and therefore used more often.

Varieties of Endosseous implants: (Fig. 23.4)

1. Blades.
2. Screws.
3. Hollow cylinders.
   a. Branemark osseointegrated screw shaped implant made of commercially pure titanium (CPT).
   b. Hollow cylinder implant of commercially pure titanium with plasma sprayed surface.
   c. Blade vent implants made of chromium, nickel and vanadium alloy.

Procedure

a. Surgery to insert the implant.

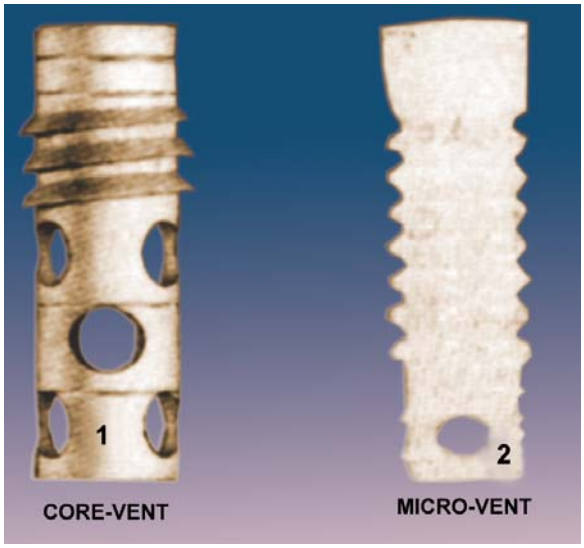


Fig. 23.4: Endosseous implant
1. Core vent; 2. Micro vent

b. Waiting period for the healing of soft tissues and firmness of implant.
c. Making impression.
d. Establishing jaw relation.
e. Set-up of teeth.
f. Acrylization of dentures.

Maintenance of Implant Denture

This is very important for the success of the implant denture. Epithelial attachment and seal around the projections of implant should be maintained intact. Inflammation or infection must not occur. Therefore, it is absolutely essential that oral hygiene of highest order must be maintained. Frequent check-up and regular home care are necessary for this purpose.

What is Osseointegration?

The implant inside the bone must be compatible with bone. That means, new bone should be formed around it and thus it becomes part and parcel of bone. This depends on;
a. Biocompatibility of material.
b. Surgical technique.
c. Infection control.
d. Surface of implant.
e. Condition of bone.

24 Obturators

Word origin and meaning.
From Latin Obturare—meaning To close.

Definitions

a. This is a dental appliance made to close a cleft (slit or fissure) in the hard and/or soft palate to improve speech.
b. This is simply a pharyngeal extension to a denture.
c. This is a special type of upper denture which replaces the missing tissues of hard and soft palate to improve speech, mastication and swallowing.

Obturator may be attached to either complete or partial denture.

Types of Obturator

a. Fixed- Rigidly fixed to the denture.
b. Movable- Loosely linked to the denture by hinge or flexible connection, which allows movement of extended part, but denture itself remains stable.

Clefts of the hard palate are no problem, because denture seals the slit and function is restored. However, clefts of the soft palate are technically difficult to close because of the movement of soft palate during speech and swallowing. Movable obturator moves with the tissues, thus maintains seal all the time.

How Cleft Occurs?

Usually cleft lip and cleft palate exist together from the birth itself, as a developmental defects.

Classification of Clefts

Veau Type I – Cleft in the soft palate only.
Veau Type II – cleft in the soft and hard palate.
Veau type III- Cleft extending into lip, but unilaterally
Veau type IV- Cleft extending into lip but bilaterally.
(Figs 24.1 and 24.2).

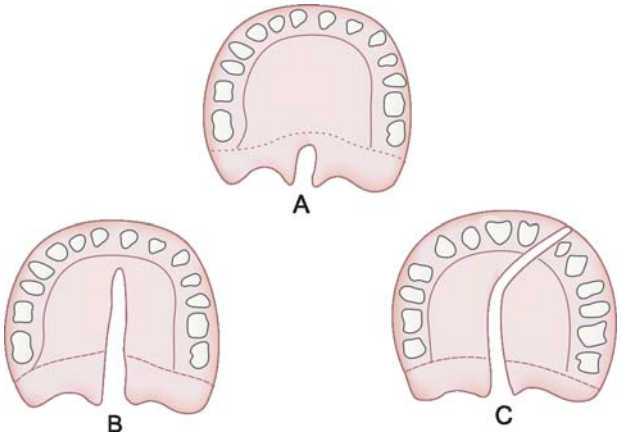


Fig. 24.1: Classification of clefts in palate
A. Veau type I; B. Veau type II; C. Veau type III

Causes of Cleft Palate

1. Congenital.
2. Acquired- Due to trauma, syphilis, Chronic abscess, Necrosis, Removal of tumors.

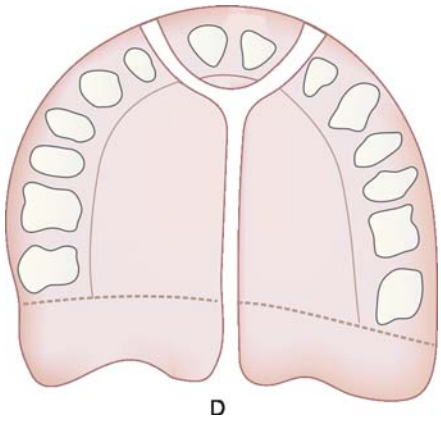


Fig. 24.2: Cleft palate
D. Veau type IV

Dental Problems of Early Surgical Repair of Cleft

1. Alveolar collapse causing deformity.
2. Under development of maxilla.
3. Malocclusion.
4. Mandibular prognathism.
5. Tight, narrow upper lip with notched vermilion.
6. Nose with depressed tip and wide nostrils.
7. Broad depressed scar on lip with stitch marks.

Requirements of Obturater

In both operated and un-operated cases the obturator should be;
a. Stable.
b. Light in weight.
c. Comfortable.
d. Well designed.

Functions of Obturator

1. Preventing food going into nasal cavity- thus helping mastication and swallowing.
2. To improve speech.
3. To restore normal occlusion.
4. Prevent seepage of nose secretions into the mouth.
5. To improve appearance.

Parts of An Obturator

a. Hard palate section: This helps in the retention of the appliance and restores occlusion and speech.
b. Soft palate extension: This closes the cleft of the soft palate and helps in swallowing andspeech.
c. Pharyngeal projection which extends almost to the posterior pharyngeal wall.

Position of Obturator (Fig. 24.3)

The obturator should be placed at the level of maximum contraction of the pharynx during swallowing i.e. at the level of Passavant's ridge. (Passavant's ridge is a bulge formed by the contraction of superior constrictor muscle on the posterior wall of pharynx) (Fig. 24.4).

How Obturator Works?

The closure of the oropharyngeal gap is brought about by the lateral and posterior walls of the pharynx and which learn to grip the obturator during speaking and swallowing. The seal provided by this helps to improve speech.

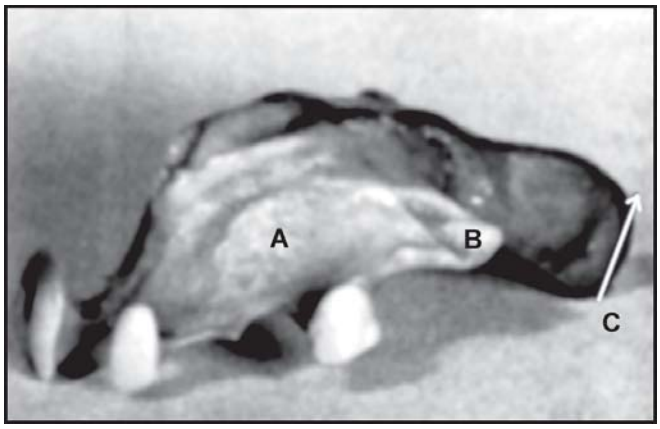


Fig. 24.3: Obturator showing
A. Hard palate section; B. Soft palate section;
C. Pharyngeal projection

MATERIALS TO MAKE OBTURATOR

For hard palate section

In Edentulous case—Acrylic resin.

In Dentulous case—Chrome cobalt or combination of chrome cobalt and acrylic resin.

For soft palate extension and pharyngeal projection, acrylic resin.

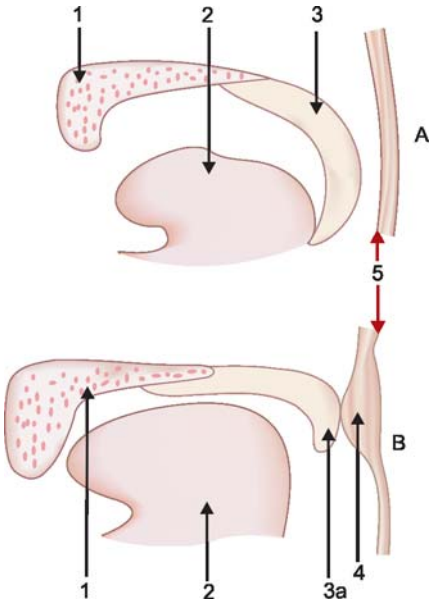


Fig. 24.4: Soft palate
A. Resting position; B. Raised position
1. Hard palate; 2. Tongue; 3. Soft palate-at rest; 3a. Soft palate raised; 4. Passavants ridge; 5. Superior constrictor muscle

Construction of Fixed Type of Obturator

Steps

Make an accurate impression of upper jaw and cleft with alginate.

Cast the impression in Plaster of Paris.

Make a final impression.

Make the stone cast.

Follow the usual steps of denture making.

Before flasking, insert two lengths of thick wire in the posterior border of the waxed denture and extending into the cleft.

Process and finish the denture as usual with the wires.

A patient is called for the next step.

In the clinic, attach a piece of softened modeling wax or gutta-percha on the extended wires and the denture inserted into the mouth.

Patient is asked to perform functions of swallowing and talking to shape the wax/gutta-percha in the mouth.

Remove the denture from the mouth, cool it.

Send to laboratory.

In the laboratory, wax or gutta-percha portion of (moulded) denture is processed into clear acrylic.

The completed obturator is now given to the patient to wear.

Adjustments are made later if necessary.

Speech therapy is usually advised (Figs 24.5 and 24.6).

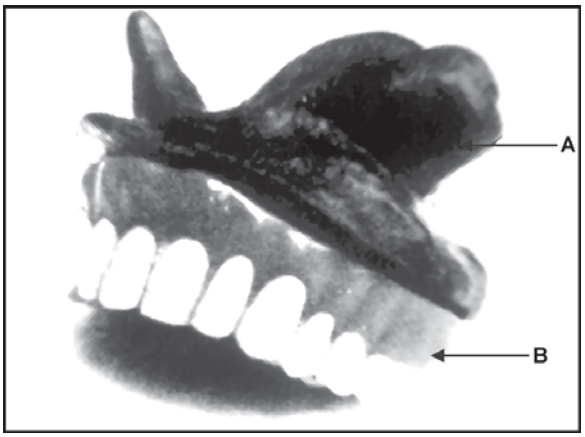


Fig. 24.5: Obturator
Maxillary denture (A) with Obturator (B) to fit into maxillary antrum

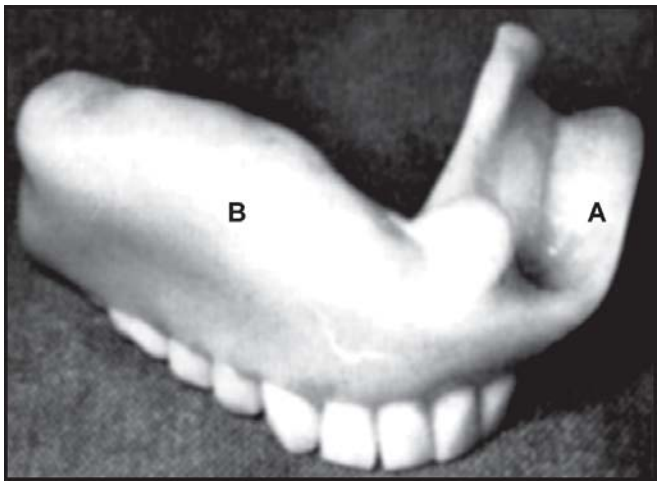


Fig. 24.6: Obturator
Lower denture (A) with obturator (B) to fit into cyst

Movable Obturator

Functions

a. Closes the cleft in the soft palate.
b. Moves along with moving muscles.
c. Movement is provided by a hinge at the junction of the hard and soft palates.

Types of Hinges

a. Stainless steel wire and tube hinge.
b. Cast hinge.

Procedure

This is same as explained with fixed type of obturator with the following exceptions;

a. One side of the hinge is fitted to the posterior border of the denture at the wax-up stage.
b. After processing the denture, another part of the hinge is attached to the first part.
c. In the clinic gutta-percha attached to the hinge is moulded and shaped in the mouth.
d. After shaping, the moulded part is removed along with the hinge part and processed in acrylic.
e. The finished soft palate part is riveted to the main part.

25 Maxillofacial Prosthesis

Human face is divided into upper two third consisting of upper jaw, nose, eyes, ears and forehead. The lower one third of face is lower jaw. Face is said to be a window to the personality of the humans. It plays an very important function of the human body. But at the same time it is subjected to many assaults and disfigurements. From time immemorable people all over the world have tried to correct facial disfigurements and to improve their appearance by means of artificial materials like wax, etc. At present day and age where life pattern has become so complex it is very common to come across people with serious disfigurement of facial parts – due to war injuries, accidents, and diseases like cancer etc. In order to save the patient, large chunks of facial parts are removed surgically. Nose, ear, eyeballs, maxillary bone and even the skin come under this operation. Such disfigured patients have to be rehabilitated by the combined effort of plastic and cosmetic surgeons, maxillo-facial surgeon and dental surgeon and dental and maxillofacial technician (Fig. 25.1).

Incidentally, in one of the famous Indian mythological epic Ramayana, Laksmana chops off the nose of one lady called Shurpanakhi, and this becomes the root cause for a great war between Rama and Ravana. Just a thought, if the lost natural nose of that lady could have been replaced by an artificial nose, the Great War could have been prevented. Alas, that was not possible then.

The prosthetic appliance which replaces any of the lost natural parts of the human face with or without teeth in it are called maxillofacial prosthesis. The materials used to make such an appliance should have special characteristics, and these materials are called maxillofacial prosthetic materials (Figs 25.2 and 25.3).

Fig. 25.1: Maxillofacial frosthesis

Fig. 25.2: Eye prosthesis

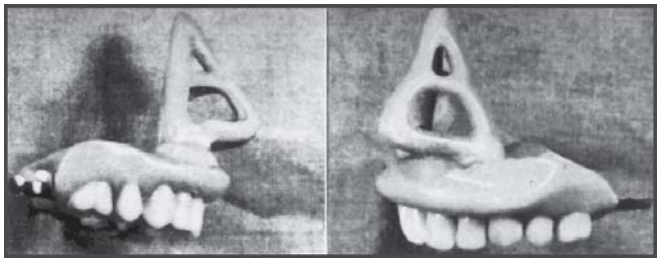


Fig. 25.3: Maxillofacial prosthesis replacing nose

Ideal Properties of Maxillofacial Prosthetic Material

1. Should be skin like in appearance, feel and texture.
2. Should be biocompatible.
3. Should be soft to touch, but strong.
4. Should be easily manipulated by the patient.
5. Should be dimensionally stable and durable.
6. Should be hygienic and easy to clean.
7. Should not be affected by temperature changes and by chemicals.
8. Should be resilient and not easily breakable.
9. Should have color stability.
10. Should not be expensive.

Maxillofacial Prosthetic Materials

1. Conventional Acrylic Resin, based on polymethylmethacrylate are not suitable for this purpose.

Disadvantages

It is hard, rigid and heavy.
Does not feel like skin.
Does not move with skin.

2. Plasticized polyvinyl chloride—"Vinyl plastisol". This is supplied as thick liquid in which vinyl particles are suspended in a plasticizer. It has coloring agent, cross-linking agent and stabilizer against ultra violet lights.
3. Silicones—types
   a. Heat vulcanized silicone—is made up of
      Polydimethyl vinyl siloxane—copolymer.
      Dichlorobenzoil peroxide—initiator.
      Silica—Filler.
      Supplied as a rubbery thick solid.
      Advantage—Strong with good color stability.
      Disadvantage—Difficult to fabricate.
   b. Room Temperature Vulcanizing (RTV) silicones–
      This contains—Polydimethyl siloxane.
      Propyl orthosilicate—Cross linking agent.
      Silica—filler.
      Tin octate—Catalyst.
      These are similar to silicone impression material.
      Advantage—Easy to make. Skin color can be matched.
      Disadvantage—Not strong.
4. Synthetic Latex, based on butyl acrylate, methyl methacrylate and methylamethacrylamide, is also not popular for this use.
5. Polyurethane polymers—This is the latest material made use for maxillofacial prosthesis. It is a product of Di – ISO – Cyanate + polyol ⟶ Polyurethane.
   Advantages—Life like in appearance and feel.
   Better color stability.
   Can be cold cured.
   Disadvantage—Careful and accurate fabrication technique.
   Overall, there is no single Ideal material suitable for maxillofacial prosthesis.

Prosthesis: Maxillary

Prosthetic appliance is the only method to make up the loss of bone and soft tissues in the maxilla. Loss of bony tissue of the maxilla is usually due to gunshot type of injury.

Treatment in such cases involves; (Figs 25.4 and 25.5)

a. Infection must be controlled as quickly as possible.
b. Prosthesis should be inserted as soon as possible. This will maintain the soft tissue contour, and reduce the deformity due to scar-tissue contraction.

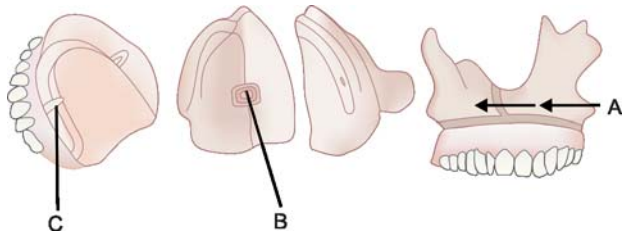


Fig. 25.4: Maxillary prosthesis replacing the upper jaw
A. Extensions into both maxillary antra; B. Latch to fix two upper extensions; C. Split pins to fit teeth bearing part

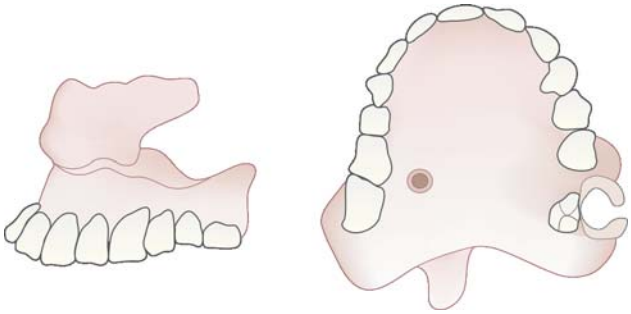


Fig. 25.5: Maxillary prosthesis extending into maxillary antrum

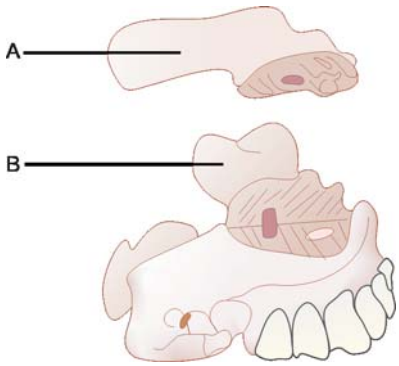


Fig. 25.6: Detachable maxillary prosthesis
A. Extension into nasal cavity; B. Extension into maxillary antrum

How a Maxillofacial Prosthesis is Retained?

If there are sound and healthy teeth present they are made use by clasping them. But even to them proper consideration must be given. Whether to make use of these few teeth or not, because these few teeth may be lost in the very near future due to over strain.

Methods to Help Retention

1. Use of epithelial inlays.
2. Use of opening into the nasal cavity or maxillary antrum.
3. Use of scar tissue.

1. *Epithelial inlay*: This is a method to deepen the buccal sulcus, which will help in the retention of the prosthesis as well as building out the soft tissue contour.
   Thiersch graft: Is a skin graft taken from the inner part of the forearm and is used for lining the raw surfaces of the sulcus to be deepened. This epithelium "takes" to its new bed and growes. The new sulcus should be made much more deeper than it is finally required. The shape of the mould which fits into the epithelial inlay cavity is also important; it should be made self-retaining. Thus implanted epithelium serves the purpose well, although it can never be like true mucous membrane. However main problem is contraction of tissues, and thus obliterating the space obtained by the operation of epithelial inlay. To avoid this, the prosthesis is made in advance of operation and then it is extended to the new sulcus after the operation.
2. Openings into nasal cavity or maxillary antrum. The prosthesis is made with more than one extensions, each inserted separately and the main denture screwed into position on to them (Fig. 25.6).
3. *Use of scar tissue*: When there is marked scar-tissue contraction of the soft tissues, the prosthesis can be so shaped as to provide a constriction around which the scar tissue contract and there by retains the prosthesis in position (Fig. 25.7).

Patient Co-operation

Maxillofacial prosthesis is usually large and cumbersome. Its insertion and removal into and from the mouth is a process, a patient has to learn with patience and perseverance. The psychological aspect is very important in this respect, the patient is encouraged and taught about the management of such a bulky, prosthesis in the mouth. After fitting the prosthesis, the patient is persuaded to wear it continuously day and night at least initially.

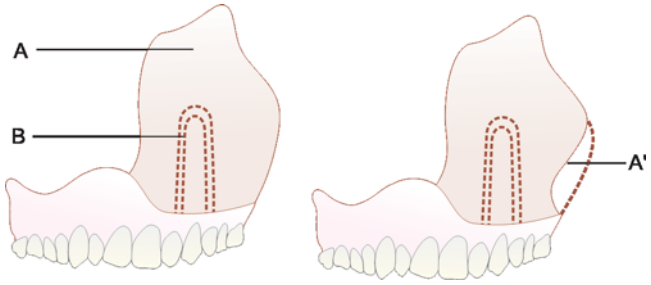


Fig. 25.7: Maxillary prosthesis to replace half of upper jaw
A. Gutta percha extension; B. Wire loop; A' Shaped gutta percha by scar tissue

Fig. 25.8: Mandibular prosthesis to retain epithelial inlay

Mandibular Prosthesis

This is made to restore a large loss of alveolus and along with an epithelial inlay to restore facial contour (Fig. 25.8).

CONCLUSION

Maxillofacial prosthesis replaces large amount of hard and soft tissues of face.

It supports the remaining soft tissues and straingly it is retained by them. Continuous change due to contraction of scar tissue, resorption of bone is taking place, and therefore the prosthesis needs to be altered every now and then. Prosthesis once made, the patient must be induced to wear it, and for this his co-operation is essential. Prosthesis should restore mastication, appearance and speech as best as it can and rehabilitate these badly mutilated patients.

Index