Review of Fixed Partial Dentures

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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...

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Published by

Jitendar P Vij
Jaypee Brothers Medical Publishers (P) Ltd
EMCA House, 23/23B Ansari Road, Daryaganj
New Delhi 110 002, India
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Review of Fixed Partial Dentures

First Edition: **2006**

ISBN 81-8061-781-5

Typeset at JPBMP typesetting unit
Printed at Replika Press Pvt. Ltd.

Foreword

The plethora of literature in the form of textbooks and journal publications has contributed to the advancement of every branch of Prosthodontics. Fixed Prosthodontics has progressed leaps and bounds in recent years mainly due to the development of the science of implantology.

This vast volume of literature has added to the confusion of undergraduate and postgraduate students in their preparation for examinations. Framing and structuring answers to specific questions definitely provides a distinct edge to the candidates in today's competitive world.

Dr. Lovely M in her book *Review of Fixed Partial Dentures* has very succinctly and precisely provided answers to questions in fixed prosthodontics that are commonly asked in the undergraduate and postgraduate examinations. She has very painstakingly attempted to include historical aspects, present trends and future promises in her answers.

I am happy to introduce *Review of Fixed Partial Dentures* to the student fraternity to prepare more effectively for the examinations.

Prof. Dr. C. Pradeep Kumar
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Preface

Review of Fixed Partial Dentures is the third book in the examination review series in Prosthodontics being brought out as study aids for the undergraduate dental students appearing for the BDS university examinations.

It is meant as a continuation of the first two books — *Review of Complete Dentures* and *Review of Removable Partial Dentures* — which were published earlier.

The world of fixed partial dentures underwent a revolution recently with the advent of implant dentistry, newer techniques and materials used. Yet many of the questions still asked for university examinations are from outdated concepts like "tenso-frictional resistance", "Davis crown" etc. It is very difficult for the students to find answers for these questions from recent textbooks. This review includes answers to the oldest and latest questions that could be asked in the final university question paper.

As mentioned in the prefaces of the earlier books, students are not expected to use this book without having read the standard textbooks. A student who goes through this book without having grasped the basics by reading the standard textbooks will probably find himself overwhelmed. Such a student will also find it difficult to reproduce the facts in this book in a systematic manner in the examination.

Even though this book is meant for the undergraduate students, I have taken care not just to include the essentials but also a little more so that the postgraduate students, practising Prosthodontists and dental practitioners, in general, will also find material of interest.

I thank God for enabling me to bring out this book in time. I especially thank Prof. K. Chandrasekharan Nair for his invaluable help and time in going through and correcting the proofs of this

review. Special thanks to my department colleagues, Dr. James. R. Rex, Dr. Nitin Joshi and Dr. Subash, for their help in drawing the diagrams which are included in this review. My special thanks are due to Dr. Sandeep Krishna, Dr. Sridhar Reddy, Dr. C. Rajesh, Dr. Priyadarshini, Dr. Binu, Dr. Saira and Dr. Srinivas Kumar. Last but not least, I thank my husband, parents and in-laws for their encouragement and support.

Lovely M

Contents

ESSAYS

SHORT NOTES

1. Discuss the Importance of Diagnosis and Treatment Planning in Fixed Partial Denture.

DIAGNOSIS AND TREATMENT PLANNING

Diagnosis is the examination of the physical state, evaluation of the mental or psychological makeup and understanding the needs of each patient to ensure a predictable result.

Treatment planning means developing a course of action that encompasses the ramifications and sequelae of treatment to serve the patient's needs.

DIAGNOSIS

Diagnosis in fixed partial denture includes:

1. Chief complaints.
2. History taking of the patient.
3. Examination.
   a. General examination.
   b. Temporomandibular joint examination.
   c. Extraoral examination
   d. Intraoral examination.
   e. Occlusal evaluation.
   f. Abutment tooth evaluation.
4. Making of diagnostic casts.
5. Full mouth radiographs.

I. CHIEF COMPLAINTS

Chief complaints are mainly of four categories:

1. Comfort (pain, sensitivity, swelling)
2. Function (difficulty in mastication or speech)
3. Social (bad taste or odour)
4. Appearance (fractured or discoloured tooth).

Comfort

Pain

Location, character, severity and frequency of the pain should be noted as well as the first time it occurred and the factors increasing pain (e.g. hot or cold things), and any changes in its character.

Swelling

The location, size, consistency, colour change during inflammation, duration, and frequency of the swelling need to be noted.

Function

Difficulties in chewing can be due to a fractured cusp or generalized malocclusion. Speech difficulty may be due to local cause or systemic problems.

Social

A bad taste or smell may be due to poor oral hygiene or periodontal disease.

Appearance

1. Missing or crowded teeth.
2. Fractured tooth or restoration.
3. Malpositioned or discoloured teeth.
4. Congenital anomalies of dentition.

II. HISTORY

1. Personal details (Name, age, sex, address).
2. Medical history.
3. Drug history.
4. Dental history.
   a. Periodontal history.
   b. Restorative history.
   c. Endodontic history.
   d. Orthodontic history.
   e. Removable prosthodontic history.
   f. Oral surgical history.
   g. Radiographic history.
   h. TMJ dysfunction history.

Medical History

- Any cardiac ailments, requiring antibiotic premedication before treatment, CNS disorders or other systemic diseases affecting treatment method. Hypertensive patients and coronary disease patients should not be given epinephrine.

- Any previous radiation therapy, blood disorders, terminal illness affecting treatment plan.
- Systemic conditions with oral manifestations.
- Infective diseases as AIDS, hepatitis and syphilis need to be evaluated.

Drug History

Previous medication history, drug allergies and if patient is taking any medicines routinely should be noted.

Dental History

Periodontal History

Oral hygiene status, any previous oral hygiene prophylaxis or any previous periodontal surgery is noted.

Restorative History

All restorations of amalgam and tooth coloured restoration along with time of these restorations are noted.

Endodontic History

If the endodontically restored tooth is a prospective abutment tooth then a radiographic evaluation of the periapical health is noted.

Orthodontic History

If radiographic evaluation shows root resorption, it can be due to previous orthodontic treatment. Occlusal adjustment with minor tooth movement can promote long-term positional stability of the teeth and reduce, or eliminate, parafunctional activity.

Removable Prosthodontic History

Previous removable prostheses must be carefully evaluated and the duration of wear needs to be noted.

Oral Surgical History

Missing teeth and period of edentulousness should be noted.

Radiographic History

Previous radiographs and current diagnostic radiographic series aids to assess the progress of the disease. It also aids in locating impacted tooth, root tips and cyst and tumours.

TMJ Dysfunction History

1. Pain or clicking in the temporomandibular joints.
2. Tenderness to palpation.
3. Difficulty in opening the mouth.
4. Deviation while opening.
5. The above symptoms with any treatment done earlier for the dysfunction as occlusal appliances, medications, or exercises should be noted.

III. EXAMINATION

a. General Examination

General appearance, gait, weight, skin colour (anemia or jaundice). Vital signs, such as respiration, pulse, temperature, and blood pressure are measured and recorded.

b. Temporomandibular Joint Examination

- Bilateral palpation anterior to the auricular tragi while the patient opens and closes the mouth, can locate disorder in the posterior attachment of the disk.
- Tenderness clicking, or pain is noted.
- Jaw opening of less than 40 mm indicates restriction.
- Deviation from midline is also recorded.
- Maximum lateral movement can then be measured (normal is about 12 mm).
- Masseter and temporal muscles are palpated for signs of tenderness and classified as mild, moderate, or severe.

c. Extraoral Examination

Includes noting of

1. Facial asymmetry.
2. Cervical lymph node palpation.

3. TMJs and the muscles of mastication.
4. Lips: Smile line, negative space between the maxillary and mandibular teeth when the patient laughs, missing teeth, diastemae, and fractured or poorly restored teeth are noted.

d. Intraoral Examination

Soft tissues, teeth and supporting structures as the tongue, floor of the mouth, vestibule, cheeks and hard and soft palates are examined and findings noted.

Periodontal Examination

1. Oral hygiene status assessment.
2. Examination of gingiva, periodontium and the response to the host tissues.
   - Healthy gingiva is pink stippled and bound to the underlying connective tissue.
   - The texture, size, contour, consistency, position and colour are noted. Any exudate or pus is examined for.
   - The width of the keratinized attached gingiva around each tooth is assessed.

Examination of Teeth

1. Absence of teeth, dental caries, any restorations, wear facets, fractures, abrasions, malformations and erosions are noted.
2. Pocket depths (usually six tooth) are recorded on a periodontal chart.

e. Occlusal Examination

1. General alignment.
2. Lateral and protrusive contacts.
3. Centric relation.
4. Jaw manoeuverability.

General Alignment

The teeth can be evaluated for crowding, rotation, over eruption, spacing, malocclusion and vertical and horizontal overlap.

Lateral and Protrusive Contacts

The presence or absence of tooth contact in eccentric movements is verified with a thin Mylar strip. Tooth movement (fremitus) should be identified by palpation.

Centric Relation

The relationship of teeth in both centric and intercuspal position is assessed. If a slide from CR to IP is present, its horizontal and vertical components can be estimated and a note made of any lateral deviation.

Jaw Manoeuverability

The ability and ease with which the patient moves the jaw and the guiding movements should be assessed.
Check for habitual occlusion.

f. Abutment Tooth Evaluation

- Abutment teeth need to be strong enough to withstand the forces directed to the missing teeth in addition to those usually applied to the abutments.
- Abutment teeth should not exhibit mobility.
- An asymptomatic endodontically treated tooth can be considered for an abutment provided it can withstand the forces transmitted to it.
- The supporting tissues surrounding the abutment teeth should be healthy and free from inflammation.

Evaluation of Abutment Teeth

1. Crown root ratio
2. Root configuration
3. Periodontal surface area.
4. Vitality testing.

Crown-root Ratio

An abutment teeth should have a combined peri-cemental area equal to or greater in peri-cemental area than the tooth or teeth to be replaced (Antes law).

Favourable crown root ratio is 1:1.

Root configuration

i. Root shape: Short conical roots give less support. Divergent multiple roots give good support.

Periodontal surface area: Root surface area: Larger teeth will have greater surface area and will handle stress better.

Vitality testing: Prior to any restorative treatment, pulpal health must be assessed by measuring the response to percussion as well as thermal and electrical stimulation.

IV. DIAGNOSTIC CASTS

- Articulated diagnostic casts aid in planning treatment procedures, provide information about static and dynamic relationships of the teeth and help to view several aspects of the occlusion not detectable within the confines of the mouth.

Advantages of diagnostic cast

1. Changing the arch relationship before orthognathic procedures.
2. Changing the tooth position prior to orthodontic procedures.
3. Modifying the occlusal scheme before attempting any selective occlusal adjustment.
4. Trial tooth preparation and waxing can be done before fixed restorative procedures.
5. Selection of an optimum path of withdrawal of a fixed partial denture can be assessed.

V. RADIOGRAPHIC EXAMINATION

1. Periapical radiographs.
2. Bite wing radiographs.
3. Panoramic films.
4. Transcranial exposure, serial tomography, arthrography, CT scanning, or magnetic resonance imaging in case of TMJ disorders.

Periapical Radiographs

(14 periapical radiographs help in complete examination)

Uses

1. To assess the extent of bone support, quality of supporting bone.
2. Detailed root morphology of each abutment tooth.
3. Width of periodontal ligament space.
4. Bone resorption (vertical, horizontal).
5. Inclination of teeth.
6. Continuity of lamina dura.
7. Pulpal morphology and previous endodontic treatment.
8. Any periapical pathology can be evaluated.
9. Evaluation of crown root ratio.
10. Evaluation of the shape, length and direction of root.
11. Helps in checking for periodontal situation of the abutment tooth, as widening or thickening of lamina dura, occlusal prematurities or trauma can cause thickening.

Bitewings

Use

Evaluation of caries on proximal surfaces and secondary caries on previous restorations.

Panoramic Films

Uses

1. Evaluation of bone resorption, pattern of bone resorption and quality of bone support.
2. To check for presence of retained root tips, impacted tooth.
3. To determine the thickness of soft tissue on the ridge in area of pontic placement.
4. They do not provide a detailed view for assessing bone support, root morphology, or caries.

TREATMENT PLANNING

Treatment planning helps to design and select the material of choice for a particular situation.

DESIGN AND MATERIAL CHOICE

It depends on:
1. Amount of tooth structure present.
2. Aesthetics.
3. Plaque control.

Choice of Restoration

In following situations fixed partial denture is contraindicated and the restoration of choice is removable partial denture.
1. Large edentulous space.
2. Edentulous space with no distal abutment.
3. Bilaterally edentulous with no distal abutment.
4. Grossly tipped teeth.
5. Periodontally weak teeth.
6. Teeth with short clinical crowns.
7. Severe bone resorption.
8. Young age.
9. Large tongue.
10. Extensive caries with poor oral hygiene.

2. List the ideal requirements of an abutment tooth and describe the steps taken to maintain biological integrity while preparing teeth for Fixed Partial Denture.

Alternate form of the question or

What are the biomechanical principles used in tooth preparation for a fixed partial denture?

I. REQUIREMENTS OF AN ABUTMENT TOOTH

- Abutment teeth need to be strong enough to withstand the forces directed to the missing teeth in addition to those usually applied to the abutments.
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FACTORS TO BE CONSIDERED IN ABUTMENT SELECTION

1. Crown root ratio.
2. Root configuration.
3. Periodontal surface area.
4. The length of the pontic span.
5. Forces.
6. Oral hygiene measures.

Crown-root Ratio

1. An abutment tooth should have a combined peri-cemental area equal to or greater in peri-cemental area than the tooth or teeth to be replaced (Antes' law).
2. The optimum crown root ratio is 2:3. A root ratio of 1:1 at least needs to be present for a prospective abutment.
3. If coronal structure is less, core build up or crown lengthening needs to be done to fulfil the crown root ratio.

Root Configuration

Root Shape and Angulation

A molar with divergent roots, single-rooted tooth with an elliptic cross-section (broader labiolingually than mesiodistally), a long root or multiple roots provide better support than a root surface area with circular cross-section.

Periodontal Surface Area

Root Surface Area

Larger teeth will have greater surface area and will handle stress better.

Bone Support

Teeth with vertical and horizontal resorption give less support.

The Length of the Pontic Span

Two abutment teeth can support two pontics.
Failures due to abnormal stress have been attributed to increased length of the span.

Forces

Varying the occlusal scheme by altering the occlusal table or plane can decrease the load on abutment teeth.

Oral Hygiene

Teeth with slight mobility can be used as abutments if stabilised and if oral hygiene is maintained.

II. PRINCIPLES OF TOOTH PREPARATION

A. Biologic considerations.
B. Mechanical considerations.
C. Aesthetic considerations.

A. BIOLOGIC CONSIDERATIONS

(Factors that affect the health of the oral tissues)

1. Prevention of damage during tooth preparation to
   a. Adjacent teeth,
   b. Soft tissues,
   c. Pulp of the tooth being prepared.
2. Conservation of tooth structure.
3. Margin placement.
4. Finish lines.
5. Occlusal consideration.

1. Prevention of Damage during Tooth Preparation to

a. Adjacent Teeth

If the proximal contact area is damaged during preparation it needs to be reshaped and polished otherwise it is susceptible to dental caries.

To prevent damage

A metal matrix band needs to be used around the adjacent tooth. A thin tapered diamond is used to break the inter-proximal contact.

b. Soft Tissues

Damage to the tongue and cheeks can be prevented by careful retraction with an aspirator tip, mouth mirror or flanged saliva ejector.

c. Pulp

Extreme temperatures, chemical irritation can cause pulpal damage.

Prevention

1. Assess morphology of the dental pulp chamber before preparation with the help of a radiograph.
2. Use new and perfect abrasives while reducing the tooth. This reduces the heat that is generated.
3. Apply gentle pressure while preparation of tooth.
4. Use copious amount of water spray directed at the area of contact between tooth and bur. This removes clogging and prevents desiccation of the dentin.
5. All retention grooves and polishing need to be done with a slow-speed handpiece with adequate amount of water spray.
6. Avoid use of chemical agents for cleaning.

2. Conservation of Tooth Structure

1. Use of partial veneer crowns instead of full veneer crowns.
2. Minimum taper between axial walls.
3. Occlusal surface reduction following anatomic planes.
4. Tilted tooth to be repositioned, so that less tooth structure is removed during preparation.
5. A conservative margin finish.
6. Supragingival or crest of the gingival margin finish line.

Failures due to Improper Preparation of Tooth

1. Insufficient axial reduction with an over contoured restoration can cause periodontal disease or dental caries.
2. Inadequate occlusal reduction can cause occlusal dysfunction and poor margin placement.
3. Excessive axial contours can cause gingival inflammation.

3. Margin Placement

Requirements

Ease of preparation without overextension.
Easy to identify in the impression and on the die.
Easy to finish on wax pattern.
Sufficient bulk of material.
Preserve tooth structure.

Types

1. Supragingival.
2. Subgingival.
3. At the crest of the gingiva.

Supragingival Margins

1. They can be easily finished.
2. They are more easily kept clean.
3. Impressions are more easily made with less potential for soft tissue damage.
4. Restorations can be easily evaluated at recall appointments.

Subgingival Margins

Subgingival margins are often on dentin or cementum.

They are done when cervical erosion or restorations extend subgingivally and when a crown-lengthening procedure cannot be carried out.

A well-designed preparation has a margin that is smooth and will provide the patient with a longer-lasting restoration.

4. Finish Lines

Types

1. *Featheredge or shoulderless crown preparations:* Conservative but not to be used.
2. *Chiesel edge:* Only on tilted tooth.
3. *Chamfer:* All metal restorations.
4. *Shoulder:* All ceramic restorations and not conservative.
5. *Sloped shoulder:* Reduces possibility of leaving unsupported enamel and leaves sufficient bulk to allow thinning of the metal framework to a knife-edge for good aesthetics.
6. *Shoulder with bevel:* In subgingivally extended finish lines due to cervical erosion. A bevelled shoulder margin is used for the facial surface of a metal-ceramic restoration where a metal collar is to be used.

Advantages of a Bevel

1. Easy burnishing of the cast metal margin.
2. Decreases marginal discrepancy.
3. Protects unprepared tooth structure from chipping.

5. Occlusal Considerations

If occlusion is disrupted by supra-erupted or tilted teeth either uprighting of tooth or a modified restoration should be considered after endodontic treatment.

Adequate occlusal clearance is required for an optimal occlusion.

B. MECHANICAL CONSIDERATIONS

1. Providing retention form.
2. Providing resistance form.
3. Preventing deformation of the restoration.

1. Providing Retention Form

This is the quality of a preparation that prevents the restoration from becoming dislodged by such forces parallel to the path of withdrawal.

Factors affecting Retention

i. Magnitude of the dislodging forces.
ii. Geometry of the tooth preparation.
iii. Roughness of the fitting surface of the restoration.
iv. Materials being cemented.
v. Type of luting agent.
vi. Film thickness of the luting agent.

i. Magnitude of the dislodging forces: Great removal forces occur with sticky food. The magnitude of the dislodging forces depends on the stickiness of the food and the surface area and texture of the restoration being pulled.

ii. Geometry of the tooth preparation: Fixed prostheses depend on the geometric form rather than on adhesion for retention as majority of the luting agents are non-adhesive like zinc phosphate.

Factors

a. Taper
b. Surface area
c. Stress concentration.
d. Type of preparation.

Taper

- Maximum retention is obtained if a tooth preparation has parallel walls.
- Smaller degrees of taper have more retention.
- As the taper increases, however, so does the free movement of the restoration and retention will be reduced.
- The recommended convergence between opposing walls is 6 degrees.

Surface area: Provided the restoration has a limited path of withdrawal, its retention is dependent on the length of this path in sliding contact. Therefore, crowns with long axial walls are more retentive than those with short axial walls.

Stress concentration: Round margins may reduce stress concentrations and hence increase the retention of the restoration.

Type of preparation: Retention is increased by adding grooves and boxes to a preparation with a limited path of withdrawal.

iii. Roughness of the surfaces: Retention is increased if the restoration is roughened or grooved by air-abrading the fitting surface with alumina.

iv. Materials being cemented

a. More reactive the alloy, more adhesion with certain luting agents.
b. Base metal alloys are better retained than less reactive high-gold content metals.
c. Cement adheres better to amalgam than to composite resin or cast gold.
d. Crowns adhere better with composite resin than with amalgam cores.

v. Type of luting agent: Adhesive resin cements are the most retentive, with less bond during long term.

2. Providing Resistance Form

Lateral forces tend to displace the restoration by causing rotation around the gingival margin which is prevented by any areas of the tooth preparation that are placed in compression called resistance area.

Resistance depends on

i. Magnitude and direction of the dislodging forces.
ii. *Geometry of the tooth preparation:* Increased taper and rounding of axial angles, short tooth preparations with large diameters reduce resistance.
iii. *Physical properties of the luting agent:* Zinc phosphate cements have a higher modulus of elasticity than polycarboxylate cements, hence polycarboxylate cement depends more on the taper of the preparation than zinc phosphate cement.

3. Preventing Deformation of the Restoration

Restoration must have sufficient strength to prevent it from being permanently deformed during function.

Factors

i. Alloy selection.
ii. Adequate tooth reduction.
iii. Margin design.

i. Alloys

Type III or Type IV gold alloys, High-noble metal content metal ceramic alloys have a hardness equivalent to Type IV golds and nickel chromium alloys are more hard and can be used in long span FPD.

ii. Adequate Tooth Reduction

A minimum alloy thickness of about 1.5 mm over centric cusps (buccal in the mandible and lingual in the maxillae) and 1 mm in

non-functional cusps. Occlusal reduction should follow the morphology of tooth.

iii. Margin Design

Depending on the type of restoration the ideal margin design needs to be followed.

C. AESTHETIC CONSIDERATIONS

1. Complete examination and assessment of teeth during smiling, talking, and laughing.
2. Find the patient's aesthetic requirements.
3. Type of restoration selected.

Partial-coverage Restorations

Proximal Margin

Place proximal margin just buccal to the maximal contact area where metal will be hidden by the distal line angle of the neighbouring tooth.

Facial Margin

The facial margin of a maxillary partial-coverage restoration should be extended just beyond the occluso-facial line angle. A short bevel is needed to prevent enamel chipping. A chamfer can be placed where appearance is less important (e.g. on molars) because this will provide greater bulk of metal for strength.

Metal-ceramic Restorations

Facial Tooth Reduction

A minimum reduction of 1.5 mm is required for sufficient bulk of porcelain and metal for strength.

Labial Margin Placement

Supragingival margin placements are easier to prepare properly and easier to keep clean.

After observing the patient's smile, margins should be placed.

Margins should not be placed subgingivally encroaching on the attachment. If it extends within 1.5 mm of the alveolar crest bone resorption tends to occur.

3. Describe various methods used for gingival retraction and add a note on the advantages of fluid control and tissue displacement.

Definition

Gingival retraction is a process of exposing margins when making impressions of prepared teeth.

Other names

Tissue dilation, tissue retraction and tissue displacement.

ADVANTAGES OF FLUID CONTROL AND TISSUE MANAGEMENT

1. Patient comfort.
2. Safety for patient.
3. Good visibility while doing clinical procedures.
4. Clear the area of saliva and water for better visibility.

ADVANTAGES OF GINGIVAL RETRACTION

1. Duplicating subgingival margins in impressions.
2. Copying the unprepared tooth surface to aid in evaluating the marginal finish line accurately.
3. Helps in accuracy of wax pattern fabrication and location of finish line.
4. Final restoration tends to have better marginal adaptation.
5. To alter the contour of the gingival tissue around the teeth or edentulous ridge.

CLASSIFICATION OF GINGIVAL RETRACTION

Gingival retraction is classified as

1. *Mechanical:* Retracted by mechanical methods.
2. *Chemical:* Dilation with the help of certain dilatants.
3. *Mechanical-Chemical:* Retracted with a cord impregnated with a chemical for hemostasis.

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ADVANTAGES OF FLUID CONTROL AND TISSUE MANAGEMENT

1. Patient comfort.
2. Safety for patient.
3. Good visibility while doing clinical procedures.
4. Clear the area of saliva and water for better visibility.

ADVANTAGES OF GINGIVAL RETRACTION

1. Duplicating subgingival margins in impressions.
2. Copying the unprepared tooth surface to aid in evaluating the marginal finish line accurately.
3. Helps in accuracy of wax pattern fabrication and location of finish line.
4. Final restoration tends to have better marginal adaptation.
5. To alter the contour of the gingival tissue around the teeth or edentulous ridge.

CLASSIFICATION OF GINGIVAL RETRACTION

Gingival retraction is classified as

1. *Mechanical:* Retracted by mechanical methods.
2. *Chemical:* Dilation with the help of certain dilatants.
3. *Mechanical-Chemical:* Retracted with a cord impregnated with a chemical for hemostasis.

4. *Surgical:* Retracted by removal of gingival tissue from the sulcus with dental electrosurgery.

All the above techniques should be done when the gingival tissue is healthy.

1. MECHANICAL METHODS

a. Rubber dam
b. Cotton rolls
c. High vacuum
d. Saliva ejector
e. Svedopter
f. Vac-ejector
g. Moisture absorbing cords
h. Oversized copper bands with elastomeric impression materials.

a. Rubber Dam

Punch holes are made in the area of preparation site of the rubber dam and clamped in position.

Uses

i. While removing old restorations.
ii. While preparing onlay or inlay.
iii. For endodontic procedures as a safety measure
iv. While using pin retained restoration.

Disadvantages

- Difficult to use while preparing crowns and fixed partial denture.
- Reacts with polyvinyl siloxane impression materials.

b. Cotton Rolls

Absorbent cotton rolls are placed in the area where saliva pools. (In maxillary arch a single cotton roll is used in buccal vestibule and in mandibular arch in lingual sulcus).

Placement of Cotton Roll

One or two cotton rolls are placed vertically against the horizontally placed cotton rolls, or one single horse-shaped roll can be used.

Limitation
The entire saliva and water soaked roll needs to be removed each time.

c. High Vacuum

Can be used as a retractor as well as for clearing saliva and water during preparation.

d. Saliva Ejector

Useful for maxillary arch along with cotton rolls.
Placed in the corner of mouth opposite the quadrant being operated with the patient's head towards that side.

e. Svedopter/Speejector

Svedopter consist of a metal saliva ejector with a tongue deflector. Effectively used in mandibular arch. Effective fluid control along with cotton rolls. The patient is seated in an upright position.

Positioning
Placed in the incisor region with the tubing under the patient's arm.

Disadvantages

i. Access to lingual aspect is limited.
ii. Metal surface can cause tissue irritation.
iii. Can cause gagging in some patients.
iv. Cannot use in mandibular tori patients.

f. Vac-ejector

Tongue control and high volume evacuation along with a bite block. It aids in removing large volumes of fluid. Tongue deflectors and bite blocks are available in several sizes. The tongue deflectors are made of plastic.

g. Moisture Absorbing Cords

Consist of pressed paper wafers covered on one side with a reflective foil. The wafer side is placed facing the tissues. Used along with cotton rolls to control saliva and retract cheek laterally.

h. Oversized Copper Bands

These bands are placed on the prepared tooth and elastomeric impression material is used to make an impression of the prepared tooth which retracts the gingiva under pressure.
Not used any more.

2. CHEMICAL METHODS

a. Anti-sialogogues.
b. Local anaesthetics.
c. Anticholinergics: Methantheline bromide (50 mg), propantheline bromide (15 mg), atropine etc.
d. Antihypertensives as clonidine hydrochloride (0.2 mg).

Chemical methods are done when mechanical methods cannot be achieved. Each of the drugs has side effects, which need to be critically evaluated.

3. MECHANICAL-CHEMICAL METHODS

This technique consists of using impregnated cords with chemicals.

Chemicals that are used

a. Racemic epinephrine: Contraindicated in cardiac, hypertensive and diabetic patients.
b. Aluminium chloride.
c. Aluminium potassium sulphate.
d. Aluminium and ferric sulphate.
e. Phenylephrine hydrochloride.

Armamentarium

1. Saliva ejector
2. Mouth mirror
3. Explorer
4. Scissors
5. Cord packing instrument
6. Retraction cord
7. Hemodent liquid
8. Cotton pliers
9. Cotton rolls
10. Dappen dish

11. Cotton pellets
12. 2 × 2 gauze sponges

Method of Gingival Retraction

1. The prepared tooth area is dried and isolated with cotton rolls.
2. A retraction cord of two-inch length is drawn out from the dispenser bottle held with sterile pliers and cut with scissors.
3. The retraction cord is dipped in 25% aluminium chloride solution or 8% epinephrine.
4. The excess amount of aluminium chloride is squeezed out with a gauze piece.
5. The cord is made into a "u", and looped around the prepared tooth. Only the end of the cord is to be touched.
6. The cord is first secured in the mesial interproximal area and the distal interproximal area with a cord-packing instrument (Fig. 1).
7. After the cord is secured in the distal interproximal area, the cord is inserted from the mesiolingual to distolingual corner. While tucking in the cord the tip of the packing instrument should be angled toward the area where the cord has been placed.
8. Cut the excess amount of cord in the mesial interproximal area and complete the placement of cord on the buccal side

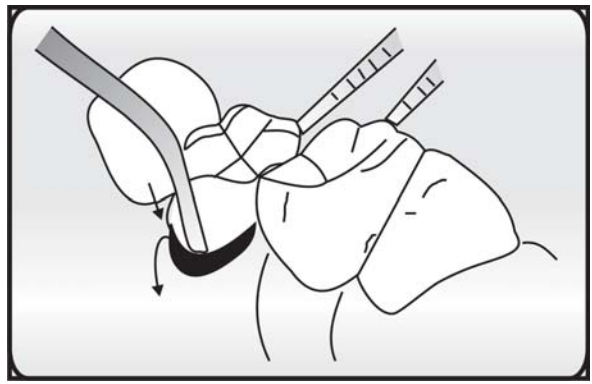

Fig. 1: The cord is first secured in the mesial interproximal area and the distal interproximal area with a cord-packing instrument

from the distal end to the mesial side until it overlaps the mesial (Figs 2 and 3).

9. After 5 to 10 minutes, the cord is gently removed with the sulcus around the prepared tooth exposed and hemostasis maintained.
10. This is followed by the impression of the arch.

Double Cord Technique

A thin cord is placed initially over which a large cord is placed. Thin cord remains during impression making.

4. SURGICAL TISSUE DILATION

a. Electrosurgery.
b. Rotary curettage.

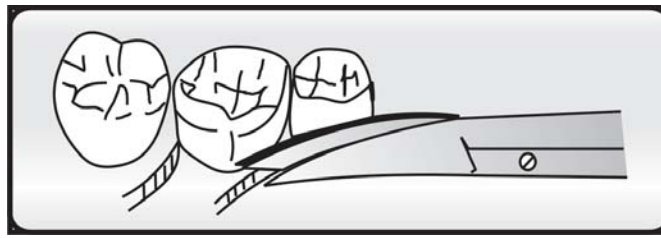

Fig. 2: Cut the excess amount of cord in the mesial interproximal area

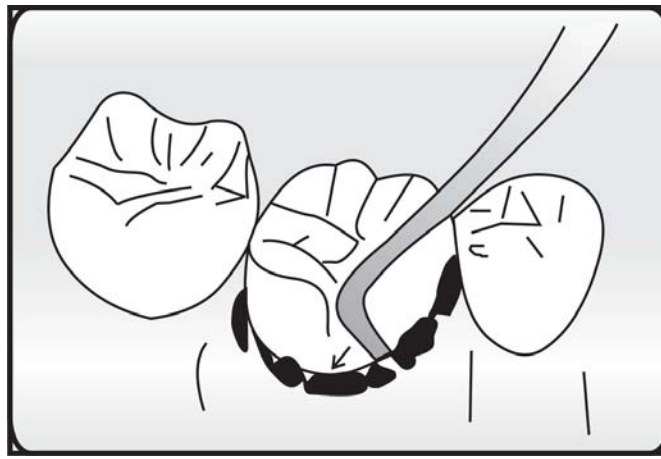

Fig. 3: Complete the placement of cord on the buccal side from the distal end to the mesial side until it overlaps the mesial

Electrosurgery/Surgical Diathermy

(Introduced by D'Arsenal).

An electrosurgery unit is a high frequency oscillator or radio-transmitter which uses either a vacuum tube or a transmitter for delivering a high frequency electric current of at least 1 Mega Hertz.

An electrosurgical unit consist of oscillator, active electrode and a ground electrode for the safety of the patient.

Types of Electrode

- *Coagulating electrode:* Controls haemorrhage.
- *Small wire-loop electrode:* Used for sulcular enlargement.
- *Round electrode:* Removes gingival tissue.
- *Large loop electrode:* It is used to remove large amount of tissue.
- *Straight electrode:* By angling the working electrode at approximately 15 to 20 degrees and carrying the tip through the tissue, a small wedge of tissue can be removed. In anterior quadrants, the angle of the working electrode is positioned parallel to the long axis of the tooth.

Posner electrode With the AP 1½ electrode, the insulated portion of the electrode is directed around the tooth, removing the gingival sulcular epithelium. If less trough depth is desired, part of the tip is removed to create the desired depth at 0.5 mm, 0.75 mm, or 1.0 mm.

Types of Current

- *Monoterminal:* Used for fulguration, removal of papillomas and fistulous tract.
- *Biterminal:* For coagulation, removal of granulation tissue.
- *Unrectified damped current:* Not used in dental treatments.
  Fully rectified full wave modulated current: Good for gingival enlargement.
- *Fully rectified filtered current:* It is the best current source.

Methods

1. Profound local anaesthesia is given and a pleasant smelling aromatic oil is applied on the vermilion border of upper lip.

2. Plastic suction tips and plastic mounted mouth mirrors are used. Odour is controlled by an outside ventilated oral evacuator system.
3. An adequate power is set on the unit. Electrode is passed quickly over the tissue to be removed. Adequate time interval between each stroke needs to be followed.
4. Fragments of tissue are removed with an alcohol soaked sponge.

Indications

1. Minor tissue removal before impression procedures.
2. Removal of granulation or inflamed tissue around a given tooth.
3. For enlargement of gingival sulcus in some cases.
4. Crown lengthening.

Contraindications

- In cardiac pacemaker patients.
- Not to use on thin attached gingiva.

Rules

1. Profound anaesthesia.
2. No metal instruments should be used.
3. Proper grounding should be done.
4. A fully rectified filtered current should be used.
5. Electrode should not make contact with any metal restorations in the patients mouth.
6. A light stroke with a 5 second time interval between applications of the electrode.
7. If the tip drags, the instrument is at too low a setting and the current should be increased.
8. If sparking is visible the current level is set high and need to be decreased.
9. A cutting stroke should not be repeated within 5 seconds.
10. The electrode must remain clean of tissue fragments.
11. The sulcus should be swabbed with hydrogen peroxide before the displacement cord is placed.
12. Maintaining the biologic width after tissue healing.
13. After the impression is made tincture of myrrh and benzoin is placed till healing completes in 5-10 days.

Rotary Curettage/Gingettage

(Introduced by Amsterdam in 1954)

This is a troughing technique to remove limited amount of epithelial tissue in the sulcus while chamfer finish line is prepared.

This technique needs to be done on healthy, non-inflamed gingiva to avoid tissue shrinkage after healing of the diseased tissue.

4. Describe the methods used to classify fixed bridges. Add a note on types of retainers used in Fixed Partial Dentures.

CLASSIFICATIONS OF FIXED BRIDGES

1. Classification depending on edentulous spaces.
2. Classification based on type of connector.
3. Classification based on type of abutments.
4. Classification based on materials used.
5. Classification based on temporary and permanent nature of bridges.
6. Classification based on span length.

1. Classification depending on Edentulous Spaces

Class 1: Posterior edentulous space.
Class 2: Anterior edentulous space.
Class 3: Anterior and posterior edentulous spaces.
Each of these classifications has divisions and subdivisions.

Divisions

To get idea on the type of support.

Division I

Abutments on one side of the edentulous area are capable of rendering support (Cantilever FPD).

Division II

Abutments on both sides of the edentulous space are capable of giving support (Conventional FPD).

Division III

A single tooth in the centre with edentulous space on either side. (Pier Abutments).

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Sub-divisions

Denote the position of an prospective abutment tooth.
Sub-division I: Ideal abutments.
Sub-division II: Tilted abutments.
Sub-division III: Periodontally weak abutments.
Sub-division IV: Extensively damaged coronal structure with good bone support.
Sub-division V: Implant abutment.

Groupings

Each of the subdivisions are further grouped into A and B.
Group A: A single abutment on one side of the edentulous space each is sufficient.
Group B: More than one abutment support is required from each side of the edentulous space.

2. Classification based on Type of Connector

a. Rigid connector.
b. Semi-rigid connector.
c. Removable fixed partial denture.

3. Classification based on Type of Abutments

a. Ideal abutment.
b. Cantilever abutment.
c. Pier abutment.
d. Abutment receiving pin support from coronal structure.
e. Telescopic crown.
f. Endodontically treated abutment with cast post or post and core support.
g. Resin bonded bridges.

4. Classification based on Materials Used

a. All metal crowns: Base metal alloys, gold alloys.
b. Metal ceramic crowns.
c. All ceramic crowns.

d. All acrylic crowns.
e. Fibre reinforced acrylic.
f. Castable ceramics.
g. Metal free ceramics.
h. Ceramic veneer.
i. Acrylic veneer.

5. Classification based on Temporary and Permanent Nature of Bridges

Temporary

Interim prosthesis, splints

Permanent

Fixed partial dentures
Implant abutments

6. Classification based on Span Length

Short span.
Long span.

TYPES OF RETAINERS

A. Complete crowns

1. All metal crowns.
2. All ceramic crowns.
3. Metal-ceramic crown.
4. Acrylic fused to metal crowns.
5. Metal free (Fibre reinforced composites) crowns.

B. Partial crowns

Posterior tooth

1. Mesial one-half crown.
2. Three-quarter crown.
3. Modified three-quarter crown.
4. Seven-eight crown.

Anterior tooth

1. Three-quarter crown.
2. Variations of three-quarter crown (Selberg crown).

A. Complete Crowns

1. All Metal Fixed Partial Dentures

- They are used for replacing maxillary and mandibular posterior teeth.
- They also provide proper guide planes for removable partial denture.
- Aids in occlusal plane modifications.

Advantages

a. They have the maximum strength and durability.
b. Less tooth structure is reduced as compared to all porcelain (chamfer margin).

Disadvantage

They are not aesthetic.

Indications

- For posterior tooth with short clinical crowns.
- For grossly caries or fractured tooth.

Preparation steps

a. Occlusal reduction: Using round-end tapered diamond.
b. Functional cusp bevel: Round end tapered diamond.
c. Buccal, lingual axial reduction: Chamfer diamond.
d. Proximal reduction: Short thin and chamfer diamond.
e. Seating groove: No. 170 bur.

Metals that can be used

- Gold
- Base metal alloys.

2. All Ceramic Fixed Partial Dentures

- All ceramic partial dentures are brittle and less fracture resistant compared to all metal partial dentures.
- Castable and alumina-reinforced porcelains have more strength compared to conventional porcelains.

Advantages

1. Can duplicate tooth colour exactly.
2. Good translucency.

3. Different shades of luting agent give the retainer a natural appearance.
4. Good as anterior retainers.

Disadvantages

1. Reduced strength.
2. Brittle.
3. More expensive.
4. Cannot be used on extensively damaged teeth.
5. More amount of tooth structure need to be removed compared to other restorations.
6. Large connectors cause impingement of inter-dental papilla.
7. Wear of opposing natural teeth.
8. Two opposing retainers in porcelain can cause a clicking sound.
9. Not advisable in posterior tooth if heavy loads have to be applied.

Preparation Steps

After placing depth orientation grooves approximately 1.0 mm on labial surface and 2.0 mm deep on incisal half is reduced.

Incisal reduction: 1.5 to 2.0 mm with flat end tapered diamond.

Labial and lingual axial reduction: With flat end tapered diamond.

Lingual reduction: Small wheel diamond.

Axial reduction: Flat end tapered diamond (Aids in retention, resistance and structural durability.)

Shoulder margin: Helps in resistance and marginal integrity.

Types of Ceramics

a. Conventional platinum matrix ceramics.
b. Alumina reinforced ceramics.
c. Slip cast alumina (Inceram).
d. Castable ceramics (Dicor).

e. Mica glass ceramic (Machinable ceramic: CAD CAM).
f. Heat pressed ceramics: Leucite crystals dispersed ceramics (Optec HSP, IPS empress).
g. Resin bonded ceramics.

3. Metal-Ceramic Fixed Partial Dentures

This retainer consists of a core of metal with a ceramic external surface.

Two types

1. Metal is fused with porcelain on all the surfaces.
2. Only the lingual and occlusal surface is of metal, whereas the labial and gingival surface is formed by porcelain.

Advantages

Aesthetic and also incorporates the strength of metal.
Characterization can be done by internal and external stains.

Disadvantages

1. Not conservative preparation.
2. For better aesthetics, the facial margin needs to be extended subgingivally. This can cause gingival destruction.
3. Failure at the metal ceramic junction can occur.

Preparation Steps

- For type one with a complete metal and porcelain, preparation is same as for all porcelain.
- For type two in which the lingual surface is of metal, a chamfer margin is sufficient, with a shoulder margin on labial aspect to accommodate for the bulk of porcelain.

4. Acrylic Fused to Metal

- Poor wear resistance.
- Easy to fabricate and adjust.
- Aesthetically pleasing.
- Less expensive.

5. Fibre reinforced Composite Resin Bridges

Materials used

Polymer or resin matrices reinforced with glass, polyethylene or carbon fibres. The reinforcing fibres may be unidirectional (long, continuous and parallel), braided or woven.

Classification

Pre-impregnated with resin (e. g. Fibrekor)
Impregnation required with fibre (e. g. Ribbond).

Contraindications

1. Cannot be used in long span bridges.
2. Patients with parafunctional habits.
3. When opposing tooth is unglazed porcelain.

Advantages

1. Optimal aesthetics.
2. Metal free.
3. Decreased wear of opposing teeth.

Tooth Preparation

- Lingual reduction: flat end-tapered diamond.
- Groove preparation on the palatal surface of the edentulous side.
- A shoulder or chamfer margin can be prepared.

B. Partial Crowns

Posterior Tooth

1. **Mesial halves:** For tilted molar abutments to obtain a parallel path of insertion and to alter the occlusal plane.

2. **Three quarter crowns**

- Only the lingual aspect is prepared extending till mesiolingual and distolingual transitional line angles.
- Proximal grooves are prepared perpendicular to the prepared surface and the buccal wall is flared with tapered carbide bur.
- In case of additional retention offset is prepared extending from proximal grooves along the buccal cusp.

3. ***Modified three quarter:*** Done on premolars with the preparation extending buccally.
4. ***Seven-eights*:** Includes lingual, occlusal and distal half of buccal surface.

Anterior Tooth

Three quarter: Refer to posterior tooth three quarter crown preparation.

Pin ledges

Indications

1. When large amount of tooth structure is lost with intact buccal walls.
2. For restoration and alteration of occlusal surface.

Contraindications

1. In short clinical crowns.
2. In long span FPD.
3. In endodontically treated tooth.
4. In patients with active caries.
5. In malaligned abutment tooth.

Advantages

1. Conservation of tooth structure.
2. Supragingival preparation.
3. Better visibility of seating and cementation.

Disadvantages

- Less retentive
- Not aesthetic if metal is displayed.

5. Define and classify retainers. List the advantages and disadvantages of partial veneer crown over other types of retainers. What are the factors that come into play in the selection of retainers?

RETAINER

The prime mechanical function of a retainer is to support and connect the body of the bridge with the abutment. It also restores the form, function, and aesthetics of the abutment.

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CLASSIFICATION OF RETAINERS FOR FIXED PARTIAL DENTURE

Class I—Extracoronal Restorations

A. Complete Crowns

1. All metal crowns.
2. All ceramic crown.
3. Metal-ceramic crown.
4. Acrylic fused to metal crown.
5. Metal free composites.

B. Partial Veneer Crowns

Posterior tooth

1. Mesial one-half crown.
2. Three-quarter crown.
3. Reverse three-quarter crown.
4. Seven-eight crown.

Anterior tooth

1. Three-quarter crown
2. Variations of three-quarter crown (Selberg crown).

Class II—Intracoronal Restorations

1. Inlays
2. Onlays
3. Pin ledge
4. Combinations.

Class III—Radicular Retainers

1. Cast core
2. Blue island posts
3. Para post techniques
4. Kurer technique.

Class I—Extracoronal restorations

- The preparation of the tooth and its cast retainer lies externally to the body of the coronal portion of the prepared tooth and restores a tissue-compatible contour for the crown.

- The retention and resistance to displacement is developed between the inner walls of the casting and the external walls of the prepared tooth (Complete crowns).

Class II—Intracoronal restorations

- The prepared cavity and its cast retainer lie within the body of the coronal portion of the tooth.
- Retention and resistance are developed between the casting and the internal walls of the prepared cavity.

Class III—Radicular retainers:

- The dowel type of retention is confined to the root portion.
- Retention and resistance to displacement is developed by the extension of an attached metal dowel into the radicular portion of the tooth.

PARTIAL VENEER CROWNS

- A partial veneer crown is a restoration covering two or more surfaces of a tooth.
- The surfaces usually covered are the lingual, proximal, occlusal, or incisal.
- The retention and resistance to displacement depend on the internal surfaces and the auxiliary retentive means such as grooves, boxing, and pins.

TYPES OF PARTIAL VENEER

Three-quarter Crowns

Covers three-fourths of the gingival circumference of the tooth, leaving the facial surface intact.

Advantages

1. Aesthetically pleasing.
2. Can serve as a single unit or as an FPD retainer.
3. Can be used on anterior and posterior teeth as retainers.

Reverse Three-quarter Crown

- It is when the preparation is done on the buccal aspect leaving the lingual surface of a mandibular posterior tooth intact.

- Commonly done on mandibular molars with severe lingual inclination.

Seven-eighths Partial Veneer Crown

Covers seven-eighths of the gingival circumference of the tooth leaving the mesial aspect of the buccal surface intact.

Indications

1. For maxillary molars and premolars with extensive carious involvement or restoration on the distal surface with intact mesial surface.
2. Used on a mandibular premolar with the preparation extending from the distal finish line to the mid-facial surface.

Mesial Half Crown

It is a three-quarter crown rotated 90 degrees, preserving the distal surface of the tooth while covering the remaining surfaces.

Indications

1. In tilted mandibular molar abutment.
2. Used as a single retainer in drifted or tipped mandibular molar to alter the occlusal plane.

Contraindication

If distal surface of the tooth is damaged by caries or large restoration.

Advantages of partial veneer crowns over complete crowns

1. Conservative tooth reduction.
2. Good aesthetics compared to complete veneer cast crown.
3. Better biocompatibility with supportive tissues as there is less gingival involvement than with complete coverage.
4. Due to supragingival finish line margin, accessibility for finishing and cleaning is good compared to complete crowns.
5. Easy verification of complete seating of the casting.
6. Seating is complete compared to complete crowns as the luting agent has space to flow out (Less hydraulic pressure).
7. Electric pulp testing can be conveniently accomplished on the intact enamel surface.

8. Reduced pulpal and periodontal trauma during tooth preparation.
9. Access to supragingival margins is easy and hence better for oral hygiene as compared to full crowns.
10. Due to direct visibility, cement removal is easy.

Disadvantages

1. Less retentive than complete veneer crown.
2. If good preparation is not carried out, there will be display of metal with the partial veneer crown.
3. The partial veneer crown preparation can be done only on intact teeth with average crown lengths.
4. Less resistance form as compared to complete crowns.
5. The placement of grooves, boxes, and pinholes requires good skill otherwise difficulty occurs in seating of casting.
6. Not recommended in cariesprone patients with poor oral hygiene.
7. Unseating is common if excessive loads are applied.

Indications

1. Intact or minimally restored teeth with intact buccal wall.
2. To re-establish anterior guidance.
3. Used as retainers for a fixed partial denture when alteration of the occlusal plane is needed.
4. To splint teeth.
5. Can be prepared on teeth with average crown length.
6. Prepared when teeth have normal anatomic crown form.
7. Anterior teeth need to have adequate labiolingual thickness.

Contraindications

1. High caries rate (More for partial veneers where both the unveneered surface and the margin to finish line interface are susceptible to decay).
2. Teeth with extensive core restorations.
3. Deep cervical abrasion.
4. Short teeth.
5. Teeth that are severely constricted at the cervical require more axial reduction to provide adequate groove length.

6. In long-span FPD.
7. Should not be given on endodontically treated posterior teeth if the buccal cusps are weakened by the access cavity, or on teeth with an extensively damaged crown.
8. Should not be placed on teeth that are proximally bulbous.
9. Not recommended in thin teeth of restricted facio-lingual dimension.
10. Not recommended in poorly aligned teeth

In all of the above situations complete veneer crowns need to be given. When there is difficulty in establishing adequate retention and resistance form complete veneer restorations are more suitable.

SELECTION OF TYPES OF RETAINERS

- The selection of the types of retainers depends on the oral-hygiene habits or the DMF rate of the patient, or both.
- If caries index is low any type of retainer is safe provided other factors as periodontal status crown length are all present.
- The length of the bridge span and the type of bridge determines the type of retainer selected.
- Retainer selection for terminal abutments is a crucial decision.

Retainer selection is affected by the following factors:

1. Age.
2. DMF rate.
3. Edentulous span.
4. Periodontal support.
5. Arch position of the teeth.
6. Skeletal relationships.
7. Interocclusal and intraocclusal conditions, such as crown length.
8. Existing and projected oral hygiene of the patient.
9. Vitality of the potential abutment.

Ideal Retainers

1. An ideal retainer needs to support and connect the body of the bridge with the abutment.
2. It should restore the form, function, and aesthetics of the abutment.

3. It should be biocompatible with tooth and its adjacent tissues.
4. Retainer should be constructed without injury to pulp and supporting structures.
5. It should protect and maintain the pulp against thermal and galvanic shock.
6. It should provide safety for the tooth during the lifetime of the restoration.
7. It should provide self-cleaning property.
8. It should be resistant to corrosion and tarnish.
9. It should be a conservative preparation with uniformity of reduction of the abutment tooth.
10. Load should be dispersed to the more receptive areas of the abutment.
11. There should be large surface contact between the abutment and a retainer.
12. Selection of an adequate luting agent is important.

6. Define retention and resistance form in fixed partial denture. What are the factors affecting retention and resistance in posterior tooth preparation?

DEFINITIONS

Retention

Retention prevents removal of the restoration along the path of insertion or along the path of the tooth preparation.

It is the quality of a preparation that prevents the restoration from becoming dislodged by such forces parallel to the path of withdrawal.

Resistance

Prevents dislodgement of the restoration, by forces directed in an apical or oblique direction and prevents any movement of restoration under occlusal forces.

FACTORS AFFECTING RETENTION

1. Magnitude of the dislodging forces
2. Geometry of the tooth preparation

3. Roughness of the fitting surface of the restoration
4. Type of restorative materials being cemented
5. Type of luting agent
6. Film thickness of the luting agent.

1. Magnitude of the dislodging forces

Factors influencing dislodging forces

a. Stickiness of the food.
b. Surface area of the restoration.
c. Texture of the restoration being pulled.

Of all the type of forces sticky food exhibits large dislodging forces.

2. Geometry of the tooth preparation

Factors influencing geometry of tooth preparation

a. Taper.
b. Surface area.
c. Stress concentration.
d. Type of preparation.

a. Taper

- Maximum retention is obtained if a tooth preparation has parallel walls.
- Smaller degrees of taper have more retention.
- Two opposing surfaces each with a 3° taper provide a 6° taper for the preparation.
- Ideal convergence between opposing walls is 6°. This amount of convergence is required to restrain the cemented restoration.

Factors decreasing retention in regard to taper

- Less amount of taper will form an undercut causing divergence between opposing axial walls, in an occlusocervical direction.
- An increased amount of taper increases free movement of the restoration and retention will be reduced (Experimented by Jorgensen in 1955).

Preparation rule

A rotary instrument of the desired taper held at a constant angulation produces the amount of taper required.

The rotary instrument of ideal taper when moved through a cylindrical path during tooth preparation will produce the desired axial wall taper on the completed preparation.

b. Surface Area

- The greater the length of the clinical crown, the more is the retention.
- In short clinical crowns the surface area needs to be increased with the help of grooves and box preparation.
- The greater the width of the clinical crown, the better the retention.
- A restoration with limited path of withdrawal is more retentive depending on the length of the surface area in sliding contact.

c. Stress Concentration

- Round margins reduce stress concentrations, which in turn increases the retention of the restoration.
- Stresses are generally concentrated around the junction of the axial and occlusal surfaces.
- Changes in the geometry of the preparation (e.g. rounding the internal line angles) reduce stress concentrations and hence increase the retention of the restoration.

d. Type of Preparation

- Additional grooves and boxes to a preparation increase the retention as the surface area is increased.
- Retention is double for complete crowns than for a partial crown.
- Luting agent is only effective if the restoration has a single path of withdrawal.
- The occluso-axial line angle of the tooth preparation should be a replica of the gingival margin geometry.
- Fixed prostheses depend on the geometric form than on adhesion of the luting agents for retention.

3. Roughness of the Surfaces

- Retention is increased if the restoration is roughened or grooved by air-abrading the fitting surface with alumina.
- A smooth internal surface of a restoration can cause retentive failure at the cement-restoration interface.

4. Materials being Cemented

- The more reactive base metal alloys have more adhesion with certain luting agents than less reactive high-gold content metals.
- Cement adheres better to amalgam than to composite resin or cast gold.

5. Type of Luting Agent

Adhesive resin cements are the most retentive.

FACTORS AFFECTING RESISTANCE FORM

Lateral forces tending to displace the restoration by causing rotation around the gingival margin is prevented by areas of the tooth preparation that are placed in compression called resistance area.

Resistance depends on

1. Magnitude and direction of the dislodging forces.
2. Geometry of the tooth preparation.
3. Physical properties of the luting agent.

1. Magnitude and Direction of the Dislodging Forces

- Patients with abnormal biting forces should be given a complete metal crown. A proper design and preparation can help to resist these displacing forces.
- In patients with parafunctional habits and pipe smoking to prevent large oblique forces from being applied to a restoration, additional retentive grooves and the restoration should be luted with adhesive cements.

2. Geometry of the Tooth Preparation

- Increased preparation taper and rounding of axial angles tend to reduce resistance.
- Short tooth preparations with large diameters have less resistance form.
- A partial-coverage restoration has less resistance when compared to complete crown.

Resistance can be increased by

a. Preparation of boxes or grooves with walls that are perpendicular to the direction of the applied force.

b. U-shaped grooves and flared boxes provide more resistance than V-shaped ones.
c. Pinholes increase resistance as they prevent rotational movement and subject additional areas of the luting agent to compression. The buccal and lingual walls must meet the axial walls at 90° to resist rotational forces.

3. Physical Properties of the Luting Agent

Factors affecting resistance to deformation of luting agent:
a. Compressive strength.
b. Modulus of elasticity.

a. Compressive Strength

- Zinc phosphate cement should have compressive strength above 70 MPa at 24 hours.
- Silico-phosphate cements have a higher compressive strength.
- Glass ionomer, resin, polycarboxylate and reinforced zinc oxide-eugenol have lower values.
- Increase in temperature during manipulation, decreases the strength of the luting agent.

b. Modulus of Elasticity

Zinc phosphate cements have a higher modulus of elasticity than polycarboxylate cements, hence polycarboxylate cement depends more on the taper of the preparation than zinc phosphate cement.

7. Classify finish lines. Enumerate the functions, indications, advantages and disadvantages of finish lines. Add a note on selection of type of finish line to be used.

Definition

Finish line/margin is the part of tooth preparation/restoration that is in close proximity to the periodontium and that forms the most important and weakest links in the success of full coverage restorations.

It is the outer edge of a crown, inlay, onlay or other restoration.

Other names

Finish line, Finish curve.

It is a line of demarcation, peripheral extension of tooth preparation and planned junction of restoration.

b. U-shaped grooves and flared boxes provide more resistance than V-shaped ones.
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CLASSIFICATION OF GINGIVAL FINISH LINES

Basic Types

a. Knifeedge/Chiseledge/Shoulderless cervical finish line.
b. Chamfer.
c. Shoulder.

Variations

Variation in knifeedge/Chiseledge /Shoulderless cervical finish line

Featheredge

Variations in Chamfer

1. Hybrid.
2. Ski-sloped.
3. Round shoulder.
4. Heavy chamfer.
5. McEwen's chamferette.

Variations in shoulder

1. Full shoulder with bevel.
2. Full shoulder with bevel and butt joint.
3. Radial shoulder.

FUNCTIONS OF FINISH LINES

1. Helps in evaluating the amount of tooth structure removed during tooth preparation.
2. To evaluate the accuracy of impression of the tooth preparation.
3. To evaluate quality of die.
4. To evaluate the marginal adaptation of wax pattern.
5. To check the seating of the final restoration.
6. To evaluate the marginal adaptation of the final restoration.

Ideal Finish Line

An ideal finish line has

1. Good marginal adaptation.
2. Biocompatibility with supporting structures.
3. Adequate contour.
4. Sufficient strength.

FEATHEREDGE/CHISELEDGE FINISH LINE (FIGS 4 AND 5)

Definition

Knifeedge preparation is a tapered preparation that has maximum tooth reduction at occlusal, incisal surfaces and tapers to zero cutting at the gingival termination.

Indications

1. In young patients.
2. Pin ledge three-fourth crowns.

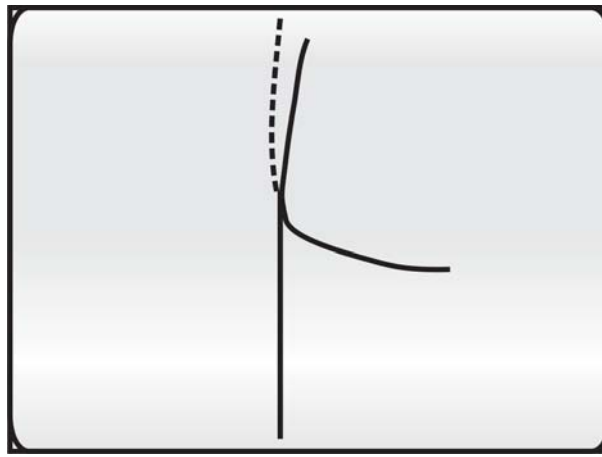

Fig. 4: Featheredge finish line

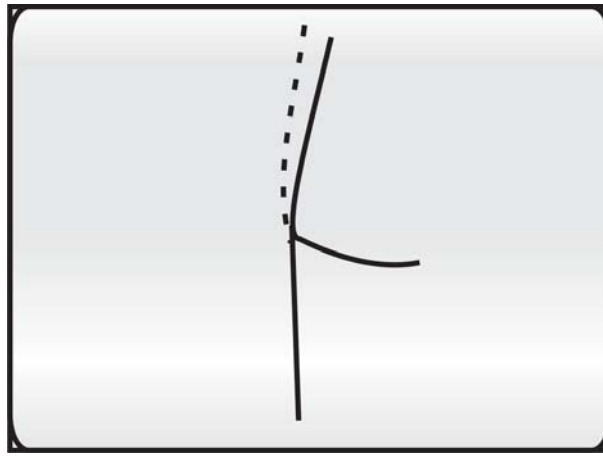

Fig. 5: Chiseledge finish line

3. In tipped teeth.
4. In long clinical crowns.
5. In inaccessible areas in the oral cavity.
6. When finish lines are on cementum.
7. As proximal finish line for inaccessible areas.

Advantages

Easy to prepare.
Conservative tooth preparation.

Disadvantages

1. Location of margin difficult to detect.
2. Over contouring of restoration is possible.
3. Over or under extended crown due to difficulty in locating the finish line.
4. Decreased marginal adaptation.
5. Decreased retention.
6. Wedging effect due to internal stresses.
7. Distortion of the margin is possible during lab procedures as it is thin.
8. Knifeedge finish line is not a recommended finish line.

CHAMFER FINISH LINE (FIG. 6)

Definition

This is a marginal finish line either curved or formed by a plane at an obtuse angle to the external surface of a prepared tooth (Boucher).

It is a concave extracoronal finish line that possesses greater angulation than knifeedge with less width than shoulder finish line.

Instrument used

Round-end tapered diamond.

Indications

1. Ideal gingival finish line for cast metal restorations.
2. Lingual finish line for metal ceramic crowns.
3. For metal collars.

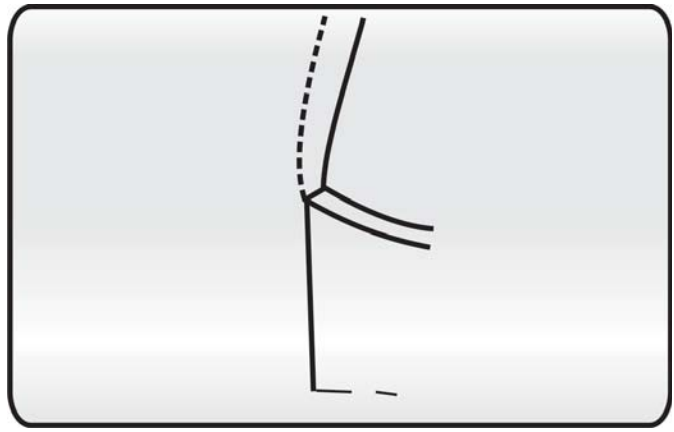

Fig. 6: Chamfer finish line

Advantages

1. Provides a slip joint
2. Provides gingival area with acceptable stress distribution, adequate seal and minimum uniform tooth reduction (El-Ebrashi et al).
3. Aids in accurate die trimming.
4. Can be terminated as subgingival preparation.
5. Adequate bulk and tooth contour.
6. Easy to prepare.

Disadvantages

1. Marginal distortion during firing of porcelain.
2. Reverse lip can form if the entire diameter of instrument is used.
3. Less room cervically than shoulder preparation, therefore cannot prepare with low speed cutting instrument.

Variations

Hybrid

When the chamfer bur is inserted to one-third of depth of stone a hybrid preparation results.

It is a preparation between chamfer and knife-edge.

Ski-sloped

When the chamfer bur is inserted to half the depth of stone a Ski-sloped preparation results.

Rounded Shoulder

When the entire depth of chamfer bur is used in preparation a rounded shoulder results.

Heavy Chamfer

Used in restorations where more axial reduction is required due to caries or previous restoration. As heavy chamfer forms a butt joint, bevel is added to make it a slip joint.

McEwen's Chamferette

Finish line between chamfer and featheredge.

SHOULDER FINISH LINE (FIG. 7)

Definition

When the external line angle of the preparation is perpendicular to the long axis of the tooth, a shoulder finish line results.

Instrument used

Flat end tapered diamond and flame diamond for gingival bevel.

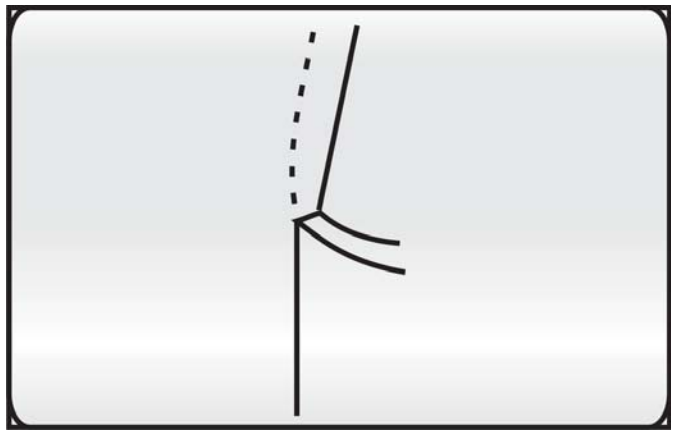

Fig. 7: Shoulder finish line

Indications

1. Facial margins of metal ceramic preparation.
2. Margin preparation for all ceramic restorations.
3. Margin for castable and injectable ceramics.
4. 135° shoulder can be used for long clinical crowns.

Advantages

1. Least stress in cervical area compared to other margins.
2. Better resistance to occlusal forces.
3. Bulk of porcelain can be accommodated.
4. Esthetic.
5. Easy to identify margin and fabricate wax pattern.
6. Increased retention.
7. Good marginal adaptation.
8. Less marginal distortion.
9. For proper contouring of restoration with a straight emergence profile.
10. Easy to check seating of restoration.

Disadvantages

1. Least conservative preparation of all the other preparations.
2. If a metal collar is not used labial porcelain butt fit is more difficult to achieve.
3. Difficult to prepare.
4. Can cause adverse pulpal involvement.
5. Difficult preparation.

Variations

Full Shoulder with Bevel (Fig. 8)

In erosion of tooth structure, gingival finish line for proximal boxes and for porcelain fused to metal restorations.

Full Shoulder with Bevel and Facial Butt Joint

Bevel on proximal and lingual surfaces and butt joint on facial surfaces to avoid metal display on labial side.

Radial Shoulder

Shoulder with internal line angle rounded.

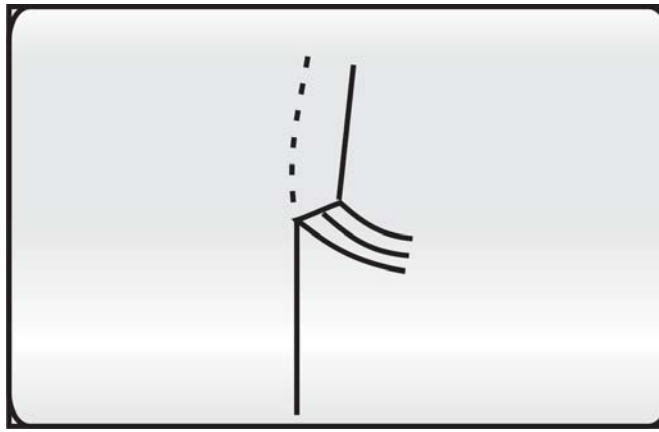

Fig. 8: Bevelled shoulder

Complete Shoulders

Finish lines for all porcelain crowns and injectable ceramic restorations.

Bevelled Shoulders

Used for veneers and selected posterior teeth.

Chamfer Margin

For posterior crowns and the lingual surface of anterior metal ceramic crowns.

Knife-edge Finish Lines

Used for younger patients, pin ledge three-quarter crowns, inaccessible areas of the oral cavity, and finish lines on the cementum.

PRINCIPLES IN DETERMINING TYPE OF FINISH LINES

a. Type of restorative materials.
b. Location of finish lines.
c. Configuration.
d. Marginal fit.

a. Type of restorative materials

Gold Alloys

- Good burnishability.
- Chamfer margin.

Base Metal Alloys

- Lack of burnishability
- Chamfer margin.

Porcelain

Shoulder margin.

Metal Ceramic Materials

Buccal/labial-shoulder margin and lingually chamfer margin.

b. Location of Finish Lines

- Supragingival.
- At the crest of gingiva.
- Subgingival.

Supragingival

Indications

1. Extensive restorations, caries, cervical erosion extending subgingivally.
2. Proximal contact area extending to gingival crest.
3. In short clinical crowns.
4. For aesthetics when labial metal collar needs to be hidden.
5. In root sensitivity, fracture subgingivally.
6. When axial contour modification is indicated.
7. In young patients with high-risk caries.
8. For addition retention and resistance form.

Advantages

1. Easy to prepare accurately without trauma.
2. Gingival retraction is not required.
3. Seating of the restoration can be evaluated.

4. Can place finish line on enamel.
5. More biocompatible with surrounding tissues.
6. Good contour can be achieved.
7. Easy oral hygiene maintenance.
8. Easy evaluation of margins during recall.
9. Can clean luting agent after luting easily.

Disadvantages

1. Difficult to access and finish.
2. Difficult to evaluate fit and cementation procedure.
3. Periodontal health can be affected if oral hygiene is not maintained.

c. Configuration

1. Ease of preparation without overextension.
2. Should be able to identify finish line in the impression and on the die.
3. A good and clear boundary to which the wax pattern can be finished.
4. For wax pattern to be handled without distortion and for strength of restoration.
5. Conservation of tooth structure.
6. Studies by El-Ebrashi showed that shoulder with rounded internal line angle and chamfer showed less stress concentrations. Shoulder with bevel and featheredge showed the maximum stress concentration.

d. Marginal Fit

- An ideal marginal fit is smooth and even.
- A sliding joint has better marginal fit.

[Mathematical equation (Cosine rule)] (Rosner, 1963)

To calculate the marginal gaps.

The closer the hypotenuse of the right triangle approaches the adjacent leg of the triangle, the smaller the gap between the bevel of the wall of the cavity and the casting. This relation is in the uncemented state.

When a luting agent is used, the fit depends on the film thickness of the luting agent used.

8. Illustrate with diagrams, the tooth preparation on right upper central incisor for receiving porcelain jacket crown. Add a note on the advantages, indications and contraindications of all-porcelain jacket crown.

TOOTH PREPARATION STEPS FOR ALL-CERAMIC RESTORATIONS

1. Placement of depth orientation grooves.
2. Incisal reduction.
3. Facial reduction.
4. Lingual reduction.
5. Axial reduction.
6. Lingual axial reduction.
7. Marginal development and refinement.

Armamentarium

1. Mouth Mirror.
2. Periodontal probe.
3. Explorer.
4. Chisels and hatchets.
5. High- and low-speed handpieces.
6. Thin tapering fissure diamonds.
7. Narrow round-tipped tapered diamonds regular and coarse grit.
8. Flat-end tapered diamond regular grit.
9. Football-shaped diamond.
10. Finishing stones and carbides.

1. Placing of Depth Orientation Grooves (Fig. 9)

a. Three depth orientation grooves, 1.0 mm deep, are placed: One in the middle of the facial wall and one each in the mesio-facial and disto-facial transitional line angles in the incisal edge.
b. Two more depth orientation grooves of 2.0 mm depth are placed on the incisal half.
c. 2 mm deep grooves are placed on the incisal edge for incisal reduction.

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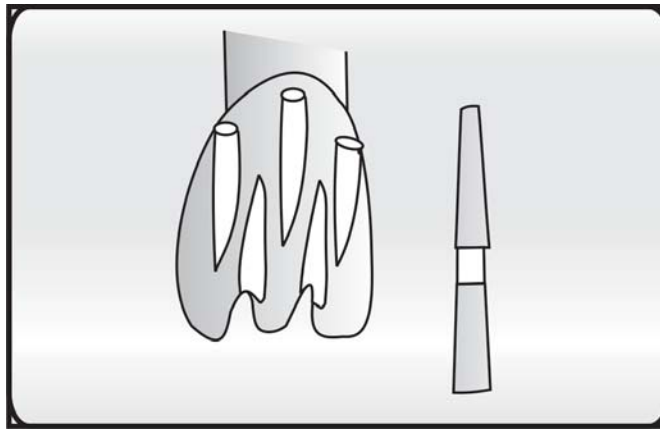

Fig. 9: Placing of depth orientation grooves

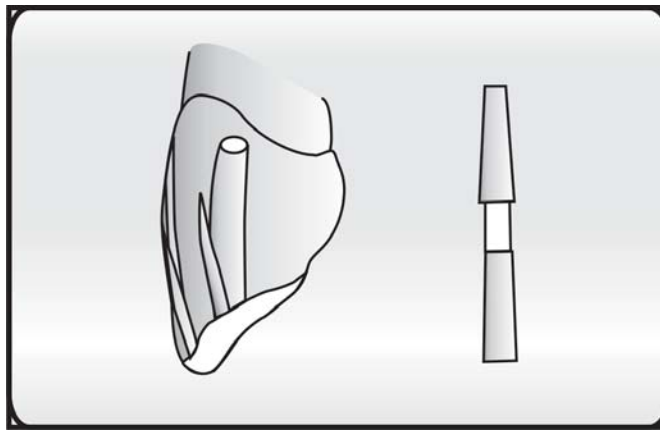

Fig. 10: Incisal reduction

2. Incisal reduction (Fig. 10)

Instrument used

- Flat-end tapered diamond.
- The completed incisal reduction should provide 1.5 to 2 mm of clearance for porcelain in all excursive movements of the mandible.

3. Facial Reduction

This is done in two stages.

First step: Incisal half reduction (Fig. 11)

1. A coarse, flat-ended diamond or No. 700 carbide bur is used to plane away tooth structure between the depth orientation grooves, on the incisal half, at a 45° angle to the long axis of the tooth in a normal occlusal relationship.
2. The reduction is done parallel to the original contour of the tooth to provide uniform porcelain thickness and good aesthetics.

Second step

1. Gingival portion of the labial surface is reduced (Fig. 12) with a flat-end tapered diamond in a flat plane perpendicular to the long axis of the tooth to a depth of 1.0 mm.
2. The reduction is carried out with cervical component parallel to the proposed path of withdrawal.
3. This reduction extends till the labio-proximal line angles.
4. The reduction is done on half of the facial surface at a time.

4. Lingual reduction (Fig. 13)

- Depth orientation grooves of 0.8 mm depth are placed.
- Football-shaped diamond/small wheel diamond is used for lingual reduction.

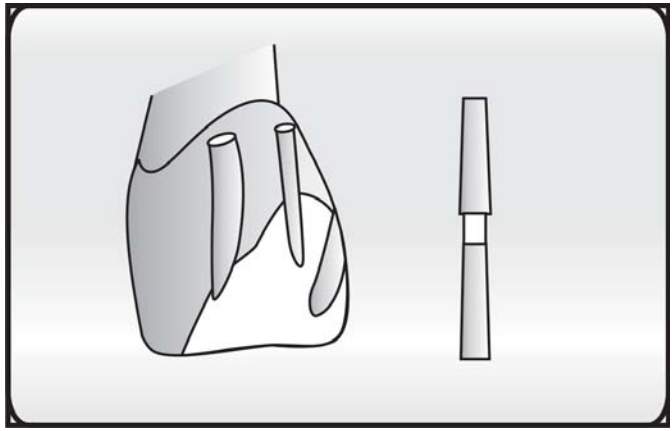

Fig. 11: Incisal half reduction

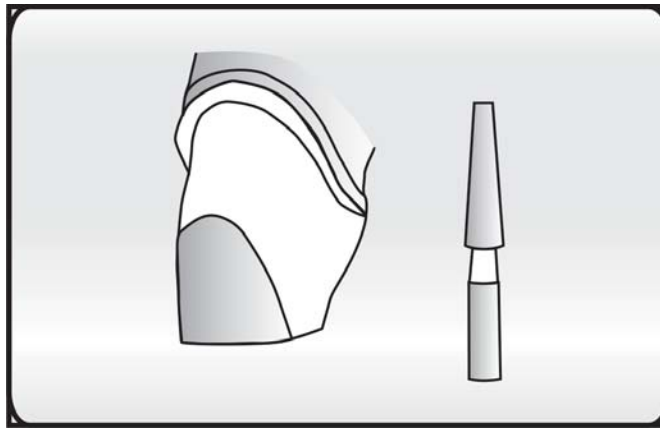

Fig. 12: Labial surface reduction

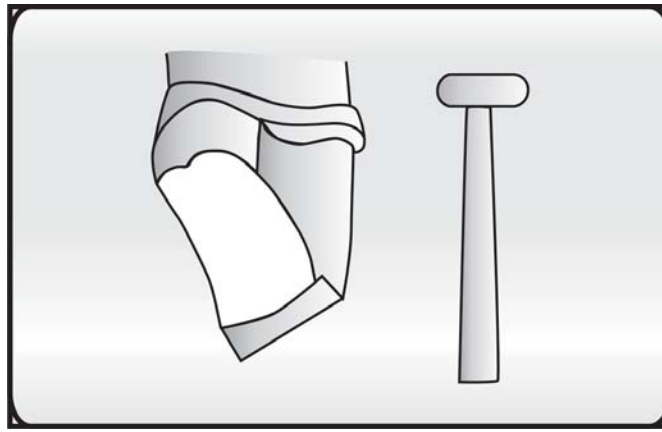

Fig. 13: Lingual reduction

- Reduction is carried out until a clearance of 1 mm in all mandibular excursive movements are obtained.

5. Axial Reduction

- A thin tapered fissure diamond is used to break the contact point with the adjacent tooth. While breaking the contact point, the adjacent tooth should not be abraded.

- The mesial and distal areas are first reduced to a 2° to 5° taper without establishing a shoulder at this time.

6. Lingual Axial Reduction (Fig. 14)

Instrument used
Flat-end tapered diamond.

The same path of withdrawal as that of the facial preparation is followed with lingual axial reduction.

- A depth groove is placed in the middle of the cingulum wall.
- The preparation of 2° to 5° taper is done from the centre of the cingulum wall until the lingual shoulder meets the facial shoulder.
- A 0.75 mm cingulum shoulder is placed with a flat-ended tapered diamond.

7. Marginal Development and Refinement

Instruments used

- An end-cutting bur held perpendicular to the shoulder can be used for lowering margins.
- A sharp chisel is used to remove undermined enamel and finishing the shoulder.

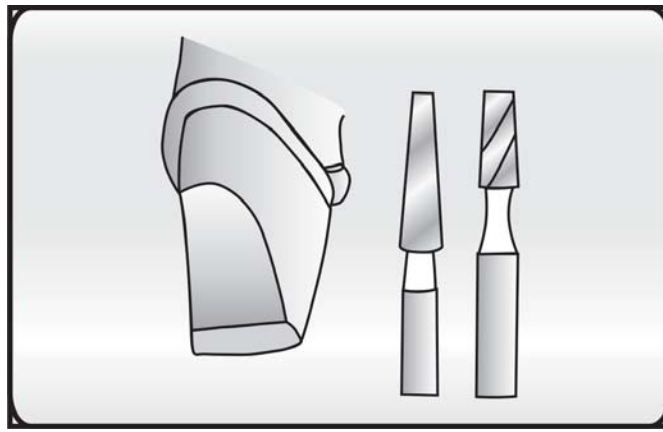

Fig. 14: Lingual axial reduction

- The axial walls are smoothed and all the sharp line angles and point angles are rounded.
- An acceptable emergence profile needs to be created for good aesthetics.

Variation in Margin Preparation

- Instead of shoulder preparation heavy chamfer can also be prepared.
- For subgingival margin placement, a gingival retraction is done before the preparation for good access and less trauma to gingival tissue.
- Initial preparation is followed by refinement with chisels.
- The completed shoulder should be 1 mm wide, smooth, continuous and without any irregularities.

ALL-CERAMIC CROWNS

Advantages

1. Superior aesthetics.
2. Good translucency as to that of natural tooth.
3. Good biocompatibility.
4. Can select the appropriate shade for luting agent.

Disadvantages

1. Reduced strength of the restoration if metal reinforcing substructure is not given.
2. Significant tooth reduction on proximal and lingual aspects.
3. Less conservative than metal-ceramic crown.
4. Difficulties in obtaining a well-fitting margin.
5. The success of the restoration depends on proper preparation design.
6. An extensively damaged tooth cannot be restored with an all-ceramic crown.
7. Cannot be used as retainers in long span FPD.
8. Large cross-sectional dimension connectors need to be incorporated for all-ceramic restorations to have bulk of material.
9. Due to large connectors, impingement on the interdental papilla can lead to periodontal failure.
10. Wear on the functional surfaces of opposing natural teeth.

Indication
Where a high esthetic requirement exists with sound tooth structure present.

Contraindications
1. Where a more conservative restoration can be used.
2. Not recommended for molar teeth.
3. Where increased occlusal loads are present.
4. When adequate support cannot be provided.
5. When an even shoulder width cannot be prepared.

9. Define a crown and mention the advantages, disadvantages and indications of a full metal crown. Describe in detail, with diagrams, the step-by-step procedure in the preparation of a full metal crown on a mandibular first molar.

Definition

An artificial crown is a fixed restoration of the entire coronal part of a natural tooth that restores anatomy, function and aesthetics, usually of metal, porcelain, synthetic resin, or combinations.

FULL METAL CROWNS

Advantages
1. Good strength.
2. Better retention.
3. Greater resistance form than a partial-coverage restoration.
4. Conservative tooth preparation.
5. Less chance of pulpal injury.
6. Can easily modify axial tooth contour.
7. Convenient development of contact areas.
8. Can be given for caries damaged tooth after core built up.
9. Can be given for endodontically treated teeth.
10. Ideal retainer for restoring craniofacial anomalies.
11. Can withstand occlusal loads.
12. Occlusal plane modifications are easily facilitated with supra-erupted teeth.
13. Ideal retainer for long span FPD and short clinical crowns.

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6. Can easily modify axial tooth contour.
7. Convenient development of contact areas.
8. Can be given for caries damaged tooth after core built up.
9. Can be given for endodontically treated teeth.
10. Ideal retainer for restoring craniofacial anomalies.
11. Can withstand occlusal loads.
12. Occlusal plane modifications are easily facilitated with supra-erupted teeth.
13. Ideal retainer for long span FPD and short clinical crowns.

14. Embrasure areas can be enhanced in periodontally compromised dentitions.
15. Buccal flutes developed for preferred contours.
16. Provide desirable guide planes for RPDs.
17. Only restoration that permits modifications to shape survey lines, guide planes and occlusal rests.

Disadvantages

1. Not aesthetic
2. Cannot be used as anterior retainers.
3. Not as biocompatible as ceramic restorations.
4. Chances of over contouring the restoration. (Over countouring can result in periodontal problems.)
5. Distortion of metal margins is common.
6. Uniform gingival finish lines are difficult to achieve.
7. Post cementation gingival caries is difficult to detect.
8. Good laboratory implementation is required for good fit of the restoration.
9. Margins are difficult to locate in the die.
10. After cementation, electric vitality testing of the abutment tooth cannot be done.
11. Restricted to maxillary molars, mandibular molars and premolars.

Indications

1. For restored posterior tooth in non-aesthetic zone unable to withstand normal occlusal loads.
2. For a retainer requiring maximum retention.
3. For short clinical crowns.
4. For extensively damaged or fractured teeth.
5. Complete gold veneer crowns can be prepared on both vital and pulpless teeth.
6. Ideal retainer for long-span FPD.
7. For endodontically treated teeth.
8. Retainers for RPD.

PREPARATION OF A FULL METAL CROWN ON A MANDIBULAR FIRST MOLAR

Metals that can be used
Gold alloys.
Base metal alloys.

Armamentarium
1. High and low-speed contra-angles.
2. Tapered carbide bur used for occlusal guiding grooves, additional retentive features.
3. Round-end tapered diamond regular (0.8 mm) used for occlusal reduction, axial reduction and chamfer preparation.
4. Round-end tapered diamond fine grit for finishing.
5. Utility wax and wax caliper for verification of occlusal clearance.

Steps in Full Metal Crown Preparation

a. Placement of occlusal guiding grooves.
b. Occlusal reduction.
c. Placement of functional cusp bevel.
d. Placement of axial alignment grooves.
e. Axial reduction.
f. Margin placement.
g. Finishing of preparation.

a. Placement of Occlusal Guiding Grooves

1. A tapered carbide bur is used to place the guiding grooves of approximately 1 mm depth in the central, mesial, and distal fossae.
2. These grooves are connected along the length of the central groove extending into the mesial and distal marginal ridge for occlusal reduction.
3. Guiding grooves are also placed in the buccal and lingual grooves and in each triangular ridge extending from the cusp tip to the centre of its base.

b. Occlusal Reduction (Fig. 15)

1. One-half is reduced and then the other half is reduced.
2. Occlusal reduction should follow the anatomic configuration for a conservative tooth preparation.
3. The occlusal reduction follows the depth orientation grooves.
4. Functional cusps (buccal cusps) on mandibular molars are "stamp cusps" and require a "two-plane" reduction with minimum clearance of 1.5 mm.
5. For non-functional cusp a minimum of 0.6 to 1 mm reduction is required.
6. Reduce the inclined planes between the depth guides in the developmental grooves and those along the triangular ridges.
7. Reduce the marginal ridge by 1.5 mm.
8. The occlusal surface is smoothened to duplicate the tooth anatomy.
9. Occlusal reduction is completed when necessary clearance during excursions of the mandible, especially at the ceramic/metal junction is achieved.
10. Evaluate occlusal clearance with wax bite and measure with wax gauge.

c. Placement of functional cusp bevel (Fig. 16)

1. A functional cusp bevel is placed to protect tooth during function by ensuring adequate thickness of metal, as this area contacts with the opposing tooth.
2. Functional cusp bevel ensures ideal restoration contour, maximum durability and conservation of tooth structure.

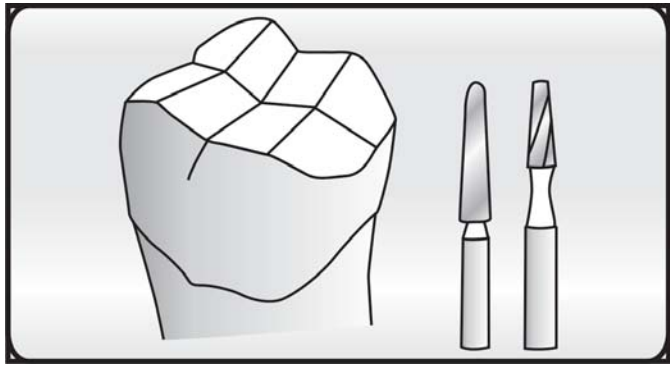

Fig. 15: Occlusal reduction

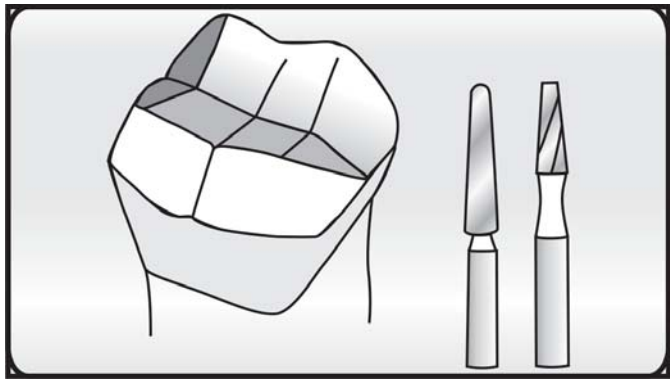

Fig. 16: Placement of functional cusp level

3. A functional cusp bevel is placed 45° to the long axis of teeth on the functional palatal cusp for maxillary molar and buccal cusp for mandibular molar.

d. Placement of Axial Alignment Grooves

1. Three depth orientation grooves are placed:
   a. On each buccal and lingual wall with round-end tapered diamond.
   b. In the centre of the wall.
   c. On each mesial and distal transitional line angles.
2. A round end tapered diamond with a taper of 6° forms an identical taper on the preparation wall.
3. Gingivally:
   Only one-half of the tip of diamond should penetrate.
4. Facial and lingual reduction (Fig. 17)
   a. The facial and lingual surface reduction is done with taper of 2° to 5°. For maxillary molar a two-plane reduction is common on the facial surface.
   b. During the facial and lingual reduction, the taper established is in relation to the path of insertion.
   c. The sharp line angles created after the proximal, facial, and lingual surfaces are rounded.
   d. Vertical seating grooves on the buccal cusp fossa for mandibular and palatal cusp fossa for maxillary to improve retention.

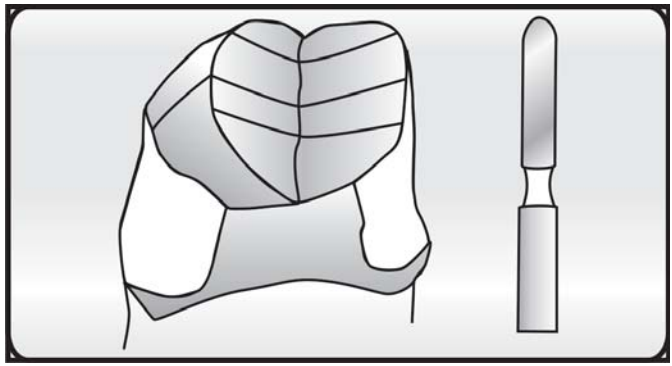

Fig. 17: Facial and lingual reduction

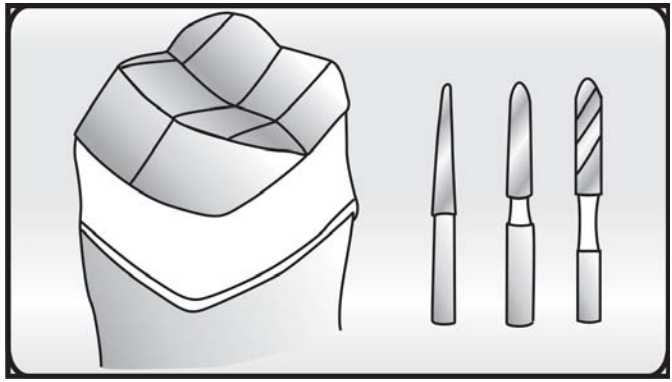

Fig. 18: Axial reduction

e. Axial Reduction (Fig. 18)

1. Break the contact points with a thin tapering fissure bur without abrading the adjacent tooth.
2. In tight contact point areas a metal matrix band can be placed.
3. Axial reduction forms the retention and resistance form.
4. The islands of tooth structure between the alignment grooves are removed while the chamfer margin is placed with a round-end tapered diamond.
5. The preparation is done on one-half at a time.
6. A 5° convergence on the mesial surface of the tooth is required. Gingival finish line is not made at this time.
7. The distal surface is prepared next.

f. Margin Placement

1. The width of the chamfer margin should be 0.5 mm.
2. Chamfer margin must be smooth and continuous mesiodistally and ideally located supragingivally.
3. Unsupported enamel should be removed with chisel.
4. The tip of the bur should not exceed the depth of one-half the diameter of the bur.

g. Finishing the Preparation (Fig. 19)

- Finish the preparation by refining the line angles and point angles.
- Smoothen sharp angles or surface irregularities with the diamond and, finally with a cuttle fish disc.

10. Describe in detail, with diagrams, the step-by-step preparation of a maxillary canine to receive a three quarter crown. Explain and justify different impression techniques for fixed partial denture.

Definition

Partial Veneer Crown is an extracoronal metal restoration that covers only part of the clinical crown. Partial veneer crowns include all tooth surfaces except the buccal or labial wall in the preparation.

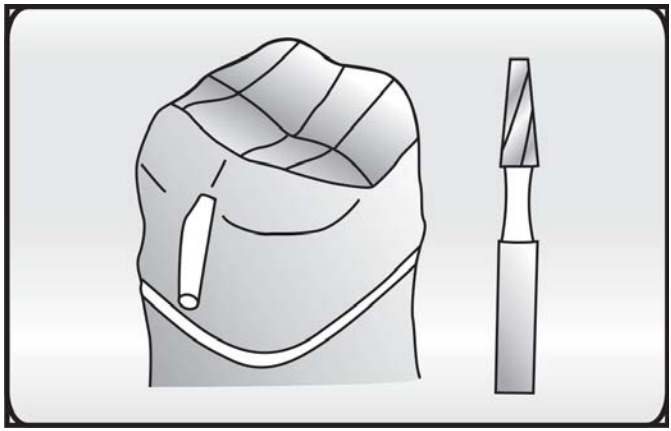

Fig. 19: Finishing the preparation

f. Margin Placement

1. The width of the chamfer margin should be 0.5 mm.
2. Chamfer margin must be smooth and continuous mesiodistally and ideally located supragingivally.
3. Unsupported enamel should be removed with chisel.
4. The tip of the bur should not exceed the depth of one-half the diameter of the bur.

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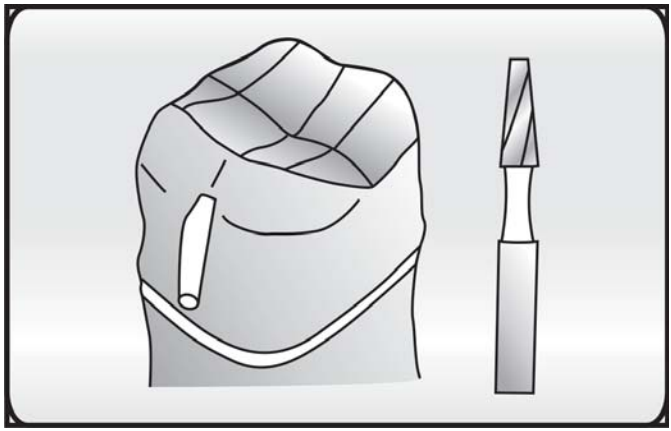

Fig. 19: Finishing the preparation

PREPARATION STEPS OF PARTIAL VENEER CROWNS

1. Incisal reduction.
2. Lingual reduction.
3. Interproximal reduction.
4. Proximal box or groove placement.
5. Incisal offset placement.
6. Facial bevel.
7. Finishing the preparation.

Armamentarium required

1. High and low speed contra-angle handpieces.
2. Burs as listed below.
3. Utility wax and wax gauge to evaluate lingual reduction.

Burs used	*Used for*
• Round ended tapered diamond	• Incisal reduction, axial reduction.
• Football shaped diamond	• Lingual reduction.
• 169L carbide bur	• Interproximal reduction.
• Narrow chamfer diamond	• Chamfer margin
• 167 carbide bur	• Proximal groove.
• Flame shaped diamond	• Flare for proximal extensions
• Inverted cone carbide bur	• Incisal groove.
• Fine, flame-shaped diamond bur	• Facial bevel.
• Carbide finishing bur	• Finishing preparation.
• No. 1/2 round bur	• Pilot hole.
• Hatchet instrument	• For contact breaking.

1. Incisal Reduction

Round ended tapered diamond used.
Reduce the incisal edge 1 mm at 45° angle to the long axis of the tooth. Remove 1.0 to 1.5 mm following the facial contour of the tooth.

2. Lingual Reduction (Fig. 20)

It is done in two steps.

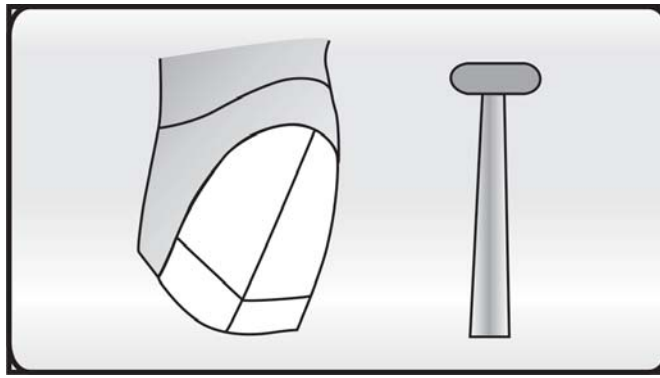

Fig. 20: Lingual reduction

a. Lingual Surface Reduction

A football-shaped diamond is used to reduce the lingual surface in two planes, with a slight ridge along the centre of the lingual surface incisogingivally. A clearance of at least 0.7 to 1 mm is required with the opposing tooth.

b. Lingual Gingival Reduction

A round-ended tapered diamond is used to achieve a chamfer of 0.5 mm deep at the cervical finish line. The chamfer is extended to include the lingual line angles.

3. Interproximal Reduction (Fig. 21)

It is done in three steps.

a. The proximal surface is reduced with a 169L carbide bur from the lingual to the facial surface with the contact point intact. The facial line angles must remain intact for good aesthetic results.
b. A light chamfer finish line is made on the proximal surface with a narrow chamfer diamond. This chamfer should merge with the lingual chamfer.
c. The contact with adjacent tooth is broken with a hatchet instrument from the facial surface, to form labial proximal extensions. The flare of proximal extensions is finished with a flame-shaped diamond.

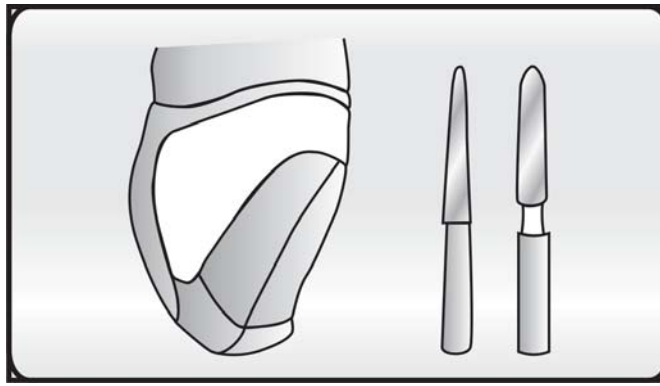

Fig. 21: Interproximal reduction

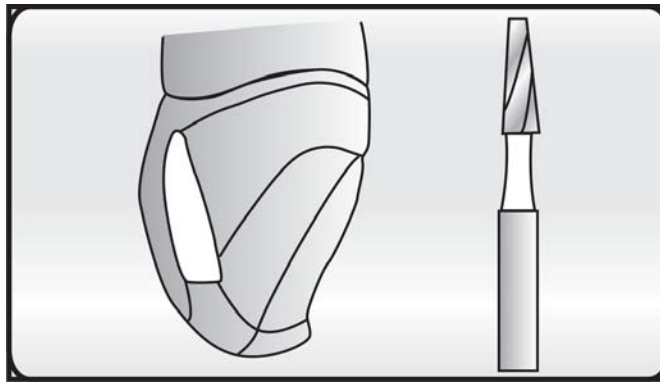

Fig. 22: Proximal groove

4. Proximal Grooves (Fig. 22)

- A 167 carbide bur is used for groove placement at the proper alignment. The proximal grooves are placed parallel to the incisal two-thirds of the facial surface (169L carbide bur).
- These grooves resist lingual displacement and should be a minimum of 3 mm long with 0.5 mm of the gingival finish line. The facial and lingual walls of the grooves should have a 2 to 5 degree incisal divergence.
- The lingual wall of the proximal grooves should have a 2 to 5 degree incisal convergence with the lingual gingival wall.
- The facial wall of the groove should be continuous with the proximal flare to add bulk to the facial margin.

5. Incisal Groove (Fig. 23)

- Inverted cone carbide bur is used.
- A 0.5 to 1 mm groove is prepared within the dentin and is made parallel to the DEJ connecting the proximal grooves. The groove is not placed at the expense of the incisal edge.

6. Facial Bevel (Fig. 23)

- Fine, flame-shaped diamond bur is used.
- A narrow bevel < 0.5 mm is prepared on the labio-incisal finish line at right angles to the incisal two-thirds of the facial surface.

7. Finishing the Preparation

- A carbide finishing bur is used.
- All the sharp and point angles are rounded to ensure continuity of all finish lines.

8. Cingulum Modification if needed for Additional Retention

a. A ledge in prepared in the coagulum after paralleling a 170 bur to the long axis on the proximal grooves.
b. A pilot hole is cut in the ledge with a No. 1/2 round bur.

DIFFERENT IMPRESSION TECHNIQUES

1. Stock Tray/Putty wash.
2. Custom.

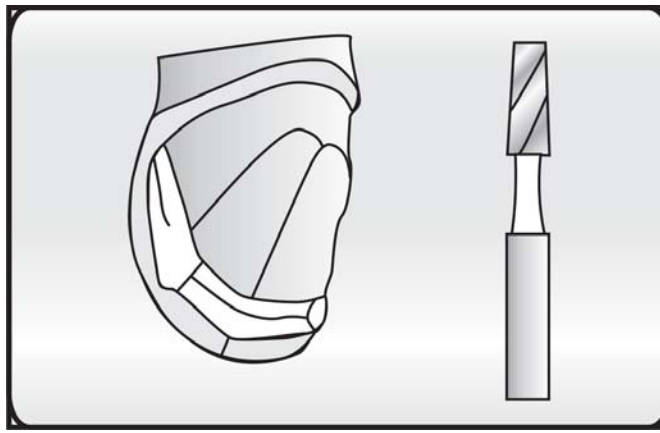

Fig. 23: Incisal goove and facial bevel

3. Closed bite.
4. Double arch.
5. Copper tube.

1. Stock Tray/Putty Wash

Polyvinyl siloxane is used.

Materials used

- Reversible, irreversible hydrocolloids and elastomeric impression materials.
- For accuracy, elastomeric impression materials are commonly used.
- In this technique, a single impression with polyvinyl-siloxanes or a double mix with medium and heavy-bodied elastomers can be done.

Single Mix Technique

1. After adjusting the chair position, a proper stock tray with the correct border extensions, and tray shape and size depending on the patient's arch shape and size is selected.
2. Apply tray adhesive on the inside and rim of the stock tray.
3. ***Manipulation of impression material:***
   - Mix the high-viscosity putty impression material and roll putty into elongated cylinder.
   - Place the putty in the stock tray and cover with polyethylene sheet.
4. ***Seating of tray***
   - Insert and seat the tray with a rocking type motion.
   - Seat the tray in the mouth without movement till initial set occurs (approximately 2 minutes).
   - For stock tray (putty wash) single mixing technique, the unset high-viscosity impression material should already be in the tray, and the preparations syringed with low-viscosity impression material.
5. ***Setting of material and tray removal***
   Remove from the mouth with minimal sideward movement and ensure the material is set using a fingernail test. (Material rebounds completely).

6. ***Trimming the impression***
   After removing the spacer, the excess impression material is removed with a sharp knife.

Advantages

- Less time required.
- No need to fabricate a custom tray.
- Metal stock trays are rigid and chances of distortion are less.

Disadvantages

- Each time the tray is used it needs to be sterilized.
- More impression material is required.

Double Mix Technique (PVS PS CS)

1. After a stock tray is selected, tray adhesive is applied; the impression putty is mixed and placed in tray.
2. A polyethylene sheet is used to cover the putty material and impression is seated in the patients mouth.
3. After the complete set of the impression is ensured by fingernail testing, the tray is removed.
4. ***Relieving the tray:***
   A sharp hand instrument is used to remove uniform amount of impression material from the tissue surface.
5. After gingival retraction, evaluate tissue displacement, check the finish line area(s), and leave cord(s) in place for 8 to 12 minutes.
6. ***Manipulation of light body material***
   After measuring the arch length of tray, the tip of the syringe carrying the low-viscosity elastomer is trimmed and then low viscosity material is dispensed.
7. ***Making final impression***
   - A mixing pad, (6 by 8 inches) or an automatic gun dispensing system is used.
   - The low-viscosity impression material is mixed with a circular motion combining the two strands, then a figure eight motion to blend and flatten the mixture onto the mixing pad (Approximate mixing time less than l minute).
8. ***Loading the impression material***
   - The syringe is loaded by holding it at a slight angle while scraping the pad.

- Screw on the tip, and insert the plunger.
- While the plunger is inserted into the syringe, the cord is removed.
- After evaluating retraction site for seepage, haemorrhage, or debris, first syringe inaccessible areas, e.g. distal lingual finish line.
- The syringe is positioned so the elastomer is ahead of the tip's orifice.

9. ***Tray Insertion***
   - Insert the low-viscosity impression material into the tray slightly less than the depth of the external borders.
   - Seat the tray from posterior to anterior, allowing the excess to extrude anteriorly.
   - Seat the tray firmly in position.
   - The tray should not be moved while the material is setting.
10. ***Final impression***
    - After the final set is over, tray is removed.
    - Rinse impression with ambient water, and dry with short, small bursts of compressed air.
    - Retraction cord(s) remaining in the impression material are removed carefully.
11. ***Evaluate set impression***
    - The area 0.5 mm beyond visible finish line should be visible. There should be no show-through in any areas of the impression, except at tissue stops
    - There should be no shiny smooth areas, no voids present.
    - Review for tears. There should be no thin areas leaving the finish line unsupported.

2. Custom Tray: PVS PE PS, CS

Advantages

1. Less impression material required compared to stock tray.
2. Sterilization is not a problem.
3. Less chances of impression material getting distorted due to curing shrinkage.
4. Precuring of the tray material is not required.

Disadvantages

1. Time consuming due to tray fabrication.
2. The tray must be used after complete curing to prevent further distortion.
3. Monomer sensitivity during tray fabrication for some personnel.

Technique

Fabrication of Tray

(Wax adaptation)

- The diagnostic cast is soaked in slurry water for 10 minutes and then painted with a layer of tinfoil substitute to prevent the resin from adhering to the cast.
- Outline of the tray extensions is marked on the cast and two sheets of base plate wax are adapted to the cast.
- Excess wax is trimmed and a thin tin-foil (or polyethylene) sheet is placed over the wax to protect resin from wax during the exothermic cure.

Placement of tissue stops

Four widely spaced hard tissue stops of 3 mm/2 mm are placed on non-functional cusps.

Manipulation of tray material

- The right proportion of monomer (liquid) and polymer (powder) are mixed and in dough stage, it is flattened to approximately 4 mm thick.
- The flattened putty is adapted to the tin-foiled cast; excess material is trimmed off and handle is formed with excess resin.

Removal of tray from the cast

- After the resin material sets (approximately 15 minutes), the tray is lifted from the cast.
- The wax spacer is removed (all wax needs to be removed).

Finishing the tray

- Tray is trimmed and polished. Gingival retraction is carried out and tray adhesive is applied.

Making Final Impression

- A mixing pad, (6 by 8 inches) or an automatic gun dispensing system is used.
- The low-viscosity impression material is mixed with a circular motion combining the two strands, and then it is blended and flattened onto the mixing pad (in less than l minute).

Loading the impression material

- The syringe is loaded by holding it at a slight angle while scraping the pad.
- Screw on the tip, and insert the plunger.
- While the plunger is inserted into the syringe, the cord is removed.
- After evaluating retraction site for seepage, haemorrhage, or debris, first syringe inaccessible areas, e.g. distal lingual finish line.
- The syringe is positioned so the elastomer is ahead of the tip's orifice.

Tray Insertion

- The low-viscosity impression material is placed into the tray and the tray is seated firmly in position until the material sets.

Final impression

- After the final set is over, tray is removed; the impression is rinsed with water, and dried with compressed air.

3. Closed Bite Double Arch Method

Synonyms: Dual quad tray, double arch, triple tray, Accu-bite, closed mouth impression. Materials used are polyvinyl siloxane and polyether.

Minimum conditions

1. The articulator must have a vertical dimension holding stop such as an incisal pin to maintain vertical dimension.
2. There should be sufficient space distal to the terminal tooth for tray approximation.

Advantages

1. A functional impression is achieved.
2. Less elastomeric impression material is needed.

3. The physical deformation of the mandible during opening is minimized.
4. Less gagging may occur.

Disadvantages

1. Tray is not rigid.
2. It is not a functionally generated technique, so it is limited to one casting per quadrant.
3. The distribution of the impression material is not uniform.

Procedure

- After evaluating the fit of the tray in patient's mouth, the tray is positioned accurately with the trays crossbar distal to last tooth in arch.
- The patient is asked to close mouth to observe the complete bilateral closure and the patient's comfort.

Making final impression

- A mixing pad, (6 by 8 inches) or an automatic gun dispensing system is used.
- The low-viscosity impression material is mixed with a circular motion combining the two strands, then a figure of eight motion to blend and flatten the mixture onto the mixing pad (in less than l minute).

Loading the impression material

- The syringe is loaded by holding it at a slight angle while scraping the pad.
- Screw on the tip, and insert the plunger.
- While the plunger is inserted into the syringe, the cord is removed.
- After evaluating retraction site for seepage, haemorrhage, or debris, first syringe inaccessible areas, e.g. distal lingual finish line.

Tray insertion

- Insert the low-viscosity impression material into the tray slightly less than the depth of the external borders.
- Seat the tray from posterior to anterior, allowing the excess to extrude anteriorly.

- Seat the tray firmly in position.
- For quadrant trays, position the crossbar distal to the last tooth in that arch.

Closed mouth technique

Instruct patient to slowly close mouth and evaluate the interdigitation on the opposite arch.

Tray removal

- When the patient opens the mouth, the impression adheres to one arch.
- Tray is removed by placing a finger on either side of the tray.
- The handle is not used to remove tray.
- Residual impression material in sulcus or interproximal areas is removed.
- Rinse impression with water, and dry with small bursts of compressed air.
- Retraction cord(s) remaining in the impression material are removed carefully.

4. Copper Band

Copper tube impressions are made when there are multiple preparations with vague margins.

Fitting copper band to preparation

- A copper band of adequate diameter is adapted to the prepared tooth.
- This adapted band is annealed by heating in flame and quenching in alcohol.
- The finish line area is marked with a sharp explorer tip.
- The marked area is cut with scissors and smoothened with carburundum stone.

Checking the fit

- The copper band should extend at least 1 mm beyond finish line with a slight gap between finish line and copper band.
- Orientation holes are placed in top one-fifth of facial surface of tube.

Making of compound plug

- Red stick compound is heated over a Bunsen burner flame.
- Once the appropriate temperature is reached the warm compound mass is inserted on top one-third of copper tube.
- The copper band is oriented and seated till the compound touches the occlusal surface of band.

Removing the impression

- The impression is cooled in water.
- A towel clamp is used to remove copper band from mouth.

Relieving for final impression

- A slow speed hand piece with No. 6 or 8 carbide bur is used to remove 0.2 mm of compound from the impressed occlusal surface creating a space for the heavy body polyvinyl-siloxane.
- A relief vent is placed with a long shank No. 6 round carbide bur, through the centre of the compound plug.

Making impression (PVS)

- More relief vents are placed with a sharp No. 4 or No. 6 round carbide 2 to 3 mm above the bottom of the copper tube. These holes help to retain the polyvinyl-siloxane impression material and provide a suitable space at the finish line area.
- Some areas in the internal surface are mildly coated with adhesive.
- The prepared tooth is cleaned and isolated.

Final impression

- Either a automatic gun or a syringe loaded with heavy-viscosity, polyvinyl-siloxane impression is injected into the copper band, filling the space completely from the compound to copper band edge.
- After loading the impression material in the copper band the band is positioned and seated properly.

Removing the final impression

After the final set is completed a towel clamp is used to remove the impression by grasping on top one-fifth of impression.

11. Name the component parts of a bridge. Define and classify pontics. Add a note on selection of pontic design in anterior and posterior teeth. What are the requirements of a pontic?

PARTS OF A BRIDGE

a. *Retainers:* Are attached to the prepared abutments.
b. *Connectors:* Pontic is connected to the retainer by a connector.
c. *Pontic:* Artificial tooth suspended from the abutment tooth.

DEFINITION OF PONTIC

An artificial tooth in a fixed partial denture that replaces a missing natural tooth, restores its function and usually fills the space previously occupied by the clinical crown (GPT).

CLASSIFICATION OF PONTICS

1. According to the shape of the surface contacting the ridge.
2. According to the material used in construction of pontic.
3. According to the type of fabrication.
4. According to mucosal-contacting or nonmucosal-contacting.

1. According to the shape of the surface contacting the ridge

a. Spheroidal/Egg shaped/Bullet shaped
b. Conical
c. Saddle
d. Modified ridge lap
e. Sanitary/Hygienic
f. Modified sanitary.

2. According to the material used in construction of pontic

a. Metal pontics.
b. Metal ceramic pontics.
c. Aluminous core porcelains.
d. Resin veneered porcelain.

3. According to the type of fabrication

a. Prefabricated:
   i. Trupontic.
   ii. Pin facing.

iii. Interchangeable.
iv. Modified pin facing.
v. Reverse pin facing.
vi. Harmony facing.

b. Custom made.

4. According to mucosal-contacting or nonmucosal-contacting

a. Mucosal contacting:
   i. Saddle.
   ii. Modified saddle.
   iii. Ridge lap.
   iv. Modified ridge lap.
b. Nonmucosal contacting
   i. Sanitary.
   ii. Modified sanitary.
   iii. Bullet.

REQUIREMENTS OF A PONTIC

1. To provide good aesthetics.
2. To restore function.
3. Should preserve residual ridge.
4. Should be biocompatible.
5. Should be comfortable for the patient.
6. Should be able to maintain good oral hygiene.
7. It should stabilize adjacent and opposing teeth.

PONTIC DESIGN

Saddle/Ridge Lap Design (Fig. 24)

Definition

A ridge lap is one in which contact extends beyond the midline of the edentulous ridge or that forms a sharp angle at the lingo-gingival aspect of the tissue contact. It forms a large concave contact with the ridge obliterating the facial, lingual and proximal embrasures.

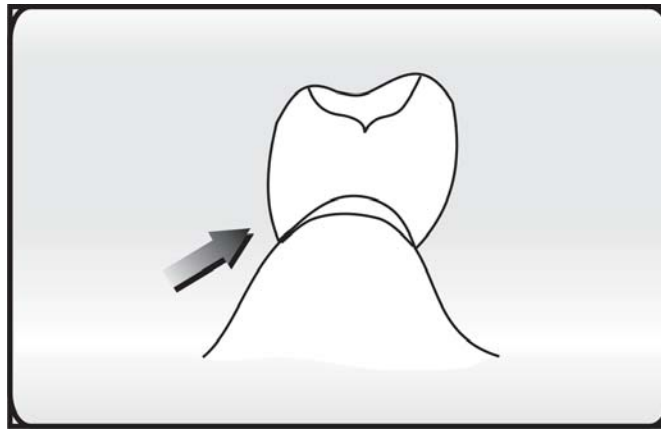

Fig. 24: Saddle/Ridge lap design

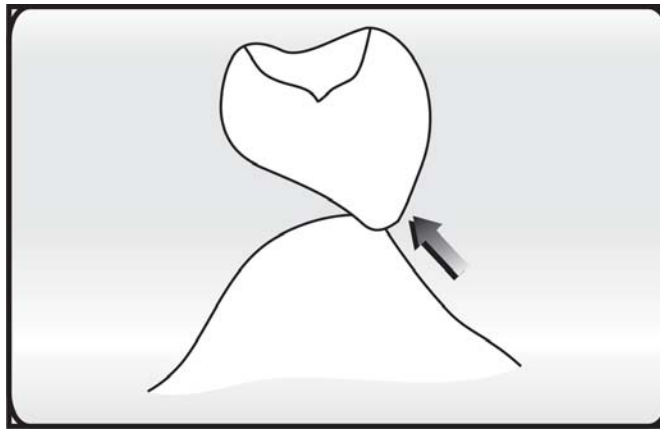

Fig. 25: Modified ridge lap

Disadvantages

- Difficult to maintain oral hygiene.
- Can cause tissue inflammation.

Modified Ridge Lap (Fig. 25)

- Lingual surface : Slight deflective contour.
- Facial surface : Slight facio-lingual concavity.
- Ridge contact : Only on crest of ridge facially (Contacting area of pontic is convex).

- Used : In maxillary and mandibular aesthetic zone areas.

Hygienic Pontic (Fig. 26)

No contact with ridge, easily cleansable.

Uses:
Mandibular molar and non-aesthetic zones.

Design
- Occlusogingival thickness should be a minimum of 3 mm and with space between the pontic and ridge for easy cleaning.
- It is an all convex design mesiodistally and faciolingually (Fish belly design).

Modified Sanitary Pontic (Fig. 27)

Design
- Concave mesiodistally and convex faciolingually (Hyperbolic paraboloid design).
- If in aesthetic zone, visible area is veneered with porcelain.

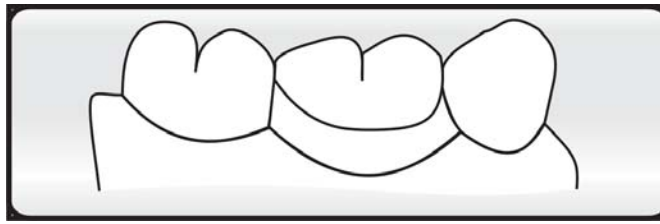

Fig. 26: Hygienic pontic

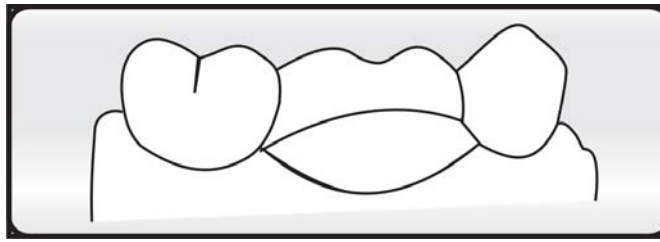

Fig. 27: Modified sanitary pontic

Spheroidal/Egg-shaped/Bullet-shaped Pontic

Design

This pontic is convex from all directions with only one point of contact at the centre of the ridge.

Use

Mandibular posterior tooth.

Modified Spheroidal Pontic (Fig. 28)

Design

This pontic is convex from all directions with the only point of contact on the buccal surfaces.

Use

Mandibular posterior tooth.

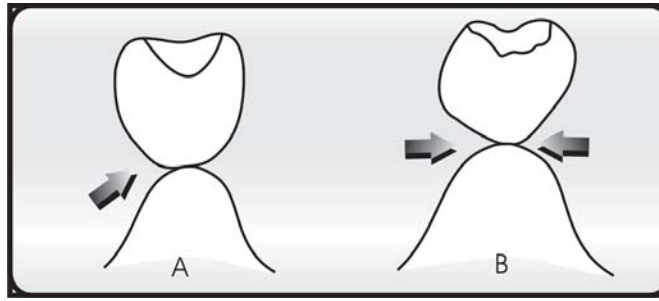

Fig. 28: A: Spheroidal pontic, B: Modified spheroidal pontic

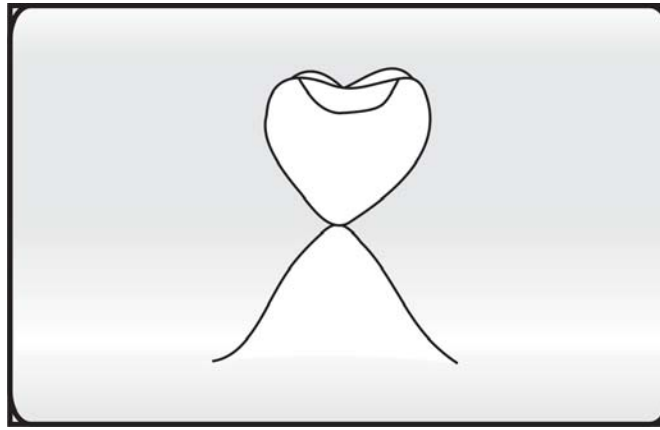

Fig. 29: Conical pontic

Conical Pontic (Fig. 29)

Design

Rounded and cleansable with a small tip.

Use

In non-aesthetic zone in thin mandibular ridges.

Ovate Pontic (Fig. 30)

Design

The round tissue contacting area is set into concavity of ridge.

Indications

1. For aesthetic zone, immediately after extraction (temporary).
2. In broad flat ridges which is surgically prepared.

Prefabricated Pontics

Trupontic

It was widely used earlier.

Design

The facing consists of a horizontal tubular slot, which runs from the centre to the lingual aspect. This slot along with wide proximal bevels provides retention for the facing.

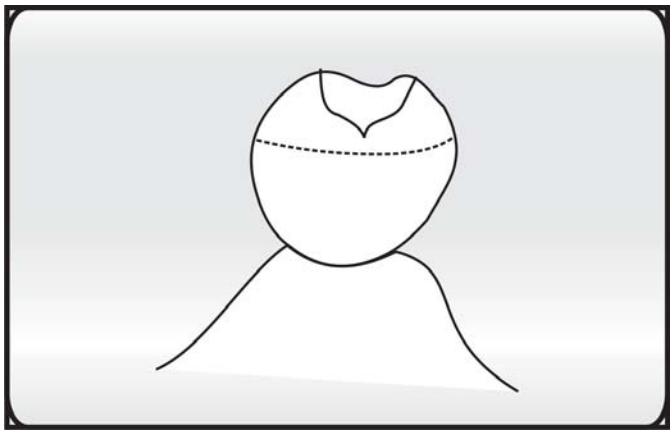

Fig. 30: Ovate pontic

Disadvantage

In case of less occlusogingival height fabrication of facing is difficult.

Interchangeable Facing (Fig. 31)

Design

It consists of a vertical slot running down the flat lingual surface, which is retained by a lug that engages the retention slot.

January Pontic

Design

- It is a rounded blunt porcelain with a slot running out to one side, which is oriented toward the lingual during fabrication of the pontic.
- After it is ground to fit into the edentulous space it is reglazed.

Harmony Facing (Fig. 32)

Design

This facing consists of an un-contoured porcelain gingival surface and two retentive pins.

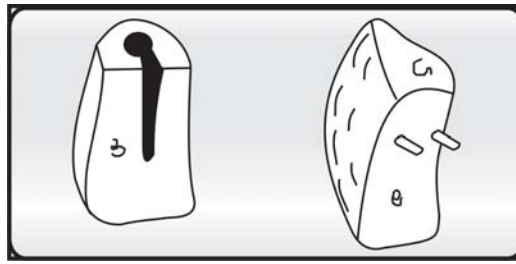

Fig. 31: Interchangeable facing

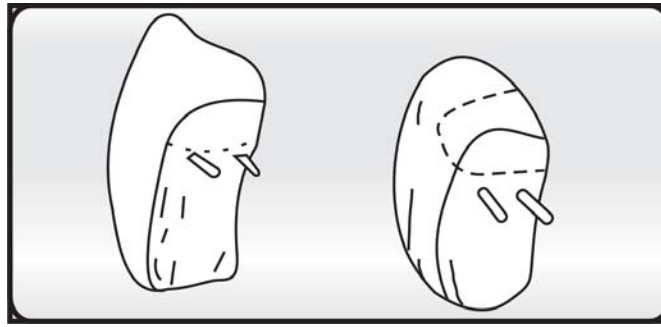

Fig. 32: Harmony Facing: 1: Anterior tooth, 2. Maxillary posterior tooth

Indication
For maximum aesthetics in anterior tooth.

Modified Pin Facing (Fig. 33)

This facing is made by adding porcelain to the lingual gingival area of a pin facing.

Harmony Reverse Pin Facing (Fig. 34)

Design

- Porcelain denture teeth modified as pontic facings.
- Multiple pinholes 2 mm deep are made with drill press in the lingual surface of reverse pin facing.
- The pins come out of the backing providing retention.

Indication:
Deep overbite situations.

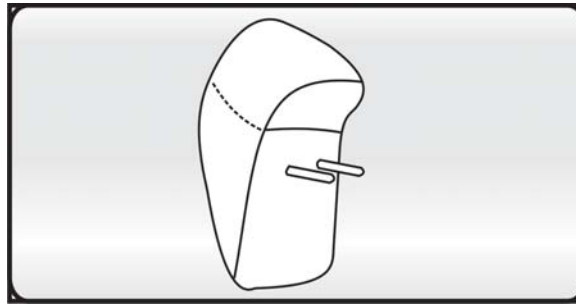

Fig. 33: Modified pin facing

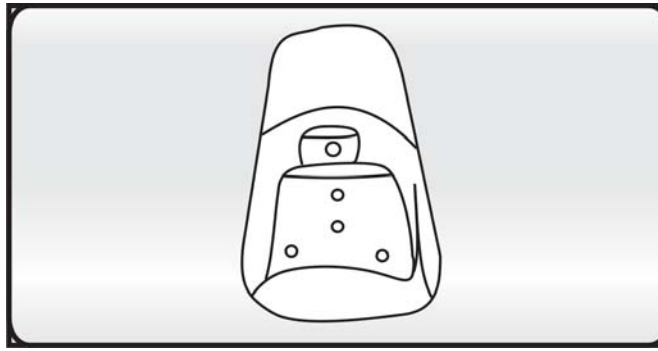

Fig. 34: Harmony reverse pin facing

PONTIC SELECTION

Factors Determining Pontic Selection

1. Type of retainers.
2. Aesthetics.
3. Occlusal gingival height.
4. Mesiodistal width of the edentulous area.
5. Ridge resorption and contour.

1. Type of Retainers

Depending on the type of retainer used, the selection of pontic varies.

- In case of porcelain-bonded-to-metal retainers, the same type of pontics is used.
- If partial veneer retainers are used, prefabricated facings with the same metal as for the retainer is used.
- In maxillary anteriors and posteriors and mandibular anteriors - Modified ridge lap is the pontic of choice.
- In mandibular posterior region - Spheroidal or hygienic pontic is preferred.

2. Aesthetics

- For maxillary anterior tooth modified ridge lap is the design of choice.
- Depending on the location of pontic placement, the selection of pontic varies.

3. Occlusogingival Height and Mesiodistal Width

- The amount of space available for a pontic alters the choice of design.
- When there is limited space for a pontic an acrylic pontic with facing is the choice.

4. Ridge Resorption and Contour

Classification of ridge deformity (Siebert)

Class I : Less facio-lingual width, normal apico-coronal height.
Class II : Decreased ridge height with normal facio-lingual width.
Class III : Loss of ridge height and width.

- Class I defects can be corrected by subepithelial or submucosal connective tissue grafts.
- Class II defects and Class III defects can be corrected by onlay grafts.
- If there is severe bone resorption placement of fixed restoration will hamper aesthetics.
- In such cases surgical ridge augmentation is done or a roll of soft tissue is created labial to the pontic site.

12. What are the biological, mechanical and aesthetic considerations in designing a pontic? Add a note on fabrication of pontics.

PONTIC DESIGN

Pontics are fixed partial denture components that replace missing teeth and restore function and appearance compatible with continued oral health and comfort.

Prerequisites

1. Proper diagnosis and treatment planning phase.
2. Proper diagnostic waxing procedures.
3. Pontic space.

BIOLOGIC CONSIDERATIONS

Pontic design needs to maintain and preserve:
1. Residual ridge.
2. Abutment.
3. Opposing teeth.
4. Supporting tissues.

Factors affecting Biologic Considerations

1. Pontic ridge contact.
2. Removal of dental plaque.
3. Direction of occlusal forces.
4. Surfaces of pontic.

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4. Surfaces of pontic.

1. Pontic Ridge Contact

- Pressure-free contact between the pontic and the underlying tissues is indicated to prevent ulceration and inflammation of the soft tissues.
- Passive contact should be present only on keratinized attached tissue.

2. Dental Plaque

- Dental plaque releases toxins that cause tissue inflammation and calculus formation.
- This occurs in the area between the tissue surface of the pontic and ridge.
- Non-mucosal contacts have better cleansing space than mucosal contacts—Spheroidal and sanitary design.

Factors influencing plaque accumulation

- Design of the pontic.
- Materials used in its fabrication.
- Oral hygiene measures.

Design

Mandibular posteriors

- An egg shaped or bullet-shaped pontic is easiest to keep clean.
- It should be as convex as possible with one point contact at the centre of the residual ridge.

Maxillary posterior and all anterior pontics

- The lingual surface is still made convex and the embrasures are exaggerated on the lingual side to facilitate cleaning.
- The tissue surface of the pontic must contact the ridge passively along the facio-cervical line-angle and on attached keratinized tissue.

Pontic materials

- Should possess good biocompatibility, rigidity, strength and longevity.
- Materials which can be used include:

1. Porcelain
2. Metal

3. Gold
4. Glazed porcelain.

- Occlusal contacts should not fall on the junction between metal and porcelain during centric or eccentric tooth contacts.
- Glazed porcelain is the most biocompatible of the above pontic materials.
- Well-polished gold is smoother, less prone to corrosion, and less retentive of plaque than an unpolished or porous casting.

3. Occlusal Forces

- If the buccolingual width of the pontic is reduced by 30% the amount of occlusal forces transferred to the abutment teeth is reduced.
- Other forces as biting on a hard object, parafunctional activities load the abutment teeth even if the occlusal table is narrowed.

4. Pontic Surfaces

a. Tissue surface.
b. Occlusal surface.
c. Buccal surface.
d. Lingual surface.
e. Interproximal surface.

Tissue surface

- The tissue surface of the pontic should have only minimal passive contact with the ridge.
- Pontic should not be placed on movable mucosa and should not blanch the tissue.

Occlusal surface

- The occlusal table should be reduced to limit forces transferred on to the abutment teeth.
- It should be placed within the neutral zone concept and provide a stable vertical dimension support.
- The maxillary buccal cusps and mandibular lingual cusps should not be altered. Altering of pontic is done when there is lack of space or to create a favourable occlusal relationship.

Buccal and Lingual Surfaces

- The pontic contours of these surfaces are determined by aesthetic, functional, and hygienic requirements.
- Aesthetically, the pontic needs to be contoured facially with proper axial alignment and length.
- Embrasures on the lingual are wider than the buccal or facial.

Interproximal surface

- Should be contoured physiologically to maintain oral hygiene.
- For proper contouring vertical clearance should be adequate.

MECHANICAL CONSIDERATIONS

Factors influencing Mechanical Aspects

1. Improper choice of materials.
2. Poor framework design.
3. Poor tooth preparation.
4. Poor occlusion.

Pontic materials

1. Metal.
2. Porcelain.
3. Metal and porcelain.
4. Resin-veneered pontics.
5. Bis-GMA resin.

Resin veneered pontics

Resin veneered pontics wear and discolour easily as water absorption and thermal fluctuations cause leakage at the metal-resin interface.

Advantages

- Easy to manipulate and repair.
- Do not require high-melting range alloys.

Microfilled composites have better physical properties than resin veneers.

Prefabricated porcelain pontics

- Prefabricated porcelain pontics as slotted facings, long pin facings.
- Harmony facings and reverse pin facings were used earlier.

Metal-ceramic pontics

Metal-ceramic pontics are strong, easy to clean and natural appearing.

Causes of failure in metal ceramic facings

1. Uniform thickness of porcelain is required for longer durability.
2. The metal surfaces to be veneered must be smooth and free of pits.
3. Sharp angles on the veneering surface increases stress concentrations causing mechanical failure.
4. Metal-porcelain junction must be placed at least 1.5 mm away from the centric contact junction.

AESTHETIC CONSIDERATIONS

Pontics should copy the form, contours, gingival margin, incisal edge, gingival and incisal embrasures, and colour of the adjacent teeth.

Factors affecting Aesthetics

1. Alveolar bone resorption and remodelling.
2. Incorrect visual perception.
3. Abnormal mesiodistal width.

In excessive bone loss cases

1. Recontouring the gingival half of the labial surface.
2. Pink porcelain to simulate the gingival tissues.
3. Ridge augmentation procedures using hydroxylapatite.
4. RPD is better than an FPD.

Abnormal mesiodistal width

Can be corrected by orthodontic treatment, or
Space can be adjusted between retainers.

PONTIC FABRICATION

Available Materials

1. Metal-ceramic pontics.
2. Resin-veneered.

3. All metal.
4. Unidirectional reinforced composite.

1. Metal-ceramic Pontics

Steps in metal ceramic pontics

a. Wax pattern formation.
b. Cut back design.
c. Investing and casting.
d. Metal preparation.
e. Application of porcelain veneer.

a. Wax Pattern Formation

i. Inlay wax is softened and shaped to the desired pontic shape, by waxing up the internal, proximal, and axial surfaces of the retainers.

The basic pontic shape can either be waxed up, or an impression of the provisional restoration can be made and duplicated in wax or a prefabricated pontic shape can be used.

ii. After the pontic is waxed up it is connected to retainers.

b. Cut Back Design

i. After outlining the area to be veneered with porcelain, make depth cuts in the wax pattern and complete the cut-back as far as access will allow with the units connected. The porcelain-metal junction should be placed as lingual as possible for good aesthetics.

ii. Separate each retainer and complete the cut back till there is a distinct 90° porcelain-metal junction.

After cutting back reflow and finalize the margins. Do each retainer one at a time and join the entire unit back.

Variation:

In some cases the gingival surface of the pontic is cut back in the metal.

c. Investing and Casting

Sprue the units and invest and cast.

d. Metal Preparation

The casting is recovered from the investment, the sprue is cut off and the remaining investment material in the casting is removed by sand blasting with aluminum oxide.

The gingival surface of the pontic is finished without over reducing.

e. Application of Porcelain Veneer

i. A separating agent needs to be applied on the residual ridge of the cast to prevent porcelain powder from sticking to the stone.
ii. The metal is prepared and opaquer is applied.
iii. Cervical porcelain is applied to the gingival surface of the pontic with the castings seated on the master cast.
iv. Porcelain is built up layer-by-layer with the appropriate cervical body and incisal shades and condensed.
v. After condensing, section between the units with a thin razor blade to prevent porcelain from pulling away from the framework due to firing shrinkage.
vi. A second application of porcelain is done to correct deficiencies caused by firing shrinkage (additions are needed proximally and gingivally on the pontic).

Contouring gingival surface:

i. After application of a porcelain separating liquid to the stone ridge the desired tissue contact is achieved and gingival surface is contoured (as convex as possible).
ii. The porcelain on the tissue surface is made as smooth as possible.
iii. Pontic is ready for try-in, staining, glazing, finishing, and polishing.
iv. The metal framework should be highly polished, and gingival embrasures well contoured.

Alternate fabrication technique

In case of partial coverage retainers made of conventional gold alloys, the retainers must be soldered to the pontic after porcelain application, final staining, and glazing.

2. Resin-Veneered Pontics

- Resins have low abrasion resistance and bonding between the resin and the metal framework is poor.
- New resins have better physical properties than the older ones.

i. Waxing and cut-back are similar to those for metal-ceramic restorations.
ii. Mechanical undercuts to retain acrylic resin can be formed by retention grooves, acrylic beads to the wax pattern, wax loops, or using an electrolytic etchant.
iii. Acrylic beads are placed on the entire metal surface to be veneered. The cast metal is also air abraded with an aluminum oxide.
iv. An opaquer is applied to the metal to mask the metal colour and body shade of resin is added with a modelling instrument and polymerised under pressure in a heated water bath. A light curing resin can be used as an alternative.
v. The body resin core is ground to the desired shape, before adding the incisal shade.
vi. Incisal resin is applied and polymerised.
vii. The finished restoration is polished.

3. All-metal Pontics

i. A wax pattern is made of the desired contour.
ii. The completed wax pattern is finished, sprued and casted.
iii. Casting is retrieved, finished and polished.

4. Unidirectional Reinforced Composite

i. An impression is made after tooth preparation, and a cast is poured.
ii. After application of a special separating medium, glass fibres are placed on the groove in the cast.
iii. The pontic is built in indirect composite resin, finished, polished and cemented on to the prepared teeth.

13. Describe different types of provisional restorations. Describe various techniques used for making provisional restoration for anterior and posterior tooth preparation.

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TYPES OF PROVISIONAL RESTORATIONS

a. Cast metal (precious and non-precious).
b. Aluminum shell, copper band temporisation.
c. Preformed metal crowns.
d. Cellulose acetate forms.
e. Prefabricated polycarbonate forms.
f. Heat-polymerised resin treatment restorations (Custom).
g. External surface forms include polycarbonate cellulose acetate, aluminum tin-silver and nickel-chromium.

a. Cast Metal Treatment Restorations

Indications

1. Patients with maladies difficult to diagnose.
2. Patients with gross maxillomandibular discrepancies.
3. As a healing matrix for medically compromised patients.
4. For maintenance of vertical dimension.
5. For duplication of the pretreatment canine function.

Variation

Preformed metal crowns can be modified at the gingival and then cast.

b. Aluminum Shell Crowns (Aluminum and tin-silver)

Availability

In anatomic tooth forms and cylindrical shells resembling a tin can.

Indication

Only to be used in premolars and molars.

Technique

- A shell of suitable diameter is selected and festooned to adapt to the preparation and height of the gingival crest.
- A resin mixture is placed within the shell for patients with a reduced interocclusal distance to enhance retention.
- The shell is then removed, trimmed for adequate occlusal relationships, and seated with a sedative cementing media.

Disadvantages

1. Less marginal strength and proximal contacts.
2. Copper band temporisation is not biocompatible and has poor occlusion.

c. Preformed Metal Crowns

- Nickel-chromium shells are used primarily for children with extensively damaged primary teeth.
- Nickel chromium shells are not lined with resin but are trimmed and adapted with contouring pliers and luted with a high-strength cement.
- Nickel-chromium alloy is very hard and thus can be used for longer-term provisional restorations.

Indications

- For the posterior teeth.
- In pedodontics for fractured teeth.

Advantages

- Improved occlusal and axial surfaces.
- Better biocompatibility than aluminum shells.

d. Cellulose Acetate Crown Forms

- Cellulose acetate is a thin (0.2 to 0.3 mm), soft, and transparent material available in all tooth types and sizes.
- Shades are dependent on the autopolymerizing resin.
- Mould guide for different sizes and shapes are available.

Procedure

1. A selected crown form is trimmed and festooned to fit the preparation.
2. The selected crown is filled with any of the resins (Polymethyl methacrylate, Vinyl polyethyl methacrylate or Epimine).
3. Commonly used resin is Polymethyl methacrylate.
4. The resin filled crown is gently pressed upon the lubricated preparation while the excess is removed.
5. The crown matrix is repeatedly removed and reseated to minimize distortion and to ensure removal after the resin is set.

6. The cellulose shell is peeled off after the material has set.
7. The occlusion is adjusted and the treatment restoration is trimmed and polished.

e. Prefabricated Polycarbonate Crowns

Indications
Can be used for anterior teeth (incisor, canine and premolar).

f. Heat-Polymerised Resins

- A wax pattern with the desired shape is made on the mounted casts.
- Wax patterns are flasked, dewaxed and packed with heat-cure as heat cure acrylic resin and cured.
- If the provisional restoration was fabricated on mock tooth preparations then the crown needs to be relined with resin before cementation.

Variation:
Plastic denture teeth can be trimmed and lined with tooth coloured self-curing acrylic on the lingual aspect of the crown to fabricate aesthetically pleasing, functional treatment restorations.

TECHNIQUES IN FABRICATION OF PROVISIONAL RESTORATIONS

1. Autopolymerizing resin-alginate impression technique.
2. Vacuum-formed plastic template technique.
3. Post-crown technique.

Provisional restorations can be done in the following modes:
- Indirect
- Direct
- Indirect-direct.

Indirect procedure

In this technique the provisional restoration is fabricated outside the mouth.
Impression is made of the prepared teeth and is poured in quick-setting gypsum.

Advantages

a. No contact of free monomer with the prepared tooth or gingiva.
b. Risk of pulpal damage to tooth is less.
c. The marginal fit is better for this technique than direct technique.
d. More comfortable for the patient with less chair side time.

1. Autopolymerizing Resin-alginate Impression Technique

Direct Technique

a. An alginate impression of the teeth is made before tooth reduction and impression is stored in a damp environment.
b. After tooth preparations are completed, acrylic resin is mixed and placed in the corresponding section of the alginate impression.
c. A separating agent is applied on the tooth preparations and the alginate impression filled with the resin and is then replaced in the mouth.
d. Impression is removed when the resin reaches a doughy stage, and ones the rigid stage is almost reached the temporary crown is removed from the alginate impression.
e. After evaluating occlusion in the mouth crown is finished, polished and luted with an appropriate luting agent.

2. Vacuum-formed Plastic Template Technique

a. Transparent sheets in cellulose acetate or polypropylene in various sizes and thicknesses are available. Polypropylene or Omnivac is adapted over the unprepared cast using a thermal vacuum machine.
b. A suitable shade of autopolymerizing tooth-coloured acrylic resin is selected and filled in the template and seated onto the lubricated tooth preparations.
c. The matrix is removed and reseated.
d. The restoration is copiously irrigated with cold water.
e. After the resin has completely set, the matrix is removed, the crown trimmed to the correct finish line with a convex tissue surface and luted with a temporary cement.

Disadvantage

Can cause pulpal injury if the polymerisation temperature is not controlled.

3. Post-crown Technique

- For endodontically treated teeth.
  a. A wire (paper clip) or a non-precious metal post is adapted to the canal.
  b. The selected polycarbonate crown form is then filled with an acrylic resin and placed over the post, including a portion of the radicular surface of the tooth.
  c. The crown form must be removed and reseated repeatedly to prevent resin from locking into undercuts.
  d. After the resin has set, the crown is removed with the temporary post set within the resin.
  e. The entire assembly of post - extension and crown form is cemented with a weak adhesive.

Indirect-Direct Procedure

a. After selecting an appropriate preformed crown with the gingival margin adjusted to approximate the gingival termination, tooth-coloured acrylic is mixed and placed inside the crown.
b. The filled polycarbonate crown is seated onto the lubricated tooth preparation on model; the seated crown is reseated repeatedly to prevent excess resin from setting into proximal undercuts.
c. After the resin has set, the excess resin is removed, the emergence profile and fit of the gingival margin is evaluated.
d. The crown is polished and is cemented with a temporary sedative luting agent.

Advantages

1. Chairside time is reduced.
2. Less heat is generated in the mouth.
3. Contact between the resin monomer and soft tissues is minimized.

14. Describe various luting agents used in crown and bridge cementing. Explain the procedure and care to be taken to lute porcelain jacket crowns.

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- For endodontically treated teeth.
  a. A wire (paper clip) or a non-precious metal post is adapted to the canal.
  b. The selected polycarbonate crown form is then filled with an acrylic resin and placed over the post, including a portion of the radicular surface of the tooth.
  c. The crown form must be removed and reseated repeatedly to prevent resin from locking into undercuts.
  d. After the resin has set, the crown is removed with the temporary post set within the resin.
  e. The entire assembly of post - extension and crown form is cemented with a weak adhesive.

Indirect-Direct Procedure

a. After selecting an appropriate preformed crown with the gingival margin adjusted to approximate the gingival termination, tooth-coloured acrylic is mixed and placed inside the crown.
b. The filled polycarbonate crown is seated onto the lubricated tooth preparation on model; the seated crown is reseated repeatedly to prevent excess resin from setting into proximal undercuts.
c. After the resin has set, the excess resin is removed, the emergence profile and fit of the gingival margin is evaluated.
d. The crown is polished and is cemented with a temporary sedative luting agent.

Advantages

1. Chairside time is reduced.
2. Less heat is generated in the mouth.
3. Contact between the resin monomer and soft tissues is minimized.

14. Describe various luting agents used in crown and bridge cementing. Explain the procedure and care to be taken to lute porcelain jacket crowns.

VARIOUS LUTING AGENTS

a. Zinc phosphate cement.
b. Zinc polycarboxylate cement.
c. Glass ionomer cement.
d. Zinc oxide-eugenol with and without EBA (Ortho ethoxybenzoic acid).
e. Silico-phosphate cement.
f. Unfilled resins—hydroxyethyl methacrylates and 4-META (4 methacryl-ethyl trimellitic anhydride).

a. Zinc Phosphate Cement

Advantages

1. Prolonged success rate.
2. Good compressive strength (9000 to 20000 psi).
3. Adequate tensile strength (720 psi).
4. It is a basic cement for comparison.
5. Reasonable working time.
6. Excess material is removed easily.

Composition

Powder

- Zinc oxide and magnesium oxide in the ratio of 9 to l.
- Water content is 33 percent.

Liquid

Phosphoric acid buffered by aluminum (50 percent) and Zinc salts (traces).

Disadvantages

1. Pulp irritation.
2. Solubility.
3. Poor seal between the cement and the dentin.
4. Not an ideal cement when preparation is close to pulp.

Manipulation

- A cooled thick glass slab is used for mixing.
- Small increments of powder is incorporated into the cement liquid and mixed with a wide circular motion on about one-half of the glass slab.

- When the mixture follows the spatula, it is ready for use as a luting medium.

b. Zinc Polycarboxylate Cement

(Introduced in 1968).

Advantages

1. Good biocompatibility.
2. Adhesive to tooth structure.
3. Exhibit thinning with increased shear rate (less film thickness).
4. Less pulpal irritation as polyacrylic acid molecules are large and cannot penetrate the dentinal tubule.
5. Cleaning the surfaces of metal with an airborne abrasive increases the adhesion of polycarboxylate cement to the metal.

Disadvantages

1. Working time is short (2.5 minutes).
2. Residual zinc polycarboxylate is more difficult to remove.
3. It provides less retention.

Indication

On retentive preparations, e.g. in children with large pulp chambers.

Properties

- The compressive strength is at least one-half that of zinc phosphate cement, whereas the tensile strength is similar to zinc phosphate cement.
- Solubility of carboxylate cements is about the same as zinc phosphate.
- The film thickness of the polycarboxylate cements is approximately ±20 um.

c. Glass Ionomer Cement

- Invented by Wilson and Kent.
- Put to clinical use by McLean and Wilson.

Advantages

1. Adhesive to enamel and dentin.
2. Good biocompatibility.

3. Anticariogenic effect (releases fluoride).
4. Set cement is translucent, more esthetic when used with the porcelain labial margin technique.
5. The mechanical properties are almost similar to zinc phosphate.

Disadvantage

It is susceptible to moisture contamination.

Composition

Glass particles and polyacrylic or polymaleic acid—Polyhyrogel + Silica gel.

Reaction

When the powder and liquid are mixed, the aluminium and calcium are displaced forming a alumino-silicate network, which degrades to form hydrated siliceous gel.

Manipulation

1. Measured powder is divided into two equal parts and mixed with a plastic spatula.
2. The first increment is rapidly incorporated in 10 seconds and the second increment incorporated and mixed for a further 10 seconds.
3. The mixing is completed when the cement can be lifted off the slab with the spatula.

To reduce belated Sensitivity

1. Rapid incorporation of powder and liquid (10-20 seconds).
2. Slight hydration of the tooth before cementation by placing a drop of water on the tooth during mixing, which is gently blown off just before placing the prosthesis on the tooth.
3. Allowing the cement to set hard to the touch, plus 1 minute before removing the excess.
4. Placing glass ionomer cement varnish on the margins of the restoration after removing the excess cement.

d. Zinc Oxide-eugenol with and without EBA (Ortho ethoxybenzoic Acid)

Quartz, and alumina have also been substituted in the mix.

Zinc Oxide-Eugenol

Advantages
1. Reinforced ZOE cement is extremely biocompatible.
2. Provides an excellent seal.

Disadvantages
1. Physical properties (such as compressive strength, solubility and film thickness) are inferior to other cements.
2. Eugenol leakage can occur.
3. Can be only used in restorations with good retention form.

EBA Cement

- The 2-ethoxybenzoic acid (EBA) replaces a portion of the eugenol in conventional ZOE cement, which improves compressive strength without affecting its resistance to deformation.
- The EBA cement has a short working time and excess material is difficult to remove.
- The compressive strength of the reinforced zinc oxide eugenol cements is approximately one-half that of zinc phosphate, whereas the tensile strength is nearly identical to zinc phosphate. The values are similar to the averages for polycarboxylate cements.

Advantages
1. Palliative effect on the dental pulp
2. Ease of placement in a moist environment.

e. Silico-phosphate Cement

It is a mixture of zinc phosphate and silicate cements.

Advantages
1. Physical properties in the range of zinc phosphate cement.
2. Exhibits lower solubility.
3. Set material is translucent, useful with porcelain margin crowns.
4. Some anti-cariogenic properties.

Disadvantage

Low pH and consequent potential for pulpal irritation.

f. Unfilled Resins

- Used since1950s.
- Less biocompatible than other cements.

Based on polymerisation method

- Chemical-cure.
- Light-cure or dual-cure.

Metal restorations : Chemically cured system is used.
Ceramics : A light or dual-cure is used.
Resin bonded : Resin cement bonded onto etched enamel surfaces.

Indications

For luting

1. Porcelain veneers,
2. Porcelain inlays and on-lays,
3. Resin bonded prostheses,
4. Post and core reinforcements (Calcium hydroxide placed in deep preparation followed by etched glass ionomer liner, before placement of resin cement).

Advantages

1. Insoluble in oral fluids.
2. Good strength properties.
3. Easy to use.

Disadvantages

1. Bonds to tooth structure.
2. It is not cariostatic.
3. Leaks at dentinal margins.
4. Film thickness of resin cements is greater.

Recent development

Organo-phosphonates, HEMA (hydroxyethyl methacrylate).
4-META (4 methacryl-ethyl trimellitic anhydride).

Other Cements

- *Red and black copper cements:* Excessively irritating to the pulp.
- *Zinc phosphate cement mixed by adding water:* It is weaker and more soluble than conventional cements.
- *Cyanoacrylate cements:* Just in the beginning stages.

PROCEDURE TO LUTE PORCELAIN JACKET CROWNS

- *Glass ionomer is the luting agent of choice.*
- Other luting agents that can be used are resins and zinc phosphate.

Cleaning tooth surfaces

- All preparation surfaces are checked for any remaining provisional luting agent.
- The luting agent shade is selected depending on the adjacent tooth shade.

Preparing restoration

- The casting is cleaned ultrasonically and any remnants of polishing agents are removed.

Preparation for cementation

- Isolate the area with cotton rolls and place the saliva evacuator.

Manipulation of glass ionomer

- Powder liquid ratio: 1.25 part of powder to 1 part of liquid.
- After shaking the powder bottle, 2 level scoops of powder and 8 drops of liquid are dispensed in a paper mixing pad.
- Reduced temperature while mixing increases working time and allows addition of more powder.
- The measured powder is divided into two equal parts and mixed with a plastic spatula. The first part is rapidly incorporated in 10 seconds and the second part incorporated and mixed for a further 10 seconds.
- Mixing time: 45 seconds.
- Working time: 3 minutes from start of mix.
- Luting consistency:
  The cement lifts off the slab with the spatula and can be pulled into a thread 20 mm in length before snapping back onto the slab. The consistency is more viscous than zinc phosphate, but the material thins out with seating pressure.

Application of cement

- A thin coat is applied to the clean internal surface of the restoration.

- Ask patient to bite on wooden stick.
- Dry the tooth with a light blast of air and seat the restoration into place.

Seating the restoration
- Final seating is seated firmly with a rocking, dynamic seating force.
- After the casting is seated, the margins are verified for complete seating.

Removing excess cement
- After the cement has set (7 minutes from start of mix) remove excess cement with an explorer.
- Early removal of cement exposes margins to moisture, increasing its solubility.
- A margin seal can be applied to prevent moisture contamination.
- Dental floss can be used to remove residual cement interproximally and from the gingival sulcus.

Evaluation of occlusion
- An articulating paper or Mylar strip is used to check the occlusion once more.

Instructions to patient
- As the cements take at least 24 hours for their final set, patients are instructed not to chew on that side for a day or two.
- Oral hygiene instructions are also given.

Resin luting agents
A light- or dual-cure can be used for porcelain jacket crowns when retention form is compromised.

15. Classify adhesive bridges/resin bonded bridges. Cite the advantages, disadvantages, indications, contraindications and preparation steps. Add a note on types of bonding to metal and tooth.

DEFINITION
Resin bonded bridges are fixed partial dentures, which are cemented onto the abutments using special resins.
First described by Rochette in 1973 (Mandibular anterior teeth.)

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CLASSIFICATION

a. Rochette bridge.
b. Maryland bridge.
c. Virginia bridge.
d. Cast mesh fixed partial dentures.

Advantages

1. Minimal tooth reduction—conservation of tooth structure.
2. Preparation is confined to enamel.
3. No pulpal trauma.
4. Anaesthesia not required.
5. More biocompatible.
6. Supragingival margin placement.
7. Less periodontal trauma.
8. Less chair side time
9. Does not require cast alterations or removable die preparation.
10. Reduced cost.

Disadvantages

1. Good patient selection is a must.
2. Technique sensitive.
3. Laboratory errors cannot be corrected easily.
4. Chances of over contouring leads to plaque accumulation.
5. Over contouring can result in patient discomfort.
6. Can only replace one tooth.
7. Cannot be prepared on thin tooth.
8. Debonding can occur due to faulty preparation or improper luting technique.
9. Difficulty in isolation during bonding procedures.
10. Cannot be done on tooth with small clinical crowns.

Indications

1. For abutments with sufficient enamel.
2. Splinting periodontally compromised teeth.
3. For medically compromised patients.
4. As a temporary restoration.
5. Young patient.

6. Large pulp chambers.
7. Post - orthoretention.

Contraindications

1. Sensitivity to base metal alloys.
2. Insufficient occlusal clearance.
3. Deep vertical overbite.
4. Thin teeth.
5. Loss of tooth structure.
6. Parafunctional habits.
7. Short clinical crowns.
8. Narrow embrasures.
9. Mobile tooth.
10. Defective enamel.
11. In extensive restorations.

a. Rochette Bridge (1973) (Fig. 35)

- It is a wing like retainer with six perforations to provide mechanical undercuts for resin cement.
- Etched retainers are coated with pyrolized silane and bonded with resin cements.

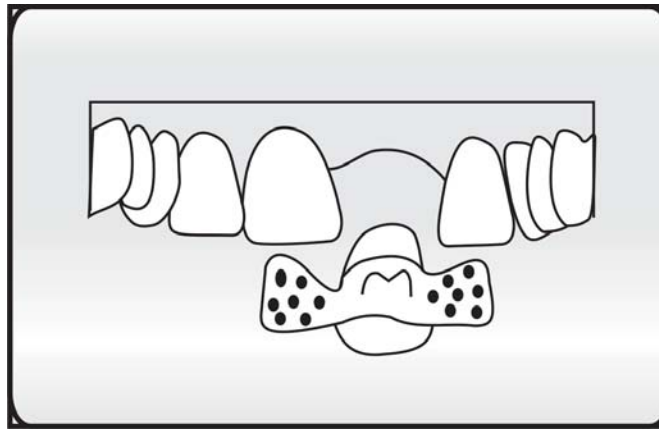

Fig. 35: Rochette bridge

Disadvantage

The resin is exposed to oral fluids and external stress, which leads to abrasion and marginal leakage.

Variation

Non-perforated retainers can be used.

b. Maryland Bridge (Fig. 36)

(Livaditis and Thompson from University of Maryland School of Dentistry)

Here a non-perforated retainer was etched for mechanical retention to form micro-porosities present and was bonded by resin cement.

c. Virginia Bridges

(Moon and Hudgins)

- Use particle-roughened retainers.
- The retainer wax patterns are sprinkled with salt crystals prior to resin fabrication.
- The salt crystals get incorporated onto the tissue surface of the resin pattern.
- During dewaxing the salt crystals dissolve leaving voids in the resin pattern for mechanical retention.
- Air abrasion with aluminium oxide improves retention.

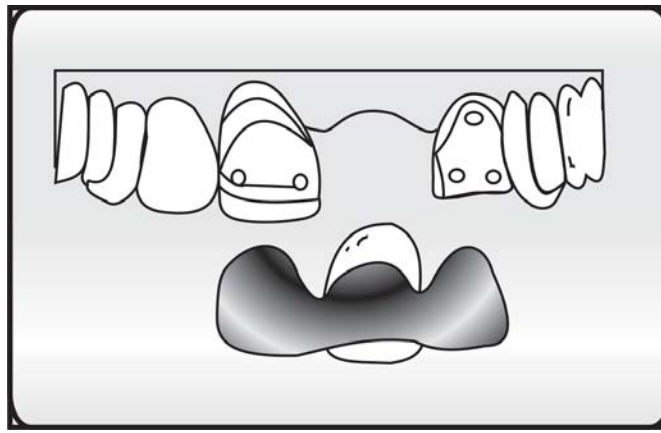

Fig. 36: Maryland bridge

Advantages

1. Surface treatment of the retainer is not necessary.
2. Noble metal alloys also can be used as retainers.

d. Cast Mesh Fixed Partial Denture (Fig. 37)

A nylon mesh is placed on the tissue surface of the retainer wax pattern before fabricating the wax pattern.

Disadvantages

1. The nylon mesh adaptation to the cast is not good.
2. The wax may flow in between the mesh locking all the undercuts.

STEPS IN THE FABRICATION/PREPARATION OF A RESIN BONDED FIXED PARTIAL DENTURE

a. Preparation of abutment teeth.
b. Fabricating the provisional restoration.
c. Design of the restoration.
d. Bonding.

Preparation of Abutment Teeth

- Single path of insertion is obtained.
- Proximal undercuts must be removed.
- Rest seats should provide good resistance form (posterior teeth).
- Definite and distinct margins should be present.

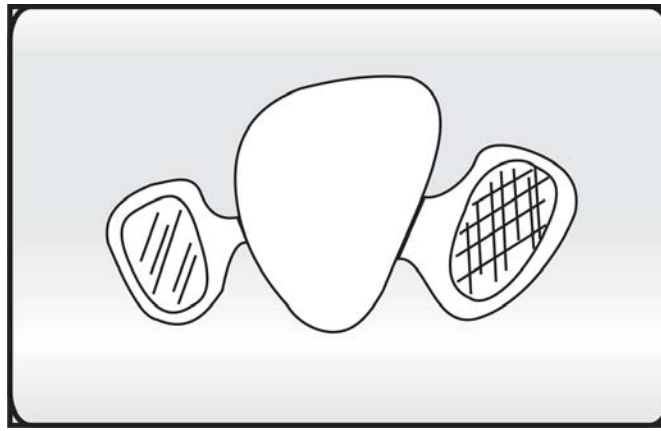

Fig. 37: Cast mesh fixed partial denture

Design of Anterior Resin Bonded Fixed Partial Dentures

1. A single path of insertion in the inciso-gingival direction along the proximal surface of the abutment.
2. Lingual clearance (0.8 to 1.0 mm) should be provided.
3. Cingulum rest seat should be prepared to act as a vertical stop.
4. A supragingival finish line (1 mm above the crest of tissue) is prepared.
5. An additional retention in proximal facial extensions is provided.

Design of Posterior Resin Bonded Fixed Partial Dentures

- The occlusal rest (for resistance to gingival displacement).
- The retentive surface (for resistance to occlusal displacement).
- The proximal wrap (for resistance to torquing forces).

Occlusal Rest Seat

Should be spoon-shaped and placed on the proximal marginal ridge of the abutment adjacent to the edentulous area.

The Retentive Surface

Proximal and lingual axial walls should have a supragingival finish line.

Proximal wrap

The alloy framework should be designed to engage at least 180° of tooth structure with a knife-edge margin.

TYPES OF BONDING TO PROVIDE RETENTION

- Mechanical.
- Chemical.

A. Mechanical Bonding

Subtypes

1. Macroscopic Retention

By mechanical locks as in Rochette's (six perforations in metal), mesh and water-soluble salt crystal.

2. Microscopic Retention

By electrolytic etching (Maryland Bridge).

B. Chemical Bonding

Chemical Bonding of Resin

1. Chemical etching.
2. Tin-plating.

A. Mechanical etching techniques

1. Electrochemical etching

Results in microscopic porosity.

a. Non-Beryllium Nickel Chromium alloys

Two stages

1. Retainer is immersed in 35% nitric acid under a current of 250 milliamps per square centimeter for 5 minutes.
2. Retainer is cleaned by immersing in 18% HCl in an ultrasonic cleaner for 10 minutes.

b. Beryllium containing Nickel Chromium alloys

1. Retainer is immersed in 10% H_2SO_4 under a current of 300 milliamps per square centimeter.
2. Retainer is cleaned by immersing in 18% HCl in an ultrasonic cleaner for 10 minutes.

c. Other technique (McLaughlin technique)

1. Retainer is etched with a mixture of HCl and H_2SO_4 in a beaker.
2. The beaker with the retainer is directly placed in an ultrasonic cleanser for 99 seconds under an electrical field.

2. Non-electrochemical

- Roughening by aluminium oxide-air abrasion.

B. Chemical Bonding of Resin

Chemical etching

A gel consisting of nitric and hydrochloric acid is applied to the internal surface of the metal framework for approximately 25 minutes.

Tin plating

Precious alloys can be plated with tin and used as retainers to increase adhesiveness of resins thereby increasing bond strengths.

16. What are the requirements of dies? Describe materials used in preparation of dies and different techniques used for preparing dies?

REQUIREMENTS OF DIES

1. It must reproduce all surfaces of the prepared teeth accurately without any bubbles or voids.
2. The remaining unprepared tooth structure (1 mm cervical to the finish line) should be readily discernible on the die.
3. Should be dimensionally stable.
4. Strong and resistant to abrasion.
5. Should be easily sectionable and easy to trim.
6. Should be compatible with the separating agent used.
7. Should colour contrasts with the wax used.
8. Should be easily wettable by the inlay wax.
9. Must be compatible with the impression material.

MATERIALS USED IN DIE PREPARATION

1. Gypsum.
2. Epoxy Resin.
3. Electroplated dies.

1. Gypsum

Disadvantages

1. Decreased accuracy.
2. Decreased resistance to abrasion.

Advantages

1. Inexpensive.
2. Easy to use.
3. Produces consistent results.

Variation of technique

Impregnate the surface of the die with a low viscosity resin (cyanoacrylate) to improve abrasion resistance.

2. Epoxy Resin

Advantages

1. Good strength.
2. Good abrasion resistance.
3. Can be cured at room temperature.
4. No complicated equipment required.
5. Dimensionally stable.
6. Retainers adapt better when made on epoxy dies.
7. Silicone and polyether are compatible with epoxy.

Disadvantages

1. More expensive than gypsum.
2. Polymerisation shrinkage.
3. Polysulfide and hydrocolloid are not compatible.

Variation

Epoxy resin, which is heat-treated after setting, is also available.

3. Electroplated die

Advantage

Good abrasion resistance.

Disadvantages

1. Silicone and polyether impressions are difficult to electroplate.
2. Polysulfide can be silver plated, but cannot be copper plated.
3. Silver plating uses cyanide solution, which is extremely toxic.

Technique

1. Finely powdered silver or graphite is brushed on to the impressions to make them conduct electricity.
2. The impression is then placed in the electroplating bath.
3. A layer of pure metal is deposited on the impression which is supported with type IV stone or resin.

METHODS OF DIE PREPARATION

1. Working cast with separate die
2. Divestment technique.
3. Working cast with a removable die.

1. Working Cast with Separate Die

Impression

Two impressions are made, one for the sectional cast and another for full arch cast and poured in hard densite stones.

Pouring Dental Stone for Full Arch Impression

Dental stone is filled by gently vibrating, until the preparation area fills and then the entire area of impression.

Additional base can be added after the initial set has occurred.

Pouring Dental Stone for Sectional Impression

The preparation area is filled without air entrapment and stone is built up to a height approximately 1 inch over the preparation for handle on the die.

Die Preparation

After the cast is removed, separating agent is applied on the prepared teeth.

A handle, larger in diameter than the preparation, octagonal in shape and parallel to the long axis of the tooth, is formed on the die.

The finally prepared die should be smooth and free of ridges with the finish line highlighted with a sharp red pencil.

2. Divestment Technique

A die is formed from a refractory material on which the restoration is waxed, kept for burnout and cast directly against the die.

Indications

For intricate patterns that are not readily removable from the die.

Disadvantages

- Does not perfectly fit as retainers made of other techniques.
- The die is destroyed in the casting process and a second cast and die needs to be made for finishing purposes.

3. Working Cast with a Removable Dies

a. Dowel Pin Technique
b. Curved Dowel Pin

c. Di-Lok Tray
d. Pindex System.

Requirements of removable dies

1. Must return to their exact original positions.
2. Must remain stable when inverted.
3. Must be easily mountable on an articulator.

a. Dowel Pin Technique

Synonyms

Straight pin technique.
Tapered pin technique.

Advantages

1. Least amount of inaccuracy in a horizontal direction.
2. Less vertical deviation.

Procedure

- An impression is made and the straight dowel pin is centred directly over the preparation.
- Bobby pins are placed across the impression buccolingually with the dowel pins placed between the arms of a bobby pin and both are stabilised by straight pins with sticky wax.

Pouring the impression

- Die stone is poured in the impression by filling the prepared teeth and covering the knurled end of the dowel pin.
- Paper clips are added to other areas to provide retention for the second pour of stone.

Removing bobby pins and straight pins

- After the first pour sets, the straight and bobby pins are removed.
- The tip of each dowel is covered by soft wax.
- A V-shaped buccolingual orientation groove is placed on each die.
- The area around each die is lubricated.

Removing cast (Fig. 38)

- After the cast sets, it is removed and trimmed.
- The utility wax is uncovered and a jeweller's blade is used to cut through mesial and distal side of each die.

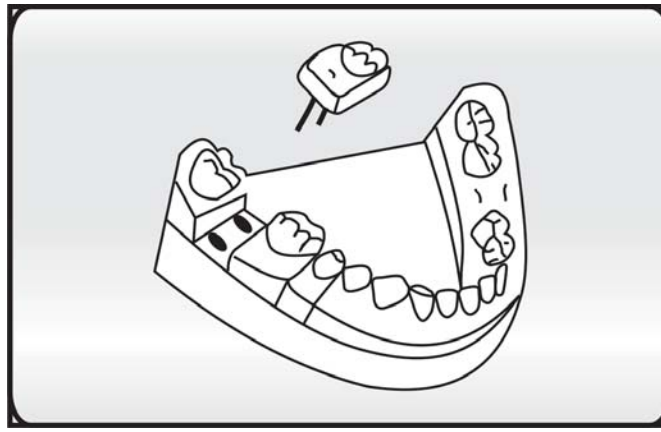

Fig. 38: Cast with removable die

- The die is loosened from the cast by gently tapping on the end of dowel.
- The cuts should taper toward each other slightly from occlusal to gingival.

Mounting the casts

- After the die is removed and ditched, utility wax is placed back into the wells around the tips of the dowels.
- The casts are mounted.

b. Curved Dowel Pin

Procedure

- A position bar is used to orient the curved dowel into the impression of the prepared tooth.
- The position bar is oriented facio-lingually till the dowel tip extends 1.1 to 2.0 mm into the impression with the tail pointing facially.

Pins placed

- One pin in the facial aspect—Straight pin.
- Second pin in the lingual aspect.
- Pins are placed for all prepared tooth and pontic region.
- A dowel pin is also placed near the centre of each segment of unprepared tooth.

- The dowel pin's head should be parallel to the long axis of the tooth.

Pouring of dental stone

- Die stone is poured into the impression until it covers the heads, and 1.0 to 2.0 mm of the thicker hexagonal bodies of the dowels.

Removal of positional pins

- After the die stone has set the two straight pins and the positioning bar is slided off each dowel.
- A 2.0 mm deep hole is cut on either side of each dowel.
- Lubricate the exposed parts of the dowels.
- Boxing wax is placed around the impression and dental stone is filled till the dowels are covered by at least 2.0 mm, except for the tips.

Sawing the cast

- After the stone sets, remove the boxing wax and place vertical saw cuts on either side of each die.
- Separate each segment by gently tapping on the protruding tail of the dowel.

Preparing working cast

- A horseshoe-shaped working cast with the base trimmed flat is made.
- Holes are drilled with drill press in the bottom of the cast directly under the centre of each prepared tooth, pontic area and segment containing unprepared teeth.
- A curved dowel is tried into the prepared holes till the head seats completely and luted with cyanoacrylate cement.
- After the cement has hardened, a thin layer of petrolatum is applied and second pour is done.

c. *Di-Lok Tray*

Requires a specially articulated tray with internal orienting grooves and notches to reassemble sectioned master cast accurately.

Procedure

- Evaluate the fit of the tray on articulator.

Pouring the impression

- The entire arch impression is poured with die stone to a height of approximately one inch. The U-shaped cast with an open lingual area must be trimmed to fit the Di-Lok tray.
- After the cast is allowed to dry, trim the lingual side of the cast on an arbor band and try the cast in the Di-Lok tray.

Placing the cast in the tray

- After horizontal grooves are cut in the base of the cast, the tray is filled three quarter with dental stone.
- Slurry water soaked cast is seated into the tray by jiggling it slightly till the cervical lines of the teeth are about 4 mm above the edge of the tray.

Removing cast from tray

- After the stone sets, the cast is removed from the tray by lifting back up, and then slide the buccal facing forward and tap on the base of the cast with a laboratory knife.
- The removed cast is sawed with a taper between the prepared tooth and the adjacent tooth.

Preparation of removable die

- Remove all dies with finger pressure and trim the excess stone gingival to the finish line.
- Mark the finish line with a red pencil.

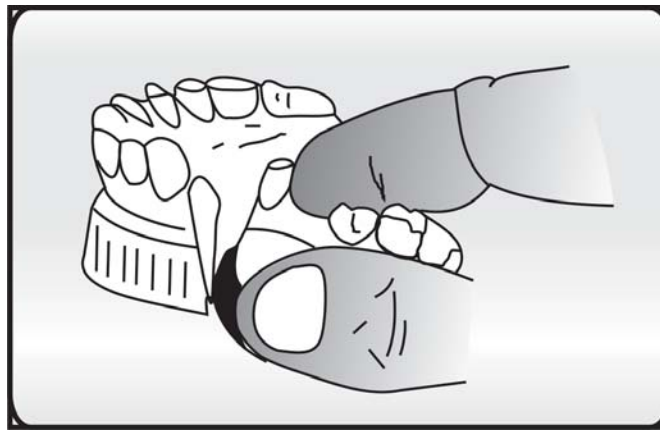

Fig. 39: Removable dies: Di-Lok tray

Disadvantage

- Large size of the tray makes articulation difficult.

d. Pindex System

Preparing the master cast

- The final impression is poured in stone.
- After the stone sets, the retrieved cast is trimmed to a horseshoe shaped form.
- The buccolingual width of the base of the horseshoe is 13 to 18 mm, and thickness 15 mm between the gingival margins of the preparations and the inferior border.

Pin Placement

- After the under surface of the cast is trimmed perfectly flat, drill two holes for each removable section as far apart to provide space for the pins and sleeves.
- The pins are cemented into holes using low viscosity cyanoacrylate cement.
- The short index pins are cemented in the lingual holes.
- Long pins cemented into the buccal holes.
- The white sleeves are placed over the long pins and the gray sleeves over the short pins.

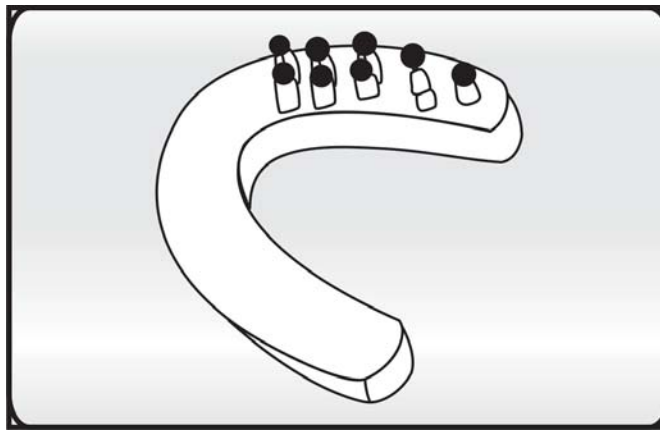

Fig. 40: Pindex system: pin placement

The Secondary Base

- A strip of carding wax is placed over the extensions of the long pins and the gray sleeves.
- The master cast is boxed or placed in a rubber base former and a secondary base is poured with cast stone.

Removable Dies

- After the secondary base sets, remove the master cast and trim the secondary base on the model trimmer.
- Dies are sectioned with a die saw and trimmed carefully to expose the finish line.
- Clean the stone grindings from the dies, pins, base and pin holes.
- Reseat the dies.
- The master cast is mounted.

17. Classify ceramics. Enumerate its advantages and disadvantages. Explain the mechanism of bonding and describe the laboratory steps involved in fabrication of different ceramics.

CLASSIFICATION

1. Depending on Use

Type 1

For denture teeth.
(Powders of feldspar, clay and quartz).

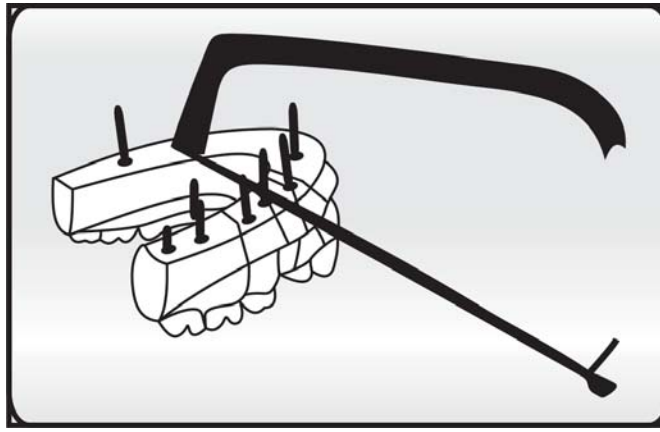

Fig. 41: Removable dies: pindex system

The Secondary Base

- A strip of carding wax is placed over the extensions of the long pins and the gray sleeves.
- The master cast is boxed or placed in a rubber base former and a secondary base is poured with cast stone.

Removable Dies

- After the secondary base sets, remove the master cast and trim the secondary base on the model trimmer.
- Dies are sectioned with a die saw and trimmed carefully to expose the finish line.
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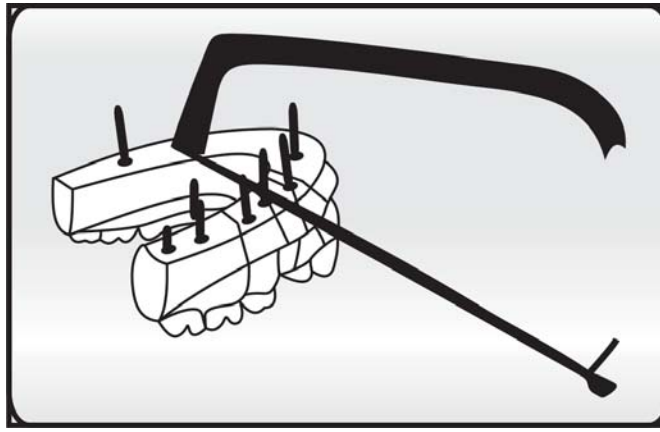

Fig. 41: Removable dies: pindex system

Type 2
For ceramo-metal applications.
(Potassium feldspar and glass).

Type 3
For all-porcelain restorations.
Porcelain jacket crowns, veneers and inlays.
(Feldspathic dental porcelain with increased amounts of aluminum oxide).

2. Depending on Fusion Temperature

High fusing

(1288-1371°C).

Medium fusing

(1093-1260°C).

Low-fusing

(871-1066°C).

Ultra-low fusing

(Below 850°C).

3. Based on Application

Core Porcelain

The basis of porcelain jacket crown must have good mechanical properties.

Dentine or Body Porcelain

More translucent than the above, this largely governs the shapes and colour of the restoration.

Enamel porcelain forms the outer part of the crown and is translucent.

4. All Ceramic Restorations

Types

Conventional powder
Slurry ceramics
Example: Optec HSP, Duceram LFC.

Castable ceramics
Example: Picon, Dicor Plus.

Machinable ceramics
Example: Cerec vitablocs Mark I, Mark II, Dicor MGC, Celay.

Pressable ceramics
Example: IPS empress, OpTEC

Infiltrated ceramics
Example: INCERAM.

ADVANTAGES

1. Highly aesthetic, can match the tooth colour in translucency, colour and intensity.
2. Special types of porcelain are available that can simulate all colours including gingival tones.
3. Life-like porcelain is achieved by glazing porcelain.
4. Glazed porcelain in contact with tissue surface is more biocompatible than metal.
5. All ceramic restoration has less failure rates.
6. Porcelain fused to metal prepared from foil copings uses thin metal copings (0.2-0.3 mm), which can increase bulk of porcelain.

DISADVANTAGES

1. If there is difference in thermal matching between metal and porcelain, the porcelain fails at the margin.
2. More reduction of tooth structure to accommodate bulk of porcelain.
3. Brittle in nature and if surface glaze is removed cracks propagate leading to failure of porcelain.
4. Porcelain restorations do not give as close a marginal adaptation as metal marginal finish.
5. All porcelain has less tensile and shear strength, hence ideal to make a metal coping.
6. Porcelain shrinks during firing and if porosities are present the overall strength and translucency diminishes.
7. Ceramics and glasses have tensile strengths that are much lower than their compressive strengths.

8. Strength of ceramics reduces to 50% by sandblasting or by etching with hydrofluoric acid solution for 1 min.
9. If tensile stresses or sub-microcracks are present on the surface, in presence of moisture may lead to stress corrosion.
10. Presence of a chemical environment decreases strength of porcelain.

ENAMEL-METAL BOND

1. Mechanical bond

- Porcelain wets the surface of metal.

2. Compressive stresses

- Compressive stresses set up during cooling of the sintered porcelain veneer aid in bonding of porcelain.

3. Chemical bonding

1. Mechanical Bond

- Microscopic irregularities on metal surface are filled with porcelain; retention of the porcelain veneer by mechanical interlocking is achieved.

Increasing mechanical bond strength

1. Grinding or sand blasting.
2. Roughening by oxidation.
3. Electrochemical corrosion of the metal by molten glass.
4. Selective oxidation of grain boundaries.
5. Etching by acid in pre-treatment for fusing.

2. Compressive Stresses

- A very small degree of thermal mismatch between metal and porcelain leaves the porcelain in a state of compression.
- This increases the bonding between metal and porcelain.

3. Chemical Bond

- True chemical bonding results from electron transfer between the oxygen of the glassy phase of porcelain and an oxidised metal surface.

Increasing chemical bond

1. By addition of tin, indium, iron to a noble metal casting alloy.
2. In nickel chromium alloy there is an indirect bond between glass and metal through an undissolved oxide formed on the metal surface.

FABRICATION OF A CERAMIC RESTORATION

a. Condensation

Fine porcelain powder is mixed with water and condensed into the desired form.

Dense condensation provides

1. Lower firing shrinkage.
2. Less porosity in the fired porcelain.

Methods of condensation

1. Vibration

- Mild vibration is aplied as to the densely packed wet powder and the excess water that surfaces is blotted with a clean tissue.

2. Spatulation

- A small spatula is used to apply and smooth the wet porcelain.

3. Brush technique

- Dry porcelain powder is added to the surface with brush to absorb the water.
- Porcelain must never be allowed to dry out until condensation is complete.

b. Firing

- The thermo-chemical reaction is complete during fritting.
- Firing is done to fuse the particles of powder together, a process called sintering.

Method

- The condensed porcelain mass is placed in a preheated furnace (approximately 650°C (1200°F) for 5 minutes.
- This removes the remaining water.

Stages in Firing

A low bisque (Low biscuit) firing
In which the glass grains have softened and have started to flow.

A medium bisque (Medium biscuit) firing
The glass grains have flowed to the extent that the powder particles exhibit complete cohesion.

In high bisque (High biscuit) firing
The shrinkage is complete and the mass exhibits a smoother surface. Lesser the firing cycles higher will be the strength and aesthetics.

c. Glazing

- Air fired porcelain cannot be polished.

Application of over glaze/self glaze

- Self-glazing, which was previously fired to a high bisque, is heated rapidly (10 to 15 minutes) to its fusion temperature.
- It is maintained at that temperature for approximately 5 minutes before it is cooled.
- Glass grains flow over the surface to form a vitreous layer.
- Glazed porcelain is much stronger and reduces crack propagation than the unglazed variety

d. Cooling

- Because of the low thermal conductivity of the porcelain, there is a thermal differencs between outside and inside of porcelain. This can introduce stresses, which embrittle the porcelain.
- The ideal cooling method for a porcelain restoration from its firing temperature to room temperature is controversial.

OTHER TYPES OF PORCELAIN FABRICATIONS

a. Cast Coping

Requirements

1. To be fusible to alloys, the porcelain has to be sufficiently low fusing.

2. It has to have a coefficient of thermal expansion that is considerably higher than ordinary porcelain.
3. The alloy should be sag resistant at the firing temperatures of porcelain.
4. It should be rigid to prevent fracture of porcelain.
5. There should be no pigmentation reaction produced between the porcelain and the alloy.
6. Further oxide formed should be soluble in porcelain and provide good wetting of the metal or metal oxide for attachment.

b. Bonded Platinum Foil Coping

- Makes use of tin oxide coatings on platinum foil.
- The aesthetics is improved with a thin platinum foil, which allows more room for porcelain.
- The bonded foil reduces subsurface porosity and micro cracks in the porcelain and increases the strength of the unit.

c. Swaged Gold Alloy Foil Coping

- Renaissance by the Williams Gold refining company, is a laminated gold-alloy foil that is delivered to the use in a fluted shape.
- This foil shape is swaged onto the die and flame sintered to form a coping.
- An interfacial alloy powder is applied and fired, and then coping is veneered with porcelain.

ALL CERAMIC MATERIALS

1. Conventional powder-slurry ceramics

Available as

- Powders to which water is added to produce a slurry.
- Available in various shades and translucencies, with characterizing stains and glazes.

Manufacturing

- Leucite crystals are dispersed in a glassy matrix by controlling their nucleation and crystal growth.

- The leucite and glassy matrix fuse together during the baking process.
- The build-up and contouring of the crown can be done by using the powder-slurry technique on semi-permeable die material.

Advantages

1. Greater strength than conventional feldspathic porcelain due its leucite content.
2. Does not require a core as with aluminous porcelain jacket crowns.
3. The body and incisal porcelains can be pigmented to provide desired shade and translucency.
4. Does not require special processing equipment.
5. These restorations fit accurately.

Disadvantage

- Their high leucite content can cause increased wear to opposing teeth.

Other types

Duceram LFC

- Hydrothermal low fusing ceramic.
- Composed of an amorphous glass containing hydroxyl ions.

Advantages

- Greater density, higher flexural strength, greater fracture resistance and lower hardness than feldspathic porcelain.
- No special laboratory techniques or equipment required.

Uses

For fabrication of ceramic inlays, veneers and full-contour crowns.

Procedure

Base layer

Duceram Metal Ceramic (a leucite-containing porcelain) is placed on a refractory die using powder-slurry techniques and baked at 930°C.

Over base layer

Duceram LFC is applied using the powder-slurry technique and baked at a relatively low temperature (660°C).

2. Castable Ceramic Systems

Available as

- Solid ceramic ingots, which are cast using lost-wax and centrifugal casting technique.
- Only one shade is available.
- Staining is done to obtain proper shading of the final restoration.

a. Picon

A polycrystalline glass-ceramic material, in which glass is heat-treated under controlled crystallization.

Procedure

When solid ceramic ingots are cast at 1350°C, a transparent glass crown is obtained.

This crown is then heat-treated at 1075°C for 10 hours. "Ceramming" causes partial crystallization (55%) of tetra-silic-mica-like crystals.

Advantages

1. Easier, as it is a lost wax technique.
2. The transparent crown after heat treatment at 1075°C for 10 hours forms an opaque crown, which increases fracture resistance and strength.
3. Less abrasive to opposing tooth structure.
4. For final restoration colourant stains are baked on the surface of the glass-ceramic material.

b. Dicor Plus

- It is a shaded feldspathic porcelain veneer applied to the Dicor substrate.

Disadvantages

1. Abrasive to opposing teeth
2. Requires a special high-temperature, electric-heated casting unit.
3. Fracture of the restorations is common.

3. Machinable ceramics

Available as:

- Ceramic ingots in various shades.
- Used in computer-aided design and computer-aided manufacturing (CAD-CAM) procedures.
- The machined restoration are stained and glazed to the desired characterization.

Cerec Vitablocs Mark I

- This is a feldspathic porcelain, used with the Cerec system.
- Composition and properties are the same as feldspathic porcelain used for porcelain-fused-to-metal restorations.

Cerec Vitablocs Mark II

- This is a feldspathic porcelain of increased strength with less abrasive wear of the opposing tooth structure.

Dicor MGC

- Contains fluoro-silicic mica crystals in a glass matrix.
- It has greater flexural strength than the castable Dicor and Cerec.
- Less abrasive wear of the opposing tooth structure than Cerec Mark I.

Celay

- Can be used for CAD-CAM-and copy-milling technique.
- Identical in physical properties to Cerec Vitablocs Mark II.

Disadvantage

- Marginal fit is not good.

4. Pressable ceramics

Available as

- Ceramic ingots, which are melted at high temperatures and pressed into a mould created by lost-wax technique.
- Can be made to full contour, or can be built up using feldspathic porcelain.

IPS Empress

- This is a feldspathic porcelain supplied in ingot form.
- The ingots are heated and moulded under pressure to produce the restorations.

Procedure

1. The ceramic ingot is placed under the plunger, and heated to 1150°C.
2. The plunger presses the molten ceramic into the mould.
3. The final shade of the crown is done by staining or veneering (cut back technique of wax pattern).

Optec Pressable Ceramic

This is a type of feldspathic porcelain with increased leucite content, processed by moulding under pressure and heat.

Advantages of IPS and OPC

1. Produce strong, translucent, dense and etchable ceramic restorations.
2. Useful in fabricating ceramic veneers.

Disadvantage

- Require special equipment to fabricate the restorations.

5. Infiltrated ceramics

Available as

- Powder (aluminum oxide or spinel), which is fabricated into a porous substrate, and a glass, which is infiltrated at high temperature into the porous substrate.
- The infiltrated ceramic is then veneered using conventional feldspathic porcelain technique.

In-Ceram

- The spinel cores are more translucent than the aluminum oxide cores.
- The core is made from fine-grained particles that are mixed with water to form a suspension referred to as a "slip".

Procedure

1. The slip is placed on a gypsum die and baked at 1120°C for 10 hours to produce the opaque, porous core.
2. An appropriate shade of glass powder is applied to the core, which is baked again at 1100°C for four hours.
3. During this process, the molten glass infiltrates the porous alumina core by capillary action.

Advantages

1. Extremely high flexure strength.
2. The aluminum oxide or spinel crystals limit crack propagation and the glass infiltration reduces porosity.
3. Provide an accurate fit.

Disadvantages

1. Cannot etch internal surface hence a resin cement such as Panavia 21TC is recommended.
2. Not as aesthetic as other systems.
3. Requires specialized equipment to fabricate a restoration.

RECENT ADVANCES IN METAL-CERAMICS

- Pure titanium can be used as a coping and framework metal for metal ceramic restorations because of its excellent biocompatibility.
- Copy milling is used to prepare duplicate dies of graphite and to machine the outer form of a titanium crown. The graphite die is then used as a positive electrode in a spark erosion system to serve as the pattern for removal of interior portion of the crown.
- Other titanium-based products such as Tycast are melted in a specialized casting machine and cast using the conventional lost-wax technology. Ultra low fusing porcelain is used along with this.

18. What are the types of veneering materials? Describe their advantages, disadvantages and indications. Add a note on the recent advances in veneering materials used in fixed partial denture.

Veneers are thin facings of porcelain or resin affixed directly to teeth using a composite resin-bonding agent.

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TYPES OF VENEERING MATERIALS

1. Porcelain veneers (Cerinate, Porcelite and Chameleon).
2. Resin veneers by direct technique (Durafill, Heliosit, Silux).
3. Resin veneers indirect technique (Dentacolour, Isosit).
4. Composite veneers direct and indirect (Visio-Gem).
5. Composite reinforced with glass fibres (Targis/Vectris, Variolink II System).
6. Castable hydroxyapatite (Cast apatite).
7. Injectable ceramics (Dicor, Cerestore).

COMPARISON OF VENEER SYSTEMS

Direct Composite Veneers

1. Require only one appointment.
2. The shade, contour and final form can be corrected to the dentist's and patient's satisfaction.
3. Less expensive when compared to porcelain and other laminate systems.
4. Direct veneers can be repaired easily.

Indirect Resin Veneers

The indirect resins have better bond strength than direct resins.

Porcelain Veneers

1. Have good translucency.
2. Reduced plaque adherence.
3. They can be fabricated only by indirect technique.
4. Their advantages are that chair side time is reduced even for placement of multiple units.

Have optimum colour stability, aesthetics, wear resistance, and tissue compatibility.

PORCELAIN LAMINATES

- Porcelain laminates are thin facings constructed on refractory dies.
- The porcelain veneer's inner surface is etched with hydrofluoric acid and bonded to tooth with composite resin cement.

Indications

1. When patient demands high aesthetics.
2. For mildly stained tooth.
3. Enamel defects and diastema.

Contraindications

1. In dark stains.
2. Patients with parafunctional habits.

Advantages

1. Highly aesthetic.
2. Good bond strength.
3. Resistant to abrasion and fluid absorption.
4. Good periodontal health.

Disadvantages

1. The fragile veneer can break.
2. Loss of glaze while finishing.
3. Technique sensitive.
4. Expensive and extensive tooth preparation.

Different technique

- Platinum foil is burnished onto the die on which porcelain is applied.
- This prevents build up of heat during firing and increases surface area for etching.

Steps before bonding

1. Check for fit of veneer.
2. Colour check:
    - Place laminate on tooth with glycerine and compare it with shade tab. If laminate appears darker then select a lighter shade composite luting agent.
3. The actual composite is placed and trial checked.
4. Clean the veneers and isolate the tooth.
5. The etched surface of veneer is applied with silane coupling agent.
6. The tooth is cleaned and enamel etching is done with 30 to 37 percent phosphoric acid for 15 to 20 seconds.

7. The tooth is cleaned, isolated again and light activated dentin bonding agent is applied.
8. The veneer is seated with composite cement and cured.
9. Lingual finishing and occlusal equilibration is carried out.

Variations
Rochette's bridge with lingual retainers and interproximal retainers.

Resin Veneer Direct Technique

Indications
1. For dark stains.
2. Patients with parafunctional habits.

Advantages
1. Good aesthetics if colour blending can be done.
2. The longevity is equally good for recent resins when compared to porcelain.
3. Easy to repair.

Disadvantages
1. Can produce staining.
2. Less abrasion resistant.

Resin Veneer Indirect Technique

Indication
1. Mildly stained or striated teeth.
2. For patients with parafunctional habits.

Advantages
1. Can be used in patients with parafunctional habits.
2. Can be adjusted with ease.

Disadvantages
1. Can produce staining.
2. Less abrasion resistant.

Indirect Composite Veneers

Indications
1. Enamel defects.
2. Diastema closures.

Advantage
Easy preparation

Disadvantage
Less bond strength.

Technique
1. Intra-enamel preparation or extra-enamel preparation can be done.
2. Intra-enamel preparations are more accurate.
3. Shade selection of body and incisal shades is done and impression is made after gingival retraction.
4. Die is fabricated and veneer is made.
5. At the second appointment the seating is evaluated and the veneer is bonded with a mixture of Visi-fil (75%) /Visio-bond (25%) blend.

RECENT ADVANCES IN VENEERING MATERIALS

Reinforced Composites

1. Encore Bridge

- The composite superstructure is bonded with porcelain veneers.
- It is composed of 81 percent filled composite with a glass fiber reinforcement (Sculpture/FibreKo, Jeneric/Pentron, Inc).
- The framework has sufficient flexure to attain a Class I mobility.
- An all-porcelain bridge will not allow flexure.

Advantage
Tooth preparation is minimal (only on lingual surface with a small proximal extension).

Technique
The preparation starts 1 mm from the most distal aspect of the lingual surface and extends into the proximal area.

Bonding the Framework:
After verifying the fit, the framework was bonded into place with C&B-Metabond (Parkel I), after which the veneers are bonded onto the composite pontics with UltraBond (Den-Mat).

2. Targis/Vectris

- A product from Ivoclar Williams.

Composition

It is a glass fiber-reinforced composite, with silanized glass fibres, a BIS-GMA matrix, and an 85% ceramic-filled composite veneer.

Advantages

a. Class I flexure attainable.
b. Good fracture resistance.
c. Aesthetic properties comparable to metal-free ceramic restorations.

3. Variolink II System

- A product from Ivoclar Vivadent.

Techniques

1. After sandblasting the veneer under surfaces, they are silanated with Monobond-S.
2. The teeth are now isolated and the preparations are etched.
3. The enamel is etched for 30 seconds and the dentin for 5 seconds.
4. The etchant is thoroughly washed away and the preparations dried.
5. Syntac dentin primer is applied for 15 seconds.
6. Teeth are dried.
7. Syntac dentin adhesive is then applied for 10 seconds and dried.
8. Heliobond (Ivoclar Vivadent) is applied to tooth and the under surface of the veneer inlays and luted with Variolink II cement (has different consistencies and shades) and cured.

Castable hydroxyapatite

Synonym: Cast apatite.

Hydroxyapatite mixed with composite fibres is slip cast by vibration.

Studies are yet to prove its clinical use.

Injectable ceramics/castable ceramics

(Dicor, Cerestore)

Dicor (Tetrasilicic fluoromica):
It was earlier used for FPDs, inlays and onlays.
Recently, it is used for laminate.

Indication
Laminates for periodontally compromised patients.

Contraindication
In short clinical crowns.

Advantages
1. Good strength.
2. Good marginal adaptation.
3. Biocompatible.
4. Highly aesthetic.
5. Low thermal conductivity.

Disadvantage
Tooth preparation is extensive.

Cerestore (shrink free ceramic system)

Indication
For periodontally compromised patients.

Advantages
1. Good flexural strength.
2. Highly aesthetic.
3. Good marginal fit.

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