

# esthetic & restorative dentistry

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material selection & technique, *second edition*



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# مرکز تخصصی پروتزهای دندانی های دندان

طراحی و ساخت انواع پروتزهای دندانی بویژه ایمپلنت

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

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Editor: Leah Huffman

Production: Sue Robinson

Printed in China

Douglas A. Terry, DDS

Willi Geller, MDT

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Nitzan Bichacho, DMD

Alejandro James, DDS, MSD

Markus B. Blatz, DMD, PhD

Mark L. Stankewitz, DDS, CDT

Olivier Tric, MDT

Pinhas Adar, MDT, CDT

John O. Burgess, DDS, MS

John M. Powers, PhD

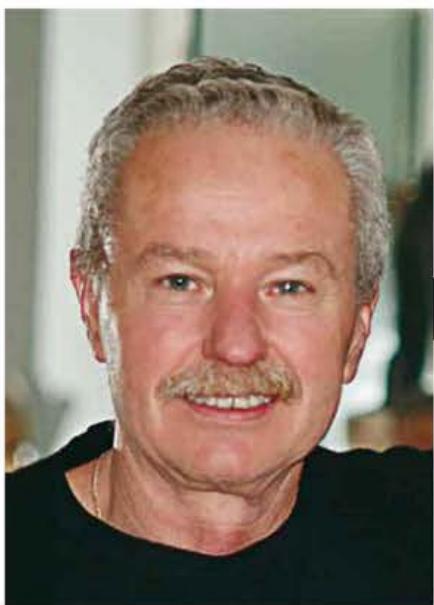
## authors

Dr Terry received his DDS in 1978 from the University of Texas Health Science Center (UTHSC) Dental Branch at Houston, where he is an assistant professor in the Department of Restorative Dentistry and Biomaterials. He is an accredited member of the American Academy of Cosmetic Dentistry, an active member of the European Academy of Esthetic Dentistry, and an honorary member of the Indian Academy of Restorative Dentistry. He has served as a research associate for REALITY Research Lab and a clinical associate for REALITY Publishing, and he is a member of the International Association for Dental Research. Dr Terry has received a number of professional

Douglas A. Terry, DDS

awards as well as fellowships in the American and International College of Dentists, the Academy of General Dentistry, and the International Academy of Dental Facial Aesthetics. He is a member and the US vice president of Oral Design International. Dr Terry is also an editorial member of numerous peer-reviewed scientific journals and has published over 230 articles on various topics in esthetic and restorative dentistry and has authored the textbook *Natural Aesthetics with Composite Resin* (Montage Media, 2004). He has lectured both nationally and internationally on various subjects in restorative and esthetic dentistry. Dr Terry is the founder and CEO of design Technique International and the Institute of Esthetic and Restorative Dentistry. He maintains a private practice in Houston, Texas.





Mr Geller is a master ceramist and dental technician from Zurich, Switzerland. Through the visionary power of his dental restorations, he has significantly influenced esthetic awareness in dentistry for an entire generation of dental technicians and dentists. He has created revolutionary rules and guidelines in dental esthetics for technicians as well as dentists at a time when it was not in vogue. Mr Geller has developed the lateral segmental layering technique, the ceramic shoulder, the "Geller-wing" technique, the Geller cutback technique, and Creation porcelain. He is recognized in the dental field as "Maestro," the true teacher, and his ideas and concepts are followed and dis-

### Willi Geller, MDT

seminated by outstanding international technicians and clinicians. Mr Geller is the founder of Oral Design International, a group of leading technicians and clinicians chosen by him to disperse new knowledge and information around the world. He has received numerous awards from international professional institutions for his outstanding professional achievements and contributions to esthetics, laboratory communication, and dental technology. He maintains an Oral Design laboratory in Zurich, Switzerland.

# editors

Dr Bichacho is the head of the Ronald E. Goldstein Center for Aesthetic Dentistry and Clinical Research at the Hebrew University Hadassah Faculty of Dental Medicine, Jerusalem, and holds the post of expert in prosthodontics at the rank of professor. He is the former president and a life member of the European Academy of Esthetic Dentistry (EAED) and a diplomate of the International Congress of Oral Implantologists (ICOI). He also serves on the editorial boards of leading international dental journals. Dr Bichacho is the inventor and creator of novel techniques, materials, and systems that have become widely used around the world. He publishes and lectures extensively worldwide in the fields of dental implant therapy, fixed prosthodontics, interdisciplinary treatments, and innovative treatment modalities in esthetic dentistry.

## Nitzan Bichacho, DMD



Dr James received his DDS from the Universidad del Bajío "La Salle" in León, Mexico, in 1990. He subsequently completed a residency in prosthodontics and a fellowship program in implant dentistry at the UTHSC Dental Branch at Houston. There he served as a director of the implant program. He has participated in many postdoctoral courses and seminars and is a graduate of the Orognathic Bioesthetic Institute. Dr James has published numerous scientific articles on esthetics, implantology, periodontal plastic surgery procedures, occlusion, and restorative dentistry. He currently

## Alejandro James, DDS, MSD



serves as an associate editor for the Spanish language version of *Dental Dialogue* and as a faculty member for the Orognathic Bioesthetic Institute. He lectures nationally and internationally on numerous topics related to esthetic and restorative dentistry and consults on product development for industry manufacturers. Dr James maintains a private practice in León, Mexico.



Dr Blatz graduated with a DMD and received an additional doctorate as well as a postgraduate certificate in prosthodontics from the University of Freiburg, Germany. He is currently a professor of restorative dentistry and chairman of the Department of Preventive and Restorative Sciences at the University of Pennsylvania School of Dental Medicine. He formerly was chairman of the Department of Comprehensive Dentistry and Biomaterials, assistant dean of clinical research, and director of the Master of Sciences in Oral Biology program at Louisiana State University Health Sciences

### Markus B. Blatz, DMD, PhD

Center School of Dentistry in New Orleans. Dr Blatz is a diplomate of the German Society of Prosthodontics and Material Sciences. He is the associate editor of *Quintessence International* and *Quintessence of Dental Technology* and an editorial board member of several recognized peer-reviewed scientific dental journals. He is also a member of multiple professional organizations, including the European Academy of Esthetic Dentistry and Omicron Kappa Upsilon National Dental Honor Society. Dr Blatz has published and lectured extensively on various facets of restorative dentistry, implantology, and dental materials.



Dr Stankewitz received his DDS from the UTHSC Dental Branch at Houston in 1983. He subsequently obtained his board certification from the American Board of Prosthodontics in 1989. He has over 20 years of experience in all phases of dental laboratory technology and is a master technician in the area of porcelain esthetic restorations on both natural teeth and osseointegrated implants. Dr Stankewitz is a member

### Mark L. Stankewitz, DDS, CDT

of numerous professional organizations and is the president of design Technique International. He is also a fellow of the American College of Prosthodontics. He has published and lectured nationally on esthetics, implant dentistry, and advanced laboratory techniques. Dr Stankewitz maintains a private practice in Houston, Texas, where he also owns and operates a dental laboratory.

Mr Tric first studied in France at the College of Leonardo Da Vinci and the University of Pharo while beginning his apprenticeship in dental technology. He has 15 years of experience in all phases of dental laboratory technology and has spent these years studying the secrets and principles of esthetics. He specializes in the many facets of porcelain esthetic restorations on both natural teeth and osseointegrated implants. Mr Tric is a member of Oral Design International and has a center for Oral Design in

## Olivier Tric, MDT

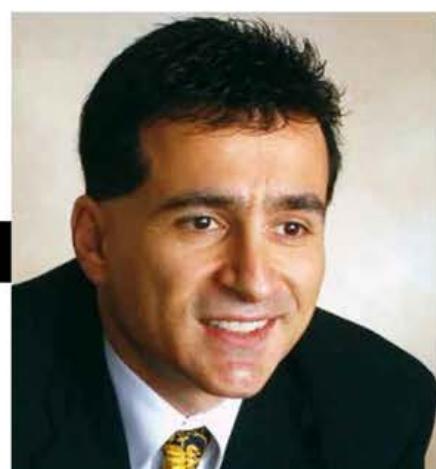
Elmhurst, Illinois. He serves on the editorial board of *Spectrum* and has authored numerous scientific articles on ceramic layering techniques and esthetic dentistry. Mr Tric has lectured and given numerous hands-on courses to dentists and technicians throughout the United States and Europe. He is also a consultant in the area of new product development and clinical testing of materials for dental manufacturers and laboratories. Mr Tric currently owns and operates a dental laboratory and an educational center in Elmhurst, Illinois.

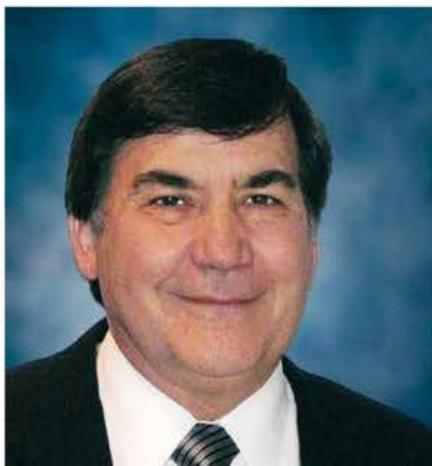


Mr Adar first studied in Tel Aviv, Israel, and then with Willi Geller in Zurich, Switzerland. With 30 years of experience in all phases of dental laboratory technology, he specializes in porcelain esthetic restorations on both natural teeth and osseointegrated implants. Mr Adar is the president of Adar International, an active member and on the executive board of the American Academy of Cosmetic Dentistry, an active member of the American Academy of Esthetic Dentistry, and the vice president of the Georgia Academy of Cosmetic Dentistry. He is also a member in the NADL and SCDL and is the

## Pinhas Adar, MDT, CDT

US coordinator of Oral Design International and has a center for Oral Design in Atlanta, Georgia. Mr Adar is on the advisory board of the Amara Institute and is a guest presenter at the Harvard School of Dental Medicine. He is on the editorial advisory board of the *Quintessence Yearly Journal*, the *Journal of Esthetic Dentistry*, the *Journal of Collaborative Techniques*, *Spectrum Dialogue*, *Everest Publishing Media*, and *Inside Dentistry*. Mr Adar is an international lecturer on various topics on esthetic and implant dentistry.





Dr John O. Burgess is a graduate of Emory University School of Dentistry. He received his MS in biomedical sciences from the UTHSC at Houston and completed a 1-year general practice residency and a 2-year general dentistry residency in the US Air Force. Currently the assistant dean for clinical research at the University of Alabama at Birmingham, Dr Burgess served as a military consultant in general dentistry to the Air Force Surgeon General. He has received certification from the American Board of Dentistry and is a diplomate of the Federal Services Board of General Dentistry. He is

### John O. Burgess, DDS, MS

a member of the American Academy of Esthetic Dentistry, the Academy of Restorative Dentistry, the American Dental Association, the American Association for Dental Research, and the Academy of Operative Dentistry. Dr Burgess received the Hollenbeck Award for outstanding work in Operative Dentistry in Biomaterials in 2010 and is a fellow of the Academy of Dental Materials and the American College of Dentists. A prolific researcher, he has published more than 400 articles, abstracts, and book chapters. He is a member of the editorial board for *Inside Dentistry*, served on the executive board for the American Association for Dental Research, and served as a consultant to the American Dental Association's Council on Scientific Affairs. He is a member of two ADA committees on specification development for materials and devices. He lectures extensively nationally and internationally and has presented more than 900 continuing education courses.



Dr Powers graduated from the University of Michigan with a BS in chemistry in 1967 and a PhD in dental materials and mechanical engineering in 1972. He received an honorary PhD from the Nippon Dental University in 2011. Dr Powers is the senior editor of the *Dental Advisor* and a clinical professor of oral biomaterials in the Department of Restorative Dentistry and Prosthodontics at the UTHSC at Houston. Dr Powers has authored more than 1,000 scientific articles, abstracts, books, and book chapters.

### John M. Powers, PhD

ters. He is a coauthor of the textbook *Dental Materials: Properties and Manipulation, Eighth Edition* (Mosby, 2003) and a coeditor of *Craig's Restorative Dental Materials, Thirteenth Edition* (Mosby, 2011) and *Esthetic Color Training in Dentistry* (Mosby, 2004). He serves on the editorial boards of many dental journals. He has given numerous scientific and professional presentations in the United States, Mexico, South America, Europe, and Asia.

# contents

introduction.....	XVI
foreword.....	XVII
preface .....	XVIII
acknowledgments.....	XXI
international editorial members .....	XXII

## chapter 1

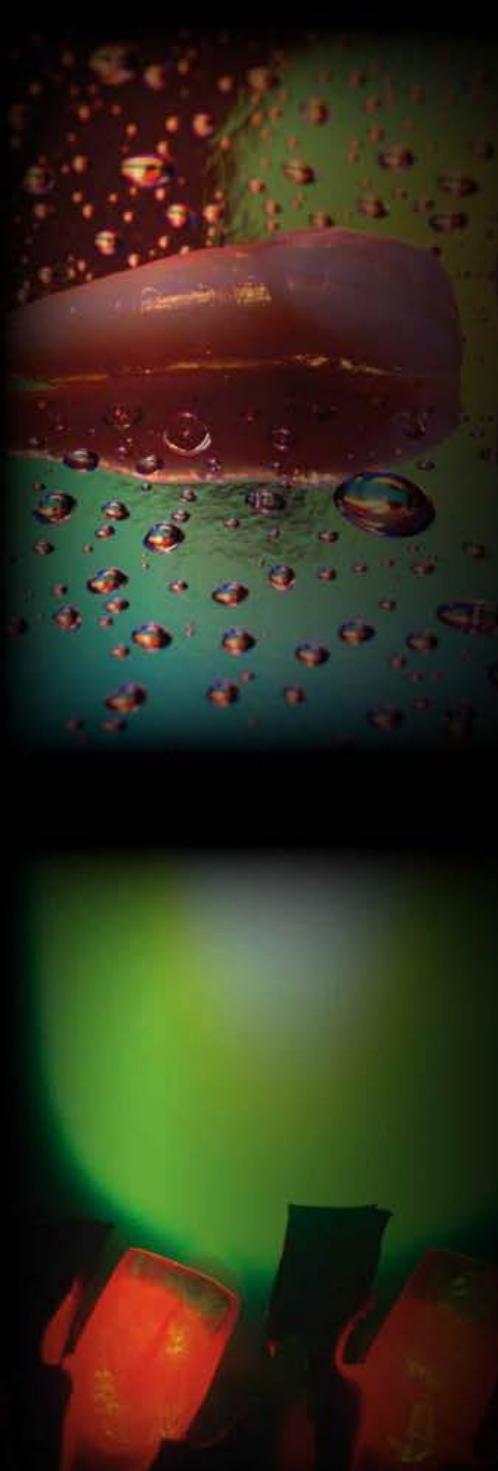
diagnostic and communication concepts .....	1
photography .....	3
shade determination and diagramming .....	4
diagnostic models .....	6
clinical techniques.....	8

## chapter 2

principles of tooth preparation .....	39
historical review.....	40
clinical objectives of modern restorative dentistry.....	42
biomaterial selection defines tooth preparation design.....	43
tooth preparation considerations for CAD/CAM technology .....	46
clinical techniques.....	50

## chapter 3

composite resins.....	77
introduction.....	78
integration of composite resin with natural tooth structure .....	79
infrastructure of the composite resin system.....	79
polymerization shrinkage .....	81
current developments in nanotechnology.....	85
conclusion.....	87
clinical techniques.....	88



## chapter 4

ceramic materials .....	143
composition of dental ceramics .....	145
historical perspective .....	145
properties of ceramic materials.....	146
classification of all-ceramic systems.....	147
current developments in biomaterials and technology.....	153
characteristics and properties of zirconia .....	154
methods for fabrication of zirconia blanks.....	155
methods for fabrication of a zirconia single-coping or FPD framework.....	156
scanning methods of different systems.....	157
3D scan and coping design (Lava software) .....	158
clinical performance of contemporary all-ceramic restorations .....	162
clinical techniques.....	163

## chapter 5

the impression process.....	253
selection of impression material.....	256
polyether impression materials.....	258
polyvinyl siloxane impression materials.....	258
vinyl-polyether hybrid impression materials.....	262
impression technique.....	262
criteria for an accurate impression .....	262
tissue management.....	263
clinical suggestions for impression techniques .....	264
conclusion.....	265
clinical techniques.....	266



## chapter 6

### contemporary adhesive cements ..... 279

historical progression of luting cements .....	281
classification of contemporary adhesive cements .....	282
mechanisms of adhesion .....	285
surface treatment of all-ceramic restorations for adhesive resin cementation .....	286
surface treatment of laboratory-processed composite restorations for adhesive resin cementation .....	288
conclusion .....	289
clinical techniques .....	290

## chapter 7

### provisionalization ..... 317

clinical objectives of the interim restoration .....	318
clinical requirements for developing an optimal interim restoration .....	319
clinical considerations for provisional materials .....	321
fabrication techniques: direct, semidirect, and indirect .....	322
consideration factors in cement selection .....	323
clinical techniques .....	326



## chapter 8

esthetic post systems.....	371
considerations for the selection of restorative materials.....	374
direct fiber-reinforced post and core system.....	378
clinical techniques.....	380



## chapter 9

mechanisms of adhesion .....	405
characteristics of enamel.....	406
characteristics of dentin.....	408
biomodification and adhesion to dental tissue substrates.....	410
adhesion at the restorative interface .....	413
conclusion.....	415
clinical techniques.....	416



## chapter 10

finishing and polishing esthetic restorative materials.....	443
finishing and polishing composite resins .....	446
finishing and polishing porcelain.....	447
maintenance of esthetic restorations.....	448
conclusion.....	449
clinical techniques.....	450



## chapter 11

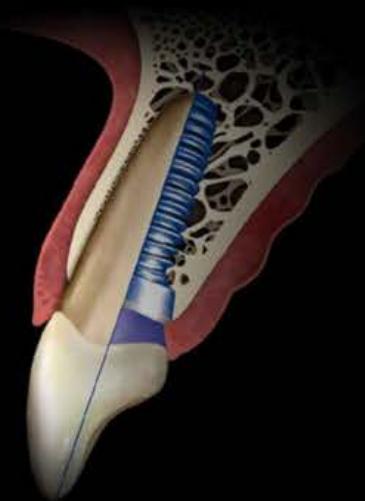
### dental photography ..... 475

historical review.....	476
digital camera systems.....	477
clinical applications of digital photography.....	478
camera system: integrated components .....	482
reflective exposure metering.....	487
exposure compensation.....	488
exposure modes.....	489
incident exposure metering.....	490
filmless imaging: viewing, transmission, and storage .....	491
guidelines for selection and application of digital camera systems .....	492
conclusion.....	492
clinical photographic techniques .....	493

## chapter 12

### periodontal plastic surgery ..... 513

crown lengthening procedures .....	514
mucogingival surgical procedures.....	519
conclusion.....	523
clinical techniques.....	524



## chapter 13

interdisciplinary implantology .....	593
historical review.....	594
contemporary implant dentistry.....	596
interdisciplinary diagnostic evaluation and treatment planning.....	597
interdisciplinary presurgical strategy.....	598
implant selection and placement.....	602
interdisciplinary surgical strategy.....	603
clinical techniques.....	606

## chapter 14

biomodification of tooth discoloration .....	677
extrinsic origin.....	678
intrinsic origin.....	679
conservative tooth color correction treatments.....	680
bleaching (tooth whitening).....	680
enamel microabrasion .....	683
clinical techniques.....	684

index.....	715
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# introduction



The dental profession has devoted most of its history to restoring the effects of dental disease. The last two decades have evidenced a paradigm shift in this philosophy that has been guided by a greater understanding of science. During this evolution, restorative dentistry has adopted a medical model for decision making in the treatment of dental disease that allows clinicians to individualize and evaluate all components of the process for a proper treatment strategy. This process also educates and involves the patient in treatment decisions, which results in acceptance of appropriate preventive and restorative strategies and improved compliance and oral health.

The public's interest in health and beauty has become an engine that continues to drive the demand for cosmetic dental procedures. In the past, achieving a beautiful smile required submission to extensive invasive procedures and expensive fixed dental prosthetic restorations. Advancements in restorative material formulations and adhesive technology have expanded the treatment possibilities for the clinician and technician. In addition, these advances have increased the myriad opportunities available to discriminating patients and have provided solutions to many of the restorative and esthetic challenges faced by clinicians. Also, this changing technology allows the clinician to treat many esthetic and restorative challenges through more simple, conservative, and economical methods. This evolution in philosophy and science has resulted in a change in the trend for dental treatment. There has been a shift from patients seeking disease-related treatment to elective cosmetic enhancement.

This edition of *Esthetic & Restorative Dentistry: Material Selection & Technique* was compiled to explain and teach esthetic dental procedures through illustrations of everyday clinical situations. It is not designed to advocate one restorative material as the best or prescribe to clinicians which materials to use. Instead, its purpose is to illustrate how a selected material and/or instrument should be used with a specific and thorough protocol to achieve the highest level of excellence for that material and clinical situation. The editorial team members were selected from different areas of the world for their scientific knowledge and clinical and laboratory expertise. This international group encompasses many facets of esthetic and restorative dentistry, including biomaterials, laboratory technology, operative, prosthetic, periodontal, and implant dentistry. This combination of input will provide clinicians, technicians, and auxiliaries with the proper information to make improvements in their work while maximizing their productivity and providing improved oral health care to their patients.

# foreword



In this second edition, Dr Douglas Terry, a member of the faculty at the University of Texas Health Science Center, has gone to great lengths to assemble an international core of experts from quite diverse dental fields, where the prerequisite was to put together a sequential series of monographs addressing those very issues that we as clinical dentists encounter in our day-to-day practices. These range from the initial phase of diagnosis and communication through the essentials of different clinical procedures, such as the different forms of tooth preparations, through impression making, provisionalization, and the actual restorative modality.

A chapter is devoted toward the complex but all-important issue of cementation, be it for a veneer, partial denture, porcelain-fused-to-metal crown, or an all-ceramic restoration. He also includes a chapter on the all-too-often-neglected aspect of clinical documentation and photography, as well as some of the essentials on esthetic post systems, periodontal plastic procedures, and implant dentistry.

The esthetics-driven decade in dentistry requires an ever-increasing body of knowledge essential to the process of clinical decision making for beautiful smiles or esthetic restorations. Since the publication of the first edition of *Esthetic & Restorative Dentistry: Material Selection & Technique*, this international forum evolved, but it continues to provide global information from a multitude of different countries. The new editors for this second edition extend from Dr John Powers from Michigan and Dr John Burgess from Alabama to Dr Nitzan Bichacho from Israel. Updated clinical, laboratory, and scientific concepts were provided by Dr Jussara Bernardon and Dr Luiz Baratieri from Brazil; Dr Tetsuji Aoshima, Dr Yoshihiro Kida, and master technician Jungo Endo from Japan; master technician August Bruguera from Spain; and myself, the representative from South Africa. No corner of any continent was left unturned seeking out the most appropriate teachers for the task at hand.

A handwritten signature in black ink, appearing to read "Douglas Terry". The signature is fluid and cursive, with a large, stylized "D" at the beginning.

# preface



The last 50 years have witnessed an unimaginable amount of change in restorative dentistry. The evolution of materials and techniques has been so great that it has become virtually impossible for the clinician to keep abreast. Silicate cement and acrylic resin have been completely replaced by composite resins. Major improvements in physical and mechanical properties, particularly wear resistance, have permitted a general substitution of composite resins for silver amalgam in posterior teeth. Just a short time ago, the average annual wear rate of posterior composite resins was 100 microns. Today, this value has been decreased to approximately five microns. Furthermore, the development of adhesion techniques coupled with modified cavity preparations has gone a long way to reduce the potential for secondary caries.

The introduction of adhesive dentin bonding agents has reduced not only the need for mechanical retention but also the size of the cavity preparation. The traditional concept of "extension for prevention" has been modified to the point that commonly it is not a pressing issue. The buccal and lingual extensions of the Class II preparation into the proximal region, for example, need not be broadened beyond the proximal surfaces unless dictated by the presence of caries. The need for extending the proximal portion of the preparation to the limits recommended for amalgam is appreciably diminished due to a lowered caries rate as well as the potential for bonding to tooth structure.

Another area of major change has been the ceramic restoration. The first breakthrough came about with the introduction of the porcelain-fused-to-metal restoration. The ability to fire and fuse porcelain against gold alloy or base metals considerably extended the use of ceramic materials. Suddenly it was possible not only to generate single units of porcelain for anterior and posterior teeth but also to fabricate extended partial dentures. It is important to note that ceramic veneering of metal crowns or copings resulted in changes not only to the ceramic material but also to the casting alloys themselves. By using metal substrates with a higher casting temperature and a ceramic material with a lower fusion range, highly esthetic and durable restorations could be developed. This method of restoring missing teeth continues to play a very important role in the field of prosthodontics.

The concept of injection molding of glass ceramics such as IPS Empress contributed greatly to the generation of highly esthetic ceramic restorations for anterior teeth. Containing a higher concentration of leucite crystals, the restoration is more resistant

to crack propagation and fracture. While highly accepted for use in the anterior region of the mouth, the injection-molded ceramic agent usually is not considered for use in the molar-premolar region.

Still another area of advancement in recent times has been the development of the aluminous core material. Essentially, the alumina core is a ceramic agent containing sufficient alumina to produce high strength and opacity when used as a single-unit restoration. The core is then veneered with the usual type of glass ceramic material. The concept of using alumina was further enhanced by the introduction of techniques that permitted the infiltration of glass into slightly sintered aluminous porcelain cores. As a result, the range of uses for prosthodontic purposes increased appreciably.

More recently, the sintered zirconia core has been introduced as a substitute for the alumina core. The zirconia material commonly exhibits twice the flexural strength compared with its counterpart, the alumina-based restoration. Interestingly, the zirconia offers another advantage: It readily stops the propagation of small cracks once initiated. Because of the high strength and excellent esthetics of veneered zirconia-based ceramic systems, they can be employed for essentially the same purposes as the traditional porcelain-fused-to-metal systems. Finally, a possible solution for the porcelain's potential for abrading antagonist tooth structure has been advanced. In "low-fusing" porcelains, the level of leucite formation is considerably lower than its high-fusing counterpart. The natural forming process of leucite from feldspar is reduced by using ceramic agents that fuse approximately 200°C lower than normal.

Cements have been part of clinical dentistry for well over a century. Zinc phosphate cement has been the material of choice for cementation of prosthetic restorations, as well as many other uses including orthodontics and the restoration of individual teeth. Although considered a minor player, it is still used by many clinicians for the cementation of crowns and partial dentures. The first adhesive luting agent was polycarboxylate, which was introduced in the late 1960s. It has been used interchangeably with zinc phosphate cement and is usually credited with exhibiting less post-operative sensitivity than zinc phosphate cement.

Throughout the last few decades, however, a number of other luting agents have been added to the clinician's list. These include composite resin, glass ionomers, resin-modified glass ionomers, and self-adhesive or self-etching cements. The introduction of composite resin cements brought about a major competition for their traditional predecessors. They provided a greater potential for shade matching, higher compressive strengths, and an appreciably enhanced resistance to fracture when used in conjunction with ceramic restorations. This characteristic was made possible by the ability of the luting agent to bond both to the surface of the restoration as well as to tooth structure itself. In addition, this class of cements was characterized by a significant reduction in solubility, improved marginal wear resistance, and less micro-leakage.

The glass-ionomer luting agents provided a physiochemical adhesion to tooth structure as well as to nonprecious alloys. In addition, they exhibited higher compressive strengths than either zinc phosphate or polycarboxylate cements. They also undergo a fluoride ion release with a potential for caries prevention, improved resistance to dissolution, and a coefficient of thermal expansion that is closer to tooth structure. The addition of a polymerizable resin component made it possible to en-

hance a number of its physical and mechanical properties. Furthermore, resin modification made it possible for the cement to cure at a considerably faster rate.

The most recent addition to the list of luting agents is the so-called user-friendly self-adhesive cement systems. This novel luting agent is easier and simpler to use because of a reduced number of bonding steps. Furthermore, it is capable of adhering to a wide variety of restorative agents, including gold and base metal alloys, resins, and ceramic materials as well. Generally, it combines the benefits of glass-ionomer and composite resin cements without any special treatment of the prepared tooth surfaces. These self-adhesive systems are appreciably different than conventional composite resin or glass-ionomer cements. Although the composition varies somewhat from one material to another, some of them do not contain Bis-GMA. They may, however, contain UDMA, 4-MET, and a fluoro-alumina-silicate glass. Their relatively low acidity causes a superficial elimination of the apatite crystal or mineral phase, which in turn creates the potential for hybridizing the tooth structure. It is probably for this reason that the postoperative sensitivity associated with its use is minimal to nonexistent. Finally, this class of material offers good radiopacity and a low film thickness.

Another restorative agent undergoing appreciable change is the endodontic post. In the past, it was assumed that a post with high flexural strength and modulus of elasticity resulted in the best clinical performance. Recent studies, however, have demonstrated that root fracture is considerably reduced by the use of posts that exhibit a modulus of elasticity closer to that of root structure. Currently, the glass-fiber post is creating an impressive acceptance by the clinician. While the elastic modulus of carbon-rod and glass-rod posts is similar, the carbon post is far less esthetic. Furthermore, because of a potential incompatibility between the dual-cured cement and the bonding agent, there is a trend toward the use of light-transmitting posts.

Currently, there are a number of publications that describe the relative physical and mechanical properties of the various restorative materials used by the clinician. Some information also is available about their relative clinical behavior. This publication is different and unique from others. It is based on the concept that optimum clinical results are best obtained through the proper utilization of a material. The use of each material and technique covered in this text is depicted in detail using high-quality photography. Furthermore, a materials science background is presented for each of the materials addressed clinically.



# acknowledgments

The inspiration for writing and sharing our experiences in dentistry can be attributed to the stimulus of our colleagues and students around the world. The questions and suggestions shared in presentations, hands-on courses, letters, and emails indicated a desire for a medium to provide knowledge and illustration for the “wet-handed” dentist and technician. There were two basic underlying themes from the input of these colleagues that were identified as to which materials one uses for specific clinical situations and how to use them. These clinicians and technicians shared concern about how to achieve accuracy and consistent, predictable results and still maintain efficiency and profitability with dental procedures.

After reviewing numerous dental educational resources and their methods for selecting and utilizing restorative materials, it was decided that an international editorial team from different educational backgrounds would provide a better source for solutions to these questions. This editorial team was selected from private practice and university faculty around the world and includes biomaterial research scientists, technicians, general dentists, orthodontists, oral surgeons, prosthodontists, and periodontists. It was the consensus of our editorial team that selection of a restorative biomaterial would not involve rating a dental material or product but would show how to use any selected biomaterial so it achieves the most optimal result and longevity for a specific clinical situation. This concept was reflected in a statement I made several years ago: “It is not which biomaterial you use but how you use it that improves the esthetics and longevity of the material.” This concept has become the catalyst to ignite this editorial project—*Esthetic & Restorative Dentistry: Material Selection & Technique*.

The initial spark began in the winter of 2002 in Zurich, Switzerland, when Willi Geller suggested that I organize a “special group” of colleagues from around the world and call them dTI—design Technique International. The group has evolved in the last 5 years to include master technicians, clinicians, and biomaterial scientists from every corner of the world. The members’ participation in this project has included not only “words and techniques” but discussions, encouragement, critique, advice, inspiration, and most importantly, camaraderie and friendship.

Of special significance, the authors, editorial team, and members of dTI would like to express our gratitude to our families, friends, patients, staff, and colleagues for their patience, commitment, and time they have shared and not shared with us to allow this project to be completed.

Finally, of special significance is Sue Terry, who is not only my mother but has been adopted and given the name “mom” by our team. This project would not have been possible or as organized without her wisdom, inspiration, dedication, comforting conversations, ability to persuade patients to come back for photographs, and her fabulous midnight “culinary delights.”



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clinical and laboratory contributors  
and scientific reviewers



# clinical and laboratory contributors

Giuseppe Allais, DDS  
Jussara K. Bernardon, DDS, MS, PhD  
August Bruguera, CDT  
Victor E. Castro, CDT  
Theodore P. Croll, DDS  
Jungo Endo, RDT  
Jean-Marc Etienne, MDT  
David A. Garber, DMD  
Gregg Helvey, DDS  
Yoshihiro Kida, DDS, PhD  
Cobi J. Landsberg, DMD  
Ernesto A. Lee, DMD  
Jack E. Lemons, PhD  
Chuck N. Maragos, CDT  
Ole H. Mathiesen, CDT  
Charles Moreno, CDT, MDT  
Susana B. Paoloski, DDS  
Juan José Gutiérrez Riera, DDS, MSD  
Giuseppe Romeo, MDT  
Maurice A. Salama, DMD  
Alex H. Schuerger, CDT  
Kevin T. Tran, CDT  
Francisco Zárate, DDS, CDT

# clinical and scientific reviewers

Irfan Ahmad, BDS  
Harry Albers, DDS  
Tetsuji Aoshima, DDS  
Luiz N. Baratieri, DDS, MS, PhD  
Danuta Borczyk, DDS  
Fabio Cosimi, MD, DDS  
Nicolas Elian, DDS  
Kostis Giannakopoulos, DDS  
Galip Gürel, DDS, MSc  
Jeffrey Hoover, DMD, MS  
David Klaff, BDS  
Sergio G. Kohen, DDS  
Fritz R. Kopp, DDS  
Constantinos Kountouras, BDS, MSc, PhD  
Gerard Kugel, DMD, MS, PhD  
Karl F. Leinfelder, DDS, MS  
Michel Magne, MDT  
Robert Margeas, DDS  
Edward A. McLaren, DDS  
Juergen Mehrhof, MDT  
Masashi Miyazaki, DDS, PhD  
Hien Ngo, BDS, MDS  
Rafi Romano, DMD, MSc  
Arturo Godoy Sentíes, DDS, CDT  
Patrick A. Simone, DDS  
Richard J. Simonsen, DDS, MS  
Bodel Sjoholm, CDT  
Stephen R. Snow, DDS  
Carsten Stockleben, DDS, PhD  
Edward J. Swift, DMD, MS  
Esam Tashkandi, BDS, MS, PhD



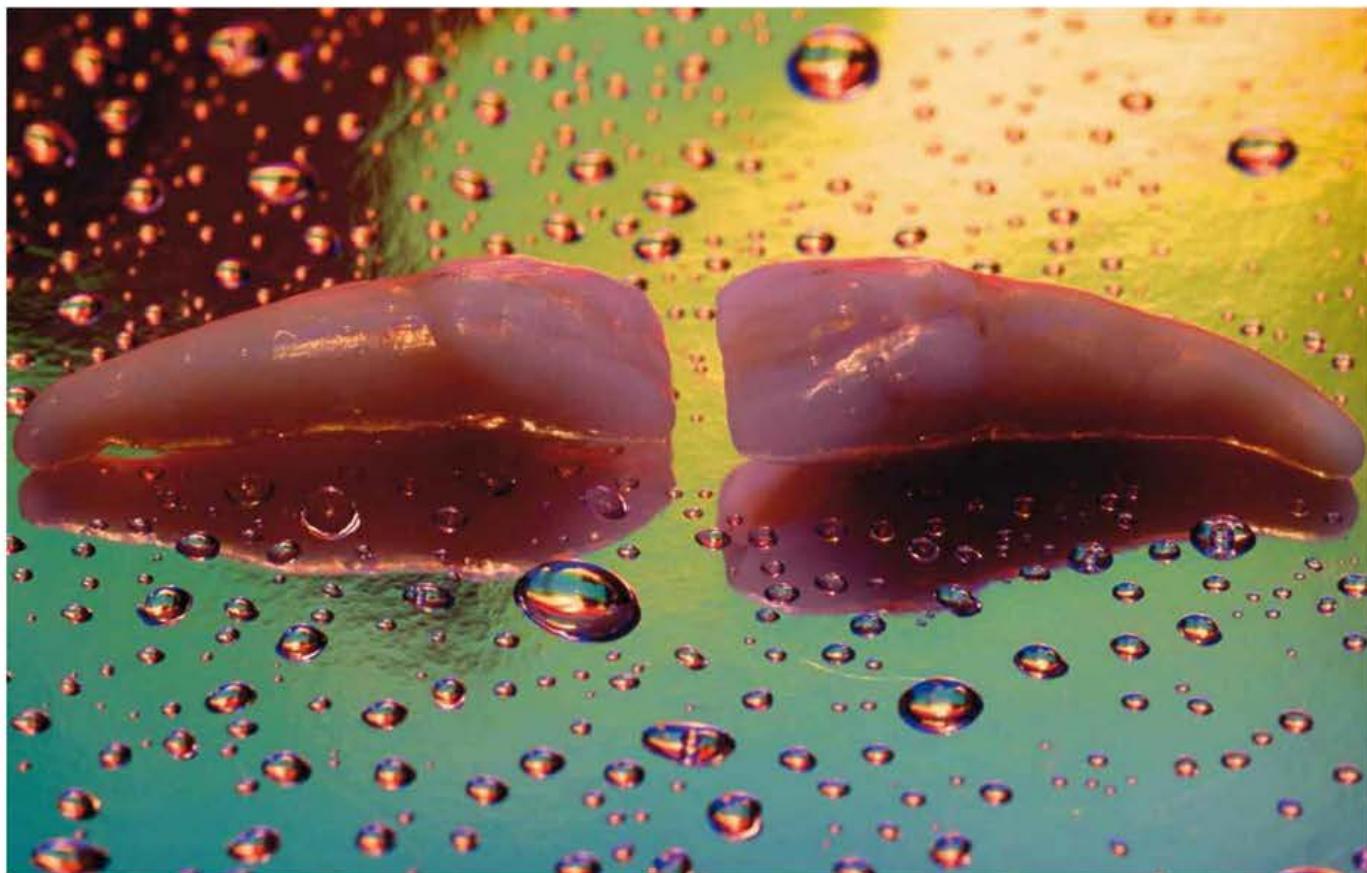
## closed sandwich technique resin modified glass-ionomer/composite resin

Figure 1 shows the preoperative view of a wedge-shaped carious cervical lesion on the mandibular right second premolar. These lesions occur from tensile forces. The initial caries control procedure provided removal of the infected dentin and placement of a resin-modified glass ionomer to provide a seal of the lesion while remineralizing the affected dentin (Fig 2). A chamfer was placed along the occlusal margin (Fig 3). A 0.5-mm scalloped bevel was placed in enamel to interrupt the straight line of the chamfer and to reduce the potential for microleakage (Fig 4).

The preparation was cleaned with a premixed slurry of pumice and 2% chlorhexidine (Consepsis) (Fig 5). The preparation was rinsed and lightly air dried. A two-component self-etching system (UniFil Bond, GC America) was used. The self-etching primer was applied to the preparation and allowed to set for 20 seconds and dried gently for 5 seconds (Fig 6), and the bonding agent was applied to the enamel and dentin surfaces and light cured for 10 seconds (Figs 7 and 8). The initial enamel layer of opacious A4-shaded composite resin (Gradia Direct, GC America) was applied to the occlusal half of the preparation with a long-bladed composite instrument (Fig 9), contoured, and smoothed with a #2 sable brush (Fig 10). A second opacious increment was placed in the gingival half of the preparation (Fig 11), smoothed with a #2 sable brush, and light cured.



# ceramic materials



Photography courtesy of Irfan Ahmad, BDS.

Ceramics, derived from the Greek word *keramos*, was the ancient art of fabricating pottery. This word may have originated from a Sanskrit term meaning burnt earth because the main constituents were clays excavated from the earth, which were heated to form pottery.<sup>1,2</sup> Although the methods of acquiring, purifying, and fabricating these raw materials into ceramic objects have significantly changed, some of the basic materials and techniques are still the same. Traditional ceramics uses clay as one of its primary components, in combination with other metal oxides including feldspar ( $K_2O Al_2O_3 6SiO_2$ ), alumina ( $Al_2O_3$ ), potash ( $K_2O$ ), and soda ( $Na_2O$ ). Ceramic objects are still fabricated by pulverizing these raw materials into fine particles and powders and adding water to help keep the particles together during sculpting and shaping. The “green” (unbaked) object is dried and placed into an oven (kiln) and heated to a specified temperature that allows the individual particles to coalesce into a solid mass. The process of coalescence of the particles is called *sintering*, and it usually re-

sults in shrinkage and strengthening of the solid mass. These traditional ceramics include stoneware (tile), earthenware (pottery), porcelain (tableware and china), electrical insulators, bricks, and sanitary ware (sinks and toilets).<sup>3</sup>

### ■ COMPOSITION OF DENTAL CERAMICS

Dental ceramics are chemical mixtures of nonmetallic and metallic elements that allow ionic and covalent bonding to form periodic crystalline structures. The most common dental ceramics are composed of metal oxides ( $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{K}_2\text{O}$ ) and other traditional ceramic materials. Most dental ceramics are semicrystalline, silicates, oxides, and derivative structures. The simple structures are usually bonded ionically, whereas the complex structures generally involve ionic and covalent bonding.<sup>4</sup>

In theory, the basic constituents for fabricating conventional dental ceramics are similar to those for traditional ceramics. These compounds include feldspar, silica, and kaolin (refined as clay). However, the major difference between the porcelain used in dental ceramics and other traditional ceramics is the proportion of the main ingredients. Dental ceramics are composed mainly of feldspar, while traditional ceramics are composed mainly of clay. Feldspar is a gray, crystalline material, and its chemical composition is potassium aluminum silicate ( $\text{K}_2\text{O Al}_2\text{O}_3 6\text{SiO}_2$ ). Other constituents found in feldspar include mica and iron, and these are removed mechanically by splitting the feldspar rock and during later stages by using strong magnets. The pure feldspar pieces are ground and milled into a powder.<sup>1</sup>

Quartz crystals are the main source of silica ( $\text{SiO}_2$ ), and they are heated and quenched in cold water to split into smaller pieces. These smaller quartz pieces are ground and milled into a fine powder, and any iron impurities are removed with magnets. Dental porcelain is comprised of approximately 15% quartz powder.<sup>1</sup> The quartz powder is infusible at the firing temperature of porcelain and is surrounded by fusible ingredients. It is this crystalline layer of quartz that contributes to the dispersed phase and is surrounded by a continuous amorphous phase. This crystalline layer is responsible for the translucent optical properties of porcelain and limits shrinkage during firing.

Kaolin is a natural form of clay obtained from riverbeds. The clay is washed, dried, and screened into a pure, fine powder. In dental porcelains, kaolin is used in small concentrations (ie, 4%) as a particle binder. The kaolin coats the nonfusible particles and becomes sticky, holding the wet porcelain particles together. This allows the technician to control the form of the restoration by manipulating the powder-liquid mass.<sup>1</sup>

To render porcelain restorations tooth colored, small quantities of coloring agents are added to porcelain powders. These pigments are derived from metallic oxides that are ground and mixed with feldspar powder. This mixture is then fired, fused to glass, and then reground to a powder. These oxides include iron oxide for brown shading, copper oxide for green shading, titanium oxide for yellow shading, manganese oxide for purple shading, cobalt oxide for blue shading, and tin oxide for opaquing. Furthermore, rare earth elements can be added in small quantities to provide fluorescence.

### ■ HISTORICAL PERSPECTIVE

The evolution of ceramic materials in the last century has been a result of an interplay between function and esthetics. Historically, concerns for strength compromised



After the preparation was cleaned with 2% chlorhexidine (Consepsis), the preparation was etched for 15 seconds with 32% phosphoric acid (Uni-Etch with BAC, Bisco), rinsed with water for 5 seconds, and lightly air dried (Fig 8). An adhesive (All-Bond 3, Bisco) was applied, air thinned, and light cured for 40 seconds (Figs 9 to 11). The composite resin cement (Illusion, Bisco) was injected into the preparation (Fig 12), and the inlay was positioned and held firmly in place using a ball-tipped instrument. The excess resin cement was removed with a sable brush, leaving only a residual amount at the margin to compensate for polymerization shrinkage, and light cured for 40 seconds (Fig 13).



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The residual cement was removed with a scalpel blade (#12 BD Bard-Parker), and a thin application of glycerin was applied to all the margins to prevent the formation of an oxygen inhibition layer on the composite resin cement (Fig 14). The restoration was polymerized from all aspects—buccal, occlusal, lingual, and proximal surfaces—each for 40 seconds. Final polishing at the restorative interface was achieved with pre-polishing and high-shine polishing points (DC1M, DC1, CeramiPro Dialite, Braseler USA) (Fig 15). The postrestorative occlusal view illustrates an optimal and durable interfacial adhesion between the tooth and ceramic biomaterial that can be attained from utilizing a thorough adhesive protocol (Fig 16).

*Laboratory courtesy of Alex H. Schuerger, CDT.*



## anatomical morphologic design of the peri-implant zone

*Biointegration* refers to the biologic impact the implant, abutment, and prosthetic contours have on the peri-implant tissues. Although the principal determinant of the esthetic potential for any implant prosthesis is the osseous anatomy, the esthetic outcome of the definitive restoration requires the creation of biologic balance between the implant fixture, the restoration, and the peri-implant tissues while developing a natural emergence profile that mimics the adjacent dentition. Natural esthetics can be achieved when the anatomical cross section of the peri-implant region has an anatomical contour similar to that of the root structure of the tooth that is to be replaced. This requires selection of the proper implant diameter, and the implant placement design must ensure that the configuration of the abutment will mimic the cervical configuration of the natural tooth when it reaches emergence. The geometric concept of tooth anatomy described by Wheeler<sup>150</sup> can provide insight for developing the peri-implant zone. This anatomical morphologic design concept creates the form and contour necessary to optimally support the biologic volume of the peri-implant tissues. Success in implant dentistry has metamorphosed from a time when osseointegration and function were a main concern to an era of peri-implant morphology that requires an anatomical morphologic thinking process.

Figure 1 shows the preoperative evaluation of a failing mandibular right first molar. Periodontal assessment reveals an osseous buccal defect from a root fracture. A diagnostic wax-up was developed to visualize the interrelationship between the definitive restorations and the oral structures before the surgical procedure was performed (Fig 2). This presurgical three-dimensional diagnostic communication tool can be shared by the interdisciplinary team prior to treatment to provide precise information essential for diagnostic and presurgical planning. In this staged implant placement



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procedure, the tooth was extracted and a bovine bone graft (Bio-Oss, Osteohealth) with a barrier membrane was placed to correct the defect. During this staged implant protocol, the cervical configuration of the natural tooth should be the guide for implant selection and placement, abutment contours, and the volume of peri-implant tissue that is maintained and developed (Fig 3). The composite provisional restoration was designed from the diagnostic wax-up, and it can be used to develop and preserve the gingival architectural form of the peri-implant region (Figs 4 and 5).

After careful radiographic evaluation, the surgical guide can be fabricated from the diagnostic wax-up (Figs 6 and 7). This guide can provide precise and predictable implant orientation with consistent esthetic results. The ideal position of the implant fixture in relation to the adjacent teeth confirms the preplanned position. This philosophy of an anatomical morphologic design of the peri-implant zone requires that the final form of the abutment is a direct derivative of the cervical configuration of the natural tooth. This preplanned concept allows for a precise placement of the implant fixture while managing the volume and morphologic contour of the peri-implant tissue for an optimal esthetic result (Figs 8 to 10).

Laboratory courtesy of Victor Castro, CDT.



## restoring the anterior alveolar ridge deficiency using the oral stratified porcelain buildup technique

Prosthetic rehabilitation of the deficient anterior alveolar ridge can be critical and challenging because of the esthetic demands and the potential requirements.<sup>153,154</sup> The ridge deformities are characterized by deficiencies in the amount of alveolar bone and/or gingival tissue volume as classified by Seibert<sup>148</sup> and Allen et al.<sup>149</sup> The etiology of these type of defects can be attributed to trauma, tooth extraction, periodontal disease, tumors, and congenital developmental disturbances.<sup>153</sup> These isolated anterior edentulous regions present difficult challenges in prosthetic reconstruction for esthetics, phonetics, and function. Periodontal plastic surgical procedures have been described in the literature to restore and maintain alveolar and soft tissue architecture for these deficient edentulous regions.<sup>7,12,18,19,23,28-31,133-136,139-141,144-149,153,155-159</sup>

In addition, prosthetic treatment alternatives can vary significantly according to a multitude of factors. These factors include alveolar bone and soft tissue augmentation requirements, periodontal biotype, alveolar bone quality, selection of implant system design and size, anticipated prosthetic design, experience and training of the interdisciplinary team, patient expectations, and cost considerations.<sup>157</sup> Predictable and optimal treatment results with these complex clinical dilemmas require advanced surgical and prosthetic training, detailed pretreatment planning, and a high level of interdisciplinary communication.

The patient had endured trauma to the anterior segment of the maxillary arch at age 4 years. Several periodontal plastic surgeries had been performed to attempt to restore the deficient maxillary anterior ridge to a normal anatomical morphology of the oral tissues. The patient presented at age 21 years with sufficient bone volume to receive implants, but optimal alveolar bone and gingiva could not be obtained (Fig 1); therefore, gingival and alveolar replacement with metal ceramics was selected. The patient was dissatisfied with the esthetics of the existing removable partial denture and was referred to an interdisciplinary team for a functional and esthetic solution (Figs 2 to 4).

The diagnostic wax-up is an essential component for evaluating and determining tooth length, form and incisal edge position, interdental papillae position, gingival architectural contours, emergence angle, incisal embrasures, lip position, occlusal and esthetic planes, smile analysis, phonetic considerations, and personal patient input. The prototype wax-up try-in technique is a removable wax-up that allows each of these parameters to be assessed intraorally prior to developing the provisional restoration. This technique provides insight into the detection and elimination of potential challenges while evaluating the future success of the definitive prosthetic therapy. This diagnostic wax-up is a schematic for the laboratory design and creation of the definitive restorations. In addition, this wax-up model provides visualization for the patient and the interdisciplinary team and communicates extensive details concerning the treatment plan. It also provides additional preprosthetic surgical planning of hard and soft tissue augmentation or elimination, as well as fabrication of the provisional restorations and development of the definitive restorations. The diagnostic wax-up should be completed and approved by the patient and the interdisciplinary team prior to finalization of the treatment plan.





index—

# index

Page numbers followed by "t" denote tables

## A

- Abraded natural tooth structure, 452–453
- Abrasion effect, 683
- Abrasive grinding, 161–162
- Acid etching
  - adhesives, 413
  - of enamel, 410–411
- Acrylic resin provisional restoration, 344–351
- Acrylic surgical guide, 624
- Addition-reaction silicones, 259
- Adhesion
  - criteria for improving, 414–415
  - definition of, 413
  - description of, 285–286
  - at restoration interface, 413–415
- Adhesive cements. *See* Cements, adhesive.
- Adhesive resin cements
  - description of, 283, 285
  - indications for, 284t
  - self-, 285–286
- Adhesive restorations
  - adhesive cementation for, 283
  - tooth preparation for, 40, 49
- Airborne-particle abrasion, 161
- All-ceramic crown
  - cementation of. *See* All-ceramic crown cementation.
  - fractured, total-etching technique for rebonding of, 416–417
- All-ceramic crown cementation
  - resin-reinforced glass-ionomer cement for, 290–291
  - self-curing resin cements for, 308–311
- All-ceramic restorations
  - case study of, 226–245
  - clinical performance of, 162
  - interdisciplinary development of, 226–245
  - laboratory and clinical procedures effect on, 161
  - surface treatment of, for adhesive resin cementation, 286–288
  - tooth preparation for, 46
- All-ceramic systems
  - feldspathic, 148, 151
  - infiltrated, 150, 152
  - machinable, 148–149, 151
  - overview of, 147–148
  - pressable, 149–150, 152
- Altered passive eruption, 525
- Aluminum oxide
  - description of, 151
  - finishing strips, 191

## Alveolar ridge

- deformities of, 522t
- preservation of, 606
- Alveolar ridge augmentation
  - anterior
    - delayed ovate pontic development for, 572–587
    - immediate ovate pontic development for, 566–571
    - implants for, 608–611
    - oral stratified porcelain buildup technique for, 658–667
    - description of, 521–523
  - Anatomical contours, 450–451

- Anterior ceramic restorations, finishing and polishing of
  - case study of, 462–463
  - in gingival/incisal/lingual regions, 466–469
- Anterior metal-ceramic crowns with a circumferential window, 198–204

- Anterior metal-ceramic partial dentures with a circumferential window, 212–217
- Anterior teeth
  - double-cord gingival displacement technique in, 270–275
  - fiber-reinforced post system
    - direct, 382–385
    - prefabricated, 386–389, 394–400

## Aperture, 486, 489

## B

- Bases, 81–82
- Bioactive materials, 595
- Biointegration, 597, 646
- Biologic width, 516, 553
- Biomaterials
  - current developments in, 153–154
  - tooth preparation design based on, 43–46
- Bis-acryl composite resins, 232, 320–321
- Bleaching
  - carbamide peroxide, 680, 682
  - definition of, 680
  - nonvital
    - description of, 682–683
    - walking bleach technique for, 682, 692–695
  - tooth sensitivity to cold caused by, 680–681
  - trays, 687–689
  - vital
    - custom tray technique for, 684–691
    - description of, 681–682
- Bonded porcelain laminate veneers, 63

## C

CAD/CAM systems  
 ceramic restoration design using, 148–149  
 description of, 44–45, 153  
 hardware, 157–158  
 scanning uses of, 157–158  
 tooth preparation considerations for, 46–48  
 zirconia single-coping and fixed partial denture framework fabrication using, 156–157

Camera, digital. *See* Digital camera.

Canines, preparationless veneer for, 194–197

Carbamide peroxide, 680, 682

Carbide burs, 446

Carbon fiber posts, 373

Castable glass ceramic, 149

Cavity configuration, 44

Cavosurface gingival margins, 67

Cementation  
 adhesion mechanisms, 285–286  
 luting cements for. *See* Luting cements.  
 provisional restorations, 323–325, 360–363  
 silica-based ceramic restorations, 286–287

Cementoenamel junction, 520, 525, 548, 599

Cements, adhesive  
 bond strength of, 325  
 composite resin cements. *See* Composite resin(s), cements.  
 description of, 280–281  
 excess, removal of, 216, 243  
 future of, 286  
 glass-ionomer cements, 282–283, 284t  
 history of, 281–282  
 indications for, 284t  
 provisional, 323–325, 360–363  
 removal of, 323  
 surface treatment of restorations for, 286–289

Ceramic butt margin, 69

Ceramic inlays, 66–67, 148

Ceramic materials  
 coloring agents added to, 145  
 composite resins and, bond between, 183, 286  
 composition of, 145  
 current developments in, 153–154  
 description of, 144–145  
 digital technology effects on, 153  
 finishing of, 447–448  
 flexural strength of, 147  
 fracture toughness of, 147  
 grinding of, 160–161  
 history of, 145–146  
 improvements in, 146  
 mechanical properties of, 146–147  
 modulus of elasticity of, 147  
 polishing of, 447–448  
 polymerization shrinkage of, 147  
 properties of, 146–147  
 surface grinding effects on, 161  
 surface treatment of, 288  
 zirconia-based, 146–147

Ceramic onlays, 66–67, 148

Ceramic restorations  
 CAD/CAM design of, 148–149

fracture resistance of, 146  
 high-strength, 287–288

Ceramic shade guides, 4

Ceramic systems. *See* All-ceramic systems.

Ceramic veneers, 200

Cervical horizontal defect, 613

Cervical resorption, 692

C-factor, 44, 83

Chamfer, 58

Characterization and surface texture evaluation, 12–17

Charge-coupled device, 157, 477

Chlorhexidine  
 description of, 206  
 tooth stains caused by, 679

Circumferential window  
 anterior metal-ceramic crowns with, 198–204  
 anterior metal-ceramic partial dentures with, 212–217

Closed sandwich technique, resin-modified glass ionomer/composite resin, 122–125

Coefficient of thermal expansion, 147

Cold isostatic pressing method, for zirconia block fabrication, 156

Color management, of maxillary central incisors, 210–211

Color measuring systems, 6

Color perception, 4

Coloring agents, 145

Color-mapping device, 5

Communication  
 diagnostic models for, 6–7  
 photography for, 3–4  
 shade determination and diagramming, 4–6

Composite resin(s)  
 cements  
 composite resin onlay cementation using, 302–303  
 description of, 283  
 indications for, 284t  
 porcelain inlay cementation using, 304–307  
 ceramic materials and, bond between, 183, 286  
 clinical performance of, 78  
 closed sandwich technique, 122–125  
 definition of, 79  
 enamel macroabrasion/microabrasion and, 704–709  
 fillers, 79–80  
 finishing of, 446–447  
 future of, 87  
 history of, 78  
 hybrid, 80  
 indirect, 84–85  
 infrastructure of, 79–81  
 laboratory-processed, 288–289, 321  
 low-shrinkage, 83  
 microfill, 80–81  
 microhybrids, 84  
 natural tooth structure and, integration between, 79  
 onlay, dual-cured resin cement for cementation of, 302–303  
 optical properties of, 375  
 particle size, 79–80  
 polishing of, 446–447  
 provisional restorations  
 case study of, 352–360  
 fixed partial dentures, 326–335  
 second-generation, 84

## INDEX

silica-based ceramic material bond with, 170

spot-bonding technique, for provisional veneer cementation, 360–363

surface treatment of, 288–289

veneers

- case study of, 126–135
- total-etching technique, 430–431

Composite restorations

- bonded, 58

Class I

- duo shade placement technique, 88–89
- stratified oblique layering technique, 90–93

Class II

- minimally invasive technique for, 94–97
- oblique layering technique, 100
- self-etching technique, 436–439
- simplified duo shade technique for, 98–103
- total-etching technique, 428–429

Class III, simplified layering technique for, 104–105

Class IV

- complex layering technique for, 108–113
- simplified layering technique for, 106–107

Class V, duo shade placement technique for, 114–117

direct composite resin veneers, 126–135

fractured, total-etching technique for repair of, 422–427

maintenance of, 448

margin quality and strength, 82

physical properties of, 44

placement techniques for, 44

polishing of, 448

posterior, finishing and polishing of, 454–455, 459

Composite surface sealant, 102

Condensation-reaction silicones, 259

Connective tissue grafting

- Class I recession-type defect treated with, 544–547
- Class II recession-type defects treated with, 556–561
- Class III recession-type defects treated with, 548–555, 562–565
- Class IV recession-type defects treated with, 562–565
- description of, 164, 520–521
- tunneling technique for, 562–565

Connective tissue pedicle grafts, 522

Contact angle, 256

Contouring, 445

Contours, anatomical, 450–451

Coping, 158–162

Copy milling, 47, 156

Core. *See* Post and core systems.

Crown(s)

- all-ceramic. *See* All-ceramic crown cementation.
- anterior provisional, 336–339
- metal-ceramic. *See* Metal-ceramic crowns.

Crown lengthening procedure

- anatomical considerations for, 515
- biologic width, 516, 553
- classification system, 518–519, 519t
- clinical considerations for, 519
- conventional approach for, 524–531
- description of, 514–515
- diagnostic considerations, 517–518
- esthetic uses of, 517–518
- gingival margin predictability, 516–517

gingival/osseous approach, 518

indications for, 515

osseous/gingival approach, 518, 532–537

surgical guide used for, 538–543

therapeutic guidelines for, 516

treatment methods, 518–519

Curing light, low-intensity, 82

Custom cast posts and cores, 372–373

Custom tray technique, for vital bleaching, 684–691

**D**

Delayed placement, of implants

- bilateral maxillary anterior implants, 612–615
- description of, 603–604
- single posterior implants, 632–645

Densely sintered high-purity aluminum oxide, 151

Dental bleaching. *See* Bleaching.

Dental ceramics. *See* Ceramic materials.

Dentin

- adhesion to, 411, 414
- biomodification of, 411
- characteristics of, 408–409

Dentin powders, 237

Dentinoenamel junction, 406–408

Depth of field, 486

Diagnostic models

- description of, 6–7
- fabrication of, 24–28

Diagnostic wax-up, 29–35, 131, 221, 326, 659, 661–662

Diamond grit, for abrasive grinding, 161–162

Diastema closure, proximal adaptation technique for, 118–121

Digital camera

- aperture, 486, 489
- automated exposure modes, 489
- body of, 486–487
- description of, 6, 477–478
- electronic flash systems, 484–485
- exposure compensation feature of, 488–489
- exposure modes, 489
- f-stop setting, 486–487
- incident exposure metering, 490–491
- lens, 482–484
- lighting for, 484–485
- manual exposure mode on, 490, 492
- reflective exposure metering, 487–488
- selection guidelines for, 492
- through the lens metering by, 487–490, 492

Digital photography

- camera systems used in, 477–478
- clinical applications of, 478–481
- diagnostic uses of, 478
- forensic documentation uses of, 479
- insurance verification uses of, 481
- laboratory communication uses of, 480
- legal documentation uses of, 478
- patient education and communication uses of, 479, 481
- professional instruction uses of, 481
- storage considerations, 491–492
- transmission considerations, 491–492
- treatment planning uses of, 478
- viewing considerations, 491–492

Dimensional stability, of impression materials, 257  
 Direct composite resin restorations, 44  
 Direct composite resin veneers  
     case study of, 126–135  
     total-etching technique, 430–431  
 Direct fabrication technique, for provisional restorations, 322–323  
 Discoloration of teeth. *See* Tooth discoloration.  
 Double-cord gingival displacement technique  
     anterior, 270–275  
     posterior, 266–268  
 Dual-cured resin cement  
     composite resin onlay cementation using, 302–303  
     fiber-reinforced composite resin post, 379, 384, 388–389, 393, 396  
     indications for, 375  
     porcelain inlay cementation using, 304–307  
 Duo shade placement technique  
     for Class I composite restoration, 88–89  
     for Class II composite restoration, 98–103  
     for Class V composite restoration, 114–117

**E**

Elastic modulus, 81  
 Elastic recovery, of impression materials, 258  
 Elastomeric impression materials, 255  
 Electrosurgery, 212  
 Emergence angle, 221  
 Enamel  
     abraded surface, 452–453  
     acid etching of, 410–411, 437  
     adhesion to, 410–411, 414  
     biomodification of, 410–411  
     characteristics of, 406–407  
     hypoplastic, biorestorative modification of, 698–703  
     "snow capping" dysmineralization, 697  
 Enamel bevels, 49  
 Enamel glaze, 683  
 Enamel microabrasion  
     case study of, 696–697  
     composite resin bonding and, 704–709  
     description of, 680, 683  
 Enamel prisms, 406–407  
 Envelope technique, 521  
 Etching. *See* Acid etching; Total-etching technique.  
 Exposure  
     bracketing, 488–489  
     compensation, by digital cameras, 488–489  
     control, 486  
     metering, 487–488  
 "Extension for prevention," 40–41  
 Extracoronal restorations, 45–46  
 Extraction sites  
     defects at, management before implant placement, 628–631  
     socket preservation, 597, 606–607

**F**

Fabrication  
     of diagnostic models, 24–28  
     of fiber-reinforced composite resin post system, 378  
     of provisional restorations, 322–323

of provisional veneers, 340–343  
 of surgical guides for implants, 622–627  
 Feldspathic ceramic systems  
     applications of, 151  
     description of, 148  
 Feldspathic porcelain veneers  
     platinum foil technique for, 174–179  
     refractory die technique for, 163–173  
 Ferrule effect, 380–381  
 Fiber-reinforced composite resin post system  
     anterior teeth, 382–385  
     components of, 378–379  
     description of, 374  
     dual-curing luting agent for, 375, 379, 384, 388–389, 393, 396  
     fabrication of, 378  
     post material, 378  
     prefabricated  
         anterior teeth application of, 386–389, 394–400  
         description of, 378  
         posterior teeth application of, 390–393  
     reinforcement material for, 377  
     root fracture concerns, 376  
     uninterrupted bonding provided by, 377  
 Fillers, 79, 286  
 Filmless imaging, 491–492  
 Finishing  
     abraded natural tooth structure, 452–453  
     anatomical contours, 450–451  
     anterior ceramic restorations  
         case study of, 462–463  
         in gingival/incisal/lingual regions, 466–469  
     anterior composite restorations  
         case study of, 456  
         in gingival region, 458  
     composite resins, 446–447  
     fine, 445  
     illustration of, 415, 426  
     indirect composite restorations, 460–461  
     instruments for, 445  
     polishing versus, 445  
     porcelain, 447–448  
     posterior ceramic restorations in occlusal region, 464–465  
     posterior composite restorations  
         case study of, 454–455  
         in occlusal region, 459  
         purpose of, 445  
 Fixed partial denture  
     abutments for, 48  
     composite resin, laboratory fabrication of, 326–335  
     metal-ceramic, 583, 585  
     zirconia framework, 156–157  
 Flap surgery, 605  
 Flapless surgery, 605  
 Flexural strength, 147  
 Fractures  
     all-ceramic crown, 416–417  
     composite resin restoration, 422–427  
     porcelain veneer, 418–421  
 f-stop, 486–487  
 Full-coverage restorations  
     considerations for, 68

## INDEX

geometric forms, 70  
 margin designs for, 69  
 tooth preparation design for, 68–71

**G**

Geller technique  
 for anterior metal-ceramic crowns with a circumferential window, 198–204  
 for anterior metal-ceramic partial dentures with a circumferential window, 212–217

Gingiva  
 anatomy of, 263, 515, 663  
 color analysis of, 664  
 scalloped, 599–600

Gingival aesthetic line, 527

Gingival displacement techniques  
 double-cord  
 anterior, 270–275  
 posterior, 266–268  
 single-cord, 269

Gingival floor, 52, 69

Gingival margins  
 after crown lengthening procedure, 516–517  
 cavosurface, 67  
 design of, 46  
 full-coverage restorations, 69

Gingival recession defects  
 Class I, 544–547  
 Class II, 556–561  
 Class III, 548–555, 562–565  
 Class IV, 562–565  
 classification of, 520, 520t  
 envelope technique for, 521

Gingival retraction  
 description of, 264  
 displacement techniques for. *See* Gingival displacement techniques

Gingivectomy, 527, 536

Glass ceramics  
 description of, 149–150  
 properties of, 152

Glass-infiltrated alumina, 152  
 with partially stabilized zirconia, 152

Glass-infiltrated magnesium alumina, 152

Glass-ionomer cements  
 description of, 282–283  
 indications for, 284t  
 resin-modified. *See* Resin-modified glass-ionomer cements.

Grinding, 160–161

**H**

Hand polishing, 448

Hard tissue augmentation, 597

Hardness, 445

Hybrid composites, 80, 100, 117

Hydroactive impression materials, 256–257

Hydrofluoric acid etching, 183

Hydrophilicity, of impression materials, 256–257

Hydrophobic impression materials, 256

Hypoplastic enamel, 698–703

Immediate placement, of implants  
 description of, 603–604  
 single anterior implant, 616–621

Implants  
 anterior  
 bilateral maxillary, 612–615  
 single-tooth, 616–621  
 anterior ridge augmentation, 608–611  
 apicocoronal placement of, 603  
 biotolerant metals, 594  
 calcium phosphate coatings on, 595  
 contemporary, 596–597  
 delayed placement of  
 bilateral maxillary anterior implants, 612–615  
 description of, 603–604  
 single posterior implants, 632–645  
 diameter of, 602  
 extraction site defect management before placement of, 628–631  
 faciolingual placement of, 602–603  
 flap vs flapless surgery, 605  
 gingival biotypes, 599–600  
 hard tissue augmentation, 597  
 history of, 594–596  
 immediate placement of  
 description of, 603–604  
 single anterior implant, 616–621  
 interdisciplinary diagnostic evaluation, 597  
 interdisciplinary presurgical strategy for, 598–602  
 maxillary anterior, 612–615  
 mesiodistal placement of, 602  
 multiple, 648–657  
 osseointegration of, 595–596  
 osseous framework for, 598–599  
 patient education about, 601  
 peri-implant soft tissue framework for, 599–600  
 peri-implant zone, anatomical morphologic design of, 646–647  
 placement of, 602–604, 612–621, 632–645  
 preservation goals, 597  
 presurgical considerations  
 communication, 601–602  
 examination, 598  
 prosthesis supported with, 648–657  
 radiographic imaging, 601  
 selection of, 602–603  
 single-tooth  
 anterior, 616–621  
 challenges associated with, 612  
 posterior, 632–645  
 small-diameter, 596  
 socket preservation extractions, 597  
 socket seal surgery, 606–607  
 soft tissue framework for, 599–600  
 staged placement of, 603–604  
 surface modification of, 596  
 surgical guide for  
 description of, 601  
 fabrication of, 622–627  
 titanium, 595

treatment planning, 600–601  
 two-stage approach, 595

**Impression materials**  
 dimensional stability of, 257  
 elastic recovery of, 258  
 elastomeric, 255  
 hydrophilicity of, 256–257  
 polyether, 258, 260t  
 polyvinyl siloxane, 259, 261t, 262  
 selection of, 256–258  
 setting time of, 257  
 tear resistance of, 258  
 vinyl-polyether hybrid, 262  
 viscosity of, 256

**Impression/impression taking**  
 accurate, 255, 262–263  
 advances in, 255  
 clinical suggestions for, 264–265  
 for composite resin fixed partial denture, 328–329  
 gingival displacement techniques for. *See Gingival displacement techniques.*  
 history of, 254  
 techniques for, 264  
 tissue management during, 263

**Incisal embrasures**, 332

**Incisolingual interface**, 172

**Incisors**  
 maxillary central, color management of, 210–211  
 maxillary or mandibular anterior, photography of  
   frontal view, 502  
   left lateral view, 504  
   right lateral view, 503  
 preparationless veneer for, 180–183

**Indirect composite resins**, 84–85

**Indirect composite restorations**, 460–461

**Indirect fabrication technique**, for provisional restorations, 322–323

**Indirect intracoronal restorations**, 45

**Indirect resins**, 289

**Infiltrated ceramic systems**  
 applications of, 152  
 description of, 150

**Inlays**, 66–67

**Internal line angles**, 49, 56

**Interpositional graft**  
 description of, 522  
 indications for, 522–523

**Interproximal**  
 contours, 238  
 finish lines, 61  
 zone, 102

**Intertubular dentin**, 408–409

**Intracoronal restorations**  
 indirect, 45  
 tooth preparation for, 44–45

**J**  
**Junctional epithelium**, 515

**L**  
**Labial butt margin**, 69  
**Laboratory-processed acrylic resin provisional restoration**, 344–351  
**Laboratory-processed composite resins**, 288–289  
**Laminate veneers**  
 bonded, 63  
 development of, 63  
 preparationless porcelain, 62–65  
**Laser sintering, selective**, 158  
**Lava software**, 158–162  
**Leucite-reinforced glass ceramics**, 152  
**Lighting**  
 for digital camera, 484–485  
 in shade selection, 5  
**Liners**, 81–82  
**Lithium disilicate**  
 applications of, 154  
 crystals, 151  
 glass ceramics, 151  
**Lost wax technique**, 149  
**Low-intensity curing light**, 82  
**Luting cements**  
 adhesion mechanisms for, 285–286  
 bond strength of, 325  
 composite resin cements, 283  
 description of, 280–281  
 glass-ionomer cements, 282–283  
 history of, 281–282  
 ideal characteristics of, 280–281  
 indications for, 284t  
 provisional restoration, 323–325, 360–363  
 removal of, 323

**M**  
**Machinable ceramic systems**  
 applications of, 151  
 description of, 148–149  
**Magnification ratio**, 482  
**Manual-aided design/manual-aided manufacturing**, of zirconia  
 single-coping and fixed partial denture framework, 156  
**Marginal tissue recession**, 520, 520t  
**Masticatory stress**, 67  
**Mechanical interlocking**, 414  
**Metal posts**, 373  
**Metal-ceramic crowns**  
 anterior, with a circumferential window, 198–204  
 existing, replacement of, 205  
 posterior, 206–209  
 self-adhesive resin cement for cementation of, 300–301  
**Metal-ceramic fixed partial dentures**, 583, 585  
**Microabrasion, enamel**  
 case study of, 696–697  
 composite resin bonding and, 704–709  
 description of, 680, 683  
**Microfill composites**, 80–81  
**Microhybrids**, 84  
**Microleakage**, 288, 375  
**Miller's classification of recession-type defects**, 231  
**Modulus of elasticity**, 147, 376–377

## INDEX

Modulus of rupture, 147  
 Molecular engineering, 85  
 Mucogingival surgery  
   alveolar ridge augmentation, 521–523  
   connective tissue grafting. *See* Connective tissue grafting.  
   description of, 519

**N**  
 Nanoparticle hybrid composite, 86  
 Nanoscience, 85  
 Nanotechnology, 85  
 Noncomposites, 86  
 Nonvital bleaching  
   description of, 682–683  
   walking bleach technique for, 682, 692–695

**O**  
 Odontoblasts, 408  
 Onlay(s)  
   composite resin, dual-cured resin cement for cementation of, 302–303  
   porcelain, total-etching technique with, 432–433  
   tooth preparation design for, 66–67  
 Onlay graft  
   description of, 522  
   indications for, 523  
 Oral stratified porcelain buildup technique, for anterior alveolar ridge restoration, 658–667  
 Osseointegration, 595–596  
 Osseous crest, 264, 518  
 Osseous framework for implants, 598–599  
 Osseous/gingival approach, for crown lengthening, 518, 532–537  
 Osteotomy, 633  
 Ovate pontic development, for anterior alveolar ridge augmentation  
   delayed, 572–587  
   immediate, 566–571  
 Ovate pontic receptor site, 212

**P**  
 Partial dentures  
   anterior, 212–217  
   fixed. *See* Fixed partial denture.  
 Pastes, polishing, 447  
 Periodontal inflammation, 219  
 Periodontal plastic surgery  
   alveolar ridge augmentation. *See* Alveolar ridge augmentation.  
   connective tissue grafting. *See* Connective tissue grafting.  
   mucogingival surgery. *See* Mucogingival surgery.  
   overview of, 514  
 Periodontal probe, 528  
 Periodontium, 515  
 Peritubular dentin, 408–409  
 Phosphoric acid etching, 187  
 Photography  
   black-and-white, 14  
   characterization and surface texture evaluation, 12–17  
   communication uses of, 3–4  
   digital. *See* Digital photography.  
   full face, 508

full smile  
   frontal view, 494  
   left lateral view, 496  
   right lateral view, 495  
 history of, 476–477  
 mandibular arch, 505  
 maxillary arch, 505  
 maxillary or mandibular anterior incisors retracted  
   frontal view, 502  
   left lateral view, 504  
   right lateral view, 503  
 maxillary or mandibular quadrant, 507  
 maxillary/mandibular retracted  
   frontal view, 497  
   left lateral view, 499, 501  
   reflected technique, 500–501  
   right lateral view, 498, 500  
 portrait, 508  
 profile, 3, 509  
 shade analysis, 10–11  
 smile analysis, 8–9, 183  
 Platinum foil technique for feldspathic porcelain veneers, 174–179  
 Point flash light, 484–485  
 Polishing  
   abraded natural tooth structure, 452–453  
   aluminum oxide–based pastes for, 447  
   anterior ceramic restorations  
    case study of, 462–463  
    in gingival/incisal/lingual regions, 466–469  
   anterior composite restorations  
    case study of, 456  
    in gingival region, 458  
   composite resins, 446–447  
   finishing versus, 445  
   hand, 448  
   illustration of, 216, 223, 415  
   indirect composite restorations, 460–461  
   instruments for, 445  
   objective of, 445, 452  
   pastes for, 447  
   porcelain, 447–448  
   posterior ceramic restorations in occlusal region, 464–465  
   posterior composite restorations  
    case study of, 454–455  
    in occlusal region, 459  
 Polycarboxylate cements, 281  
 Polyether impression materials, 258, 260t  
 Polyhedral oligomeric silsesquioxanes, 85–86  
 Polymerization inhibition, 259  
 Polymerization shrinkage  
   ceramic materials, 147  
   description of, 44–45, 81  
   marginal adaptation of provisional restoration affected by, 322  
   methods for managing  
    cavity liners and bases, 81–82  
    indirect composite resin systems, 84–85  
    low-intensity curing light, 82  
    low-shrinkage composite resin, 83  
    placement techniques, 82–83  
    stress, 81

Polysiloxane impression, 232–233

Polyvinyl siloxane impression materials, 259, 261t, 262

Porcelain

- compressive strength of, 146
- finishing of, 447–448
- polishing of, 447–448
- shoulder, 146
- smoothness of, 447

Porcelain inlay cementation, using dual-cured resin cement, 304–307

Porcelain onlay, total-etching technique with, 432–433

Porcelain restorations

- leucite-reinforced, 146
- try-in, 241

Porcelain veneers

- facial reduction, 61
- feldspathic
  - platinum foil technique for, 174–179
  - refractory die technique for, 163–173
- fractured, total-etching technique for rebonding of, 418–421
- history of, 63
- illustration of, 23
- intra-enamel preparation, 61
- preparationless, 62–65
- retreatment of, 218–225
- tooth preparation for, 46, 60–61

Porcelain-fused-to-metal, 146, 148

Post and core systems

- carbon fiber, 373
- corrosion issues, 376
- custom cast, 372–373
- esthetics of, 375
- failure of, 372, 374
- ferrule effect, 380–381
- fiber-reinforced composite resin. *See* Fiber-reinforced composite resin post system.
- flexural strength of, 377
- ideal characteristics of, 374
- internal adaptation of, 375
- metal, 373
- modulus of elasticity, 376–377
- overview of, 372–373
- prefabricated, 373
- retention of, 373, 374
- root fracture considerations, 373, 375–376
- rotational forces on, 376
- tensile strength of, 377
- tooth structure conservation, 374–375
- tooth-colored, 373

Postcuring, 84

Posterior ceramic restorations, finishing and polishing of, 464–465

Posterior composite restorations, finishing and polishing of

- case study of, 454–455
- in occlusal region, 459

Posterior metal-ceramic crowns, 206–209

Posterior teeth

- double-cord gingival displacement technique in, 266–268
- prefabricated fiber-reinforced post system, 390–393
- single-tooth implants, 632–645
- tooth preparation requirements for, 47

Post-retained crowns, 374

Pouch graft, 522

Predentin, 409

Prefabricated fiber-reinforced composite resin post system

- anterior teeth application of, 386–389, 394–400
- description of, 378
- posterior teeth application of, 390–393

Preparationless veneer

- for canines, 194–197
- for incisors, 180–183
- porcelain laminate, 62–65

Pressable ceramic systems

- applications of, 152
- description of, 149–150

Prosthesis, implant-supported, 648–657

Provisional materials

- acrylic resins, 320, 344–351
- bis-acryl composite resins, 320–321
- clinical considerations for, 320–321
- light-cured composites, 321
- polyethyl methacrylate used as, 320
- selection of, 321–322
- self-curing resins, 321

Provisional restorations

- acrylic resin, 344–351
- anterior crown, 336–339
- bond strength, 325
- cementation of, 323–325, 360–363
- clinical objectives of, 318–319
- composite resin
  - case study of, 352–360
  - fixed partial denture, 326–335, 575
- crown, 336–339
- description of, 7
- development of, 319–321
- direct fabrication technique for, 322–323
- fabrication of, 322–323
- indirect fabrication technique for, 322–323
- luting cement for, 323–325
- marginal fit of, 322
- plaque accumulation on, 322
- polymerization shrinkage effects on, 322
- semidirect fabrication technique for, 322–323
- veneer
  - cementation of, using composite resin spot-bonding technique, 360–363
  - fabrication of, 340–343

Proximal adaptation technique for diastema closure, 118–121

**R**

Recession-type defects, 231, 520, 520t

Reflective exposure metering, 487–488

Refractory die technique, for feldspathic porcelain veneers, 163–173

Relationships with team members, 3

Removable wax-ups, 232

Resin cements

- composite resin onlay cementation using, 302–303
- description of, 283
- indications for, 284t
- self-adhesive. *See* Self-adhesive resin cements.

## INDEX

self-curing, 308–311, 321  
 wetting capacity affected by, 375

Resin-modified glass-ionomer cements  
 all-ceramic crown restoration cementation using, 290–291  
 bond strength of, 282  
 closed sandwich technique, 122–125  
 excess, removal of, 282–283  
 history of, 281  
 indications for, 284t  
 properties of, 281–282

Restorations  
 adhesion to, 413–415  
 all-ceramic. *See* All-ceramic restorations.  
 ceramic. *See* All-ceramic restorations; Ceramic restorations.  
 maintenance of, 448–449  
 provisional. *See* Provisional restorations.  
 surface treatment of, for adhesive resin cementation, 286–289

Restorative dentistry  
 clinical objectives of, 42–43  
 tooth structure preservation goals of, 42

Retraction cords, for gingival displacement. *See* Gingival displacement techniques.

Retreatment, of porcelain veneers, 218–225

Ring flash light, 484

Root fracture, 373, 375–376

Rotational forces, on post-and-core systems, 376

**S**

Scalloped gingiva, 599–600

Scanning methods, 157–158

Sealants  
 composite surface, 102  
 total-etching technique, 434–435

Second-generation composite resins, 84

Selective laser sintering, 158

Self-adhesive resin cements  
 all-ceramic crown cementation using  
 description of, 285–286  
 metal-ceramic crown cementation using, 300–301

Self-curing resin cements, 308–311, 321

Self-etching adhesives, 85, 413

Self-etching primer, 206, 215

Self-etching technique  
 Class II composite resin restorations, 436–439  
 description of, 412–413

Semidirect fabrication technique, for provisional restorations, 322–323

Setting time, of impression materials, 257

Shade analysis, 10–11, 480

Shade determination and color diagramming  
 complex, 20–21  
 description of, 18–19

Shade evaluation and complex color diagramming, 22–23

Shade guides, 4–5, 22

Shade tabs, 17, 118, 705

Shade-communication diagram, 18

Shade-modification lights, 5

Sharp line angles, 47–48

Shoulder porcelains, 146

Silane coupling agents, 183, 420

Silica-based ceramic restorations  
 bonding, 170, 287  
 composite resin bond, 170  
 illustration of, 201  
 surface treatment of, for adhesive resin cementation, 286–287

Siloxane bonds, 183

Silsesquioxanes, 85

Simplified layering technique  
 for Class III composite restoration, 104–105  
 for Class IV composite restoration, 106–107

Single central, 205

Single-coping, zirconia, 156–157

Single-cord gingival displacement technique, 269

Single-tooth implants  
 anterior, 616–621  
 challenges associated with, 612  
 posterior, 632–645

Sintering, 149, 158

Smear layer, 410–411

Smile analysis, 8–9

Socket preservation extractions, 597, 606–607

Socket seal surgery, 606–607

Spot metering, 488

Sprues, 158

Stone model, 11

Stratified oblique layering technique, 90–93

Subepithelial connective tissue grafts/grafting, 521, 564

Subgingival finish lines, 264

Subgingival margin, 263

Surface grinding, 161

Surface texture evaluation, 12–17

Surface treatment  
 of ceramic materials, 288  
 of high-strength ceramic restorations, 287–288  
 of implants, 596  
 of laboratory-processed composite resin restorations, 288–289  
 of silica-based ceramic restorations, 286–287

Surface wetting, 256

Surgical guides  
 acrylic, 624  
 for crown lengthening, 538–543  
 for implants  
 description of, 601  
 fabrication of, 622–627

**T**

Tear resistance, of impression materials, 258

Teeth  
 anterior. *See* Anterior teeth.  
 dehydration of, 4  
 posterior. *See* Posterior teeth.  
 shade determination of, 4–6

Teleconverter, 483–484

Tetracycline-related tooth discoloration, 679

Tooth discoloration  
 bleaching techniques for. *See* Bleaching.  
 conservative treatments for, 680  
 enamel microabrasion for  
 case study of, 696–697  
 composite resin bonding and, 704–709  
 description of, 680, 683

extrinsic causes of, 678–679  
 hypoplastic enamel, 698–703  
 intrinsic causes of, 679  
 tetracycline-related, 679

Tooth preparation  
 adhesive restorations, 40, 49  
 biomaterial selection effects on, 43–46  
 for CAD/CAM systems, 46–48  
 Class I restorations, 50–51  
 Class II restorations, 52–53  
 Class III restorations, 54–55  
 Class IV restorations, 56–57  
 Class V restorations, 58–59  
 extracoronal restorations, 45–46  
 full-coverage restorations, 68–71  
 historical review of, 40–41  
 inlays, 66–67  
 intracoronal restorations, 44–45  
 onlays, 66–67  
 porcelain veneers, 46, 60–62  
 posterior teeth, 47

Tooth replacement criteria, 43

Tooth stains. *See* Tooth discoloration.

Tooth whitening, 681–682

Total-etching technique  
 all-ceramic crown fracture rebonded using, 416–417  
 Class II composite resin restoration, 428–429  
 composite resin restoration fracture repaired using, 422–427  
 description of, 412  
 direct composite veneer restoration, 430–431  
 porcelain onlay, 432–433  
 porcelain veneer fracture rebonded using, 418–421  
 sealants, 434–435

Transformation toughening, 150, 155

Transverse strength, 147

Treatment planning, for implants, 600–601

Trough margins, 48

Tunneling technique, for connective tissue grafting, 562–565

Twin flash light, 484–485

Two-stage implant approach, 595

**U**

Unilateral dry pressing method, for zirconia block fabrication, 155–156

**V**

Veneers  
 direct composite resin  
 case study of, 126–135  
 total-etching technique, 430–431  
 laminate  
 bonded, 63  
 development of, 63  
 preparationless porcelain, 62–65  
 porcelain. *See* Porcelain veneers.  
 provisional  
 cementation of, using composite resin spot-bonding technique, 360–363  
 fabrication of, 340–343  
 surface preparation of, 342  
 Vinyl-polyether hybrid impression materials, 262

Viscosity, of impression materials, 256

Vital bleaching  
 custom tray technique for, 684–691  
 description of, 681–682

**W**

Walking bleach technique, 682, 692–695

Wax carver, 30

Wax crowns, 348

Whitening of teeth, 681–682

Working time, of impression materials, 257

**Y**

Yttria-stabilized tetragonal zirconia polycrystals, 151, 155, 161

**Z**

Zirconia  
 characteristics of, 154–155  
 description of, 47, 146–147  
 fit adjustments, 161  
 fixed partial denture framework, 156–157  
 grinding effects on, 160  
 properties of, 149, 153–155  
 pure, 154  
 single-coping, 156–157  
 stabilization of, 154  
 transformation toughening of, 155  
 yttria-stabilized tetragonal zirconia polycrystals, 151, 155, 161

Zirconia blocks  
 cold isostatic pressing method, 156  
 unilateral dry pressing method, 155–156

Zirconia restoration cementation, 287, 296–299

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A handwritten signature in black ink, appearing to read "Douglass".