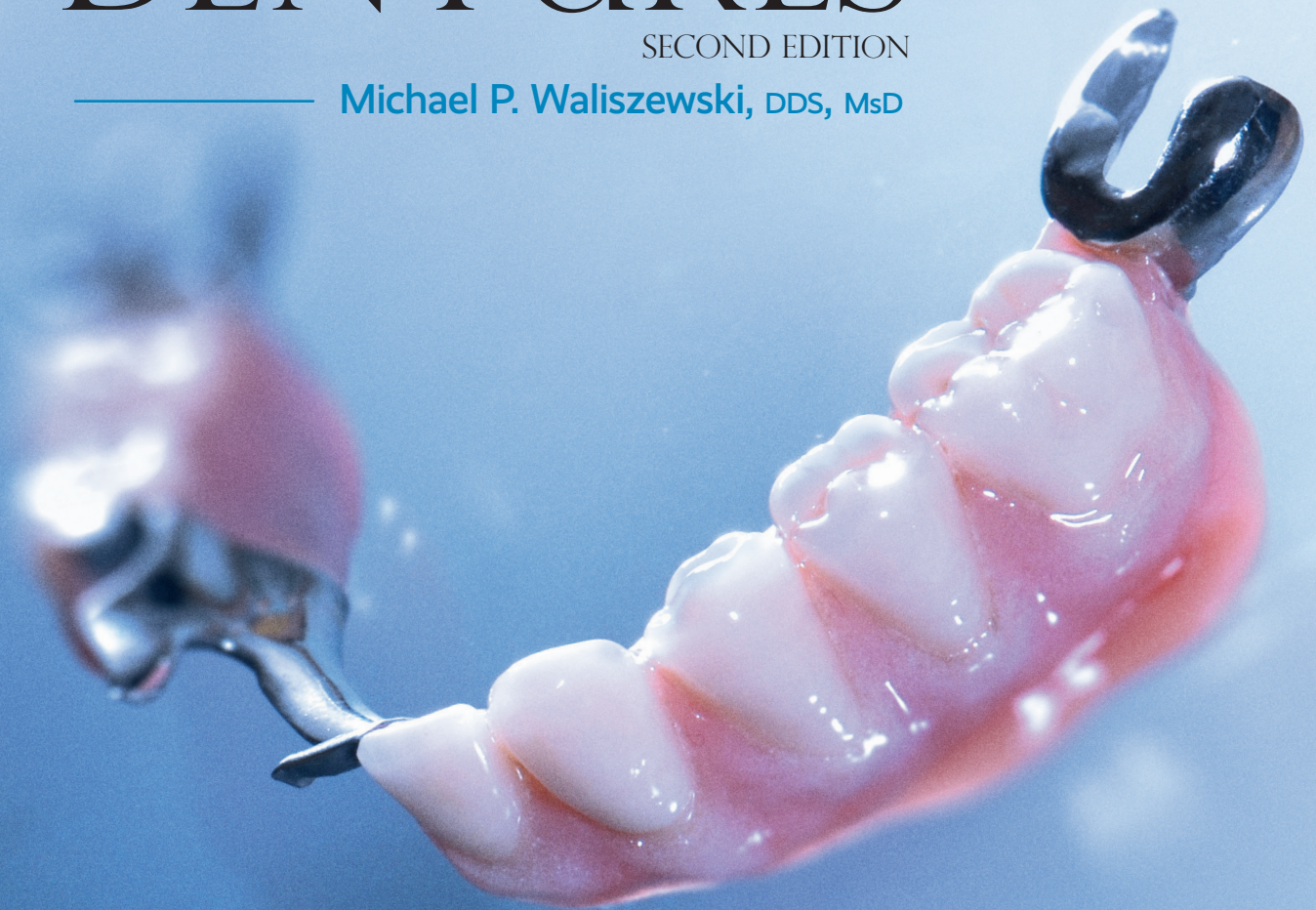


BRUDVIK'S

ADVANCED
REMOVABLE
PARTIAL
DENTURES

SECOND EDITION

Michael P. Waliszewski, DDS, MsD



**Brudvik's Advanced Removable Partial Dentures
Second Edition**



Dedication

*To my wife, Deanne, and our children, Alice and Elliot,
for tolerating all those nights I would come home after a 10-hour workday
only to type away in my office all night.*



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Library of Congress Cataloging-in-Publication Data

Names: Waliszewski, Michael P., author. | Brudvik, James S. Advanced removable partial dentures.
Title: Brudvik's advanced removable partial dentures / Michael P. Waliszewski.
Other titles: Advanced removable partial dentures
Description: Second edition. | Batavia, IL : Quintessence Publishing Co, Inc, [2022] | Preceded by Advanced removable partial dentures / James S. Brudvik. c1999. | Includes bibliographical references and index. | Summary: "Technical manual describing the function of each element of removable partial dentures, clinical and laboratory steps of RPD design and fabrication, and discussions of various types of prostheses and when/how to use them"-- Provided by publisher.
Identifiers: LCCN 2022014309 (print) | LCCN 2022014310 (ebook) | ISBN 9781647241025 (hardcover) | ISBN 9781647241445 (ebook)
Subjects: MESH: Denture, Partial, Removable
Classification: LCC RK667.I45 (print) | LCC RK667.I45 (ebook) | NLM WU 515 | DDC 617.6/93--dc23/eng/20220408
LC record available at <https://lcn.loc.gov/2022014309>
LC ebook record available at <https://lcn.loc.gov/2022014310>

A CIP record for this book is available from the British Library.
ISBN: 978-1-64724-102-5



© 2022 Quintessence Publishing Co, Inc

Quintessence Publishing Co, Inc
411 N Raddant Road
Batavia, IL 60510
www.quintpub.com

5 4 3 2 1

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Editors: Marieke Z. Swerski and Leah Huffman
Design: Sue Zubeck
Production: Angelina Schmelter

Printed in Croatia

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ADVANCED
REMOVABLE
PARTIAL
DENTURES

SECOND EDITION

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PREFACE

It was the Wednesday before Thanksgiving 2016. The day prior, I had lectured to the current graduate prosthodontic residents at my alma mater, the University of Washington Graduate Prosthodontics (UWGP) Program. Dr James Brudvik, affectionately referred to as “The Colonel” by UWGP alumni, had attended. He of course wouldn’t miss the opportunity to listen to anything related to removable partial dentures. The phone call was out of the ordinary; email usually sufficed in the interim between my Seattle visits:

“I have a favor to ask you, Mike.”

“Yes, Colonel.”

“I think it’s time to update ‘Das Book’ [as he called it], and I think you’re the only one who might have any interest in doing it.”

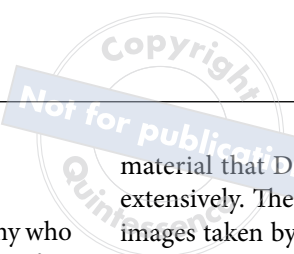
As usual, he was correct on both counts. Originally published in 1999, *Advanced Removable Partial Dentures* was Dr Brudvik’s effort to share “a more sophisticated look at this treatment modality.” It was legendary among the residents. Most of us would wait until graduation was assured, and then we would ask him to sign the inside cover as evidence of prosthodontic knowledge well earned. While it was never meant to be more than a monograph, the information it contained was the rare resource that helped us manage actual (rather than theoretical) technical problems. Throughout the course of this update and really ever since I met the Colonel in 2002, the energy and enthusiasm he has for this topic never waned. The lack of this level of RPD energy within dentistry is palpable.

Now, nearly 6 years since the Colonel’s phone call, it’s clear that this project was always going to be more than a simple update. I am honored to present this topic in greater depth and intensity than in the first edition. All of the original diagrams, drawn by Dr Brudvik himself, remain. These have been supplemented with images of relevant clinical cases where highlighting was necessary. These images come from one of three

sources: (1) my own clinical cases and work, (2) images from Dr Brudvik’s University of Washington archive, or, where I was able to identify specific UWGP alumni, (3) images from past students of Dr Brudvik’s.

References to specific RPD and related research has also been added. This reference list is a biased one, as it includes the entirety of Dr Brudvik’s peer-reviewed RPD literature. Beyond these additions, there is a 40% increase in subject matter and four additional chapters. Despite this updating, the intention was to maintain the original feel and purpose of the first edition. The introduction to the first edition, included for context, explains how this is a text for experienced RPD providers and graduate students looking to provide care at a higher level.

The volume of information included reflects how influential Dr Brudvik has been in keeping the RPD a relevant, successful, and advanced means of tooth replacement. The philosophy and ideas presented here come from Dr Brudvik and the many colleagues, residents, and technicians with whom he interacted and shared RPD enthusiasm. As I see it, my most worthwhile contribution beyond organizer was selecting the title of this work. When informing the Colonel that the plan was to title it *Brudvik’s Advanced Removable Partial Dentures*, he was hesitant. In what is the only time I ever superseded the Colonel’s authority, my reply was that this is the way it has to be. No more was said on the issue. This reflects the humble nature and goodwill that so many at the University of Washington, and I gather during his military days as well, came to know. He was more interested in what the student could do with the knowledge given than the accolades the teacher would receive. Now 89 and recently entered into memory care, Dr Brudvik will unfortunately no longer be encouraging students and clinicians to do better RPDs. It is therefore left to the rest of us to not let the RPD remain neglected and ill-considered. While his name will live on with his many students and this title, his legacy can only continue if more read this book and put its lessons into practice.



Acknowledgments

Beyond Dr Brudvik himself, there are many who have at various points contributed to the information and philosophy within this textbook. This is one of the reasons why all of Dr Brudvik's peer-reviewed and published articles are included. In them the reader will find numerous worthy coauthors, all sharing and contributing to Dr Brudvik's philosophy and energy. It must be noted that there was an unofficial edit of *Advanced Removable Partial Dentures* that Dr Brudvik completed with Dr Sami Dogan in January 2014. This was a digital copy, with some updating and editing, that was shared among many after the 1999 version went out of print in 2008.

Dr Hai Zhang, now full professor at the University of Washington, was a most valuable contributor to this project. Chapters 5, 6, 7, and 13 were all first handled by Dr Zhang prior to further editing. His greater contribution, however, was being the on-site contact at the University of Washington. Between finding old slides, contacting the company 3DRPD, and detailing many of the digital fabrication concepts, Dr Zhang was a key man throughout this project.

Acknowledgments for certain specific images can be found in the margin here. As previously mentioned, all but a single drawing comes from the first edition, with Dr Brudvik as the original artist. The vast majority of images, listed without any acknowledgment, are my own. There are a fair number of images that come from the "Dr James Brudvik archive." This is the collection of

material that Dr Brudvik used to lecture with extensively. These are images of his own cases, images taken by or for the University of Washington School of Dentistry, as well as images from cases treated by various University of Washington residents while in the Graduate Prosthodontics Program. Where I was able, I acknowledged the name of the resident who treated the case in the photograph. There are, however, a handful that went unidentified and are therefore listed simply under "Dr James Brudvik archive." For not being able to match 100% of these images to a specific resident, I apologize. For all those who were able to share images for this book, I thank you once again. These include Dr Hongseok An, Ruth Bourke (BSc), Dr Jacopo Castelnuovo, Dr Kinsey Chitswe, Dr Daniel Domagala, Dr Yoshihiro Goto, Dr Yu-Bin (Crystal) Hsu, Dr Jack Keesler, Dr Seungbum Lee, Dr Marie (Val) Lim, Dr Shwey-Chun (Polly) Ma, Dr Tal Morr, Dr Ricardo Mitrani, Dr Rosario Palacios, Dr Alexander Shor, Dr Kavita Shor, Dr Kenneth Waliszewski, Dr Keng Mun Wong, Dr Hai Zhang, and the company 3DRPD.

In this list above, one should notice a Dr Kenneth Waliszewski. This is my father. By accounts more unbiased than my own, he is the most honest, well-respected, and selfless retired prosthodontist in Wisconsin. Without his (and my mother's) loving encouragement for our entire family, things would not have turned out so well for all. His lessons of hard work, honesty, and giving were more valuable than anything I learned in school (including his crown and bridge course at Marquette).

IMAGE CREDITS

- Dr James Brudvik archive**
1-15, 1-16, 1-17, 1-19, 1-20(a,b), 3-21(a-c), 4-2(a,b), 4-5(a-d), 5-2(a,b), 5-4(a,b), 5-5, 5-11(a-d), 5-12, 5-13, 5-15, 5-16(a,c), 6-37d, 7-1b, 8-3, 8-4, 8-7, 8-9, 9-9, 9-20, 9-22, 9-23, 9-24, 10-26(a-d), 12-2a, 12-7, 12-8, 13-5, 13-7, 13-17, 13-18, 13-19, 13-37, 13-41
- Dr Jack Keesler**
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- Dr Yoshihiro Goto**
2-12b, 3-18, 11-5, 11-6, 11-26(a-c)
- Dr Rosario Palacios**
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- Dr Kenneth Waliszewski**
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14-17(a-e)

INTRODUCTION TO THE SECOND EDITION

Michael P. Waliszewski, DDS, MsD

The Philosophy of Care outlined by Dr Brudvik in the Introduction to the First Edition remains a modern, logical, and successful approach to successful RPDs. There have, however, been significant changes to how this approach is applied. These changes are most obvious in the new or most extensively expanded chapters 1, 3, 10, 13, 14, and 15.

Dentistry in general is more attuned to risk assessment than in the past. If dentists can control why dental disease occurs, logically they should be able to prevent it. Focusing on prevention rather than replacement, as recommended and highlighted in the first edition, has finally become the standard-of-care approach. For patients who are good at losing teeth, like partially edentulous patients, there can be no other way to treatment plan. The caries management by risk assessment (CAMBRA) protocols are tools that were not available to traditional RPD clinicians. These types of modern disease management protocols are highlighted in chapter 1. Chapter 3 reflects in great detail the need to separate tooth and tissue support when planning and designing. This is noted as even more necessary when “extreme” Kennedy classifications are considered.

Chapter 10 advances the disease management mentality of chapter 1, through a discussion of interim prostheses. Often mentioned but previously little detailed, nonmetal RPDs now have a full chapter dedicated to their use. Advances in material technology and their influence on real-world, everyday clinical care are highlighted within this chapter.

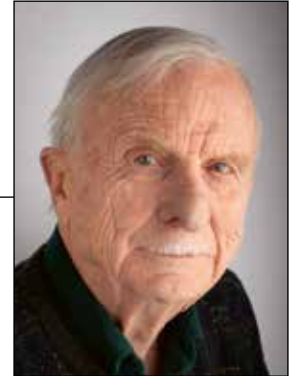
A greatly expanded and better organized chapter 13 deals with dental implants and partial dentures. The early adoption of implants into RPD therapy at the University of Washington has given graduates the advantage of long-term outcome analysis. Multiple methods and philosophies for incorporating implants, even preexisting ones, into RPD treatment is detailed. Chapter 14 is more or less an extension of chapter 13, as metal frameworks are so integral to implant prostheses. An earlier version of this chapter on frameworks for implant overdentures was created for the unpublished edit of *Advanced Removable Partial Dentures* when it became obvious that the volume and detail of information on this neglected topic warranted dedicated space.

Having graduated from Marquette University School of Dentistry in 2002 and then from the University of Washington Graduate Prosthodontics Program in 2005, I had access to direct mentorship from exceptionally experienced prosthodontists who still remembered a time “before dental implants.” Their respect for and appreciation of osseointegration offered a level-headed and unbiased comparison with conventional means of tooth replacement. With their retirement and the overall thinning of the dental educator ranks (I now list myself as a former faculty member), one wonders where current students might receive unbiased mentorship in regard to conventional prosthodontics. It does not appear Dr Brudvik’s assessment that “dental schools make a serious effort to teach the subject” is still the case in the year 2022.

Where does this leave the RPD if the quality seen in most commercial laboratories and updated cross-sectional studies indicate further deterioration? Chapter 15 has been added to highlight key historical reasons for how and why the RPD has evolved. The turning point in RPD philosophy, predicted when the parent article to this chapter was written, no longer appears accessible for the average dental patient at the corner dental service organization chain location. In today’s environment of large group or managed practices providing ever faster, cheaper, and more efficient care, one wonders if most dentists will do anything other than “install” partial dentures made from digital scans that the assistants made and sent immediately to a lab. The counter to this pessimistic outlook, confirmed by the experience of nearly all prosthodontists interested in RPDs, is that the volume of partially edentulous patients who could benefit from the philosophy of this textbook is ever-increasing. Patients frustrated by poor results overseen by uneducated or disinterested providers will seek out those who can help in an unbiased, conventional, and economical way. Herein lies the path to continued relevance for the RPD.

INTRODUCTION TO THE FIRST EDITION

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(1933–2022)

The removable partial denture has long been considered an inferior means of replacing missing teeth and associated structures when compared with the fixed partial denture. Some have even spoken of it as a stepping stone to a complete denture. The old rhyme, “Little RPD, don’t you cry, you’ll be a CD by and by,” may best express past feelings toward this treatment modality. Many surveys, published over the years in our journals, indicate that dentistry does a rather poor job with the RPD. These reports testify to the fact that most RPDs are created entirely by the technician with a minimum of input from the clinician in the form of mouth preparation or design.

Dental schools make a serious effort to teach the subject, and excellent texts are available for the undergraduate. Nonetheless, the state of RPDs seen in the commercial laboratories and in the cross-sectional studies available to us indicates that, in general, RPDs are poorly designed and constructed and poorly maintained.

Therefore, it is no wonder that patients dislike their RPDs to the point of not wearing them and, if they can afford alternative treatment, request it routinely. It has been our experience that the patient who states, “I had a partial once and couldn’t wear it!” most likely had a substandard prosthesis and, when treated with a partial denture that is made to the state of the art, finds it tolerable and easily accepts the limitations of this form of tooth and tissue replacement.

Plainly stated, there is a dramatic difference between the standard RPD and the one that approaches the state of the art as we know it today. It was in the attempt to create that quality RPD that this manuscript was written. It is intended to serve as a guide to both graduate students in prosthodontics and concerned general practitioners; to challenge them to think of the removable appliance as they would the fixed partial denture, with all the same considerations of soft tissue management, caries control, periodontal support, orthodontic therapy, and implant involvement. In almost every clinical situation, the patient who requires a removable partial denture will have a need for some form of fixed prosthodontics as well, from a simple bonded rest to the most complex precision attachments extending from fixed units.

This work is not intended to be a textbook in the classical sense. It will not have a bibliography or extensive illustrations. It is, rather, a monograph on the removable partial denture, written with the expectation that the reader will already have covered the basics of the partial denture and is now ready to take a more sophisticated look at this treatment modality. Here, then, are our thoughts as they have evolved in over 50 years of practice and teaching in this fascinating area.

Philosophy of Care

What makes a successful RPD? At the risk of oversimplification, one could say that the successful removable appliance need be only six things:

1. **Strong:** It does not wear, break, distort, or come apart when worn.
2. **Stable:** It will have maximum lateral contact with abutment teeth through parallel guide planes, which will limit the path of removal to as close to 0 degrees as possible.
3. **Retentive:** It remains in position in the patient's mouth during use and gives the patient confidence that it will continue to do so over its life.
4. **Esthetic:** It will satisfy the patient's expectations without undue evidence of its presence.
5. **Comfortable:** It will have the minimal amount of metal and resin necessary to support abutments and replace missing tissue.
6. **Pain-free:** It does not cause discomfort when in the mouth for the short term and causes no long-term damage to either hard or soft tissue over its life.

If these six requirements can be met, the RPD stands a good chance of long-term success. Unfortunately, the success of the RPD in and of itself does not guarantee the long-term health of the remaining teeth and soft tissues. Maintenance therefore becomes the primary factor in the long-term success of the treatment. The profession has usually substituted concern over the type of clasp to be used for the more fundamental requirements of regularly scheduled recall and appropriate maintenance. Preparing the mouth to its very best state of health before starting prosthodontic procedures and then keeping the tissues in that state of health over the life of the RPD is far more important than any design considerations. It has become obvious to us that a partial denture in a healthy mouth—assuming that it meets our six requirements—will be successful regardless of its design. Rest placement and clasp design, interesting as they may be to argue over from a theoretical point of view, are simply not germane to the real question of what makes a successful RPD. Suppositions derived from bench studies do not necessarily transfer to the clinical realities of long-term care. We can think of the factors that compose successful RPD treatment in these percentages:

- Maintenance: 50%
- Mouth preparation: 23%
- Construction: 23%
- Design: 4%

How long should a properly designed, constructed, and maintained RPD last? Good evidence exists that this state-of-the-art partial could be expected to last a minimum of 10 years, assuming that the patient was seen at regular intervals and that both the mouth and the RPD received the

indicated maintenance. RPDs providing good service for 20 years are not unheard of, although the long-term maintenance requirements increase dramatically after 10 years. The construction of the RPD, more than any other form of dental therapy, is almost always delegated to the dental laboratory because the equipment required to produce an acceptable cast framework is not going to be found in the dental office. In many cases, the clinician may have never even met the technicians creating the prostheses. This fact requires that the clinicians maintain control by inserting themselves into the process at the critical steps in construction. These steps will be covered in depth in this manuscript. Because the actual construction is relegated, the average clinician is apt to have very little confidence or experience in these matters and is likely to take the technician's view of the design and construction process—a view that will be more mechanical than biologic. The wise clinician will make a point of remaining in close contact with the technician and bringing these auxiliaries into the clinical aspects of care whenever possible.

The modern removable partial denture combines fixed and removable prosthodontics with implant support when key abutments are missing and requires a thorough understanding of both aspects of care by the clinician and by the technician. Unfortunately, the evolution of the dental laboratory industry has separated technicians into often isolated specialties: complete dentures, removable partial dentures, and fixed partial dentures and implant prostheses. The technician who is knowledgeable in all areas is a vanishing breed. In order to direct the construction of the most sophisticated restorations, the clinician must assume the responsibility of coordinating the laboratory phases. This text is intended to set standards of care for the comprehensive management of the partially edentulous patient who will require some form of a removable restoration.

Patient satisfaction with their RPD has been studied and several factors identified. Age, general health, previous experience with a partial denture, and the opposing dentition all have been shown to play a role in how the patient views their new partial denture. Older patients are more apt to accept the limitations of the partial. The better the patient's overall health, the greater their satisfaction with the same effect based on the amount of experience they have had. As could be expected, what they have in the opposing arch will be a factor as well. Having a removable appliance in both arches increases their dissatisfaction with their partials. These factors must be discussed with the patient as a part of their informed consent to treatment with RPDs and may well influence their decision to consider other forms of treatment, especially now when implant options have become a clinical reality.

TREATMENT PLANNING



These patients have demonstrated the ability to lose teeth.

The Challenges of Partial Edentulism

Patients with RPDs, having demonstrated the ability to lose teeth, are high risk and will remain that way as long as they have remaining natural teeth. To forget this fundamental fact is to disregard the dental history of the average RPD patient. Why have these teeth been lost? What has been or will be done to keep more teeth from being lost? Dentists are all too quick to consider the patient “cured” after several fillings and a visit for root planing. What is the value of this treatment if the etiologic factors remain unresolved, as is typically the case? The traditional focus of RPD therapy has been on the technical expertise required to make a quality partial denture. Unfortunately, the technical outcome is far less influential than disease management in maintaining the remaining dentition. In other words, maintenance of dental health is the primary determinant of long-term success with RPDs. Maintenance, as a separate and distinct part of the patient’s ongoing treatment plan, is the core requirement for good outcomes.

RPDs are typically unfairly blamed for contributing to tooth loss. This association often overlooks an error in judgment when the treatment was originally planned. Patients with multiple recent extractions are typically rushed through the process of RPD fabrication without regard to continued disease risk. The patient, now with tooth replacements, often goes on their way with the etiologic factors still present. It should not be a surprise then when caries or periodontitis returns a short time later and the process of treatment begins all over again.

Modern RPD therapy must address the dental disease process rather than continue to be overwhelmingly focused on technical issues. As with any definitive prosthodontic therapy, initial therapy must first manage the reasons why disease occurred in the first place. Only after successful initial therapy can definitive (long-term) therapy be considered. This requires patience on the part of the patient and the provider. It may also mean that an interim prosthesis will be necessary while time is given for the patient to demonstrate whether the disease is truly under control.

Caries

Caries is currently the most prevalent dental disease by a wide margin. Since the 1990s, the caries experience within the adolescent and adult population appears to have leveled off with little recent change.^{1,2} Among US adults aged 50 to 64 years evaluated in 2011 and 2012, 97% had dental caries experience (either active caries or a dental restoration). Some data show that the dental caries experience for older adults may even be increasing.³ It appears that the influence of fluoride in general has

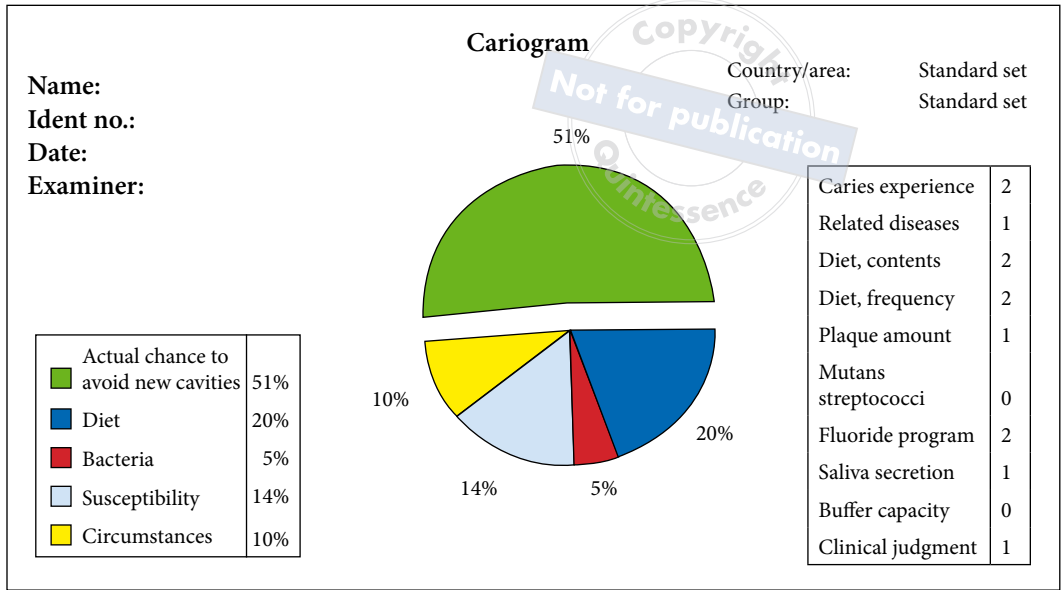


FIG 1-1 An example Cariogram from the open-access software. A “preliminary interpretation and proposed measures” are also created after data input is complete. It therefore provides risk assessment as well as guidelines for preventive treatment.

been maximized. Further gains may be difficult considering the current cariogenic diets of developed countries. Much of the lack of improvement is due to high rates of caries and tooth loss within lower socioeconomic populations. This is also the population of patients least likely to be able to afford more expensive fixed prosthodontic treatment options.

Using diagnostic aids to determine future risk prior to treatment decision-making is an absolute requirement. This is a major philosophical shift away from dentistry’s “drill and fill” approach that does nothing more than manage the consequences of caries. Articles such as those by Anderson et al⁴ are classic summaries about changing the mindset of the profession to one focused on disease prevention rather than treatment. Once caries experience has been confirmed, determining future risk by use of a caries risk assessment tool is now considered the standard of care. Traditionally, the Venn diagram was a good starting point for this risk assessment. However, this limited analysis has been expanded to include the many significant challenges imposed by socioeconomic and medical realities. The American Dental Association has a more appropriate yet still efficient standardized caries risk assessment form available free online.⁵ It assists with evidence-based classification of low-, medium-, or high-risk individuals. A third method to determine risk is the Cariogram. This is an open-access computer program that graphically illustrates caries risk and the etiologic factors

behind it (Fig 1-1). It was designed as an educational tool for both dentists and patients and is also easily available online.⁶

Several systems exist that incorporate caries risk analysis with caries risk prevention recommendations. One such system utilized frequently in the United States is the CAMBRA protocol. CAMBRA stands for Caries Management By Risk Assessment. It was developed as an evidence-based approach to preventing and managing cavities at the earliest stages. Internationally, the ICCMS (International Caries Classification and Management System) is another. The ICCMS is a comprehensive way of using and following the modern noninvasive caries management philosophy. Its purpose is to deliver effective risk-based caries therapy that prevents new lesions, controls initial caries nonoperatively, and preserves tooth tissue at all times. These systems are most effective when used before patients lose teeth or—better still—before patients experience carious lesions.

Unfortunately, for the patients we wish to treat with RPDs, the consequences of disease have already been severe, and reversal of the risk factors may not be possible (Figs 1-2 and 1-3). This makes the philosophical shift to disease prevention more challenging within prosthodontics. The preventive strategies employed must therefore be more aggressive and thoroughly applied if further tooth loss is to be prevented.⁷ While not always successful, caries experience can be reduced when preventive strategies are

FIG 1-2 A Cariogram with the data input as shown.

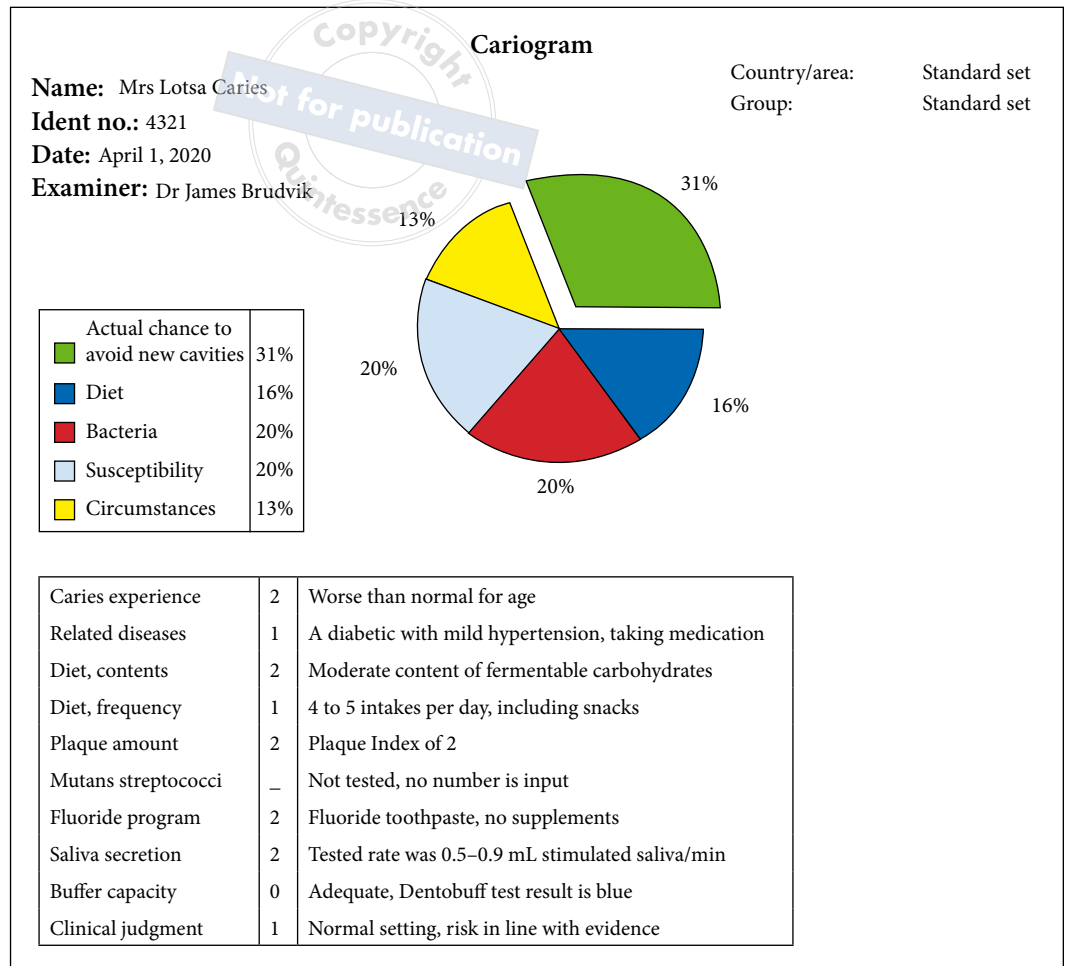


FIG 1-3 In the Cariogram in Fig 1-2, the “chance” to avoid caries was 31%. This is quite low. The severity of these risk factors predicts new caries lesions in this environment. Unsurprisingly, caries returned 2 years after this patient was treated. The patient factors listed are typical of the average RPD patient.



applied as designed. Due to the desire to reduce recurrent disease, dental benefit plans are beginning to require caries risk assessments prior to restorative intervention. This trend is likely to continue.

Periodontal disease

Periodontal disease is commonly a more generalized disease process, resulting in the loss of multiple teeth rather

than on an individual basis as with caries. When severe periodontal disease is considered on its own, the prevalence was found to be 9%.⁸ It is currently accepted that periodontitis largely stems from various biologic, systemic, and pro-inflammatory mediators.⁹ Due to the complexity of the disease, the etiologic factors can be many and varied. On a population level, sex, age, smoking, diabetes, and ethnicity are just a few of the factors that may predict an individual's risk.¹⁰

Management of periodontal disease is admittedly non-curative. Patients at risk due to systemic or genetic predispositions will remain at risk for attachment loss after treatment. The necessity to continually address the etiologic factors for the disease was identified much earlier within the periodontal community than the same philosophy was for caries management. The need for posttreatment periodontal maintenance is clear. The standard of care established for all high-risk periodontal disease patients is more frequent professional cleanings with dedicated oral hygiene instruction and reinforcement. That being said, even after disease is established and without any further treatment, the rate of progression at specific teeth may be slow and infrequent.¹¹

The idea that the RPD complicates the oral environment by its presence has been extensively researched. Certain results indicate that this is the case. Plaque retention, bacterial levels, and gingival inflammation have been shown to increase after an RPD is placed. However, when this research is more closely evaluated, the RPDs in use by the research population often fail to meet the standard of care for long-term prostheses.¹²⁻¹⁶ The presence of acrylic resin, gingival coverage, and tissue impingement all contribute to negative tissue response and can be managed by prosthesis design. That makes the negative periodontal conclusions made by these articles pertinent only to RPDs that fall below the standard of care.

Often, the result of the research is speculative in nature rather than proof of causation. If we know the risk remains after losing teeth due to periodontitis, is it fair to blame the RPD that follows for the periodontitis? Taken as a whole, when controlled studies on patients wearing definitive RPDs are conducted, the results show that the RPDs are not contributing to disease progression if the patients consistently follow standard disease management protocols. This means that if these high-risk patients receive RPDs that adhere to certain standards of care, and if these patients follow the disease management protocols dentistry has developed, then the RPD will not be the cause of further destruction.¹⁷⁻²¹ The idea of poorly maintained and designed RPDs contributing to inflammation and bacterial colonization in the mouth will continue to be highlighted throughout this textbook.

Malocclusion

On the most basic level, all occlusal concepts begin with the goal of having even and simultaneous bilateral contact. Due to lost, migrated, restored, or fractured teeth, this type of contact is often missing in debilitated partially edentulous situations. Assuming that there are opposing occlusal contacts in each arch, these contacts must occur evenly, simultaneously, and bilaterally. From a treatment perspective, this allows accurate and reliable articulation of casts or digital scans. It also gives the clinician a defined point from which to assess whether the prosthesis itself creates any interferences that need adjustment. Easy-to-miss, subtle interferences can contribute to further migration, more rapid attrition, framework displacement, and fractures (Fig 1-4a). This means an equilibration is almost always indicated before prosthesis fabrication (Fig 1-4b). If it is not done, the dentist will be relying on the prosthetic teeth to restore a comfortable and stable articulation. This is exceedingly difficult and infrequently maintained when there are limited opposing natural tooth contacts. For these reasons, the goal of having centric occlusion coincident with maximal intercuspal position needs to be met more stringently in RPD patients than in completely dentate patients.

On an arch relationship level, there is a belief that Class II malocclusions have significant biologic cost in the form of attrition, fracture, and reduced longevity of restorations.²²⁻²⁷ Perhaps this is why prosthodontists believe that a larger percentage of their patient-practice base is Class II, when compared with that of the average general dentist. This in turn implies that patients with these malocclusions, and with malocclusions in general, have significant dental consequences.

Research into the effects of malocclusion on masticatory efficiency has been inconclusive.²⁸⁻³⁰ This is partly due to the lack of correlation between the subjective experience of masticatory performance and the objective masticatory efficiency.²⁸ If muscle forces and mandibular movement patterns are not in harmony with the hard tissue determinants of occlusion (namely the teeth), excessive and more frequent contact of the opposing teeth may result.³¹ This type of dysfunction may have symptoms of increased rates of attrition, periodontal concerns, or fracture. In some examples, this type of dysfunction has been described as *traumatic occlusion*.³²⁻³⁴ In essence, a biologic problem like caries weakens the restorative condition of the teeth, creating an environment where malocclusions are now much more influential. The implication is that significant malocclusions are tolerated without biologic complications until the physiology is disrupted. Once this occurs, these malocclusions often need more aggressive correction to prevent damage to oral structures. This is clearly the situation for

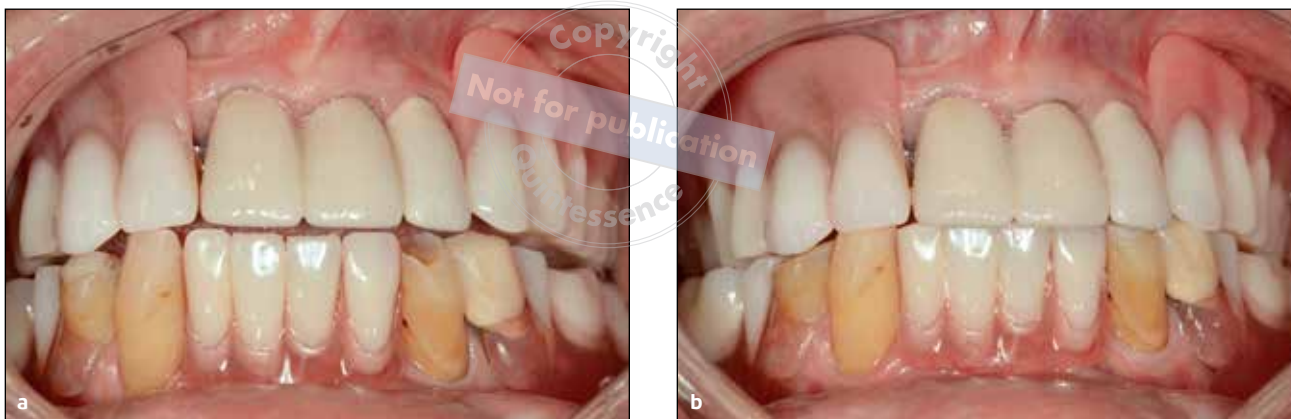


FIG 1-4 (a) An obvious interference between prosthetic and natural teeth. This particular interference is contributing to instability, wear, and tooth fracture of both prostheses. (b) The same patient, now after an occlusal equilibration done as part of initial therapy. This allows the clinician to confirm the diagnoses and helps predict the outcome with the new prostheses.



FIG 1-5 Properly articulated diagnostic casts are necessary to determine the extent of a malocclusion. These casts demonstrate the significant problem this skeletal Class III patient has with his occlusal plane.

partially edentulous patients. Normal physiology has been disrupted, typically by the loss of several teeth, which allows the negative influence of a previously tolerated malocclusion to become significant.

Diagnosis of a malocclusion is not always possible with simple examination. More often than not, articulated diagnostic casts are required to accurately and thoroughly diagnose occlusal relationships (Fig 1-5). While experienced operators can find more occlusal interferences than can novices, even they must rely on diagnostic casts for the complex situations that often present. Beyond defining interferences, diagnostic casts help demonstrate the extent of occlusal plane and interocclusal space issues. Casts, when properly articulated, will demonstrate these issues and the clinician's options to address them. Most common among these is the lack of space for prosthetic teeth or components of the RPD. It is also the author's opinion that with the current state and cost of the technology, this procedure is more efficient and accurate when done on an analog rather than digital basis.

Disease Management

In practice, the sequence of treatment for potential RPD patients can take three basic routes. The particular sequence is based on the patient's risk profile determined at the initial examination. While all RPD patients are high risk when compared with the average dental patient, we must further subdivide them into low-, high-, and extreme-risk categories. A low-risk profile is one where we would expect to be successful in managing the risk factors and disease. Commonly, these are long-time RPD or fixed partial denture patients who require a new removable prosthesis due to a technical rather than biologic failure. These patients can typically proceed rapidly into definitive prosthodontic therapy.

A high-risk profile is one where the patient presents with active generalized disease. These patients commonly have existing or recently failed prostheses (Fig 1-6). The challenge with these patients is determining whether their disease can be controlled long-term. This determination cannot be made



FIG 1-6 Pretreatment photograph of a patient with severe generalized periodontal disease. It will take time to reestablish oral health. It is not advisable to proceed with definitive prosthodontics until this has occurred.



FIG 1-7 After beginning initial therapy. An interim resin-based RPD was used during the disease-control phase for this patient.

quickly. It often requires a period of initial therapy to first manage and then prevent disease. The only way to determine whether disease has been controlled is to recall and evaluate the patient over time. This presents many challenges for those in everyday clinical practice. The idea of delaying definitive prosthodontic care is given little more than cursory lip service in dental school. Once in practice, the day-to-day demands of production-oriented care pushes providers to “complete care.” Likewise, the patient frequently demands that their functional and esthetic condition be improved. Most certainly, these are the main reasons that brought them to the dentist in the first place. This means the definitive RPD is made as soon after active disease removal as the dentist’s schedule allows. Unfortunately, this eliminates the time period for actual risk reduction and leaves the new RPD in an oral environment just as at-risk for disease as when the patient first entered the dental office. Herein lies the main reason for so many of the biologic RPD failures.

These high-risk patients must have their dental health reestablished. This means the patient is free from active caries, periodontitis, and other dental disease processes. When RPD patients are managed this way, definitive crowns and other complex restorative dentistry is avoided at all costs. This may require long-term provisional crowns or large core build-ups that are not prepared for full-coverage crowns. If the patient is missing anterior teeth or long spans of posterior teeth, an interim RPD will likely be required as well (Fig 1-7). This common and important treatment modality allows the dentist to address immediate need without committing to more expensive and extensive therapy. These prostheses are discussed in detail in chapter 10. Once the patient is “under control,” they are placed in a personalized maintenance program. Examples of typical

disease-control and maintenance procedures are listed in Table 1-1. The frequency and type of treatment is dependent on the patient’s risk level. The higher the risk, the more intense and frequent the recall and procedures.

When RPD patients are maintained by regularly attending a professional prophylaxis appointment with dedicated oral hygiene instruction, the recurrence of disease is low and the continued successful use of the RPD is high.¹⁶⁻²⁰ Recent research into risk-based caries and periodontal disease-control supports the risk-based management philosophy.^{35,36}

Many of the commonly cited references for RPDs being a risk factor for disease actually indicate that the RPD itself has no significant detrimental effect when oral hygiene protocols are followed.³⁷⁻⁴¹ In fact, many of the plaque or bacteriologic tests were completed after the test subjects were told to not brush their teeth or during the time period between regular prophylaxis appointments. Regardless, all the research noted reinforces the critical need of increasing the frequency of regular prophylaxis with oral hygiene instruction for RPD patients.

The key point to be repeatedly stressed is that definitive therapy is not conducted until a demonstrated reduction in risk has occurred. Evidence of risk reduction is only found when patients present disease-free at reevaluations. The dentist must then determine the length of time needed before proceeding to definitive therapy. In general, the higher the risk, the longer the period required to determine successful disease control. A major advantage of this protocol is that the posttreatment maintenance program has already been established and proven successful prior to the definitive RPD being fabricated. This tends to greatly increase the odds of long-term RPD survival. It does so by weeding out those

Table 1-1 The most popular and effective preventive procedures for RPD patients

| RISK FACTOR | PREVENTIVE MEASURE | PROVIDER | SUGGESTED PROTOCOL |
|----------------------|---|-----------------------------|--|
| All RPD patients | Increased recall frequency | In office | Minimum two times per year with frequency determined by risk assessment. Extreme risk cases may require recall as frequently as every 2 months. |
| | Oral hygiene instruction | Dental hygienist | Repeated at every recall. A dedicated time period of personal interaction to review and critique previous effectiveness. Time must be given to practice proper technique and demonstrate results. Plaque-disclosing agents facilitate patient understanding. This time includes instruction on cleaning of the RPD itself. |
| | Dental prophylaxis | Dental hygienist | A prophylaxis appointment duration should be at least 1 hour. This includes time for operatory setup and cleaning. Effectiveness of the necessary preventive measures listed here is questionable if less time is available. As fewer teeth are present, the time shifts from cleaning of the natural teeth to cleaning of the prosthesis and oral hygiene instruction. |
| Caries (low risk) | Diet counseling and modification | Dental team and at home | A discussion and review of risk factors found in a patient interview. Review of a 5-day diet history completed by the patient tends to be more effective and can be analyzed by a nutritionist or online at https://www.esh.com/products/food-processor/ . Follow-up is required for assessment of modification and can be completed efficiently with front-office phone calls. |
| | Xylitol lozenges | At home | Frequent dosing required for effectiveness. Must ensure product provides effective concentration. Some risk of gastrointestinal disturbance. Chewing-gum versions not appropriate for RPD patients. |
| | Prescription-strength fluoride toothpaste | At home | Generally for the average-risk RPD patient. Typically used after regular hygiene procedures prior to bed and/or before leaving the house in the morning. The patient brushes on teeth, spits out excess, and does not rinse. |
| Caries (medium risk) | Topical fluoride varnish | In office or at home | Generally for the moderate-risk RPD patient. Applied to all teeth after completion of prophylaxis appointment. Frequency determined by risk. Patient is not to eat or drink for at least 2 hours after application. A protocol of three applications within a 10-day period is often suggested for initial caries control regimens. |
| Caries (high risk) | Fluoride gel tray | At home | Generally for high/extreme caries risk. A flexible pull-down shell with drops of 1.1% fluoride gel in the areas of the teeth. Used after regular oral hygiene daily for 30 minutes. |
| | Silver diamine fluoride | Dental hygienist or dentist | Applied to early or active carious lesions to arrest progression. Little current evidence for the adult population but may be an effective means to control root surface caries in the high-risk elderly population where the black discoloration is not an issue. |
| | Chlorhexidine varnish | Dental hygienist or dentist | Currently not available in the United States. Some early evidence of benefit in root caries prevention. |
| Caries/periodontitis | Chlorhexidine rinse | At home | Nonalcoholic version recommended. Used to reduce bacterial load on recurring rather than continuous basis. Use 0.12% rinse (or stronger if available) for 2 minutes prior to bed for 2 weeks prior to upcoming recall appointment. This minimizes stain formation and times its removal efficiently. Must use at least 60 minutes after any product that contains sodium lauryl sulfate (most toothpastes) to avoid possible inhibitory interaction. |
| Xerostomia | Salivary substitutes | At home | Several versions now available on mainstream pharmacy shelves. Must ensure they do not reduce PH of oral environment. |



FIG 1-8 A complex tooth-supported fixed-removable reconstruction would not be advised in this patient, considering the poor restorative condition of the remaining teeth, the cost to manage that condition, and the continued disease risk.



FIG 1-9 Example of interim RPDs being used in a high-risk elderly patient.



FIG 1-10 Example of a shortened dental arch. This patient, a cancer survivor, functions on two occluding units.

patients who are either not motivated or unable to reduce their risk of disease. In these instances, disease will return despite the management steps taken. When this occurs, there is less at stake because the more expensive and extensive therapies have been avoided. These saved resources can then be invested in alternative therapies.

When we look ahead to the complex fixed-removable reconstructions later in this textbook, the comment on saving resources for a more predictable alternative therapy must be remembered. The more complex the tooth-tissue-supported reconstruction, the higher the risk of failure.⁴² This likely indicates the poor condition of the preoperative condition as well as the higher disease risk profiles that required the more extensive reconstruction in the first place (Fig 1-8). The clinician must decide if the extensive rehabilitation efforts needed for these more complex situations are worthwhile in terms of function, cost, and time. If not, alternatives must be strongly considered.

Alternatives

It must not be assumed that preventive strategies will always work. If the evidence collected by the risk assessment points to disease recurrence, then treatments not involving the natural teeth must be recommended. This brings us to the third category, an extreme-risk patient. If RPDs are made within an uncontrollable extreme-risk environment (which, in spite of the evidence, they often are), they will fail. The sequence of treatment in these scenarios is typically direct, with edentulation and implant therapy being the basis of the reconstruction choices.

Interim RPD

When an RPD is not indicated, there are six basic alternatives. One option is the interim acrylic RPD. For the extreme-risk patient, the word *interim* is in reference to

both the teeth and the RPD. These patients will generally never have a definitive RPD. Instead, this type of plan is used to delay the undesired use of complete dentures. This is often a very appropriate choice for very elderly or terminally ill patients in whom quality of life for the remaining months is the most important goal (Fig 1-9).

Shortened arch

In certain situations, a second alternative to RPDs can be the shortened-arch concept.⁴³⁻⁴⁵ Popularized in Europe by Dr Kayser and others, this concept utilizes the fact that a significant percentage of partially edentulous patients function well enough with a limited number of occluding posterior units (Fig 1-10). This can be as extreme as the patient having only one or two opposing premolar teeth in their entire mouth.

Dentists have a tendency to want to replace missing teeth. However, this should be a patient-driven choice. The patient should have a comfort or function complaint directly related to the lack of posterior occluding units before an RPD is considered. Research has shown no significant detrimental effects long-term from lacking posterior occluding units.^{46,47} This concept is particularly appropriate for elderly patients or patients who have never worn removable devices. Part of the reason for the high rate of patients not using Kennedy Class I RPDs is the fact that patients can often function acceptably well with the limited numbers of natural teeth that they have. Two common contraindications to the shortened arch are esthetics in broad smile situations and the need for additional occluding units opposing a conventional complete denture.

Conventional complete denture

Conventional complete dentures are another obvious alternative. A simple analysis of the patient's edentulous anatomy often demonstrates a favorable prognosis (Fig 1-11).



FIG 1-11 Favorable denture anatomy.



FIG 1-12 These maxillary roots have been maintained as overdenture abutments. They are critical to maintain favorable denture anatomy that resists the force of the dentate mandible.



FIG 1-13 Two stud attachments for an implant overdenture.

Experience has also shown that a favorable maxillary arch form has the potential to support a maxillary complete denture at least as well as a Kennedy Class I RPD supported by only anterior teeth. This is due to common challenges with gravity and retention faced by the maxillary RPD. The esthetic improvement in this scenario is also often dramatic. There is frequently no better way to improve the cosmetic result when heavily restored, discolored, and malpositioned maxillary incisors are present. Replacement by a well-designed complete denture also has the potential to compensate for age, lip support, and disease management issues where an RPD cannot. This choice is also often economical, as investment in the anatomically inferior mandibular arch is preferred. This is to more predictably avoid the use of a mandibular conventional complete denture, which often results when first-round treatment fails and the patient no longer has resources for retreatment. It has been the author's experience that maxillary conventional complete dentures have a high success and satisfaction rate. While not as common, there are scenarios where a mandibular conventional complete denture can be made predictable and successful. Therefore, they too should be a consideration when the anatomy is favorable and the disease burden/risk too high.

Overdenture

Some anatomical situations are predictive of poor denture function. If edentulation is indicated and conventional dentures are economically and/or cosmetically preferred, then an overdenture should be considered (Fig 1-12). It is common to find teeth that have previous root canal therapy in partially edentulous patients. These can be fairly easily and economically utilized to maintain the residual ridge and lend support where the edentulous anatomy is otherwise lacking. A significant volume of research from the 1980s shows good results and offers suggestions to manage

the high rate of caries found on the root abutments. These roots can be used with various types of attachments as well, further increasing their benefit and effect on retention.

Implant overdenture

The fifth alternative to RPDs has been the most influential in treatment planning. The implant overdenture has been so successful biologically and functionally that much of the prosthodontic profession considers it the standard of care for edentulous patients. Here we are speaking specifically about the mandible and the tissue-supported implant-retained overdenture concept. By placing two mandibular anterior dental implants—or even a single implant—most issues with retention and stability in mandibular complete dentures are vastly improved (Fig 1-13). When this therapy is compared to the typical Kennedy Class I RPD, it is often the implant overdenture that comes out ahead. Consider this in terms of future disease risk, function, esthetics, comfort, and long-term management. The two most positive factors are the elimination of caries risk and near-total control over tooth position/occlusion. While maintenance is a continual challenge and cost is somewhat greater than an RPD, this is among the most successful and gratifying treatments in prosthetic dentistry. It must be noted that there is concern with long-term implant health when the same concept is used on the maxillary arch.

Full-arch implant-supported prosthesis

The sixth and final alternative to RPDs is also the most expensive. The mainstream use of full-arch implant-supported fixed complete dentures is a reality. The transition into this fixed prosthetic solution commonly also occurs in a single visit (Fig 1-14). The success rates in the long term continue to be very high. The fact that this is a fixed solution that eliminates the caries risk and reduces



FIG 1-14 (a) Pretreatment view. (b) Immediately placed maxillary denture and mandibular implant-supported fixed complete denture (hybrid).

maintenance issues makes the economic cost worthwhile for many patients. Traditionally, Kennedy Class I patients have been left with RPDs as the primary recommendation because they lack adequate bone volume to safely accept dental implants in the posterior region. This alternative uses the favorable anterior anatomy to provide a fixed prosthesis. This widens the patient base for which it is appropriate and beneficial. The experienced reader will no doubt remember Kelly syndrome and its relation to mandibular Kennedy Class I situations. This treatment modality restores rigid posterior support and therefore theoretically eliminates the proposed etiology for combination syndrome.

Diagnostics

The challenges of partial edentulism, risk factor analysis, disease management, and alternatives all highlight the complex planning required for RPD patients. As discussed, in many situations it will take weeks or months to make final decisions and finalize an RPD treatment plan. The obvious first step in treatment for the partially edentulous patient is the phase that includes the gathering of diagnostic data and those diagnostic procedures commonly grouped under the heading of treatment planning. The preceding discussion about treatment planning focused on mouth-level issues. Tooth-level and arch-level prognoses must also be gathered. Intimate detail of every aspect of the patient's remaining teeth is required to assess prognosis at an individual tooth level. Tooth-level prognosis is almost exclusively an assessment of the structural integrity and durability of the tooth. Simply put, the more remaining healthy tooth structure and periodontal support an individual tooth has, the better the prognosis.

Arch-level prognosis is the viability of the total amount of teeth within a specific arch to support and resist the function placed on it by the opposing arch. Arch-level prognosis

typically cannot be determined until articulated diagnostic casts have been evaluated. Better still, a diagnostic wax-up and tooth arrangement that includes a tentative RPD design will fully illustrate the arch-level challenges. It may well be that the diagnostic phase is second only to maintenance as an indicator of long-term success. This is because the more accurate the thought process during the diagnostic phase, the more likely it is that complicating factors are avoided or eliminated.

An experienced clinician can make many early determinations at the initial examination appointment. This requires a skilled interviewer and focused questions. At a minimum, the following questions (in no particular order) must be addressed as part of the evaluation of the gathered data:

- Are the patient's expectations achievable?
- Can the patient's dental disease be adequately managed?
- What further analysis of disease risk factors is necessary to predict the patient risk profile?
- Is an RPD indicated/necessary for this patient at this time?
- What prosthodontic/restorative needs are apparent in the opposing arch, and how will their treatment affect the RPD?
- Are the hard and soft tissues that would relate to a removable appliance acceptable (ie, in an ideal state of health) at this time, or will they require preprosthetic therapy? This could include everything from orthognathic surgery to a bonded rest. Will the abutment teeth provide all the required support, or will additional support be required from the soft tissues of the edentulous areas (stress relief)?

- Would the patient be better served with implant-supported/implant-retained prostheses, and can the increase in cost of care be justified?
- Should ideal treatment be modified because of age, chronic systemic disease, or psychologic factors?
- Will the patient be able to provide the required level of home care that will be necessary for long-term success?

Some of these answers will require direct questioning of the patient. Others may only need to be a part of the clinician's thought process but should be considered while the patient is still present. Some questions will result in referrals to other specialists and/or additional diagnostic tests. The following basic information must be obtained before definitive treatment planning can occur:

- Identification of the chief complaint
- Evaluation of existing prostheses (if available)
- Head and neck examination
- Evaluation of mandibular movement and temporomandibular disease screening to include sounds and mouth opening
- Intraoral examination of both soft and hard tissues with emphasis on cancer screening

Accurate and complete charting of the following is required:

- Caries and caries risk assessment
- Existing restorations
- Periodontal tissues to include probing, gingival location/volume, mobilities, and general bone levels
- Pulp testing for vitality, especially on potential abutment teeth
- Radiographic evaluation of both a full-mouth series and a panoramic film are a minimum (in cases where jaw discrepancies and malocclusions are severe, radiographic or other imaging of the TMJ areas should be considered)
- Occlusal contacts, centric and eccentric, presence and location of interferences
- Diet analysis
- Impressions for diagnostic casts
- Interocclusal jaw relation record (if indicated)
- Shade and mold selection

The need for these diagnostic data should be obvious to any clinician; unfortunately, the planning for the average RPD seldom includes all this information, and as a result, the treatment is compromised from the very beginning. There is no point even considering the "design" portion of

the treatment plan until this information is available and has received some consideration and reflection.

The wise clinician will not give the patient any definitive plan or fee at the time of the initial examination. The more complex the situation, the more likely this is to be the case. It is far better to tell the patient that no intelligent response can be made until all of the diagnostic data have been evaluated and any required consultations obtained. However, postexamination discussion is very valuable to explain the initial findings and the basics of the possible treatment options. This serves to narrow the discussion on which options the patient is willing to entertain. Effort can then be focused on assimilating the data and creating the final list of necessary procedures.

Preliminary impressions

The quality of the initial impressions and the casts that result from them, although diagnostic only, need to be of far higher quality than that normally seen. Most every specialist in removable prosthodontics has had the experience of attending a meeting or seminar when someone asks for help in treatment planning a case: A plaster cast, pulled from a pocket, usually without a decent base, full of blebs and voids and with no evidence of ever having been on a dental surveyor and then, "I apologize for this cast, but can you help me with a design?"

The preliminary impression and resultant cast should be of the same quality as the final impression as far as extensions, hard and soft tissue details, and integrity of the occlusal surface are concerned. This impression should be considered as a trial impression for the final. Tray size is evaluated, patient compliance with instructions noted, ease of placement discovered, and the patient's ability to sit still during the set of the alginate evaluated. Everything that can be learned from this impression will aid the clinician in making an accurate final impression.

Sometimes no stock tray will adequately fit the mouth, indicating that a custom tray will have to be included in preparation for the final impression. Modification of the stock tray with wax or compound may be necessary to allow the impression of border tissues or high palatal vault. All these issues must be evaluated at the preliminary impression so that in the final impression, the clinician can concentrate on those factors related to accuracy of the impression of the hard tissues.

Alginate can be expected to give overextended borders due to its consistency when properly mixed. Under no circumstances should the powder/water ratio be changed to reduce the viscosity of the mix. Rather, the amount of alginate required to make a quality impression should be carefully estimated and only that amount placed in the tray.



FIG 1-15 Alginate applied to critical areas to reduce bubbles and voids.



FIG 1-16 Large-diameter syringes can be used to fill difficult-to-reach anatomical areas.



FIG 1-17 Stock tray seated and stabilized throughout the complete setting of the alginate.

Alginate must be placed into the critical areas: occlusal surfaces, marginal gingival crevices, soft tissue undercuts, etc (Fig 1-15). One cannot count on the material flowing to these areas of its own accord. The material can be placed with the finger or injected using a syringe, but in no instance should the tray be placed in the mouth until all critical areas are wiped with alginate. Borders should be filled using a syringe (Fig 1-16). The critical areas are buccal to the tuberosities and the retromylohyoid space, places where voids are often found in the completed impression. Another advantage of placing alginate in the mouth before seating the tray is that less material needs to be placed in the tray, resulting in increased visibility for tray placement.

Whenever possible, the stock tray is modified by adding wax or compound to allow a minimum of 0.25 inch of alginate around all critical structures. A common problem with alginate is overseating of the tray, resulting in less than the required 0.25 inch of material over the occlusal surfaces. Stops can be placed in the tray using hard wax or dental

compound to restrict the overseating. Unfortunately, the area of the stop will often be distorted due to the minimal alginate present. The required occlusal spacing may be obtained by placing the empty tray in the mouth, seating it to contact with the occlusal surfaces, and evaluating the relative position of the handle to the lips when the tray is lifted the 0.25 inch. In making the impression, the tray is seated to that lifted position and held in place until the impression is set (Fig 1-17).

When the impression is removed from the mouth, it must be rinsed and lightly dried and then inspected for tears because alginate will usually tear before it distorts. Visual inspection will also show any evidence of the material breaking free from the Rim-Lock or retentive holes. When using a Rim-Lock tray, excess alginate should be cut from the borders with a sharp knife so that the edge of the tray can be seen and the retention of the alginate verified.

Alginate is clearly an imperfect impression material—often due to user error—but it is the material of choice for both preliminary and often final impressions for the RPD. Seldom is the alginate mixed for the manufacturer's recommended time. Likewise, it is often not allowed time for a complete set before removal from the mouth. Many inaccurate impressions can be traced to the patient's inability to remain motionless during the setting phase. When the time in the mouth has been altered by using very cold water or not mixing for the usual 60 seconds, the patient is forced to remain motionless for longer than necessary. Because alginate sets not all at once but in scattered "islands" of setting material, any movement by the clinician or patient during the setting period runs the risk of reorienting the partially set material, producing a distorted impression. Ideally, the set should begin promptly after the tray is in its proper position and any border molding has occurred. Alginate mixed with the proper measure of room-temperature (65°F



FIG 1-18 Mechanical alginate mixing bowl (*left*) and centrifugal-style alginate mixer (*right*). Both result in improved consistency. Note also the measuring device for room-temperature water in the center.



FIG 1-19 After verification and prior to patient departure, key anatomical extensions, such as the buccal shelf, are outlined with an indelible marker.

to 70°F) water will allow roughly 1 minute for loading the tray and placing it in the mouth before the set begins. Optimal gelation time should be between 3 and 4 minutes using 68°F water. The patient is instructed to remain motionless during this time. The initial impression gives the clinician the opportunity to test the patient's ability in this regard. This should increase the probability that the final impression will be accurate. Should the patient move during the final impression, it must be remade and the patient informed again of their part in this procedure. Following the manufacturer's instructions for handling properties is obviously necessary.

If the mixing of the alginate is incomplete, a reduction of up to 50% in the strength of the gel can be expected. On the other hand, alginate mixed beyond the manufacturer's stated time will have reduced gel strength because the forming gels will be broken. Mechanical mixing devices, including vacuum mixing, are more apt to give consistency and thereby accuracy and should be considered as essential instrumentation (Fig 1-18). The cost of centrifugal alginate mixing machines has become much more reasonable over the last decade. These machines accurately, efficiently, and reliably create a nearly bubble-free, completely integrated mix. A typical mixing time is 6 to 8 seconds. For clinicians who regularly use alginate, this machine becomes almost a necessity to create reliable and predictable mixes every time. The hand-mixing method should only be used when no other options are available because it is impossible to accurately, efficiently, and reliably mix alginate by hand.

Alginate adhesives must be considered essential for all final impressions, but because they are not easy to remove from the tray, they are not required for the diagnostic impression. When a stock Rim-Lock tray is used, however, care must be taken to force the alginate into the Rim-Lock

with the spatula when loading the tray. Once this has been done, the alginate is not likely to pop free of the lock. As more offices move to disposable plastic trays, the location and extent of perforations become more important, and the use of adhesive is required. Another advantage to plastic trays is that they can be easily modified. Regardless, the impression should be carefully inspected before pouring so that if a separation has occurred, the set alginate can be replaced in the lock of the tray. While this maneuver would be unacceptable for a final impression, it will normally produce a cast that is accurate enough for diagnostic procedures.

Once the impression has been removed from the mouth, the following series of steps will maximize chances for an accurate diagnostic cast:

1. Rinse the impression under running water.
2. Using a cotton tip, gently clean the tooth impressions. (Plaque and other oral debris, if left in the impression, will reduce the surface hardness of the resultant cast because the surface-hardening agents in the alginate must come into contact with the dental stone to gain the maximum quality of cast).
3. Blow excess fluid from the impression and evaluate the impression under good light for tears and defects.
4. With an indelible pencil or other marker, trace the outline of the proposed denture on the alginate (Fig 1-19). Because the patient is still in the chair, extensions can be quickly verified. Should contours seen in the mouth and essential to the construction not be present in the impression, the decision to remake the impression will not require an additional appointment. Attempts to identify denture base extensions from a stone cast days after the impression was made often lead to problems with extensions and will never be as accurate as

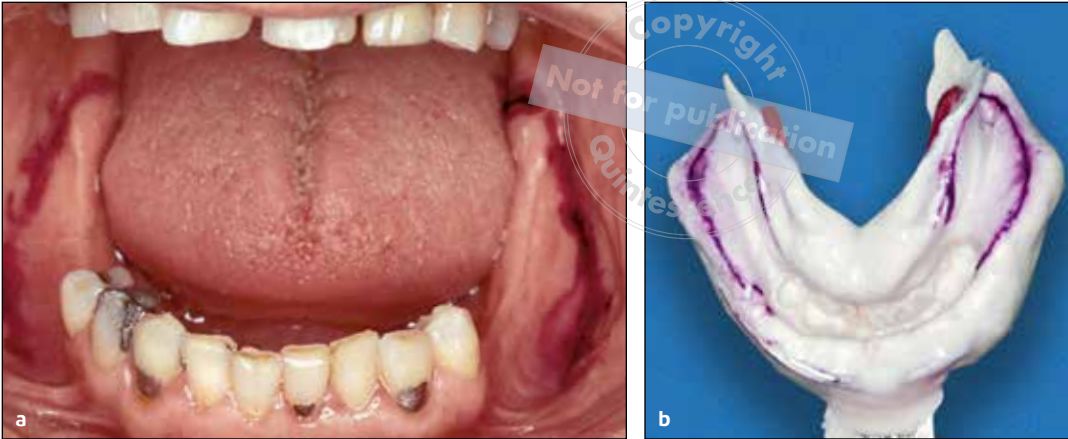


FIG 1-20 (a) If moisture can be controlled, markings can be made prior to the impression. (b) An adequately extended impression, now marked, is poured as soon as possible.

those determined via this method of drawing on the alginate impression. Anatomical landmarks can also be outlined prior to the impression (Fig 1-20a), with the highlighted areas transferring into the alginate and eventually to the cast (Fig 1-20b).

5. The technique used to pour the preliminary impression is immaterial, and any approach that results in a dense cast with no voids and a base suitable for mounting in the dental surveyor will suffice for diagnostic purposes. As a general rule, boxing the alginate impression is discouraged because any pressures on unsupported alginate will cause distortion. The double-pour approach will be more dependable. As a minimum, the cast should be trimmed so that a land area of 3 mm is established, and any and all blebs are removed because this cast may be seen by the patient as well as by the technician. The author's experience has been that a neat diagnostic cast with a careful design, properly drawn, goes a long way to indicating that the clinician really knows what the standards are, and technicians are impressed when they see a quality diagnostic cast.

Preprosthodontic therapy

One of the essentials of the state-of-the-art RPD is the level of mouth preparation that is required before the actual partial denture is constructed. Mouth preparation is, regrettably, usually interpreted to mean only the creation of rest preparations on some of the remaining teeth. Unfortunately, reviews of cases submitted to the dental laboratories show that many mouths do not have even this level of mouth preparation.

For the modern RPD, mouth preparation will cover any and all therapy required to bring the mouth to optimum

health and to modify tissue in such a manner as to make the final prosthesis ideal. Obviously, a removable appliance can still be made accepting the mouth as it presents. In fact, most of the RPDs seen in any review of prosthetic treatment will fall into this category, with little or no recontouring of teeth, occlusal plane discrepancies, malocclusions, and the like. A discussion of the basic therapies for mouth preparation at this point in the treatment planning process is necessary to fully develop the concept of ideal mouth preparation.

While the sequencing of the actual care is a critical issue, the sequencing of consultations is not. The prosthodontist almost always manages the restorative dental examination and caries risk assessment. The periodontal examination is a different matter because most prosthodontists work with a circle of periodontists with an exchange of referrals. No matter how the data are gathered, a baseline of pocket depth, furcation involvement, plaque scores, mobilities, and general periodontal soft tissue conditions must be made. Baseline data of this magnitude provide the clinician with a starting point for referrals as well as protection for medicolegal matters. When determined, periodontal therapy referrals are best made as soon as a preliminary treatment plan has been confirmed. This allows initial therapy and the long-term process of disease management to begin.

Endodontic referrals are apt to be more common, especially those regarding existing endodontic restorations. Retreatment decisions can greatly affect the treatment plan, both in regard to abutment selection and to total cost of care. Root canal filling material exposed for any reason may need to be retreated before definitive care is undertaken as a protection against failure after crowns have been cemented. In addition, as debilitated individual teeth are disassembled and reconstructed, the need for endodontic intervention often becomes clearer as treatment proceeds.

Orthodontic and oral and maxillofacial surgical consultations are almost always case specific and may not always be necessary, although to plan treatment without them, the clinician must be assured that they cannot contribute to the care of the patient. A large number of cases will require minor tooth movement to align the arch and to establish the ideal occlusal plane. In practice, it may be difficult to find an orthodontist willing and able to manage the unique challenges of individual tooth movements in older partially edentulous patients. Direct consultation in these instances is in order rather than simple letters or phone calls. Often, these consultations can best be done after a preliminary treatment plan and design has been established. This is particularly true when one is considering tori removal or adjunctive dental implant therapy.

Along with the periodontal examination, the evaluation of existing restorations and tooth contours is critical to our treatment. In far too many instances, restorations of marginal quality are left in the mouth and the partial denture built around them.

A critical component of treatment planning involves the use of dental implants. Obviously, patients with unlimited funds can avoid an RPD entirely. However, there will be situations where implants cannot be placed, usually in very complex treatments. Implants and considerations for their use are discussed later in this book.

Once the aforementioned information has been gathered, the clinical findings can be summarized as a part of the patient's record and included in the treatment plan letter. This document establishes a diagnosis and prognosis of the mouth with and without treatment. At this point, the diagnostic casts, radiographs, and periodontal charting are reviewed together and the cast "surveyed" to determine the RPD options. The treatment plan and the patient's informed consent letter can only be completed after the tentative design of the final appliance has been established.

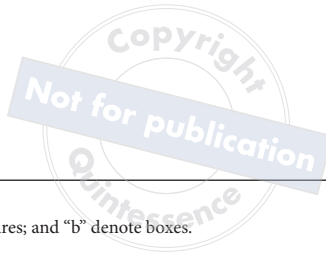
Is all this really necessary? Must a written treatment plan and consent letter be given to the patient? Should we make an orthodontic consult as part of our chain of diagnostic procedures? The answer to these and similar questions is, of course, most certainly yes! The type of treatment described in this book, the partial denture at the most advanced level, does require more work, both in planning and execution. The results are, very obviously, worth our time and our best efforts.

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