Kratochvil's Fundamentals of Removable Partial Dentures

Kratochvil's Fundamentals of REMOVABLE PARTIAL DENTURES

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Dedication

To my mother, Te-Chih Wang; my father, Tien-Dow Chang; my husband, Felix Peng; and my daughter, Lillian, for their unwavering love and support.

— Ting-Ling Chang

To my mentor and father, Dr Eduardo Orellana, and my mother, Dr Maria Isabel Vasquez, for their love and support throughout my academic journey.

— Daniela Orellana

To Jan, for her continuing love and support.

— John Beumer

Contents

Preface

Professor F. J. Kratochvil, conferring with Dr Arun Sharma.

Few people changed the practice of prosthodontics like Professor F. J. Kratochvil did. After a distinguished career in the US Navy, he joined the faculty of the University of California, Los Angeles (UCLA) School of Dentistry as Chair of the Section of Removable Prosthodontics in 1966. The school had been established in 1964, and Professor Kratochvil was charged with developing the predoctoral curriculum devoted to removable prosthodontics. This program was soon recognized as one of the best in the country and was copied by many schools throughout the United States, Europe, and Asia. Indeed, the school's clinical identity was closely associated with the excellence of this training program. In the early 1970s, Professor Kratochvil also initiated the school's postdoctoral residency program in advanced prosthodontics and served as its director for many years. Many of the residents he mentored became important contributors to the specialty of prosthodontics.

However, Professor Kratochvil's most notable contribution to his discipline was the development of the so-called "RPI system" of removable partial denture (RPD) design: a clasp assembly consisting of a rest, a proximal plate, and an I-bar retainer. He was one of the first to recognize the importance of biomechanics in RPD design and used these principles to develop a whole new design philosophy. His initial article in *The Journal of Prosthetic Dentistry* in 1963 (and later his textbook) forever changed the way dentists approach partial denture design. Before he developed this system, RPDs were thought to be a transitional dental treatment, with the assumption that RPD patients would inevitably become edentulous and be forced to wear complete dentures, forever compromising their chewing function. Professor Kratochvil's research changed that thinking, and the RPI system is presently used throughout the world.

Kratochvil's Fundamentals of Removable Partial Dentures presents the basic philosophy of the RPI system as developed by Professor Kratochvil and is not intended as a reference book describing other philosophies. Throughout the book we have attempted to retain the flavor of Professor Kratochvil's original text. Our prime objective was to convey to the reader the basic philosophy of the RPI system as Professor Kratochvil envisioned. After an introductory chapter, several short chapters follow that describe RPD components and their functions. The real distinctiveness of Professor Kratochvil's RPI system begins in chapter 6, which describes his design philosophy in intimate detail as well as the basic principles of biomechanics upon which his design philosophy is based. This chapter is almost an exact duplicate of the same chapter in Professor Kratochvil's original textbook, and from our perspective it is the most important chapter in the book. Readers who understand the basic principles outlined in this chapter will be able to design a biomechanically sound RPD framework for just about any dental configuration they encounter.

Throughout the book we make several references to the rapidly emerging field of digital design and manufacturing of RPD frameworks. We have attempted to indicate to the reader the current limits of this new and exciting technology, and indeed chapter 11 is devoted to digital design and manufacturing of RPDs. We have added several more chapters that were not included in Professor Kratochvil's original textbook, including chapters dedicated to esthetics and the proper use of attachments in edentulous extension RPDs, the design and fabrication of overlay RPDs and surveyed crowns, and the application of Kratochvil's RPI design concepts for use in patients with maxillofacial defects. Finally, we have included an illustrated glossary because we recognize that prosthodontic terminology is confusing and constantly changing and as a result can bewilder the student and novice practitioner.

Acknowledgments

We would like to acknowledge the special contribution that Professor Ted Berg has made to this book and to the teaching of RPDs at UCLA. Dr Berg was a very special clinician, mentor, and educator. He loved to teach and developed many creative tools to make the design and fabrication of RPDs interesting to his students. His students recognized his dedication and expertise and presented him with more than 25 teaching awards during his career. Many of his teaching slides and examples of his clinical cases are found in this book.

The authors extend a special thanks to Dr Robert Duell for his support, advice, and counsel. Dr Duell was one of Professor Kratochvil's original residents in the advanced prosthodontics training program. Upon completion of his Navy service, he established a prosthodontic practice in Laguna Woods, California, devoted primarily to removable prosthodontics. For the last 20 years, he has been a valuable part-time faculty member in the Division of Advanced Prosthodontics at UCLA, teaching courses in complete dentures to sophomore students and conducting a seminar series in removable prosthodontics to residents in the advanced prosthodontics program. He has generously provided slides of his clinical cases for use in this book and has reviewed the manuscript and made many useful suggestions.

John Beumer would like to take this opportunity to thank Dr F. J. Kratochvil. Considered one of the giants of the discipline of prosthodontics, Dr Kratochvil recruited me to UCLA, and I was his first resident in the advanced prosthodontics residency program. The opportunity to study and work with him was wonderful and laid the groundwork for everything that followed in my professional career. His commitment to excellence and his enthusiasm for his work have inspired me and countless others in our profession.

Daniela Orellana would like to thank her program director and mentor, Dr Michael Razzoog, Professor of Prosthodontics, University of Michigan, for his professionalism, commitment, and heart. Dr Razzoog welcomed me into his family while mine was 5,000 miles away. On campus walks, his gentle soul, humor, and advice manifested his concern for my well-being beyond scholarly achievements. I also wish to thank Dr John Beumer for taking me under his wing. It has been an honor and privilege to work by his side. Dr Beumer is an exceptional mentor, and I am grateful beyond words. The fact that our paths have crossed will forever be a fortuitous event in my professional and academic career.

Ting-Ling Chang wishes to thank her incredible mentors Dr Ted Berg and Dr John Beumer. Dr Ted Berg was a wonderful role model who has inspired me in my academic career. Another mentor who greatly shaped my professional life is Dr John Beumer. His love and generosity in knowledge dissemination and sharing is most inspiring. I feel fortunate and blessed to work with him. It was John's vision, energy, and drive that made this book possible.

Finally, the authors would like to thank Brian Lozano, senior artist, UCLA School of Dentistry, for his wonderful illustrations.

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Chapter 1

Introduction to Removable Partial Dentures

John Beumer III | Ting-Ling Chang | Daniela Orellana

Professor F. J. Kratochvil was one of the first to recognize the importance of biomechanics in the design of removable partial dentures (RPDs) and used these principles to develop a whole new design philosophy. It is the purpose of this book to present this philosophy. His initial publication[1] forever changed the way in which dentists approached RPD design. Although he is most often associated with the use of the I-bar retainer, the reader should understand that he stressed the totality of RPD design and recognized the important role of other major components in the successful use of the I-bar retainer. Obviously, the I-bar retainer was an important component of his design philosophy, but the design of the guide planes and proximal plates were also fundamental. Because the I-bar has a relatively low retentive value compared to other retainer designs, its effectiveness is dependent upon the horizontal stability provided by the minor connectors and the proximal plates, and these portions of the RPD are integral to his design philosophy. He believed that there was no such thing as a simple I-bar RPD, just as there is no one technique that serves as a panacea for all clinical situations.

RPDs will continue to be one of the primary methods used to restore the missing dentition of partially edentulous patients in the foreseeable future, and consequently, it will continue to be important for dentists to be intimately familiar with the basic principles of RPD design and fabrication. The recent innovation in digital technologies will change the manner in which we design and fabricate RPDs, but the laws of biomechanics, and therefore the principles of RPD design that Kratochvil established, will not change.

Treatment of partially edentulous patients with RPDs has become increasingly sophisticated in recent decades, and when this treatment is planned and executed properly it will help to preserve the existing structures. In contrast, a poorly designed and fabricated RPD can trigger resorption of bony bearing surfaces and accelerate the loss of remaining dentition. Unfortunately, in recent years, curriculum time devoted to RPDs has been significantly reduced in many dental schools, and those directing the curriculum often lack appropriate training, experience, and educational resources. The result of this change has been startling. In recent surveys of dental laboratories in the United States, more than 90% of casts submitted lacked visible rests and RPD designs. Many students graduate from dental school without fabricating an RPD for a patient. In many studies, significant numbers of RPDs do not meet even half of the usual and customary design standards.[2]

The widespread perception that the health of the remaining teeth is compromised by RPDs as compared to other forms of treatment is not supported by the evidence. Studies comparing the outcomes of fixed dental prostheses (FDPs) and RPDs have indicated no differences in periodontal health of abutment teeth between the groups. The only differences noted in these studies were the higher levels of maintenance required by RPDs.[3,4]

The number of partially edentulous patients continues to increase as the population in most developed countries continues to age. Often times the only viable treatment option available to most patients is to restore the integrity of the dental arch and replace the missing dentition with an RPD. There are several reasons for this. In many patients, FDPs are not indicated, such as when the edentulous span is too great or in edentulous extension areas. Also, cost precludes the use of dental implants in most patients.

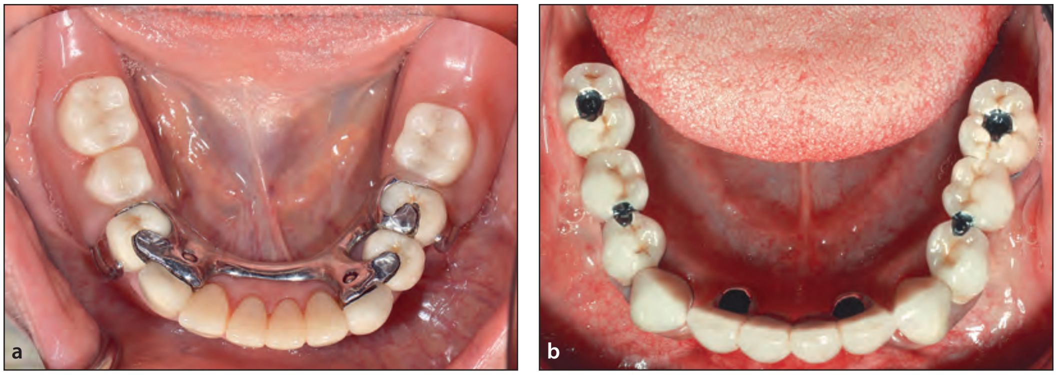

Fig 1-1 *(a)* Bilateral extension base RPD. (Courtesy of Dr R. Faulkner, Cincinnati, Ohio.) *(b)* Bilateral extension areas restored with a single implant connected to a natural tooth abutment. The mastication efficiency of the RPD is equivalent to that obtained with the implant-supported FDP.

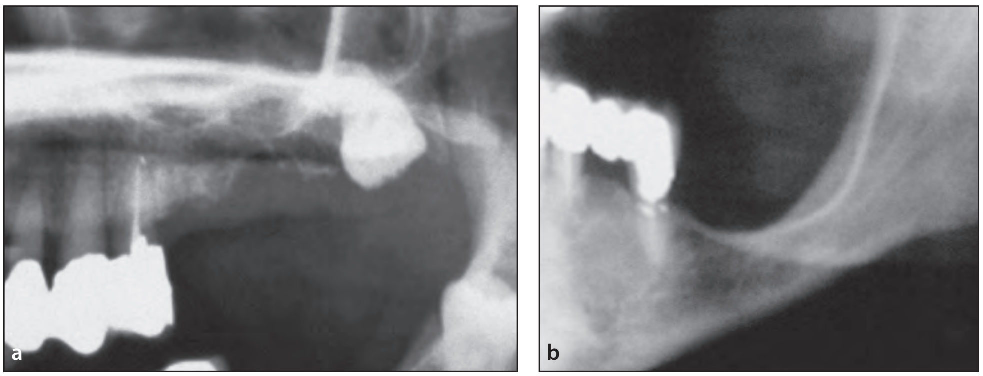

Fig 1-2 *(a)* Pneumatized maxillary sinus. *(b)* Resorption of bone over the inferior alveolar nerve. Both preclude implant placement in the absence of site enhancement.

RPDs Versus Implants

It is quite clear that the expanding need for tooth replacement cannot be met with osseointegrated implants. In the United States, the number of partially edentulous patients restored with dental implants is expected to plateau at 3% to 5% of those potentially in need of this service. Cost is an important factor, but there are several other reasons for this phenomenon. An interesting paper published several years ago by Bassi et al[5] illustrates the impact of additional factors. Forty consecutive partially edentulous patients seeking implant therapy were screened at the dental clinic at the University of Turin. Only 1 out of the 40 patients was ultimately restored with osseointegrated implants. There were a variety of reasons why implant therapy was not delivered to the other 39 patients. Many patients were not suitable candidates because they lacked sufficient bone volume at the desired sites. Another group, upon questioning, were happy with their RPDs, while another, when described the nature of the surgery to place the implants and/or enhance the potential implant sites, declined to undergo the surgery.

Another factor to consider is that the functional outcomes achieved with RPDs are comparable to those achieved with implant-supported FDPs. In the late 1980s and early 1990s, Kapur et al[3,6–9] conducted a randomized clinical trial comparing the mastication efficiency of implant-supported FDPs with extension base (tooth-mucosal borne) RPDs (Fig 1-1). Both treatments were equally effective in improving chewing function. A large number of patients in both groups expressed satisfaction with their prostheses, but as expected, the level of patient satisfaction was higher in the fixed implant-supported group. Similar outcomes were recently reported by Nogawa et al.[10] Kapur et al[3,6–9] concluded that despite the superiority of the implant-supported FDPs in terms of patient satisfaction, lack of functional differences and success rates do not support the selection of implant-supported FDPs over RPDs, without consideration of other factors.

Moreover, implants cannot be used in many patients in need of tooth replacement in the posterior quadrants because of pneumatization of the maxillary sinuses or insufficient bone over the inferior alveolar nerve in the mandible (Fig 1-2). Sinus augmentation has become common in recent years, and the success rates of implants placed into these sites is quite good. However, the high cost of this procedure plus the cost of implant placement precludes most patients from selecting this option. In the mandible, most patients missing dentition in the posterior quadrant lack sufficient bone volume over the inferior alveolar nerve for implant placement, and the development of predictable procedures aimed at supplementing the vertical height of these bony sites has proved illusive.

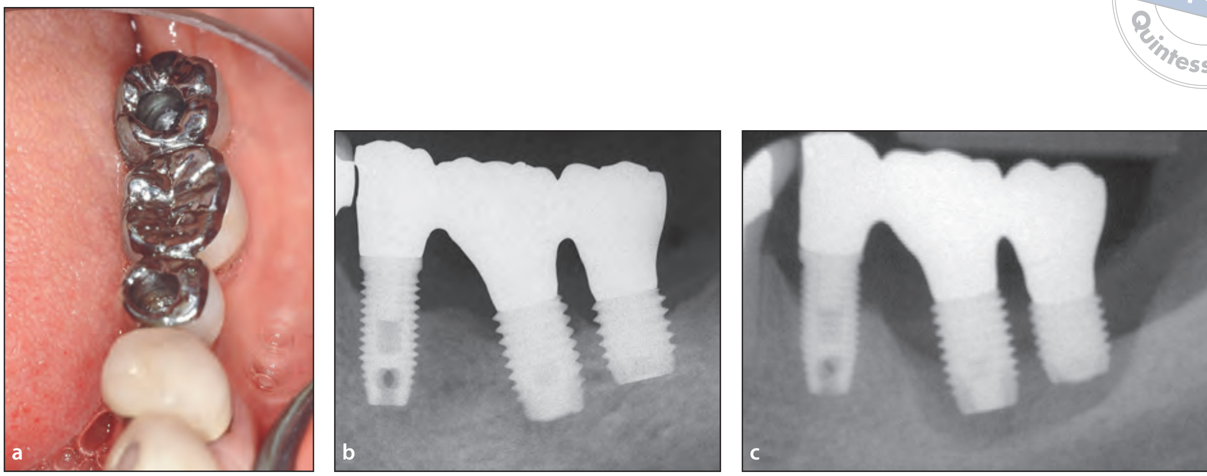

Fig 1-3 *(a)* Implant-supported FDP at delivery. *(b)* Bone levels 2 years after delivery. *(c)* Bone levels 5 years after delivery.

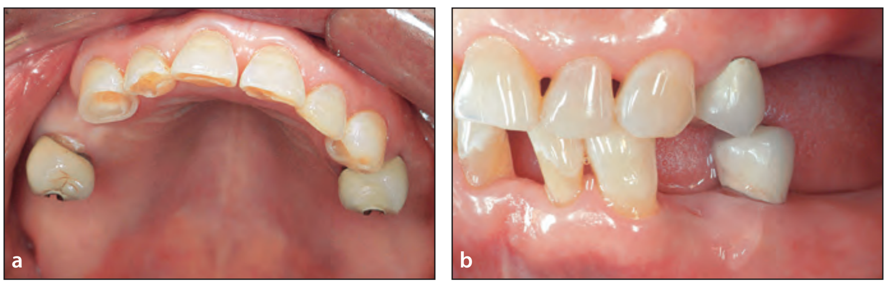

Fig 1-4 *(a and b)* Typical partially edentulous patient with multiple missing posterior teeth, lost occlusal vertical dimension, and loss of arch integrity. (Courtesy of Dr A. Davodi, Beverly Hills, California.)

Fig 1-5 If the progression of tooth loss and malposition persist, the dentition will become irretrievably lost. (Courtesy Dr A. Pozzi, Rome, Italy.)

Short, wide-diameter implants in these sites have not obtained an acceptable level of success.[11,12] The reasons for this are now becoming clear and include not only the length of the implants but also the lack of width of the alveolar bone to enclose the implant (Fig 1-3). Lateralizing the inferior alveolar nerve enables the placement of implants of suitable length. However, the morbidity associated with injury to the nerve can be quite significant.[13]

A typical partially edentulous patient is shown in Fig 1-4. The patient is missing posterior dentition in both the maxilla and mandible. Numerous spaces and diastemata have developed, destroying the integrity of both arches. Multiple teeth exhibit erosion and wear. Occlusal vertical dimension has been lost, reducing the height of the face and compromising facial esthetics. With proper treatment this dentition can be saved, the integrity of the arch restored, missing teeth replaced, and occlusal function restored to reasonable levels. Restoring the occlusal vertical dimension will dramatically improve facial esthetics. The purpose of this text is to delineate a treatment approach and RPD design principles that will consistently lead to favorable long-term treatment outcomes in such patients.

Objectives of Treatment: The Partially Edentulous Patient

When teeth are lost, the remaining dentition loses the interproximal contacts that permitted the intact arch to function as a continuous unit. Loss of integrity is one of the first steps toward disorganization of the dental arch, leading to progressive compromise and eventual loss of the remaining dentition (Fig 1-5). Individual teeth may supererupt or become mobile or displaced, altering the plane of occlusion and occlusal relationships. The relationship between centric relation and centric occlusion becomes unfavorable, disrupting the functional harmony of the temporomandibular joint and the muscles of mastication. Individual teeth may be displaced and tipped, resulting in the delivery of nonaxial forces and unfavorable leverages on the periodontal ligament and bone during function. The usual course of these events eventually reaches a turning point in the life of the dentition, and if this progression is not stopped, edentulism is the inevitable result.

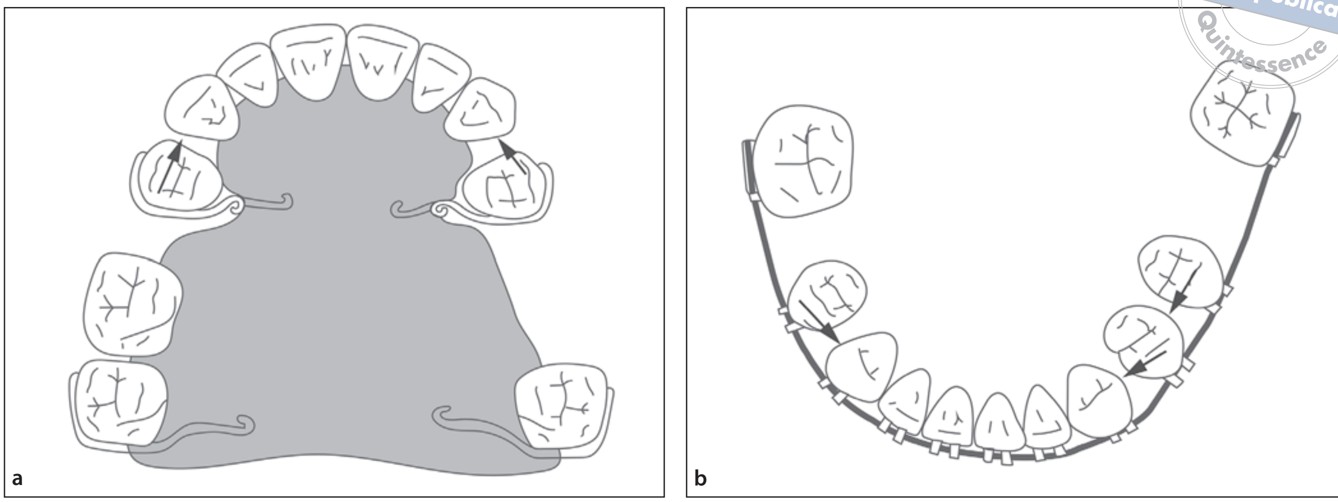

Fig 1-6 *(a)* A removable orthodontic appliance to restore premolar contact prior to prosthodontic treatment. *(b)* Treatment by orthodontic movement to restore tooth position with bodily tooth movement.

Therefore, two treatment objectives for a partially edentulous patient are to do the following:

1. Stabilize the individual arch and protect remaining hard and soft tissues
2. Organize interarch functions (proper occlusal vertical dimension, occlusal plane, and centric occlusal contact) and esthetics

A well-designed RPD should provide cross-arch support, unite the remaining teeth, restore function, and control the direction of force onto remaining teeth and edentulous bearing surfaces without violating the biomechanical equilibrium.

Methods of Restoring and Stabilizing the Partially Edentulous Arch

Repositioning teeth

In some situations it may be advantageous to consolidate individual arch segments by repositioning the teeth with orthodontic devices (Fig 1-6). The missing segments can then be restored with conventional FDPs, implant-supported FDPs, RPDs, or a combination of these.

Individual restorations

When individual teeth are lost, teeth adjacent to the resultant edentulous space migrate out of position and lose interproximal contacts, disrupting relationships with the opposing occlusion. If the spaces are not excessive, mesiodistal contacts can be restored with individual restorations. Re-establishing proximal contacts restores the integrity of the arch, allowing it to function as a unit as before (see Fig 1-7).

Fixed dental prostheses

Sometimes an FDP is used to restore the integrity of the remaining dental arch or individual arch segments so it may function as a continuous unit, and an RPD is used to replace the teeth in the posterior and/or anterior extension areas (Figs 1-7 and 1-8). The degree of arch stability thus created is dependent upon the number of teeth involved in the restoration and the quality of the periodontal support provided by each of the abutments versus the value of cross-arch stabilization that could have been achieved if an RPD was employed. FDPs and individual restorations can also be used to unite individual arch segments and to idealize the occlusal plane; this practice is especially advantageous when the RPD opposes a complete denture.

Good examples of these approaches are shown in Figs 1-7 and 1-8. The patient in Fig 1-7 presented with multiple missing teeth in the mandible opposed by an edentulous maxilla. The mandibular left molars and the incisors have also been lost. The residual dentition on the right side is disorganized with individual teeth tipped, disrupting the plane of occlusion. The FDP was used to restore the integrity of this arch segment and to idealize the occlusal plane before the mandibular RPD and maxillary complete denture were fabricated. Such an approach to treatment leads to more sustainable long-term clinical outcomes.

The patient in Fig 1-8 presented with multiple spaces and diastemata secondary to tooth loss and migration of the remaining teeth (see Fig 1-4). The integrity of the maxillary arch has been restored with individual crowns and an FDP. Thus restored, the arch can function more like a continuous unit,

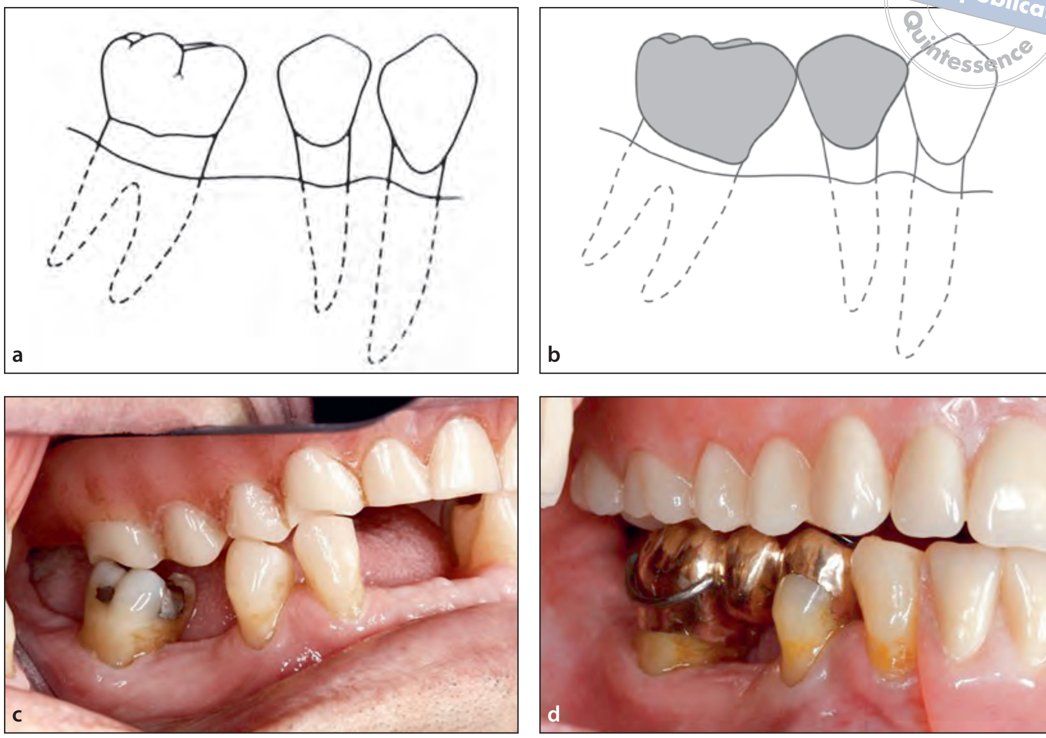

Fig 1-7 *(a)* Migrating teeth resulting in disorganization of the occlusion. *(b)* Contacts, occlusion, and stability restored with overcontoured restorations. *(c)* Following the loss of several teeth, those remaining have migrated and tipped. Note that the molar is tipped to the mesial and that the interproximal contact has been lost between the canine and the premolar. The patient has an edentulous extension area in the left posterior region, and the incisors have also been lost. *(d)* Before the RPD is fabricated, the integrity of this arch segment is restored with an FDP. Such practice leads to sustainable results with an RPD. (Parts *c* and *d* courtesy of Dr J. Kelly, Omaha, Nebraska.)

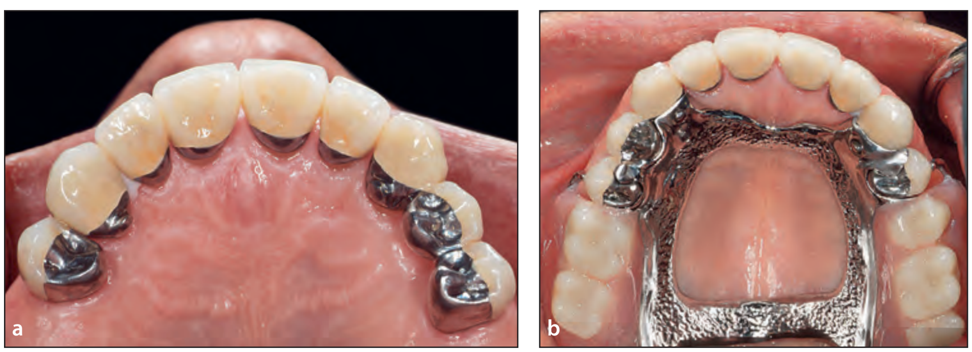

Fig 1-8 *(a)* The dental arch of the patient shown in Fig 1-4. Integrity of the arch has been restored with crowns and an FDP. *(b)* An RPD was fabricated to restore the missing posterior teeth. (Courtesy of Dr A. Davodi, Beverly Hills, California.)

distributing the forces delivered during occlusal function more widely among the individual units as opposed to an isolated tooth or arch segment.

Osseointegrated implants

Individual teeth and missing arch segments can be restored with dental implants given sufficient bone volume at the implant sites and an adequate number of implants[14] (Fig 1-9). They can also be used in combination with an RPD to facilitate retention and improve the esthetic outcome. For example, in a patient with a large extension defect, the implants can be used as overdenture abutments to facilitate support (see chapter 16).

Fig 1-9 Dental implants have been used to replace the mandibular right second premolar and first molar but also serve to restore arch integrity, stabilizing the position of remaining teeth and allowing the arch to function as a unit. (Reprinted from Beumer et al[14] with permission.)

Fig 1-10 *(a and b)* In instances, it is prudent to remove tori prior to RPD treatment.

Fig 1-11 The maxillary molars have supraerupted, disrupting the plane of occlusion. This discrepancy must be addressed before the definitive RPD is fabricated. (Courtesy of Dr T. Berg, Los Angeles, California.)

Removable partial dentures

In posterior edentulous extension areas and partially edentulous arches with long edentulous spans, RPDs continue to be the most cost-effective treatment. However, as noted above, often it is necessary to supplement this treatment with FDPs or individual full-coverage restorations to ensure sustainable clinical outcomes. An RPD can be designed to provide cross-arch support, to stabilize the position of the remaining dentition, and to restore the integrity of the arch as a continuous functioning unit. A properly designed and executed RPD restores a harmonious occlusion and controls and idealizes the direction of forces that are directed against remaining teeth and denture-bearing tissues during function.

Supporting Structures and Other Considerations

Successful long-term treatment outcomes take into consideration the needs of the supporting structures of the residual dentition and the mucosa and bone of the edentulous bearing surfaces. A thorough evaluation of the health of the supporting structures should be undertaken and any pathologic conditions addressed prior to commencing treatment. This may include extraction of diseased teeth, endodontic therapy, periodontal therapy, and splinting periodontally compromised teeth together that are adjacent to an edentulous extension area. If an RPD is planned, preprosthetic surgical procedures may need to be employed prior to treatment such as removal of mandibular or maxillary tori, tuberosity reduction, and maxillary osteotomies to reposition dentoalveolar segments (Fig 1-10) (see chapter 9).

Establishing a Proper Plane of Occlusion

Restoring a proper plane of occlusion is likewise fundamental to long-term successful treatment outcomes with RPDs, especially when opposed by a complete denture. In some instances it may be necessary to remove teeth and their anchoring bone or perform endodontic procedures on selected teeth and restore them in order to develop a proper plane of occlusion (Fig 1-11).

Professional Responsibility

It is the professional responsibility of the dentist to understand and develop all procedures associated with RPD treatment. Thorough treatment planning and design is the foundation upon which any successful therapy is based. It is the responsibility of the clinician to make these decisions, and they cannot ethically be delegated to other allied heath care personnel.

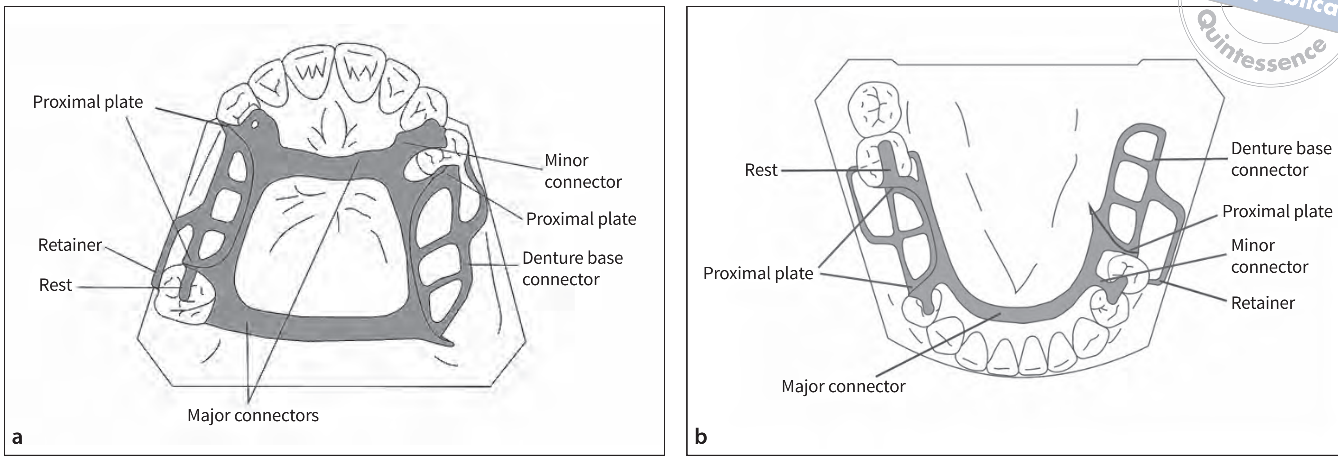

Fig 1-12 *(a)* Components of a mandibular RPD framework. *(b)* Components of a maxillary RPD framework.

Components of an RPD and Their Functions

To provide a systematic approach to partial denture therapy, it is important to identify the parts of an RPD and their functions (Fig 1-12). Each part is presented individually and in the sequence in which it is designed. The parts of the RPD that provide support are considered first.

Rests

A rest is a rigid extension of a partial denture that contacts a remaining tooth in a prepared rest seat to transmit vertical or horizontal forces.

Function

Positive rests control the relationship of the prosthesis to the supporting structures and are contoured and positioned to direct occlusal forces along the long axis of the abutment teeth. As the occlusal force increases, the prosthesis should remain firmly seated in the rest seats prepared in the abutment teeth. The rest should be positioned insofar as it is possible in the center of the abutment tooth. They should never be placed on an inclined plane in such a way as to deliver lateral forces to the abutments. Where necessary, rests can also be used to restore the occlusal plane and provide reciprocation for retainers (see chapter 2).

Major connectors

A major connector joins the components of the RPD on one side of the arch to those on the opposite side.

Function

The major connectors are rigid and provide cross-arch stability (resistance to lateral forces) for the RPD and in some instances enhance support (resistance to occlusal forces). In the mandible, the prime example is the lingual bar. This rigid bar connects the components from one side of the arch to the other side, and its rigidity enhances stability. The prime example in the maxilla is the anteroposterior palatal strap (see chapter 4).

Minor connector

A minor connector is the connecting link between the major connector of the RPD and the other units of the prosthesis, such as the clasp assembly, indirect retainers, occlusal rests, or cingulum rests.

Function

The minor connectors are strong, rigid components of an RPD that provide stability (resistance to lateral forces) (see chapter 4). They can also be used to facilitate frictional retention when proximal surfaces, through which the minor connectors traverse, are recontoured to be parallel to the guiding surfaces.

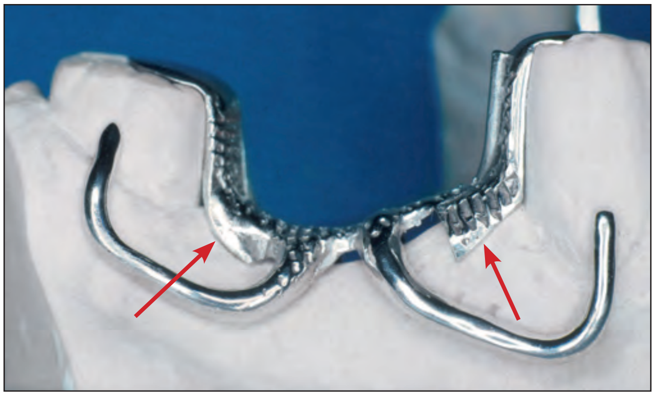

Fig 1-13 Proximal plates are plates of metal in contact with proximal surfaces of the abutment teeth. They should extend 2 mm onto the mucosa of the alveolar ridge *(arrows)*.

Proximal plates

A proximal plate is an extension of the minor connector in contact with the proximal surface of the abutment tooth (Fig 1-13).

Function

The proximal plates maintain arch integrity by an anteroposterior bracing action. If the guide planes on the abutment teeth, which the proximal plates engage, are relatively parallel to one another, they also enhance retention by frictional contact. They can also be designed to provide reciprocation for a retainer (clasp). According to the Kratochvil philosophy, they are extended to cover the gingival margin and extend approximately 2 mm beyond the tooth-mucosa junction onto the edentulous area (see chapter 3).

Denture base connectors

A denture base connector is the part of the RPD to which the resin denture base is connected.

Function

The denture base connectors provide a strong rigid support structure for attachment of the acrylic resin portion of the prosthesis containing the teeth.

Retainers

A retainer is the component of an RPD used to prevent dislodgment, usually consisting of a clasp assembly or precision attachment.

Function

The retainers can provide both retention and stability (bracing action). A properly designed retainer also helps to control the position of the prosthesis in relation to the remaining teeth and supporting structures (see chapter 5).

Denture base

A denture base is the part of the denture that rests on the edentulous bearing surfaces and to which the denture teeth are attached.

Function

The denture base engages the edentulous bearing surfaces. A properly extended denture base (eg, extending the denture base to cover the retromolar pad and buccal shelf in a mandibular extension-base RPD) will significantly enhance the support (resistance to the vertical forces of occlusion) for the RPD and limit the resorption of the underlying bone.

Impact of Digital Technologies on Design and Manufacture of RPD Frameworks

Computer-aided design/computer-assisted manufacture (CAD/CAM) systems are beginning to have a significant impact on the design and fabrication of RPD frameworks (Fig 1-14). Presently, the master cast is scanned and the RPD framework is designed and printed in a light-curing resin. The printed resin pattern is then invested and cast in the usual manner.

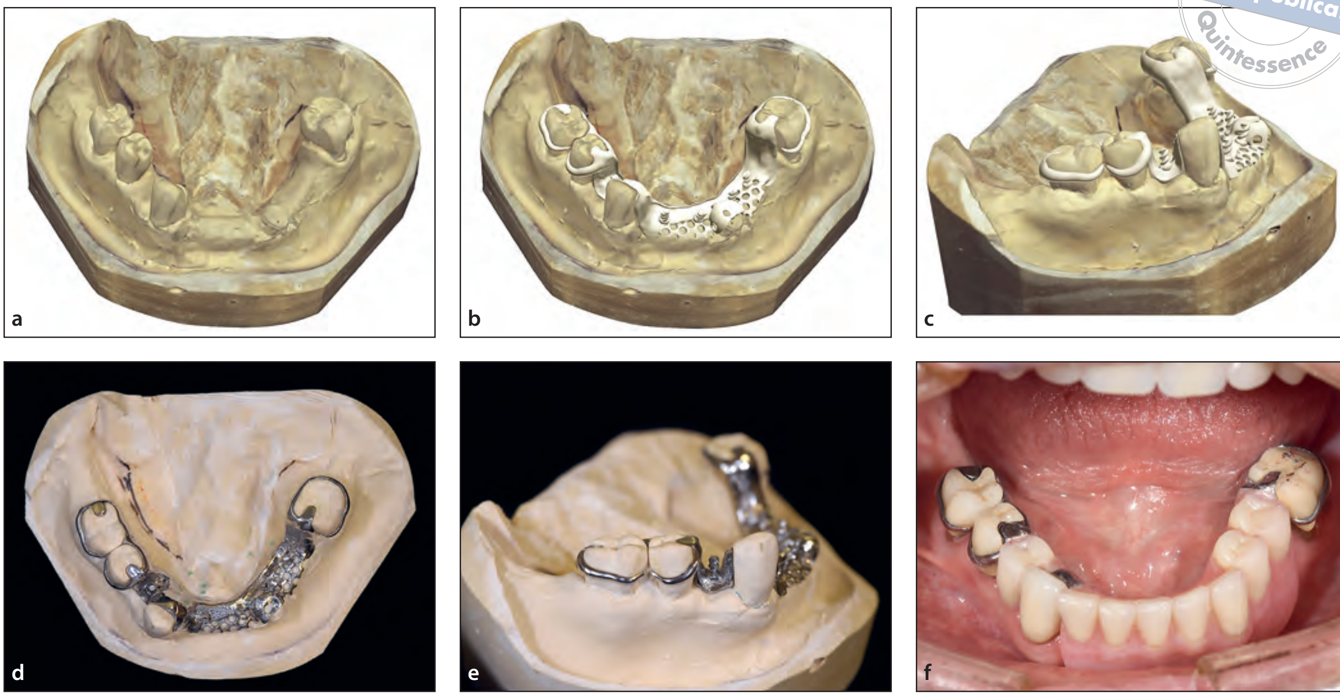

Fig 1-14 *(a)* Digitized master cast. *(b and c)* Virtually designed RPD framework. *(d and e)* Cast framework seated on the stone master cast. *(f)* Completed prosthesis seated intraorally. (Courtesy of Dr J. Jayanetti, Los Angeles, California.)

However, it is not yet possible to fabricate RPD frameworks with CAM techniques with the accuracy and consistency necessary for clinical use. In the past, most of the techniques were "subtractive" (eg, three-dimensional milling), and this approach was made difficult by the lack of bulk and ease of deformation of portions of most RPD frameworks. However, recent advances in additive manufacturing techniques, specifically selective laser melting (SLM), have made it possible to fabricate RPD frameworks of reasonable accuracy.[15]

Conventional impressions have remained the most cost-effective and accurate means of obtaining a full-arch master cast, although this method may also be displaced by intraoral scanners in the not-too-distant future. Presently, the master cast can be scanned and surveyed with available software (Dental System, 3Shape); a specific path of insertion can be identified; and undercuts can be identified, quantified, and blocked out virtually as needed. The RPD framework can then be designed consistent with the principles of RPD design (see chapter 11). The RPD design data can be transferred as an STL (standard triangulation language) file and imported into an SLM rapid prototyping system for fabrication in chrome cobalt. The frameworks are finished and polished in the usual fashion. Fit and finish have been shown to be nearly comparable to those obtained with conventional fabrication methods.[15] These methods are becoming increasingly cost-effective and nearly as accurate as conventional methods of design and fabrication, and the time is rapidly approaching when they will be.

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Suggested Reading

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