WHAT IS FIXED FULL-ARCH IMPLANT DENTISTRY?

CHAPTER 1

Commitment: Don't overlook opportunity, and take calculated risks.

Keep your eyes open. There are opportunities everywhere; don't be afraid to risk taking one if it aligns with your goals and purpose.

FIXED FULL-ARCH IMPLANT DENTISTRY DEFINED

I have observed and participated in the fixed full-arch dental implant space since my introduction to the All-on-4® concept in 2003. The way it is being explained, discussed, and taught among clinicians today is changing.

The term *fixed full-arch implant dentistry* encompasses a treatment modality that provides full-arch rehabilitation for a patient utilizing dental implants and a fixed dental prosthesis.

This prosthesis can only be removed by a dental clinician. There is a surgical phase in which four or more dental implants are placed and a prosthetic phase where these implants are used to fully support a fixed dental prosthesis. This fixed prosthesis can occupy a defect that includes missing teeth as well as lost bone and tissue. It is designed for rehabilitating patients that are edentulous, partially edentulous, or in a failing dentition.

In the past, fixed full-arch implant dentistry was perceived by many general dentists, including myself, as confusing, time consuming, nonprofitable, and tedious. It was an analog process, generally involving multiple clinicians and laboratory technicians. At present, many dentists placing and/or restoring full-arch dental implants are interested in a more pragmatic approach to fixed full-arch implant dentistry that is simpler, profitable, more efficient, systematic, and rewarding.

> There are five stages to a practical approach for fixed full-arch implant dentistry. This book reviews each stage and its corresponding parts in a step-by-step manner. The five stages are:
> 1. Patient Selection and Data Collection
> 2. Prosthetically Driven Case Engineering and Design
> 3. The Surgical Process Utilizing a Stackable Surgical Guide System
> 4. A Simplified Prosthetic Workflow
> 5. Hygiene and Maintenance

BACKGROUND AND HISTORY OF FIXED FULL-ARCH IMPLANT DENTISTRY

Fixed full-arch implant dentistry did not make its entry into dentistry overnight like some other procedures and technologies that have appeared recently. Fixed full-arch implant dentistry has evolved over time and is rapidly becoming very popular among dentists who practice and promote dental implant therapy.

The evolution of full-arch dental implant therapy has been in progress for over 50 years. It began when Per-Ingvar Brånemark—considered by most in our profession as the patriarch of dental implants—placed the first titanium dental implant into a human volunteer in 1965. He coined the term *osseointegration*. In the years that followed, the "root-form" type of implant made of titanium was developed. Implants were adopted by our profession as the standard of care for replacing a tooth or several teeth. Prof. Brånemark made the following statement that has always resonated with me and has become part of my own philosophy:

> A decisive factor in patient care is simplification of treatment, which should be based on identifying and utilizing the enormous capacity of existing original anchoring tissues. When possible, one should avoid unnecessary advanced and complicated major grafting procedures[1].

In the mid to late 1980s, Dr. Carl Misch developed a classification for dental implant prostheses (abbreviated as FP1, FP2, FP3, RP4, and RP5) that remains in use today[2]. The All-on-4® technique itself was developed in the early 1990s by Dr. Paulo Maló to provide a set of fixed teeth that were immediately loaded for elderly patients who were not good candidates for bone grafting. The term *All-on-4* was later coined by Dr. Maló after he and others performed a series of studies funded by Nobel Biocare to determine the efficiency and cost effectiveness of the approach. It was formally introduced in 2003 and All-on-4 become commonly recognized by dentists and the public alike.

In the years since then, advances in treatment planning software and digital design and engineering have been made. CAD/CAM milling, 3D printing, and the introduction of new materials have all helped shape fixed full-arch implant dentistry. Digital diagnostic data can be collected, uploaded, and merged into software. Interim prostheses, as well as dental implant type, size,

and positioning, can be digitally planned. Some surgeons have begun to switch from manual surgery to a guided approach. Once a patient is ready to transition to their definitive prosthesis, the case can be completed with digital technology that is making analog processes obsolete. Dental companies, laboratories, and clinicians have started to collaborate to create an even more predictable way to integrate cutting-edge technology within the dental industry into this space.

DEFINITIONS AND CLASSIFICATIONS OF FIXED FULL-ARCH IMPLANT-SUPPORTED PROSTHETICS

In order for the reader to understand the prosthetics used in fixed full-arch implant-supported dentistry, I will review some classifications that have become widely accepted by dentists throughout the world. Please note, however, that the lines between the different types of fixed prostheses have become blurred over the past several years. This is due to advances in implant and restorative technology. Moreover, some clinicians have recently proposed new categories for classifying patients and determining which prosthesis is most appropriate. To date, however, none has been widely adopted within the industry.

Most dentists today recognize the three types of fixed full-arch implant-supported prostheses described below.

Fixed prosthesis 1 (FP1) (Fig. 1.1)

The FP1 is the most complex and formidable type of full-arch implant surgery and fixed prosthetic dentistry. It is not for the weak of heart, it requires both extraordinary skill and extensive knowledge of bone and soft tissue manipulation on the part of the surgeon, and the associated laboratory costs can be astronomical. Historically, the FP1 was typically surgically sequenced in stages: In qualified patients, teeth were serially extracted, implants were placed in a submerged fashion, and the remaining dentition was used to support temporary fixed partial dentures. Once the implants osseointegrated, the remaining teeth would be extracted, additional implants would be placed, and the osseointegrated implants would support new temporary bridges. Finally, the case could be restored with a more definitive prosthesis. Today, it is more common to do this type of procedure without having to extract the teeth in stages if primary stability of the implants can be achieved. The introduction of multiunit abutments (MUAs), stronger temporary materials, implants designed for immediate placement and loading, and more reliable grafting techniques have made this possible.

Figure 1.1 **An example of a maxillary FP1 prosthesis except with significant gingival scalloping and contours.**

The **FP1**:

- Can be used in patients with minimal loss of hard and soft tissue
- Replaces only the teeth or crowns and generally includes no pink porcelain
- Is most often desirable in the maxillary anterior region for esthetics
- Is typically supported by six to eight dental implants (or more) often positioned similarly to the roots of the natural teeth
- May require complex bone grafting and augmentation in patients with deficient crestal bone
- May require the patient to undergo gingivoplasty and soft tissue grafting to improve gingival contours in order to address esthetic concerns
- Has required restorative material that was traditionally porcelain-fused-to-metal, but full monolithic and multilayer zirconia is becoming more popular
- Restorations were traditionally built direct to implant and utilized crowns and/or fixed partial dentures on custom implant abutments. Today, many clinicians are using MUAs and designing the definitive prosthesis with either multiple-section or full-arch style bridges
- May involve several dental implant procedures and can take between 6 months and a year or more to complete.

Fixed prosthesis 2 (FP2) (Fig. 1.2)

To me, the FP2 is a kind of crossbreed of the FP1 and FP3. It can have similar complexity, cost, and implant design as the FP1. It is only esthetically acceptable in patients who do not expose gingival tissue with an exaggerated smile. The FP2 allows the clinician to preserve more bone (when appropriate) than the FP3.

Figure 1.2 **An example of a maxillary FP2 prosthesis built on custom abutments using traditional crown and bridge restorations. This photo was taken 5 years postoperative. Note that the teeth are elongated with a complete lack of papillae.**

The **FP2**:

- Can be used in cases with limited bone loss and with slight gingival recession
- Replaces teeth or crowns and a portion of the root but features little or no pink porcelain
- Has a gingival one-third of the crown that is overextended
- Requires implant placement that is less prescriptive than the FP1 prosthesis, and papillae may or may not be present
- Allows for six to eight (or more) implants to be utilized to support the definitive prosthesis, like the FP1
- Creates an impression of longer teeth in the definitive prosthesis than in an FP1
- Traditionally was fabricated with porcelain-fused-to-metal alloy, like the FP1, but today is often made with full monolithic and multilayer zirconia
- Like the FP1, was often built on custom implant abutments with traditional crown and bridge designs and a direct interface with the dental implants. Today, clinicians are using MUAs as an alternative and designing their FP2 cases much like the FP1s
- Shares a similar timeline to complete as the FP1.

Fixed prosthesis 3 (FP3) (Fig. 1.3)

The FP3 design is what many commonly refer to as the All-on-4 or All-on-X. This design has become increasingly popular among dentists and patients alike. Compared with other options, the cost of the FP3 can be more affordable, there are fewer surgical concerns, and it takes less time to reach completion. Is it the best choice for every patient needing a full arch of dental implants? No, but planned properly, keeping bone reduction in consideration, and maximizing implant support throughout the ridge, this can be a very acceptable prosthesis. I find that many of the patients I serve who have failing dentitions or are fully or almost fully edentulous are good candidates for the FP3 design.

The **FP3**:

- Is a good option when natural resorption has reduced bone height, or bone reduction is required for restorative factors (discussed later in chapter)
- Replaces the missing teeth, gingival architecture, and a portion of the edentulous ridges
- Closely resembles natural dentition and soft tissues when visible during function, speaking, and smiling
- Allows implant placement that is less restrictive compared with the FP1 and FP2
- Requires four to six dental implants
- Offers more options for restorative materials. Substructures have been fabricated from titanium, polyether ether ketone (PEEK), zirconia, and cobalt-chrome, and teeth and gingival architecture may be acrylic, milled, or printed polymethylmethacrylate (PMMA), zirconia, resin composite, or other restorative materials. In addition, new options for substructures, teeth, and gingiva are being developed at a rapid pace.
- Can be completed in as little as 3 to 6 months.

Figure 1.3 (a, b) Two examples of FP3 prostheses in both the maxillary and mandibular arches. Note the presence of gingiva as well as teeth within the prostheses.

THE RIGHT PROCESS AND DESIGN FOR YOUR PATIENT

Each of these prosthetic designs can be accomplished utilizing prosthetically driven case engineering and design, a stackable surgical guide system, and the simplified prosthetic workflow. The surgical process I follow for providing fixed full-arch dentistry to my patients is to extract all remaining dentition, place the dental implants with a stackable surgical guide system, and deliver and immediately load the interim prosthesis all in one visit. The case examples presented in this book will be representative of that. The FP3 design is what I most commonly use in my practice. This is due to many patients failing to meet the requirements for other designs or not being able to afford a more expensive option.

An argument made by some clinicians, mostly academics, is that the design of a case should be based solely on objective physical factors. In the world of academia, practical matters such as the financial and time commitment to the patient and other elements affecting a private practitioner are often overlooked. I would suggest that before settling on a particular design, whether it be FP1, FP2, or FP3, the clinician should consider the patient's desires and expectations as well as their corporeal attributes.

The advantages and disadvantages of the various fixed full-arch implant prosthesis designs should be discussed with patients no less thoroughly than those considering a removable prosthesis. During the initial planning phase, it is important to determine which designs your patients are candidates for and then go through the process of settling on which of those is most appropriate for them.

THE OSTEOPLASTY DEBATE

The need to reduce a considerable amount of bone that sometimes occurs in fixed full-arch implant dentistry has become a source of contention over the years. There are clinicians and academics on both sides. Critics argue that bone reduction is not good for patients. Excessive bone reduction can lead to disability in the event of a catastrophic failure of the implants. Such patients would have to consider additional and more expensive procedures such as sinus elevation and (additional) bone grafting. Dental implants placed in the zygoma and pterygoid regions of the maxilla, and possibly nerve repositioning in the mandible, might also be necessary. However, bone reduction is needed in some cases to avoid esthetic complications. One example in an FP3 type of design is where the transition line between the prosthesis and the patient's maxillary gingival anatomy becomes exposed during smiling. In addition, a certain amount of restorative space must be available to create a prosthesis with strength and longevity. As yet, no standard of care has been established to determine what is appropriate when it comes to bone reduction. Using a prosthetically driven workflow and logical principles to safeguard as much bone as possible are becoming expected concepts when it comes to fixed full-arch implant dentistry. Fortunately, with careful planning, design, and engineering, appropriate bone levels can be preserved.

OBJECTIVES FOR FIXED FULL-ARCH DENTAL IMPLANT REHABILITATION

Clinicians must continually remind themselves of the goals of full-arch implant rehabilitation. Without understanding your own goals as well as those of your patients, you may not succeed in meeting anyone's expectations.

What matters most to patients

Over the years, I have learned that most patients want four things (not necessarily in the order presented).

Function

Patients who have failing dentitions or are edentulous want to be able to eat the foods they love again. Overlooking a patient's masticatory ability and desires is a recipe for disaster. Your objective should be to enable the patient to eat anything on the menu at their favorite restaurant. Of course, there are things that even people in perfectly healthy natural dentitions should not chew. However, if you can give your patients the ability to eat most foods, they will be delighted.

Phonetics is also a part of function. Even though most patients have acceptable speech when you first meet them, those who do not use a fixed or removable appliance or do not have their natural front teeth may struggle to be understood. It should be our goal to give the patient understandable speech that is as good as or better than what they already have.

Confidence

Having confidence in one's smile means being able to interact with others without having to hide one's teeth.

Patients want to be able to speak, smile, and laugh without conscious or subconscious thoughts about what others might be thinking about their teeth. This is paramount to an individual's self-esteem. Patients will sometimes minimize the importance of esthetics to their dentist because of shame and the fear of being judged as vain. In my experience, all patients who go through a rehabilitative dental procedure are interested in improving their appearance to some degree. If the eyes are the window to one's soul, the smile is the front door.

Freedom from pain and discomfort

Patients with missing, broken, or decayed teeth may or may not be in any pain. Many of the dentally disabled patients I visit with have somehow adapted to their situation. However, a certain percentage of patients suffer daily from odontogenic pain. By treating and resolving infection and other sources of pain, we can provide healthier outcomes to our patients both physically and emotionally.

Health

This is usually most important to us as dentists but not always at the top of a patient's list of priorities. In recent years, however, I have noticed that more people have become familiar with the oral-systemic relationship, probably because of the growing attention it has been given in the media, on the internet and

social media platforms, as well as by dental health care professionals. Some patients appreciate the link that their mouths have to the rest of their body and are interested in living a healthier lifestyle and extending their lifespan.

My case-planning goals

A fixed interim prosthesis within 48 hours of surgery: *Gratification*

I am a strong believer in loading implants immediately or shortly after surgery with a fixed interim prosthesis. Patients coming to me for rehabilitative implant dentistry are tired of wearing removable appliances or are generally not interested in having teeth removed and being tethered to a denture for even a few months. Although we cannot always promise a patient that they will have a fixed prosthesis after surgery, it is my goal to create value right from the beginning. We can do this by improving their smile and confidence with an immediate fixed prosthesis.

Stability with long-term function and esthetics: *Predictability*

Patients who accept complex restorative implant dentistry are not interested in having the procedure done repeatedly. Unlike much of the restorative dentistry we do, dental implants are considered by our patients to be "permanent." We are very careful to explain to patients that nothing that is in function lasts forever. But our goal is to create an implant foundation that satisfies our patients with long-term service, provided appropriate maintenance is carried out.

A pragmatic surgical and prosthetic protocol: *Efficiency and Profitability*

As a clinician, I am interested in being efficient whenever possible. Efficiency increases profitability, which then allows me to create success for my team as well as our practice. Patients are concerned with efficiency as well. Most people value their time and will appreciate your efforts to streamline a process for them. Using a guided surgical protocol and a simplified prosthetic workflow, we have been able to reduce the amount of time and appointments for patients.

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Hygiene and maintenance: *Maintainability*

Without the means to maintain their new teeth and implants, patients may eventually have issues that lead to catastrophic failure. It is important to have a support plan in place for patients to help them manage their dental implants and prosthetics. Many patients assume that after a fixed full-arch dental implant procedure, they are free of the dentist at last. "Completely the opposite" is the message I give to my patients, and I like to use analogies about automobiles: "Would you buy a Mercedes and never take it in for an oil change?" Dentists and patients should understand that there are prosthetic forces and loading conditions, as well as biologic factors, that can create significant complications if hygiene and maintenance are not addressed.

Avoidance of unnecessary bone grafting, multiple complex surgeries, and other case complexities: *Affordability*

One of the great benefits of fixed full-arch dentistry is that the surgery can frequently be performed without additional complicated forms of bone augmentation and soft tissue grafting. In addition, there is generally one surgical visit vs. multiple surgeries when the traditional serial extraction method is employed in the FP1 and FP2 approach. With advancements over the years, particularly with the introduction of the All-on-4, we know that fewer dental implants are necessary for prosthetic stabilization. All these elements factor into a more cost-effective option for my patients. Granted, the expense of undergoing fixed full-arch implant rehabilitation can be significant, but our goal is to give patients an affordable alternative to more expensive procedures.

OPTIONS FOR EDENTULOUS AND PARTIALLY EDENTULOUS PATIENTS

Fixed full-arch implant-supported prostheses are not the only option for patients who are edentulous, partially edentulous, or have failing dentitions. Although I will be addressing fixed full-arch dentistry throughout this book, it is important to have an overview of what else is out there and what other options are available to patients. This not only gives us a better idea of what the advantages and disadvantages are but also a deeper understanding of why a fixed full-arch rehabilitation may or may not be a good treatment plan for the patients we serve.

Traditional dentures

Complete maxillary and mandibular dentures have been an option for patients who are fully edentulous since the beginning of dentistry (Fig. 1.4). Humans have been replacing their own teeth with teeth from animals or other humans, stones, ivory, and shells since as early as the seventh century BC. People have never wanted to be without teeth, but until the last several decades, the options for fully edentulous patients were limited.

Figure 1.4 **Maxillary and mandibular complete dentures with open-face gold crowns on the maxillary lateral incisors.**

For patients, the modern denture offers both advantages and disadvantages.

Advantages

Cost

The most cost-effective of all options, dentures can vary from hundreds of dollars when provided by a so-called denture mill to thousands of dollars when provided by a general dentist or prosthodontist.

Time

Dentures can be fabricated quite easily due to the advent of scanning technology. A set of "digital" dentures can be completed in as few as two visits.

Removability/ease

The fact that these appliances are removable by the patient with little or no effort may be seen as an advantage as well as a disadvantage. For some patients that may be a benefit, but for others it may be a drawback.

Low maintenance

Denture wearers need to visit the dentist less frequently than individuals with natural dentitions or dental implants. An annual visit for an oral exam and cancer screening as well as evaluation of their appliances is considered acceptable within the industry. Dentures are easy to keep clean and maintain.

Elimination of disease

If a patient is in a failing dentition where there is infection present, removing the teeth creates a healthier overall situation. Dental caries, periodontal disease, and tooth abscesses can be eliminated by removing teeth.

Esthetics

Typically, a patient in an edentulous or failing partially edentulous situation can gain pronounced cosmetic improvement with dentures. There are also ways to be creative with dentures to provide realistic-looking teeth.

Mastication

Chewing may improve for patients with a well-fitting denture compared to a fully edentulous or partially edentulous situation.

Disadvantages

Removability

Though it may be an advantage for some patients, a removable option may not be advantageous for most people. One of the most common complaints I receive from patients with dentures is that they dislike having teeth that are removable.

Bone loss

Most patients do not understand the fact that their bone resorbs as soon as they lose a tooth or teeth. Fear of losing additional bone is a strong motivation for patients to pursue implant options. Bone loss leads to loosening of the dentures over time and in turn creates poor fit of the dentures and collapse of the facial vertical dimension, among other problems.

Phonetic challenges

Many patients report that they experience phonetic challenges when wearing dentures. Up to 88% of patients who are fully edentulous complain of some difficulty with speech[3].

Decreased masticatory ability and stability

Compared with patients in implant-retained/supported prostheses, patients in dentures are significantly more challenged in their chewing. Removable appliances move and shift, creating a considerable struggle which many patients have difficulty adapting to. Although these appliances may feel somewhat stable to a clinician, function, motion, and sometimes speech can cause them to dislodge or become loose. This is why denture adhesive is a multi-billion-dollar industry.

Loss of muscle tone

In patients who are edentulous, the muscles of facial expression lose tone, and ptosis of the buccinator and mentalis muscle attachments occur[3].

Taste impairment and possible gagging

In a traditional denture, the palate is covered. Most patients wearing dentures report significant impairment in their ability to taste, and for those with an active gag reflex, adapting to a removable appliance may be difficult or impossible.

Emotionally disabling

Wearing a denture was considered somewhat socially acceptable for the Silent Generation (those born in the years 1925-1945), where-

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as the Baby Boomer generation and beyond seem to be much less satisfied with the idea of wearing traditional dentures. For many, there is a stigma attached to dentures that triggers embarrassment and shame. These individuals find dentures less socially acceptable and are less satisfied with a denture option.

Adaptability

Younger patients tend to adapt more quickly to wearing dentures than older patients. The high level of neuroplasticity that is required by denture wearers is less available as patients get older. Therefore, as people age, they are less likely to cope with wearing dentures.

Overdentures

Overdentures are relatively new compared to traditional dentures. Although they may look similar to traditional dentures when they are in place, overdentures can be retained or supported by dental implants and, in some cases, with natural teeth equipped with anchoring devices. A large variety of designs and types of overdentures are available. Many different types of dental implant designs have been used to support or retain overdentures. These vary from mini and small-diameter implants to traditional and even subperiosteal implants. Attachments for overdentures abound. Moreover, in addition to bars and other underlying supports, overdentures can be designed to fit directly on implants.

Overdenture designs that derive support and retention from dental implants, often using cast and/or milled bars attached to the implants, are referred to as *RP4* appliances, or implant-supported overdentures. Overdentures that use dental implants primarily for retention and rest on the soft tissues for support are referred to as *RP5* designs, or implant-assisted overdentures (Figs. 1.5-1.10).

Overdenture designs have changed and new designs and configurations have proliferated over the years. Consensus about what the standard of care should be is lacking. There is some agreement among clinicians that overdentures offer advantages over traditional removable dentures,

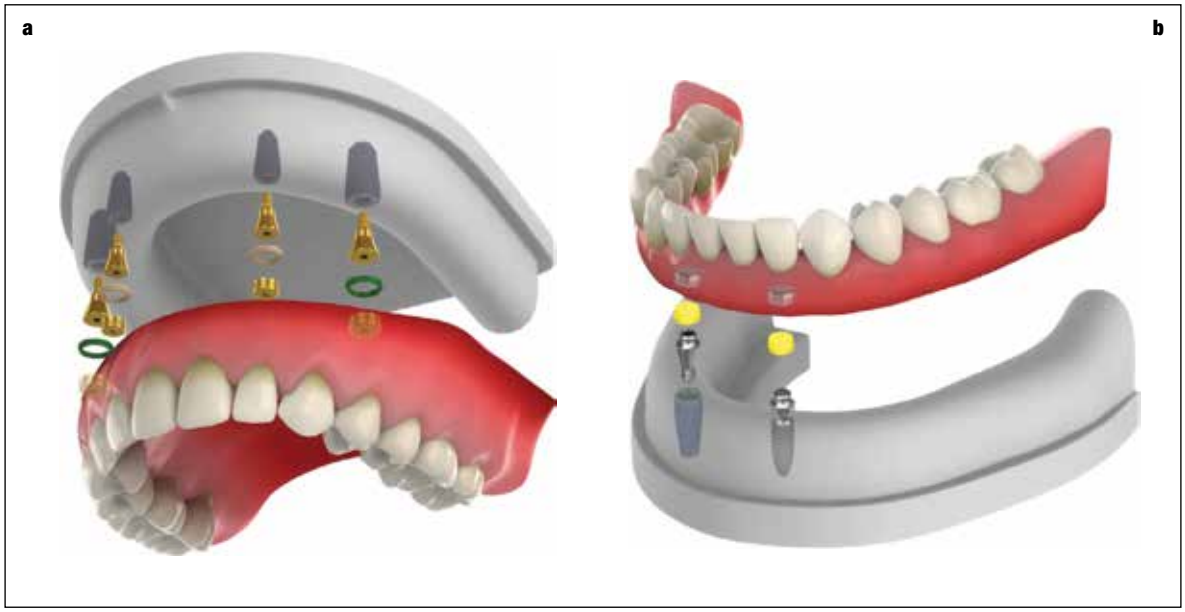

Figure 1.5 Illustrations of RP5 overdentures. (a) An RP5 design that uses four implants to retain a maxillary overdenture. (b) An RP5 design that uses two implants to retain a mandibular overdenture. Both examples use implants for retention and the soft tissues for support. *Source: Courtesy of MegaGen America.*

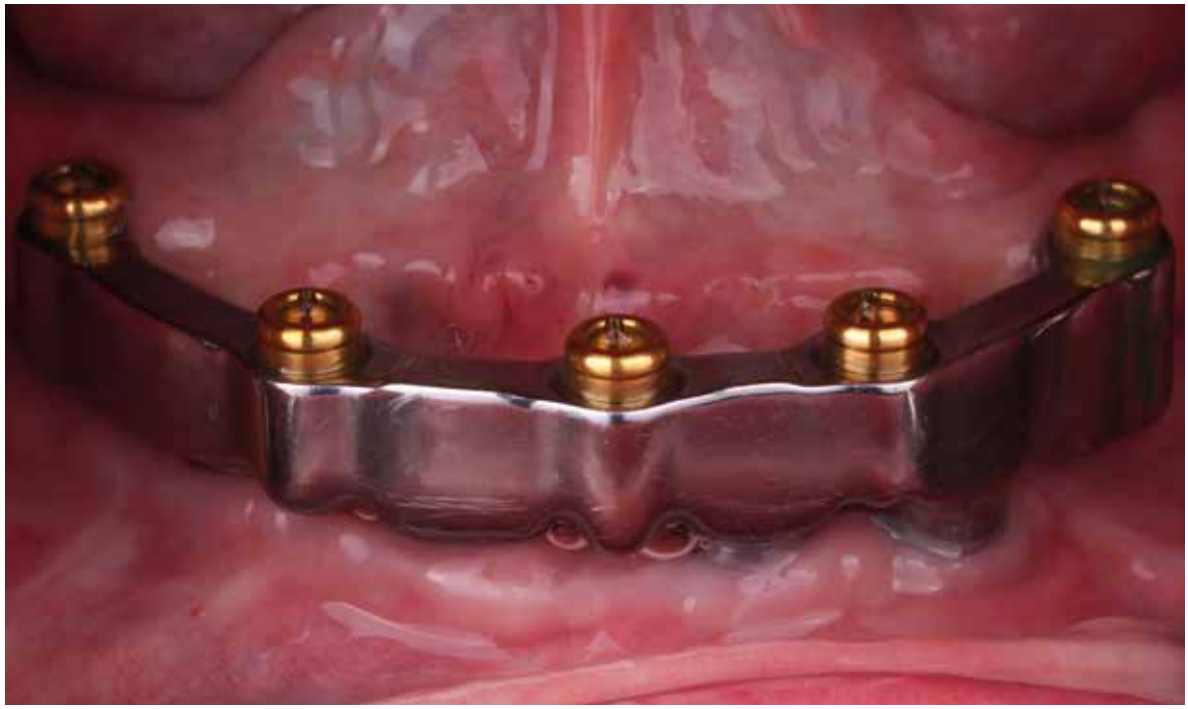

Figure 1.6 Example of a mandibular RP4 overdenture bar fabricated from milled titanium and five Zest Locator® abutments.

Figure 1.7 Printed overdenture (RP4 design) with polyether ether ketone (PEEK) thermoplastic polymer embedded into the intaglio surface holding Locator housings and nylon inserts.

Figure 1.8 Implants placed in the mandibular arch with abutment fixtures designed to retain an overdenture. This is an RP5 design.

Figure 1.9 Printed mandibular overdenture.

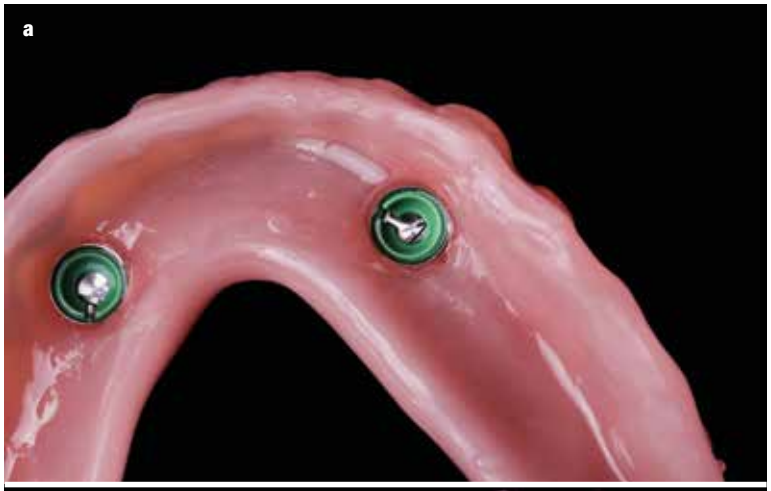

Figure 1.10 (a, b) Printed mandibular overdenture in an RP5 design. This is a Neodent Novaloc® (Straumann) case with titanium matrix housings and retention inserts.

especially when the appropriate number of implants and distance between implants is ideal. However, the failure rate of dental implants is higher in cases where the overdenture is retained or assisted by implants vs. supported by them[4, 5].

For clarity and simplicity (and because of its current popularity in dentistry), the discussion of advantages and disadvantages below is based on a maxillary overdenture using four individual, nonsplinted, traditional dental implants with an abutment that has a retention design. This appliance, referred to as an *RP5*, can be described as an overdenture that takes advantage of dental implants as retention fixtures and for assistance, mostly supported by the edentulous ridges.

Advantages

Removability/ease, low maintenance, elimination of disease, esthetics
(See advantages of traditional dentures, above).

Prevention of bone loss
Implants spaced appropriately in the mandible and maxilla can prevent much of the typical bone loss associated with full edentulism. This ridge preservation, although often limited to the anterior regions, reduces patients' chances of losing excessive facial vertical dimension and provides better long-term support.

Improved phonetics and taste (compared with traditional dentures)
In a maxillary overdenture supported by four implants, the palate can often be exposed to some degree, which allows better phonetics for some patients. In addition, it gives patients the ability to taste food as they would with a natural dentition. Although the palate is not entirely open, simply having the center removed is very freeing for most if not all the patients for whom I have provided this service.

Stability
Patients are most aware of the stability of their overdenture during chewing/function and speaking. An edentulous patient will rave about how stable overdentures feel compared to traditional dentures. Overdentures do not require the use of denture adhesives, which is important to many of my patients.

Disadvantages

Removability

Like dentures, overdentures are removable, which is a feature that may be seen as a benefit to some. For the vast majority, especially younger patients or those who have never worn dentures, however, it can be disabling both physically and emotionally.

Not socially acceptable

Patients who are opposed to wearing dentures because of a social stigma of wearing a removable appliance are likely to feel the same about overdentures. As a general rule, overdentures are a significant upgrade for patients already wearing dentures but much harder to adapt to for those with a full or even partial dentition that is failing and may not offer the confidence they are yearning for.

Cost

While a maxillary overdenture tends to be more affordable than a full-arch fixed prosthetic implant option, it can cost considerably more than a traditional denture, especially when four or more traditional implants are used under a reinforced or high-quality prosthesis. Because this option often lands between the two in terms of cost, there are patients who choose to "settle" for this. I usually try to encourage patients to consider a fixed option first. However, if a fixed prosthesis does not fit in their budget and they are good candidates for an overdenture, then an overdenture might be the appropriate choice. Also, if there is enough prosthetic space and appropriate distance between the implants, the possibility of upgrading to a fixed prosthesis may be open to them in the future.

Increased maintenance (compared with traditional dentures)

Implant options will always require more work on the part of the patient. Not only will they need to take care of their implants at home, but I encourage patients with implants to attend a recall appointment no less than once every 6 months. There is some debate over what implant maintenance for fixed and removable implant options are, but very few clinicians would agree that an implant should be placed and then forgotten by the dentist or hygienist. Both the literature and anecdotal evidence show that dental implants are susceptible to peri-mucositis as well as peri-implantitis. Hygiene maintenance should be reviewed with patients before treatment. (See Chapter 10 for more on this topic.)

Replacement parts

Nothing lasts forever, including dental implant abutments and attachments. After several thousand cycles of denture seating and re-

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moval, the abutments and attachments wear out. The attachments, many of which are made of plastic or elastomeric material, tend to wear out first and are easily replaced at an insignificant cost. However, the abutments can also begin to wear and gradually provide less retention of the attachment regardless of how much resistance is applied. Like attachments, abutments are quite simple to replace, but the cost to the patient is more significant.

Retention but not support

Overdentures derive most of their stability from the support of the edentulous arch; implants are only designed to provide retention. It is important to make sure patients understand this, so they know even overdentures need to be relined over time. If an RP5 type of overdenture starts to depend on the implants for support, patients are at more risk of implant failure issues as well as lack of retention.

Fixed full-arch implant-supported prosthesis (Fig. 1.11)

A fixed prosthesis, whether an FP1, FP2, or FP3, is typically the option most clinicians would choose for themselves or a family member. So why would we not want this to be the first option we present to people seeking our help? Let us now consider the advantages and disadvantages of the fixed full-arch implant-supported prosthesis.

Figure 1.11 **A mandibular fixed full-arch implant-supported prosthesis on a master cast or model.**

Advantages

Elimination of disease

Like the previous two options, this option removes odontogenic and periodontal disease and can reduce occlusal and muscular dysfunction.

Prevention of bone loss

By placing enough implants throughout the arch in appropriate, equidistant locations, bone loss in the jaw can be almost entirely prevented in these areas.

Cross-arch stabilization and primary implant stability

Because of the engineering and design of this prosthesis, cross-arch stabilization and primary implant stability can be achieved, and the prosthesis can be immediately loaded.

Efficiency

Fixed full-arch implant-supported dentistry can be quite efficient. Dentists and patients alike are attracted to this process because it

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allows patients to avoid wearing a removable appliance. It also gives patients the ability to be in a fixed prosthesis immediately after surgery in most cases. Efficient workflows help patients avoid additional surgical visits and procedures as well.

Hygiene

Not having to remove dentures or overdentures from their mouth for cleaning is seen as a benefit by most patients. Maintaining these prostheses is straightforward, and most patients are not opposed to brushing and using water flossers around their prosthesis at home.

Unimpaired taste

This prosthetic device has even less palatal coverage than the overdenture and allows patients to experience the normal taste of food as they would with a natural dentition.

Masticatory function

Improved chewing and a more natural-feeling bite can be developed into these prostheses. Most patients report that they chew as well as, or nearly as well as they did with a full natural dentition.

Stability

A fixed prosthesis is far more stable than either dentures or overdentures. Because the prosthesis is supported by the implants and not the edentulous ridges, there is no movement within the system. By eliminating instability, patients acquire a new sense of confidence.

Improved phonetics

Phonetics can be a challenge with all types of dental prosthetics, but with careful planning and custom engineering, the fixed prostheses you create for your patients have a greater chance of allowing them to maintain acceptable speech and to speak without stumbling over their words.

Socially acceptable

In a world where removable teeth are considered a handicap and disabling, the fixed prosthesis is a solution rather than a problem. When made right, a fixed full-arch prosthesis is virtually undetectable by the average nonclinician, and very few patients ever find themselves in situations that make them feel embarrassed or uncomfortable. In fact, patients who have successfully gone through this process in my practice find themselves inspired with confidence, emotionally enabled, and possessed of an improved sense of well-being and self-esteem.

Esthetics

Early in its development, the fixed full-arch prosthesis design and materials were limiting factors in the esthetics of a case. More recently, due to the development of more life-

like materials and the option to digitally plan and design these cases, very few patients complain about their cosmetic transformation. As with any cosmetic dental procedure, esthetics can be less than satisfactory if done incorrectly. However, by following the proper process and paying attention to detail, it is possible to achieve amazing and lifelike, natural esthetics with a fixed full-arch implant restoration (as outlined in the principles of design in Chapter 5).

Reduced risk of damage/loss

Compared to a removable appliance, there is less risk of damage for most patients because the fixed full-arch prosthesis cannot be removed by the patient. And the fact that it is fixed obviously makes it impossible for the patient to lose or misplace it. Making the right material choice and providing protective recommendations to your patients can allow them years of useful benefit with these prostheses.

Disadvantages

Cost

Compared with other teeth replacement options, the cost of a fixed full-arch prosthesis is considerable. In our practice, patients typically spend between US$20,000–$30,000 (or more) per arch, and they will have different expectations of you and your practice when they pay anywhere near that much for treatment. Presenting this option to patients requires a different approach than other options. It is important to spend more time developing a trusting relationship and creating value. Patients who are investing in full-arch implant dentistry are often interested in financing options and/or long-term payment plans.

Along with the initial investment, it is important to consider what a fixed full-arch implant prosthesis will cost a patient over time—for hygiene maintenance visits, for example, or to replace prosthetic screws (and potentially other parts), and possibly to repair or replace their prosthesis at some point in the future. One must also remember the costs associated with potential replacement of one or more failed dental implants or tissue grafting and augmentation procedures that may be needed.

Cont'd ▶

Maintenance

Patients with fixed full-arch prostheses may have the misguided idea that this process is a "one and done," and that is not the case. Patients should be prepared for semi-annual hygiene visits as well as a home care regimen that is more demanding than soaking their dentures at night. Although this may not be considered a disadvantage by most patients, some will choose dentures or removable appliances over a fixed prosthesis because they are less complicated to maintain.

Bone reduction

Denture and overdenture options often require little or no alveolar ridge reduction after teeth are extracted. The prosthetic space requirements are less for most of the removable appliance designs than for a fixed FP3-type prosthesis. Some fixed full-arch implant cases may require a considerable amount of additional bone reduction to create adequate space for the prosthesis. The amount of bone reduction necessary should be thought through carefully to avoid dentally disabling a patient if implant failures were to occur.

FEATURES OF FIXED FULL-ARCH IMPLANT REHABILITATION

The following pages will help you to understand some of the specific attributes of fixed full-arch implant dentistry and why you might consider this option for a patient. The features discussed are more specific to the FP3, or what might be commonly referred to as All-on-X by some practitioners.

Characteristics of the ideal patient

Typically, the ideal patient for a fixed full-arch prosthesis has lost bone volume via natural resorption as a result of full or partial edentulism, particularly in the posterior areas. Patients who lose bone secondary to periodontal infection or disuse atrophy may begin to show signs of a collapsing occlusion, which can reduce the vertical dimension of the face. Patients with gross decay in much of their dentition in addition to periodontal disease, tooth mobility, or edentulism are also candidates for fixed full-arch implant dentistry. In Chapter 2, I discuss the term *terminal*

dentition: understanding what this term means and how to classify it will help you determine whether a patient might be ideal for a fixed full-arch prosthesis.

Implants and engineering options

The classic or early All-on-4 fixed full-arch designs used four implants placed in the anterior maxilla and anterior mandible to provide support for prostheses. As time goes on, more implant configurations are being used and have become widely accepted in fixed full-arch implant dentistry.

Maxilla

To make things simpler to explain and understand, we can divide the maxilla into four zones (Fig. 1.12):

- **Zone 1** consists of the anterior maxilla from canine to canine (also referred to as the *premaxilla*).
- **Zone 2** is the area of the premolars.
- **Zone 3** is the molar area.
- **Zone 4** consists of the pterygoid and zygoma regions.

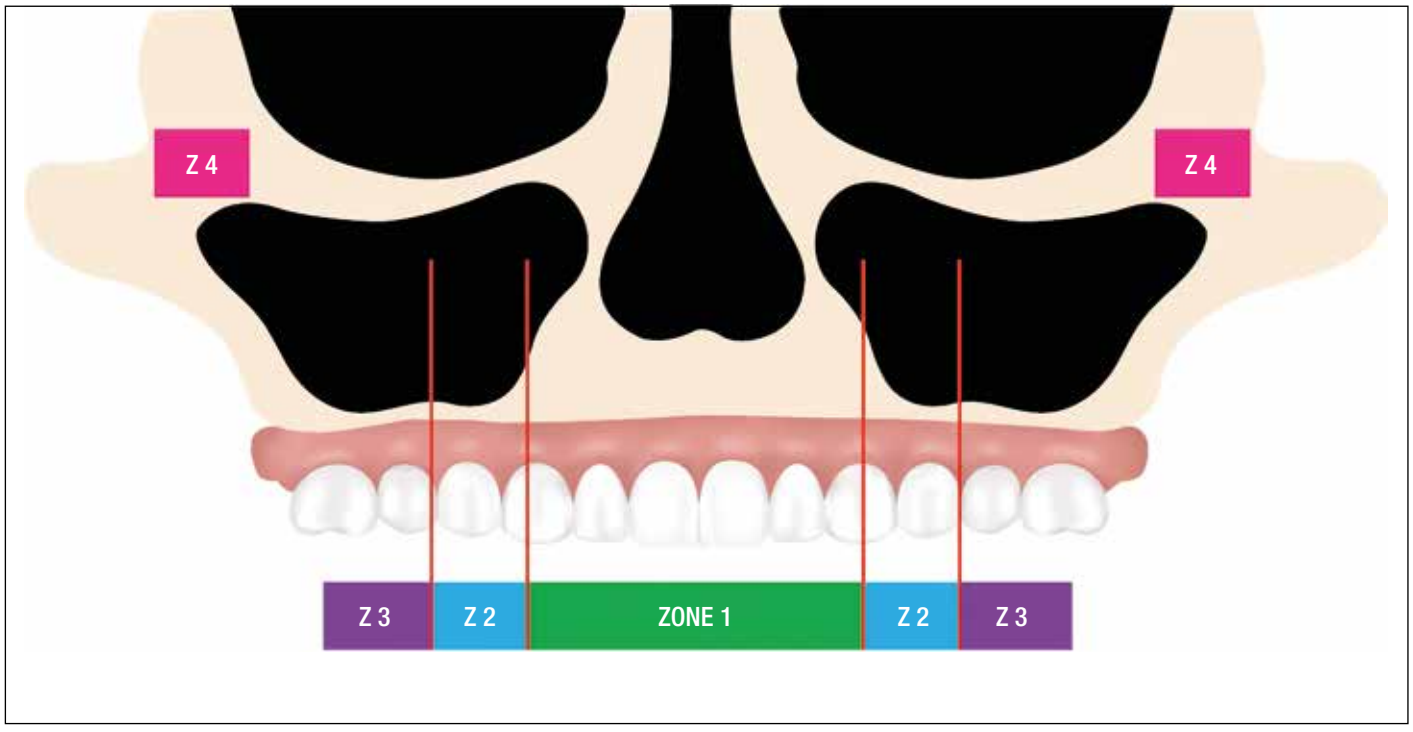

Figure 1.12 **Four zones in the maxillary arch.**

One of the most common implant engineering designs in fixed full-arch dentistry consists of four to six implants placed anterior to the maxillary sinuses in Zone 1 (Fig. 1.13). The most posterior or terminal implants flank the sinuses, taking advantage of dense bone along the anterior sinus wall, and they are usually tilted somewhere around 30 degrees. (In cases where there is adequate bone to provide the appropriate posterior support for a prosthesis, the terminal implants may or may not be tilted.) The other implants are spaced as equidistant as possible in the remaining area of the anterior maxilla. This design most closely follows the one developed by Dr. Paulo Maló in the 1990s.

The size and position of the maxillary sinuses, the width and height of the alveolar ridge, and the density of the maxillary bone are the primary considerations when it comes to implant choice in the maxilla. In patients with large, pneumatized sinuses, Zone 1 may not have enough bone available for the most common implant engineering, and a fixed full-arch prosthesis may not be possible in such patients without sinus elevation and/or extensive grafting. To address this lim-

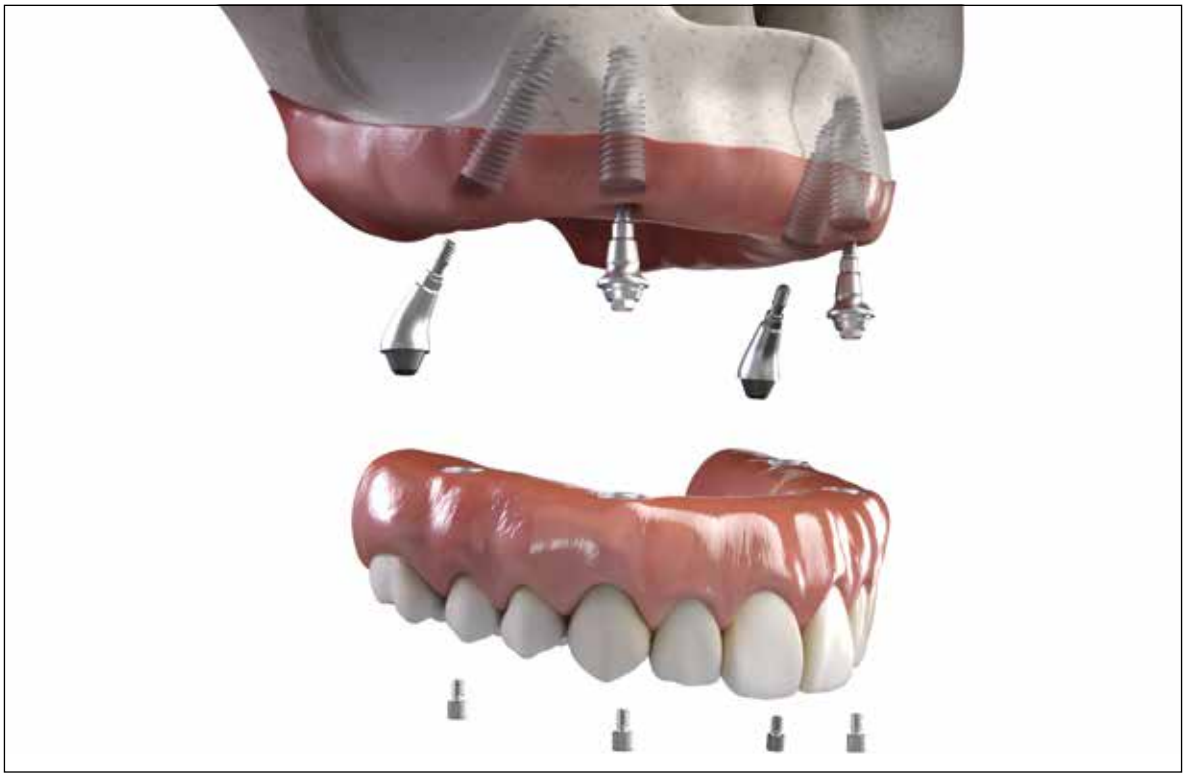

Figure 1.13 **A popular engineering design for a fixed dental implant prosthesis utilizing four dental implants in Zone 1 of the maxillary arch. The terminal implants are tilted 30 degrees and the anterior implants are straight.** ***Illustration used by permission of Straumann Group.***

itation, specially made zygomatic implants have been designed to utilize bone in the zygomatic arch and can be placed (*a*) unilaterally, (*b*) in a dual (×2) design, or (*c*) in a quad (×4) design. These implants get apical support from the zygomatic arch in Zone 4 and generally terminate in Zone 2, which allows for posterior support of a prosthesis and a more appropriate distance between the anterior and posterior implant connections (A-P spread). Implants designed to be stabilized within the zygomatic arch may be placed through the maxillary sinus as well as in an extramaxillary fashion (Fig. 1.14).

Another implant engineering option that is gaining popularity among clinicians involves the use of longer implants in the pterygoid region. This design is also appropriate for patients who do not have adequate bone in Zone 1, to avoid sinus elevation and grafting procedures. In some cases, this implant engineering concept will be used alongside zygomatic implants and in others as an alternative to them. Implants placed in the pterygoid region are good at supporting the posterior areas of the prosthesis and can help clinicians avoid cantilevers in their design. If there is a particular disadvantage to using implants in the pterygoid region, it is that they are placed so far posteriorly that restoring them with the prosthesis can be difficult. This is especially true in patients with limited jaw opening.

Figure 1.14 **A fixed full-arch prosthesis utilizing dental implants in the anterior maxillary zone 1 as well as in the zygomatic process. Note that the anterior implants are tilted to a similar degree as the terminal implants.** ***Illustration used by permission of Straumann Group.***

Each of these designs is considered acceptable in fixed full-arch implant dentistry. However, zygomatic and pterygoid implants require advanced surgical implant experience on the part of the clinician. Currently, they are not easy to place in conjunction with a stackable surgical guide system and are typically placed manually. Implants placed in the zygoma and pterygoid regions might be considered as alternatives to more traditional implant engineering when:

- Sinus elevation and other grafting procedures are not an option and anteroposterior (A-P) spread is inadequate for support of the fixed full-arch prosthesis.
- In an implant revision case where the dental implants and/or the prosthesis has failed. Implants in the pterygoid or zygomatic regions can be used to salvage a patient's chances of continuing to wear a fixed full-arch prosthesis.

Mandible

Fixed full-arch engineering in the mandible has not changed significantly since the inception of the All-on-4 concept was developed. Clinicians still tend to use the bone in the mandible anterior to the mental foramina for placing implants to support the prosthesis. The primary considerations for engineering implant placement to support prosthetics in the mandible are the location of the alveolar nerves and the height and width of the mandibular bone. It is not uncommon for several implants to be placed vertically in the most anterior region of the mandibular arch and then for the terminal implants to be longer and tilted distally to avoid the inferior alveolar nerves. Because the bone in the mandible is typically more dense, concerns about not having adequate initial stability for an immediate-load prosthesis are not as common as in the maxilla (Fig. 1.15).

There is another implant arrangement I have seen used, which some clinicians seem to prefer. This option uses short implants in a parallel fashion, placed vertically, without terminal implants that are angled. Placing shorter nonangled implants is technically easier and eliminates the need to use corrective angled MUAs to achieve parallelism. However, more implants may be necessary to achieve an adequate A-P spread for biomechanical stability of the prosthesis[6]. Adequate bone height and width in the posterior regions of the mandible are also necessary for this design to be successful (Fig. 1.16).

In the posterior mandible of patients who are dentate, the ridge can be considerably wider than in patients who have become edentulous over time. In these cases, clinicians have used implants posterior to the mental foramen with success. This technique could also be used in conjunction with the more traditional designs, particularly to reduce the amount of cantilever that would be present in the definitive prosthesis when implants in the anterior mandible will not provide as

Figure 1.15 Mandibular fixed full-arch prosthesis utilizing tilted implants just anterior to the mental foramina. *Source: Courtesy of the Straumann Group.*

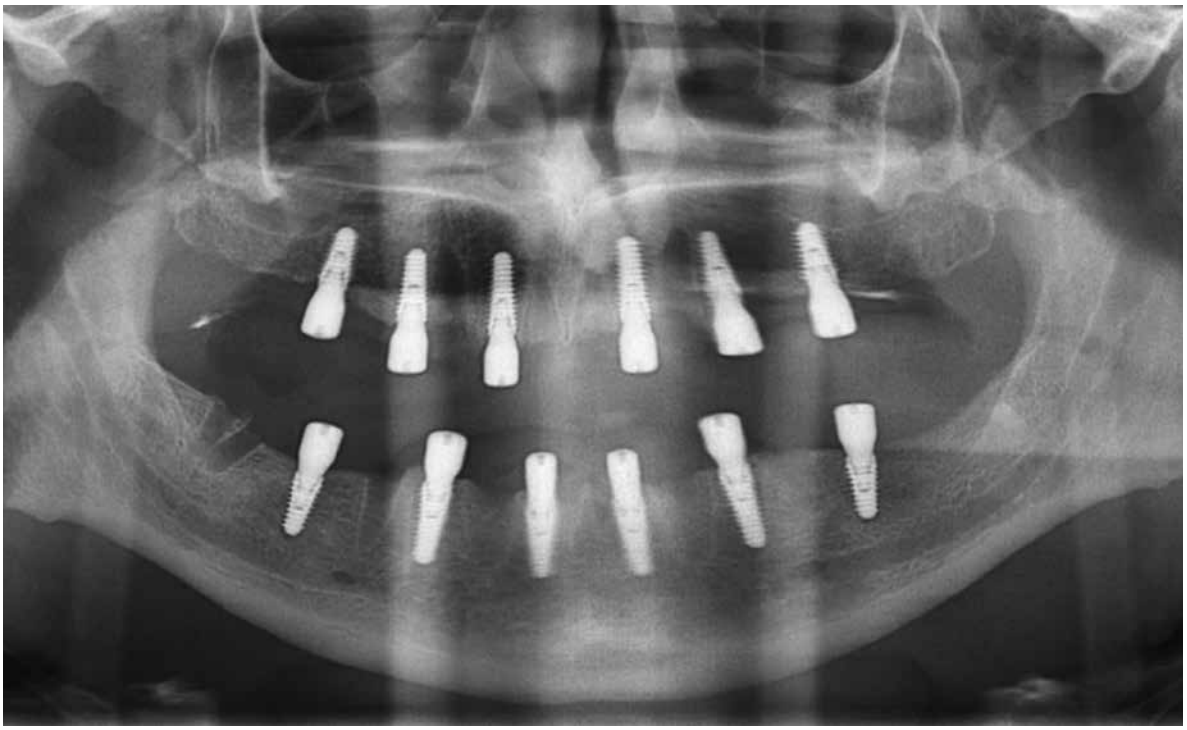

Figure 1.16 Orthopantomogram (OPG) of a full-arch implant design in the maxilla and mandible, where short, straight implants with straight MUAs were utilized in the posterior regions. *Source: Courtesy of MegaGen America.*

much A-P spread for support. Straight and shorter implants can also be used in the maxillary arch in Zones 2 and 3 if bone height and width permit.

When considering alternative placement of the implants within your planning, always keep in mind prosthetic and surgical success variables that will come into play. These may include the amount of bone reduction that will be necessary for adequate thickness of the prosthesis, anatomical landmarks, quality and quantity of bone available, loading forces, and implant locations. Design patterns for implant placement in the maxilla and mandible have been studied carefully over the last two decades. Traditional implant engineering has provided success for many patients, and there is wisdom in the phrase "if it ain't broke, don't fix it." However, there is also a place for deliberate holistic innovation, and I believe we will see more changes and nontraditional designs (and acceptance of them) as research and development continues.

Other implant design considerations

Implant sizes in both maxillary and mandibular fixed full-arch cases can vary in diameter based on the width of the bone present. It is acceptable to use the largest-diameter implants that will fit in the space, as long as respect is paid to the amount of bone present on the buccal or facial aspect. Most dentists I speak to are using 3.5- to 5.0-mm-diameter implants and larger 6- to 7-mm-diameter implants in the posterior maxilla and mandible when the bone permits (Fig. 1.17). Stress created by loading forces may vary based on the diameter of the implant. The use of smaller-diameter implants can create higher stress on the cortical bone, implants, and framework of a prosthesis, whereas the use of larger-diameter implants creates higher stress in the trabecular bone, abutments, and crowns of the prosthesis[7]. For the most predictable outcomes, 2 mm of buccal and lingual bone should be present after placement of the implants, and 3 mm of space should be present between the implants. Implants should have enough space not to be touching at their apices.

The length of implants used in traditionally engineered cases also varies. Clinicians may use implants as short as 8-10 mm in length in the anterior maxilla and mandible. Terminal tilted implants with a length of up to 16 mm are commonly found in the maxilla and mandible. Clinicians place implants frequently along the anterior maxillary sinus wall in Zone 1 and anchor more anterior implants into the anterior nasal sinus floor. In the mandible, they may reach into the inferior cortex for initial and apical stabilization.

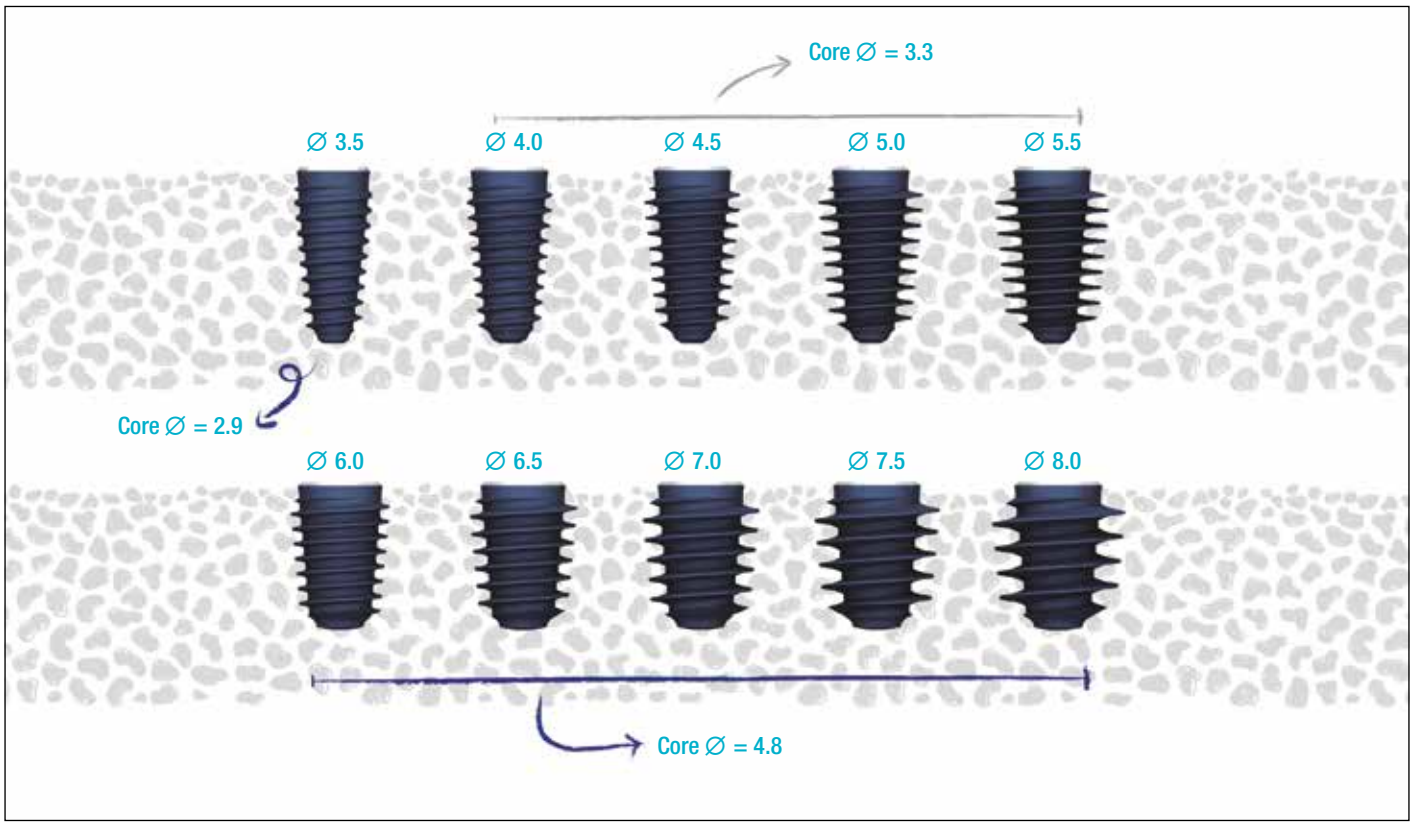

Figure 1.17 Various diameters of implants that can be utilized in fixed full-arch cases. *Source: Courtesy of the Straumann Group and MegaGen America.*

Prosthetic design

At this time the prosthesis most commonly used in fixed full-arch implant dentistry is a single unit one piece design and is referred to by many as "All-on-X". We usually refer to prosthetics that replace partial areas of the arch using more traditional terminology, such as *bridges* or *partials*, although some components of the fixed full-arch process, such as MUAs, can also be used in partial reconstruction circumstances. Fixed full-arch prostheses replace the missing teeth and (in FP3 designs) the gingiva as well as a portion of the edentulous ridge (Fig. 1.18). They are often fabricated from zirconia, printed or milled polymethyl methacrylate (PMMA), or acrylic resins and may be supported by frameworks made of metal, PEEK, or some other reinforcement material. The teeth on the prosthesis typically extend from first molar to contralateral first molar including 10 to 12 teeth. A fixed full-arch prosthesis will often have posterior cantilevers if dental implants cannot feasibly be placed in the most posterior areas of the maxilla and/or mandible.

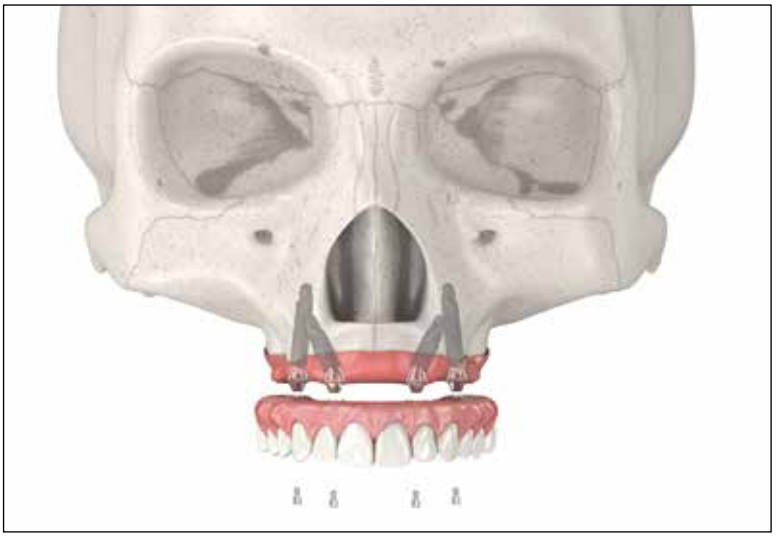

Figure 1.18 **A typical maxillary FP3 type of fixed full-arch prosthesis.** ***Source: Courtesy of the Straumann Group.***

Multiunit abutments (MUAs)

Today, fixed full-arch dental implant cases are typically built on MUAs. These specialized abutments allow the prosthesis to fit passively on the implants by correcting the path of insertion and the screw-access channels to be optimally positioned in the definitive prosthesis. MUAs are also advantageous in leveling out the platform for the prosthesis and allowing for a predictable connection of the prosthesis to the implant at the appropriate height in the gingiva (Fig. 1.19).

Figure 1.19 **Angled (left) and straight (right) multiunit abutments (MUAs).** ***Source: Courtesy of the Straumann Group.***

MUAs look similar across implant brands but may have varying platform sizing and screw diameters. It is imperative to know which implant brand was used as well as the internal diameter of the implant on some systems. This information is necessary when restoring inherited cases where changes should be considered.

MUAs are available in varying heights and degrees of angulation. Typically, angulations range from 0 to 45 degrees, but manufacturers are developing MUAs with even greater angulation for more clinical flexibility. The heights of the MUAs can vary as well but generally range from 1 to 5 mm. In most cases we aim for placing the implant connection with the MUA at or just below the bone, and the collar of the MUA at or just below the gingiva.

Immediate placement and loading

A fixed full-arch implant prosthesis can generally be immediately loaded on the day of surgery. There are some dentists who will place implants and keep their patients in dentures for 3 to 4 months before loading and placing an interim prosthesis. I have found most patients are looking for a solution that allows them to avoid wearing removable appliances. Placing and loading a full-arch interim prosthesis on the day of surgery is widely accepted and even encour-

aged by most practicing clinicians. There are, however, some exceptions. I base my decision to load an interim prosthesis at the time of surgery on the current literature, the teachings of well-respected, experienced clinicians and my own personal experience. We know that loading a fixed prosthesis with cross-arch stabilization immediately after surgery, when ideal conditions exist, does not significantly decrease the survival rate of implants, and possibly even decreases marginal bone loss[8-12].

There are several factors that might be considered when deciding whether to load a fixed full-arch prosthesis immediately after surgery: the total torque value of the implants, implant stability quotient (ISQ), a patient's compliance, the presence of extreme bruxism and/or parafunctional habits, and others. However, being able to help patients avoid wearing dentures after surgery is almost always preferred in my practice.

Another reason for seating and loading an interim prosthesis on the day of surgery—besides avoiding the need for the patient to wear a denture or dentures—is avoiding the necessity of a second surgical visit to uncover dental implants. In fixed full-arch implant rehabilitation, I have found that efficiency is a critical component. Having to manage a second surgical visit adds time to the case and appointments for the clinician and patient. This potential loss of efficiency should be taken into consideration during the initial planning phase of any case.

SHOULD YOU CONSIDER ADDING FIXED FULL-ARCH DENTISTRY INTO YOUR PRACTICE?

Fixed full-arch implant dentistry has gained wide acceptance and popularity in the dental community and with patients in recent years. Oral surgeons, prosthodontists, periodontists, as well as general dentists have become more interested in this technique and are embracing it. Dentists are flocking to courses that teach fixed full-arch implant techniques because they see the need for their patients to have alternative options to removable appliances. General dentists are gaining confidence and are more willing to take on these cases themselves without referring to specialists. But is it something you should add to your repertoire? Consider some of the following points.

Profitability

One powerfully attractive feature of fixed full-arch implant dentistry is the high case dollar value associated with this procedure. At first glance it may appear to many dentists that these cases are incredibly profitable, but this can be deceiving. To be profitable, the procedure must be done efficiently and without mistakes: one wrong move in a fixed full-arch implant rehabilitation case can create negative to catastrophic loss to a patient, all considerations of profitability aside.

Determining the profitability of this in your office is important before committing to making it a big part of your practice. Variable expenses such as dental implants and parts, anesthesia and medications, laboratory fees, planning and guide costs, biologics, and other details should be taken into consideration. Technology and equipment expenses are important too. For those starting without the required equipment to provide fixed full-arch implant dentistry, there is a sizable investment to be made.

Time is money, as the saying goes. Contemplate how much your time is worth and figure that into the equation as well. Then you will have to determine what the fee in your practice should be. The number of appointments and the amount of doctor time per appointment are two factors that significantly impact the profitability of these cases.

Another important factor in the equation is knowing what your marketplace will tolerate as an acceptable cost for this procedure, which can vary nationally and internationally by thousands of dollars. For an investment of this magnitude, many patients will investigate what other doctors and practices are charging. While it is not the most important thing for you to consider, keep in mind that patients are cost conscious and will often compare your fees to those of other providers.

Simplicity

Just because someone tells you something is easy, that does not make it simple. Unfortunately, the dental industry is filled with weekend courses promising to make you an overnight expert and assuring you that full-arch dentistry is not complicated. Becoming proficient at anything, including fixed full-arch implant rehabilitation, takes knowledge as well as practice. Make no

mistake, this is a complex procedure, but with the appropriate training, education, and time put in, you can master it.

Though it may appear daunting, you can choose to follow an established, systematic method and set of guidelines that can be duplicated time and again. The sequential method and workflow I employ are presented in this book. By utilizing technology and guided surgery, getting textbook results is much simpler than it has been in the past. I often use the analogy that performing fixed full-arch dentistry, with a prosthetically driven approach and stackable surgical guide system, is like coloring by numbers. Nevertheless, there is no single book or course that can make you an expert over a weekend.

Efficiency

In the method I use for fixed full-arch implant dentistry cases, much of the work can be delegated. This frees up a practitioner's time to do other things. As noted above, time is money, and efficiency and time go hand in hand. A dentist's assisting team can be trained to perform many of the tasks necessary to complete the case. Dental auxiliaries can be responsible for much of the data collection, surgical setup, and prosthetic process as well as managing patient expectations and lab communications. I believe case planning and engineering should always be reviewed and approved by the restoring dentist as well as the surgeon (who may be one and the same). In addition, working with a digital treatment planner can really save time. The duties they can perform include the new smile simulation and segmentation of the CBCT. Digital treatment planners can also merge digital impressions, digital proposal, and photographs in planning software, as well as preliminary planning of dental implant placement. Partnering with a trained technician working in a laboratory or implant-planning service allows a dentist to cut a significant amount of time from the process. That said, some of the emerging technology in software that is becoming available is very interesting and could save digital treatment planners and dentists an enormous amount of time. One such software solution I have had the opportunity to test in my practice is Diagnocat™. This software can provide radiology reports, segmentation of CBCT, integration of multiple data sources, cloud storage and viewing, as well as a collaborative tool for multiple clinicians and technicians. Diagnocat uses artificial intelligence (AI) to streamline processes and make things more efficient.

In the last several years, 3D printing and milling machines have become widely available for use in the dental office. Some dentists are under the impression that if they print or mill their own guides and prosthetics, they may save money. I would argue that one must consider the expense of the equipment as well as the time needed to use it and evaluate whether it produces a more- or a less-efficient workflow. As dentists, we are more profitable doing dentistry than just about anything else. Delegate procedures and processes that create unnecessary work for you. Unless you have a well-trained laboratory assistant and/or you are doing a large volume of cases, you may consider outsourcing some of these tasks.

Avoiding extensive grafting and augmentation

Clinicians who follow the principles of the All-on-4 concept and choose their cases discriminatingly often can avoid additional bone grafting and augmentation procedures such as sinus elevation, lateral ridge splitting, vertical ridge augmentation, and so forth. While I do advocate socket preservation and the use of platelet-rich fibrin (PRF) and other biologics when appropriate, more expensive and advanced augmentation procedures are not always necessary for many cases. If you can do this, you will minimize the time and financial burden for yourself and your patient.

Good biomechanics

The term *biomechanics* is generally used in implant dentistry to define how dental implants and prosthesis relate to different forces and stresses. Fixed full-arch implant prostheses can perform very well over time with major biomechanical advantages over alternative therapies, such as dentures and implant-retained overdentures. For this reason, more patients and doctors are drawn toward fixed full-arch dentistry as a viable and even preferred treatment.

Hygiene and maintenance

There has historically been a bit of controversy or at least a lack of agreement and consistency on the topic of how hygiene and maintenance should be handled in fixed full-arch implant dentistry. This can be straightforward and acceptable to both clinician and patients, especially when expectations are laid out clearly prior to surgery.

In my practice, we provide patients with a hygiene and maintenance contract that clearly spells out our recommendations so patients understand what is expected of them and what they can expect from our practice. Most patients are happy to visit our office at least two times a year to have their prosthesis and implants examined and cared for. Some of our patients have exquisite home care and can keep their prostheses clean and the tissue surrounding the implants healthy. Other patients need a little more help. In Chapter 10, I review the specifics of hygiene and maintenance for the fixed full-arch dental implant patient.

Predictable clinical outcomes with high success rates

For almost 20 years, fixed full-arch implant dentistry using All-on-4 type concepts has been completed successfully for hundreds of thousands of individuals with predictable long-term outcomes. Nevertheless, there have been challenges over time, such as:

- Lack of an established, systematic method for doing the surgical procedure
- Lack of consistent and accurate communication between multiple providers and laboratories
- Small numbers of skilled and qualified clinicians and training programs
- A dearth of scientific evidence-based studies, clinical research as well as follow-up with patients in the early stages of its development
- Inadequate analog prosthetic workflows and the use of acrylic denture materials for prosthetics that were less durable than those available today
- The frequent absence of following a prosthetically driven protocol by the dental surgeon.

Recently, however, clinicians and others involved in the development of this treatment modality have been instrumental in advancing the process. Online and in-person training programs have been established throughout the world. Laboratories and manufacturers have developed better materials and methods. Research has been conducted and books have been written to support fixed full-arch implant dentistry. Industry leaders have taken steps to steer what was once a strictly analog procedure into the digital realm using hardware and software solutions.

As dental technology has evolved, this procedure has become easier to provide to patients and has facilitated better results. Following a systematic approach is more reliable with fewer errors and less stress, and it is more rewarding for both patients and clinicians. Technology has brought us into the mindset of a prosthetically driven process. By planning cases with the end in mind, starting with smile simulations and planning software, a dentist can provide more predictable results.

It is and will continue to be important for clinicians, dental laboratories, digital treatment planners, dental companies, and others to work together to get even better and more predictable outcomes for patients. Collaboration within our industry is necessary to provide improved solutions in fixed full-arch dentistry. This will in turn allow us to provide more patients with consistent quality and excellent results.

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