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Interim Prosthesis Options for Dental Implants

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Abstract

Dental implants have become a popular treatment modality for replacing missing teeth. In this regard, the importance of restoring patients with function during the implant healing period has grown in recent decades. Esthetic concerns, especially in the anterior region of the maxilla, should also be considered until the definitive restoration is delivered. Another indication for such restorations is maintenance of the space required for esthetic and functional definitive restorations in cases where the implant site is surrounded by natural teeth. Numerous articles have described different types of interim prostheses and their fabrication techniques. This article aims to briefly discuss all types of implant-related interim prostheses by different classification including provisional timing (before implant placement, after implant placement in unloading and loading periods), materials, and techniques used for making the restorations, the type of interim prosthesis retention, and definitive restoration. Furthermore, the abutment torque for such restorations and methods for transferring the soft tissue from interim to definitive prostheses are addressed.

Dental implants, as a predictable and documented treatment modality, are used for replacing missing teeth. With the increased number of patients and raised level of expectations, both patients and clinicians consider the esthetic outcome, especially in the anterior region of the maxilla. For the sake of social communication, patients need to feel secure both in regard to esthetics and function during the implant treatment period. Interim prostheses are used to restore lost function and esthetics for this purpose.[1,2] Interim prostheses are fabricated to enhance esthetics and function, provide stabilization, and also may act as a reference in designing the definitive prosthesis.[1-3]

Selection between different interim prostheses is dependent on some factors including provisional timing, interocclusal space, longevity, ease of fabrication and modification, ease of removal, esthetic demands, and economic considerations.[4] Interim prostheses have several advantages, including serving as a diagnostic tool, helping evaluation of peri-implant soft tissue, evaluation of neighboring teeth, and evaluation of the patient's oral hygiene. They also are helpful for patient management (esthetic, phonetic, psychological), communication between patient, prosthodontist, and technician, determination for implant site development, healing of the soft tissue around the implants, potentially loading the implants, improving tissue contours related to emergence profile, and developing of an interdental or inter-implant papillae, and therefore potential avoidance of a third surgical procedure.[5-7] This review summarizes the literature on the provisionalization of dental implants and identifies deficiencies suggesting future research. A general classification of implant interim prostheses based on different subjects is presented in Figure 1.

Provisional timing

The type of interim prosthesis should be determined during the presurgical treatment planning phase by the dental team.[5] Interim prostheses can be categorized in three treatment sections: before placing the implant, after placing the implant in unloading time, and after placing the implant in loading time.

Before placing the implant

Usually, an 8- to 16-week healing period following tooth extraction allows predictable results for implant placement.[8,9] However, in case of bone grafting and reconstructive procedures, usually a 4- to 8-month healing period is expected.[10,11] It is undesirable for patients to live without teeth during this phase. Therefore, an interim prosthesis that would not exert undesirable pressure upon the grafting sites is beneficial.[4] An acrylic resin removable partial denture (RPD) may create problems such as inadequate stability and comfort, in addition to

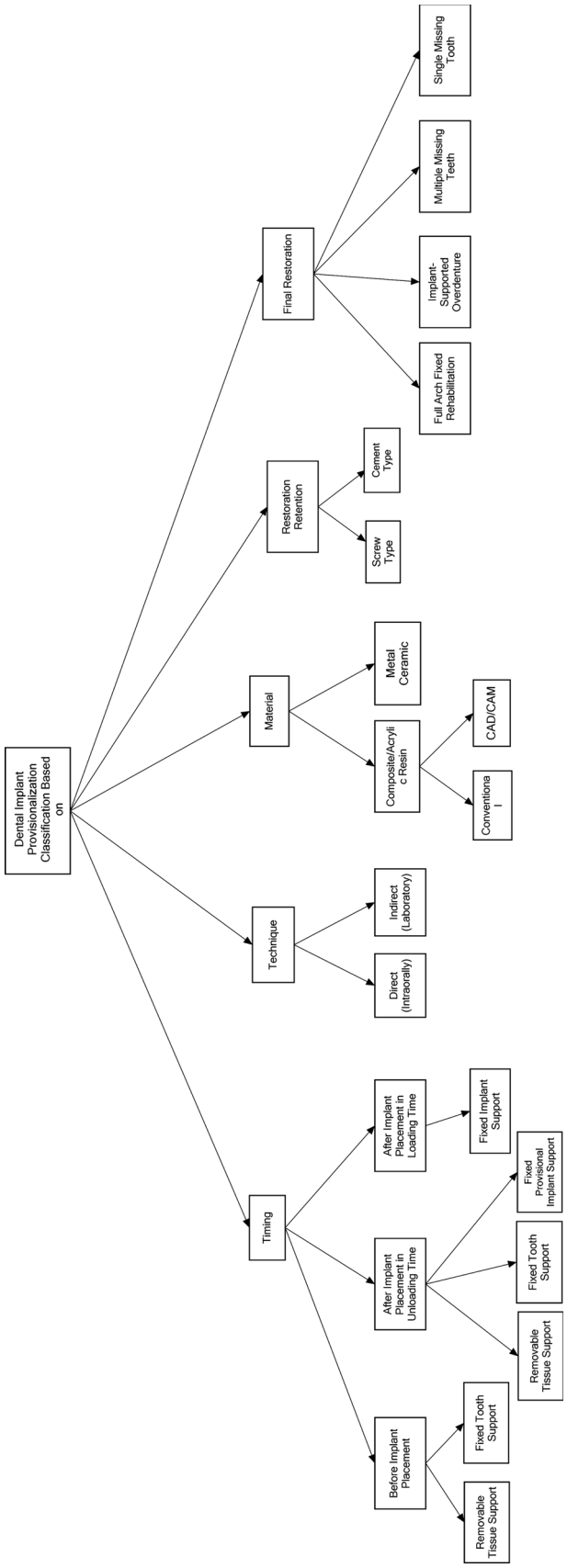

Figure 1 Classification of implant interim prostheses.

unfavorable distribution of stresses to the supporting tissues.[12] Therefore, interim prostheses fixed to the adjacent teeth, such as bonded interim prostheses (Maryland fixed partial denture [FPD], fiber-reinforced composite, polyethylene ribbon), can be useful.[13-15] Fixed interim prostheses can be better tolerated by patients due to their improved esthetics, stability, and fixation; however, when economic problems and multiple reentries to the surgical site are required, this method is contraindicated.[15] Polyethylene ribbon can be used to untangle the restoration; however, long-term durability of this kind of adhesive FPD is still unknown.[13]

After placing the implant in unloading provisionalization

Provisionalization some kinds of interim prostheses can be used in this period of treatment (Table 1).[4,14-23] An RPD may be indicated when there are adjacent or scattered multiple missing teeth. If the patient's existing removable prosthesis is acceptable, the clinician can use it in combination with tissue conditioner or soft liner materials.[14] However, discoordinated occlusal contacts can exert undesirable loading upon graft sites around the implants during speaking or chewing.[14-16] Uncontrolled implant/graft loading complications can be prevented by minimizing the contact between the restoration and the healing abutments or by use of a vacuum-formed retainer called an Essix appliance.[14] An Essix appliance is introduced for patients with limited interocclusal space and deep anterior guidance.[14] This removable interim prosthesis covers occlusal surfaces; however, patient lack of compliance can lead to rapid occlusal wearer bite.[14,18] Since an Essix appliance does not contact the surrounding soft tissues, it is unable to mold surrounding soft tissues.[18]

A bonded interim prosthesis does not apply any pressure on the gingival tissues or implant site.[4] However, this kind of prosthesis may frequently lose its bonding. Therefore, multiple reinsertions during the treatment can be objectionable.[4,15] In cases with a serial extraction treatment plan, the hopeless teeth can support a provisional FPD during the healing phase.[4]

Transitional or provisional narrow-diameter implants that support interim prostheses are another treatment option.[21-23] These implant-supported FPDs provide continuous healing of the implant site and restore function and esthetics during this time. They are self-tapping screws with a diameter ranging between 1.8 and 2.8 mm in various lengths.[21-23] However, improper placement can cause damage to alveolar ridge or principle implants. To avoid disturbance of osseointegration around the implant/bone interface, they should be placed at least 1 mm from the site of the permanent implants.[22] These provisional implants are positioned between the permanent implants or if the width of the alveolar bone allows, they are placed in a lingual position to them.[21-23]

After placing the implant in loaded provisionalization

In 1983 Branemark recommended that a 4- to 6-month period of healing would lead to highly predictable outcomes with a two-stage surgical protocol.[24] However, the increased time interval between implant installation and restoration placement

Table 1 Available options of provisionalization after placing implant in unloading time

Type of support	Type of prosthesis	Advantages	Disadvantages	Indication
Removable tissue support[12,14]	* RPD, interim RPD	*Stimulate bone remodeling around dental implants *Inexpensive *Facilitate removal and replacement *Simplicity of fabrication *Could also be used before implantation	*Unstable during speaking or chewing *Undesirable pressure upon graft sites *Uncontrolled implant loading	Replacing multiple missing teeth
	*Essix appliance	*Used in limited interocclusal space and deep anterior overbite *Avoid pressure on the surgical sites	*Inability to mold the surrounding soft tissue *Lack of patient compliance *Esthetically unacceptable	Replacing single or multiple missing teeth
Fixed tooth support[13-15]	*Resin-bonded FPD	*Does not exert any pressure on the implant area *Better tolerated by the patient *Improved esthetic results, stability, and fixation *Minimal or no abutment tooth preparation	*Difficult to reuse *High laboratory costs *Debonding	Replacing single or two missing teeth
	*Fixed interim prostheses on remaining teeth	*Used in staged extractions *Does not exert any pressure on the implant area	*Difficult to reuse *Debonding	Replacing multiple missing teeth
Fixed implant support[21-23]	*Provisional implants	*Used for patients who refuse to wear a removable prosthesis *Minimal surgical intervention *Possibility of providing immediate function after implant placement *Restoration of phonetics and esthetics	*Improper placement can cause damage to alveolar ridge or permanent implants *Difficulty of using these implants in the restoration of a single missing tooth due to lack of space *Fracture of implant	Replacing full-arch missing teeth

is not desirable for the patient. To date, immediate or early implant interim prostheses may be similar to conventional loading protocols under particular conditions.[25,26] The aims of fixed immediate or early interim prostheses include patient comfort, proper management of soft tissue, and elimination of second-stage surgery.[25]

In the Third ITI Consensus Conference, procedures related to dental implant loading protocol were defined in three categories: immediate loading/restoration, early loading/restoration, and delayed or conventional/progressive loading.[19] In this context, immediate loading/restoration refers to a method in which the interim prosthesis would be inserted within 48 hours after implant surgery. The early loading/restoration term is related to an interim prosthesis delivered in 48 hours to 12 weeks after implant placement. Delayed loading refers to the conventional loading protocol, which is performed 3 months or more after implant placement.[19]

Immediate interim prostheses can be used in situations where the bone volume is ideal, and there is no guided bone regeneration procedure. They can be used when dental implants have adequate length (< 8 mm) and diameter (< 4 mm) and good primary stability.[27-29] In esthetic regions, these restorations must be out of occlusion contacts in both centric and eccentric positions.[28,29] During the healing period of approximately 6 weeks, the interim prosthesis should not be removed.[30] There is insufficient evidence regarding the use immediate interim prostheses in the posterior regions of the maxilla.[31] However, it is a valid treatment option in the posterior regions of the mandible.[32]

Early interim prosthesis protocol in the anterior of the maxilla is a highly predictable treatment option from an esthetic point of view.[30] In the posterior of the maxilla and mandible with D3 bone quality, using implants with rough surfaces is a predictable treatment option.[29,31,32] In low-quality bone (D4), a progressive loading protocol with two or three nonoccluding interim prostheses is recommended during the first 2 months after implant placement.[31]

Materials used for interim prostheses

The material used is based on the type of interim prosthesis. Besides traditional methods that use materials such as acrylic or composite resin and metal-ceramics,[33] recently CAD/CAM technology has been introduced for fabricating interim prostheses.[34,35] This technology could use prefabricated polymethylmethacrylate (PMMA)-based high-density polymer or composite-based polymer blanks. These materials offer more wear resistance, enduring stability, superior fitness, and biocompatibility over conventional acrylic or composite resin

materials. Moreover, in comparison to ceramic restorative materials they can be used in thinner thicknesses.[34,35]

Techniques and components for making implant-supported interim prostheses

Interim prostheses can be fabricated through two different protocols, including direct and indirect techniques. In the direct technique, an interim prosthesis is made intraorally with autopolymerizing materials and without the need for an implant-level impression.[36] In the indirect technique, the prosthesis is constructed in the laboratory and is more color stable, less porous, more wear resistant, and esthetically enhanced as compared to direct restorations.[36]

Although almost all dental implant systems present prefabricated provisional abutments for the fabrication of fixed interim prostheses, these components are not always available and cost-effective. Also, no manufactured component with an anatomical emergence profile is appropriate for supporting soft and hard tissue structures. The various components used for this purpose are summarized in Table 2 and include provisional abutment, definitive abutment, impression coping central pin, interim metal cylinder, healing abutment, and fixture mount transfer.[37-44]

Misch[45] in 2004 introduced the denture conversion technique for turning a complete denture into a fixed full-ach interim prosthesis. This method can be useful for screw-retained interim prostheses in mandibular immediate loading conditions.[45] Lin and Ercoli[36] also presented an indirect technique for fabrication of implant-supported fixed interim prostheses on provisional abutments using denture teeth laminates with long-term color stability and esthetics.[36] Some articles have described an approach in which the interim prosthesis is created in the laboratory before implant placement, in order to be inserted at the time of surgery.[45,46] In these conditions, surgery would be done faster and be less invasive, with less pain and swelling and faster initial healing time.[45-47]

Types of fixed interim prosthesis retention

Implant-supported fixed interim prostheses may be either cement or screw retained. Depending on inter-arch space, submucosal implant shoulder location, the number of supporting implants, and their angulations, the selection can be done.[48] The advantages of cement-retained interim prostheses are improved occlusion, enhanced esthetics, reduced cost, and simplicity.[39,48] However, in deep implant positions, removal of excess residual cement surrounding an implant interim prosthesis is more critical and difficult. This residual cement is not detectable clinically and can create chronic inflammation in peri-implant tissues.[43,48] Furthermore, the margin of the cement-retained interim prosthesis is made of an acrylic coping, which may have less marginal integrity than a screw-retained prosthesis. Therefore, un-cementation of the interim prosthesis may be necessary.[43] Screw-retained interim prostheses eliminate the possibility of having provisional cement and peri-implant inflammation caused by excess residual cement. Also, their removal and reinsertion is easier than with cement-retained interim prostheses.[45]

Interim prostheses based on definitive restorations

Full-arch fixed rehabilitation

One of the prosthetic options for this category is a fixed full-arch prosthesis according to immediate loading protocol (made before or after implant placement), which also could be made using the patient's existing complete denture through the conversion technique.[45,46] Support of the full-arch interim prosthesis could be provided using either original implants or transitional narrow-diameter implants.[21-23]

Implant-supported overdenture

A common provisionalization for this group of patients is their existing complete denture. Since the tissues have been modified by the surgery procedure, after relieving the denture over the implants, soft liner materials are usually used to improve the adaptation and retention of the denture over the tissues and/or healing abutments. Another method to restore implants with a patient's denture as described by Misch is to make a bar attachment on implants and relining the existing denture on the bar.[49] In this method, implants would be immediately loaded by using the patient's denture as a template for making the bar attachment and also as the provisional overdenture.[49]

Multiple missing teeth

The interim prostheses used for this purpose could be either removable or fixed. The removable choices are tooth-supported interim RPD, cast-metal RPD, and Essix appliance.[14] The fixed prostheses could be supported by adjacent remaining teeth including acrylic/composite resin FPD (indirect/direct/CAD/CAM).[13-15] They also could be supported by implants using provisional abutment, definitive abutment, impression coping central pin, interim metal cylinder, healing abutment, and fixture mount transfer as abutments.[37-44]

Single missing tooth

The interim prostheses used for replacing a single missing tooth also consist of tooth-supported prostheses such as bonded interim prostheses (Maryland FPD, FRC, polyethylene ribbon) as immediate interim prosthesis.[13-15] They could also be implant-supported using different aforementioned components, such as an abutment restored with appropriately sized prefabricated provisional crowns (e.g., polycarbonate, acetate cellulose) relined with resin materials.[15]

Abutment torque

Depending on the type of retention, the amount of torque between abutment and fixture is critical for immediate interim prostheses. Block et al[46] used 20 Ncm implant insertion torque for immediate provisionalization, although they did not report the provisional abutment torque for interim prostheses. Nedir et al[50] used implants 6 mm in length and applied 35 Ncm torque without rotation or pain for early loaded implants. Other

Table 2 Different approaches suggested for making fixed implant-supported interim prostheses in loading time for single, multiple, or full-arch missing teeth

Authors	Components	Product information	Cement/screw	Advantages	Disadvantages
Hirayama et al[37]	Implant interim metal cylinders	Nobel Biocare USA, Yorba Linda, CA	Cement	1. Emergence profiles in the esthetic zone 2. Proper peri-implant tissue contours 3. Fast	
Chaimattayompol et al[38]	Healing abutments	Implant Innovations Inc, Palm Beach Gardens, FL	Cement	1. Close coordination between the prosthodontist and surgeon 2. Decreases the number of surgical visits and the amount of chair time required 3. Eliminates interim implant abutment placement and allows proper soft tissue healing 4. Accelerates the prosthodontic phase 5. Comfort and convenience to the patient	1. Undercuts caused by malposed or angled implants 2. Prosthodontist and surgeon should be present for this procedure or patient needs two appointments.
Kökat and Akça[39]	Premounted transfer portion of the fixture	Institute Straumann AG, Basel, Switzerland	Screw	1. Cost-effective 2. Not necessary to use the definitive abutments in the fabrication of interim prosthesis 3. May be used for immediate loading	1.Lack of an antirotational feature between the implant and customized screw-retained abutment
Gilboa and Cardash[40]	Healing cap & Allen key	Tooled-up, Enfield, Middlesex, UK	Cement	1. Easy method 2. Economical 3. Additional retention	
Ganddini et al[41]	Implant carrier	Zimmer Dental, Carlsbad, CA	Cement	1. Reduces gingival trauma 2. Eliminates the use of acrylic resin intraorally 3. Minimal chair time (laboratory procedure) 4. Cost effective 5. Fewer components are needed	1.Technique is contraindicated in the presence of axial misalignment of the implant, requiring the use of an angulated or custom abutment
Proussaefs[42]	Healing abutments	Steri-Oss; Nobel Biocare, Yorba Linda, CA	Cement	Restorative dentist will not need to unscrew the abutments	1. Severely misaligned implants that require extensive reduction of the healing abutment 2. Preparing the healing abutments with carbide burs is difficult
Hartlev et al[43,44]	Definitive abutments	Replace Select Tapered Ti-Unite; Nobel Biocare, Kloten, Switzerland	Cement	1. Cost-effective 2. Fewer components are needed 3. Familiarzing the patient with the definitive restoration appearance 4. High subjective and professional satisfaction	1. Requires careful abutment selection 2. Proper implant angulation and placement is needed

suggestions for immediately loaded single implant insertion torque is ≥ 30 Ncm and for splinted implants is ≥ 20 Ncm.[31] den Hartog et al[51] applied an initial insertion torque of at least 45 Ncm for a single anterior maxillary implant. Roccuzzo and Wilson[52] used provisional abutment torque of about 15 Ncm in D3 bone quality. Later, the permanent abutment must be tightened at 30 to 35 Ncm torque depending on the type of implant system after 4 to 6 additional months prior to definitive restoration.[31]

Anatomic soft tissue modeling

After 4 months of tissue healing and implant osseointegration, the margins of the abutment are refined and formed according to the emergence profile of the existing fixed implant-supported interim prosthesis. Wittneben et al[53] introduced a method called the dynamic compression technique, which includes using a screw-retained interim prosthesis. This restoration is minimally overcontoured in the mesial and distal areas to insert pressure to the surrounding tissues. Within the first 2 weeks, flowable or light-curing composite is added to the underside of the restoration extraorally to exert selective pressure to some regions. After 2 weeks, the restoration is reduced in interproximal and cervical areas to make room for papillae formation and to provide an appropriate emergence profile.[53] However, the incidence of papilla formation is dependent on the distance between the contact point of the adjacent natural tooth to the crest of the bone.[54] This procedure also requires highly polished restoration and proper plaque control by the patient.[53]

There are direct and indirect techniques for transferring the emergence profile of the interim prosthesis from clinic to laboratory, after providing the desirable matured gingival contours.[51,55-60] In the direct technique, a customized impression coping is fashioned from a provisional crown index.[51] The provisional crown is assembled with an implant analog and embedded in type IV dental stone. Then, silicone impression material is added in the cervical portion of the crown. After replacing the crown with an impression post, flowable light-cured composite resin is injected in the cervical portion of the index. After polishing the custom-made impression post, it is inserted into the implant intraorally, an open-tray impression is made, and an anatomic soft tissue cast is prepared.[51]

In another direct method by Schoenbaum,[58] the final impression is made with custom open-tray impression copings. Immediately after removing the interim prosthesis, impression copings are fastened, and a dual-polymerizing resin cement is injected in the emergence profile and into the pontic site. After cement polymerization, the final impression is made.[58]

In the indirect technique, an interim prosthesis is used as an impression coping and master cast with implant analog used for reforming the soft tissue.[61] The interim prosthesis is trimmed and retrofitted around the implants on the master cast. Then, the gingival mask is injected around the restoration. After removal of the interim prosthesis, an anatomic soft tissue cast is fabricated.[61]

Discussion

Along with increasing patient demands and expectations for esthetics and function with dental implant treatments, excellence in providing suitable implant interim prostheses has become more important. Depending on the available support, they are either removable or fixed. The advantage of removable prostheses for this purpose is their ease of fabrication, and their main disadvantage is lack of sufficient stability, which could be a danger for an underlying healing implant/graft. A great advantage of fixed interim prostheses (either supported by adjacent teeth or implants) is that they provide the patient with esthetics and comfort, which is especially valuable for those who have not experienced edentulism or removable prostheses before. Furthermore, in some situations interim prostheses help provide function and space maintenance for the final restoration. The need for extra time, components, and cost as limitations of such restorations could be justified by their critical role in creating a more esthetically predictable definitive restoration in terms of emergence profile. Further studies and research could help in exploring new methods and materials that could be more cost-effective, esthetic, and satisfactory in this field.

Conclusion

The aim of this article was to briefly address the importance of provisionalization, types of interim prostheses, their timing, and methods for transferring the resultant gingival contours to the final restorations. Providing a patient with interim prostheses in implant dentistry is not as common as in the fixed dental field; however, their use offers many advantages that should be taken into consideration. The advantage of interim prostheses is maximized when their final emergence profile is transferred to the definitive restorations.

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