

# Esthetic Potential of Single-Implant Provisional Restorations: Selection Criteria of Available Alternatives

GEORGE PRIEST, DMD\*

## ABSTRACT

Provisional implant restorations are essential tools used to optimize the esthetic outcomes for single-tooth implant restorations. This article describes three groups of available alternatives and the specific options within each group including removable prostheses (*interim removable partial denture, vacuum-formed appliance*), tooth-supported prostheses (*bonded extracted or denture teeth, cast metal or fiber-reinforced resin-bonded fixed partial denture [FPD], wire-retained resin-bonded FPD, acrylic resin provisional FPD*), and implant-supported fixed prostheses (*implant-retained provisional restoration*). Advantages and disadvantages as well as fabrication guidelines for each option are provided. The author proposes that the restorative dentist consider eight criteria in selecting the most appropriate type of provisional prosthesis for a specific patient situation including the esthetic potential, patient comfort, treatment time, laboratory cost, occlusal clearance, ease of removal, durability, and ease of modification. The patient's esthetic expectations are critical in determining the most suitable type of provisional restoration. Esthetically pleasing provisional restorations are part of the evolving implant continuum, making implant dentistry more appealing to practicing dentists and potential patients.

## CLINICAL SIGNIFICANCE

Provisional restorations for single implants have evolved from temporary expedients during osseous and soft tissue integration to critical therapeutic tools used to assess patient expectations, communicate with the laboratory, and optimize definitive implant treatment. The selection of the type of provisional restoration may significantly influence esthetics during the period of implant integration and soft tissue healing. However, it is unlikely that there is a direct correlation between the type of provisional restoration used and the esthetic outcome of the definitive prosthesis.

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## INTRODUCTION

Provisional implant restorations are essential tools used by restorative dentists to optimize esthetic outcomes for single-tooth implant restorations. They are not

merely temporary expedients during implant integration, but a communication method used between the dentist and the laboratory to assist in the development of tooth contours and soft tissue profiles.

They also serve as a means to capture a patient's confidence in their dentist's restorative capabilities.<sup>1</sup> Even though the provisional phase of treatment is often the longest in duration and the most challenging

\*Private practice limited to prosthodontics, Atlanta, GA, USA

aspect of implant therapy for the restorative dentist, there is minimal published information on the existing types of provisional restorations, their indications, and their clinical fabrication. The purpose of this article was to describe three groups of available options of provisional restorations for single implants, from removable prostheses to tooth-supported prostheses to implant-supported fixed prostheses (Table 1). Their advantages and disadvantages are compared by the author to aid restorative dentists in their determination of the most appropriate alternative for a given patient situation.

**Removable Prostheses**

**1. Interim Removable Partial Denture (RPD)**

Interim RPDs, often referred to as “flippers,” are commonly used

options during single-implant therapy. Simplicity of fabrication and ease of seating are this option’s most compelling advantages. The ability to modify an acrylic resin interim RPD easily presents an additional benefit. For patients who may require multiple procedures of extraction, soft and hard tissue augmentation, and implant placement, interim removable prostheses may be quickly removed and acrylic resin added or reduced to accommodate changes in ridge anatomy. In younger patients who are still developing, yet not old enough for implant placement, the adjustable nature of interim removable prostheses again facilitates modifications.

However, for many patients, bulky removable appliances are cumbersome, interfere with speech, initiate an inflammatory soft tissue

response from the acrylic base, and are frequently lost or destroyed. Implant or graft integrity may be compromised if passivity of fit cannot be maintained. It may be difficult to prevent pressure from the pontic on a fresh surgical site. Patients with inordinately strong gag reflexes are often unable to wear removable prostheses that partially cover the palate. For those patients with minimal distance between the implant platform and the opposing dentition, the thin connector area is prone to fracture, and repeated repairs during the interim period can be frustrating for both patients and dentists. In patients who have undergone orthodontics, an RPD will maintain coronal spacing, but a relapse may occur apically, resulting in convergence of the roots and ultimately insufficient space for an implant. An adhesive fixed prosthesis, which

**TABLE 1. AVAILABLE OPTIONS OF PROVISIONAL RESTORATIONS FOR SINGLE IMPLANTS.**

Type	Removable		Fixed Tooth Supported				Implant Supported
	Interim RPD	Vacuum-Formed Appliance	Bonded Tooth	Metal or Fiber-Reinforced FPD	Wire-Retained Resin-Bonded FPD	Acrylic Resin FPD	Implant-Retained Restoration
Esthetic potential	Good	Fair	Poor	Good	Good	Very Good	Excellent
Patient comfort	Poor	Poor	Good	Good	Good	Excellent	Excellent
Treatment time	Minimal	Minimal	Moderate	Lengthy	Moderate	Lengthy	Lengthy
Laboratory cost	Medium	Low	None	High	Low	Low	Medium
Occlusal clearance	Substantial	None	Minimal	Moderate	Moderate	Minimal	Minimal
Ease of removal	Easy	Easy	Moderate	Difficult	Easy	Easy	Easy
Durability	Fair	Fair	Poor	Good	Good	Fair	Excellent
Modifications	Easy	Moderate	Difficult	Difficult	Moderate	Easy	Easiest

RPD = removable partial denture; FPD = fixed partial denture.

will maintain coronal and apical spacing, may be more appropriate for these patients.

Acceptable esthetics may be difficult to master with interim removable appliances. The denture teeth used in removable prostheses can be modified to match the shape of the corresponding tooth, but the limited shade selections may not closely approximate the adjacent natural dentition. During initial periods of integration or after hard and soft tissue augmentation, removable appliances should remain passive over the implant site, which may necessitate an unsightly gap between the ridge and neck of the denture tooth. After initial soft tissue healing, the tooth can passively contact the ridge to impart a more natural appearance. It is best to eliminate any flange in the region of the pontic, thus giving the patient and dentist a more

realistic approximation of the result. Healing abutments on the implants may be facially inclined or too long to be completely hidden by a removable appliance in the esthetic zone. A facially angled healing abutment may be reduced on the facial aspect with a carbide bur and polished, allowing the pontic to contact the ridge slightly facial to the modified healing abutment. A long-healing abutment can be replaced with one that is nearly subgingival, allowing the pontic to seat directly over it and slightly into the soft tissue of the ridge (Figures 1 and 2).

Clasps, which are usually needed to retain interim RPDs, present two disadvantages. First, they may interfere with occlusion if interocclusal space is limited. If there is inadequate space between opposing teeth even for thin clasp wires, patients must rely on undercuts in

the acrylic resin base or resort to denture adhesives. Second, visible clasps can be unsightly. Ball clasps placed between premolars and molars are not objectionable to most patients. If their esthetic demands require a more pleasing appearance, or if patients object to removable appliances, fixed prosthetic options should be explored. Another disadvantage of interim RPDs is their inability to facilitate soft tissue development. Although implant-site soft tissue development has been reported with interim removable appliances using ovate pontics,<sup>2</sup> direct implant provisional restorations are significantly more effective.

## 2. Vacuum-Formed Appliance

Vacuum-formed appliances are made either in the laboratory or in-office from clear thermoplastic sheets that retain pontics for tooth replacement. Dentists using



Figure 1. Using an interim removable partial denture, a denture tooth, modified to mimic the contours of the adjacent central incisor, sat passively on the ridge just facial to the subgingivally placed healing abutment.



Figure 2. Palatal undercuts on the surrounding teeth provided retention for the claspless prosthesis.

vacuum-formed matrices to retain prosthetic teeth as temporary appliances often refer to them as Essix retainers, although true Essix retainers (Raintree Products, Metairie, LA, USA) are made with specific copolyester sheets that are reported to be stronger and more durable than typical plastic sheets. Essix retainers, originally conceived to overcome the disadvantages of Hawley appliances for orthodontic retention,<sup>3</sup> were later suggested as temporary prostheses for missing anterior teeth,<sup>4</sup> and most recently recommended as interim prostheses for implant patients.<sup>5</sup>

The technique for making vacuum-formed prostheses is relatively quick and inexpensive and is therefore convenient prior to fabrication of longer-lasting alternatives. A cast is made of the arch that is missing the tooth and a denture tooth pontic is adapted to the site. A mesiodistal

trench 4-mm wide and 3-mm deep is then cut into the palatal or lingual surface of the denture tooth to create a mechanical lock during the thermoformation process. The tooth is fixed to the cast with acrylic resin. Wax is an unsuitable alternative because it will melt during heating. A plastic sheet, usually 0.030-inch thick, is thermoformed over the cast and trimmed.

Esthetic results can be as good as those of interim RPDs, primarily because unsightly clasps are unnecessary (Figure 3). In contrast to interim removable partial prostheses, pressure on surgical sites is easily avoided because vacuum-formed prostheses are tooth retained and supported. Essix retainers or other vacuum-formed prostheses provide tooth replacement while avoiding compromise of the site following tooth extraction, site development, or implant surgery.



*Figure 3. This vacuum-formed appliance for a maxillary lateral incisor remained passive on the ridge and unsightly clasps were unnecessary.*

Vacuum-formed prostheses may not be appropriate for longer-term implant therapy because they cover the teeth, which may interfere with effective mastication, and occlusal wear of the appliance may limit their long-term durability. As with other removable appliances, vacuum-formed prostheses are not as comfortable as fixed alternatives. Essix retainers are reported to be excellent tools for orthodontic retention.<sup>3</sup> However, implant placement relies not only on coronal alignment, but also on retention of adequate apical space. Particularly in young patients who have completed orthodontic treatment, fixed appliances are the best means of orthodontic retention while waiting for skeletal maturity and implant placement.

### **Tooth-Supported Fixed Prostheses**

#### ***3. Bonded Extracted Natural Teeth, Denture Teeth, and Ceramic Pontics***

Extracted natural teeth,<sup>6</sup> denture teeth or ceramic pontics,<sup>7</sup> and resin-bonded fixed partial dentures (FPDs) (options 3 through 5) are examples of adhesive prostheses used for provisional implant prostheses. Denture teeth or extracted natural teeth may be bonded to adjacent etched tooth surfaces and are usually indicated for short-term use, particularly if there is insufficient time to make or prescribe other options (Figures 4–6).



Figure 4. A composite resin restoration was used to mask a darkened endodontically treated maxillary central incisor, but compromised gingival color was still evident.



Figure 5. A denture tooth was bonded to the adjacent teeth during implant integration and soft tissue maturation.



Figure 6. Natural tooth and gingival color was restored with a single-implant restoration.

Because laboratory involvement is not required, bonded teeth provide an immediate solution. Esthetic results may be inferior due to the bulk of composite resin in proximal spaces needed to retain the pontic. If an extracted tooth is used, additions to the gingival aspect are difficult, which also compromises esthetics.

#### 4. Cast Metal or Fiber-Reinforced Resin-Bonded FPD

Cast-metal, resin-bonded FPDs, originally developed as conservative

options for definitive tooth replacement, are used frequently as provisional prostheses for implant patients. In young patients with congenitally missing teeth who have not attained sufficient skeletal maturity for implants, cast-metal resin-bonded FPDs are ideal interim prostheses. As mentioned previously, following orthodontic treatment, a fixed appliance, such as an adhesive FPD, is more effective than an interim removable appliance for preventing orthodontic relapse and root convergence

(Figures 7–9). Resin-bonded FPDs are retained and supported by adjacent teeth, and thus will remain passive over the implant site and not interfere with implant integration or soft tissue healing.<sup>8,9</sup> Because they are fixed appliances, they are unlikely to be misplaced or damaged.

Optimal esthetics can be problematic with cast-metal resin-bonded prostheses. Thin or translucent teeth are unable to mask the palatal metal retainers, thus lowering the value of the adjacent teeth, and proximal metal margins may be visible.

Cast-metal and fiber-reinforced adhesive prostheses are not ideal provisional restorations during active implant treatment entailing multiple procedures of placement and removal. The laboratory cost is relatively high for a short-term appliance, retention and removal are unpredictable, and modification of a ceramic pontic during ridge



Figure 7. Although implant spacing for the maxillary left lateral incisor was ideal at the completion of orthodontic therapy, the patient had not reached skeletal maturity.



Figure 8. A cast metal resin-bonded prosthesis was fabricated on the adjacent, unprepared teeth.



Figure 9. Coronal and apical implant spacing were maintained with the resin-bonded fixed partial denture, and esthetic continuity was achieved with a ceramic veneer on the peg-shaped right lateral incisor.

maturation is problematic. Fiber-reinforced adhesive prostheses provide acceptable esthetics,<sup>10</sup> but are usually destroyed upon removal.

##### 5. Wire-Retained Resin-Bonded FPD

A wire-retained resin-bonded FPD incorporates a 30-gauge, 1/2 round wire embedded in a customized composite resin tooth. A full-arch impression is made of the unpre-

pared teeth, a shade is selected, and the prosthesis is made in the laboratory. The technician adapts the wire to the palatal surfaces of the teeth on the cast adjacent to the edentulous space, and extends the wire across the palatal or lingual tooth surfaces for maximum retention. A composite resin tooth is then processed to the wire. Upon return to the restorative dentist, the palatal surfaces of adjacent teeth

are etched. Flowable composite resin is injected onto the etched surfaces, the wire is embedded into the resin, which is then polymerized with a curing light. Removal of the prosthesis is easy and predictable. Once the resin is detached from the wire, the prosthesis debonds and the remaining composite resin is polished from the tooth surfaces.

The author prefers to use this prosthesis in lieu of other resin-bonded provisional options (options 3 and 4, mentioned earlier) because wire-retained prostheses incorporate the advantages of cast-metal FPDs but eliminate the disadvantages of high laboratory costs and unpredictable retention and removal. Clinical time is minimal and esthetics are pleasing to most patients (Figures 10–14).

All resin-bonded prostheses used as implant provisional restorations require clearance with little or no



Figure 10. An implant was treatment planned to replace a failing and unaesthetic endodontically treated maxillary central incisor.



Figure 11. A 30-gauge,  $\frac{1}{2}$  round wire was embedded into the customized composite resin tooth and retainers to secure the provisional resin-bonded prosthesis intraorally.



Figure 12. The seated resin-bonded prosthesis met the patient's esthetic expectations.



Figure 13. On the palatal aspect, the retainers blended in smoothly with the supporting teeth.



Figure 14. Natural color and contours were restored to the central incisor with an implant and a metal ceramic crown.

removal of tooth structure. This technique is readily applicable to mandibular anterior teeth where occlusal interferences are not a consideration. In the maxillary arch, sufficient clearance on palatal surfaces of incisors is usually obtainable. However, in patients with significant vertical overlap, there may be inadequate space for the wire retainers. Provisional

resin-bonded prostheses are particularly difficult to use on posterior teeth because an occlusal rest is difficult to obtain without tooth reduction. If substantial tooth preparation is required, patients would be better served with RPDs, vacuum-formed retainers, or implant-level provisional restorations.

#### 6. *Acrylic Resin Provisional FPD*

Acrylic resin provisional prostheses are used routinely to protect abutment teeth and provide temporary replacements when using conventional FPDs. In those cases in which teeth adjacent to implant sites require complete coverage restorations, provisional FPDs are

convenient and predictable options for single-tooth implant restorations (Figures 15–18). They can be seated immediately after implant placement without risk of compromising the implant site. For shorter-term use, chairside restorations made from self-curing materials, such as bis-acrylic resin, provide



Figure 15. Anterior crowns were esthetically unacceptable and the maxillary left lateral incisor was fractured subcrestally.



Figure 16. A laboratory-processed provisional fixed prosthesis provided improved esthetics while replacing the extracted tooth.



Figure 17. Following implant placement, the pontic was modified to fit passively over the implant abutment.



Figure 18. Individual crowns on the single implant and prepared teeth restored esthetic continuity to the maxillary arch.



esthetically acceptable results at a low material cost. A limited number of acrylic resin shades and darkening over a period of weeks limit the esthetic potential of chair-side provisional restorations. However, for protracted implant therapy, laboratory-processed prostheses are more durable and shades can be customized for individual patients, but the cost will be higher. On the other hand, if adjacent teeth are to be prepared, the cost of the provisional restoration is not necessarily related to implant treatment, but to the cost of the total reconstruction. Like other tooth-borne provisional options, implant sites can be maintained without pressure on gingival tissues. Minimal effort is required to remove the acrylic prostheses when alterations are necessary to follow the evolving anatomy of the implant site. In sites that may require several procedures, a provisional FPD can be placed on prepared teeth prior to extraction of the failing tooth, quickly removed and resealed at the time of extraction, and easily modified during continued site development and prosthetic therapy.

## Implant-Supported Prostheses

### 7. *Implant-Retained Provisional Restoration*

An implant-retained provisional restoration supported by a temporary implant cylinder can be made in the dental laboratory or by the restorative dentist. The author's

preference is to make the provisional restoration from a vacuum or silicone matrix on a preoperative cast or on an ideally contoured waxing of the replacement tooth.<sup>11,12</sup> A prefabricated crown is also an acceptable option.<sup>13,14</sup> Immediately following implant placement or upon second-stage uncovering, a temporary implant abutment is secured to the implant. A temporary abutment cylinder made of titanium or acrylic resin is effective, easy to prepare, and less costly than a definitive abutment. Reduction and preparation of a temporary cylinder may be completed intraorally on an integrated implant. However, extraoral abutment preparation is necessary on an immediately placed implant to avoid disruption of initial implant stability and contamination of the site with debris from the temporary cylinder. The cylinder is resealed and the screw is gently hand-tightened. Depending on implant angulation, provisional crowns on anterior implants can be temporarily cemented or screw-retained. For a screw-retained provisional crown, a hole must be placed in the matrix,

providing access for screw removal prior to complete setting of the temporary resin. For a cement-retained provisional crown, the temporary cylinder is tapered for removal and subsequent cementation of the restoration.

The vacuum-formed or silicone matrix is filled with a bis-acrylic resin, seated, and then removed before complete setting of the material. Because the soft tissue will quickly collapse around the temporary abutment cylinder, a void will remain between the gingival crest and the subgingival implant margin. After removal, flowable composite resin is injected and cured to fill the void, and the restoration is contoured. The subgingival contours of the restoration are modified by adding or subtracting resin until the soft tissue profile is optimal (Table 2).<sup>15-18</sup> Increasing or decreasing pressure on the fixed amount of soft tissue present with the provisional restoration will subtly influence soft tissue levels.<sup>19</sup> The limitation of this process is that the contours of the provisional and definitive restoration must still

**TABLE 2. MODIFICATION OF CROWN CONTOURS TO OPTIMIZE THE SOFT TISSUE PROFILE.**

Soft Tissue Profile	⇒	Crown Contours
To position facial margin apically	⇒	Increase facial convexity
To position facial margin coronally	⇒	Decrease facial convexity
To position papilla apically	⇒	Decrease proximal contours
To position papilla coronally	⇒	Increase proximal contours

closely match those of the adjacent or contralateral teeth for esthetic continuity. In addition to optimizing soft tissue contours, the other objective of contouring the provisional restoration is to progress from the cylindrical form of the implant to the three-dimensional contours of the tooth as the crown emerges from the sulcus (Figures 19 and 20).<sup>20</sup> After final polishing and addition of a resin glaze, the provisional restoration is seated (Figure 21). The laboratory can pattern the definitive prosthesis from the blueprint of the crown and soft tissue profile provided by the provisional restoration.

An alternative to a chairside implant provisional restoration is a laboratory-processed restoration. An index of implant position is made at the time of implant surgery and is used to attach an implant analog to a diagnostic cast.<sup>21,22</sup> A provisional implant restoration is then made on the cast by the dentist or the laboratory technician and delivered at the time of implant exposure.

Because an implant-level provisional restoration actually emerges from the sulcus, it provides the highest potential for optimal esthetics during the provisional stage of implant treatment. The ability of the dentist, patient, and laboratory technician to observe crown and soft tissue profiles prior to placing the final restoration may be the



*Figure 19. Due to external root resorption, the crowned and endodontically treated maxillary right central incisor was treatment planned for implant replacement.*



*Figure 20. The completed provisional restoration demonstrated a smooth transition from the cylindrical implant to the three-dimensional form of the maxillary central incisor.*



*Figure 21. Sulcular levels matured around the provisional restoration over the ensuing weeks prior to seating of the definitive restoration.*



Figure 22. A sulcus developed with the provisional restoration provided easy and atraumatic seating of the definitive restoration.



Figure 23. On the day of seating, the periimplant gingiva contributed to a natural continuity between the ceramic crown and adjacent central incisor.

most significant benefit of this option. Provisional implant restorations for development of emergence profiles are indicated primarily in the esthetic zone, from maxillary canine to canine. Implant-retained provisional restorations have been demonstrated to be an effective means to temporarily restore single implants following integration and uncovering by facilitating the development of the soft tissue prior to definitive restoration.<sup>23-27</sup> The sulcular profile may ultimately be the same when using a provisional or definitive crown,<sup>28</sup> but developing it in the provisional stage provides a guide to the soft tissue form before the definitive restoration is made (Figures 22 and 23).<sup>29</sup>

An implant-supported provisional restoration may be the best way to establish the optimal restorative design of the definitive restoration.<sup>30</sup> Placement of a provisional

restoration at the time of implant placement or second-stage uncovering accomplishes several goals: (1) the patient receives a restoration that provides superior esthetics and maximum comfort compared with other alternatives; (2) it eliminates the inconvenience of removable or fixed tooth-supported interim restorations;<sup>31</sup> (3) the implant-supported provisional restoration allows the dentist to evaluate sulcular depth and papilla heights prior to making the definitive restoration; (4) tissue maturation occurs at the same time as integration, decreasing overall treatment time; (5) the definitive restoration can be atraumatically seated in a sulcus already established by the provisional restoration, instead of attempting to force the restoration into a small cylindrical space developed by a healing abutment; (6) the patient can view the potential outcome and provide the dentist with input and

approval; and (7) a direct implant restoration requires few modifications compared with other options and entails minimal additional chair time once the provisional restoration is placed.

The only disadvantage of the implant provisional restoration is its higher cost due to the expense of a laboratory-made provisional restoration or the longer appointment time for one made at chair-side. Therefore, this technique should be reserved for esthetically critical sites.

#### CONCLUSION

The provisional phase of implant treatment may be the longest and most critical stage of restorative implant therapy. Available options for provisional implant restorations include various types of removable prostheses, tooth-supported fixed prostheses, and implant-retained

provisional restorations. The criteria that the restorative dentist should consider in selecting the type of provisional prostheses include the esthetic potential, patient comfort, treatment time, laboratory cost, occlusal clearance, ease of removal, durability, and ease of modification. Selection of the most appropriate provisional option for single-implant therapy significantly affects the esthetics during this phase of treatment. However, there does not appear to be a direct correlation between the type of provisional restoration used and the esthetic result of the final restoration. Optimal esthetics of the definitive implant restoration can be achieved with all types of provisional restorations.

The alternatives for provisional restorations for single implants carry varying degrees of esthetic potential. The more visually prominent the implant is, the more critical the esthetic outcome becomes. The restorative dentist should choose the type of provisional restoration that is most appropriate for the specific patient and meets the patient's esthetic expectations. Advancing surgical and restorative techniques and components are providing dentists with superior and more consistent esthetic results with implant therapy. Esthetically pleasing provisional restorations are part of the evolving implant continuum, making implant dentistry more appealing to

practicing dentists and potential patients.

#### DISCLOSURE

The author does not mention any products and therefore has no financial interest in any company or product.

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*Reprint requests: George Priest, DMD, 999 Peachtree Street, NE, Suite 795, Atlanta, GA 30309. Tel.: 404-872-3140; Fax: 404-872-3177; e-mail: georgepriest@mindspring.com.*

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