

Provisional Restorations Used in Immediate Implant Placement Provide a Platform to Promote Peri-implant Soft Tissue Healing: A Pilot Study



Hanae Saito, DDS, MS¹
 Stephen J. Chu, DMD, MSD, CDT²
 Mark A. Reynolds, DDS, PhD³
 Dennis P. Tarnow, DDS⁴

The use of an immediately placed provisional restoration that mirrors the cervical contours of the extracted tooth at the time of implant placement may provide a platform to promote peri-implant soft tissue healing. This study examined the association of sulcular bleeding at the time of initial disconnection of the provisional restoration with stability of the buccolingual ridge dimension following immediate implant placement. Eighteen immediate implants grafted with particulate bone were restored with a screw-retained, single-unit, provisional restoration and abutment. The presence of sulcular bleeding was recorded after 5 to 7 months of healing. Stability of the buccolingual ridge dimension at the level of the free marginal gingiva and 1, 2, 3, 5, 7, and 9 mm apical was estimated using the contralateral tooth as a control. Gingival bleeding was associated with the disconnection of the provisional restoration in 11 (61.1%) of the grafted implant sites. Bleeding upon initial disconnection of the provisional restoration was significantly correlated with smaller changes, or greater stability, in the buccolingual ridge dimension at each reference point from 0 to 3 mm apical to the free gingival margin. The use of anatomically contoured provisional restorations may provide a platform to promote peri-implant soft tissue healing and minimize remodeling of the buccolingual ridge dimension.

Int J Periodontics Restorative Dent 2016;36:47–52. doi: 10.11607/prd.1945

Creating a natural and healthy supra-implant gingival morphology, with the appropriate volume, color, and shape, is essential for a positive esthetic outcome.¹ The supra-implant soft tissue morphology is dependent primarily upon the characteristics of the bone and soft tissues surrounding the implant as well as the implant restoration. Moreover, the position of the midfacial gingival tissue and the interproximal soft tissue volume are critical to achieve esthetic outcomes around implants that are indistinguishable from the contralateral tooth. Immediate implant placement has shown benefit in the preservation of the interproximal bone and papillae, with comparable success rates to delayed implant placement.²

Immediate implant placement, however, is not normally sufficient to prevent dimensional loss of supra-implant soft tissue—specifically, buccal marginal soft tissue recession.^{3–5} Animal studies have shown that postextraction bone formation and remodeling cannot be prevented by immediate implant placement, possibly resulting in additional midfacial recession.^{6–8} Human studies have shown that 90% of patients have a buccal bone plate thickness of 1 mm or less.^{9,10} Buccal gingival thickness, which ranges from about 0.1 to 1.2 mm, is moderately but significantly correlated

¹Assistant Professor, University of Maryland School of Dentistry, Baltimore, Maryland, USA.

²Clinical Associate Professor, Ashman Department of Periodontology and Implant Dentistry, Department of Prosthodontics, New York University College of Dentistry, New York, New York, USA.

³Dean and Professor, Department of Periodontology, University of Maryland School of Dentistry, Baltimore, Maryland, USA.

⁴Clinical Professor, Director of Implant Education, Columbia University College of Dental Medicine, New York, New York, USA.

Correspondence to: Dr Hanae Saito, Department of Periodontics, University of Maryland School of Dentistry, 650 W. Baltimore St., Room 4201, Baltimore, MD 21201, USA
 Fax: 410-706-7201. E-mail: hsaito@umaryland.edu

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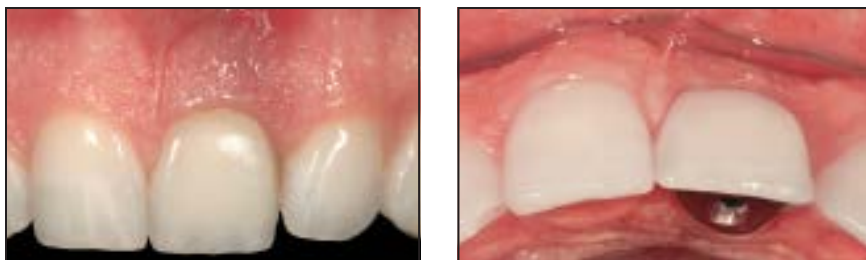


Fig 1 Gingival discoloration (left) and buccolingual collapse (right) of an implant in the esthetic zone with a bone graft.

with underlying bone thickness around the natural dentition.^{11,12}

Several adjunctive treatments have been suggested to compensate for possible loss of hard and soft tissue volume with immediate implant placement, such as bone grafting the space, or gap, between the implant and buccal alveolar bone, augmenting the soft tissue with a connective tissue graft, and inserting an immediate provisional restoration.^{5,13,14} Grafting the gap between the implant and the buccal plate of bone does not enhance the wound healing process or the biologic outcome of osseointegration;^{15,16} however, a bone graft helps maintain the buccolingual ridge dimension, averting collapse of the buccal plate and discoloration of the marginal gingiva resulting from tissue translucency over the implant (Fig 1).¹³ Therefore, the clinical benefit of grafting the gap at the time of immediate implant placement is to enhance esthetic outcomes rather than increase implant survival and osseointegration.

Provisional restorations inserted at the time of immediate implant placement have been used to restore esthetics, improve patient

comfort, and reduce the number of treatment visits; however, the effect of the provisional restoration on healing and maintenance of the hard and soft tissue morphology remains unclear. Immediate implant placement with a provisional restoration can provide mechanical and physical support for the peri-implant soft tissues, although studies have shown inconsistent results.^{17–19} Moreover, the provisional restoration presumably helps contain, protect, and stabilize the bone graft material within the blood clot during healing, in addition to helping develop the desired contours of the marginal gingiva. One potential role of the provisional restoration is to provide a surface for adhesion of the marginal soft tissue during the early stages of healing.

Soft tissue adhesion to clean surfaces, such as titanium, gold, and other dental materials placed on natural teeth, is well documented in the literature. Soft tissue adhesion may serve as a biologic barrier, protecting the underlying tissues during healing.^{20,21} Abrahamsson found that repeated insertion and disconnection of the healing abutment of the Brånemark-type external-hexed im-

plant resulted in apical migration of the junctional epithelium, consistent with disruption of the epithelial adhesion.²² The purpose of this study was to examine the association between bleeding upon first disconnection of the provisional restoration and stability of the buccolingual ridge dimension at sites treated with immediate implant placement.

Materials and methods

In this retrospective case series, anterior maxillary postextraction implant placement with a provisional restoration was evaluated in 18 participants. Written informed consent was obtained from all participants. The inclusion criteria for implant replacement included no uncontrolled systemic or other medical conditions, maxillary anterior teeth (first premolar to first premolar), good periodontal health with no gingival recession, and no perforation of the buccal alveolar bone secondary to endodontic infection. Exclusion criteria included pregnancy, extraction sockets Type II and III,²³ and parafunctional habits (Fig 2). Fourteen implant sites had a bone graft with either inorganic bovine bone (Bio-Oss Collagen, Geistlich) or cancellous mineralized allograft (Puros, Zimmer Dental) placed in the gap between the implant and the buccal wall of bone to the level of the free gingival margin (Fig 3). Selection of bone graft material was at the surgeon's discretion. A screw-retained provisional restoration and abutment were fabricated as a single unit using acrylic filled with



Fig 2 Preoperative radiograph of site 9 in a patient presented with external resorption.



Fig 3 Implant in extraction socket with bone graft placed up to the free gingival margin.



Fig 4 Insertion of an anatomically contoured screw-retained, single-unit, provisional restoration-abutment (site 9) at the time of extraction and immediate implant placement.



Fig 5 Postoperative radiograph of site 9 with bone graft and provisional restoration placed at a time of flawless postextraction immediate placement.



Fig 6 (left and right) Clinical presentation of site 9 at 2.5 years follow-up.



autopolymerizing resin (Super T, American Consolidated Manufacturing) and polyether-ether-ketone polymer abutment.²⁴ Prior to insertion of the provisional restoration, the subgingival surface of the restoration was steam-cleaned for 20 seconds (Touchsteam, Kerr) and provisional restoration was placed in a screw-retained manner (Fig 4). Participants were put on a presurgical broad-spectrum antibiotic and analgesic and seen 7 to 14 days

postoperative for follow-up. A 5- to 7-month healing time was given before the first disconnection of the provisional restoration and documentation of bleeding from the peri-implant sulcus.

After the final restoration was delivered, gypsum casts were made from alginate impressions and seven points of reference were measured at the midface with digital calipers (Avenger Measuring Tools) at the level of the free marginal gingiva

and 1, 2, 3, 5, 7, and 9 mm apical at the implant site and contralateral tooth (Figs 5 and 6). The change in buccolingual ridge dimension at the implant site was estimated based on the contralateral tooth (Table 1).

Data were subjected to regression analysis (JMP Version 10, SAS). Stability of the postextraction implant site was estimated using the contralateral site as the control. Statistical significance was set at an α level of .05.

Table 1 Presence of bleeding and changes in buccolingual width at the level of the free gingival margin and 1, 2, 3, 5, 7, and 9 mm apical

Patient	Bleeding	Δ 0 mm	Δ 1 mm	Δ 2 mm	Δ 3 mm	Δ 5 mm	Δ 7 mm	Δ 9 mm
1	No	-0.8	-1.0	-0.7	0.0	0.5	1.1	1.4
2	No	-0.6	-0.7	-0.7	-0.6	-0.4	-0.8	0.1
3	No	-0.8	-0.7	-0.5	-0.3	-0.2	0.0	-0.1
4	No	-0.1	-0.2	-0.3	-0.1	0.1	0.1	-0.2
5	No	-0.2	-1.5	-1.6	-1.3	-0.8	-0.4	-0.9
6	No	-1.5	-1.4	-1.4	-1.0	-0.8	-0.4	0.1
7	No	-0.1	-0.1	-0.2	-0.3	-0.1	0.0	-0.2
8	Yes	0.4	0.3	0.6	1.2	1.2	0.3	-0.4
9	Yes	0.6	0.4	0.3	0.4	0.1	-0.2	-0.8
10	Yes	0.6	-0.4	-0.4	-0.1	-0.1	0.0	N/A
11	Yes	0.5	-0.4	-0.4	-0.4	0.0	-0.4	N/A
12	Yes	0.9	0.3	0.3	0.1	1.1	-0.1	-0.3
13	Yes	0.2	0.1	-0.3	-0.4	0.1	-0.1	-0.2
14	Yes	0.7	0.6	0.5	0.8	-0.1	0.2	0.1
15	Yes	-0.2	-0.2	0.2	0.2	0.2	-0.6	-0.8
16	Yes	-0.5	-0.9	-1.1	-0.9	-0.4	-0.8	-0.9
17	Yes	-0.1	-0.1	0.1	0.0	0.1	0.0	-0.2
18	Yes	0.5	0.4	0.5	0.4	0.0	0.0	0.1

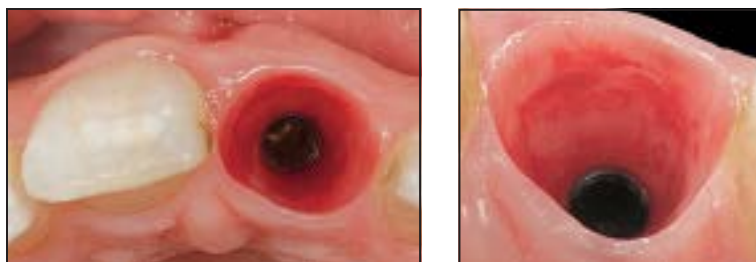


Fig 7 (left and right) Preservation of buccolingual dimension with sulcular bleeding upon first removal of provisional restoration.



Fig 8 (left and right) Clinical loss of buccolingual dimension, with no evidence of sulcular bleeding upon first removal of provisional restoration of tooth 11.

Results

In all cases, healing following implant surgery and insertion of the provisional restoration proceeded uneventfully (ie, no visible sign of inflammation or plaque). Clinically, all implants exhibited healthy marginal gingiva prior to removing the provisional restoration. Gingival bleeding was associated with the disconnection of the provisional restoration in 11 (61.1%) of the grafted implant sites. The buccolingual dimension of the ridge was significantly correlated between implant sites and contralateral teeth: 0 mm ($r = 0.66$, $P < .05$); 1 mm ($r = 0.82$, $P < .05$); 2 mm ($r = 0.83$, $P < .06$); 3 mm ($r = 0.89$, $P < .05$); 5 mm ($r = 0.96$, $P < .001$); 7 mm ($r = 0.89$, $P < .0001$); 9 mm ($r = 0.99$, $P < .0001$). The strength of association was greatest at the reference points most apical to the free marginal gingiva (7 mm and 9 mm). These correlation coefficients reflect a significant degree of concordance, or anatomic symmetry, between sites within subjects.

Bleeding upon disconnection of the provisional restoration (present or absent) significantly predicted change in buccolingual dimension at each reference point from 0 to 3 mm apical to the free gingival margin. The coefficients were as follows: 0 mm (-0.72 , ≤ 0.001); 1 mm (-0.63 , ≤ 0.005); 2 mm (-0.58 , ≤ 0.01); 3 mm (-0.52 , ≤ 0.05); 5 mm (-0.48 , NS); 7 mm ($r = -0.12$, NS); and 9 mm ($r = -0.32$, NS). These significant coefficients indicate that bleeding upon disconnection of the provisional restoration was correlated with greater dimensional ridge stability,

or less loss in buccolingual dimension, compared to sites without bleeding (Figs 7 and 8).

Discussion

This study examined the association between bleeding from the peri-implant sulcus upon first disconnection of the provisional restoration and stability in buccolingual ridge dimension at sites treated with immediate implant placement. Placement of a provisional restoration contoured to mirror the extracted tooth is postulated to help support the marginal gingiva by providing a platform to promote peri-implant soft tissue healing as well as protect the healing extraction socket.²⁵ Waerhaug showed that epithelium and connective tissue can adhere to a clean surface of artificial crowns and teeth made of acrylic.^{20,21,26} In the present study, this concept was applied to provisional restorations made of the same material, which was steam-cleaned prior to insertion with postextraction socket implants. All implants exhibited healthy marginal gingiva (ie, no visible signs of inflammation or plaque) prior to first disconnection of the provisional restoration; nevertheless, nearly 70% of all sites exhibited bleeding from the gingival sulcus upon disconnection with no correlating inflammation. Moreover, significant bleeding predicted greater stability in buccolingual ridge dimension at each reference point from 0 to 3 mm apical to the free gingival margin. It can be speculated that the presence of adhesion of peri-implant sulcus epi-

thelium to the surface of provisional restoration after sulcular bleeding is consistent with disruption of a gingiva-restoration interface, or adhesion, which in part presumably constitutes a long junctional epithelium. Therefore, bleeding upon first disconnection of the provisional restoration was found to significantly predict stability of the buccolingual ridge dimension.

In Abrahamsson's animal model study, the implants were placed at the level of the healed alveolar ridge in the posterior region.²² Given the thinner gingival phenotype of the canine model, it is unclear whether a thicker soft tissue biotype would have remained stable following repeated disconnection and connection of the healing abutment. In the present study, implants were placed into fresh extraction sockets 3 mm to 4 mm apical to the free gingival margin, equivalent to the midfacial crest of bone, to facilitate adequate emergence for the prosthetic component of the restoration and maintain initial bone stability.^{27,28} Bone grafts were placed in the gap between the implant and the buccal bone up to the level of the free gingival margin, coronal to the buccal crest of bone, prior to insertion of a customized tooth-colored and contoured provisional restoration. This approach may promote the development of supraimplant gingival adhesion coronally that may minimize changes in buccolingual hard and soft tissue dimensions.

A limitation of this study is the indirect method used to estimate the stability of postextraction implant sites using the contralateral tooth

as a fixed reference. This method is based on evidence that both the teeth and contours of the anterior arch segments exhibit a high degree of symmetry.^{29,30} Similar approaches have been used to assess esthetics of implant restorations, given the important role of harmony and symmetry with the surrounding teeth in determining esthetic outcomes.^{31,32} Another limitation of the study is the lack of histologic data to verify the presence and characterize the nature of the adhesion or interface between the gingival tissue and the provisional restoration.

Conclusions

Bleeding upon first disconnection of the provisional restoration was found to significantly predict stability of the buccolingual ridge dimension. At the time of immediate implant placement, the use of a provisional restoration contoured to mirror the cervical morphology of the extracted tooth may provide a platform to promote peri-implant soft tissue healing and minimize remodeling of the alveolar bone.

Acknowledgments

The authors would like to thank to Mr Adam Mielezsko, CDT, for his laboratory support in the fabrication of the restoration. The authors reported no conflicts of interest related to this study.

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