A restorative protocol for implants replacing adjacent maxillary central incisors in a compromised site

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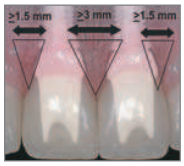

Achieving natural sulcular profiles is arguably the most challenging aspect of restoring adjacent implants. Especially when treating patients with visible gingival architecture, clinicians must use all available means to optimize the sulcular and papillary forms. This article describes a protocol for restoring maxillary central incisors when a delayed approach to implant placement is required.

Key Words: implants, aesthetic zone, zirconia abutments

The Surgical Influence on the Restorative Outcome

Implant dentistry is restoratively driven, but the surgical component of treatment is the most critical step because it establishes the aesthetic potential. From the initiation of implant therapy, the restorative endpoint must be the continuous focus of the implant team. Belser and colleagues, after reviewing pertinent literature, noted that soft-tissue anatomy around single-implant restorations is usually acceptable because of tissue support of adjacent teeth, but soft-tissue profiles around multiple implants are often unpredictable.[1] Inevitable interimplant bone resorption following multiple extractions and implant placement is largely responsible for the altered soft tissue.[2] Removal of contiguous teeth often results in flattening of the interproximal osseous scalloping and subsequent collapse of the interproximal papillae.[3] Regarding adjacent implants, Kan et al have observed that site development and an ideal osseous-gingival relationship remain the fundamental components for implant treatment in the aesthetic zone.[4]

The most effective means of ensuring the presence of a papilla between central incisors is to prevent its loss and the loss of the underlying bone at the time of tooth removal (Figs. 1-5).[5] Atraumatic extraction techniques, using periotomes or piezosurgery for example, are becoming standard bone-preserving protocols, but some loss of interseptal bone is still unavoidable (Figs. 6-8).[3] Furthermore, the initial osseous anatomy may be so compromised that it is not possible to place an implant and preserve the interseptal and labial bone. Augmentation of such sites is usually indicated followed by a delayed protocol.


Fig. 1


Fig. 2


Fig. 3


Fig. 4

Implant Placement

Implant placement must be both restoratively and biologically driven. Placement is directed by the position of the anticipated restoration(s) but is also influenced by the goal of preserving osseous levels and soft-tissue profiles.[6] In this case, the author selected implants designed to aid in crestal bone preservation (NanoTite™ PREVAIL® Implants, BIOMET ***3i***).[7] The surgeon must use caution to avoid encroachment on the interseptal bone between the central and lateral incisors when attempting to procure at least 3mm between central incisor implants. Otherwise, the papillae both mesial and distal to the central incisors may be jeopardized (Figs. 9-11).

Recent data from Magne et al[8] indicate that central incisors range in width from 8.5mm to 11.1mm, and Chu's data show slightly smaller dimensions of 7.1mm to 10.1mm.[9] These data indicate that even when replacing the narrowest central incisors, use of standard implants should allow for maintenance of 3mm between the central incisor implants and at least 1.5mm between the implant and the adjacent teeth.

Implant placement becomes more complex when replacing a central and lateral incisor, or a lateral incisor and canine. Maxillary lateral incisors range in width from 5.5mm to 8.2mm according to Magne et al,[8] and from 6.0mm to 8.0mm according to Chu.[9] Replacement of narrow maxillary lateral incisors adjacent to central incisors or canines can result in compromise of interseptal bone even when reduced diameter implants are utilized. Two additional factors also make the aesthetic potential of two adjacent central incisor implants greater than that of a central and lateral incisor or a lateral incisor and canine (Table 1).[10] While there is only one papilla between central incisors and no contralateral papilla for comparison, that is not the case with lateral incisors.[11] Furthermore, a remnant of the nasopalatine papilla often remains between central incisors that can be supported to help form the papilla.

If teeth adjacent to potential implant sites require full-coverage restorations, a processed provisional restoration may be made prior to implant placement and seated on the adjacent teeth (Figs. 4 and 5). The surgeon can easily remove the prosthesis and reseat it. Healing and implant integration may not be compromised because grafted sites can be maintained without any pressure being placed on gingival tissues. Minimal effort is required to remove the acrylic prosthesis when alterations are necessary to adapt to the evolving anatomy of the implant site. The restorative dentist then has the luxury of choosing when to develop the soft tissue. The provisional restoration may undergo a transformation during the course of treatment as healing progresses and/or if multiple surgical procedures are necessary.

Soft-Tissue Development with Provisional Restorations

Grunder[12] has noted that three factors determine peri-implant soft-tissue levels: (1) the level of bone, (2) the volume of the connective tissue, and (3) proximal support of the implant crowns. The bone is the limiting factor. If a site is properly developed, the potential for optimal soft tissue is high. Once the implant is placed, it is then the responsibility of the restorative dentist to maximize the soft-tissue potential established by the implant surgeon.

Implant-retained provisional restorations have been demonstrated to be effective tools for developing the soft tissue prior to fabrication of the definitive restoration.[13] A well-contoured, implant-level provisional restoration may redirect the existing volume of soft tissue to optimal levels.[14]


Fig. 5


Fig. 6


Fig. 7


Fig. 8

The sulcular profile may ultimately be the same when placing a provisional restoration or definitive crown,[15] but developing it in the provisional stage provides a guide to the soft-tissue form before the definitive restoration is made.[16]

Peri-implant sulcular development of adjacent central incisor implants with a provisional restoration accomplishes several objectives: (1) the restorative dentist and implant surgeon can observe tissue levels and determine if further tissue refinement is necessary, (2) patient expectations can be evaluated early, (3) the patient receives the benefits of a fixed restoration during interim treatment,[17] (4) the developed soft tissue can be accurately communicated to the laboratory technician using varied impression techniques, and (5) the definitive prosthesis easily slips into a previously developed sulcus. Alternatively, the soft tissue can be developed solely by using the definitive restoration, but this process is subjective, requiring the laboratory technician to estimate contours.

Delivery of a provisional restoration can be accomplished as follows: immediately following implant placement, or upon second-stage uncovering, provisional implant abutments are secured to the implants. Provisional abutments made from a polymer, such as PreFormance® Provisional Components (BIOMET ***3i***) can be prepared more quickly and easily than those made of metal alloys. The white color of the polymer material (PEEK) is easier to mask beneath resin provisional restorations, and it provides a warmer hue to the gingival tissues. The provisional cylinders are quickly reduced, and chairside or laboratory-processed provisional restorations are fabricated. If provisional restorations have been made previously, these may be hollowed out, relined, and attached directly to the temporary cylinders.

Fig. 1 Due to trauma at a young age, the maxillary central incisors of a 35-year-old patient were treated endodontically, and all four incisors received metal-ceramic crowns.

Fig. 2 The papilla between the two central incisors was relatively intact, but the height was compromised between the central and lateral incisors as a result of the accident.

Fig. 3 Upon clinical and radiographic examination, the symptomatic teeth were diagnosed with a vertical root fracture of the right central incisor and non-restorable caries of the left central incisor.

Fig. 4 The old crowns were removed from the incisors and the teeth reprepared.

Fig. 5 Processed, splinted provisional crowns were relined and cemented with temporary cement.

Fig. 6 At the surgical appointment, the provisional restoration was removed, and the central incisors were atraumatically extracted.

Fig. 7 The provisional restoration was recemented after site augmentation and remained undisturbed for several months prior to implant placement.

Fig. 8 Removal of the provisional prosthesis revealed the flat architecture of the augmented ridge.

The author prefers screw-retained as compared to cement-retained implant-level provisional restorations for soft-tissue development. During adjustment procedures, it is more convenient to remove the crown and temporary cylinder as a single unit as opposed to removing a provisional crown and a separate abutment. It is also easier to develop the subgingival contours beginning at the level of the implant with a screw-retained provisional restoration; most temporary posts for cement retention are straight in profile and do not mimic the subgingival contours of teeth. If an abutment for cement retention is prepared subgingivally for optimum contours, it can be difficult to capture the margins during modifications. Use of a screw-retained provisional restoration also eliminates the need for cement-margin clean-up. The only disadvantage is that the screw-access opening must be masked, particularly if the implant is angled through the facial aspect of the restoration.

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Fig. 10

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Fig. 18

Fig. 19

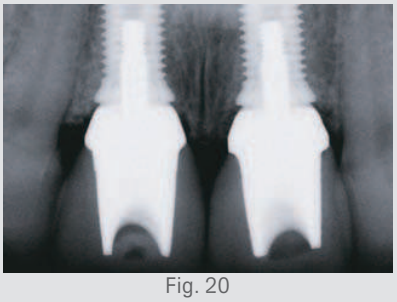

Fig. 20

Fig. 9 Implants were placed into the central incisor positions with ideal mesiodistal spacing, and healing abutments were seated.

Fig. 10 The provisional restorations were modified for passive seating over the implants and remained in place during integration.

Fig. 11 A radiograph demonstrated preservation of osseous levels.

Fig. 12 The provisional restoration was again removed, temporary cylinders were attached to the integrated implants, and the restoration was modified to support the remaining peri-implant soft tissue.

Fig. 13 Over a few weeks, the sulcular implant tissue reformed to the altered provisional restoration.

Fig. 14 Prefabricated zirconia abutments displaying straight and abrupt emergence profiles (ZiReal® Posts, BIOMET *3i*) were marked for reduction and contour refinements.

Fig. 15 Zirconia preparation diamonds (Komet USA, Rock Hill, South Carolina, USA) were used to prepare gradual emergence profiles and finish lines that followed the gingival scallop.

Fig. 16 Both abutments were reseated on the master cast for crown fabrication.

Fig. 17 Ceramic crowns for the central incisors transitioned smoothly from the customized zirconia abutments.

Fig. 18 Four aspects of crown fabrication on adjacent implants include: (1) optimal subgingival abutment support, (2) a long contact area, (3) elimination of black triangles, and (4) bright ceramics in proximal aspects.

Fig. 19 The patient's revitalized smile demonstrated balanced sulcular levels and crown contours and colors that blended naturally with the remaining dentition.

Fig. 20 Marginal bone levels that are critical to soft-tissue form remained stable following implant placement and restoration.

Fig. 21 Soft-tissue profiles developed with the provisional restorations were preserved by the subgingival contours of the abutments and crowns.

Soft-tissue support with the provisional restoration should begin at the level of the implant and progress coronally from the cylindrical form of the implant to the trigonal shape of a tooth as it emerges through the gingival sulcus (Fig. 12).[18] Subgingival contours are gently adjusted by adding or subtracting flowable composite resin until the soft-tissue profile is optimal.[19] Increasing or decreasing pressure on the fixed amount of soft tissue present will subtly influence the sulcular and papillary levels.[12] The provisional and definitive restoration must still closely match the contours of the adjacent or contralateral teeth for aesthetic continuity. Once the sulcular levels have been optimized, the provisional restoration should be left in place until the tissues have matured and are ready for impression making (Fig. 13). Continued removal, modification, and reseating should be avoided as these processes may actually lead to loss of bone and soft tissue.[20]

Definitive Crowns and Abutment Contours

Once the restorative dentist or prosthodontist has maximized the potential of the sulcular contours around adjacent central incisor implants with provisional restorations, these contours must be replicated within the definitive abutments and crowns. The laboratory can use the provisional restoration as a blueprint for the subgingival and supragingival contours that must be achieved.[21] This information can be relayed to the laboratory by several methods: the provisional restoration itself can be impressed,[22] impression copings can be modified to duplicate the subgingival contours of the provisional restorations,[23] digital images of the soft-tissue profiles can be sent to the laboratory, or soft-tissue casts can be contoured with burs specifically designed for reduction of silicone materials. A custom or prefabricated definitive abutment may be used, although prefabricated abutments may require slight modifications (Fig. 14). For example, a prefabricated abutment with a stepped emergence profile between the abutment and the definitive crown may require modification to make it more closely mimic the natural tooth/root contours (Figs. 15-17).

To compensate for the inevitable loss of papillary height between maxillary incisor implants, four aspects of abutment and crown fabrication require special consideration (Fig. 18): (1) the subgingival abutment form must optimally support the available soft tissue, (2) proximal contact areas must be extended gingivally, (3) unsightly black triangles must be completely closed, and (4) fluorescent or high chroma ceramics should be applied in the gingival proximal aspects between the crowns to minimize the shadow effect.[24]

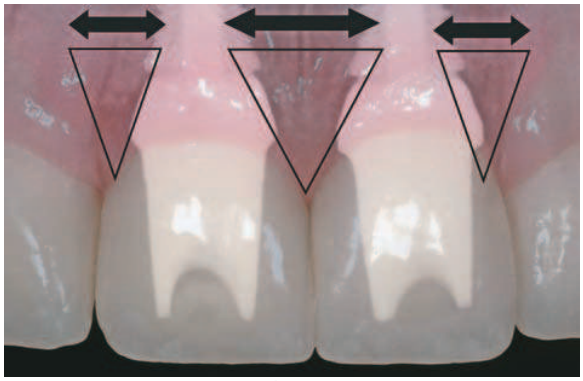

Fig. 21

Central Incisor Central Incisor	Lateral Incisor Central Incisor/Canine
Symmetrical	Asymmetrical
Nasopalatine papilla	No papilla
Larger tooth	Smaller tooth
Greater interseptal space	Less interseptal space

Table 1
The soft-tissue potential of implants replacing adjacent maxillary anterior teeth

The definitive restorations should easily slip into the previously developed sulci, and the reformed peri-implant gingiva will be supported by the subgingival contours of the definitive abutments and crowns (Figs. 19-21).

Clinical Relevance

Although restitution of soft-tissue levels around adjacent implants is not consistently achievable, protocols predicated on preservation and restoration of osseous architecture may result in clinically acceptable aesthetics for many patients. Optimal placement of implants in well-developed sites provides the restorative dentist with the potential to redevelop the soft-tissue to normal sulcular form with implant-level provisional restorations. The support established with the provisional prostheses are then duplicated in the subgingival form of the implant abutments and crowns to preserve the peri-implant anatomy and can provide naturally appearing restorations for adjacent implants.

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