

Single tooth replacement utilizing implants in the esthetic zone: a case report

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Replacing a single tooth with an implant has become a common dental procedure; however, careful evaluation is necessary before placing one in the esthetic zone. Thorough diagnosis and planning – including the use of transposed diagnostic casts and cone beam computed tomography scans – can help dentists predict the final esthetic result prior to treatment, and help inform the patient of the potential result prior to performing any irreversible therapy. In the present case, the primary concern was the presurgical location of the facial free gingival margin

(FGM) of the implant-supported crown, in relation to the adjacent teeth. Steps taken to correct the position of the facial FGM prior to implant placement led to a successful esthetic result.

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The utilization of dental implants for single tooth replacement has become one of the most common implant procedures in the U.S.¹ The advantages of single tooth implants include prevention of tilting and supraeruption of adjacent and opposing teeth, the conservation of adjacent tooth structure, and the psychological benefits of tooth replacement.^{1,2} When a single tooth is deemed nonrestorable, extraction and socket preservation may be necessary, followed by replacement with an implant-supported single crown.³

Implant placement in the esthetic zone

Placing a single implant in the anterior maxilla is a multifactorial process that requires attention to detail. When placing implants in this esthetic area, maintaining the bone architecture of the implant site and the accompanying gingival contours is vital.^{1,4} In a 2001 article, Kois described 5 “diagnostic keys” to help the clinician determine the predictability of peri-implant esthetics: relative tooth position, periodontium form, periodontium biotype, tooth shape, and position of the osseous crest.⁵ Optimal support and stability of the peri-implant soft and hard tissue depends on the correct 3-dimensional placement of the implant. In 2004, Buser et al suggested the following guidelines for implant placement: first, the mesio-distal distance between the adjacent teeth and the implant should not be less than 1 to 1.5 mm.⁶ In addition, the facial implant shoulder should be positioned 1 mm palatal to the

point of emergence of the adjacent teeth for the proper emergence profile of the implant crown, and the top of the implant shoulder should be placed approximately 1 mm apical to the cemento-enamel junction (CEJ) of the facial surface of the contralateral tooth with no recession.⁶

Preservation and maintenance of soft and hard tissues

The final location of the facial gingival margin and the preservation of the interdental papilla help to determine the esthetic outcome of an anterior implant. It is easier to maintain or create a papilla between an implant and a natural tooth than between 2 implants.⁷ A 1992 study by Tarnow et al compared the presence or absence of papilla between 2 teeth, using the distance from the crest of the bone to the contact point between the teeth.⁸ When a distance of ≤ 5 mm was achieved, the papilla filled the embrasure space 100% of the time. At 6 mm, the papilla filled the embrasure space 55% of the time; at 7 mm, the papilla filled the space 25% of the time. When an implant was placed adjacent to a natural tooth with < 5 mm between the contact point and the crest of the bone, the papilla was maintained.⁸ It appears that the key to maintaining the interdental papilla is the bone level of the adjacent tooth, rather than the interproximal bone level of the implant.⁴

Maintaining the facial gingival margin of an implant is more complicated. The facial gingival margin of an implant is related to the implant’s facial bone height and the

thickness and position of the FGM prior to removing the natural tooth.⁹ The thin facial plate may be lost after the maxillary tooth is extracted. This amount of resorption/bone loss is directly related to facial contours and the amount of time a tooth has been absent.¹ The buccal bone crest is comprised of bundle bone, which resorbs more readily after tooth extraction than palatal bone, which has a cortical bone plate.⁴ A 25% bone width reduction of the maxillary anterior ridge can occur within the first year of loss of a tooth.¹ To minimize the amount of facial bone resorption after implant placement, a labial bone thickness of 1.8 to 2 mm is desired.¹⁰ Preserving the extraction site through bone grafting helps to maintain the vertical bone height, thus maintaining the soft tissue at the extraction site.^{11,12} This preservation of the extraction site results in a healed site which is conducive to ideal implant placement and improved soft tissue contours.^{11,12}

Immediate placement of implants

It has been reported that the concurrent placement of implants into extraction sites and immediate provisionalization preserves gingival anatomy and prevents bone resorption.⁴ In addition, the immediate placement of implants decreases the total treatment time and the number of surgeries.^{3,4} However, it also has been reported that facial bone loss may occur despite the immediate placement of an implant.¹

Three factors determine the feasibility of an immediate implant placement: the absence of acute noncontained infection,

the initial stability of the implant, and the nature of the bone present.¹³ If a patient does not have bone of sufficient quantity and quality, then additional procedures (such as orthodontic forced eruption and hard/soft tissue grafting) may be required prior to implant placement.¹⁴⁻¹⁶

This case report presents the esthetic concerns involved in replacing a failing tooth No. 8. There was swelling and tenderness in the area; in addition, the facial gingival margin of the natural tooth had a 1 mm recession as a result of infection. As a result, it was decided to extract the tooth and prepare the site for implant placement at a later date.

Case report

A 22-year-old female patient presented to the University of Tennessee College of Dentistry, Undergraduate Endodontic Clinic, for the evaluation of her tooth No. 8. The patient's chief complaint was pain and an inability to chew with tooth No. 8. According to the patient, tooth No. 8 had been a source of pain for 3 months. Swelling was noted in the area, with slight tenderness to percussion and palpation. The tooth had been avulsed and re-implanted 6 years earlier without endodontic therapy. A radiograph of the tooth revealed external root resorption with a periapical radiolucency (Fig. 1). In addition, a cone beam computed tomography (CBCT) scan was performed to further evaluate the tooth.

The CBCT scan revealed a large area of external resorption on the distolingual surface of the tooth and a small area on the buccal surface close to the tooth apex. The extent of the external root resorption was discussed with the patient and, at that time, the tooth was deemed unrestorable. The treatment options for replacing the missing tooth were discussed with the patient, including a removable partial denture, a fixed partial denture, and an implant crown. The patient agreed to the extraction of tooth No. 8 and replacement with an implant crown. The patient was referred to the Graduate Prosthodontic Clinic for extraction, implant placement, and restoration. Additional information was obtained during consultation. The patient had canine disclusion, with a 2 mm vertical overlap and a 1 mm horizontal overlap. The patient revealed a



Fig. 1. A periapical radiograph of tooth No. 8 revealing external root resorption.



Fig. 2. A pre-extraction photograph of maxillary anterior teeth. Note 1 mm recession of FGM at tooth No. 8.



Fig. 3. An occlusal view of tooth No. 8 area with putty in the extraction site.



Fig. 4. A provisional bridge is bonded in place after the extraction of tooth No. 8.

high smile line with 1 mm gingival recession on the facial aspect of tooth No. 8 (Fig. 2). The facial gingival contour of tooth No. 8 was highly scalloped with a thin biotype; the deepest facial periodontal probing was 3 mm. Following anesthesia, tooth No. 8 was extracted atraumatically, using forceps and periostomes. Care was taken not to damage the labial bone, and the socket site was examined to verify an intact buccal plate. The site was irrigated with saline and curetted. The socket was preserved utilizing Puros Demineralized Bone Matrix Putty (Zimmer Dental) (Fig. 3). A provisional undercontoured ovate pontic was fabricated with composite material (Integrity, DENTSPLY Caulk). Teeth No. 7 and 9 were etched with phosphoric acid (Ultra-Etch, Ultradent Products, Inc.) and bonding agent (Optibond Solo Plus, Kerr Corporation) was applied per

manufacturer's instructions. Using composite (Esthet-X, DENTSPLY Caulk), the highly polished pontic was bonded to teeth No. 7 and 9 (Fig. 4).

The implant site healed for 13 weeks. At the end of the healing period (and prior to the implant surgery), another CBCT scan was taken with a laboratory fabricated radiographic template in place to confirm good bone quality and quantity. The CBCT scan revealed that the bone thickness was adequate for placing an implant 4.5 mm in diameter. The distance between the nasal floor and the crest of the alveolar ridge measured 17 mm, while the distance between the implant platform and the cervical portion of the prosthetic tooth in the radiographic template measured 2.2 mm. The tissue over the implant site also was evaluated prior to surgery, and the attached tissue was determined to be adequate. The



Fig. 5. Photograph showing the implant after placement.



Fig. 6. Photograph showing the temporary abutment placed with markings for modifications.



Fig. 7. Photograph showing the temporary abutment after final adjustments, prior to fabrication of provisional tooth No. 8.

patient returned to the clinic for surgery. Anesthesia was administered to the attached tissue, providing hydrosopic dissection and hemostasis.

To identify the implant site specifically, it was decided to use the radiographic template as the surgical template. A 5 mm biopsy punch was used to remove tissue from over the implant site. The surgical template was reinserted and the drilling sequence was performed as follows. First, an Astra implant (DENTSPLY Implants) measuring 4.5 mm x 13 mm was placed, according to manufacturer's instructions (Fig. 5) and adequate primary stability was achieved (>50 Ncm). An Astra Tech TempDesign provisional abutment (DENTSPLY Implants) was screwed on the implant and marked for reduction (Fig. 6). Next, the provisional abutment was removed and a healing abutment placed to prevent tissue collapse while the provisional abutment was adjusted. The prepared provisional abutment was disinfected and evaluated intraorally for fit and adequate occlusal reduction (Fig. 7). Before the provisional was fabricated, the screw access was maintained by obturating the screw access hole with monophasic impression material (AquaSil VPS, DENTSPLY Caulk). A retraction cord (Ultrapak No. 2, Ultradent Products, Inc.) was placed gently around the abutment to prevent the provisional material from extending subgingivally. A laboratory-fabricated temporary was relined *in situ* with Integrity (shade B-1). The provisional was removed from the mouth and the subgingival contours of the provisional were modified with Esthet-X Flow (shade B-1)



Fig. 8. Side view of the provisional implant crown after final contouring and polishing.



Fig. 9. Anterior view of the provisional implant crown for tooth No. 8.

(Fig. 8). The provisional was adjusted, polished, and screwed into place by torquing the fixation screw to 15 Ncm (Fig. 9). The screw access hole was sealed with System curing material (Ivoclar Vivadent, Inc.), universal shade. The occlusion on the provisional was evaluated and adjusted to remove any lateral interferences. After 6 months of healing, the provisional crown was removed and a fixture level impression was made. An Atlantis zirconium abutment (DENTSPLY Implants) was designed and fabricated. The final all-ceramic crown was fabricated to optimize the esthetics of the case as described by Gallucci et al.¹⁷ The Atlantis abutment was placed and the final crown was tried in and evaluated for fit, function, and esthetics (Fig. 10). Custom staining was required to blend the crown with the adjacent teeth. Once the patient accepted the esthetics of the prosthesis, the Atlantis

abutment was torqued to 35 Ncm and the all-ceramic crown was cemented (GC Fuji Plus Cement, GC America, Inc.) (Fig. 11).

Discussion

The following 5 diagnostic keys presented by Kois were integral to the planning of this case.⁵

Relative tooth position

The failing tooth was evaluated in relation to the adjacent dentition in the apicocoronal, mesiodistal, and faciopalatal planes.⁵ In this case, tooth No. 8 had an unfavorable facial gingival margin, positioned 1 mm more apical than the adjacent dentition. Without addressing the presurgical location of the facial gingival margin of tooth No. 8, the final location after healing could have been 3 mm more apical than the surrounding teeth.



Fig. 10. Anterior view of the placement of the Atlantis zirconium abutment.



Fig. 12. Facial view of the final restoration of implant-supported tooth No. 8.

Form of the periodontium

The facial recession on tooth No. 8 was classified as highly scalloped with a facial pocket depth of 3 mm. An undercontoured bonded provisional was fabricated to prevent loss of papilla height, develop the emergence profile of the implant site, and support the soft tissue contours.^{15,18,19} Undercontouring the provisional's facial and proximal contours promoted incisal migration of the soft tissue.^{19,20} Care was taken to ensure the provisional pontic did not apply any pressure to the socket site during the healing phase, thus preventing additional apical migration of the facial gingival margin.

Biotype of the periodontium

The gingival biotype for this patient was thin, thus fragile and more likely to recede. To minimize the anticipated recession, a flapless procedure (that is, a punch biopsy) was performed during implant placement, which minimized the loss of blood supply to the underlying bone and decreased the gingival recession.⁵

Tooth shape

The shape of the patient's teeth was determined to be square tapering, which has an advantage over oval and triangular teeth. This shape minimizes the formation of black triangles due to long proximal contact, and provides more proximal support for the interproximal papilla.⁵

Position of the osseous crest

The soft tissue contours depend on the location of the underlying osseous structure.¹⁵ The position of the osseous crest is

an important predictor of the FGM after implant placement. Since the probing depths on the facial was 3 mm, one could expect recession of 1 mm in the area after surgery.⁵

Other diagnostic information was used to help predict and control the final esthetic results. The CBCT scan was used to verify the position of the prosthetic tooth and the location of the planned implant; and to predict the thickness of the labial bone. A 2000 study by Spray et al reported that the average labial bone thickness is 1.7 mm and the greatest amount of bone loss occurs when the labial thickness is less than 1 to 1.4 mm.¹⁰ Very little bone loss occurs when the labial bone thickness is ≥ 1.8 mm.

In the present case, the implant to be used was superimposed virtually over the cross-section of the bone. The thickness of the bone was measured to be 1.7 mm, close enough to estimate that the amount of bone recession would be minimal. Previous studies have reported the ideal platform depth of 1 to 4 mm from the implant platform to the gingival margin or CEJ.^{1,10,21-23} Utilizing CBCT, the distance from the implant platform to the cervical portion of the provisional pontic was gauged to be 2.2 mm. At the time of surgery and provisional placement, the FGM was approximately 4 mm from the implant platform. The FGM after placement of the provisional was more coronal than the FGM of tooth No. 9 (Fig. 5). With a predicted recession of 1 mm, the location of the FGM better approximated that of the adjacent teeth after healing.⁵

Summary

Placing a single tooth implant in the esthetic zone is a challenging task. The literature has provided diagnostic aids for predicting the final esthetic results of a case. By applying these aids during the treatment planning stage, a dentist can accurately predict the esthetic outcome and inform the patient before the implants are placed. In the present case, the presurgical location of the facial FGM relative to adjacent teeth was the primary concern. Steps were taken prior to implant placement to correct the position of the facial FGM, leading to an acceptable esthetic result.

Disclaimer

The authors have no financial, economic, commercial, and/or professional interests related to topics presented in this article.

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Manufacturers

DENTSPLY Caulk, Milford, DE
800.532.2855, www.dentsply.com

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