Esthetic Rehabilitation of Maxillary Incisors in Conjunction with Flapless Surgical Techniques, an Implant Zirconia Crown, and Porcelain Veneers

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ABSTRACT

Esthetic replacement of a maxillary central incisor using a dental implant can be a challenging task. The hard and soft tissues must be managed in a way that minimizes the risk of tissue loss, while preserving and/or regenerating full interdental papillae. In order to achieve this, flapless surgical techniques have been developed. Advances in dental materials have led to the introduction of zirconia abutments and crowns that can be synergistically combined with other ceramic materials. This article describes a case in which a hopeless maxillary central incisor is replaced with an implant using flapless techniques, and restored with a customized zirconia abutment and crown. In addition, the remaining maxillary incisors were restored with feldspathic porcelain veneers to yield a highly esthetic result.

CLINICAL SIGNIFICANCE

This case demonstrates how a conservative multidisciplinary approach facilitates excellent results in an esthetically demanding area. Atraumatic surgical techniques can maintain the natural soft tissue architecture, while a detailed approach to provisional and final restorations allows for a highly esthetic smile.

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INTRODUCTION

Esthetic replacement of a maxillary central incisor using a dental implant can be a challenging task. Beyond osseointegration of the implant, the hard and soft tissues must be managed in a way that creates a natural architecture that is symmetrical with the contralateral side. The preservation and development of full interdental papillae and stable gingival margins have been of particular concern.[1,2] Many variables are involved in the management of the biologic tissues. Biologic width associated with implants,[3] the depth of implant placement,[4] the space between teeth and implants,[5] and the position of the interproximal contacts of crowns[6] are among the factors that influence bone and interdental papillae. The stability of the buccal gingival margin is also influenced by the gingival biotype,[7] bone resorption following implant placement,[8] and the implant position relative to the

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buccal alveolar bone.[9] In order to minimize the risk of tissue loss around dental implants, flapless implant surgical techniques have been developed.[10,11]

After the hard and soft tissue support system has been addressed, the implant must be restored in a manner that is esthetic and consistent with the adjacent teeth. When the treatment plan calls for the use of different restorative modalities and the combination of dissimilar materials, the challenge can be even greater. New developments in dental materials have led to the introduction of zirconia abutments. These can be beneficial in the esthetic zone because they allow for light transmission through the peri-implant tissues,[12] and are especially suited for areas with thin gingival tissue.[13] This article describes a case in which a dental implant is placed with a flapless technique to replace a hopeless maxillary central incisor, and a customized zirconia abutment and crown are used in conjunction with feldspathic porcelain veneers to restore the four maxillary incisors.

CASE REPORT

A 38-year-old nonsmoking woman presented with the chief concern of a highly painful and mobile maxillary right central incisor. The patient reported a history of this tooth being treated with an apicoectomy. Clinical examination found the maxillary right central incisor to have a class III mobility and mild super eruption (Figure 1). The patient had esthetic soft tissue contours, full papillae, and a thin biotype. Moderate hypercalcifications and medium-sized deficient interproximal composite restorations were noted on all maxillary incisors. Radiographic evaluation revealed severe periapical pathology (Figure 2). After discussing the findings and treatment plan options with the patient, the patient elected to replace the maxillary right central incisor with an implant-supported crown. The remaining maxillary incisors would be treated with feldspathic porcelain veneers.

Profound local anesthesia was achieved using 5.4 cc 2% lidocaine with 1:100,000 epinephrine.

Figure 1. Preoperative view. Note mildly discolored maxillary right central incisor and generalized decalcifications.

Figure 2. Preoperative radiograph shows maxillary right central incisor with short root and large periapical radiolucency.

Figure 3. Following atraumatic extraction, interdental papillae are left intact.

Figure 4. Regenerative membrane is secured in buccal gingival pouch.

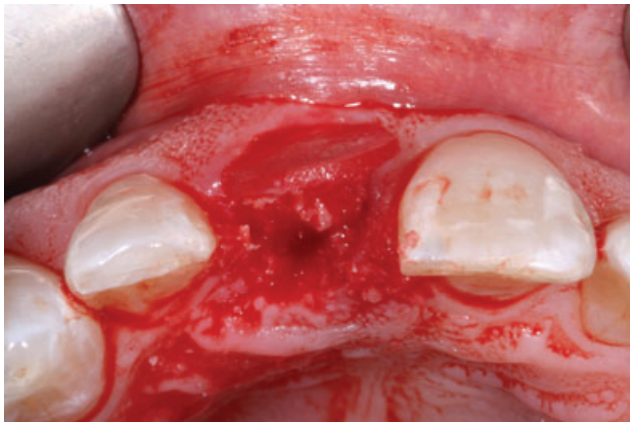

Figure 5. Calcified particulate bone graft has been placed into extraction socket.

Figure 6. Regenerative membrane secured over bone graft.

Incisions were made using a #15 scalpel blade in the gingival sulcus around the maxillary right central incisor. Using periotomes and forceps, this tooth was atraumatically removed (Figure 3). The extraction socket was meticulously curetted. A gingival pouch was carefully elevated on the buccal aspect of this site, and the interdental papillae were avoided. The buccal plate of bone was found to be thin, but intact. A collagen membrane (BioMend Extend, Zimmer Dental, Carlsbad, CA, USA) was trimmed to approximately 15 × 7 mm with rounded corners. The membrane was inserted into the buccal pouch (Figure 4), and a calcified particulate bone graft (Puros Allograft, Zimmer Dental) was placed into the extraction socket (Figure 5). The collagen membrane was folded over the graft material and tucked under the palatal gingiva. A continuous 4.0 chromic gut suture was used to secure the membrane in place (Figure 6). An interim removable partial denture was used to provisionalize the edentulous space.

After 4 months, the site was found to be healing well (Figure 7). A flapless surgical design was used to access the alveolar bone. Using a

Figure 7. Following 4 months of healing, normal gingival architecture has been maintained.

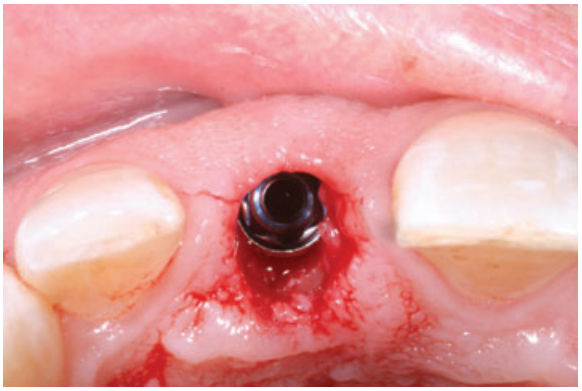

Figure 8. Implant placed using flapless surgical design.

#15 scalpel blade, a circular incision was made on the ridge crest, toward the palate, and within the zone of keratinized gingiva. The gingiva was removed exposing the underlying bone. The position of the buccal bone was carefully confirmed by sliding a periotome under the buccal flap. Using surgical implant drills, an implant osteotomy was prepared. Following this preparation, the buccal plate of bone was found to be intact. A regular diameter, 4.0 × 13 mm, threaded dental implant (PrimaConnex, Keystone Dental, Burlington, MA, USA) was placed with its prosthetic table approximately 3 mm below the future cervical margin of the restoration as determined by a surgical guide, and 4.5 mm below the crestal tip of the interdental papillae (Figure 8).

The implant had a rough surface, a 1-mm machined smooth collar with a medialized microgap and an internal prosthetic connection. A stock contoured healing abutment with a 6 mm flare and 3 mm cuff was placed on the implant. Radiographic evaluation confirmed proper implant placement and complete seating of the healing abutment (Figure 9).

After 3 months, the implant site was found to be healing well (Figures 10 and 11). The gingiva had natural and esthetic contours. The interdental papillae were full and showed no signs of shrinkage. Mild gingival overgrowth covered the healing abutment. With the healing abutment removed, the gingival cuff was found to be healthy and free of inflammation (Figure 12). The patient was referred to the prosthodontist for final restorative treatment.

The remaining maxillary incisors were prepared for porcelain veneers. Enamel reduction of about 0.4 mm was done, and margins were placed at the gingival crest. This limited reduction would allow the resulting shade to be a combination of the tooth preparation and the shade chosen for the restorations. At the same appointment, a PMMA provisional abutment (PrimaConnex, Keystone Dental) was used to fabricate a screw-retained provisional restoration. The PMMA abutment was secured to the implant and prepared. Polymethyl methacrylate was loaded into a silicone matrix that duplicated an initial diagnostic wax-up, and the matrix was seated over the provisional abutment (Figure 13). Once the material was set, the provisional restoration was trimmed and polished. The remaining incisors were spot etched and bonded. Provisional veneers were fabricated using the same matrix and a

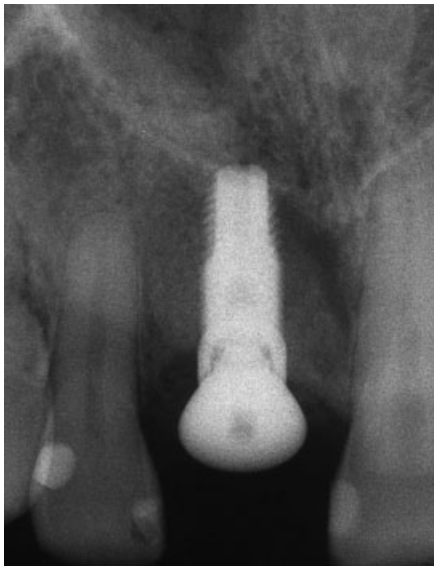

Figure 9. Radiograph showing good bone regeneration and implant placement.

Figure 10. Following 3 months of healing, the implant site appears healthy.

Figure 11. Facial view shows scalloped gingival architecture has been preserved.

Figure 12. Removal of healing abutment shows gingival cuff to be free of inflammation.

bis-acryl material (Protemp 3 Garant, 3M ESPE, St. Paul, MN, USA). All provisional restorations were carefully finished and adjusted intraorally.

Approximately 2 months later, the gingival health and contours showed a satisfactory response. The provisional restorations and abutment were removed, showing an adequate development and maturation of the emergence profile (Figure 14). Two thicknesses of retraction cord were packed around the natural abutments, and a flared impression post (Primma-Connex, Keystone Dental) was connected to the implant (Figure 15). Because the contours of the gingival cuff of the impression post matched those of the healing and provisional abutments, proper gingival support was

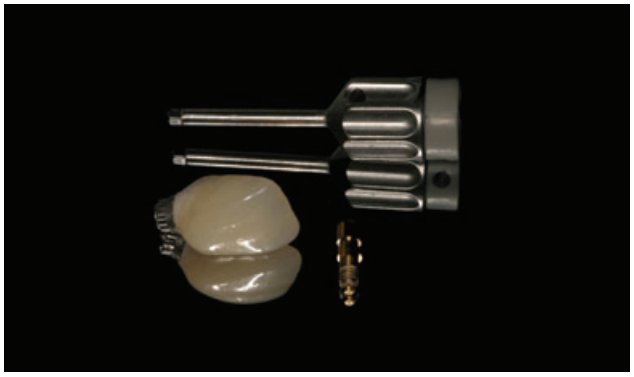

Figure 13. Provisional screw-retained restoration shown with retaining screw and implant driver.

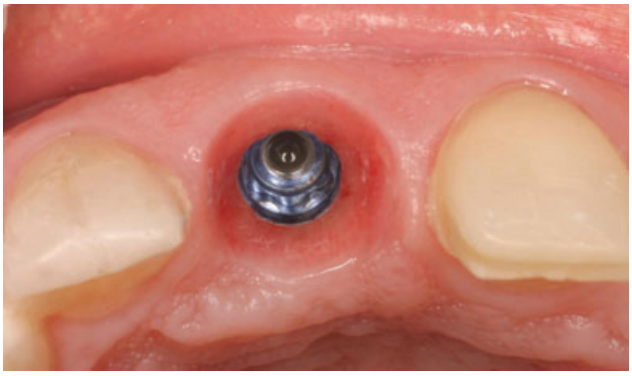

Figure 14. Following 2 months of provisionalization, ideal emergence profile has been developed.

Figure 15. Simultaneous impression of prepared teeth and implant site.

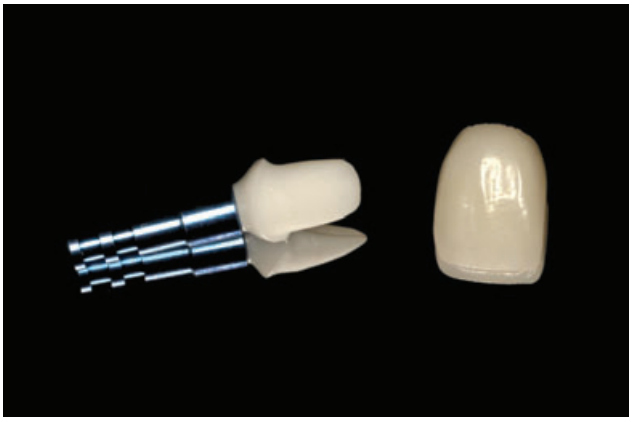

Figure 16. Customized prefabricated zirconia abutment and zirconia crown.

maintained, allowing for a closed-tray final impression that accurately communicated the soft tissue profile to the laboratory.[14]

A custom abutment was made using a prefabricated straight zirconia abutment (Esthetic ContourZi Abutment, Keystone Dental) modified with veneering porcelain to provide optimal margin placement, retention, resistance, support, and emergence contours. The abutment was then scanned, and a zirconia coping with a 1-mm circumferential cervical cutback was fabricated. Compatible veneering porcelain was used to seal the cutback margins and to achieve adequate anatomy and esthetics (Figure 16). The zirconia abutment was torqued to 30 Ncm (Figures 17 and 18), and a light-cured semi-rigid composite material was used to seal the screw access hole. The feldspathic veneers and the cervical margins of the zirconia crown were etched with hydrofluoric acid, silanated, and the restorations were adhesively cemented with a resin cement (Figure 19).

DISCUSSION

Several treatment plans were available to this patient. Most notably,

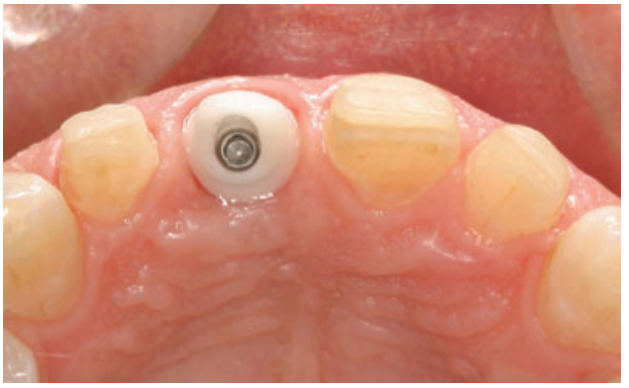

Figure 17. Occlusal view of torqued zirconia abutment and prepared teeth.

Figure 18. Facial view prior to final cementation of restorations. Careful management of the soft tissue has preserved the gingival esthetics during each step of treatment.

Figure 19. Postoperative view shows good esthetic integration of gingiva and ceramic restorations.

the maxillary right central incisor could have been replaced using a fixed partial denture using the adjacent incisors as abutments. This patient, however, specifically requested replacement of the maxillary right central incisor using a dental implant and single crown. Because of the highly esthetic nature of this area, proper management of this site was critical.

Flattening of the osseous architecture and collapse of the interdental papillae have been reported when teeth are removed.[15] Therefore, preservation of the natural osseous and gingival architecture was considered most prudent. Considering the need for exceptional results, it was decided that the maxillary right central incisor would be removed and treated with a regenerative technique described by Elian et al.[16] prior to implant placement. Securing a regenerative membrane and leaving it exposed over the bone graft in an atraumatic manner permit the regeneration of bone in the extraction socket without compromising the natural soft tissue architecture. The exposed membrane is expected to resorb in the first few weeks after surgery.

Because flap reflection around teeth can result in gingival recession and bone resorption,[17,18] and regeneration of hard and soft tissues has been shown to be difficult,[15,19] flapless implant surgery was performed.[10,11] In addition, care was taken not to place the implant too buccally[7] to prevent buccal bone resorption.[20]

Esthetic concerns were important in the selection of the implant system used. The implant chosen was a two-stage implant with a

stable internal connection and a medialized microgap. The goal of the medialized microgap is to reduce crestal bone loss associated with the establishment of the biologic width,[21] therefore maintaining the stability of the gingival margin. The implant system used, with the desired narrowed prosthetic table, as well as esthetically contoured healing abutments, has been shown to yield highly esthetic results.[22,23]

Recent advances in ceramic restorations and abutments have greatly transformed esthetic dentistry. Porcelain veneers are frequently the restoration of choice when the goal is to modify tooth form, position, and/or color.[24] They can restore appropriate rigidity to the crown[25] and have the benefit of preserving sound tooth structure over full-coverage restorations.[26] Ceramic abutments have the advantage over metallic ones of avoiding the possibility of gingival discoloration as a result of abutment material show-through, and can improve translucency and illumination of the peri-implant soft tissues.[13,27] Zirconia is of particular interest to the dental profession because of its high toughness and strength,[28] which has made it the material of choice for ceramic abutments.[29]

Zirconia abutments are showing promising results both in vitro and in vivo. Laboratory studies comparing their behavior to titanium abutments report that both types should be able to withstand functional forces in a similar manner[30] and have sufficient fracture resistance for anterior and posterior regions.[31,32] Clinical studies have shown no failures or screw-loosening between 1 year and up to a 44-month observation period.[33,34] The particular zirconia abutment used in this case has no metal collar, which allows customization with veneering porcelain to enhance the emergence profile, support, and retention of the restoration.[35]

CONCLUSION

This article demonstrates the progressive management of an extraction site, implant placement, and its restoration. In combination with modern ceramic technology, these techniques can maintain natural soft tissue contours while further advancing the natural appearance and esthetic results of treatment.

DISCLOSURE

The authors do not have any financial interest in the companies whose materials are included in this article.

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