SINGLE-TOOTH IMPLANT RESTORATIONS IN THE ESTHETIC ZONE WITH PUREFORM CERAMIC CROWNS: 3 CASE REPORTS

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KEY WORDS

Alumina
Zirconia
Abutments
Ceramic
Esthetic zone

The anterior maxillary jaw is frequently called the ''esthetic zone'' because of its high visibility and influence on facial appearance. Implant placement and single-tooth restoration in this region can present some esthetic challenges for the clinician. The underlying titanium abutment, for example, can diminish porcelain translucency and result in a darkened prosthesis. Subsequent changes in soft-tissue margins can also result in the visibility of titanium at the gingival crevice. In recent years, all-ceramic restorations have gained popularity in response to increasing patient demands for improved esthetics. This article describes the clinical use of a new, tooth-shaped, ceramic coping system in the restoration of single teeth in the esthetic zones of 3 patients. Four tapered screw implants were placed in the locations of the central incisors (n = 3) and bicuspid (n = 1). Conventional ceramic protocols were used to fabricate all-ceramic crowns that were cemented onto small core abutments attached to the implants. All prostheses restored the biomechanical needs of the patients and achieved excellent esthetic results.

INTRODUCTION

Tooth loss in the anterior maxilla represents a significant esthetic challenge for the restorative dentist because of the region's visibility and role in smile performance.[1] Conventional dentistry and implant prosthodontics offer a variety of strategies for replacing the missing anatomy,[2,3] and both require special presurgical case planning to achieve optimum esthetic results.[4] In conventional dentistry, fixed restorations can restore maximum function, but esthetics and oral hygiene may be compromised by short pontics and ridge laps, respectively. Conversely, removable partial dentures can help improve esthetics, but their lack of stability can impede the ability to function. In both cases, conventional restorations must compromise the adjacent teeth for support or retention. Substitution of the missing anatomy by means of root-form implants has thus become the treatment of choice for many clinicians because of its

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lack of invasive procedures on the adjacent teeth[5] and its long-term predictability.[6]

To maintain soft-tissue contours and preserve hard-tissue anatomy, many clinicians now advocate placing implants with the widest possible platform[7] directly into fresh extraction sockets.[8] Numerous recently published articles have also advocated the immediate insertion of both a temporary abutment and a provisional prosthesis with immediate,[9] early,[10] or delayed[11–13] full occlusal function. In this way, treatment time can be considerably reduced by eliminating the need to deter implant placement until reossification of the extraction socket, and soft-tissue contours can be more easily preserved for optimal esthetic results.[10] In cases where a tooth is already missing, treatment often requires additional surgical steps to enlarge the mucosa or bony anatomy to compensate for tissue losses that occur after extraction. At second-stage surgery, it is often desirable to place a temporary abutment and crown to enable the soft tissue to heal in the correct anatomical contours.

One drawback to implant placement in the esthetic zone is that the titanium restorative abutment can sometimes be seen below the soft tissue and cause the porcelain restoration to have an unesthetic grayish appearance. Over time, gingival recession can cause an increase in unsightly abutment visibility. To overcome these problems, it has been recommended that all implants in the anterior maxilla be placed from 2 to 3 mm below the cementoenamel junction of adjacent teeth to help conceal abutment metal and prevent its further exposure in the event of gingival recession.[14] It has also been recommended[15] that porcelain be extended to just below the finish line of cast gold abutments to anticipate future changes in tissue contours, but this technique is not always free from risks because of limitations in material thickness and possible material contraction. The ideal solution would be to have a component made of esthetic material that will maintain esthetics in the event of exposure.

This article reports on 3 cases that used a new ceramic restorative system to replace single missing teeth in the esthetic zone of the anterior maxilla.

Case Reports

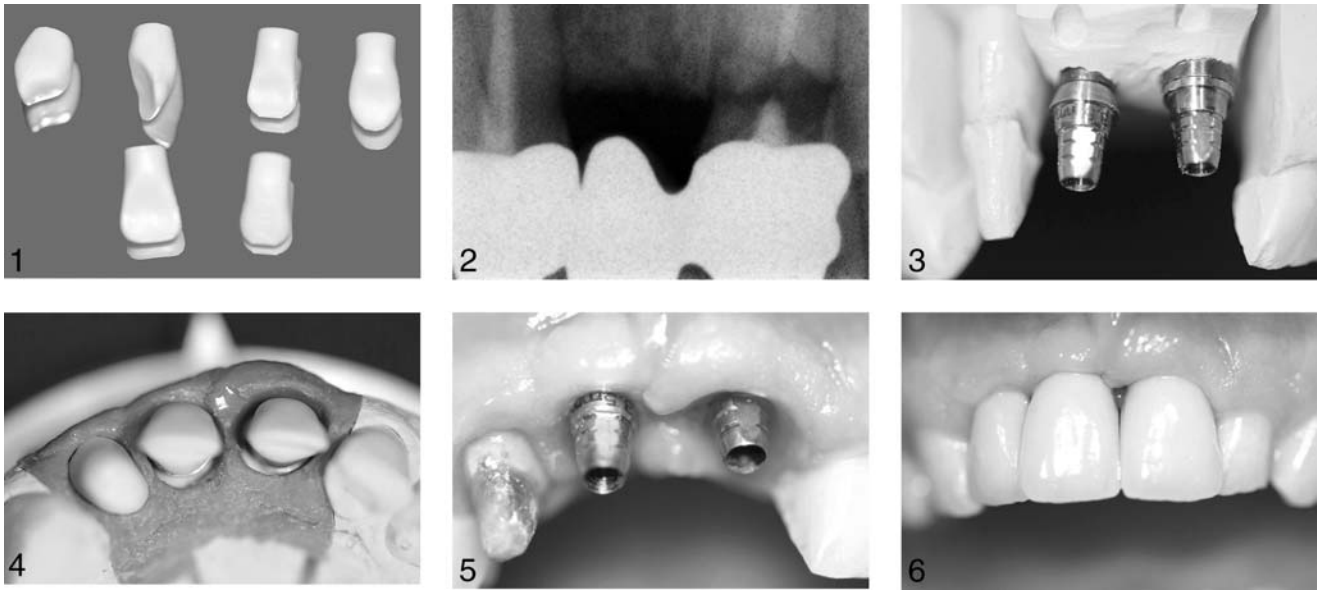
Each patient was carefully evaluated medically, clinically, and radiographically to assess current health status and to identify any pathologies that required preliminary treatment. A diagnostic workup was performed to evaluate the volume and location of available bone, esthetic and functional needs of the case, and desires of the patient. A study cast was fabricated and mounted on a semiadjustable articulator with a face bow and vertical registration to determine the jaw relationships, available occlusal dimension, proposed implant position, crown-root ratio, and potential complications. This enabled fabrication of a prosthetic wax-up and surgical template to guide placement of the implant. Treatment alternatives were presented, and informed patient consent was obtained before surgery.

The patient was prepared for surgery and anesthetized via local infiltration and N_2O_2 sedation. Hopeless teeth were extracted without trauma. To prevent disruption of the vascular network and maintain soft-tissue architecture, the implant was placed without reflection of the soft tissue. Socket debridement with curettes was first performed to remove granulation tissue. With the surgical template as a guide, the socket was sequentially prepared with internally irrigated drills according to the recommended protocol for the implant system. A self-tapping, screw-design implant (Tapered Screw-Vent MTX, Zimmer Dental Inc, Carlsbad, Calif) was placed into the prepared receptor site and its fixture mount was removed. Prescribed prophylactic antibiotic therapy consisted of 500 mg of amoxicillin 2 hours before surgery and 3 days postoperative.

The restorative system (PureForm, Zimmer Dental Inc) consisted of 6 ceramic (30% zirconia, 70% alumina) copings in 2 different sizes (small and large) and angulations (straight and 17°) that were shaped like prepared natural teeth (Figure 1). In each case, the ceramic coping was prepared with a diamond grinding wheel (Diadur Tools S.L., Barcelona, Spain) under copious irrigation. No chipping or cracking of the ceramic coping occurred during preparation, and porcelain was applied directly to the modified component without preliminary waxing or casting. A titanium core abutment was seated directly onto the implant and secured in place with a retaining screw tightened to 30 Ncm with a calibrated torque wrench. The finished porcelain crown was sterilized in an autoclave at 250°F for 60 minutes and cemented onto the core abutment with resin cement (Panavia, Kuraray Medical Co Ltd, Osaka, Japan).

Case 1

A 32-year-old male nonsmoker presented with a conventional, 3-unit fixed partial denture that replaced a missing maxillary



FIGURES 1–6. FIGURE 1. Six ceramic copings are shaped like prepared natural teeth. FIGURE 2. Case 1. Preoperative radiograph shows fracture of the maxillary left-central incisor and decementation of the prosthesis. FIGURE 3. Core abutments were selected for collar height on the master cast. Note that both 0.5 mm (right) and 1.5 mm (left) collar heights were used. FIGURE 4. Ceramic copings were selected for angulation and shape on the master cast. FIGURE 5. Core abutments were connected to the implants in the patient's mouth. FIGURE 6. Definitive all-ceramic fixed partial dentures were delivered (buccal view).

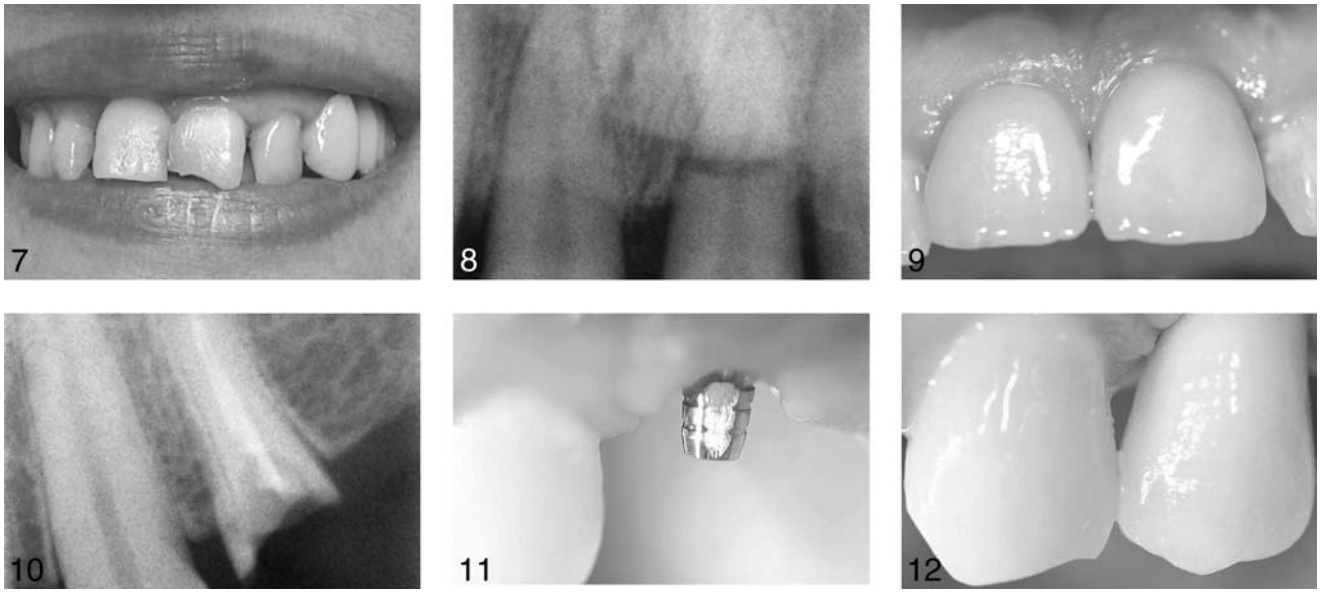
right-central incisor. Clinical evaluation revealed that the prosthesis was decemented by deep decay and the maxillary left central incisor was fractured (Figure 2). The plan involved extraction of the fractured tooth, insertion of 2 implants, and restoration with 3 single-unit restorations. A 3.7- × 13-mm implant was placed in the location of the missing maxillary right-central incisor, and a 4.7- × 13-mm implant was immediately placed in the prepared extraction site of the adjacent maxillary left-central incisor. The fixture mounts of the implants were prepared as transitional abutments, and the case was immediately loaded with a nonoccluding, 3-unit, provisional fixed partial denture that was splinted to the maxillary right-lateral incisor. After soft-tissue maturation, the provisional prosthesis was removed, a definitive impression was made, and the prepared fixture mounts were used as transfers to fabricate a working cast containing implant analogs. The core abutments (Figure 3) and ceramic copings (Figure 4) were selected on the master cast. The definitive, custom-made, all-ceramic crowns were fabricated in the dental laboratory and delivered to the patient (Figures 5 and 6).

Case 2

A 51-year-old female nonsmoker presented with a fractured maxillary left-central incisor (Figure 7) several days after a motorbike crash. A periapical radiograph revealed a congenital root defect (lusus naturae) of the maxillary right-central incisor (Figure 8). The maxillary right-central incisor was extracted without trauma, and a 4.7- × 13-mm implant was placed in the prepared extraction socket. The implant's fixture mount was prepared for use as a transitional abutment, and the adjacent maxillary left-central incisor was prepared for a conventional, single-tooth restoration. Both units were loaded with a nonoccluding, splinted, provisional fixed partial denture. After 2 months of healing, the prosthesis was removed and a definitive impression was made of the prepared fixture mount and adjacent prepared tooth. The definitive core abutment and ceramic coping were selected on the resulting master cast. Conventional ceramic procedures were conducted to fabricate the all-ceramic crown with the ceramic coping and a conventional ceramometal crown. The definitive restoration was delivered several days later (Figure 9).

Case 3

A 42-year-old male nonsmoker presented with a nonrestorable root fragment in the location of the maxillary left first premolar (Figure 10). The tooth root was extracted without trauma, and a 4.7- × 13-mm implant was placed into the prepared socket.



FIGURES 7–12. FIGURE 7. Case 2. Patient presented with a fractured left-central incisor from a motorbike accident. FIGURE 8. Case 2. Periapical radiographic revealed a maxillary right-central incisor root defect. An immediate implant was placed in this location after tooth extraction. FIGURE 9. Case 2. The case was restored with all-ceramic and conventional ceramometal crowns. FIGURE 10. Case 3. Radiograph of a nontreatable maxillary left first premolar root. FIGURE 11. Case 3. At the delivery appointment, the core abutment was attached to the implant with 30 Ncm of applied torque. FIGURE 12. Case 3. The definitive, all-ceramic crown in place (buccal view).

The implant's fixture mount was prepared for use as a transitional abutment and restored with a nonoccluding provisional crown. The provisional crown was removed after soft-tissue maturation, and the prepared fixture mount was used as an impression post-and-transfer to fabricate a master cast containing an implant analog. Selection of the core abutment with the appropriate cuff height and the ceramic coping was done on the master cast. The ceramic coping was sent to the technician for preparation and color customizing by conventional ceramic layering. After dynamometric blocking of the core, the finished all-ceramic crown was cemented onto the core abutment (Figures 11 and 12).

DISCUSSION

Implants in the present cases were progressively loaded through a gradual increase in the application of force by their provisional prostheses, adjacent anatomic structures, and parafunctional behaviors of the patients.[16] Progressive loading of the implant in relation to external forces allows bone time to remodel, organize, and develop a lamellar interface that increases bone-implant apposition and ensures greater long-term implant survival.[17] Placement of an acrylic provisional prosthesis also enables the soft tissue to mature in the correct anatomical contours and provide the patient with an esthetically acceptable provisional prosthesis without delivering direct shock or stress to the bone-implant interface.[17,18]

The implants selected for these cases were a tapered screw design with a microtextured (Tapered Screw-Vent MTX, Zimmer Dental Inc) surface and a triple external thread pattern.

Tapered implant designs have been reported to be advantageous for placement into compromised anatomical locations such as ridges with undercuts, between convergent tooth roots,[19] and into prepared tooth-extraction sockets.[20] Their immediate placement into prepared tooth sockets can also help preserve the dimensions of the alveolar ridge by curtailing postextraction resorption patterns.[20] Research on screw-type implants with multiple thread patterns has documented faster insertion with less heat generation, greater initial stability, and increased insertion torque compared with single-thread, screw-type implants.[21–24] Coupled with new surface-roughening treatments, multiple thread patterns, and improved surgical techniques, tapered screw implants can offer greater stability in soft bone than can conventional nontapered screw implants.[19–21,25,26]

The prosthetic stability of these cases was enhanced by a friction-fit, implant-abutment

connection. During assembly, a self-locking taper on the male hexagon of the core abutment component created frictional resistance as it seated into the female hexagon and cervical bevel of the implant.[27,28] When fully assembled under 30 Ncm of applied torque, the mated components create a ''virtual cold weld'' frictional interface that has been documented to completely eliminate rotational micromovements.[28] To remove a seated core abutment, a special tool is required to first disengage the tight frictional interface with the implant. The core abutments successfully withstood attachment and removal with the appropriate tools without any perceived distortion or damage. The fixture mounts used to seat the implants into the receptor sites were also used as transitional abutments to support the provisional restorations and as impression posts-and-transfers to fabricate master casts containing implant analogs. This technique helped reduce cost and enabled the soft tissue to heal in the optimal anatomical dimensions.

Dental implant restoration has become a predictable therapeutic option for single-tooth replacement, but careful case planning is essential to meet the esthetic requirements of the anterior maxilla. In a 2002 survey, 80% of responding dentists acknowledged using metal-free crowns, which was a 36% increase over the preceding 3-year period.[29] Although some implant manufacturers have offered all-ceramic restorative systems for several years, the associated drawbacks of preparation time and less-than-optimal restorative materials have resulted in slow market growth.[30] The ceramic copings in the present cases required little or no preparations, and the laboratory technician easily completed the prostheses by routine laboratory procedures for porcelain. Restorative time and costs were considerably reduced, and all cases achieved excellent esthetics.

CONCLUSIONS

Within the context of these cases, the ceramic restorative system provided a relatively simple technique for achieving excellent esthetics in the esthetic zone of anterior maxillae.

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