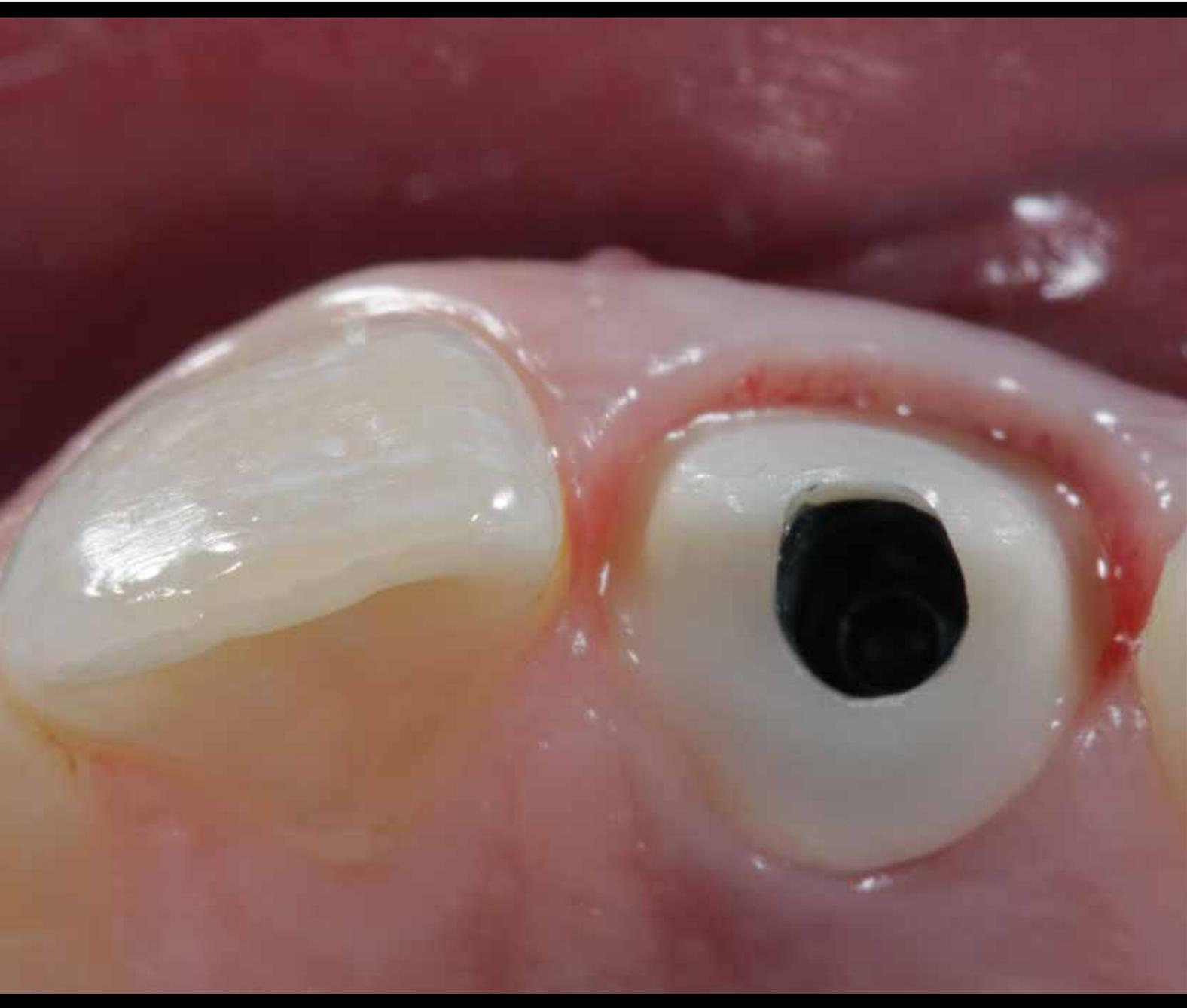


# FUNCTIONAL and Esthetic



# Challenges

## Replacing a Single Anterior Tooth with an Implant

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### Abstract

Key aspects of achieving success in the replacement of anterior teeth with implants require an interdisciplinary approach. The collaboration between the surgeon, restorative dentist, and laboratory technician mandates communication of expectations and understanding of surgical and restorative requirements. Even with ideal implant placement there must be synergy between the dentist and technician to deliver the patient with the desired esthetic outcome. The purpose of this article is to highlight the key principles, from a restorative team approach, to deliver single-tooth implant esthetics with conservative techniques and material choices. The essentials addressed cover provisionalization, laboratory communication from both the dentist and ceramist perspectives, and utilization of simple materials and techniques to handle final esthetic challenges.

**Key Words:** Immediate implant, implant provisional restorations, custom impression coping, single tooth implant restorations

## Introduction

It is always preferable to have a clear plan and understanding of how the interdisciplinary team is to handle the replacement of a single anterior tooth before commencing any treatment. The restorative dentist must understand the minimum space requirements for treatment and utilize other specialists (e.g., an orthodontist) if necessary to establish proper results. Circumstances may arise, such as dental emergencies and/or trauma, that limit the amount of pretreatment data collected by the dentist to anticipate all the possible esthetic challenges that can occur. In these situations the restorative dentist must first treat the immediate trauma that is causing the patient pain or is threatening to the patient's health.

## Patient Description

A 17-year-old male in good health presented with a complete mid-root fracture on tooth #9, the result of a swimming accident. The coronal half of the tooth was mobile and the patient was in considerable discomfort (Fig 1). The patient was seen immediately after the accident and swelling was minimal. A periapical radiograph was taken to further assess the degree of trauma and evaluate the bone on adjacent teeth (Fig 2). Review of the radiograph aided in assessment of any potential esthetic shortcomings, assuming atraumatic extraction of #9. The patient was promptly sent to the surgeon's office to have #9 extracted and, if conditions were determined favorable, for placement of an immediate implant (3i, Biomet; Warsaw, IN) (Fig 3). The patient returned immediately to the restorative dentist for fabrication and placement of a provisional restoration. It would be desirable to, at the very least, give the surgeon an understanding of final restorative tooth position and deliver all necessary models and stents to accomplish this task. However, due to malposition of #9 from the accident, the surgeon was asked to mirror the coronal tooth position of #8 in determining the final position for #9 as bone heights and tissue contours surrounding #8 were all esthetically desirable.<sup>1</sup>

## Treatment

### Immediate Provisional Technique

Under more ideal scenarios, the restorative dentist would have obtained more comprehensive data on the patient such as historical photographs, radiographs, and the diagnosis and risk assessment in the biomechanical, functional, periodontal, and dentofacial categories.<sup>2</sup> In this particular case, the patient was new to the practice and there was insufficient time to



Figure 1: Tooth #9 avulsed after a swimming pool accident.



Figure 2: Complete mid-root fracture on #9.



Figure 3: Immediate implant placed.



**Figure 4:** Provisional #9, one week postoperative.



**Figure 5:** Provisional, one month postoperative.



**Figure 6:** Provisional, four months postoperative (1:1 view).

collect all the pretreatment data. An occlusal and functional evaluation was done and tooth positions were found to be acceptable. The surgeon was asked to return the extracted tooth to the restoring dentist so it could be used as a guide in making a provisional restoration. The apical aspect of #9 was carefully contoured until it could be positioned intraorally in a position that mirrored #8. The tooth fragment was secured to the adjacent teeth with a small amount of flowable composite. A putty matrix (Ivoclar Vivadent; Amherst, NY) was used to capture the new position and allowed to fully set.

A polyform temporary abutment (Biomet 3i) was secured into place and a coarse diamond bur (Brasseler USA; Savannah, GA) was used for incisal reduction. The matrix was repeatedly tried in to ensure there were no areas that were binding and preventing the matrix from fully seating. When using the putty matrix technique, the clinician does not have the ability to evaluate implant angulation in relation to desired provisional location, so it is prudent to verify that there is enough clearance from the incisal, facial, and lingual aspects. A clear plastic vacuum-formed stent technique can be used to allow visualization of the polyform abutment position. This technique simplifies reduction evaluation, especially in cases where implant angulations are not ideal. The putty matrix will, however, establish more detail in the provisional than the plastic stent. A combination of both techniques can be used to maximize the benefits if needed.

In this case, only the putty matrix technique was used. Once it was verified that a positive seat was obtained, a cotton pellet was placed into the screw access, the matrix was filled with bis-acryl (Luxatemp Ultra, Zenith/DMG; Englewood, NJ), seated in the mouth, and allowed to fully set. The access hole was then located, the cotton pellet removed and the provisional was unscrewed and retrieved. Flowable composite (Ivoclar Vivadent) was added to the cervical portion of the provisional to fill the deficient areas and create a smooth transitional surface. It is important to create a facial emergence profile that will allow the tissue to be in harmony with the teeth surrounding it. By under-contouring or flattening the emergence profile, the free gingival margin may provide a thicker collar of tissue that is more incisally positioned. Likewise, by over-contouring the emergence profile, the tissue may be more apically positioned.<sup>3-5</sup> Once proper emergence profile and form was verified, the provisional was positioned, the screw hand tightened, and the access hole filled with a cotton pellet and flexible resin (Systemp.inlay, Ivoclar Vivadent). The patient had a fair amount of white hypocalcification marks present on his teeth; a mixture of white tint (SDI; Bayswater, Victoria, Australia) that was thinned with some clear glaze (Anaxdent; Ardmore, OK) was applied to the provisional to mimic his natural

characterizations (Figs 4-6). It is sometimes necessary to make modifications to the provisional during the three-to-six-month healing phase. It is desirable to keep those alterations closer to the beginning of the healing phase to limit disturbance during final site development.<sup>6</sup>

### Functional Perspective

From a functional occlusal perspective, the patient had minimal wear, an absence of symptoms, and was considered to be low risk. The provisional occlusion was checked in maximum intercuspation with Troll-foil (TrollDental; Trollhattan, Sweden) and adjusted accordingly. Shimstock (Almore Int.; Beaverton, OR) was used to verify that the provisional and opposing tooth were free of contact within the 12 $\mu$  range. The final equilibration, to remove any interference on the lingual of the provisional when chewing, was accomplished with the patient sitting up and chewing gum in the posterior region while 200 $\mu$  articulating paper (Bausch; Nashua, NH) was placed in the anterior region. All chewing streaks on the lingual of the provisional were removed, as these illustrate areas of friction within the chewing envelope. Most of the occlusal reduction in this case was due to the chewing envelope and resulted in a rather thin incisal edge (Fig 7). In retrospect, slight incisal wear of #24 can be seen and the original position of #9 most likely was more facial than #8. However, the lack of patient historical photographs limited the clinician in recognizing this until the restorative phase.<sup>7</sup>

### Five Diagnostic Keys

To accurately predict the peri-implant esthetic outcome, the five diagnostic keys include relative tooth position, form of the periodontium, biotype of the periodontium, tooth shape, and position of the osseous crest.<sup>8</sup> While the determinants of peri-implant esthetics are not dependent upon a provisional restoration, they can serve as a valuable communication tool for both the restorative dentist and the laboratory technician. The ability to see the tissue contours with a provisional before going to a final restoration will allow the restorative team to know the esthetic limitations of what can be achieved.<sup>9,10</sup> In this case the patient, doctor, and technician all approved the esthetics of the provisional and it was decided to proceed with the final restoration after a four-month integration period. A customized impression coping technique was used to capture the cervical tissue contours of the provisional (Figs 8 & 9).<sup>11,12</sup>



**Figure 7:** Thin incisal edge due to adjustments made for the chewing envelope.



**Figure 8:** Groomed tissue contours after four months.



**Figure 9:** Custom impression coping technique. Note the blanching of tissue collar after only a few minutes of the provisional being out of the mouth.



**Figures 10a-10d:** Photographs at different angles to communicate texture, characterizations, and luster.

## Laboratory Perspective

### The Single Central

The replacement of a single central incisor remains one of dentistry's great challenges. When the tooth is being replaced with an implant, unique obstacles to ultimate esthetics arise. If the implant site is perfectly developed and pink esthetics are ideal, these are usually limited to implant position, tooth form, and color.

An edentulous site provides a technician with a blank canvas to work with free of existing tooth discolorations. If communication is excellent, impressions are perfect, photography is immaculate, and color in the images has been calibrated and verified, a single crown in the esthetic zone can be made satisfactorily in a laboratory without the patient actually visiting the ceramist (Figs 10a-11). The technician had all of the benefits of a perfect site and excellent communication when making the crown presented in this article. The crown still required three separate try-in appointments prior to final modifications being made to the contralateral incisor to bring the case together esthetically.



**Figure 11:** Shade communication.



**Figures 12a & 12b:** The first crown displayed tooth width discrepancies and too much translucency. The patient also presented, unaware, with slight screw loosening and peripheral inflammation as a result.

### First Fabrication

An esthetic hybrid abutment with zirconium luted to a titanium base was fabricated (Core3d Milling Centers; Calgary, Canada) following the design developed by the clinician, and an IPS e.max (Ivoclar Vivadent) core was waxed and pressed from an MO1 ingot.<sup>1</sup> The first crown attempted mimicked the provisional in width and recreated esthetic deficiencies due to the difference in tooth widths of the original #8 and #9. The surface morphology was acceptable, as the working casts were made from impressions that were perfect and communicated surface in great detail.

### Second Fabrication

Translucency is one of the most difficult parameters to evaluate in photographs of teeth. Incisal translucency is relatively simple compared with that of the middle and gingival thirds of teeth. The technician failed to recognize the color density of the natural #8 and applied layering techniques that expressed too much translucency in the body of the crown, thereby lowering its value. Great care should be taken by the dentist to provide verbal confirmations of similarities and differences to and from our known references (shade tabs) in the images sent to the laboratory. The technician should take great care in his or her evaluation of the references in the images to avoid costly corrections and remakes (Figs 12a-13).

The second crown attempted better managed the spatial discrepancy by manipulation of line angles but could not correct the width difference perfectly (Figs 14a-14c). IPS e.max Ceram enamel porcelains were modified with dentin powders and stains to better mimic the density and value of #8.



**Figure 13:** First crown try in and shade photographs.

“Circumstances may arise, such as dental emergencies and/or trauma, that limit the amount of pretreatment data collected by the dentist.”



**Figures 14a-14c:** Second crown try in. Color match is excellent but tooth width discrepancy is still evident. Tooth #9 is also more facial to #8 due to occlusion. Note the facial embrasure discrepancy.

### Occlusal Analysis

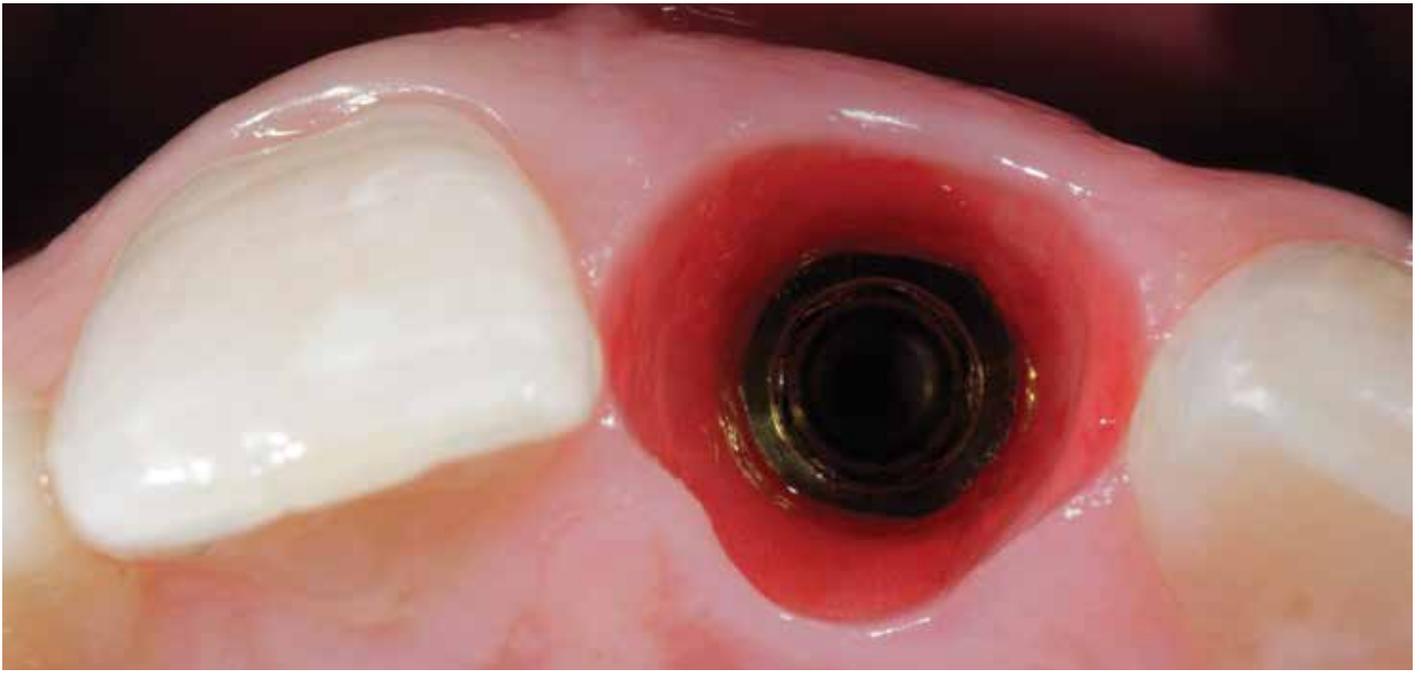
A minor occlusal problem was discovered that affected the positioning and shaping of the crown. Fabrication of a restoration for #9 with a worn, esthetically compromised incisal edge was not desirable to the patient. Positioning a restoration with an unworn incisal edge in the same arch plane as #8 was not considered a reasonable option. To avoid interfering with the opposing mandibular incisors and match the incisal edge profile of #8 it was necessary to position the incisal edge of the crown labial to that of #8. Other options included adjustment to mandibular teeth on the opposing cast (which would have necessitated further reduction of already worn incisal edges in the patient's mouth). The new crown was sent to the dental office for try in.

Upon evaluation of the crown many things were considered acceptable. The width discrepancy and relative labial position were not. Options were discussed. The technician suggested modification of #8 with composite in order to perfect shade, width, symmetry, and labial positioning relative to the crown made for #9. Minor shade modification was performed in the laboratory prior to returning the crown to the dental office for delivery.

### Clinical Delivery of Final Implant Crown

#### Direct Composite Technique

Once the final implant crown was tried in, evaluated, and determined to be the correct shade and best possible form, the clinician then had to assess the esthetic changes needed to alter #8 in order to replicate #9 as accurately as possible (Figs 15-16b). When trying to choose restorative materials, a clinician often considers not only the cost for the patient and limitations of certain materials, but most importantly, a conservative option that will preserve enamel. Composite (Venus Diamond, Heraeus Kulzer; South Bend, IN) was selected as the material of choice for its chameleon-like ability to match a particular shade and cost savings to the patient. It is both authors' opinion that it is easier to accurately obtain a proper shade match with composite than it is with porcelain. Composite allows multiple and instant shade try ins and color verification. Before commencing the final composite procedure, several shades of composite (A1, CL, AM) were applied to the tooth to visualize and color map a mock-up of the final esthetics. The patient had notable white hypocalcification marks that would need to be replicated using some white tint and layered with a translucent enamel composite shade. Previewing the



**Figure 15:** Tissue site development.



a



b

**Figures 16a & 16b:** Zirconium custom abutment.

various materials to be used allowed the clinician to begin the procedure with a clear understanding of layering and shade requirements to achieve an accurate color match.

While color accuracy was important in the restoration of the composite, it was just as critical to ensure the contours of #8 resembled those on the implant crown of #9. A pencil was used to draw the heights of contour and transitional line angles of the two teeth to more readily assess if proper match had been achieved, as well as evaluation from an occlusal view. The final polish also had to match that of the implant crown and surrounding teeth, which had considerable texture. A fine diamond flame bur (Brasseler USA) was used at low speed and light pressure to create some horizontal lines and a fine disc (Sof-Lex, 3M ESPE; St. Paul, MN) was used to bring the whole restoration to a satin luster. A super-fine polishing cup (Cosmedent; Chicago, IL) was then used to highlight the line angles and create a high shine in those areas (Figs 17a-17d).<sup>13-17</sup>

### Summary

Implant esthetics is influenced by a variety of factors throughout the treatment process. Proper understanding of goals and limitations must be communicated throughout the process between the surgeon, restorative dentist, and laboratory technician. The restorative team, in turn, must also have a grasp on the material choices and their capabilities for selective situations. This is essential in any given clinical circumstance to achieve the desired esthetic outcome.



**Figures 17a-17d:** Final implant crown on #9 and direct composite on #8.

“Proper understanding of goals and limitations must be communicated throughout the process between the surgeon, restorative dentist, and laboratory technician.”

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Mr. Patrick did not report any disclosures.