Immediate Placement of Anatomically Shaped Dental Implants

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Immediate placement of dental implants into tooth extraction sites is an effective treatment option. When immediate placement procedures are performed with a round implant, a void is often evident between the implant and the orifice of the socket. Previous treatment focused on the use of membranes or special closure techniques to induce bone growth into the void. Anatomically shaped dental implants provide a predictable alternative to previous filling techniques since the anatomical implants decrease or completely fill the void at the socket opening. This article describes a surgical technique developed for the immediate placement of these implants in extraction sites.

INTRODUCTION

Osseointegration is most predictably obtained when dense healthy bone surrounds dental implants at the time of initial placement. In 1985, Bränemark et al. reviewed their principles of osseointegration to define how this sound bone tissue was best achieved. They reported that optimal osseointegration was predictably accomplished in the anterior symphysis region of mandibles that had been edentulous for a period of time. Based on Bränemark’s early studies, Adell et al., attempted to define the recommended period of edentulism and advocated that at least 6 to 9 months should pass prior to implant placement in an edentulous ridge. When the recommended delay as defined by Adell was combined with Bränemark’s period of complete osseointegration, the patient was often forced to wait from 9 to 15 months before the implant was ready for restoration.

Tarnow and Fletcher indicated that it was a useful compromise to place root-form implants 2 to 3 months after tooth extraction. Coatoam demonstrated that a waiting period of only 6 to 8 weeks resulted in a moldable osteoid material within the socket that would readily accept anatomically shaped implants (PACE, CAL-Form Inc, Longwood, Fla). This osteoid also could be used to facilitate indirect sinus lift procedures.

Numerous researchers demonstrated successful osseointegration of dental implants when placed into fresh extraction sites of laboratory animals. Lazzara observed that implants could be placed immediately following tooth extraction, and that this immediate placement results in the surgical and restorative advantages of maintaining tissue morphology. A number of clini-
cians have reported cases of immediate implant placement in the treatment of patients. Block and Kent, Yukna, and Rosenquist et al have demonstrated clinical success in the immediate placement of dental implants; in fact, Rosenquist et al reported the success rate of these procedures to be 95.8%.

In cases where implants are immediately placed into extraction sites, there is often a void adjacent to the head of the implant due to the discrepancy in size and shape between the implant and the extraction orifice. A number of researchers have reported on barrier membranes or grafting materials used for the exclusion of epithelium so that bone could fill into the void. Collagen membranes, expanded polytetrafluoroethylene membranes (ePTFE), decalciﬁed freeze-dried bone, and hydroxyapatite have all been used singularly or in combination to ﬁll the void.

Recent investigators have examined the role of the shape of the implant in the achievement of more rapid and predictable results during immediate placement procedures. Strub et al reported on the immediate placement of a computer-milled anatomic implant (Re Implant Systems, Hagen, Germany) in the replacement of a maxillary lateral incisor. These researchers suggested that there were advantages to using an anatomic implant in immediate placement cases. Those advantages included the prevention of alveolar bone resorption, improved soft tissue management, prevention of epithelial down-growth, elimination of barrier membranes, and less postoperative infection.

**Materials**

One recently introduced implant system (PACE, CAL-Form) is comprised of a series of anatomically shaped dental implants of varying lengths. These commercially pure titanium implants are available in threaded or cylinder designs and may be selected with titanium plasma spray or hydroxyapatite coatings. These implants are generally placed into specially prepared osteotomy sites. The osteotomy sites are initially created with traditional implant drills and are subsequently enlarged and shaped using oval osteotomes designed for the system. In addition to this conventional application, these anatomically shaped implants can be used in fresh extraction sites. The opening of the site conforms to the anatomical shape of the osteotomes and the corresponding shape of the selected implant (Figs 1–10).

In immediate placement cases, the ﬁxure can be placed as a one-stage or two-stage implant. A ﬂat surgical cover cap allows the gingival tissue to be sutured over the head of the implant during two-stage healing. The ﬂat surgical cover cap can also be left exposed, resulting in a modiﬁed one-stage procedure. Conventional one-stage implant procedures are facilitated by winged surgical cover caps, which can be used to position the tissue.

The ﬂat two-stage surgical healing caps generally are used when the implant is placed into fresh extraction sites in combination with other procedures (eg, barrier membranes). When the implant adequately ﬁlls the extraction site orifice, however, the anatomical implant can be placed as a conventional one-stage implant because no barrier is required. The dual-winged surgical caps facilitate surgical positioning of the ﬂaps during traditional one-stage implant placement. The dual wings of the surgical cover cap are designed to provide tissue- and suture-engagement rims, which provide precision flap positioning and easier suturing. In these one-stage surgical procedures, gingivoplasty is seldom necessary at the conclusion of the osseointegration period.

**Presurgical Considerations**

A necessary prerequisite for the immediate replacement of a tooth with any dental implant is the absence of acute infection. Low-grade chronic infection associated with gingivitis or early periodontitis may be treated during implant placement, provided that the tone of the gingival tissue is not signiﬁcantly compromised. Provided all granulation tissue at the apex can be completely eradicated by curettage or extension of the osteotomy site, low-grade chronic infection at the apex of the tooth may also be managed. Due to the report of periapical lesions associated with implants, only implants designed without end holes should be used if any suspicion of endodontic pathology exists. If the clinician determines that it is imperative to use an implant with holes in the end, then the extraction site should be allowed to heal for 6 months prior to the placement of this design of implant into the site.

Additional recommendations for immediate placement implants include the presence of intact labial and lingual bone plates. Although two-stage implant procedures can be performed with barrier membranes when a bone plate is missing, the lack of predictability in regenerating sufﬁcient bone to maintain aesthetics is always a challenge. In these instances, it is recommended that bone grafting of the socket be performed initially; the socket can be closed with resorbable membranes or connective tissue grafts. Following 8 weeks of healing, the osteotomy site can be recreated with drills and osteotomes. Despite a collapse of the labial bone, the osteoid can be displaced labially with the osteotomes to create the root eminence.

**Surgical Procedure**

A patient is initially examined to determine the prognosis of the tooth and the presence of infection (Figs 11 and 12). Once presurgical concerns have been addressed, the tooth is carefully extracted; preservation of the buccal and lingual plates of bone and the size of the socket site is attempted (Fig 13). Oval osteotomes are then successively inserted into the extraction orifice to determine the head size of the appropriate implant. The oval osteotomes
IMMEDIATE PLACEMENT OF IMPLANTS

FIGURE 1. A hopeless tooth is extracted. FIGURE 2. Oval osteotomes of increasing sizes are sequentially inserted into the extraction site to determine the size most closely matched to the extraction orifice. FIGURE 3. When the appropriate osteotome binds in the extraction orifice, it is gently tapped into place to assure a snug fit. The edge of the osteotome should not be tapped below the edge of the crest of bone. FIGURE 4. A drill guide may be used to center the starter drill as the extraction site is deepened to accept the dental implant. FIGURE 5. Cannon drills of increasing diameter sizes are used to enlarge the osteotomy opening to 3.5 mm. FIGURE 6. A counter-bevel drill is used to finish the sides of the osteotomy opening. This prevents unwanted binding when the implant is pushed to position. FIGURE 7. The anatomically shaped implant is tapped into place so that the bottom of the bevel of the implant is approximately 1 mm above the crest of bone. FIGURE 8. A flat surgical cap is used in two-stage surgeries. If the extraction orifice is tightly sealed by the implant, it is not necessary to close the gingiva over the head of the implant. The flat surgical cap can also be used with GTR procedures. FIGURE 9. A winged surgical cover cap is used to suture the tissue into its proper position in one-stage surgical procedures. FIGURE 10. The appropriate post and core is inserted into the implant so that a naturally shaped crown can be fabricated to fit the restored implant. The implant has a good physiologic exit profile.

Corresponding exactly in size to the head of the implant fixtures. The proper head size is determined when the osteotome begins to bind in the opening of the extraction site and requires gentle but deliberate force to be inserted to 1 mm above the level of the crestal bone. A gentle blow from a surgical mallet is the maximum force that is required to fully seat the oval osteotome.

Barrier membranes may be utilized if the extraction site is larger than the largest available implant. Even in these instances the amount of necessary bone regeneration is less than other immediate implant cases since the size and shape of the anatomic implant head more closely approximates the size and shape of the lost tooth. The anatomic head of the implant also provides an emergence profile compatible with the tooth.

Radiographs and direct measurements within the socket are used to determine the length of the implant. It is essential to curette all granulation tissue from the apex of the socket; the implants should be placed minimally to this depth. Additional sound bone is often found apical to the tip of the
FIGURE 12. A radiograph of the maxillary central incisor confirmed that the remaining root structure had a poor prognosis.

FIGURE 13. The tooth was carefully removed to preserve the bony housing, especially the buccal plate of bone.

FIGURE 14. The anatomic implant, which corresponded in length to the created osteotomy site, was transferred to the prepared opening.

FIGURE 15. The transfer post was replaced with a flat two-stage surgical cover cap.

FIGURE 16. An acrylic denture tooth was bonded to the adjacent teeth to serve as a provisional restoration during the healing period.

socket, and the depth of the osteotomy site may be increased to utilize this support. This deepening of the osteotomy site may also obliterate chronically infected apical tissue.

An internally irrigated 2.5 mm-diameter spade drill is initially used to deepen the osteotomy site. Scored lines on the drill correspond with the bevel of the implant. The bevel of the implant should be placed approximately 1 mm above the crest of bone. When increasing the depth of the osteotomy site with the spade drill, care should be taken to maintain the position of the drill centered in the extraction opening. Although this can generally be performed manually, drill guides shaped like the oval osteotomes may also be used. These drill guides differ from the oval osteotomes by virtue of an offset handle and a 3.6 mm-diameter hole through the center. The drill guide is centered in the extraction orifice just as the oval osteotome was initially positioned; the clinician uses the hole in the drill guide to keep the drill centered. Once the osteotomy site is prepared to the desired depth, a 3.5-mm cannon drill is used to enlarge the osteotomy site. Since threaded and cylinder designs are ultimately pushed to place, the cannon drill is used for both designs. In order to prevent binding of the implant, a counter bevel cannon drill may be used to hone the sides of the osteotomy site prior to implant insertion.

Once the osteotomy site had been developed, the implant is transferred to the site (Fig 14). The implant transfer post has flat sides, which facilitates fixture alignment prior to being seated with a mallet and seating tool. In instances where an implant must be retrieved, rongeurs should be used to grasp the transfer post. A downward blow is then delivered to the rongeurs with a surgical mallet to dislodge the implant.

Following alignment and seating of the implant fixture, the transfer post is removed, and the appropriate surgical cover cap is selected. For anterior teeth, it is often easier to place a two-stage surgical cover cap, even if the implant is being placed as a one-stage fixture (Fig 15). The cover cap and the head of the implant can remain exposed. The surgical area is coated with a generous application of 3% a-chromycin ointment (Lederle Labs, Pearl River, NY) to reduce the potential for needle-track infections. If there is any suspicion of pre-existing infection, the patient is placed on an antibiotic for 10 days. The patient is also instructed to rinse with Peridex (Proctor & Gamble, Cincinnati, OH) twice daily.

Since the flat cover cap does not extend out of the gingiva like the winged two-stage cap, it is easier to bond a provisional tooth in place. Plastic denture teeth are suitable (Fig 16). Although the patient can wear a removable transitional prosthesis, care should be taken to ensure that no force is transmitted to the implant. The two-stage surgical cover cap also helps to prevent undue pressure to the implant by virtue of its subgingival position. When using the two-stage cap, however, soft tissue may require some trimming at the completion of the osseointegration (Fig 17). Tissue trimming is significantly less disruptive.
SUCCESS OF IMMEDIATELY PLACED ANATOMIC IMPLANTS

Of the immediately placed anatomically shaped implants, 83 out of 86 successfully integrated. This compares favorably with the results of Rosenquist et al. who studied 109 immediately placed Nobelpharma implants from 1
to 67 months and experienced success in over 95% of the cases. The anatomic implants have been followed 42 months with a success rate of 96.5%.

The anatomically shaped implant has an external bevel around the outer edge at the opening of the implant, and the final restoration is finished over this bevel. There is a slight convex curvature of the implant orifice from buccal to lingual at this beveled edge. This convexity generally corresponds to the saddle-shaped curvature of the interproximal bone in the anterior areas of the mouth. Due to anatomical differences from one patient to another, the interproximal bone may be significantly higher than the crest of bone at the facial opening of the osteotomy site, so the convexity of the curved interproximal bone may be more than average. In cases of extreme curvature of the buccopalatal crest of bone, the bevel of the implant should remain a minimum of 1 mm above the crestal bone in the interproximal regions. In these instances, the bevel of the implant may extend coronally 2 to 3 mm above the crest of bone on the buccal aspect. Although it is desirable to have this beveled conical seat in a subgingival position, in these more extreme situations the bevel may end up in a supragingival position on completion of osseointegration. In order to accommodate these variances in conical seat position, the anatomically shaped implant was designed with an extension tube into the implant body. This extension tube engages an extension rod on the post and core insert, which provides protection to the internal screw, thereby allowing some reduction of the actual body of the implant itself. Because of the extension tube, the conical seat may be adjusted by reducing the labial edge of the implant. The reduction can be as much 3 mm without overly compromising the strength of the connection. In cases where the bevel of osseointegrated implant finished in a supragingival position, the labial crown margin was still restored in an optimal subgingival position by altering the conical seat.

There are different-sized, anatomically shaped implants that may be used in various areas of the mouth. The larger sizes are particularly useful for replacement of molar teeth. The mesiodistal dimension of these implants can be up to 7 or 8 mm, whereas the labiolingual dimension is 5 mm. These implants effectively allow the development of a good interproximal embrasure space but do not impinge on the buccal or lingual plates (Figs 26 and 27).

**CONCLUSION**

Although computer-milled, anatomically shaped implants such as the Re Implant system may serve a similar role in the treatment of patients, potential shortcomings may be associated with the use of these implants. In cases of undesirable root formation (e.g., on the concave mesial root surface of maxillary first molar), the compromised morphology will be replicated in the milled implant, decreasing the ability to hygienically maintain the implant. In addition, the cost of the computer-driven milling technology adds considerable expense to immediate implant treatment. Moreover, custom-milling the implant will also add to the duration of the treatment since impressions must be made of the socket, and then the patient must return for subsequent insertion of the implant fixture. Such procedures could take several hours, which is significantly greater than the 20-minute period required for the immediate placement of a prefabricated, anatomically shaped implant.

This article has described a systematic approach for the placement of anatomically shaped implants into immediate extraction sites. With the use of the matched oval osteotomes in the PACE system, the approximation to the extraction site orifice is as tight as those that would be expected with computer-milled implants. As new therapies for immediate tooth replacement continue to be developed, the predictability and success of these procedures will need to be evaluated for immediate and long-term success.

**REFERENCES**

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