IMMEDIATE PLACEMENT OF ANATOMICALLY SHAPED DENTAL IMPLANTS

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Immediate placement
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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. 14–17 Block and Kent,18 Yuki- 
na,19,20 and Rosenquist et al21 have demon- 
strated clinical success in the im- 
mediate placement of dental implants; in 
fact, Rosenquist et al22 reported the 
success rate of these procedures to be 
95.8%.

In cases where implants are imme-
diately placed into extraction sites, 
there is often a void adjacent to 
the head of the implant due to the disap-
pearance in size and shape between the im-
plant and the extraction orifice. A num-
ber of researchers have reported on 
barrier membranes or grafting materi-
als used for the exclusion of epithelium 
so that bone could fill into the void. 
Collagen membranes,17,22,23 expanded 
polytetrafluoroethylene membranes 
(ePTFE),13,24,25 decalciﬁed freeze-dried 
bone,16 and hydroxyapatite19 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 al26 re-
ported on the immediate placement of 
a computer-milled anatomic implant 
(Re Implant Systems, Hagen, Ger-
many) in the replacement of a maxillary 
lateral incisor. These researchers sug-
gested that there were advantages to 
using an anatomic implant in imme-
diate placement cases. Those advantag-
es included the prevention of alveolar 
bone resorption, improved soft tissue 
management, prevention of epithelial 
down-growth, elimination of barrier 
membranes, and less postoperative in-
fection.

**MATERIALS**

One recently introduced implant sys-
tem (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 ti-
tanium plasma spray or hydroxylapa-
tite coatings. These implants are gen-
erally placed into specially prepared 
osteotomy sites. The osteotomy sites 
are initially created with traditional 
implant drills and are subsequently en-
larged and shaped using oval osteo-
tomes designed for the system. In ad-
dition 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 se-
lected 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 su-
tured over the head of the implant dur-
ing two-stage healing. The ﬂat surgical 
cover cap can also be left exposed, re-
sulting in a modiﬁed one-stage proce-
dure. 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 im-
plant is placed into fresh extraction 
sites in combination with other proce-
dures (eg, barrier membranes). When 
the implant adequately ﬁlls the extrac-
tion site orifice, however, the anatomi-
cal implant can be placed as a conven-
tional one-stage implant because no 
barrier is required. The dual-winged 
surgical caps facilitate surgical posi-
tioning of the ﬂaps during traditional 
one-stage implant placement. The dual 
wings of the surgical cover cap are de-
signed to provide tissue- and suture-
engagement rings, which provide pre-
cision flap positioning and easier su-
turing. In these one-stage surgical pro-
cedures, gingivoplasty is seldom 
necessary at the conclusion of the os-
seointegration period.

**PRESURGICAL CONSIDERATIONS**

A necessary prerequisite for the im-
mediate replacement of a tooth with 
any dental implant is the absence of 
acute infection. Low-grade chronic in-
fection associated with gingivitis or 
early periodontitis may be treated dur-
ing 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 as-
soicated with implants,27 however, only 
implants designed without end holes 
should be used if any suspicion of end-
odontic pathology exists. If the clinici-
ian determines that it is imperative to 
to use an implant with holes in the end, 
then the extraction site should be al-
lowed to heal for 6 months prior to the 
placement of this design of implant 
into the site.28

Additional recommendations for im-
mediate placement implants include 
the presence of intact labial and lingual 
bone plates. Although two-stage im-
plant procedures can be performed 
with barrier membranes when a bone 
plate is missing, the lack of predict-
ability in regenerating sufﬁcient bone 
to maintain aesthetics is always a chal-
lenge. In these instances, it is recom-
pended that bone grafting of the sock-
et be performed initially; the socket 
can be closed with resorbable mem-
branes or connective tissue grafts. Fol-
lowing 8 weeks of healing, the osteot-
omy site can be recreated with drills 
and osteotomes. Despite a collapse of 
the labial bone, the osteoid can be dis-
placed labially with the osteotomes to 
create the root eminence.

**SURGICAL PROCEDURE**

A patient is initially examined to de-
termine 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 appro-
priate 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.

FIGURE 11. A hopeless maxillary left central incisor with thin and significantly scalloped gingival is scheduled for extraction.

correspond 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% achromycin 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 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.\textsuperscript{21} who studied 109 immediately placed Nobelpharma implants from 1
FIGURE 25. A radiograph taken 46 months postplacement revealed continued bone health.

FIGURE 26. A large-size anatomic implant supports a well-shaped molar crown.

FIGURE 27. A 4-year postplacement radiograph of the molar revealed good bone health.

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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