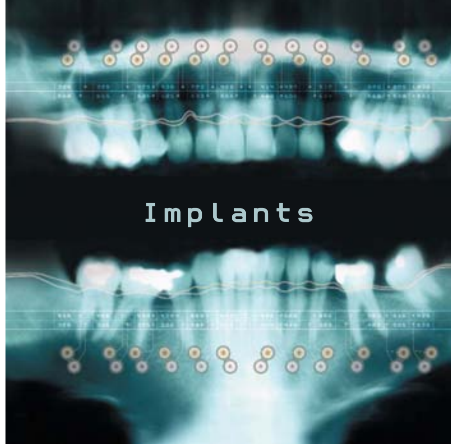

Anterior Esthetic Implants: Microsurgical Placement in Extraction Sockets With Immediate Provisionals

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ABSTRACT

Dentists worldwide have hoped to realize the potential for dental implants for immediate replacement of failing teeth in the maxillary esthetic zone. This article is an analysis from private practice of a case series of 100 dental implants in the anterior maxilla placed under the microscope in extraction sockets with immediate implant-supported provisionals.

The most frequent traumatic tooth injury is a fractured crown of the maxillary central incisor in the permanent dentition.[1] Fractured teeth frequently follow a downhill course through bonding, endodontics, posts and crowns.[2] Many are lost to root fracture or root resorption.[3] For more than 100 years, dentistry's best answer to a missing tooth in the maxillary esthetic zone has been fixed bridgework.[4] This was usually preceded by extraction and a removable provisional, whose other designation "the flipper" is self-descriptive of its inherent limitations. Esthetic collapse of adjacent gingival tissue and loss of buccal alveolar bone are sequela familiar to dentists restoring patients following maxillary anterior tooth loss[5,6] (**Figure 1**).

Figure 1. Ridge resorption following loss of central incisor.

Dental Implants and Tooth Loss

Since their introduction, dental implants have proven exceptionally predictable and successful in the edentulous and partially edentulous patient.[7-10] The biological and restorative improvements implants have undergone have increased their applications for single tooth replacement.[11,12] Dentists worldwide have hoped to realize the potential for dental implants for immediate replacement of failing teeth in the maxillary esthetic zone. This article is an analysis from private practice of a case series of 100 dental implants in the anterior maxilla placed under the microscope in extraction sockets with immediate implant-supported provisionals.

Surgical Trauma and Tooth Loss

Microsurgery is a movement in medicine and dentistry toward minimally invasive alternatives to replace

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The results described are achieved using a surgical microscope and may be statistically misleading when extrapolated to protocol not utilizing a surgical microscope.

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procedures that previously required extensive surgical incisions.[13] Using a microscope for surgery greatly enhances visual acuity and improves surgical dexterity.[14] Exodontia has been a traumatic procedure for centuries. Under a microscope, minimal invasive principles can be applied to tooth extraction. The aim of extraction microsurgery is to reduce trauma. Using a periotome luxator, a tooth root can be lifted vertically from its alveolar socket by carefully separating it from the surrounding ligament. This limits injury to the papilla and preserves natural gingival anatomy[15,16] (**Figures 2 and 3**).

The increased visibility provided under the microscope allows a surgeon to detect subtle nuances in the direction of luxation which are not apparent through normal vision, thus avoiding damaging the bone and gingival tissue.

Figure 2. Periotome luxation of fractured root.

Figure 3. Periotome extraction site. Note lack of bleeding and trauma.

Figure 4. Preoperative failing cuspid.

Figure 5. Provisional in placing with screw access opening.

Figure 6. Provisional at time of microsurgery.

Figure 7. Provisional at eight weeks, ready for final restoration.

Implant Microsurgery

All phases of implant treatment may be performed using a microscope. Studies show that motor coordination and accuracy is generally increased when surgeons use a microscope.[17] Increased visual acuity, improved ergonomics, and body posture are closely related to those improvements.[18] In medicine, microsurgery has significantly reduced postsurgical pain in a variety of surgical disciplines.[19] Likewise, in endodontics, microsurgery has demonstrated measured reduction in postoperative pain.[20] Although no studies establish that microsurgery reduces postoperative pain following extraction or implant placement, there is strong theoretical rationale to suggest that less surgical trauma results in less pain and faster healing, and that microsurgery leads to those ends. The author's experience has shown that extraction under the microscope with implant placement in the socket followed by an immediate anatomical provisional reduces visible surgical trauma and prevents soft tissue collapse following tooth removal. Anecdotally, patients describe their discomfort level as inconsequential (**Figures 4-7**).

Materials and Methods

Patient Selection

This study comprises a case series of 100 consecutive patients in private practice requiring extraction of maxillary central incisors, lateral incisors, or cuspids. No exclusion criteria were employed. Teeth were extracted due to vertical root fracture, horizontal root fracture, root resorption or endodontic failure. One hundred implants were placed in extraction sockets and implant-supported screw-retained provisionals were delivered at the time of surgery. Preoperative and postoperative images were digitally recorded and cataloged in Extensis Portfolio image database for easy retrieval and analysis. Preoperative and postoperative radiographs were taken utilizing a Rinn film holder. These were taken without the benefit of a custom-acrylic bite plane to standardize angulation.

Surgical Technique

Tooth extractions were performed using periotome luxation. The sockets were debrided of granulation tissue and the sulcus de-epithelialized with a flame diamond. The sockets were irrigated, then filled for 30 seconds with 3 percent tetracycline solution. Lateral cutting burs were used to correct angulation between each incremental increase in twist drill size. Following completion of the osteotomies, implants were inserted utilizing a drilling unit set to 67 ncm torque and 25 rpm. All patients received NobelBiocare Mark IV 4.0 mm-diameter threaded implants with textured surfaces and 2-degree thread taper geometry.[21] Of 100 implants placed, 89 were 15 mm in length, nine were 18 mm in length, and two were 13 mm in length. In 81 implants, bone collected through aspiration filtration from the osteotomy preparation was rinsed with sterile water, dried and saturated with 3 percent tetracycline, then placed over any buccal thread dehiscence within the socket. Particulate bone zenograft was used to fill the remaining void between the implant and socket wall. A layer of collagen was placed over grafted bone before the implant provisional was placed. In 28 cases, preoperative buccal tissue height or thickness was judged deficient. In those cases, at the time of surgery, connective tissue was transferred from the palate into shallow subepithelial envelope incisions on the buccal. This was done to restore or maintain normal gingival height.

Drilling in the Extraction Socket

Implant drilling under the microscope is a revealing experience. The socket appears as large as a room with the apex and walls clearly visible. Drilling in extraction sites requires a different set of skills than drilling in edentulous sites.[22] The most favorable bone in the anterior maxilla lays to the palatal and apical of the socket[23] (**Figures 8 and 9**).

For this reason, drilling must be done at an oblique angle to the socket wall. Twist drills are not designed for this purpose. They track in the direction of less dense bone and into the open socket. Unless the osteotomy site is redirected with lateral cutting burs before each incremental increase in twist drill size, the implant angulation and position will invariable move buccally. With the magnification and lighting a microscope provides, drilling in the lateral socket wall can be accomplished for stable and accurate esthetic positioning of the implant in the socket.

Figure 8. Implant properly placed in lingual side of socket. Note immediate tissue collapse on the buccal without provisional support.

Figure 9. Lateral cutting burs for osteotomy preparation in the lateral wall of the socket.

Immediate Implant Provisional

To preserve natural esthetics, an implant provisional must emerge from the surrounding gingiva exactly like the extracted tooth.[24,25] There is no margin for error. Creating a provisional crown begins before the tooth is removed.[26] A clear silicone impression is made, capturing the dento-gingival junction. A light-cured composite resin duplicate of the tooth is fabricated from the impression (**Figures 10-12**).

The duplicate tooth is trimmed to the exact location of the dento-gingival

Figure 10. Blank replica of failing tooth.

Figure 11. Replica tooth hollowed and shaped. The rough surface facilitates adding flowable composite to create ideal tissue support.

Figure 12. Polished and glazed provisional with proper subgingival profile.

Figure 13. Lateral incisor removed microsurgically with implant in place.

Figure 14. Opaqued titanium screw-retained abutment on implant.

Figure 15. Replica tooth fitted to abutment.

Figure 16. Replica tooth bonded to the temporary abutment with light-cured composite.

Figure 17. Final finished and polished provisional crown.

Figure 18. Provisional crown at time of implant microsurgery.

Figure 19. Provisional crown at eight weeks, ready for final restoration.

junction. The replica tooth is hollowed for luting to a titanium screw-retained temporary abutment. The outer surface of the titanium abutment is opaqued to provide accurate color match. The temporary titanium abutment is placed on the implant and the duplicate crown filled with light-cured composite then joined to the abutment. (**Figures 13 and 14**).

This provisional crown is removed utilizing a screw access opening in the incisal third. The subgingival profile is individually shaped for each patient at the time of surgery.[27] Voids and rough edges are eliminated, and the provisional carefully contoured to support the gingival tissue. As a final step, it is polished and glazed (**Figures 15-18**).

Using light-cured composite assures that no free monomer is present to irritate tissue or bone. The machined titanium provisional abutment reduces the possibility of the provisional loosening. In this study, of the 100 provisionals placed, screw loosening occurred in one patient (**Figure 19**).

Provisional Occlusion

Early loading bone forces are controlled in multiple implant immediate loading cases through splinting.[28] Early loading bone forces in single implant cases are controlled by eliminating centric and lateral occlusal contact. Symmetrical and light mesial and distal contacts are established and the provisional is taken completely out of centric and lateral occlusal contact using green occlusal indicator wax. This protocol allows patients to leave the dental office with a non-loaded esthetic provisional tooth securely anchored to the dental implant.

Final Esthetic Restoration

An immediate provisional crown assures that patients are never without a natural-looking tooth. Because the gingiva is never unsupported, natural tissue height and contour can be preserved. The subgingival emergence profile of the provisional must be accurately registered and transferred to the ceramicist.[29-31] This transfer of subgingival anatomy is accomplished through an impression made of the gingival third of the provisional crown with an implant analog attached. The impression is used to create a custom impression transfer coping which duplicates the subgingival emergence profile of the provisional[32-34] (**Figures 20-23**).

After final impressions with the custom impression transfer coping, computer-assisted scanning and machining then creates a final Procera Zirconia ceramic abutment and ceramic crown[35,36] (**Figures 24 and 25**).

This process assures that the final abutment exactly matches both the original tooth shape and the provisional emergence profile. Working together as a team, surgeons, restorative dentists, and ceramists can combine their skill and knowledge to create a tooth in harmony with adjacent gingival anatomy and the overall appearance of face and smile (**Figures 26-29**).

For many patients, traumatic anterior tooth loss is their first exposure to implant dentistry. In the author's experience, patients are pleased with the simplicity of a technique which does not involve major incisions, suturing, raising of mucogingival flaps or the need for multiple surgical procedures. They frequently comment on the "sturdiness" of their provisional and lack of pain associated with the procedure (**Figure 30**).

Figure 20. Impression of provisional crown is taken before it is placed on the implant.

Figure 21. Registration of the provisional crown emergence profile.

Figure 22. Clear acrylic reproduces provisional emergence profile.

Figure 23. Custom impression transfer coping polished and glazed.

Figure 24. Zirconia all-ceramic implant abutment.

Figure 25. Procera all-ceramic crown

Clinical Results

Using the described protocol, 100 implants were placed over a 36-month period. The average follow-up time was 18 months. Of 100 implants placed, 98 implants were approved for restoration at eight weeks and successfully restored. Two implants failed to integrate before restoration. These were removed and replaced, then provisionalized with bonded pontic provisionals prior to restoration. The clinical success rate for implants placed using this protocol was 98 percent based on the following parameters:

- Absence of clinical inflammation, infection or bleeding on probing
- Absence of mobility, pain or sensitivity of the implant or surrounding tissues
- Soft tissue sulcus less than 1 mm beyond the implant platform
- Ability to withstand rotational torque of 45 ncm at abutment insertion
- Radiographic evidence of bone to within the topmost thread of the implant
- The implant is restored and remains in clinical function

Discussion

Dental implants originally followed a protocol which required lengthy periods of undisturbed healing before loading, typically three and six months.[37-39] Immediately loading of full arch splinted implants is now accepted therapy.[40-43] Immediate loading of single tooth implants has also proven successful.[44-49] Combined data from six studies, comprising 287 single tooth implants immediately loaded showed a 96.7 percent survival rate.[50] Seven studies have examined the outcome of implants placed in extraction sockets of the anterior maxilla with immediate provisionals.[51-57] Combined data from these studies comprised 190 implants and showed a 95.9 percent survival rate.[58] The successful outcomes described by these investigators have proven controversial. Reviewing these seven studies, Ganeles and Wismeijer stated, "It should be recognized that, with few exceptions, these conclusions may be misleading statistical phenomena of the authors, as most publications were written by exceptionally experienced, highly skilled practitioners working under tightly controlled clinical conditions on a relatively small, statistically inconclusive number of implants and patients."

Such ad hominem arguments marginalizing obviously successful results reflect the frustration experienced by many clinicians who attempt immediate provisionals on implants placed in extraction sockets. However, our current study confirms a high clinical success rate of implants placed microsurgically in extraction sockets of the anterior maxilla with immediate provisionals. Comprising 100 consecutive implants, it is the largest study to date examining this protocol. The operator skill requirements and technical demands of the protocol are admittedly high. It is the author's opinion that optical magnification afforded by the microscope increases the precision of placement and initial stability during implant microsurgery. In addition, the minimal invasiveness and reduced surgical trauma of microsurgically placed dental implants may contribute to rapid healing, lessened morbidity and successful osseointegration.

Clinical success describes the basic survival, health, comfort, and function of dental implants but does not define esthetic success. In implant dentistry, evidence-based statements regarding esthetic procedures are difficult to generate. Most studies focus on implant survival. Scientific evidence of esthetically reproducible parameters is rare. The stability of soft tissue esthetics around single tooth implants has been studied. Significant regeneration of mesial and distal papilla was shown after a follow-up period of 1.5 years.[59] On the other hand, soft tissue buccal recession of 0.6 mm was also shown after one year.[60] This has led to a consensus that a provisional restoration with adequate emergence profile should be used to guide and shape the peri-implant tissue prior to final restoration.[61] Priest proposed an esthetic analysis based on soft tissue gingival height around dental implants. In his analysis, the positions of midfacial gingival tissue margin and the heights of mesial and distal papillae were numerically compared using fixed reference points on preoperative and postoperative photographs. Our current study utilized a variation of Priest's analysis as a subjective measure of esthetic outcome on a visual analog scale. Based on before and after digital photographs, the gingival anatomy remained unchanged or improved in 95 patients. Five patients required postoperative connective tissue grafts to bring the gingival zenith to preoperative levels. A more comprehensive numerical digital analysis of this case series will be forthcoming in future publications.

Belser, Buser and Higginbottom defined an esthetic implant crown as one in harmony with the perioral facial structures. In addition, the soft tissues, including, height, volume, color, texture and contours, should be in harmony with the surrounding teeth. Finally, the restoration should imitate the natural appearance of the missing tooth.[62] This study shows that microsurgery can be utilized for implant placement in extraction sockets with a high degree of

Figure 26. Preoperative X-ray of failing central incisor.

Figure 27. Preoperative central incisor.

Figure 28. Postoperative implant at 44 months.

Figure 29. Postoperative X-ray at 44 months.

Figure 30. Smile line esthetics with implant and crown (Restoration courtesy Kathleen McClintock, DDS).

clinical success. When provisionals are placed at the time of surgery, the gingival tissues are supported and undergo little change in anatomy. This protocol offers an opportunity for implant therapy with less morbidity and highly esthetic outcomes. This translates into increased patient acceptance and satisfaction.[63] Dentistry will see increasing use of the microscope in clinical practice, including applications for extraction, implant placement and restoration.[64] Microscopy has the potential to advance dentistry from an era of traumatic tooth loss to one of exact and seamless replacement of a failing anterior tooth with an esthetic implant-supported crown. CDA

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