Eur. J. Prosthodont. Rest. Dent., Vol.22, No. 2, pp 51-55
Printed in Great Britain

doi:10.1922/EJPRD_1216Dhima05

Correction of Bone and Soft Tissue Deformity of the Single Implant in the Aesthetic Zone: A Case Treated with Alveolar Ridge Preservation, Modified Roll Technique and a Digitally Coded Healing Abutment

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Abstract - *The correction of soft tissue deformity and aesthetic rehabilitation of a single implant in the aesthetic zone with a combination of periodontal and prosthodontic approaches is described. Soft tissue deformity was corrected resulting in significant soft tissue volume increase and eliminated the need for prosthetic gingival replacement. A two stage implant placement protocol, ridge preservation and a soft tissue augmentation flap design preserved epithelium attachment to the connective tissues. Use of a digitally coded healing abutment preserved the newly established soft tissue volume, allowed impression making without implant component removal, and minimized trauma to the newly established soft tissue architecture.*

KEY WORDS: Aesthetic zone, single, implant, digitally coded, abutment, crown

INTRODUCTION

Development of stable bone and soft tissue architecture with a single tooth implant supported restoration in the aesthetic region is often challenged by the loss of buccal alveolar plate at time of tooth extraction [1, 2]. A recent systematic review on the soft tissue management for dental implants replacing missing teeth found inconclusive evidence on the ideal flap design, soft tissue augmentation technique or the best incision, suture technique or material[3].

Autografts or animal derived collagen matrix are effective in soft tissue thickness increase but ultimately result in compromised aesthetics with 0.5mm recession[3]. Additional aesthetic challenges of these approaches are visible scars, painful post operative recovery, compromised papillae architecture and need for pink porcelain replacement of the soft tissues.

Socket preservation, soft tissue augmentation procedures and a delayed implant placement protocol are recommended in complex cases with a combination of bone and soft tissue deformities, thin periodontium and a history of trauma or infection [4]. Various approaches to correction of bone and soft tissue defects concurrent with or after implant placement include socket preservation techniques, bone augmentation techniques, forced orthodontic extrusion, surgical soft tissue augmentation techniques and immediate provisionalization [4-7].

Techniques for correction of soft tissue deformities in the aesthetic region have included coronally advanced flaps, subepithelial connective tissue grafts and roll techniques[8-11].

Several described techniques harvest connective tissue from the palate and graft it to a pouch in the mucosa over the alveolar defect [11-13].

A technique where the epithelium is stripped from connective tissue pedicle of the palate and rolled to the buccal mucosa was described by Abrams [8]. A modification to this technique retained the epithelial pedicle resulting in increased volume of the connective tissue transfer, faster healing and less postoperative discomfort [14].

A recently developed digitally coded two-piece healing abutment system (Encode ®, Biomet 3i, Palm Beach Gardens, FL, USA) allows impression making directly on the healing abutment as early as 6 weeks after abutment connection without disturbing peri-implant soft tissue architecture which can also be controlled by the abutment's dimensions [15, 16]. Techniques to fabricate implant dentistry casts with impression coping components have been shown to be inconsistent in maintenance and transfer of the soft tissue architecture from impression making to the delivery of the final restoration [17, 18]. The one step approach of placement and impression making of digitally coded healing abutments has resulted in working casts with low levels of distortion [19].

Staged combined periodontal and prosthodontic treatment for correction of soft tissue deformity for the replacement of an anterior single tooth in the aesthetic region is presented. The selection of periodontal and prosthodontic approaches was guided by consideration of various parameters known to impact implant placement, osseointegration and final aesthetic outcome.

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CLINICAL REPORT

A 19 year old Caucasian male was referred for evaluation and treatment to the Mayo Clinic Department of Dental Specialties with a chief complaint of "infection and dark tooth". The maxillary left lateral incisor was treated with root canal therapy in 2005 subsequent to which radiographic periapical radiolucency was noted on a recall examination in 2011. The patient denied any history of trauma. The clinical examination was remarkable for a bony exostosis onthe facial of the maxillary right lateral incisor. The maxillary left lateral incisor revealed a buccal plate deficiency, thin scalloped periodontium, and intrinsic graying of the clinical crown (Figure 1a). The radiographic examination revealed a radiographic periapical radiolucency and internal resorption in the apical one third of the maxillary left lateral incisor with a previous history of root canal therapy (Figure 1b).

The patient was a nonsmoker, healthy and did not take any medications.

After a diagnosis of:

- radiographic periapical radiolucency
- internal resorption
- intrinsic staining
- thin scalloped periodontium with triangular tooth form

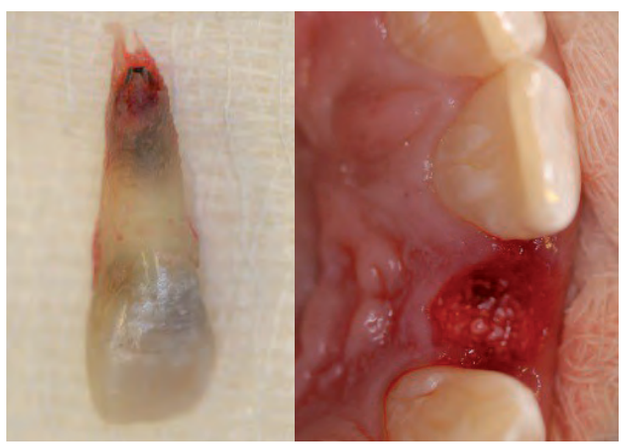
The long term prognosis of the maxillary left lateral incisor was deemed poor. The treatment options discussed were apisectomy and a full coverage ceramic restoration, extraction with a tooth retained resin bonded fixed partial denture, extraction with endosseous dental implant retained restoration. Atraumatic extraction of the tooth with alveolar ridge preservation, a delayed two stage implant placement protocol with a modified roll technique and digitally coded healing abutment was pursued by the patient as a definitive treatment due to the poor long term prognosis of treatments that aimed at preserving the tooth. The alveolar ridge preservation was incorporated in the treatment plan to minimize ridge resorption at time of tooth extraction and preserve the anatomy of the bone and soft tissues for subsequent implant placement.

Treatment initiated with atraumatic extraction of the maxillary left lateral incisor with forceps technique after adequate local anaesthesia (Figure 2A, 2B, 2C). The ankylosed root tip was removed with a surgical round rotary instrument and copious irrigation. The socket was degranulated and irrigated copiously. Bio-Oss (Osteohealth, Shirley, NY) was placed in the socket (Figure 2B) and stabilized with resorbable collagen wound dressing (CollaPlug; Zimmer Dental, Carlsbad, CA). Simple interrupted 4-0 chromic gut sutures were placed. Patient was prescribed Amoxicillin (1000 mgs a day for ten days) and Vicodin (500 mg tabs, every four hours for four days) for post-operative pain management. A provisional removable partial denture was delivered to replace the extracted tooth.

After four months, the site preservation did not maintain the natural ridge anatomy in the extraction site. A deficiency in the buccal plate of the extraction site was noted (Figure 3) on examination of the ridge contours and further confirmed surgically when a concavity of the buccal surface was noted. After local anaesthesia, intrasulcular incisions with vertical releasing incisions extending to the adjacent teeth were

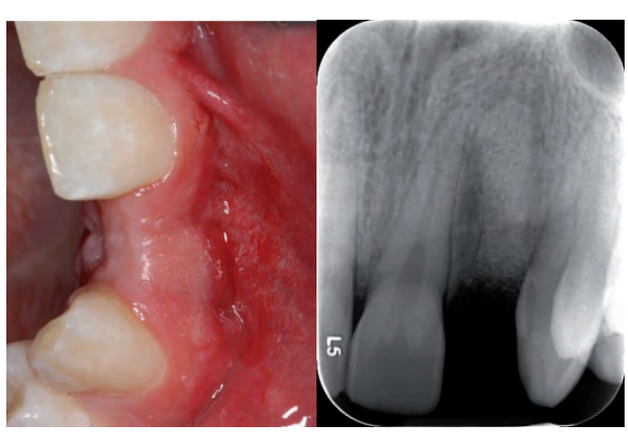
A **B**

Figure 1. *Maxillary left lateral incisor at time of extraction.*
A:*Tooth presentation at time of extraction.*
B: *Periapical radiograph at time of extraction.*



A **B**

Figure 2. *Extracted tooth and site after socket preservation.*
A: *Extracted tooth demonstrating intrinsic root resorption.*
B: *Extraction site after completion of socket preservation procedure.*



A **B**

Figure 3. *Extraction site before endosseous implant placement*
A: *Extraction site four months after socket preservation demonstrating buccal plate deficiency.*
B: *Periapical radiograph of extraction site four months after socket preservation in preparation for implant placement.*

carried. Upon reflection of full thickness facial and palatal flaps, implant placement protocol was followed to place a 3i NanoTite tapered Certain Prevail implant (Biomet 3i, Palm Beach Garden, FL). A cover screw was placed (Figure 4A) and flaps were repositioned with simple 4-0 chromic gut sutures (Figure 4B). A non-steroidal anti inflammatory agent (Ibuprofen 600 mg every 6 hours for the first 24 hours) was prescribed for post-operative pain management. Patient was instructed to use a 0.12% chlorhexidine rinse twice daily starting 24 hours after procedure, and resume regular oral hygiene care.

In three months, second stage uncovering followed. At this time, a facial soft tissue deformity was noted (Figure 5A). It was deemed necessary to complete a soft tissue deformity correction with a modified roll technique in conjunction with placement of a digitally coded healing abutment with appropriate height and width to preserve the soft tissue architecture. After adequate anaesthesia, a crestal incision partial-thickness flap was dissected on the palatal aspect.

The remainder of the connective tissue was detached from the bony substructure, and reflected to the facial aspect. Thereafter, it was rolled underneath the facial aspect and soft tissue. A digitally coded two-piece healing abutment 3.4mm x 5mm x 4mm (Certain Encode, Biomet 3i, Palm Beach Gardens, FL) was hand tightened. The flaps were stabilized with simple interrupted 4-0 chromic gut sutures (Figure 5B). Patient was prescribed Vicodin (500 mg tabs every four hours for four days) for pain management and 0.12% chlorhexidine rinse (rinse twice daily for one week, and apply with Q tip to area thereafter).

The patient healed uneventfully and returned 6 weeks postoperatively[3, 6, 14] at which time excellent correction of the soft tissue deformity was noted. Soft tissue architecture was in harmony with contralateral and adjacent teeth soft tissue architecture (Figure 5C). After ensuring a minimum requirement of 2mm supragingival abutment height, an impression was made with light body and heavy body polyether material (Permadyne Garant; 3M ESPE, St. Paul, MN) using a stock dual impression tray (Premier triple tray; Premier Dental, Plymouth Meeting, PA).

At time of definitive restoration, upon removal of the two-piece digitally coded healing abutment (Figure 5D) excellent soft tissue health and architecture were noted. A custom zirconia abutment (Procera; Nobel Biocare, USA) and an all ceramic crown were delivered as the final restoration (Figure 5E).

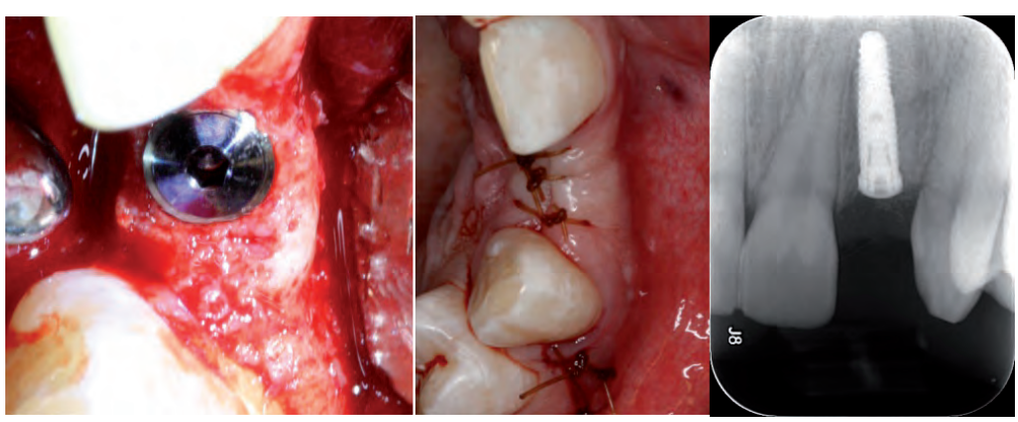
DISCUSSION

Correction of soft tissue deformity in the rehabilitation of a single tooth in the aesthetic region with a staged combined periodontal and prosthodontic approach has been described. Clinical and radiographic examination led to identification of several pre existing conditions known to compromise implant placement, osseointegration and aesthetic outcome.

Consideration of internal root resorption, periapical pathology, a previous history of root canal therapy, thin scalloped periodontium, and triangular root form of a single tooth in the aesthetic zone prompted a staged combined periodontal and prosthodontic approach to improve the long term treatment outcome. Careful staging of periodontal techniques was combined with planned selection of prosthetic implant components to promote maintenance of soft tissue architecture and minimize soft tissue distortion when preparing the definitive restoration.

The advantage of socket preservation with alveolar ridge augmentation during tooth extraction was preservation of bone and soft tissue architecture in preparation for implant placement. The decision to pursue a delayed staged implant placement protocol was made based on the high risk for compromised implant placement and soft tissue healing.

Despite this, soft tissue deformity persisted after tooth extraction and socket preservation. The two stage approach for implant placement allowed for the opportunity to manage with more control the soft tissue architecture at a later time so that adequate flap reflection and access could be obtained at time of implant placement. Although concurrent soft tissue deformity correction and implant placement



A **B** **C**

Figure 4. *Implant placement site.*
A: *Implant placement site after cover screw placement demonstrating adequate buccal bone volume.*
B: *Flap closure after implant placement.*
C: *Periapical radiograph of implant placement.*

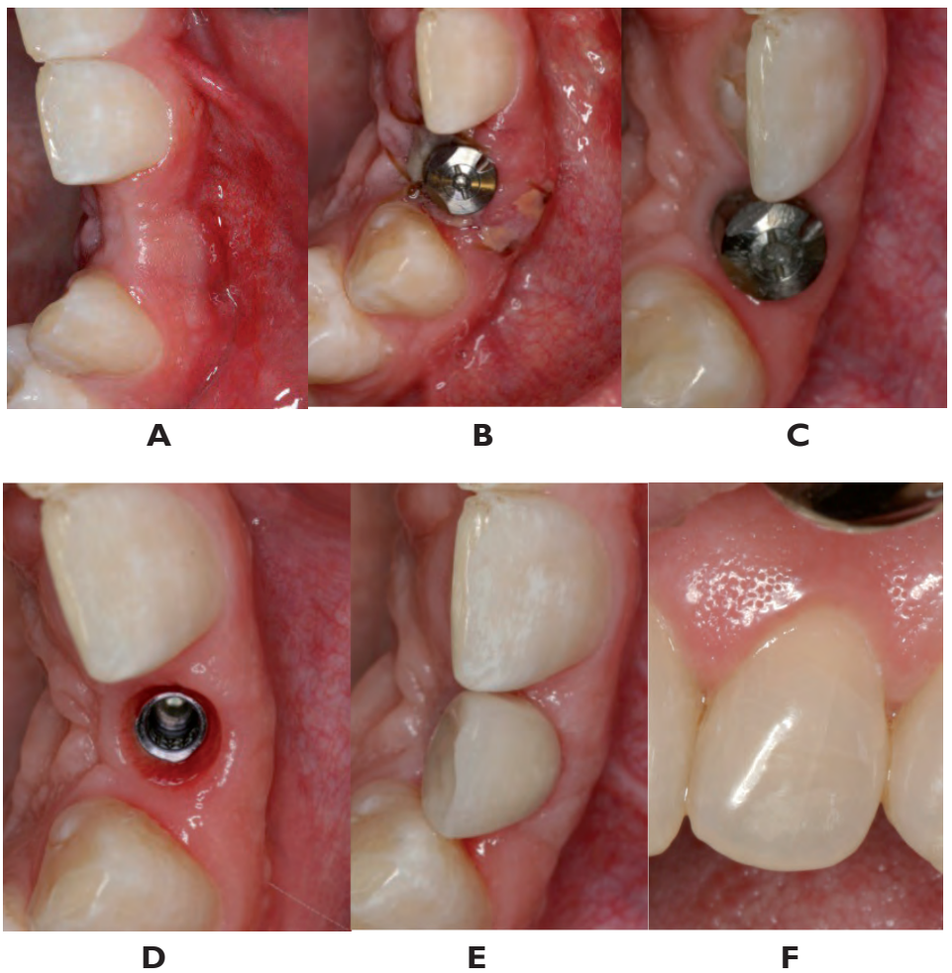


Figure 5. *Soft tissue changes from implant placement to final restoration.*
A: *Extraction site demonstrating buccal plate deficiency after first stage implant placement in preparation for second stage uncovering.*
B: *Second stage uncovering completed with digitally coded healing abutment in place and completed modified roll technique.*
C: *Optimal soft tissue volume noted 6 weeks after connection of digitally coded healing abutment and modified roll technique.*
D: *Soft tissue after removal of digitally coded healing abutment at time of definitive restoration placement.*
E: *Final restoration in place and optimal soft tissue volume is noted.*
F: *Frontal view of restoration 22 months after initial placement.*

could have been completed, this one stage approach allows for less control of soft tissue architecture and healing.

The modified roll technique approach maximized the connective tissue transfer, allowed for faster and less painful healing. The use of a digitally coded abutment permitted soft tissue architecture manipulation and contouring at time of implant component placement.

Another consideration could have been use of a provisional custom abutment. This would require placement of a full coverage restoration. Since the patient lived a significant distance from the clinic, access to care for management of prosthetic or surgical complications was difficult. By using a more conservative approach, soft tissue architecture was preserved by selection of appropriate diameter of the digitally coded abutment and modified roll technique. Advantages of placing a digitally coded healing abutment were less postoperative pain, minimal soft tissue disturbance at time of impression, more cost effective since no impression components or radiographs for seating verification were needed. Another significant advantage of using the digitally coded healing abutment was the ability to maintain the soft tissue architecture undisturbed from time of soft tissue volume augmentation to delivery of final restoration. Although use of a modified temporary abutment is also an option to help with contouring of soft tissue architecture, this approach does not allow for undisturbed soft tissue architecture since components will need to be removed and replaced at time of impression making and final restoration delivery. The digitally coded healing abutment can be selected to contour the tissues based on the anticipated desired soft tissue contours. These contours can also be duplicated in the cast so that the custom abutment design can follow this established soft tissue architecture. This approach enhances maintenance of soft tissue contours at time of delivery.

One of the disadvantages of this approach is the need for additional training and parts acquisition from the surgeon since the abutment itself will need to be placed at time of surgery. Other disadvantages of this approach are extended treatment time, and the need for multiple surgeries. In cer-

tain cases, the height of the abutment supra gingivally may interfere with the interim removable prosthesis, especially in cases where limited interarch distance is present. Since the abutment is required to be placed at time of surgery, it is not possible to provide immediate provisionalization with an implant retained restoration. Some patients may be opposed to wearing an interim removable prosthesis during healing.

Another consideration of using such digitally coded abutment is the need for at least 2mm of the abutment surface above the gingival crevice. This height is necessary to "read" the abutment digitally. Clinically, when this height is not present, it is advised to place a cord in the sulcus to displace the tissue. Another more aggressive approach may include trimming of the gingiva. This last approach is not recommended especially in highly aesthetic areas. Appropriate treatment planning of cases is crucial prior to selecting a digital abutment, especially for highly aesthetic areas.

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