A MODIFIED SOCKET SEAL SURGERY WITH COMPOSITE GRAFT APPROACH

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KEY WORDS

Bone contour
Socket seal
Composite graft
Dental exograft

The contour of the residual ridge is reduced within 1 year by approximately 25% in width after the extraction of a natural tooth. The augmentation of a tooth socket after an extraction decreases the loss of available bone width for an endosteal implant. Grafting at the same time as the extraction has benefits from both a patient and doctor perspective. However, primary closure is more difficult, and may require the facial keratinized gingiva to be undermined and approximated on the crest of the ridge, or the use of membranes, which are exposed during the soft tissue healing. The modified socket seal surgery uses a technique described by Landsberg and couples his procedure with autologous bone harvested from the maxillary tuberosity. As a result, the tooth extraction socket may be augmented with autologous bone and connective tissue with a simplified approach at the same time as the extraction of a tooth.

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INTRODUCTION

The healthy natural tooth stimulates the alveolar bone, thus maintaining its volume and density. The removal of a tooth begins a cascade of events within the socket that will completely heal with bone within 4 to 6 months.[1] However, the final contour of the bone is reduced in width by 25%.[2] In addition, as the epithelium migrates over the socket, the intraseptal bone is lost and the bone slopes from the higher lingual aspect to the more apical facial cortical plate, which reduces the crestal height of bone.[3] It is speculated this is due in part to the constriction of the blood clot within the alveolus and the thin labial cortical plates remodeling in response to inadequate blood supply after the extraction. In addition, pre-existing periodontal or endodontic disease or trauma from the extraction often destroy the labial bony plate and causes the immediate loss of width and height of bone, which may exceed 50% of the optimum volume. The decrease in width and height of bone can compromise replacing the tooth with an implant. The diameter of the implant, the implant position in relation to the crest, and the cervical contour of the crown for aesthetics and hygiene can be directly affected by bone loss following the removal of teeth.

Several procedures have been suggested to maintain adequate width and height of the alveolar ridge after extraction to insert endosteal implants. Misch and Dietsh[4] suggest different graft materials based on the number of bony walls that remained after the

tooth is removed. A 5 bony wall defect will grow bone with almost any alloplast, allograft, or autograft. When a labial plate is missing (4 bony wall defect), allograft or guided bone regeneration increases the predictability of restoring the original bony contour. A 2 or 3 bony wall defect requires using autogenous bone, and a block of autogenous bone fixated into position is required for 1 bony wall defects.

The graft material placed into the socket can become contamination or graft material may be lost without primary closure. In order to achieve primary closure over a bone graft at the time of tooth extraction, a flap is rotated from the facial aspect of the alveolus. When the flap is closed, the keratinized gingiva is placed over the socket reducing the amount of attached tissue on the facial aspect of the alveolus. It also requires incisions to close the flap, which may deplete the blood supply to the very thin labial plate of bone. Instead of repositioning a flap, the tooth can be extracted, allowing the gingiva to granulate over the socket for 6 to 8 weeks following the extraction. The advantages of the delaying the graft procedure is that the attached gingiva will be newly formed secondary bony spongiosa, along with a decreased risk of infection. The disadvantages of this technique are a 2-month delay and additional surgery. The delayed technique does not take advantage of the initial increase in bone formation rate from the regional acceleratory phenomenon (RAP) triggered by the trauma of the extraction.[5]

The soft and hard tissues of a tooth socket heal by secondary intention. The healing sequence in both hard and soft tissue includes inflammation, epithelialization, fibroplasia, and remodeling.[6] The sequential pattern of bone formation prior to bone remodeling is unique.

Oral epithelium surrounds the crestal aspect of the socket and averages 3 mm in thickness in the absence of periodontal disease (1 mm suillus, 1 mm junctional epithelial attachment, and 1 mm connective tissue attachment). The inflammatory stage of healing is initiated by the extraction trauma. The cribriform plate of the tooth socket is composed of cortical bone and after the extraction is covered with the residual periodontal ligament (PDL). The socket fills with blood from the torn blood vessels originating from the PDL. The blood coagulates and protects the bone during initial healing.

The epithelium around the crest of the alveolus migrates down the socket walls during the first week. The migration continues until it reaches the bed of granulation tissue situated under the blood clot formed from the bleeding vessels. It then migrates over this tissue until it makes contact with the epithelium migrating from the other sides. Osteoclasts also gather along the crestal bone of the extraction site.

The actual time for the healing of an extraction socket varies between individuals. The number of bony walls around the socket greatly influences the bone regeneration. Since the apical region often has a 5 wall defect of bone and a good bony blood supply, its conditions are most conducive to form bone more rapidly. The size of the socket also affects the rate of healing. Molars take longer to completely form bone compared to anterior teeth. Teeth with horizontal bone loss and a smaller remaining root diameter heal faster than teeth with a wider socket dimension; however the bone does not grow above the horizontal level of bone. The crestal aspect of bone healing is the most variable as to the number of bony walls, blood supply, and absence of infection. Yet it is the most important region for ideal implant placement.

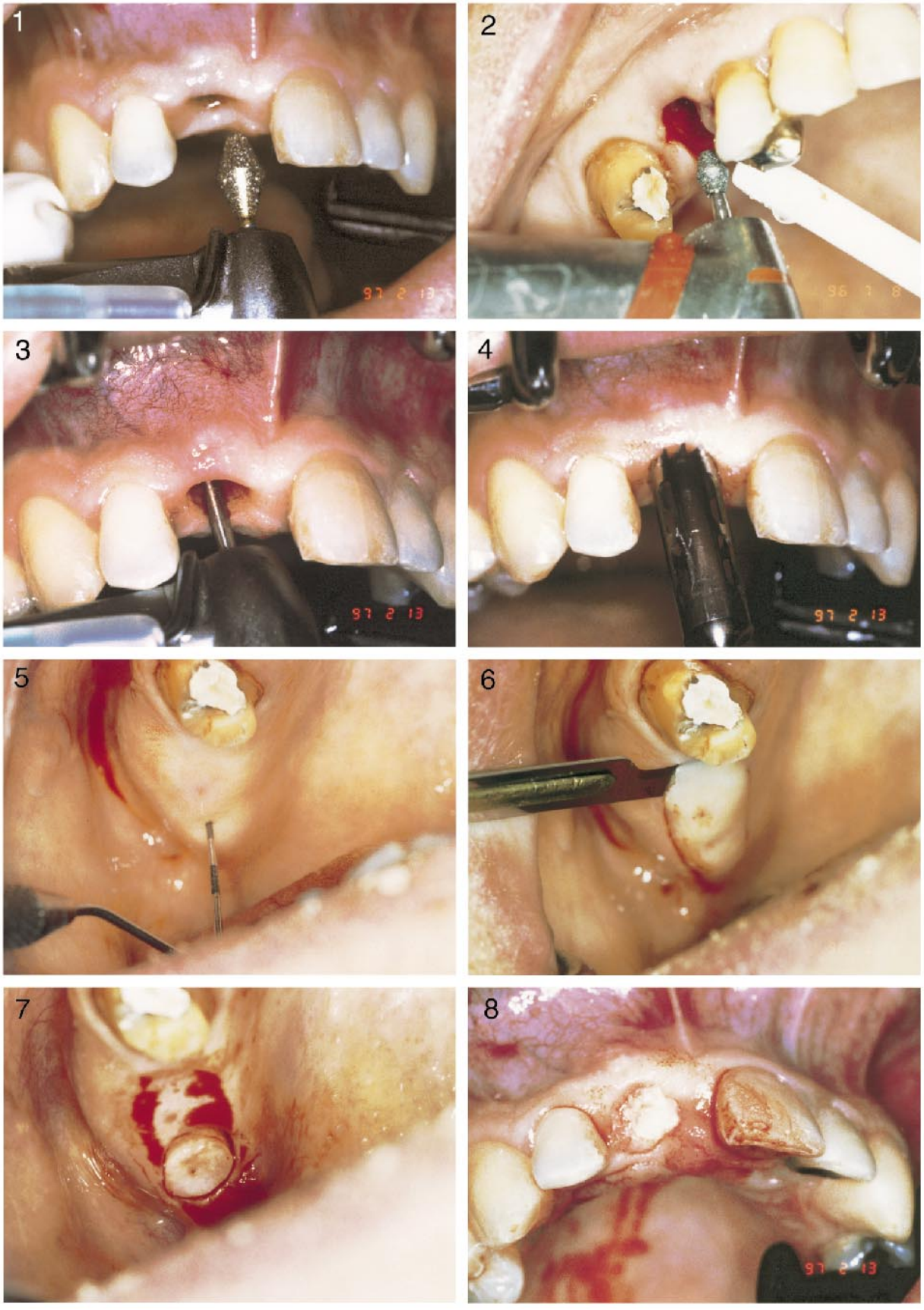
Socket Seal Surgery

Landsberg and Bichacho[7] developed a ''socket seal surgery'' (SSS) for the maxillary anterior region. The SSS procedure is preferably performed for intact socket walls (a 5 wall bony defect). The tooth is extracted with as atraumatic a technique as possible and a mucoperiostal flap is avoided if possible. The socket walls are curretted to remove remnants of the periodontal membrane, pathology, or granulomatous tissue. A water-cooled, high-speed handpiece and bur removes the epithelium of the gingival socket walls and exposes the vascularized connective tissue. The socket walls are decorticated to expose the bone-forming cells in the adjacent bone. A 3- to 5-mm thick graft of attached tissue that fits the extraction site is harvested from the palate using a no. 15 scalpel blade. Demineralized freeze-dried bone is packed into the socket until it reaches the crest of the bony socket walls. The attached tissue graft is placed over the socket and sutured into place. Surgeons should be aware that both air and water handpieces can cause air emphysema and must be used with caution.

The advantages of the SSS technique, according to Landsberg and Bichacho,[7] are that the socket is completely sealed and prevents physical interferences, bacterial, or chemical contamination of the wound. The submucosa at the base of the attached tissue graft acts as a barrier to prevent undesirable penetration of epithelial cells into the socket. This is prevented because the lamina propria of the graft heals with the connective tissue in the socket gingival walls. In addition, the soft tissue width and height of the ridge is preserved for future implant restorations.

Composite Graft Socket Seal Surgery

A modified socket seal surgery has been developed by the author.[8,9] A composite graft of connective tissue periosteum and bone is used to seal the socket. A connective tissue graft has the advantage over a keratinized graft by blending into the surrounding attached gingival regions offering similar color and texture of the epithelium. This is most advantageous in the maxillary anterior region and other aesthetic areas. The composite graft also contains autogenous bone. The major advantage of autologous bone is a



more rapid and predictable bone formation via osteogenesis. This technique is indicated any time a noninfected tooth is extracted and an implant is planned as replacement. It is not indicated in cases of infection in the socket area or if bone removal was required to extract the tooth. In such cases, grafting should follow a delayed approach.

Five mL of venous blood is drawn from the arm of the patient preoperatively. Place this into a multipurpose centrifuge for 8 to 18 minutes. The blood will be separated into 3 layers: red blood cells on the bottom, buffy coat in the middle, and serum on the top. The buffy coat is composed of platelets and white blood cells. Platelets are a source of fibrin for the initial clot, and platelet-derived growth factor (PDGF). PDGF acts as a chemo-attractant for mesenchymal cells involved in bone formation. When PDGF is mixed with DFDB, an increase of cartilage and bone formation has been reported.[10]

A modified composite graft technique for the socket seal surgery involves extraction of the tooth without periosteal elevation and minimal bone loss. (The trauma from the extraction stimulates the rate of bone formation due to the RAP of bone repair.[5]) This is followed by curettage of all granulomatous tissue from the socket, especially the coronal and apical regions. If exudate is present, 2 or more weeks should be allowed elapse to insure that a normalized pH is reacted and the risk of infection is reduced (Fig 1). The soft tissue epithelial lining around the extraction socket is debrided with a diamond bur and handpiece under copious irrigation (Fig 2). This provides additional blood supply to the connective tissue graft and helps prevent the apical migration of epithelium within the socket. The bone is then decorticated at the apical and lingual cribriform plates with a handpiece and surgical bur to increase the vascular bed and ensure the RAP process (Fig 3). A 6- to 10-mm trephine bur corresponding to the extraction site diameter (Fig 4) is used in a slow-speed, high-torque handpiece to harvest a gingival graft with underlying bone. The most common site for the intra-oral composite graft harvest is the maxillary tuberosity region. Care must be exerted not to enter the antrum. This can be assured by exposing local periapical radiographs with the assistance of 5-mm steel ball templates. The trephine is used as a lever to green stick fracture the bone core from its base. A Molt elevator may also be used for this purpose. The bone core (usually 5 to 10 mm in height) and the attached soft tissue (about 3 mm in height) is trimmed of its epithelium with a tissue scissors leaving 3 mm of connective tissue attached to the bone core (Figs 5–7).

If the bone core does not fill the extraction socket completely, demineralized freeze-dried bone and the buffy coat may be used in the apical portion of the socket, provided the labial plate is still intact (allografts are most predictable in 5 wall bony defects). Since the new bone forms from the apical portion of the socket, this is the least important region to augment. If no bone plate remains in the apical half of the socket, additional autogenous bone should be harvested from another intraoral site to overfill the apical half of the socket. The bone of the composite graft (connective tissue attached to periosteum and bone) is compressed and fitted into the remaining portion

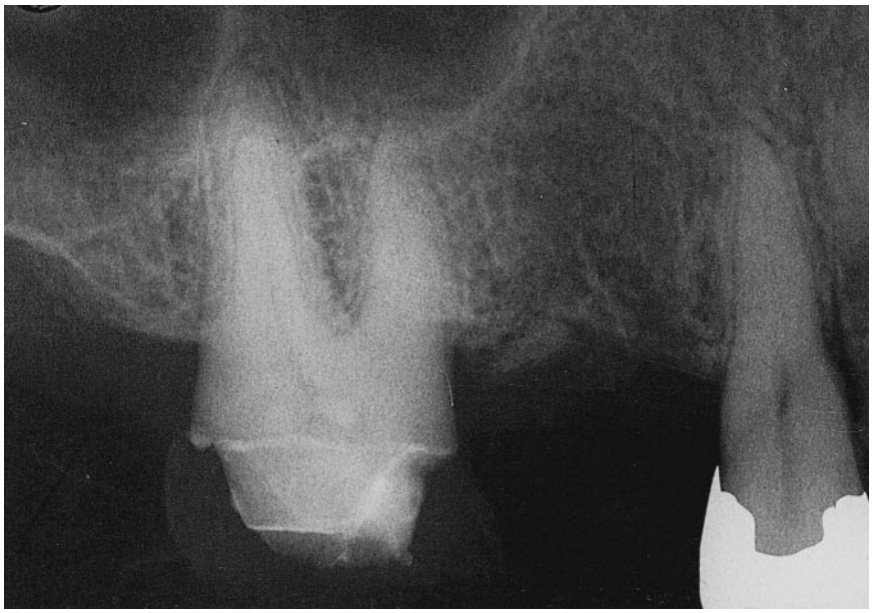


FIGURE 9. A periapical radiograph after 3 months demonstrates a lack of residual lamina dura and complete healing.

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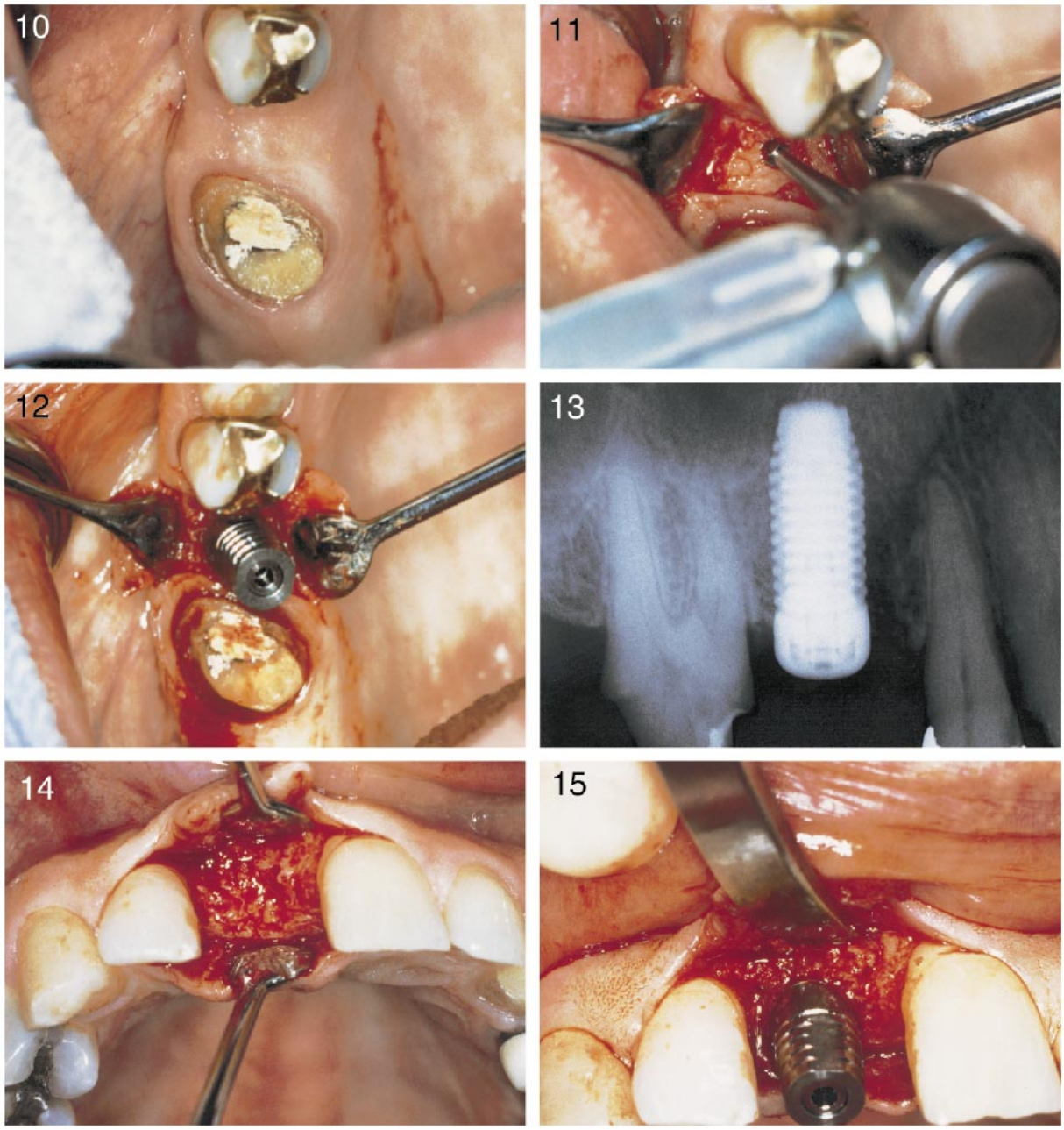
FIGURES 1–8. FIGURE 1. The tooth was extracted and the apical pathology curetted. A 2-week healing period decreases the risk of apical pathology affecting the graft. FIGURE 2. A rough diamond is used to remove the keratinized lining of the gingival sulcus. FIGURE 3. A long surgical bur is used to perforate the apical and palatal regions of the socket. FIGURE 4. A trephine drill is selected that corresponds to the diameter of the socket. FIGURE 5. The tuberosity is the ideal harvest site. However, the tissue is often more than 3 mm thick. FIGURE 6. The tissue may be reduced in thickness before or after the graft is harvested. FIGURE 7. A trephine drill proceeds to the floor of the antrum. The composite core is fractured at the base and removed with the bone periosteum and connective tissue. FIGURE 8. The core is inserted into the socket and sutured into position.



FIGURES 10–15. FIGURE 10. An intraoral view of the healed site after 3 months. FIGURE 11. Reflection of the tissue demonstrates a healed socket, complete with cortical plate. FIGURE 12. A D3 implant is inserted with the attached abutment for cement retention. FIGURE 13. A periapical radiograph of the implant in position. FIGURE 14. A 4-month re-entry of the composite graft in a maxillary central region. FIGURE 15. A 5-mm-diameter D2 implant and abutment is inserted.

of the socket. The tissue of the composite graft will seal the socket and remain above the surrounding gingiva. A mallet and blunt instrument should be used to tap it into place and compress the bony core to conform to the crestal contour of the socket (Fig 8). The connective tissue portion of the graft is then sutured to the surrounding gingival tissue with facial and palatal interrupted 4–0 Vicryl sutures. A transitional prosthesis should not be permitted to load the tissue during the first few weeks after extraction. Otherwise, the composite graft may become mobile and sequestrate.

The benefits of this modified technique permit the surrounding keratinized gingival tissues to migrate and form a similar color and texture of keratinized tissues over the socket. In addition, because autogenous bone is used as the graft in the coronal half of the socket where the facial bone is

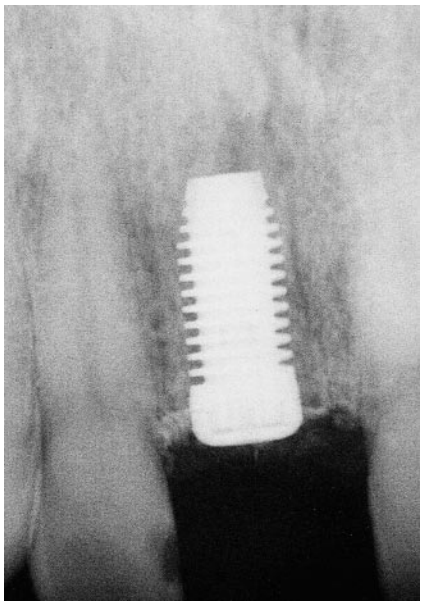


FIGURE 16. A periapical radiograph of the D2 implant body in the central incisor position.

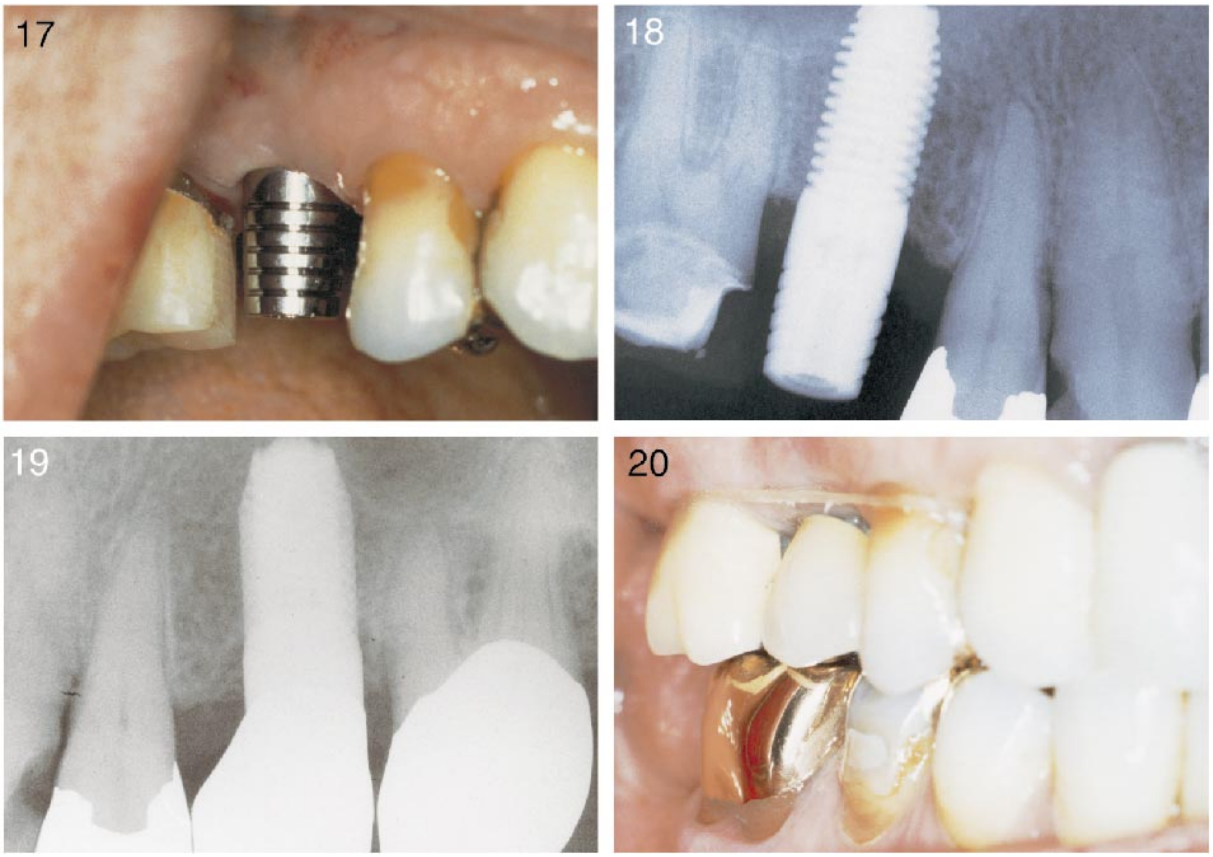
most often very thin or absent, more predictable results will result than if an allograft were used. As a result, re-entry may be in 3 to 5 months, and placement of larger-diameter implants made possible.

The blood supply to the composite graft is established from the surrounding soft tissue and the broken vessels of the PDL. Using these techniques all the advantages of the socket seal surgery as presented by Lansberg and Bichacho[7] are maintained and enhanced.

DISCUSSION

The healthy, natural tooth maintains the alveolus. The unhealthy tooth often loses a portion of the thin labial plate from disease or surgical trauma. The more available bone, the larger the implant width, the better cervical esthetics, and ease of daily oral hygiene techniques. Extractions of teeth lead to a rapid decrease in residual bone width. Grafting the socket improves the prognosis to maintain the width and height of remaining bone. However, primary closure of the tissue is necessary for grafting to prevent contamination or loss of the graft material. When grafting is performed at the same time as tooth extraction, the facial attached tissue is typically brought over the exposed socket, resulting with less keratinized tissue, and stripping the periosteum off the thinner labial plate of bone. Delaying the graft for 2 months increases the amount of keratinized tissue but delays treatment and adds an additional surgical procedure.

The socket seal surgery of Landsberg and Bichacho[7] allows grafting at the time of extraction without an additional procedure and without kerati-



FIGURES 17–20. FIGURE 17. After 4 months, the abutment was reinserted into the implant body. FIGURE 18. A periapical radiograph of the D3 implant in position. FIGURE 19. An intraoral periapical radiograph of the maxillary second premolar implant after 6 months of prosthetic loading. FIGURE 20. An intraoral view of the final crown on the maxillary second premolar implant. A rubber band is used to orthodontically move the molar anteriorly to a more favorable position.

nized tissue decrease. However, a 5 bony wall extraction socket is desirable since an allograft is used in the socket. The trauma of the extraction brings a cascade of events to fill the socket with bone. Grafting at the same time takes advantage of this phenomenon. Grafting with autogenous bone accelerates the bony repair and permits this procedure even when the labial plate is no longer present.

The graft site may be re-entered after 3 to 5 months, depending upon the size of the tooth root and the amount of autogenous bone in the composite core (Figs 9–16). The site is often healed without evidence of a lamina dura and has a crestal cortical plate. Since the residual ridge width is maintained, a larger-diameter implant (5 mm or more) often may be inserted, which improves the facial contour and emergence of the final crown. After the appropriate healing time, the implant may be restored (Figs 17, 18). Six months postoperatively the patient's progress was satisfactory (Figs 19, 20).

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