The four-layer graft technique, a hard and soft tissue graft from the tuberosity in one piece

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Abstract
Objective: Successful immediate implant placement in the maxillary anterior zone continues to be a challenge. There is an uncertainty on whether it should be performed on patients with thin gingival phenotype or incomplete buccal plate. This clinical case report describes a novel technique for immediate implant placement with simultaneous hard and soft tissue augmentation.

Clinical considerations: This technique employs a combined epithelialized-subepithelialized connective tissue graft and cortical-cancellous autogenous bone graft for the treatment of incomplete buccal plate at an extraction site. Significant horizontal bone regeneration appears to have been achieved as well as soft tissue augmentation for a central incisor in a single surgical step. Following three and a half years, gingival contours and bone augmentation were stable with a pleasant esthetic result.

Conclusions: The use of the four-layer tissue graft for immediate implant placement can be suggested to improve hard and soft tissues in a single procedure.

Clinical significance: The use of the four-layer graft technique has shown to be successful regarding function and esthetic outcomes in anterior immediate implant placement. It reduces surgical interventions and treatment time and minimizes soft tissue recession and bone resorption.

KEYWORDS
bone augmentation, immediate implant, implants, soft tissue graft, soft tissue management

1 INTRODUCTION

Immediate implant placement in post extraction socket in the maxillary anterior segment has currently increased its popularity and become a routine procedure for clinicians. It also has proved to be a predictable treatment with a very high survival and success rate.¹ The esthetic outcome for immediate implants can be a challenge due to dimensional ridge alterations that occur following tooth extraction. These changes are irreversible and involve horizontal and vertical bone loss.² Contrary to what was initially thought, immediate implant placement fails to reduce bone loss after tooth extraction, with clinical studies showing that hard tissue resorption occurs irrespective of implant insertion.³ Following these studies, clinical research has been focused on improving the esthetic outcome of immediate implant placement. Results from clinical studies have shown a high risk of midfacial recession following immediate implant placement in cases of an incomplete buccal bone wall.⁴,⁵ However, case series studies have reported reconstitution of the absent labial bone plate through different techniques.⁶-⁸ Because of this, hard and soft tissue augmentation procedures have been proposed to minimize buccal bone resorption and to maintain the soft tissue volume following tooth extraction.⁹,¹⁰ There is still a controversy on proper treatment selection when a nontreatable tooth is present in the anterior region with a missing buccal plate.
The purpose of this report is to present a novel technique to successfully treat extraction sockets with incomplete buccal bone wall and interproximal bone loss with immediate implant placement combining autogenous hard and soft tissue grafting simultaneously.

2 | CLINICAL CONSIDERATIONS

2.1 | Atraumatic extraction, graft site preparation and implant placement

A 53-year-old patient presented with a failing maxillary left central incisor, with advance attachment loss and severe bone loss on the adjacent teeth (Figures 1 and 2). A critical step for a nontreatable tooth that presents with severe clinical attachment loss is to perform an atraumatic extraction preserving the interdental papillae of the extraction site with the adjacent teeth (Figures 3 and 4). On the labial aspect of the extraction site, immediately following tooth removal, the socket is debrided, eliminating all the granulation tissue. To facilitate the debridement of the granulomatous tissue a high-speed diamond bur or a microsurgical blade can be utilized. A supraperiosteal tunnel is made on the buccal and palatal aspect of the socket. It is recommended to dissect sharply past the mucogingival junction on the buccal aspect and 4 to 5 mm on the palatal aspect with an microsurgical blade (1.25 mm Crescent Sharpoint; Surgical Specialties Corporation, Wyomissing, PA) (Figure 5). The buccal defect then needs to be measured in order to harvest an adequate graft with the proper dimensions and a correct shape. Thus, bone sounding is performed at three sites: disto-buccal, mid-buccal, and mesio-buccal sites. Once the receptor site has been prepared, the placement of an immediate implant is carried out (4.3 mm in diameter and 13 mm in length; Camlog Screw Line; Camlog Biotechnologies, Wimsheim, Germany). The implant was placed 4 mm apical to the gingival margin of the contralateral tooth.11

2.2 | Donor site preparation and placement of the graft

The next step in this surgical technique involves harvesting the four-layer tissue graft, a combined epithelialized-subepithelialized connective

FIGURE 1  Initial presentation: periapical radiograph

FIGURE 2  Initial presentation: facial view

FIGURE 3  Extraction socket

FIGURE 4  Extraction socket: note the absence of buccal plate
tissue graft and cortical-cancellous autogenous bone graft. At the outset, when planning this surgery, the tuberosity must be evaluated in order to have an adequate volume of hard and soft tissue, as this will be the main donor site. Hence, it is required to have a cone beam computerized tomography (CBCT) of both areas (receptor and donor) for preoperative examination. The tuberosity area has to be evaluated on the CBCT in order to ensure that enough height of bone is available to avoid a maxillary sinus communication while harvesting the graft. The soft tissue thickness can be measured performing bone sounding with a periodontal probe.

The four-layer tissue graft is harvested from the hard palate and tuberosity area. An incision is made with a 15c blade perpendicular to the palatal surface. An area of intact epithelium with the shape of the coronal area of the extraction socket is left intact. The anterior component of the graft, where the subepithelial connective tissue is needed, is raised as a partial thickness flap. The middle portion is harvested utilizing a combination of epithelized-subepithelized connective tissue graft (Figure 6A). The posterior area of the palate and the tuberosity, where the autogenous bone is needed, is elevated with the subepithelial connective tissue using a bone chisel (FL-143 Bontempi; Quirurgical Bontempi; Barcelona, Spain) and a mallet to harvest the bony portion of the graft (Figure 7). Elevating the anterior soft tissue portion of the graft first, will allow for a better visibility and access of the bone, which will be harvested. The bone is cut with a chisel held perpendicularly to the palatal bone in the soft tissue incision line to define the dimensions of the bone graft. After inserting the chisel 3 to 4 mm into the bone, the angulation of the chisel is changed so that it is now parallel to the outer surface of the subepithelial connective tissue. It is then deepened until the most posterior area of the incision is reached.

The four-layer graft is then trimmed and adapted to the donor surgical site (Figure 8). The soft tissue is modified with a blade or tissue scissors, and the bone is modified with rongeurs. After the graft is trimmed, it is introduced in the pouch by means of a suture at the apical end of the tunnel (Figure 9). This way, the bone graft is placed at the inner buccal aspect of the socket and the subepithelial connective tissue at the outer aspect. Once buccal aspect is stabilized, another suture at the apical palatal aspect is placed to introduce the palatal subepithelial connective tissue component of the graft. Finally, the sulcular margins and the epithelized component of the graft are secured with simple interrupted 6-0 monofilament sutures (6-0 Polypropylene, Prolene, Ethicon, Johnson and Johnson, New Brunswick, NJ) (Figure 10).

The site is temporized with a resin crown made chairside, which is splinted to the adjacent anterior teeth using an orthodontic wire bonded with flowable composite.

3 | RESULTS

The patient was instructed to apply chlorhexidine gluconate 0.12% to this area twice a day. Ibuprofen 600 mg three times a day for 3 days was prescribed for pain relief and amoxicillin 500 mg three times a day for 7 days.

Clinical monitoring was undertaken every 2 days for the first 2 weeks and every 15 days for the next 4 months. The site healed uneventfully, and the sutures were removed at 2 weeks. The patient reported minimal postoperative swelling and discomfort. At 6 weeks postsurgery the appearance of the soft tissue was normal without any
signs of infection or inflammation. After 4 months of healing, a second stage surgery to expose the implant head was performed by means of a 4 mm diameter tissue punch blade and the implant was restored with a provisional implant supported prosthesis to contour the soft tissues. At 6 months the implant was finally restored with a titanium-base zirconia abutment and all-ceramic crown (Figure 11). The patient underwent periodontal maintenance appointments every 4 months during 3 and a half years. Three years after surgery, there appeared to be slight radiographic marginal bone loss that could be due to the platform matching design of the implant. Regardless, the esthetic result was stable and no increase in gingival recession was recorded at the buccal surface of the implant (Figure 12A,B). The peri-implant soft tissues appeared healthy and the probing depths ranged from 3 to 4 mm with no bleeding on probing. The CBCT examination showed a stable buccal bone plate with 3 mm of thickness in the coronal aspect (Figure 13).

Figure 13 illustrates the surgical technique step by step.

**FIGURE 7** Tuberosity graft: note the four layers, cancellous bone, cortical bone, connective tissue, and epithelium

**FIGURE 8** Insertion of the tuberosity graft by means of an apical suture

**FIGURE 9** Sutures: simple interrupted sutures on the coronal part of the graft

**FIGURE 10** Insertion of the all ceramic crown after 6 months of healing

**FIGURE 11** Insertion of the all ceramic crown after 6 months of healing

**FIGURE 12** Sutures: simple interrupted sutures on the coronal part of the graft

4 | DISCUSSION

Immediate implant placement in the anterior maxilla requires a successful completion of many interdependent coordinated steps to preserve the bony hard tissue architecture and to maintain the soft tissue profile. The present case report describes a surgical technique that was able to combine soft and hard tissue autogenous grafting in the treatment of a nonrestorable tooth.

This novel technique is indicated for patients with interproximal attachment loss of a nontreatable tooth with an incomplete buccal plate. When performing extraction of teeth missing a portion of their buccal plate, significant resorption of the ridge is anticipated leading to a complex esthetic situation and a presumably long treatment. The main objective of the four-layer tissue graft technique is to restore an incomplete buccal bone wall as well as increasing the soft tissue volume without the use of any biomaterial in a single procedure.

When a nontreatable tooth is present, meticulous case selection is critical for successful outcomes following immediate implant placement in the esthetic zone. There are many classifications that can aid in this decision making process. All of these classifications assess many anatomical factors such as presence or absence of buccal bone,
thickness of buccal plate, soft tissue thickness and soft tissue recession on the buccal aspect. While most of these classifications assess clinical attachment loss in the buccal area of the socket, none of these mention the possibility of having a socket with clinical attachment loss in the interproximal area, which is common in patients with chronic periodontitis.

It has been described that ≥2 mm of soft tissue thickness is necessary to achieve a pleasant esthetic result and a minimum of 1.5 to 2 mm of buccal bone is critical to help prevent facial bone loss.\textsuperscript{17–19} However, some authors have reported that the thickness of the peri-implant soft tissue is more critical than the bone width in terms of avoiding marginal tissue recession.\textsuperscript{20} The advantage of this technique

\textbf{FIGURE 11} A, Three and half years follow up: facial view. B, Three and half years follow up: periapical radiograph

\textbf{FIGURE 12} (A, B) Three and half years follow up: sagittal view of the CBCT at 3 and half years

\textbf{FIGURE 13} Graphic description of the technique
is that by placing the graft in a vertical direction from buccal to palatal it not only increases the soft tissue volume in the buccal area but also in an occlusal direction. This preserves the height of the interproximal soft tissue, which commonly collapses lingually and apically following tooth extraction due to the presence of interproximal attachment loss. The epithelialized aspect of the graft helps to seal the socket, the connective tissue portion increases the soft tissue volume in the buccal aspect and stabilizes the bone which is the most important portion of the vascular supply, and the autogenous bone replaces the missing buccal plate.

The implant selected had a regular diameter neck following the criteria of leaving a minimum of 3 mm gap between the buccal aspect of the implant and the internal portion of the buccal soft tissue to achieve adequate bone and soft tissue contour.21,22

There are two similar techniques described in the literature. Stimmelmayr described a technique where a connective tissue graft was done simultaneously with an immediate implant leaving a collar of epithelium intact covering the socket.23 While Stimmelmayr’s technique is effective to enhance buccal gingiva, the present technique enhances osseous contour, augments palatal tissue and improves the stability of the interdental papilla by thickening the interproximal mucosa. Another technique has been described by Da Rosa to enhance both hard and soft tissues.24 Despite the fact that this technique is indicated for immediate implant placement with an incomplete buccal plate, it is also indicated for immediate loading. This can become a challenge when there is an incomplete buccal plate and attachment loss.

Although the present technique has led to a good esthetic result, there are, however, some disadvantages. It is a technique sensitive procedure because the preparation of the pouch has the risk of perforation, and the elevation of the interdental tissues can cause rupture of the buccal and palatal flaps. The harvesting of the graft can be technically demanding due to the difficulty in accessing the posterior palate and inadequate visibility. Furthermore, it is essential that the donating area has enough thickness for the graft to be harvested.

5 | CONCLUSION

In summary, this technique has shown favorable results in terms of preservation of the horizontal and vertical soft and hard tissue ridge contours.

Within the limit of the present case reports, the use of the four-layer tissue graft for immediate implant placement can be suggested to improve hard and soft tissues in a single procedure.

CONFLICT OF INTEREST

The authors report no conflicts of interest to declare.

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REFERENCES


**SUPPORTING INFORMATION**

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