Immediate Implant Placement into Extraction Sockets with Labial Plate Dehiscence Defects: A Clinical Case Series

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ABSTRACT

Purpose: To measure the buccal plate reconstruction of extraction sockets with labial plate dehiscence defects using a bone allograft in combination with an absorbable collagen membrane and a custom-healing abutment at the time of tooth removal.

Materials and Methods: Ten patients underwent immediate implant placement and reconstruction of the buccal plate. Cone beam computed tomography (CBCT) was performed preextraction, immediately after bone grafting and implant placement (day 0), and between 6 and 9 months following implant surgery. Measurements were taken at three levels: coronal (L1), middle (L2), and apical (L3) level.

Results: Implants placed into sockets with labial plate dehiscence defects demonstrated radiographic reformation of the labial plate dehiscence defect at 6 to 9 months posttreatment. The net gain in labial plate on cone beam computerized tomography (CBCT) in L1 and L2 was 3.0 mm, where 0 mm existed at pretreatment. The minimum amount of labial plate thickness of 2.0 mm was achieved in all treated sites, evaluated radiographically at 6 to 9 months postoperatively, in a single procedure, without flap elevation and maintaining the gingival architecture and satisfactory esthetics.

Conclusion: Placing an absorbable membrane, bone graft, and custom-healing abutment at the time of flapless anterior tooth extraction and immediate implant placement into a socket with a labial osseous dehiscence is a viable clinical technique to reconstitute the absence of the labial bone plate.

KEY WORDS: alveolar ridge reconstruction, bone defects, bone grafting, clinical study, cone beam computed tomography, guided bone regeneration, immediate implants

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INTRODUCTION

Immediate tooth replacement with endosseous implants into extraction sockets has become a common and consistent clinical procedure by today's standards in regard to implant survival, osseointegration, and esthetics.[1–13] The challenge in treatment is when the labial bone plate presents with a dehiscence type defect stemming from etiologies such as a chronic inflammation from a midfacial vertical fracture affecting the periodontal attachment or severe trauma and chronic infection.

Elian and colleagues described a facial-palatal socket classification where risks could be potentially assessed in regard to potential midfacial recession depending upon the existing socket condition.[14] Type 1 sockets were classified as having the labial bone plate and soft tissues completely intact; Type 2 where the soft tissue was present but a dehiscence bony defect existed, indicating the partial or complete absence of the labial bone plate; and Type 3 where a midfacial recession defect occurred, indicative of loss of the labial bone plate and soft tissues.

Clinical outcomes of Type 1 postextraction socket implants in respect to labial-palatal change have been documented.[2,3,5,7–11,13] To minimize the potential for facial collapse, recommended treatment include bone grafting the space that results from having a dimensional discrepancy between the bony walls of an extraction socket and the body of the implant, commonly described as "gap" as well as graft containment with a custom-healing abutment or full provisional restoration.[11–13,15] In addition, other less conventional clinical procedures, such as the socket shield technique, have been described to retain part of the facial coronal third of the extracted tooth in an effort to maintain the coronal labial bone plate, thereby diminishing collapse.[16]

Lastly, Lee and colleagues published the quantitative outcomes of 14 maxillary incisors treated with an immediate implant following tooth removal with a xenograft in the gap and full provisional restoration.[12] Their findings showed minimal change on average of 0.1 mm reduction in thickness of the labial bone plate on cone beam computed tomography (CBCT) over a 6-month period.

The clinical outcomes of Type 2 socket reconstituted with the "ice cream cone" technique using three different forms of evaluation were published by Tan and colleagues.[17] The outcomes showed a net change in ridge dimension width of 1.32 mm following surgical correction using a bone allograft and collagen barrier membrane. Adequate bone was regenerated 4 to 6 months later to place implants where no labial plate was present prior to this grafting technique.

Noelken and colleagues published survival and PES (pink esthetic score) outcomes of 16 patients with a long-axis root fracture and complete loss of the labial bone plate. Flapless extractions were performed in all patients; immediate implants were placed and buccal gaps were filled with autogenous bone without the use of a barrier membrane. These authors reported 100% implant survival and a mean PES average of 12.5 (range 10.0–14.0).[18]

In addition, da Rosa and colleagues published survival and esthetic outcomes of 18 patients where a technique was described to treat Type 2 sockets with flapless extractions, immediate implant placement, the use of a cortico-cancellous autogenous block graft harvested from the tuberosity, and simultaneous provisional restoration.[19] The autogenous bone was carefully measured and placed in the buccal gap. No barrier membrane was used. The parameter measured was midfacial recession associated with this technique where there was no reported change.[20] Even though the indication of a barrier membrane used to prevent bone remodeling with resorption and enhance incorporation of autologous bone grafts is disputable, little is known about how much gain in labial plate thickness can be achieved with such a clinical procedure, especially without utilizing the concept of guided bone regeneration.[21]

PURPOSE

Therefore, the objective of this paper was to measure the buccal plate reconstruction of extraction sockets with labial plate dehiscence defects (Type 2 sockets) using a bone allograft in combination with an absorbable collagen membrane and a custom-healing abutment at the time of tooth removal. The dimensional change in labial bone plate socket reconstruction and its thickness immediately postsurgery was compared with the posttreatment outcomes following 6 to 9 months healing time using CBCT on 10 consecutive cases.

MATERIALS AND METHODS

Surgical Protocol

Ten patients with maxillary anterior postextraction sockets were treated with immediate implant placement. Implant location and number, implant type, and bone graft material used are listed in Table 1. The study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000. All patients signed an informed consent form. The dehiscence defects were diagnosed clinically and radiographically using a periodontal probe, a periapical film, and CBCT, respectively (Figures 1–3). All treated teeth were deemed hopeless due to midfacial vertical root fracture and loss of the labial osseous plate. The defects were limited to the midfacial aspect only (Type 2) and did not involve the interproximal or palatal bone.

Among the inclusion criteria for implant replacement were: good systemic health of the patient, maxillary anterior teeth (second bicuspid to second bicuspid)

TABLE 1 Implant Location, Implant Manufacturer, and Bone Graft Material Utilized

Implant Location/ Number	Implant Manufacturer	Bone Graft Type/Brand
4	Biohorizons Plus	Allograft/Puros
4	Biohorizons Plus	Allograft/Puros
12	Biohorizons Plus	Allograft/Puros
10	Biohorizons Plus	Allograft/Puros
11	AlphaBio Tec	Allograft/Puros
12	Biohorizons Plus	Allograft/Puros
5	Biohorizons Plus	Allograft/Puros
8	AlphaBio Tec	Allograft/Puros
11	AlphaBio Tec	Allograft/Puros
6	Biohorizons Plus	Allograft/Puros

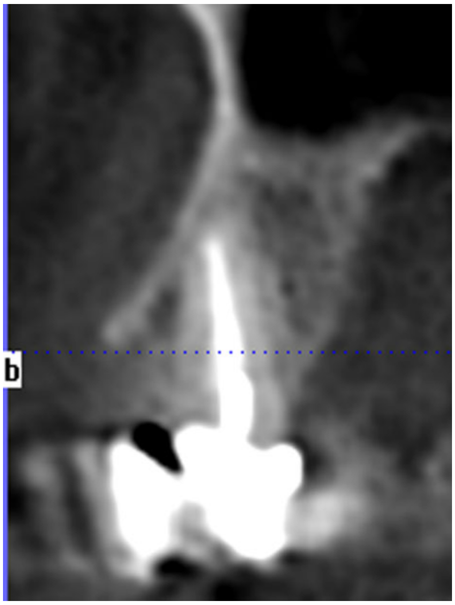

Figure 2 Preoperative CBCTs were taken on all patients to assess the extent of the defect prior to treatment. In this particular situation, the middle one-third of the labial plate was absent. B = buccal.

affected by fracture, endodontic lesions that affected the integrity of the facial plate (dehiscence or absence), no periodontal disease or gingival recession, and the presence of adjacent teeth. Exclusion criteria were general medical or psychiatric contraindications, pregnancy, patients with local or generalized healing limitations, diabetes, smoking, Type III extraction sockets, bruxism or other destructive parafunctional habits, compromised soft tissue conditions at the surgical or control site, and poor patient compliance.

The surgical treatment protocol entailed atraumatic tooth removal *without* flap elevation, thereby maintaining the periosteal blood supply to the interproximal and residual labial bone plate. Sharp dissection of the supracrestal fibers was performed with a 15c scalpel blade prior to tooth extraction. The residual socket was

Figure 1 Clinically, midfacial dehiscence boney defects were diagnosed using a periodontal probe and sounding to the apex of the lesion.

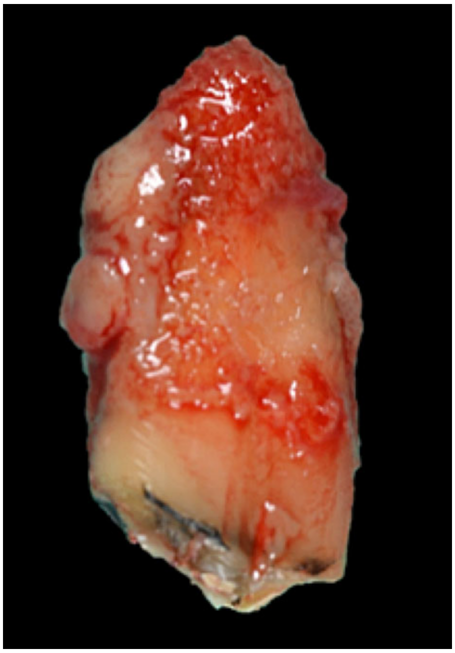

Figure 3 The clinical presentation of extracted tooth #4 in Figure 2 that had a vertical root fracture with the associated buccal lesion causing a dehiscence defect of the labial bone plate.

debrided thoroughly and a detailed clinical examination was performed to assess the labial bone plate deficiency to ensure adequate interproximal bone levels. An osteotomy was made with a palatal bias for the placement of the implant. Palatal implant placement in anterior extraction sockets commonly results in avoiding the dehiscence of the labial plate, allowing sufficient running room for prosthetic components and a lack of facial bone implant contact referred to as the "buccal gap" (Figure 4A). In the present study, where the facial plate of bone was missing or deficient, the palatal placement was intended to allow for (1) adequate space (gap) so that guided bone regeneration procedures could be performed, and (2) the facial plate to be adequately regenerated.

Tapered platform switched internal connection implants (Biohorizons Plus, Birmingham, AL, USA; AlphaBio Tec, Petah Tikva, Israel) at the implant shoulder were placed no less than 3.0 mm and no greater than 4.0 mm apical to the facial free gingival margin (FGM). Primary stability was obtained from the implant macro-thread design either at the apical third or proximal walls of the extraction socket, and confirmed with hand-torque (minimum of 35 Ncm) to facilitate immediate custom-healing abutments (Figure 4B).

Screw-retained customized healing abutments were fabricated using polyether-ether-ketone (PEEK) internal-hexed connection temporary cylinders (Biohorizons Plus) or titanium temporary cylinders (AlphaBio Tec), preformed submergence profile root-form shells (SDNY Dental Lab, NY, NY), and autopolymerizing acrylic resin (Super-T, American Consolidated, Solon, OH, USA). The customized healing abutments possessed the subgingival contours that conform to the preextraction state of the tooth root cervix to support the soft-tissue submergence profile and help protect the blood clot and contain the bone graft particles.[22] An absorbable collagen membrane (Biomend Extend, Zimmer Dental, Carlsbad, CA, USA) was trimmed and contoured conforming to the size and shape of the labial bone deficiency previously assessed (Figure 5, A and B). The membrane was placed against the internal surface of the residual labial socket wall and the gap was filled with small particle bone allograft (Puros Cortico-Cancellous particles, 250–1000 microns, Zimmer Dental) at the time of implant placement (Figure 6, A and B). Once this was accomplished, the customized healing abutments were steam cleaned or disinfected and inserted using hand torque, and adequate support of the soft tissues and gingival architecture was ensured immediately postoperatively (Figure 7).[23]

Patients were placed on postsurgical antibiotic therapy and an analgesic as needed, and seen 7 to 14 days postoperatively for follow-up.

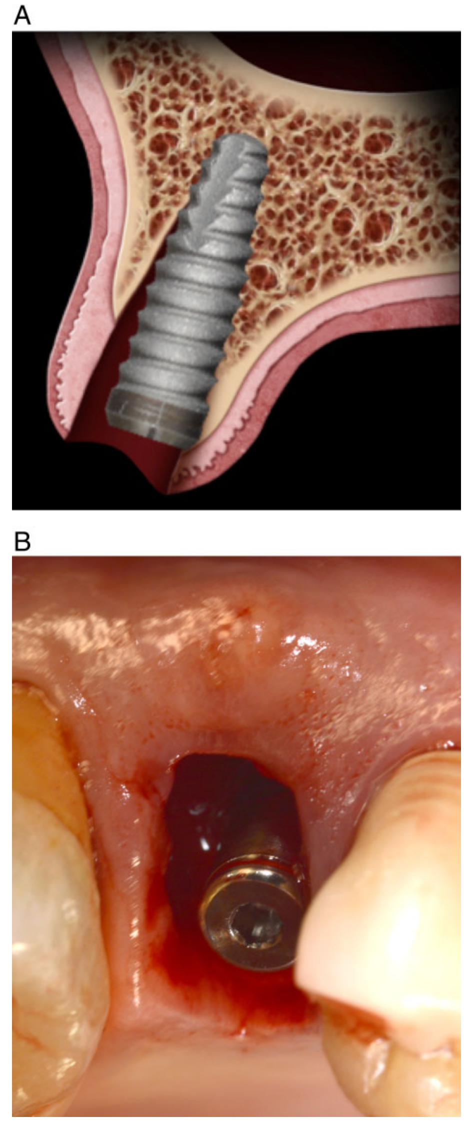

Figure 4 *A*, Diagramatic representation of implant placement. Anterior extraction socket implants were stabilized by engaged the apical palatal bone beyond the extraction socket. The lateral proximal walls of the socket were used for bicuspids. *B*, For premolar sites, implants were placed after proper socket debridement and primary stability was achieved using wider diameter platform-switched implants that engaged the proximal walls. All implants attained a minimum insertion torque value of 35 Ncm.

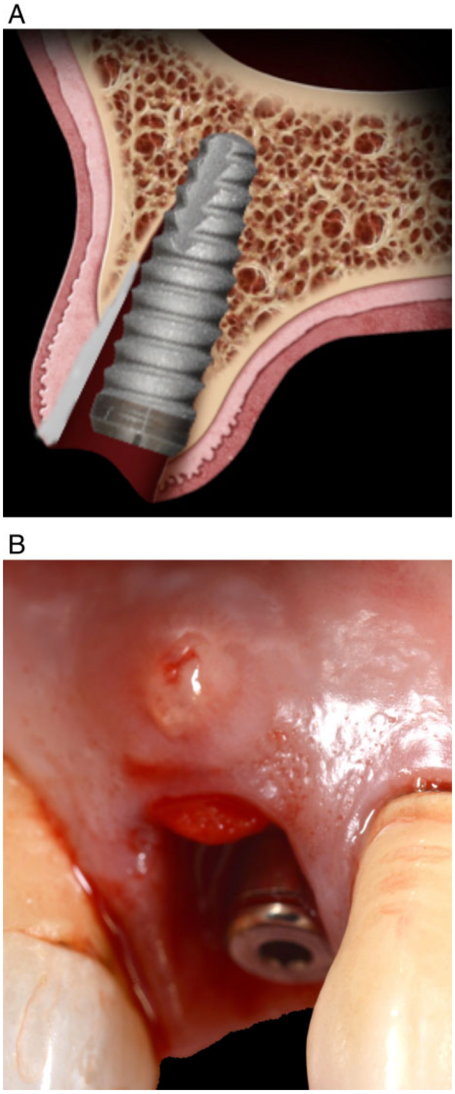

Figure 5 *A*, Diagrammatically, the collagen membrane was placed palatal to the buccal wall of the extraction socket yet labial to the implant up to the level of the free gingival margin. *B*, The collagen membrane is shaped to extend beyond the lateral walls of the defect and is subsequently placed into the socket to the level of the free gingival margin. Only the "cone" part of the "ice cream cone" membrane is used.

CBCT Measurement

CBCT was performed preextraction (Figure 2), immediately after implant placement and bone grafting (Day 0) (Figure 8), and between 6 and 9 months postsurgery healing (Figure 13). The custom-contoured two-piece healing abutments remained in place for a minimum of 6 months observation period to eliminate any potential effect of abutment disconnection/reconnection on hard and soft tissue levels (Figure 9). Measurements were taken at three levels as described by Lee and colleagues[12]: L1 = coronal level, L2 = middle level, and L3 = apical level at the time of implant placement and at 6 to 9 months posttreatment. The coronal level corresponds to the implant head; the middle level corresponds to the implant half-length, as where the apical level is at the implant tip. At each level, two reference points were identified: the most labial point of reconstructed bone and the bone to implant contact point (Figure 10). A straight line connected the points. The distance between the two points at each level was measured and the labial bone thickness dimension recorded. Note each measuring line to be perpendicular to the implant body.

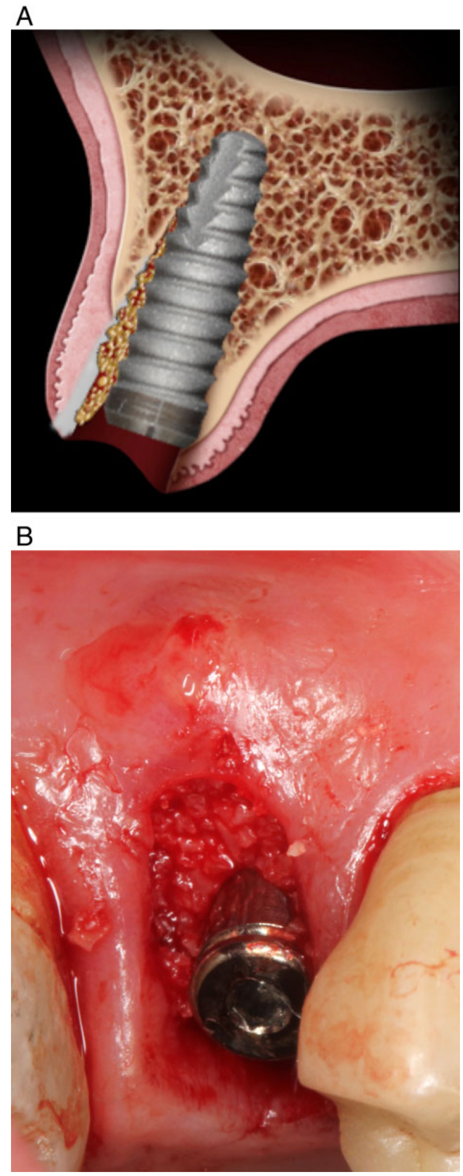

Figure 6 *A*, The bone graft was placed between the labial aspect of the implant and palatal to the collagen membrane. *B*, Clinically, the bone graft is packed and placed to the level of the free gingival margin between the membrane and implant. A healing abutment is placed to prevent bone graft material from migrating into the implant abutment connection.

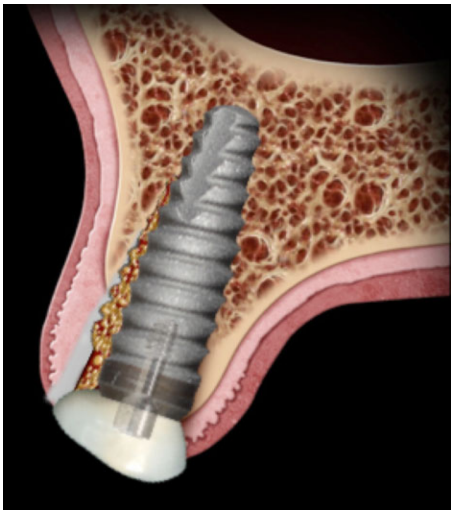

Figure 7 A custom two-piece healing abutment or full provisional restoration in nonfunctional occlusion was placed to contain and protect the bone graft material and absorbable membrane during the 6 to 8 months healing phase or treatment.

A minimum of 6 to 9 months healing time was given before the first removal (disconnection) of the custom-healing abutment (Figure 11). Waiting a minimum of 6 months ensured the presence of an average 40% of woven bone formation within the extraction site with the potential presence of areas of lamellar bone as described by Trombelli and colleagues.[25]

Provisional restorations were made to replace the custom-healing abutments. Implant-level transfer

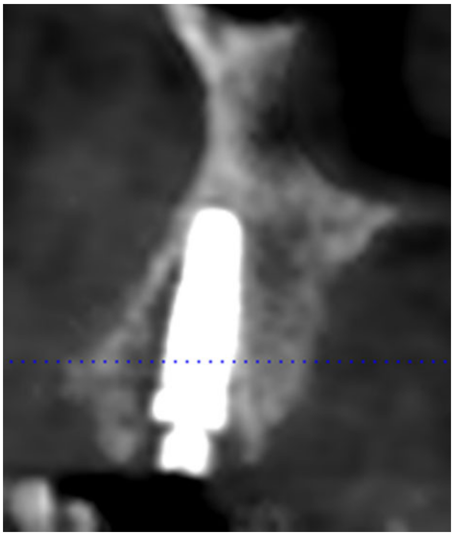

Figure 8 Immediate posttreatment CBCT showing the bone graft in place contained by the collagen membrane. The range and mean values for L1 to L3 are reported in Table 2.

Figure 9 A custom-healing two-piece abutment in place, which was allowed for 6 to 8 months posthealing before first disconnection.

copings were attached to an open-tray impression, and GC pattern resin (GC America, Alsip, IL, USA) was used to capture the subgingival soft-tissue contour and profile. Implant level impressions were made with a monophase impression material (Flexitime, Heraeus, Hanau, Germany). The dental laboratory fabricated a soft-tissue cast (G-Mask, GC America) that allowed a screw-retained or cement-retained noble metal alloy abutment or one-piece frame to be constructed, respectively. Custom abutment and ceramo-metal or all-ceramic crowns were fabricated and delivered

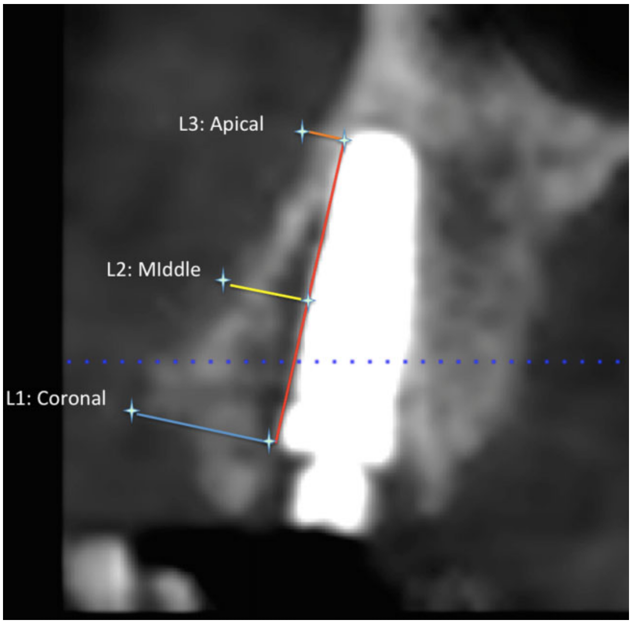

Figure 10 CBCT showing L1, L2, and L3, the respective reference points and the lines connecting the points providing the measurements.

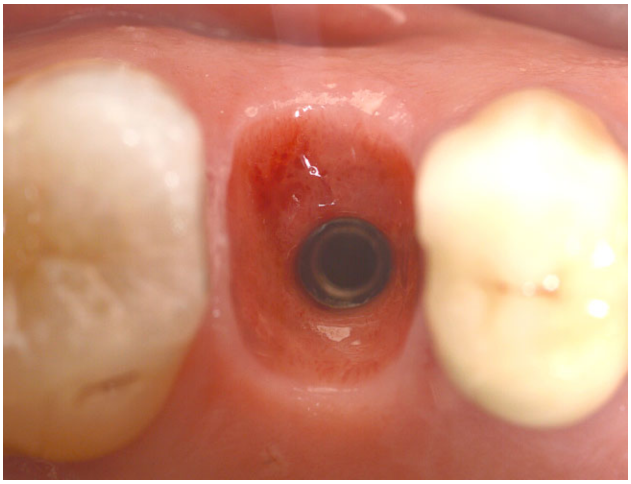

Figure 11 First disconnection of the healing abutment tooth #4 shows anatomic shape of the socket and buccal ridge maintenance.

approximately 2 to 3 months after the final impression. The definitive crowns were either cement-retained with temporary cement (TempBond NE, Kerr, Orange, CA, USA) or screw-retained and torqued to the manufacturer's recommendation (Figures 12 and 13). The minimum number of abutment disconnections after final impression taking was three (metal frame try-in, crown try-in/shade check, and time of crown delivery).

After definitive restoration delivery, patients were placed on maintenance/follow-up recall visits.

Changes in labial plate thickness were monitored from immediate posttreatment and 6 to 9 months CBCTs along the implant surface at all three levels and measured in mm (Figure 14).

Figure 12 Occlusal-buccal view of the definitive screw-retained crown for tooth #4.

Figure 13 Facial view of the definitive screw-retained crown for tooth #4.

RESULTS

The results of 10 consecutive case series are reported in Table 2. There was a 100% survival rate of all implants placed. In all patients, the coronal one-third of the labial bone plate was absent at the time of treatment. Seventy percent of the patients possessed a socket where two-thirds of the labial bone plate were absent at the time of tooth removal. One hundred percent of the patients had a preoperative measurement of 0 mm at L1; 70% had a pretreatment L2 measurement of 0 mm.

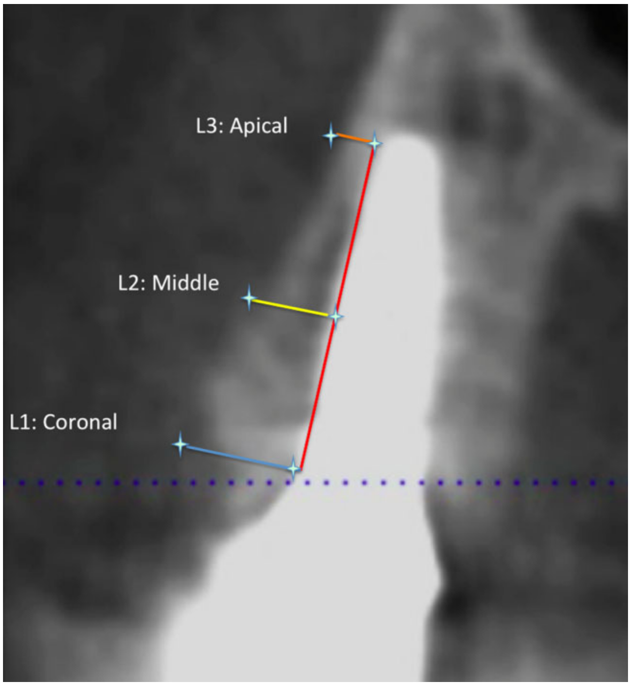

Figure 14 Six to nine months posthealing, CBCT shows radiographic reestablishment of the buccal bone plate and the corresponding measurements.

TABLE 2 Preoperative, Postoperative, and Day of Insertion of Definitive Restoration Range and Mean Values in mm, Respectively

	Preoperatory (mm)	Postoperatory (mm)	Day of Insertion (mm)
Coronal	Range: 0	Range: 2.8–4.3	Range: 2.2–3.6
(L-1)	Mean: 0	Mean: 3.69	Mean: 3
Medial	Range: 0–3	Range: 1.8–4	Range: 1.8–3.4
(L-2)	Mean: 0.75	Mean: 3.23	Mean: 2.82
Apical	Range: 1–3	Range: 1–3	Range: 1–2.2
(L-3)	Mean: 1.8	Mean: 1.78	Mean: 1.74

The reconstitution mean value of the graft thickness immediate posttreatment at L1 was 3.7 mm for the 10 patients with a range of 2.8 to 4.3 mm. The mean thickness in the buccal plate at 6 to 9 months CBCT was 3.0 mm at L1 with a range of 2.2 to 3.6 mm. The mean net change in thickness at L1 was –0.7 mm with a range of –0.2 to –1.0 mm.

In 70% of the patients where the buccal plate was absent to the apical one-third, the immediate posttreatment graft thickness at L2 was 3.6 mm with a range of 3.0 to 4.0 mm. The mean thickness in buccal plate at 6 to 9 months CBCT was 3.0 mm at L2 with a range of 2.7 to 3.4 mm. The mean net change in thickness at L2 was –0.6 mm with a range of 0.0 to 1.0 mm.

All patients had the apical one-third of the labial bone plate intact at pretreatment with a mean width of 1.7 mm. This dimension change was within a range of 0 to 0.3 mm over the 6 to 9 months posttreatment healing period.

DISCUSSION

The treatment protocol outlined in this study combines the knowledge from what is known about socket preservation techniques as well as the treatment of Type 1 sockets with immediate implant placement and grafting, and provisional restoration. Several authors have shown that a xenograft particulate material placed into the buccal gap minimizes the amount of ridge collapse.[12,15]

However, no one has classified defect types nor measured and quantified the gain of the labial plate thickness on cone beam computerized tomography.

This consecutive case series of 10 patients with a Type 2 extraction socket demonstrates that placing a bone graft, absorbable membrane, and custom-healing abutment at the time of immediate postextraction implant placement results in radiographic reformation of the labial plate dehiscence defect at 6 to 9 months posttreatment. The net gain in labial plate on CBCT in L1 and L2 was 3.0 mm, where 0 mm existed at pretreatment.

The amount of graft remodeling that occurred during the 6 to 9 months healing phase was 0.7 and 0.6 mm for L1 and L2, respectively.

Insignificant change was recorded at the unaffected apical portion of the labial bone plate (L3) on all patients.

In socket preservation techniques where implant placement is delayed, the amount of ridge contour change reported is almost twice that found in this study on CBCT (1.32 mm vs 0.65 mm, respectively). The hypothesis is that the geometry and architecture of the ridge are preserved due to the containment of the bone graft material offered by the custom-healing abutment. This in turn allows for protection and stability of the bone graft material during the 6 to 9 months healing and remineralization phase.

It is interesting to note that with a minimally invasive surgical technique (no flap elevation), the noncompromised intact apical third of all sockets underwent insignificant remodeling on CBCT.

The minimum amount of labial plate thickness of 2.0 mm was achieved in all treated sites as reported in the literature for implant stability and esthetics.[24]

Several factors can influence the amount of labial plate thickness reconstruction such as the amount of labial plate loss, preoperative soft tissue inflammation, and periodontal phenotype.

Limitations of the present study include the relatively low number of patients as well as the finite 6 to 9 months CBCT follow-up.

Further research is required to assess the long-term stability of reconstructed labial plates of Type 2 sockets on CBCT with a larger number of patients. In addition, the histologic evaluation of the reconstructed buccal plate would be of paramount importance, as this would provide both qualitative and quantitative data on the type of tissues regenerated.

CONCLUSIONS

Placing an absorbable membrane, bone graft, and custom-healing abutment at the time of flapless anterior tooth extraction and immediate implant placement into a Type 2 socket can reconstitute the absence of the labial bone plate maintaining the gingival architecture with satisfactory esthetics. The mean gain in labial plate thickness on CBCT was 3.0 mm, where 0 mm was present at the time of tooth removal.

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