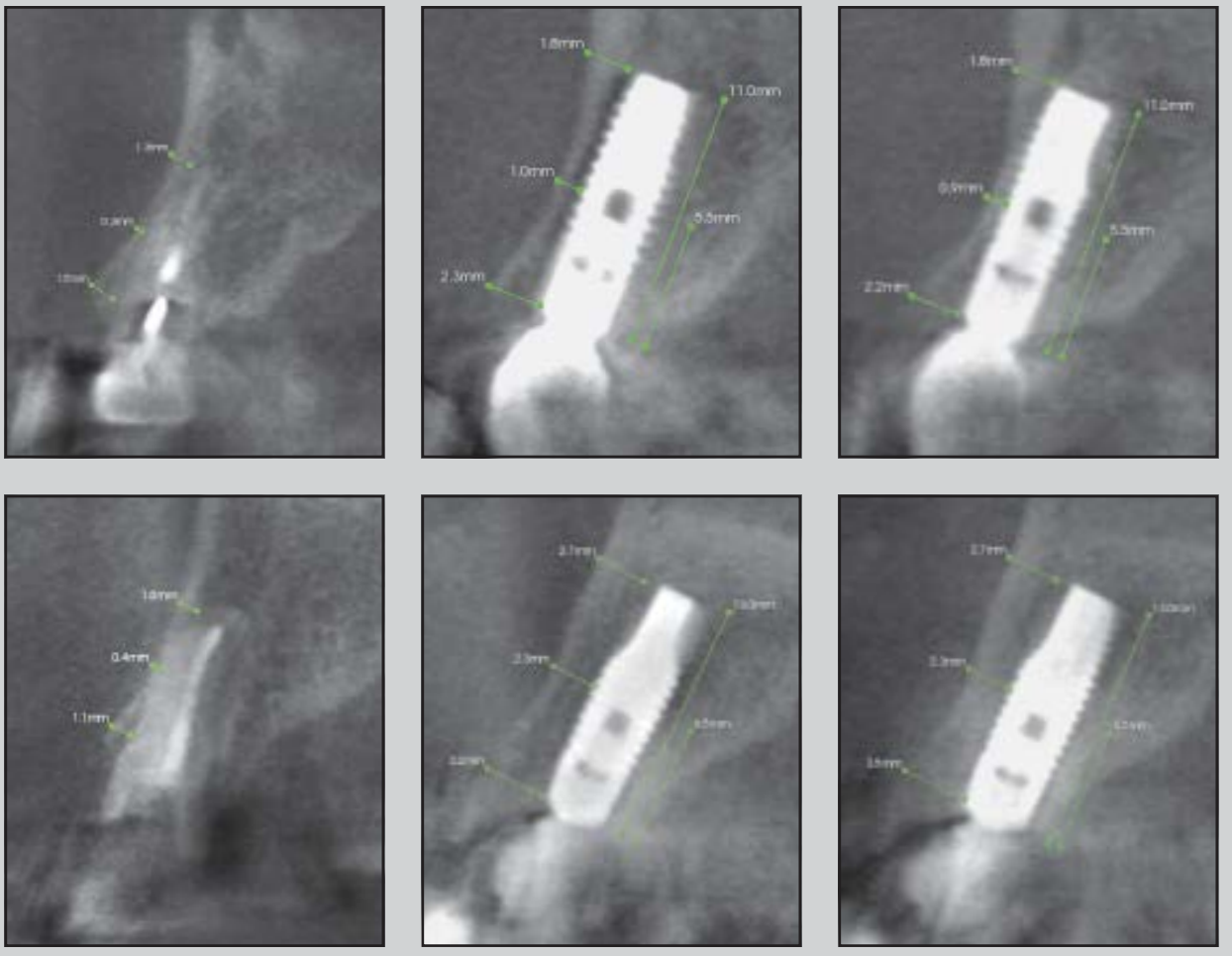

Lingualized Flapless Implant Placement into Fresh Extraction Sockets Preserves Buccal Alveolar Bone: A Cone Beam Computed Tomography Study

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The use of immediate placement and loading protocols in implant dentistry has increased during the past several years. However, limited information related to the response of the osseous architecture has been reported. The purpose of this study was to evaluate the fate of the buccal alveolar plate with cone beam computed tomography (CBCT) following lingualized placement of implants into fresh extraction sockets using a flapless surgical approach and immediate nonocclusal loading. A total of 14 patients who required extraction of a single maxillary incisor were selected for this study. CBCT was performed preextraction, at the time of implant placement, and 6 months following implant surgery. The results of this study indicate that resorption of the buccal alveolar plate was not significant. It was therefore concluded that with strict patient selection and appropriate technique, predictable healing can be achieved with lingualized implant placement into fresh extraction sockets and immediate loading. (Int J Periodontics Restorative Dent 2014;34:61–68. doi: 10.11607/prd.1807)

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Postextraction alveolar ridge alterations have been described by Pietrokovski and Massler, Johnson, and Richardson.[1–3] More recent studies have reported a substantial reduction in bone volume following tooth extraction that resulted in a loss of up to 50% of the height of the labial plate.[4–6] Furthermore, it has been reported that implant placement into fresh extraction sockets did not prevent alveolar bone remodeling and resorption of the buccal plate.[7–9] It is important to note, however, that these studies included flap reflection and placement of the implant in the three-dimensional center of the socket, which may have impinged upon the buccal alveolar plate.

These results contradict favorable esthetic outcomes reported in humans by Wöhrle and Kan and Rungcharassaeng.[10,11] Flapless placement of implants into fresh extraction sockets followed by immediate provisionalization has been advocated as an alternative to enhance gingival margin stability, particularly in the midfacial aspect.[12–14] This approach has been increasingly performed by clinicians

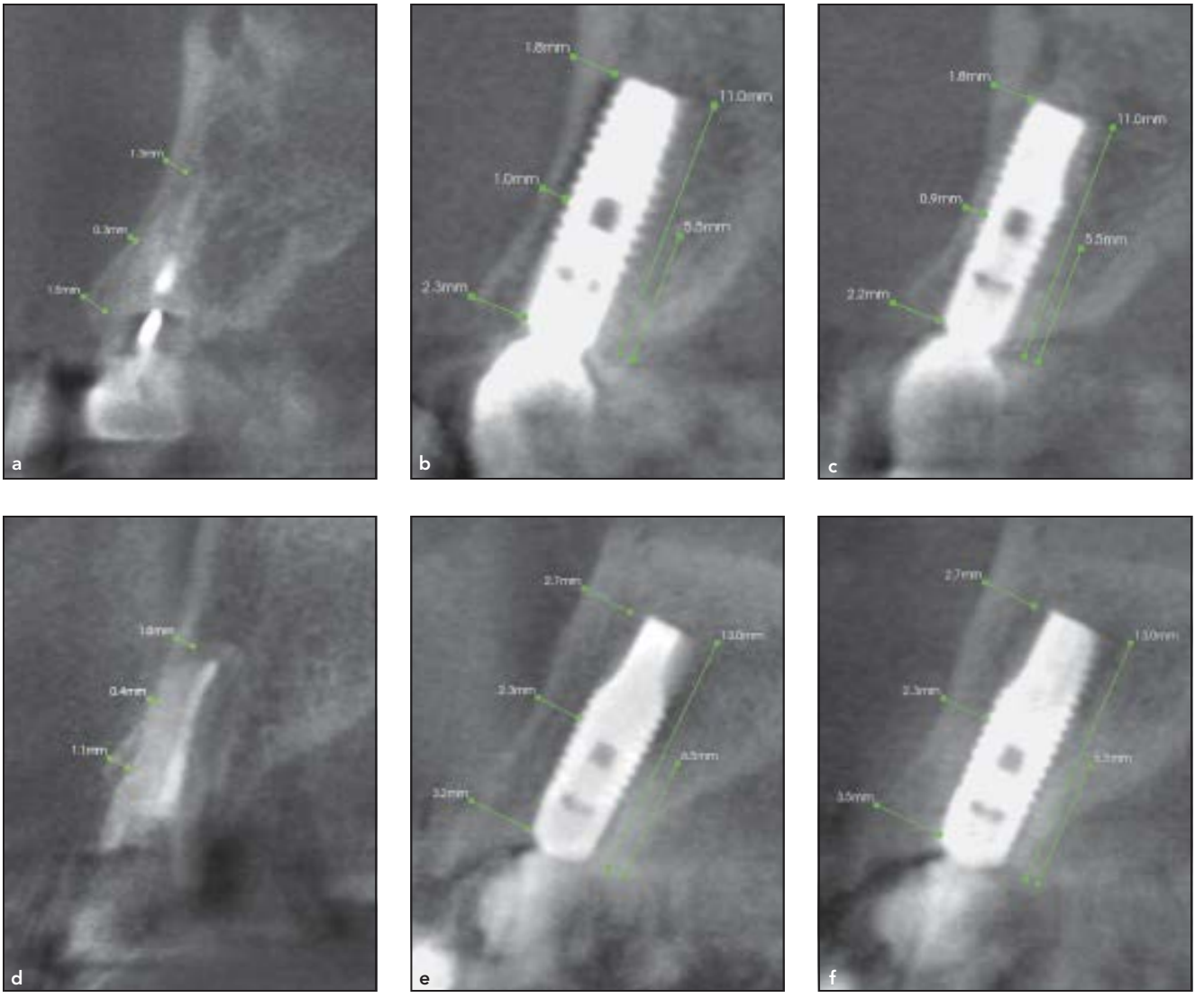

Fig 1 *CBCT scans were taken preoperatively* (a and d), *at the time of implant placement* (b and e), *and 6 months following implant placement* (c and f). *Measurements were taken at three levels: L1 = coronal level, L2 = midfacial level, L3 = apical level.*

in everyday practice since it appears to yield enhanced esthetic results.[15,16]

Despite the various advantages reported in the literature, questions regarding the stability of the buccal alveolar bone and periimplant tissue have kept this technique controversial.[17–19] Hence, the objective of this prospective study was to evaluate the fate of the buccal alveolar plate with cone beam computed tomography (CBCT) following lingualized placement of implants into fresh extraction sockets using a flapless surgical approach and immediate nonocclusal loading (Fig 1).

Method and materials

This study was approved by the University of Pennsylvania Institutional Review Board. Patients who required the extraction of a single maxillary incisor were selected. These teeth had been diagnosed as hopeless due to fracture, endodontic failure, and/or inadequate

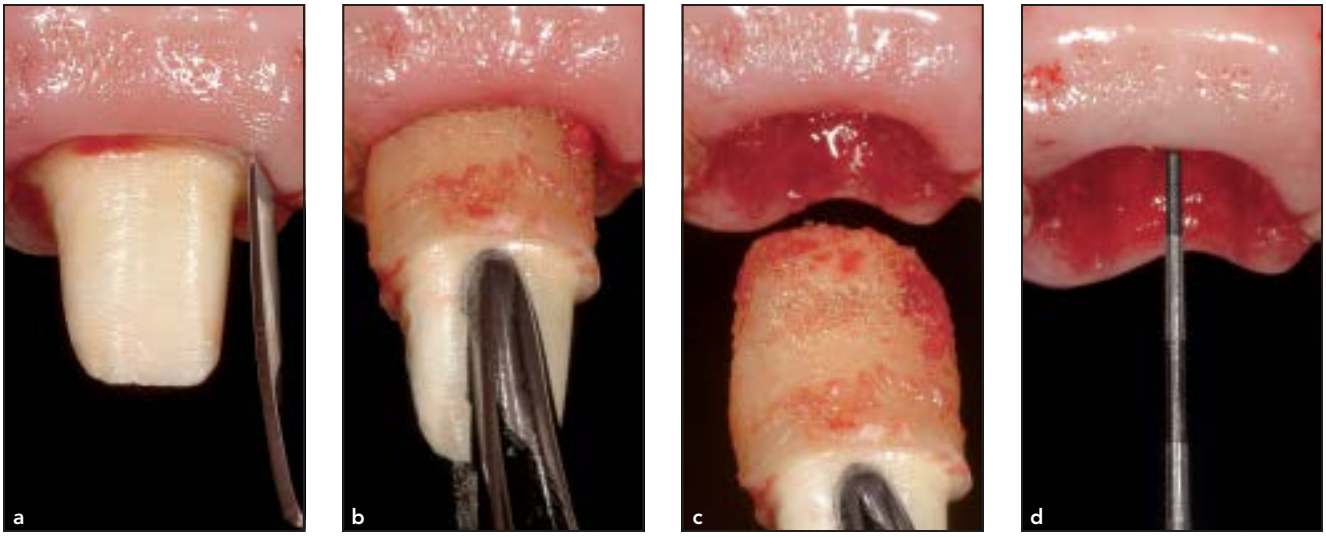

Fig 2 *Teeth were removed while minimizing trauma to preserve the integrity of the alveolar bone and gingiva. The presence of an intact socket is verified prior to implant placement.*

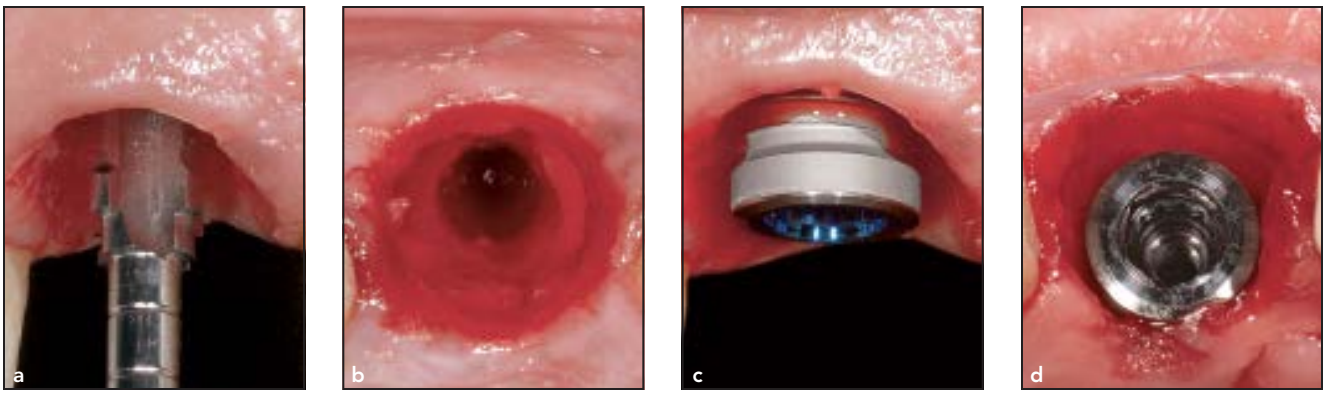

Fig 3 *Preparation of the implant site is performed using a flapless approach. The osteotomy is drilled toward the lingual plate, preventing any contact with the buccal plate.*

tooth structure. Among the inclusion criteria were an intact healthy periodontium, absence of dehiscences or periapical lesions, intact extraction socket, and the presence of adjacent teeth. Exclusion criteria included smoking, diabetes, bisphosphonate therapy, and the presence of parafunctional habits or inadequate interocclusal space. Tooth extraction was performed without flap elevation and as atraumatically as possible. Precautions were taken to avoid damage to the alveolar crest and gingival tissues (Fig 2). Following tooth removal, a detailed clinical examination was performed to confirm the integrity of the alveolus. The presence of any fractures, perforations, or dehiscences on the buccal alveolar plate resulted in the patient being excluded from the study.

The osteotomy preparation was subsequently initiated without raising a flap, using a precision drill to ensure appropriate placement on the lingual wall of the socket (Fig 3). A modified drilling sequence was implemented to

Fig 4 *Lingualized implant placement resulted in a gap between the internal aspect of the labial alveolar plate and the surface of the implant. The gap was subsequently grafted.*

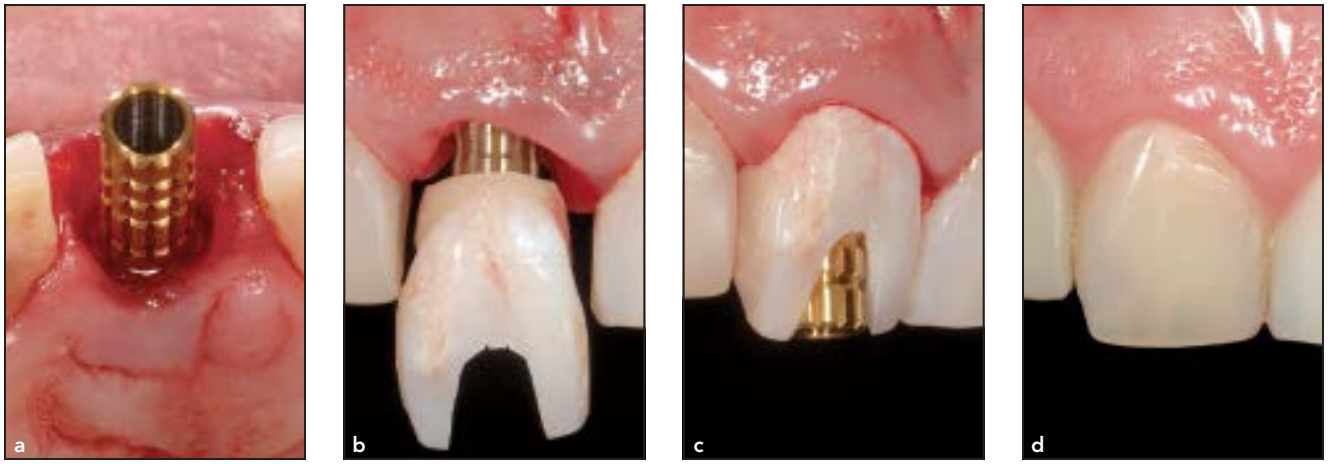

Fig 5 *A provisional restoration is placed out of occlusal contact. Maintenance of soft tissue profiles can be observed at the 3-month follow-up.*

ensure a minimum insertion torque of 45 Ncm.[10,11,20] Dental implants incorporating a platform-switching design were placed to a level 1 mm apical to the buccal alveolar crest and with a lingual orientation. This resulted in a gap between the internal surface of the labial socket wall and the implant surface (Fig 4). This gap was filled with a bovine-derived particulate grafting material (Bio-Oss, Geistlich).

A provisional restoration was placed immediately with customized contours designed to support the preexisting gingival tissues, using previously reported techniques (Fig 5).[10,21] Precautions were taken to ensure the absence of centric and eccentric occlusal contacts. Follow-up postoperative visits occurred at 1-week, 1-month, 3-month, and 6-month intervals. All implants were subsequently restored with a screw-retained or cemented single crown (Fig 6).

CBCT was performed preextraction, at the time of implant placement (day 0), and 6 months following implant surgery. The provisional restorations remained in place during the entire 6-month observation period to eliminate any potential effect of abutment disconnection/reconnection on bone levels. Radiographic stents incorporating metallic markers were used to identify the cross sections selected for measurement and sequential comparison. Anatomical landmarks were also used to align and overlay the CBCT scans. Preoperative measurements of the distance from the external surface of the buccal alveolar plate to the

Fig 6 *Completed implant restoration demonstrates maintenance of the gingival margin level and buccal soft tissue profile 17 months following immediate implant placement and provisionalization.*

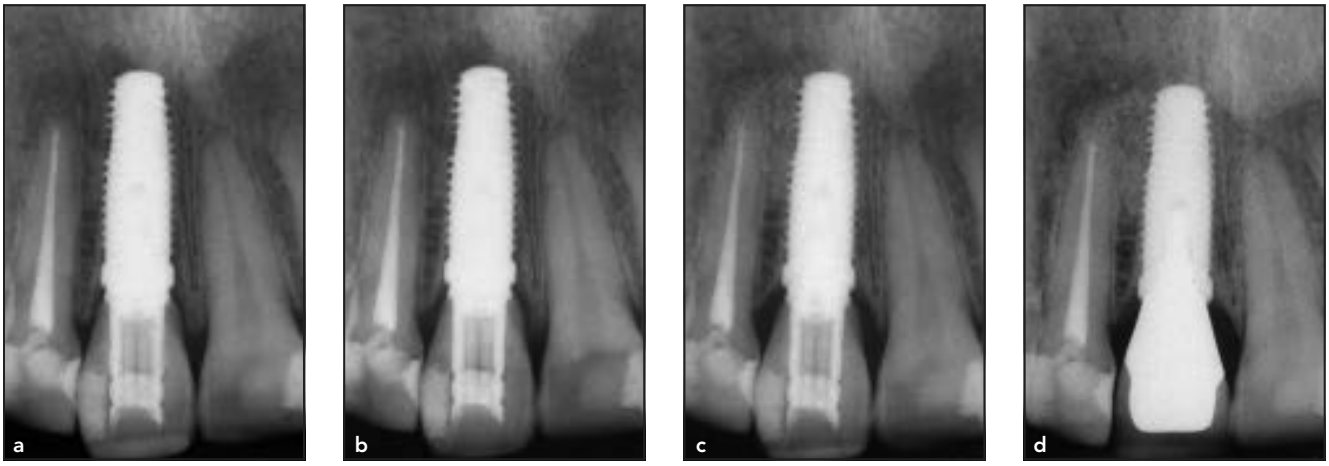

Fig 7 *Sequential radiographic monitoring from the day of implant placement* (a) *demonstrates remodeling to accommodate biologic width and maintenance of crestal bone levels after 17 months* (d).

buccal surface of the root were taken at coronal (L1), middle (L2), and apical (L3) points. The same measurements were taken from the external surface of the buccal alveolar plate to the surface of the implant at the time of implant placement and at 6 months (Fig 1). Crestal bone changes along the implant surface were measured as percent change and converted to millimeters. This was accomplished with a simple formula and the known implant length. Means and SDs were calculated for all radiographic assessments.

Results

A total of 14 patients were included in this case series. The healing in all cases was uneventful, and implants were clinically stable throughout the duration of the study (Fig 7). The overall mean and SD distance

Table 1 Distance between the external surface of the labial plate and the labial surface of the root

	Preextraction (mm)
L1	1.02 ± 0.41
L2	0.36 ± 0.09
L3	1.28 ± 0.67
Overall	0.89 ± 0.58

L1 = coronal level; L2 = midfacial level; L3 = apical level based on overlay of day 0 CBCT scan.

Table 2 Distance between the external surface of the labial plate and the labial surface of the implant

	Day 0 (mm)	6 mo (mm)	Change (mm)
L1	2.15 ± 0.55	2.08 ± 0.57	0.12 ± 0.22
L2	1.50 ± 0.54	1.41 ± 0.60	0.06 ± 0.14
L3	2.01 ± 1.98	1.91 ± 0.79	0.11 ± 0.15
Overall	1.82 ± 0.81	1.76 ± 0.78	0.08 ± 0.20

L1 = coronal level; L2 = midfacial level; L3 = apical level.

from the tooth to the labial plate in the preextraction CBCT scan was 0.89 ± 0.58 mm. The measurements at L1, L2, and L3 were 1.02 ± 0.41 mm, 0.36 ± 0.09 mm, and 1.28 ± 0.58 mm, respectively (Table 1). The distance between the external surface of the labial plate and the labial surface of the implant were measured at day 0 and at 6 months for L1, L2, and L3 (Table 2). The overall change in buccal plate thickness from day 0 to 6 months was also calculated (Table 2). These results indicate that the alterations in buccal alveolar plate width were negligible after 6 months of follow-up.

Discussion

In this study, placement of the implants in a lingual position resulted in the presence of a gap between the buccal implant surface and the internal surface of the buccal alveolar wall. At the 6-month follow-up, this gap was filled with bone and complete radiographic healing was noted. Postextraction ridge alterations in humans were initially described by several authors.[1,2,4] It should be noted, however, that none of these studies correlate surgical trauma to the degree of bone resorption. Several studies have documented a reduction of up to 50% of buccal plate height following the healing of extraction sites in the dog model.[4,5] A theory was proposed, whereby tearing of periodontal ligament fibers that inserted into the alveolar walls during extraction was responsible for the loss of buccal plate height. The layer of bone into which the fibers insert has been described as "bundle bone."[6] Subsequent experiments also demonstrated that immediate implant placement failed to prevent bone resorption of the buccal aspect of the ridge.[7–9] However, these canine model experiments featured flap elevation and implants positioned in the three-dimensional center of the socket, which may very well have impinged on the buccal alveolar plate. Additionally, these studies are in contradiction with favorable esthetic outcomes and periimplant soft tissue stability reported by Wöhrle and Kan and Rungcharassaeng.[10,11] Immediate implant placement with immediate provisionalization has been increasingly adopted by clinicians since the maintenance of bone architecture and soft tissue stability that results from this technique appears to significantly enhance esthetic outcomes.[12–16] The maintenance of the soft tissue in these cases is clearly related to the supporting bone. Questions remain, however, with regard to the stability of the buccal bone and periimplant soft tissues.[17,18]

In the study subjects, the data clearly demonstrated preservation of the buccal alveolar bone thickness up to a 6-month period following the clinical protocol used. Potential reasons for preservation of the buccal alveolar bone include the use of a flapless technique, which may limit extra-alveolar resorption by avoiding elevation of the periosteum and exposure of

the buccal plate.[22–24] Additionally, the placement of implants in a lingualized position resulted in a gap between the internal aspect of the buccal alveolar wall and the labial implant surface. Lingualized implant placement may thus avoid surgical trauma and impingment of the internal aspect of the buccal plate, therefore limiting intra-alveolar resorption. More recently, Caneva and co-workers confirmed these results in a dog model, where they demonstrated the preservation of the buccal alveolar plate in experimental sites where implants were placed in a lingual position compared to substantial buccal plate resorption in control sites where implants were placed in the three-dimensional center of the alveolus.[21] These facts call into question the validity of the so-called bundle bone theory as a model to explain postextraction alveolar remodeling.[6] Interestingly, a trend toward increased remodeling was observed in areas of thin bone. These include patients with a thin buccal plate and those with a midfacial (L2) concavity. It is possible that these areas were more susceptible to trauma from the extraction because of their reduced bone volume. Lastly, a bovine-derived xenograft was used to fill the implant/alveolar gap. The CBCT scans revealed, however, that placement of this material was limited to the coronal aspect of the gap, and it may have therefore not played a role in preserving buccal alveolar thickness beyond this point.[25,26] This may be of significance at the midfacial level (L2), where a constriction in the width of the buccal alveolar plate is often observed.[27] The ability to fill the gap with a xenograft may prevent the development of buccal plate dehiscences and exposure of the implant surface, therefore contributing to the stability of the peri-implant soft tissues.[28] Although immediate temporization is required for the maintenance of peri-implant gingival margin levels, its role in the preservation of the buccal alveolar plate remains unclear. It should be noted, however, that in the present study the provisional restorations were not removed through the entire 6-month observation period in an effort to avoid the potential effects of abutment reconnection.

Conclusion

The results of this study indicate that the buccal alveolar plate did not exhibit significant resorption. Essential requirements to achieve this outcome include the presence of an intact periodontium, integrity of the buccal alveolar bone following extraction, flapless surgical approach, lingualized placement of a platform-switching implant, adequate primary stability, and grafting using a bovine-derived bone substitute. Within the limitations of this study, it may be stated that in the presence of these requirements, implants placed into fresh extraction sockets followed by immediate provisionalization yield predictable esthetic outcomes, buccal alveolar bone maintenance, and stable peri-implant tissues.

Acknowledgment

The authors reported no conflicts of interest related to this study.

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