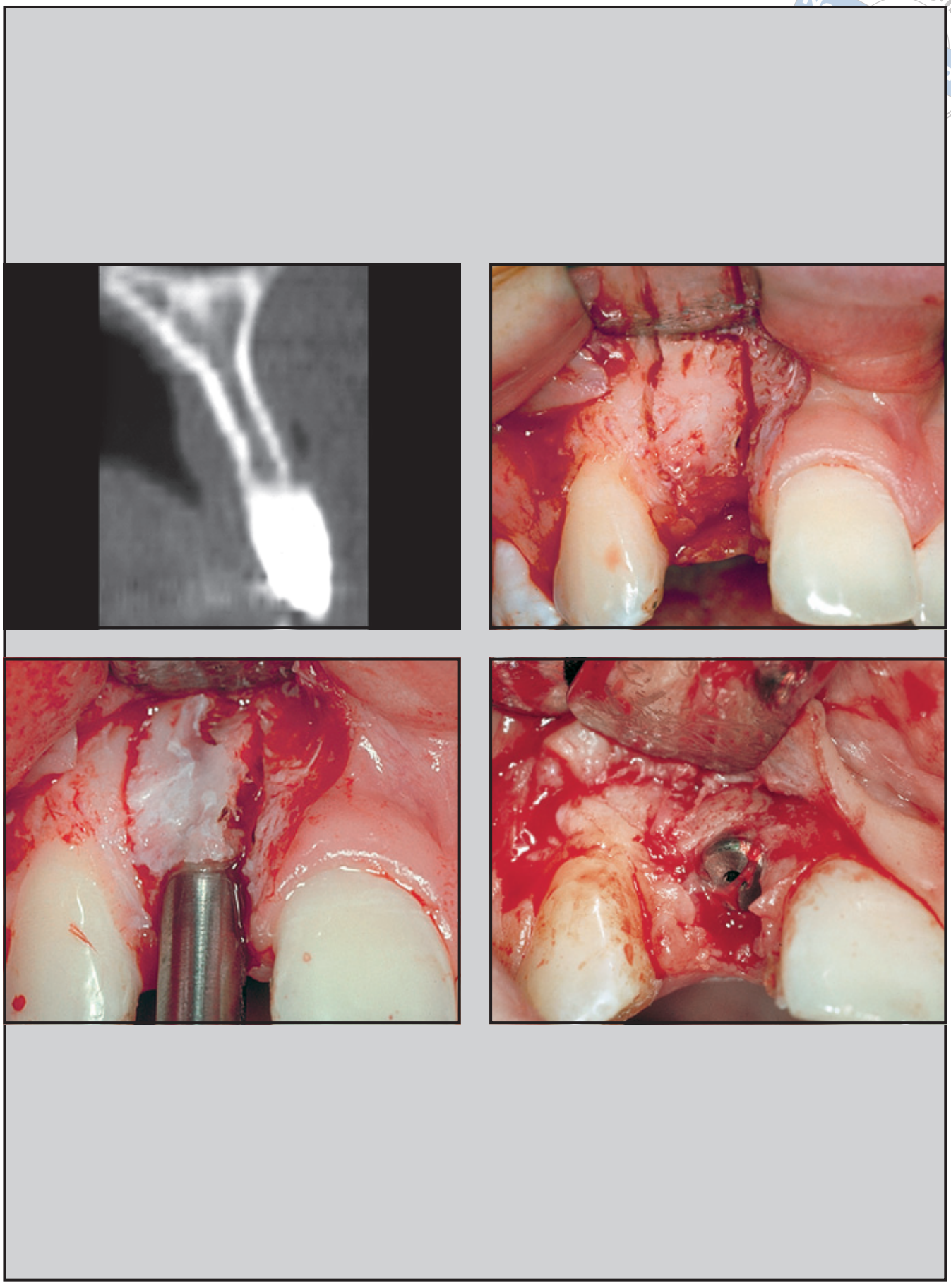
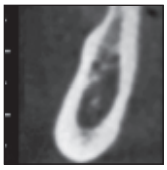


Planned Labial Plate Advancement with Simultaneous Single Implant Placement for Narrow Anterior Ridges Followed by Reentry Confirmation



*Burton Langer, DMD**
*Laureen Langer, DDS**
*Richard M. Sullivan, DDS*****

This article reports on the efficacy of a technique involving expansion of edentulous ridges of less than 3 mm in width by means of a planned green stick fracture of the labial plate and simultaneous implant placement without the need for membranes. This retrospective case series includes long-term results from 21 patients with 36 sites and 37 implants with a mean follow-up of 4 years, 5 months from the date of restoration. Freeze-dried bone allograft was used in 22 sites (61%) to augment the ridge. Reentry at stage-two surgery confirmed the preservation of the displaced labial plate after implant integration. Three implants were removed prior to the planned uncovering because of incomplete healing of the overlying gingival tissue; therefore, the survival rate of the labial advancement was 92%. No implants failed after definitive prosthetic loading; therefore, the cumulative survival rate of loaded implants was 100%. No significant bone loss was detected at the final follow-up visit. Follow-up after loading ranged from 9 to 148 months. Advancement of the labial plate with simultaneous implant placement to gain horizontal ridge width dimension was shown to be a reliable and practical procedure for single-tooth sites where other grafting methods are often difficult. (Int J Periodontics Restorative Dent 2012;32:509–519.)

*Private Practice, New York, New York.
**Vice President, Clinical Technologies, Nobel Biocare, Yorba Linda, California.

Correspondence to: Dr Burton Langer, 933 Fifth Avenue, New York, NY 10021; fax: 212 861 7934; email: BurtL2@aol.com.

There are many obstacles to the successful placement of osseointegrated implants. These obstacles can be overcome with small modifications in methodology. One such condition is a thin labiolingual or labiopalatal bone dimension of the residual alveolar ridge. Even though there are thinner-diameter implants available to overcome this problem, situations exist in which the ridge width is still insufficient to accommodate even this narrower implant diameter.

Horizontal augmentation is indicated when there is sufficient bone height available but insufficient alveolus width to accommodate an implant of adequate diameter to meet the biomechanical and restorative requirements of tooth replacement. A number of techniques have been developed to help overcome this problem and have proven successful for an edentulous segment of multiple missing teeth.[1–5] Several literature reviews provide an objective overview of approaches and results available for the broad area of horizontal augmentation for implants.[6–9]

Many authors have reported on techniques for ridge expansion in the anterior maxilla with advantages for simultaneous implant placement.[10–13] Simion et al[14] rejuvenated the technique of employing tapered chisels to widen the narrow edentulous ridge. After expansion, a membrane was used, requiring reentry. Histologic examination that included both the native and expanded bone showed normal trabecular patterns very similar to the preexisting bone.[14] Buser et al[15] used guided bone regeneration to expand the thickness of bone. This was a two-step procedure in which the implant was placed after the bone was expanded. Jensen et al[16] compared the effect of different flap approaches on the stability of marginal bone after alveolar split ridge expansion. Blus and Szmukler-Moncler[17] demonstrated the use of a Piezosurgery device to section the ridge in a study that included single implant sites. Nishioka and Souza[18] reported on the use of threaded bone spreaders as osteotome alternatives in the maxilla to accomplish horizontal ridge expansion. Scipioni et al[19,20] used both labial and palatal expansion with simultaneous implant placement to gain increased alveolar width. Another approach to gaining ridge width was evaluated by Watzak et al,[21] who showed the possibility of providing horizontal expansion of single-tooth implant sites using horizontal alveolar distraction. With modified micro–bone screws and a staged approach, horizontal expansion was demonstrated by comparison of pre- and postexpansion computed tomography (CT) scans of seven patients.

The purpose of this article is to report on a technique that involves expanding the labial plate of bone by means of a planned green stick fracture confirmed by reentry at stage-two uncovering. The concept of this procedure includes simultaneous implant placement within the expanded displaced labial bone to capitalize on the healing potential of the marrow cells without the need for membranes.

Method and materials

Patients selected for this procedure had a labiolingual residual ridge width of 3 mm or less. Prior to treatment, a reformatted computed tomography scan was used to confirm the presence of marrow space between the cortices (Fig 1a). If almost no marrow space was visible, the bone was considered to be too narrow and too unyielding to utilize this method, since a reservoir of marrow cells is required for predictable regeneration.

A full-thickness flap was used for the advancement procedure at implant placement. After the soft tissue was reflected, a 2-mm-diameter twist drill was used to prepare the site to the planned implant length. Then, a small 0.6-mm round carbide bur or Piezosurgery device was used to make perforations through the labial cortex into the marrow slightly wider than the planned implant in the configuration

of a rectangle or trapezoid as the anatomy dictated (Fig 1b). The implant site was then further widened using a 2.7-mm twist drill at slow speed (approximately 25 rpm). If the crest of the ridge is wide enough, the 3-mm twist drill may follow, again at slow speed. This will protect the bone from being fenestrated, which can occur at higher speeds.

In cases where the labiopalatal or labiolingual bone thickness was severely diminished, site preparation ended with the 2-mm-diameter twist drill to prevent complete destruction of the labial plate of bone. If this situation was encountered, tapered osteotomes were used, but only after the labial plate of bone was separated completely on its perimeter, which was accomplished to ensure that the osteotome would advance the entire bone plate in the labial direction. The remaining apical osteotomy was then completed using the 2.7-mm twist drill at slow speed. This approach will not traumatize the displaced labial bone plate and still allows proper apical preparation for stable seating of the implant in the apical aspect.

Implants ranging from 3.3 to 4.3 mm in diameter were used. As the implant was introduced into the osteotomy, the labial plate was displaced horizontally outward (Fig 1c). In most situations, the labial plate was not completely displaced from its original location.

Depending on a subjective assessment of the amount of displacement, appearance of the gap, and vascularity, a decision was made whether to add an allograft of cancellous demineralized freeze-dried bone (DFDBA-Cancellous, Miami Bone Bank). The soft tissue was then released as necessary to coapt the margins for primary closure. This was followed with a 4- to 6-month unloaded integration period.

Reentry for implant uncovery and healing abutment placement was accomplished with a full-thickness flap allowing direct visualization to verify osseous coverage of the implant and to assess bone gain (Fig 1d). Loading of the implants with provisional restorations followed, ranging from the same day to typically 1 month after reentry. Following definitive restoration, patients received routine photographic, clinical, and radiographic follow-up examinations (Figs 1e and 1f).

Results

Twenty-one patients (12 females, 9 males; age range, 17 to 63 years) with 36 sites (25 maxillary, 11 mandibular) with a labiolingual width of 3 mm or less requiring ridge expansion followed by reentry confirmation were treated with implant placement by one operator using this procedure (Figs 2a to 2e and 3a to 3e). Twenty-two sites (61%) were augmented with cancellous DFDBA to fill the gap and add an enhanced buccal dimension for esthetic purposes. Implants ranged from 3.3 to 4.3 mm in diameter and 8.5 to 18 mm in length (Table 1).

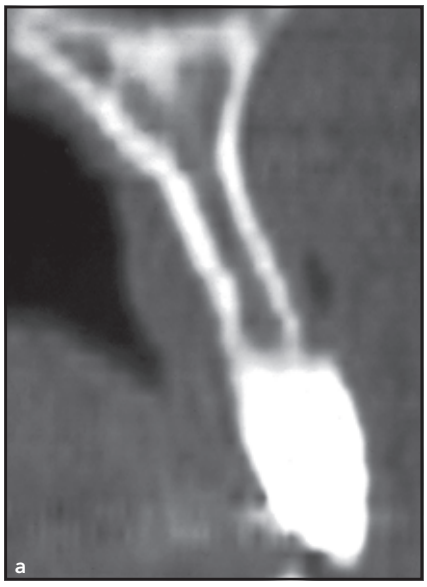


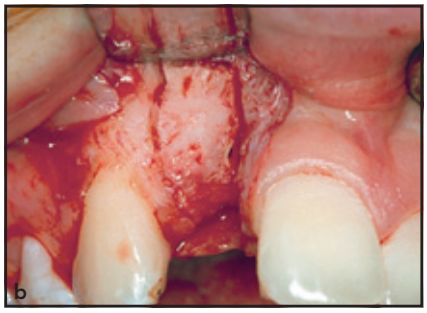
Fig 1a *Preoperative CT scan showing a narrow labiopalatal ridge that was too narrow to accommodate a 3.3- to 4-mm-diameter implant.*

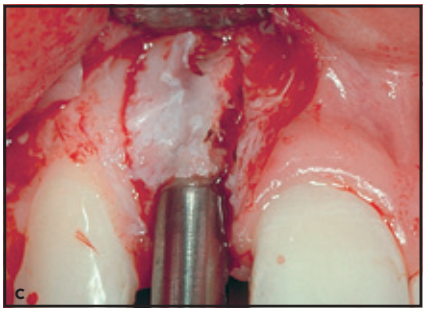
Fig 1b *A trapezoidal osteotomy into the underlying marrow allows for displacement of the labial bone as the intended implant is inserted.*

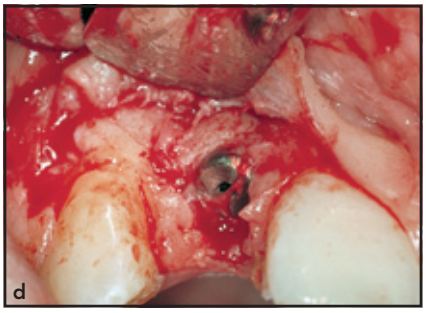
Fig 1c *The implant mount was visible as the implant was inserted into the osteotomy site, displacing the labial plate outward. A gap was created at the osteotomy site as the implant was seated. This gap can be allowed to heal by itself or filled with bone substitute.*

Fig 1d *Reentry showed bone covering the implant and repair of the vertical osteotomies.*

Figs 1e and 1f (e) *Radiographic and* (f) *clinical views of the right lateral incisor at the 12-year follow-up.*







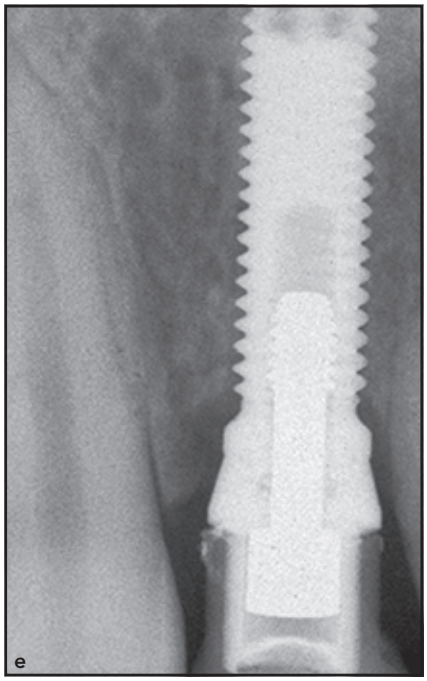
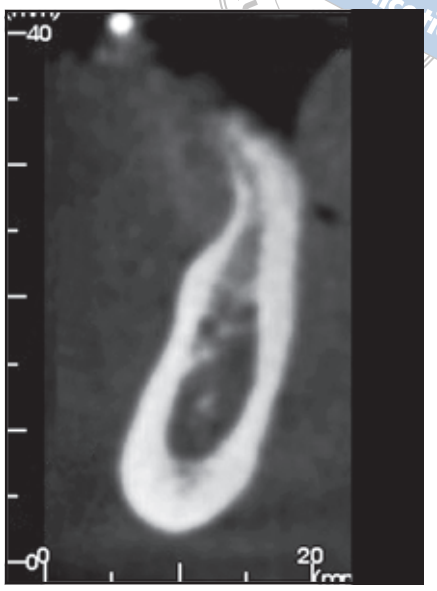


Fig 2a (left) *Space for the mandibular right first premolar was created by orthodontic tooth movement in anticipation of an implant restoration.*

Fig 2b (right) *CT scan showing a narrow ridge of 2.5 mm for the first 6 mm of bone from the alveolar crest apically.*



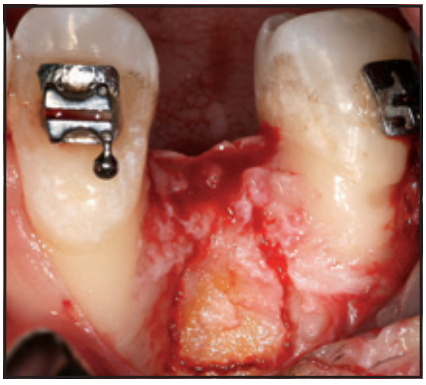


Fig 2c *At the surgical site, the labial plate was perforated into the underlying marrow to form the outline of a trapezoid.*

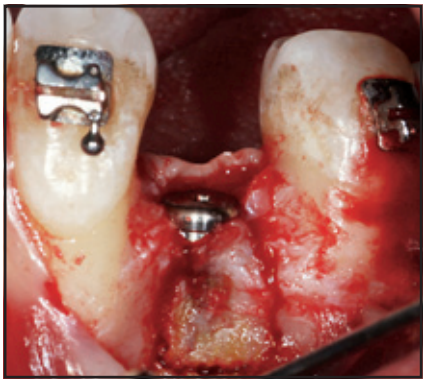


Fig 2d *A narrow screw tap was first used to advance the buccal plate. At insertion of a 3.75-mm-diameter implant, the mesial portion of the labial plate was driven away from the implant, but the distal portion was still attached, allowing for hinged displacement. A DFDBA allograft was placed on the entire labial plate and covered with the buccal flap.*

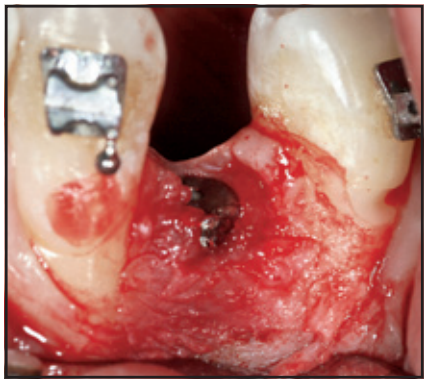


Fig 2e *At uncovery, the bone was completely reformed over the displaced labial plate.*

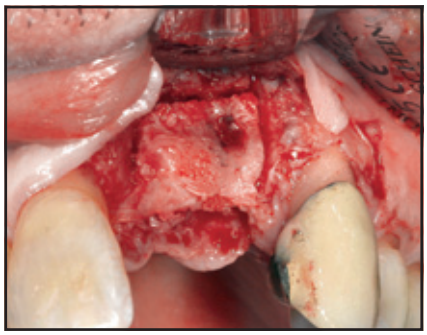


Fig 3a *The patient had a traumatic loss of the maxillary left central and lateral incisors. The intention was to prepare the site to receive either one or two implants to replace the lost teeth.*

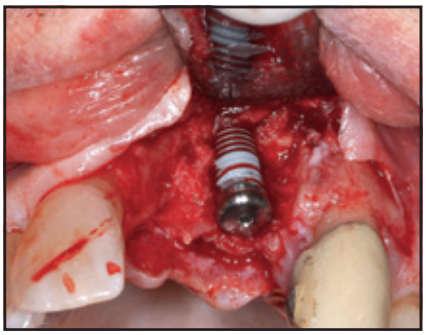


Fig 3b *As the implant was inserted into the lateral incisor site, there was complete detachment of the labial bone.*

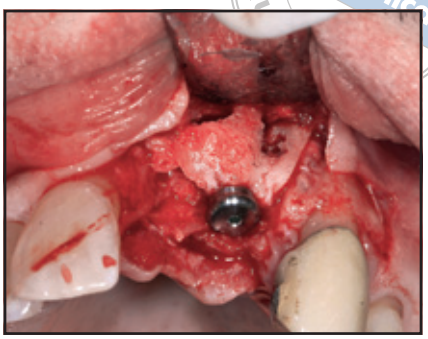


Fig 3c *The labial bone was replaced over the implant covering the exposed labial threads. Part of the displaced bone was placed in the central incisor region, and both sites were grafted with DFDBA.*

Table 1 **Dates of placement and uncovering and length of follow-up of restored implants**

Patient	Sex	Implant placed	Implant uncovered	Follow-up after loading	Site*	Implant size (mm)	Design	Arch
1	F	5/22/92	1/5/93	12 y, 4 mo	12	3.75 × 13.0	Brånemark Std	Mx
1		5/22/92	1/5/93	12 y, 4 mo	22	3.75 × 15.0	Brånemark Std	Mx
2	F	6/1/95	1/11/96	11 y, 1 mo	12	3.75 × 15.0	Mk II	Mx
2		6/1/95	1/11/96	11 y, 1 mo	22	3.75 × 18.0	Mk II	Mx
3	F	10/3/01	10/16/02	8 y, 4 mo	12	4.00 × 10.0	Mk IV, TiU	Mx
3		10/31/01	10/16/02	8 y, 4 mo	14	3.75 × 10.0	Mk III, TiU	Mx
3		4/11/02	10/16/02	8 y, 4 mo	17	4.00 × 10.0	Mk IV, TiU	Mx
3		4/11/02	10/16/02	8 y, 4 mo	22	3.75 × 10.0	Mk III, TiU	Mx
3		4/11/02	10/16/02	8 y, 4 mo	23	3.75 × 10.0	Mk III, TiU	Mx
4	F	7/23/03	5/25/04	5 y, 1 mo	23	3.75 × 8.5	Mk III	Mx
5	F	12/17/04	11/10/05	5 y, 2 mo	22	3.30 × 13.0	Mk III, TiU	Mx
6	M	4/7/06	9/26/06	3 y, 0 mo	42	3.50 × 13.0	ReplSel, TiU	Md
7	F	8/4/06	1/9/07	4 y, 1 mo	24	3.50 × 13.0	ReplSel, TiU	Mx
8	M	11/08/06	Removed	3 y, 11 mo	22	4.30 × 13.0	ReplSel, TiU	Mx
		2/9/07	6/15/07	3 y, 11 mo	22	4.00 × 10.0†	Mk III, TiU†	
9	M	11/14/06	4/25/07	3 y, 11 mo	42	3.50 × 13.0	ReplSel, TiU	Md
10	F	5/16/07	11/09/07	3 y, 6 mo	37	4.00 × 10.0	Mk III, TiU	Md
10		5/16/07	11/9/07	3 y, 6 mo	36	4.00 × 11.5	Mk III, TiU	Md
10		5/16/07	11/9/07	3 y, 6 mo	35	4.00 × 11.5	Mk III, TiU	Md
11	M	11/7/07	11/4/08	2 y, 3 mo	22	3.75 × 15.0	Mk III, TiU	Mx
11		5/20/08	11/4/08	1 y, 11 mo	21	3.30 × 11.5	Mk III, TiU	Mx

*FDI tooth-numbering system.
†Final implant.
F = female; M = male; TiU = TiUnite; ReplSel = Replace Select; Mx = maxilla; Md = mandible.

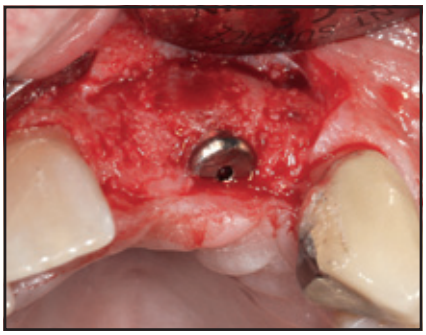


Fig 3d *Reentry showed complete bone coverage over the implant. There was now sufficient bone to place a second implant in the central incisor site.*

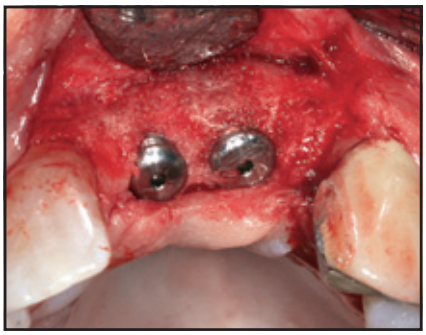


Fig 3e *Second reentry showed complete bone regeneration in both sites.*

	Lost	Replaced	Graft
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
	1/27/07	2/9/07	DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous

Table 1 Dates of placement and uncovering and length of follow-up of restored implants (cont)

Patient	Sex	Implant placed	Implant uncovered	Follow-up after loading	Site*	Implant size (mm)	Design	Arch
12	F	2/22/08	9/25/08	1 y, 11 mo	26	3.75 × 11.5	Mk III, TiU	Mx
12		2/22/08	9/25/08	1 y, 4 mo	27	3.75 × 11.5	Mk III, TiU	Mx
13	M	5/13/08	12/16/08	2 y, 3 mo	12	3.50 × 13.0	ReplSel, TiU	Mx
14	M	8/15/08	2/17/09	1 y, 10 mo	12	3.50 × 15.0	ReplSel, TiU	Mx
14		8/15/08	2/17/09	1 y, 10 mo	22	3.50 × 13.0	ReplSel, TiU	Mx
15	F	11/20/08	6/25/09	1 y, 4 mo	42	3.30 × 11.5	Mk III, TiU	Md
16	M	1/16/09	5/22/09	1 y, 11 mo	34	3.75 × 11.5	Mk III, TiU	Md
16		1/16/09	5/22/09	1 y, 11 mo	44	3.50 × 13.0	ReplSel, TiU	Md
17	M	1/21/09	7/21/09	1 y, 3 mo	42	3.30 × 13.0	Mk III, TiU	Md
18	M	4/16/09	4/16/09	2 y, 1 mo	12	3.50 × 13.0	ReplSel, TiU	Mx
18		4/16/09	4/16/09	2 y, 1 mo	22	3.50 × 13.0	ReplSel, TiU	Mx
19	F	4/22/09	8/4/09	1 y, 6 mo	22	3.50 × 13.0	ReplSel, TiU	Mx
20	F	1/26/10	5/25/10	0 y, 9 mo	11	3.30 × 14.0	Roxolid	Mx
20		1/26/10	5/25/10	0 y, 9 mo	21	3.30 × 14.0	Roxolid	Mx
21	F	11/24/10	10/6/11	0 y, 0 mo	33	3.50 × 10.0	ReplSel, TiU	Md
21		11/24/10			43	3.50 × 10.0	ReplSel, TiU	Md

*FDI tooth-numbering system.
†Final implant.
F = female; M = male; TiU = TiUnite; ReplSel = Replace Select; Mx = maxilla; Md = mandible.

One maxillary implant was removed at 3 months and later replaced; this additional implant is included in the data as a second entry in Table 1 (patient 8), bringing the total number of implants placed in expanded sites to 37. Two mandibular implants in one patient were removed at 1 month because of a lack of primary stability and subsequent exposure; the patient is currently receiving treatment with one site grafted and one site having a submerged implant.

Routine clinical and radiographic follow-up has been provided for 34 restored implants over an observation period of 9 to 148 months. No implant failed after loading; therefore, the cumulative survival rate of loaded implants was 100% (Table 2). All sites with surviving implants demonstrated an increased width from preoperative values whether the labial plate of bone was fractured to complete detachment or the space was filled with graft material.

	Lost	Replaced	Graft
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
			DFDBA-Cancellous
	12/23/10	4/5/11	DFDBA-Cancellous
	12/23/10		DFDBA-Cancellous

Table 2 Life table analysis

Time (y)	Patients (n)	Implants (n)	Lost (n)	Survival (%)	Cumulative survival rate (%)
0	21	37	3	91.9	91.8
0–1	20	34	0	100.0	91.8
1–2	19	32	0	100.0	91.8
2–3	17	30	0	100.0	91.8
3–4	11	20	0	100.0	91.8
4–5	9	17	0	100.0	91.8
5–6	5	11	0	100.0	91.8
6–7	4	10	0	100.0	91.8
7–8	3	9	0	100.0	91.8
8–9	3	9	0	100.0	91.8
9–10	3	9	0	100.0	91.8
10–11	2	4	0	100.0	91.8
11–12	2	4	0	100.0	91.8
12–13	1	2	0	100.0	91.8

Discussion

From a theoretic point of view, it might seem that a partial-thickness flap would be a requirement to maintain some blood supply to the labial plate of bone. However, even a thin ridge in an edentulous site has some underlying active marrow space compared to a thin labial plate surrounding a tooth root. Maintenance of labial vascularity to the displaced bony plate with a partial-thickness flap would have dictated that the procedure be done blind and not allowed reentry confirmation.

In each of the presented treatments, full-thickness flaps were used both initially for the advancement procedure and again after several months for implant uncovering and to verify any gain in bone width and implant coverage with direct visualization and photographic documentation at reentry. Since the labial plate would not have had an intact labial or lingual blood supply after displacement, continued vitality of the labial plate was dependent on reestablishment of marrow connection, lateral bone margins, and labial soft tissue blood supplies. This is not so dissimilar from the angiogenesis associated with distraction osteogenesis or LeFort I downfracture. These results appear to indicate that the advanced labial plate may function as a barrier membrane as it becomes integrated into the wider ridge dimension achieved, especially when considering the histology presented by Simion et al.[14]

The procedure was successful whether an allograft was used or not in that the implants all continue to maintain a steady state of bone to the first thread. Of the cases treated in this fashion, approximately 20% had total severance of the labial plate from the host site, which was replaced over the implant and then grafted with allograft particulate matter. With experience gained, it was observed that cases that received allograft not only in the gap but also onlayed to the labial plate produced more bulk, supporting an enhanced esthetic result.

The healing times for stage-two surgery were not delayed by use of this technique. In fact, to verify that the area was healing as desired, in an early case, the area of displacement was reentered at 4 months to find complete reformation of the buccal plate. It is not inconceivable that the new bone is reinstated within 3 months of maturation. Reentry was necessary for the first patients treated with this method to confirm the viability of the method visually. After this confidence had been established, this procedure was used routinely for patients outside this report with reliance on implant stability and radiographic bone levels to determine success without full-flap uncovering, unless reentry was indicated for other reasons.

As with any procedure, the surgeon must become comfortable with the technique and recognize in which sites the procedure will be indicated before the site is prepared beyond the first twist drill. It is important that the decision of whether to use an advancement procedure be made before initial implant site preparation. The sequence is such that the vertical and horizontal releasing cuts for the labial plate advancement are made before preparation for the implant. If the labial plate is damaged by the implant osteotomy procedure without first preparing the labial plate for the displacement, the procedure will not be successful.

The three failures reported resulted from an inadequate quantity and thickness of trabecular bone. In these situations, both labial and lingual cortical plates of bone were fractured, resulting in inadequate implant stability. These cases demonstrated where the limits were exceeded, when insufficient marrow space is available to support the revascularization of the advanced bone. This approach to widen the ridge in a single procedure does not exclude use of the same procedure with staged implant placement. Extremely thin bone without obvious marrow can be better handled by employing a two-stage procedure: one to widen the bone followed by implant placement 3 to 4 months later.

Conclusions

Long-term follow-up results show that the labial plate advancement technique with simultaneous implant placement to gain horizontal ridge width is a practical solution for narrow-width single-tooth implant sites. Follow-up from 9 to 148 months demonstrated a continuation of stable bone and soft tissue for restored implants. Subsequent reentry of sites at implant uncovery confirmed the preservation of the advanced labial plate after implant integration. Based on this information, reentry confirmation with a full-thickness flap is not a requirement if radiographic bone levels and soft tissue stability are otherwise within normal limits prior to the uncovering procedure.

Disclosure

Dr Sullivan is employed by Nobel Biocare, the manufacturer of the implant used in this clinical case series.

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