

# The Osteoperiosteal Flap

A SIMPLIFIED APPROACH TO ALVEOLAR BONE RECONSTRUCTION

Edited by

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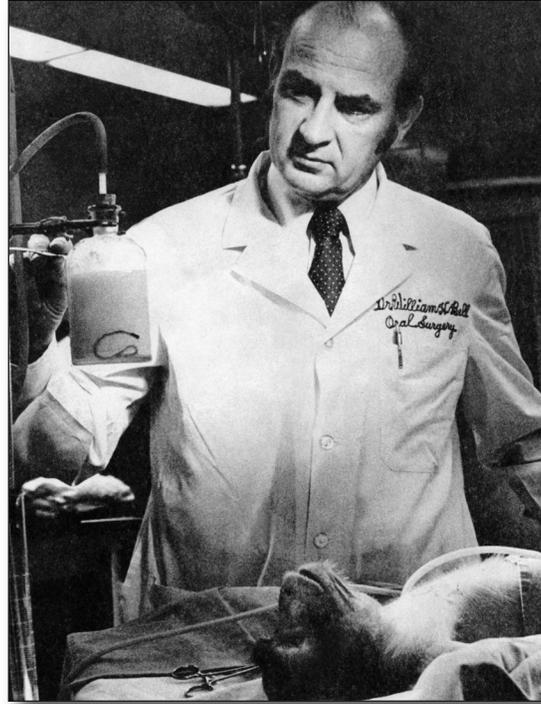
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# Dedication



The Le Fort I osteotomy, as developed by Dr William Bell, sparked a worldwide revolution as it became perfected by Dr Bell and his many colleagues. From the Le Fort I came not only bigger, more expansive operations but also smaller segmental osteotomies. Now it has led to the subject of this book, even smaller fragmentary procedures called *osteoperiosteal flaps*, which are flaps of edentulous alveolar bone used in reconstruction with dental implants.

In one seminal publication, Dr Bell observed that engorged collateral vascularization in the palate and labial gingival periosteum in monkeys developed immediately or soon after Le Fort I procedures. In later healing phases, a massive vascular proliferative response developed without significant scarification of the osteotomy site. Osseous gaps healed via well-vascularized bone modeling. Concern about avascular necrosis and non-union as intrinsic outcomes of a Le Fort procedure was forever put to rest. The bone was alive and nourished by the vascular pedicle even during the surgical procedure.

This famous innovator, a man who systematically has addressed maxillary orthognathic surgery from the biologic, functional, and esthetic standpoints, must be credited, as much as anyone, for this idea that a pedicled vascularized bone can be moved and subsequently heal into a new place. Thus, it is to Dr William Bell that I dedicate this book, with deference, humility, and respect.

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# Preface

Why another book on alveolar bone graft augmentation? Because it is time to abandon what works. The paradox of scientific progress is that, to advance a discipline, clinicians must from time to time rethink a problem that they believe has already been solved. Such is the case with alveolar bone grafting. We must now move away from the idea of implant success to one of gingiva-alveolus-implant success, a much different goal than simple implant longevity based on a life table.

If this idea is true, then we must immediately rewrite the history of implant dentistry because historical significance changes to one of alveolar reconstruction and not simply insertion of titanium into bone. The surgical discipline of alveolar reconstruction really began with manipulation of alveolar bone and not implantation of metallic devices. Under this interpretation, the seminal developments included not only Maggiolo's first report of the use of an endosseous implant for a dental restoration, in 1809, but Simon Hüllihen's first use of an alveolar osteotomy to reposition jawbone structure in 1849.

The latter discovery seems to be of forgotten importance for establishing dentoalveolar function in implant dentistry. If this is so, we have come back around to meet ourselves at yet another new beginning, that is, to perform jawbone osteotomies for alveolar reconstruction, after having spent the last three decades considering dental implant position as primacy for success in dentoalveolar restoration.

Discussion of the use of alveolar osteotomy for dental implantology has been remarkably absent in the literature, which has been instead dominated by studies of guided bone regeneration and/or various techniques for block bone grafting, which have been shown to be effective

enough to get us by. So must we abandon what works?

There is always a sense of cognitive dissonance that arises when someone suggests that further scientific advancement is possible in a field you know well, in this case alveolar bone grafting. However, critical appraisal of bone graft performance is lacking in the literature. The success of current alveolar and sinus grafting procedures is notoriously measured by *implant* osseointegration or *implant* retention, often in settings where the implants are not relying on those bone grafts in order to succeed.

This book makes the argument that alveolar bone should have greater sway in determining the success of an implant restoration. Restoration involves not just a tooth or a root form but alveolar morphology and gingival soft tissue. Ideally the alveolar bone must be restored to its desired form, function, and vitality in what has been termed *orthoalveolar form*. Soft tissue generally follows suit, and implant placement then follows, creating a functional gingiva-alveolus-implant matrix.

With the use of osteoperiosteal flaps, the surgeon manipulates available bone to recover what is missing in a very special way: endosteally. Because of this relatively closed wound approach, it is as if the epigenetic signal, designed long before we wondered how a deficient bone could be improved, is suddenly turned on within the gingivoalveolar complex and the augmentation develops analogous to primordial growth.

The various osteoperiosteal flaps discussed herein are procedures that not only can be easily learned and result in fewer complications but also probably lead to a more vital alveolar reconstruction. Once mastered, bone flaps can almost entirely eliminate the need for block grafting or guided bone regeneration.

What then are the advantages and disadvantages of the osteoperiosteal flap?

*Advantages:*

- Resulting changes in the alveolar crest are stable.
- Gingival architecture is maintained.
- The transported segment is vascularized.
- The periosteum is left intact and a relatively closed flap is used.
- The procedure results in early periosteal and endosteal osteogenesis.
- The operating time is relatively brief.
- Infection and dehiscence rates are low.

*Disadvantages:*

- It is a technical procedure with relatively blind operator access.
- Sufficient bone mass is needed to allow use of the osteoperiosteal flap.
- The vector of segment movement can be unfavorable.
- Vertical movement is often limited to 5 mm.

For dental implant reconstruction, I have used various bone flaps for the past 20 years and am using guided bone regeneration and block grafting less and less each year. These historically important procedures are now largely absent from my surgical protocol.

For example, the book flap, although only recently described as a technical note, has been used for about 15 years with little or no complication for sites with width deficiencies of 2 mm or more. For a single-tooth site, the book flap procedure generally takes about 30 minutes to perform, and the patient generally experiences very little postoperative pain or morbidity. The dimensional stability of the augmentation is excellent and wound break-

down is negligible. In short, in a busy practice, the book flap is an easy way for both the patient and the surgeon to achieve the desired goal. Such is the case for the entire osteoperiosteal flap repertoire compared to alternative therapies.

This text is written and edited for the “wet finger” clinician—the private practice clinician, who must use techniques that work consistently, have minimal morbidity, and are simple and relatively quick. The osteoperiosteal flap, shown here in all its permutations, fulfills these criteria beautifully.

## Acknowledgments

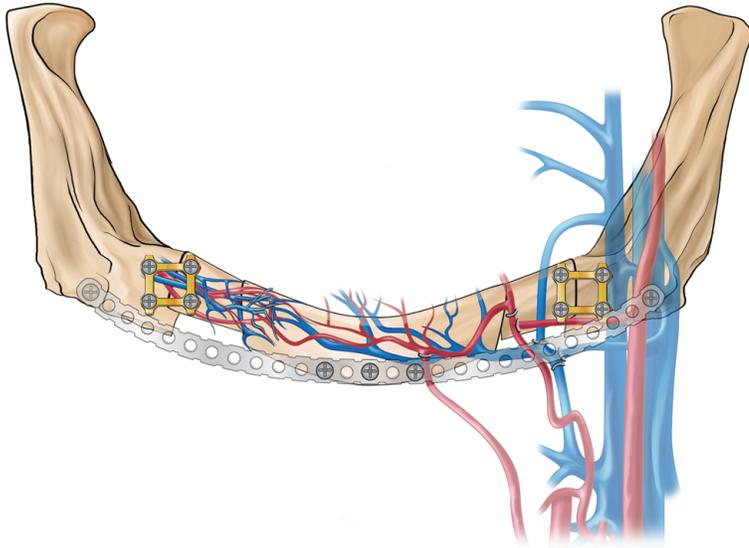
I would like to acknowledge my wife Marty, my children Sverre, Autumn, and Trygve, and my grandchildren as the underlying inspiration and drive for any success I might have outside the home.

I especially want to thank those who contributed so greatly to making this book possible: my publisher Tomoko Tsuchiya for taking a chance on me *once again*, Lisa Bywaters for her extreme patience and expert guidance, Bryn Goates for her positive and concise editing, Sue Robinson on an artistic layout and design, and Peter Jurek for his outstanding renderings.

I also want to express special thanks to Karen Shoop, my implant coordinator and brain away from home, Kristen Stifflear, who gave birth to a child this year and still provided many of the photos and essential content organization for the book, and my fantastic surgical assistants Cindy Formanek and Jennifer Patrick.

Dr Jared Cottam contributed as a research assistant; special thanks to him. Without my staff and associates, this decade-long process could not have been completed.





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# A New Biologic Classification of Bone Augmentation

*There is a miracle when two things unite to form something new.*  
 —Samuel Butler

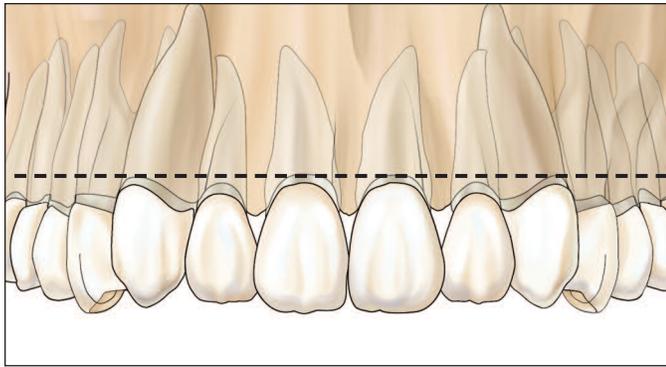
**A**ugmentation of alveolar bone loss should constitute regeneration of the tissue being replaced and not simply spatial repair.<sup>1</sup> Osseous and soft tissue surgery should therefore reconstruct both form and function of the desired replacement tissue.

## **Rationale for the New Classification**

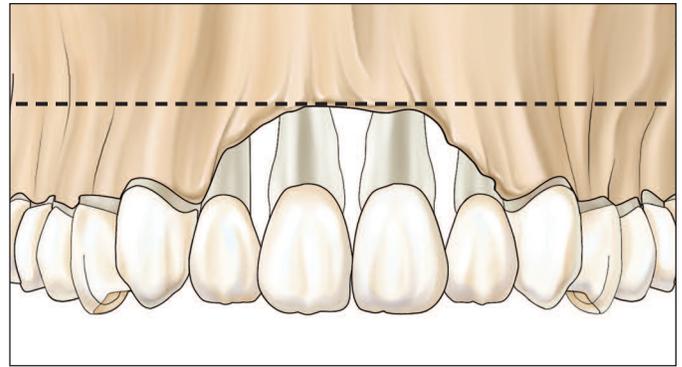
Reconstructive bone graft repair of osseous defects does not always form well-vascularized bone, even when the defect is filled.<sup>2</sup> True regeneration implies that the defect is filled with viable mineralized tissue that models and re-

models as bone and is not an admixture of devitalized inclusions or scar tissue. Bone generation methods for defect reconstruction can be differentiated according to bone graft vitality, the extent of consolidation, and marginal integration. These aspects can only be verified by late-term biopsy findings to determine the extent of vital mineralization.<sup>3</sup> However, routine biopsy analysis is impractical.

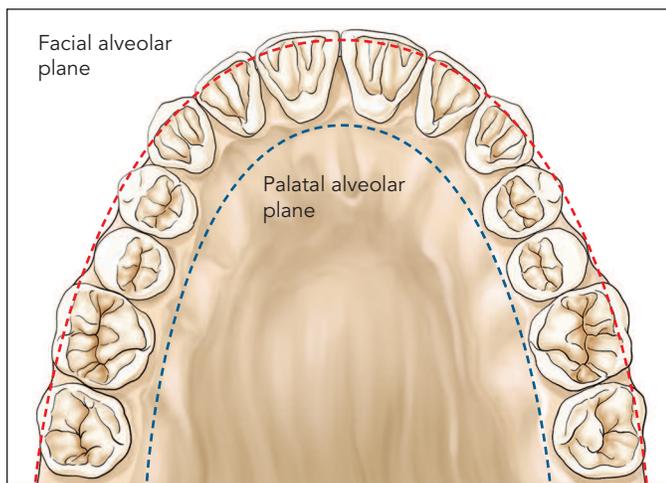
Short of invasive procedures to verify graft performance, hard tissue augmentation can be empirically classified based on vascularization of the grafting approach used, in order to suggest the likely vitality of the graft. Therefore, we propose that our earlier classification<sup>4</sup> for bone generation techniques in defect reconstruction be differentiated into five classes, according to vascularization or induction of vascularization:



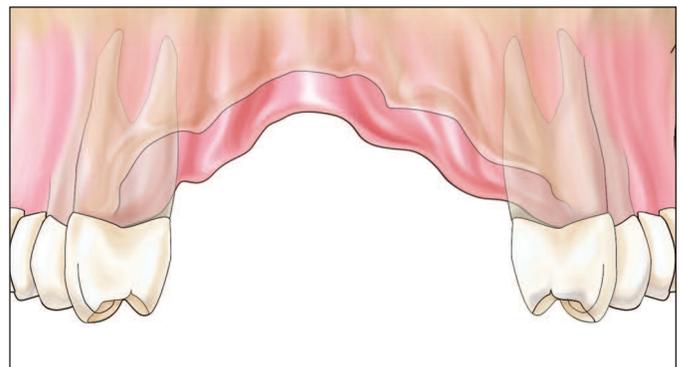
**Fig 6-2a** The alveolar plane (black line) may be thought of as the crestal bone level around the arch.



**Fig 6-2b** Disturbances in the alveolar plane (black line) are especially noticeable with alveolar bone loss.



**Fig 6-2c** The alveolar plane is a composite of the facial alveolar (red line) and the palatal alveolar (blue line) planes.



**Fig 6-2d** Once teeth are lost, a defect of the alveolar plane is evident and the surgeon can visualize potential corrective measures.

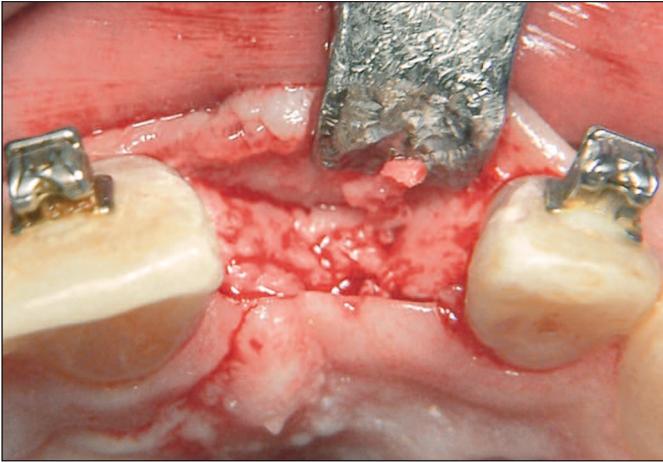
## ■ Case Selection

The book flap is used most frequently in the partially edentulous maxilla, especially for single-tooth sites. Segmental edentulous sites, even an entire alveolar arch, can also be split and interpositionally grafted using the book flap approach. The ideal alveolar width for this procedure is a 4.0-mm-wide ridge that is to be widened 2.0 to 5.0 mm. The minimum existing width that is sufficient to perform an alveolar split is probably about 2.5 mm. However, to perform ridge splitting, piezoelectric tools may be necessary because of the extremely thin osteotomy they create (Fig 6-3).<sup>3</sup> The risk for flap detachment or late facial plate resorption is probably a greater risk for thin segments of bone, so this possibility should be considered before the book flap technique is used for very thin alveolar ridges.

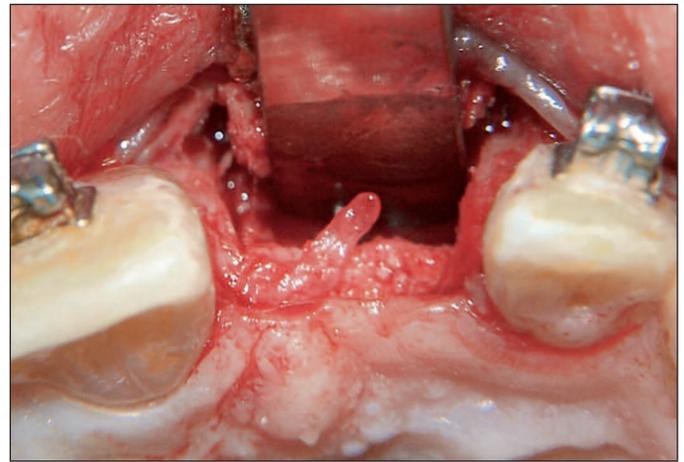
## ■ Surgical Technique

For a single-tooth site with adjacent teeth bordering the edentulous space, an incision is made along the palatal side of the alveolar crest, extending from one tooth to the other. Minimal flap reflection is performed to expose the alveolar crest only. A piezoelectric knife or sharp osteotome is used to make a vertical osteotomy through facial cortex, starting from the alveolar crest and extending apically about 10 mm. Care should be taken to remain about 2 mm away from the periodontal ligament spaces of the adjacent teeth. The vertical cuts establish the borders for the crest-splitting osteotomy.

When a piezoelectric knife is used to make the osteotomies, the vertical cuts are made strictly endosteally (from within the alveolus) and then extended through the facial plate. For the osteotome technique, the osteo-



**Fig 6-3a** Following minimal crestal mucoperiosteal reflection, the alveolus is split coronally. The split extends 8 to 10 mm in depth. Osseous releasing vertical cuts are made on each side of the edentulous space to protect subpapillary bone. (These cuts are made endosteally without periosteal reflection.)



**Fig 6-3b** A flat osteotome is used to outfracture the buccal plate, creating an osteoperiosteal flap to establish a new facial plate. The site is widened about 4 mm, and graft material is placed. If the resulting facial plate exceeds 2 mm in thickness, simultaneous implant placement can be considered.

tome will extend into the soft tissue as it advances<sup>2</sup> in making the vertical cut, but the instrument can be used in such a way as to remain submucosal even as it cuts through the unreflected periosteum.

Following completion of the vertical osteotomies, the connecting alveolar ridge-splitting osteotomy is made with either piezoelectric surgery or an osteotome. Care should be exercised to leave at least a 2-mm-wide facial plate. The osteotome is then malleted to the depth of the vestibule (about 10 mm), bisecting<sup>4</sup> the available alveolar bone. Next, the osteotome is deflected facially, which spreads the osteotomy segment (facial plate of bone) apart, pivoting at the basal bone. This process creates a greenstick outfracture of the facial plate of bone, which remains in continuity with the osseous base and is intimately invested with mucoperiosteum as a mucosteoperiosteal flap. The outfracturing of the facial bone usually creates approximately a 4-mm-wide space at the alveolar crest on removal of the osteotome.

Typically, the site is then grafted interpositionally with graft material and left to heal for 4 months prior to implant placement. The wound is closed with resorbable sutures. The site of the ridge-splitting osteotomy can be covered with soft tissue or it can be left open, that is, covered by a collagen wound dressing that is sutured in place, similar to the procedure that might be followed in a socket preservation bone graft technique. Alternatively, an implant can be placed immediately after the ridge-splitting osteotomy, with or without grafting, but this

should never be done unless the facial plate demonstrates 2 mm or greater thickness. Also, the implant preparation should notch into the palatal or lingual plate to keep the implant within the buccal line.

Subsequent facial crestal bone resorption is related to the width of the facial segment of bone; the narrower the facial plate, the more likely bone resorption will occur after implant placement. This may be particularly true for immediate implant placement. The threshold of osseous stability is approximately 2 mm. When the facial plate is less than 2 mm thick, late bone resorption may expose the facial implant surface if the implant is placed simultaneously.<sup>3</sup> Therefore, when a 2-mm facial plate cannot be achieved, a delayed implant placement protocol is recommended.

## ■ Delayed Implant Placement

### Case 1: Missing maxillary central incisor with facial plate dehiscence

A 25-year-old woman had lost her maxillary left central incisor as a result of trauma 12 months prior to evaluation for dental implant placement. On examination, she presented with a labially concave alveolar ridge that had lost vertical height from loss of the labial plate and had an alveolar width of less than 5 mm (Figs 6-4a and 6-4b).

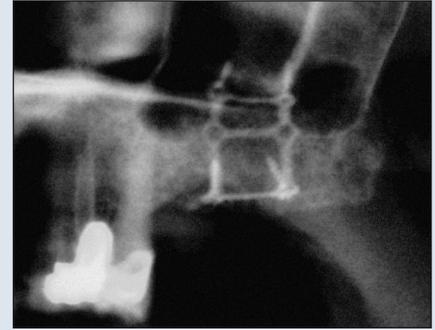
## Case 2: Posterior sandwich osteotomy with internal alveolar split



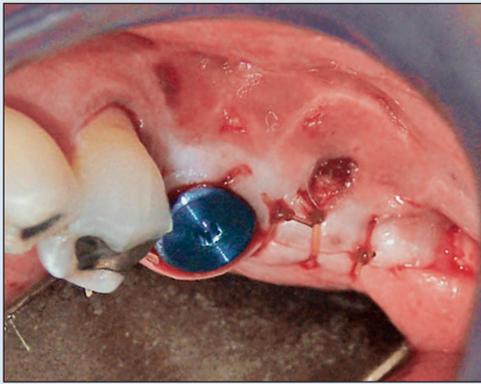
**Fig 13-3a** Two left molars are missing, and there is a 7-mm vertical defect as well as a 4- to 5-mm horizontal defect. The sinus is prominent, and minimal bone is available for osseointegration.



**Fig 13-3b** A vestibular incision is used to elevate the sinus floor through a lateral antrostomy. The alveolar segment is moved downward 5 to 6 mm via a sandwich osteotomy, which is also split internally to widen the alveolus, and the segment is fixed in position with a bone plate.



**Fig 13-3c** Immediate postoperative radiograph showing combined sinus and intra-alveolar bone graft.



**Fig 13-3d** Four months after osteotomy, two implants are placed.



**Fig 13-3e** The implants are restored 4 months after implant placement.

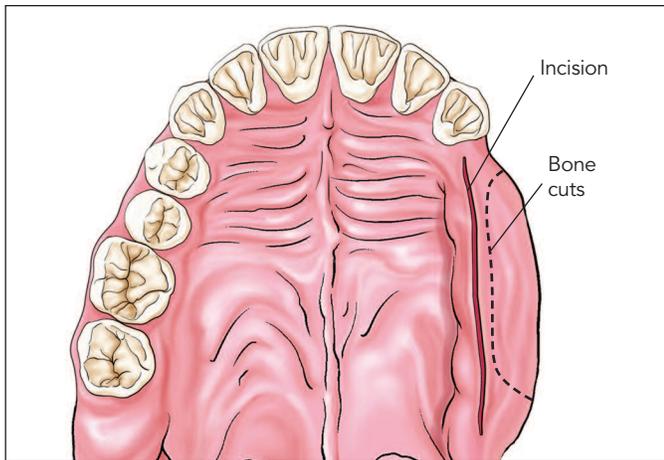
### Case 2: Posterior sandwich osteotomy with internal alveolar split

A 48-year-old woman presented with loss of the maxillary right molars and vertical loss of 5 or 6 mm of alveolar bone. The sinus was prominent, although 4 or 5 mm of basal bone was still present (Fig 13-3a).

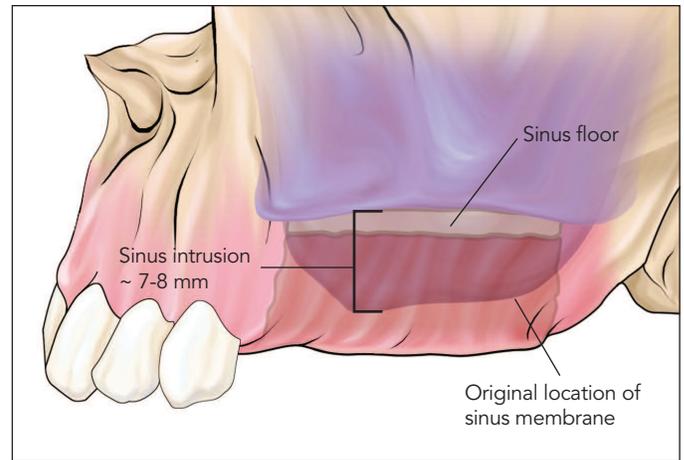
Following sinus elevation and alveolar osteotomies to move the alveolus to the alveolar plane, the 6-mm-wide alveolus was internally split and fixed with a bone plate

in a widened alveolar position (Fig 13-3b). Autogenous bone and xenograft mixed with platelet-derived growth factor BB (PDGF-BB) were applied between the alveolar plates and in the sinus floor (Fig 13-3c).

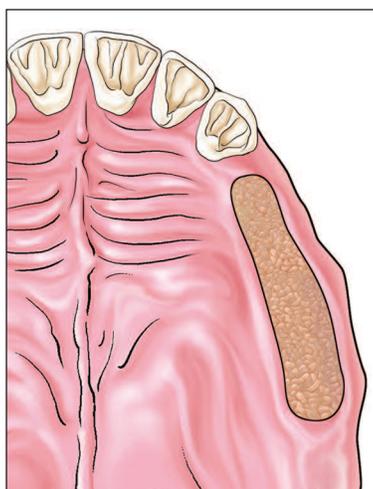
By 4 months after surgery, there was excellent consolidation. The titanium plate was removed, and implants were placed so that the implant platform was nearly level with the alveolar plane (Fig 13-3d). Final restoration proceeded 4 months after implant placement (Fig 13-3e).



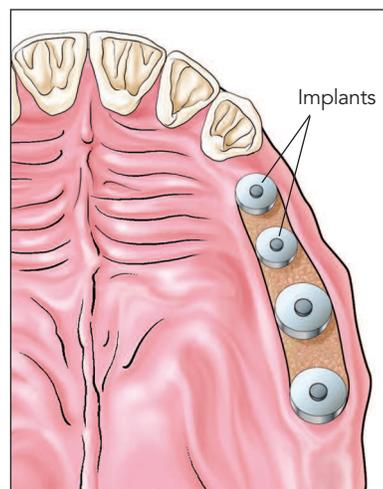
**Fig 13-4a** A crestal incision is minimally reflected, and the alveolus is split sagittally. Vertical stop cuts are made anteriorly and posteriorly.



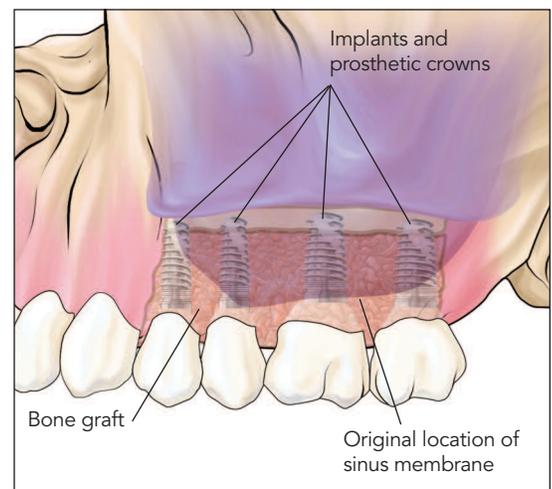
**Fig 13-4b** The sinus floor is elevated the entire length of the alveolar split as an osteoperiosteal flap.



**Fig 13-4c** For multitooth sites, graft material is placed to maintain alveolar width.



**Fig 13-4d** Four months later, implants are placed into the sinus graft through the alveolar split site.



**Fig 13-4e** The implants have a more axial position and are restored.

## ■ Posterior Maxillary Alveolar Split and Sinus Graft

### Surgical Technique

In the partially edentulous posterior region of the maxilla, when alveolar height is sufficient but the alveolar ridge is narrow and a prominent sinus cavity is present, an alveolar split osteotomy can be combined with transalveolar sinus floor elevation.

The incision is a palatal-crestal incision that is minimally reflected, leaving mucoperiosteal attachment on the buccal plate. Following alveolar split osteotomy in the form of a book osteoperiosteal flap (Fig 13-4a), sinus floor

access is gained *transalveolarly*, and blunt osteotomes are used to infracture the sinus floor the entire length of the edentulous space (Fig 13-4b).

When a two- or three-tooth segment of sinus floor is mobilized, the segment can be easily elevated up to 10 mm; however, a modest elevation of several millimeters is usually sufficient. For a single-tooth site, a 4- to 5-mm elevation is carried out without bone grafting.

Implants placed in conjunction with an alveolar split technique end up in a more axial location. Bone graft material is placed to maintain alveolar width and fill the defect in multitooth sites for delayed placement (Fig 13-4c). Four months after grafting, implants are placed *transalveolarly* in a one-stage protocol and then restored 4 months after placement (Figs 13-4d and 13-4e).