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RESULTS AFTER INTERFORAMINAL MANDIBULAR SANDWICH PROCEDURE IN COMBINATION WITH TITANIUM SCREW IMPLANTS

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During the last 40 years, a large number of operative methods have been developed to attempt to reconstruct atrophic jaws so that comfortable functional dentures can be constructed.[19–22, 24, 30] Because the onlay grafting procedures using autogenous bone have not provided stable long-term results,[4, 11, 25, 32] interposed osteotomy procedures combined with bone grafting, such as the visor osteotomy,[10, 16] the interforaminal sandwich technique,[2, 27] and other interposition techniques for mandibular ridge augmentation,[5, 8, 23, 28, 29] were introduced; however, bone resorption also occurs with these methods, and none results in fixed prosthetic rehabilitation, which can be achieved only with the use of implants.

Edentulous patients with at least 7 mm of mandibular bone height could be treated without grafting.[13] In these cases of severely resorbed mandibles, it is possible, however, to insert only extremely short implants, and the anterior facial height is not improved. This could lead to greater potential dislodging forces, with subsequent risk of implant loss because of overloading.[9] In these patients, an augmentation with rigid fixation of a graft is necessary. With mandibular autogenous onlay grafts and immediate fixture placement, the reported individual fixture success rate is high.[1, 6, 7, 15, 18] Other techniques are onlay grafting[3, 17] and interpositional grafting[9, 31] with delayed implant placement to prevent, for example, fracture of the mandible with fixture placement.

The technique described herein, which was developed by Sailer in 1987[26] is a modification of the interpositional graft procedure inaugurated in 1976 by Schettler[27] in which the lingually pedicled cranial part of the mandible is repositioned superiorly and bicortical iliac bone graft is interpositioned. In the same session, implants of maximal length are inserted into the pedicled cranial part through the interpositioned bone graft into the symphyseal cortex. Before the insertion, bovine bone morphogenetic protein (b-BMP) is fitted into the bur holes.[14] This interforaminal procedure is combined with the classic onlay technique in the lateral part of the mandible.

This procedure has been performed in 23 patients. The method creates excellent recipient sites for maximum-sized endosseous implants. The longest follow-up period was 5

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years, and the success rate was 98.7%. Satisfactory results with regard to the maintenance of the augmented height have been achieved.

MATERIAL AND METHODS

The surgical method has been described elsewhere.[26] The procedure is performed under general nasotracheal anesthesia. The mandibular alveolus is exposed with a crestal incision, and both mental foramina are identified without dissection from their perineural sheath.

A horizontal osteotomy is made with an oscillating saw between the mental foramina. The lingually pedicled cranial part of the mandible is repositioned superiorly until the designed original vertical dimension is restored. A bicortical iliac crest bone graft, which was taken simultaneously in the usual fenestration manner, is interpositioned to form the filling in the sandwich. The cortex should not be removed. The iliac crest bone should be interposed with their outer and inner surfaces oriented horizontally. The sandwich is compressed with specially designed fixation clamps (Fig. 1) and stabilized in the median part with a fixation screw that is removed when the implants are inserted.

Endosseous dental implants of maximal length are then placed through the pedicled cranial part and the interpositioned bone graft and are anchored in the residual mandibular bone. Depending on the interforaminal distance, three to six implants of 18 to 20 mm can be inserted. Before their insertion, b-BMP is fitted into the bur holes.

This interforaminal procedure is combined with the classic onlay technique in the lateral part of the mandible, posterior to the mental foramina, to ensure a smooth mandibular contour (Fig. 2). Simultaneous sulcoplasties are possible.

After a 6-month healing period—during which the patient's existing mandibular denture is relined for temporary use—the abutment procedure is carried out, and the fabrication of a definitive fixed-detachable mandibular prosthesis is begun. Depending on the number of implants, a bar (Fig. 3) or precision attachments can be used to support a denture, or fixed devices can be provided. From 1988 to 1992, 23 patients—21 women and 2 men, the youngest being 43 and the eldest 72 years of age, with a mean age of 54.3 ± 10.1 years—underwent reconstruction of a severely atrophic mandible according to the described technique. None had had any prior preprosthetic operation.

A total of 78 implants were involved in the procedure. Four Brånemark implants were placed simultaneously in 14 patients; 3, in 4 patients; and only 2, in 5 patients.

In all 23 cases there was an observation time of at least 1 year. Radiographs were taken and available for investigation preoperatively, immediately postoperatively, and 6

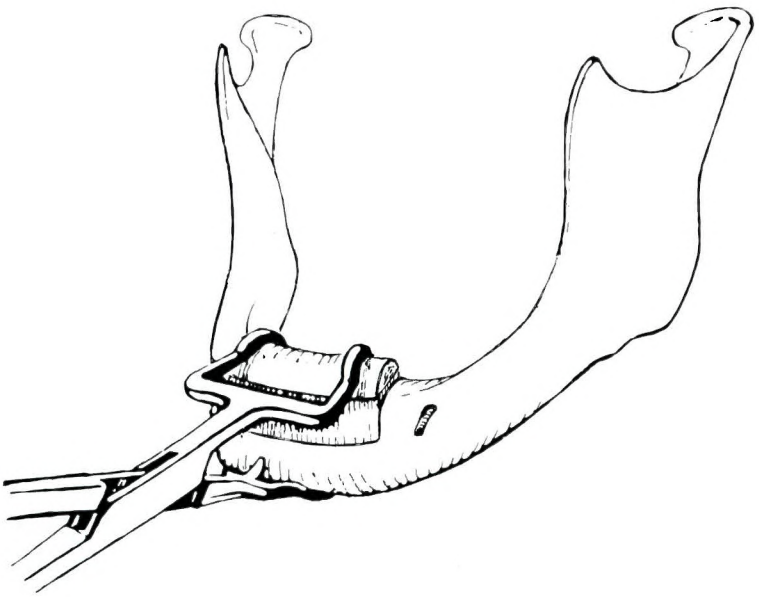


Figure 1. Specially designed fixation forceps compressing the sandwich.

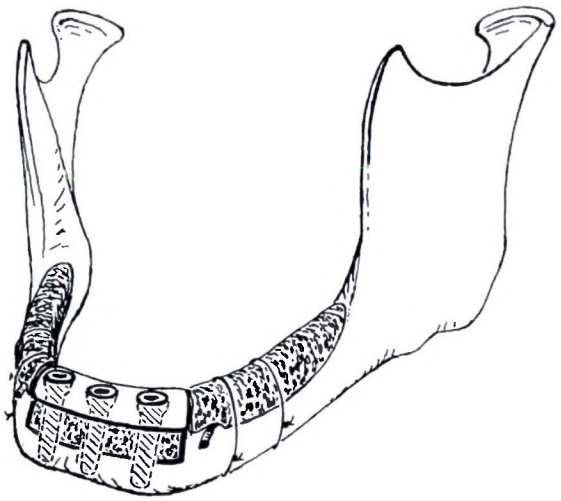


Figure 2. The principle of the anterior mandibular sandwich procedure with endosseous screw implants.

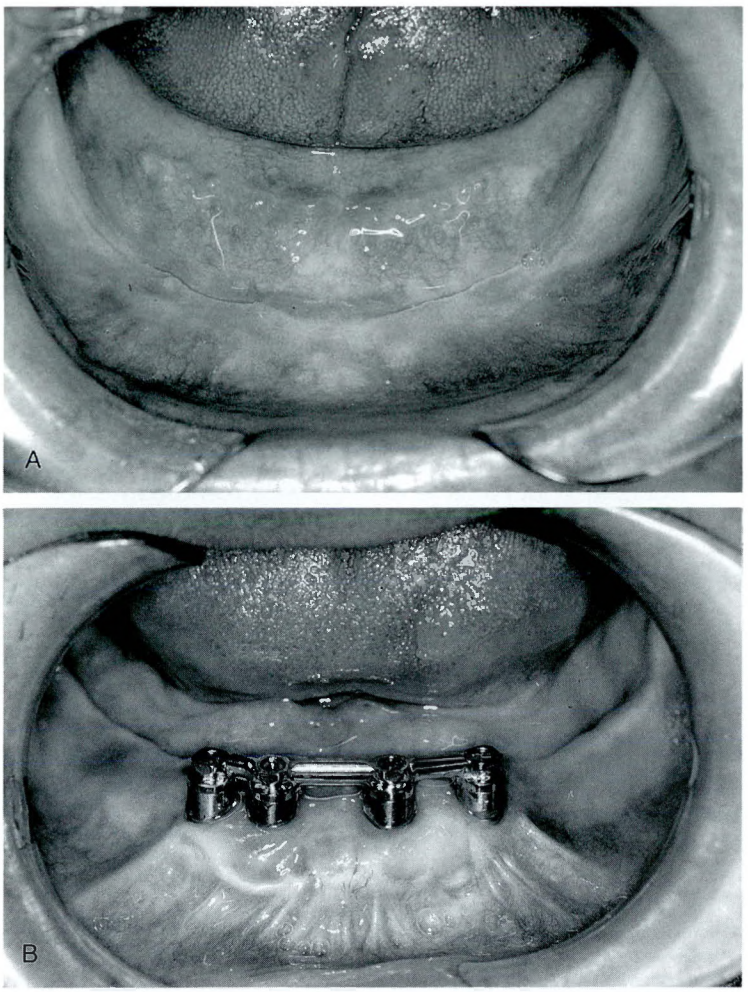


Figure 3. Intraoral views of preoperative ridge contour *(A)* and four implants with a bar for clip retention of the denture *(B)*. Note the attached mucosa around the implants 2 years after surgery.

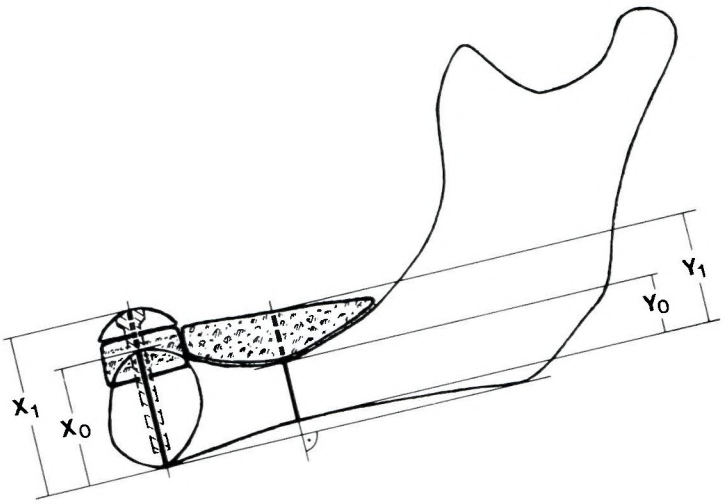


Figure 4. Measurement technique.

months and 1 and 2 years postoperatively. The lateral cephalometric radiographs were traced on acetate paper, and measurements were made for exact determination of the resorption in the anterior and lateral regions perpendicular to the gonion-menton line according to Figure 4. The mean preoperative anterior mandibular height was 18.2 ± 2.8 mm, with a range of 15 to 23 mm (Table 1). Sensory disturbances were tested in regular intervals.

RESULTS

One of 78 implants failed to osseointegrate in the 5-year period, representing a 98.7% success rate for the individual implant. In eight patients a partial vestibuloplasty with palate mucosa grafting was carried out secondarily, as was lowering of the floor of the mouth in one patient.

Sensory disturbance of the mandibular nerve 1 year postoperatively was present in nine patients (Fig. 5).

The total augmentation and resorption, measured in millimeters, for the whole group are listed in Table 1 and illustrated for the frontal and lateral parts of the mandible in Figure 6. The total resorption after a period of 2 years, compared with the absolute height, was 16% in the anterior region and 17% in the lateral part. In the panoramic and cephalometric radiographs (Figs. 7 and 8), the consolidation of the interpositioned and augmented bone grafts is shown, as are the osseointegration of the implants and the resorption over a period of 2 years. Most of the patients were highly satisfied with their external appearance and denture function.

DISCUSSION

The method developed combines an absolute augmentation of the mandible with the simultaneous insertion of endosseous screw implants and achieves the aims of preprosthetic reconstructive surgery: improvement of the effectiveness of prosthodontic treatment and restoration of facial esthetic appearance in patients with severely resorbed mandibles. The procedure described filled a gap in the preprosthetic reconstructive surgical reper-

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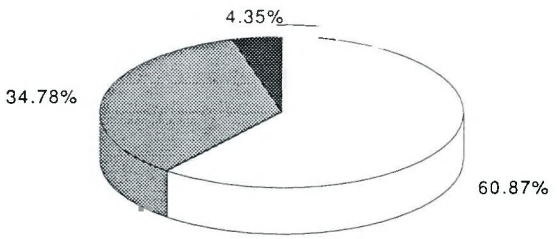


Figure 5. Sensory disturbance of the mandibular nerve 1 year after surgery. White area = normal; shaded area = unilateral disturbance; dark area = bilateral disturbance.

Table 1. AVERAGE LOSS OF HEIGHT (IN MILLIMETERS) IN THE ANTERIOR AND LATERAL PARTS OF THE MANDIBLE

	Preoperative	Postoperative	Loss 1 Y	Loss 2 Y
Frontal site				
Total	18.2 ± 2.8	25.5 ± 3.6	2.3 ± 1.3	4.2 ± 1.5
4 Implants	17.9 ± 2.9	25.5 ± 3.1	2.8 ± 1.4	4.4 ± 1.5
3 Implants	20.3 ± 3.1	26.5 ± 4.2	—	—
2 Implants	17.2 ± 1.6	23.8 ± 1.9	1.6 ± 0.6	—
Buccal site				
Total	10.9 ± 2.1	19.1 ± 3.2	2.6 ± 1.4	3.4 ± 2.0
4 Implants	11.1 ± 2.1	19.5 ± 2.9	2.9 ± 1.3	3.7 ± 2.0
3 Implants	11.7 ± 2.1	19.7 ± 3.8	—	—
2 Implants	10.0 ± 2.1	17.8 ± 4.2	2.2 ± 1.6	—

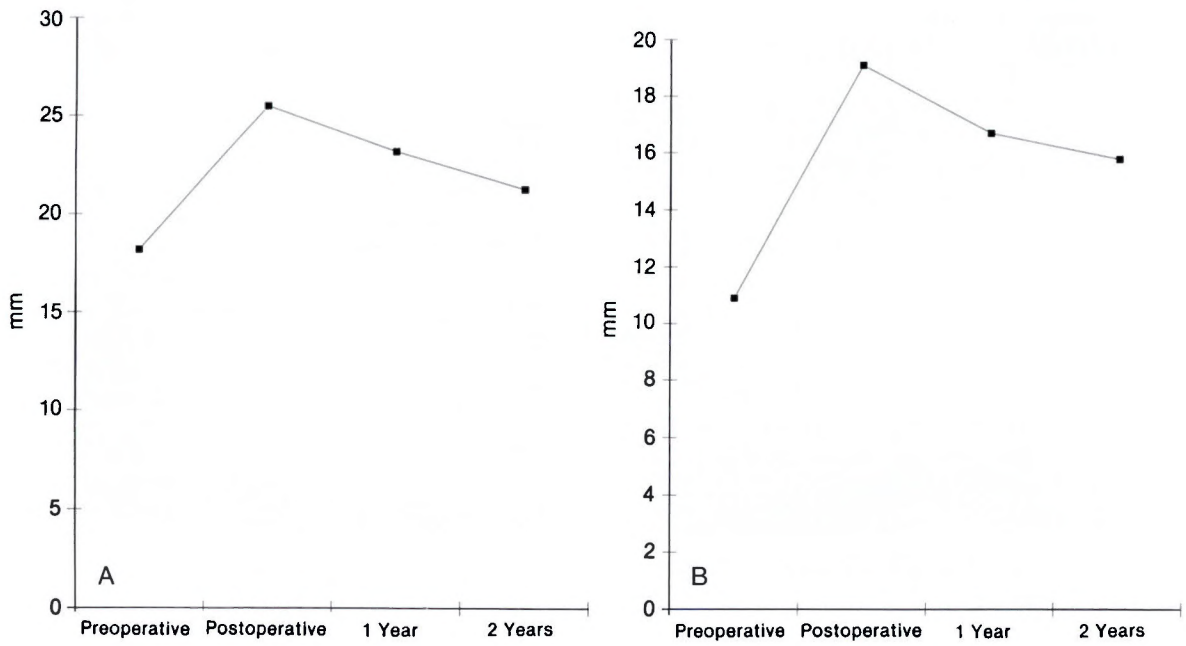


Figure 6. Average loss of height in millimeters in the frontal part *(A)* and the lateral part *(B)*.

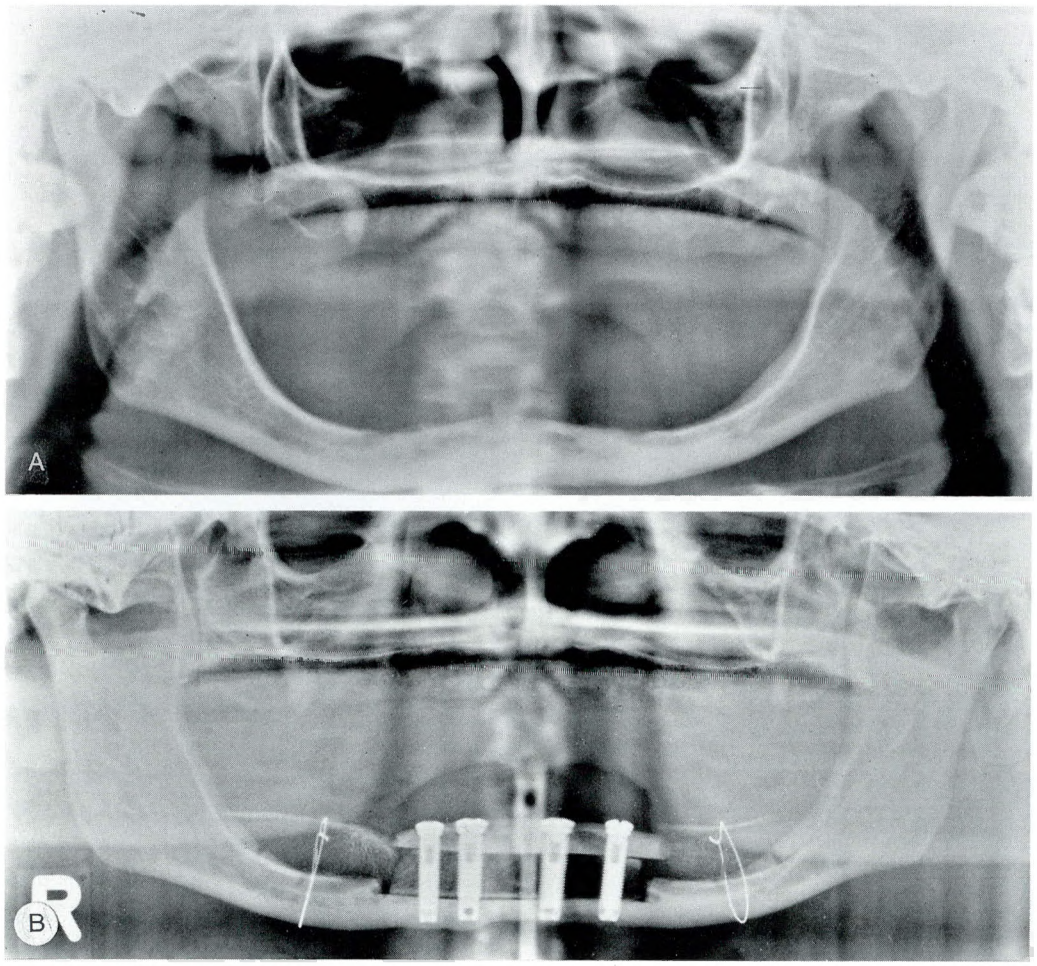


Figure 7. Panographic radiographs: *A*, preoperative; *B*, immediately after surgery.

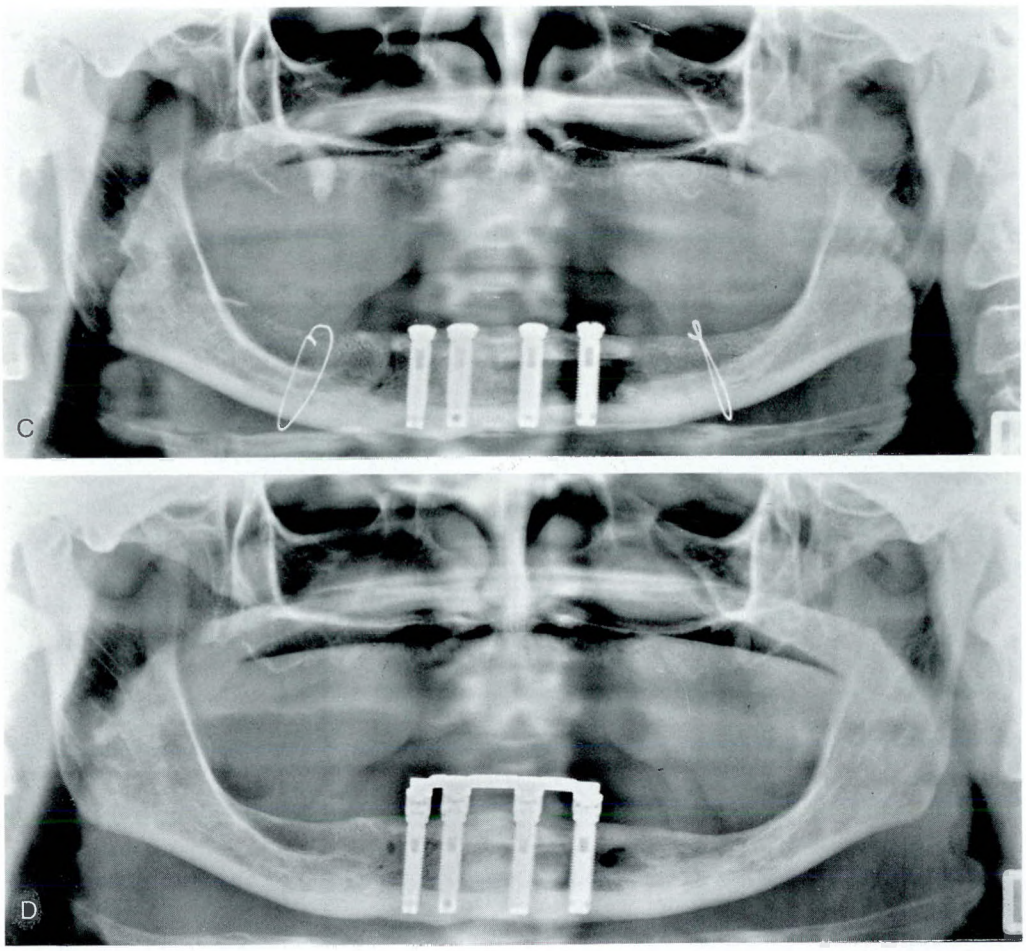


Figure 7 *(Continued). C,* 1 year after surgery; *D,* 2 years after surgery.

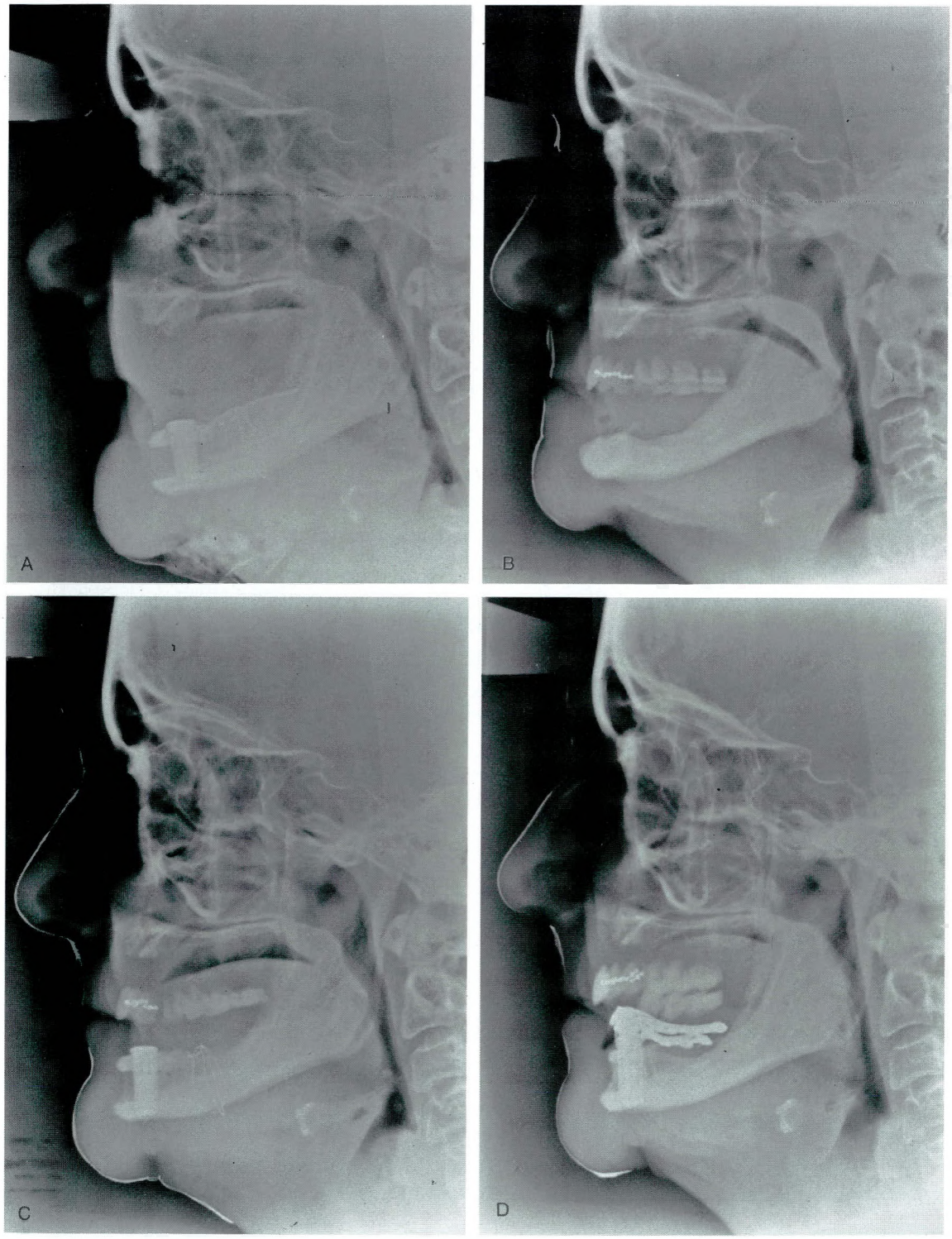


Figure 8. Cephalometric radiographs of the same patient: *A,* preoperative; *B,* immediately after surgery; *C,* 1 year after surgery; *D,* 2 years after surgery.

toire when it was first described[26] and linked two different but complementary methods of oral rehabilitation of the edentulous patient: the disadvantage of the lack of abutments in the conventional preprosthetic methods is overcome by the simultaneous insertion of endosseous osseointegration implants; on the other hand, adequate bone volume is provided so that screw implants of maximal length can be inserted, minimizing the risk of overloading and improving anterior facial height, especially in younger women who have high esthetic standards. The screw implants also permit osteosynthesis of the lingually pedicled cranial part of the sandwich and the interpositioned bone graft surfaced by cortical bone to the symphyseal cortex, which may lead to better and faster vascularization and functional stimulation of the transplanted bone and may prevent the collapse of the cranial fragment. The success rate for the individual implant is high; only 1 of 78 implants was lost. The implants are not loaded for at least 6 months, but shorter times may be possible.[18]

The question of whether implants in sandwich augmentation also diminish the bone resorption rate arises. The method appears to lead to fairly stable results, with a total resorption, compared to the total height, of 16% in the anterior part after 2 years.

Sensory disturbance presented 1 year postoperatively was relatively high, but it is nearly impossible to compare figures reported in the literature.[12]

A particular feature of this method is that a combination with a submucosal vestibuloplasty is possible so that, during the several months between implant placement and completion of osseointegration, there is adequate sulcus depth for construction of a stable and retentive denture. The use of b-BMP, which is produced in our own laboratory, should facilitate the incorporation of the implants.

SUMMARY

A new anterior mandibular sandwich procedure, in combination with simultaneous placement of titanium endosseous implants, interpositions autogenous bicortical iliac crest bone for augmentation of extremely atrophied mandible is described. Before insertion of implants, b-BMP is fitted into the bur holes.

Twenty-three patients were evaluated in a retrospective study. One implant among 78 failed to osseointegrate. The total resorption after a period of 2 years, compared with the absolute height of the augmentation, was 16% in the anterior region and 17% in the lateral part of the mandible. Most of the patients were highly satisfied with their external appearance and denture function.

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