

BONE SPREADER TECHNIQUE: A PRELIMINARY 3-YEAR STUDY

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The purpose of this study was to observe the clinical outcome of bone spreading and standardized dilation of horizontally resorbed bone during immediate implant placement using a “screw-type” configuration of expansion and threadformers. Fifty-three patients were included in this study, and 41 edentulous areas in anterior and posterior maxillas were treated. Sixty-eight implants were placed using an insertion torque of at least 40 Ncm. Abutments were delivered 4 to 6 months after implant placement. The overall failure percentage was 4.41% (3 failures). A retrieved analysis of 1 implant removed at 3 years after placement demonstrated bone resorption down to the level of the third thread. The bone spreader technique is different from Summers’ osteotome, both in clinical use and in armamentarium. The main advantage of the crest-expanding technique is that it is a less invasive procedure; the facial wall expands after the medullary bone is compressed against the cortical wall. Within the limits of this preliminary study, the cumulative survival rate for this method of implant placement is 95.58% at 3 years. This study confirms that a bone spreader used in the maxilla shows an unusually low failure rate after 3 years.

Key Words: spreader, threadformer, ridge expansion, single-stage surgery

INTRODUCTION

Alveolar resorption following trauma, extraction, or infection has resulted in a ridge form with deficient width and/or height for the placement of dental implants. The advanced resorption of alveolar bone in the maxillary region is often a problem for the placement of implants. Bone volume must be available at the position needed to place a fixture. The limitations of drilling into an atrophic ridge in the maxilla constitute a challenging clinical situation. Zarb and Schmitt,¹ on the basis of clinical experience, indicated that the minimum required dimensions of bone include a ridge width

of 5 mm. Over the past few years, much effort has been placed in developing a surgical technique to overcome this problem of bone resorption. To fulfill both functional and esthetic requirements for implant placement in the residual alveolar bone, the plan may include placement of an implant in concert with ridge expansion procedures.

Several techniques have been developed for the placement of dental implants in an effort to shorten the length of treatment, avoid a second surgical appointment, reduce the use of additional surgical sites, reduce challenges to the patient, and decrease patient morbidity. Ridge augmentation procedures available for implant placement include bone grafting and bone-guided regeneration. The advantages and disadvantages of local bone grafts from the mandible have been described.²⁻⁸ A technique that would both lessen the trauma to the patient and conserve the maximum amount of alveolar bone at the site of an anticipated implant placement would offer clinical benefits.

The bone spreader technique (BST) involves horizontal augmentation with minimal trauma for simultaneous implant placement and is an alternative

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TABLE 1
Distribution of inserted implants by position and length of implant

Position of Maxilla	No. of Implants by Length of Implants						Total
	8.5 mm	10 mm	11.5 mm	13 mm	15 mm	18 mm	
Incisor	0	4	11	8	2	0	25
Canine	0	0	0	2	2	0	4
Bicuspid	0	13	18	8	0	0	39

to Summers' osteotome.⁹⁻¹⁶ BST utilizes a "screw-type" configuration of expansion and condensing burs and screw spreaders in increasing diameters for lateral bone expansion and condensing for placement of an endosseous dental implant. This technique uses a series of 6 screw spreaders with increasing diameters, which are gently introduced to expand the osteotomy site. With insertion of a larger screw spreader, the bone is pushed laterally. A control system allows for substance-saving compression of the medullary bone to a sufficient horizontal dimension. The implant should be slightly larger in diameter than the site created by the last screw spreader. The objectives of this technique are to conserve all bone in the surgical site and to selectively displace the bone laterally. Trauma and invasiveness are reduced with instrumentation through the ridge crest. The aim of the present study is to summarize materials, methods, and results derived from 3 years of clinical use of BST.

MATERIALS AND METHODS

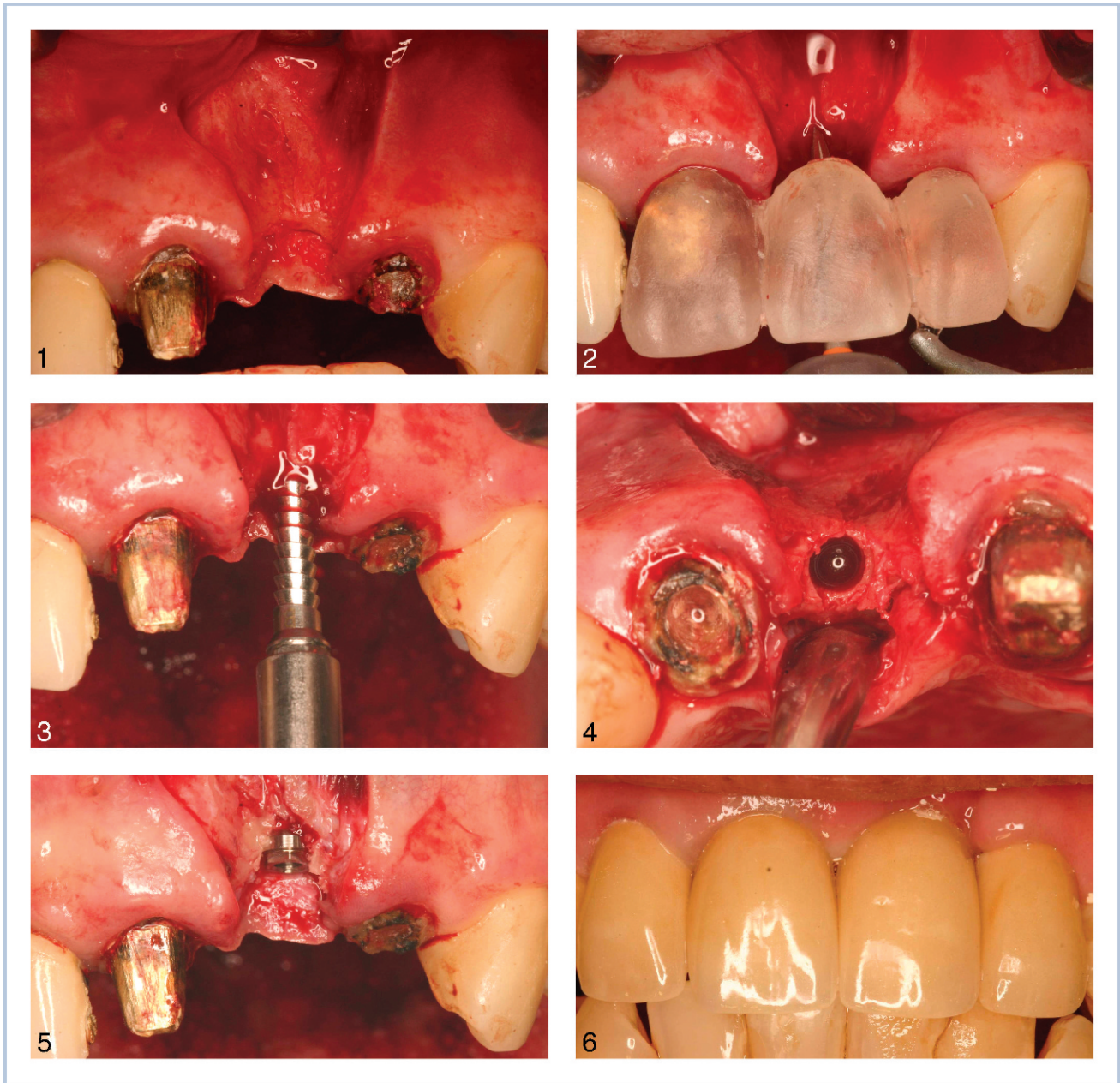
The patient population for this study consisted of 43 females and 25 males, ranging in age from 25 to 54 years. Following a thorough review of medical histories, patients were excluded if they had a history of immune disease, uncontrolled diabetes, ongoing chemotherapy, radiation therapy to the head and neck, uncontrolled periodontal disease, psychological problems, or drug abuse. Smokers were recommended to refrain from smoking for 1 month before surgery and during the healing period.

A complete examination of oral hard and soft tissues was carried out for each patient (Table 1). Preoperative standardized periapical and panoramic radiographs were taken and a cast of the maxillary arch was made to determine if there was poor bone width of the maxilla on 1 or both sides. Selection criteria included inadequate bone width (Figure 1). The computerized tomography (CT) scan was used preoperatively and during the final investigation. Diagnostic casts, diagnostic wax-ups, and surgical

acrylic templates were fabricated. It was required that the opposite jaw have a sufficient number of remaining teeth to give good occlusion. Interferences in occlusion were corrected preoperatively. The CT scan was produced with this acrylic template in place to analyze the sites for implant placement. A surgical acrylic template was used to indicate the optimal direction of the implant (Figure 2). Patients were given written information regarding the risks of the surgery, and their written informed consent was obtained. Patients were premedicated with 2.0 g of amoxicillin (semisynthetic oral penicillin) 1 hour before surgery and 500 mg, 4 times a day, for 7 days postoperatively. All implants were placed by the same operator in adherence to the same protocol. Before surgery was performed, patients were asked to rinse with .12% chlorhexidine digluconate for 1 minute. Surgical procedures were performed with the patient under local anesthesia.

After 2% mepivacaine was administered, a crestal incision was made. A buccal full-thickness flap was reflected to expose the alveolar ridge. To secure proper alignment of the implants, a surgical template was used. The proposed implant site was marked with an initial bur (1.8 mm in diameter) at 1800 rpm under copious irrigation with sterile saline, with removal of the cortical plate. The initial bur prevented the pilot bur from slipping. The pilot bur produced a sub-dimensional bone cavity, which the 2 pilot burs (diameters of 1.8 mm) penetrated to reach the desired height. Then, a series of 6 spreaders/threadformers and a condenser (Meisinger USA, Centennial, Colo) were used in succession. The diameters of the instruments were 2.7 mm (Figure 3), 2.9 mm, 3.1 mm, 3.3 mm, 3.5 mm, and 4.0 mm at 13 mm of depth. The diameter increased as the maximum length was reached.

With the help of the appropriate threadformer carrier, the threadformer was gently screwed into the bone cavity and, if necessary, a ratchet was used. This allowed slow and gradual expansion of the bone. After the implant cavity was widened in this manner, it was possible to place a suitable implant (Figure 4). Furthermore, the bone condensation provided increased bone rigidity, which resulted in improved primary stability, irrespective of the subsequent implant brand to be used. The cone morse, a self-tapping implant with a 3.75-mm diameter (Conexão Sistemas de Prótese Ltd, São Paulo, Brazil), was placed at 40 Ncm at 20 rpm (Figure 5), and a titanium cover screw was placed. Finally, the flaps were sutured in their original place. A 12% chlorhexidine digluconate oral rinse was prescribed to be used for 1 minute



FIGURES 1–6. FIGURE 1. Buccal view of missing incisive. The full-thickness flap was raised and showed bone concavity on the buccal bone. FIGURE 2. The surgical acrylic template in place to indicate the optimal direction of the implant. FIGURE 3. Initial threadformer of 2.7 mm diameter is gently screwing into the bone cavity. FIGURE 4. Widening of the implant cavity, buccal cone condensation. FIGURE 5. The implant was inserted at 40 Ncm. FIGURE 6. Prosthetic crowns.

twice a day for 2 weeks as a chemical plaque control. Nonsteroidal anti-inflammatory agents were prescribed for postsurgical analgesia. No occurrence of hematoma was reported. Most patients returned to their normal life on the day after surgery.

Patients were not allowed to use any removable prosthesis until after the sutures were removed 10 days postoperatively. After 15 days, removable pros-

theses were relined and placed for cosmetic purposes only. Patients were recalled twice during the healing period to ensure that the surgical area was free of infection and that plaque control was being maintained. Patients presented with excellent oral hygiene. The implants were allowed to heal for a minimum of 6 months before their osseointegration was assessed at the second-stage surgery and a restoration was placed

TABLE 2

Sulcus depth implant and adjacent tooth

	Implant	Adjacent Teeth
	Mean, mm	Mean, mm
Healing phase	3.0	3.0
Latest examination	4.0	3.5

subsequently. Patients were not allowed to function with these restorations throughout the regenerative phase. Survival was defined as an implant in the patient's bone with no signs of peri-implantitis, and failure was defined as a mobile implant.¹⁷

The healing cap was removed and the abutment was placed. Pocket depth was measured using gentle pressure on the probe until a slight increase in resistance was encountered. The Sulcus Bleeding Index was used to register sulcular bleeding, with the adjacent tooth used as a control. The same protocol was followed for the implant restoration. A transfer coping was mounted on the abutment and an elastomeric impression was taken. The abutment analogue was mounted on a coping for use on the working cast. Implant restoration proceeded with a single ceramometal crown or with restoration of 2 or 3 implants with a fixed partial denture (Figure 6).

The implants were deemed successful if they fulfilled Albrektsson¹⁸ criteria while under function. The occlusion contacts on the crown were registered using a 40- μ m-thick occlusion test foil.

RESULTS

No signs of peri-implantitis nor of infection were found around the implants, nor did any patients report pain or any subjective sensation; radiolucency was absent around the implant, as were clinical implant mobility, sulcus depth implant, and sulcus bleeding (Tables 2 and 3). At recall examinations, the presence of plaque around the implant was uncommon and could not be correlated with bleeding of the peri-implant mucosa. The implant sulcus was 1 mm deeper at the first reexamination appointment than at the initial registration. At the last examination, the sulcus was 1 mm deeper than at the healing phase. The bleeding index was higher for the adjacent teeth than at the implant site. Studies have claimed that peri-implant probing is a good indicator of crestal bone loss.^{19,20}

Follow-up X-ray evaluation showed a stable bone level around the base of the implants with formation of the cortical lamella.

TABLE 3

Sulcus bleeding at least examination

	Bleeding Index			
	0	1	2	3
Implant	44	13	3	0
Adjacent teeth	18	22	8	0

Sixty-two of the 68 patients were followed throughout the study period. Four patients died and 2 had moved and could not attend the follow-up examination at 3 years. Two implants failed after different durations of use. One was lost after almost 10 months of function; even though no clinical or radiologic evidence of a problem was found, when the temporary crown was substituted with a metal ceramic restoration, the implant appeared slightly mobile and was removed. One was lost after almost 1 year of function.

DISCUSSION

An atrophic maxilla provides a challenge that may affect successful osseointegration. A variety of surgical modalities have been proposed for implant reconstruction of atrophic bone, including guided bone regeneration therapy and bone grafting. This prospective study demonstrated the possibility of achieving osseointegration when placing fixtures in inadequate maxillary bone.

The objective of this study was to emphasize the surgical advantages that BST presents when compared with Summers' osteotome. Unique challenges posed by the atrophic posterior maxilla often require hard tissue augmentation in conjunction with implant placement.

The modified technique was developed on a biologically based foundation by the author in a university practice.^{21,22} The author suggested that horizontal augmentation using screw spreading was available for patients who had at least 2.5 mm of bone remaining between the facial and lingual walls. The BST allows the clinician to place implants in anatomic situations involving insufficient bone thickness. The use of screw spreaders to enhance the dental implant site is a highly predictable procedure and a relatively complication-free therapeutic option. This noninvasive technique can enhance effective bone quality for a site of primary stabilization, moving the external cortical plate of the maxilla in the labial and palatal directions to increase ridge width to allow introduction of implants of appropriate diameter. Improvements in

techniques using screw spreaders appear promising for increasing the bone width of a ridge. All fixtures in the present study achieved strong primary stability with a suitable bone-to-implant facial and palatal contact when the spreading technique was used. This technique represents a means of shortening surgical time, lessening the financial cost of treatment, and limiting surgical trauma to the patient.

Summers described a technique^{9–15} in which round tapered osteotomes with diameters increasing from 1 to 4 mm were used. By tapping the instruments, the lateral wall of the bone can be compressed, while bone is conserved because no drilling takes place. The osteotomes are malleted into the predetermined implant site, with the disadvantages of applied force and repeated malleting, which can be disconcerting to the patient. The crucial difference between Summers' osteotome technique and the current technique is that the spreader/threadformer used in the present study did not present discomfort to the patient, thus eliminating the need for extensive malleting.^{21–23} The author's clinical observations revealed no complications.

The current authors agree with Summers' technique with regard to the importance of obtaining a tight fit of the fixture within the bone. The osteotome technique improves the bone density of the premolar and molar areas, where Type 4 bone normally is found.⁹ For the surgeon, the choice of technique in each case has been based on specific indication criteria because these techniques differ in how invasive and time consuming they are. Patient acceptance of BST has been very high. Five patients who had implants placed with both the BST and Summers' osteotome preferred the BST technique.

The very short observation period may contribute to the lack of failure and the good percentage of success shown for the spreading technique; therefore, this result must be considered as preliminary. Because of the nature of the treatment modality, a rather long follow-up period of 3 years seemed appropriate. BST seems to be a promising therapy for situations involving insufficient bone thickness.

CONCLUSION

BST offers several advantages over Summers' traditional technique, with the screw spreader procedure allowing the relative atraumatic placement of an implant.

This surgical modality is a predictable procedure when patient selection and surgical technique are appropriate. With the BST, it is possible to place

implants even when minimal horizontal bone is available. Despite the small number of implants placed in this study, the results suggest that BST may be a predictable method for dealing with insufficient bone thickness in the maxilla.

DISCLOSURE

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

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