Two-Stage Crestal Sinus Elevation by Sequential Drills in Less Than 4 mm of Residual Ridge Height: A Clinical and Histologic Case Report

Fabio Bernardello, MD, DDS,* Enrico Massaron, DDS,* Sergio Spinato, DDS,† and Davide Zaffe, MBioSc§

Purpose: *The aim of this work, the first human histologic case report of this technique, was a clinical and histologic evaluation of implant placed in a severely atrophic maxilla using a 2-stage crestal sinus elevation.*

Case Presentation: *A 52-year-old woman required rehabilitation of an atrophic maxilla with a fixed implant-supported prosthesis. At the first surgery, a crestal sinus lift was performed using beta-tricalcium phosphate (β-TCP), as radiographic tracer, and mineralized human bone allograft (MHBA) as grafting material. After 6 months, a bone core biopsy was taken, and 2 implants were placed in the augmented sites. Four months later, implants were exposed, and 2 splinted gold-porcelain crowns were delivered. Histology highlighted basal bone disappearance, replaced by a wide composite network (~50% vol/vol) of MHBA granules connected by newly formed bone, and osteoblastic activities.*

Conclusion: *This case report demonstrates the possibility of executing a staged transcrestal sinus lift in atrophic situations. MHBA evidenced usefulness in maintaining bone volume. Histologic analyses confirmed the sound outcome of the graft augmentation. Additional studies would be beneficial to confirm or refute the reliability of this technique. (Implant Dent 2014;23:378–386)*

Key Words: histology, 2-stage crestal sinus lift

Resorption and pneumatization of alveolar ridges are common occurrences in the posterior maxilla after tooth extraction. These may cause not only a quantitative reduction but also a qualitative deterioration of bone leading to a skeletal segment inadequate for implant placement. In these situations, the residual vertical bone height is reduced making standard implant placement difficult.

More than 30 years ago, Boyne and James[1] introduced the maxillary sinus augmentation by lateral approach, a modification of the known sinus revision procedure according to Caldwell-Luc, to allow proper implant insertion into an atrophic maxillary posterior bone crest. Subsequently, sinus augmentation with lateral access has been widely studied depicting this technique as a safe and highly predictable treatment.[2–8]

In 1986, a crestal approach for sinus floor elevation was initially suggested by Tatum.[9] Summers,[10] 8 years later, proposed the osteotome technique to place implants in a simpler, more conservative and less invasive manner than the lateral approach.[11] Subsequently, some authors suggested modifications to Summers' technique based specifically on the use of different biomaterials and on the expansion and compression of the alveolar crest to lift the sinus floor of the maxilla.[12,13]

At the beginning of 2000, some authors proposed a 1-stage technique using a specific sequence of drills[14–16] or an ultrasonic piezoelectric device.[17,18] These crestal techniques also demonstrated to be safe and highly predictable treatments when residual bone height was 5 mm or more.[19] Some studies suggested that residual bone height had a significant influence on the outcome of crestal procedures.[20,21] Specifically, success and survival rates decrease with reduced residual bone height.[22] Nevertheless, more recent multicenter studies demonstrated that the residual bone height did not reduce the success rate of the implants and associated prostheses,

*Private Practice, Terranegra, Italy.
†Adjunct Professor, Department of Biomedical and Neuromotor Sciences, School of Dentistry, Unit of Periodontology and Implantology, University of Bologna, Bologna, Italy.
§Associate Professor of Human Anatomy, Department of Biomedical, Metabolic and Neural Sciences, Human Morphology Section, University of Modena and Reggio Emilia, Modena, Italy.

Reprint requests and correspondence to: Davide Zaffe, MBioSc, Dip. Scienze Biomediche, Metaboliche e Neuroscienze, Sez. di Morfologia Umana, Via del pozzo 71, Policlinico, 41124 Modena, Italy, Phone: +39 0594224804, Fax: +39 0594224861, E-mail: davide.zaffe@unimore.it

ISSN 1056-6163/14/02304-378
Implant Dentistry
Volume 23 • Number 4

DOI: 10.1097/ID.0000000000000120

and that the crestal approach should be considered a viable technique also for use in patients with residual bone height of ≤5 mm.[23,24] Nevertheless, the ability to ensure high primary implant stability in a severely atrophic ridge is of primary concern. Therefore, a staged crestal technique is recommended in these situations.

However, to the best of our knowledge, very limited information is available regarding the clinical outcomes of the 2-stage crestal sinus lift technique,[25,26] and no histologic evaluations are reported in the literature.

The aim of this case report is a 1-year clinical and radiographic evaluation of implants placed in a severely atrophic maxillary ridge using a 2-stage sinus elevation crestal approach (Cosci's technique). Histologic analysis of bone remodeling after using a mixed mineralized graft [mineralized human bone allograft {MHBA} plus beta-tricalcium phosphate {β-TCP}] in the augmented maxillary sinus was performed.

CASE REPORT

A 52-year-old woman was referred to a private practice for rehabilitation of teeth #13 and #14, which had been extracted 3 months and 7 years before, respectively. The patient required rehabilitation of the edentulous area with a fixed implant-supported prosthesis. The patient exhibited moderate chronic periodontitis and was consequently treated with nonsurgical therapy. In each of the 4 quadrants, treatment was performed weekly over a 1-month period before implant placement. The patient signed an informed consent in which all study procedures were detailed according to 2008 Helsinki protocols and ethical requirements.[27]

A reevaluation of the patient's periodontal condition confirmed good oral hygiene and motivation. Periapical digital radiographs (CSN Industrie, Cinisello Balsamo, Italy) (Fig. 1, A) and cone beam computerized tomography (CBCT) (Gendex Dental Systems, Hatfield, PA) obtained before surgery revealed inadequate bone volume to support the fixtures. On site #13, the available height of bone below the sinus floor was initially 6.5 mm, considered

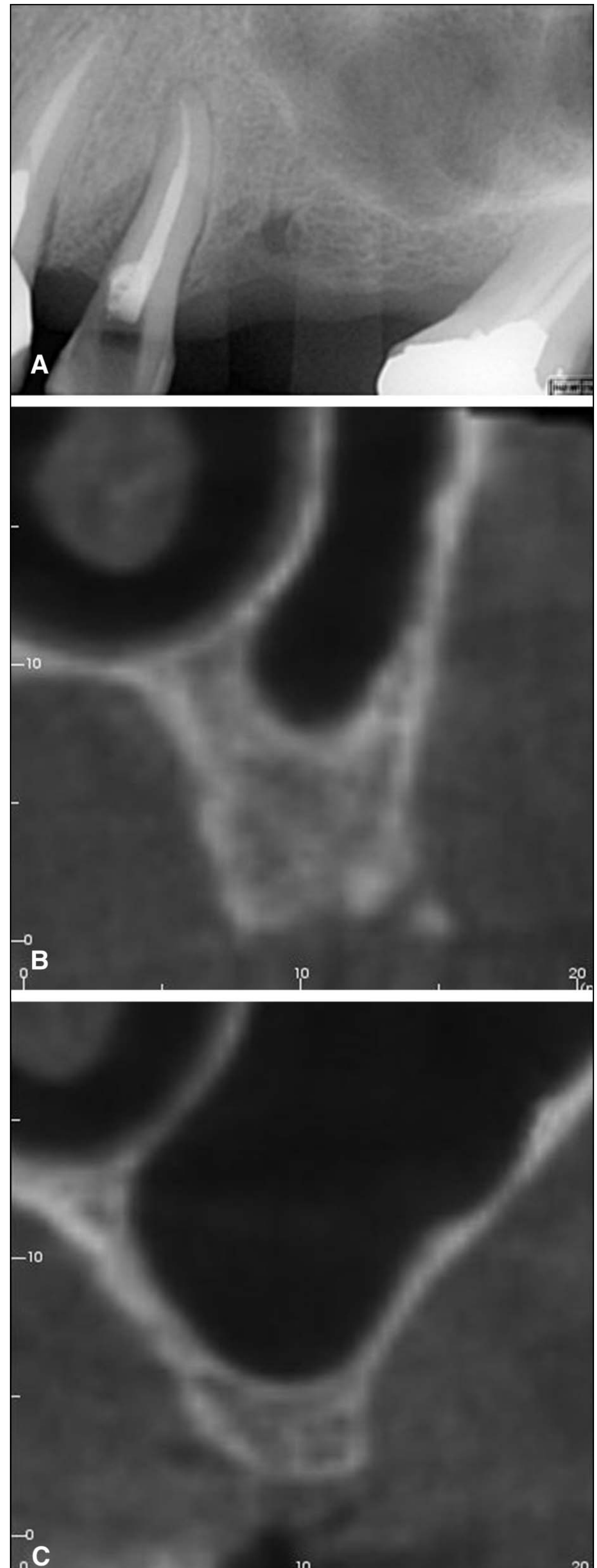

Fig. 1. A, Preoperative endoral radiography. CBCT images of bone availability of site #13 (**B**) and #14 (**C**).

adequate for a crestal sinus lift with simultaneous implant insertion (Fig. 1, B). However, after extraction, the socket did not heal ideally, and the formation of new bone did not appear complete. On site #14, the height of available bone was only 3.2 mm, adequate for transcrestal sinus lift, but hazardous for contextual implant insertion (Fig. 1, C). Consequently, the first surgical stage of the crestal sinus lift of both sites was planned, to develop the edentulous area for a delayed implant insertion.

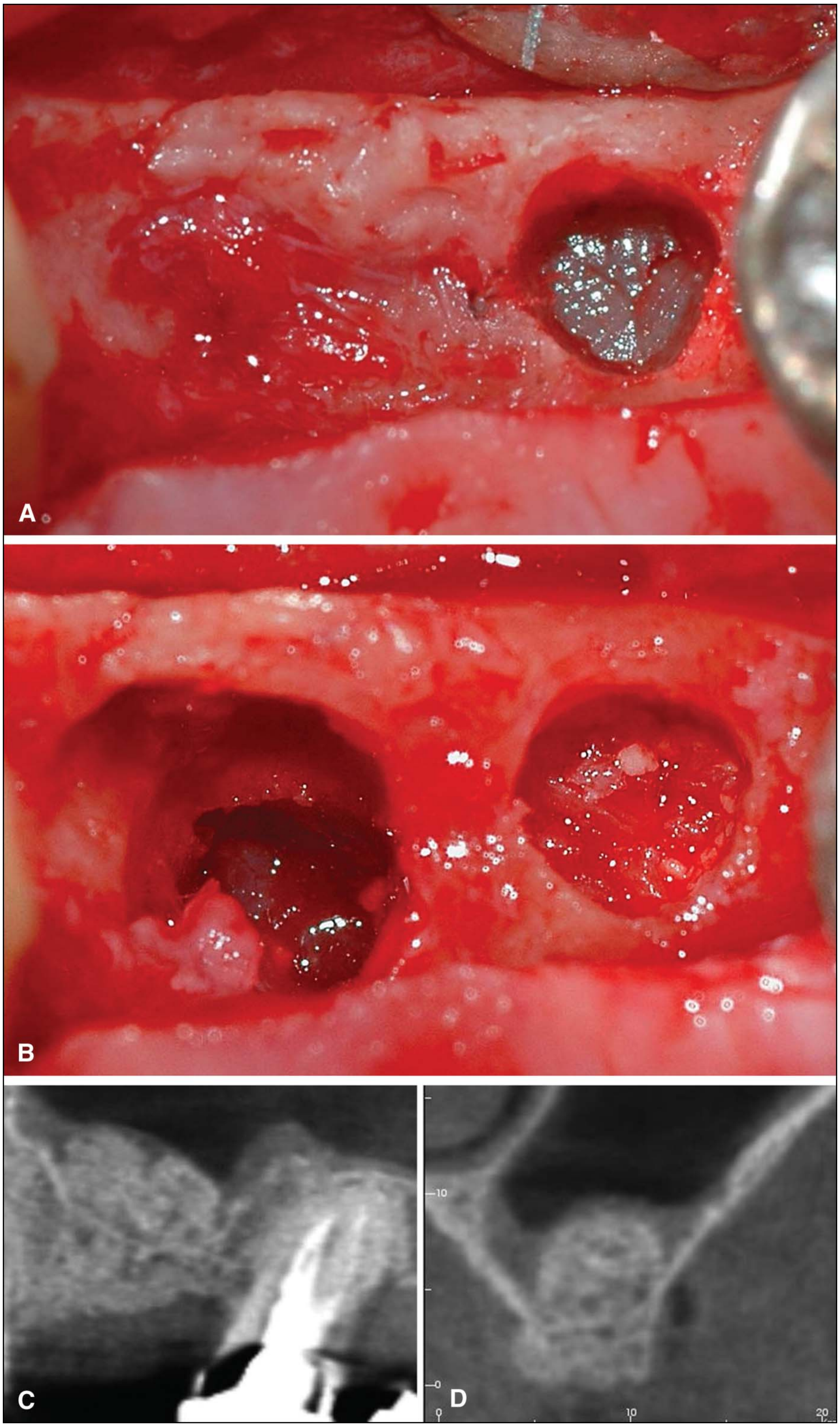

Fig. 2. Views of Schneider membrane integrity in site #14 (**A**) and membrane detachment in incompletely healed site #13 (**B**). **C**, Postsurgical CBCT of augmented area. **D**, Detail of the most atrophic site (#14) after crestal sinus lift.

First Surgery

After preventive antibiotic medication, under local anesthesia, a crestal incision without releasing incisions was made. A flap was elevated, and a transcrestal sinus lift (Cosci's technique) was performed in both sites. This sequential crestal approach is based on the usage of specific sequential drills of 3.1 mm in diameter and increasing length from 2 to 12 mm. The tips of these drills are characterized by a smooth cutting angle that permits gentle removal of cortical bone of the sinus floor with reduced risk of fracturing. The specific shape of the tips also preserves Schneider membrane integrity during contact. (Fig. 2, A).

The crestal sinus lift was obtained first by the insertion of a collagen sponge into the osteotomies to begin Schneiderian membrane elevation and protect the membrane from the possible roughness of graft particles. First, a small amount (about 100 μL) of β-TCP (Cerasorb Plus, Riemser, Germany) was inserted. β-TCP is a radiopaque calcium-phosphate ceramic that allows radiographic checking of membrane integrity. After verification of absence of perforations, the remaining portion of the lift was completed using a cortical MBHA (Oragraft cortical 250–1000 μm; LifeNet Health Inc., Virginia Beach, VA) (Fig. 2, B). After sinus lift (Fig. 2, C and D), the new bone heights were 11.3 mm (#13) and 9.4 mm (#14). MHBA particles were also used to correct incomplete crestal bone formation on site #13 by means of guided bone regeneration using a resorbable collagen membrane. The elevated flap was sutured, and the stitches were removed 7 days later. No complications were apparent and healing of the sites was

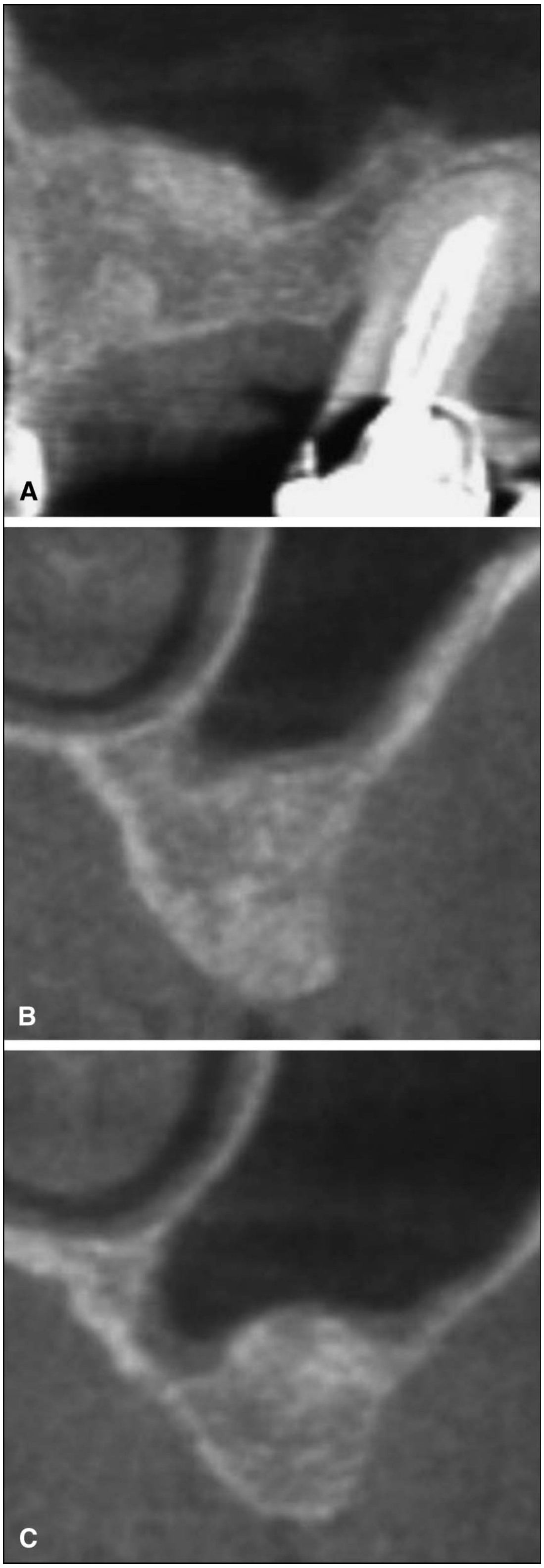

Fig. 3. A, CBCT after 6-month healing. Regenerated bone before implant insertion in site #13 (**B**) and #14 (**C**).

checked monthly with endoral radiographs.

Second Surgery

After 6 months endoral radiographs and CBCT confirmed good graft remodeling in the lifted areas (Fig. 3, A) with bone height in both sites (9.8 mm in site #13 and 8.4 mm in site #14) (Fig. 3, B and C) adequate to proceed with the second surgery. Specifically, more than 5 mm of bone gain was observed in the most atrophic site (#14).

Under local anesthesia, a simple crestal incision without releasing incisions was performed and a flap elevated. Different site preparations were performed on #13 and #14. Cosci drills (3.1 mm external diameter) were used to complete the former. Under saline irrigation, bone harvesting was performed using a trephine drill (4 mm external and 3 mm internal diameter) on the latter. An additional minimal crestal sinus lift (Fig. 4, A and B) was obtained by filling the osteotomies with a collagen sponge and a small amount of β-TCP on both sites. Tapered implants (Shape1; I-RES, Milano, Italy), 10 mm length, were inserted into sites #13 and #14 (4.1 and 4.7 mm diameter, respectively). Both implants were placed in an adequate 3D position with insertion torque of 35 to 40 N·cm.

On site #14, the harvested core biopsy was immediately rinsed in sterile saline, gently wiped, labeled on the crestal (periosteal) surface by China (black) ink-pad blotting, then fixed in 4% of paraformaldehyde (Fluka; Sigma-Aldrich Schweiz, Buchs, Switzerland) in 0.1 M phosphate buffer pH 7.2, for 4 hours at room temperature, for the histologic study.

Follow-up of the patient was uneventful and monthly x-ray examinations confirmed good healing. Four months after implant insertion, implants were surgically exposed. Two splinted gold-porcelain crowns were delivered after 5 weeks of soft tissue healing (Fig. 5, A and B), and after 1 year of loading, no problems were recorded (Fig. 5, C).

Histologic Preparation

The fixed core biopsy was dehydrated through ethanol series at 4°C and

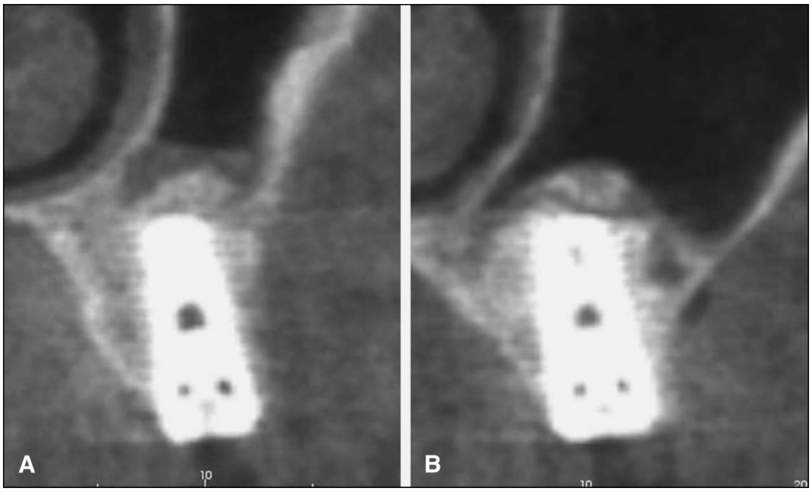

Fig. 4. CBCT after implant insertion showing an additional transcrestal membrane elevation in site #13 (**A**) and #14 (**B**).

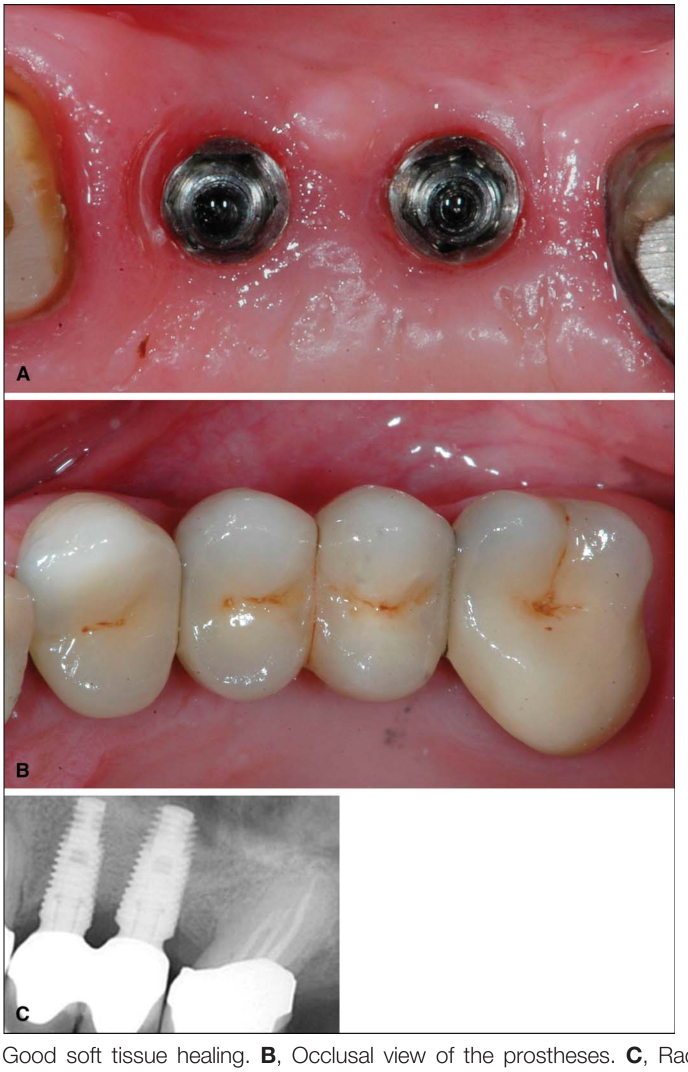

Fig. 5. **A**, Good soft tissue healing. **B**, Occlusal view of the prostheses. **C**, Radiographic check after 1 year of loading.

subsequently embedded in methyl methacrylate (PMMA) using a water bath at 4°C as described elsewhere.[28]

The PMMA block was sectioned to obtain 2 sets of sections: thick (100 μm thick) and thin (5 μm thick) sections. First, the PMMA block was serially sectioned along the longitudinal axis of the cylindrical bone sample to its center using a diamond saw microtome (SP1600; Leica Microsystem, Nußloch, Germany). A thick section (200 μm) was obtained from the center of cylindrical sample using the diamond saw microtome. This section was reduced to 100 μm by grinding, perfectly polished with emery paper and alumina, and then x-ray microradiographed (3K5; Ital Structures, Riva del Garda, Italy) at 15 kV and 10 mA on high-resolution film (SO 343; Eastman Kodak Co., Rochester, NY).

A set of 5-μm thick sections was obtained starting from the level at which the thick section was performed, using a tungsten carbide knife (profile D) on a bone microtome (Autocut 1150; Reichert-Jung GmbH, Nußloch, Germany). Thin sections were stained with toluidine blue or trichrome Gomori stain.[29] The microradiographs and the sections were analyzed and photographed using a microscope (Axiophot; Carl Zeiss AG, Oberkochen, Germany) under ordinary light.

The surface of the remaining part of the PMMA block was perfectly polished and analyzed under SEM (ESEM Quanta 200; FEI, Eindhoven, the Netherlands), using the back-scattered electron detector, and x-ray microprobe (INCA; Oxford instruments, Abingdon, United Kingdom) at low vacuum.[29]

Histologic Outcome

Histology highlighted that the biopsy was made from a composite of ceramics and bone (Fig. 6, A). The histomorphometric analysis returned a content of 18.4% bone and 30.8% ceramics. Probably because of the crestal technique, the biopsy resulted almost totally lacking in native bone. The appositional bone sometimes had a woven structure but frequently a lamellar structure at the periosteal end of the biopsy (Fig. 6, D). New

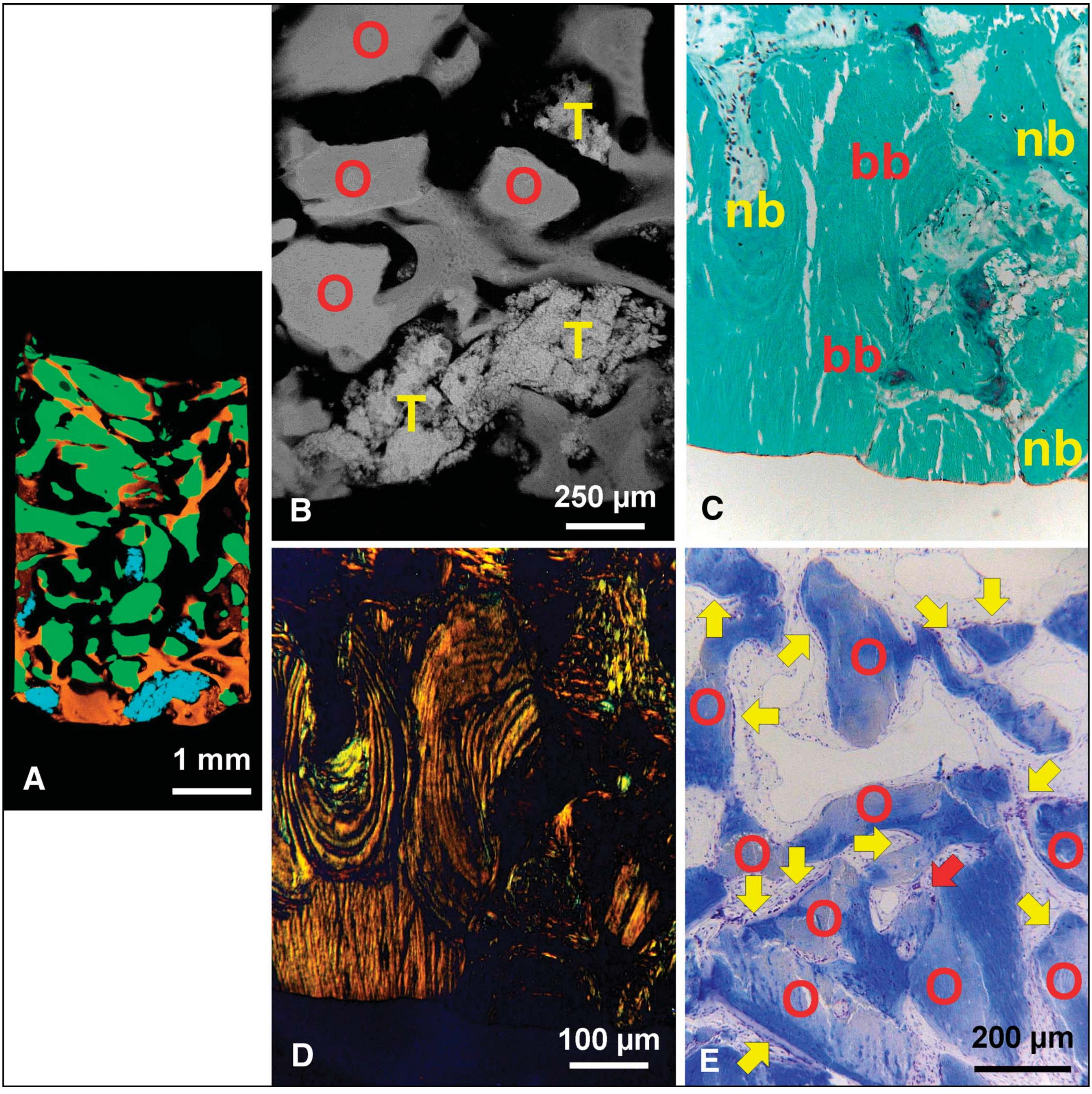

Fig. 6. **A**, Microradiograph of the biopsy in false colors (cyan = TCP, green = Oragraft, orange = bone). Images of sections of the biopsy-periosteal side: microradiograph (**B**), trichrome Gomori-stained (**C**, ordinary light and **D**, polarized light). **E**, Section of the biopsy-inner side, toluidine blue stained. Note on panel **B** how the bone contacts almost all Oragraft granules (O), whereas TCP (T) results poorly in contact with bone. The new bone (nb) has normally a woven structure, even if sometime may have a lamellar structure as the basal bone (bb). The yellow arrows in panel **E** point to the several osteoblast layers, which increase the size of the bone (dark blue) formed in apposition to the Oragraft (O) surface. The red arrow points to 2 osteoclasts in eroding an Oragraft granule.

bone seemed to have formed in apposition to remnants of native bone (Figs. 6B and 7B). This new bone surrounded the β-TCP granules without contacting them (Figs. 6B and 7B). On the contrary, several short bone trabeculae were formed to connect the MHBA particles thus transforming the biopsy content into a network of MHBA-bone (Figs. 6E and 7C). Several active osteoblast layers were found in the Schneiderian half of the biopsy, engaged in increasing the thickness of the bone trabeculae (Fig. 6E). Few osteoclasts were instead found to be engaged in

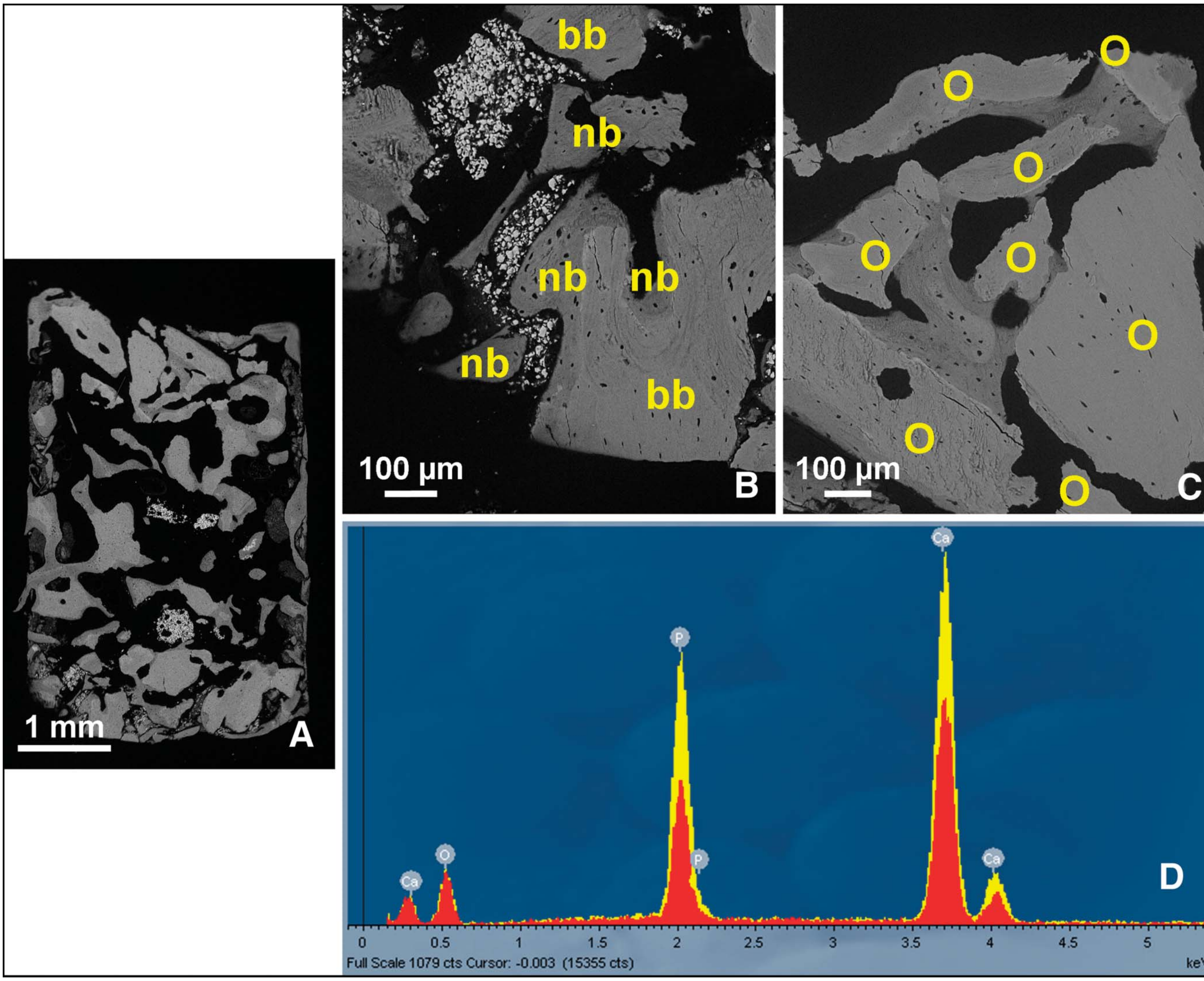

Fig. 7. Back-scattered scanning electron microscope images of the biopsy (**A**), its periosteal (**B**), and inner (**C**) sides. **D**, X-ray microanalysis spectrum of TCP (yellow) and of the new bone (red—superimposed). Note on panel **B** how the new bone (nb), formed in apposition to the basal bone (bb) or not, hardly contacts the TCP granules (white). On the contrary, panel **C** highlights the several bone trabeculae which link Oragraph granules (O) transforming the mineralized content of the biopsy in a composite network. Referring to the corresponding Ca peak, note how the P peak of TCP (yellow) results relatively more extended (+surface = +content) than those of bone (red), so causing a lower Ca/P rate.

resorbing the graft or bone (Fig. 6E). Beyond any morphological (microradiographic or backscattered SEM) identification, the quantitative x-ray analysis, performed using a fragment of $CaHPO_4 \cdot 2H_2O$ as a standard, confirmed the chemical composition of the components forming the biopsy, with Ca/P rates very close to the theoretic values (Table 1).

Table 1. Calcium and Phosphorus Content of the Biopsy Parts After Quantitative X-ray Microanalysis, Performed Using as Standard a Fragment of $CaHPO_4 \cdot 2H_2O$

	Calcium	Phosphorus	Ca/P
TCP	38.8	20.0	1.94
MHBA	28.3	13.3	2.13
Native bone	25.7	12.2	2.11
New bone	24.3	11.7	2.08

Discussion

Lateral access is a widely documented, highly predictable, and effective technique for maxillary sinus floor augmentations and allows for remarkable increases of bone thickness of 10 to 12 mm,[30] in the presence of markedly atrophic ridges.[6–8] Transalveolar sinus elevation techniques have been considered safe and predictable if performed in ridges with residual alveolar bone of at least 5 mm.[19–21] Recent studies have shown an implant survival rate similar to that of implants inserted in nonaugmented sites, also in the presence of minimal residual bone height (lower than 5 mm).[23,24]

The crestal approach is more conservative than the lateral one. In fact, in residual alveolar bone height from 3 to 6 mm, a transalveolar procedure may lead to less complications and less postoperative morbidity than lateral window technique.[31]

Some authors suggested, for extremely atrophic ridges, a staged osteotome crestal technique to develop the site in the first surgical phase allowing to achieve good primary implant stability in the second delayed surgical stage.[25,26,32]

Nevertheless, comparing the Cosci (sequential drills mediated) and the Summers (osteotome mediated) techniques, the former requires less surgical time, produces less intraoperatory and postoperative morbidity and is therefore preferred by patients.[16]

For these reasons, the authors selected this sequential approach to obtain a safe sinus lift with the minimal discomfort for the patient. The difficulty to obtain reassuring primary implant stability, starting from a ridge of less than 4 mm, suggested to the authors to perform a 2-stage crestal augmentation procedure as well established by Bruschi et al.[32] In the presence of a residual bone height of 2.11 mm, these authors performed a staged transcrestal sinus floor elevation without the use of bone grafts obtaining 5 mm of endo-sinus bone gain at implant placement appointment 3 months after the first surgical phase. In the present case report, using a composed graft, a similar amount of bone gain was assessed.

The necessity of the use of grafts for sinus elevation procedures is controversial. Some authors described successful sinus floor elevation without the use of grafts also using transalveolar technique.[33] However, the achievable bone gain after crestal sinus lift without graft is limited (1.7 mm),[34] whereas using a graft more significant bone gain (4–6 mm) is reported.[23,34]

The lack of implant insertion during the first surgical step could lead to a greater graft shrinkage. For this reason, a slow resorption graft material was used to avoid the collapse of the augmented site and its repneumatization. β-TCP and MHBA resorb at a relatively slow rate and effectively maintain the sinus membrane elevated throughout the 6-month bone remodeling phase. The use of β-TCP and MHBA used for the sinus augmentation avoided the necessity of the second surgical site, permitting a more comfortable postoperative healing period. Moreover, the use of β-TCP, a clear radio-opaque graft, allows to check sinus membrane integrity during the augmentation procedure initial phase. The possibility to radiologically detect possible membrane perforations during the first phases of the lift is important considering the fact that transcrestal techniques are blind approaches.

CONCLUSION

The results of this case report demonstrates the possibility to carry out a staged transcrestal sinus lift using sequential drills in very atrophic situations. The use of MHBA and β-TCP has proven to be useful in maintaining bone volume in the regenerated area, avoiding autologous bone harvesting, and for checking membrane integrity. Histologic analyses confirmed that the biopsy consists of a mineralized composite network, reaching a considerable amount (close to 50%), with a content improved because of the osteoblast activity. An additional case series study would be beneficial to confirm, or refute the reliability of this staged trancrestal sequential technique.

DISCLOSURE

The authors claim to have no financial interest, either directly or indirectly, in the products or information listed in the article.

ACKNOWLEDGMENTS

The authors thank Andrea Colla, Albino Martinelli, and Danilo Azzolini (Laboratorio MC Dental, San Bonifacio, Verona, Italy) for their technical contribution.

REFERENCES

1. Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. *J Oral Surg.* 1980;38: 613–616.
2. Block MS, Kent JN, Kallukaran FU, et al. Bone maintenance 5 to 10 years after sinus grafting. *J Oral Maxillofac Surg.* 1998;56:706–714.
3. Wallace SS, Froum SJ. Effect of maxillary sinus augmentation on the survival of endosseous dental implants as compared to the survival of implants placed in the non-grafted posterior maxilla: An evidence based literature review. *Ann Periodontol.* 2003;8:328–343.
4. Del Fabbro M, Testori T, Francetti L, et al. Systematic review of survival rates for implants placed in the grafted maxillary sinus. *Int J Periodontics Restorative Dent.* 2004;24:565–577.
5. Aghaloo TL, Moy PK. Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement? *Int J Oral Maxillofac Implants.* 2007;22:49–70.
6. Pjetursson BE, Tan WC, Zwahlen M, et al. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. *J Clin Periodontol.* 2008; 35:216–240.
7. Chiapasco M, Casentini P, Zaniboni M. Bone augmentation procedures in implant dentistry. *Int J Oral Maxillofac Implants.* 2009;24:237–259.
8. Soardi CM, Spinato S, Zaffe D, et al. Atrophic maxillary floor augmentation by mineralized human bone allograft in sinuses of different size: An histologic and histomorphometric analysis. *Clin Oral Implants Res.* 2011;22:560–566.
9. Tatum H. Maxillary and sinus implant reconstructions. *Dent Clin North Am.* 1986;30:207–229.
10. Summers RB. A new concept in the maxillary implant surgery: The osteotome technique. *Compend Contin Educ Dent.* 1994;15:152–160.
11. Summers RB. The osteotome technique: Part 3. Less invasive methods of elevating sinus floor. *Compendium.* 1994;15:698–708.
12. Bruschi GB, Scipioni A, Calesini G, et al. Localized management of the sinus floor with simultaneous implant placement: A clinical report. *Int J Oral Maxillofac Implants.* 1998;13:219–226.
13. Fugazzotto PA. The modified trephine/osteotome sinus augmentation technique: Technical considerations and

discussion of indications. *Implant Dent.* 2001;10:259–264.

14. Cosci F, Luccioli M. A new sinus lift technique in conjunction with placement of 265 implants: A 6-year retrospective study. *Implant Dent.* 2000;9:363–368.

15. Soardi E, Cosci F, Checchi V, et al. Radiographic analysis of a transalveolar sinus-lift technique: A multipractice retrospective study with a mean follow-up of 5 years. *J Periodontol.* 2013;84:1039–1047.

16. Checchi L, Felice P, Antonini ES, et al. Crestal sinus lift for implant rehabilitation: a randomized clinical trial comparing the Cosci and the Summers techniques. A preliminary report on complications and patient reference. *Eur J Oral Implantol.* 2010;3:221–232.

17. Ping-Yuen F. Piezoelectric-assisted osteotome-mediated sinus floor elevation: An innovative approach. *Implant Dent.* 2010;19:299–305.

18. Kim JM, Sohn DS, Heo JU, et al. Minimally invasive sinus augmentation using ultrasonic piezoelectric vibration and hydraulic pressure: A multicenter retrospective study. *Implant Dent.* 2012;21: 536–542.

19. Rosen PS, Summers R, Mellado JR, et al. The bone-added osteotome sinus floor elevation technique: Multicenter retrospective report of consecutively treated patients. *Int J Oral Maxillofac Implants.* 1999;14:853–858.

20. Emmerich D, Att W, Stappert C. Sinus floor elevation using osteotomes: A systematic review and meta-analysis. *J Periodontol.* 2005;76:1237–1251.

21. Tan WC, Lang NP, Zwahlen M, et al. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. Part II: Transalveolar technique. *J Clin Periodontol.* 2008;35: 241–254.

22. Del Fabbro M, Corbella S, Weinstein T, et al. Implant survival rates after osteotome-mediated maxillary sinus augmentation: A systematic review. *Clin Implant Dent Relat Res.* 2012;14:e159–e168.

23. Bernardello F, Righi D, Cosci F, et al. Crestal sinus lift with sequential drills and simultaneous implant placement in sites with less than 5 mm of native bone. A multicenter retrospective study. *Implant Dent* 2011;20:439–444.

24. Gonzalez S, Tuan MC, Ahn KM, et al. Crestal approach for maxillary sinus augmentation in patients with ≤4 mm of residual alveolar bone. *Clin Implant Dent Relat Res.* 2013;4. doi: 10.1111/cid. 12067. [Epub ahead of print].

25. Summers RB. The osteotome technique: Part 4. Future site development. *Compend Contin Educ Dent.* 1995;16:1090–1099.

26. Kang T. Sinus elevation using a staged osteotome technique for site development prior to implant placement in sites with less than 5 mm of native bone: A case report. *Int J Periodontics Restorative Dent.* 2008;28:73–81.

27. Puri K, Suresh K, Gogtay N, et al. Declaration of Helsinki, 2008: Implications for stakeholders in research. *J Postgrad Med.* 2009;55:131–134.

28. Bertoldi C, Zaffe D, Consolo U. Polylactide/polyglycolide copolymer in bone defect healing in humans. *Biomaterials*. 2008;29:1817–1823.

29. Zaffe D, D'Avenia F. A novel bone scraper for intraoral harvesting: A device for filling small bone defects. *Clin Oral Implants Res.* 2007;18:525–533.

30. Zitzmann NU, Scharer P. Sinus elevation procedures in the reabsorbed posterior maxilla. Comparison of the crestal and lateral approaches. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1998;85:8–17.

31. Esposito M, Grusovin MG, Rees J, et al. Effectiveness of sinus lift procedures for dental implant rehabilitation: A Cochrane systematic review. *Eur J Oral Implantol.* 2010;3:7–26.

32. Bruschi G, Crespi R, Capparè P, et al. Transcrestal sinus floor elevation: A retrospective study of 46 patients up to 16 years. *Clin Implant Dent Relat Res.* 2012; 14:759–767.

33. Nedir R, Nurdin N, Szmukler-Moncler S, et al. Placement of tapered implants using an osteotome sinus floor elevation technique without bone grafting: 1-year results. *Int J Oral Maxillofac Implants.* 2009;24:727–733.

34. Pjetursson B, Ignjatovic D, Matuliene G, et al. Maxillary sinus floor elevation using the (transalveolar) osteotome technique with or without grafting material. Part II: Radiographic tissue remodeling. *Clin Oral Implant Res.* 2009; 20:677–683.