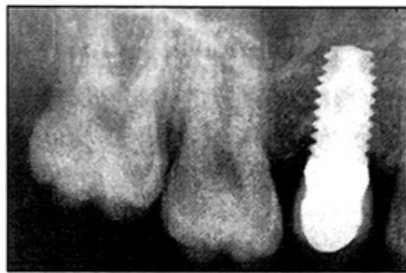


Ten year Follow-up of Implant Supported Restorations Combined with Osteotome Sinus Floor Elevation: A Clinical Report

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Abstract



Background: Posterior alveolar bone resorption associated with increased maxillary sinus pneumatization often leaves insufficient bone for implant anchorage. In such cases, a sinus floor elevation may be indicated to provide sufficient bone volume for an implant-supported restoration.

Methods: The aim of this paper was to describe the long term follow-up of implant-supported restorations replacing congenitally missing maxillary second premolars associated with vertically reduced bone volume and to review the literature on success

rate of implants inserted in combination with sinus floor elevation through a crestal approach.

Results: In the present clinical report the increased maxillary sinus pneumatization required a bilateral sinus floor elevation with a crestal approach using osteotomes to allow the placement of two endosseous implants.

Conclusions: The implant-supported restorations were followed for 10-years after loading and successfully maintained with a good functional and esthetic outcome.

KEY WORDS: Dental implants, maxillary sinus, close sinus lift, osteotome

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INTRODUCTION

The high concentration of functional and para-functional forces in the maxillary posterior regions requires implants of adequate diameter and length. A progressive maxillary sinus pneumatization often occurs after tooth extraction involving both sinus floor and lateral walls reducing the available crestal bone dimension. This three-dimensional expansion process may reduce the possibility of predictable implant-supported restorations.¹⁻³ Furthermore the volumetric reduction of the alveolar crests can be associated with structural bone changes such as cortical components are replaced by low density trabeculae.^{4,5} This poor bone density (Type III/IV according to Lekholm and Zarb scale⁶) can amplify the quantitative limitations, compromising the successful outcome of the implant treatment.⁵

Boyne and Tatum^{7,8} described a technique for accessing the maxillary sinus from a lateral bone window. This technique involved the apical-lateral displacement of the sinus membrane and the placement of a bone-grafting material to improve the amount of bone volume. A transalveolar technique for sinus floor elevation with subsequent placement of implants was first suggested by Tatum.⁹ Utilizing this approach, a "socket former" for the selected implant size was used to prepare the implant site. A "greenstick fracture" of the sinus floor was accomplished by hand tapping the "socket former" in the vertical direction. After preparation of the implant site, a root-formed implant was placed.

In the presence of a residual bone crest higher than 5mm, Summers⁹⁻¹¹ presented another technique for sinus floor elevation with simultaneous grafting and immediate



Figure 1: Occlusal view of retained maxillary deciduous second molars.

implant placement. This technique involves a crestal approach leading to a localized and targeted sinus elevation. A gentle fracture of the sinus floor is induced by using a series of specific hand instruments (osteotomes) of varying diameters without preparing a lateral window. Furthermore, according to Summers, the use of osteotomes seemed to induce an increase in bone density providing a higher primary implant stability. Several studies showed the clinical success of the Summers procedure confirming that the implant placement associated with sinus floor elevation is a predictable and reliable technique for implant-supported restorations.¹²⁻²²

Rosen et al²³ in a multicentre retrospective study that evaluated the application of the "Summers technique" for placement of 174 implants in 101 patients, reported a survival rate of 96% when residual bone height was 5mm or more, declining to 85.7% when residual bone height was 4mm or less. In another study of Ferrigno et al,²⁴ the survival and suc-

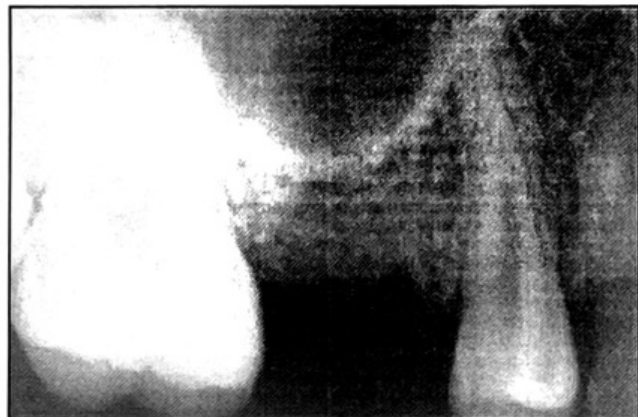


Figure 2A: Preoperative periapical radiographs of right deciduous second premolar showing insufficient alveolar bone for implant-supported restorations.



Figure 2B: Preoperative periapical radiographs of left deciduous second premolar showing insufficient alveolar bone for implant-supported restorations.

cess rates of 588 ITI implants (Institute Straumann, Waldenburg, Switzerland) placed in conjunction with osteotome sinus floor elevation in 323 consecutive patients with a residual bone height ranging from 6 to 9mm, were analyzed. After a mean observation period of 5 years, the survival and success rates were 94.8% and 90.8%, respectively. Moreover, Emmerich et al²⁵ in their systematic review and meta-analysis of the literature evaluated the effectiveness of the procedure showing that 3-year clinical success/survival rate of implants placed with the osteotome sinus floor elevation technique seems to be similar to that of implants conventionally placed in the partially edentulous maxilla (96%). However, the authors mentioned that the long-term (> 5 years) outcome of implants placed with this technique was not well documented. Recently Than et al²⁶ in a systematic review and meta-analysis including around 2,830 patients and 4,388 implants inserted in sites with transalveolar sinus floor elevation, reported a survival rate of

92.8% after 3 years in function. According to the authors this technique is predictable with a low incidence of complications during and post-operatively. In the present clinical report, the long-term follow-up of implant-supported restorations combined with osteotome sinus floor elevation is described in a case of congenitally missing maxillary second premolars.

CASE REPORT

A 23-year-old female was referred to the Department of Dental and Maxillofacial Sciences at the University "Federico II" in Naples in 1997 for the persistent erosion and discoloration of the maxillary deciduous second molars (figure 1). The patient was in good general health and the medical history was non contributory. The dental history reported the missing eruption of the maxillary second premolars. Intraoral examination showed adequate oral hygiene conditions with only mild, localized gingivitis and the retention of the deciduous second molars.

Initial radiographic examination showed the

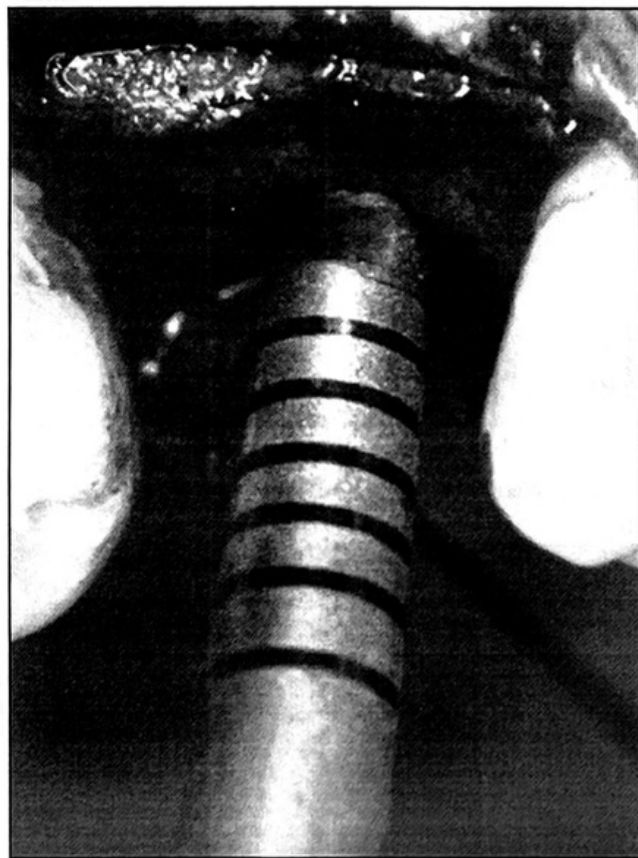


Figure 3: Osteotomy preparation; osteotome No. 4 is inserted.

congenital absence of both maxillary second premolars and an enlargement of the maxillary sinus in the same regions. This expansion was associated with a reduced alveolar bone height requiring a technique of sinus floor elevation to enable implant placement. The patient accepted a treatment plan that included oral hygiene instructions and supragingival scaling, extraction of the maxillary deciduous second molars and implant-supported restorations associated with osteotome sinus floor elevation. The extraction sites were allowed to heal for 12 weeks and periapical radio-

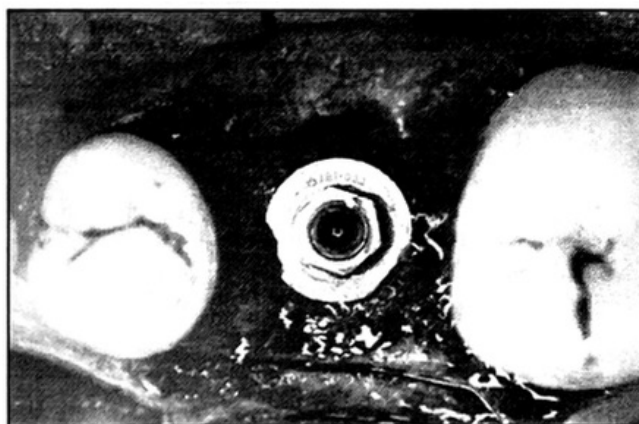


Figure 4: Occlusal view of implant placement.

graphs were taken following extractions in order to evaluate the residual bone volume (figures 2a, 2b). A bilateral sinus lift by means of a surgical crestal approach with osteotomes was then performed to allow the simultaneous placement of 2 endosseous implants.

Under local anesthesia (2% mepivacaine), a flap was raised with a full thickness crestal incision, without using releasing incisions. A guide hole was prepared using a round bur. This allowed for the bone density to be tested. In this case, the density was found to be Type III, according to the Lekholm and Zarb scale.⁶ Preparation of the osteotomy began with a 2mm diameter twist drill inserted to 1mm below the sinus floor; the osteotomy preparation continued using osteotomes (figure 3). The last used osteotome was the number 4 to slightly undersize the osteotomy in relation to the selected implant diameter (5mm). Undersizing the osteotomy improves implant primary stability.

The grafting material used for the sinus elevation was a mixture of autologous bone, harvested from the adjacent areas, and bovine hydroxyapatite (Bio-Oss; Geistlich, Wolhu-

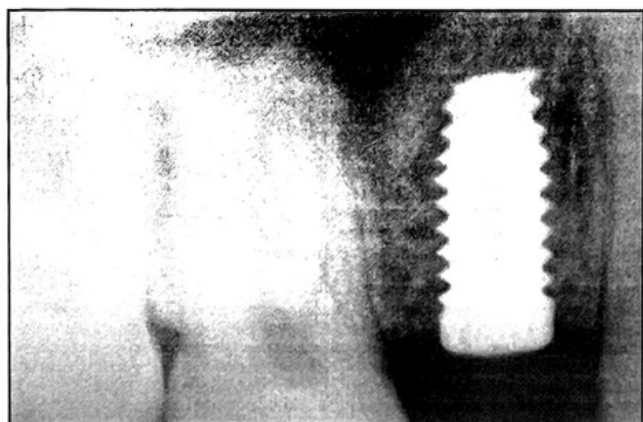


Figure 5A: Periapical radiographs immediately after implant placement in the augmented right maxillary sinus.

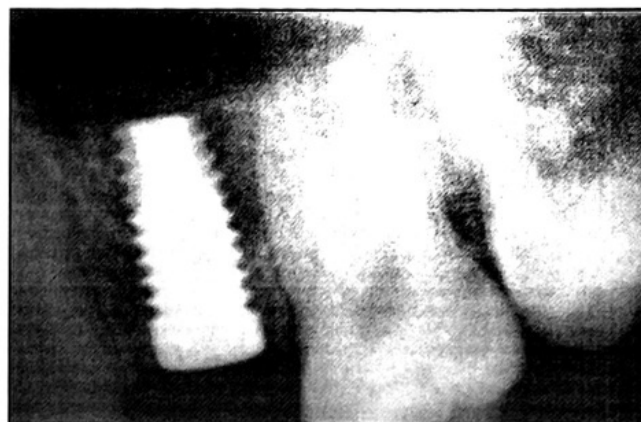


Figure 5B: Periapical radiographs immediately after implant placement in the augmented left maxillary sinus.

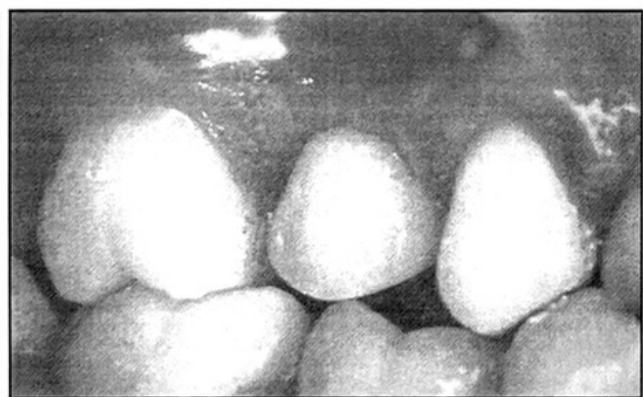


Figure 6A: Metal-ceramic screw-retained crowns for teeth #4.

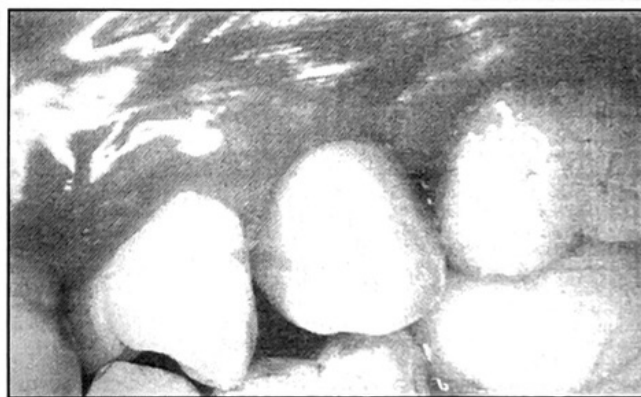


Figure 6B: Metal-ceramic screw-retained crowns for teeth #13.

sen, Switzerland) combined in a ratio of about 1:4. The bone-graft particulate was inserted in small increments into the bone cavity and compressed with the osteotome number 4 until the gentle fractures of the sinus floor. The incremental augmentation continued until obtaining the planned elevation. Throughout the procedure, the patient was repeatedly evaluated with Valsalva's maneuver in order to check for possible lacerations of the sinus membrane. Two 5 mm x 11 mm submerged straight walled

threaded implants (OSSEOTITE; BIOMET 3i, Palm Beach Gardens, FL) were inserted up to the planned level of sinus elevation (figure 4). Periapical radiographs confirmed the successful outcome of the procedure (figures 5a, 5b).

Eight months later implant placement, soft tissue healing appeared satisfactory. Radiographic examination revealed good preservation of bone graft in both maxillary sinuses. No peri-implant radiolucencies were detected. The implants appeared to be clinically and radio-

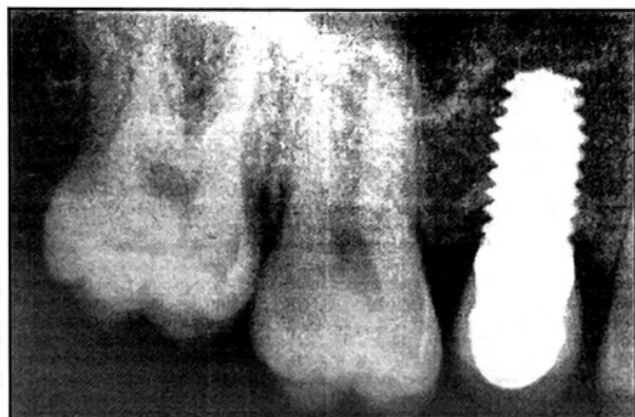


Figure 7A: Periapical radiographs of implant #4 after 10 years of loading.

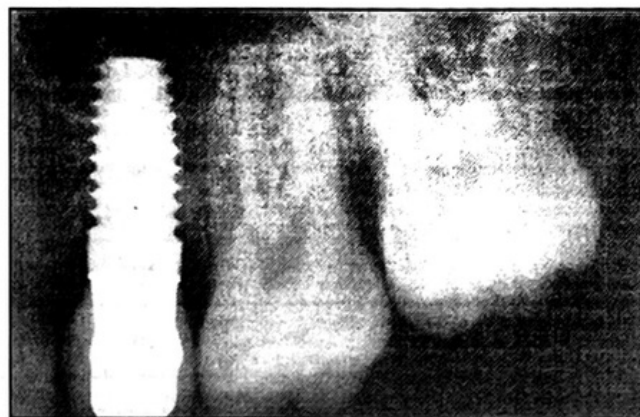


Figure 7B: Periapical radiographs of implant #13 after 10 years of loading.

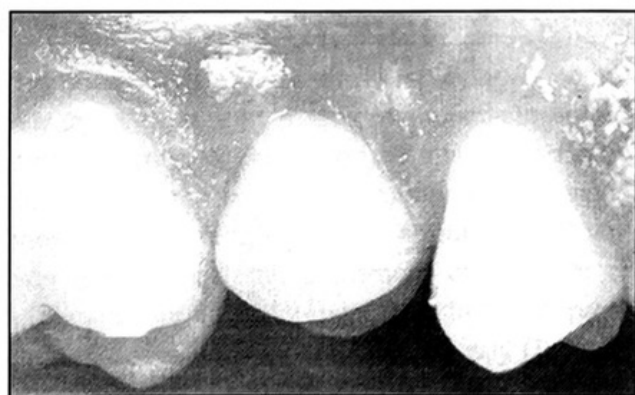


Figure 8A: Clinical view of implant # 4 at 10 year follow up visit.

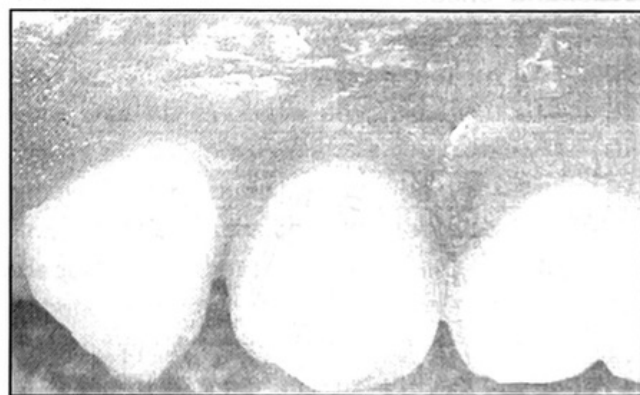


Figure 8B: Clinical view of implant # 13 at 10 year follow up visit.

graphically osseointegrated. Therefore, a second-stage surgical procedure was performed with minimal incisions at the crestal level to remove the cover screws and place healing abutments. After 1 month, an implant level impression (Impregum Penta; 3M ESPE St. Paul, Minn) was made and both implants were restored with fixed provisional restorations in acrylic resin (Jet; Lang Dental Mfg Co, Wheeling, IL). Definitive metal-ceramic screw-retained crowns were fabricated, evaluated intraorally

and inserted at torque of 35 Ncm, 4 weeks later (figures 6a, 6b). The patient was scheduled for a protocol of supportive therapy to monitor clinically and radiographically the maintenance of osseointegration, according to Albrektsson's criteria²⁷, function and esthetics. Data regarding the surgical sites are reported in Table 1, while periapical radiographs and clinical conditions of the implant supported prostheses 10-years post loading are illustrated in figures 7a,b and 8a,b respectively. The implants during this period

Table 1: Tooth site, alveolar bone height, bone quality, implant dimensions

Dental Site	Presurgical X-ray Bone Height (mm)	Bone Quality (Lekholm and Zarb scale)	Implant (mm)
4	6	III	5 x 11.5
13	7	III	5 x 11.5

showed no signs of failure, and the patient continued to be monitored on an annual basis.

DISCUSSION

The possibility of successfully replacing congenitally missing teeth by means of implant-supported restorations increases the therapeutic options. However, in the maxillary posterior region, sinus pneumatization might reduce alveolar bone volume and hamper the placement of implants of adequate length. Moreover, the frequent presence in this area of a poor bone density (Type III/IV according to Lekholm and Zarb scale⁶) makes the placement of short implants questionable, due to an increased risk of insufficient primary stability.^{4,10} In the presence of localized edentulous areas with a residual bone height of at least 5-6 mm, sinus floor elevation may be indicated using osteotomes in a crestal approach.^{9,11} This procedure is less traumatic and has a reduced morbidity compared to the Boyne and Tatum lateral approach.^{7,8} Furthermore it seems to compress the residual maxillary trabecular bone, offering better bone quality for implant primary stability and a more effective bone-implant interface.^{9, 10, 15, 16, 18-20}

The present clinical report describes the 10-year successful follow-up of restorations sup-

ported by osseointegrated implants placed using the osteotome sinus lift technique in a case of congenitally missing maxillary second premolars with reduced bone quantity due to an increased sinus pneumatization. During the follow-up period there was no evidence of clinical mobility, peri-implant tissues infection and inflammation, radiolucency or severe bone loss, and pain or discomfort. The patient's occlusion was stable, oral hygiene adequate and the patient was satisfied with the esthetic outcome. This approach may be a reliable and predictable treatment and, within the limits of a clinical report, seems to lead to functional and esthetic implant-supported restorations which can be successfully maintained for 10-years. ●

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Disclosure

The authors report no conflicts of interest with anything mentioned in this article.

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