Edentulous ridges in the posterior maxilla are often compromised by reduced bone volume. This anatomic condition often limits dental implant placement of 10 mm in length without prior or simultaneous sinus augmentation. The osteotome technique is an alternative and conservative technique for sinus floor augmentation and immediate implant placement in the posterior region of the maxillary jaw. According to the relevant literature, the osteotome technique appears to be a predictable and safe method for augmenting bone at the sinus floor and to improve bone density and quality of the implant site sufficiently so that immediate loading is possible. A 46-year-old male patient was referred to the authors to replace the single upper premolar with an implant-supported crown restoration without interfering with the integrity and topography of the adjacent gingival tissues. Only one clinical study analyzed minimally invasive implant and sinus lift surgery with immediate loading. In that case report, the osteotomy was widened to its final diameter using a series of incrementally larger twist drills. In our clinical case, a series of incrementally larger diameter osteotomes improved bone density. This simplified treatment modality can make single tooth implant rehabilitation of the atrophic premolar maxilla region more accessible, and immediate loading is facilitated by improved bone density.

Key Words: sinus lift, immediate loading, osteotome technique

INTRODUCTION

An adequate amount of bone, in both width and height, is required for successful implant placement. The success rate obtained with implants in various clinical situations depends to a great extent on the volume and quality of the surrounding bone.\textsuperscript{1–4} Initial stability of the implant is one of the fundamental criteria for obtaining osseointegration.\textsuperscript{2} Sufficient density and appropriate volume of bone are therefore crucial factors for successful implant treatment.\textsuperscript{5,6} Important factors influencing implant survival with the osteotome technique are the existence of preexisting residual bone...
height between the sinus floor and ridge crest of at least 5 mm and the absence of an antral membrane perforation.

The aim of this clinical report is to analyze the possibility of sinus lift and immediate placement and loading of a dental oral implant in the premolar region of the maxilla using the osteotome technique.

**CASE REPORT**

A 46-year-old male patient was referred to the authors to replace the single maxillary premolar with an implant-supported crown restoration without interfering with the integrity and topography of the adjacent gingival tissues. The choice of treatment was based on the amount of bone available for implant placement and determined by clinical and radiographic presurgical examination (Figures 1 and 2).

Measurement of the maxillary crest height was performed via periapical radiograph and was recorded as 8.5 mm (Figure 2).

Inclusion criteria for this case report were the following: good general state of health, a nonsmoker or light smoker (less than 10 cigarettes per day), absence of pathology affecting the maxillary sinus, correct interarch relationship, and patient consent to treatment. Exclusion criteria were: a history of intravenous bisphosphonate therapy, uncontrolled diabetes, chemotherapy, and/or head and neck radiation therapy within the 2 years previous to consultation.

The fixture and xenogenic bone substitute materials used were: BioHorizons Internal, diameter 4.0 mm and length 12 mm (BioHorizons, Birmingham, Ala), a collagen membrane (eg, Duo-Teck OsteoBiol, ROEN, Pianezza, Italy), and prehydrated and collagenated corticocancellous porcine bone graft (Gel 40 OsteoBiol, ROEN).

A midcrestal, full-thickness incision was performed (Figure 3). Once the flap was reflected, the implant osteotomy site was prepared to full dimension by osteotomes of increasing diameter (Friadent GmbH, Mannheim, Germany) (Figure 4). Each instrument remained in the implant site for 1 minute before the next diameter was used. Next, a collagen membrane (eg, Duo-Teck OsteoBiol, ROEN) was introduced through the osteoto-
my and placed against the slightly elevated Schneiderian membrane. This serves to minimize the possibility of graft extravasation if a small perforation exists. An additional height of 5 to 10 mm can be achieved by this technique. A tent-like effect may be accomplished by lifting this localized region of the sinus membrane. The graft material—prehydrated and collagenated corticocancellous porcine bone graft (Gel 40 OsteoBiol, ROEN)—was prepared and introduced through the osteotomy and into the elevated sinus cavity. The graft material was inserted into a syringe and injected through the osteotomy site.

Finally, a BioHorizons Internal, diameter 4.0 mm and length 12 mm (BioHorizons), was placed (Figure 5). The flap was repositioned and sutured with 5/0 nylon Monofil (Lorca Marin, S.A., Murcia, Spain). The abutment was adjusted chairside according to the patient’s occlusion to allow clearance for the restoration. The implant abutment was removed from the implant intraorally and placed on an implant analog; the provisional

Figures 3–6. Figure 3. Clinical photograph illustrating a midcrestal, full-thickness incision. Figure 4. Osteotome technique. Figure 5. Photograph illustrating the clinical situation immediately following fixture installation and connection abutment. Figure 6. Clinical photograph illustrating the situation immediately following placement of provisional crown.
Immediate postoperative period, was performed (Figure 7).

Systemic antibiotics (amoxicillin and clavulanic acid), 2 gr/die, were also prescribed for 4 days, and 0.2% chlorhexidine-gluconate rinses for 1 minute 3 times daily were prescribed for 10 days. Ice was applied postoperatively externally for 24 to 48 hours.

The implant was placed with good primary stability. No intraoperative complications were recorded. A panoramic radiograph 5 months following minimally invasive implant and sinus surgery was performed (Figure 8). At 12 months follow-up the implant (100%) met Albrektsson criteria for success (Figure 9).

**DISCUSSION**

When alveolar ridges are severely resorbed, the bone volume must be increased before implants may be placed. A variety of grafting techniques that successfully remedy this limitation have been developed, but often require multiple surgical procedures and a prolonged healing time. The minimally invasive sinus floor elevation as first described by Summers is limited in the volume of augmentation that is possible.\(^8\)\(^{-12}\) In contrast, the more invasive approach is the sinus lift of Tatum, which is indicated for greater bone deficiencies.\(^13\)

The osteotome technique is an alternative and conservative technique for sinus floor augmentation and immediate implant placement in the posterior region of the upper jaw. According to the relative literature, the osteotome technique appears to be a predictable and safe method for augmenting bone at the sinus floor and improving bone density and quality of the implant site.\(^14\),\(^15\) The advantages of this method, as contrasted with the 1–2 step antrostomy with a lateral approach (Caldwell-Luc operation), are less complex, less invasive, and have a shorter healing and waiting period. In addition, the need for a distant donor site is eliminated. The

restoration was then relined on the abutment. The restoration margins were refined with flowable composite resin. Margins were refined on the analog to allow optimal and emergence profile (Figure 6).

It is imperative that temporary restoration be kept out of occlusion for 6 to 8 weeks. A periapical radiograph, exhibiting implant and minimally invasive sinus lift in the

**FIGURES 7–9.** Figure 7. A periapical radiograph exhibiting implant and minimally invasive sinus lift in the immediate postoperative period. Figure 8. Panoramic radiograph 5 months after sinus lift and immediate loading. Figure 9. A periapical radiograph follow-up after 12 months of implant placement.
disadvantages of this technique are its limited indications—the lack of 1–2 mm height and the absence of direct visual control of the state of the membrane. However, tapping of the expansion osteotomes with the surgical mallet is the greatest inconvenience of the technique, and in some cases it may induce paroxysmal positional vertigo in patients who have experienced no previous episodes of this form of vertigo. This form of vertigo is caused by otolith displacements within the posterior semicircular canal of the inner ear, favored by hyperextension of the head of the patient and the impacts of the surgical mallet. In order to avoid these problems, the patient is to get up slowly after surgery, and excessive tapping with the mallet during surgery should be avoided. If such vertigo appears, the Epley maneuver can be applied, involving hyperextension of the head with movement towards the side of the affected ear, thereby contributing to reposition of the calcium carbonate particles floating within the endolymph compartment. Pharmacologic treatment with antivertigo drugs can also be provided.\textsuperscript{16}

Only a few experimental studies have been performed that were aimed at the improvement of bone density and quality of the implant site.\textsuperscript{14,15,17} Furthermore, only one clinical study analyzed minimally invasive implant and sinus lift surgery with immediate loading: in this case report, the osteotomy was widened to its final diameter using a series of incrementally larger twist drills.\textsuperscript{18} In our clinical case, a series of incrementally larger osteotomes were used to achieve improvement of bone density.

In conclusion, this simplified treatment modality can make implant rehabilitation of the atrophic maxilla premolar region more accessible in a single stage with immediate loading to facilitate bone density improvement.

**REFERENCES**