

PIEZOELECTRIC SURGERY IN MANDIBULAR SPLIT CREST TECHNIQUE WITH IMMEDIATE IMPLANT PLACEMENT: A CASE REPORT

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SUMMARY

Piezoelectric surgery in mandibular split crest technique with immediate implant placement: a case report

Implant supported rehabilitation of thin edentulous ridges with horizontal atrophy necessitates a regenerative approach. Within the procedures for horizontal bone defects augmentation, ridge expansion techniques permit dislocation of the buccal bone plate in a labial direction and simultaneous implant insertion in single-stage surgery, abbreviating overall treatment time.

The piezoelectric ridge expansion technique permits to obtain the expansion of very mineralized bone crests without excessive traumas or the risk of ridge fractures. The case reported shows an implant treatment for partial edentulous lower arch rehabilitation. A full-split thickness flap was raised. The mucoperiosteal reflection permitted to identify alveolar crest contour where osteotomies had to be performed. Split thickness dissection allowed periosteal blood supply to be maintained on the buccal bone plate. After horizontal and vertical osteotomies were performed with OT7 piezoelectric microsaw (Piezosurgery, Mectron), a single-bevel scalpel was used to move the buccal bone plate to the labial. Two Straumann TE 3.3/4.8 mm wide implants were inserted in the lower right premolar area, and 1 Straumann 4.8 mm Wide Neck implant was inserted to replace lower right first molar. The amount of bone expansion was equal to the cervical diameter of the placed implants (4.8 mm) and residual bone gap was packed with Bio-Oss granules (Geistlich). Healing was uneventful and 3 months later final restorations with implant-supported porcelain-fused-to-metal crowns were cemented.

Key words: ridge expansion technique, piezoelectric surgery, immediate implant placement.

RIASSUNTO

La chirurgia piezoelettrica nella split-crest mandibolare con inserimento implantare immediato: un caso clinico

La riabilitazione protesica supportata da impianti di sottili creste edentule con atrofia orizzontale necessita di un approccio rigenerativo. Tra le procedure per la correzione dei deficit ossei orizzontali, le tecniche di espansione di cresta consentono la dislocazione della corticale ossea vestibolare in direzione buccale ed il simultaneo inserimento implantare in un unico intervento chirurgico, riducendo i tempi di trattamento totali.

La tecnica piezoelettrica di espansione crestale permette di espandere creste molto mineralizzate senza eccessivi traumi, minimizzando il rischio di fratture. Il caso clinico mostra una riabilitazione implantoprotesica di un edentulismo parziale mandibolare. È stato eseguito un lembo a spessore misto. Lo scollamento a tutto spessore ha consentito il denudamento del contorno della cresta alveolare dove effettuare le osteotomie. Lo scollamento a spessore parziale ha mantenuto il supporto sanguigno periostale sul tavolo osseo buccale. Dopo aver eseguito le osteotomie orizzontali e verticali con la microsega piezoelettrica OT7 (Piezosurgery, Mectron), l'inserimento di uno scalpello con singolo bisello ha permesso al tavolo osseo vestibolare di muovere buccalmente. Due impianti Straumann TE da 3.3/4.8 mm di diametro sono stati inseriti nella regione dei premolari inferiori destri, e un impianto Straumann Wide Neck di 4.8 mm di spessore è stato inserito nella regione del primo molare inferiore destro. La quantità di espansione ossea ottenuta è stata uguale al diametro cervicale degli impianti (4,8 mm) e il gap osseo residuo è stato colmato con granuli di Bio-Oss (Geistlich). La guarigione è stata priva di complicazioni e 3 mesi dopo l'intervento gli impianti sono stati caricati con corone in oro-ceramica.

Parole chiave: tecnica di espansione di cresta, chirurgia piezoelettrica, inserimento implantare immediato.

Treatment of edentulous sites with horizontal atrophy represent a situation in which the positioning of endosseous implants might be complex or sometimes impossible without a staged regenerative approach.

The presence of a thin edentulous ridge can be acquired or congenital. Acquired alveolar defects may be caused by post-extraction defects, traumatic tooth avulsion, periodontal disease, and/or prolonged denture wear with subsequent disuse atrophy. In most of the cases the most significant loss is in the horizontal dimension.

Within the procedures for horizontal bone defects augmentation there are autogenous onlay bone grafts, guided bone regeneration (GBR), and split-ridge expansion/distraction techniques.

Use of an autogenous onlay bone graft, harvested from maxillary tuberosity, symphysis of the chin, or external oblique line of the mandible, is a well predictable procedure to reestablish an appropriate alveolar ridge width (1, 2). However, donor site morbidity, long healing period of about 6 months, graft resorption, and a staged approach that necessitate two surgical interventions, are considered important disadvantages.

GBR is a well documented technique to treat a vestibular dehiscence, when there is an exposure of several millimeters of the thread of the implant (3-5). The long healing time that leads to bone regeneration, from 9 to 12 months, and the risk of eventual membrane collapse, exposure, or infection, with incomplete reformation of the bone, are considered important disadvantages of this technique.

Ridge expansion techniques have been acknowledged to offer several advantages in the correction of ridge deformities (6). The expanded defect heals in a similar manner to an extraction socket and simultaneous implant placement, in the space formed after the dislocation of the buccal plate in a labial direction, can be achieved during ridge expansion. The limitation of this technique lies in its inability to create bone vertically. Therefore, it is not indicated for the correction of vertical defects. The main indication for the ridge expansion is in the maxillary arch when between the labial and palatal cortical plates there is a clear evidence of

medullary bone. The presence of only corical bone represents a contraindication of the technique.

The surgical technique for implant placement with inadequate buccolingual thickness of bone was firstly described by Tatum (7) and then modified by other Authors.

Tatum described a flap with a palatal incision to move keratinized tissue to the labial, with split-thickness dissection of the flap, particularly indicated when there is uncertainty as to whether the ridge can be expanded without a risk of fracture of the labial wall. The periosteum was not reflected and its integrity should be maintained for bone blood supply, and the chisel was very lightly tapped into the medullary space with a parallel direction to the palatal wall to avoid the perforation of the concavity normally present on the labial of the anterior maxilla. The palatal wall should stay intact and not be moved, the facial wall will expand after the medullary bone was compressed against the cortical wall.

Edentulous ridge expansion (ERE) technique, described by Bruschi and Scipioni, utilizes a partial thickness flap too (8, 9). The bone ridge stayed covered by a thin connective tissue layer and the underlying periosteum to preserve the blood supply to the buccal cortical bone. A crestal incision separating the buccal from the palatal/lingual bone was connected to two beveled vertical relaxing incisions in the buccal bone plate, allowing the horizontal distraction of the vestibular corical plate.

The apical portion was prepared with ball burs that worked only in the apical area to preserve the thin distracted crestal bone plate during drilling procedures. A two-stage technique was necessary, primarily in the mandible, when the bone elasticity and the resulting expansion were insufficient for implant placement, the bone gap was packed only with collagen. After a healing period of only 40 days, the ERE technique was repeated and implants were placed (10).

Split-crest technique, described by Simion et al., added the use of expanded polytetrafluoroethylene (e-PTFE) membranes for GBR following crest-splitting to regenerate bone within the bone gap created by the expansion (11). In this procedure a mucoperiosteal flap was raised.

Alveolar reconstruction with splitting osteotomy and micofixation of implants was described by Engelke et al. (12). In this technique a full-split thickness flap was used. The alveolar crest was exposed subperiosteally to just identify its contour and to free it from fibrous tissue. Further exposure of the labial surface was carried out using a supraperiosteal preparation technique. A cortical segmental bone splitting was performed to transfer the vestibular cortical plate to its pre-extraction position. The vertical osteotomies were carried out approximately 5 mm mesially and distally to the planned position of the implant, cutting through the buccal cortex. After fracturing the base, the buccal segment was mobilized and shifted buccally using multiple osteotomes to create adequate space for the implant that may be positioned between the lamellae (sandwichlike) without the need for preparation of a congruous bone cavity. Three-dimensional stability of the shifted lamellae and the implants in the desired position was provided by microfixation with 0,5 mm thick plates, and 0,8 mm thick screws.

Horizontal distraction osteogenesis was described by several Authors (13-18). Laster et al. developed an alveolar width distractor, the "Laster Crest Widener" (17). Seven days after the horizontal distraction device was placed, distraction proceeded at a rate of 0,4 mm/day for 14 to 18 days, and increased alveolar width from 4 to 6 mm. After a 7 to 10 days retention period for early bone "consolidation" the distraction device was removed and 1 week later implants were inserted. Twenty implants successfully osteointegrated of 21 placed in 9 patients. The advantages of horizontal distraction over block grafting include simultaneous expansion of soft tissue, high degree of dimensional stability, abbreviated overall time, and no graft requirement.

Nowadays technology helps the clinician to obtain the expansion of a very mineralized bone ridge of 2 to 3 mm in thickness. Piezoelectric surgery is able to cut bone according to the requirements of the case, with a powerful and precise energy and without excessive traumas or the risk of ridge fracture. The piezoelectric ridge expansion technique described by Vercellotti (19), that tanks to the use

of modulated-frequency piezoelectric energy scalpels, permits the expansion of the edentulous ridge no matter what the quality of bone, even in the case of the most mineralized, and the placement of implants in single stage surgery.

Case report

The patient was a healthy non-smoking 47 years old woman. Her dental history included a recent failure of a fixed traditional prosthesis for the lost of the lower right first premolar, and earlier loss of second premolar and first molar in the right side of the mandible (Fig. 1).

During clinical examination, a ridge defect with reduction in the thickness of bone, which appeared to be thin, was diagnosed (Fig. 2, 3).

A computed tomography (CT) scan demonstrated adequate ridge height, but showed a thickness from 2 to 3 mm in the coronal segment of the ridge with progressive apical expansion (Fig. 4). The bone quality was type 2, with the medullary bone separating the vertical cortical bone from the palatal bone.

The patient was treated with local anesthetics under antibiotic therapy.

A mid-crestal incision was extended buccally and lingually into the sulcus of the adjacent teeth (Fig. 5). Mesially to the canine a releasing vertical incision was extended into the vestibule.

A mucoperiosteal flap of the total thickness of the summit of the bone ridge was lifted and then continued with a partial thickness flap in the vestibular fornix (Fig. 6). This flap permitted the denud-



Figure 1
Preoperative panoramic radiograph.



Figure 2
Clinical view of the ridge.

ing of the summit of the ridge while maintaining the periosteum on the vertical walls and permitting the creation of an extremely mobile mucous flap that permitted a tension-free suture after expansion.

Periosteal membrane vertical cuts were performed even in correspondence of the two bone releasing incisions, because Piezosurgery device (Mectron) selectively cuts hard tissues. A horizontal bone incision was then performed in the middle of the ridge with OT7 piezoelectric microsaw (Mectron) (Fig. 7) with a depth of 8 mm, starting 2 mm dis-



Figure 3
Occlusal view: a reduction in thickness of the bone crest was diagnosed.

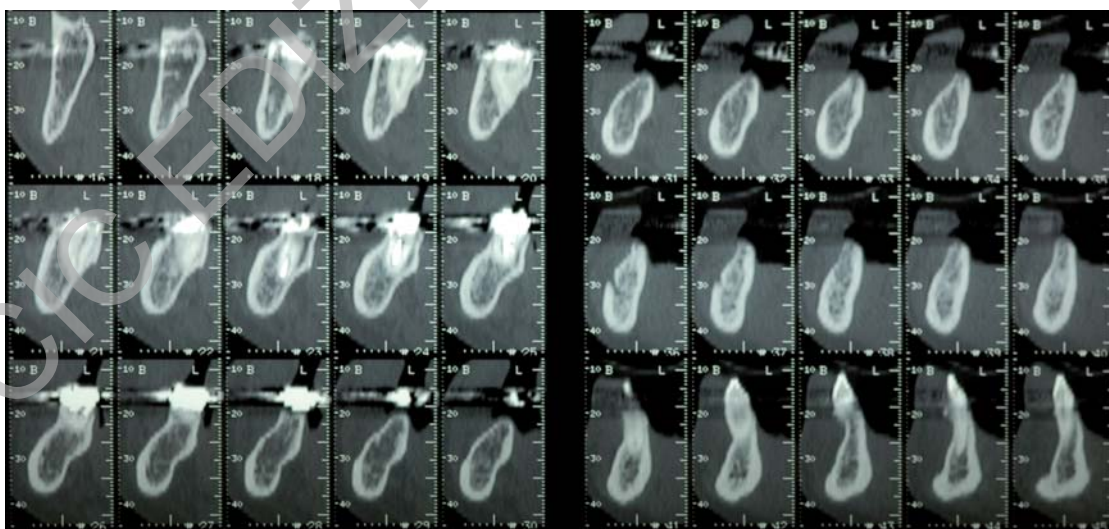
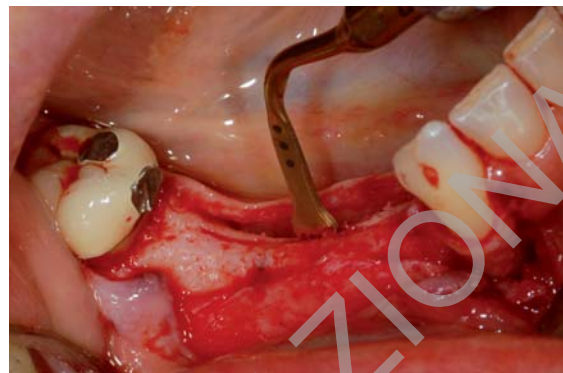


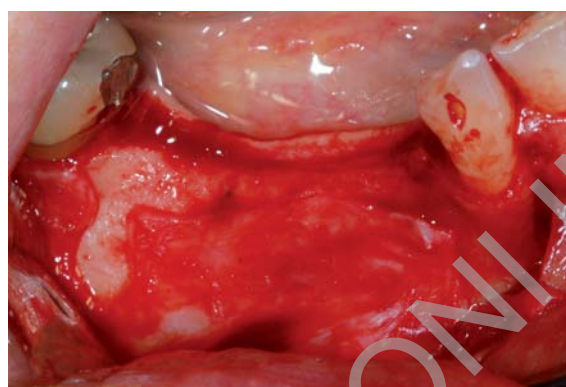
Figure 4
CT scans permit the measurements of bone ridge thickness.

**Figure 5**

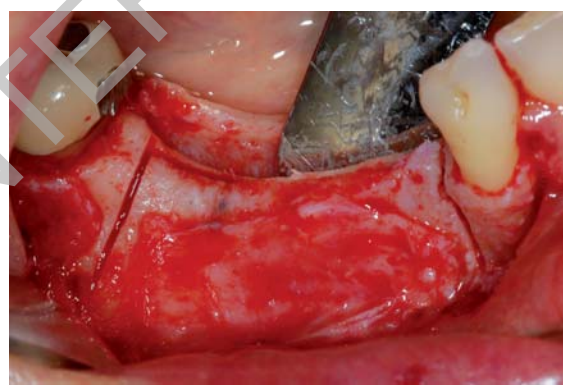
Flap design: a crestal incision was connected to a mesial vertical incision into the vestibule.

**Figure 7**

OT7 piezoelectric microsaw was used to perform crestal osteotomy.

**Figure 6**

A full-split thickness flap was raised.

**Figure 8**

Vertical bone releasing incisions were performed with OT7 microsaw.

tal to the canine and 2 mm mesial to the second molar. At this two edges, two vertical releasing incisions were made in the vestibular bone (Fig. 8). A single-bevel scalpel were successively inserted apically to obtain a mobile vestibular bone flap (Fig. 9).

The implant sites were prepared with progressive twist drills on the palatal side to obtain an apical implant preparation of about 3 mm to get primary stability of the 3 implants.

During drilling, the thin buccal bone plate was preserved by the use of distracting osteotomes (Fig. 10). One-stage implants were placed within the splitted ridge, surrounded by particulate bone

xenograft (Bio-Oss, Geistlich) to fill the bone defect obtained by the separation of the bone flaps (Fig. 11), and allowed to heal with healing abutments in a transgingival way for 3 months prior to loading (Fig. 12).

Two Straumann TE implants 3.3/4.8 mm in diameter and 10 mm in length were used for first and second premolar replacement. One Straumann Wide Neck implant 4.8 mm in diameter and 10 mm in length was used for first molar replacement.

The amount of bone expansion was equal to the cervical diameter of the placed implants (4.8 mm). Healing was uneventful and 3 months later abut-

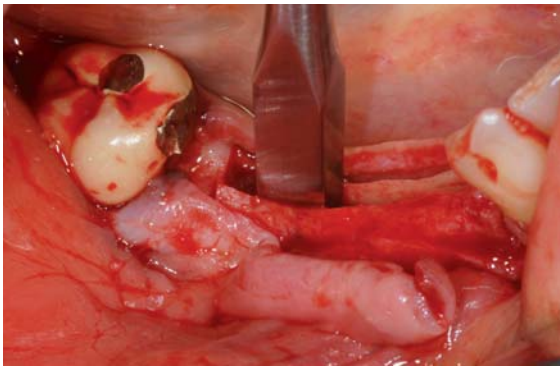


Figure 9
Insertion of a single-bevel scalpel permitted vestibular bone plate to move to the buccal.



Figure 11
Implants insertion: the bone gap was packed with Bio-Oss granules.

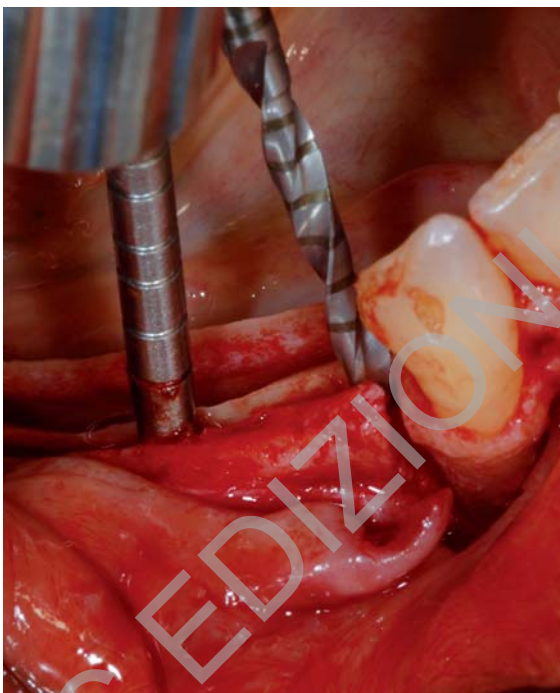


Figure 10
Twist drills prepared implants sites apically. A distracting osteotome preserved the thin buccal bone plate from drilling.

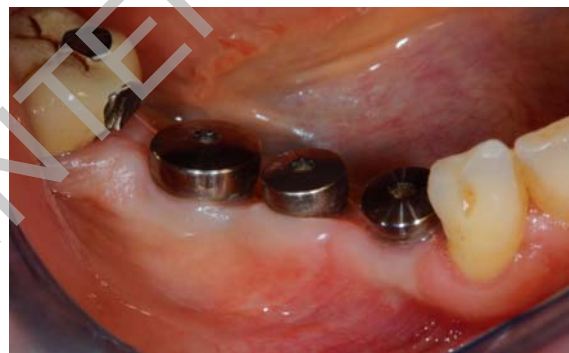


Figure 12
3-month follow-up.

were cemented. A one-year clinical and radiographic follow-up are shown (Fig. 15, 16).

Conclusions

Piezoelectric bone surgery has been recently introduced as a novel osteotomic technique. Its application to perform split-crest procedure allows the clinician to augment thin edentulous bone crests, even with a very mineralized ridge, and implants insertion in single-stage surgery.

When bone quality is characterized by 2 cortical plates divided by a thin medullary layer, the lack

ments were connected to implants (Fig. 13), an impression was taken with the Straumann snap-on technique (Fig. 14). A temporary prosthesis was made, and one week later final restorations with implant-supported porcelain-fused-to-metal crowns



Figure 13
Abutment connection.



Figure 15
1-year clinical follow-up.



Figure 14
Snap-on impression technique.



Figure 16
1-year radiographic follow-up.

of elasticity can lead to fractures that are responsible for dehiscence and/or fenestration and loss of primary stability, limiting the use of split-crest techniques only in cases of bone quality 3 and 4. Piezosurgery device permits implant placement in advanced and complex situations previously treated in 2 surgical stages, in the first of which a bone graft augmented the volume, and implant placement after a 6-month healing period, in the second.

In this case piezoelectric surgery allowed a 4.8 mm ridge augmentation and contextual insertion of 3 implants in single-stage surgery with a safe and comfortable procedure.

References

1. Boyne PJ, Mickels TE. Restoration of alveolar ridges by intramandibular transposition osseous grafting. *J Oral Surg* 1968; 26: 569-576.
2. Buser D, Dula K, Hirt HP, Schenk RK. Lateral ridge augmentation using autografts and barrier membranes. A clinical study in 40 partially edentulous patients. *J Oral Maxillofac Surg* 1996; 54: 420-432.
3. Buser D, Bragger U, Lang NP, Nyman S. Regeneration and enlargement of jaw bone using guided tissue regeneration. *Clin Oral Implants Res* 1990; 1: 22-32.
4. Parma Benfenati S, Tinti C, Albrektsson T, Johansson C. Histologic evaluation of guided vertical ridge aug-

- mentation around implants in humans. *Int J Periodontics Restorative Dent* 1999; 19: 425-437.
5. Dahlin C, Gottlow J, Linde A, Nyman S. Healing of maxillary and mandibular bone defects using a membrane technique. *Scand J Plast Reconstr Hand Surg* 1990; 24: 13-19.
 6. Elian N, Jalbout Z, Ehrlich B, Classi A, Cho SC, Al-Kahtani F, Froum S, Tarnow DP. A two-stage full-arch expansion technique: review of the literature and clinical guidelines. *Implant Dent* 2008; 17: 16-23.
 7. Tatum H. Maxillary and sinus implant reconstruction. *Dental Clinics of North America*. 1986; 30: 207-229.
 8. Bruschi GB, Scipioni A. Alveolar augmentation: New application for implants. In: Heimke G (ed): *Osseointegrated implants*, Vol 2. Boca Raton, FL: CRC Press, 1990: 35-61.
 9. Scipioni A, Bruschi GB, Calesini G. The edentulous ridge expansion technique: a five-year clinical study. *Int J Periodontics Restorative Dent* 1994; 14: 451-459.
 10. Bravi F, Bruschi GB, Ferrini F. A 10-year multicenter retrospective clinical study of 1,715 implants placed with the edentulous ridge expansion technique. *Int J Periodontics Restorative Dent* 2007; 27: 557-565.
 11. Simion M, Baldoni M, Zaffe D. Jawbone enlargement using immediate implant placement associated with a split-crest technique and guided tissue regeneration. *Int J Periodontics Restorative Dent* 1992; 12: 462-473.
 12. Engelke WGH, Diederichs CG, Jacobs HG, Deckwer I. Alveolar reconstruction with splitting osteotomy and microfixation of implants. *Int J Oral Maxillofacial Implants* 1997; 12: 310-318.
 13. Aparicio C, Jensen OT. Alveolar ridge widening by distraction osteogenesis: A case report. *Pract Proc Aesthetic Dent* 2001; 13: 663-668.
 14. Nosaka Y, Kitano S, Wada K, Komori T. Endosseous implants in horizontal ridge distraction osteogenesis. *Int J Oral Maxillofacial Implants* 2002; 17: 846-853.
 15. Takahashi T, Funaki K, Shintani H, Haruoka T. Use of horizontal alveolar distraction osteogenesis for implant placement in a narrow alveolar ridge: A case report. *Int J Oral Maxillofacial Implants* 2004; 19: 291-294.
 16. Oda T, Suzuki H, Yokota M, Ueda M. Horizontal alveolar distraction of the narrow maxillary ridge for implant placement. *J Oral Maxillofac Surg* 2004; 62: 1530-1534.
 17. Laster Z, Rachmiel A, Jensen OT. Alveolar width distraction osteogenesis for early implant placement. *J Oral Maxillofac Surg* 2005; 63: 1724-1730.
 18. Chiapasco M, Ferrini F, Casentini P, Accardi S, Zaniboni M. Dental implants placed in expanded narrow edentulous ridges with the Extension Crest device. A 1-3 year multicenter follow-up study. *Clin Oral Implants Res* 2006; 17: 265-272.
 19. Vercellotti T. Piezoelectric Surgery in implantology: A case report - a new piezoelectric ridge expansion technique. *Int J Periodontics Restorative Dent* 2000; 20: 359-365.

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