EXPANSION OF THE ALVEOLAR BONE CREST WITH ULTRASONIC SURGERY DEVICE: CLINICAL STUDY IN MANDIBLE

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The purpose of this paper was to document the application to the split-crest mandibular procedure in two stage in order to avoid cortical resorption due to periosteal detachment in buccal cortical bone of the alveolar crest. Twenty-two healthy patients with non-contributory past medical history (14 women and 8 men, all non-smokers, mean age 59 years, range 54–65 years) were included in this study. After buccal mucoperiosteal flap was followed by a sagittal corticotomy in the coronal area of the alveolar crest and a second sagittal corticotomy, but in a lower (basal) position and two vertical corticotomies in the buccal wall, using a ultrasonic surgery device (Surgysonic, Esacrom, Imola Italy). Adequate crest expansion was achieved without compromising cortical vascularisation by utilising a combination of scalpel, thin chisels and threaded osteotomes (Bone System, Milano, Italy). Postoperative results were assessed by panoramic and periapical radiographs. Ossification of the osteotomy lines was evident and could be observed as sites with increasing radiopacity on panoramic and periapical radiographs 3 months after implants insertion. No dehiscence of the mucosa was observed. No patient suffered from hypoaesthesia. The mean horizontal bone increase in coronal area was 5±3 mm. Mandibular ridge expansion using a split-crest technique that included grafting the implant sites with a ultrasonic surgery device is a viable therapeutic alternative for implant placement in this patient population.

Horizontal bone resorption occurring after the extraction of a tooth is one of the most frequent anatomical limitations that do not allow the ideal placement of an implant. One of the most predictable regenerative techniques to improve the amount of buccal bone is the sagittal osteotomy of the ridge (E.R.E.) (1-6). Such technique was reported to have very high success rates (98-100%) and showed the minimum volumetric contraction in the long-term, since the buccal bone is maintained in situ provided with both endosteal and periosteal blod vessels, limiting secondary bone resorption. Bone expansion in oral surgery consists of expanding atrophic bone crests in order to secure sufficient bone width for dental implant placement. One of the most common anatomical limitations in oral implantology is bone atrophy of the mandible. Narrow alveolar crests make implant bed preparation difficult, with the appearance of fenestrations or dehiscence of the cortical layers.

To avoid these problems, different regenerative surgical techniques have been developed using autologous or homologous bone grafts, xenografts or bone substitutes to allow implant placement in one or two surgical steps. The presence of atrophic alveolar crests measuring less than 3 mm in width complicates the placement of implants and makes the complementary use of bone grafts necessary.

Novel developments in relation to the host bed and surgery include the application of growth factors and the

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use of bone condensation techniques in the implant bed and the application of expansion techniques for very thin crests (split crest).

However, the split-crest bone expansion technique may be indicated for sharp mandibular and maxillary ridges in patients whose bone quantity is inadequate for primary stabilization. Slight separation of a maxillary ridge crest is performed as a hinge-like separation of the buccal cortex. It is difficult to achieve the same hinge-like separation in the posterior mandible because of the compact outer cortex and external oblique line (7). The posterior mandible is the most difficult region for reconstruction and early implant placement in cases of severe alveolar resorption in the maxillomandibular complex. The atrophic ridge is often dense; mobilization of the vestibular flap is difficult to achieve with the osteotomes. To increase the elasticity of the vestibular bony flap, a basal longitudinal discharge notch was performed, in addition to the vertical and longitudinal incisions and longitudinal incisions. This longitudinal notch increases the bone resilience and eases mobilization of the vestibular bone flap. In cases of buccal plate fracture, the mobile plate may be retained with bone fixation screws (7).

The objective of these techniques is to increase bone density and avoid the cortical bone loss produced by drilling, thereby, favoring primary implant stability and earlier prosthodontic implant loading.

The purpose of this paper was to document the application to the split-crest mandibular procedure in two stage in order to avoid cortical resorption due to periosteal detachment in buccal cortical bone of the alveolar crest

MATERIALS AND METHODS

Twenty-two healthy patients with non-contributory past medical history (14 women and 8 men, all non-smokers, mean age 59 years, range 54–65 years) were included in this study. All patients with posterior mandibular edentulism were candidates for implant treatment, and all patients signed a written informed consent. Three clinicians have performed the surgeries. The inclusion criteria were: fully edentulous or partially edentulous patients with a unilateral or bilateral loss of teeth in the mandibular premolar or molar areas with a severe alveolar atrophy and a residual alveolar ridge thickness between 1,5 and 3 mm in coronal area. This scarce horizontal bone availability did not permit the predictable insertion of 3,5 or 4,1 mm implants. The exclusion criteria were severe illness, head and neck radiation therapy, chemotherapy, uncontrolled diabetes, uncontrolled periodontal disease, smoking. After a thorough oral and physical examination, patients were scheduled for bone reconstruction procedures including crest expansion and implant insertion after four weeks. Preoperatively, they were extensively informed concerning the surgical procedures and they were asked for their full cooperation during treatment. Prior to surgery, the patients mouths were rinsed with a chlorhexidine digluconate solution 0,2% for 2 minutes. Local anesthesia was obtained with Articaine® (Ubistesin 4% - Espe Dental AG Seefeld, Germany) associated with epinephrine 1: 100.000. In the first stage, supracrestal incision and elevation of the buccal mucoperiosteal flap was followed by a sagittal corticotomy in the coronal area of the alveolar crest and a second sagittal corticotomy, but in a lower (basal) position and two vertical corticotomies in the buccal wall, using a ultrasonic surgery device (Surgysonic, Esacrom, Imola Italy). The wound was closed with interrupted suture, followed by a four weeks interval for periosteal revascularisation of buccal cortical bone. In the second stage, a minimal mucoperiosteal elevation was performed. Adequate crest expansion was achieved without compromising cortical vascularisation by utilising a combination of scalpel, thin chisels and threaded osteotomes (Bone System, Milano, Italy), the osteotomes was used to progressively widen the bone, permitting implant placement.

Two submerged implants (Bone System, Milano, Italy) were placed in the premolar and molar area. Implant sockets were made using a ultrasonic surgery device (Surgysonic, Esacrom, Imola Italy) and final conventional drill sequence according to implant size. Implants were inserted by using a mechanical system initially and final turns were completed with a manual wrench. Immediate stability was evaluated clinically and all implants had insertion torque bigger than 25-30 N/cm.

The gap filled was filled by particles of cortical-cancellous porcine bone (OsteoBiol Gen-Os, Tecnoss, Coazze, Italy).

The flaps were sutured carefully with Vicryl 4.0 (Ethicon FS-2). A periapical radiograph was taken after implant insertion to verify the correct implant position. Amoxicillin with clavulanic acid was administered, with a dose of 2 g given preoperatively, followed by 1 g twice daily for 5 days. Ibuprofen 600 mg was prescribed to be taken as needed. A cold/soft diet was recommended for 2 weeks, together with appropriate oral hygiene. The sutures were removed 7 days after the surgical procedure. In this phase, the patients were not allowed to wear removable dentures before implant uncovering. The postsurgical instructions included a soft-food diet for 2 weeks and appropriate oral hygiene, including twice daily rinsing with a 0.2% chlorhexidine digluconate mouthwash. The sutures were removed 10 days postoperatively. The patients were followed with a clinical examination in the first month after surgery, and twice in the subsequent months before implant insertion. The healing process was uneventful. Panoramic X-ray assessments were performed immediately after the surgical procedure. After tree months, the healing screw was applied.

RESULTS

The postoperative course was uneventful in twenty-one seven of the twenty-two patients. During the implant insertion phases no dehiscence or perforation took place either vestilary or apically. The two planed implants were 4,2 mm apically inserted reaching quite good primary stability. Unfortunately, the one implants did not reached osseointegration and had to be removed after 3 months of healing period. This one failed implant represents the 2.5%

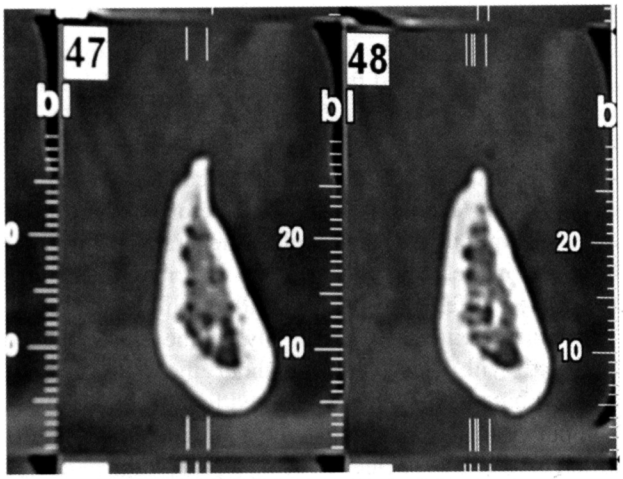

Fig. 1. *CT image showing alveolar width deficit*

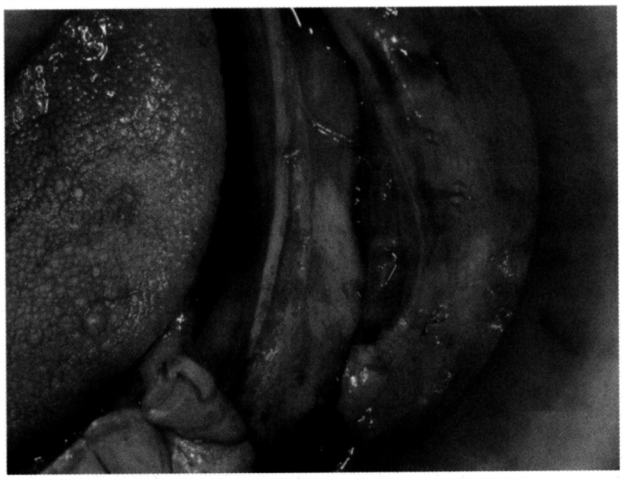

Fig. 2. *Following a crestal incision with vestibular release incisions and mucoperiosteal flap elevation, the thin residual ridge is clearly visible*

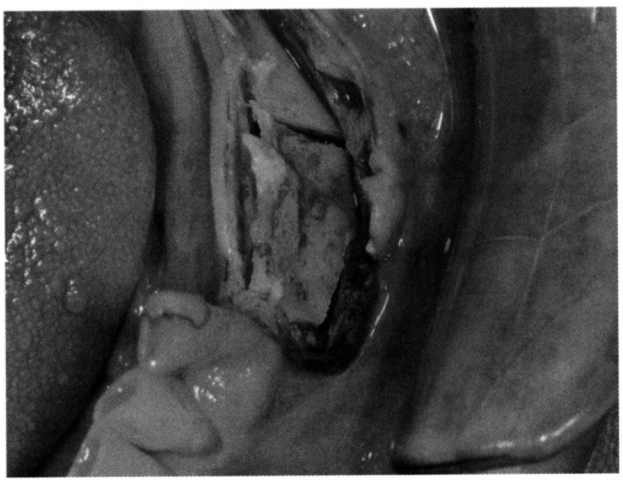

Fig. 3. *The horizontal osteotomy was performed with a ultrasonic surgery device along the marrow ridge and vestibular incision. In addition to the discharge incisions, a longitudinal basal discharge notch has been performed to mobilize easily the dense cortical table without breaking it*

Fig. 4. *After 1 months of split-crest widening with the osteotomes, the implants are placed*

of the 44 implants. Postoperative results were assessed by panoramic and periapical radiographs. Ossification of the osteotomy lines was evident and could be observed as sites with increasing radiopacity on panoramic and periapical radiographs 3 months after implants insertion. No dehiscence of the mucosa was observed at the marginal ridge of the mobilized fragments. The mucosa on the lingual and buccal side over the augmentation sites appeared unaffected in all patients. No patient suffered from hypoaesthesia in the region supplied by the mental nerve. The mean horizontal bone increase in coronal area was 5±3 mm.

DISCUSSION

The posterior mandible is the most difficult region on which to perform alveolar bone reconstruction for implant placement.

Narrow edentulous ridges required a technique of bone expansion before implant placement. Horizontal bone augmentation is possible using 3 different procedures:

1) lateral augmentation (guided bone regeneration technique (8) or cortical bone block (9); 2) interpositional augmentation (split crest) (10); 3) distraction osteogenesis (11).

The bone expansion technique on a mandibular level is a result of, in my experience, the evolution of the conventional split crest technique, in that a mandibular cortical plate if not completely osteotomized tends to mal fracture in an uncontrollable manner, creating serious obstacles to the success of the operation. With the bone expansion technique, a mal fracture of the labial cortical plate is impossible. The application of this technique to an edentulous ridge in which 2 cortical plates are not

Fig. 5. *The gap between implants filled with bone grafting*

Fig. 6. *After 3 months is observed a bone formation between implants*

separated by intervening cancellous bone is possible. Basa et al. (7) applied this approach to 120 implants with a 100% success rate at 4 months of loading. The challenging feature of this technique is that the perfusion of the buccal segment is critical. In the present study, no complications developed. The osteotomized bone should be considered an autogenous cortical graft, because perfusion and revascularization of osteotomized bone could be compromised. The split-crest mandibular procedure in two stage in order to avoid cortical resorption due to periosteal detachment in buccal cortical bone of the alveolar crest. The displaced bone must remain anchored on basal bone by a bone pedicle (green-stick fracture) that facilitates fracture callus stability and osteoblastic rather than fibroblastic/centroblastic differentiation of undifferentiated mesenchymal cells. Infact the expanded cortical is vascularised from the periosteum and not from the medullar. Consequently, this technique should not be performed in a single stage if the expanded fragment is very thin or highly porous. Revascularization of the cortical bone should be permitted before expansion to avoid resorption of the buccal plate. Generally, mandibular bone has higher density compared with maxillary bone, requiring a different approach in ridge splitting.

In the maxilla, the osteotomy of the crest may be achieved with chisels and without the assistance of surgical burs. A mallet may be used to expand the plates without vertical osteotomy. In the mandible, however, the initial osteotomy is achieved using a piezosurgical device on the alveolar crest and two vertical osteotomies.

Additionally, an apical osteotomy connecting both verticals with a round bur allows the expansion and minimizes any chance of bone fracture.

To separate the ridge gently, Chiapasco et al. (4) reported 45 cases using a wedge-type device with two surgical steel arms hinged apically and a transversal screw, which allows a progressive activation of the device. A fracture of the mandibular buccal plate occurred in one patient. In nine patients, the expansion was achieved gradually in 4 to 5 days by activating the device 1 mm per day.

Mandibular ridge expansion using a split-crest technique that included grafting the implant sites with a ultrasonic surgery device was a viable therapeutic alternative for implant placement in this patient population. The split-crest technique should be considered a safe ridge expansion procedure in cases of crestal augmentation. In conclusion the advance of mandibular ridge expansion using a split-crest technique in two stage is prevent of bone resorption and fracture of buccal plate.

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