Two-stage split-crest technique with ultrasonic bone surgery for controlled ridge expansion: a novel modified technique

To the Editor:

In patients with long-standing edentulous arches, extreme bone resorptions (both vertically and horizontally or combined defects) are frequently observed. Bone augmentation procedures represent an effective treatment option when there is a lack of supporting bone as a result of atrophy, trauma, or surgical resection. The “split-crest” technique consists of splitting the vestibular and buccal cortical tables\(^1,2\) and displacing the vestibular cortical bone in maxilla or mandible to create a middle gap, which is usually occupied mostly by the inserted implants. The unoccupied space by the implants can be filled with biomaterials, such as autologous bone grafts, particulate bone, or autologous biological therapies, such as plasma rich in growth factors (PRGF-Endoret).\(^3,6\) However, the use and predictability of the conventional split-crest technique is limited when the alveolar ridge is reabsorbed into the apical or occlusal points.

This study reports the clinical evaluation of a novel technique based on a modification of the conventional split-crest expansion technique. This procedure is indicated in cases of extremely resorbed ridges (3-4 mm) and consists of expanding the bone in 2 consecutive stages using transitional implants. The approach presented herein provides a twofold or even threefold increase in the width of the ridge, facilitating the placement of large-diameter implants that otherwise could not be inserted with the conventional 1-stage technique. The status of the soft and hard tissues surrounding the implants, and the success of inserted implants have been carefully analyzed.

Between March and September 2008, 3 patients received 4 implants (BTI Biotechnology Institute, Vitoria, Spain) after a 2-stage split-crest technique performed with ultrasonic bone surgery and using transitional narrow-diameter implants. The clinical histories of all patients were carefully evaluated to obtain the necessary demographic and anthropometric data, and clinical backgrounds of patients.

The procedure was performed in 2 stages. The first stage consisted a conventional split-crest procedure involving the opening of a full-thickness flap, after which scaling with the ultrasonic spoon around the bone bed was performed with the aim of stimulating bone bleeding. The starting drill was used to localize the sites where transitional implants were placed. Using an ultrasonic flat chisel, a side-to-side cut in the osseous crest was performed to connect the holes previously created (Fig. 1, a and b). At that point, the expansion was begun using the different motorized expanders (BTI Biotechnology Institute). The expansion was performed by means of the necessary drills (BTI Biotechnology Institute) depending on bone width and the type of implant to be placed (Fig. 1, c). The drilling sequence was 1.8-, 1.8- to 2.5-, 2.5-, and exceptionally 3.0-mm drills. Then, implants were placed (Fig. 1, d) and the “gap” on the ridge was overcorrected using an initial graft made of autologous bone mixed with liquid PRGF-Endoret (BTI Biotechnology Institute), a second layer consisting of porous bovine inorganic freeze-dried bone (BIOS, Geistlich, Switzerland) mixed with liquid PRGF, and a final layer of fibrin membrane obtained from PRGF technology. Closure was made without tension. Once the osseointegration period was completed (4-6 months), a new full-thickness flap was performed to access to the previously inserted implants, which were covered by the gum (Fig. 1, e and f). The implants that had to be replaced by larger diameter ones were retrieved using the BTI Extraction Kit (BTI Biotechnology Institute) (Fig. 1, g). Once the transitional implant wasatraumatically removed, a new drilling sequence was performed to place the definitive implants. The latter favored a new expansion process, compacting the native bone and enhancing the horizontal bone ridge width (Fig. 1, h). The ridge was overcorrected if necessary, following the same protocol described previously. Implants were loaded in function 4 to 6 months later.
Once the intervention was conducted, patients were referred for a series of periodic evaluations and were recalled for a final clinical evaluation at least 6 months after implant loading. Clinical assessment included the status of soft tissues: plaque index,\textsuperscript{7} bleeding index,\textsuperscript{8} probing depth (PD) measured at 4 sites per implant (mesial, distal, vestibular, lingual), and suppuration (yes/no); and the status of hard tissues around implants: scanner and measuring of bone expansion achieved in comparison with the scanner before the procedure. The measurement of the width of the bony ridge for each implant was made at 2 points: 1 in the basal part of the ridge and in a middle zone located at 8 mm from the first measurement (defined as apical and occlusal points of the ridge). Implant success rate was measured according detailed success criteria.\textsuperscript{9}
Transitional implants were replaced 5 to 7 months after placement by definitive larger diameter implants. The mean age of the 3 patients at first surgery was 64.7 years (SD = 11.0). Three subjects were women and one of them was a smoker. The diameters of the transitional implants were 2.5 and 3.0 mm, whereas the diameters of the definitive implants ranged between 3.3 and 4.0 mm. All implants were inserted in the upper jaw. Final rehabilitations included 2 complete overdentures and 1 bridge. All prostheses were screwed, and resin was used in all cases. Mean follow-up time was 20.5 months (SD = 1.7; range, 19-22 months).

The status of soft tissues surrounding implants was good. All implants showed low rates of plaque index. In fact, all of them showed values of 1 or less. Furthermore, low values of bleeding index were recorded (all implants showed values ≤1) and none had drainage at final assessment. The mean probing pocket depth measured in 4 different sites around implants was 3.06 mm (SD = 0.69).

Bone ridge width was measured and compared between baseline and the final computed tomography (CT) scan of the patients. The initial mean width of the ridge was 3.35 mm at apical (SD = 1.14, range 2.68 to 5.06) and 2.74 mm at occlusal (SD = 0.24, range 2.48 to 3.06 mm), whereas the final measurements after the 2-stage split-crest technique was 10.46 mm at apical (SD = 0.6, range 9.9 to 11.11 mm) and 11.23 mm at occlusal (SD = 2.02, range 8.77 to 13.22 mm). Therefore, mean crest expansion was 8.49 mm (SD = 1.8) and 7.10 mm (SD = 0.80) at apical and occlusal, respectively. Interestingly, no implants failed during the observation period, and all met the defined success criteria, showing a 100% success rate at the end of the follow-up period.

In general, when the ridge is extremely narrow, usually the only viable solution to the insertion of dental implants is the block bone graft, which would increase a patient’s morbidity. The technique report in this study is especially interesting for those patients with insufficient bone ridge for implant placement and very compact bone. Moreover, it provides more bone expansion and lip support than the conventional split-crest technique. In fact, when using the 2-stage split-crest approach it is possible to triple the width of the initial narrow ridge, whereas with the conventional technique it is difficult to duplicate the width.10

To achieve a controlled and progressive bone ridge expansion, the procedure is performed in 2 separate stages. In the first expansion stage, transitional implants are placed, whereas in the second, these implants are replaced by larger-diameter implants facilitating native bone growth. By dividing the bone expansion procedure into 2 consecutive stages, the bone volume gained during the first intervention can be progressively increased by the second procedure.

These results, although preliminary, support the predictability and safety of the 2-stage split-crest technique with ultrasonic bone surgery and its potential use in patients with extremely resorbed ridges. This new approach is less aggressive than other techniques, such as the use of bone grafts but can provide the same or even greater capacity for bone expansion.

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