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Case Report

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Horizontal alveolar ridge expansion in anterior atrophic maxila using rotatory instruments (bone expander®): a case report

Abstract

Some conditions are necessary when placing an dental implant, good bone density, height and weight must be available in the alveolar process. Tooth decay, trauma, periodontal disease and other causes can lead to tooth loss and subsequently bone loss. Therefore, many sites where dental implants are needed have also lack of bone support. The main of this present study is to report a case where a implant surgery was performed using rotatory instruments Bone Expander®, for volume gain in atrophic alveolar ridge and low bone density, due to the absence of the four upper incisors. Guided Bone Regeneration was associated in order to gain vestibular bone volume in the alveolar ridge. The results showned that the use of Bone Expander® is able to expand the alveolar ridge horizontally and at the same time compacting bone in the inner walls of the prepared site increasing bone density in this area and allowing to the implant greater primary stability.

Keywords: dental implant, ridge augmentation, anterior atrophic maxila, bone regeneration, osseodensification, bone expander

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Introduction

Most of the sites that need an implant are alveolar ridges that don't configure good conditions to receive one. Atrophic alveolar ridges don't have sufficient volume, thickness and height to receive an implant, and if done will violate it's functionals and aesthetics principals. The atrophic ridges can be caused by trauma; periodontal disease, and tooth loss.[1,2] Mostly, alveolar ridges with 4mm thickness or less need an augmentation.[3]

Narrow-diameter dental implants between 3mm and 3.5mm decreased the need for surgeries on which purpose was ridge augmentation. Although, the 1mm thickness of bone surrounding the implant must be respected, and in cases of very narrow ridges a surgery for augmentation still is a necessary intervention. [4] Therefore, for implant placement, several techniques allow gaining bone volume, increasing the size of the alveolar ridge.[2] Some of the most frequently used methods that make possible vertical or horizontal augmentations are osteotome technique, distraction osteogenesis, block bone graft, guided bone regeneration (GBR), and split crest.[1]

Alveolar ridge expansion using rotatory instruments has been documented in osseodensification technique, lateral bone condensing and expansion, and bone spreader technique, these techniques show to be relatively simple to implement and also does not require lots of additional material. They have demonstrated good primary stability in atrophic and low bone density alveolar ridge.[5–7] Horizontal alveolar ridge expansion with Bone Expander® (Maximus, Contagem, Brazil) performed in this article is a relatively new technique and there is no scientific study published about this subject until this present moment.

The Bone Expander® is a rotatory instruments kit consisting of a sequence of reamers of differents diameters, when used in the thin trabecular bone of an atrophic ridge is capable of its horizontal expansion. After the initial perforation made with a needle drill to cut and remove bone, and also guide the site preparation, the reamers are inserted with "in and out" movement and clock-wise rotation in order to expand and condense the bone, instead of removing it. Following the manufacturer instructions, the site preparation should be done between 800 to 1200 rpm and an insertion torque value of 20N when done in the maxillary bone. This preparation must be done under irrigation with a saline solution to prevent Osseo tissue from overheating and subsequently healing complications. The reamers sequence must be used increasing its diameter until it reaches a diameter compatible with the diameter of the chosen implant. The aim of the study is to report a case where Bone Expander was used in atrophic ridge. For being a new technique, no case report was found about it.

Case report

Female patient, 50 years old, systemically healthy, attended the clinic complaining of the lack of four upper incisors. Clinically, the lack of bone support was evident, and in the absence of the four upper incisors the patient had a fixed bridge prosthesis supported by the upper canines (Figure 1&2). This prosthesis was poorly adapted and aesthetics compromised.

Computed Tomography was requested, which showed an atrophic anterior maxilla with thin width thickness and presented differences in thickness when observing the transverse sections, varying between 3.40mm and 4.28mm. Regarding the height of the alveolar ridge, the variation was between 13.08mm and 16.54mm, which demonstrated to be satisfactory to receive an implant treatment (Figure 3).

The treatment of choice was idealized by reverse planning, starting with prosthetic planning so it could serve as a guide, and from that, it was possible to determine the best implant position (Figure 4). It was

decided that two implants in the lateral uppers incisors regions would be sufficient to rehabilitate the area. Bone ridge preparation would be done with Bone Expander® rotary instruments followed by implant placement, associating the GBR technique. For aesthetic reasons, the patient would use a temporary canine-supported prosthesis until the complete alveolar healing process.

Figure 1 Lack of four lateral upper incisors.

Figure 2 Alveolar bone defect.

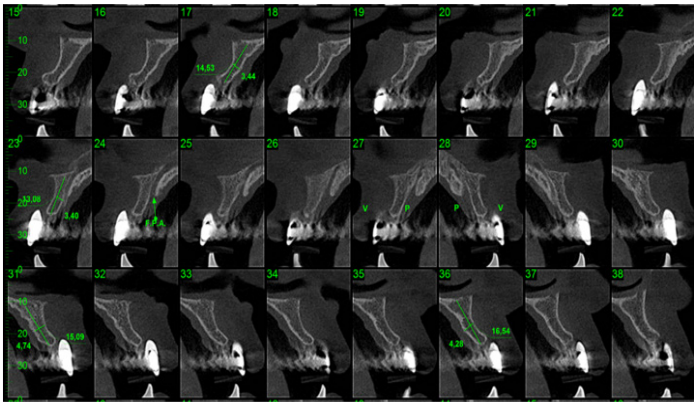

Figure 3 Computed tomography, transverse sections of anterior maxilla.

After the pacient signed the whritten informed consent form treatment has began. Treatment included two implant placements, one in the region of element 12, and the other in the 22 region, both sites preparated with Bone expander®. As the anterior ridge was too narrow, there was a need for ridge augmentation, which would be associate to some bone grafting; the grafting of choice was guided bone regeneration (GBR), with xenogen bone graft and resorbable membranes.

Figure 4 Guide made from reverse planning to provide the best position of the implants.

Under local anesthesia using articaine hydrochloride 4% with epinephrine 1:100.000 (Nova DFL, Rio de Janeiro, Brazil), an incision was made on the alveolar crest, two relaxing incisions were made in first premolars and took to beyond the mucogingival junction. A full-thickness mucoperiosteal flap was elevated on both sides, buccal and palatal (Figure 5). After the Osseos tissue was exposed, with the guide assistance initial perforations were made with the 1.3 diameter needle drill in 12mm depth. In this first perforation, a clockwise rotation was used on purpose to cut and remove bone (Figure 6). Further, the Bone Expander® (Maximus, Contagem, Brazil) reamers sequence was used until a reamer which had a 2.8mm diameter and reached 12mm depth in the bone site (Figure 7). As manufacturer instructions, reamers were acting with "in and out" movement, clockwise rotation, at a speed of 800 rpm and under irrigation.

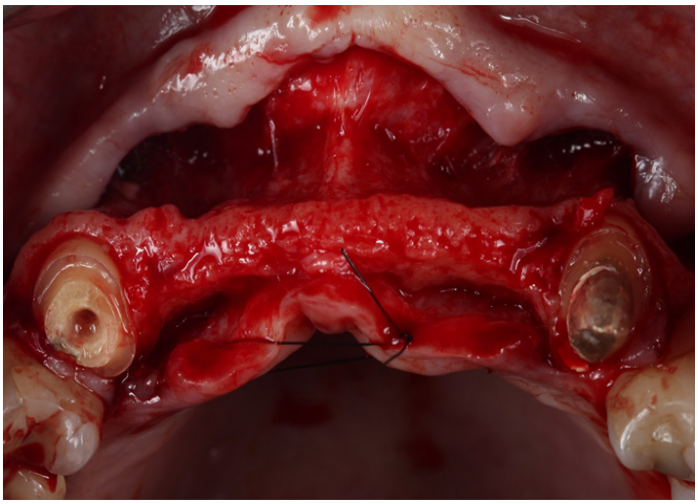

Figure 5 Full-thickness mucoperiosteal flap exposing alveolar bone.

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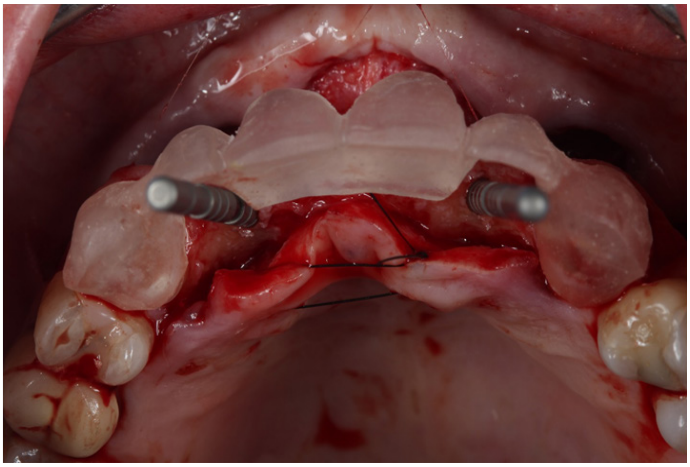

Figure 6 Alignment pin showing future implant position.

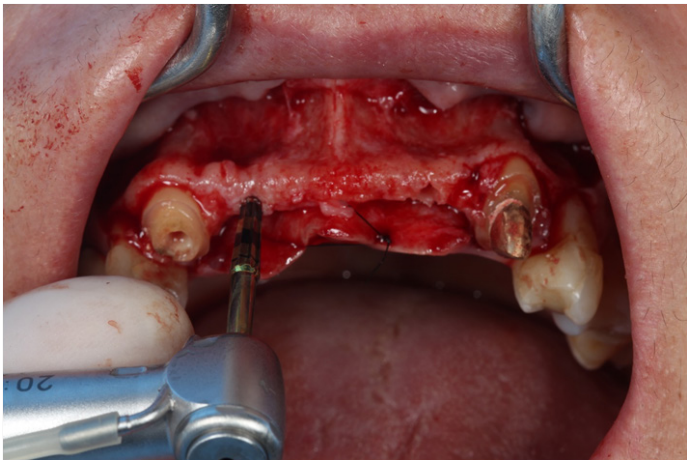

Figure 7 Horizontal alveolar expansion using bone expander.

After the sites were prepared, two BLT Ø3.3 mm X 10mm (Straumann® Basel, Switzerland) implants were placed, the implant which was replacing the region of element 12 reached a torque value of 30N, while the implant who took place of 22 element achieved a torque of 35N (Figure 8). Implants positions were verified by placing the guide (Figure 9). Afterward, healing abutments 3.3 mm x 2mm (Straumann® Basel, Switzerland) were placed (Figure 10). Observing the buccal side, the alveolar bone showed to be really thin, allowing us to see the implant by translucence, but no fenestration has occurred.

GBR was performed, the bone was prepared with small perforation using 1.3mm diameter spherical burr (Straumann® Basel, Switzerland) in order to provide blood nutrition from the bone to the xenogen bone graft Cerabone® (Straumann® Basel, Switzerland) (Figure 11), the graft was covered with a colagen resorbable membrane 15mm x 12mm Jason® (Straumann® Basel, Switzerland) that has been cutted in two separeted pieces, so each piece of the membrane could cover each implant (Figure 12). The flap was repositioned and sutured with Mononylon 5.0 Ethilon® (Ehicon®, São Paulo, Brazil) (Figure 13&14). A provisory prosthesis was cemented because of the aesthetic demand of the region (Figure 15&16). Postoperative care instructions were given to the patient, and following medications were prescribed: Amoxicillin 875mg every 12 hours for 7 days, Ibuprofen 600mg every 12 hours for 3 days, Acetaminophen 750mg every 6 hours for 3 days, Chlorhexidine digluconate 0.12% every 12 hours for 7 days. The patient returned within 7 days for reassessment and suture removal (Figures 17&18). Clinically presented asymptomatic and with good healing pattern.

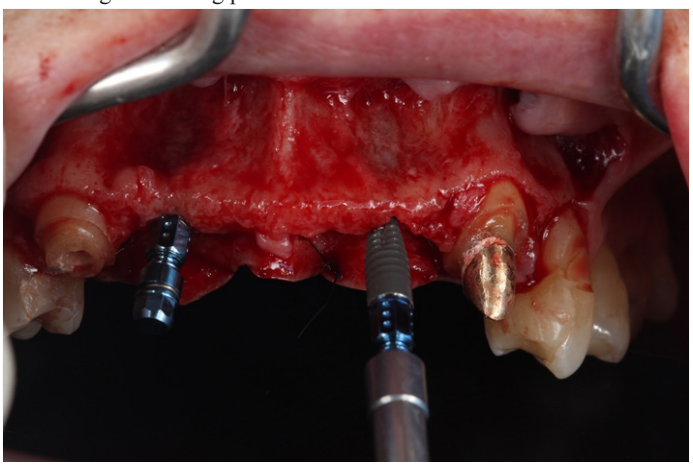

Figure 8 Implant placement.

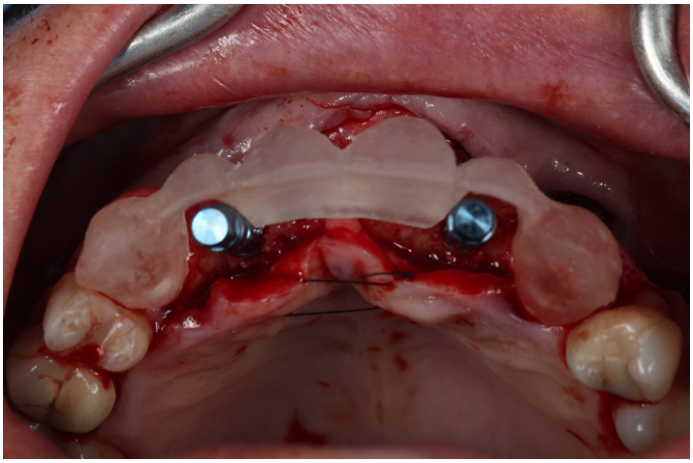

Figure 9 Verifying implants position using the guide as a reference.

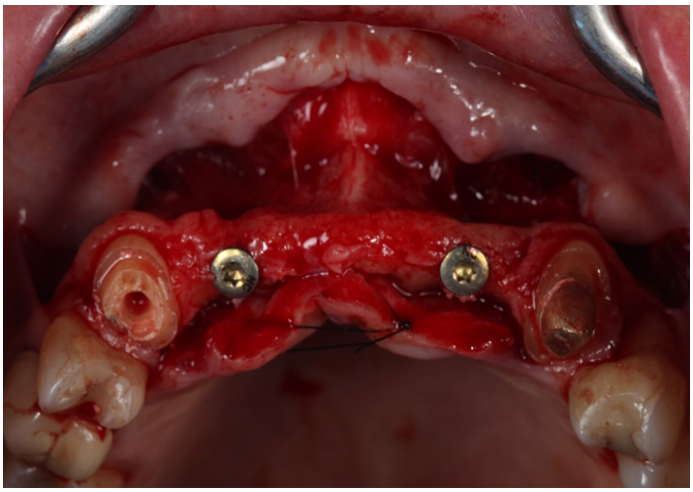

Figure10 Healing abutments.

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Figure 11 Particulate bone graft cerabone®.

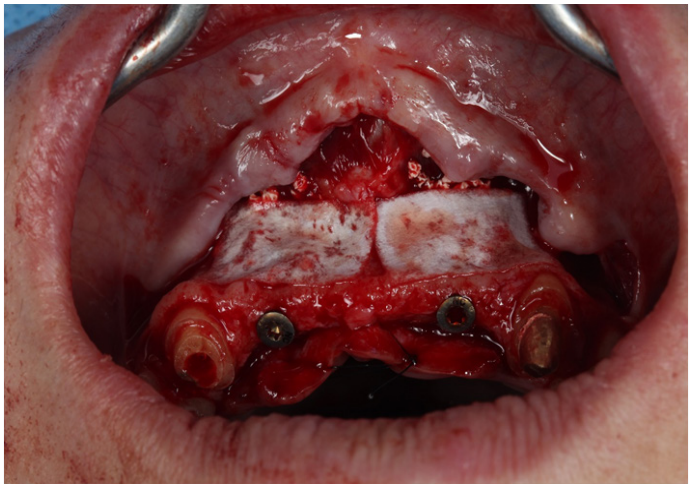

Figure 12 Bone graft covered with resorbable mambrane jason®.

Figure 13 Suture.

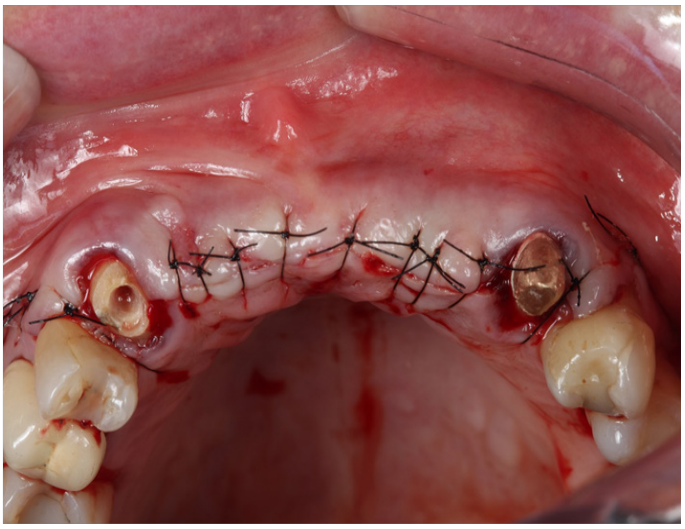

Figure14 Suture.

Figure 15 Pos-operative with temporary prothesis cemented.

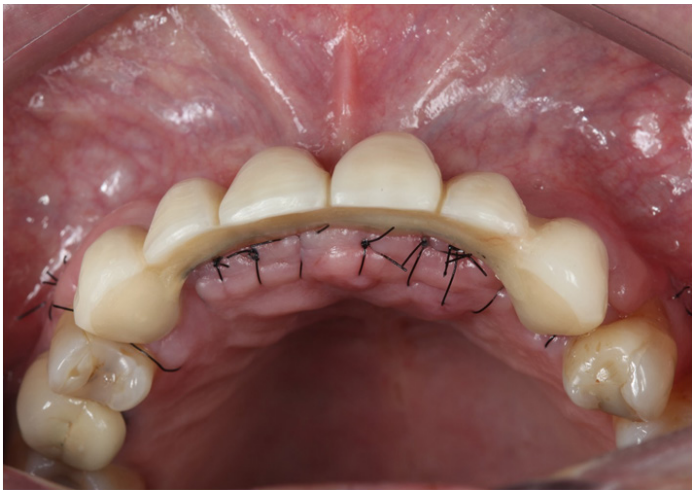

Figure 16 Temporary prothesis.

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Figure 17 Healing pattern 7 days after the surgery.

Figure 18 Healing pattern 7 days after the surgery.

Discussion

Due to the physical characteristics of the reamers kit, use and results obtained with Bone Expander®, the technique developed when using these instruments is similar to osseodensification. This technique allows you to expand ridge volume and increase bone density in contact with the implant without removing bone.[8] While the conventional technique uses drills to excavate and remove bone for later implant placement, osseodensification drills increase bone density by compacting the bone in the socket walls, which could be compared to an autogenous graft. They increase bone density at the bone-implant interface and primary stability.[9] Features, again, very similar to those reproduced by Bone Expander®.

However, there are some differences in the manufacturers' recommendations. While the osseodensification proposes to use the counterclockwise rotation at a speed of 800 to 1500rpm, because this rotation does not promote the cut, but bone compaction in the preparation walls. [5] The manufacturer of Bone Expander recommends that its reamers be used clockwise, as in this sense the arrangement and geometry of the blades preserve a greater amount of irrigating liquid in the site, reducing the chances of bone tissue overheating. Although they differ in the direction of rotation, both techniques require movement in the vertical direction, with "in and out" movement in the osteotomy site. Bone expansion occurs thanks to the viscoelasticity provided by a large amount of collagen in the trabecular bone. Bone deformation is directly related to the stress applied to it by the drill in vertical movements and the pressurization of irrigation.[5–10] In both techniques, it is possible to visualize increase the ridge width and the bone density.

A histological analysis comparing bone remodeling of implants placed with the standard technique and implants placed after the use of osseodensification drills clockwise and counterclockwise promoted different patterns. Counter-clockwise osseodensification showed a faster regeneration in which there was no bone resorption of the cervical third,[5] an important characteristic for the maintenance of gingival tissue. There are no studies showing histological analyses of bone tissue prepared with Bone Expander, but with this study, we can see that there is a significant increase in the ridge width and that there was no implant fenestration, which would be common when using the conventional technique. Taking the hypothesis that Bone Expander would bring less bone resorption by preserving the integrity of the alveolar walls.

The osteotome technique is performed using osteotomes (cylindrical instruments), sequentially increasing the diameters until the desired implant size is obtained.[11] The use of osteotomes in low density bone works with bone viscoelasticity, induces small fractures of the bone trabecular bone then compressing them.[12] This technique shows better results in the vertical increase of the ridge, and some authors disagree on the ability of osteotomes to increase primary stability and accelerate the healing process.[11–13]

In the split crest technique, an osteotomy is performed on the ridge crest, and chisels induce a green branch fracture of one of the bone segments. The implants are placed in the space created by osteotomy and generally achieve good primary stability. However, this technique is sensitive and requires the surgeon's experience, in very thin ridges the total fracture of the bone segment can occur, culminating in the failure of the technique. It provides its best results when performed on edges 3 to 5mm thick.[14] Reamers can still be used on alveolar ridge smaller than 3mm. A combination of the split crest and alveolar expansion techniques with rotary instruments can be used in cortical bone.[15]

Distraction osteogenic consists of expanding the bone gradually. For this purpose, an osteotomy is performed detaching de area of expansion in two segments of bone, then a distracting device is placed.[16] The activation of the device causes the bone segments to be pulled away gradually from the bone, and in the space generated between them there is a new formation of bone.[17] After the distraction and complete mineralization of the gap, bone density is still the same as before in this region. The anterior maxilla after distraction and complete mineralization of the newly formed bone has a density of D3, rarely D4, constituting a difficult substrate to achieve adequate primary stability.[18] Maximus, Bone Expander's manufacturer, explains that with bone compression done by the reamers can enhance bone density, transforming a D4 bone into D2 bone, but there is no histological analysis to support such a transformation. Even without any such research, this modification in bone density would explain the increased primary stability that was clinically found.

Also, distraction osteogenic requires more than one surgical intervention, one to settle the device and another at the end of treatment for its removal and implant placement.Iit is recommended that an overdistraction of 2 to 3mm should be done due to the high level of reabsorption.[14–16] With Bone Expander only one surgery is

required, where preparation of the alveolar rigde for implant and widht augmentation are done in teh same surgery intervention. Although there is no fenestration of the implant at the time of surgery, the association of GBR was made to decrease chances bone volume loss due to bone remodeling process.

Conclusion

The use of rotary instruments for alveolar expansion is an effective and easy technique to perform. It represents advantages such as low material demand and only one surgical intervention, in which the implant site preparation itself already results in alveolar width expansion and increases bone density in its internal walls, leading to greater primary stability. The simplicity of the technique minimizes operator inherent failures, decreases chances of implant fenestration, and can still be associated with other techniques. Bone Expander reamers kit is a good alternative for horizontal alveolar expansion of atrophic ridges in the anterior maxilla.

Acknowledgments

None.

Conflicts of interest

The authors declare that there is no conflicts of interest.

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None.

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