A Two-step Method for the Preparation of Implant Recipient Site in Severe Atrophic Maxilla: A Case Report of the Alveolar Ridge Split Technique Followed by Bone Expansion

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Abstract

Augmentation of deficient and atrophic alveolar ridges is an important aspect of dental implant therapy with the goal of providing a functional restoration in harmony with adjacent natural dentition. Bone splitting technique is considered a distinguished augmentation method for treatment of deficient alveolar ridges. According to this procedure, the compromised alveolar ridge is opened from the crest of the ridge and subsequently split with special chisel instruments.

In this report, we described a case of horizontal ridge augmentation of an atrophic anterior maxillary ridge using ridge split in the first step and ridge expansion concomitant with implant placement in the second stage after 6 months.

A two-step method of alveolar ridge split using piezosurgery followed by bone expansion is a reliable and successful treatment plan for implant recipient site rehabilitation in severe atrophic maxilla (less than 3 mm).

Keywords: Alveolar ridge split, atrophic alveolar ridge, bone expansion.

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Introduction

Treatment of the patients with atrophic ridges who require prosthetic rehabilitation is a challenging issue in oral and maxillofacial implant surgery (1). The success of dental implant placement predominantly depends on the presence of adequate bone quantity and quality in the edentulous site. The volume of optimal osseous positively affects osseointegration, as well as the long-term stability and final esthetic and prosthetic outcomes of dental implants (2).

In general, labial cortical plates are thinner in the esthetic anterior regions compared to the lingual plate and are the first to be removed or resorbed after tooth extraction or trauma. The labial alveolar bone often undergoes rapid reconstruction after natural tooth loss and is associated with 25% reduction in volume during the first year, followed by 40-60% reduction in width in the next three years, leading to the more medial labial cortex of the bone compared to the original position (2, 3).

In the cases of advanced bone loss, there is insufficient bone width for rehabilitation with osseointegrated implants. Consequently, other alternatives must be considered for bone augmentation. Conventionally, width defects are managed using partial bone reconstruction techniques with bone blocks, guided bone regeneration, horizontal osteogenic distraction, and bone grafts. These techniques have proven effective in highly resorbed ridges to achieve optimal outcomes in horizontal and vertical dimensions. However, they have several limitations, such as invasiveness, additional donor site morbidity, resorption of the grafting materials, membrane collapse, risk of infections, and delayed implant installation for graft maturation (4, 5).

Bone splitting is another technique used in the treatment of narrow bone ridge. In this procedure, the compromised alveolar ridge is opened from the crest of the ridge and split with special chisel instruments. To avoid the collapse of the expanded ridge, bone substitutes are packed into the created bone defect in order to maintain the space. Another option is to insert the implant into the expanded space between the medial and buccal bone walls in order to allow healing in a submerged position (5, 6).

Splitting could be performed using chisels and hammers or rotating/oscillating saws, as well as piezosurgery, which has recently been introduced in the literature (7, 8).

The present study aimed to introduce a two-step method of alveolar ridge splitting through piezosurgery, followed by bone expansion for the rehabilitation of the recipient site and implant placement in a severely atrophic anterior maxillary ridge in a 52-year-old female patient.

Report of Cases and Technique

A 52 year old female with missing teeth from right second premolar to left canine of maxilla for about 15 years was referred to the Department of Implantology of Mashhad Dental School. She had been using a removable partial denture (RPD) for more than 14 years and was seeking a better treatment option. Periodontal evaluation of the area showed a thin keratinized gingiva and the patient was in a good oral hygiene condition. The patient had no systemic medical problems Since the patient had regular dental visits during last 3 years, periodontal and dental condition in dentate areas were in good condition and she had a good oral hygiene. After clinical evaluation, we proposed the treatment plan for rehabilitation of the edentulous area with five dental implants and a fixed partial denture (FPD).

In evaluation of the edentulous area with cone beam computed tomography (CBCT), we encountered an atrophic alveolar ridge (Fig. 1) due to long-term RPD wearing. Surprisingly, there was less than 3mm width of alveolar ridge in the anterior region.

In the first surgical step, we executed ridge split technique using piezosurgery (Piezotome® Solo, Acteon, South Korea).

The operation was performed under local anesthesia (Lidocaine 2%, Epinephrine 1/80000, IranDaru, Iran). At first a full thickness flap on crestal ridge without vertical cuts was created and dissected. Then a small palatally horizontal osteotomy cut on the alveolar ridge was prepared with a piezosurgery device for ridge splitting. This osteotomy cut had a 2-mm distance from the existing teeth.

After that, through sub-periosteal tunneling, three vertical equidistant cuts from the teeth were made in the buccal cortex. By utilizing the split kit chisels (crest splitting kit, Acteon, South Korea) the buccal cortex was separated from the palatal meticulously to cause green-stick fractures**.** Since these fractured segments were attached to the periosteum, they were repositioned without fixation screws. Finally, the ridge splitting was completed, and the bone substitution material (Cerabone®, Bottiss, Germany) was used to fill the gap between the two cortical plates. Moreover, the entire grafted area was covered with a resorbable barrier membrane (Jason® Membrane, Bottiss, Germany), and the flap was sutured with resorbable polyglycolic acid in a tension-free manner. Antibiotics (co-amoxiclav [625 mg] every eight hours for seven days), analgesics (ibuprofen [400 mg] every six hours for four days), and

antiseptic mouthwash (chlorhexidine [0.12%] every 12 hours for two weeks) were prescribed for the patient.

After six months, another CBCT was obtained from the patient (Fig. 2), which showed a slight ridge width deficiency in the implant sites. As a result, ridge expansion/spreading was performed using the thread formers of the implant kits (BEGO Semados®, RI Implant, BEGO, Germany) concomitant with implantation.

After the drilling of the implant sites with initial drills (800 rpm with 35 n/cm), site preparation continued with the thread formers (30 rpm with 35 n/cm) until reaching the final diameter (Fig. 3). At the final stage, five bone-level implants (BEGO Semados, RI Implants, BEGO, Germany) with the diameter of 3.75 millimeters were inserted into the expanded osteotomy sites with satisfactory primary stability. After three months, radiographic and clinical examinations demonstrated successful osseointegration.

The uncovering of the implants was performed to place the healing abutments (Fig. 4). After three weeks, the impression was taken, and an FPD was delivered to the patient (Fig. 5). No clinical and radiographic problems were observed in the implanted areas, and the success rate of the implants was 100% after a one-year follow-up (Fig. 6). Despite the prolonged course of treatment (10 months), the patient was satisfied with the new implant-borne prosthesis (Fig. 5).

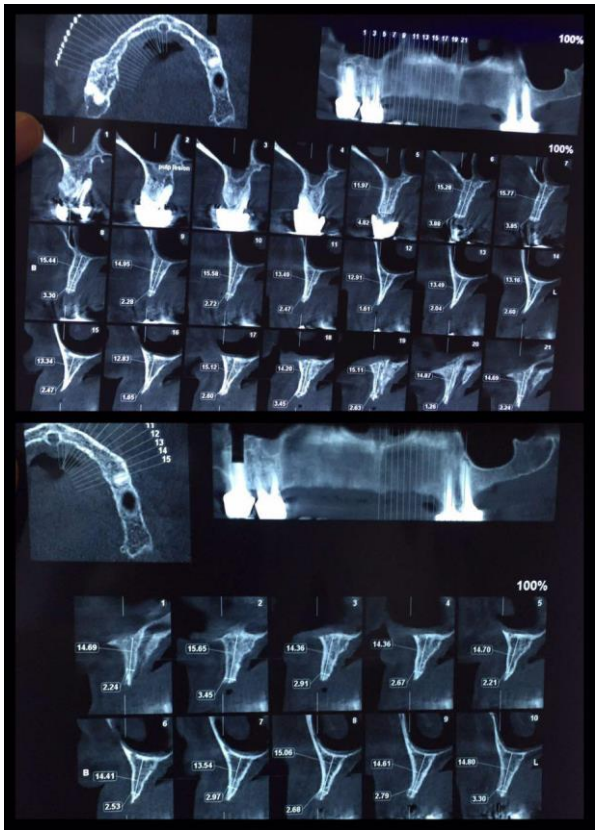

Figure 1 . Cone Beam Computed Tomography View of Edentulous Maxilla before Ridge Split Surgery

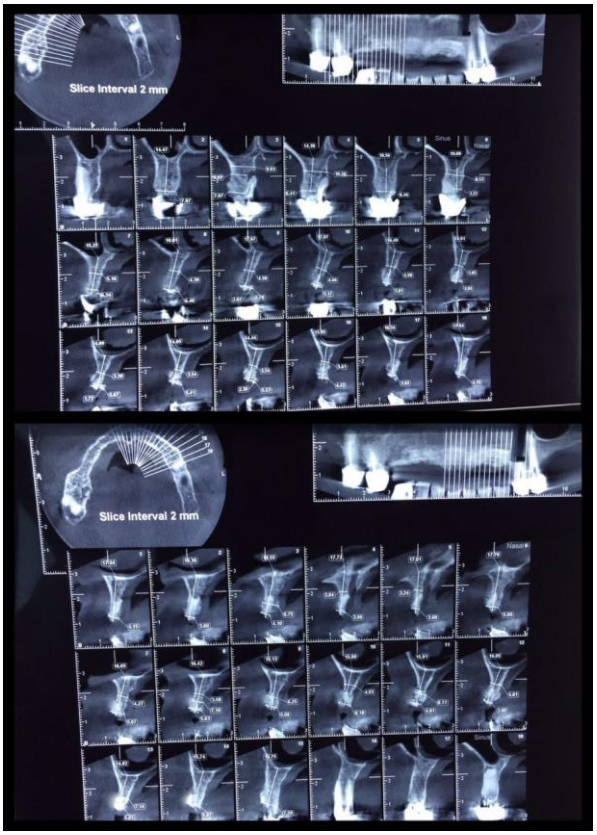

Figure 2. Cone Beam Computed Tomography View of Split Area after Six Months and before Bone Expansion

Figure 3. Clinical View of Prepared Implant Sites in Ridge-split Maxillary Alveolar Site after Bone Expansion

Figure 4. Uncovering of Implants and Placement of Healing Abutments after Four Months

Figure 5. FPD Delivered to Patient

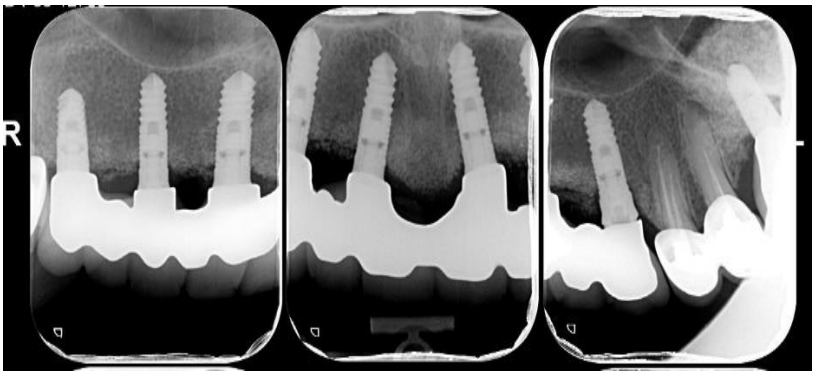

Figure 6. Periapical Radiography of Osseointegrated Implants after One-year Follow-up

Discussion

Alveolar ridge splitting is a distinguished technique for bone expansion, which is used in the treatment of atrophic ridges with horizontal defects. In a study, Vercellotti et al (6). introduced piezosurgery for the treatment of atrophic jaws. This technique could be implemented through the simultaneous insertion of implants in one session or in two steps (1). Alveolar ridge splitting has several advantages, such as the elimination of the intra-oral (ramus, tuberosity, and mandibular symphysis) or extra-oral bone harvest (tibia and iliac crest). Moreover, it eliminates the need for second site surgery, thereby reducing patient morbidity (9).

The ideal indications of the ridge splitting and bone expansion procedures are the cases that do not require vertical ridge augmentation and have adequate cancellous bone between the labial and palatal cortical plates. These procedures are optimally performed in a narrow ridge (minimum of three millimeters) with greater preference in the maxillary bone over the mandible (5).

In the current research, the patient had a severely atrophic bone width (<3 mm) in some areas. Therefore, augmentation and implantation were carried out in two stages to achieve better outcomes and prevent the complete fracture of the buccal plate, which is occasionally caused by drilling in a split alveolar ridge. Through meticulous splitting by piezosurgery and osteotomes, an acceptable alveolar width was achieved in the first surgical step. Afterwards, the expansion osteotomes were used to insert the implants with proper width in proper positions.

The main surgical risk associated with the ridge split procedure (RSP) is the fracture of the labial-cortical plate (9). Our patient had minor fractures in the crestal edge of the buccal plate, especially in the thinner areas, due to the minimally reflected flap that remained attached to the periosteum. These segments were repositioned and covered with a resorbable barrier membrane. In the second surgical step, we observed that the bone segments were healed with minimal resorption.

Infections and uncontrolled bleeding are among the rare complications of RSP, which are often controlled by antibiotics/debridement and local hemostatic agents, respectively (8). However, no such complications were observed in our patient. In a study in this regard, Sethi and Kaus (10) reported the success rate of higher than 97% in a five-year period, which involved the use of a two-stage implant procedure through maxillary expansion by osteotomes. Subperiosteal tunneling at the sites of the vertical bone cuts is a modification of the split thickness flap reflection, which leaves the periosteum intact in the remainder of the fractured bone segments.

Some clinicians, who perform the ridge splitting technique with delayed implant placement, prefer a full thickness flap prior to making the corticotomies upon the first surgery. Following that, they perform a partial thickness flap during the second surgery for implant placement in order to reduce the overall bone resorption (7, 11, 12). In the present study, we used a subperiosteal flap and performed tunneling in the first and second surgery steps, which helped us to conservatively manipulate and manage the fractured buccal plates in order to prevent necrosis or resorption.

Conclusion

A two-step method of alveolar ridge splitting using piezosurgery followed by bone expansion is a reliable, successful treatment plan, as well as a viable option for the rehabilitation of the implant recipient sites in severe atrophic maxilla (<3 mm). Although this surgical approach could be used in both jaws, it is better suited to the maxilla.

Conflicts of interest

None declared.

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