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CASE REPORT

Multidisciplinary Management of a Protrusive Malocclusion in an Adult Patient with Atrophic Ridges by Alveolar Ridge Split Technique - A Case Report

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Abstract

Objective: Closing old extraction spaces in adults can be an arduous task for the orthodontist. Loss of teeth results in alveolar ridge atrophy, reducing its height and labiolingual thickness which severely restricts orthodontic tooth movement. This case report highlights successful orthodontic treatment encompassing retraction of protruded teeth in an adult patient who presented with knife-edge shaped edentulous posterior ridges. **Method:** Esthetic and functional rehabilitation was achieved in this case with an interdisciplinary approach. The barrier of narrow atrophic posterior edentulous ridges which was inhibiting orthodontic tooth movement for retraction was overcome by bilateral alveolar ridge split followed by bone grafting. This procedure led to increased alveolar ridge height and width facilitating orthodontic space closure and retraction of forwardly placed anterior teeth. Simultaneously corticotomy cuts were placed in the mandibular anterior teeth region to accelerate the tooth movement as significant delay in treatment completion had occurred due to the pandemic situation. After achieving the required retraction of anterior teeth, the remaining edentulous spaces were managed with fixed prosthesis. **Findings:** A 22-year-old female patient was found to have protrusive and incompetent lips with acute nasolabial angle due to forwardly and irregularly placed front teeth with an overjet of 6mm. The patient had missing 35, 36, 45, 46, and 47 leading to bilateral posterior narrow edentulous ridges. The lateral cephalogram revealed skeletal class II jaw bases with vertical growth pattern and proclined upper and lower incisors. Clinical and radiographic evaluation post-treatment revealed significant improvements in smile aesthetics and

periodontal phenotype. Hence, augmented corticotomy assisted orthodontic treatment could be a promising treatment strategy in adult patients with posterior edentulous atrophic ridges. **Novelty:** This case report describes successful treatment of an adult patient with posterior edentulous ridges and forwardly placed anterior teeth which was a challenging situation in itself and got further complicated due to covid 19 pandemic situations wherein the patient had to discontinue her treatment for more than 2 years. After such a long break the chances of successful space closure were scarce and the patient demanded early completion of treatment as it was over delayed. Meticulous planning and execution of surgical interventions combined with accelerated orthodontic procedures helped to overcome all the hindrances, yielding a significant esthetic enhancement, improvement in functional occlusion and patient satisfaction within a short duration of time.

Keywords: Ridge Split Technique; Atrophic Ridge; Bonegraft; Corticotomy; Accelerated orthodontics

1 Introduction

Ridge resorption after loss of teeth is a natural consequence and a continuous process. Most commonly, following extractions many alterations occur in the alveolus, affecting the height and width of the ridge. These alterations are the result of normal remodelling process of bone following extraction of teeth, periodontal disease, prolonged denture wear, surgical resection or disuse atrophy. Loss of teeth can cause significant ridge resorption in all three planes, the most prominent being in the horizontal direction [(1)]. Additionally, the conversion of cancellous bone into dense cortical bone following alveolar bone reduction poses a significant challenge to orthodontic tooth movement within these areas leading to complications such as dental root resorption, gingival recession or traumatic injuries to pulp vitality of moved teeth [(2)]. Hence, attempting orthodontic tooth movement across the narrow alveolar ridge area with reduced height and labiolingual thickness, inevitably entails certain adverse reactions. Unlike the routine reconstruction of alveolar ridge in the field of implants, the orthodontic practices are distinctive, which require dental movement across the constructed alveolar ridge with safety and stability. Therefore, re-establishment of the atrophic alveolar bone prior to orthodontic tooth movement is an essential prerequisite for safe and efficient tooth movement.

Surgical interventions to modify the alveolar housing and tooth movement has been described in various forms for over a hundred years. Several methods have been proposed to augment the narrow alveolar ridge, such as guided bone regeneration (GBR) using various graft materials (autograft, allograft, xenograft, and alloplast), autogenous onlay block grafts harvested intra-orally or extra-orally, distraction osteogenesis, ridge expansion osteotomy and ridge splitting [(3,4)]. However, it is the spirit of interdisciplinary collaboration in orthodontics that has expanded the realm of traditional orthodontic tooth movement protocols. Selective alveolar decortication along with particulate bone grafting results in an increase in alveolar bone width, shorter orthodontic treatment time, increased post treatment stability, and decreased amount of apical root resorption [(5,6)].

The purpose of this article is to describe the functional and esthetic rehabilitation achieved in an adult orthodontic patient with protruded anterior teeth and atrophic mandibular posterior ridges using ridge split technique with bonegrafting combined with anterior corticotomy procedure.

2 Methodology

A 22-year-old female patient reported for orthodontic treatment with a chief complaint of protrusive lips, unesthetic smile and inability to chew food properly due to multiple missing teeth. Extraoral examination of the patient revealed mesoprosopic facial form, convex profile, acute nasolabial angle and protrusive lips with a 3 mm interlabial gap at rest (Figure 1) . Intraorally, anterior teeth were proclined and irregularly placed with an increased overjet. 35,36 and 46 were missing whereas 45 and 47 were found to be grossly decayed (Figure 2).

Radiographic examination revealed poor prognosis for 45 and 47 due to which extraction was advised. The lateral cephalogram revealed skeletal class II relationship and hyper divergent mandibular plane angle (Figure 3).

Fig 1. Extraoral Photographs

Fig 2. Intraoral Photographs

Orthodontic treatment objectives included addressing the patient's chief concern through alignment and retraction of anterior teeth that would lead to improvement in facial esthetics and lip competency.

Orthodontic treatment was initiated with a fixed orthodontic appliance (MBT 0.022 prescription). Alignment and levelling was achieved in the upper and lower arches till 19X25 ss wire. For retraction of anterior teeth, extraction of first premolars in upper arch and utilization of existing edentulous spaces in the lower arch was planned. After required retraction, restoration of remaining edentulous spaces with fixed prosthesis was considered in lower arch to restore functional occlusion. Unfortunately, the patient could not continue her treatment due to covid 19 pandemic situation. She reported back for resuming her treatment after a gap of 2 yrs. The mandibular posterior edentulous ridges were found to be narrow and atrophic challenging orthodontic space closure in that region. Hence, it was planned to go for a ridge split procedure with bone grafting to increase the width of alveolar ridges in order to facilitate orthodontic tooth movement. Simultaneously, corticotomy cuts were planned in anterior

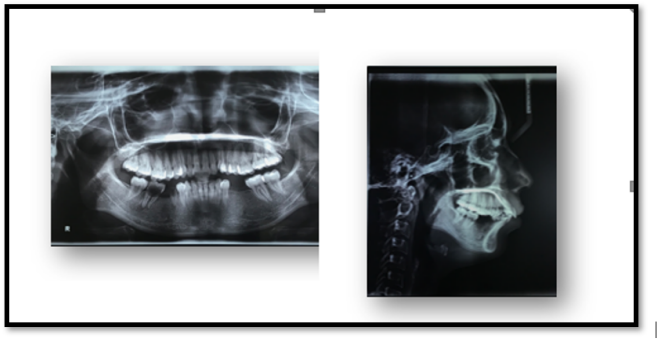

Fig 3. Pretreatment : Opg And Lateral Cephalogram

teeth region to accelerate the retraction of teeth and reduce treatment duration.

For the ridge split procedure, a full-thickness mucoperiosteal flap was elevated after mid-crestal and intra-crevicular incisions to expose the ridge crest. Osteotomy cuts were outlined with depth of 1 mm. Care was taken to retain the lingual and buccal periosteum attachment with the bone. This was followed by two vertical releasing incisions beyond the mucogingival line.

The first osteotomy cut was made at the crest of the ridge and extended in an anteroposterior direction for the planned length. Subsequently, the vertical osteotomy cuts were performed on the proximal and distal ends of the crestal incision. Once desired expansion was achieved the space between the two bone plates was filled with bone graft (Bio-oss, xenograft with plate late-rich plasma). Flaps were replaced into their pre-surgical positions and sutured (Figure 4)

Corticotomy procedure was performed for anterior teeth (Figure 5). A full-thickness mucoperiosteal flap was elevated labially beyond the apices of the lower anterior teeth. An initial horizontal incision was given at a distance of 5mm apical to the tip of the interdental papilla, preserving the gingiva over the cervical region and avoiding unnecessary exposure of alveolar bone, which may cause undue bone resorption. In order to facilitate adequate exposure of the alveolar bone, vertical releasing incisions were given extending up to the depth of the vestibule at both ends of the horizontal incision.

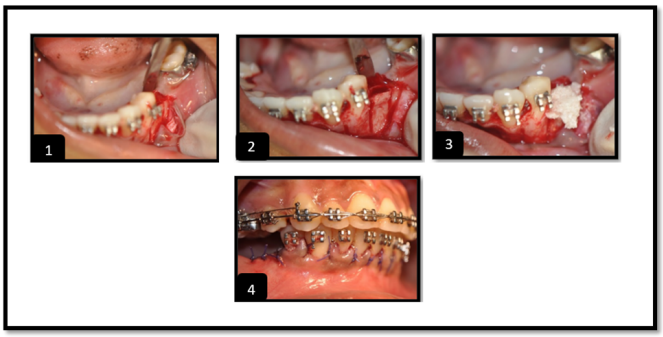

Fig 4. 1: Mucoperiosteal flap elevation 2: Ridge split technique 3: Bio-oss, xenograft plus plate late rich plasma 4: Suture placement

Vertical bone cuts were then placed in the cortical bone with Piezosurgical Unit using osteotomy insert 7 (OT 7 insert). The Piezosurgery handpiece was used with vibrations of amplitude 60–210 μm and frequency range of 25 and 30 kHz utilizing power exceeding 5 W. The vertical cuts with a depth of 1.5–2 mm (the thickness of cortical bone) was made and were joined using the horizontal cuts 2–3 mm apical to the root apex. The flaps were then reapproximated with interrupted sutures.

Less postoperative discomfort and quick healing are the benefits of employing the Piezosurgery device. Patient was advised to maintain proper oral hygiene and one-week postsurgery, the sutures were removed.

After the surgical procedure, the ridge dimensions improved considerably with 3mm increase in width and 2 mm increase in height. Orthodontic retraction of anterior teeth was resumed 4 weeks after surgery using sliding mechanics and was successfully accomplished in a short time span of 4 months. 5mm retraction of lower anterior teeth was achieved. Remaining lower posterior edentulous spaces were managed by fixed prosthesis Figure 6.

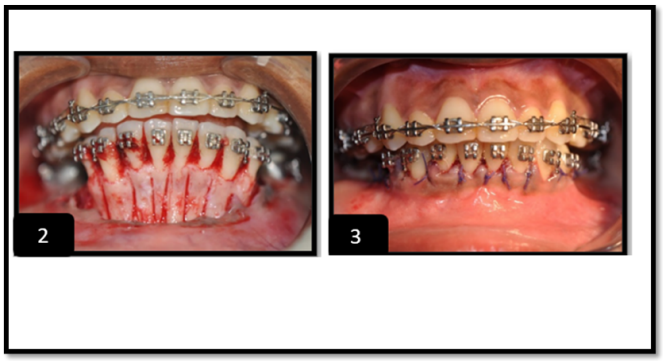

Fig 5. Elevationof mucoperiosteal flap corticotomy incision 2: Suture placement

Fig 6. Treatment Progress: Intraoral Photographs

3 Result and Discussion

Comparison of cephalometric values of pre and post treatment are enlisted in Table 1. The change in the patient's facial esthetics was the most impressive part of the treatment. Following 6 mm retraction of the upper anteriors and 5mm retraction of lower anteriors, lip competency was achieved with improvement in nasolabial angle Figure 7.

Following alveolar ridge expansion by ridge split technique and bone grafting, the modified ridge resembled a fresh extraction site, which is considered ideal for rapid tooth movement. In the present case, the corticotomy lines and space between the expanded cortexes would have acted similar to bone sockets and eased the distal movement of the mandibular anterior teeth. An additional advantage that was gained by expanding the alveolus was that it reduced the risk of gingival recession, which is most likely to occur in areas where the root diameter is greater than the alveolar ridge width. Post treatment clinical and radiographic evaluation revealed no signs of gingival recession or root resorption.

In the present case, esthetic and functional rehabilitation of protrusive malocclusion with bilateral posterior atrophic ridges was achieved through an orthodontics-periodontics synergistic approach.

Adequate alveolar bone volume being an essential prerequisite for successful orthodontic tooth movement, often makes orthodontic treatment challenging in adults, especially when the requirement of amount of retraction of the anterior teeth is large [(7)].

On comparison of various techniques that have been advocated for management of atrophic ridges, such as onlay bone graft, guided tissue regeneration, horizontal distraction osteogenesis etc, it has been found that, ridge split technique offers several advantages like predictable ridge expansion of 2–4 mm, optimal graft stability and decreased postoperative graft exposure [(8)].

The principal disadvantage with onlay bone graft is its invasiveness and requirement of additional donor sites. Despite the fact that guided tissue regeneration has been considered as one of the effective methods, it has certain drawbacks such as risk of exposure and collapse of the membranes and the risk of resorption which the grafting material encounters when the membrane

Table 1. Composite Cephalometric Analysis

Measurements	Pre-treatment	Posttreatment
SNA (Degree)	80	79
SNB (Degree)	76	77
ANB (Degree)	4	2
Wits Appraisal	6mm	6mm
Upper incisor to NA	10mm/ 32^0	5mm/25^0
Lower incisor to NB	14mm/36^0	6mm/30^0
IMPA(Degree)	120	100
Upper incisor to NF	120	110
SN To mandibular plane	35	34
Jaraback Ratio	56.18%	57.18%
FMA	29%	30%
Nasolabial angle	101^0	108^0
Stms -stmi	2mm	0mm
E line to upper lip E line to lower lip	2mm 5mm	4mm -2mm
S line to upper lip S line to lower lip	5mm 6mm	1mm 2mm

Fig 7. Post-Treatment: Extraoral Photographs

is removed[9].

Bone grafts and bone graft substitutes support regeneration in bone defects and can be used for bone augmentation. The ideal bone-graft materials should possess properties required for achieving adequate inflammation, efficient vascularization, and osteogeneration. These are the key factors that determine the success of grafting procedure. Ridge split technique facilitates faster orthodontic tooth movement[10]. The degree of tooth movement has been observed to be higher with the usage of Bio-Oss graft as compared to other grafts which although increased the volume and density of bone, were found to impede tooth movement[11].

In the present case, along with the posterior ridge split technique, selective decortication was done in the anterior region as an adjunctive procedure to reduce mechanical resistance and accelerate tooth movement. There is a general consensus that corticotomies induce a regional acceleratory phenomenon that accelerates tissue turnover and tooth movement thereby considerably reducing treatment duration[12,13]. Periodontally accelerated osteogenic orthodontics (PAOO), also known as Wilckodontics, effectively aids in regulation of the periodontium's remodelling process resulting in rapid tooth movement[14,15]. Decortication of the alveolar bone reduces the resistance that the thick alveolar housing offers against tooth movement. It also triggers the regional acceleratory phenomenon (RAP), which causes a brief burst of hard and soft tissue remodelling processes

that aid in the regeneration of bone [15].

Corticotomy procedures have historically been carried out using manual tools like chisel and mallet or motor-driven tools like surgical burs, trephine burs or micro saws with external irrigants. Conventional instruments are more difficult to maneuver in situations that require precision and the frictional heat produced by motor driven equipment may impede the healing process.

In the present case, a piezoelectric device was used for decortication as it is a minimally invasive surgical technique that results in lesser pain and better patient acceptance. In comparison with conventional surgical instruments, the piezosurgery knife generates gentle vibrations that allow for more precise cutting with minimal patient discomfort. Since it doesn't require manual force, intraoperative control is better, especially in anatomically challenging areas [16].

Proper risk assessment and diagnosis is the key to successful orthodontic management of adult patients with atrophic ridges. Comprehensive treatment entails all the procedures necessary to produce a healthy, esthetic, well-functioning and self-maintaining masticatory mechanism.

4 Conclusion

In this adult patient, presence of bilateral posterior atrophic ridges combined with discontinuity of treatment for a long duration due to pandemic situation presented a substantial challenge to orthodontic retraction of proclined teeth. In such scenario, conventional orthodontics could not have yielded satisfactory results due to the hindrance created by bony barriers of atrophic ridges. Alveolar ridge split technique along with bone grafting improved arch dimensions and facilitated tooth movement. Corticotomy assisted accelerated tooth movement helped in accomplishing treatment goals in reduced duration as time factor had become crucial due the discontinuity of treatment. Interdisciplinary approach with proper diagnosis and meticulous planning of surgical interventions helped in achieving good functional and esthetic rehabilitation. Hence, augmented corticotomy assisted orthodontic treatment could be a promising treatment strategy in adult patients with edentulous atrophic ridges.

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