THE STATIC PERIOSTEAL DISTRACTION WITH PLASMA RICH IN GROWTH FACTORS (PRGFS) IN HORIZONTAL AUGMENTATION OF THE MANDIBLE: CLINICAL STUDY

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Osteogenesis by "periosteal distraction (PDO) without corticotomy has been suggested as a new technique for bone augmentation. Various methods have been used to enhance bone healing in the distracted area. This study was aimed to evaluate the role of static periosteal distraction with plasma rich in growth factors (PRGFs) in a new bone formation. Titanium mesh was placed between the periosteum and lateral surface of the mandible in ten patients. The space between the surface of bone and titanium mesh was filled with PRGFS soaked onto a pre-cut absorbable collagen sponge. There were significant differences in alveolar bone width at all measured sites before and after surgery. Additionally, Histological analysis of specimens extracted from the distraction sites showed a newly formed bone between the cortical bone and the mesh plate.

Abstract

The purpose: This study was aimed to evaluate the role of static periosteal distraction with plasma rich in growth factors (PRGFs) in horizontal augmentation of the mandible.

Materials and methods:

Ten patients who needed horizontal augmentation of the mandible were included in this study, the periosteum was distracted by using a titanium mesh which fixed 3-4 mm apart from the buccul surface of the mandible with two 7 mm titanium screws. The space between the surface of bone and titanium mesh was filled with PRGFS soaked onto a pre-cut absorbable collagen sponge. Alveolar bone width was measured before the operation and after 4 month of healing period. Additionally, bone cores were harvested after 4 months from three patients and prepared for histologic evaluation.

Results: The mean of alveolar bone width value (T1+T2+T3/3) was 3.7±0.43 before surgery and 6.2±0.35 after surgery. There were significant differences in alveolar bone width at all measured sites (T1,T2,T3) before and after surgery. Additionally, Histological analysis of

specimens extracted from the distraction sites showed a newly formed bone between the cortical bone and the mesh plate.

Conclusion: The static Periosteal distraction with plasma rich in growth factors (PRGFs) could be considered as a reliable technique for bone in horizontal augmentation of the mandible.

Keywords: Horizontal augmentation, periosteal distraction, plasma rich in growth factors (PRGFs).

Introduction:

Atrophy of the edentulous mandible and maxilla can have systemic and local causes (*Aaboe et al.1995*) Reconstructive management of these cases continues to pose a clinical challenge for the oral and maxillofacial surgeon (*Schmidt et al.2002*). Various reconstructive techniques have been developed, but are clinically controversial, autografts (*Triplett &Schow,1996*) or alveolar distraction osteogenesis (DO)(*Block et al.1998*) , can be used for augmentation of the atrophic alveolar ridge. Autogenous grafts have some disadvantages such as resorption and donor site morbidity (*Simion et al.2001*). Alveolar DO requires a corticotomy or osteotomy that is difficult to carry out in the thin and short alveolar ridge (*Oda et al.2000 ;Polat et al.2009*) Recently, osteogenesis by "periosteal distsraction (PDO) without corticotomy has been suggested as a technique for bone augmentation (*Lundgren et al.2000;Schmidt et al.2002;Yamauchi et al.2008;Weng et al.2000*). This method is based on the concept that tensile strain on the periosteum, which causes tenting of the subperiosteal capsule, is sufficient to produce bone formation without corticotomyor local harvesting of bone (*Kostopoulos& Karring,1995*). Although the application of this technique results in de novo bone formation, The previous studies presented evident heterogeneity with respect to surgical technique, the used device, the distraction rate and the adjunctive techniques (*Al Nashar et al.2016;Al Nashar et al.2016*). Additionally, the quality and the quantity of the newly formed bone are less than ideal compared with that produced by DO (*Sencimen et al.2007;Altug et al.2011*). Therefore, new techniques such as adding vascular endothelial growth factor VEGF (*Casap et al.2008*) and Platelet rich fibrin PRF (*Pripatnanont et al.2015*) to promote a bone formation at the gap created by periosteal distraction have been investigated and showed positive results. Plasma Rich in Growth Factors (PRGFs) is derived from autologous blood by sequestering and concentrating the platelets by centrifugation

(*Anitua .1999*). It is advocated the platelet concentration can enhance oral wound healing by releasing abundant growth factors, including platelet-derived growth factor (PDGF), transforming growth factor- (TGF-), insulin-like growth factor (IGF) and epidermal growth factor (*Marx,2004*). Recently, (PRGFs) has been applied clinically to facilitate and improve bone healing (*Anitua et al.2007*). The purpose of this study is to evaluate the role of static periosteal distraction with plasma rich in growth factors (PRGFs) in horizontal augmentation of the mandible.

MATERIALS AND METHODS:

All patients in this study were asked to sign surgical consent forms. The study protocol was approved by an ethical committee of Al-Andalus University for Medical Sciences. Ten patients (6 females and 4 males) ranging in age 55-62 years who needed horizontal augmentation of the mandible for oral rehabilitation with dental implants were included in this study. All patients in this study were at physically able to tolerate the procedure, had to be in good health, with no chronic disease or smoking habits. Patients were excluded if any of the following were evident: the width of alveolar is less than 3 mm, any disease, condition, or medication that might compromise healing; or inability or unwillingness to return for follow-up visits. Preliminary diagnostic procedures included a digital panoramic radiographic evaluation..

Preparation of PRGFs:

Before surgery and the administration of local anesthesia, 10 ml of peripheral blood was drawn. The blood was deposited in laboratory glass tubes pre-treated with 3.8% trisodium citrate. The tubes were centrifuged at 270 rpm at room temperature for 7 min in a centrifuge unit specifically designed for use with this technique (PRGF System; BTI Biotechnology Institute, Vitoria-Gasteiz, Alava, Spain). This allows the separation of blood into distinct layers: a cellular layer at the bottom, PRP in the middle, and platelet-poor plasma at the top. The cellular components (mostly red blood cells and a thin layer of white blood cells) remain at the bottom of the tube, above which is the plasma component consisting of PRGFs and finally a layer of plasma poor in growth factors. The middle layer was collected and stored in a sterile glass container until use. Leukocytes were not collected in this preparation. At the time of the application, approximately 50 µl of 10% CaCl2 solution was

added per 1 ml of PRGF concentrate to enable clot formation. A platelet cell count was done before and after centrifugation.

Surgical procedure:

All of the surgeries were performed by the same surgeon using a standard oral surgical procedure under local anaesthesia by nerve block of the inferior alveolar, lingual and buccal nerves, using 4% articaine containing 1:100,000 epinephrine. Full-thickness mucosal envelope flaps were raised to expose the lateral surface of alveolar bone. Then, the buccal cortex was porously perforated by drilling with fissure bur with copious irrigation with sterile saline. A titanium mesh 0.1 mm thickness was cut and adujusted to distract the periosteum 3-4 mm apart the surface of bone and fixed with two 7 mm titanium screws. The space between the surface of bone and titanium mesh was filled with PRGFS soaked onto a pre-cut absorbable collagen sponge. Eventually, the wound was sutured with 3-0 silk sutures. Post-operatively all patients were given antibiotics (amoxicillin and clavulanic acid 1000mg every 12 hours for 7 days), oral anti-inflammatory treatment (ibuprofen 1800 mg every day for 3 days) and 0.12% chlorhexidinegluconate rinses every 12 hours for 10 days. Oral hygiene was assessed for all patients at 2, 4, and 6 weeks after surgery. All patients were given instructions on the importance of maintenance of oral hygiene. Suture removal was done on the 7th post-operative day. Fig 1

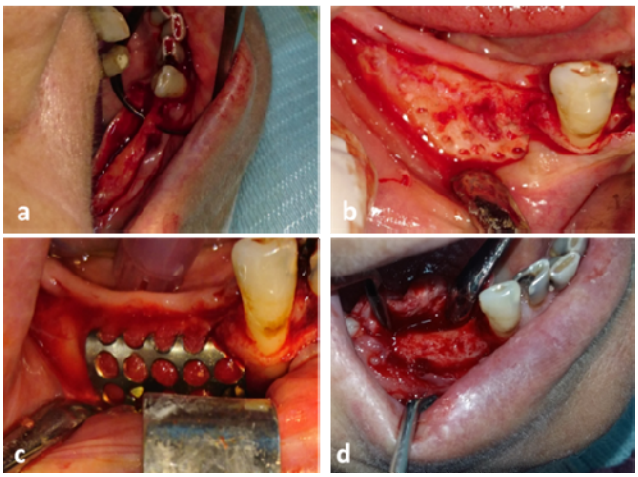

Figure1. a: measurement of alveolar, b:decorticaion of the buccal cortex, c:fixation of titanium mesh, d: after 4 month

Evaluation of changes in alveolar bone width:

Alveolar width was measured using bone calipers. The measurements were mad 3 mm inferior from the top of the alveolar ridge in three points of edentulous area (T1,T2,T3) and the mean was calculated. The measurements were recorded before the operation and after 4 month of healing period and removal of titanium mesh. Table 1,2

The statistical analysis was performed using SPSS version 17 software (SPSS Inc., Chicago, IL, USA). The student t‟ test was used to determine whether there was a statistical difference in the parameters measured.

Histological analysis:

Bone cores of approximately 5 × 2mm were harvested from three patients with a trephine bur and prepared for histological evaluation. The specimens were fixed for 72 h in 10% formalin, after which they were decalcified and embedded in paraffin. Then, 5 mm plane sections were prepared and stained using hematoxylin eosin.

Results:

Ten patients were included in this study. The periosteal was distracted by using a titanium mesh. The space between the surface of bone and titanium mesh was filled with PRGFS soaked onto a pre-cut absorbable collagen sponge .

Clinical Evaluation:

The measurements of alveolar width were mad 3 mm inferior from the top of the alveolar ridge in three points of edentulous area (T1,T2,T3) before and after 4 months of operation and the mean was calculated. Table 1,2.

There were significant differences before and after surgery at T1 ,T2,T3 and T1+T2+T3/3 at 5% level (P>0.05), "Table 3" .

Mean alveolar width values were 3.7±0.67 before surgery and 6.15±0.47 after surgery at T1. 3.7±0.42 before surgery and 6.3±0.42 after surgery at T2, 3.9±0.59 before surgery and 6.3±0.48 after surgery at T3 and 3.7±0.43 before surgery and 6.2±0.35 after surgery at T1+T2+T3/3.

Table 1: The measurements of alveolar width before periosteal distraction

Case No.	T1	T2	T3	T1+T2+T3/3
1	3	3	4	3.33
2	3	3.5	3	3.16
3	4	4.5	5	4.5
4	3	3.5	3.5	3.33
5	4	3.5	3.5	3.66
6	5	4	4	4.33
7	4	3.5	4.5	4
8	4	3.5	4	3.83
9	3	4	4.5	3.83
10	4	4	3.5	3.83

Table 2: The measurements of alveolar width after 4 months of distraction

Case No.	T1	T2	T3	T1+T2+T3/3
1	6	6	6.5	6.16
2	5.5	6	6	5.83
3	6	7	7.5	6.83
4	6	6	6	6
5	6.5	6.5	6	6.33
6	7	7	6.5	6.83
7	6.5	6	6.5	6.33
8	6.5	6	6	6.16
9	5.5	6	6	5.83
10	6	6.5	6	6.16

Table 3. Mean± SD and t test of the differences of alveolar width

	Baseline	After distraction	P value
T1	3.7±0.67	6.15±0.47	0.000
T2	3.7±0.42	6.3±0.42	0.000
T3	3.9±0.59	6.3±0.48	0.000
T1+T2+T3/3	3.7±0.43	6.2±0.35	0.000

Histological analysis :

Histological analysis of specimens extracted from the distraction sites showed a newly formed woven bone between the cortical bone and the mesh plate. The newly-formed bone contained large number of osteocytes and was covered by a lining of osteoblasts. Fibrous connective tissue with high vascularity and immature cells was observed adjacent to the newly formed bone at the internal side of the mesh plate .

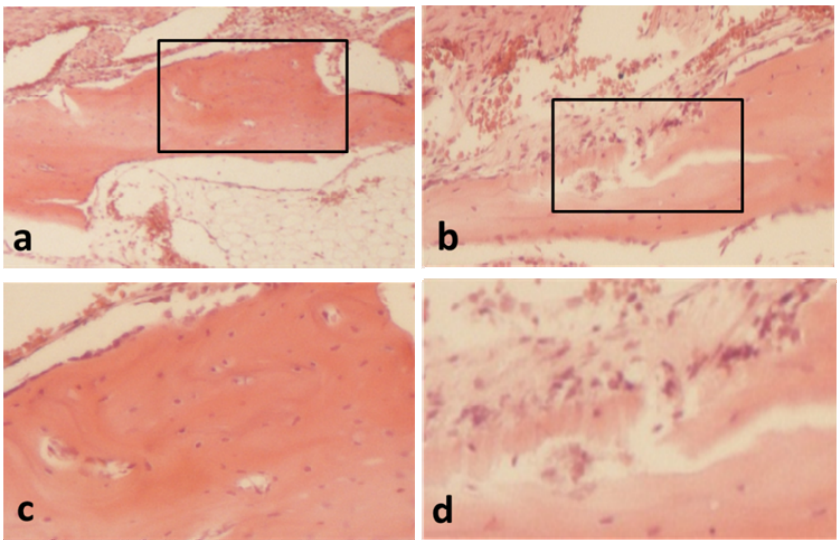

Figure. 2: (a,b) sections of trephined core showing newly formed bone (H&E staining X40), (c,d) higher magnification of the same sections respectively

DISCUSSION:

Recently, osteogenesis by periosteal distraction for bone augmentation has been suggested (*Kessler et al.2007;Zakaria et al.2012;Takiguchi et al.2009;Dziewiecki et al.2016*) Sencimen et al (*Sencimen et al.2007*) reported that the bone tissue newly formed by periosteal distraction is not suitable for occlusal forces because it is rich in interstitial fatty tissue. Therefore, the development of alternative methods is necessary to produce more effective bone are capable of withstanding occlusal force. In this study, the space between the surface of bone and the mesh plate was filled with collagen sponge socked with plasma rich in growth factors (PRGFs). Autologous PRGF has been shown to enhance and accelerate soft bone regeneration in the preparation of future sites for dental implants (*Al Nashar& Yakoob.2015*). The mean of alveolar width value (T1+T2+T3/3) was 3.7±0.43 before surgery and 6.2±0.35 after surgery. There were significant differences in alveolar width at all measured sites (T1,T2,T3) before and after surgery. Additionally, Histological analysis of specimens extracted from the distraction sites shoed a newly formed between the cortical bone and the mesh plate. Oda et al (*Oda et al.2009*) investigated the role of decortication of bone with PDO in a rabbit model to enhance the bone formation, they concluded that this technique might be effective in promoting bone formation. These results are in accordance with the results of Yamauchi et al (*Yamauchi et al.2013*), they confirmed that the decortication procedure enhanced early bone formation from the original bone surface. Sato et al (*Sato et al.2010*) claimed that the administration of mesenchymal stem cells into the gap between bone surface and periosteum improve volume, height, bone mineral density, and

bone mineral content significantly. Casap et al (*Casap et al.2008*) investigated the intracallus administration of vascular endothelial growth factor (VEGF) into distracted area, they concluded that VEGF has a positive effect on osteogenesis. Pripatnanont et al (*Pripatnanont et al.2015*) evaluated the effect of a modified Hyrax device and platelet-rich fibrin (PRF) on osteogenic periosteal distraction, they confirmed that a greater bone maturation was achieved with the addition of PRF. Whereas, the local appilacation of simvastatin to the distraction zone made no significant contribution to the new bone formation (*Kahraman et al. 2015*).

CONCLUSION:

Within the limits of the present study, we concluded that the static Periosteal distraction with plasma rich in growth factors (PRGFs) could be considered as a reliable technique for bone in horizontal augmentation of the mandible.

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