



Versatility of Vertical Distraction Osteogenesis and Sticky Bone in Three-Dimensional Augmentation for Atrophic Alveolar Ridge

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KEYWORDS

*Atrophic ridge,
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ABSTRACT

Aim. This prospective study was designed to evaluate three-dimensional (3-D) alveolar ridge augmentation through two stages surgical approach, using vertical alveolar distraction osteogenesis (VADO) followed by onlay sticky bone covered by collagenmembrane, for augmentation of the atrophic alveolar ridge to facilitate implant installation. **Subjects and Methods:** Ten patients with atrophic alveolar ridge were treated by VADO. After bone consolidation the distractors were removed, implants were inserted, sticky bone graft was packed at buccal aspect, and covered by guided tissue regeneration (GTR) membrane. The implants were loaded after three months of its placement. Clinical evaluation was done to assess wound healing and implant stability. Also, the following parameters were evaluated on orthopantomography and cone-beam computed tomography; relapse in the distracted bone, crestal bone loss around the implant and bone density around the implant. All data was statistical analysed. Results: Mean vertical bone gain was 6.5 mm (range 5-8 mm), and the mean width gain was 4 mm (range 3-5mm). There was 100% survival rate of all implants. There was significant decrease in the mean bone height throughout all periods. Also, significant improvement in bone density around the implant was reported along follow up periods. **Conclusion:** VADO followed by onlay sticky bone graft with GTR can be successfully performed to gain proper 3-D measurements of alveolar ridge that are essential for ideal implant installation in severe atrophic mandibular alveolar ridge.

INTRODUCTION

Alveolar ridge atrophy is one of the most common challenges that could be faced during rehabilitation of the edentulous patient by dental implant and may be associated with compromised functional and esthetic results⁽¹⁻³⁾.

Alveolar ridge resorption phenomenon, that occurred as a result of tooth extraction or avulsion, follow a predictable pattern as the facial aspect of the alveolar ridge is the main site of resorption, which first reduces in width and later in height⁽⁴⁾. The rate of alveolar bone

resorption during the first year after extraction is very rapid. The amount of bone resorption is predestined to be 40-60 percent during the first 3 years after tooth extraction and then decreases to 0.25 – 0.5 percent annual loss rate thereafter⁽⁵⁻⁷⁾. Ideal implant placement can be compromised by inadequate alveolar ridge height and width. Therefore, alveolar ridge reconstruction is essential step to allow ideal implant insertion and creates more esthetic profile and long-term implant stability^(8,9).

Different modalities have been used for alveolar ridge augmentation, such as autogenous or alloplastic bone grafting^(10,11), guided bone regeneration^(12,13) and vertical alveolar distraction osteogenesis (VADO)^(14,15). The main advantage of VADO is the increased alveolar bone height with new bone formation beneath the distracted bone segment. Furthermore, simultaneous lengthening of the surrounding soft tissues that achieved by histogenesis^(16,17).

Recently, for acceleration of graft healing, autologous concentrated growth factors (CGF) enriched bone graft matrix (sticky bone) using autologous fibrin glue (AFG) was developed. Sticky bone has several advantages including, its moldability, so could be adapted over various shape of bony defect and the fibrin network that entraps platelets and leukocytes releases growth factors enhancing bone and soft tissue regeneration. Also, the fibrin interconnection minimizes soft tissue ingrowth into the sticky bone graft⁽¹⁸⁾. These advantages encouraged researchers to use sticky bone combined with guided tissue regeneration (GTR) membrane or no for augmentation of narrow alveolar ridge with simultaneous placement of dental implant⁽¹⁸⁻²⁰⁾.

Accordingly, the aim of the present study was to assess the efficacy of 3- dimensional alveolar ridge augmentation; through alveolar distraction to increase bone height, and sticky bone covered by GTR to improve ridge width in patients requiring implant placement in atrophic posterior mandibular region.

PATIENTS AND METHODS

Patient selection:

Patient suffering from atrophic posterior mandible and candidate to restore the missed teeth by dental implant were selected from those attending the Outpatient Clinics of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Al-Azhar University. This prospective study extended from November 2015 till November 2019 year. Research procedures were explained to all the patients and they signed an informed consent form before the study. The study was conducted according to rules of ethics declared by Helsinki, and ethical committee approval was obtained from Al-Azhar ethical committee.

Preoperative evaluation:

History and clinical examination were performed for all patients to evaluate their medical and dental condition. Also, intraoral clinical examination was performed to evaluate oral hygiene, periodontal condition, amount of keratinized mucosa, and level of muscle attachment at areas planned for implant placement.

Radiographically, orthopantomogram (OPG) (Orthophos3, Sirona system) and cone beam computerized tomography (CBCT) (Kodak 9500 cone beam 3D system) were used to assess the alveolar bone height and width available for implantation (Fig.1a&b).

Inclusion criteria:

Patients were included in this study if they were free from any local or systemic condition that may interfere with healing. Also, presented with 2-3 missing teeth at least in posterior mandibular area and CBCT demonstrated that ridge width ranged from 4-6 mm and bone height above inferior alveolar canal ranged between 8-10mm.



Exclusion criteria:

Patients were excluded from this study if they suffered from any medical disease that could complicate wound healing, mucosal diseases, such as lichen planus in the areas to be treated, poor oral hygiene or heavy smoking patients.

Surgical procedure:

It consisted of 2 stages. The first stage included vertical alveolar distraction to correct ridge height and the second stage included implant insertion and horizontal augmentation.

First stage:

During stage one, all surgeries were performed under general anesthesia and complete aseptic condition. Each patient was received prophylactic antibiotic (Augmentin 1gm vial, GlaxoSmithKline, Fifth district, New Cairo, Cairo, Egypt), mouth wash (DG-wash, Al Esraa Pharmaceuticals, Fourth Industrial Zone, Badr Industrial City, Cairo, Egypt), and antiedematous (Alpha Chymotrypsin Ampule, Amoun Pharmaceutical Co., Cairo, Egypt).

In all patients we used extraosseous alveolar distractor (made by Modern Techniques Centre, Cairo, Egypt). A mucoperiosteal incision was placed on buccocrestal aspect of the ridge and a mucoperiosteal flap was raised. Extraosseous alveolar distractor was applied on the facial aspect of the ridge to prepare site of screw insertion and then removed. A Trapezoidal osteotomy of the transport segment was achieved by burs which were used to place marks of osteotomy lines under copious saline irrigation. The bilateral vertical bone osteotomy lines were made in an angulated manner, and a horizontal osteotomy was performed at a safe distance of 2 mm above inferior alveolar canal (Fig.1c). After that, saws were used under copious saline irrigation to complete the osteotomy, and complete separation of transport segment was done by thin osteotome. The distractor was placed and fixed to the basal and the osteomatized segment

with monocortical 2.0 screws. The basal plate was fixed by 2 screws on either side of distraction rod while the transport plate was fixed with one screw on either side of the distraction rod (Fig.1d). Then the device was checked for mobility. After that, the wound was closed with 3 zero vicryl suture (Fig.1e).

The distractor was left in place for 7 days as latent period that followed by activation of the distractor at rate of 1mm/ day (at rhythm 0.5 mm twice), till the required bone height was obtained (slight overcorrection of 2 to 3 mm was performed). Then distractor left 3 months to achieve bone consolidation.

Second stage:

After completing the consolidation period, the patient returned for removal of the distractor, and instillation of implant (Superline Systems, Dentium, Co. Ltd, Suwon, South Korea). Before implant insertion sticky bone was prepared^(18,20) as follow; 10 mL of patient's venous blood was taken from the antecubital fossa. After that, the blood in the test tubes was centrifuged at 2700 rpm for 2 minutes. The test tube showed 2 different layers. The upper layer is autologous fibrin glue (AFG) layer and red blood cell is collected in bottom layer which had been discarded. The upper AFG was aspirated by syringe and mixed with particulate bone powder (Bonemedic, Meta-biomed, Korea) and allowed for 5-10 minutes for polymerization in order to produce sticky bone which has a yellow color (Fig.1f).

After implant instillation, sticky bone was placed on buccal aspect of alveolar ridge and was covered by collagen membrane (GENOSS, Dentium, Co. Ltd, Suwon, South Korea) (Fig.1g).

After surgical procedures, all patients received the same medications which prescribed before surgery for 5 days. Postoperative instructions for the patients included soft diet and oral hygiene with 0.2% chlorohexidine mouth rinse. The fixed prosthetic restoration of implants was performed after 3 months of osseointegration (Fig.1h).

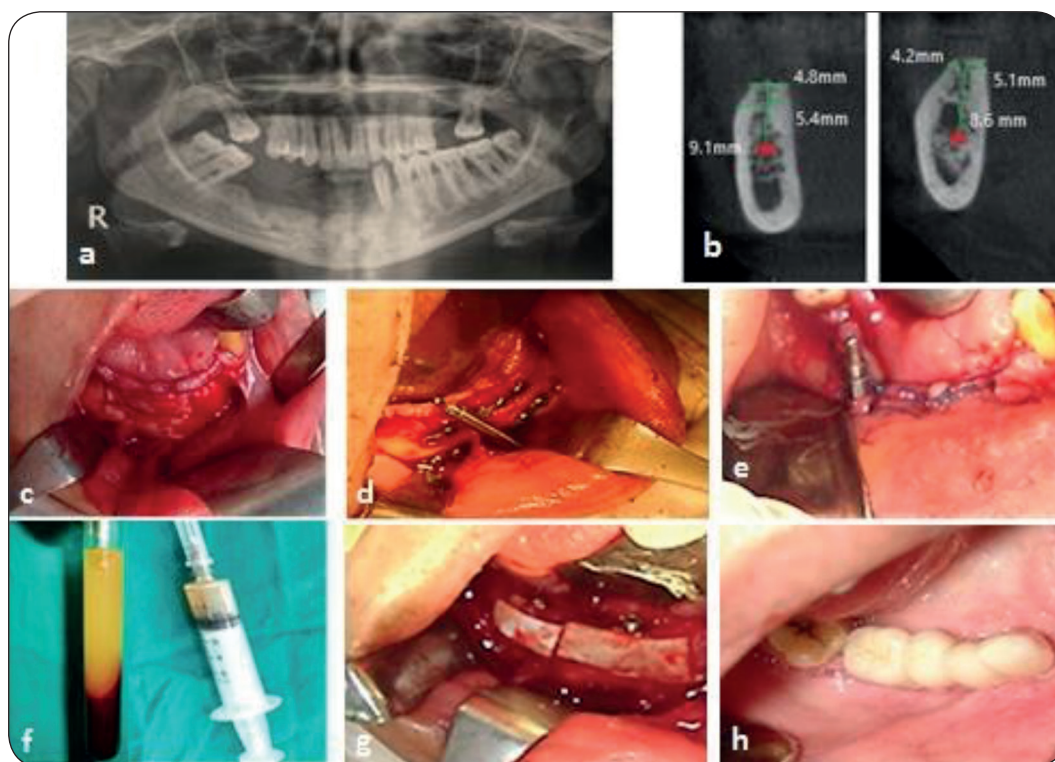


Fig. (1) (a) Preoperative OPG showing atrophic alveolar ridge (b) Preoperative measurements on CBCT (c) Intraoral photograph showing surgical approach and segmental alveolar osteotomy (d) Extraosseous alveolar distractor after fixation (e) wound closure (f) Aspiration of AFG after preparation (g) Application of sticky bone and collagen membrane after implant installation (h) Final prosthetic rehabilitation after 3 months from implant installation.

Postoperative evaluation

After both surgical stages, clinical evaluation was performed to observe signs of infection, wound dehiscence, and function of inferior alveolar nerve. Primary implant stability was recorded by using Osstell TM. Changes in Implant Stability Quotient (ISQ) values taken immediately after implant placement, at 3 months, and 6 month of implant placement. They were measured in triplicate and averaged to yield the mean baseline ISQ value for each implant.

Radiographic evaluation:

OPGs were taken immediately after placement of distractor, after completing the distractor activation (to evaluate the gain in the alveolar bone and used as reference to evaluate the relapse at the

subsequent periods), after distractor removal and implant installation, and at 3 month of implant placement (to record the relapse in the augmented bone). Relapse in alveolar distraction is amount of decrease in augmented bone.

The augmented bone was measured on OPG as the distance from osteotomy line in the basal bone to the top of alveolar crest. The relapse in alveolar distraction was estimated at the end of activation period T1, at the end of consolidation periods T2, and after 3 months of implant placement T3. The amount of bone relapse could be estimated as the differences between T1 and T2, and T1 and T3.

CBCT were taken immediately after implant placement (baseline), at 3 months and 6 months to evaluate the change in alveolar ridge width at different follow up periods. Also change in crestal



bone level around dental implant was assessed on the CBCT sagittal cuts on computerized software. The distance from implant apex to a reference point at the implant surface where the marginal bone contacts the implant was measured. This was measured mesially and distally for each implant.

Measuring of bone density: Average density was determined at the implant marginal bone using Bioquant® (G Power, Ver. 3.192 copy right 1992-2014). The region of Interest (ROI) was selected and traced (color density selection). Through counting of threshold pixels in each ROI, a single pixel that represents a specific color (white pixels in radiographs) is selected allowing for automatic selection of all other pixels in the ROI that threshold areas are traced and counted as a number of pixels that can be calculated as a ratio of the whole ROI.

Data analysis:

Data were coded and entered into a Microsoft excel sheet and then transferred to IBM SPSS statistical software version 21; for displaying a descriptive distribution of each variable including the frequency and percentage in addition to the mean and standard deviation. This was followed by comparative paired and unpaired t test were used to compare continuous variables, significance level was considered at ≤ 0.05 .

RESULTS

The study was carried on ten systemically healthy patients (6 female and 4 male) with mean age of 43 ± 7 years. The gained bone was evident clinically and radiographically. Two of them were had bilateral free end saddle (Kennedy class 1), 3 patients with Kennedy class 2 and other patients were had Kennedy class 3. The mean gain in bone height was 6.5mm (range 5- 8 mm) and the mean gained bone width was 4 mm (range 3-5mm).

A total of 11 alveolar distractors (one patient had bilateral VADO & 9 patients had unilateral VADO)

were used in this study. A total of 22 endosseous dental implants (two in each distracted area) were placed. Implant diameter ranged from 3.6 to 4.8 mm and implant length ranged from 10 to 12 mm.

In all patients healing was uneventful. Neither infection nor lymphadenitis were reported throughout the study. Two patients show wound dehiscence and plate exposure during activation of distractor, and 1 case showed wound dehiscence after 2nd stage of surgery (sticky bone grafting). Lip paresthesia were reported in four patients after distractor placement which resolved after 8 – 12 weeks later with vitamin B medication.

All patients had mucosal redness around the implant at the second day after implant placement; this redness was completely resolved one week later. On percussion all implants showed resonant sound.

Changes in Implant Stability Quotient (ISQ):

The mean value of ISQ was 49.700 ± 4.98 at time of implant insertion that increased to 66.55 ± 2.66 at 3 months, and became 69.00 ± 3.03 after 6 month. Statistical analysis showed highly significant difference (0.001) between time of implant instillation and at 3 and 6 months and low significant difference $P < 0.05$ between 3 and 6 month intervals.

Radiographic observations:

OPG measurements presented that the mean bone height was 7.3 ± 23 mm before distraction and became 13.6 ± 1.4 mm after distraction (T1). Then it reduced to 13.1 ± 1.2 mm, and 11.7 ± 0.9 mm at T2, and T3 periods respectively. The mean reduction of bone height (relapse) from T1 to T2, was 0.5 ± 0.2 mm, from T2 to T3, was 1.4 ± 0.3 mm, and from T1 to T3, was 1.9 ± 5 mm. Statistical analysis showed statistically significant increase of the bone height after distraction, that followed by significant decrease in the mean bone height at the subsequent follow up periods.

Table (1) Mean and SD values of reduction in bone height, and P value along observation periods

Period	Mean difference	± SD	t- value	P
T1 – T2	0.5	± 0.2	6.7	0.025*
T2 – T3	1.4	± 0.3	2.1	0.001*
T1 – T3	1.9	± 0.5	1.9	<0.001*

* Statistically significant: ($p < 0.05$).

**High statistically significant: ($p < 0.01$).

The preoperative mean width of the alveolar ridge on CBCT was 4.825 ± 0.706 mm and increased to 7.840 ± 0.533 mm immediately after the surgery. Then it decreased to 6.725 ± 0.456 mm and 6.640 ± 0.435 mm at 3 and 6 months postoperative respectively. There was high statistically significant

increase in the ridge width immediately postoperative that followed by significant reduction in the width during the subsequent periods.

Mean marginal bone loss around the implants immediately after placement was zero and increased into 10.010 ± 0.460 mm after 3 months, then elevated to become 1.040 ± 0.380 after 6 months. There was no significant loss of crestal bone level around dental implant at the end of the study.

Immediately after implant insertion mean bone density was 371.6 ± 150.08 HU and increased to 613.7 ± 177.94 HU and 914.0 ± 296.36 HU at 3 and 6 months after implantation respectively. There was highly statistically significant increased bone density ($p < 0.001$) between different intervals.

Table (2) Comparison between, ISQ, MBL, BD scores & Alveolar ridge width measurements at different periods

	Immediate after implant insertion VS. 3 m		Immediate after implant insertion VS. 6 m		3 m VS. 6m							
	t value	P	t value	P	t value	P						
ISQ	7.11	0.0001**	16.960	0.001 **	2.92	0.015*						
Marginal bone loss	6.531	0.001 **	7.107	0.001 **	1.643	0.121						
Bone Density	11.117	0.001 **	11.055	0.001 **	6.472	0.001 **						
Alveolar ridge width	Preoperative VS. Immediate after implant Insertion		Preoperative VS. 3 m		Preoperative VS. 6 m		3m VS. 6m		Immediate after implant insertion VS. 3 months		Immediate after implant insertion VS. 6 months	
	t value	P	t value	P	t value	P	t value	P	t value	P	t value	P
Alveolar ridge width	25.586	0.001*	23.680	0.001**	20.105	0.001**	-1.039	0.312	-2.558	0.019*	-3.365	0.003 *

*Statistically significant: ($P < 0.05$)

**High statistically significant: ($P < 0.01$).



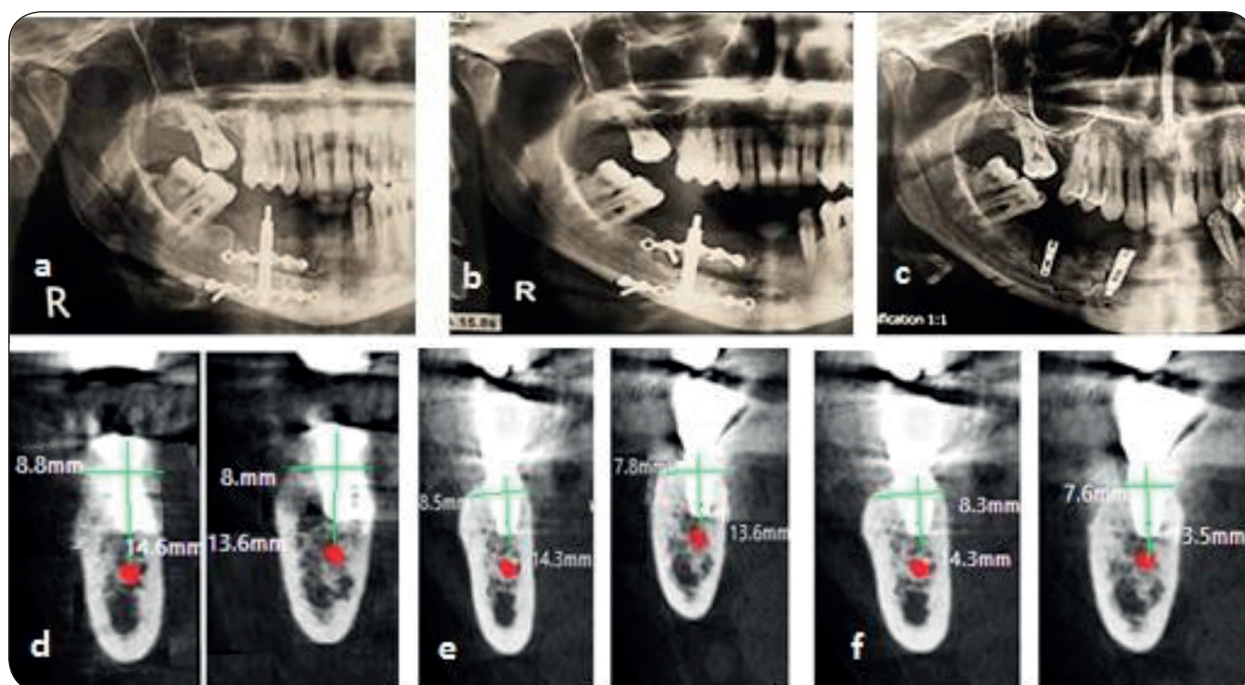


Fig. (2) Postoperative OPG at different intervals (a) Immediately after osteotomy and distractor fixation (b) after distraction (c) after consolidation period. Postoperative CBCT at different intervals after implant insertion and bone grafting (d) Immediately (e) at 3 months (f) after 6 months

DISCUSSION

Alveolar ridge deficiency could limit the esthetic and functional outcomes of implant rehabilitation and, it might compromise long term implant success rate. In these cases, bone augmentation is performed to gain enough bone volume. Adequate bone volume is mandatory to provide patients with proper inter-arch relations and an adequate crown-to-root ratio for superior prosthetic results⁽³⁻²¹⁾.

Several reconstructive and regenerative methods have been used for augmentation of mandibular alveolar ridge including inferior alveolar nerve (IAN) lateralization to allow placement of long implants in this region. However, mental nerve paraesthesia has been reported⁽⁶⁾. Another method is to place short implants above IAN. This technique compromises load-bearing capacity of such implant^(5, 7). Neither of these techniques resolves the problem of excessive length of the crown. Another approach is autologous bone grafting, but such grafts are subjected to resorption, limited to soft tissue tolerance and associated with donor site morbidity^(8,9).

Alveolar distraction osteogenesis provides natural formation of bone in the distracted chamber in a relatively short time. This eliminates the need for autogenous bone graft and allow a shortening of treatment time. Soft tissues can follow the elongation of the underlying bone, and there is a lower risk of infection of the surgical site (0% in this study) as compared to grafts on GBR (Chiapasco et al^(22,23)).

Present study described new technique for 3-D augmentation in vertically and horizontally deficient alveolar ridge cases. Through benefiting from aforementioned advantages of VADO in vertical augmentation, and regenerative preoperative of combined using for sticky bone with GTR in horizontal augmentation of alveolar ridge.

In our study, preoperative ridge height more than 8 mm was essential to perform VADO. This was in the same side with Rachmiel et al.⁽²¹⁾ technique, who described that the minimal height of 6 mm for the crestal transported segment is essential to achieve

fixation of the distraction device and to avoid fracture of the segment. Also, it is essential to perform safe distance of 2 mm of bone above mandibular canal to maintain inferior alveolar nerve.

In the present study, VADO protocol involved 7 days latency period, activation of distraction devices at rate of 0.5 mm twice daily until reach to desired height, and 3 months for consolidation. This is in agreement with standard protocol which described by several authors^(24,25).

In a review by Saulacic et al.⁽²⁴⁾, it was shown that a 7-day latency period provide good bone quality and allows gingival/mucosal healing. Regarding the activation rate different studies^(22,26,27) concluded that the standard activation rate 1mm\ day at rhythm 0.5mm twice. In opposite side, Rachmiel et al.⁽²¹⁾ used 0.5mm/ day (activation) for vertical elongation in their study. Explanation of that a latency period was 4 days in their study.

In this study, the consolidation period was 3 months. This is in agreement with other investigation^(25,28). This explained by histological study of Chiapasco et al⁽²⁸⁾ which demonstrated that 3 months following mandibular distraction showed woven bone reinforced by parallel-fiber bone undergoing maturation.

In contrast to Quereshy et al⁽²⁹⁾ article which enumerated different applications of CBCT in oral and maxillofacial surgery. Our study used OPG to evaluate bone formation and height gait during VADO while CBCT was used for evaluation bone quality and quantity after implant installation. This to decrease number of CBCT done and avoid artifacts which may be occurred due to distractor device presence. Where, repeated and high doses of CBCT is harmful. This is in agreement with Gang Li⁽³⁰⁾, and Abd-Elaal et al⁽³¹⁾.

Pérez-Sayáns et al.⁽²⁵⁾ review reported that the mean height gain was greater with extraosseous distraction devices in contrast with intraosseous ones, ranging from 8.13 to 6.97mm. Saulacic

et al.⁽³²⁾ found a mean gain of 6.88+2.52mm. These results are in accordance with our results. In the present study, the amount of reduction in the distracted area (relapse in ADO) at the end of consolidation period (T2) was 0.5± 0.2 mm, and at 6 months after implantation (T3) was 1.9± 0.5 mm. There was significant decrease in the mean bone height throughout all periods. This is in accordance with the results of Saulacic et al⁽³²⁾ and Kim et al⁽³³⁾. Which demonstrated that after vertical alveolar distraction, 3 to 20% of the gained vertical bone may undergo relapse. Therefore, we performed a slight overcorrection of 2 to 3 mm. This is in agreement with Rachmiel et al⁽²¹⁾ who recommended an overcorrection of 15-20% to overcome relapse of distracted segment.

In current study, dental implant installation was performed at the same surgery of distractor removal and accompanied with horizontal augmentation of the ridge using sticky bone and GTR. This is in accordance with Kim et al.⁽³³⁾ and Pérez-Sayáns et al⁽³⁴⁾ studies.

In the current study, the mean increase in alveolar ridge width was 4 mm. Also, there was no complication such as infection, inflammation or lip paresthesia after bone grafting procedure. Only one case of wound dehiscence was reported that was healed over couple of days through application of good oral hygiene measures. This is in accordance with Roy et al.⁽³⁵⁾ who demonstrated that the use of PRF matrix effectively induce endothelial cell proliferation and improved wound angiogenesis in chronic wound.

Mean crestal bone loss around the dental implant was 1.040±0.380 at 6 months after implant placement. This is in agreement with Adell et al.⁽³⁶⁾ who reported 1.5mm marginal bone loss around dental implants during the first year. Also in accordance with Lobo et al.⁽³⁷⁾ and Sohn et al.⁽¹⁸⁾ who demonstrated that mixture of PRF with biphasic bioceramics facilitates cell attachment, proliferation and differentiation which in turn provides more



biocompatible, osteoconductive and osteoinductive combination leading to more new bone formation.

Regarding mean values of bone density around dental implant material, there was marked increase in bone density along follow up intervals. This is in agreement with Ozemir et al.⁽³⁸⁾ who stated that the use of PRF can increase the quality (density) of the newly formed bone and enhance the rate of new bone formation and this may be explained by the presence of concentrated growth factor in the PRF which is in agreement with our result

According to our results VADO combined with sticky bone and GTR is a technique with greater potential in vertical and horizontal gain. The performance of dental implants has a success and survival rate like dental implants placed on bones that does not need bone augmentation techniques. Their results indicated that alveolar distraction offers more predictable long-term results for vertical-height bone than other methods. On the other hand, Enislidis et al.⁽³⁹⁾ reported that the use of subperiosteal devices for vertical augmentation of edentulous mandibles is hazardous and offers no advantage over other surgical methods and that all of the patients had severe complications. We have not observed serious complications in our study. It may be because of careful selection of patients, proper treatment planning, and using concentrated growth factor matrix in our study.

CONCLUSION

From our results can concluded that 3-D alveolar ridge augmentation through two stages surgical approach, using VADO followed by implant installation and onlay sticky bone covered by GTR membrane proved to be associated with high success rate and limited complication. It has been evidenced that the generated bone by distraction osteogenesis can withstand the biomechanical demands of implant loading. Sticky bone not only enhances the rate of new bone formation, but also increases the density of the newly formed bone around dental implant.

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Conflicts of interest: There are no conflicts of interest

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إمكانية استخدام الشد التدريجي العمودي والعظم اللزج في التزويد ثلاثي الأبعاد للحافة السنخية الضامرة

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الملخص :

الهدف: صُممت هذه الدراسة الاستباقية لتقييم زيادة الحافة السنخية ثلاثية الأبعاد من خلال تدخل جراحي على مرحلتين . باستخدام الشد التدريجي العمودي متبوعاً بترصيع العظم اللزج المغطى بغشاء الكولاجين . لتكبير الحافة السنخية الضامرة لتسهيل تركيب الغرسة .

المواد والاساليب: تم علاج عشرة مرضى يعانون من الحافة السنخية الضامرة بواسطة الشد التدريجي العمودي. بعد الالتئام العظمي . تمت إزالة اجهزة الشد. وأدخلت الغرسات . وعبأ الترقيع العظمي اللزج في الجانب الشدقي . وغطى بغشاء جديد الأنسجة الموجه . تم تحميل الغرسات بعد ثلاثة أشهر من وضعها. تم إجراء التقييم السريري لتقييم التئام الجروح واستقرار الزرع. أيضاً. تم تقييم المعايير التالية على أفلام الأشعة البانورامية والتصوير المقطعي المحوسب ذو الحزمة المخروطية. الانتكاس في العظم . وفقدان العظم حول الغرسة وكثافة العظام حول الغرسة. تم تحليل جميع البيانات إحصائياً.

النتائج: متوسط العظام المتكون رأسياً 6.5 م (بتراوح من 5 إلى 8 م) . ومتوسط العظام المتكون عرضياً 4 م (بتراوح من 3 إلى 5 م). كان هناك معدل بقاء 100% لجميع الغرسات. كان هناك انخفاض كبير في متوسط ارتفاع العظام في جميع الفترات. أيضاً . تم الإبلاغ عن تحسن كبير في كثافة العظام حول الزرع على طول فترات المتابعة.

الخلاصة: يمكن إجراء الشد التدريجي العمودي متبوعاً بطعم عظمي لزج مع غشاء الكولاجين بنجاح للحصول على قياسات ثلاثية الأبعاد مناسبة للحافة السنخية والتي تعتبر ضرورية لوضع الغرسة المثاليه في الحافة السنخية الضامرة.

الكلمات المفتاحية: الحافة السنخية الضامرة. الشد التدريجي العمودي .العظم اللزج. غشاء جديد الأنسجة الموجه. الأشعة المقطعية المخروطية .غرسه سنخيه.

