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Simultaneous 3D Reconstruction and Implant Placement Using Allogenic Laminar Bone Membranes in Atrophic Mandible. A Comparative Clinical Study

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ABSTRACT

Aim: to compare the outcome of allogenic bone sheets clinically and radiographically in posterior mandibular vertical augmentation in Luhr class III cases with simultaneous implant placement using autogenous versus xenografts. **Patients and methods:** this study was based on a total of 12 implants placed in 4 patients, 2 of which were males and 2 females. Patients were divided into 2 groups, both treated with implants placed with exposed threads 3 mm crestally and covered buccolingually with the laminar bone membrane; group 1 received autogenous bone obtained from the same surgical site using 4.5 diameter ACM bur mixed with PRP and packed around the crestally exposed implant threads. Group 2 received xenograft bone particles mixed with PRP and packed around the crestally exposed implant threads in the same manner. **Results:** CBCT was done pre-operatively, immediate post-operatively and 4 months post-operatively for each implant to compare the bone gain radiographically. In group 1, the mean amount of residual bone height pre-operatively was 7.8 mm (SD 0.86) and increased to 14.44 mm (SD 1.75) and 14.1 mm (SD 1.85) immediate and 4 months post-operatively, respectively. The mean amount of bone gain after 4 months was 6.3 mm, denoting a minimal amount of graft loss during the first 4 postoperative months was 0.27 mm (less than 2%). In group 2, the mean amount of residual bone height pre-operatively was 8.37 mm (SD 0.99) and increased to 12.86 mm (SD 1.75) and 12.53 mm (SD 1.65) immediate and 4 months post-operatively, respectively. The mean amount of bone gain after 4 months was 4.16 mm, denoting a minimal amount of graft loss during the first 4 postoperative months was 0.33 mm (less than 3%). Upon comparing bone gain in both groups, Group I (Autogenous) had a bone gain of 6.33 mm versus 4.16 mm for Group II (Xenograft). Denoting more gain in Group I (autogenous). While the amount of graft loss between the immediate and 4 months postoperative CBCT was less than 2% and less than 3% in the autogenous versus the xenograft group respectively. **Conclusion:** Cases initially lacking keratinized mucosa will need soft tissue intervention along with this technique. Exposure after 4 months appeared to have been too early, which lead to bone loss and exposed threads. Bilateral augmentation has led to patients using the grafted edentulous sites for mastication early following soft tissue healing, prior to prosthetics, which might suggest that tooth-bounded posterior edentulous sites might be a better candidate for such technique. Results were clinically different than radiographically in the CBCT, so longer lag time is recommended before loading.

1. INTRODUCTION

One of the greatest challenges met during implant placement is bone insufficiency at the recipient site. This deficiency occurs as a result of tooth loss, in elderly patients, with alveolar crest resorption, and in cases of a partial or complete blockage of the inferior alveolar artery as vascularization to the alveolar ridge and teeth diminishes. In elderly patients, this obstruction comes from atherosclerosis of main feeding arteries leading to a decreased blood flow (with its oxygen and nutrients) to the alveolar process that can possibly cause ischemic bone atrophy [1].

Bone insufficiency is encountered more in the mandibular bone because of its dense nature with relatively lower blood supply than the maxilla, which subsequently decreases the rate of bone remodeling and successively bone width and height, accordingly, approximating the inferior alveolar nerve to the ridge crest, rendering it challenging to restore tooth or teeth using an implant. Therefore, implant placement shortly after tooth loss is regarded as the most suitable approach for its replacement [2].

In case of partial or complete edentulism four major stages of atrophy in terms of residual vertical bone height are classified according to Luhr et al[3] into 3 classes, mild atrophy; class I (> 15 to 20 mm), moderate atrophy; class II (>10 to 15mm), severe atrophy; class III (≤10 mm).

The recommended safety zone between the mandibular canal and the implant is 2 mm [4]. Thus, for this approach to be applicable, [3] 8mm bone

height, [3] 6 mm width are required to achieve implant primary stability; that would be absent in the atrophic posterior mandibular region, hence bone augmentation surgeries are done [5,6].

Vertical ridge augmentation is one of the most challenging scenarios faced by the treating clinician [7]. Therefore, multiple parameters need to be met for optimizing bone regeneration. First of which, is space maintenance to avoid compression towards bone. This is directly linked to bone resorption due to reduced vascular supply [8].

Placement of short dental implants appears to be a straightforward, quick, predictable method for resolving intermediate atrophied mandibles, but extremely resorbed mandibles should still be treated with bone regeneration surgeries [9]. Vasco et al [10] reported higher risk of marginal bone loss with short implants compared to standard long implants. However, Dursun et al [6] reported bone level changes to be similar in both groups.

A ridge height of at least 8 mm should be available to accommodate a short (6 mm length) implant. Shorter ridge height should be augmented before implant placement [5,11]. This could be done using various techniques including osteotomy techniques: sandwich techniques and bone split, distraction osteogenesis, particulate techniques: stiff GBR (using titanium membranes), block techniques: blocks and lamellae guided bone regeneration (GBR), autologous local block augmentation, modified techniques such as piezo surgery or pelvic bone blocks [12]. Ridge augmentation varies in sensitivity according to the procedure type and the operator proficiency [13].

Some surgeons prefer to cover grafts with non-resorbable membranes such as titanium meshes. This method has been known to be effective for vertical and horizontal augmentation results with the stable mechanical properties of the membrane [14].

Block type autogenous bone, harvested mainly in intraoral sites, is fixed with screws after intimate adaptation to the recipient surface. Particulate autogenous bone or other particulate bone substitutes are then packed in the surrounding empty space. A resorbable membrane is generally used as a cover to provide additional stability to the graft [15–17].

Recently, it was hypothesized that along with the updates in implant surgeries, simultaneous implant placement speeds graft coalition by providing space maintenance, reducing the defective bone volume in need for regeneration, and a titanium surface that favors osteoconduction[18].

2. PATIENTS AND METHODS

In accordance with the 2013 Helsinki Declaration and after the approval of Future University's Research and Ethics committee number FUE. REC (11)5-2020, the present prospective study was conducted at Future University's Dental Hospital. This study was based on a total of 12 implants placed in 4 patients (2 males and 2 females).

Through a computer randomization program, patients were divided into 2 groups. Both groups were treated with implants placed with threads exposed 3mm crestally and covered buccolingually with the laminar bone membrane; group 1 treated with autogenous bone obtained from the same surgical field using 4.5 diameter Auto Chip Maker (ACM) bur (Neo Bio Tech, Korea) mixed with Platelet Rich Plasma (PRP) and packed around the crestally exposed implant threads, and group 2 treated with xenograft bone particles (European Egyptian Pharmaceutical Industry, Egypt) mixed with PRP and packed around the crestally exposed implant threads.

Patients included in the study were between 45 and 60 years of age, with severely resorbed posterior mandibular residual alveolar ridge (Luhr Class III; vertical height ≤ 10 mm) and no local pathosis or uncontrolled systemic diseases or undergoing bisphosphonate therapy or have received chemo or radiotherapy in the maxillofacial region that may interfere with bone healing.

Pre-Operative evaluation

All patients signed an informed consent describing the procedure, potential benefits, and possible complications. 3D Cone Beam Computed Tomography (CBCT) to evaluate the quality and quantity of residual bone (fig.1), clinical assessment of occlusion for the available inter-arch space and lab investigations to screen for any underlying systemic diseases prior to the surgery.

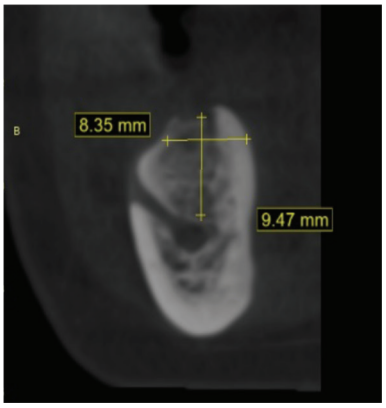

Figure (1) — Pre-operative radiograph of residual alveolar bone with measured height and width.

Surgical planning

Surgical planning of implants (size and diameter) was carried out based on the pre-operative CBCT, and dental implants virtually placed for ease of explanation to each patient (fig.2). The implants were planned to extrude 3mm occlusal to the crest of the residual bone (Luhr Class III; vertical height ≤ 10 mm), to comply with the study design.

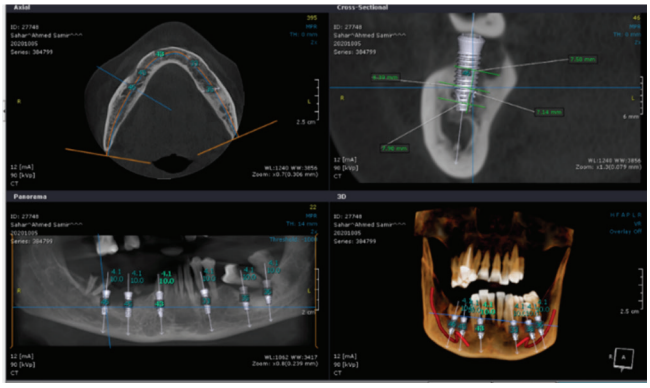

Figure (2) — Pre-operative CBCT illustrating the surgical plan with implants in place.

Surgical Intervention

Standard inferior alveolar nerve block, long buccal nerve block and field block anesthesia were administered for both pain control and local hemostasis in all patients. A 2-line full thickness mucoperiosteal flap was elevated, in which the horizontal incision was carried out buccal to the crest of the ridge and with an anterior releasing incision to expose the site to be augmented (fig.3). Sequential drilling was done for implant placement at a speed of 500 rpm under copious saline irrigation, followed by implant placement using the surgical motor at speed 50 rpm (fig.4). Implants (DTI-1 SLA and Dry Active implant system: DTI, Turkey) were inserted in place leaving 3mm

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of the implant threads exposed (fig.5). Implants of diameters ranging from 3.5-4.0 mm and lengths of 10-11.5mm were used. Blood was drawn into the anticoagulant Acid Citrate Dextrose (ACD) tubes and centrifuged at 1300 relative centrifugal force (rcf) for 5 minutes, then again at 2300 rcf for 7 minutes as described by Nugraha [19] to obtain the PRP (fig.6). Multiple bone fenestrations were done using micro-drill bits (Anton Hipp, Germany) (fig.7). Allogenic laminar bone membranes (Maxxeus, United States of America) were unpacked and placed to adapt over the extruding dental implants. Fixation of the membrane was done using 5 mm bone tacks (Helmut Zepf, Germany). Tacks were carried by specific applicator and driven through membrane and bone using a mallet with Teflon head (fig.8).

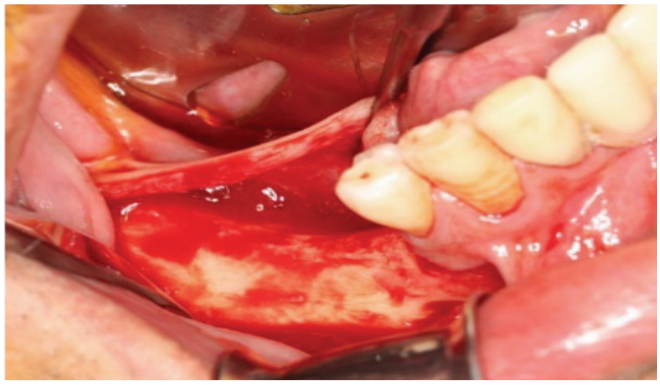

Figure (3) — Flap reflection

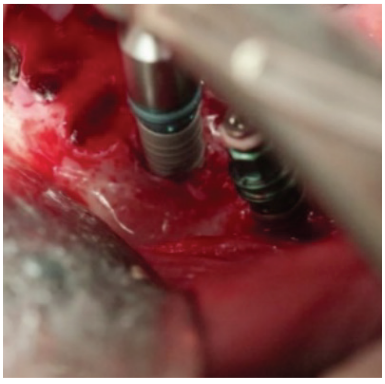

Figure (4) — Implant placement

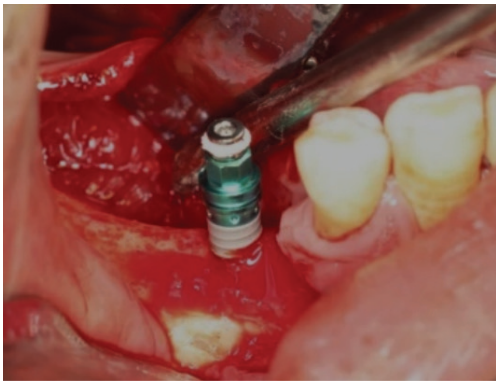

Figure (5) — Implants in place with exposed threads

Figure (6) - PRP in ACD tube

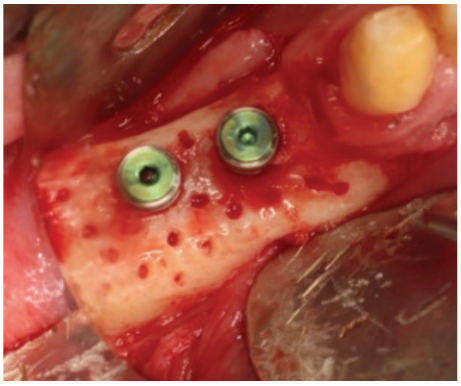

Figure (7) — Bone fenestrations.

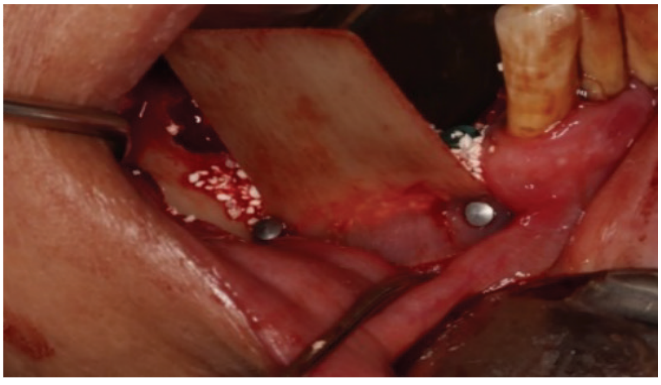

Figure (8) — Laminar bone membrane fixation using bone tacks.

Harvesting of the autogenous bone using the ACM bur from the same surgical site (fig.9), mixing it with PRP and placing it in the patients in group 1 to cover the exposed implant threads (fig.10). Group 2 patients received a mixture of xenograft with PRP (fig.11). Tugging of the laminar bone sheet lingually to cover the implant and bone was done (fig.12) and secured by submucosal sutures (fig.13). Tension-free approximation of the mucoperiosteal flap edges was done using horizontal mattress and interrupted suturing techniques (3.0 vicryl (Assut sutures, Switzerland) suture material (fig.14).

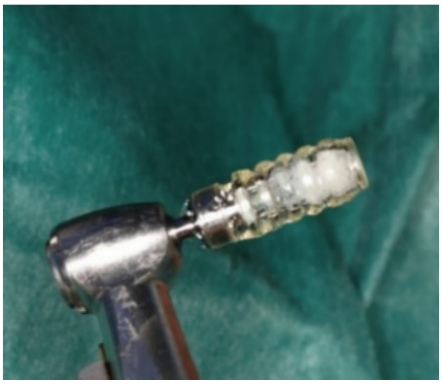

Figure (9) — Harvested autogenous bone.

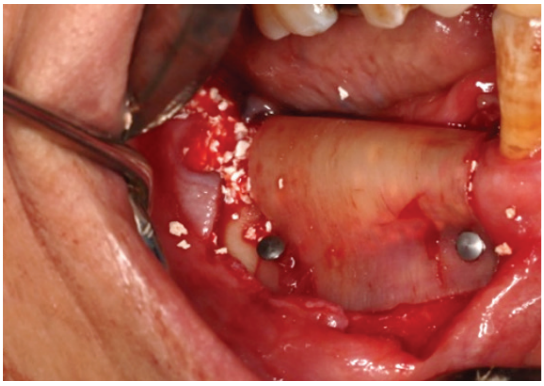

Figure (12) — Laminar Bone sheet enclosing the bone graft and the implants.

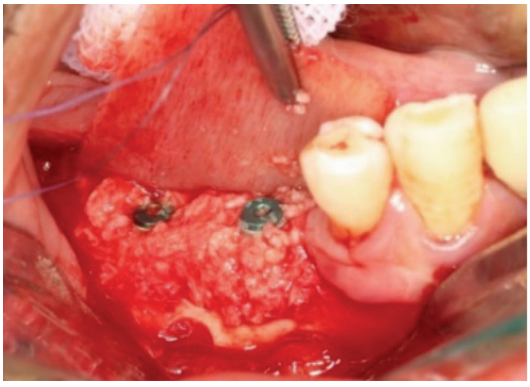

Figure (10) — Autogenous bone and PRP mixture.

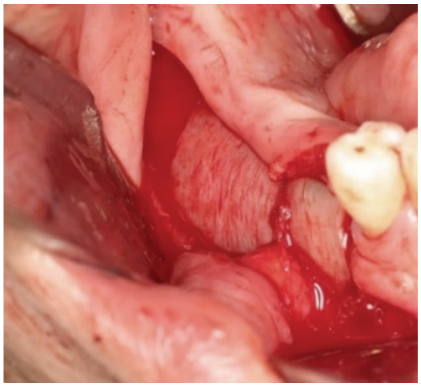

Figure (13) — Submucosal sutures.

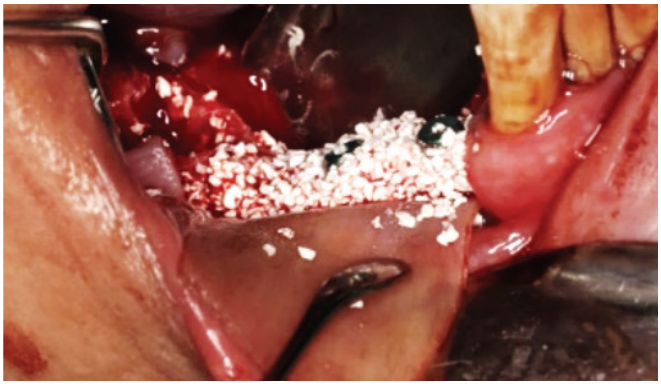

Figure (11) — Xenograft and PRP mixture.

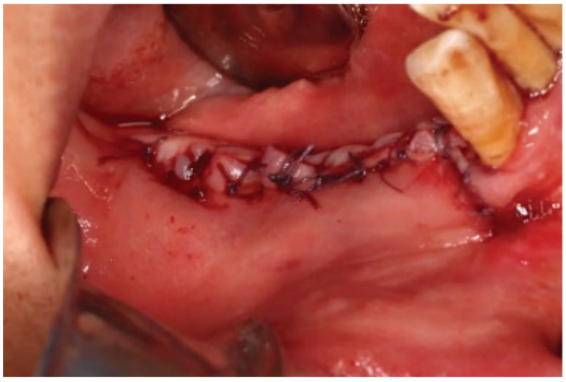

Figure (14) — Closure of the surgical site.

Post-Operative Instructions and Medications

Patients were instructed to follow a strict oral hygiene measures and instructions, and prescribed a specific medication protocol postoperatively including dexamethasone ampoule (Amriya pharm, Egypt) intramuscular once right after the surgery, amoxycillin-clavulanic acid 1gm tablets (Augmentin, GlaxoSmithKline, United Kingdom) twice a day for 1 week, metronidazole 500 mg tablets (Flagyl, Sanofi aventis, Canada) twice a day for 1 week, chymotrypsin and trypsin tablets (Alphintern, Amount, pharmaceuticals, Egypt) 2 tablets 1-hour before meals thrice per day for 1 week, ibuprofen 600 mg tablets (Brufen, Abbott, United Kingdom) thrice per day for 3 days then in case of pain, povidine iodine mouthwash (Betadine mouthwash, Mundipharma, United Kingdom) thrice per day for a week starting 24 hours after the surgery.

Suture removal and follow up

Clinical follow up was done at 1 week (fig.15), 2 weeks in which the sutures were removed, and then on monthly basis till 4 months post-operatively. Oedema, dehiscence, pain, oral hygiene, and neurosensory affections were recorded for each patient. Radiographic (CBCT) was done immediate post-operative and 4 months post-operative for evaluation and assessment of amount of bone gain. Resonance Frequency Analysis (RFA) using Osstell (Osstell ISQ, W&H, Germany) was used 4 months post-operatively to evaluate degree of osseointegration and implant stability.

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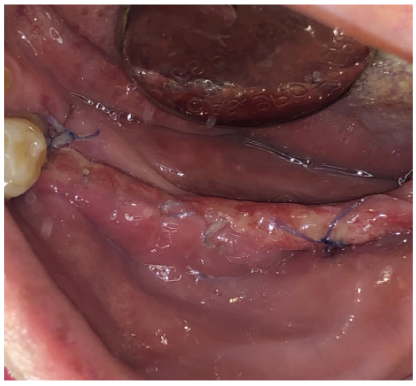

Figure (15) — Clinically 1 week postoperatively.

3. RESULTS

No intra-operative complications were encountered in any of the cases in either group. The only technical difficulty was the insertion of the bone tacks in the mandible on the lingual side, and hence the laminar bone was tightly secured lingually over the grafted site using submucosal sutures running transversely over the grafts and laminar bone.

Clinical outcome:

During the first follow-up visit neurosensory affection was encountered in 2 sites in the chin and lips along the surgical side. Patients were prescribed vitamin B tablets (Neurobion forte tablets: Merck, United States of America) q.d. for a month. The numbness resolved gradually by the end of that month. No implant failures were encountered. During the second month of follow up, 3 implants were exposed through a wound dehiscence as the patient was comfortable chewing on the surgical site (fig.16), despite being asked not to. The wound was irrigated with saline and povidine-iodine and followed up, and the patient was instructed proper oral hygiene measures. Healing was uneventful, but these implants had exposed threads, that will need further intervention.

Due to the mandibular atrophy: Luhr class III, all cases had minimal or no keratinized mucosa covering the implant sites following augmentation (fig.17). This resulted in continuous uncomfortable feeling after the exposure of the implants for loading, when the healing collars were in place.

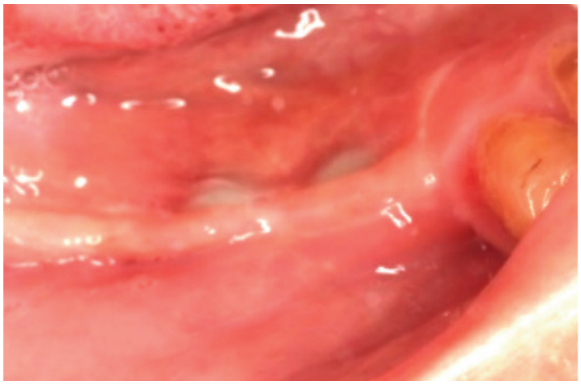

Figure (16) — Exposed implant during the 2nd postoperative month, as the patient was comfortable chewing on surgical site.

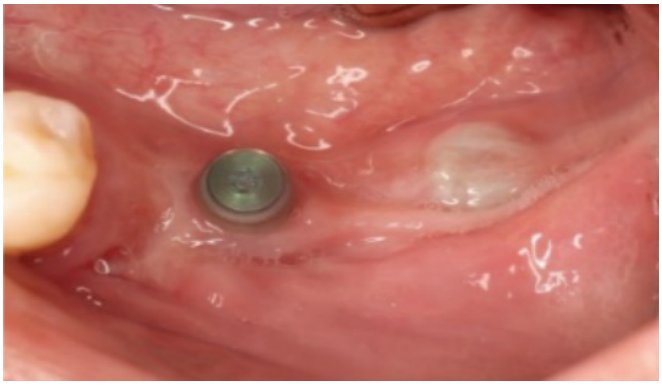

Figure (17) — Clinical at 4 months postoperatively, minimal keratinized mucosa.

In one case in Group II (Xenograft) upon exposure of the implants after 4 months, residues of the laminar bone membrane were clinically visible along the buccal aspect of the implants (fig.18). All cases were exposed at 4 months postoperatively, and healing collars placed, followed by prosthetic phases 2weeks postoperatively (fig.19).

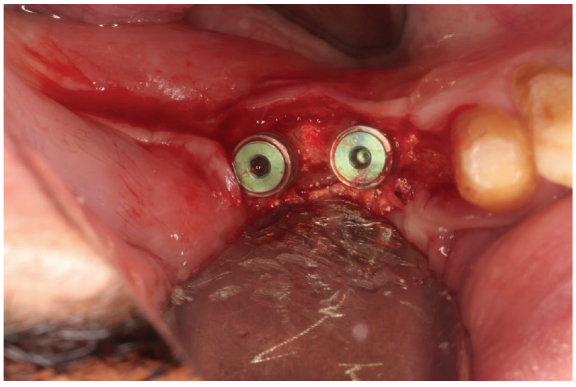

Figure (18) — Arrow pointing to residues of the laminar bone membrane buccally during exposure after 4 months.

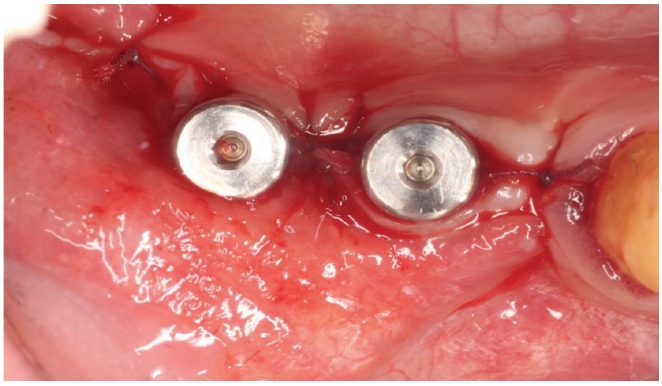

Figure (19) — Placement of healing collars and closure.

Radiographic outcome

CBCT was done pre-operatively, immediate post-operatively and 4 months post-operatively for all patients in both groups. Residual bone height and width were recorded for each patient at the aforementioned time intervals (fig.20A,B,C&D).

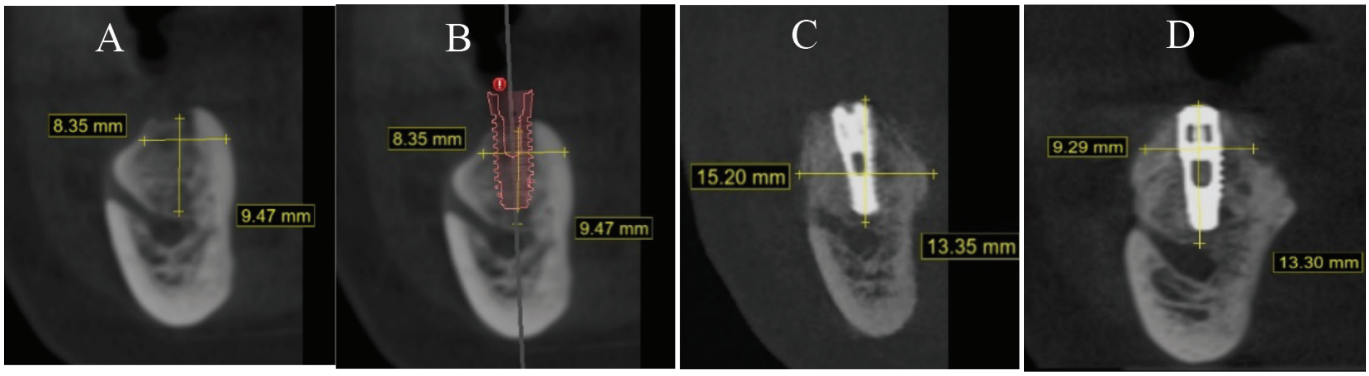

Figure (20) — (A) Pre-operative CBCT and bone quantity measurements; (B) Virtual implant planning; (C) Immediate post-operative CBCT with implant in place with bone graft and covered by laminar bone sheet; (D) 4 months postoperative CBCT.

Group 1: Autogenous Bone Graft

The mean amount of residual bone height pre-operatively was 7.8 mm (SD 0.86) and increased to 14.44 mm (SD 1.75) and 14.1 mm (SD 1.85) immediate and 4 months post-operatively, respectively. The mean amount of bone gain after 4 months was 6.3 mm (Table 1), denoting a minimal amount of graft loss during the first 4 postoperative months was 0.27 mm (less than 2%) (fig.21).

Group 2: Xenograft

The mean amount of residual bone height pre-operatively was 8.37 mm (SD 0.99) and increased to 12.86 mm (SD 1.75) and 12.53 mm (SD 1.65) immediate and 4 months post-operatively, respectively. The mean amount of bone gain after 4 months was 4.16 mm (Table 2), denoting a minimal amount of graft loss during the first 4 postoperative months was 0.33 mm (less than 3%) (fig.22).

Table (1)

Measurements of residual bone height pre-operatively, immediate and 4 months post-operatively with the average bone gain and SD in the autogenous graft group.

	Pre-operative residual bone height	Immediate post-operative	4 months Post-operative	Difference (Amount of bone gain)
Implant 1	7.46	14.06	13.59	6.13
Implant 2	7.78	12.23	12.02	4.24
Implant 3	9.12	17.35	17.3	8.18
Implant 4	6.57	13.48	13.15	6.58
Implant 5	7.54	14.12	13.73	6.19
Implant 6	8.35	15.4	15.24	6.89
Mean	7.803333333	14.44	14.17166667	6.368333333
Standard Deviation (SD)	0.865024084	1.757395801	1.851198711	0.986174626

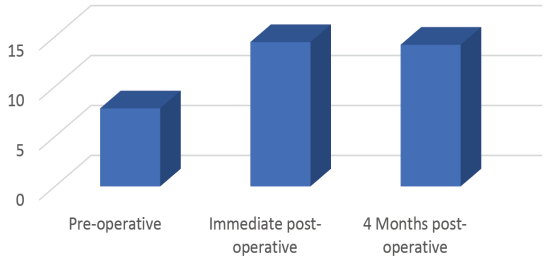

Figure (21) — Histogram illustrating the mean bone gain in the autogenous bone graft group.

Table (2)

Measurements of residual bone height pre-operatively, immediate and 4 months post-operatively with the average bone gain and SD in the xenograft group.

	Pre-operative residual bone height	Immediate post-operative	4 Months post-operative	Difference (Amount of bone gain)
Implant 1	8.46	11.44	10.93	2.47
Implant 2	7.6	10.74	10.74	3.14
Implant 3	9.65	15.78	15.23	5.58
Implant 4	9.47	13.35	13.3	3.83
Implant 5	7.66	13.1	12.74	5.08
Implant 6	7.39	12.76	12.29	4.9
Mean	8.371666667	12.86166667	12.53833333	4.166666667
Standard deviation (SD)	0.99135093	1.751849499	1.658208873	1.217828669

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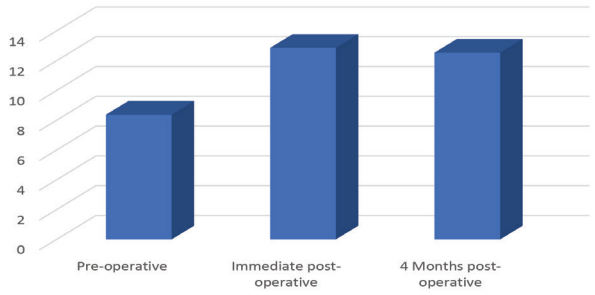

Figure (22) — Histogram illustrating the mean bone gain in the xenograft group.

Upon comparing bone gain in both groups, Group I (Autogenous) had a bone gain of 6.33 mm versus 4.16 mm for Group II (Xenograft). Denoting a more gain in Group I (autogenous) (Table 3). While the amount of graft loss between the immediate and 4 months postoperative CBCT was <2% and <3% in the autogenous versus the xenograft respectively (fig.23).

Table (3)

The mean bone height among both groups at different time intervals.

Mean	Autogenous	Xenograft
Pre-operative	7.803333333	8.371666667
Immediate Post-operative	14.44	12.86166667
4 months Post-Operative	14.17166667	12.53833333

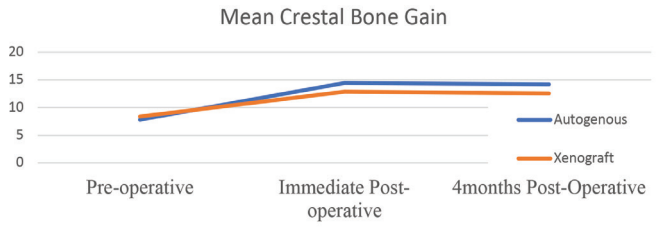

Figure (23) — Line chart of the bone height at different time intervals among the 2 groups.

Osstell results: Resonance Frequency Analysis results at 4 months postoperatively were collected and tabulated for all patients from both groups Table 4-5). Data was plotted as a line chart (fig.24).

Group 1: Autogenous Bone Graft

Table (4)

RFA Osstell results in autogenous bone graft group.

	Implant stability/ISQ
Implant 1	65.3
Implant 2	63.8
Implant 3	71.01
Implant 4	62.2
Implant 5	74.4
Implant 6	71.22
Mean	67.98

Group 2: Xenograft

Table 5:

RFA Osstell results in xenograft group.

	Implant stability/ISQ
Implant 1	69.99
Implant 2	65.47
Implant 3	65.89
Implant 4	71.28
Implant 5	72.03
Implant 6	61.36
Mean	67.67

The following line chart illustrates the osstell readings in both groups. The lowest reading in group 1 being 62.2 and the highest reading 74.4 with a mean of 67.98. Whereas, in group 2 the lowest reading is 61.36 and the highest reading 72.03 with a mean of 67.67.

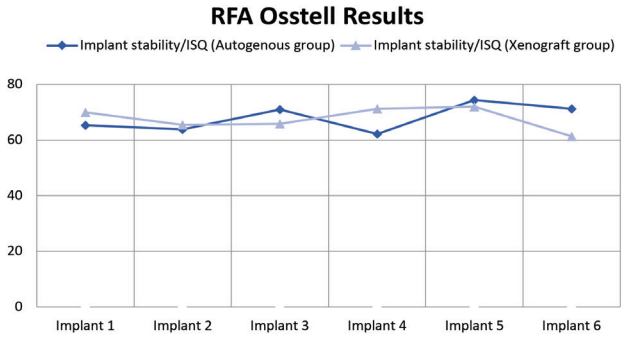

Figure (24) — Osstell readings 4 months post-operatively in both groups.

4. DISCUSSION

Vertical bone augmentation (VBA) procedures for dental implant placement are biologically and technically challenging [20].

Many techniques have been introduced to overcome the posterior mandibular atrophy as short dental implants. Those have been reported as successful treatment options in cases of reduced alveolar bone height due to them negating the need for bone augmentation and thus sparing the risk of its complications. Nevertheless, according to Sun HL et al [21] short implants showed improved performance in the mandible than in the maxilla, however, extremely resorbed mandibles should still be treated with bone regeneration surgeries [9].

Vasco et al [10] reported higher risk of marginal bone loss with short implants compared to standard long implants. However, in Luhr class III cases as presented in the current study, placement of such short implants in the presence of anterior dentition, necessitates the placement of hybrid prosthetics with a gingival component. Moreover, the increased inter-arch space will jeopardize the mechanical long-term prosthetic success, as well as diminished esthetics.

This is in accordance with Deporter 2018 [22], who reported that despite the recent data challenging the consensus of high failure rates when using short and ultrashort implants, yet that the clinical outcome is highly manipulated by

many factors. Moreover, failure rates of shorter implants were also reported to be high in the posterior mandible [23].

Another valuable technique is distraction osteogenesis, and even though holds the advantage of increasing the amount of available keratinized soft tissue at the augmentation site, which was a limitation faced in the current clinical trial, it requires the use of a distractor, to be attached to the bone from two opposite ends and a distraction line in between.

The main problems limiting wide application are twofold: (1) If there is enough bone for a distractor, there will also be enough bone for a dental implant. (2) The distraction device leads to additional costs, as described by Triaca et al [24]. As well as distraction as a process requires multiple visits to the clinic for adjustments of the distractor, which prolongs the treatment period before the placement of the implant. Triaca et al [24] achieved a 2-5 mm bone gain using the distractor, while in this study a mean of 4 mm and 6 mm bone gain in the xenograft and the autogenous bone graft groups respectively, has been achieved.

The osteotomy techniques preserve the crestal soft tissue but bears the risk of fracture of the cut bone. The sandwich technique being superior to the distraction osteogenesis regarding costs and morbidity [25]. The sandwich osteotomy is reputable for its successful prognosis because of its optimal soft tissue coverage and blood circulation, as well as, the vertical portion is positioned on cortical bone, which has the advantage of enduring occlusal loads and absorption. But is limited to the soft tissue availability and increased liability to donor site morbidity if autogenous bone is harvested as known [25].

In addition, some cases cannot undergo sandwich osteotomies due to the limitation of anatomical structures such as the inferior alveolar canal and maxillary sinus as reported by Simion et al, Triaca et al and Stenport et al [24,26,27]. The average increase in onlay grafts is 3 to 4 mm, while sandwich osteotomies are reported to exhibit an increase of approximately 5 to 7 mm.

On the contrary to the here within presented technique, the soft tissue is not an issue as far as the quantity is concerned, as a full mucoperiosteal flap can be elevated both buccally and lingually, allowing for tension free approximation following grafting. And the here within reported bone gains of 4-6mm are comparable to the reported data in literature. However, the presented technique still lacks in terms of soft tissue quality, as it does compensate for the lack of keratinized mucosa.

The supraplant technique was introduced to increase vertical bone height simultaneously with implantation on the top of the alveolar crest similar to the used technique in this study. An implant is placed after drilling in the traditional manner, only to be implanted with a part of it exposed crestally. While the reported incidence of complications has been high with most of the surrounding grafted bone exhibiting resorption [13], several reports have shown acceptable results, but long-term clinical results have been rarely reported [26–28].

Titanium membranes have been proposed over supraplants yet they exhibit the drawback of occluding the blood supply from the soft tissues completely from the underlying graft material and bone bed, not optimizing the environment for bone growth. [13] This issue was addressed by creating holes in the membrane, i.e., meshes. These meshes exhibit the problem of soft tissue ingrowth through the holes and the risk of exposure of the membrane through the gingiva. Using a collagen membrane additionally limits both risks[29]. In the current study the proposed allogenic laminar bone sheet had the advantage over titanium meshes in that it does not need to be removed in a second surgery.

It provides the necessary flexibility to conform to both the underlying graft and implants as well as, provide the contour of a mandibular ridge, while maintaining a smooth surface overcoming the disadvantages of titanium meshes. Moreover, this laminar bone eliminated the need for use of collagen membranes. Collagen membranes that get exposed early through healing stages, have been commonly reported to get infected and need intervention for removal. In the current study, exposed implants in the 2nd postoperative month did not show any signs of infection nor the need for any intervention.

Systematic reviews and meta-analyses of studies on VBA have failed to identify clinical procedures that provide superior results of treatment of the vertical ridge deficiencies.

The choice of a particular augmentation technique will also depend on other factors, including the size and morphology of the defect, location, and clinician or patient preferences [20]. Commonly, a two-stage approach is performed in which a grafting procedure is performed with a typical xenograft/autograft mixture and an expected healing period of 9 months. Only thereafter can implant placement and restoration be accomplished with a total treatment time upwards of 1-1.5 years [18]. Hence the current study was designed aiming at reducing the treatment time, through simultaneous implant placement and ridge augmentation. Others have advised an adequate bone healing of at least 12 months following bone augmentation procedures [13].

In the current study, the challenge was to reduce the overall time of augmentation, implantation, and prosthetics to four months. This might have been too optimistic, as the bone grafts and bone gain seen in CBCT after 4 months, was too soft on clinical exposure, and more time is advised prior to exposing the site. Yet, it is pertinent to state that no implant failures have been encountered in this study, despite having early dehiscence in 2 cases (3 implants), patients occluding on the grafted edentulous site once soft tissue healing occurred -contrary to instructions- and upon 4 months clinical exposure the bone graft was still soft and not mature.

The RFA (Osstell) results should not be taken as a sole indicator for osseointegration and early loading of implants in grafted sites. This is since all implants returned satisfactory RFA readings, while clinically the bone graft whether autogenous or xenograft was clinically still soft.

Furthermore, the limitations of this study include: the limited number of cases and limited number of implants, that need further research to justify the technique. Four months post grafting is too early to expose the grafted site even if the CBCT and RFA results indicate otherwise. While bilateral patients appear to be great candidates from a research point of view, yet, doing them bilaterally has led to patients using the grafted edentulous sites for mastication early following soft tissue healing, prior to prosthetics, which might suggest that tooth-bounded posterior edentulous sites might be a better candidate for such technique.

Despite the limited sample size and short follow-up period, the preliminary results presented are promising and would recommend that further studies are needed using larger sample size, for longer follow-up periods, preferably animal studies to provide the histologic basis for time of exposure, and long-term follow-up for implant survival following loading. Moreover, the decisive factors for success should be multiple and not based on a single tool; as we had successful CBCT and osstell results, while upon exposure the graft was still soft from a clinical point of view.

5. CONCLUSIONS

Based on the results of our study, we concluded that cases initially lacking keratinized mucosa will need soft tissue intervention along with this technique, e exposure after 4 months appeared to have been too early, which lead to bone loss and exposed threads, bilateral augmentation has led to patients using the grafted edentulous sites for mastication early following soft tissue healing, prior to prosthetics, which might suggest that tooth-bounded posterior edentulous sites might be a better candidate for such technique, results were clinically different than radiographically in the CBCT, so longer lag time is recommended before loading.

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Conflict of interest

There was no conflict of interest in our study.

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