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ALVEOLAR RIDGE AUGMENTATION WITH "SCREW TENT-POLE TECHNIQUE" : A STUDY OF 10 CASES

KEY WORDS: Tent-pole, ridge augmentation, PRF, DFDBA

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ABSTRACT

Purpose: The purpose of this study is to evaluate the 3-dimensional increase in bone volume using screw tent pole technique with demineralized freeze dried bone allograft (DFDBA) in a tenting fashion for future prosthesis.

Materials and method: This prospective study evaluated augmentation in 10 consecutive patients with large 3-D alveolar ridge defects. Alveolar ridge augmentation was performed using demineralized allograft placed around titanium screws to tent out the soft tissue matrix. The alveolar ridges were clinically and radiographically evaluated 4 months after augmentation.

Results: 10 Patients with horizontal and/or vertical soft tissue defect as well as hard tissue defect had undergone the procedure. 0.182 cc (52.9%) mean bone volume fill is noted after 4 months of the procedure. One patient had complete dehiscence of the grafted site with screw & graft exposure requiring subsequent graft. Two patients had partial wound dehiscence and one patient had screw head exposure only. Increase in bone volume was evaluated with special software.

Conclusion: It can be concluded that screw tent-pole technique is an effective treatment in patients with large vertical alveolar defects. This technique involves expanding the soft tissue volume and prevents contraction of soft tissue matrix around the graft, subsequently preventing graft from displacement or physiological resorption. Thus a stable increase in alveolar bone height is achieved by this tent-pole technique.

INTRODUCTION :

Extraction of teeth can result in loss of alveolar ridge width and height within first one to three years. This bone loss is exacerbated if the tooth is removed traumatically or if there are pre-existing endodontic or periodontal pathologies. These often require bone augmentation to create ideal gingival contour and aesthetics.[1]

Following tooth removal varying amounts of bone resorption takes place due to qualitative and quantitative changes that occurs in the alveolar bone around the extraction site. Alveolar ridge is a tooth dependent structure and therefore, after a tooth is extracted, 3-dimensional bone resorption takes place both, horizontally and vertically resulting in changes that may lead to esthetic and functional problems. A deficient alveolar ridge fails to provide sufficient support and retention for dentures. This will not only compromise the soft tissue support and lower anterior facial height but also preclude dental implants placement. Such deformities of the alveolar ridge may compromise future implant placement[2] as well as esthetic results when a fixed partial denture is constructed in a visible area.

Various techniques have been described for the reconstruction of these large 3-dimensional defects before implant placement. These techniques have included autogenous onlay block grafts[3-4], autogenous particulate grafts[5-6], distraction osteogenesis[7], and porous titanium mesh tray, or a combination of these. **Marx et al**[8] reported on a novel surgical approach using dental implants as "tent-poles" in combination with iliac crest bone grafting. The novel strategy of this surgery was to allow iliac bone grafts to consolidate and maintain their volume with dental implants that create a tenting effect.

Wang and Boyapati proposed the **PASS principles** for predictable bone regeneration in 2006 which outlines the four major principles underlying successful GBR[9]:-

- Primary wound closure,
- Angiogenesis,
- Space creation/maintenance and
- Stability of both the initial blood clot and implant fixture (PASS).

A major challenge to reconstructing large 3-dimensional bone defects is the contraction of the "soft tissue matrix" leading to resorption and migration of the bone graft. Surgical control of the expanded soft tissue volume prevents resorption of graft material[10] by maintaining a space between the periosteum and bone.

The hypothesis for this case study was whether 1.5-mm screws in combination with human demineralized bone could be used as an osteoconductive and osteoinductive scaffold to restore large horizontal and vertical defects. So this technique may result in sufficient bone quantity and quality after 4 to 5 months to allow for subsequent osseointegration of endosseous implants.

MATERIALS AND METHODS:

This prospective study evaluated augmentation in 10 consecutive patients presenting with vertical and horizontal alveolar ridge defect. Inclusion criteria for this study were Patients aged between 20-60 years both male and female who lost or got their teeth extracted (Mandibular Posterior teeth or Maxillary Anterior teeth) due to severe periodontitis or who have undergone traumatic extraction. Preoperative examination and CBCT imaging were evaluated. Smokers, diabetic patients, and any medically compromised patients were excluded from this series.

Horizontal ridge augmentation was performed using human

demineralized allograft placed around titanium screws to tent out the soft tissue matrix and periosteum. The ridges were clinically evaluated 4 months after augmentation. Soft tissue dimensions with UNC probe and clinical ridge mapping was done at baseline and at 4 months. Cone Beam computed tomography (CBCT) scans were taken to evaluate all grafted segments. All the patients have undergone initial scaling and root planing with oral hygiene instructions. 4 weeks following the phase I therapy, patients were re-evaluated.

SURGICAL TECHNIQUE:

All aseptic precautions were taken before the surgical procedure. A preoperative 0.2 % chlorhexidine rinse was given for 2 minutes. Surgical area was anesthetized with local infiltration, using 2% Lignocaine hydrochloride with 1:80000 adrenaline local anesthetic solution. A crestal incisions were made in all cases with vertical releasing incisions. Whenever possible, available keratinized tissue was identified and included in the flap. Aggressive tissue undermining was performed before screw or graft placement to ensure tension-free closure. In the anterior maxilla, subperiosteal dissection was carried up to the anterior nasal spine to obtain adequate release for passive primary closure. In the posterior mandible, this often involved split thickness dissection on the labial for supraperiosteal advancement. Titanium screws of 1.5 mm width & 8 mm height were placed in the alveolar bone monocortically from buccal bone towards palatally so that approximately 5 to 7 mm of screw threads was exposed. Particulate demineralized allograft (250 to 1,000 µm) was mixed with the PRF (Platelet rich fibrin). The composite graft was reconstituted with normal saline and covered with moist gauze dampened with saline for 15 minutes, to expand the DFDBA particles and placed to cover the screw completely. (Fig. 1)

In order to obtain the PRF, we begin by taking a venous blood sample using a 21× 3 quarter gauge butterfly Vaccutte needle and a vaccum-packed Vaccutte 9ml.

The defect was overcorrected with particulate material in anticipation of future graft resorption. A resorbable membrane was placed over the grafted sites. Passive primary closure over the entire graft was obtained with interrupted 5-0 Vicryl sutures. All the patients were recalled after 10 days. Postoperatively, the patient prosthesis was adjusted to avoid impingement on the grafted site and, when possible, to create positive tissue architecture. All patients were prescribed, postoperative antibiotic and analgesic for 7 days and a 0.2% chlorhexidine gluconate mouth rinse for 2 weeks. Sutures were removed 10 days post-operatively. After 4 months, the grafted sites were uncovered and the screws removed.

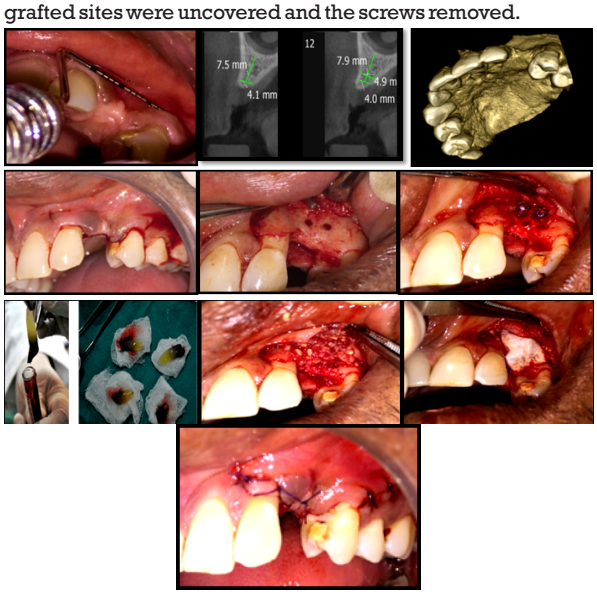

Fig. 1 :- Stepwise procedure of "tent-pole technique".

RESULTS:

10 patients (7 male/3 female) consecutive patients with localized vertical and horizontal alveolar ridge defects underwent surgery. (Table 1) The mean patient age was 50.06 years (range 20 to 60 yrs). Procedure was performed in the mandible in five patients and in five patients partially edentulous maxilla was augmented. Adequate tension-free closure over the graft was achieved in all patients.

There were no postoperative wound infections. Complete dehiscence of the grafted site with graft and screw exposure was noted after 4 months in one patient which required subsequent grafting. Although there was complete exposure of the graft material, partial graft uptake was noted upon re-entry after 4 months. Two patients had partial wound dehiscence and one patient had screw head exposure only after 10 days. Wound dehiscence and screw head exposure were treated with conservative care with oral hygiene maintenance and oral rinse during the 4 months healing period. Partial graft loss was noted on re-entry in 3 patients with complete or partial wound dehiscence.

Clinically ridge mapping was done with the help of k-files and acrylic stent for standardization. Gingiva mucosal thickness was also evaluated for the soft tissue changes. Soft tissue height and width were evaluated with the help of UNC-15 probe. Radiographically, 3-D imaging was carried out for the accurate pre operative and post operative results of bone height and width. Bone volume was also measured at baseline and 4 months with the help of EZ3Di software on C.B.C.T. (Table 1) (Fig. 2)

Mean of soft tissue height at baseline 12.30 ± 1.636 mm and at 4 months 14.80 ± 1.751 mm, the difference is statistically significant. ($P < 0.05$)

Mean of soft tissue width at baseline 6.50 ± 1.080 mm and at 4 months 9.60 ± 1.075 mm, the difference is statistically significant. ($P < 0.05$)

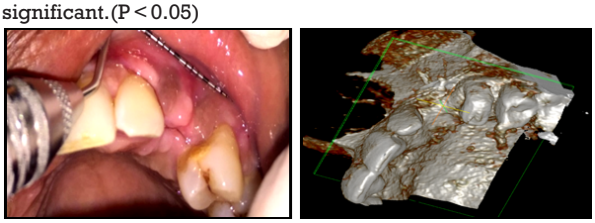

Fig. 2 :-Clinical and radiographical measurement after 4 months of the procedure.

DISCUSSION:

Dealing with a resorbed edentulous maxilla or mandible remains a major challenge in modern dentistry.[11,12] A deficient alveolar ridge fails to provide sufficient support and retention for dentures. That will not only compromise the soft tissue support and the lower anterior facial height, but also preclude dental implants placement, which may dramatically reduce the quality of life for patients.[3,13]

Vertical ridge augmentation remains a challenge in the reconstruction of the atrophic maxilla and mandible. The main problem arises from the need to expand the soft-tissue envelope and achieve the proper bony architecture. Techniques that have been developed to solve or circumvent this problem include onlay bone grafting with particulate bone graft, block bone graft, barrier techniques with permanent or resorbable membranes, distraction osteogenesis, vascularised ridge splitting techniques, sinus lifts, nerve repositioning techniques, short implants, and angled implants.

The choice of technique depends on the size of defect, horizontal or vertical defect, anatomical structures, and the size of area to be augmented.

Distraction osteogenesis is mainly used for vertical ridge deficiencies. More than 12mm of bone height can be achieved by this method. The main disadvantages are patient compliance and cost factor. Various soft tissue changes also occur during distraction and consolidation periods. So, when a large amount of bone is to be obtained, better results are seen if total amount of distraction is divided into several time periods rather than distracting the bone at once.[19]

Onlay bone grafting **(Le et al. and Le and Burstein)** is the positioning and securing of bone grafts on the surface of alveolar ridge. It can be either block or particulate onlay bone grafts. Titanium mesh (**Louis et al.**) for localized alveolar ridge augmentation can also be used. Complications with traditional grafting include : infection, soft tissue defects, graft exposure due to soft tissue dehiscence, loss of grafting material, in adequate bone volume.[14,15,16]

Guided Bone Regeneration (GBR) is a predictable therapeutic technique that can be used separately in a staged approach to first augment the ridge or in conjunction with implant placement when primary stability of the implant is desirable. This technique is based on filling the defect with bone grafts and/or bone substitutes and covering the material with a membrane to prevent ingrowth of epithelial and gingival connective tissue cells. Possible complications are : exposure of the membrane or early breakdown of the membrane. It is mostly restricted to defects where vertical bone augmentation of about 2-7 mm is needed.

So the present study was planned by placing 1.5 mm screws in combination with human demineralized bone that could be used as an osteoconductive scaffold to restore large ridge defects resulting in sufficient bone quantity and quality after 4 months to allow for subsequent osseointegration of endosseous implants. Autogenous bone graft has long been considered the gold standard for grafting severe hard tissue defects. Louis et al reported on the use of titanium mesh for reconstruction of severely atrophic maxilla or mandible using iliac crest bone graft with a 97% overall graft success rate, although exposure of the titanium mesh was reported to be high (52%). The obstacles to using iliac crest bone are obvious. In addition to the higher resorption rate of iliac crest grafts, other disadvantages include the high costs of hospitalization, risk of general anesthesia, and morbidity of the procedure.

Conversely, the use of mineralized allograft offers many advantages, including an unlimited amount of donor bone, reduced anesthesia and operative time. The procedure can be performed ideally as outpatient surgery, thereby decreasing the overall costs of the procedure. Le and Burstein reported the successful use of mineralized allograft for the reconstruction in patients with severely atrophic maxilla for implant placement. Le et al reported the use of mineralized allograft as a particulate onlay graft to augment atrophic alveolar ridge for single implant site development.

Various studies through their result have shown regenerative action of PRF and hence has proved efficacy of PRF in bone regeneration. Recently, **Shah M et al. in 2015** in a randomized clinical trial compared the regenerative capacity of PRF as sole bone substitute and DFDBA for infrabony defects. They concluded that PRF group showed significant improvement in clinical parameters at 6 months post-operatively.

Barrier membranes should create secluded space over the area to be augmented, in order to stabilize the blood clot and to exclude the soft tissue penetration. The protected space is then colonized by osteogenic cell populations resulting in new bone formation. Various resorbable or non-resorbable membranes can be used in increasing the bone volume in both horizontal and vertical augmentations.[17] Collagen membranes, as all resorbable membranes, do not normally require a second surgery for retrieval. Patients appreciate the elimination of a second surgery, in addition to less morbidity. Collagen is the principal component of connective tissue and provides structural support for tissues throughout the body.

The main cause of wound dehiscence is failure to provide tensionless closure. Other reasons for a dehiscence are infection, trauma from opposing dentition, irritation from a removable prosthesis, and hematoma development. Flap advancement is a required part of ridge augmentation procedure to attain tension-free primary closure along the incision line. Primary closure results in decreased discomfort, faster healing and is critically important in attaining desired objectives (e.g., bone regeneration). Failure to attain tensionless closure may result in a soft tissue dehiscence along the incision line that can cause a poor outcome and/or postoperative complications.[18]

CONCLUSION:

It can be concluded that tentpole procedure is an effective technique for treatment in patients with large alveolar ridge defects. This technique involves expanding the soft tissue volume and prevents contraction of soft tissue matrix around the graft, subsequently preventing graft from displacement or physiological resorption. Thus a stable increase in bone volume can be achieved by this tentpole procedure.

Table 1 :- Comparative evaluation of alveolar augmentation using screw tent-pole technique,

Pt. No.	AGE (Yrs.)	SEX	EDENTULOUS SITE	SIEBERTS CLASSIFICATION	CLINICAL PARAMETERS												RADIOGRAPHIC PARAMETERS							
					RIDGE MAPPING (Acrylic Stent) (mm)						GINGIVAL PHENOTYPE (mm)		SOFT TISSUE DIMENSIONS (mm)				3D IMAGING				BONE VOLUME (cc)		BONE VOLUME FILL	% OF VOLUME FILL
					Buccal		Palatal/ Lingual		Occlusal		Buccal		Height		Width		Height		Width					
					B	4	B	4	B	4	B	4	B	4	B	4	B	4	B	4	B	4	4	4
1	50	M	23	Class I	1.5	3	2	3	5	4	1.5	3	11	11	7	12	7.5	8	4.1	6	0.26	0.42	0.16	61
2	45	M	36	Class II	1.5	2	1	2	3.5	2	1.5	2	13	15	6.5	9	9.5	13	4.5	5.2	0.2	0.32	0.12	60
3	49	F	14	Class II	1	2	1.5	2	1.5	2	1	2	9.5	13	7.5	10	8	11	5	6	0.33	0.48	0.15	45
4	51	M	23	Class I	1.2	2.1	1	2	1	2	1.2	2.1	13	15	7.4	9.3	12	14	5.2	6.3	0.46	0.66	0.26	56
5	45	M	46	Class II	1.3	2.2	1.2	2.3	1.5	1.5	1.3	2.2	10.5	15.5	5	8	9	14	3.5	4.5	0.3	0.46	0.16	51
6	54	F	13	Class I	1.5	2.5	1	2	1.5	1.5	1.5	2.5	13	15	6.5	10.5	11.5	13.5	4	6.5	0.37	0.52	0.15	41
7	48	F	46	Class II	2	2	1	2	2	2	2	2	11.5	16	7.2	10	9.5	14.5	4.2	6	0.29	0.48	0.19	65
8	40	M	24	Class I	1	2	2	2	3	3	1	2	14	16	6.2	9	11	13	3.2	5	0.41	0.67	0.26	56
9	55	M	36	Class II	1.6	1.8	1.7	1.8	2.5	2	1.6	1.8	12	14	8	9	10.5	12	4.7	5.4	0.31	0.49	0.18	58
10	52	M	44	Class I	1	2.5	1	1.5	2	2	1	2.5	15	17	5	9.5	13	15	3	5.5	0.51	0.76	0.25	49

B = Baseline (pre-operative), 4 = After 4 months (post-operative).

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