

## Original Article

# Alveolar ridge augmentation by connective tissue grafting using a pouch method and modified connective tissue technique: A prospective study

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## ABSTRACT

**Background:** Localized alveolar ridge defect may create physiological and pathological problems. Developments in surgical techniques have made it simpler to change the configuration of a ridge to create a more aesthetic and more easily cleansable shape. The purpose of this study was to compare the efficacy of alveolar ridge augmentation using a subepithelial connective tissue graft in pouch and modified connective tissue graft technique.

**Materials and Methods:** In this randomized, double blind, parallel and prospective study, 40 non-smoker individuals with 40 class III alveolar ridge defects in maxillary anterior were randomly divided in two groups. Group I received modified connective tissue graft, while group II were treated with subepithelial connective tissue graft in pouch technique. The defect size was measured in its horizontal and vertical dimension by utilizing a periodontal probe in a stone cast at base line, after 3 months, and 6 months post surgically. Analysis of variance and Bonferroni *post-hoc* test were used for statistical analysis. A two-tailed  $P < 0.05$  was considered to be statistically significant.

**Results:** Mean values in horizontal width after 6 months were  $4.70 \pm 0.87$  mm, and  $4.05 \pm 0.89$  mm for group I and II, respectively. Regarding vertical heights, obtained mean values were  $4.75 \pm 0.97$  mm and  $3.70 \pm 0.92$  mm for group I and group II, respectively.

**Conclusion:** Within the limitations of this study, connective tissue graft proposed significantly more improvement as compare to connective tissue graft in pouch.

**Key Words:** Alveolar ridge augmentation, connective tissue graft, periodontal plastic surgery

Received: May 2014  
Accepted: April 2015

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## INTRODUCTION

Localized alveolar ridge defects are frequently found in partially edentulous patients that impair proper aesthetic, phonetic, and oral hygiene.<sup>[1-3]</sup> These defects are associated with deficit in volume of bone

and soft tissues within the alveolar process resulting from traumatic tooth extraction, advanced periodontal diseases, developmental defects, external trauma and tumors.<sup>[3,4]</sup>

From a morphologic standpoint, Seibert classified

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**How to cite this article:** Agarwal A, Gupta ND. Alveolar ridge augmentation by connective tissue grafting using a pouch method and modified connective tissue technique: A prospective study. Dent Res J 2015;12:548-53.

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ridge deformities into three types according to the vertical and horizontal defect components:<sup>[4]</sup>

1. Class I defect (Buccolingual loss of tissue contour with a normal apicocoronal height)
2. Class II defect (Apicocoronal loss of tissue with normal buccolingual contour)
3. Class III defect (A combination of buccolingual and apicocoronal loss).

Later, Allen *et al.*<sup>[5]</sup> introduced severity as a classification criterion in the evaluation of alveolar deformities. Severity is classified as:

Mild deformity <3 mm, moderate deformity 3-6 mm, and severe deformity >6 mm.

Abrams *et al.*<sup>[6]</sup> studied the prevalence of anterior ridge deformities in the mandibular and maxillary arches of partially edentulous patients and reported the presence of defects in 91% of the cases. Class III defects were the most prevalent (55.8%), followed by Class I defects (32.8%) and Class II defects (2.9%).

Over the last decade, advancements and modifications in technologies in the field of restorative dentistry and Periodontics have been able to achieve best results to restore form, function and aesthetic of the patient. Reconstructive procedures for the deformed alveolar ridge are guided bone regeneration, bone graft and soft tissue graft placement beneath the flap or in pouch made in damaged area.<sup>[7,8]</sup> Soft tissue ridge augmentation is a valuable periodontal plastic surgery procedure for correction of ridge defects for aesthetic purposes. Epithelial connective tissue graft, onlay graft, subepithelial connective tissue graft, roll pedicle graft, interpositional graft technique, and combined onlay interpositional graft are the most employed approaches in this scenario.<sup>[7-13]</sup>

In literature, little data is available about the comparison of subepithelial connective tissue graft in pouch and modified subepithelial connective tissue graft in the treatment of alveolar ridge defects. Therefore, to explore the beneficial effects of modified subepithelial connective tissue graft over subepithelial connective tissue graft in pouch, if any, in alveolar ridge defects the present study was undertaken.

## MATERIALS AND METHODS

Forty non-smoker individuals (24 males and 16 females, age between 25 and 55 years) with 40 class III alveolar ridge defects in maxillary anterior

region were selected for the study in the Department of Periodontics, Dr. Z. A. Dental College, Aligarh. The study was designed as a randomized, clinical study comparing the alveolar ridge augmentation outcomes using modified connective tissue graft and subepithelial connective graft in pouch. Inclusion criteria for the patients were absence of any systemic and periodontal diseases, not taking any medication, no pregnancy or lactation, not previously treated for periodontal reasons, cause of tooth loss be trauma, congenital missing, and tooth fracture. To be included in the study, each patient had to present <20% plaque (PL+), and bleeding on probing (BOP+) sites. Selected sites were randomly divided by flip of coin method in two groups. Group I was treated by modified subepithelial connective tissue graft (combined onlay connective tissue graft), while group II by subepithelial connective graft in pouch method.

After recruitment of the patients, the study protocol, risks, benefits, and procedures were explained, and written informed consents were obtained from every patient. All the examinations, treatment, and procedures associated with this study followed the principles according to the Declaration of Helsinki. The study was properly reviewed, and approved by the Ethical Committee of Institute.

### Measurement of the localized alveolar ridge defect

Stone casts were prepared at baseline and after 3, and 6 months postoperatively for measuring the dimension of alveolar ridge defects. The extension of the ridge defect was defined as distance between the buccal-proximal line angles of both adjacent teeth at the vertical level of the papilla tips. It was measured with an orthodontic caliber (Zürcher Model, Medidenta Zürich, Swiss), having a division of one tenth of a millimeter. The result was rounded up to the next tenth of a millimetre.

The measurements of the ridge defect was assessed on the dental cast with a manual UNC-15 periodontal probe (Hu-Friedy, Chicago, IL, USA), in nearest millimetre by measuring the defect size separately in the vertical and horizontal dimension.<sup>[14]</sup> The vertical component of the ridge defect was measured between the deepest point of the ridge defect to a line, which run through the adjacent papilla tips, named the papilla line.

The horizontal component of the ridge defect was assessed between the deepest point of the ridge

defect to the tooth arch curvature, which runs through the adjacent gingival zeniths, or the buccal cemento-enamel junction, respectively.

The papilla line and the tooth arch curvature defined in a semiquantitative manner according the aesthetically ideal ridge form, which outlined the target volume for augmentation. Both lines were determined with a tin wire, having a circle round cross-section with a diameter of 1 mm, possessing no elasticity. In this manner, the ridge defect was semi-quantitatively determined at the mentioned time periods. The measured results were rounded up to the nearest millimetre. The absolute gain in the vertical and horizontal dimension, expressed in millimetres, was calculated by subtracting the postoperative from the preoperative value. All measurements were done by a masked clinician who was unaware about the type of surgeries. All surgeries were performed by single well experienced periodontist for minimization of the inter operator variability.

### Surgical protocol

#### *Subepithelial connective tissue graft*

After administering local anaesthesia, incision was given for pouch formation at the buccal side of involved area. This pouch was extended to the alveolar ridge for adequate depth with the help of periosteal elevator. Subepithelial connective tissue graft was harvested from the palatal aspect of left second premolar region. This connective tissue graft transferred to the preformed pouch and adjusted according to ridge deficiency. After suturing, the site was covered with periodontal pack.

#### *The modified subepithelial connective tissue graft technique*

Half of the graft's width remained covered with epithelium whereas in the other half of the graft's

width epithelium was removed leaving connective tissue and fatty tissue. Therefore, this graft represented a combined onlay — Connective tissue graft. The onlay part of the graft was fixed on the palatal aspect of the recipient site. The connective tissue part of the graft was placed on the buccal aspect of the recipient site, correcting the ridge defect [Figures 1-7].

### Medication after surgery

Postoperative regime included 500 mg amoxicillin and 125 mg clavulanic acid (Augmentin 625, GlaxoSmithKline) thrice a day for 7 days and 0.12% Chlorhexidine gluconate mouth rinse (10 ml; Peridex, Procter and Gamble) twice daily for 2 weeks.

Recall sessions were made at biweekly intervals for periodontal examination for professional tooth cleaning. Analysis of variance and Bonferroni *post-hoc* test were used for statistical analysis. A two-tailed  $P < 0.05$  was considered to be statistically significant.

## RESULTS

All patients maintained a high standard of PL control throughout the study, and all the defects healed with no infectious episodes or uneventfully both clinically and radiographically. The controls showed %PL+ and %BOP+ sites of 14.4% and 15.2%, respectively at base line; the same parameters were 13.3% and 14.1% after 6 months. Similarly, for the group II, %PL+ and %BOP+ were 13.8% and 14.6% at base line and 12.8%, and 14.0% after 6 months. Both groups showed a nonsignificant change in %PL+ and %BOP+ at base line and after 6 months. The mean mesio-distal width of the ridge extension was 12.8 mm in group I, and 13.0 mm in group II.



**Figure 1:** Facial view of alveolar ridge deficiency.



**Figure 2:** Occlusal view of alveolar ridge deficiency.



Both techniques showed significant horizontal and vertical fill after 3 and 6 months as compared to base line dimensions. On inter group comparison group I demonstrated significantly better results than group II in terms of mean change from base line to 3 and 6 months for both horizontal and vertical defect fill. Mean gain in horizontal width after 6 months was  $4.70 \pm 0.87$  mm, and  $4.05 \pm 0.89$  mm for group I and II respectively. While increase in vertical height was  $4.75 \pm 0.97$  mm and  $3.70 \pm 0.92$  mm respectively for group I and group II [Tables 1 and 2].

## DISCUSSION

This study was undertaken for the assessment of ridge augmentation capacity of subepithelial connective tissue in pouch, and modified subepithelial connective tissue graft (combined onlay — Connective tissue graft) for class III alveolar ridge defects.

Both treatment modalities proposed significant horizontal and vertical gain in ridge height after 3 and 6 months as compared to base line dimensions. However, modified subepithelial connective tissue graft observed significantly more gain than connective tissue graft in pouch for the same parameters. The intragroup results of our study were in agreement with previous literature in which above mentioned techniques have showed significant improvement in horizontal and vertical ridge height.<sup>[1,2,14-18]</sup> However, intergroup results of present study were not in accordance to Studer *et al.*<sup>[14]</sup> study.

In this study, preoperative defect size did not differ statistically from each other in both groups, either in the vertical dimension ( $P > 0.05$ ) or in the horizontal dimension ( $P > 0.05$ ), as well as for the extension of the defect size ( $P > 0.05$ ). The observation time was also similar for both surgical groups. This allows the conclusion that both groups possessed the same presurgical conditions regarding defect morphology;



Figure 3: Donor site in palatal area after modified graft removal.



Figure 5: Graft in recipient site.



Figure 4: Modified connective tissue graft (note: onlay portion and connective tissue in same graft).

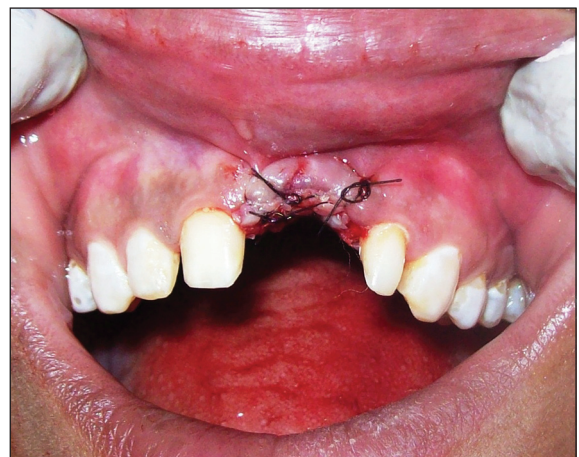
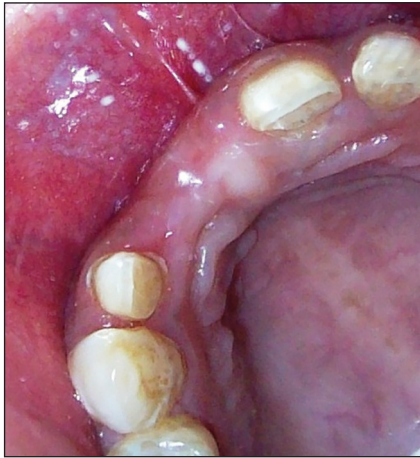


Figure 6: Graft suture at recipient site.



**Figure 7:** Improvement in bucco-lingual width. (After 6 months).

**Table 1: Pre- and post-treatment values in mm (mean ± SD)**

Defect type	Base line	3 months	6 months	Mean change
<b>Group 1</b>				
Horizontal defect (mm)	6.10±0.72	2.50±0.51	1.40±0.50	4.70±0.87
Vertical defect (mm)	9.95±0.95	5.90±0.64	5.20±0.41	4.75±0.97
<b>Group 2</b>				
Horizontal defect (mm)	6.25±1.02	3.30±0.66	2.20±0.62	4.05±0.89
Vertical defect (mm)	9.40±1.00	6.50±0.51	5.70±0.57	3.70±0.92
<b>P value</b> (comparison between both parameters)				
Horizontal defect	P>0.05	P=0.00	P=0.00	P<0.05
Vertical defect	P>0.05	P<0.05	P<0.05	P<0.05

SD: Standard deviation.

**Table 2: Intergroup comparison of mean improvement at different time periods in horizontal and vertical defects (mm)**

Time period	Groups	Mean ± SD	t	P
<b>Horizontal defect (mm)</b>				
Baseline-3 months	Group 1	3.60±0.75	2.245	0.007*
	Group 2	2.95±0.69		
Baseline-6 months	Group 1	4.70±0.87	2.347	0.024*
	Group 2	4.05±0.89		
3-6 months	Group 1	1.10±0.64	0.000	1.000 <sup>NS</sup>
	Group 2	1.10±0.45		
<b>Vertical defects (mm)</b>				
Baseline-3 months	Group 1	4.05±0.76	4.921	0.000*
	Group 2	2.90±0.72		
Baseline-6 months	Group 1	4.75±0.97	3.513	0.001*
	Group 2	3.70±0.92		
3-6 months	Group 1	0.70±0.47	-0.717	0.478 <sup>NS</sup>
	Group 2	0.80±0.41		

SD: Standard deviation, \*Significant, \*A two-tailed P < 0.05 was considered to be statistically significant, NS: Non significant.

therefore, differences between these groups which were determined after surgery were not related to presurgical existing differences.

Modified subepithelial connective tissue graft (combined onlay–connective tissue graft) showed significantly better results. This may be because in the recipient site combined graft solves the two purposes; first it increases the horizontal width by connective tissue portion, and second it also increases vertical height by intact epithelium. The advantages of this kind of graft have been documented as:<sup>[17]</sup>

1. The submerged connective tissue section of the graft aids in the revascularization of the onlay section of the graft, thereby gaining a greater percentage of take of overall graft.
2. A smaller postoperative open wound in the palate donor site.
3. Faster healing in the palate donor site with less patient discomfort.
4. Greater latitude or ability to control the degree of bucco-lingual and apico-coronal augmentation within the single procedure.
5. Vestibular depth is not decreased and the mucogingival junction is not moved coronally, thereby eliminating the need for follow-up corrective procedure.

For the present study a simple and economical measurement method was applied, which allowed a fast and easy assessment of ridge defects prior to and after surgery. The drawback of this method lies in its limited precision, and the location of the defect size assessment does not necessarily remain at the same location between the pre- and post-operative measurements. Consequently, this measurement method may be defined as a semi quantitative one. The alternative for the assessment of three-dimensional volume differences could be the projection Moiré technique. This method offers volume assessments with sufficient accuracy. However, it is time-consuming and demands significant computer equipments.<sup>[15,19]</sup> It would be of interest to measure the present data with the Moire projection method and compare its results with the present study, possibly establishing the presented method as a fast control method.

It must be critically commented that the aim of the ridge augmentation procedure was to augment “as much as possible.” The exact graft volume which was placed in the recipient site was not measured in this study due to its limited accuracy. The known graft volume would possibly give more accurate information about the efficacy of different surgical procedures, if the volumetric outcome is

quantitatively assessed, e.g., by projection Moiré technique.

The results of this small cohort study would have had more validity if power calculation was also a consideration criterion. Differences in the outcomes of the various studies might be due to the variation in several associated factors, that can alter the extent of dimension gain after soft tissue grafting procedure, like patient selection, defects characteristics, data collection, biochemical characteristics of grafted materials, surgical variation, and patient attitude towards the treatment.<sup>[20]</sup>

## CONCLUSION

Within the limitations of this study, modified connective tissue graft is a better option as compared to subepithelial connective tissue in pouch for the treatment of alveolar ridge deficiency.

### Financial support and sponsorship

Nil.

### Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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