



# GRAFTED VERSUS NON GRAFTED ULTRASONIC RIDGE SPLITTING TECHNIQUE WITH SIMULTANEOUS IMPLANTS PLACEMENT INTO NARROW POSTERIOR MANDIBULAR ALVEOLAR RIDGE: A CLINICAL AND RADIOGRAPHIC STUDY

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## ABSTRACT

The present study was designed to evaluate clinically and radiographically the ultrasonic ridge splitting technique with and without bone grafting material with simultaneous implant placement into narrow posterior mandibular alveolar ridge. This study was carried out on 24 patients with partial edentulous narrow posterior mandibular alveolar ridge. Patients were divided randomly into two equal; group I was treated with RST and simultaneous implant placement into their ridge without any bone graft; group II was treated with RST and simultaneous implant placement into their ridge supplemented by synthetic bone substitute (Osteon™ P collagen). Patients were evaluated clinically to assess probing depth, implant stability quotient, and radiographically to assess alveolar ridge width and the bone density measurement parameters at 3, 6, 9, and 12 months. The results of the present study showed significant difference of probing depth and implant stability quotient between the two groups at the different intervals, and there was a superiority of the Osteon™ P collagen group (grafted group) in bone density, with high statistically significant difference at all follow up periods.

**Keywords:** grafted, non grafted, ultrasonic ridge splitting technique, implant.

## INTRODUCTION

Alveolar bone resorption patterns after tooth extraction may jeopardize correct implant placement with respect to position and angulation<sup>(1,2)</sup>. Therefore, only bone grafting or guided bone regeneration techniques have been developed to increase the bone volume of narrow ridges<sup>(3-6)</sup>. Many studies have demonstrated the success of these well-documented surgical approaches, but donor site morbidity, unexpected bone resorption, block consolidation at the site of grafting, and infection are among the drawbacks of these conventional techniques<sup>(7,8)</sup>.

One of these methods was ridge splitting, ridge splitting is a procedure used to expand the narrow ridge bone by separating the buccal and lingual plates. Splitting of the alveolar bone longitudinally

is performed using chisels, osteotomes or piezosurgical devices. The result is an increase of the horizontal ridge width, provided that the buccal and lingual cortical plates are not fused and some intervening cancellous bone is present, with adequate vascularity and stabilization of the mobile bone segment<sup>(9-11)</sup>.

RST allows simultaneous implant placement at the time of bone grafting. In this context bone splitting presents the advantage of simultaneous implant placement and avoiding bone graft harvesting from secondary donor sites<sup>(12,13)</sup>. However, RST has certain limitations such as buccal plate resorption<sup>(14)</sup>, gingival recession, devitalization of the outfractured segment with subsequent facial bone loss/ resorption, and the lack of ability to gain vertical bone height<sup>(15,16)</sup>.

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A possible solution to overcome these challenges may represent the use of bone substitutes such as osteon™ P collagen synthetic bone substitute Composed of synthetic bone graft material (osteon™ II composed of 30% hydroxyapatite and 70% beta-tricalcium phosphate) and natural type I collagen. It have numerous advantages; moldable property to accommodate any shape or form, Significantly reduce chair time due to excellent handling and delivery, Collagen content becomes resorbed over several weeks after the initial shaping, and osteon™ II is highly resorbable due to higher  $\beta$ -TCP content (HA: $\beta$ -TCP=30:70)<sup>(17)</sup>.

As a result of these advantages, Osteon™ P collagen as a regenerative material could be of great value in the ultrasonic ridge splitting technique with simultaneous implant placement into anarrow posterior mandibular alveolar ridge.

## PATIENTS AND METHODS

### Patients selection:

This study was carried out on 24 (16 women and 8 men; mean age of 39years) patients with partial edentulous narrow posterior mandibular ridge according to clinical examination and radiographic evaluation by cone beam computed tomography. An informed consent was obtained from all patients before carrying out any study procedures. All patients will be selected from those attending at the Out Patient Clinic, Oral and Maxillofacial Surgery Department, Faculty of Dental Medicine, Al-Azhar University, Assiut Branch.

### Inclusion and exclusion criteria:

Systemically healthy patients missing a multiple teeth in the posterior mandibular region and those with the crestal residual ridge width of at least 3 mm at the crest and 6 to 8mm at the base with sufficient vertical bone height provided that the recipient site of the implant should be free from any pathological conditions were included in the study.

Whereas patients with dental history of bruxism, parafunctional habit, smoking habit, Pregnant or receiving contraceptive pills, and History of radiotherapy and chemotherapy were excluded.

### Patients grouping and randomization:

Patients were classified randomly into the following equal two groups using the online software (<https://www.randomizer.org>):

**Group I**, twelve patients with partial edentulous narrow posterior mandibular ridge; treated by ultrasonic ridge splitting technique and simultaneous implant placement into their ridge without any bone graft

**Group P**, twelve patients with partial edentulous narrow posterior mandibular ridge; treated by ultrasonic ridge splitting technique and simultaneous implant placement into their ridge; supplemented by synthetic bone substitute (osteon™ P collagen)

### Surgical procedures

1. After local anesthesia administration, a bard parker blade No 15 was used to create a crestal mesio-distal incision and reversion of envelope flap “minimal booklet-flap”. The periosteum along the lateral cortices should remain intact to ensure blood supply to the underlying bone.
2. After exposure of narrow ridge, a piezosurgical device (Piezotome SOLO; Satelec Acteon, Bordeaux, France), was used for ridge splitting (Fig 1). After splitting completed, preparation of the implant site was performed and the Superline or Narrow Ridge Dentium (Dentium, Seoul, Korea) implants were inserted until bone level (Fig 2). Implant diameter ranged from 3.1 to 3.6 mm, whereas implant length ranged from 11 to 14 mm. Then final wound closure was performed.
3. In group I, the remaining distraction gap was not filled with any material. In group II, the remaining distraction gap was filled with

synthetic bone substitute (osteon™ P collagen) (Fig 3) and wound closure performed by interrupted 0/4 non resorbable sutures

- 4. Standard postsurgical instructions and medications were given to the patients preoperatively and postoperatively for 7 days and chlorhexidine mouth rinsing was recommended for 15 days.

- 5. Sutures were removed after 10 days and all patients recurrently checked for any complications every 4 weeks.

- 6. After 6 months, the patients were called back for the second-stage surgery. Definitive abutments were tightened. The final prostheses made of porcelain were cemented with resin cement. (Fig 4)

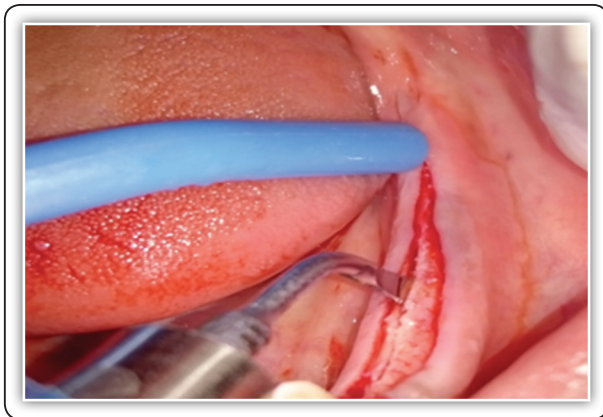


FIG (1)



FIG (2)

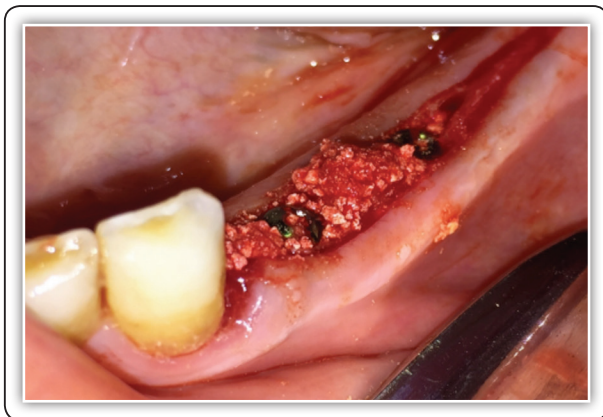


FIG (3)

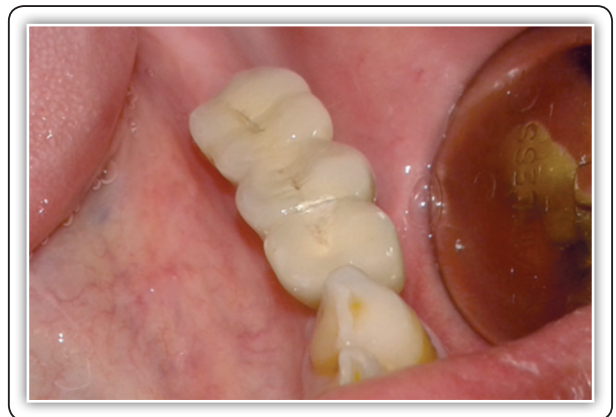


FIG (4)

## Postoperative evaluation

### Clinical evaluation

1. Probing depth (PD): It was measured as the distance from the crest of gingival margin to the bottom of the gingival sulcus at four sites around implants using a Williams probe.
2. Changes in implant stability quotient (ISQ): By using Osstell, (Osstell AB Stampgatan 14, Gothenborg, Sweden); primary stability was recorded immediately after implant placement and secondary at 6 months for each implant.

### Radiographic evaluation

1. Postoperative ridge width: It was measured and compared with preoperative CBCT measurements.
2. Measurement of bone density (BD): Average density was By using of CBCT software, the change in bone density around the implant was calculated in Hounsfield units (HU). The positions of the measurement sites were located at the top, middle and apical part of the implant on the buccal, lingual, mesial and distal sides. The thickness of slices was constant in all examinations. The mean values of bone density along each side of the implant were recorded and the average density was determined. BD was measured immediately after the implant placement and at 3, 6, and 12 months' intervals.

### Statistical analysis

The data were collected, tabulated, and statistically analyzed by using the statistical package for the social sciences SPSS, version 17 for Windows ( SPSS, Chicago, Illinois, USA).

## RESULTS

During the period of the study, only four cases showed gingival wound gaps of 0.5 mm to 1 mm that were healed by secondary intention and had

optimal epithelial covering by the end of third week postoperatively, while the majority of cases showed primary eventual soft tissue wound healing.

### Changes in probing depth measurement:

Showed that probing depth was increased gradually by the end of study in the two groups. Unpaired test, used for comparing PD between groups, showed statistically significant difference in the results of group II at the 12th month of the observation periods when compared with the other group. The accretion of probing depth in the two groups occurred but it still in acceptable range ( $\leq 3$ mm) (Table 1).

### Changes in implant stability quotient:

Were recorded immediately after operation and at 6 month observation periods showed that high statistical significant difference at 6 month observation interval when compared to immediate observation period in the two groups. When comparing ISQ between groups, showed no statistical significant difference at immediate observation period. While it showed high statistical significant difference in comparing G II vs. G I at 6 month observation interval (Table 2).

**Changes in alveolar ridge width:** In this study, the alveolar ridge width was increased in the two groups. The changes showed that high statistical significant difference in comparing pre-operative versus post-operative alveolar ridge width in the two groups. When comparing between the two groups (Unpaired test); it showed statistical significant difference between the two groups post-operatively (Table 3).

**Changes in bone density measurements:** Paired t-test showed gradual elevation in BD readings in the two groups during the observation periods of the study. The difference within each group was highly statistical significant at 3, 6, 9, 12 months when compared with immediate values. When comparing G II VS. G I, it showed high statistical difference at all intervals (Table 4).

**TABLE (1):** Showing mean ± SD values of probing depth scores among studied groups at each evaluation period, along with significance level using paired & unpaired t-test.

Follow up Periods Studied groups	6 month		9 month		12 month		9 month Vs. 6 month		12 month Vs. 6 month	
	Mean ± SD		Mean ± SD		Mean ± SD		Paired t-test			
	Mean ± SD		Mean ± SD		Mean ± SD		t	p	t	p
Group I	2.146±0.198		2.333±0.268		2.625±0.226		3.45	0.01**	5.70	0.00**
Group II	2.000±0.354		2.271±0.225		2.421±0.249		3.77	0.00**	5.23	0.00**
<b>Unpaired t-test</b>										
<b>6 month                      9 month                      12 month</b>										
<b>t                      p                      t                      p                      t                      p</b>										
<b>GII Vs. GI</b>	1.246	0.226	0.618	0.543	1.873	0.036*				

\* Statistically significant: (p < 0.05).

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

**TABLE (2):** Showing mean ±SD values of ISQ scores among studied groups immediately and at 6 months post-operatively, along with significance level using paired & unpaired t-test.

Follow up periods Studied groups	Immediate	6 month	Baseline Vs. 6 Month	
			paired t-Test	
	Mean± SD	Mean± SD	t	p
Group I	69.3±3.02	73.7±2.16	6.00	0.000**
Group II	69.00±3.03	77.36±1.63	9.89	0.000**
<b>Unpaired t-Test</b>				
<b>t                      p                      t                      p</b>				
<b>G II Vs. G I</b>	0.22	0.82	4.40	0.000**

**ISQ:** implant stability quotient

\* Statistically significant: (p < 0.05).

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

**TABLE (3):** showing mean ±SD values of Pre-& post- operative alveolar ridge width (using CBCT) among studied groups, along with significance level using paired & unpaired t-test.

Follow up periods Studied groups	Pre-operative	Post-operative	Pre-operative Vs. Post-operative	
			paired t-Test	
	Mean± SD	Mean± SD	t	p
Group I	3.99±0.4	6.84±1.1	12.31	0.0001**
Group II	4.17±0.7	6.65±0.4	15.29	0.0001**
<b>Unpaired t-Test</b>				
<b>t                      p                      t                      p</b>				
<b>G II Vs. G I</b>	1.74	0.467	2.40	0.015*

**Pre-& post- operative alveolar ridge measured by mm.**

\* Statistically significant: (p < 0.05).

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



**TABLE (4):** Showing mean ±SD values of Bone Density scores among studied groups at each follow up period, along with significance level using paired & unpaired t-test.

Follow up Periods	Immediate	3 months	6 month	9 month	12 month	3 month Vs Immediate		6 month Vs. Immediate		9 month Vs. Immediate		12 month Vs. Immediate	
						t	p	t	P	t	p	t	p
Studied Groups	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Paired t-test							
						t	p	t	P	t	p	t	p
Group I	452 ±4.51	740 ±8.32	1149 ±10.13	1296 ±9.88	1380 ±14.12	9.12	0.00**	25.11	0.00**	31.25	0.00**	41.25	0.00**
Group II	664 ±3.89	811 ±5.13	1202 ±8.16	1398 ±10.15	1479 ±11.36	5.65	0.00**	19.12	0.00**	29.12	0.00**	37.86	0.00**
Unpaired t-test													
	Imme-diate	3 months		6 month		9 month		12 month					
	t	p	t	p	t	p	t	p	t	p			
GII Vs. GI	6.71	0.00**	5.11	0.00**	8.14	0.00**	11.12	0.00**	7.98	0.00**			

**Bone Density** are expressed in HU.

\* Statistically significant: (p < 0.05).

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

**DISCUSSION**

Problem of resorbed ridges and the ways to add hard and soft tissue in defective sites to provide adequate height and width for appropriate implant insertion have still remained challenging <sup>(18)</sup>. To resolve this situation, alveolar ridge augmentation had been performed by many methods; guided bone regeneration, distraction osteogenesis, onlay block grafting and ridge splitting. One of these methods was ridge splitting <sup>(19)</sup>.

One major drawback of RST is the risk for bone resorption due to malnutrition of the laterally out displaced buccal bone wall <sup>(13)</sup>. Although some approaches were proposed to reduce this drawback, as using of bone graft. Using of bone

grafts are usually necessary to correct peri-implant defects and/or to augment surrounding tissues. This approach can also, achieve successful treatment outcomes of ridge expansion associated with implant placement with high predictability and a low risk of complications <sup>(17)</sup>.

The present study was designed to evaluate clinically and radiographically the ultrasonic ridge splitting technique with and without bone grafting materials with simultaneous implants placement in treatment of patients with partial edentulous narrow mandibular ridge. Clinical as well as radiological results after 1 year revealed stable hard and soft tissue conditions with no soft tissue recessions or peri-implant bone loss in groups I and II, with superiority for groupII (grafted group).

In the present study, postpartum depression and ISQ measurement showed no statistically significant difference between the two groups at baseline, and ISQ measurement showed statistically significant difference at the sixth months of observation periods. These results can be explained by that the two groups had the same technique that preserved soft tissue and blood supply at the distracted site when a piezosurgical device was used for the preparation of bone cut. This explanation is in agreement with the conclusion drawn by Kshirsagar et al.<sup>(20)</sup>. Another explanation for statistically significant difference at the sixth months of observation periods is the usage of osteon™ P collagen bone substitute in group II as a gap filler around implants.

The present study, reported that bone density measurements during all observation periods in the two groups increased (more value in group II) and BD measurements showed that group II had high statistically significant difference at all intervals when it was compared with group I. These results are in contrast to the findings of the clinical study of Zhang et al.<sup>(21)</sup> that showed a similar regenerated BD after 6 months in sinus lifts performed using bovine hydroxyapatite alone or in combination with L-PRF. This can be attributed to the presence of another type of bone graft in our study. Moreover, our results are in agreement with the findings of Hassan et al.<sup>(22)</sup> which demonstrated that bone density of implant with autogenous bone graft was 101.49 at 3 months increased to 129.56 at 12 months while bone density of implant with synthetic bone graft was 92.89 at 3 months increased to 107.66 at 12 months.

## CONCLUSION

From the results of the study, it can be concluded that osteon™ P collagen has a highly regenerative effect in RST that leads to decreased bone resorption after RST and increased BD of the alveolar ridge when compared with non grafted cases

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