



## Socket Preservation Using Autogenous Tooth Graft: An in vivo study

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### ABSTRACT

**Background:** Tooth loss is still considered an epidemic condition affecting populations in different areas of the world. The aim of the present study was to evaluate efficiency of using autogenous tooth graft for socket preservation clinically and radiographically. **Patients and methods:** Seventeen patients with two single rooted teeth indicated for extraction in the same dental arch. The two extraction sockets were allocated to Group A (test group): Socket grafted with autogenous tooth graft; and Group B (control group): Socket left ungrafted (control). **Results:** There was no statistically significant difference between the two groups as regard age or sex. Concerning Buccal bone loss, There was statistically significant difference between the two groups at day 90 ( $P=0.045$ ) and Change ( $P<0.001$ ). There was statistically significant difference between the two groups regarding Mean alveolar bone thickness at day 90 ( $P=0.03$ ) and Change ( $P<0.001$ ). With regard to bone density, There was statistically significant difference between the two groups at day 90 ( $P=0.045$ ) and Change ( $P<0.001$ ). There were strong significant correlations between Bone density and Buccal Labial (day 1), Alveolar Thickness (day 1) ( $P<0.0001$ ). **Conclusion:** Mineralized dentin particulate can be used as a good autogenous graft material that can replace other autogenous graft material with no need for additional donor site, it can be used for socket preservation giving favorable results reducing vertical and horizontal bone loss and gives high bone density values after three months.

**Keywords:** Autogenous Tooth Graft ; Socket Preservation ; Mineralized dentin

### INTRODUCTION

Oral conditions including tooth loss remain a major and growing global public health challenge. After tooth extraction bone remodeling and soft tissue changes occurring during healing may pose a problem for the practitioner in 2 ways: it creates an esthetic problem in the manufacturing of an implant-supported restoration or a conventional prosthesis; and it may make the placement of an implant challenging if not unfeasible <sup>(1,2)</sup>.

The survival of implants and their ability to provide adequate function and esthetic are strictly correlated with their proper positioning in relation to the alveolar housing, the

neighboring teeth and the occluding dentition<sup>(3)</sup>.

Many hard and soft tissue regenerative options are available for alveolar ridge preservation. These techniques are designed to minimize ridge resorption and soft tissue recession, as well as maximize formation of bone. Alveolar bone preservation using grafting materials with or without barrier membranes, provides space maintenance in order to decrease tissue collapse and maintain a healthy architecture for future restorative options<sup>(4)</sup>.

Therefore, the aim of the present study was to evaluate efficiency of using autogenous tooth graft particulate for alveolar ridge preservation after teeth extraction.

## **PATIENTS AND METHODS**

This study was conducted on adult patients classified as ASA class I & II patients. Seventeen patients with two single rooted teeth that needed extraction simultaneously in the same dental arch were selected and divided randomly into two equal groups, with 17 teeth for each group. The same patient is considered as a control and a study group at the same time. Group A: Underwent tooth extraction and extraction socket was left for healing without any graft material (Control group). Group B: Underwent socket grafting using autogenous tooth graft particulate after tooth extraction (Study group).

The patients were selected from the outpatient clinic of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Suez Canal University, who required extraction of two single rooted teeth in the same dental arch (maxillary or mandibular) simultaneously.

### **Inclusion criteria:**

Individuals had at least two single rooted teeth indicated for extraction in the same dental arch. Patients were co-operative, motivated, non-smokers. Patients with status classification (ASA I & II) with adequate oral hygiene condition. Alveolar sockets free from any preexisting periapical pathology based on intraoral periapical radiograph.

### **Exclusion criteria**

Patients with any medical condition that contraindicated the procedure. Patient who were allergic to any drugs, pregnant, lactating. Presence of active infection around the tooth or remaining root. Osseous disease or medical treatment that alter bone remodeling and healing. Perforation and/or loss of buccal bone plate following tooth extraction. Psychological reasons that might affect the procedure or the subsequent follow up.

### **Patients Grouping:**

The seventeen patients were divided into two groups, the same patient is considered as a control and a study group at the same time (self-control).

**Group 1:** where extraction socket left ungrafted.

**Group2:** where extraction socket received autogenous tooth graft particulate after extraction.

## **I. Pre-surgical phase**

Medical and dental histories were taken through a printed questionnaire and discussion with the patient. Evaluation of the teeth or remaining roots to be extracted periapical periodontitis, mobility and gingival health and confirming that they could be extracted with closed extraction in an atraumatic way. The surgical procedures were explained to the patient in details, also complication of tooth extraction and grafting (postoperative bleeding, pain or swelling) were mentioned. Photographs as well as exposure to x-ray for follow up.

Preoperative impression for the dental arch with teeth to be extracted was taken for study cast fabrication using alginate impression material. Vacuum-formed clear stent for the area. An acrylic occlusal stent was fabricated and used to standardize the measurement of clinical parameters. Two holes were made in the vacuum-formed stent, one buccally/labially and the other lingually/palatally to standardize the measurement of the bucco-lingual thickness of the alveolar ridge. Drilled guide holes were large enough to accommodate the bone caliper tips.

On the cast model, Occlusal acrylic stent was fabricated using self-cure clear acrylic resin, the area over the tooth to be extracted was blocked with a layer of wax, acrylic stent extended covering occlusal surface of the neighboring teeth, a groove was prepared on the midbuccal aspect of the stent corresponding to the buccal cortical. The stent allowed for accurate replications of clinical measurements from baseline at the surgical appointment to 3 months follow-up.

Intraoral periapical radiographs for teeth to be extracted were requested to evaluate periapical and periodontal conditions, and root length.

## **II. Surgical phase**

All surgical procedures were done under strict aseptic conditions by the same surgeon to minimize differences due to operator variability. Patient was asked to rinse with 15 ml of 0.1% chlorhexidine mouth wash before surgery to reduce oral microbial count. A perioral facial preparation of the patient using povidene-iodone 10% was done. Surgical procedures were performed under local anaesthesia using Articaine hydrochloride 4% with Epinephrine 1:100,000 as a vasoconstrictor presented in carpule 1.8 ml (Artinibsa 4%). For maxillary teeth extractions, patients were anaesthetized by labial/buccal and palatal infiltration techniques. For mandibular teeth extractions, patients were anaesthetized by inferior alveolar, lingual, and long buccal nerve block techniques.

Every attempt was made to minimize trauma to the alveolar bone during extraction, this was done by using a periosteal elevator inserted mesial and distal to the tooth cutting the periodontal ligament, then fine straight elevator was used for tooth luxation if needed, and the appropriate forceps was used just for tooth delivery. After teeth extraction, sterilized dressing was used to control bleeding until tooth graft was prepared.

### **Tooth Graft preparation:**

Immediately after extraction, restorations like crowns and fillings were cut off or removed. Carious lesions and discoloured dentin, or remnants of periodontal ligament (PDL) and calculus were reduced by tungsten bur in high speed handpiece with coolant. Pulp extirpation or debridement was done using endodontic files. Clean teeth, including crown and root dentin, were dried by air syringe and put into the grinding sterile chamber of the Smart Dentin Grinder (SDG) that used to grind teeth in the grinding chamber for 3 seconds and sorting particles for 20 seconds. The grinding and sorting protocol was repeated to grind the remaining teeth particles left in the grinding chamber, till collecting particles between 300µm and 1,200µm. In small sterile glass container, the tooth particulate from the drawer were immersed in alcohol based cleaner covering the graft for 10 minutes. The basic alcohol cleanser consists of 0.5M of NaOH and 30% alcohol (v/v) for defatting, dissolving all organic debris, bacteria, and toxins of the tooth particulate. Used cleanser was absorbed using sterile gauze. After decanting the basic alcohol cleanser, the particulate was washed twice in sterile

phosphate-buffered saline (PBS) for 3 minutes each. The PBS was decanted using sterile gauze, leaving wet whole tooth particulate ready to graft into fresh extraction socket.

### Clinical parameters:

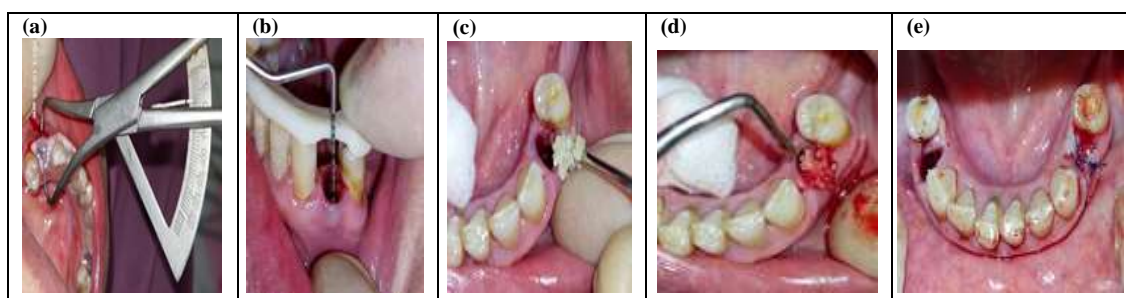
- **Horizontal dimensions (buccolingual width)**

The first clinical measurements were done by sterile alveolar ridge mapping caliper for measuring Bucco-lingual thickness of the alveolar ridge at extraction sockets area, the vacuum-formed stent was immersed in an antiseptic Povidone-Iodine solution and was placed in the area to be measured; the tips of the bone caliper were inserted into the guide holes, penetrating through the soft tissue until there was contact with bone and the measurements were recorded in millimeters.

### Vertical dimensions

Using the occlusal acrylic stent, measurements were recorded from the fixed reference point FRP (groove on acrylic stent) to mid-buccal crestal point on buccal cortical plate. Readings were obtained using UNC-15 probe and recorded in millimeters. Local infiltration was used while measuring dimensions at 3 months follow-up. After recording clinical parameters, autogenous tooth particulate was grafted in one of extraction sockets using bone graft carrier and packed in socket using bone graft plugger. A figure eight suture using 3-0 polypropylene suture was used to stabilize the graft material and post-operative instructions was be given and Ibuprofen 600 mg twice daily was prescribed for 5 days and chlorhexidine gluconate mouth wash three times daily for a period of two weeks to enhance plaque control (**Figure 1**).

Patients were evaluated throughout the first week for any signs of inflammation, swelling, pain or infection and were recalled for suture removal after 7 days.



**Figure (1):** Clinical parameters showing (a) ridge mapping caliper and its tips through guiding holes; (b) Occlusal acrylic stent and vertical measurement ; (c,d) Application of autogenous tooth graft into extraction socket; (e) Figure eight suture was used to stabilize the graft material.

### Statistical analysis:

All data were statistically analyzed using SPSS 26.0 for windows (SPSS Inc., Chicago, IL, USA). Qualitative data were described using number and percent. Quantitative data were described using range, mean, standard deviation and median. All statistical comparisons were two tailed with significance Level of P-value  $\leq 0.05$  indicates significant, p 0.05 indicates Nonsignificant difference. The used tests were chi-square ( $X^2$ ) test, and independent T-test. P value was set at  $<0.05$  for significant results &  $<0.001$  for high significant result.

## Results

The current study showed the mean age of groups A & B was  $43.35 \pm 6.98$  and  $43.35 \pm 6.98$  respectively, 29.41% were male in group A while 29.41% were male in group B (**Table 1**). The mean Buccal Labial (day 1) of group A, group B  $10.88 \pm 1.89$  and  $10 \pm 2.45$  respectively. Mean Buccal Labial (day 90) of group A, group B was  $11.03 \pm 1.59$  and  $10.85 \pm 2.49$  respectively. There was statistically significant difference between the two groups as regard Mean Buccal Labial (day 90) and Change (**Table 2**).

The mean Alveolar Thickness (day 1) of group A, group B was  $10.94 \pm 1.98$  and  $11.12 \pm 2.57$  respectively. Mean Alveolar Thickness (day 90) of group A, group B was  $10.41 \pm 1.5$  and  $9.2 \pm 1.7$  respectively. There was statistically significant difference between the two groups as regard Mean Alveolar Thickness (day 90) and Change (**Table 3**).

The mean Bone density (day 1) of group A, group B was  $117.34 \pm 16.31$  and  $86.44 \pm 11.51$  respectively. Mean Bone density (day 90) of group A, group B was  $110.87 \pm 12.88$  and  $103.97 \pm 11.31$  respectively. There was no statistically significant difference between the two groups as regard Mean Bone density (day 90) and Change (**Table 4**).

There were strong significant correlations between Bone density and Buccal Labial (day 1), Alveolar Thickness (day 1) (**Figure 2**).

In Univariate correlation regression, there were strong significant correlations between Bone density and Buccal Labial (day 1), Alveolar Thickness (day 1) (**Table 5**).

In Multivariate correlation regression, there were strong significant correlations between Bone density and Buccal Labial (day 1), Alveolar Thickness (day 1) (**Table 6**).

**Table (1): Comparison between studied groups regarding demographic data**

	Group (A)	Group (B)	Test	P value
<b>Age, years</b>			-	1
Mean $\pm$ SD	$43.35 \pm 6.98$	$43.35 \pm 6.98$		
Median (Minimum - Maximum)	42 (35-57)	42 (35-57)		
<b>Gender</b>			-	1
Male	5 (29.41%)	5 (29.41%)		
Female	12 (70.59%)	12 (70.59%)		

$\chi^2$ : Chi Square, T: Two-Sample Independent t Test, p value >0.05: nonsignificant, p value <0.05 significant, Group A (test group): Socket grafted with autogenous tooth graft, Group B (control group): Socket left ungrafted (control)

**Table (2): Comparison between studied groups regarding reduction in buccal / labial alveolar crest height**

	Group (A)	Group (B)	Test	P value
<b>Crestal bone loss</b>				
<b>Day 1</b>			1.5	0.08
Mean $\pm$ SD	$10.88 \pm 1.89$	$10 \pm 2.45$		
Median (Minimum - Maximum)	11 (7-14)	10 (7-15)		
<b>Day 90</b>			4	<b>0.045</b>
Mean $\pm$ SD	$11.03 \pm 1.59$	$10.85 \pm 2.49$		
Median (Minimum - Maximum)	11.5 (8.5-13)	11.5 (7-16.5)		
<b>Change</b>			12	<b>&lt;0.001</b>

Mean ± SD	0.15 ± 0.68	0.85 ± 0.75		
Median (Minimum - Maximum)	0 (-1-1.5)	1 (-1-2)		

T: Two-Sample Independent t Test, p value >0.05: nonsignificant, p value <0.05 significant, Group A (test group): Socket grafted with autogenous tooth graft, Group B (control group): Socket left ungrafted (control)

**Table (3): Comparison between studied groups regarding Alveolar bone Thickness**

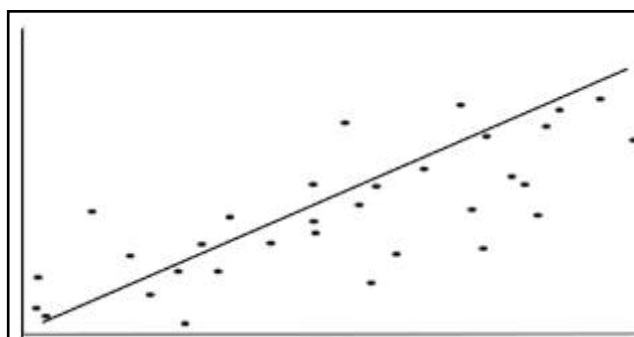
	Group (A)	Group (B)	Test	P value
<b>Alveolar Bone Thickness</b>				
<b>Day 1</b>			1.4	0.25
Mean ± SD	10.94 ± 1.98	11.12 ± 2.57		
Median (Minimum - Maximum)	11 (8-14)	12 (7-15)		
<b>Day 90</b>			4	<b>0.03</b>
Mean ± SD	10.41 ± 1.5	9.2 ± 1.7		
Median (Minimum - Maximum)	11 (8-13)	9.5 (7-12)		
<b>Change</b>			12	<b>&lt;0.001</b>
Mean ± SD	-0.53 ± 1.17	-2.18 ± 0.53		
Median (Minimum - Maximum)	-0.5 (-3-1)	-2 (-2-3)		

T: Two-Sample Independent t Test, p value >0.05: nonsignificant, p value <0.05 significant, Group A (test group): Socket grafted with autogenous tooth graft, Group B (control group): Socket left ungrafted (control).

**Table (4): Comparison between studied groups regarding Bone density**

	Group (A)	Group (B)	Test	P value
<b>Bone density</b>				
<b>Day 1</b>			1.8	0.06
Mean ± SD	117.34 ± 16.31	86.44 ± 11.51		
Median (Minimum - Maximum)	121.07 (86.81-142.9)	87.38 (54.24-104.22)		
<b>Day 90</b>			4	0.045
Mean ± SD	110.87 ± 12.88	103.97 ± 11.31		
Median (Minimum - Maximum)	107.72 (92.28-143.11)	100.88 (86.55-123.85)		
<b>Change</b>			12	<b>&lt;0.001</b>
Mean ± SD	-6.47 ± 19.08	17.54 ± 12.71		
Median (Minimum - Maximum)	-7.66 (-35.84-28.8)	13.2 (2.71-48.35)		

T: Two-Sample Independent t Test, p value >0.05: nonsignificant, p value <0.05 significant, Group A (test group): Socket grafted with autogenous tooth graft, Group B (control group): Socket left ungrafted (control).



**Fig. (2): Correlations between one density and Alveolar Thickness (day 1).**

**Table (5): Univariate Correlations between Bone density and different parameters**

		Bone density
<b>Buccal Labial (day 1)</b>	<b>Correlation</b>	0.348
	<b>Significance</b>	<0.0001
<b>Alveolar Thickness (day 1)</b>	<b>Correlation</b>	0.471
	<b>Significance</b>	<0.0001

*P value < 0.05: Statistically significant difference | P value < 0.001: Statistically high significant difference.*

**Table (6): Multivariate Correlations between Bone density and different parameters**

Variable		Bone density
<b>Buccal Labial (day 1)</b>	<b>Correlation</b>	<b>71.305</b>
	<b>Significance</b>	<0.0001
<b>Alveolar Thickness (day 1)</b>	<b>Correlation</b>	<b>20.495</b>
	<b>Significance</b>	<0.0001

*Correlation regression: ANOVA, P value > 0.05: Statistically non-significant difference | P value < 0.05: Statistically significant difference | P value < 0.001: Statistically high significant difference.*

## DISCUSSION:

Alveolar bone resorption and also periodontium loss caused by tooth extraction have both made a significant effect on implant placement process, especially in the aesthetic zone<sup>(5)</sup>. Extraction of the present growth factors and BMPs from mammalian teeth, encouraged researchers to use tooth-derived substances in the development of bone substitution<sup>(6,7)</sup>.

Many published findings have encouraged the researchers to develop a new protocol for processing a bone graft material depending on the use of extracted teeth<sup>(8)</sup>.

In this study, Autogenous tooth graft was used for alveolar ridge preservation after tooth extraction. Radiographic assessment is done at graft application time and after three months to evaluate the new bone that is formed in the preserved sockets. The extraction socket for the control side was left to heal without graft and the autogenous tooth graft was used for study side. Split-mouth design in this study was used to control confounding variables such as age, sex, and local tissue conditions; this study was able to unify the kind of operation and patient characteristics.

This study showed that mean age of group A, group B was  $43.35 \pm 6.98$  and  $43.35 \pm 6.98$  respectively, 29.41% were male in group A while 29.41% were male in group B. In agreement with our results, **Taman et al.**<sup>(9)</sup> who carried out a split mouth randomized clinical experiment. Their study included 10 patients and 20 mandibular extraction sockets of single-rooted teeth. The patients' ages ranged from 25 to 55 years old. Participating in this study were ten patients who had been advised to have one or more of their bilaterally carious mandibular single-rooted teeth extracted. Their ages ranged anywhere from 25 all the way up to 55, with a mean of 42.4 years which similar to our result. The number of males to females was two to three, with four males and six females totaling the group.

The present study demonstrated that mean Buccal / labial (day 1) of group A, group B was  $10.88 \pm 1.89$  and  $10 \pm 2.45$  respectively. Mean Buccal / labial (day 90) of group A, group B was  $11.03 \pm 1.59$  and  $10.85 \pm 2.49$  respectively. There is statistically significant difference between the two groups as regard Mean Buccal Labial (day 90) ( $P=0.045$ ) and Change ( $P<0.001$ ). This finding in agreement with the study of **Joshi et al.**<sup>(10)</sup> who made socket preservation for fifteen patients with three extraction sockets in which the control site left to heal by its natural course and study sockets grafted by autogenous tooth graft and the other with beta-tricalcium phosphate. He reported autogenous tooth grafted sites consistently showed least reduction in ridge height,  $0.28 \pm 0.13$  mm which was significantly lower as compared to

$\beta$ -TCP-grafted sites with  $1.72 \pm 0.56$  mm reduction and ungrafted sites with  $2.60 \pm 0.88$  mm reduction ( $P < 0.05$ ).

Also **Elfana et al.**<sup>(11)</sup> in regard to amount of vertical buccal bone loss; he made socket preservation for Twenty extraction sockets in ten patients in split-mouth study comparing autogenous whole tooth graft versus autogenous demineralized dentin graft. All sites healed uneventfully, and the reduction in buccal ridge height was  $0.61 \pm 0.20$  mm in socket grafted with autogenous whole tooth graft.

**Fathy et al.**<sup>(12)</sup> evaluated the efficiency of autogenous tooth graft in preserving vertical bone dimension after tooth extraction using CBCT at baseline image and after six months follow up. They carried out on 20 patients with mean age of 37 years; the results showed that the vertical bone loss was much lower in the graft group compared to the control group. The amount of vertical dimension loss in control group was more than three times (3X) that happened in graft group.

The loss of vertical socket height in graft group was statistically significantly lower than in control group ( $P = 0.0003$ ), with mean vertical bone loss of 0.58mm and 1.94mm in graft and control groups respectively. The reported more bone loss in the two groups may be due to longer follow up period than the present study. In the present study there was statistically significant difference between the two groups as regard Mean Alveolar bone thickness at day 90 ( $P = 0.03$ ) and Change ( $P < 0.001$ ). The mean changes in alveolar bone thickness was  $(-0.53 \pm 1.17)$  and  $(-2.18 \pm 0.53)$  in graft and control groups respectively. This finding in agreement with **Joshi et al.**<sup>(10)</sup> who concluded that The mean width change was greatest for ungrafted sites ( $2.29 \pm 0.40$  mm) followed by  $\beta$ -TCP-grafted sites ( $1.45 \pm 0.40$  mm) and least for autogenous tooth-grafted sites ( $0.15 \pm 0.08$  mm). A mean width change for autogenous tooth-grafted sites was significantly lesser when compared to  $\beta$ -TCP-grafted sites and ungrafted sites ( $P < 0.05$ ).

Also, in agreement with **Elfana et al.**<sup>(11)</sup> who found a mean loss of  $0.85 \pm 0.38$ mm ( $11 \pm 5.36\%$ ) concerning the buccolingual ridge width in the whole tooth graft group after six months follow up period, while in this study it was  $0.53 \pm 1.17$ mm after three months follow up.

According to **Fathy et al.**<sup>(12)</sup>, there was no statistically significant difference between both groups at immediate postoperative interval, while at six months postoperative interval the horizontal socket width of graft group was statistically significantly higher than in control group. The mean changes in alveolar bone thickness was  $(-0.59$ mm) and  $(-2.18$ mm) in graft and control groups respectively, which supports our study.

Our study revealed that mean Bone density (day 1) of group A, group B was  $117.34 \pm 16.31$  and  $86.44 \pm 11.51$  respectively. Mean Bone density (day 90) of group A, group B was  $110.87 \pm 12.88$  and  $103.97 \pm 11.31$  respectively. There was statistically significant difference between the two groups as regard mean bone density at day 90 ( $P = 0.045$ ) and Change ( $P < 0.001$ ). In agreement with our results **Fathy et al.**<sup>(12)</sup> required CBCT images immediate after extraction and after six months to measure differences in bone density during healing period. Slow resorption rate was noticed in his study, as six months post-operative CBCT images showed well demarcated dentin graft particles remnants. These remnant particles were also noticed in three months follow up in the present study. He found that the bone density of graft group was statistically significantly higher than that of the control group after six months ( $P = 0.002$ ).

Similarly, **Taman et al.**<sup>(9)</sup> measured Bone densities immediately after bone graft placement and after 2 month of healing in the previously preserved socket using: Digital standardized periapical x-ray films analyzed by ImageJ computer software, it was found that



The mean bone density value immediately after bone graft placement and two months later within the same group (study and control) was found to be statistically significant. ( $P < 0.001$  &  $= 0.009$  respectively).

The present study was also supported by **Sah et al.** <sup>(13)</sup> who did split-mouth study for twenty patients undergoing bilateral mandibular third molars extraction.

For group A (control group) : Placement of PRF (Platelet Rich Fibrin) membrane in the third molar extraction socket followed by primary closure of the site, and group B (study group) : Placement of autogenous tooth as graft material in the third molar extraction socket, followed by placement of PRF membrane and primary closure of the site.

According to sah, Overall density: The score for overall density for Group B was higher as compared to that of Group A at the end of 7th day, 1st month, 3rd month, 6th month and was statistically significant. However, the density in group B decreased over time which can be attributed to the presence of dense bone graft initially which underwent resorption in subsequent visits but was still significantly higher when compared to the control group.

This study supports our results regarding bone density after three months follow up where there was slight reduction in density for grafted socket ( $-6.47 \pm 19.08$ ) but still has higher overall density than control socket that had mean increased density by ( $17.54 \pm 12.71$ ) after three months.

### Conclusion:

Mineralized dentin particulate can be used as a good autogenous graft material that can replace other autogenous graft material with no need for additional donor site, it can be used for socket preservation giving favorable results reducing vertical and horizontal bone loss and gives high bone density values after three months.

**Conflict of interest:** The authors declare no conflict of interest.

**Sources of funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Author contribution:** Authors contributed equally in the study.

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