EVALUATION OF MINERALIZED PLASMATIC MATRIX WITH AND WITHOUT COLLAGEN MEMBRANE IN ANTERIOR MAXILLARY HORIZONTAL ALVEOLAR DEFECT (RANDOMIZED CLINICAL TRIAL)

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ABSTRACT

INTRODUCTION: Various grafting procedures and bone substitutes can be used to achieve optimum treatment outcome in cases with deficient bone volume. Recently, Mineralized Plasmatic Matrix (MPM) was introduced as an autologous blood product highly enriched in platelets and fibrin network in a liquid form combined with a bone substitute.
OBJECTIVES: This study was conducted to compare the effect of mineralized plasmatic matrix (MPM) with and without collagen membrane as a bone regenerative material in anterior maxillary horizontal alveolar bone defect.
MATERIAL AND METHODS: Sixteen patients with anterior maxillary horizontal alveolar defect were randomly divided into 2 equal groups. Delayed implant placement (Dentis s-clean system) was done for all patients followed by defect grafting with MPM in group 1 while in group 2 the defect was completely grafted with MPM then covered by collagen membrane.; All implants were loaded after 3 months. Postoperatively, patients were followed up at immediately postoperative and at 3 for 9 months to clinically assess peri-implant probing depth and implant stability using Osstell® and to radiographically evaluate bone density, crestal bone loss and buccal bone thickness using CBCT.
RESULTS: There was no statistically significant difference in peri-implant probing depth, implant stability, bone density, peri-implant bone loss and buccal bone thickness between the two groups. However, there was a statistically significant increase in implant stability, bone density and buccal bone thickness between follow up periods in each group.
CONCLUSION: Our results proved that MPM provides a more compact, durable and stable structure that helps the formation of new bone tissue without the use of a covering collagen membrane.
KEYWORDS: Horizontal alveolar bone defect, MPM, collagen membrane and platelets concentrate.
RUNNING TITLE: Peri-implant bone regeneration using MPM with and without collagen membrane.

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INTRODUCTION

Esthetics poses a challenge in clinical practice and is critical for successful implant-supported prostheses in the anterior maxilla (1). Resorption of the alveolar ridge is inevitable following tooth loss; this situation is particularly more pronounced in the anterior maxilla. The resultant insufficient bone quantity and quality is reported to be associated with compromised esthetics, poor long-term prognosis and an increased failure rate of dental implants (2,3).

Several surgical procedures were proposed to increase ridge thickness such as onlay grafts, (4) interpositional bone grafts, (5) guided bone regeneration and combinations of these procedures.

Autogenous bone graft materials were always considered the gold standard in bone grafting. However, autogenous bone graft has disadvantages related to the need of a second surgical site, risks of vascular and neurological injuries (6).

Autologous blood products high in growth factors and platelets have recently been used to improve graft success rates (7). The regenerative effect obtained by platelets was first reported in the 70's (8); a number of platelet concentrates are now implemented to enhance hard and soft tissue healing in oral and maxillofacial surgery; among those are platelet rich plasma (PRP), platelet rich

fibrin (PRF) and mineralized plasmatic matrix (MPM)(9).

In an experimental study conducted by El Moheb et al (9) at which a comparison between the PRF and MPM was done prior to implants placement at sheep heads, they found out that PRF alone does not preserve the area necessary for bone formation as it is a gel component, so it is not able to resist the chewing forces. Therefore, the need to use the bone graft or the bone substitutes to secure the scaffolding was necessary. They also described the stability of the bone graft to be a critical factor for success of grafting technique.

The mineralized plasmatic matrix (MPM)was presented by Perisse (10) followed by El Moheb,(11)as an autologous blood product with high concentrations of platelets with fibrin in a liquid form integrated with a bone graft that could be autogenous, allogenic, xenogenic or synthetic bone (12).

Several authors (13-16) have documented the efficiency of MPM in the field of implant dentistry. MPM is a homogenous mixture of plasmatic phase and mineralized phase which acts as a scaffold material for bone cells necessary for bone formation (10). This gives the MPM appropriate positional stability (10,11) by stabilizing the bone particles and maintaining its shape in the defect, and thus MPM can be used alone without membrane. Moreover, MPM improves implants osseointegration and stability and minimize peri implant bone loss (17).

The use of barrier membranes has always been an essential and key component of guided bone regeneration procedures. Membranes are used to exclude the fast-growing epithelial and connective tissue cells from invading the graft material, giving time for the slowly growing bone cells to populate the created space and form osseous tissue. Resorbable barriers are more commonly used because there is no need for a second procedure for removal, as with the case of non-resorbable barriers (18,19).

In this study, our aim is to compare the effects of MPM with and without collagen membrane on delayed implant insertion in anterior maxillary horizontal alveolar defect.

The null hypothesis in this study is that there was no difference between MPM with collagen membrane and without it regarding enhancement of bone regeneration.

MATERIALS AND METHODS

Study design: This study was a randomized clinical trial.

Study sample: Patients were recruited from the out-patient clinic of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University, for this clinical trial. It involved 16 implants in individuals who were missing their anterior maxillary teeth and had horizontal alveolar ridge deficiencies.

Method of randomization: Random allocation was conducted into two equal groups according to Kim and Shin (20).

Sample size calculation: A minimal total sample size of sixteen dental implant (divided into two groups eight implants for each group) was needed to detect an average significant difference between the 2 techniques in this study at 80% power and 95 confidence level using fisher exact test power analysis.

All procedures were done in accordance with Ethics research committee, Faculty of Dentistry, Alexandria University. All patients were told about the purpose of this study, and an informed consent was obtained from all patients after a simple and easy explanation of all treatments, including all benefits and side effects.

Inclusion criteria

The inclusion criteria of this study were; patients having good oral hygiene according to O'Leary Index (21), the width of the alveolar ridge lesser than 4 mm measured from pre-operative CBCT using OnDemand 3D™ software (OnDemand 3D™ software Cybermed Inc, Korea E-mail: info@ondemand3d.com) and patients' age ranging from 20 to 40 years.

Exclusion criteria

The exclusion criteria of this study were; patients who were on chemotherapy or radiotherapy, medically compromised patients (uncontrolled systemic disease such as uncontrolled diabetes, bleeding disorders, bone disease as osteoporosis) and heavy smokers or drug/alcohol abuse.

Materials used

1. Dentis s-clean tapered Implant system. (Dentis s-clean system DENTIS Co., #951. Woram-Dong, Dalseo-Gu, Daegu, Korea)
2. Ovis bone graft (Hydroxyapatite 20% + β-TCP 80%). (DENTIS Co., LTD. Korea)
3. Collagen membrane. (Evolution membrane DENTIS Co., LTD. Korea)
4. Centrifuge machine. (Compact Laboratory Centrifuges, digital)

Pre-operative assessment and examination

Medical and dental history

Full medical and dental history was recorded including; name, age, sex, job, address, and date was taken for each patient.

Clinical examination

A thorough clinical examination by inspection and palpation was completed to all patients to decide the overall periodontal (oral mucosa was examined for color, texture, firmness and thickness), oral health state for detection of any infection or pathology, neighboring teeth were checked for mobility and occlusion was also evaluated to exclude patients with unfavorable occlusion or parafunctional habits.

Radiographic examination

Cone beam computed tomography CBCT was done for all patients for assessment bone width, height, implant size and location, evaluating the neighboring teeth inclination and checking of any osseous abnormality. (Fig.1)

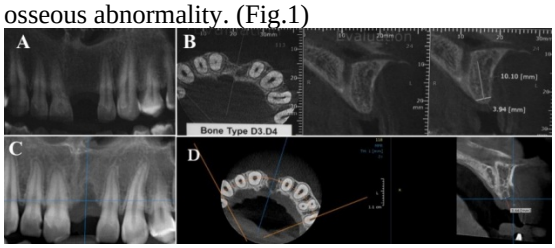

Figure (1): pre-operative radiographic examination. (A) Pre-operative Panoramic examination (group I). (B) Pre-operative CBCT (group I). (C) Pre-operative panoramic examination (group II). (D) Pre-operative CBCT.

Surgical phase

The oral cavity was prepared by 0.12% chlorhexidine mouth rinse solution for thirty seconds. local anaesthesia was administered followed by a para crestal incision and reflection of a full thickness mucoperiosteal flap to expose the surgical site. Implant was placed according to the surgical protocol suggested by the manufacturer followed by grafting the buccal bone defect using MPM with or without collagen membrane depending on the group. Flap was sutured using simple interrupted 3/ 0 silk suture (manufactured by Goldenwell, China).

In group I: Following implant placement, the buccal bone defect was grafted using MPM. (Fig.2)

***In group II*:** Following implant placement, the buccal bone defect was grafted using MPM and covered with collagen membrane (Evolution membrane DENTIS Co., LTD. Korea , size 20*20) which was properly trimmed with sterile scissors to the desired size then adapted to the graft site and fixed using implant cover screw. (Fig.3)

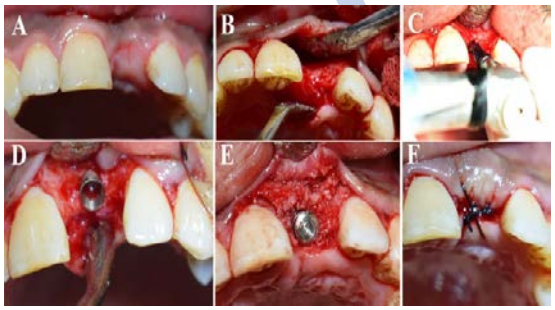

Figure (2): Surgical phase for group I. (A) preoperative clinical view (group I). (B) raising the flap (group I). (C) implant insertion (final drill) (group I). (D) showing the buccal bone defect (group I). (E) The defect covered with MPM (group I) (F) suturing (group I).

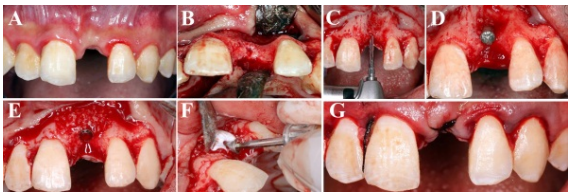

Figure (3): Surgical phase for group II. (A) Showing preoperative clinical view (group II). (B) Showing reflection of the flap (group II). (C) showing implant insertion (initial drill) (group II) (D) showing the buccal bone defect. (E) The defect covered with MPM. (F) MPM covered with collagen membrane and fixed with cover screw. (G) suturing.

Mineralized plasmatic matrix (MPM) preparation (Fig.4)

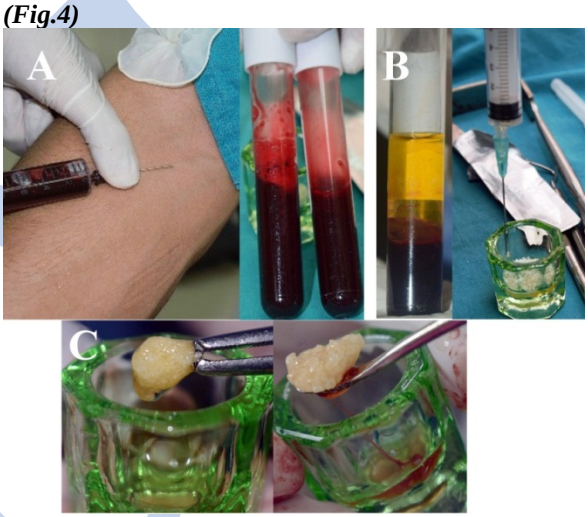

Figure (4): MPM preparation (A) showing collecting venous blood sample. (B) Showing the resultant product after centrifuging. (C) Showing prepared material (MPM).

According to **Perisse et al (**22**)** protocol; 2 plain plastic evacuated test tubes without anticoagulants (VACUTEST ® TUBE 9 ml Z No Additive by VACUTEST KIMA srl, ARZERGRANDE-ITALY) containing (9 mL) of the patient venous blood were taken and centrifuged for 12 minutes at 2500 rpm. The final output is made up of the following two layers:

- At the top of the tube, there is a yellow plasma liquid.
- at the bottom, there are red blood cells.

- A syringe was used to collect the yellow component, which was then transferred to a cup containing the Ovis bone graft material (hydroxyapatite 20% + TCP 80%) and the entire mixture was mixed for few seconds to obtain MPM.

Post-surgical phase

a) Early postoperative care: All patients were instructed to apply cold fomentation for 24 hours following surgery, then use warm saline mouthwash on the second day and the sutures were removed after 7 days.

b) Postoperative medication

- Amoxicillin clavulanate (Augmentin: Amoxicillin 875 mg + Clavulanic acid 125 mg GlaxoSmithKline, UK):1 gm every 12 hours for 7 days (23).
- Diclofenac potassium 50 mg (Cataflam: Novartis-Switzerland): every 8 hours for 5 days.
- All patients were told to use chlorhexidine antiseptic mouth wash (Hexitol: Chlorhexidine 125mg/100ml, concentration 0.125%: Arabic drug company, ADCO).

Follow up phase

Clinical evaluation

a)

eri-implant Probing depth:

The peri-implant probing depth was assessed at the third, sixth and ninth months post-operatively. Probing depth was measured according to Gallagher and Silver(24) using a periodontal probe from the gingival margin to bottom of the gingival sulcus. This was at 6 points around the implant and the mean value was calculated.

b)

mplant stability:

The implant stability was measured by Osstell® (Osstell, Stampgatan, Göteborg, Sweden) immediate postoperative and after 3 months before implant loading. (25) The implant stability quotient (ISQ) was measured by applying the osstell measurement probe to the SmartPeg™ after attaching to the implant. The SmartPeg is excited by a magnetic pulse from the measurement probe on the handheld instrument. The implant's stability was assessed on the buccal, palatal, mesial, and distal sides, and mean implant stability quotients (ISQs) was calculated. (Fig.5)

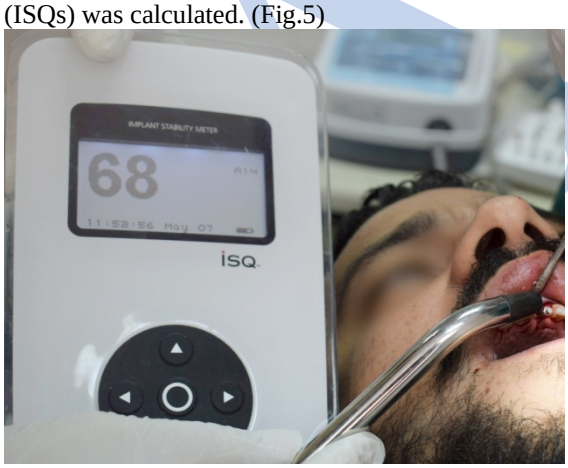

Figure (5): showing checking implant stability using Osstell®

Radiographic evaluation

A CBCT was done immediate postoperative (to serve as a baseline measurement for all measured parameters), at 3 and 9 months postoperatively (Fig.6) for evaluation of:

a) Peri-implant bone loss (Marginal bone loss) (26):

Marginal bone loss (MBL) was measured using the OnDemand3D™ software (OnDemand 3D™ software Cybermed Inc, Korea E-mail: info@ondemand3d.com) at the mesial and distal aspects of each implant from the implant/abutment junction to the most coronal bone –implant junction and the mean was calculated. Measurements were performed on the CBCT after 3 and 9 months postoperatively.

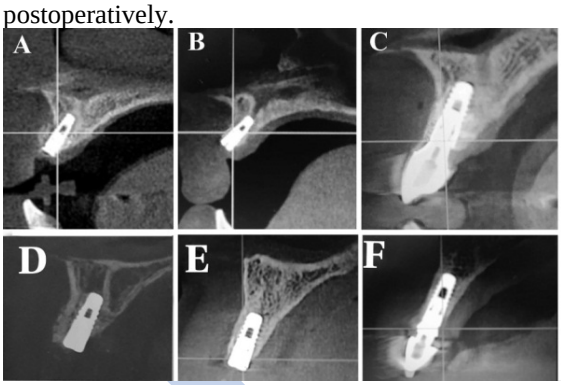

Figure (6): post-operative follow up phase: (A)Immediate post-operative CBCT (group I). (B) CBCT after 3 months (group I). (C) CBCT after 9 months (group I). (D) Immediate post-operative CBCT (group II). (E) CBCT after 3 months (group II). (F) CBCT after 9 months (group II).

b) Peri-implant bone density (27):

The bone density around each implant was measured in Hounsfield unit using the OnDemand3D™(OnDemand 3D™ software Cybermed Inc, Korea E-mail: info@ondemand3d.com) at immediate post-operatively, 3 and 9 months post-operatively. The bone density was measured within three predetermined fixed areas just adjacent to the implant and the mean was calculated.

c) Buccal bone thickness (28):

The buccal bone thickness was measured at immediate post-operatively, 3 and 9 months post-operatively on the OnDemand 3D™* software (OnDemand 3D™ software Cybermed Inc, Korea E-mail: info@ondemand3d.com) using the ruler tool to measure the distance from the implant surface to the most buccal bone. This was done at three points and the mean was calculated.

Prosthetic phase

Implant loading was done after 3 months postoperatively by fabricating a porcelain fused to metal fixed prothesis.

Statistical Analysis of the data

The data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) numbers and percentages were used to describe qualitative data. The Kolmogorov-Smirnov test was used to confirm the normality of distribution. Range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR) were used to describe quantitative data. Significance of the obtained results was judged at the 5% level.

The used tests were:

1. Friedman test
2. Chi-square test
3. Student t-test.
4. Mann Whitney test
5. Paired t-test.
6. ANOVA with repeated measures.
7. Fisher's Exact test.
8. Wilcoxon signed ranks test.

RESULTS

The patients' ages varied from 20 to 40 years old, with a mean of 28.8 years.

Clinical evaluation

1) Peri-implant probing depth:

In group 1, the mean peri-implant probing depth at 3rd month post-operatively was 3.31± 0.59 mm, 3.13 ±0.52 mm at 6th month, and 2.94± 0.42 mm at 9th month.

In group 2, the mean peri-implant probing depth at 3rd month post-operatively was 3.25± 0.60 mm, 3.06± 0.56 mm at 6th month, and 2.94 ±0.42 mm at 9th month.

There was no statistically significant difference between the two groups according to peri-implant probing depth, however statistically significant differences existed between the time periods within each group.

2) Implant stability:

In group 1, the mean implant stability value was 63.13 ± 5.03 immediate post-operatively while it was 75.0 ± 4.34 at the third month post-operatively.

In group 2, the mean implant stability value was 64.25 ± 5.73 immediate post-operatively while it was 73.75 ± 4.71 at the third month post-operatively.

There was no statistically significant difference between the two groups (p=0.683 & 0.590).

Radiographic evaluation

1) Assessment of Marginal Bone Loss (MBL)

In the third month post-operatively, group 1 had a mean vertical bone loss of 0.34 ±0.18 mm, while group 2 had a mean vertical bone loss of 0.35± 0.15 mm.

In the ninth month post-operatively, group 1 had a mean vertical bone loss of 0.65 ±0.22 mm, while group 2 had a mean vertical bone loss of 0.63 ±0.21 mm. There was no statistically significant difference between the two groups (p=0.878 &0.798). (Table.1)

2) Assessment of peri-implant bone density

Group 1

The mean peri-implant bone density was 550.8 ±115.7 HU immediately post-operative, it was 631.6 ±135.0 HU in the third month post-operatively and it was 774.2 ±95.02 HU in the ninth month post-operatively.

Group 2

The mean peri-implant bone density was 610.8 ±144.9 HU immediately post-operative, it was 708.0± 120.4 HU in the third month post-operatively and it was 816.1± 92.42 HU in the ninth month post-operatively.

There was no statistically significant difference between the two groups while there was statistically significant difference between the time periods. (Table.2)

Table (1): Comparison between the two studied groups according to Peri implant bone loss

Peri implant bone loss	Group I (n = 8)	Group II (n = 8)	U	p
3 months				
Min. – Max.	0.11 – 0.61	0.14 – 0.56		
Mean ± SD.	0.34 ± 0.18	0.35 ± 0.15	30.50	0.878
Median (IQR)	0.33 (0.19 – 0.49)	0.35 (0.21 – 0.47)		
9 months				
Min. – Max.	0.39 – 1.08	0.39 – 0.95		
Mean ± SD.	0.65 ± 0.22	0.63 ± 0.21	29.50	0.798
Median (IQR)	0.64 (0.49 – 0.76)	0.60 (0.47 – 0.80)		
% Increase	118.0 ± 75.59	104.4 ± 72.74		
p_0	**0.012***	**0.012***		

U: Mann Whitney test IQR: Inter quartile range
SD: Standard deviation
p: p value for comparing between the two groups
p_0: p value for Wilcoxon signed ranks test for comparing between 3months and 9 months
*: Statistically significant at $p \leq 0.055$

Table (2): Comparison between the two studied groups according to Peri-implant bone density

Peri implant bone density	Group I (n = 8)	Group II (n = 8)	T	p
Pre-operative				
Min. – Max.	195.3 ± 523.1	178.2 – 517.3		
Mean ± SD.	360.8 ± 110.1	384.5 ± 116.3	0.419	0.682
Median (IQR)	350.8 (285.4– 447.7)	387.5 (314.6 – 488.3)		
Immediate postop				
Min. – Max.	392.2 – 728.5	382.5 – 874.9		
Mean ± SD.	550.8 ± 115.7	610.8 ± 144.9	0.916	0.375
Median (IQR)	559.6 (453.7 – 629.5)	592.7 (540.3 – 681.7)		
3 months				
Min. – Max.	430.2 – 791.2	502.1 – 905.3		
Mean ± SD.	631.6 ± 135.0	708.0 ± 120.4	1.194	0.252
Median (IQR)	649.7 (516.7 – 749.4)	713.7 (654.2 – 760.3)		
9 months				
Min. – Max.	662.1 – 914.6	678.2 – 993.2		
Mean ± SD.	774.2 ± 95.02	816.1 ± 92.42	0.894	0.386
Median (IQR)	778.3 (685.3 – 844.7)	791.2 (781.2 – 856.2)		

t: Student t-test IQR: Inter quartile range
SD: Standard deviation
p: p value for comparing between the two groups

3) Assessment of buccal bone thickness

Group 1

The mean buccal bone thickness was 0.61± 0.13 mm in the third month phase, while it was 1.02

±0.15 mm at the ninth month phase. There was a statistically significant difference between the two time periods (p <0.001).

Group 2

The mean buccal bone thickness was 0.67 ±0.12 mm in the third month phase, while it was 1.11± 0.18 mm at the ninth month phase. These variations were statistically significant between the time line (p<0.001).

However, no statistically significant difference existed between the two groups. (Table.3)

Table (3): Comparison between the two studied groups according to Buccal bone thickness

Buccal bone thickness	Group I (n = 8)	Group II (n = 8)	t	p
3months				
Min. – Max.	0.37 – 0.75	0.46 – 0.82		
Mean ± SD.	0.61 ± 0.13	0.67 ± 0.12	0.937	0.364
Median (IQR)	0.65 (0.52 – 0.71)	0.66 (0.61 – 0.76)		
9 months				
Min. – Max.	0.81 – 1.25	0.82 – 1.38		
Mean ± SD.	1.02 ± 0.15	1.11 ± 0.18	1.175	0.259
Median (IQR)	1.02 (0.90 – 1.12)	1.10 (1.0 – 1.25)		
% Increase	70.94 ± 23.34	67.44 ± 5.69		
p_0	**<0.001***	**<0.001***		

t: Student t-test IQR: Inter quartile range

SD: Standard deviation

p: p value for comparing between the two groups

p_0: p value for Paired t-test for comparing between 3months and 9 months

*: Statistically significant at $p \leq 0.05$

DISCUSSION

In this study, patients with remaining alveolar ridge width less than 4 mm were included. This coincides with Milinkovic and Cordaro's study in 2014 (29) in which they stated that if the horizontal ridge size reaches 4 mm, a simultaneous one-stage operation may be indicated, and if the horizontal dimension of the remaining ridge is <3.5 mm, a delayed two-stage operation may be indicated.

In addition, Chiapasco (30) reported in 2006 that inserting the implant concurrently with bone augmentation in the same procedure diminishes the period between ridge augmentation and prosthetic rehabilitation, potentially reducing the risk of bone resorption. Furthermore, single-stage and two-stage operations have been shown to have similar implant survival rates.

Patients were chosen in this study to be free of any uncontrolled systemic diseases that could complicate the healing of the implant procedure or the surgery, as advocated by Moy et al (31) in 2005, who found that hypertension, coronary artery disease, pulmonary disease, chemotherapy, steroid therapy, diabetes, and postmenopausal women affected the implant survival rate.

Furthermore, Clementini et al (32) in 2014 postulated that smoking may lead to implant failure. This finding was reached based on the study's patient selection criteria, which eliminated heavy smokers for the same reason. In addition, Hessling et al (33) in 2015 reported a link between implant loss and radiotherapy/chemotherapy. This was consistent with our study's exclusion criteria for patient selection.

In this study, CBCT was used instead of CT scanning for all patients pre-operatively and post-operatively in this investigation. This matches with Bornstein et al in 2014 (34) as they reported that CBCT can be used in implant dentistry for a number of objectives, including preoperative anatomic examination, site design, and treatment planning, as well as postoperative assessment, according to research done by. Furthermore, they stated that it offers an advantage over computed tomography owing to the reduced radiation dosage and reduced prices.

The peri-implant probing depth was measured at 3,6 and 9 months postoperatively. the mean peri-implant probing depth in group 1 was 3.31 ± 0.59 mm on the 3rd month, 3.13 ±0.52 mm on the 6th month and 2.94 ±0.42 mm on the 9th month. In group 2, the mean peri-implant probing depth was 3.25 ±0.60 mm on the 3rd month, 3.06 ± 0.56 mm on the 6th month and 2.94 ±0.42 mm on the 9th month. Between the two groups, there was no statistically significant difference. These findings were consistent with those reported by Winitsky N et al (35) who discovered that the mean probing depth was 4.0±1.8 mm in retrospective research conducted in 1996 and 1997 on 42 patients (average age 20.7 years) who had 53 anterior maxillary single implants.

The mean implant stability value in group 1 was 63.13 ± 5.03 at immediate post-operative phase, and 75.0 ± 4.34 at the 3rd month post-operatively and in group 2 was 64.25 ± 5.73 at immediate post-operative phase, and 73.75 ± 4.71 at the 3rd month post-operatively with no statistically significant difference between the two groups, however there was a statistically significant increase between different time periods. These findings matched those of Huwiler et al. in 2007 (36) who reported that the mean ISQ readings appeared to increase throughout the implant's integration and healing periods.

There was no significant difference between the two groups in terms of crestal bone loss after 3 and 9 months postoperatively. In group 1, the mean value of peri-implant bone loss was 0.34± 0.18 mm at 3 months and 0.65± 0.22 mm at 9 months, whereas in group 2 it was 0.35± 0.15 mm at 3 months and 0.63± 0.21 mm at 9 months. This was in line with the findings of Sghaireen et al (37) in 2020 in their study comparing bone loss, bone density and implant stability using standard graft

operations against mineralized plasmatic matrix (MPM). A typical graft was put in one site surrounding one implant on one side while MPM was used on the other side in a cross-over design clinical experiment. The mean bone loss on the MPM side was 0.53±0.69 mm while in the typical graft side was 0.57±0.27. there was statistically significant difference between the two groups, the MPM have better treatment outcomes regarding bone loss.

In this study, there was no significant difference between the two groups regarding peri-implant bone density as in group 1, the mean was 550.8 ± 115 HU immediately post-operative, 631.6 ± 135.0 HU at 3 months and 774.2 ± 95.02 HU at 9 months while in group 2 was 610.8 ± 144.9 HU immediately post-operative, 708.0 ± 120.4 HU at 3 months and 816.1 ± 92.42 HU at 9 months. This was in line with the findings of Sghaireen et al (37) in 2020 in their study comparing bone loss, bone density and implant stability using standard graft operations against mineralized plasmatic matrix (MPM), after 4-5 months, the mean value of radiographic density of bone at the MPM side was 665.2±236.5 HU while in the typical graft side was 577.8±201.2 HU. There was statistically significant increase in bone density in the MPM side.

In terms of the quantity of newly formed bone postoperatively (buccal bone thickness), the current study revealed that in group 1 the mean bone thickness at three months was 0.61± 0.13 mm and at 9 months was 1.02± 0.15 mm, but in group 2 it was 0.67± 0.12 mm at 3 months and 1.11± 0.18 mm at 9 months, with no statistically significant difference in the two groups (p=0.364,0.259). This is agreement with the results of Slagter KW et al (38) in 2016, who reported that mean buccal bone thickness after one year ranged between 1.08-1.44 mm.

The findings of this study suggest that the use of barrier membranes with MPM may be unnecessary with MPM. In contrast, many other studies have demonstrated the benefits of using barrier membranes even without bone substitutes like Sterio et al (39) in 2013 who reported displacement or resorption of about 50% of the graft added for horizontal ridge augmentation when no method of membrane fixation is used. This can be easily attributed to the displacement of the graft under the tension of soft tissue closure and muscle function. However, Salata et al (40) in 1998 have reported that bone formation does not significantly increase regardless of whether the bone substrate is used alone or with barrier membranes.

CONCLUSIONS

Our findings show that MPM is reliable and effective in enhancing osseointegration around the implant. In addition, it enhances the formation of new bone in anterior maxillary alveolar defects without the need of a collagen membrane.

Conflict of Interest

The writers state that they have no conflicts of interest.

Registration

This clinical trial was registered at clinical trial .gov under the number NCT04816110 and under the name of Evaluation of Mineralized Plasmatic Matrix with and Without Collagen Membrane in Anterior Maxillary Horizontal Alveolar Defect.

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