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# EVALUATION OF MINIMALLY INVASIVE ALVEOLAR AUGMENTATION PROCEDURE OF ANTERIOR MAXILLARY RIDGE USING TUNNELING SURGICAL TECHNIQUE (PROSPECTIVE NON-RANDOMIZED CLINICAL TRIAL)

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## *ABSTRACT*

**Aim:** This study aimed to evaluate tunneling technique alveolar ridge augmentation of horizontally deficient anterior maxillary alveolar ridge.

**Materials and Methods:** Ridge augmentation was carried out on 10 patients who required dental implants; all patients were suffering from horizontal bone loss in anterior maxillary ridge. They received plasma concentrate mixed with xenograft bone particles to form mineralized plasmatic matrix as the graft material through subperiosteal tunnel for horizontal ridge augmentation. Bone width was measured at 3, 6 and 9 mm from the alveolar crest.

**Results:** The mean width value showed statistically significant increase immediate postoperative and after 4 months at all levels (crestal, middle and apical), and insignificant decrease in width mean value after 4 months of follow up at the middle and apical levels (p value 0.339NS - 1NS, respectively), but significant decrease at crestal level (p value 0.041).

**Conclusion:** Within the limitation of this study, horizontal ridge augmentation using mineralized plasmatic matrix through subperiosteal tunnel in anterior maxilla yields good results in bone gain after 4 months of follow up, but the absence of space maintainer device led to crestal bone resorption after follow up period due to micro movement. In spite of this resorption the augmented bone allowed to place implant in proper position, so ridge augmentation through subperiosteal tunneling technique is recommended in the knife edge anterior maxillary alveolar ridge

**KEYWORDS:** Tunneling, augmentation, mineralized plasmatic matrix.

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## INTRODUCTION

A fresh wave of directed bone regeneration research erupted in the early 2000s. In the medical and dental fields, particularly in the areas of oral and maxillofacial surgery, plastic surgery, and sports medicine, platelet concentrates (PC), platelet-rich plasma (PRP), and platelet-rich fibrin (PRF) were utilized during surgical techniques. [1]

In 2017, a comparative study on sheep was done. They compared mixed bone graft with PRF and mixed bone graft with PRP which is called mineralized plasmatic matrix (MPM) and they found complete disappearance of the graft particles in MPM after 14 days. Also, they found osteoblasts, osteocytes and fibroblasts are formed with 100% of cases that used MPM forming bone. [2]

Nowadays, the revolution of the use of platelet rich plasma (PRP) in formation of MPM gives predictable results. PRP contains highly loaded growth factors which act as chemotactic factors increasing blood supply, increase action of osteoblasts and helps in bone substitution procedure. MPM is considered an autogenous fibrin glue freshly made from the same patient. [3]

Techniques of guided bone regeneration (GBR), which utilize barrier membranes to exclude epithelium and connective tissue, are predictable procedures to provide ridge augmentation. [4] However, this surgical approach may be associated with wound dehiscence, and often requires a secondary surgical site to harvest the autogenous bone graft. Thus, current surgical trends lean toward minimal surgical trauma, postoperative discomfort and morbidity. These techniques have been reported for ridge augmentation and periodontal regeneration procedures. [5]

A number of variations on the subperiosteal tunneling technique have been attempted and reported, with particulate hydroxyapatite and particulate human mineralized bone allograft used to enhance thin alveolar ridges. [6] The aim of the study is to evaluate minimally invasive tunneling technique alveolar ridge augmentation of horizontally deficient anterior maxillary alveolar ridge.

## MATERIAL AND METHODS

This study was conducted on 10 cases of horizontally deficient anterior maxillary alveolar ridge, selected from the outpatient clinic, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Cairo University. It was held after the understanding and acquiring written consent of each subject. The study was independently reviewed and approved by Ethics committee of scientific research, Faculty of Dentistry, Cairo University. Approval number was (18 5 18). The Evidence-Based committee, Faculty of Dentistry, Cairo University, did the auditing of the study design.

The full detailed personal data of the patient was written in a separate sheet having the patient's serial number for further contact with patient. Adverse events were minimal or rare. However, if any harm was recognized, it was documented as part of routine monitoring not as outcome to be reported at the end of the trial.

Inclusion criteria involved patients suffering horizontal bone defect in anterior maxillary area in addition to being free from any systemic disease that may affect normal healing of bone and predictable outcome. Exclusion criteria were any systemic diseases as history of radiation therapy or chemotherapy, hematological disorders and autoimmune diseases that may affect normal healing.

**Surgical method**: One or two vertical releasing incision were made adjacent to the ridge augmentation site, the buccal muco-periosteum dissected carefully to create tunnel with periosteal elevator, (fig 1) to allow for primary closure using simple interrupted sutures. The type of bone used

in alveolar ridge augmentation was mineralized plasmatic matrix produced from xenograft and autologous growth factors mixing.

MPM Preparation was done using plain tubes of venous blood drawn from patient and immediately centrifuged at 2500 rpm for 10 minutes. After 10 minutes of centrifugation, the plain tubes present 2 layers, 1st layer is the RBC's in the bottom of the tube then in the upper portion an amount of clear yellow plasma rich in leukocytes, platelets, mesenchymal stem cells and fibrinogen. The 2nd layer was then mixed with the bone graft material and a drop of patient blood from the surgical site to provide the thrombin which will initiate the conversion of insoluble fibrinogen into soluble fibrin and all mixed together in a sterile bowel. After a couple of minutes, a homogenous mixture of fibrin network with integrated bone graft particles inside formed and the mixture was rich in platelets, leukocytes and mesenchymal cells. (Fig 2) The MPM, which was obtained, was placed in the bony defect in the anterior region. The surgical incision was closed using 3-0 black silk sutures.

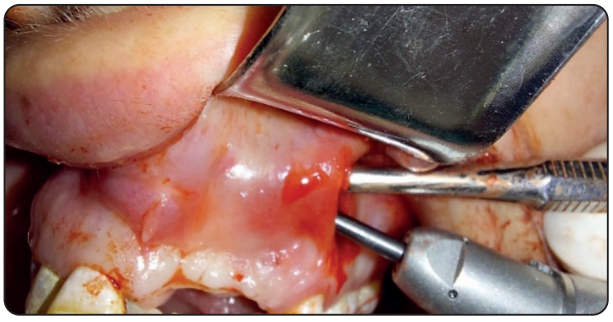

Fig. (1): decortication through tunnel

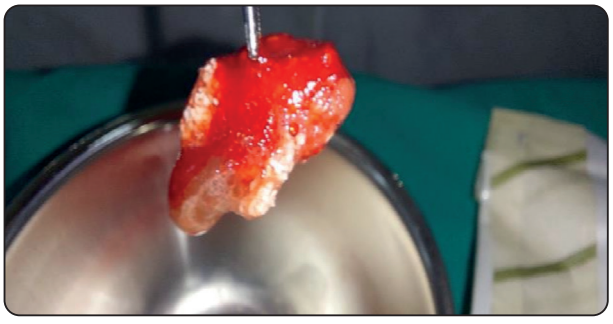

Fig. (2): mineralized plasmatic matrix

Cone Beam CT (CBCT) scans were done preoperatively, immediate postoperatively and after 4 months, width measured at three levels crestal, middle and apical at the same points.(Fig 3)

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). For comparison of serial measurements within each group repeated measures ANOVA was used (Chan, 2004). P-values less than 0.05 were considered as statistically significant.

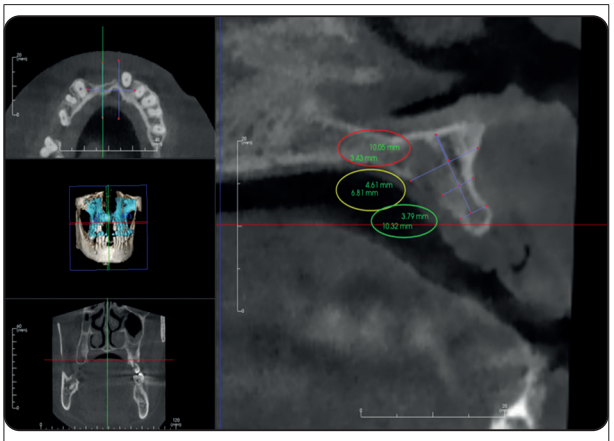

Fig. (3): preoperative cross section and measurements

## RESULTS

### Clinical Results

Healing was uneventful in all patients except for post-operative mucosal thinning without dehiscence in two patients having originally thin gingival biotype. Also, displacement of the grafted bone in one patient after one week which lead to augmentation beyond the proposed area for implant placement. Moreover, softer bone was noticed during implant drilling in cases with larger amount of augmentation and small residual ridge.

### Radiographic results

a) Bone width measurement at the crestal level preoperatively showed mean width (4.90±0.50) mm with minimum width 4.28 mm and maximum 5.65 mm. ANOVA test showed that there

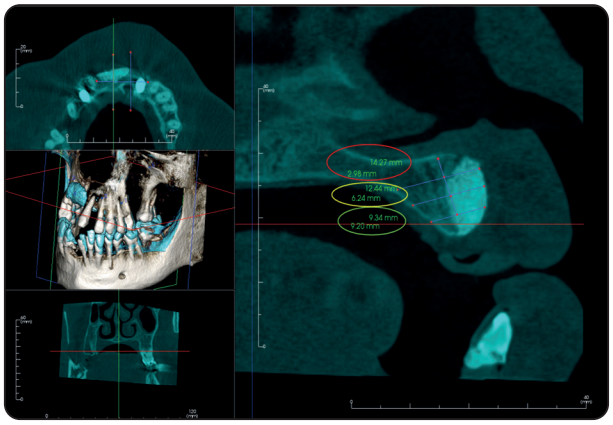

Fig. (4): the graft four months postoperatively

was statistically significant difference in mean width values between different examination periods. As illustrated in table (1) the p value at immediate post-surgery (post 1) was 0.012 and it was 0.008 after 4 months (post 2).

b) The middle level width measures showed mean width (5.40±0.49) mm with minimum width 4.93 mm and maximum 6.39 mm. the bone width at the middle level showed statistically significant difference compared to the base line with p value (0.007) at post 1 and (0.003) at post 2 as illustrated in table (1).

c) The apical level width measures showed mean value (6.09±1.32) mm preoperatively with minimum 5.05 mm and maximum 9.42 mm, which showed statistically significant difference when compared to post 1 with p value (0.008), and (0.001) when compared to post 2. As shown in table (1).

d) Comparative results between post 1 and post 2 at the crestal level showed mean width gain of immediate post-surgical was 8.12 mm and became 7.14 mm at 4 months post-surgical which was statistically significant different of p value (0.041) due to bone resorption of the graft as table (2).

e) Middle level comparative results between post 1 and 2 showed mean width gain 8.86 mm at post 1 and 8.16 mm at post 2 with p value (0.339) which was statistically not significant as table (2).

f) Comparative results between post 1 and post 2 at apical level showed mean width gain 9.31 mm immediate post-operative and 9.21 mm after 4 months, there was statistical insignificant difference p value (1.000) as table (2)and fig (5).

TABLE (1) Mean ± Std. Deviation and P-value of the average width at immediate postoperative and follow up CBCT compared to perioperative at crestal, middle and apical level.

| | **Crestal** | | | | **P value compared to** |
|---|---|---|---|---|---|
| | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** | **baseline** |
| **Average width pre** | 4.90 | 0.50 | 4.28 | 5.65 | ---- |
| **Average width post 1** | 8.12 | 2.55 | 3.51 | 11.63 | 0.012* |
| **Average width post 2** | 7.14 | 1.74 | 4.60 | 10.14 | 0.008* |
| | **Middle** | | | | **P value compared to** |
| | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** | **baseline** |
| **Average width pre** | 5.40 | 0.49 | 4.93 | 6.39 | ---- |
| **Average width post 1** | 8.86 | 2.45 | 3.78 | 12.69 | 0.007* |
| **Average width post 2** | 8.16 | 1.81 | 5.88 | 11.00 | 0.003* |
| | **Apical** | | | | **P value** |
| | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** | **compared to baseline** |
| **Average width pre** | 6.09 | 1.32 | 5.05 | 9.42 | ---- |
| **Average width post 1** | 9.31 | 2.03 | 5.91 | 12.69 | 0.008* |
| **Average width post 2** | 9.21 | 2.03 | 5.92 | 13.28 | 0.001* |

TABLE (2) Repeated measures ANOVA showed statistically significant difference in width mean values at crestal, middle and apical level in post 2 compared to post 1

| | Crestal | | | | P value |
|---|---|---|---|---|---|
| | Mean | Standard Deviation | Minimum | Maximum | |
| **Average width post 1** | 8.12 | 2.55 | 3.51 | 11.63 | 0.041* |
| **Average width post 2** | 7.14 | 1.74 | 4.60 | 10.14 | |
| | **Middle** | | | | **P value** |
| | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** | |
| **Average width post 1** | 8.86 | 2.45 | 3.78 | 12.69 | 0.339NS |
| **Average width post 2** | 8.16 | 1.81 | 5.88 | 11.00 | |
| | **Apical** | | | | **P value** |
| | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** | |
| **Average width post 1** | 9.31 | 2.03 | 5.91 | 12.69 | 1NS |
| **Average width post 2** | 9.21 | 2.03 | 5.92 | 13.28 | |

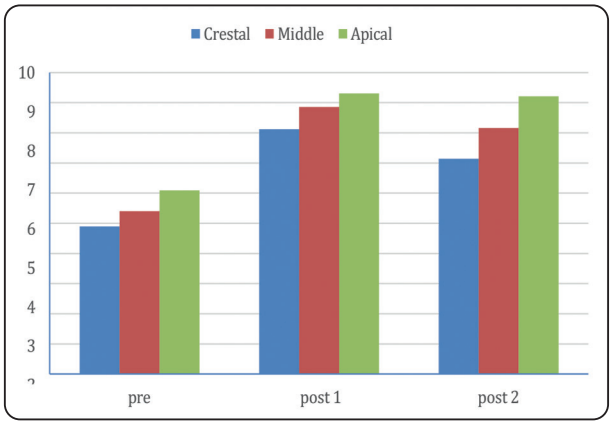


Fig. (3) Preoperative cross section and measurements

## DISCUSSION

Periosteal blood supply preservation through avoiding periosteal scouring with subperiosteal tunneling technique reduces postoperative pain, edema, dehiscence, infection and site morbidity. This was in agreement with Ernesto A Lee where he treated 60 atrophic sites in 21 patients with Subperiosteal minimally invasive aesthetic ridge augmentation technique (SMART), and reported that ridge augmentation through subperiosteal tunnel reduces postoperative complications than conventional techniques. [7]

The choice of Xenograft mixed with Plasma concentrate (MPM) or sticky bone in moderate bone defects was used due to its positive effect on bone gain in small bony defects. This was in accordance with Perisse and his team, the author reported that small bony defects could be augmented with xenograft without mixing with autogenous graft, but in large bony defect augmentation autogenous bone with or without mixing other synthetic bone is the best choice. [8]

MPM used in this study represented the lost property in bovine bone graft as growth factors act as osteoinductive material and the xenogenic bone act as osteoconductive scaffold material provide space maintenance for angioneogenesis. [9]

Bone decortication was performed throughout all cases of this study. Greenstein et al found that performing decortications in onlay grafting techniques to aid angioneogenesis and cellular bone progenitor cells penetration to the newly attached graft through macropores inside it gives positive results.[10] On the contrary, others stated that decortications of surgical sites have no effect on healing and remodeling of the graft. [11]

Statistical results revealed that there was a significant decrease in graft width at crestal level after 4 months but nonsignificant decrease at apical and middle levels, this may due to lesser amount of micro movement that were applied to apical and middle levels than crestal. This was in accordance with Ahmed M A et al. [12]

Patients suffered from mucosal thinning between crestal and middle level in the current study, Puisys A and Tomas L explained that knife edge ridge with crestal width less than 2mm underwent mucosal thinning and less keratinized soft tissue. [13]

In this study, MPM was used through tunnel technique without barrier membrane. This was in line with Abdelfadil and Abo el maaty. In their study, they concluded that MPM can be effectively used in horizontal ridge augmentation with no need of barrier membrane. [14] This is contradictory to El Moheb et al as their research considered non absorbable reinforced membrane important in prevention micro movement completely. [2]

In this study, MPM preparation was done by using plastic tube without anticoagulant centrifuged at 2500 for 10 mins. This was in line with Ahmed M A et al 2023 [12] where they prepared PRP at 2500 rpm for 12 mins and mixed with xenograft bone particles to form sticky bone or MPM. Also, this was in accordance with Ayoub H et al who reported preparation of MPM by centrifuging patient blood for 10 mins at 3000 rpm and then mixed plasma concentrate with bone graft material to obtain MPM. [15]

This was contradicting with Sohn et al. They reported that sticky bone was prepared in non coated tubes, were used with anticoagulant centrifuged by specific centrifuge for 2 mins at 2400-2700 rpm. [16]

## CONCLUSION

Within the limitation of this study, horizontal ridge augmentation using MPM through subperiosteal tunnel in anterior maxilla yields good results in bone gain after 4 months of follow up. MPM has a remarkable quality as easy manipulation, rapid healing and cost-effective material, but the absence of space maintainer device led to crestal bone resorption after follow up period due to micro movement. In spite of this resorption, the augmented bone allowed to place implant in proper position. So, ridge augmentation through subperiosteal tunnel with MPM is recommended in horizontally deficient anterior maxillary alveolar ridge.

## REFERENCES

1- Bischof, M., Nedir, R., Szmukler-Moncler, S., Bernard, J.P. and Samson, J., 2004. Implant stability measurement of delayed and immediately loaded implants during healing. A clinical resonance-frequency analysis study with sandblasted-and-etched ITI implants. Clinical oral implants research, 15(5), pp.529-539.

2- Moheb, M.E., Al-Zarea, B., Sghaireen, M.G., Toriya, J., Mizohata, A., Patil, S., Siada, A., Brad, B., Kochaji, N., Alam, M.K. and Osuga, N., 2017. Mineralized plasmatic matrix to enhance the bone grafting technique. Journal of Hard Tissue Biology, 26(3), pp.289-292.Miron, R.J., Hedbom, E., Saulacic, N., Zhang, Y., Sculean, A., Bosshardt, D.D. and Buser, D., 2011. Osteogenic potential of autogenous bone grafts harvested with four different surgical techniques. Journal of dental research, 90(12), pp.1428-1433.

3- Sethi, S. and Fervenza, F.C., 2012. Membranoproliferative glomerulonephritis—a new look at an old entity. New England Journal of Medicine, 366(12), pp.1119-1131.

4- Dohan, D.M., Choukroun, J., Diss, A., Dohan, S.L., Dohan, A.J., Mouhyi, J. and Gogly, B., 2006. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 101(3), pp.e37-e44.

5- Bonsmann, M., Kettner, R., & Wunderlich, S. (2023). Dentoalveolar Surgery. In Oral and maxillofacial surgery: Surgical textbook and atlas (pp. 31-76). Berlin, Heidelberg: Springer Berlin Heidelberg.

6- Leventis, M. D., Fairbairn, P., Kakar, A., Leventis, A. D., Margaritis, V., Lückerath, W., & Nagursky, H. (2016). Minimally invasive alveolar ridge preservation utilizing an in situ hardening β-tricalcium phosphate bone substitute: a multicenter case series. International Journal of Dentistry, 2016.

7- Lee, E.A. (2017). Subperiosteal minimally invasive aesthetic ridge augmentation technique (SMART): a new standard for bone reconstruction of the jaws. Int J Periodontics Restorative Dent, 37(2), 165-173.

8- Perisse, J., Alami, H. B., Vassalaky, L. M., Caveriviere, P., Betito, M., & Marchou, M. (2012). Aspect clinique et histologique des Matrices Plasmatiques Minéralisées (MPM). Revue d'implantologie, 23-5.

9- Nadon, F., Chaput, B., Périssé, J., de Bérail, A., Lauwers, F., & Lopez, R. (2015). Interest of mineralized plasmatic matrix in secondary autogenous bone graft for the treatment of alveolar clefts. Journal of Craniofacial Surgery, 26(7), 2148-2151.

10- Greenstein G, Greensten B, Cavallaro J,Tarnow D. The Role of Bone Decortication in Enhancing the Results of Guided Bone Regeneration: A Literature Review. Journal of Periodontology. 2009 march 80(2):175-89.

11- Adeyemo WL, Reuther T, Bloch W, Korkmaz Y, Fischer JH, Zöller JE, Kuebler AC. Influence of host periosteum and recipient bed perforation on the healing of onlay mandibular bone graft: an experimental pilot study in the sheep. Oral Maxillofac Surg (2008) 12:19–28 Aghaloo TL, Moy PK. Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement? The International Journal of Oral & Maxillofacial Implants. 2007;22 (Suppl):49-70.

12- Ahmed, M.A. and Ahmed, H.M., 2023. Use of Mineralized Plasmatic Matrix in 3-Dimensional Maxillary Ridge Deficiency Augmentation (Prospective Non-Randomized Clinical Trial). Advanced Dental Journal, 5(2), pp.412-425.

13- Puisys, A., & Linkevicius, T. (2015). The influence of mucosal tissue thickening on crestal bone stability around bone-level implants. A prospective controlled clinical trial. Clinical oral implants research, 26(2), 123-129.

14- Abdelfadil, E., & Aboelmaaty, W. (2020). Mineralized plasmatic matrix for horizontal ridge augmentation in anterior maxilla with and without a covering collagen membrane. The Open Dentistry Journal, 14(1).

15- Ayoub, A.H. and Agbor, R.O., 2016. Tissue engineering, platelets concentrates and its role in dental implant treatment. EC Dent Sci, 5, pp.969-80.

16- Sohn, D. S., Huang, B., Kim, J., Park, W. E., & Park, C. C. (2015). Utilization of autologous concentrated growth factors (CGF) enriched bone graft matrix (Sticky bone) and CGF-enriched fibrin membrane in Implant Dentistry. J Implant Adv Clin Dent, 7(10), 11-18.