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REGENERATION OF MAXILLARY CYSTIC BONE CAVITIES GRAFTED WITH MPM VERSUS PRF (COMPARATIVE STUDY)

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ABSTRACT

Objectives: The aim of this study was to compare the outcome of defect filling with mineralized Plasmatic matrix (MPM) versus Platelets Rich fibrin (PRF) after conservative intraosseous cystic lesions enucleation in maxillary bones.

Patients and methods: Twelve patients with large intra osseous maxillary cystic lesions were included in this study, all underwent conservative cyst enucleation. They were randomly divided into 2 groups. Group I the defect was filled with Mineralized Plasmatic Matrix (MPM), and group II the defect was filled with Platelets Rich Fibrin (PRF). Patients were evaluated clinically and radiographically at zero and 6 months postoperatively.

Results: A statistical significant decrease ($p \leq 0.05$) at cysts sizes was obvious at both groups at the follow up interval. When the groups were compared, Group I had statistically significant ($p \leq 0.05$) decrease at the cysts sizes than Group II at the follow up period.

Conclusion: MPM showed better values than PRF as a grafting material in defect filling after conservative cystic enucleation in maxillary bones.

KEYWORDS: PRF, MPM, bone regeneration, growth factors, and platelet concentrates.

INTRODUCTION

Bony defects in the oral and maxillofacial region may results following enucleation of cysts and cyst-like lesion. This resulting cavity can be left for spontaneous bone healing or it may need a grafting material to fill the defect. [1-5]A variety of bone grafts were used to fill the defects, including autografts, allografts, xenografts and synthetic bone substitutes.[6-10]Although, it is well documented in the literature that critical size defects need to be grafted to achieve complete regeneration,[11] there is no evidence to support the use of one material over the other.

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Since the introduction of platelets regenerative capacity in the 70's[12], a wide range of platelets concentrates are used to enhance the healing of hard & soft tissue. Platelet-rich fibrin (PRF) and the mineralized plasmatic matrix (MPM) are two of the promising platelet concentrates used to fill the bony defects with optimized healing.

PRF is considered to be the second generation of platelet concentrate. It contains fibrin mesh, platelets, cytokines and growth factors.[13] In oral surgery it was presented for the first time by ***Dohan et al.*** [14] PRF is believed to stimulate angiogenesis & release a variety of growth factors such as platelet derived growth factor (PDGF) insulin-like growth factor and tumour growth factor (TGF) that enhance the healing of hard & soft tissue.[15] Clinical reports showed that cystic cavities filled with PRF had enhanced healing in shorter period of time.[16,17]

Mineralized Plasmatic Matrix (MPM) is a modified platelet concentrate introduced by ***Perisse***[18]It consists of platelet concentrate with fibrin network that is mixed with bone substitute. [19] This unique preparation has superior advantage over other platelet preparations in stabilizing the grafting material at the defect site along with growth factors included in the platelets, leukocytes & fibrin network.[20] Recently the application of MPM as a regenerative material showed enhanced healing of hard & soft tissue.[21-24]

The past decade has been that of the Cone beam computed tomography (CBCT) due to the revolution in dental imaging. It led to a precise pre-operative surgical planning, resulting in a surgery with minimal invasion and time saving [25]. The main advantage of CBCT imaging is that it offers a real-size dataset with multiplanar cross-sectional and 3D reconstructions which are based on a single scan using a low radiation dose [26]. In evaluating cysts, a single intraoral radiograph may not fully record the superio-inferior and mesio-distal dimensions of the lesion. Multiplanar sections (axial, coronal, and sagittal planes) are required when cysts are located deep in the tissues. CBCT is the proper choice for making the diagnosis [27]. Apart from pre surgical evaluation of cysts, CBCT is also helpful in post-surgical follow-ups of lesions that may have high recurrences. Because of super imposition of large tissue volume, an extra-oral film radiograph often cannot provide reliable information on the internal structure of a lesion. Other benefits of CBCT are accuracy in measurement and absence of image distortions [28].

PATIENTS AND METHODS

For the current study twelve patients were selected from the outpatient clinic from the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, October University of Modern Sciences and Arts. The age of the selected individuals ranged between 26-52 years old with mean value of 39. All subjects included in this study were suffering from cystic lesions in the upper jaw.

Thorough preoperative clinical and radiographic examination was carried out for all patients. Cone beam computerized tomography (CBCT) was taken for all patients to evaluate the cyst size preoperatively and at the consolidation of the follow up.

The presence of any medical condition that may affect bone regeneration was considered as exclusion criteria. Teeth related to the cystic lesion were evaluated carefully in terms of vitality and restorability. They were either endodonticlly treated preoperatively or planed for extraction during surgery if they lack enough bony support.

Patients Grouping:

Selected candidates were randomly divided into two equal groups:

Group I: six patients (3 females and 3 males) received **MPM** as grafting material to fill the cystic cavity.

Group II: six patients (4 females and 2 males) received **PRF** as grafting material to fill the cystic cavity.

Surgical technique:

A muco-periosteal flap was elevated to gain access to the cystic cavity. With the aid of small curette the overlying bone is separated from the cyst lining. The cyst lining was then carefully identified and dissected from mucoperiosteal layer and the surrounding bon (Fig.1). Following complete enucleation the surrounding bony edges were saucerized using bone rongeur. Bone file was then used for smoothing the bone and the cavity was irrigated with saline.

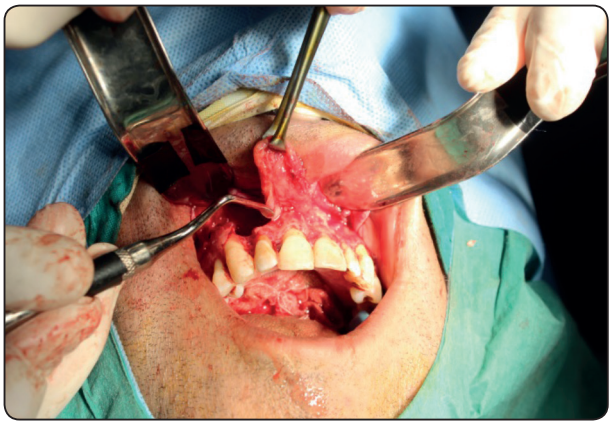

Fig (1): Maxillary cyst enucleation.

Preparation platelet concentrates:

Following ***Dohan et al***[29] protocol venous blood withdrawn from the antecubital vein was transferred to (10ml) sterile test tubes without the addition of any anticoagulant. The test tubes were then placed in the centrifuge machine for 10 minutes running at 3,000 rpm. At the end of the centrifuge cycle, blood was divided into three characteristic layers: bottom layer of red blood cells, middle layer of platelet rich plasma and upper most layer composed of platelet poor plasma.

PRF preparation:

Tissue forceps was used to hold the middle layer that contains the fibrin clot.

It was then separated from the underlying layer with scissors. Following this fibrin clot was compressed between two glass slabs to obtain PRF. (Fig.2,3)

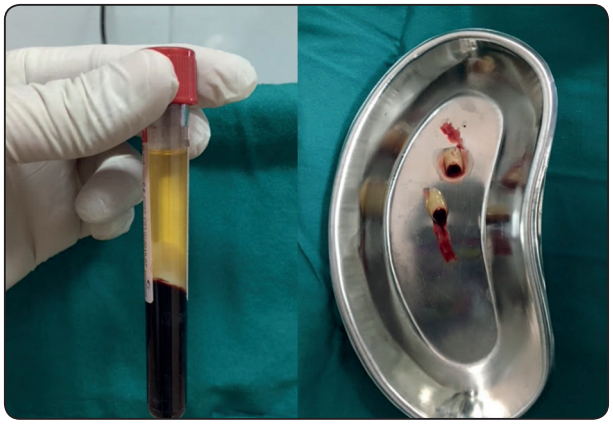

Fig (2,3): PRF preparation.

MPM preparation:

We collected the middle plasma rich layer that contains fibrin leukocytes and mesenchymal cells. Particulate bone graft (Beta tri calcium phosphate β-TCP) was added to the fibrin mix along with few drops of the patient blood for sticky bone formation. The mixture was allowed to set for few minutes, thus allowing the coagulation cascade and polymerization to take place. (Fig. 4)

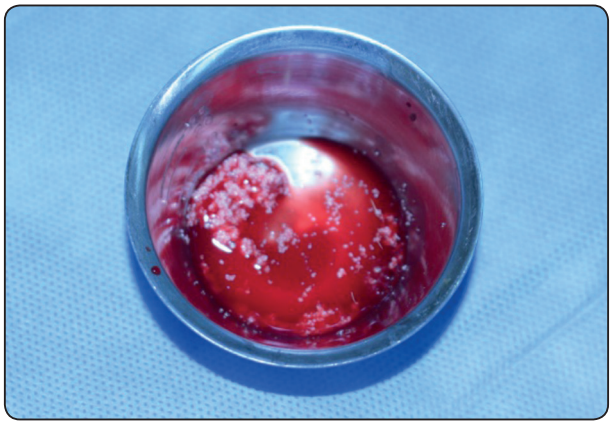

Fig (4): MPM preparation. (Mixing of platelet rich fibrin layer with particulate bone graft for MPM preparation)

Fig (5,6): PRF filling of the maxillary cavities following cyst enucleation

In group I the cystic cavities were filled with MPM. Group II the cystic cavities were filled with PRF. Following that the wound edges were approximated and sutured. (Fig .5,6)

Postoperative care:

After surgery, patients received adequate postoperative instructions along with oral hygiene measures. Prescription of ***Augmentin*** antibiotic (amoxycillin + clavulanatepotassium,GSK) 1gm b.i.d for 5 days. For postoperative pain they received ***Brufen*** 400mg. Sutures were removed one week after surgery.

Follow up:

Clinical examination:

During the first month patients were recalled every week. Then once every month till the end of the follow up period. The wound site was carefully examined for signs of healing. Any possible complications including edema, infection and wound dehiscence or breakdown were reported in the patient chart.

Radiographic examination:

Cone beam computed tomography CBCT were taken at the end of follow up to evaluate the amount of bone regeneration.

CRANEX 3Dx (Soredex, Tuusula, Finland) was set for high resolution atMidi FOV (60x80)), 10 mA, 90 kV for a single scan of 360˚ rotation and exposure time of 4 sec, with voxel sizes of 0.15mm.

*CBCT linear measurements*were made with OnDemand3DApp software, measured on image slices from sagittal, coronal or axial cuts where the defects were best visible to the operator.

Statistical analysis

The collected data were statistically analysed. The significance of the difference between the preoperative and postoperative data regarding bone height,width and depth at the same group was assessed using the Student T test (paired and unpaired). The two groups were compared to each other using also the Student T test (paired and unpaired). The statistical analysis was carried out using SPSS ver. 22 software (statistical package for social science on windows 2013). A probability value $p \leq 0.05$.

RESULTS

The twelve patients were divided into two groups. Group I receiving MPM as bone grafts after cysts enucleation and group II receiving PRF as grafting material after cysts enucleation.

A statistical significant decrease ($p \leq 0.05$) at cysts sizes (height-depth-width) was obvious at the CBCT for both groups at the follow up interval. When the two groups were compared together, Group I (MPM group) had statistically significant ($p \leq 0.05$) decrease at the cysts sizes than Group II at the follow up period. (Fig:7,8,9), (Table 1).

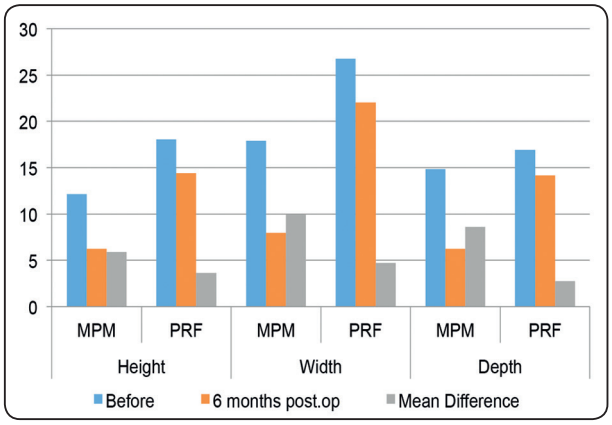

Fig (7): showing the decrease at the cysts sizes of the two groups and the mean difference between the two groups preoperatively and at 6 months follow up period.

TABLE (1)

	GROUP I(MPM)			GROUP II(PRF)		
	Before Mean ± SD	After Mean ± SD	Mean Difference Mean ± SD	Before Mean ± SD	After Mean ± SD	Mean Difference Mean ± SD
Height	12.13± 1.98	6.23± 0.31	5.9± 2.29	18.03± 1.3	14.39± 0.64	3.65± 0.67
P value (before & after)	0.0015			0.0000		
P Value (2 Groups)	0.0002	0.0000	0.0613			
Width	17.9± 1.98	7.96± 0.38	9.94± 2.20	26.77± 7.74	22.03± 8.00	4.73± 0.40
P value (before & After)	0.0001			0.00001		
P Value (2 Groups)	0.0369	0.0076	0.0019			
Depth	14.84± 1.44	6.23± 0.40	8.61± 1.78	16.9± 3.76	14.17± 3.65	2.73± 0.31
P value (before & after)	0.0001			0.0001		
P Value (2 Groups)	0.2538	0.003	0.0004			

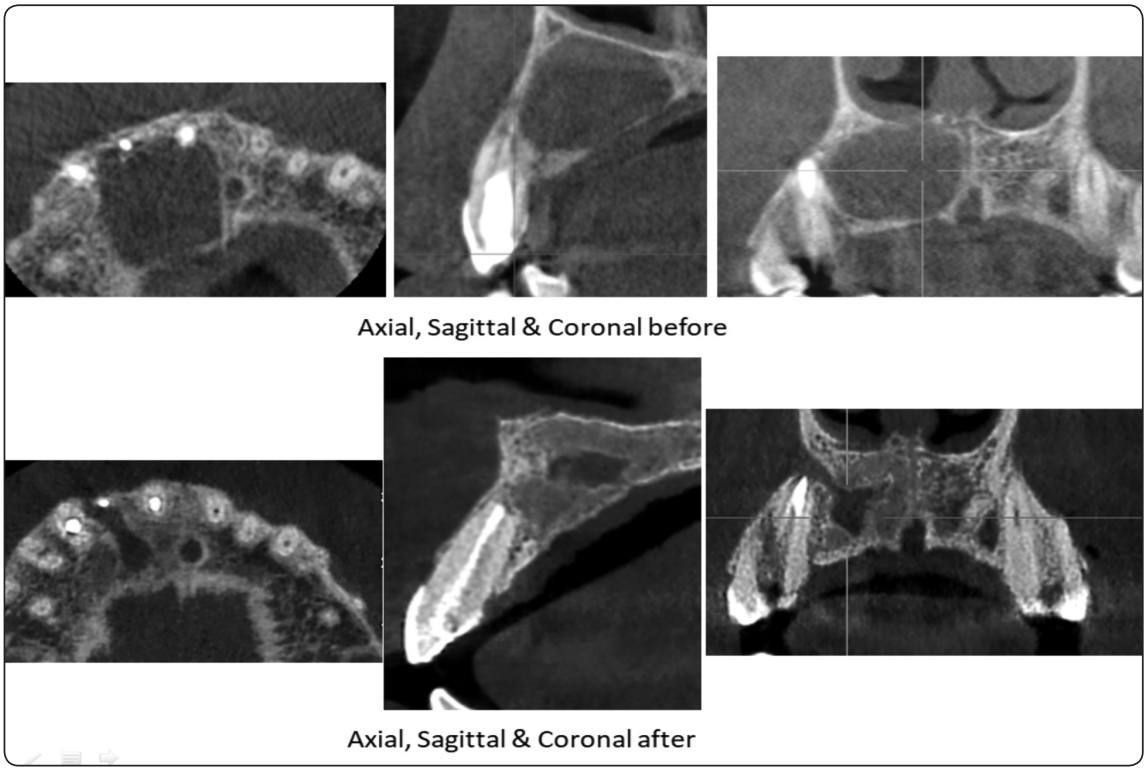

Fig (8): CBCT of Group I (MPM group) showing the decrease at the cysts sizes.

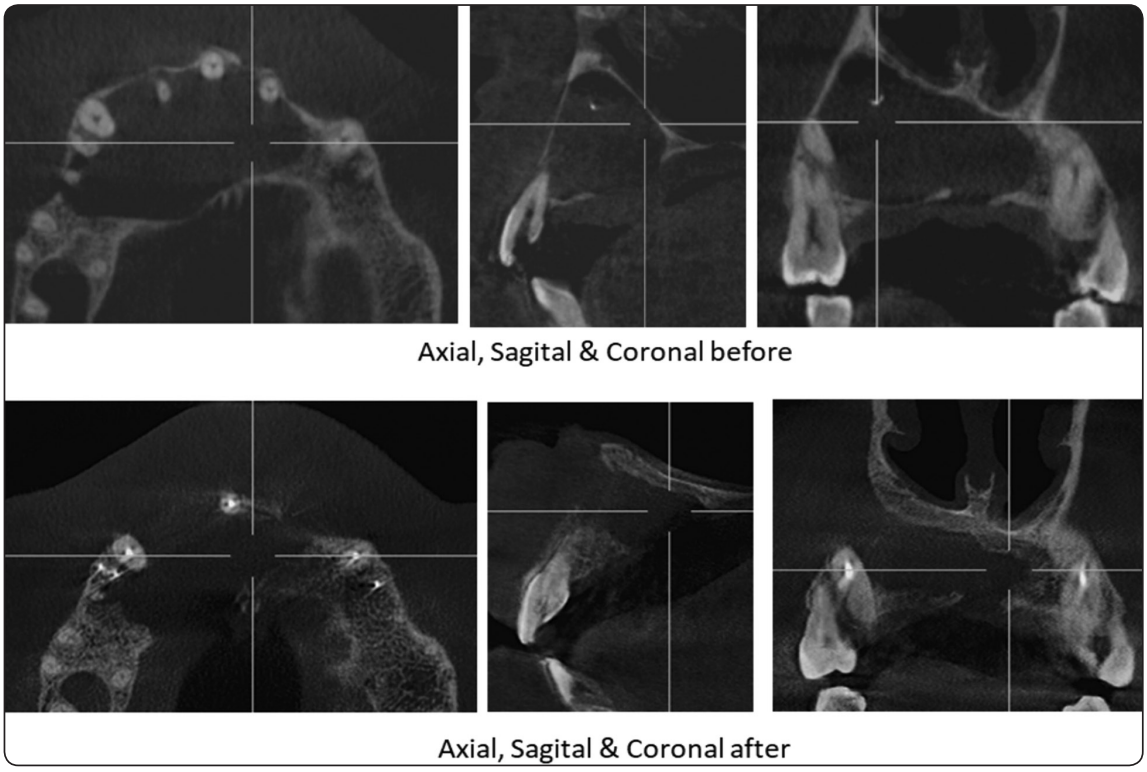

Fig (9): CBCT of Group II (PRF group) showing the decrease at the cysts sizes.

DISCUSSION

Cystic lesions may affect the upper and lower jaws during any period of life. Usually they remain asymptomatic till they result in large bony defects. Two main treatment modalities were described in the literature for management of such lesions. Marsupialization technique which depend on decompression of the cystic cavity to stimulate bone apposition and regeneration.[30-32] This will lead to reduction in the cyst size that facilitate it is removal with minimal bony defects. Although, this technique results in smaller bony defects it require longer period of time and more than one surgery to remove the cyst completely. The second technique is enucleation, have the advantage of total removal of the cystic lining with single surgical interference.[33,34]

The resulting bony cavity following complete cystic enucleation can be left for spontaneous healing as reported by many studies. [35,37] However, it is well documented in the literature that critical size defects will not show complete bone regeneration without grafting.[38-40] An animal experimental study by ***Schlegel et al***, showed that 10x10mm mono-cortical defects had incomplete bone regeneration even after 52 weeks.[41] Therefore such defects need to be grafted following cystic enucleation. Moreover, many grafting materials were described in the literature for defect filling ranging from autografts, xenografts, allografts as well as synthetic bone substitutes.[42-46]

Since the introduction of PRF as the second generation of platelets concentrate by ***Choukroun et al.***[47] the use of this material in bone regeneration has revolutionized massively. Owing to it is unique criteria, being totally autologous prepared without the addition of anticoagulant it had an advantage over the Platelets Reach Plasma PRP the first generation of platelet concentrate.[48] The fibrin network in PRF acts as a reservoir allowing slow release of growth factors over 7-14 days at the wound area.[49] It enhances the healing of hard and soft tissue via stimulation of angiogenesis and cellular proliferation and differentiation. [50]This behaviour advocated the use of PRF for filling bony defects either separately or mixed with other grafting materials.

Dhote, et al.[51] presented clinical report applying PRF as a grafting material for augmentation of bony cavity following enucleation of large radicular in the mandible. The author reported enhanced faster healing after one year follow up. Similarly, in the current study PRF was used in group I as the sole grafting material after enucleation of cystic lesion from the maxilla.

A new generation of platelet reach plasma is MPM was first developed by ***Perisse.***[52]It is a unique homogenous material composed of two main phases. The plasma phase that is collected after blood centrifugation. This is mixed with any type of bone graft (autogenous, allogenic, xenografts or synthetic bone substitute) presenting the mineral phase. The resulting component is stable with great ability to enhance healing achieved by the platelets entrapped in the fibrin network along with mineral bone graft. [53] This mixture was described to have many advantages over the PRF: The mineral phase that has an osteoconductive property acting as scaffold for bone cells. Although it is easy to shape it has a stable consistency to prevent the micro & macro movement of the graft particles.[54] This biologic quality of MPM encouraged it is application as a graft in many surgical fields, including alveolar clefts[55], ridge preservation[56] and implant dentistry.[57]

Histological study presented by ***Ayoub AH., et al.***[58] compared between PRF & MPM as a grafting material for socket preservation. They reported that MPM had better healing capability on hard tissues than PRF. This was demonstrated by the high osteoblastic activity & bone maturation recorded in MPM group at four month post-operative period.

These finding in favouring the use of MPM over PRF wasfurtherly explained in a study reported by ***El Moheb et al***. [59] the authors compared the results

of sinus lifting procedures performed with PRF mixed with bone graft at one group versus MPM in the other group. They described the stability of the bone graft to be a critical factor for success of grafting technique. Since PRF are in the gel form, they were not able to provide the needed stability for the graft as they were not linked to its particles. Therefore they cannot resist the chewing forces & cannot preserve the space necessary for the bone formation. This was explained in the histological features showing that: MPM had woven bone at 14 days while the side of the PRF mixed with bone graft had only granulation tissue.

CONCLUSION

The results of the current study showed better bone fill in cavities grafted with MPM compared PRF.

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