

International Journal of Oral Care & Research

Volume 2 Issue 5 (Jul - Sep 2014)

ISSN 2347-6249



**An Official Publication of
“Ivano-Frankivsk National Medical University, Ukraine”
Officially Associated with
“The Egyptian Society of Oral Implantology”
“International Group for Oral Rehabilitation, France”**

COMPARISON OF HEALING OF BONE DEFECTS BY AUTOGENOUS PLATELET RICH PLASMA WITH HYDROXYAPATITE AND NATURAL HEALING IN PEDIATRIC PATIENTS

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ABSTRACT

OBJECTIVES: Objective of this prospective study was to evaluate the early new bone formation in bony defects after placement of PRP along with hydroxyapatite and to compare the efficacy and regenerative potential with normal healing in pediatric patients.

METHOD: Forty pediatric patients were selected for the study and were randomly divided in group 'A' and 'B' each consisting 20 patients. Patients were operated for removal of pathologies. PRP was extracted from patients own blood and mixed with hydroxyapatite and placed in defect in all patients of group B while no grafting was done in group A patients. Post-operative clinical and radiographic observation was done at 1st, 2nd, 4th, 12th and 18th week. Data analysis was carried out using χ^2 test. **RESULTS:** Radiographic evaluation indicated accelerated bone healing in all patients where grafting was done when compared with normal healing. **CONCLUSION:** Conclusion on the basis of results emphasizes that the clinical requirement of a bone substitute material which is biocompatible and non-allergic is fulfilled with PRP. Therefore PRP with hydroxyapatite crystals for the management of osseous defects resulted in superior healing when compared to natural healing.

KEYWORDS: Platelet rich plasma [PRP]; bone regeneration; osseous defects; osteoinduction; osteoconduction

INTRODUCTION

Bone defects as a result of surgery are frequently restored by bone graft substitutes which may be of different types like autograft, allografts or xenografts.^[1] These grafts may be toxic, chemically unstable, cause inflammatory or antigenic reaction.^[2] Another important property is that its microstructure can not be controlled to promote the formation of pores that can allow the migration of blood vessels and bone tissues into the material.^[3] Platelet Rich Plasma [PRP] is being used now a days as an accelerator for bone regeneration in osseous defects.^[4] It can be used alone or in combination with other alloplast or xenograft materials. Autogenous PRP has numerous advantages over allografts in terms of increased biological processes like osteoinduction.^[5] This osteoinduction process is initiated by growth factors which are derived from platelets. When these platelets are present abundant in number, can produce large amount of growth factors initiating bone formation.^[6] Extraction of platelets from patients own blood can be done in labs via different procedures. PRP not only initiates bone regeneration but also initiates healing of surrounding tissues producing better results in bone as well as in surrounding areas.

Materials and Methods

This prospective study was carried out on 40 patients, age ranging from 10 to 14 years. Acute infection and medically compromised patients were excluded from study. Patients were randomly divided in group 'A' and 'B', each consisting 20 patients. Group 'A' was assigned as natural healing group and group 'B' was assigned as healing with graft. Cases of periapical

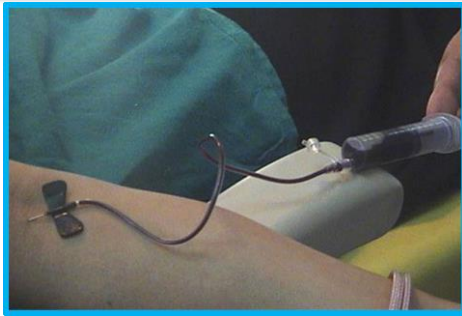


Fig. 1: Blood withdrawal



Fig. 2: Separated plasma and RBC's

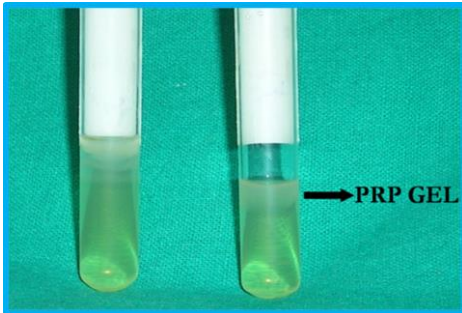


Fig. 3: Separate PRP from plasma



Fig. 4: PRP & H-A packed in osseous defect

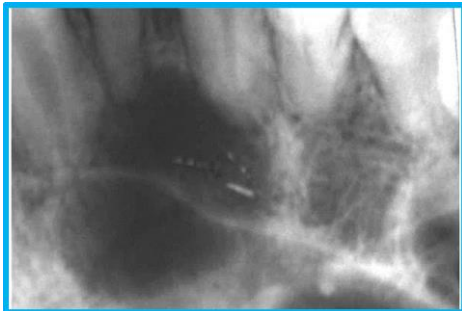


Fig. 5: 2nd week post op IOPA in Group "A"

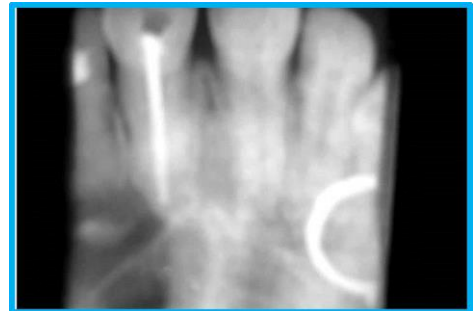


Fig. 6: 18th week post-op IOPA showing incomplete bone formation in Group "A"

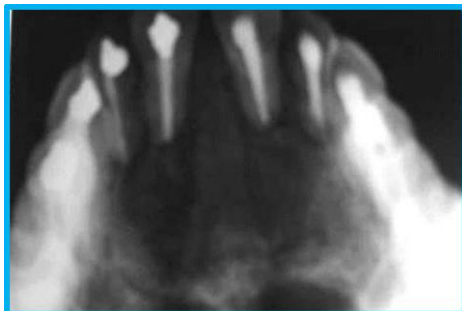


Fig. 7: 2nd week post op IOPA in Group "B"

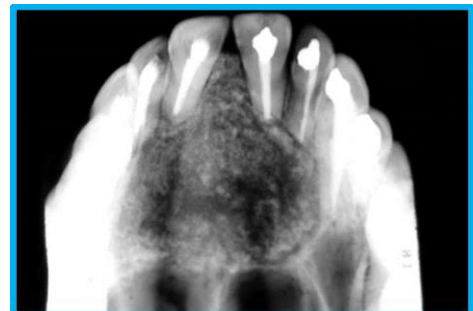


Fig. 8: 18th week post op IOPA showing bone formation in Group "B"

pathologies and bone defects after extraction were selected. The surgical procedure was performed to remove pathologies or tooth. In group A, complete debridement of the defect and curettage was done, no graft was placed into the defect. The flap was approximated and primary closure was done with 3-0 silk suture. Antibiotics (Amoxicillin 20mg/kg/day every 8 hourly) and

Ibuprofen 15-18 mg/kg/day every 8 hourly for 3 days were prescribed. In group 'B' patients, 10-20 ml blood was withdrawn (Fig. 1) and centrifuged at 20000 rpm for 20 minutes. This procedure produces separate layer of plasma visible on top layer of sample (Fig. 2) which was taken up and re-centrifuged for 15 minutes. Now 0.5 ml of 5% calcium chloride was added and hot water bath

Table I: Analysis of Pain in Group A

	1 st week follow up (n=20)	2 nd week follow up (n=20)	4 th week follow up (n=20)	12 th week follow up (n=20)	18 th week follow up (n=20)
Pain (mean±SD)	6.21±0.98	4.26±0.99	2.05±1.02	0.42±0.69	0±0
Change from 1 st week	-	1.947± 0.621	4.158± 0.958	5.789± 1.032	6.21±0.98

Table II: Analysis of Pain in Group B

	1 st week follow up (n=20)	2 nd week follow up (n=20)	4 th week follow up (n=20)	12 th week follow up (n=19)	18 th week follow up (n=18)
Pain (mean±SD)	5.95±1.39	3.53±1.39	1.00±0.58	0±0	0±0
Change from 1 st week	-	2.421± 0.692	4.947± 1.129	5.833± 1.339	5.833± 1.339

Table III: Incidence of Swelling in Group A

	1st week follow up		2nd week follow up		4th week follow up		12th week follow up		18th week follow up	
	No.	%	No.	%	No.	%	No.	%	No.	%
Present	20	100	12	63.16	0	0	0	0	0	0

Table IV: Incidence of Swelling in Group B

	1st week follow up		2nd week follow up		4th week follow up		12th week follow up		18th week follow up	
	No.	%	No.	%	No.	%	No.	%	No.	%
Present	18	94.74	6	31.58	0	0	0	0	0	0

Table V: Radiographic evidences of bone formation in Group A

	1stweek		2 nd week follow up		4 th week follow up		18 th week follow up	
	[No]	[Yes] mild/moderate/complete	[No]	[Yes] mild/moderate/complete	No	mild/moderate/complete	No	[Yes] mild/moderate/complete
	no	-	no	-	-	No/mild	-	Mild/moderate

Table VI: Radiographic evidences of bone formation in Group B

	1stweek		2 nd week follow up		4 th week follow up		18 th week follow up	
	[No]	[Yes] mild/moderate/complete	[No]	[Yes] mild/moderate/complete	No	mild/moderate/complete	No	[Yes] mild/moderate/complete
Radiopacity	no	-	no	-	-	Moderate	0	Complete

was given for 25 minutes. Separate plasma layer rich in platelets was taken out (Fig. 3) for clinical use and hydroxyapatite granules were mixed with it. Within minutes the mixture attains a gel like consistency which is packed into the defect to the level of surrounding bony wall (Fig. 4). Water tight closure of flap was done and post-operative medications were prescribed in same manner. Postoperative evaluation of all the patients was done at 1st, 2nd, 4th, 12th and 18th weeks to assess swelling, pain, healing and graft rejection. Visual analogue scale [VAS], radiographs and clinical observation were used as assessment tools for this purpose.

RESULT

There was significant reduction in pain at 2nd week and onwards till 18th week in Group A (Table 1). In Group B, there is significant reduction in pain at 2nd week and onwards (Table 2). No significant difference in first week and second week in both groups and both groups showed significantly lower pain score in 2nd week. In Group A, swelling was seen in all cases at 1st week follow up. On 2nd week there were 12 (60.00%) cases showing swelling. However, 4th week onwards there was no case of swelling (Table 3). In both groups, no swelling was observed 4th post-operative week onwards

indicating uneventful healing. Significant difference in second week was observed (Table 4). Radiographically in group A (Table 5), upto 2nd week follow up there was no evidence of bone formation (Fig. 5). On 18th week follow up, incomplete ossification was seen in all of the patients (Fig. 6). On the basis of radiographs, evidences of mild bone formation rate were observed. In group B (Table 6), upto 2nd week no evidence of ossification was seen (Fig. 7). On 4th week, evidence of beginning of ossification was seen in 19 (95.00%) patients. In one patient, follow up could not be performed after 3rd week. In the remaining 19 patients, marked ossification was seen by 12th week and complete ossification was seen at 18th week follow up (Fig. 8). Comparison of radiographic findings between two groups revealed no statistically significant difference till 2nd week follow up ($p > 0.05$, NS). On 18th week follow up, Group B had a significantly better response (Table 6) as compared to Group A ($p < 0.001$) (Table 5). Although in Group A, low rate of bone formation was noted as compared to Group B. It is significant to note that the quality of results achieved in Group B was significantly higher as compared to Group A.

DISCUSSION

Bone substitute materials are grafted to serve as a filler and scaffold to facilitate bone formation and promote wound healing. The present study was done to determine the efficacy of PRP with hydroxyapatite when grafted into the osseous defects in pediatric patients with age group ranging from 10-14 years having same pace of bone healing rate with minimal medically compromised conditions making our data more reliable and authentic. Hypothesis behind early bone formation in PRP cases was explained by different authors as a result of action of different growth factors. There are three main growth factors; i) platelet derived growth factors (PDGF); ii) transforming growth factors (TGF); iii) insulin growth factors (IGF). PDGF induces mitogenesis, angiogenesis, fibroblastic and osteoblastic activity and macrophage activation. TGF induces paracrine growth factors which acts on fibroblast, preosteoblast and marrow stem cells.^[7] IGF induces osteoblastic activity, maturation of bone and osteoclast mediated resorption.^[8] These processes take place to initiate bone formation as

well as replacement of debris from the site of grafting. Bone is deposited directly onto the surface of hydroxyapatite without intervening fibrous tissue.^[9] Hydroxyapatite is an osteoconductive graft material but does not stimulate osteogenesis. PRP bring about osteogenesis thus advancing front of new bone grows into the porous matrix of hydroxyapatite.^[10] Although it was difficult to use various graphic findings for reliable numerical data because it was difficult to get absolutely reproducible radiograph in all cases and interpretation is further complicated by the fact that density of graft was similar to density of surrounding bone, however an attempt was made to compare radio-opacity and trabecular pattern of bone in the defect to that of surrounding bone at the grafted site. Within the limits of the experimental and clinical studies, these results indicate that the PRP with hydroxyapatite met the requirement and can be used successfully as an adjunct in management of various osseous defects with lesser complications.

CONCLUSION

Bone substitutes are used for treatment of various osseous defects as well as periodontal diseases and traumatic defects. The use of autogenous bone has remained the gold standard in restoring bone defects, but it is not always possible to obtain enough bone or the amount of bone needed to fill the defect.^[5] Therefore biomaterials have been used as an alternative to autogenous bone grafts. Synthetic hydroxyapatite has been the most frequently used material because of its chemical composition that is similar to human bone. From this prospective comparative controlled clinical study, it can be concluded that; 1) There was a good clinical and radiographic response when PRP with hydroxyapatite was used; 2) There was excellent post-surgical healing response to PRP and hydroxyapatite treatment with no adverse complication; 3) At 18th post-operative week, there was advanced bone formation radiographically showing complete healing of the defect which was statistically significant. Therefore PRP with hydroxyapatite crystals for the management of osseous defects resulted in superior healing when compared to natural healing.

CONFLICT OF INTEREST & SOURCE OF FUNDING

The author declares that there is no source of funding and there is no conflict of interest among all authors.

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ISSN 2347-6249

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Oral Care
& Research***