



RESEARCH ARTICLE

USE OF PLATELET RICH PLASMA (PRP) WITH HYDROXYAPATITE IN POST SURGICAL JAW DEFECTS

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ABSTRACT

Objective: To evaluate the effect of Platelet-rich plasma (PRP) with hydroxyapatite (HA) in healing of post surgical osseous defects clinically and radio graphically. To evaluate the role of PRP in modifying the physiologic response to grafting of alveolar bone defects in maxillofacial region.

Methods: After selection according to inclusion and exclusion criterias, 40 patients were selected. All the patients were to undergo surgical enucleation of the cystic lesion or extraction of impacted mandibular teeth, followed by placement of platelet rich plasma (PRP) with hydroxyapatite in the surgical defect. Pre operative and post operative radiographs, ultrasonography and color doppler were utilized as diagnostic tools. Surgery was performed. After removal of the lesion/tooth the bone defect was packed with mixture of platelet rich plasma (PRP) and hydroxyapatite (HA). Closure of wound was achieved by interrupted sutures using 000 black silk with 16 mm 3/8 reverse cutting needle. The data was analyzed statistically.

Results: the findings of the study suggest that platelet rich plasma is a feasible method to treat post-treatment jaw defects with a very high success rate and very low rate of complications such as pain, swelling and infection. Ultrasonographic evaluation proved to be very beneficial in evaluation of bone formation and calcification whereas Color Doppler evaluation helped to predict the vascularization of the affected area thus showing the evidence of wound healing.

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INTRODUCTION

Regeneration may be defined as reproduction or reconstitution of a lost or injured part in order to restore form and function (Brunsvold and Melloni, 1993). Bone is a dynamic organ that can regenerate. The development of a bone regenerative enhancing material to replace bone remains a formidable challenge in modern dentistry. The use of various bone graft materials have rendered effective in the regeneration process. Platelet rich plasma [PRP] is an autologous concentration of human platelet in a small volume of plasma. Known for its high content of growth factors such as PGDF, TGF- β , insulin like growth factors etc, it allows the defect to heal faster along with rapid bone formation (Marx *et al.*, 1998). This study was planned to assess the osteogenic potential and clinical outcome

of PRP with Hydroxyapatite in alveolar osseous defects. The immediate and short term results were assessed clinically while bone regeneration was observed radiographically. The evaluation of the complications related to the grafting procedure and natural healing of bone in osseous defects were evaluated.

MATERIALS AND METHODS

The study was carried out on 40 patients selected from patient attending the outpatient department of Dental College, Regional Institute of Medical Sciences, Imphal, Manipur. The inclusion criteria included Patient in good physical health and free of systemic disease and those with either pre-existing bony defects caused by cystic cavity or undergoing surgical extraction of impacted mandibular molars. Patient suffering from malignancy or acute infections were excluded from the

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study. Informed consent was obtained and oral prophylaxis was performed for all the patients.

Pre and post operative evaluation

Pain was evaluated by the visual analogue scale (VAS) preoperatively and post operatively. A scale of 0-5 was used to assess the intensity of pain, 0 means no pain and 5 being the most acute.

additionally observe the healing pattern in selected cases both pre and post operatively. Routine blood examination along with RBS and HIV were performed.

Procedure: Pre operative preparation included oral prophylaxis, RCT, if required followed by preparation of Platelet rich plasma (PRP).

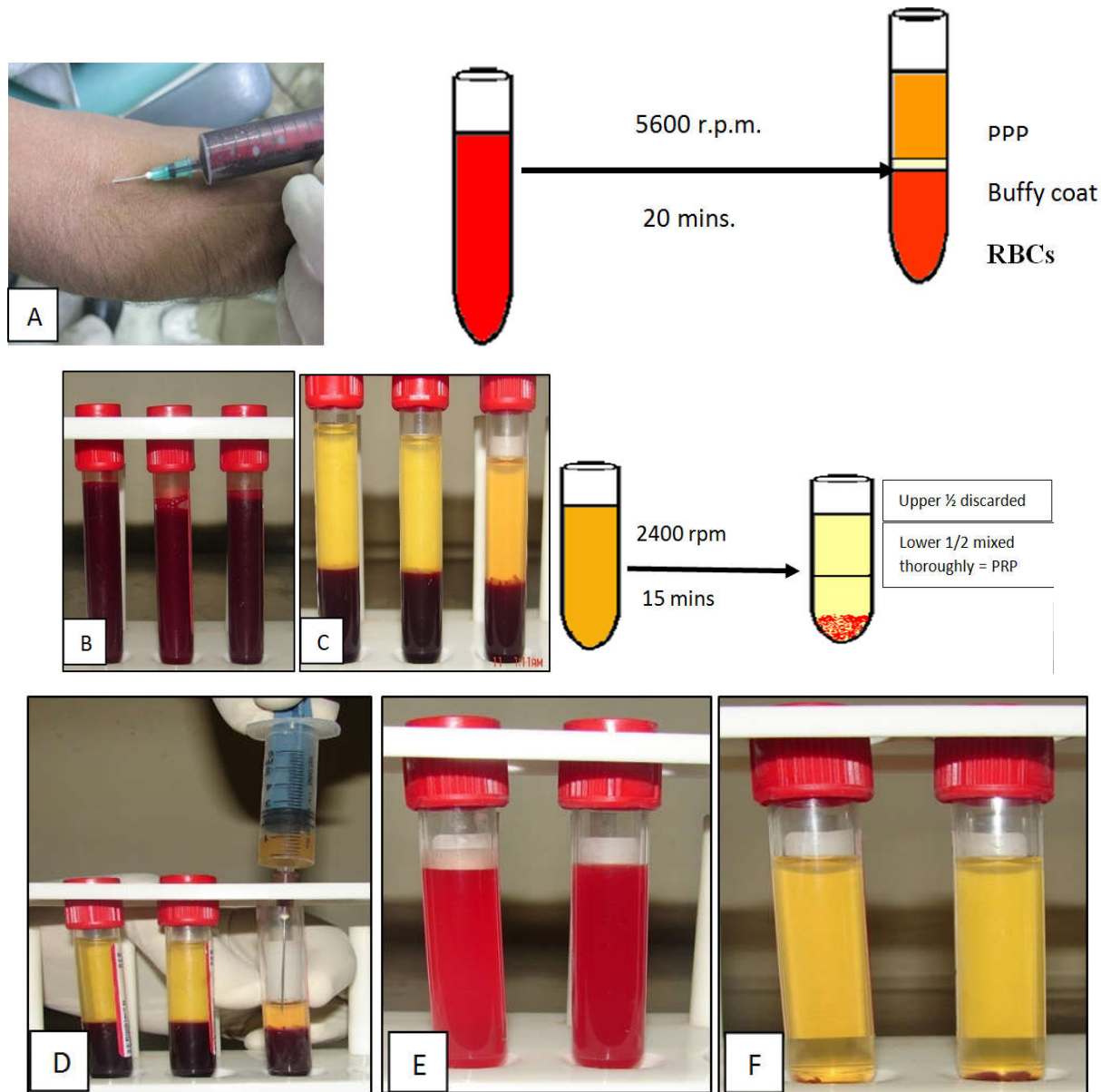


Fig. 1. PRP Preparation A. Drawing of blood. B. Drawn blood. C. After 1st Spin. D. Separating Plasma and Buffy coat. E. Plasma + Buffy coat. F. After 2nd spin

The patient was asked to place a mark on the location of line that the best described his or her pain pre-operatively. Radiographs which included Intra-Oral Periapical Radiograph (IOPA) at regular intervals, OPG, occlusal view (if required) and Para-nasal sinus (PNS) (if required). The radiographs were taken immediately, 1st month, 3rd month and 6th months postoperatively.

Ultrasound (Fig 3)

An ultrasonographic examination and color power was done by using 10-20 MHz linear array transducer by extra oral application of the probe as an additional diagnostic tool to

Preparation of PRP (Fig 1)

15-20 ml of autogeneous venous blood was withdrawn was placed in test tube containing 3.2% sodium citrate in a ratio of 100 μ L/ml of blood followed by two step centrifugation technique. The first centrifugation was done at the rate of 5600 rpm for 20 minutes. As the blood was centrifuged, it separated into three basic components as a function density.

The upper most layer was the PRP which was carefully withdrawn with a pipette and re-centrifuged at the rate of 2400 rpm for 15 minutes. PRP gel was formed by initiating the

coagulation process with 10% calcium chloride (50µl/ml) which was measured with the help of micropipette. The test tube was then placed in a water bath at a temperature of 37°C for 20 minutes for completion of the gel formation. Hydroxyapatite crystal (G-bone graft) of size 0.4 to 0.9 mm in diameter was added to the PRP gel to form a jelly-like mixture which was used to fill the bone defect.

of wound was achieved by interrupted sutures. Statistical analysis was done using SPSS 13.0

RESULTS

The present study was conducted with the objective to assess the effect of platelet rich plasma with hydroxyapatite in the treatment of post surgical jaw defects.

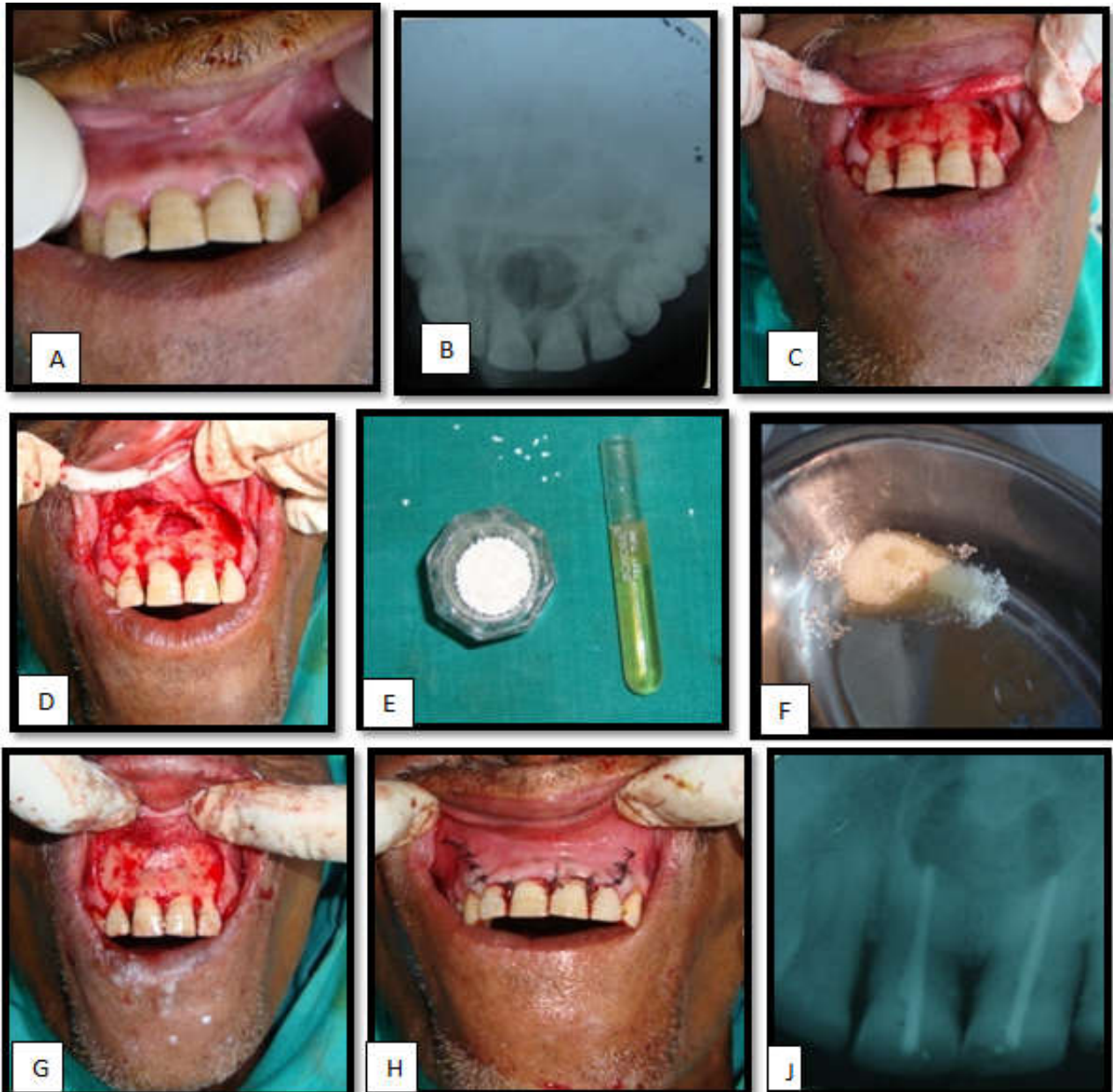


Fig. 2. Apicoectomy (maxillary central incisors) defect closed with PRP & hydroxyappetite. A. Preoperative view Intraorally. B. Preoperative view Intraorally . C. Trapezoidal Incision given and mucoperiosteal flap raised intraorally. D. Cyst excised. E. PRP and hydroxyappetite. F. Platelet rich plasma gel mixed with hydroxyapatite. G. PRP placed in defect. H. Closure done with 3-0 silk suture I. Postoperative IOPA X-ray

Surgical procedure (Fig 2)

A full thickness mucoperiosteal flap was raised exposing the bone defect. Bone cutting was done and apicoectomy was performed, when required. The pathological site was curetted removing the lining and granulation tissue. Adequate toileting of wound was done with normal saline solution. Obturation of teeth/tooth was done with guttapercha. After removal of the lesion /tooth the bone defect was packed with mixture of platelet rich plasma (PRP) and hydroxyapatite (HA). Closure

Table 1. Presenting Complaints

| S.No. | Complaints | No. of patients | Percentage |
|-------|-----------------|-----------------|------------|
| 1. | Pain | 37 | 92.5 |
| 2. | Pus discharge | 6 | 15.0 |
| 3. | Swelling | 2 | 5.0 |
| 4. | Sinus formation | 7 | 17.5 |

Pain was the most common complaint reported by 37 (92.5%) of patients, discharge from the affected site was reported by 6

(15%) subjects while swelling and sinus formation were reported by 2 (5%) and 7 (17.5%) patients.

Post-operative assessment

On statistical evaluation comparing the immediate post-op pain value with pain at different time intervals revealed a statistically significant difference was observed at all time intervals ($p < 0.001$).

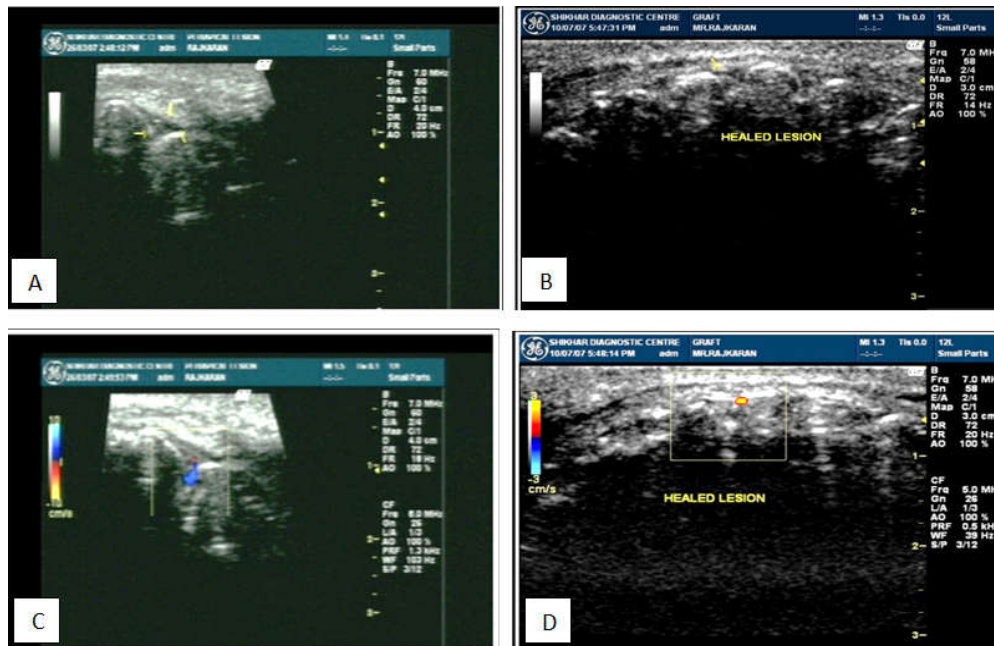


Fig 3. A & B Ultrasonographic examination **A.** Preoperative examination **B.** Postoperative 12 weeks. **C & D** Color Power doppler examination. **C.** Preoperative. **D.** Post operative 12 weeks

Table 2. Pain

| S.No. | Time Period | Grade of Pain (using VAS criteria) | | | | Significance of change from baseline (Wilcoxon Signed rank test) | |
|-------|----------------------------|------------------------------------|----------------|--------------------|-----------------|--|--------|
| | | No pain (VAS=0) | Mild (VAS 1-2) | Moderate (VAS 3-4) | Severe (VAS =5) | z | p |
| 1. | Immediate post op. – Day 0 | 0 | 39 (97.5%) | 1 (2.5%) | 0 | - | - |
| 3. | At 1 week | 0 | 39 (97.5%) | 1 (2.5%) | 0 | 6.083 | <0.001 |
| 2. | At 1 month | 36 (90%) | 4 (10%) | 0 | 0 | 6.164 | <0.001 |
| 3. | At 3 months | 37 (92.5%) | 3 (7.5%) | 0 | 0 | 6.164 | <0.001 |
| 4. | At 6 months | 37 (92.5%) | 3 (7.5%) | 0 | 0 | 6.164 | <0.001 |

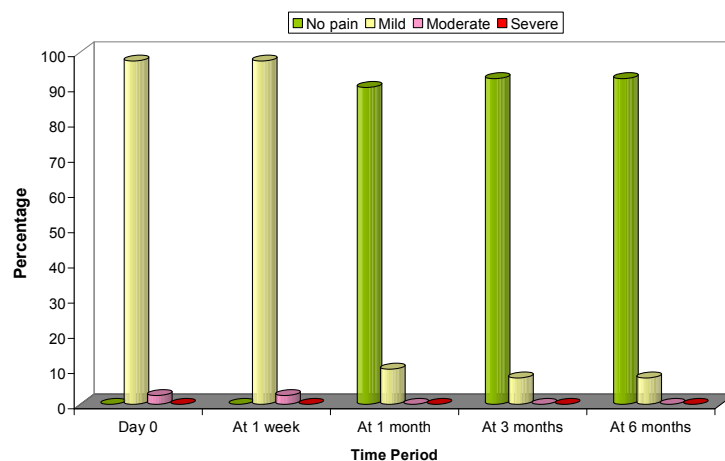


Table 3. Swelling

| S. No. | Time Period | No. of patients | Percentage | Significance of change from Pre-op. | |
|--------|----------------------------|-----------------|------------|-------------------------------------|--------|
| | | | | χ^2 | P |
| 1. | Immediate post op. – Day 0 | 39* | 97.5 | - | - |
| 2. | At 1 week | 0 | 0 | 76.098 | <0.001 |
| 3. | At 1 month | 2 | 5 | 68.493 | <0.001 |
| 4. | At 3 months | 2 | 5 | 68.493 | <0.001 |
| 5. | At 6 months | 2 | 5 | 68.493 | <0.001 |

*All the subjects showing swelling had mild swelling as per the criteria defined in Materials and Method section.

Table 4. Infection

| S. No. | Time Period | No. of patients | Percentage | Significance of change from Immediate post-op. interval | |
|--------|----------------------------|-----------------|------------|---|-------|
| | | | | χ^2 | P |
| 1. | Immediate post op. – Day 0 | 5 | 12.5 | – | – |
| 2. | At 1 week | 1 | 2.5 | 2.883 | 0.090 |
| 3. | At 1 month | 1 | 2.5 | 2.883 | 0.090 |
| 4. | At 3 months | 2 | 5.0 | 1.409 | 0.235 |
| 5. | At 6 months | 2 | 5.0 | 1.409 | 0.235 |

Table 5. Radiological Evaluation for Calcification

| S. No. | Radiological evaluation for calcification | No. of patients | Percentage | Significance of change from 1 month interval | |
|--------|---|-----------------|------------|--|--------|
| | | | | χ^2 | P |
| 1. | Immediate post op. – Day 0 | 0 | 0 | – | – |
| 2. | At 1 month | 11 | 27.5 | – | – |
| 3. | At 3 months | 19 | 47.5 | 3.413 | 0.065 |
| 4. | At 6 months | 38 | 95 | 22.029 | <0.001 |

Table 6. Radiological Evaluation for Trabeculae Formation

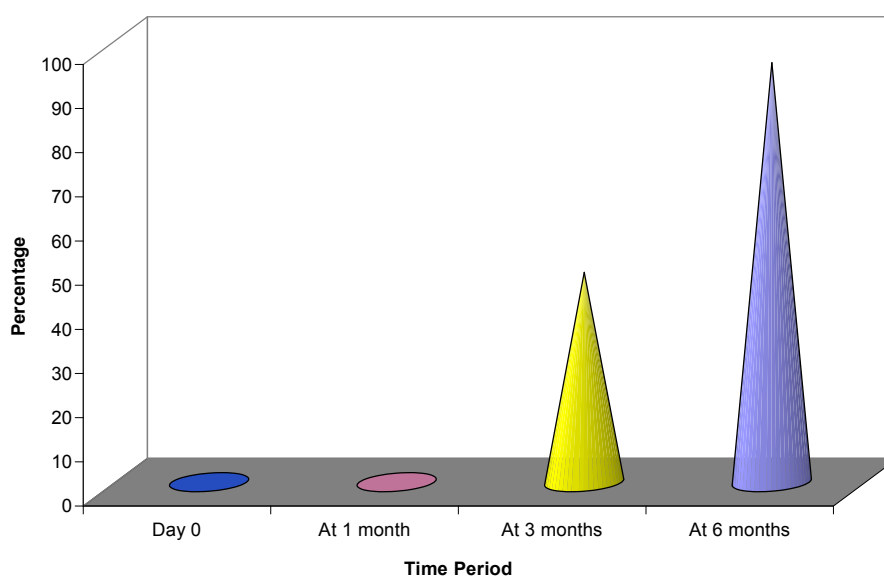


Table 7. Ultrasonological Findings (n=6)

| S.No. | Time interval | Anechoic | Hypoechoic | Echoic |
|-------|---------------|----------|------------|------------|
| 1. | At 1 months | 6 (100%) | 0 | 0 |
| 2. | At 3 months | 0 | 1 (16.7%) | 5 (83.33%) |
| 3. | At 6 months | 0 | 0 | 6 (66.7%) |

Table 8. Graft Rejection

| S.No. | Graft Rejection | No. of patients | Percentage |
|-------|-----------------|-----------------|------------|
| 1. | No | 38 | 95.0 |
| 2. | Yes | 2 | 5.0 |

DISCUSSION

PRP has been used alone as a gel or combined with autogenous bone grafts or alloplastic materials in order to enhance healing of bony defects (Merckx *et al.*, 2004; Dean *et al.*, 1997; Shanaman *et al.*, 2001; Kim *et al.*, 2001). The present study combined PRP with Hydroxyapatite and found that early bone regeneration occurs in the bony defects which are filled with mixture of PRP and Hydroxyapatite. The results obtained were satisfactory with good enhancement of wound healing. The cystic bone defects showed consolidation within 3 months. However many clinicians do not support the utilization of PRP with alloplastic materials as they support minimally to the regeneration process (David Gerard *et al.*, 2006). Hydroxyapatite $\text{Ca}_{10}(\text{OO}_4)_6(\text{OH})_2$ is the primary

mineral component of bone. The synthetic hydroxyapatite grafts are osteophilic, osteoconductive and acts primarily as inert biocompatible filler. Kenny *et al.* (2001) provided evidence suggesting that Hydroxyapatite supports bone formation (Kenny *et al.*, 1986). Other studies also proved that Hydroxyapatite generally is osteoconductive but not osteoinductive, it acts as a trellis for the in growth & subsequent deposition of new bone. A recent study by Hallman *et al.* (2001) showed that crystalline bone substitutes such as bovine or synthetic HA along with PRP may be advantageous in maxillary sinus augmentation for placement of dental implants. The reasons include that they are radiographically opaque and therefore it is easier to monitor volume changes, they are less prone to unpredictable resorption than autogenous free, non vascularized bone grafts, and they produce new bone with high density (Hallman *et al.*, 2001). Robert E. Marx (1998) described PRP as a growth factor enhancement for bone grafts (Robert *et al.*, 1998). Significant radiographic early maturation has been noted in the study group of the present study at 1 month and 3 months post op intervals. But at 6 months post op, both the control and the study groups showed similar radiodensities. Ultrasound was used to detect the vascular changes occurring post treatment which cannot be done by traditional radiographical methods. Vascular changes are the most important features that occur during the healing phase of any lesion (Rajendran and Sundaresan). Ultrasound provides a stronger evidence of bone formation even at

cartilaginous stage, though radiograph sometimes fails to provide evidence of cartilage formation, ultrasound provides the evidence in form of echoic patterns. The role of PRP in acceleration of osteogenesis is one of the key factors in providing this evidence. Results showed that PRP had significantly less swelling (*i.e.* $p < 0.001$) in the first post operative week, while the remaining post operative phase was similar. The probable reason being the macrophage activation by the principal growth factors *i.e.* PDGF which results in debridement of wound site along with removal of inflammatory products at the same time providing promoting second phase source of growth factors. Marx reports 2%- 3.5% post operatively infection rate when PRP was used. Our experience revealed a statistically significant difference in post operative infection rate *i.e.* study group has less incidence (*i.e.* $p = 0.235$) in comparison to control group. We conclude that the low infection rate in the study has been achieved by strict aseptic technique of procuring PRP and meticulous surgical procedures (Robert *et al.*, 1998). Apart from accelerating the bone formation PRP also helps in tissue regeneration and wound healing. In present study, while wound healing can be identified through clinical examination itself, color doppler provides a better evidence of vascularisation in the healed tissue. The accelerated osteogenesis requires substantial vascularity in order to keep the process of bone formation going on.

Conclusion

The findings of the study suggest that platelet rich plasma is a feasible method to treat post-treatment jaw defects with a very high success rate and very low rate of complications such as pain, swelling and infection. Ultrasonographic evaluation proved to be very beneficial in evaluation of bone formation and calcification whereas Color Doppler evaluation helped to predict the vascularization of the affected area thus showing the evidence of wound healing.

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