Original Article

Platelet-rich plasma, valuable adjunct in wound healing-A comparative study

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Abstract

Introduction

To evaluate the efficacy of autologous platelet rich plasma in soft tissue healing and bone regeneration in mandibular first premolar (for orthodontic treatment) extraction sockets.

Methods:

The study was conducted in 20 patients visiting in outpatient department of Oral and Maxillofacial Surgery from February 2012 to July 2012, requiring extraction of bilateral mandibular first premolar, following extraction platelet rich plasma (PRP) was placed in one extraction sockets, the other socket was studied as the control sites with no PRP. The patients were assessed for post opertive pain, soft tissue healing and trabecular pattern in healing bone. Radiological assessment of the extraction site was done for period of 3 months to evaluate the change in bone density.

Results:

Pain was less in study side compare to control site, soft tissue healing was better in study site. Evaluation of trabecular bone farmation started earlier in PRP site compares to control site. The evaluation of bone density by radiological assessment showed the grey level value calculated after 3 months at the PRP site was comparatively higher than the average baseline value of the bone density at the extraction site in control site.

Conclusion:

The study showed that autologous PRP is biocompatible and has significantly improved soft tissue healing. Bone regeneration and increase in bone density in extraction sockets. However, a more elaborate study with a large number of clinical cases is essential to be more conclusive regarding its efficacy.

Key words:

Bone density, pain, platelet rich plasma, soft tissue healing.

Introduction:

Maxillofacial reconstructions, oral implants, regenerative procedures etc. are highly dependent on successful regeneration and healing, and one of the great challenges faced in clinical research in development of bioactive surgical additives regulating inflammation and increasing healing[1].

Bone regenerative techniques including graft materials, protein and barrier membrane are often used to improve the bone quality. Healing in tissues is mediated by variety of signaling proteins. Understanding of this process at microcellular level is still not complete, but it is proven fact that platelets do play an important role in wound healing. Platelet rich plasma is an immune and platelet concentrate containing all the constituents of a blood favourable for healing and immunity. Through platelet and leukocyte, cytokines play an important part in the biology of this biomaterial; potential of PRP[2]. To understand the biologic effect of this PRP matrix, it is important to divide clinical observations into four highly specific aspects of healing angiogenesis, immune

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control, harnessing the circulating stem cells, and wound protection by epithelial cover. Angiogenesis, immunity and epithelial cover are the three keys to healing and soft tissue maturation. PRP is able to simultaneously support the development of these three phenomena. The angiogenesis property of PRP matrix is explained by the 3 dimensional structures of the PRP gel and by the simultaneous action of cytokines trapped in the meshes. The structure and mechanical properties of the PRP are important factors. The rigidity of the matrix considerably influences the capillary formation by endothelial cells in response to fibroblast growth factor (FGFb) or vascular endothelial growth factor (VEGF) stimulation.

Furthermore main angiogenesis soluble factors such as FGFb, VEGF and platelet derived growth factor (PDGF) are included in PRP. Fibrin and fibrinogen degradation products (FDP) stimulate the migration of neutrophil and increase the membrane's expression of CD11 c/CD 18 receptor. This receptor permits adhesion of the neutrophil to endothelium and fibrinogen as well as the transmigration of neutrophils. Moreover, the phagocytosis of neutrophils and the enzymatic degradation process are modulated by FDP and hence fibrin also plays an important role in immunity control. Studies have shown that PRP appears to be superior to collagen as a scaffold for human periosteal cell proliferation and, rapid healing of the wound is observed without pain, dryness or purulent complications.

Technical Aspect of PRP Preparation

Approximately 5-10 ml of venous blood is drawn from patient and transferred to test tubes containing a citrate-phosphate-dextrose anticoagulant. The blood first is centrifuged at 5,600 rotations per minute(rpm) to separate the platelet-poor plasma from the erythrocytes, platelets and leukocytes. The centrifuge speed then is slowed to 2,400 rpm to allow for further separation of the platelets and leukocytes from the red blood cell pack. Removal of this red blood cell pack yields of plasma with the concentrated platelets. This study was undertaken at the Department of Oral and Maxillofacial Surgery, Kantipur Dental College' Teaching Hospital and Research Centre. This study involved both male and female patients, who were referred to the department of oral and maxillofacial surgery for removal of mandibular first premolar.

Inclusion Criteria

1. Patient aged between 12 and 22 years
2. Patients requiring bilateral mandibular 1st premolar extraction
3. ASA grade 1
4. Patient was non-smoker

After obtaining the complete history patient was examined clinically and was explained about the procedure, its complications and the follow up period involved in the study. Informed consent was taken; study sample included 20 patients. All patients were operated by a single operator. All patients underwent bilateral removal of 1st premolar in single appointment and autologous PRP of that patient was prepared as per the above mentioned protocol. PRP was then placed in the extracted socket on one side and other side was taken as control group. Both sockets were closed primarily by resorbable sutures. All patients were recalled on day 1, 3, 7, 1st, 2nd and 3rd month post-operatively for follow up study. Clinical evaluation included assessment of pain, soft tissue healing. Pain was evaluated by visual analogue scale. Evaluation of soft tissue healing by Landry and Turnbull. IOPA radiograph was taken pre-operatively and 4, 8, 12 week post-operatively to assess and compared radiographic bone density between PRF sites and non PRP sites. All data was statistically analyzed with the help of student t test and ANOVA test.

Results

Following the completion of clinical study on the patients, the measurement and data taken from all the patients were tabulated for statistical studies and after the analysis of data following observation was made.

There were 10 (50%) male subject and 10 (50%) female subject who participated in the study. The patients who participated in the studies were of 12-22 years with mean age of 17 years.

Results of Clinical Assessment

Assessment of Pain (Chart I)

Assessment of pain was visual analogues scale of the 1st day showed mean pain score of 3.6 in study site and 3.8 in control site. On 3rd day mean pain score was 1.6 in the study site and 1.8 in control site. On seventh day pain was 0 in both control and study site. Though

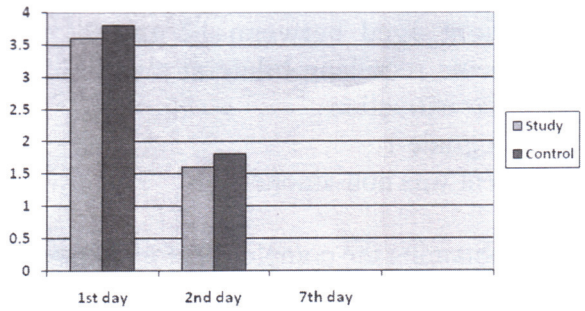

Chart I

pain was less in study site compared to control side there was no statistically significant difference between study and control group and 1st, 3rd day (P = 0.005) and 7th day (P = 0.035).

Assessment of Healing Index of Soft Tissue (Chart II)

Assessment of soft tissue healing index by Landry, Turnbell and Howley showed mean scores on 1st day of 3.4 in study site, 2.9 in control site. On 3rd day 4 in study site, 3.2 in control site and on 7th day mean score of 4.8 in a study site and 4.3 in control site. By doing repeated ANOVA measure test for study and control group healing was better in study site compared to control site. Between 3rd and 7th day P value for 3rd day was P = 0.022 and 7th day P = 0.015. There was significant difference between study and control site in all 20 patients.

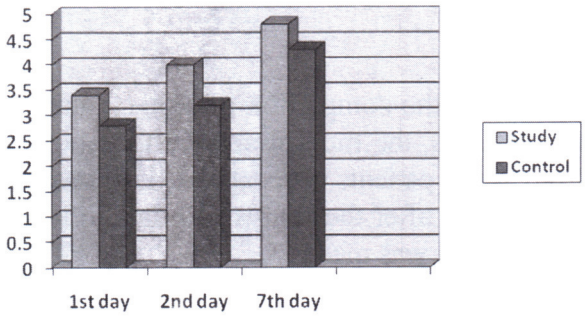

Chart II

Radiographic Assessment (Chart III)

Radiographic assessment at 4 week showed trabecular bone formation in 8 patients at study site but absent in all 20 control site. At 8 week trabecular bone formation seen in 18 patients in study site but only in 10 patients in control site (P = 0.063). There was no significant difference between study and control site. At 12 week trabecular bone formation was seen in all 20 patients including test and control site. Assessment of bone density (Gray level value) at 12 week showed that

Chart III

average gray scale value for PRP (study) site (146.9) was comparatively higher than non- PRP(control) site

Mean Pain Score

Chart I Assessment of pain using VAS post operative

Score

Chart II Assessment of healing index post operative

Discussion

There are several allografts, xenograft or alloplastic graft materials commonly used for bone regeneration procedures like freezed dried bone grafts, demineralised freezed dried bone grafts, hydroxyapatite, bioactive glass etc. which have shown to possess good osteoinductive and osteoconductive properties, but risk of disease transmission and unpredictable outcome many a times, led to search of materials which can independently produce predictable regeneration or can improve properties of these graft materials PRP has been referred as first generation and PRF (Platelet rich fibrin) is second generation platelet concentrate[3]. A report of clinical trials comparing the growth factors content of PRF and PRP was presented[4] by Dohan and Diss at the second international Symposium on growth factors held in May 2005. Combining the growth factors has been shown to accelerate bone repair and promote fibroblast proliferation[5] and increase tissue vascularity, rate of collagen formation[6], mitosis of mesenchymal stem cells and endothelial cells,[7] as well as osteoblasts, playing key roles in the rate and extent of bone formation[8]. This activity, together with increased vessel ingrowth, is mediated by PDGF and TGF. Its chief advantages include ease of preparation and lack of biochemical handling of blood which makes this preparation strictly autologous. It provides adhesiveness and tensile strength for clot stabilization. PRP is natural guide of angiogenesis, traps the circulating stem cells, and provides wound protection[9] by epithelial cover. Several

authors have demonstrated that a fibrin matrix provide an optimal support to mesenchymal stem[10,11] which contribute to regeneration of bone cells and many other tissues and helps in osseous defect healing. Because of all of these powerful effects on tissue regeneration, a growing number of human clinical studies have detailed the use of growth factors in reconstructive oral and maxillofacial surgery, periodontal surgery, implants, and sinus grafting. Its preparation is technically easy and cost effective as the steps of addition of thrombin or anticoagulant are eliminated. Few studies have shown that PRP releases growth factors before there is cell outgrowth in surrounding tissues, thereby limiting its regeneration potential. Our results regarding enhanced soft tissue healing and increased rate of bone formation are due to above mentioned properties of PRP.

Conclusion

In this study, autologous PRP was used as an adjunct to promote healing and osseous regeneration in human mandibular 1st premolar extraction site. The improvement of wound healing, decrease in pain and increase in bone density signifies and highlights the use of PRP as a valid method in promoting and accelerating soft and hard tissue regeneration. The procedure of PRP preparation is simple, cost effective and demonstrated good results. The present study was done with follow up of 3 months; further clinical trials with longer duration of follow up with larger sample size should be done to get more affirmative and conclusive results.

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