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Original Article

Alveolar bone graft with Platelet Rich Plasma in cleft alveolus

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ABSTRACT

Introduction: Cleft of the lip, palate and alveolus are the commonest congenital anomaly to affect the orofacial region. Currently, there is great interest in the alveolar bone grafting procedures that involve use of platelet-rich-plasma (PRP), to enhance bone formation and specifically to promote bone graft healing.

Materials and methods: 20 patients with residual alveolar cleft, in the age group of 9–29 years, having unilateral or bilateral cleft lip and palate were selected. They were randomly assigned in either group A (with PRP) or group B (without PRP).

Results: Primary healing was observed in 90% patients in group A. Secondary healing was seen in 30% patients in group B. There was no graft rejection in group A but was seen in one patient (10%) in group B. Pain and swelling persisted longer in group B than group A. Bone grafts with added PRP presented with increased bone density (1028.00 ± 11.30 HU) in comparison to grafts without PRP (859.50 ± 27.73 HU) at end of 6-month postoperative. However, the mean bone density (as determined by the Dentscan image analyzer software) was 1.04 times more in the PRP group than non PRP group at 3-month and 1.2 times more at 6 months.

Conclusion: We conclude that on preliminary investigations, PRP seems to enhance bone formation in alveolar clefts when admixed with autologous cancellous bone harvested from the iliac crest.

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1. Introduction

Clefts of the lip, palate and alveolus are the commonest congenital anomaly to affect the orofacial region, for which efforts have been made to classify and repair, since the time of Veau (1931). Repair of cleft alveolus is an adjunctive procedure to further improve the functional and esthetic rehabilitation of patient with unilateral or bilateral cleft lip and palate, and is recommended during the mixed dentition period.¹

Currently, there is a great interest in the alveolar bone grafting procedures that involve use of platelet-rich-plasma (PRP), to enhance bone formation and specifically to promote bone healing.² Use of PRP is based on the premise that its platelets release statistically significant quantities of growth factors to aid in bone graft maturation. Also, PRP acts as a fibrin glue.³ The adhesiveness of this gel enables predictable flap adaptations and hemostasis. Due to its acidic nature, PRP also reduces the chances of infection. As PRP concentrates WBC's and platelets to cause early vascularization, bring in circulating macrophages and neutrophils and create a more oxygen rich environment, the chances of infection are further reduced.

The current state of the art in-growth factor-aided tissue engineering with regard to reconstruction of the alveolar cleft is use of bone morphogenetic protein (BMP), transforming growth factor beta, platelet-derived growth factor, insulin-like growth factor, fibroblast growth factor, vascular endothelial growth factor and platelet-rich-plasma.⁴ It is interesting to know that biphasic calcium phosphate (BCP) mixed with autologous bone has not been found to interfere with dental eruption or maxillary growth.⁵ Closure of wide alveolar clefts using mid face distraction has been reported as an alternative treatment modality.⁶

This study was planned with an aim to evaluate the efficacy of PRP for secondary alveolar bone graft procedure.

2. Material and methods

20 patients with alveolar cleft, in the age group of 8–30 years, with unilateral or bilateral cleft lip and palate, who visited the outpatient clinic of Department of Oral and Maxillofacial Surgery, King George's Medical University, Lucknow and Vivekananda hospital, Lucknow, from July 2011 to November 2012, were selected. The patients were randomly divided into two groups, the test group A (10 patients) received cancellous bone graft from the anterior iliac crest mixed with PRP, while the control group B (10 patients) received the same without PRP.

Alveolar bone grafting was performed under GA using standard surgical methodology for secondary alveolar bone grafting. Autogenous cancellous bone chips from the anterior iliac crest and PRP gel was mixed to obtain a gel-like consistency. This mixture was then packed into the alveolar cleft and closed with gingival mucoperiosteal flaps.

Clinical assessment was based on wound healing, pain, swelling, discharge, and dehiscence. Bone density of the grafted bone was assessed with Dentscan, using pixel tools image analyzer software, at regular postoperative follow up of 1, 3 and 6 months.

3. Results

In this study, secondary alveolar bone grafting was performed in all the cases and most patients were adults. 2 patients (20%) in group A and 3 (30%) in group B were in mixed dentition period, whereas 8 patients (80%) in group A and 7 (70%) in group B received late secondary repair.

Primary healing was observed in 90% patients, while rest 10% healed secondarily within 180 days in group A. Secondary healing was seen in 30% patients in group B. There was no graft rejection in group A but in one patient (10%) in group B, but managed with frequent irrigation and dressings to promote secondary healing. However, there was no statistically significant difference between the two groups.

Pain and swelling persisted longer in group B then group A, but the difference was not statistically significant. Although, discharge was present in one patient in group A (10%) and 4 (40%) in group B, but resolved within 90 days; the difference in both groups was not statistically significant.

Bone grafts with added PRP presented with increased bone density (1028.00 ± 11.30 HU) in comparison to grafts without PRP (859.50 ± 27.73 HU) at end of 6-month postoperative (Tables 1–3). A statistically significant improvement in the density was found. However, the mean bone density (as determined by the Dentscan image analyzer software) was 1.04 times more in the PRP group than non PRP group at 3 months and 1.2 times more at 6 months (Figs. 1 and 2).

4. Discussion

The accepted time for secondary alveolar cleft repair is between 6 and 12 years. Usually children with cleft lip, alveolus or palate have undergone multiple surgeries viz. lip closure within 3 months of birth, palate around two years of age; due to which there is sufficient scar tissue formation. Furthermore, revision surgeries and tooth removal compromise the potential recipient tissue in the alveolar cleft. In India and other developing countries, lack of awareness and scarcity of surgeons further complicates potential reconstruction, as many individuals do not have access to reconstructive and dental procedures until they are well into their teenage years or even into their 20s and 30s as seen in our study where most of the patients were adults.

Primary healing using PRP in our study was similar to other reported studies.^{7–10} Although, the rate of graft rejection was more in group B than A, the difference was not statistically significant. The incidence of wound dehiscence, graft infection, graft loss and redevelopment of oronasal fistula have been shown to increase with age.

Discharge was seen in less patients when PRP was used because PRP primarily due to its acidic pH (6.5–6.7) inhibits bacterial colony growth. Secondly, PRP concentrates WBCs and platelets to cause bacterial inhibition by greater number of functionally viable leucocytes. Thirdly, rapid development of granulation tissue by early in-growth of capillaries prevents bacterial growth by bringing in circulating macrophages and neutrophils. Thus, creating an oxygen rich environment suppresses the growth of anaerobic micro-organisms.

Table 1 – Comparison of bone density improvement at different time interval in PRP group.

(N = 10)	Bone density (mean $\pm$ SD)	Change in bone density from post-op. (mean $\pm$ SD)	't'	'p'	Sig.
Post-op 1 week	865.50 $\pm$ 12.56	—	—	—	
1 Month	831.50 $\pm$ 21.35	–35.0 $\pm$ 19.00	5.82	<0.001	Sig.
3 Month	869.50 $\pm$ 28.32	3.00 $\pm$ 20.57	0.46	0.86	NS
6 Month	1028.00 $\pm$ 11.30	161.50 $\pm$ 100.00	5.10	<0.001	Sig.
Negative bone density reduction. Positive improvement in bone density.					

Table-1 shows that, at 1 month there was statistically significant reduction in bone density at 1 month, at 3 month there was not statistically significant difference in bone density at 3 month and post-operative bone density (Bone recover at it was at post-operative), at 6 month there was statistically significant improvement in bone density at 6 month from post-operative.

Table 2 – Comparison of bone density improvement at different time interval in control group.

(N = 10)	Bone density (mean $\pm$ SD)	Change for post-op. (mean $\pm$ SD)	't'	'p'	Sig.
Post-op 1 week	866.50 $\pm$ 9.36	—	—	—	
1-month	821.50 $\pm$ 10.01	–44.50 $\pm$ 10.91	12.87	<0.001	Sig.
3-month	835.50 $\pm$ 18.47	–30.50 $\pm$ 19.06	5.06	<0.001	Sig.
6-month	859.50 $\pm$ 27.73	–6.50 $\pm$ 27.10	0.75	0.47	NS
Negative shows reduction in bone density.					

Table-2 shows that, at 1 month and 3 month there was statistically significant bone reduction in bone density at 1 month and 3 month, at 6 month there was not statistically significant difference in bone density at 6 month and post-operative (But slightly less at 6 month then post-operative).

Table 3 – Comparison of bone density improvement in group A and group B.

	Group A (mean $\pm$ SD)	Group B (mean $\pm$ SD)	't'	'p'	Sig.
1-month	-35.0 ± 19.00	-44.50 ± 10.91	11.61	<0.001	Sig.
3-month	3.0 ± 20.57	-30.50 ± 19.06	3.82	<0.001	Sig.
6-month	161.50 ± 100.00	-6.50 ± 27.10	5.37	<0.001	Sig.

Table-3 shows statistically significantly improvement in bone density at 1, 3 and 6 months in Group-A (PRP Group).

Fig. 1 – Alveolar bone grafting with PRP radiological assessment. (a) Preoperative axial view of Dentascan showing right alveolar cleft. (b) Axial view of Dentascan at 1 month postoperative showing increase radiodensity. (c) Axial view of Dentascan at 3-month follow up. (d) Axial view of Dentascan at 6-month showing healed alveolar cleft.

Fig. 2 – Alveolar bone grafting without PRP radiological assessment. (a) Preoperative coronal view of Dentascan showing left alveolar cleft. (b) Coronal view of Dentascan at 1 month after alveolar bone grafting. Follow up Dentascan. (c). Coronal view of Dentascan at 3 months. (d) Coronal view of Dentascan at 6 months showing healed alveolar cleft.

Murukawa¹¹ observed that PRP reduces postoperative bone resorption.

In our study, bone chips were harvested from the anterior iliac crest using trephine method and none of the patients reported any complications. Frequently cited complications of iliac bone harvesting are gait disturbances, post surgical pain, excessive blood loss and paresthesia as reported in earlier studies.¹² All patients were mobilized on the first post-operative day and they walked normal in a week's time, without any gait disturbance. This finding was in accordance with the study of McGurk¹³ who used hand powered trephine that penetrated up to 8 cm in length. His results of 20 patients indicated no complications and reduced post-operative pain.

Bone graft studies using autogenous marrow from the ilium have shown capillary in-growth within 5–6 days without PRP versus 3 days with PRP and complete revascularization by 20 days without PRP versus 14 days with PRP. Studies by Marx⁷ provide evidence that addition of PRP to milled bone graft obtained from posterior ilium increased the rate of bone formation. Results suggest that growth factors accelerate and intensify alveolar bone regeneration. Luaces-

Rey¹⁴ found no significant differences between both therapeutic groups on bone regeneration based on digital orthopantomographs, 1–6 months after surgery.

Increase in bone mineral density in PRP supported grafts has been reported ranging from 1.6 to 2.2 times that of a non PRP supported graft,⁷ as seen in our study. However, Lee¹⁵ suggested that PRP may enhance bone remodeling in the early phase, it seems to be insufficient as a counter measure against bone resorption following secondary bone graft in the long term. Macisaac used supplemental demineralized bone matrix and allograft, and observed complete canine eruption in 71.4%, partial in 21.4, and unerupted in 3.5%.¹⁶

The limitation of our study was a short follow up of 6 months, hence only the early results could be compared. All the patients were referred for orthodontic treatment.

5. Conclusion

We conclude that on preliminary investigations, PRP seems to enhance bone formation in alveolar clefts when admixed

with autologous bone chips harvested from the iliac crest as it leads to early bone formation, increased bone density, low infection rate and least postoperative complications.

Conflicts of interest

All authors have none to declare.

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