Applications of platelet- rich plasma (prp) in contemporary pediatric dentistry

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Current evidence and understanding of bone science recognize the pivotal role of growth factors in all the aspects of bone grafting and regeneration. Platelet-rich-plasma (PRP) is one of the richest sources of growth factors to enhance bone regeneration. The present article aims to highlight the basic mechanisms involved in the successful use of PRP and its clinical applications in Pediatric dentistry based on our case-reports citing its use for bone grafting in young children. With pertinence to its current advantages and recent applications, PRP could soon prove to be an invaluable tool for pediatric dental surgeons worldwide.

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"The richest of resources in nature, lie in the nature itself!"

The world seems to be going back to natural substitutes for all its queries and dilemmas. Modern day medicine and surgery are certainly no exceptions to this rule. Platelet-rich plasma (PRP) which is a proven natural source of growth factors to enhance bone regeneration, has recently caught the interest of dental surgeons, periodontists, oral and maxillofacial surgeons as well as several other specialties that deal with bone healing.[1,2] However, there is paucity of literature citing its use in an important fraction of oral surgical patients - children.

Platelet-rich plasma (PRP) is an autologous concentrate of human platelets in a small volume of plasma. Therefore, the term PRP is preferred to autologous platelet gel, plasma-rich growth factors (PRGFs) or a mere autologous platelet concentrate.[3]

Platelet rich plasma was developed in the early 1970's as a by-product of multi-component pheresis.[4] Techniques and equipment have dramatically improved through the 1990's. However, the credit of introducing platelet rich plasma into contemporary oral surgery goes to Whitman *et al* who first advocated its use for oral surgical procedures in 1997.[5,6]

The current paradigm of using Platelet rich plasma is far different from the multi-component pheresis system which was originally suggested in the 1970's. The current procedures utilize the patient's own (autologous) platelets. Because it is an autogenous preparation, PRP today is inherently safe and therefore free from concerns over

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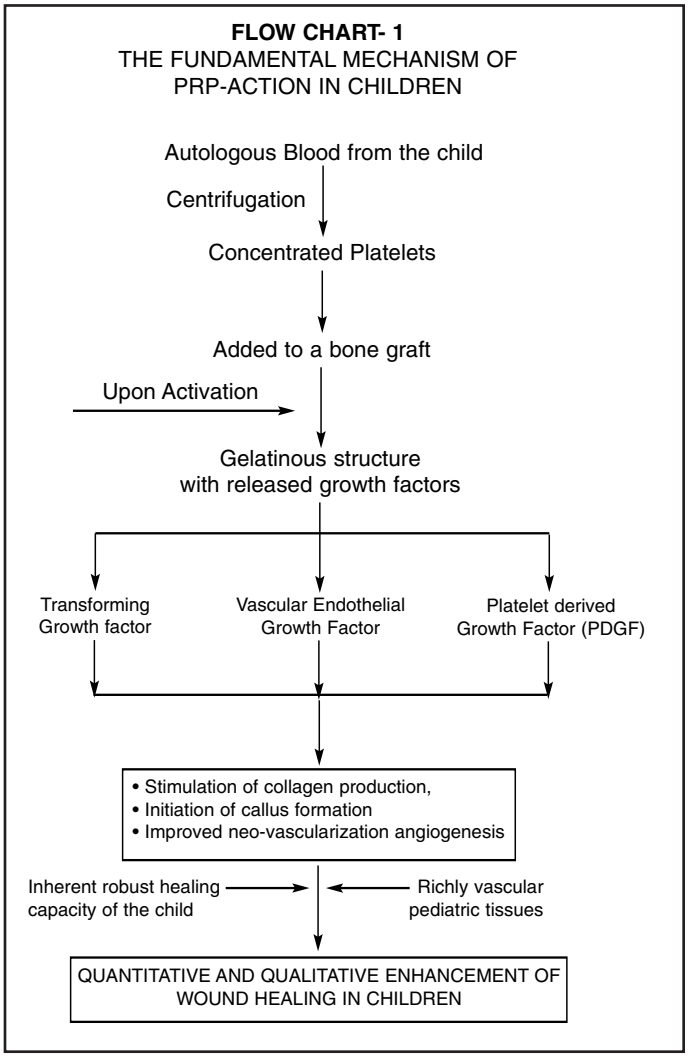


transmissible diseases such as HIV, hepatitis, West Nile fever and Cruetzfeld-Jacob disease (CJD-"mad cow disease").[3,4]

Current evidence says that platelets have many functions beyond that of simple hemostasis. Platelets contain important growth factors that, when secreted, are responsible for increasing cell mitosis, increasing collagen production, recruiting other cells to the site of injury, initiating vascular ingrowth and inducing cell differentiation.[6,7] All these entities coupled with the inherent robust healing potential in children make PRP an invaluable proposition in contemporary pediatric oral surgery. (Flow Chart-1)

The preparation of PRP is relatively simple.[2,6,8,9] Blood collected from the child undergoes a centrifugation process to concentrate the platelets. The platelets are concentrated into a small volume, which can then be added to a bonegraft (Flow Chart-2). When the platelet concentrate is activated, a gelatinous structure is formed and the all important wound-healing growth factors are released (Table-1).[3,9] It is this inherent natural-healing capacity of PRP which dictates its clinical applications in children. (Table-2) [2,3,6,7,9]

Table 1. Growth Factors released from Activated Platelets

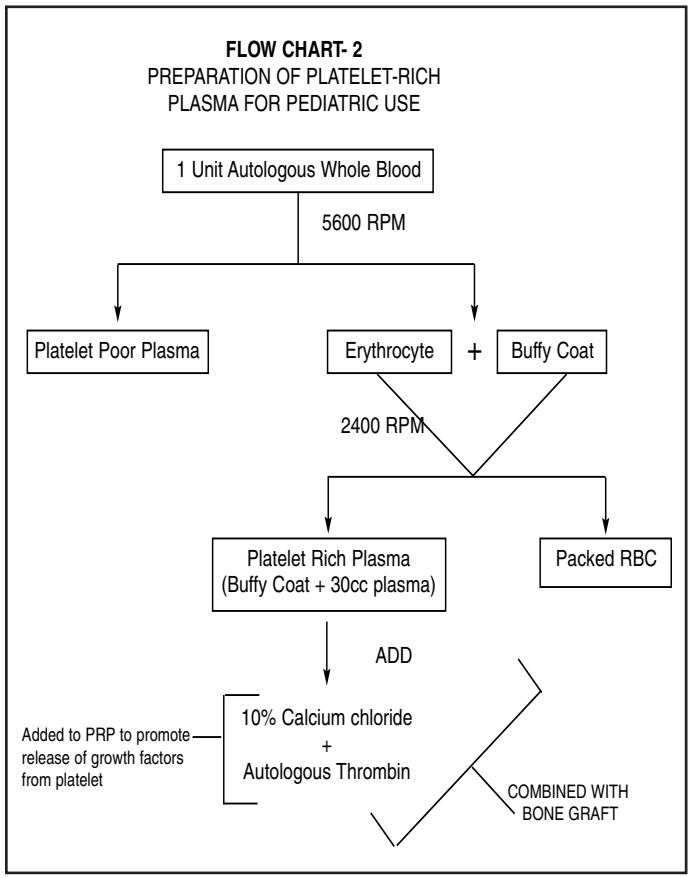
1. Platelet derived growth factor (PDGF)
2. Transforming growth factors - beta 1 and 2 (TGF- _1 & _2)
3. Vascular Endothelial Growth Factor (VEGF)
4. Platelet derived endothelial cell growth factor
5. Interleukin-I (IL-I)
6. Basic Fibroblast Growth factor (bFGF)
7. Platelet activating factor- 4 (PAF-4)

Table 2. Applications of Platelet Rich Plasma in Pediatric Oro-Facial Surgical Procedures

1. Cyst enucleations / Periapical Surgeries
2. Healing of Extraction wounds
3. Endodontic surgeries and retrograde procedures
4. Ablative Surgeries of the Maxillo-facial region / Face-lifts
5. Mandibular Reconstructions
6. Bone grafting after sinus lift
7. Alveolar Ridge augmentation / Ridge preservation grafting
8. Surgical repair of alveolar clefts and associated oro-antral / oro-nasal fistular corrections
9. Adjunctive augmentation of Osseo-integration at Implant sites
10. Periodontal / Peri-implant defects
11. Blepharoplasty
12. Laser Resurfacing Surgery

CLINICAL EXPERIENCE OF USING PRP IN CHILDREN

Understanding of bone science recognizes the pivotal current role of growth factors, in clinical bone grafting success. The application of growth factors such as PDGF and TGF-ß through the technique of platelet sequestration and concentration into platelet-rich plasma is seen as an available and practical tool for enhancing the rate of bone formation and the final quantity of bone formed.[7] There is enough evidence to suggest its use for oral bone grafting procedures because, the addition of platelet rich plasma to bone grafts has produced a radiographic maturation rate, 1.62 to 2.16 times that of grafts without PRP. As assessed by histomorphometry there was also a greater bone density in grafts in which PRP preparation was added.[10]



The preceding facts prompted us to try using platelet rich plasma in children who needed some kind of an oral surgical procedure, the success of which would be directly related to the quality of bony healing. Hence we decided to use PRP (mixed with Ortograf PB (Hydroxyapatite and Tricalcium phosphate crystals, Avanti laboratories, Hyderabad, India) after cyst enucleation in young children aged 4 to 12 years. After procuring the ethical clearance and informed consents, PRP was placed into the bony cavity after cyst enucleation. The post operative clinical and radiographic assessments revealed an enhanced healing of the bony lesions. (Figures 1 to 6). Upon clinical usage, we could decipher that apart from improved wound healing and enhanced osteogenesis, autologous platelet rich plasma (on activation with thrombin/calcium) acts as a fibrin tissue adhesive, having hemostatic and tissue sealing properties. These finding are in accordance with and in support of what has been previously suggested for adult patients.[11,12,13] PRP promotes local tissue growth and repair and is reabsorbed by the body in a few days to weeks.[4] Thus, after the initial clinical success of 5 cases we have formulated a protocol of using PRP on all children needing a surgery for a bone lesion in our institution. The sole motive behind this decision is to enhance the post-operative comfort levels of our young clients by way of enhanced wound healing and reduced surgical morbidity. Based on our current experience we can say that using PRP in children is safe, efficacious, and cost-effective. Its non-

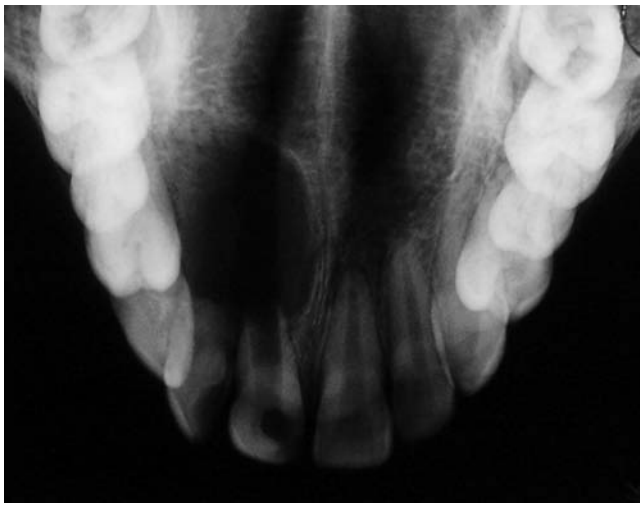


Figure 1: Occlusal radiograph of a 11 year old child showing a cystic lesion related to tooth 21

Figure 2: Autologous Platelets (whole blood) being harvested from the child

Figure 3: Mixture of PRP-Bone graft

Figure 4: Bony cavity after cyst enucleation and apicoectomy in tooth

Figure 5: PRP-Bone graft mixture being introduced into the bony cavity after apicoectomy and retrograde root canal filling on tooth 21

Figure 6: Healing is evident in the bony cavity within one month of PRP insertion.

toxic nature, ease of availability and FDA approval could indeed make PRP an invaluable find for pediatric oral surgical procedures worldwide.

Previously, the harvesting of platelet-rich plasma was a tedious process. Currently, four devices are available which work on advanced centrifuge technology by which platelet-rich plasma can be easily harvested in the pediatric dental-office setting. These in-office systems - Smart PReP (Harvest technologies, Norwell, MA), Plasma Seal (Plasmaseal, San Francisco, CA), Platelet Concentrator Collection System – PCCS (3i Implant Innovations, Palm Beach Gardens, Florida) and Curasan PRP kit (Curasan, Pharma Gmbh AG, Lindigstrab, Germany) are likely to revolutionize the use of PRP for pediatric dental procedures in the near future.[1,2,13,14]

CONCLUSION

Today, PRP remains the sole growth factor preparation available for outpatient pediatric dental surgery. The recent withdrawal of the recombinant human BMP-2 for craniofacial, oral surgical and dental applications further underscores the importance of PRP. The fact that PRP is an autologous preparation, introduced at the time of surgery eliminates concerns about disease transmission and immunogenic reactions in children.

Though Platelet-Rich Plasma (PRP) seems to have all the ingredients for success it cannot be termed a panacea for pediatric oral surgical procedures unless we have long term studies to support its use in children. Based on our experience we can suggest the use of PRP for enhancement of bone healing after surgical cyst enucleation in children.

"Those things are better which are perfected by nature than those which are finished by art."

De Natura Deorum

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