A Clinical and Radiographic Comparison of Platelet-rich Fibrin and Lyophilized Platelet-derived Preparation as Pulpotomy Agent in Primary Molars

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Introduction: Vital pulpotomy in primary molar teeth is aimed to retain the tooth in function until it is replaced by its successors. Aim: The aim of this study was to evaluate and compare platelet-rich fibrin (PRF) and lyophilized platelet-derived preparation (LPDP) as a pulpotomy agent in primary molars. Materials and Methods: Forty primary molars from 20 healthy children aged 5–9 years requiring pulpotomy in the contralateral side of mandible were randomly selected. In both the groups, pulpotomy was carried out by removing coronal pulp and achieving hemostasis, the radicular part of pulp tissue was packed with PRF preparation in Group I and LPDP (Mothercell Research Centre, Trichy, Tamil Nadu, India) in Group II. The teeth were restored with zinc oxide eugenol and glass ionomer cement (GIC), followed by stainless steel crown in the same visit. Clinical and radiographic evaluation was undertaken at 1, 3, and 6 months interval. Results: The overall success rate was 90% in PRF group and 95% in LPDP group at the end of 6 months. The results were statistically nonsignificant between the groups (P > 0.05). Conclusion: The overall outcome of the study suggests that PRF and LPDP are acceptable pulpotomy agents and are promising in the era of new vital pulp therapy procedure.

Keywords: Lyophilized platelet-derived preparation, platelet-rich fibrin, primary molar teeth, pulpotomy agent, vital pulpotomy

INTRODUCTION

American Academy of Pediatric Dentistry (1998) defined pulpotomy as the amputation of affected, infected coronal portion of the dental pulp, preserving the vitality and function of the remaining part of radicular pulp.

It can be classified broadly into vital pulpotomy and non-vital pulpotomy. The vital pulpotomy agents devitalize (mummification and cauterization), preserve (minimal devitalization and noninductive), and regenerate (inductive and reparative) the radicular tissue. The nonvital pulpotomy is done in compromised cases.[1]

Recent advances in vital pulp therapy procedures have improved the outcome of the treatment procedures. The vital pulp tissue in the teeth maintains the protective feedback mechanism,[2] and the presence of organic tissue in the dentinal tubules helps in the prevention of fracture as a result of the damping property.[3]

Formocresol remains the gold standard[4] agent for pulpotomy, which is found to be carcinogenic and mutagenic[5] at higher concentrations, therefore the
search for a more idealistic material still remains under trial.

The progressive development toward better understanding of biological mechanism has led to a shift toward preservation and tissue regeneration.[6] Regenerative pulpotomy medicaments include calcium hydroxide, mineral trioxide aggregate, bone morphogenic proteins, and newer materials include lyophilized freeze-dried platelet, enamel matrix derivative, propolis, sodium hypochloride, bioactive glass, Ankaferd blood stopper, nano-hydroxyapatite, platelet-rich plasma, and calcium phosphate cement.[7]

Lyophilized freeze-dried platelet contains transforming growth factor, platelet-derived growth factor, bone morphogenic proteins, and insulin growth factor. It serves as signaling proteins that induce cells to proliferate, migrate, and lay down extracellular matrix.[8] This helps in the regulation of cellular processes associated with differentiation, mitogenesis, and chemotaxis.[9]

Choukroun et al.[10] in France by 2001 introduced platelet-rich fibrin (PRF), also known as the second-generation platelet concentrate that contains growth factors, which helps in the healing and repair of tissues.[11]

Therefore, this study was conducted to compare PRF and lyophilized platelet-derived preparation (LPDP) as pulpotomy agent in primary molars to identify an appropriate material for pulpotomy procedure with less cytotoxicity and also for better clinical outcome.

**Materials and Methods**

The study was carried out in the Department of Pediatric and Preventive Dentistry, Vinayaka Mission’s Sankarachariyar Dental College, Salem, Tamil Nadu, India, after obtaining ethical clearance from institutional ethics committee (VMSDC/IEC/Approval No. 149). A total of 40 first and second primary molars from 20 children aged 5–9 years were selected based on the criteria by Heilig et al.[12] and Waterhouse et al.[13] The patients were selected from the outpatient department with good general health. The teeth, which are restorable, with deep carious lesion radiographically approximating the pulp and where hemostasis can be achieved in the pulp stumps within 5 min were included in the study. Patients with advanced pulpal inflammation (such as spontaneous pain or history of nocturnal pain), presence of clinical and radiographic signs of pulpal necrosis (i.e., such as suppurating sinus soft tissue swelling furcation involvement), periapical pathology, internal resorption, calcification in canal, and those with medical conditions (such as the history of heart surgery, leukemia, or immunocompromised conditions, congenital heart defects, and history of antibiotic intake in the past 6 months) were excluded from the study. The procedure was performed after explaining the entire procedure in their local language and obtaining a written informed consent from the parents or guardians.

**Methodology**

Local anesthesia was administrated using 2% lignocaine with 1:100,000 adrenaline. The tooth was isolated using rubber dam, and the cavity outline was established. The pulp chamber was entered and the roof was removed with the round bur using high-speed air rotor. Coronal pulp tissue amputation was achieved using spoon excavator, the chamber was irrigated with normal saline. Hemorrhage was controlled using a sterile pledget of moist cotton under pressure. Each tooth was randomly categorized to Group I and Group II using table of random numbers.

**Group I: platelet-rich fibrin**

PRF was prepared using Choukroun’s procedure. A total of 2.5 mL of blood was drawn by a trained medical staff into 10 mL test tubes without an anticoagulant, and centrifuged immediately.[10] The process was done in a tabletop centrifuge for 12 min at 2700 rounds per minute. The resultant product shows following three layers: platelet-poor plasma at the surface, PRF clot in the middle, and red blood cells at the bottom. Sterile tweezers were inserted into the test tube to retrieve the PRF clot. The platelet fibrin membrane was obtained by squeezing the clot between dry gauges. The prepared fibrin membrane was gently packed over the pulp stumps using a sterile pledget of moist cotton [Figures 1–3].

**Group II: lyophilized freeze-dried platelet-derived preparation**

A lyophilized freeze-dried platelet-derived preparation was obtained from Mothercell Research Centre (MCHC), Trichy, Tamil Nadu, India, which was allogeneic in nature, free of human immunodeficiency virus (HIV) antibodies, hepatitis B surface (HBS) antigen, hepatitis C virus (HCV) antigen, and allergic reaction. The product was available in airtight glass bottles.

In Group II, the lyophilized preparation was gently packed over the pulp stumps using a sterile pledget of moist cotton [Figure 4].
A thick mix of zinc oxide eugenol cement and glass ionomer cement was placed in both the groups to seal the coronal pulp chamber, followed by Stainless steel crown (SSC) in the same visit.

The patients were clinically checked for symptoms such as pain, tenderness to percussion, soft tissue swelling, mobility, and sinus formation. Radiographic parameters such as furcal or periapical radiolucency, canal calcification, and pathologic root resorption were analyzed at 1, 3, and 6 months interval, and the results were tabulated [Figures 5–10].

**RESULTS**

The study groups did not show any sign of failure at the end of 1 month. The clinical assessment of teeth in Group I revealed pain in one tooth at 3 months and tenderness to percussion in one tooth at the end of 6 months, whereas one tooth in Group II was tender on percussion at 6 months. Therefore, the success rate was 95% at 3 months and 90% at 6 months in Group I, whereas it was approximately 95% at 6 months in Group II.

In radiographic parameters, the overall success rate was 95% in Group I (PRF) as one tooth had shown signs of furcal radiolucency at the end of 6 months, whereas in Group II (LPDP), it was approximately 100%.

The overall success rate of Group I (PRF) and Group II (LPDP) as pulpotomy agents in primary molars with a follow-up at 6-month interval was approximately 90% and 95%, respectively. The results were statistically analyzed with Fischer’s exact test that was found to be nonsignificant ($P > 0.05$) between the groups [Table 1].

**DISCUSSION**

Vital pulp therapy has been a subject of debate for decades. Cox et al.\(^{14}\) stated that the capacity to heal in case of an exposed pulp depends directly on the ability of the capping agent.

In this study, children in the age range of 5–9 years were selected. This age-group was considered as children less than 5 years lack cooperative ability and those older than 9 years of age undergo physiologic root resorption.\(^{15}\) SSCs were placed in all tooth included in the study, as crowned teeth had less leakage compared with other forms of restoration.\(^{16}\)

As the search for an ideal pulpotomy agent is never ending due to the limitation of the material used, both PRF and LPDP used in this study are regenerative
materials and have got advantages over the conventional materials.

PRF is an autologous material containing platelet-derived growth factor, transforming growth factor β, and healing proteins in a dense fibrin matrix that promotes cell migration, cell attachment, cell proliferation, and cell differentiation.[11]

Lyophilized freeze-dried platelet-derived preparation contains Transforming growth factor, Platelet-derived growth factor (PDGF), insulin-like growth factors (IGFs), Bone morphogenetic proteins (BMPs), which act as signaling proteins that play an important role in cell differentiation, mitogenesis, and chemotaxis.[17] They have been used extensively in the oral and maxillofacial reconstruction, that is, placement of osseointegrated implant in humans[9] and periodontal regeneration.[18] A few in vivo and in vitro trials on animals and humans has revealed its capacity to differentiate cells of pulp to deposit dentin by stimulating the odontoblast.[19]

These properties make both PRF and LPDP suitable for use as pulpotomy agent and therefore was used in this study.

PRF, which is used in this study, is a cost-effective means of performing vital pulp therapy but the blood
withdrawal makes it a limitation in pediatric patients. A study conducted by Surendra et al.\textsuperscript{[20]} has shown a success rate of 92% with PRF, which is less than that of this study.

LPDP used in this study is a very good alternative as the preparation and handling is relatively easy with high success rates. A study by Kalaskar and Damle\textsuperscript{[21]} has shown 100% success rate with LPDP, which is slightly higher than that of this study.

**CONCLUSION**

- PRF and LPDP are appropriate alternate material for pulpotomy procedure in primary teeth.
- Studies with greater sample size and follow-up over a longer period along with histological analysis would be required to discuss the long-term success rates.

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**Conflicts of interest**

There are no conflicts of interest.
Table 1: Clinical and radiographic assessment for both the study groups

| Groups       | Clinical assessment | 1 month (%) | 3 months (%) | 6 months (%) |
|--------------|---------------------|-------------|--------------|--------------|
| Group I      | PRF                 | 100         | 95           | 90           |
| Group II     | LPDP                | 100         | 100          | 95           |
| Radiographic assessment | | | | | |
| Group I      | PRF                 | 100         | 100          | 100          |
| Group II     | LPDP                | 100         | 100          | 100          |
| Overall assessment |           | | | |
| Group I      | PRF                 | 100         | 95           | 90           |
| Group II     | LPDP                | 100         | 100          | 95           |

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