Comparative Evaluation of Platelet-rich Fibrin and Mineral Trioxide Aggregate as Pulpotomy Agents in Permanent Teeth with Incomplete Root Development: A Randomized Controlled Trial

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Abstract

Introduction: The purpose of this study was to evaluate and compare, clinically and radiographically, the effects of platelet-rich fibrin (PRF) and mineral trioxide aggregate (MTA) as pulpotomy agents in permanent teeth with incomplete root development. **Methods:** A total number of 70 children requiring pulpotomy in 70 permanent molars with incomplete root development were screened. Sixty-two patients met the inclusion criteria and were enrolled in the study. The patients were randomly allocated equally in 2 treatment groups. MTA pulpotomy was performed in group A (the control group), and PRF pulpotomy was performed in group B (the experimental group). The treated teeth were restored with amalgam followed by stainless steel crowns. Clinical and radiographic evaluations were performed after 6, 12, and 24 months. Thus, the data obtained were blindly analyzed using the chi-square test. **Results:** There was no significant difference between the 2 groups in terms of clinical and radiologic success. Radiographically, all available cases (53 teeth) showed evidence of root growth and canal narrowing. Complete apical closure was observed in 88.8% in the PRF group (experimental group) and 80.07% of roots in the MTA group (control group), respectively, at 24 months. **Conclusions:** PRF could be used as a suitable biological and economic alternative to MTA in pulpotomy procedures of permanent teeth with incomplete root development. *(J Endod 2014;40:599–605)*

Key Words

Mineral trioxide aggregate, platelet-rich fibrin, pulpotomy

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The management of permanent teeth with incomplete root development with compromised pulpal integrity presents a unique challenge. The preservation of pulp vitality is of the utmost importance for continued dentin formation and root development in immature teeth. The loss of pulpal vitality before the completion of dentin deposition leaves a weak root more prone to fracture as a result of the thin dentinal walls. Every attempt should be made to preserve the vitality of these immature teeth until maturation has occurred. Pulpotomy is a universally accepted treatment modality for pulp exposures in immature permanent teeth to preserve the vitality of the radicular pulp and to ensure continued root development. The guidelines of the American Academy of Pediatric Dentistry on pulp therapy for primary and permanent teeth with incomplete root development states that pulpotomy is a procedure in which the coronal pulp is amputated and the remaining radicular pulp tissue is treated with a medicament to preserve the pulp's health (1).

Vital pulp therapy procedures in permanent teeth with incomplete root development have advanced in recent years. There has been a tendency toward investigating materials for restoring true pulp health via the stimulation and formation of biological tissue. Mineral trioxide aggregate (ProRoot MTA; Dentsply Tulsa Dental Specialty, Tulsa, OK) has shown promising potential as a pulpotomy agent in permanent teeth with incomplete root development (2, 3). Despite its many advantages, MTA has some drawbacks that include the presence of toxic elements in the material composition (4), higher cytotoxicity in its freshly mixed state (5), high pH during setting (6), difficult handling characteristics (7), long setting time (8), tooth discoloration (9), and high cost.

Hence, the need arises to discover a pulpotomy agent that potentiates the natural pulp healing process, is biocompatible, and is cost-effective. Recently, there has been growing optimism about the prospect of the use of a biologic approach for the treatment of pulp exposures.

A recent innovation in dentistry has been the preparation and use of platelet-rich fibrin (PRF), a second-generation platelet concentrate. PRF was first developed in France by Choukroun et al (10) in 2001. It is considered as an autologous healing biomaterial incorporating leukocytes, platelets, and a wide range of key healing proteins in a dense fibrin matrix (11). PRF serves as a reservoir for the slow continuous release of growth factors. Smith and Lesot (12) reported that growth factors influence and direct the processes of reparative dentinogenesis. Huang et al (13) investigated the effect of PRF on cultured primary dental pulp cells and concluded that PRF can increase dental pulp cell proliferation and differentiation. The present study was envisaged to evaluate the efficacy of PRF, both clinically and radiographically, as a pulpotomy agent in permanent teeth with incomplete root development in comparison with MTA.

Materials and Methods

The study protocol was approved by the Research Ethics Committee of King George's Medical University, Lucknow, India. The study included patients who attended the Outpatient Department of Pedodontics with Preventive Dentistry, Faculty of Dental Sciences, King George's Medical University. Sixty-two children between the ages of 6 and 12 years were included in the study. The study was

performed as a randomized parallel-group controlled clinical trial. The study was designed in accordance with the CONSORT guidelines (Fig. 1).

The inclusion criteria included symptomatic/asymptomatic vital immature (radiographically open apex) permanent molars with clinical carious exposure of the pulp and the presence of bleeding upon exposure. The exclusion criteria included patients with a history of systemic disease; patients exhibiting clinical signs and symptoms of pulp degeneration such as spontaneous throbbing pain, tenderness to percussion, tooth mobility, swelling, or sinus tract; radiographic evidence of a widened periodontal ligament space, internal or external resorption, inter-radicular bone loss, or periapical pathosis; a nonrestorable tooth; and a tooth requiring more than 5 minutes to achieve hemostasis during the clinical procedure.

A power analysis was conducted, and a minimum sample of 25 teeth in each group was set to ensure that an adequate sample size was collected and recalled to show validity and 80% power. Two treatment groups were constituted in which patients were randomly allocated equally in each treatment group by the envelope draw method. MTA pulpotomy was performed in group A (the control group), and PRF pulpotomy was performed in group B (the experimental group). The nature of the recommended treatment, alternate treatment options, and the risks of the recommended treatment were explained in detail to the parents/guardians of the children. Written consent was obtained from patients/guardians before the treatment. Participation in the present study was on a voluntary basis.

A detailed history of all the participants was taken followed by a thorough clinical and radiographic examination. Preoperative radiographic assessments were made by examining periapical radiographs. A standardized bisecting angle technique was performed using periapical films. The films used over the duration of the study were either E speed (Ektaspeed; Kodak, Delhi, India) or F speed (Insight, Kodak). The films were processed using an automatic X-ray film processor. Inferior alveolar nerve block or infiltration of local anesthetic using 2% lignocaine with 1:100,000 epinephrine (Lignox; Indoco Remedies Ltd, Mumbai, India) was administered. The tooth was then isolated with a rubber dam (Hygenic Dental Dam; Colténe Whaledent, Langenau, Germany), and all coronal caries were removed, leaving the last carious dentin overlying the pulp. After caries removal, coronal access was performed using a no. 330 high-speed bur (Dentsply Maillefer, Tulsa, OK) with water spray to expose the pulp chamber. A sharp spoon excavator was used for coronal pulp amputation. One or more cotton pellets moistened with sterile saline were placed over the pulp stumps, and light pressure was applied for 2–3 minutes. After the removal of the cotton pellets, homeostasis was apparent. The tooth with signs of prolonged bleeding for more than 5 minutes was excluded from the present study (14).

In the control group (MTA), after achieving hemostasis, the pulp stumps were covered with white MTA (Fig. 2*C* and *D*). One gram of cement powder was mixed with a premeasured unit dose of 0.3 mL distilled water to achieve a powder/liquid ratio of 3:1 as per manufacturer's instructions. After 30 seconds of mixing, a putty consistency

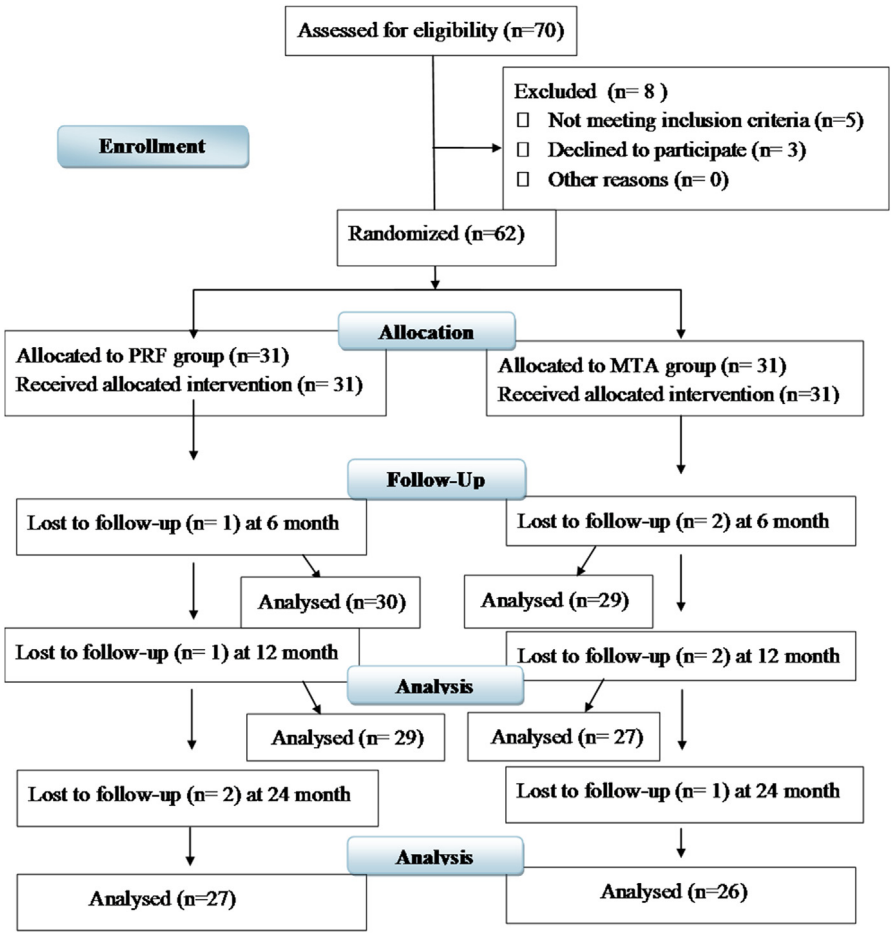

Figure 1. A CONSORT diagram showing the flow of participants through each stage of trial.