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Research Article

COMPARATIVE CLINICAL AND RADIOGRAPHICAL EVALUATION OF SUCCESS OF PULPOTOMY USING BIODENTINE AND PRF-BIODENTINE COMBINATION: AN IN-VIVO STUDY

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ABSTRACT

Introduction: Removal of infected pulp tissue from the coronal portion leads to preservation of a remaining vital and functioning pulp. Preservation of pulp vitality by pulpotomy is one of the universally accepted treatment procedure with the aid of latest bioactive materials leading to a more conservative approach in the management of teeth involving the pulp based on clinical conditions.

Aim: To comparatively evaluate the clinical and radiological outcome of single visit pulpotomy procedure using Biodentine and the combination of Plasma Rich Fibrin (PRF) and Biodentine

Materials and Methods: Twenty permanent molars were selected and randomly assigned to two groups that included pulpotomy with only Biodentine and the other group with the PRF-Biodentine combination. Single visit pulpotomy procedure was completed with the restoration. Later the patients were recalled after one day, three months and six months for clinical and radiographical evaluation.

Results: Chi-square test was used to compare the responses for various study variables between Biodentine and PRF-Biodentine combination. The comparison between the two groups was statistically not significant.

Conclusion: Single visit pulpotomy procedure performed with either Biodentine or Combined PRF and Biodentine was equally efficient at 6 months follow-up. But with PRF-Biodentine combination, PRF an ideal biomaterial which is autologous can help better than Biodentine alone in the success of vital pulp therapy

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INTRODUCTION

Most cases of pain associated with pulpal exposure either by caries, trauma or the mechanical procedures are managed with two immediate treatment modalities; root canal therapy (RCT) and extraction¹. However there are varying opinions based on the clinical scenario on how to manage when pulp that has been exposed by caries or through mechanical procedures². Preservation of pulpal vitality is of paramount importance as the vital functioning pulp is capable to initiate several important functions like formation of dentin, providing nutritive support to the tooth, enabling a defensive function and a unique reparative capacity on dentin³.

Vital pulp therapy (VPT) is defined as a treatment procedure which aims to preserve and maintain pulp tissue that has been compromised but not destroyed by caries, trauma or restorative procedures in a healthy state or to be vital⁴. Vital pulp therapy

includes direct and indirect pulp capping and pulpotomy procedure⁵. Pulpotomy is a vital pulp therapy in which the coronal portion of the pulp is removed surgically and the remaining radicular pulp is preserved intact and a suitable material is placed over the radicular pulp to protect it from further insult and initiate healing and repair⁶.

Pulpotomy is based on the hypothesis that the inflammation and reduced vascularization, caused by bacterial invasion are confined to the coronal pulp, while the radicular pulp which when protected with hard tissue stimulating material, the pulp would heal and remain vital^{1,2}.

Various materials have been introduced and advocated for use in pulpotomy procedures based on their important properties such as biocompatibility, sealing ability and antimicrobial efficacy when placed in direct contact with the radicular pulp³. Formocresol introduced by Buckley, is considered as the gold standard pulpotomy agent owing to its bacteriostatic and

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fixative properties. It was composed of formaldehyde and cresol which are carcinogenic and mutagenic which led to the search for more biocompatible alternatives in the form of Mineral Trioxide Aggregate (MTA), laser irradiation and Biodentine⁷. Mineral Trioxide Aggregate (MTA) introduced in the year 1993, is one of the most commonly used and researched material in endodontics and for such pulpotomy procedures with successful clinical results. However, due to certain inherent drawbacks of MTA such as presence of toxic elements in the material composition, higher cytotoxicity, high pH, difficult handling characteristics and longer setting time lead to the search for the material that can potentiate the natural healing process and which is biocompatible and can overcome the limitations of MTA^{3,8,9} leading to the introduction of PRF and Biodentine.

Biologically based therapeutic agent PRF¹⁰, is a second generation platelet concentrate introduced in the year 2001, which is strictly autologous and helps to release the growth factor necessary for the regeneration of dentin pulp complex there by accelerating the healing process³. A new material Biodentine was developed to overcome the cytotoxic effects of MTA. Biodentine, a calcium silicate based material is commercially available since 2009, which has fetched attention in recent years due to its better sealing ability and reduced setting time^{3,8}. The present study was aimed at comparatively evaluating the clinical and radiological outcome of single visit pulpotomy procedure using Biodentine and the PRF-Biodentine combination to obtain advantage of growth factors present in PRF and the stimulation of calcium secretion from the pulpal cells which induce the odontoblast stem cells from Biodentine.

MATERIALS AND METHODS

The present study was conducted in the Department of Conservative Dentistry and Endodontics. Twenty patients in the age group of 19 to 28 years with good general health and no history of systemic illness were chosen for the study.

Figures No. 1 Biodentine Pulpotomy



Figure 1a Pre-operative radiograph



Figure 1b Coronal Pulpotomy at the orifice level



Figure 1c Biodentine placement in the coronal pulp chamber



Figure 1d Immediate post operative radiograph



Figure 1e Post-operative radiograph at 3 months follow up



Figure 1f Post-operative radiograph at 6 months follow up

Twenty molars were selected with history of mild pain on intake of hot and cold fluids, with no history of previous pain and swelling, no tenderness on percussion and no associated sinus opening adjacent to the involved teeth. Diagnostic tests were performed on all the patients which revealed lingering pain to hot and cold tests. Electric pulp tests (EPT) results showed a more intense response in the involved tooth as compared to the contralateral healthy mature permanent tooth. Radiographic examination revealed presence of radiolucency of

carious lesion or radiopacity of fractured restoration approaching the pulp with normal periodontal ligament space and lamina dura. There was no periapical lesion visible on the radiograph. (Figure 1a, 2a) After complete clinical and radiographic examination, a diagnosis of vital teeth with signs and symptoms of irreversible pulpitis was made in the involved tooth in respect to all the cases.

Procedure was explained to the patient and the informed consent was obtained. Teeth were anesthetized, isolated with a rubber dam. Treatment included removal of caries and fractured restoration if any. Pulpotomy was performed using a high speed airtor hand piece and the coronal pulp tissue was removed to orifice level. Associated bleeding indicated pulp vitality; hemostasis was achieved with sterile normal saline with gentle application of small pieces of sterile cotton pellets for five minutes. (Figure 1b, 2b)

Procedure was explained to the patient as an alternative to the conventional RCT to preserve the vitality of the radicular pulp. Patients were randomly divided into two groups:

- Group I: The treatment modality of single visit coronal pulpotomy using only Biodentine for ten patients.
- Group II: The treatment modality of single visit coronal pulpotomy using combined PRF and Biodentine for ten patients.

In Group I Biodentine was manipulated and an approximately 2 mm thick layer of Biodentine was placed over the exposed clot free pulp with a plastic instrument and was packed using dry cotton pellets for five minutes. (Figure 1c) The cotton pellets were then removed and a layer of glass ionomer cement was placed upon the Biodentine. Permanent restoration was done in the same appointment using composite restorative material in all the ten patients. (Figure 1d)

In Group II the medical examination and tests for the bleeding time, clotting time and platelet count were performed and were found to be in normal range. PRF was prepared by drawing blood from median cubital vein into a 10 ml test tube without the addition of an anticoagulant. Hence to prevent the blood from coagulating after coming in contact with the glass tube, it was centrifuged immediately using a table top centrifuge. The product thus obtained consisted of the three layers: the top most layer of acellular platelet poor plasma, the middle layer of platelet rich fibrin and the bottom most layer of red blood corpuscles. (Figure 2c) The PRF was segregated and was squeezed with a sterile gauze piece. (Figure 2d)

Figure No. 2 PRF-Biodentine Pulpotomy



Figure 2a Pre-operative radiograph



Figure 2b Coronal Pulpotomy at the orifice level



Figure 2c Layers obtained with PRF in the middle layer



Figure 2d PRF segregated on a sterile gauze piece



Figure 2e PRF placement in the coronal pulp chamber



Figure 2f Biodentine placement in the coronal pulp chamber



Figure 2g Immediate post operative radiograph



Figure 2h Post-operative radiograph at 3 months follow up



Figure 2i Post-operative radiograph at 6 months follow up

The PRF membrane obtained after centrifugation of the patients own blood was placed over the exposed pulp stumps. (Figure 2e) Biodentine was manipulated and an approximately 2 mm thick layer of Biodentine was placed over the PRF with a plastic instrument. (Figure 2f) It was packed using dry cotton pellets for five minutes and then the cotton pellets were removed. A layer of glass ionomer cement was placed upon the Biodentine and permanent restoration was done in the same appointment using composite restorative material in all the ten patients. (Figure 2 g)

The patients were recalled after one day, three months and six months for clinical and radiographical evaluation.

(Figure 1e, 1f, 2h, 2i) Clinically status of pain, sinus tract, swelling, vestibular tenderness on palpation and tenderness on percussion and radiographically, periodontal ligament widening, internal/ external resorption and periapical/furcal radiolucency and calcifications were evaluated in both the groups. (Table 1, 2)

RESULTS

Five teeth were associated with pain and tenderness on percussion at one day follow-up out of which three teeth were treated with Biodentine and two teeth were treated with combined PRF and Biodentine of the total 20 patients.

Statistical analysis was done by SPSS software Version 20.0 using Chi square test to compare the clinical criteria between the two groups and was found to be statistically insignificant. There were no radiographical signs during the follow-up period.

DISCUSSION

Several factors influence the treatment decisions of a clinician when encountering a tooth with a pulpal exposure. The treatment of teeth involving pulp is generally done with root canal therapy, which is considered as a prophylactic treatment procedure as the radicular pulp is often free of infection and to avoid further infection of the root canal system. An infected pulp usually undergoes a degenerative process in a coronal to apical direction. When pulpal infection and inflammation are restricted to the coronal portion of the pulp chamber, unaffected healthy pulp tissue remains in the deeper portion of the root canal system. Theoretically, removal of the compromised/infected tissue should lead to preservation of a remaining vital and functioning pulp^{11,12}

Preservation of the vitality of the radicular pulpal tissue, prevention of pain, swelling and finally preserve the tooth through the extirpation of the coronal pulp and prevention of radicular pulp inflammation is the goal of pulpotomy treatment procedure.¹³ Pulpotomy can be carried out with various materials based on their biocompatibility, sealing ability and antimicrobial efficacy when they are in contact with the dental pulp. Latest bioactive materials such as MTA and Biodentine have excellent biocompatibility and sealing abilities. In various studies, limitations of MTA as difficulty in manipulation, increased cost, two visit treatments and longer setting time have been noticed.⁸

A comparative study done to evaluate the PRF and MTA as pulpotomy agent in immature permanent teeth concluded that success obtained with PRF was more than MTA in root end closure with no statistically significant difference between the two groups.⁹

Table 1 Radiographical finding after single visit pulpotomy procedure

Groups	Periodontal ligament widening		Periradicular lesions		Furcation bone loss		Internal/external resorption		Calcification	
	3 months	6 months	3 months	6 months	3 months	6 months	3 months	6 months	3 months	6 months
Biodentine 10 cases	A	A	A	A	A	A	A	A	A	A
PRF And Biodentine 10 cases	A	A	A	A	A	A	A	A	A	A

A: Absent

Table no. 2 Clinical findings after single visit pulpotomy procedure

Group	Pain			Swelling			Sinus tract			Vestibular tenderness			Tenderness on percussion		
	One day follow up	3 months follow up	6 Months follow up	One day follow up	3 months follow up	6 Months follow up	One day follow up	3 months follow up	6 Months follow up	One day follow up	3 months follow up	6 Months follow up	One day follow up	3 months follow up	6 Months follow up
Biodentine 10 Cases	3	A	A	A	A	A	A	A	A	A	A	A	3	A	A
PRF and biodentine 10 cases	2	A	A	A	A	A	A	A	A	A	A	A	2	A	A

A: ABSENT

Table No. 3 Statistical analysis

	Pain At One Day Follow Up	Tenderness On Percussion At One Day Follow UP	P- Value
Biodentine 10 Cases	3 (30%)	3 (30%)	
PRF and Biodentine 10 Cases	2 (20%)	2 (20%)	0.61
Chi Square Value	0.267	0.267	

*p<0.05 statistically significant; p>0.05 Non significant, NS

A study conducted to determine the physicochemical properties and dentin bond strength of MTA and Biodentine as a retrograde filling material revealed that Biodentine exhibited faster setting time, long term higher compressive strength and bonding to dentin than MTA.¹⁴

So, in the present study Biodentine and PRF-Biodentine combination were used to evaluate the pulpotomy outcome clinically and radiographically.

PRF often named as Choukroun’s PRF, is a second-generation platelet concentrate. The PRF constitutes components of blood that are beneficial to improve wound healing. PRF can be considered as an immune concentrate with specific composition and a three dimensional architecture. It contains numerous growth factors like platelet derived growth factor, transforming growth factor β1, insulin like growth factor which exhibits varied potent local properties such as cell migration, attachment, proliferation and differentiation. It has been shown as an ideal biomaterial for pulp-dentin complex regeneration. PRF is both a healing and interpositional biomaterial¹⁵

Biodentine has bioactive properties which encourages hard tissue regeneration and has the ability to maintain the successful marginal integrity due to formation of hydroxyapatite crystals at the surface, enhancing the sealing ability.¹⁶ Biodentine display properties of biocompatibility of MTA with more efficient characteristics such as significantly shorter setting time, good handling characteristics, better marginal integrity and no tooth staining with better cytocompatibility and bioactivity than MTA.¹⁷

In the present study patients showed no post-operative pain and discomfort in the three months and six months follow up in both the groups, showing complete success in the treatment with none of the clinical and radiographical signs which is in accordance with the study conducted by Matsuo et al., which concluded that three months was an adequate time to evaluate the success or failure of vital pulp therapy treatment procedures.¹⁸ The success rate of the VPT is governed by adequate blood supply, obtaining hemostasis, biocompatibility of the restorative materials and the provision for the adequate seal. Control of hemorrhage/hemostasis is an important key to enhance the success.

Hemorrhage of exposed dental pulp tissue is in part due to inflammatory response of the pulp to bacteria and their byproducts from carious dentin. Two other important factors in predicting pulpal response to VPT are the sealing ability and the non-toxicity of material.^{15, 19}

The success in this study may also be attributed to the immediate placement of permanent coronal restoration, as demonstrated by Massler who concluded that the most important cause of failure in VPT is the presence of leakage during the healing process.²⁰

CONCLUSION

Both the groups showed successful outcome over a period of the 6 months follow-up. However, when Biodentine is combined with PRF, one can gain the advantage of being autologous and inherent growth factors which synergistically can help in angiogenesis, cell differentiation, regeneration, mineralization, tissue formation and repair in the dentin-pulp complex.

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