

**A comparative evaluation of PRF, blood clot and collagen scaffold in regenerative
endodontics**

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ABSTRACT

Aim:The present study was conducted evaluate the efficacy of revascularization procedures for the management of traumatized immature, nonvital, infected permanent teeth.

Materials & Methods:24 adult patients age ranged 13-24 years of both genders with immature necrotic permanent teeth were classified into 3 groups of 8 each. Group I used platelet rich fibrin (PRF). Group II used blood clot and group III used sterile collagensponge scaffold. Patients were recalled regularly and clinical and radiographic evaluation was performed at 6 months and at 1 year.

Results:In group I, 20% teeth had good and 80% had excellent healing, in group II, 20% had fair, 50% had good and 30% had excellent healing and in group III, 70% had good and 30% had excellent healing. In group I, 90% teeth had fair and 10% had good root lengthening, in group II, 20% had fair and 80% had good root lengthening and in group III, 71% had fair and 29% had good root lengthening. None of the group had excellent root lengthening. Apical closure was good in 40% and excellent in 60% in group I, good in 25% and excellent in 75% in group II and fair in 30%, good in 30% and excellent in 60% in group III. Dentinal wall thickening in group I was fair in 30% and good in 70%, in group II, 50% had fair and 50% had good and in group III, 30% had fair, 50% had good and 20% had excellent response.

Conclusion: Authors found that PRF and collagen was superior than blood clot in terms of apical closure and healing. Regenerative healing with different scaffolds is useful method of preserving immature non- vital permanent teeth.

Key words: Apexification, Necrotic teeth, Regenerative endodontics

Introduction

Management of immature, necrotic teeth is biggest challenge for endodontists. The process of inducing closure of open apex by the process of apexification is widely recommended method. It is initiated by formation of mineralized pulp tissue at apical region which comprised of osteodentin, osteocementum and bone.¹ These immature teeth cannot undergo root canal treatment because of presence of thin dentinal walls as well as chances of fracture is more even after treatment.²

Apexification is usually performed by mineral trioxide aggregate (MTA) or calcium hydroxide (Ca (OH)₂).³ Regenerative endodontics is considered as paradigm shift in the management of these teeth by the way of regenerating pulp tissue into a canal thus ensuring continuation of normal root formation. This can be induced by endogenous stem cells through lacerating the periapical tissues to fill the canal with blood.⁴

The benefit of regenerative endodontics over apexification is that with regenerative endodontics root lengthening and thickening is possible whereas with apexification it is not possible. Moreover, regenerative endodontics prevent reinfection by providing adequate coronal seal.⁵ It utilizes scaffold which offers the framework for cell growth and differentiation at a local site. For the successful outcome of regenerative endodontics, a porous, biocompatible and correct shaped scaffold is of paramount importance. It should be biodegradable and possess correct form and shape allowing replacement of the lost tissues.⁶ It is evident that both natural and artificial scaffolds are used in regenerative endodontics with

advantages and disadvantages over each other. It regenerates dentin or dentin-pulp complexes in combination with dental pulp cells. Natural scaffolds are more bioactive and biocompatible on the other hand synthetic scaffolds prevent degradation and have superior mechanical properties.⁷ This study compared natural and synthetic scaffolds such as PRF, blood clot and collagen in the management of immature necrotic teeth.

Methodology

This study was done in Department of conservative dentistry and endodontics and commenced after obtaining no clearance certificate from ethical committee of the institute. We recruited 24 adult patients age ranged 13-24 years of both genders with immature necrotic permanent teeth. Inclusion criteria consisted of maxillary permanent central incisors with presence of periapical lesions. Exclusion criteria was patients with systemic illness. The study was explained to all enrolled patients in vernacular language and once they agreed to participate after signing the consent form, study was initiated. To calculate the case number of cases, the following parameters were defined as significance level: 0.05, power: 80% and number of clusters (immature teeth): 24.

The procedure of canal preparation was done following all standardized protocol as instructed by manufacturer with K-files under strict aseptic condition using rubber dam isolation. The triple antibiotic paste was used followed by temporary restoration with calcium hydroxide material. In patient's next visit after 4 weeks, canals were assessed clinically and once there was no drainage from root canal, revascularization procedure was started. All 24 selected teeth were randomly allocated 3 groups by the lottery method.

Group I used platelet rich fibrin (PRF). It was introduced into the canal. Glass ionomer cement was used for sealing the cavity. Group II used blood clot. Bleeding was induced in the canal using sterile needle of 21 gauge and clot formation was waited by inserting cotton

pellet in the canal. Glass ionomer cement was used for sealing the cavity. Group III used sterile collagen sponge was inserted into the root after inducing clot formation. Access cavity was sealed with glass ionomer cement.

Patients were recalled regularly and clinical and radiographic evaluation was performed at 6 months and at 1 year. Digital intraoperative periapical radiographs were taken at each visit.

Radiographs were assessed for presence for healing which was as- No healing- 0, fair healing- 1, good healing-2 and excellent healing-3.

Statistical analysis

Results were statistically analyzed using ANOVA with level of significance set below 0.05. SPSS version 21 was used for comparison between groups.

Results

Table I shows that there were 3 males and 5 females in age group 13-16 years, 5 males and 6 females in age group 17-20 years and 2 males and 3 females in age group 21-24 years. Table II shows that group I used PRF, group II used blood clot and group III used collagen. Each group had 8 patients. Table III shows that in group I, 20% teeth had good and 80% had excellent healing, in group II, 20% had fair, 50% had good and 30% had excellent healing and in group III, 70% had good and 30% had excellent healing. ANOVA test showed significant difference between groups ($P < 0.05$).

Table I Distribution of patients

Age group (Years)	Males	Females
13-16	3	5
17-20	5	6
21-24	2	3
Total	10	14

Table II Distribution of patients in different groups

Groups	Group I	Group II	Group III
Material	PRF	Blood clot	Collagen
Number of patients	8	8	8

Table III Assessment of healing in all groups

Healing	Group I	Group II	Group III	P value
Fair	0%	20%	0%	0.014
Good	20%	50%	70%	
Excellent	80%	30%	30%	

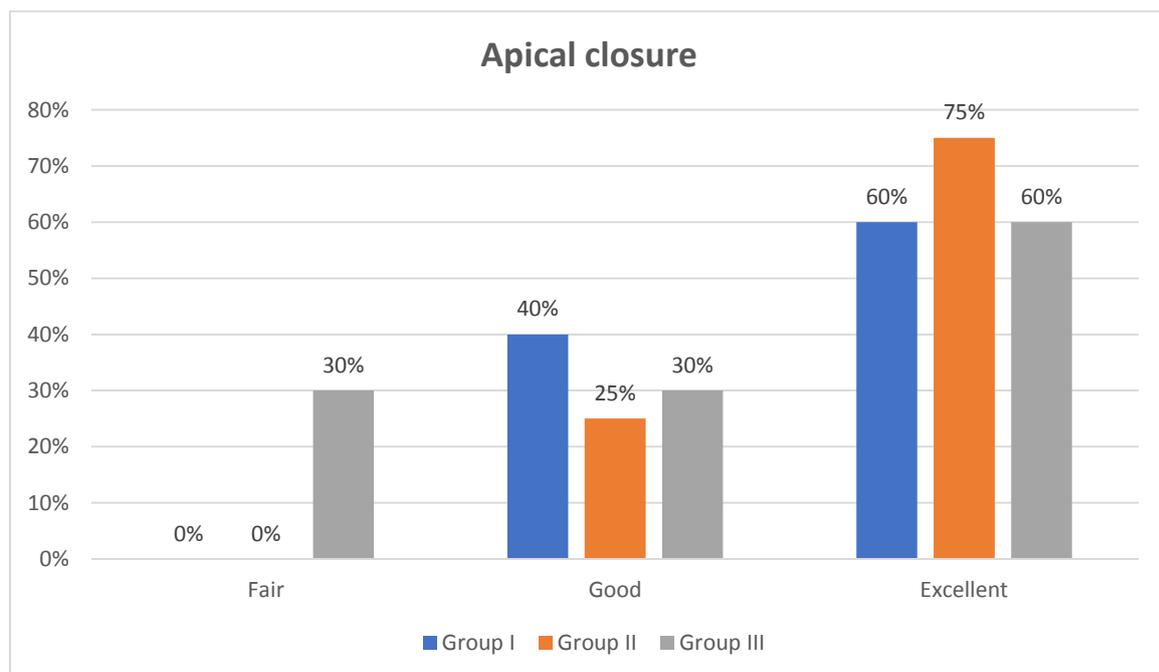
ANOVA, Significance, $P < 0.05$

Table IV Assessment of root lengthening in all groups

Root lengthening	Group I	Group II	Group III	P value
Fair	90%	20%	71%	0.082
Good	10%	80%	29%	
Excellent	0%	0%	0%	

ANOVA, Significance, $P < 0.05$

Graph I Assessment of Apical closure



Graph II Assessment of dentinal wall thickening

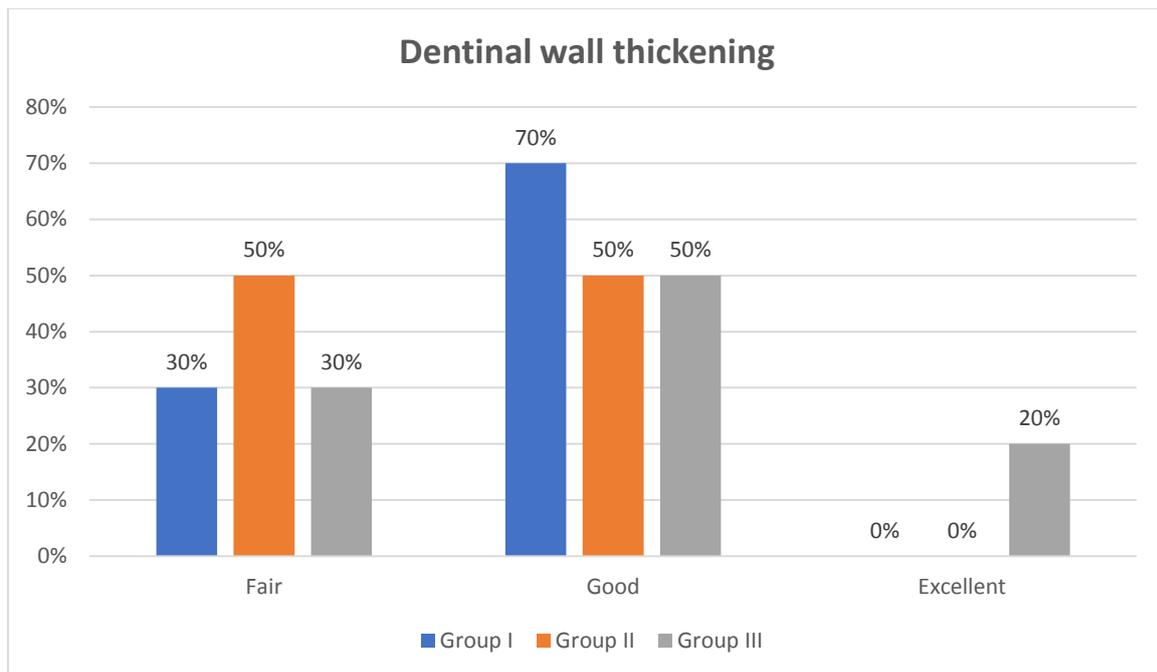


Table IV shows that in group I, 90% teeth had fair and 10% had good root lengthening, in group II, 20% had fair and 80% had good root lengthening and in group III, 71% had fair and 29% had good root lengthening. None of the group had excellent root lengthening. ANOVA test showed non- significant difference between groups ($P > 0.05$). Graph I shows that apical closure was good in 40% and excellent in 60% in group I, good in 25% and excellent in 75% in group II and fair in 30%, good in 30% and excellent in 60% in group III. A non- significant difference between groups ($P > 0.05$) was obtained. Graph II shows that dentinal wall thickening in group I was fair in 30% and good in 70%, in group II, 50% had fair and 50% had good and in group III, 30% had fair, 50% had good and 20% had excellent response. A non- significant difference between groups ($P > 0.05$) was obtained.

Discussion

Revascularization also called regenerative endodontics is recent treatment option for immature teeth with incomplete apical closure.⁸In this method damaged tooth portion such as root, dentin and cells of pulp dentin complex is replaced. This procedure allows root

maturation results in reestablishment of the pulp dentine complex.⁹ Regenerative dental procedures include bone augmentation with platelet rich plasma (PRP) and recombinant human bone morphogenic protein and Emdogain for periodontal tissue regeneration. Regenerative endodontic techniques utilize cells, growth factors and scaffolds.¹⁰ In this study natural and synthetic scaffolds such as PRF, blood clot and collagen in the management of immature necrotic teeth were compared.

We included 24 patients which comprised of 10 males and 14 females of age group that ranged from 13- 24 years having immature permanent maxillary incisors. Teeth were divided into 3 groups of 8 each. Group I used PRF, group II used blood clot and group III used collagen.

PRF is known as autologous leucocyte and platelet-rich fibrin biomaterial. It is second generation platelet concentrate. It has effect on gene as well as cell level.¹¹ Literature shows that platelet α -granules contain growth factors such as epidermal growth factor, platelet-derived growth factors, transforming growth factor beta, vascular endothelial growth factor, insulin like growth factor-1 etc. which play a significant role in soft tissue and hard tissue repair.¹²

We observed that in group I, 20% teeth had good and 80% had excellent healing, in group II, 20% had fair, 50% had good and 30% had excellent healing and in group III, 70% had good and 30% had excellent healing. Sharma *et al*¹³ conducted a study on 16 necrotic immature permanent maxillary incisors which were selected for regenerative endodontics. Based on material used they were classified into 4 groups. Group I used blood clot, group II used PRF, group III used collagen and group IV used poly- lactic- co- glycolic acid. Result of the study demonstrated that there was improvement in terms of periapical healing, apical closure, root lengthening, and dentinal wall thickening. PRF and collagen gave better results than

blood clot and PLGA in terms of periapical healing, apical closure and dentinal wall thickening.

We found that in group I, 90% teeth had fair and 10% had good root lengthening, in group II, 20% had fair and 80% had good root lengthening and in group III, 71% had fair and 29% had good root lengthening. None of the group had excellent root lengthening. Yamauchi *et al*¹⁴ showed that in patients with periapical periodontitis, the use of crosslinked collagen scaffold resulted in formation of mineralized tissues in teeth with open apical foramen. Collagen scaffold also provide dental pulp-like structures and complete tooth morphology with rootlike structures. In present study we used collagen scaffold in group III because it can be easily placed.

We found that apical closure was good in 40% and excellent in 60% in group I, good in 25% and excellent in 75% in group II and fair in 30%, good in 30% and excellent in 60% in group III. We observed that dentinal wall thickening in group I was fair in 30% and good in 70%, in group II, 50% had fair and 50% had good and in group III, 30% had fair, 50% had good and 20% had excellent response. Blood clot also acts as suitable and effective scaffold in regenerative endodontics. Nosrati *et al*¹⁵ in their study demonstrated that teeth with the presence of blood clot in their canals had better radiographic treatment outcome as compared to teeth without it. Apical closure as well as thickening of dentinal walls were better in these cases.

The limitation of the study of small sample size. Only three materials such as blood clot, PRF and collagen was included in this study. Inclusion of more materials could have shown better results.

Conclusion

Authors found that PRF and collagen was superior than blood clot in terms of apical closure and healing. Regenerative healing with different scaffolds is useful method of preserving immature non- vital permanent teeth.

References

1. Hargreaves KM, Giesler T, Henry M, Wang Y. Regeneration potential of the young permanent tooth: What does the future hold? *J Endod* 2008;34 7 Suppl: S51- 6.
2. Prescott RS, Alsanea R, Fayad MI, Johnson BR, Wenckus CS, Hao J, *et al.* *In vivo* generation of dental pulp- like tissue by using dental pulp stem cells, a collagen scaffold, and dentin matrix protein 1 after subcutaneous transplantation in mice. *J Endod* 2008;34:421- 6.
3. Kim NR, Lee DH, Chung PH, Yang HC. Distinct differentiation properties of human dental pulp cells on collagen, gelatin, and chitosan scaffolds. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108:e94- 100.
4. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, *et al.* Platelet- rich fibrin (PRF): A second- generation platelet concentrate. Part III: Leucocyte activation: A new feature for platelet concentrates? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:e51- 5.
5. Kerezoudis NP, Valavanis D, Proutzos F. A method of adapting gutta- percha master cones for obturation of open apex cases using heat. *Int Endod J* 1999;32:53- 60.
6. Cvek M. Prognosis of luxated non- vital maxillary incisor treated with calcium hydroxide and filled with gutta- percha. A retrospective clinical study. *Endod Dent Traumatol* 1992;8:45- 55.
7. Frank AL. Therapy for the divergent pulpless tooth by continued apical formation. *J Am Dent Assoc* 1966;72:87- 93.

8. Chala S, Abouqal R, Rida S. Apexification of immature teeth with calcium hydroxide or mineral trioxide aggregate: Systematic review and meta-analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;112:e36-42.
9. Kanfar MA, Al-Nazhan SA. Mineral trioxide aggregate root canal filling of traumatized immature tooth. *Saudi Endod J* 2013;3:144-7.
10. Torabinejad M, Turman M. Revitalization of tooth with necrotic pulp and open apex by using platelet-rich plasma: A case report. *J Endod* 2011;37:265-8.
11. Kling M, Cvek M, Mejare I. Rate and predictability of pulprevascularization in therapeutically reimplanted permanent incisors. *Endod Dent Traumatol* 1986;2:83-9.
12. Sumita Y, Honda MJ, Ohara T, Tsuchiya S, Sagara H, Kagami H, et al. Performance of collagen sponge as a 3-D scaffold for tooth-tissue engineering. *Biomaterials* 2006;27:3238-48.
13. Sharma S, Mittal N. A comparative evaluation of natural and artificial scaffolds in regenerative endodontics: A clinical study. *Saudi Endod J* 2016;6:9-15.
14. Yamauchi N, Yamauchi S, Nagaoka H, Duggan D, Zhong S, Lee SM, et al. Tissue engineering strategies for immature teeth with apical periodontitis. *J Endod* 2011;37:390-7.
15. Nosrat A, Seifi A, Asgary S. Regenerative endodontic treatment (revascularization) for necrotic immature permanent molars: A review and report of two cases with a new biomaterial. *J Endod* 2011;37:562-7.