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ORIGINAL ARTICLE

Regenerative Endodontics Procedure in Treatment of Permanent Immature Teeth with Necrotic Pulp

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ABSTRACT

Aim: To evaluate the radiographical success of Regenerative endodontics procedure in permanent immature teeth with necrotic pulp.

Methods: This Descriptive case series was conducted at the Department of Operative Dentistry, de'Montmorency College of Dentistry/ Punjab Dental Hospital, Lahore from November 2015 to November 2016. A total of 30 cases were included using non-probability consecutive sampling. Patients of both genders with age range from 9 to 14 years were considered. Performance of procedure and evaluation of success was done in terms of root development on periapical radiographs. . Data was entered and analysed with IBM SPSS 20. Level of significance was kept at *p*-value ≤ 0.05

Results: Out of 30 patients, 13 were females and 17 were males. Mean age of patients included in this study was 11.5±1.737. Follow up at 12 months showed 90% success, with 27 cases showed root development on periapical radiograph. There was no significant relation of success with age and gender of patient with *p*- value greater than 0.05.

Conclusion: It is concluded from current study that Regenerative Endodontics procedure in permanent immature teeth is encouraging and can be recommended for the treatment of permanent immature teeth with necrotic pulp. Further research studies are required for evaluation of root development in regenerative endodontics procedure.

Key words: Regenerative Endodontics, Permanent Immature teeth, Root development

INTRODUCTION

The development of permanent immature teeth may be halted owing to various harmful stimuli such as caries, trauma, anatomic variations which leads to thin and fragile dentinal walls. The long-term survival of these teeth is conceded due to open apices, large apical diameters and short roots[1,2]. Conventional techniques of root canal filling rely on the presence of an apical constriction at the apex of the tooth. This presents management challenge in permanent immature teeth[1-3].

Apexification is the traditional procedure used for treating such cases. The method of Apexification induces a calcified barrier at the apex of root and allows for continuation of development of the root in open apex teeth[4]. The primary purpose of this procedure is to form a hard calcified tissue barrier at open apex so that root canal filling can be easily placed subsequently within the root canal. Inhibition of extrusion of root canal filling beyond apex of the tooth is also achieved with this procedure[3,5].

Calcium hydroxide (CaOH) Apexification is the preferred choice for treatment of necrotic immature teeth[6]. However, this method comes with associated disadvantages such as multiple appointments owing to lengthiness of the procedure, greater chances of reinfection in root canal system due to possibility of dislodgment of filling material and coronal leakage. CaOH Apexification may also lead to increase brittleness of root dentin and cervical root fracture[7]. An alternate material that is used for apexification is Mineral Trioxide Aggregate (MTA). MTA is used for sealing the open apex by carrying it with an MTA carrier[7]. As opposed to CaOH Apexification, MTA based procedure requires one or two appointments. The disadvantages associated with lengthy procedural duration are avoided with this process and the tooth is restored in a much shorter duration in addition to the benefits of not having to rely on patient compliance. The risk of cervical fracture is thereby greatly reduced[6,8,9].

Regenerative Endodontic Procedures (REPs), utilizing the concept of tissue engineering are recent advancements for treatment of immature teeth wherein damaged structure such as dentin, pulp-dentin complex and root structures are made to regenerate biologically. The use of REPs results in the continuation of normal physiologic functions of the pulp-dentin complex such as continuation of root development, normalized nociception and immune competency along with the rectification of apical periodontitis[10-12].

While a number of studies have been conducted regarding Regenerative Endodontics for treatment of immature teeth with necrotic pulp, only a handful can be attributed to the dental research professionals of Pakistan. Thus the rationale of current study is to promote the procedure of Regenerative Endodontics procedure for treatment of permanent immature teeth with confidence in future.

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The objective of study was to evaluate radiographical success of Regenerative endodontics procedure in permanent immature teeth with necrotic pulp.

MATERIALS AND METHODS

The study was conducted at Department of Operative Dentistry at de'Montmorency College of Dentistry, Lahore from November, 2015 to November 2016, following approval from the institution's Ethical Committee. Male and female patients aged 9 to 14 years with permanent immature maxillary anterior teeth and open apices (observed on periapical x-ray) and necrotic pulp on clinical assessment were included in this study. Teeth that were periodontally involved, non-restorable or had vertical root fracture were excluded. A total 30 cases were included after obtaining an informed consent from all patients. Detailed history for each case was recorded after clinical examination. Preoperative periapical radiographs were taken as pre procedural record.

The affected tooth in each case was isolated with rubber dam, and anesthetized using local anesthesia (2% Lidocaine) with vasoconstrictor. Access cavities were prepared and canals were irrigated with 10ml 1.5% sodium hypochlorite (NaOCL) solution followed by saline. Minimal preparation was done and canal was dried. Triple antibiotic paste was prepared by mixing 1:1:1 ciprofloxacin: metronidazole: minocycline with normal saline to a final concentration of 0.1-1.0mg/ml as recommended by American Association of Endodontists[13]. 1ml prepared triple antibiotic paste was injected, and the access cavity was restored using a temporary restoration (CAVIT, 3M ESPE). Patients were recalled after 3 weeks and if tooth was found symptomatic, triple antibiotic paste was replaced and the patients recalled.

If the tooth was free of symptoms, the canal was irrigated by 1.5% NaOCl and dried with paper points. 2% Lidocaine was administered without vasoconstrictor for local anaesthesia and sharp strokes into the periapical tissue with a sterile hand file were given beyond the apex to the point where evident bleeding was observed in the canal's cervical portion. MTA was then placed at the canal orifice and covered with a moist cotton pellet. Access cavity was then temporarily restored with temporary restoration (GIC) which was then layered with adhesive composite resin after 1 week. On 12 months follow up, postoperative radiographs were taken and root development was assessed by comparing them with preoperative periapical radiographs. The case was labelled as successful when root development in terms of decrease in apical diameter was observed on periapical radiograph.

Data analysis: Data were entered and analyzed with IBM SPSS 23. Mean and standard deviations were evaluated for quantitative variables like age of patient. *p*-value ≤ 0.05 was termed significant based on the application of post stratification Chi Square Test.

RESULTS

A total of thirty (30) cases were included in this study. The mean age was 11.5 (S.D±1.737) with a range of 9-14 years. Among the patients 16(53.3%) were in age group 9-11 years and 14(46.7%) were in age group 12-14 years. Out of these 17(56.7%) were male and 13(43.3%) were female. Follow up at 12 months showed 90% success, with 27 cases showed root development on periapical radiograph as shown in Table-I

No significant difference was seen between age and success with p-value greater 0.05 as shown in Table-II

There was no significant relation found between gender and success with p-value greater than 0.05 as demonstrated in Table-III

Table I: Frequency distribution of success of the regenerative endodontics procedure

Success	Frequency	%age
Yes	27	90.0
No	3	10.0
Total	30	100.0

Table II: Analysis of gender and success

Gender	Success		Total
	Yes	No	
Male	14	3	17
Female	13	0	13
Total	27	3	30

P value 0.110

Table III: Analysis of age and success

Age	Success		Total
	Yes	No	
9-11	14	2	16
12-14	13	1	14
Total	27	3	30

P value 0.626

DISCUSSION

The continuous process of tooth development comprises of three distinct developmental stages namely bud, cap, and bell stage. Crown maturation begins following amelogenesis and dentinogenesis and is characterized by completion of enamel's mineralization and establishment of its final thickness. Formation of dentin meanwhile continues thereby forming the crown of the tooth. Root formation is the next stage of development. Hertwig's Epithelial Root Sheath (HERS) is responsible for root development. Dentin formation continues from the crown into the root. The role of HERS is also pivotal in cementoblasts' differentiation and cementum's formation. The process of dentinogenesis continues until establishment of appropriate root length. Thickening of the root continues till restriction of the apical opening to 1–3mm approximately which sufficiently allows neural and vascular communication between periodontium and pulp[14,15].

The treatment of necrotic permanent immature tooth constitutes a challenge in endodontics since anatomic variation, caries, trauma, incomplete root development and other such harmful stimuli can arrest tooth development[1,3,9]. Pulp necrosis of an immature permanent tooth leads to discontinuation of tooth development causing thin dentinal walls and open apices. This makes the tooth prone to fracture and decreases its survival rate. Their blunderbuss canals present difficulty in root canal debridement and obturation[16,17].

Apexification is used to treat cases of permanent immature teeth with open apex and pulp necrosis. This is either done by material like Calcium hydroxide (CaOH) or bioceramic material like MTA. CaOH is placed in the root canal space for a long period of time. This induces a calcific barrier at apex of the root. MTA is placed directly at the apex of tooth to form apical plug which leads to formation of hard tissue barrier[6,7].

The relatively new procedure of Regenerative Endodontics Therapy is an alternative to apexification for treatment of permanent immature teeth and is the subject of several ongoing researches. This procedure permits regeneration of tissues which leads to continuous root development and re-establishment of the basic function and anatomy of native tissue through genesis of novel tissue. This allows for better chances of regaining nociception as well as immune competency[10,18-19].

In the current study Regenerative Endodontics procedure was performed. In this study American Association of Endodontists (AAE) guidelines were followed for Regenerative Endodontics Procedure. Canal disinfection is the key to success in treatment of permanent immature teeth. Minimal preparation was done as such teeth are prone to fracture. Triple antibiotic paste (1ml) was used for canal disinfection as recommended by AAE guidelines[13]. This material was used for disinfection. Discoloration was observed in few cases in present study as it is a common side effect of triple antibiotics paste. Other materials recommended by AAE are calcium hydroxide (CaOH) and modified triple antibiotic paste[13]. Despite the limitations associated with the use of TAP, it still remains an excellent option in terms of the complete elimination of microorganisms as found in study by Juliana[20]. In this study bleeding was induced by evoking periapical tissue. In many studies blood clot has been used as a scaffold. In one such recent study, Alexander found that the blood clot is a reliable scaffold for RET[21]. The blood clot is less expensive as compared to more invasive scaffolds.

MTA is used for sealing the orifice after inducing bleeding in this study due to its various advantages. Nakata et al studied comparison of amalgam and MTA. He studied the sealing ability of these materials in furcal perforations and found that MTA was superior in preventing leakage as compared to amalgam[22].

Clinical outcomes such as absence of pain and swelling were achieved in this study in all cases. In current study radiographical success in terms of root development was found 90% in Regenerative Endodontics. These results are comparable with other studies. .

Jeeruphan et al. demonstrated a retrospective study by having follow-up of six months and established significantly better radiological success in regenerative endodontics which is 100% in controlled environment[23]. Nagata et al performed study on 23 patients, with 9–19 months follow-up, showed a success rate of 100% in revascularization[16]. Gottfried Schmalz et al found that rates of success in terms of absence of clinical symptoms and periapical lesion's complete radiographic healing was 91.3% for revitalization. Further development of root was noted to occur in 79% of the cases following revitalization[2]. Vanessa Chrepa observed 91.4% success in Regenerative Endodontics cases in terms of root development[10]. The results of this study are in accordance with the aforementioned studies. Long-term outcome of regenerative endodontics are limited. Young patients were included in this study as it is found that with increasing age, certain physiologic changes occur[24]. In this study, maxillary teeth were included because they have single root and single canal as described by Vertucci[25]. This allows better standardization of the procedure. In addition, maxillary anterior teeth were treated more successfully by regenerative endodontics[24].

In this study successful root development was found 90% in Regenerative Endodontics. However, because of the limited number of cases included in this study, the results of this study should be interpreted with caution. So multi-Centre study should be conducted for Regenerative endodontics procedure in larger number of subjects. The results of current study are significant, so this procedure can be carried out in our local population with confidence in future.

CONCLUSION

It is concluded from current study that Regenerative Endodontics procedure in permanent immature teeth is encouraging and can be recommended for the treatment of permanent immature teeth with necrotic pulp. Further research studies are required for evaluation of root development in regenerative endodontics procedure.

Conflict of interest: None

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