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Regenerative pulp therapy for immature non-vital tooth: A case report

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Abstract

Regenerative Endodontics is a biologically based procedure designed to replace damaged structures such as dentin, root structures and cells of the pulp dentin complex. Regeneration of dental tissue is possible from a variety of pre-existing dental stem cells in a properly disinfected root canal system in presence of suitable growth factors and scaffold medium. Blood clot induced by over-instrumentation within the root canal system act as ideal three dimensional scaffold medium and a rich source of growth factors that favours from stem cell multiplication and differentiation. The present case report presents a case of Regenerative Endodontic Procedure in an eight year old female child with necrosed 11 with radiographic evidence of peri apical radiolucency.

Keywords: Regenerative Endodontics, Tri antibiotic paste, tissue engineering, bleeding induction, MTA

1. Introduction

Modern medical science has moved from surgical model of care to the medicinal model and is likely to move onto the biological model of care, seeking biological replacement of biological tissue. From this perspective, the goal of regenerative dentistry is to induce biological replacement of dental tissues and their supporting structures^[1]. Regenerative Endodontics is a biologically based procedure designed to replace damaged structures such as dentin, root structures and cells of the pulp dentin complex allowing continuous increase in root length and increased thickness of dentinal wall making the tooth less vulnerable to fracture^[2]. Permanent teeth with necrotic pulp and immature apex are most suitable for such treatment procedure^[3]. Revascularization through an open apex allows the delivery of mesenchymal stem cells into the root canal space of necrotic immature teeth after a clinical regenerative endodontic procedure^[4]. This could allow host cell homing to form new tissues in the root canal space^[5]. Regenerative Endodontics is based on the principles of Tissue Engineering which require a correct spatial assembly and dynamic interactions between distinct stem cells, growth factors/morphogens and scaffolds to form a functional pulp dentin complex^[6]. Clinically Regenerative Endodontic Procedure consist of 1st phase of disinfection by suitable medicaments followed by 2nd phase of treatment by blood clot induction or autologous fibrin matrix like platelet rich plasma or platelet rich fibrin implantation in the canal and periodic follow ups^[7].

The present case report presents a case of Regenerative Endodontic Procedure in an eight year old female child with necrosed 11 with radiographic evidence of peri apical radiolucency.

2. Case Report

An eight year old female patient (Figure:1) reported with the chief complaint of pain in upper front teeth region for last 20 days. There was history of trauma to the upper front teeth region 1 year back. Dental, medical and familial history was non-contributory. Intra oral examination revealed Ellies and Davy alas III fracture in the above mentioned tooth which was tender on vertical percussion. Intra oral periapical radiograph of maxillary anterior region (Figure: 2) revealed slight irregular periapical radiolucency (approx 2 mm in diameter) in relation to 11. Apical closure was still incomplete in 11. Pulp vitality testing by heat test and Electric Pulp Tester (Parkel Digitest 2) were performed and both were found to be nonresponsive.

Considering the age of the patient, pulp vitality status and extent of apical closure, clinical decision of performing Regenerative Endodontic Procedures (REP) was taken in the tooth. A written informed consent form was signed by the parent of the child.

On the 1st appointment, access cavity was prepared in 11 under rubber dam isolation and canals were thoroughly irrigated with 1.5%, 20 ml Sodium Hypochlorite for 5 minutes with side vented irrigation needle (Max I Probe) followed by Normal Saline 20 ml for 5 minutes (According to clinical protocol by AAE for a regenerative procedure; 7/31/2013) [3]. The tip of Needle is placed at apical third of root for achieving proper disinfection of root canal system. No mechanical preparation was done to avoid any harm to varieties of resident stem cells. Canals were dried with paper point and a creamy paste of tri antibiotic paste mixture (minocycline, metronidazole and ciprofloxacin) in 1:1:1 concentration in normal saline vehicle was placed in the canals with sterile paper points below Cementoenamel Junction. The access cavity was sealed with a layer of Zinc oxide eugenol cement (Cavit) followed by a second layer of Type II Glass Ionomer Cement (Fuji II).

During the second appointment (after 4 weeks) there was no tenderness on percussion, absence of mobility on both vertical and horizontal directions in 11. Intra oral peri apical radiograph of 11 (Figure 3) revealed decreased periapical radiolucency. Access cavity was reopened and again root canal was thoroughly irrigated with 1.5%, 20 ml/canal Sodium Hypochlorite for 5 minutes with side vented irrigation needle (Max I Probe) and saline 20 ml/ canal for 5 minutes. A sterile 15 no K File was introduced within the canal and placed beyond the apex (as visualised in RVG) for induction of bleeding and kept for 10 minutes for blood clot formation. White MTA (Proroot MTA, Densply) of 3-4 mm thickness was placed coronally and the access cavity was closed with Type 2 Glass Ionomer Cement (Fuji II) (Figure 4)

The patient was advised for recall visit after 1 month, 3 month, 6 month, 9 month and 1 year for review. In follow up visits (Figure 5, 6) the teeth showed negative response to percussion and palpation tests but did not respond positively to heat or an electric pulp tester (EPT). Radiograph revealed continued thickening of the dentinal walls, root lengthening, regression of the periapical lesion and apical closure. Patient is advised for regular recall visit in every 6 months.



Fig 1: Ellis and Davy class III fracture of 11



Fig 2: IOPAR showing incomplete root formation and periapical radiolucency



Fig 3: 4 weeks after application of tri antibiotic paste



Fig 4: MTA placement for coronal sealing



Fig 5: 6 weeks after application of MTA showing continuous root growth



Fig 6: 1 year after application of MTA showing definite root lengthening and widening.

3. Discussion

Regenerative Endodontic Procedure is emerging as a very popular alternative to more traditional treatment like apexification in treating non-vital immature permanent teeth as they provide biological replacement of damaged structures such as dentin, root structures and cells of the pulp dentin complex allowing further increase in root length and increase in thickness of dentin making the tooth less vulnerable to fracture [8].

The present case report demonstrates the potential for revascularisation of infected root canal spaces with some form of vital pulp like tissues. Continuous widening and lengthening of root canal wall was also noted.

The most important criteria for case selection for such treatment modalities are teeth with necrotic pulp and open apex. The large diameter of immature (open) apex may act as a pathway for the in growth of tissues into the root canal space. The young pulp is necrotic but usually not degenerated and infected so that it can act as a scaffold into which the new tissue can grow. Kling M *et al* [9] (1986) reported that the incidence of revascularisation was enhanced by 18%, if the

apex showed radiographic opening of more than 1.1 mm.

The irrigation protocol and the application of tri antibiotic paste was done in accordance with the clinical protocol by AAE for a regenerative procedure; 7/31/2013 [3].

The regeneration of pulp like tissue depends upon the concept of Tissue Engineering utilising the dynamic relationship between stem cells, growth factors or morphogens and scaffold medium. Immature permanent tooth consists of various types of stem cells having unique potentials of differentiation and multiplication into newer cells. Growth factors affect a broad range of cellular activities including migration, proliferation, differentiation, and apoptosis of all dental pulp cells, including stem/progenitor cells. A scaffold is a 3-dimensional construct or support substance used for several tissue engineering applications. When stem cells are seeded on scaffolds, they are expected to attach, proliferate, and differentiate into new tissues that will eventually replace the scaffold. In the present case induced blood clot act as an autologous scaffold medium and rich source of various growth factors such as PDGF, FGF, VEGF, TGF b [10, 11].

Blood clot was introduced by insertion of sterile 15K file beyond apex of the tooth for 10 minutes. The tooth was anaesthetised with 3% mepivacaine without vasoconstrictor before induction of the blood clot.

For coronal sealing MTA is regarded as the material of choice as it gives excellent coronal seal, it is hydrophilic so moisture contamination does not hamper its setting and also MTA itself provides signalling molecules for growth of stem cells [12, 13]. In the present case White MTA (Proroot MTA, Densply) of 3-4 mm thickness was placed coronally and the access cavity was closed with Type 2 Glass Ionomer Cement (Fuji 2).

There are several case reports in literature showing successful regenerative endodontic procedures in immature non-vital teeth with induction of blood clot with the root canal space. However, this procedure might cause discomfort for the patient and most importantly the amount and extent of clot formation cannot be controlled by the operator. The amount of bleeding induction in a long standing non-vital tooth is also questionable. So there was a quest for a better approach in regenerative endodontics which led to the introduction of autologous fibrin matrix as Platelet Rich Plasma or platelet rich fibrin in the revitalization procedures.

Recently there are several studies that have tried to perform regenerative endodontic procedure in mature non-vital teeth with close apex with either intentional opening of apex or application of autologous fibrin matrix as Platelet Rich Plasma or platelet rich fibrin.

4. Conclusion

The benefit of root lengthening and widening in regenerative endodontic procedure makes it an attractive alternative to traditional apexification procedure for non-vital immature teeth. However, the predictability of this procedure and the type of tissue that is present in the pulp space has to be studied and clinical research is necessary before a conclusion can be reached.

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