Revascularization of an immature Permanent molar with necrotic pulp and apical periodontitis using MTA: A case report

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Abstract

In recent times there has been a constant effort to harness the regeneration capacity of certain pluripotent cells to replace the lost part. In the contemporary practise, there has been shift in the paradigm towards maturogenesis than apexification for an immature permanent tooth. Revascularisation is a modality of treatment in which is a part of regeneration. First molar is most susceptible for caries involvement, which may lead to pulpal involvement at an early age. So it becomes imperative to plan a treatment which improves the overall prognosis. One of the most promising modality is revascularisation. Hence we present a case of successful revascularisation in Permanent molar of 7 year old child with necrotic pulp. In present case 18 months follow up has shown fair amount of maturogenesis both clinically and radiographically.

Key words: Revascularisation, Molar, Immature root, Necrotic pulp

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Introduction

Regenerative endodontics gives a hope of regeneration of lost pulp. Regenerative endodontic procedures (REPs) can be defined as "biologically based procedures designed to replace damaged structures including dentin and cells of the pulp-dentin complex".[1] Pulp revascularization is the induction of angiogenesis in an endodontically treated root canal, as a part of regenerative procedure. Prevalence of caries in permanent molar is highest[2] and gets pulpally involved when roots are immature with open apex. Still, revascularisation has not been tried much in molars. Here we present the case of successful revascularisation in immature permanent molar with apical periodontitis.

Case Report

Patient aged 7 years reported with a chief complaint of pain in lower left back tooth region since 4 days. Pain was moderate, intermittent, localised and increased on chewing. On examination a deep occlusal carious lesion was seen with respect to 36. It was tender on vertical percussion. Pulp vitality test was negative. Radiographic examination revealed a large coronal radiolucency involving mesial pulp (Fig. 1) and Periapical radiolucency was observed with widening of periodontal ligament space. Roots were immature with open apex. Diagnosis was made as apical periodontitis.

Taking into consideration low root/crown ratio, thin root dentin, open apex and sufficient coronal tooth structure revascularisation was planned. With that, to preserve the space loss caused by premature loss of primary second molar removable space maintainer was planned and it was planned to straighten tilted molar after completion of revascularisation.(Fig. 2)

Informed consent was obtained. Local anaesthesia was administered following which rubber dam was placed. After access opening, irrigation with alternate 3% sodium hypochlorite and saline was done. Canal was dried and Triple antibiotic paste (200mg Ciprofloxaciln, 400 mg Metronidazole, and 100 mg Minocycline) was placed 3 mm below CEJ (Cemento-enamel junction) to minimize staining of crown. GIC restoration was done for coronal seal. Patient was recalled after three weeks and was found asymptomatic. Local anaesthesia without vasoconstrictor was administered. Rubber dam was placed and restoration was removed. Copious irrigation was done with Ethylenediamine Tetra Acetic Acid (EDTA) and followed by normal saline. Subsequently, after drying with paper point, bleeding was introduced into canal by overintrumentation with number 15 K-file beyond apex. Bleeding was stopped 3 mm below the CEJ. MTA was placed over the clot till the orifice (Fig. 3). GIC and composite restoration was placed for giving "Double seal". Patient was followed up till 18 months (Fig. 4, Fig. 5). Progressive resolution of periapical pathosis, increase in root dentin thickness and root length were observed. Root ends were almost closed.

Discussion

Regenerative endodontic procedures are part of stem cell research and tissue engineering. Nakashima[3] described three essential components of tissue

engineering: stem/progenitor cells, morphogenetic signals and three-dimensional scaffolds.

Concerning pulp revascularization, mature type of stem cells is of interest. Pulp revascularization is dependent on the ability of residual pulp, mesenchymal stem cells residing in the apical papilla, known as stem cells of apical papilla (SCAP)[4] which are the multipotent stem cells,[1] and resistant to necrosis/infection[5,6] and periodontal stem cells to differentiate[7,8]. These can generate a highly vascularized and conjunctive rich living tissue. They are able to colonize the available pulp space. Subsequently, these stem cells will differentiate into newly formed odontoblasts that will induce an apposition of hard tissue. The nature of this hard tissue is unknown yet.[9] Histologically, 'Mermaid Phenomenon' has been observed because of both Cementoid and Osteiod nature of the tissue.[10]

Successful regeneration depends on a race between the new tissue and bacteria populating the pulp space is strengthened by the fact that the incidence of revascularization is enhanced if the apex shows radiographic opening of more than 1.1 mm[11] because diameters of the neural, vascular, and cellular structures are less than 100 µm(micrometre).[12,13] Therefore age plays a significant role.

Regenerative endodontic treatment involves passive decontamination with irrigants[7,14] and antibiotics. Multiple aerobic and anaerobic bacteria cause infection of the root canals, and single type of antibiotic is ineffective. Hoshino and Sato recommended a combination of three antibiotics (ciprofloxacin, metronidazole, minocycline).[15,16] But disadvantages such as development of bacterial resistance allergic reactions and crown discoloration due to minocycline have been reported.[7]

An empty canal space will not support in growth of new tissue from the periapical area on its own.[17] Early studies on attempted revascularization used blood or blood substitutes to act as a scaffold to aid the in-growth of new tissue into the empty canal space leading to a significant increase in expression of undifferentiated mesenchymal stem cell markers in the root canal space.[18]

Before stimulating bleeding, irrigation with EDTA was done followed by normal saline, as it removes the smear layer, exposes dentinal tubules, and conditions the dentin to release growth factors such as transforming growth factor b (TGF-b).[19,20,21]

After formation of the blood clot, fast setting MTA was placed over the clot. MTA has shown to provide an excellent bacteria-tight seal[22], hence is currently the material of choice.[23] 3 mm of MTA was placed over the clot, as increment of 3 to 4 mm of MTA seems to be sufficient to attain this seal.[24]

The primary goals of these procedures are the elimination of symptoms and the evidence of bony healing. Secondary include increased root wall thickness and/or increased root length. A tertiary goal is a positive response to vitality testing. So far, variable rate of success has been achieved. Following table gives a review of the published articles on 1st molar revascularisation.

Author, Year	Age Group	Material used for Passive Canal disinfection	Materials used for seal	Follow up time	Resolution of Apical Pathosis	Increase in Root Dentin thickness	Increase in root Length	Apical closure
Cehrelli et al 2011	8-11 years	$Ca(OH)_2$	MTA and Composite	9-10 months	Complete	Continued	Continued	Obvious
Nosrat et al 2011	8-9 years	Triple antibiotic paste	Calcium enriched mixture and GIC	15 months	Continued	Continued	Continued	Near completion
Jeon et al 2012	9 years	Triple antibiotic paste	MTA and GIC	12 months	Continued	Continued	Continued	Complete
Sönmez et al 2013	9 years	Triple antibiotic paste	MTA and composite	24 months	Complete	Continued	Continued	Complete
Martin et al 2013	9 years	Triple antibiotic paste	MTA and Composite	14 months	Continued	Continued	Continued	Near completion

In our case we achieved primary, secondary goal as well as tertiary goal, which is the pinnacle of success as positive pulp tests may be an indication of regeneration of innervation in the canal space. We achieved normal range value with electric pulp testing. The lack of a pulp response, however, does not necessarily indicate a lack of vitality. Series of successful cases had no response to pulp testing.[25]

According to Chueh and colleagues[26] radiographic evidence of apical bone healing in 3 to 21 months, and radiographic evidence of root development in 10 to 29 months should be seen. In our case we achieved these objectives within 18 months.

This innovative treatment approach will shift the paradigm towards maturogenesis from traditional apexification or MTA barrier which has disadvantage of thin dentinal walls and no further development of roots.[27]

Fig. 1: Pre-operative radiograph of 36: showing large coronal radiolucency involving mesial pulp chamber and periapical radiolucency with widening of periodontal space. Roots are immature with short root, thin root dentin and open apex

Fig. 2: Removable functional space maintainer to prevent space loss from premature loss of second primary molar

Fig. 3: After revascularisation: showing 3 mm MTA over the blood clot in the canal till the orifice to act as a biocompatible seal

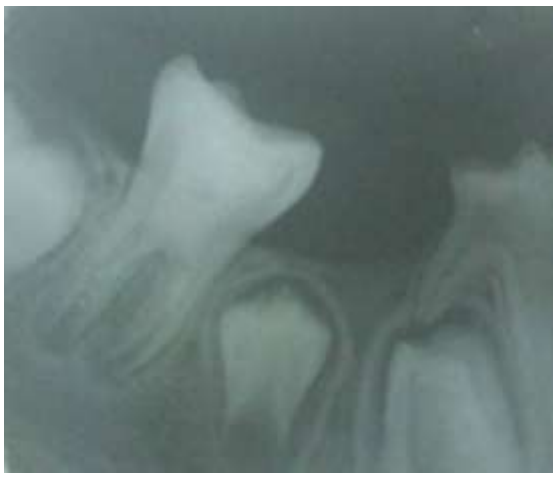

Fig. 4: Radiograph after 3 months: Progressive resolution of periapical radiolucency, increase in root dentin thickness, increase in root length, root ends are appearing each other

Fig. 5: Radiograph of 18 months after revascularisation: Resolution of periapical radiolucency, increase in root dentin thickness, increase in root length and closure of root ends

Conclusion

Successful case of molar revascularisation has been presented based on clinically functional interpretation of the healing process as all the objectives of regenerative endodontics have been achieved.

References

1. Murray PE, Garcia-Godoy F, Hargreaves KM. Regenerative endodontics: a review of current status and a call for action. J Endod. 2007 Apr;33(4):377-90.
2. Demirci M, Tuncer S, Yuceokur AA. Prevalence of Caries on Individual Tooth Surfaces and its Distribution by Age and Gender in University Clinic Patients.European Journal of Dentistry. 2010;4(3):270-279.
3. Nakashima M, Akamine A. The application of tissue engineering to regeneration of pulp and dentin in endodontics. J Endod. 2005 Oct;31(10):711-8.
4. Huang GT, Sonoyama W, Liu Y, Liu H, Wang S, Shi S. The hidden treasure in apical papilla: the potential role in pulp/dentin regeneration and bioroot engineering. J Endod. 2008 Jun;34(6):645-51
5. Heithersay GS. Stimulation of root formation in incompletely developed pulpless teeth. Oral Surg Oral Med Oral Pathol. 1970 Apr;29(4):620-30.
6. Lin L, Shovlin F, Skribner J, Langeland K. Pulp biopsies from the teeth associated with periapical radiolucency. J Endod. 1984 Sep;10(9):436-48.
7. Reynolds K, Johnson JD, Cohenca N. Pulp revascularization of necrotic bilateral bicuspids using a modified novel technique to eliminate potential coronal discolouration: a case report. Int Endod J. 2009 Jan;42(1):84-92.

8. Torabinejad M, Turman M. Revitalization of tooth with necrotic pulp and open apex by using platelet-rich plasma: a case report. J Endod. 2011 Feb;37(2):265-8.
9. Zhang W, Yelick PC. Vital pulp therapy-current progress of dental pulp regeneration and revascularization. Int J Dent. 2010;2010:856087.
10. Martin G, Ricucci D, Gibbs JL, Lin LM. Histological findings of revascularized/ revitalized immature permanent molar with apical periodontitis using platelet-rich plasma. J Endod. 2013 Jan;39(1):138-44.
11. Kling M, Cvek M, Mejare I. Rate and predictability of pulp revascularization in therapeutically reimplanted permanent incisors. Endod Dent Traumatol. 1986 Jun;2(3):83-9.
12. Provenza DV. The blood vascular supply of the dental pulp with emphasis on capillary circulation. Circ Res. 1958 Mar;6(2):213-8.
13. Matthews JI, Dorman HL, Bishop JG. Fine structures of the dental pulp. J Dent Res. *1959*;38:940–*6*. 54.
14. Shin SY, Albert JS, Mortman RE. One step pulp revascularization treatment of an immature permanent tooth with chronic apical abscess: a case report. Int Endod J. 2009 Dec;42(12):1118-26.
15. Hoshino E, Kurihara-Ando N, Sato I, Uematsu H, Sato M, Kota K, Iwaku M. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. Int Endod J. 1996 Mar;29(2):125-30.
16. Sato I, Kurihara-Ando N, Kota K, Iwaku M, Hoshino E . Sterilization of infected root canal dentine by topical application of a mixture of ciprofloxacin, metronidazole and minocycline in situ. Int Endod J. 1996 Mar;29(2):125-30.
17. Thibodeau B, Teixeira F, Yamauchi M, Caplan DJ, Trope M. Pulp revascularization of immature dog teeth with apical periodontitis. J Endod. 2007 Jun;33(6):680-9.
18. Lovelace TW, Henry MA, Hargreaves KM. Evaluation *of* clinically delivered SCAP cells *in* regenerative endodontic procedures. J Endod 2010;36:554.
19. Smith A. Dentin formation and repair. In: Hargreaves KM, Goodis HE, editors. Seltzer and Bender's dental pulp. 3rd edition. Chicago: Quintessence Publishing; 2002. p. 41–62.
20. Yamauchi N, Yamauchi S, Nagaoka H, et al. Tissue engineering strategies for immature teeth with apical periodontitis. J Endod 2011;37:390–7.
21. Galler KM, D'Souza RN, Federlin M, et al. Dentin conditioning codetermines cell fate in regenerative endodontics. J Endod 2011;37(11):1536–41.
22. Torabinejad M, Rastegar AF, Kettering JD, et al. Bacterial leakage of mineral trioxide aggregate as a root-end filling material. J Endod 1995;21:109–12.
23. Banchs F, Trope M. Revascularization of immature permanent teeth with apical periodontitis: new treatment protocol? J Endod 2004;30(4):196–200.
24. Lawley GR, Schindler WG, Walker WA 3rd, et al. Evaluation of ultrasonically placed MTA and fracture resistance with intracanal composite resin in a model of apexification. J Endod 2004;30:167–72.
25. Cehreli ZC, Isbitiren B, Sara S, et al. Regenerative endodontic treatment (revascularization) of immature necrotic molars medicated with calcium hydroxide: a case series. J Endod 2011;37:1327–30.
26. Chueh LH, Ho YC, Kuo TC, et al. Regenerative endodontic treatment for necrotic immature permanent teeth. J Endod 2009;35:160–4.
27. Cotti E, Mereu M, Lusso D. Regenerative treatment of an immature, traumatized tooth with apical periodontitis: report of a case. J Endod 2008;34:611–6.