Case Report

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PULP REVASCULARIZATION OF A NECROTIC INFECTED IMMATURE PERMANENT TOOTH: A CASE REPORT AND REVIEW OF THE LITERATURE

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ABSTRACT:

Regenerative endodontics (revascularization/pulpal regeneration) is one of the most exciting new developments in endodontics. The current American Association of Endodontists defines regenerative endodontics as "biologically-based procedures designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex." This case report demonstrates the evidence of continued root growth by the process of revascularization after going through a period of $Ca(OH)_2$ apexification.

Key words: Root growth, Revascularization, Necrosed Pulp, $Ca(OH)_2$ regenerative endodontics, MTA

INTRODUCTION:

The treatment of pulpal necrosis in an immature tooth with an open apex presents a unique challenge to the dentist. Traditionally, multiple-visit apexification with calcium hydroxide was the treatment of choice in necrotic immature teeth, which aimed at formation of an apical hard tissue barrier.(1)

An alternative technique for apexification is by placing an artificial barrier in apical portion of the root canal. The material of choice for this technique is mineral trioxide aggregate (MTA), which has been shown to have high success rates and reduce the number of required clinical session.(2,3)

Traditionally, the apexification procedure has consisted of multiple and long-term applications of calcium hydroxide [Ca (OH)2] to create an apical barrier to aid the obturation. Recently, artificial apical barriers such as those made with mineral trioxide aggregate (MTA) have been used in teeth with necrotic pulps and open apices. More recently, procedures referred to as regenerative endodontic have received much attention as an option for these teeth.

MTA is a powder aggregate, containing mineral oxides, it has good biological action (2) and stimulates repair (3) because

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it allow cellular adhesion, growth and proliferation on its surface [4].The ideal outcome for a tooth with an immature root and a necrotic pulp would be the regeneration in the canal of pulp tissue capable of promoting the continuation of normal root development. Many studies show a favorable long-term prognosis with an overall success rate of 88.8%. ([5,6]

Revascularization is an emerging regenerative endodontic treatment approach that aims to allow continuation of root development. Because periapical tissues around immature teeth have a rich blood supply and contain stem cells that have relative potential to regenerate in response to tissue injury, revascularization of young permanent teeth is possible after necrosis.

After the root canal disinfection with sodium hypochlorite irrigation and antibiotic paste consisting of ciprofloxacin, metronidazole, and minocycline, or $Ca(OH)_2$ therapy procedure, apical bleeding is induced to form a blood clot under the cemento-enamel junction (CEJ). The root canal hole is then covered with MTA. Finally, the crown is restored permanently. There is strong evidence in the literature to support the success of the revascularization procedure, with increased root length, thickening of the root walls, and desirable apical closure.[2,6,7,8,9]

The aim of this case report was to demonstrate that apexification (complete removal of necrotic pulp and placement of CaOH), and revascularization of the root canal is a viable clinical solution

CASE DETAIL:

A healthy 11-year-old Greek male was referred by general dentist, to my pedodontics clinic.

The patient chief complaint was pain related to the upper left second premolar (#25), with a history of previous dental treatment. Review of the patient's record revealed that the patient was initially seen 10 months earlier in the general clinics (Fig1), where initial examination and pulp testing was carried out. Caries excavation, access, pulp extirpation, irrigation with saline, drying of the canal, calcium hydroxide placement and temporization with cavit was performed. The patient returned seven months later, complaining of a fallen restoration and upon examination there was an exposed canal of #25. The root canal was cleaned and refilled with calcium hydroxide and referred to the clinic.

The patient appeared at the my clinic 3 months after the refill of the canal with Ca(OH)2. Clinical examination revealed that the tooth was tender to percussion with an intact temporary restoration. Standard procedures dictated that pulpal testing must be done, which revealed no response to cold or electric stimuli. A diagnostic periapical radiograph showed a calcified barrier at mid-root with an underdeveloped root and wide-open apex with no periapical (PA) radiolucency (Fig.2). The diagnosis was determined to be necrotic pulp with normal PA structure. Treatment plan was to evaluate midroot barrier and attempt completion of RCT.

After the administration of buccal infiltration local anesthesia (1 carpule of 2% Lidocaine with 1:80,000 epinephrine), the tooth was isolated with a rubber dam. The temporary restoration was removed with a #3 high speed round carbide bur under copious irrigation.

The access cavity was refined and the canal was negotiated. A paper point was used to probe the canal, and once a sturdy barrier was found, verification was followed with a size #25 k-file . A definite solid barrier was found at mid-root, and the maximum length that could be reached was 14.5mm. The canal was necrotic with a great amount of debris. The canal was cleaned to the barrier and irrigated with NaOCL (2.5%). The canal was obturated with Obtura system, and the tooth was restored with Ketac-Fil (Fig3). The patient was referred to the restorative specialist clinic for a final restoration.

A clinical and radiographic check up on the same tooth was carried out after 10 months and after 12 months by the same operator (Fig 4). The radiograph showed evidence of healing and closure of the apex. The root walls were thick and the development of the root below the restoration was similar to the adjacent and contra-lateral teeth

DISCUSSION:

Treatment of the young permanent tooth with a necrotic root canal system and an incompletely developed root is fraught with difficulty. More recently, procedures referred to as regenerative endodontics have received much attention as an option for these teeth.[10,11]

The ideal outcome for a tooth with immature root and a necrotic pulp would be the regeneration in the canal of pulp tissue capable of promoting the continuation of normal root development. The key factor for the success of this process is disinfection of the root canal system, because tissue growth will halt at the level where bacteria are found.[3,7,9]

The most effective disinfection of the infected root canal is in general attained by the mechanical de-bridement and chemical irrigation of the canal with the addition of an intracanal dressing. It is extremely important to ensure that the irrigating needle is loose in the canal and that the NaOCl irrigation is performed very slowly. In cases reported to date, the careful application of NaOCl does not produce postoperative sequelae.[10,11]

This case proves the potential of root revascularization and regrowth, thereby drawing the attention to clinicians of this possibility, emphasizing this attempt with more rigorous protocol. The value of this case report is the demonstration of what is possible and to add to the growing number of case reports to provide insights to the roles of different factors that come into play in pulpal revascularization and/or regeneration.[2,6,8,9,11]

Chueh et al. have reported that $Ca(OH)_2$ commonly caused progressive calcification of the root canal space when it was used as an intra-canal medicament

in teeth, suggesting that root development induced by regenerative endodontic treatment may not follow a natural pattern. Although, there is no sign of root canal obliteration in the present case, the progressive periapical lesion occurred in the long-term.[12] Generally, a multi-visit treatment method is followed to achieve satisfactory revascularization; however, **Shin et al**. suggested a singlevisit technique without the use of triple antibiotic paste to revascularize a partially necrotic pulp with associated chronic apical periodontitis. Hence, case selection is critical when deciding which revascularization protocol is ideal for a particular pulpal condition. A multi-visit, tri-antibiotic paste sequence could be a better treatment choice for teeth presenting with complete pulpal necrosis.[13]

Cvek reported an average barrier formation time of 18.2 months, however shorter average barrier formation times of <12 months have been reported in more recent reports . There was a tendency for earlier detection in cases with more frequent CaOH changes. On the other hand it has been postulated that if CaOH is not replaced often enough, its dissolution from the apical area will create a void thus allowing in-growth of tissue and increasing the likelihood that the barrier is formed coronal to the apex· Others have found that for at least 6 months after initial root filling with CaOH there is nothing to be gained by repeated root filling either monthly or after 3 months.[14,15,16,17]

Nygaard-Østby and Hjortdal who were unsuccessful in the case of infection in the pulp space. However, Andreason [12] suggested that root formation could continue even in the presences of pulpal inflammation and necrosis due to the vascularity and cellularity of the apical region of the tooth.(18)

Wang et al. in an animal study on revascularization showed that a cemental bridge is formed beneath MTA in most cases, which might be the result of cementogenic and osteogenic properties of MTA. In addition, in the present case, glass ionomer base was placed as a second sealing agent over MTA, followed by a permanent coronal resin-bonded restoration. Hence, successful outcome may also be attributed to this effective coronal seal.[19]

Kling suggested that an apical opening greater than 1 mm mesiodistally was associated with successful revascularization of avulsed permanent teeth, while no revascularization occurred in teeth with a smaller apical opening. The materials required for this protocol can be obtained from any pharmacy, and the treatment procedures themselves are less challenging than the more traditional techniques of treating pulpless teeth with open apices. If the attempted revascularization procedure fails, the traditional options of treatment remain, including long-term Ca(OH)2 apexifi cation or MTA apexifi cation followed by a conventional root filling.[20]

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presences of pulpal inflammation and necrosis due to the vascularity and cellularity of the apical region of the tooth.[21]

Recently a Mineral Trioxide Aggregate (MTA) apical barrier technique has steadily gained popularity with clinicians, as it allows an immediate hard tissue barrier after disinfection of the root canal, although long-term comparative outcome studies to that of the traditional $CaOH_2$ technique are not available. Both techniques have many disadvantages; prolonged treatment time for barrier to form in the CaOH technique (6-18 months). In addition, the roots of teeth treated with both apexification methods are thin and have a significant risk of subsequent fracture. This also complicates obturation, as there should be no pressure applied to these thin fragile roots during condensation. In this case; a thermoplastisized obturation method that did not place any pressure on the walls and produced a homogenous mass of gutta percha was used for that reason. Although arguably a better approach might be to use a material that adhered to the canal walls, rather than adapt to it.[21,22,23]

For this reason, case reports with long-term follow-up can make meaningful contributions in identifying potentially important parameters that can guide the design of future prospective clinical trials. Moreover, regenerative procedures lack standardization of treatment protocols with a myriad of reported techniques, intracanal medicaments and irrigants. Hence, guidelines are needed to ensure that regenerative endodontic procedures are used appropriately.

CONCLUSIONS:

This present case report has demonstrated that revascularization of the pulp of immature permanent teeth is a clinical possibility, a treated tooth might even respond normally to cold test after about a year. This treatment modality should be preferable to the traditional apexification treatment.

REFERENCES:

1. Glossary of Endodontic Terms. 8th ed. Chicago: American Association of Endodontists 2012.
2. Hargreaves KM, Diogenes A, Teixeira FB. Treatment options: Biological basis of regenerative endodontic procedures. J Endod 2013;39:S30-43.
3. Ding RY, Cheung GS, Chen J, Yin XZ, Wang QQ, Zhang CF. Pulp revascularization of immature teeth with apical periodontitis: A clinical study. J Endod 2009;35:745-9.
4. Torabinejad M, Chivian N. Clinical applications of mineral trioxide aggregate. J Endod 1999;25:197-205.
5. Sakthi S, Bharadwaj SL. Pulp revascularisation in pediatric dentistry.

J Int Dent 2012;1:34-6.

6. Jeeruphan T, Jantarat J, Yanpiset K, et al. Mahidol study 1: comparison of radiographic and survival outcomes of immature teeth treated with either regenerative endodontic or apexification methods: a retrospective study. J Endod 2012;38:1330-6.
7. Petrino JA. Revascularization of necrotic pulp of immature teeth with apical periodontitis. Northwest Dent 2007;86:33-5.
8. Thibodeau B. Case report: pulp revascularization of a necrotic, infected, immature, permanent tooth. Pediatr Dent 2009;31:145-8.
9. 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.
10. Oktem ZB, Cetinbas T, Ozer L, Sönmez H. Treatment of aggressive external root resorption with calcium hydroxide medicaments: A case report. Dent Traumatol 2009;25:527-31.
11. Jung IY, Lee SJ, Hargreaves KM. Biologically based treatment of immature permanent teeth with pulpal necrosis: A case series. J Endod 2008;34:876-887
12. Chueh LH, Ho YC, Kuo TC, Lai WH, Chen YH, Chiang CP. Regenerative endodontic treatment for necrotic immature permanent teeth. J Endod 2009;35:160-4.
13. Shin S, Albert J, Mortman R. One step pulp revascularization treatment of an immature permanent tooth with chronic apical abscess: a case report. Int Endod J 2009; 42: 1118–1126
14. Cvek M, Nord CE, Hollender L. Antimicrobial effect of root canal debridgement in teeth with immature roots. A clinical and microbiologic study. Odontological review 1976;27:1-10
15. Finucane D, Kinirons MJ. Non-vital immature permanent incisors: factors that may influence treatment outcome. Endod Dent Traumatol 1999;15:273-277
16. Mackie IC, Bentley EM, Worthington HV. The closure of open apices in non-vital immature incisor teeth. British Dental Journal 1988;165:169-173 117. Yates JA. Barrier formation time in non-vital teeth with open apices. International Endodontic Journal 1988; 21:313-319
17. Chosack A, Sela J, Cleaton-Jones P. A histological and quantitative histomorphometric study of apexification of non-vital permanent incisors of vervet monkeys after repeated root filling with a calcium hydroxide

paste. Endod & Dent Traumatol 1997; 13: 211-217

18. Nygaaard-Østby B, Hjortdal O. Tissue formation in the root canal following pulp removal. Scand J Dent Res 1971:79;333-348
19. Wang X, Thibodeau B, Trope M, Lin L, Huang G. Histological characterization of regenerated tissues in canal space after the revitalization/ revascularization procedure of immature dog teeth with apical periodontitis. J Endod. 2010; 36:56-63.
20. Kling M, Cvek M, Mejare I. Rate and predictability of pulp revascularization in therapeutically reimplanted permanent incisors. Endod Dent Traumatol 1986;2:83-9.
21. Andreason JO, Hjorting- Hansen R. Intra-alveolar root fractures: radiographic and histologic study of 50 cases. J Oral Surg 1967;25:414-26
22. Giuliani V, Baccetti T, Pace R, Pagavino G. The use of MTA in teeth with necrotic pulps and open apices. Dent Traumatol 2002; 18:217-221
23. Maroto M, Barberia E, Planells P, Vera V. Treatment of a non-vital immature incisor with mineral trioxide aggregate (MTA). Dent Traumatol 2003:19;165-169

FIGURES:

Figure 1:Initial Radiograph

Figure 2: Calcific barrier at mid-root with an underdev eloped root and wide-open apex with no PA radio lucency after 10 months of initial CaOH placement

Figure 3: Obturation

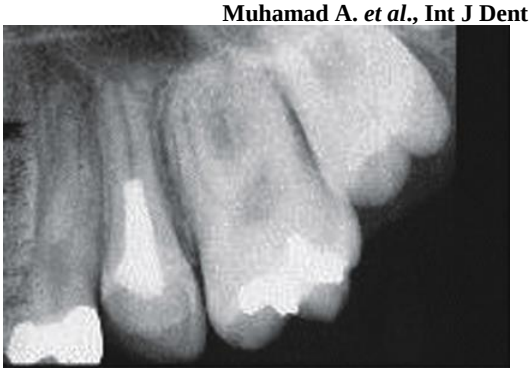

Figure 4: Continued growth and regeneration of root after 12 months