

Case report

Treatment of Traumatized Non-Vital Immature Tooth

Mohamed Ben-hakoma, Khaled Elhenshiri, Farouk Fadel

Department of Endodontics and Operative dentistry, Faculty of Dentistry, the University of Tripoli, Libya.

ABSTRACT

The aim of this trial to evaluate the clinical and radiographic appearance of tooth that suffered from premature root formation and was treated non- surgically by mineral trioxide aggregate (MTA) as apical plug. Treatment of maxillary left central incisor which had open apices and periapical lesions by using MTA apical plugs after the root canals had been debrided and rinsed with 2.5% Sodium hypochlorite was successful. The results add to the rapidly expanding field of use of MTA (Mineral trioxide aggregate) as apical plug in teeth with open apex.

Keywords: Immature tooth, MTA, Apical plugs.

Citation: Ben-hakoma M, Elhenshiri K, Fadel F. Treatment of Traumatized Non-Vital Immature Tooth. Khalij-Libya J Dent Med Res. 2019;3(1):11–17. <https://doi.org/10.26719/kjdmr.19.049>

Received: 11/02/19; **accepted:** 30/02/19

Copyright © Khalij-Libya Journal (KJDMR) 2019. Open Access. Some rights reserved. This work is available under the CC BY-NC-SA 3.0 IGO license <https://creativecommons.org/licenses/by-nc-sa/3.0/igo>

INTRODUCTION

It is interesting to note that traumatic injuries to young permanent teeth affect 30 % of children; these injuries often result in pulpal inflammation or necrosis and subsequent incomplete formation of dentinal wall and root apices [1]. Several reports have shown the completion of root development and closure of the apex occurs up to 3 years after eruption of the tooth [2]. Also, it is important to bear in mind the main goal of root canal treatment is to fill the root canals completely to prevent the bacterial infections [3].

The first phase of treatment is estimating the length with a parallel preoperative radiograph after access to the canal is made; a K file is placed and recorded for reference. In particular, the infected root canal space in an immature tooth cannot be disinfected with standard protocol; the potential concern of using a full strength of sodium hypochlorite is the danger of placing it through the apex of immature teeth, the canal is then dried with sterile paper points. Once the

microbial phase of treatment is completed, filling of canal system get started. occupy this sort of root canal is a challenge for any dental clinician in which the absence of natural constriction at the end of root canal with irregular dentinal wall and divergent apices requires a large volume of filling material that may extrude into the periradicular tissue initiating the foreign-body reactions and makes the control of filling material difficult [9].

Apexification is a method of activating apical closure through enhancing the formation of calcified callus in apical pulp region of a non- vital tooth with an incompletely formed root; This closure occurs through formation of mineralized tissue in the apical region which the osteo-cementum and osteo-dentin are the main structure of this tissue. Furthermore, several methods currently exist for the measurement of this closure, but the exact mechanism of action still a mystery [4]. That method requires an environment similar to that required for hard tissue formation in

vital pulp therapy, which are mild inflammation and bacteria free environment [5,6].

The use of life story data has relatively long tradition within calcium hydroxide application. The calcium hydroxide was first introduced in 1964 by Kaiser and his procedure was generalized in 1966 by Frank, (7:8) its relatively good success has been attributed of one or more of the following properties; the PH, antibacterial effect and calcium ion [9]. These claims have been strongly contested in recent years by a number of investigators in term of how frequently the dressings have to be changed to induce the apexification. Some of them had been reported that repeated changes ranging from 3- 18 months to induce the formation of calcific barrier [10,11] also, the lengthy course of this modality and high level of patient compliance present challenges. Moreover, the fragility and porosity with different shapes of Apical stop although apparently calcified [12,13]. Last but not least, the roots of these teeth, due to Long-term calcium hydroxide as a root canal dressing, are thin with high than normal susceptibility to fracture [13-15].

Currently, many authors have been highlighted the necessity to materials capable for applying at the end of root to create artificial barrier. Torabinejad and Chivian (1999) was apparently the first to use the MTA (Mineral Trioxide Aggregate) which is a powder containing hydrophilic particles, and hardens in less than four hours upon contact with moisture. The main components of MTA include tri-calcium silicate, tri-calcium aluminate, tri-calcium oxide and silicate oxide [16]. As far as the MTA has been broadly described as a biocompatible material which capable of being applied at the end of tooth roots to create a safe barrier in order to shorten the treatment in one or two visits, biocompatibility, and a bacteriostatic action with favorable sealing ability when used to repair root/pulp chamber perforations or as root-end filling material (17:18:19:20:21) ,moreover obtained satisfactory adaptation of MTA by using hand methods rather than ultrasonic condensation which was shown by other to be superior; whereas the need

of matrix to prevent MTA extrusion into the periodontal tissues and a suitable coronal seal after use of an apical plug of MTA are the elements to improve the degree of success [22].

CASE REPORT

An 11 year- old female presented to the private clinic referred from public hospital with fractured and discolored upper left central incisor. The patient reported previous episodes of swelling and pain related to the upper right region. The patient claimed that; she falls down the stairs when she was 8 years old and tooth was never treated since then. Review of medical history, no statistically significant, the Clinical examination revealed a discolored tooth number 9 with coronal fracture; the tooth gave a negative response to ENDOICE as well as EPT. Also, the mobility of the tooth considered within normal limit. Radiographically; the tooth had blunderbuss morphology with well-defined radiolucency related to tooth #9 with wide open apex.

Apparently, the tooth was diagnosed as necrotic pulp with symptomatic apical periodontitis. To confirm the diagnosis, the access entry was prepared without anesthesia under rubber dam isolation (Clamp less technique), and working length was obtained radiographically. At this stage, the number 80 k file was found loose and easily passing beyond the apical limit of the canal. The canal is disinfected with gentle instrumentation, copious 2.5% sodium hypochlorite irrigation. The canal was dried with sterile paper points and a creamy mix of calcium hydroxide was placed for 3 weeks and temporized, the patient had got the calcium hydroxide dressings repeated two times (48 hours and 72 hours intervals) . Small piece of gelatin sponge, (Gelfom from Pfize) manipulated as a matrix, was placed through the canal and condensed with aid of # 80 K file and white MTA (Pro-Root MTA from Dentsply Sirona) was mixed to paste consistency with sterile water and introduced to the canal using an amalgam carrier and condensed to about 3mm thickness with the aid of fine tipped MTA carrier. A sterile moist cotton pellet was placed inside the

chamber to allow complete setting of MTA. Correct placement of MTA was confirmed radiographically, and unfortunately the radiograph revealed some excess MTA beyond the apex. 48 hours later, after confirming the tooth was asymptomatic, the remainder of canal was filled with gutta percha. An immediate placement of a suitable bonded restoration to seal the access preparation after non vital bleaching was done.

Nine months follow up demonstrated a healing when a reduction or disappearance of the periapical radiolucent area and complete regeneration of the periodontal ligament space could be seen, furthermore, clinically was considered successful when symptoms such as pain, swelling, buccal sinus tract, or tenderness to apical and gingival palpation or percussion were absent.

DISCUSSION

Previous research has established that filling of tooth with blunderbuss morphology is difficult because the anatomy of the canal dictated the use of plastic filling material as well as the open apex provides no barrier for stopping the root filling material before impinging on the periodontal tissues [23-25].

Over the past century, there have been dramatic methods of treating open apex with necrotic pulp which are: (1) Custom made roll cone technique. (2) Short fill technique by Moodnick. (3) Periapical surgery with a root end filling. (4) Revascularization/revitalization /Regenerative Endodontic Therapy (RET). (5) Apexification: a- Conventional apexification: e.g. Calcium hydroxide. b- One visit apexification: e.g. MTA plug.

(1) Custom made roll cone technique:

In teeth with these clinical conditions, the outcome of conventional gutta-percha fillings would be uncertain, the apical foramen is generally wider than the root canal orifice so preparation of the canal would weaken the tooth considerably, gutta percha shrinkage and poor apical seal of obturation will be the result. (25)

(2) Short fill technique by Moodnick:

Start with remove the bulk of the necrotic tissue and fill the canal short of the apex with Diaket (Beta keton & zinc oxide). With this technique the microbes can be left remaining within the apical part of the root canal system and healing may not take place [26].

(3) Periapical surgery with a root end filling:

The use of this technique is still controversial; surgery would remove the root sheath and prevent possible further root development. Also, the thin irregular dentinal walls can make condensing retrograde filling material so difficult and lead to inadequate sealing; furthermore, the young patient could be physically and psychology traumatized by surgery [27].

(4) Revascularization/revitalization/Regenerative Endodontic Therapy (RET)

RET is defined as a biologically-based procedure designed to replace damaged structures, including dentin and cells of the pulp-dentin complex.

RET is possible due to the presence of stem cells in the apical papilla with odontogenic differentiation potential. RET should have the three basic requirements for achieving regeneration Presence of stem cells, scaffold and inducing substances such as growth factors.

In fact, most studies do not follow a standard protocol for RET (table 1). Simply the procedure starts with Pulp removed with minimal or no mechanical instrumentation. Disinfection is achieved with different irrigants and intra-canal dressings at variable concentrations left in the canal for varying periods of time. When the tooth is asymptomatic, the blood clot is induced through over-instrumentation and the blood invades the root canal carrying stem cells and growth factors. There are things to consider in this technique, Irrigation with 1.5% - 3% sodium hypochlorite showed the best results in stem cell survival and less effect on odontoblast like cell markers. Also, intra-canal dressing with calcium hydroxide water-based paste has shown the stem cells

from the apical papilla survival and proliferation while the main weakness with this theory is the patient is not agreed to the time constraints.

Table 3. Characteristics, clinical protocols, clinical and radiographic outcomes of the clinical studies

Authors	Groups	N of teeth / n of periradicular lesion	Intra-canal irrigation	Intracanal dressing (time)	Intracanal dressing (time)	Intracanal dressing (time)	EDTA (concentration) + Time	Blood clot
Alghayour et al. 2019 [24]	Control (BC) Experimental (PFP)	20/9	No	NaOCl (2.5%) (Dialysis-dye (2/1), Saline (2/1))	TRP (3 weeks)	Saline (5)	Yes (27) + NR	Yes
Alshaykh et al. 2013 [28]	Control (BC + Collagen sponge) Experimental (BC + PFP + Collagen sponge)	20/20	Mixtral	NaOCl (2.5%)	TRP (NR)	NR	No	Yes
Alshaykh et al. 2014 [28]	Control (TRP) Experimental (Calcium hydroxide)	12/6	No	NaOCl (5%) + Sodium thiosulfate + Chlorhexidine (2/1) + Saline (2/1) (3 weeks)	TRP (3 weeks)	Saline	Yes (27) + 3 weeks	Yes
Alshaykh et al. 2014 [20]	Control (BC) Experimental (BC + Hydrogel + PFP)	12/NR	Mixtral	NaOCl (2.5%)	TRP (3 weeks)	NaOCl (2.5%) + Saline	No	Yes
Alshaykh et al. 2015 [22]	BC PFP + Collagen PFP	5/5	Mixtral	NaOCl (2.5%)	TRP (4 weeks)	NaOCl (2.5%)	No	Yes
Alshaykh et al. 2015 [22]	-	5/5	Mixtral	NaOCl (5.25%)	Calcium hydroxide (6 weeks)	NaOCl (5.25%)	No	No
Alshaykh et al. 2012 [22]	-	20/12	No	NaOCl (5%)	TRP (in cases of displacement, irrigant was replaced with control) (24 weeks)	NaOCl (NR)	No	Yes
Alshaykh et al. 2014 [4]	-	20/14	No	NaOCl (5%)	TRP (4 weeks)	NaOCl (5%)	No	Yes
Alshaykh et al. 2013 [32]	-	20/22	Mixtral	NaOCl (3%) or Chlorhexidine (NR)	TRP (3-4 weeks) (m2)	NaOCl (NR)	No	Yes
Alshaykh et al. 2014 [32]	-	20/17	No	NaOCl (2.5%)	Saline (2 weeks)	Saline	No	Yes
Alshaykh et al. 2009 [17]	-	24/14	Mixtral	NaOCl (2.5%) Hydrogen peroxide	Percussive NR	N/A	No	Yes

(5) Apexification

It is thought that a process in which debridement, cleaning and reduction of root canal space with material leading to favorable periapical environment. (28) It has commonly been assumed that the most frequently used procedure appeared to be apexification with calcium hydroxide. The eventual success of outcome in an immature tooth can partly result from the antibacterial and calcification inducing action of it. Also, it is often used as a temporary paste filling due to the availability of ease of removal. (29) In contrast to earlier findings, it appears that with multiple visit which should have done with using of calcium hydroxide, the reopening of root canal and its re-cleaning disturbs the process of apexification.(30:31) As well as the long period of treatment required and a high level of patient compliance. Hence, a one-step apexification procedure has been suggested to eliminate these drawbacks. (32)

One visit apexification; it is likely the MTA plug is being a material applied permanently at the end of tooth roots to provide an operator- made apical barrier in order to compress the process of treatment into one or two visit. The successful performance of this technique benefits for both patients and practitioner in term of the amount of office time required is reduced, high degree of biocompatibility and an acceptable setting time (about 4h) (33) ;

moreover, the rationale of placement the apical plug is to obtain a barrier to stop the passage of bacteria and their toxins into peri-radicular area. (34)

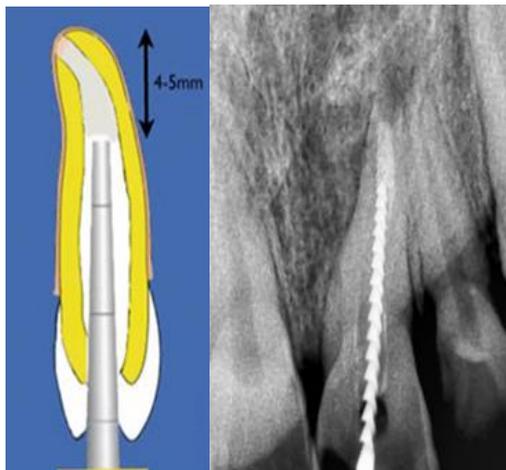
For the present clinical observation, MTA favors the apexification and periapical healing even when a considerable amount of this material had inadvertently been extruded. While it is recognized that extrusion of MTA via an open apex is not a common mishap during the apexification procedure, Although some scholar holds the view that the type of intra-canal delivery technique may contribute to the final success of treatment in one visit apexification, it must be further emphasized that ortho-grade delivery placement of the apical plug is more technique sensitive than the retrograde method. (35) There is some evidence to suggest that the orthograde use of MTA provided an adequate seal against bacterial infiltration regardless of the thickness of the apical plug. (36:37) In consideration of all these circumstances, it was decided to treat the teeth with MTA apical plugs.



Pre-op x-ray



Working length determination



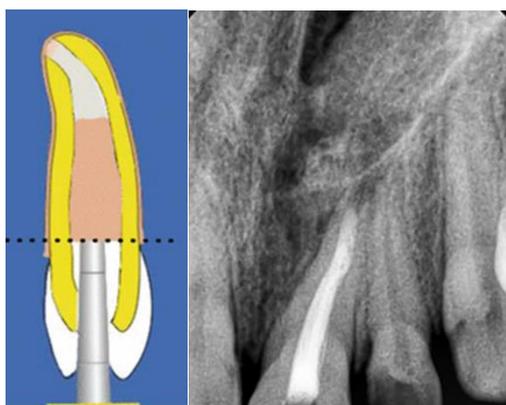
**MTA
plug
delivered**



10 months follow up



MTA Packing



**Back
fill
Gutta
percha**

CONCLUSION

Based on the existing literature and our present case, both MTA and Calcium Hydroxide have a pivotal role in apexification procedure. Considering the time duration for the apex closure, ortho-grade MTA plug has superior properties when compared with calcium hydroxide. Moreover, the presented case has confirmed what was revealed in a series of case reports that have been done by Chang Oh, Lee et al, in which they evaluated the effect of the MTA that was extruded past the apex, They determined not only the MTA did not negatively affect the periapical tissues' healing, but also even when the open apex was infected there was favorable healing and resolution around this material (38). Overall, this paper strengthens the idea that long-term clinical trials and investigations are further required.

Conflict of Interest

Not declared.

REFERENCES

1. Anantharaj A et al: Challenges in pulpal treatment of young permanent teeth a review. J Dent Science Res. 2011; 2:142.
2. Seltzer S: Endodontology: biologic consideration in endodontic procedures, 2ed. Philadelphia, Lea & Febiger, 1988, PP 31-54.

3. Anantharaj A et al: Challenges in pulpal treatment of young permanent teeth a review. *J Dent Science Res.* 2011; 2:142.
4. Nicholls E: *Endodontics*, 2ed. Bristol, England, John wright and son Ltd, 1977, PP 254-258.
5. American Association of Endodontists. 2003, *Glossary of Endodontic Terms*, 7th ed. Chicago: American Association of Endodontists.
6. Raymond: Apexogenesis versus apexification. *Dent Clin North Am.* 1984 Oct; 28(4):669-97.
7. Frank Al: Therapy for the divergent pulp less tooth by continued apical formation. *J Am Dent Assoc.* 1966, 72:87-93.
8. Kaiser HJ: Management of wide open apex canals with calcium hydroxide. Presented at 21st annual meeting of American association of Endodontist Washington DC, April 17, 1964.
9. Rafter M. 2005 Apexification: a review. *Dental Traumatology* 21.1 -8.
10. Stephen Cohen, Kenneth M. Hargreaves *Pathways of the pulp*, St Louis Missouri, Mosby 2006, 622.
11. Sheehy EC, Roberts GJ. 1997, Use of calcium hydroxide for apical barrier formation and healing in non-vital immature permanent teeth: a review. *British Dental Journal* 183, 241-6.
12. Binnie WH, Rowe AHR. 1973, A histological study of periapical tissues of incompletely formed pulpless teeth filled with calcium hydroxide. *J Dent Res* 52, 1110-1116
13. Brett Rosenberge et al. 2007, the effect of calcium hydroxide roots filling on dentin fracture strength. *Dental Traumatology* 23 (1), 26-29.
14. Jens Ove Andreasen et al. 2006 Comparison of fracture resistance in root canals of immature sheep teeth after filling with calcium hydroxide or MTA. *Dental Traumatology* 22 (3), 154 -156.
15. Katebzadeh N, Dalton BC, Trope M. 1998, Strengthening immature teeth during and after apexification. *J Endod* 24, 256-259.
16. Torabinejad and Chiavian N 1993, Clinical applications of mineral trioxide aggregate. *J Endod* 25, 197-205.
17. Torabinejad M, Watson TF, Pitt Ford TR. 1993, Sealing ability of a mineral trioxide aggregate when used as a root end filling material. *J Endod* 19, 591-595.
18. Torabinejad M, Smith PW, Kettering JD, Pitt Ford TR. 1995, Comparative investigation of marginal adaptation of mineral trioxide aggregate and other commonly used root-end filling materials. *J Endod* 21, 295-299.
19. Koh ET, McDonald F, Pitt Ford TR, Torabinejad M. 1998, Cellular response to mineral trioxide aggregate. *J Endod* 24, 543-547.
20. Arens DE, Torabinejad M. 1996, Repair of furcal perforations with mineral trioxide aggregate: two case reports. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics* 82, 84-8.
21. Xavier CB, Weismann R, de Oliveira MG, Demarco FF, Pozza DH. 2005, Root-end filling materials: apical microleakage and marginal adaptation. *Journal of Endodontics* 31, 539 -42.
22. Lawley GR, Schindler WG, Walker WA III, Kolodrubetz D. 2004, Evaluation of ultrasonically placed MTA and fracture resistance with intra-canal composite resin in a model of apexification. *Journal of Endodontics* 30, 167-72.
23. Englander JA: treatment of non- vital teeth with incompletely formed roots. *J Dent Med* 1956; 2: 90-96.
24. Hare G: obturation of root canal with open apex *J endodontia* 1948; 3: 31-35.
25. Freien LA: the treatment of immature teeth with non-vital pulps. *J BR Endod soc* 1967; 1:28-33.
26. Moodnick RM: clinical correlation of the development of the root apex and surrounding structures. *Oral Surg Oral Med Oral Pathol* 1963; 16: 600-607.
27. Steiner JC, et al, inducing root end closure of non-vital permanent teeth. *J Dent Child* 1968; 35:47-54.
28. Torneck CD. Smith J: biological effect of endodontic procedure on developing incisor teeth. *Oral Suerg Oral Med Oral Pathol* 1970;30: 258-266.
29. Frank AL: Calcium hydroxide the ultimate medication. *Dent Clin North Am* 1979; 23:691-703.
30. Lin LM, et al. Clcium hydroxide in endodontic therapy. *Comp Contin Educ Dent* 1980; 7:122-129.

31. Holland R et al. A histological study of the effect of calcium hydroxide in the treatment of pulpless teeth of dogs. *J Br Endod Soc* 1979; 12: 15-23.
32. Morse DR, et al, Apexification: review of the literature. *Quintessence International* 1990; 21: 589–598.
33. Koh ET, McDonald F, Pitt Ford TR, Torabinejad M Cellular response to mineral trioxide aggregate. *J Endod* 1998; 24, 543-547
34. Kubasad GC, et al. Apexification with apical plug of MTA-report of cases. *Arch Oral Sci Res.* 2011; 1:104–107.
35. Al-kahtani A et al. evaluation of microleakage of an orthgrade apical plug of mineral trioxide aggregate in permanant teeth with simulated immature apicies. *Journal of endodontics.* 2005; 31: 117-119.
36. De Leimburg ML et al. MTA obturation of pulpless teeth with open apices: bacterial leakage as detected by polymerase chain reaction assay. *Journal of Endodontics.* 2004; 30, 883–886.
37. Hachmeister DR, et al. The sealing ability and retention characteristics of mineral trioxide aggregate in a model of apexification. *Journal of Endodontics* 2002; 28, 386–390.
38. Seok-Woo Chang et al. Long-term observation of the mineral trioxide aggregate extrusion into the periapical lesion: a case series, *International Journal of Oral Science* volume 5, pages 54–57 2013.