ORIGINAL ARTICLE

COMPARISON OF EFFECTIVENESS OF MINERAL TRIOXIDE AGGREGATE AND CALCIUM HYDROXIDE IN APEXIFICATION PROCEDURE

[1]SOBIA MASOOD TIRMAZI, [2]HANNA ABDUL MAJEED, [3]UMME RUBAB SHERAZI
[4]BADER MUNIR

ABSTRACT

An incompletely formed apex (open apex) is one of the most common features seen in immature permanent teeth after dental trauma. Endodontic treatment of open apex teeth presents with problems of overfilling and poor apical seal, thus it is imperative to create an artificial apical barrier or to induce apical closure with calcified tissue. Different materials have been tried for Apexification procedure, the most common are calcium hydroxide and mineral trioxide aggregate (MTA). The objective of this article was to compare the effectiveness of Mineral Trioxide Aggregate and Calcium hydroxide in creating apical closure.

This is a comparative study of 80 patients with Open Apex teeth. They were randomly allotted into two groups (Group A and Group B). In Group A(40 patients), calcium hydroxide was used as an apexification material, While in Group B (40 patients) apical plugs were produced with mineral trioxide aggregates (MTA) followed by obturation.

In Group A,30 patients showed complete absence of lesion while in Group B, 37 patients showed complete healing. Ten patients showed no healing in Group A, because of improper packing of material into the canal, while only three patients showed no healing in Group B because of poor delivery of MTA to the apex. The results showed that 75% teeth had complete healing in Group A and 92.5 % had complete healing in Group B. The results of the study concluded that MTA is significantly better than Ca (OH)2 in Apexification of non- vital immature permanent teeth.

Key Words: *immature permanent teeth, Apexification, calcium hydroxide, MTA.*

INTRODUCTION

Traumatic injuries are common amongst young children because of outdoor sports activities and accidents at home or school.[1] Dental trauma primarily occurs in the anterior part of oral cavity, affecting the maxillary jaw more than the mandibular jaw.[2] The injuries include avulsion, intrusion, lateral displacement, fracture and concussion. In most cases, such traumatic injuries leads to cessation of tooth development, resulting in an incompletely formed apex, large root canals and weak and fragile walls.[3] These features retard root canal instrumentation and prevent the estabilishment of an adequate apical stop. In such cases, in order to condense the obturation material and to estabilish the apical seal, it is essential to create an artificial apical stop or to induce an apical closure with apexification procedure.[4,5]

Calcium hydroxide has been used famously in the past for induction of apical barrier, having success rates ranging from 79%-96%.[6] However, being a long history of use in apical closure procedures, there are many drawbacks associated with the use of calcium hydroxide for apexification procedure. These include increased time period for root apical closure, multiple of dressings of calcium hydroxide are important to complete apical closure, severity of infection, and the fracture resistance of the teeth after long term use of calcium hydroxide. Depending on the case severity, barrier formation is reported to take approximately 3- 24 months.[7,8]

In recent advancement in terms of introduction of new materials, researchers have been experimenting with materials, capable of being applied permanently at the apical area of the root to estabilish an artificial

[1] **Corresponding Author:** Dr. Sobia Masood Tirmazi, BDS, FCOP (OPD) Assistant Professor, Department of Operative Dentistry, Institute of Dentistry and CMH medical College Lahore , Pakistan. Res: 357-j 2 wapda Town Lahore Email: sobia trimazi@gmail.com
[2] Hanna Abdul Majeed, BDS, FCPS (OPD), Assistant Professor, Department of Operative dentistry, Islam Dental College, Pasrur Road, Sialkot.
[3] Umme Rubab Sherazi, BDS, FCPS (OPD), Associate Professor, Department of Operative Dentistry, Institute of Dentistry and CMH medical College Lahore , Pakistan.
[4] Bader Munir, BDS, FCPS, Associate professor Department of Operative Dentistry, de'Mont morency College and Punjab Dental Hospital Lahore, Pakistan
Received for Publication: May 9, 2017
First Revision: July 28, 2017
Second Revised: May 9, 2018
Approved: May 10, 2018

apical barrier to reduce the process of treatment in one or two appointments.[9] Another alternative is to establish an artificial apical stop with mineral trioxide aggregate.[10] MTA is a potential apical barrier material with excellent sealing properties, greater biocompatibility, low solubility, can be used safely when placed next to pulp and periradicular tissues.[10,11]

MATERIAL AND METHODS

This randomised control trial was conducted on 80 open apex cases visiting Department of Operative Dentistry, de'Montmorency College of Dentistry/Punjab Dental Hospital, Lahore from May 2010 to November 2010.

Informed consent for participation in the study was obtained from each patient. The Patients were divided into two groups using random number table.

In Group A (n=40) Calcium Hydroxide mixed with normal saline, was packed inside the canal with lentulo spiral and coronal access was sealed with glass ionomer. In Group B (n=40) MTA plug (3-4mm) was formed at the apex and dam cotton pledget was placed within the coronal access and then after gaining hard MTA plug ,obturation was followed. Post-operative radiographs were taken after placement of both materials. Then follow up radiographs were taken after 3 and 6 months duration. Healing was observed both clinically and radiografically and barrier formation was observed radiographically.

This comparative study was conducted in Operative Dentistry Department of de'Mont morency College of Dentistry and Punjab Dental hospital Lahore. A total of 80 patients were treated. Out of 80, 54 were male (65%) and 26 were female (35%) The age of patients was between 7 to 30 years {Table 1}

RESULTS

Radiographic evaluation of teeth in both groups revealed that In Group A, 30 patients showed absence of radiolucency while 10 patients showed presence of lesion after 3 months{Table 2}.Out of 10 failure cases, 2 patients showed pain and 4 showed swelling clinically, while 4 of them showed radiolucency radiographically {Table 3}.

In Group B, 37 patients showed absence of radiolucency and only 3 patients showed presence of lesion after 3 months {Table 2}.Out of 3 failure cases, one showed swelling clinically while 2 of them showed radiolucency radiographically {Table 3}.

The overall success rate in Group A was 75% and in Group B 92.5%. Success rate was significantly higher in Group B than Group A (p value= 0.034) {Table 4}.

DISCUSSION

Management of immature, non-vital permanent anterior teeth with blunderbuss apex include surgery, retrograde sealing, apical plug formation by dentinal chips, calcium hydroxide apexification and recently introduced mineral trioxide aggregate (MTA) apical plug formation followed by obturation and coronal restoration.[3,12,13]

According to Hakki et al, MTA provides an ideal environment that promotes cementum regrowth and having ability to induce dental pulp and periradicular tissue regeneration.[14,15] A study by Tahan E et al, observed that complete periapical healing takes place despite extrusion of MTA. This attributed biologic properties of the MTA. At 12 months, the radiograph showed complete bony healing of preoperative periapical pathosis.[16]

In review of 10 studies, Sheehy and Roberts reported that the use of calcium hydroxide for apical closure was successful in 74-100% of cases irrespective of the proprietary brand used. They also studied that long term follow up was important and information for long-term outcomes was limited. Drawbacks such as reinfection and cervical root fracture could occur.[17]

In another study, El□Meligy and Avery examined a total of 30 teeth. They were evenly divided into control group ($Ca(OH)_2$ apexification) ,or the experimental group (MTA apexification). Clinical and radiographic evaluations were carried out after 3, 6, and 12 months. The results concluded that the clinical and radiographic success rate for MTA was 100% and for the $Ca(OH)_2$ it was 87%.They concluded that MTA could potentially

TABLE 1: ANALYSIS OF AGE

Mean age + St.D	15.19 + 4.10	P Value
Minimum age	9	0.045
Maximum age	28	

TABLE 2: COMPARISON OF EFFECTIVENESS BETWEEN GROUPS

Effectiveness	Group A	Group B	P Value
Effective	30	37	0.034
Non Effective	10	3	

TABLE 3: CLINICAL AND RADIOGRAPHIC EVALUATION AFTER 3 MONTHS FOLLOW UP

Groups	Pain	Swelling	Radiolucency	Failure cases
Group A	2	4	4	10
Group B	0	1	2	3

TABLE 4: COMPARISON OF SUCCESS RATE BETWEEN BOTH GROUPS AFTER 3 MONTHS FOLLOW UP

Groups	Total Patients	Failure	Success %
Group A	40	10	75%
Group B	40	3	92.5%

be an excellent alternative for apexification.[18]

In another study, Sarris et al used MTA for the Apexification of non vital immature teeth (incisors). They concluded that MTA has superior properties over $Ca(OH)_2$ when used as a root end closure material.[19] Kinirons et al, used calcium hydroxide for apexification in immature incisors and evaluated that frequently changing the dressings of $Ca(OH)_2$ rapid would be the establishment of hard tissue apical barrier, but many appointments would be needed for the whole procedure, While in case of MTA a minimum of two appointments are needed for the completion of procedure.[20]

The necrotic immature permanent incisors treated with MTA required shorter duration for apexification than those treated with calcium hydroxide.[21]

In another meta-analysis, Jia cheng Lin et al observed that MTA was associated with a significantly shorter duration for apexification than the calcium hydroxide. This is the utmost clinical significance because many failures with calcium hydroxide are due to lack of patient follow-up.[22]

In another study done by Bonte et al observed that the MTA group showed better results in terms of apical closure.[23]In another comparison study MTA was successful in terms of immediate obturation of immature roots with blunderbuss apices.[24]

CONCLUSION

MTA is considered to be more effective in terms of closure of apical end of the root canal as compared to calcium hydroxide in immature permanent teeth in apexification procedure.

REFERENCES

1 Skaare AB, Jacobsen I. Dental injuries in Norwegians aged 7-18 year. J Dent traumatol 2003;19:67.

2 Bastone EB, Freer TJ,MC Namara JR. Epidemiology of dental trauma: a review of literature. Aust Dent J 2000;45:2.

3 Shah N, Logani A, Bhaskar U and Aggarwal V. Efficacy of Revascularization to induce Apexification/Apexogenesis in infected, non-vital, immature Teeth. J Endod 2008;34:919-25.

4 Orosco FA, Bramante CM, Garcia RB, Bernardineli N and de Moraes IG. Sealing ability of gray MTA AngelusTM, CPMTM and MBPC used as apical plugs. J Appl oral Sci 2008; 16(1):50-4.

5 Felippe WT, Felippe MCS,Rocha JC. The effect of mineral trioxide aggregate on the apexification and periapical healing of teeth with incomplete root formation. Int Endod J 2006;39(1):2-9.

6 Witherspoon DE, Small JC, Regan JD and Nunn M. Retrospective Analysis of open apex teeth obturated with mineral Trioxide aggregate. J Endod 2008; 34: 1171-76.

7 Frank AL.Therapy for divergent pulpless tooth by continued apical formation. J Am Dent 1966;72:87-93.

8 Zarrabi MH, Mohtasham N, Nezamy MS and Bidar M. Comparative Study of Apical Healing of Open Apices Using MTA and Ca (OH)2 Apical Plugs in Cats. JOD Tehran 2005; 2:58-63.

9 Ghaziani P, Aghasizadeh N, Nezami MS. Endodotic treatment with MTA apical plugs: a case report .J Oral Sci 2007;49: 325-29.

10 Torabinejad M, Watson TF, Pittford TA. Sealing ability of mineral trioxide aggregate when used as root end filling material. J Endod 1993; 19:591-5.

11 Torabinejad M, ChivianN. Clinical application of mineral trioxide aggregate .J Endod1999;25: 197-205.

12 Holden DT, Schwartz SA, Kirkpatrick TC and Schindler WG. Clinical outcomes of Artificial Root-end Barriers with mineral trioxide aggregate in teeth with immature apices. J Endod 2008; 34:812-17.

13 Simon S, Rillard F, Berdal A and Machtou P. The use of mineral trioxide aggregate in one-visit apexification treatment: A Prospective study. Int Endod J 2007;40: 186-97.

14 Hakki SS, Bozkurt SB,Hakki EE, Belli S. Effects of mineral trioxide aggregate on cell survival gene expression associated with mineralized tissues and biomineralization of cementoblasts. J Endod 2009;35: 513-19.

15 Camilleri J, Pittford TR. Mineral trioxide :A review of constituents and biological properties of the material. Int Endod J 2006; (10)747-54.

16 Tahan E, Celik D, ErK, Tasdemir T. Effect of unintentionally Extruded Mineral Trioxide Aggregate in Treatment of tooth with periradicular lesion. J Endod 2010;36:760-3.

17 Sheehy EC, Roberts GJ. Use of calcium hydroxide for apical barrier formation and healing in non-vital immature permanent teeth: a review. Br Dent J 1997;183:241–6.

18 El-Meligy OA, Avery DR. Comparision of apexification with mineral trioxide aggregate and calcium hydroxide. Pediatr Dent 2006;28:248-50

19 Sarris S, Tahmassebi JF, Duggal MS, Cross IA. A clinical evaluation of mineral trioxide aggregate for root‐end closure of non‐vital immature permanent incisors in children‐apilot study. J Dent Traumatol. 2008; 24(1):79‐85.

20 Kinirons MJ, Srinivasan V, Welbury RR, Finucane D.A study in two centres of variations in the time of apical barrier detection and barrier position in non vital immature permanent incisors. Int J Paediatr Dent. 2001;11(6):447-51

21 Lee LW, Hsieh SC, Lin YH, Huang CF, Hsiao SH, Hung WC. Comparison of clinical outcomes for 40 necrotic immature permanent incisors treated with calcium hydroxide or mineral trioxide aggregate apexification/apexogenesis. J Formos Med Assoc. 2015;114:139-46.

22 J.C Lin et al.Comparison of mineral trioxide aggregate and calcium hydroxide for apexification of immature permanent teeth. A systematic review and meta-analysis.J Formos Med Assoc.2016, 115:523-530.

23 Bonte E, Beslot A, Boukpessi T, Lasfargues JJ. MTA versus Ca(OH)2 in apexification of non-vital immature permanent teeth: a randomized clinical trial comparison. Clin Oral Investig 2015;19:1381-8.

24 Damle SG, Bhattal H, Damle D et al.Clinical and radiographic assessment of mineral trioxide aggregate and calcium hydroxide as apexification agents in traumatized young permanent anterior teeth: A comparative study.Dent Res J 2016:13(3)284-93.

CONTRIBUTIONS BY AUTHORS

1 Sobia Masood Tirmazi:	Conception and design of study library searches and assembling relevant literature, acquisition of data analysis and/or interpreation of data review of manuscript.
2 Hanna Abdul Majeed:	Drafting the work.
3 Umm-e-Rubab Sherazi:	Assembling of data, review of Manuscript.
4 Bader Munir:	Suprvise all the cases.