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Research Article

Evaluation of Mineral Trioxide Aggregate (MTA) and Zinc Oxide Eugenol Root Canal Sealers on Intensity of Post Operative Tooth Tenderness in Non-Vital Single Rooted Teeth - A Comparative Study

Bithi Rani Nath[1]*, Mir Abu Naim[2], Khaled Mohammad Islam[3], Md Abul Kalam Azad[4] and Arup Kumar Saha[5]

[1]BDS, MS, Associate Professor and Head of Conservative Dentistry and Endodontics Department, Gonoshasthaya Samajvittik Medical College Dental Unit, Savar, Dhaka, Bangladesh

[2]BDS, FCPS, Associate Professor and Head of Orthodontic Department, Udayan Dental College and Hospital, Rajshahi, Bangladesh

[3]BDS, MS (Prosthodontics), Chief Consultant, Islam Dental Care, Banasree, Rampura, Dhaka, Bangladesh

[4]BDS, MS, Consultant, Central Police Hospital, Rajarbagh, Dhaka, Bangladesh

[5]BDS, MPH, PhD, Professor and Head, Department of Dental Public Health, City Dental College and Hospital, Dhaka, Bangladesh

***Corresponding Author:** Bithi Rani Nath, Associate Professor and Head of Conservative Dentistry and Endodontics Department, Gonoshasthaya Samajvittik Medical College Dental Unit, Savar, Dhaka. Bangladesh.

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Abstract

The purpose of the present study was to compare the clinical outcome of Mineral trioxide aggregate (MTA) as a root canal sealer with that of Zinc oxide eugenol sealer for obturation of nonvital teeth with periapical lesion. A total of 50 nonvital teeth with periapical lesion were randomly divided into 2 groups of 25 teeth in each group and treated as follows: Group-I: obturated with Zinc oxide eugenol sealer. Group II: obturated with MTA based sealer (MTA fillapex). Patients were recalled after 3, 6 and 12 months interval. Clinical outcome was evaluated by assessing tenderness on percussion and radiological evaluation was done to determine periodontal ligament widening . Chi-square test and unpaired student t-test were used for testing differences between the two groups and a value of $p < 0.05$ was considered as statistically significant. It was found that at 6 and 12 months, the periodontal ligament widening were reduced in MTA fillapex, which was statistically significant than that of Zinc oxide eugenol sealer ($p<0.05$). It can be concluded that MTA based sealer is more effective than Zinc oxide eugenol sealer in respect to periapical healing.

Keywords: MTA; Root Canal Sealer; Obturation; periapical healing

Introduction

Infections of the dental pulp occur as consequence of caries, dental operative procedures and trauma, and involve a mixed, predominately Gram- negative, anaerobic bacteria flora [1]. These infections often cause total pulpal necrosis and subsequently stimulate an immune response in the periapical region. This is commonly referred to as a periapical lesion [2]. Most periapical lesions can be classified as dental granulomas, radicular cysts or abscess [3].

The ultimate goal of endodontic therapy should be to return the individual teeth to a state of health and function without surgical intervention. All inflammatory periapical lesions should be initially treated with conservative non-surgical procedure [4]. Surgical intervention is recommended only after non-surgical treatment and re-treatment have failed. Besides surgery has many drawbacks, which limits its use in the management of periapical lesions. A high percentage of 94.4% of complete and partial healing of periapical lesions following nonsurgical endodontic therapy has also been reported [5].

A large periapical lesion may have a direct communication with the root canal system and respond favorably to non-surgical treatment [6]. Non-surgical treatment with proper infection control can promote healing of large periapical lesion [7]. In recent years a greater awareness of the complexities of root canal system has led to the development of newer techniques, instruments and materials to control infection [8]. Therefore, a 3-dimensional filling must avoid leakage from the oral cavity and/or periapical tissues, thereby reducing periapical inflammation. This filling is currently achieved using a combination of endodontic sealer and gutta-percha. Gutta-percha is widely used because of its good physical and biological properties, but the lack of adhesiveness and flow makes the association with endodontic sealers necessary [9]. Inadequate filling can result in fluid movements into the filling defects favoring a periapical chronic inflammatory reaction and compromising the treatment success [10]. Furthermore, root canal ramifications, such as lateral, secondary and accessory canals can establish connection between the main root canal and periodontal ligament, as well as the apical foramen [11]. Therefore, localized periodontal problems might be associated with necrotic and infected root canal ramifications highlighting the importance of the capacity of the endodontic sealer to flow into these irregularities [9].

Root canal sealers are used to attain impervious seal between core materials and root canal wall [12]. According to their basic components classification of root canal sealers are zinc oxide eugenol, calcium hydroxide, glass ionomer, resin, iodoform, silicon and recently mineral trioxide aggregate (MTA) based root canal sealer (MTA fillapex). Zinc oxide eugenol containing sealers have a history of successful use over an extended period of time. Advantages of this sealer are radiopaque with germicidal properties, accepted working time and good sealing properties [13]. But they exhibit a slow setting time [14], shrinkage on setting, solubility and they can stain tooth structure [15].

Mineral trioxide aggregate (MTA) was developed by Torabinejad in the early1993s. Being biocompatible and bioactive it has been used as a successful material for vital pulp therapy, apexification [16], repair of internal and external root resorption [17], repair of furcal and lateral root perforations [18], and root-end fillings [19].

Recently, MTA based sealer known as MTA Fillpex has been introduced. Its composition after mixture is basically MTA, salicylate resin, natural resin, bismuth and silica. MTA fillapex (Angelus Londrina, PR, Brazil), is first paste form MTA based salicylate resin root canal sealer. It has antimicrobial activity against *S. aureus, E. coli, C. albicans* and *E. faecalis* by its high alkaline pH [20]. It provides effective seal against dentin and cementum and promotes biologic repair and regeneration of periodontal ligament [16]. They also exhibit a higher adhesiveness to dentin than conventional Zinc oxide eugenol based cements. They form a hydroxyapatite on the MTA surface and provide biological seal [21]. Furthermore, MTA fillapex has a high flow rate and a low film thickness, so it easily penetrates the lateral and accessory canals. Regardless of the obturation technique, MTA fillapex delivers high sealing capability that, unlike other sealers, is not adversely affected by heat [22]. However, no clinical studies have been performed whether MTA based sealer is suitable as an alternative to Zinc oxide eugenol sealer for healing periapical lesion in non-vital teeth. Therefore, this study was designed to compare the clinical and radiological outcome of MTA fillapex and Zinc oxide eugenol as root canal sealers for obturation of nonvital teeth with periapical lesion.

Materials and Methods

This comparative study was conducted in the Faculty of Dentistry, Department of Conservative Dentistry and Endodontic, Bangabandhu Sheikh Mujib Medical University, Shahbagh,

Dhaka-1000, Bangladesh during the period of study- 1year and six months from Feb. 2014 to Aug. 2015.

Sample collection

Fifty nonvital single rooted permanent teeth with were selected requiring endodontic treatment in the Department of Conservative Dentistry and Endodontic Bangabandhu Sheikh Mujib Medical University (BSMMU), along with a preoperative intra oral periapical radiograph. The age of the patients ranged from 18 to 5o years old. Inclusion Criteria were as follows: symptomatic single rooted mature tooth and restorable tooth. All patients were examined after clinical evaluation prior to entry into the study. To minimize allocation bias, the 50 teeth were randomly assigned (lottery method) into two groups by randomization procedure. In Group I, Zinc oxide eugenol sealer and in Group II, MTA based root canal sealer was used. Data were collected after the written informed consent was taken from the patient. Patient's symptoms, clinical signs and a detailed medical and dental history were recorded and radiograph was taken for each case.

Pre-operative planning

After taking approval from IRB committee of BSMMU, proper counseling of the patients about treatment procedure, its benefit and cost was performed. Eradication of plaque and calculus was performed by mouth scaling.

Steps of treatment procedure

At first visit, disinfection of the operative field and proper sterilization of instruments were ensured. Hand gloves, face mask were used in every case. A preoperative intraoral radiograph was taken using parallel cone technique. Isolation of teeth was done with cotton roll and saliva ejector. A straight line access cavity was prepared by using diamond round and fissure bur with maintaining standard protocol and coronal necrotic pulp tissue was removed by excavator and irrigated with 2.5% NaOCl. Coronal flaring was done by Gates Glidden bur. Canal was negociated no-10 or 15 K file according to the size of the canal and then established a smooth glyde path. Removal of necrotic pulp tissue in the canal. The working length was determined by radiographic method. Biomechanical preparation of the canal was done with standardized technique. During biomechanical preparation, the canal was irrigated with 2.0 ml of 2.5% sodium hypochlorite (NaOCl) followed by rinsing with 2.0 ml of normal saline after every instrument change. The canal was dried with a sterile paper point. $Ca(OH)_2$ powder (Calcium hydroxide extrapure, Deepti dental product of India Pvt,Lit.) mixed with normal saline was placed in the canal with lentulospiral. The access opening was sealed well with Fuji IX glass ionomer filling material. Patient was advised to visit after one week. In the next visit

Next visit

Evaluation criteria

The patients were recalled for clinical evaluations after 3, 6, and 12 months interval. The clinical evaluation was done for each patient by the designated investigators at every follow up visit by the presennce or Permanent filling and cotton were removed from the access cavity and repeated copious irrigation was done with normal saline followed by 2.5% sodium hypochlorite to remove all the $Ca(OH)_2$ paste properly. Then canal was dried with sterile paper point and the tooth was obturated according to their groups.

For group I

Zinc oxide eugenol was used as root canal sealer. Zinc oxide powder (Zinc-oxide powder-arsenic free, Deepak enterprise) was mixed with eugenol to a thin consistency. The root canal was coated with the sealer using lentulospiral in a slow speed micromotor hand piece. Obturation was performed with Gutta-percha cones and sealer by lateral condensation technique followed by permanent restoration with Giomer.

For group II

MTA fillapex (Angelus Indústria de Produtos Odontológicos Londrina–PR – Brazil) was used as root canal sealer in Group II. Two tube paste was mixed in 1:1 ratio on a mixing pad according to their manufacturer's instructions. MTA-fillapex was coated in canal walls using lentulospiral in a slow speed micromotor hand piece, and then obturated as in Group I. Permanent restorations was done with composite restoration (Giomer).

Follow up visit and absence of signs and symptoms. Blind to the treatment record, two evaluator were assessed the clinical findings. The following clinical assessments were performed:

- **Tenderness on percussion:** Percussion of tooth was performed by gentle tapping with gloved finger or blunt handle of mouth mirror on the offending tooth. Degree of

response to percussion was directly proportional to degree of inflammation. In data collection sheet, tenderness on percussion was recorded as, 0 = Absent, 1 = Present.

- **Widening of the periodontal ligament:** Widening of the periodontal ligament was assessed by means of intraoral periapical radiograph (IOAP) with same x-ray machine (BLUEX, IntraO 70 70KVP 7maFONA SRL, Italy), same position, same technique and same technician. Widening of the periodontal ligament was observed from the radiograph at 3, 6 and 12 months interval. In data collection sheet, the widening of periodontal ligament was recorded as, 0 = Normal, 1 = Widening.

Statistical analysis

Statistical analysis of the results was done by using computer based statistical software, SPSS 20.00 version (SPSS Inc. Chicago, USA). Significant of difference between two groups was performed by Chi-square test and unpaired student t-test was performed and a value of $p < 0.05$ were considered as statistically significant.

Results

Figure 1 & 2 showed the radiographs of obturation of tooth with periapical lesion by ZnO eugenol sealer and MTA Fillapex, respectively and the results are described in Table 1-2.

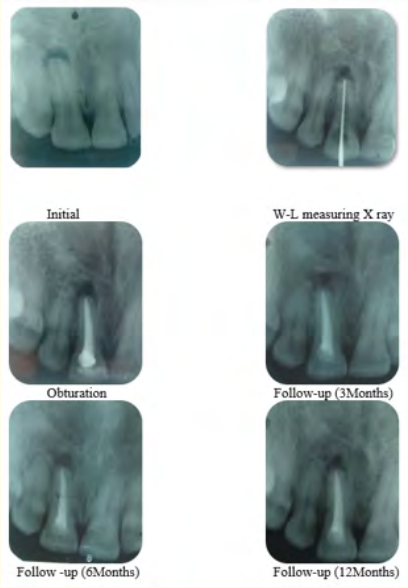

Figure 1: Radiographs showing obturation of 11no. non-vital tooth with periapical lesion by ZnO eugenol sealer.

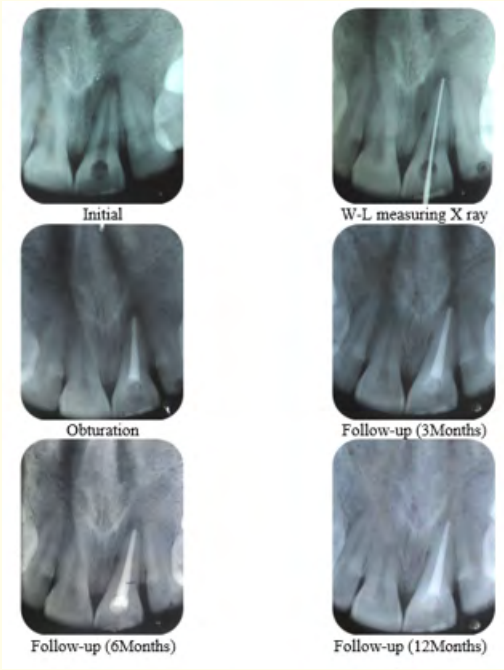

Figure 2: Radiographs showing obturation of 21 no. non-vital tooth with periapical lesion by MTA fillapex.

Evaluation period	Group I (n = 25 teeth)		Group II (n = 25 teeth)		p value
	No.	%	No.	%	
Baseline					
Present	5	20%	3	12%	0.440[ns]
Absent	20	80%	22	88%	
After 3 months					
Present	3	12%	1	4%	0.312 [ns]
Absent	22	88%	24	96%	
After 6 months					
Present	1	4%	0	0.0%	0.312 [ns]
Absent	24	96%	25	100%	
After 12 months					
Present	1	4%	0	0.0%	0.312 [ns]
Absent	24	96%	25	100%	

Table 1: Comparison of tenderness on percussion between two groups (n = 25 teeth in each group).

Data were expressed in number and percentage. Statistical analysis was done by Chi-square test. The test of significance was calculated and p values < 0.05 was accepted as level of significance.

ns = Not significant

n = Number of samples.

Group I = Zinc oxide eugenol sealer.

Group II = MTA fillapex.

Table 1 shows the comparison of tenderness on percussion between MTA fillapex sealer and ZnO Eugenol sealer groups following each observation period. It was observed that at 3,6and 12 months follow up period, the differences between two groups were not statistically significant (p > 0.05).

Evaluation period	Group I (n = 25 teeth)		Group II (n = 25 teeth)		p value
	No.	%	No.	%	
Baseline					
Normal	0	0.0%	0	0.0%	-
Wide	25	100%	25	100%	
After 3 months					
Normal	1	4%	6	24%	0.042*
Wide	24	96%	19	76%	
After 6 months					
Normal	2	8%	8	32%	0.034*
Wide	23	92%	17	68%	
After 12 months					
Normal	3	12%	9	36%	0.047*
Wide	22	88%	16	64%	

Table 2: Comparison of periodontal ligament widening between two groups (n = 25 teeth in each group).

Data were expressed in number and percentage. Statistical analysis was done by Chi-square test. The test of significance was calculated and p values <0.05 was accepted as level of significance.

n = number of samples.

* = Statistically significant (p < 0.05).

ns = Statistically not significant.

Group I = Zinc oxide eugenol sealer.

Group II = MTA fillapex.

Table 2 shows the comparison of periodontal ligament widening between ZnO eugenol sealer and MTA fillapex sealer groups following each observation period. It was observed that at 3, 6 and 12 months follow up period, the differences between two groups were statistically significant (p < 0.05).

The results of assessment of tenderness on percussion were showed in Table-1. It was revealed that at baseline, tenderness was present 5 of 25 teeth in ZnO oxide eugenol group and 3 of 25 MTA fillapex group. The differences between two groups were not statistically significant (p > 0.05). However, it was reduced during follow up period. After 3 months, 3 of 25(12%) teeth showed tenderness on percussion in Zinc oxide eugenol group. On the other hand, tenderness was present in 1 of 25 teeth (4%) of MTA fillapex group. The differences between two groups were not statistically significant (p > 0.05). Furthermore, after 6 and 12 months follow up period, 100% of MTA fillapex treated teeth and 96% of ZnO eugenol treated teeth showed no tenderness on percussion. Again the differences between MTA fillapex and ZnO eugenol treated groups were not statistically significant (p > 0.05).

The results of assessment of periodontal ligament widening were showed in Table-2. It was revealed that at baseline, Periodontal ligament widening present all teeth in ZnO eugenol group and MTA fillapex group. However, it was reduced during follow up period. After 3 months, 4% teeth of ZnO eugenol and 24% teeth of MTA fillapex showed normal status of periodontal ligament. The differences between two groups were statistically significant (p<0.05). Furthermore, after 6 and 12 months follow up period, 68% to 64% of MTA fillapex treated teeth and 92% to 88% of ZnO eugenol treated teeth showed widening of periodontal ligament. Again the differences between MTA fillapex and ZnO eugenol treated groups were statistically significant (p < 0.05).

Discussion

The result of this study had confirmed that MTA based sealer is more effective than Zinc oxide eugenol based sealer for obturation of the non-vital teeth When periodontal ligament widening and size of the lesion was observed at 3, 6 and 12 months, it was found

that MTA fillapex was more capable of reducing tenderness, which is statistically significant than that of Zinc oxide eugenol sealer.

Regarding tenderness on percussion, it was found that tenderness gradually decreased in both MTA and Zinc oxide eugenol sealer. The differences between two groups were not statistically significant ($P > 0.05$). Previous study has indicated that tenderness following MTA fillapex may be reduced due to it promotes biological repair and regeneration of periodontal ligament [16]. On the other hand, the releases of free eugenol is gradually reduced overtime, the incidence of tenderness on percussion could be minimized. When eugenol contact directly, during extrusion/overfilling or through its diffusible substances, it may leach into periradicular tissues, and causes destruction and inflammation of periradicular tissues, which manifest as pain, tenderness on percussion [23].

The results found in the present study also indicated that although lesion repair by MTA fillapex and Zinc oxide eugenol sealer was possible *in vivo* but the of widening of the periodontal ligament did not sufficiently decreased. At 12 months observation period, 36% MTA fillapex and 12% Zinc oxide eugenol treated teeth showed decreased of periodontal ligament space. Smith., *et al*. [24] indicated that reduction in lesion size and periodontal space might take 3- 5 years. Therefore, to found reduced lesion size and periodontal ligament widening, long term clinical evaluation is required.

Conclusion

It can be concluded that MTA based sealer (MTA fillapex) is more effective for obturation of the single rooted nonvital teeth than Zinc oxide (ZnO) eugenol sealer.

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