Healing of periapical lesion with mineral trioxide aggregate apexification

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Article Info

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Abstract

In the present study, the ability of mineral trioxide aggregate in the formation of apical plug for healing of large periapical lesion with open apex was assessed and evaluated the clinical outcome. Fifteen participants with periapical lesion at the upper anterior teeth with open apex were treated with mineral trioxide aggregate. The effect on healing of apical size was evaluated at 3, 6, and 12 months by radiological examinations in the form of periapical index criteria, diameter of the lesion size and the presence or absence of apical tissue barrier. The results found that neither pain nor any sinus was detected at 12 months. The mean size of the apical lesion was gradually reduced from 5.1 × 3.8 to 1.5 × 0.9 mm and mean periapical index was reduced from 3.3 to 1.7 mm. The differences between mean size of periapical lesion at preoperative and 12 months observation period was also statistically significant ($p<0.05$). The clinical success shown significant success rate of 93.3% analyzed with Z-test. In conclusion, tooth with open apex can be successfully treated with mineral trioxide aggregate apexification technique followed by root canal obturation.

Introduction

Traumatic injuries generally interrupt the pulpal blood supply results in necrosis of the pulp and develop anaerobic conditions favorable for the growth of opportunistic microorganisms. This condition often leads to the development of periapical lesions.[1] Furthermore, patient with teeth that were incompletely developed or had open apices further complicate the condition which is difficult to manage. Endodontic treatment in the form of apical barrier or apical stop to resist the root canal filling material from over extrusion is termed as apexification.[1]

Several materials are used to form an apical barrier. These include calcium hydroxide powder, collagen calcium phosphate, osteogenic protein, bone growth factor, oxidized cellulose and mineral trioxide aggregate.[1] Mineral trioxide aggregate was originally developed as the root canal filling material. It can be carried out in a single visit and has many advantages over the traditional calcium hydroxide apexification. Calcium hydroxide requires 5-20 months to induce the formation of a calcific barrier.[2] On the other hand, apexification with mineral trioxide aggregate require less time. It is neither gets resorbed nor weakens the root dentin and also sets in wet environment.[3] It is biocompatible, has good sealing property, stimulates cell growth, adhesion and proliferation.[3] Therefore, the capability of mineral trioxide aggregate in the formation of apical plug or barrier for healing of large periapical lesion with open apex was observed and evaluated the clinical outcome.

Materials and Methods

Subjects

Fifteen participants with large periapical lesion at the upper anterior teeth with open apex including 11 males (12-23 years old) and four females (10-18 years old) attending the output clinic were selected. As a whole, all patients were considered healthy. Six patients had mild pain and they were using pain killer. Figure 1 represents the pre-operative clinical and radiological photographs of a case, respectively.

Therapeutic procedure

Following isolation of each tooth with cotton roll and saliva ejector, a straight line access cavity was prepared to establish the working length within 1 mm of the radiographic apex (Figure 2). Each root canal was then debrided with Hedstrom file followed by alternative irrigation with sodium hypochlorite (2.5%) solution and normal saline, and dried with sterile paper points. The canal was prepared with circumferential filing and calcium hydroxide paste mixed with glycerin was placed into the canal by using lentulospiral and restored with temporary filling material. Calcium hydroxide was kept into the canal for at least one week according to some other clinical studies.[4-7]

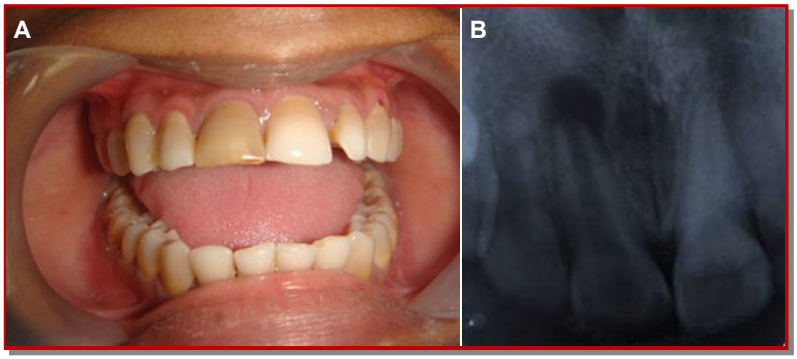

Figure 1: Representative clinical photograph. Right central incisor tooth showed discoloration (A); Representative radiological photograph (B). Large radiolucent area was located at the periradicular area

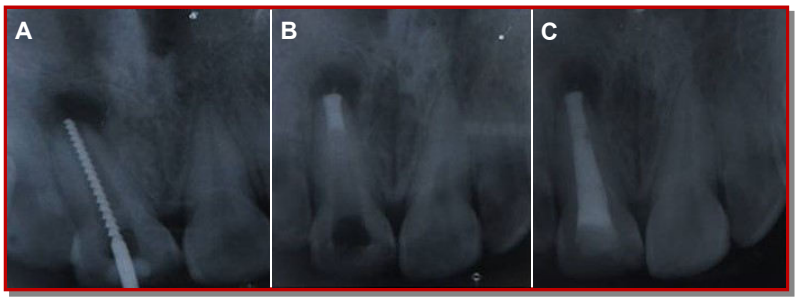

Figure 2: Working length determination (A); Initial apical plugging by mineral trioxide aggregate (B) and Full canal obturation (C)

Second visit:

After one week, the temporary filling was removed and each canal was then irrigated with 2.5% sodium hypochlorite solution and normal saline alternatively to remove all the calcium hydroxide paste from the root canal. The canal was then dried with sterile paper points. Reapplication of calcium hydroxide dressing was performed for another one week if there was any presence of exudate into the root canal. For condensation of mineral trioxide aggregate at the apical area, a plugger was prepared manually by heating and rolling two protaper gutta percha. The plugger was set at least 3-4 mm short of the apex which was confirmed by an X-ray (Figure 2). The ProRoot mineral trioxide aggregate (Densply) was mixed according to manufacturer instruction as follows: A thick creamy consistency of mineral trioxide aggregate was prepared after mixed with distilled water (3:1) and then inserted into the canal with lentulospiral. Condensation of mineral trioxide aggregate was performed with a thickness of not less than 3 mm at the apex and correct placement was confirmed by radiograph (Figure 2). Finally, a moist cotton pellet was placed into the pulp chamber and the access cavity was filled with zinc oxide eugenol cement. After 24 hours, hardness of mineral trioxide aggregate was checked again by means of a condenser and the rest of the canal was sealed with gutta percha and zinc oxide eugenol sealer using vertical compaction technique. Following the completion of the treatment, the access cavity was then filled with composite resin and a postoperative radiograph was taken (Figure 2).

Follow-up, clinical and radiological evaluation

Routine follow-up was performed to determine the success in the prevention of treatment of apical periodontitis. Restorative procedure should be assessed to ensure that in no way promote root fracture. The clinical outcome and effect of mineral trioxide aggregate in healing of apical size was evaluated at 3, 6, and 12 months interval during follow-up therapy (Figure 3). Radiological assessment was performed by taking a periapical radiograph with a holder to maintain angulations of position. Then, clinical evaluation of mineral trioxide aggregate apexification was assessed by two examiners who evaluated the pretreatment and post treatment radiographs in dark room using a magnifier according to following criteria; success: Neither pain nor any tenderness on palpation or percussion and no sinus tract was detected, uncertain: Slight discomfort on percussion or palpation and/or persistent mobility, failure: Presence of persistent pain, predictable discomfort on percussion or palpation, and there was recurrent sinus tract with excessive tooth mobility.[5]

Periapical area was evaluated according to the periapical index criteria.[8] The diameter of the lesion size was mea-sured by using a millimeter ruler and the qualitative analysis of apical tissue barrier over the surface of mineral trioxide aggregate at apex was also calcula-ted by the following criteria: Score 1: Normal periapical structure. Score 2: Small changes in bone structure, Score 3: Changes of bone structure with mineral loss, Score 4: Periodontitis with well defined radiolucent area and Score 5: Severe periodontitis with exacerbating feature.

Evaluation of final outcome was achieved according to a previous study,[5] as follows: Absolute success: There was a reduction of periapical index score and size of the lesion significantly; relative success: Although the size of the lesion was decrease but periapical index score was inert with previous score. There was no change in lesion size but periapical index score was decreased; relative failure: No change in the lesion size and periapical index score was stable; absolute failure: Increasing the size of the lesion or greater periapical index score.

Results

Table I showed the pre-operative and the post-operative clinical results. It was found that among the 15 patients, neither pain nor any sinus and 1 patient was found tooth mobility and tenderness on percussion at 12 months. Furthermore, apical lesion

Table I

Clinical evaluation (n=15)

Variable	Pre-operative	After 12 months	p value
Pain	7	0	0.000
Tenderness	8	1	0.001
Mobility	3	1	0.167
Sinus tract	2	0	0.123
Mean lesion size (mm)	5.1 × 3.8	1.5 × 0.9	0.005
Mean periapical index score	3.3	1.7	0.000

was gradually decreased at 12 months. The mean periapical index was reduced from 3.3 to 1.7 mm. The mean size of lesion was reduced from 5.1 × 3.8 to 1.5 × 0.9 mm at 12 months. Statistical significant difference was found between pre-operative and at 12 months follow-up visit ($p<0.005$). Furthermore, at 12 months, clinical success rate of 93.3% in mineral trioxide aggregate was achieved with Z-test.

Discussion

In the present study, the periapical index score was used to evaluate the periapical health and healing of periapical lesion as suggested by a previous study.[9] When an apical lesion was present, its largest dimension was recorded. The mean periapical index score was reduced from 4 to 1.5 mm, and the mean size of the lesion was reduced after 12 months from 10.7 × 8.7 to 0.6 × 0.4 mm. The differences between pre-operative and 12 months observation period was statistically significant. The results found in the present study with corresponded to some of the previous studies. Simon et al.[5] in their study indicated that when considering the periapical index score and the decrease in size of the apical lesion, healing occurred in 81% of cases at 12 months. El-Meligy et al.[7] reported that mineral trioxide aggregate-treated teeth did not show any sign of clinical or radiological pathology. In the case of open apical foramen, placement of resorbable collagen, hydroxyapatite and calcium sulfate are suggested before placing the mineral trioxide aggregate into the root canal.[10] Furthermore, mineral trioxide aggregate showed better clinical outcome when placed at the cemental limit of the canal than that of over filling.[11] Moreover, apical barrier with mineral trioxide aggregate revealed 94.1% success rate in clinical examination, 76.5% in radiological evaluation and 100% in animal study.[9, 12] Regarding hard tissue formation, mineral trioxide aggregate showed almost similar ability of hard tissue formation to calcium hydroxide or osteogenic protein-1. The formation of bone, osteogenic cementum and uninflamed periodontal tissue in mineral trioxide aggregate treated tooth has proved its good sealing ability and degree of biocompatibility.[9, 12]

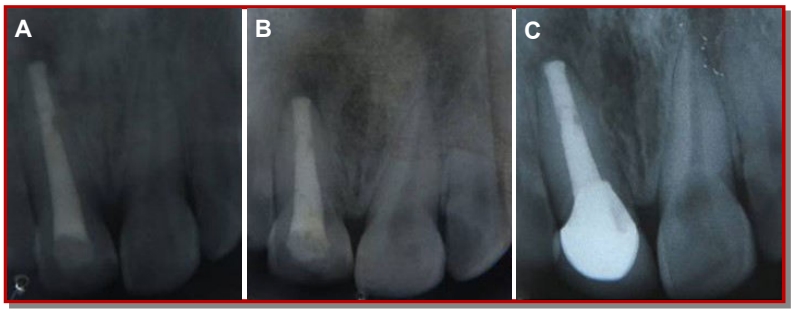

Figure 3: Radiological finding at 3 months (A); 6 months (B) and 12 months observation period (C)

The time required for biological barrier formation in mineral trioxide aggregate group was significantly less than that of calcium hydroxide group but the healing time for periapical radiolucency was almost equal.[13] De leimburg et al.[14] reported that an adequate seal against bacterial infiltration can be achieved with the apical plug of mineral trioxide aggregate. However, Hachmeister et al.[15] indicated that the apical thickness may only have a significant impact on bacterial resistance. In the present study, the thickness of mineral trioxide aggregate apical plug of 3 to 4 mm was sufficient to resist bacterial penetration.

Conclusion

Tooth with open apex can be successfully treated with mineral trioxide aggregate apexification technique followed by root canal obturation.

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