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Case Report

Apexification with mineral trioxide aggregate on post trauma right maxillary central incivus teeth

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ABSTRACT

Background: *Trauma often occurs in the maxillary anterior teeth in both children and adults. This usually causes the pulp of a tooth whose root is not yet fully formed to experience necrosis, and the apex closure stops causing the apex to be wide and open. Apexification is a method to induce a calcified barrier in necrotic roots with open apex. Treatment with Mineral trioxide aggregate (MTA) can shorten treatment time and has a higher long-term success rate than using* $Ca(OH)_2$. ***Purpose:*** *The aim of this report is to describe apexification cases using MTA on a non-vital right maxillary central incisor.* ***Case:*** *A 21-year-old male patient came to the Dental Conservation Clinic at Airlangga University Dental Hospital with complaints of broken and discolored front teeth. The tooth was broken after falling ± 10 years ago (2013) while playing football, it was swollen and painful, but in the last ± 1 year (2022) it has never hurt again. The patient's medical history revealed no systemic abnormalities. Objective examination of tooth 11 class IV ellis fracture, negative percussion and bite test, surrounding normal gingiva, no mobility. The radiographic appearance of tooth 11 shows a wide open apex and a radiolucency at the root tip. Vitality of non-vital teeth, Diagnosis of pulpal necrosis with asymptomatic apical periodontitis.* ***Case Management:*** *In this case, the treatment plan is endodontic treatment in the form of apexification with MTA material. The obturation technique was performed using warm thermoplastic (backfill) and accompanied by a fixed restoration using a fiber post and all porcelain crown with a good prognosis for patient care.* ***Conclusion:*** *Apexification with MTA with post and IPS Emax crown restoration is a good treatment option for immature right maxillary central incisor with open apex. The patient is satisfied because the teeth can return both aesthetically and functionally according to the stomatognathic system.*

Keywords*: Open apex; non-vital tooth; apexification; MTA; fiber post; lithium disilicate crown*

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INTRODUCTION

Endodontic treatment for open apex teeth is apexification. Apexification is a method to induce a *calcified barrier* in necrotic root teeth with open apex.[1] The causes of open tooth apex are caused by untreated dental caries that occurs at a young age or experiencing severe tooth trauma so that it prematurely stops root development. Presence of pathological abnormalities such as inflammation of external root resorption or iatrogenic factors due to *over*-instrumentation that change the diameter of the apical foramen of mature teeth.[2,3]

Apexification treatment is indicated in non-vital teeth where the apical foramen is still open or not fully formed. Apexification aims to stimulate further development or continue the process of forming the apex of a tooth that has not yet fully grown but has experienced pulpal death by forming hard tissue in the tooth apex area.[4] The goal of apexification treatment is also to induce closure of the apical third of the root canal or the formation of an *apical calcific barrier* so that the obturation procedure can be performed with a *hermetic seal*. A *calcific barrier* is needed to prevent extrusion of gutta percha and cement in a periapical direction during obturation. Closure of the apex can be done by forming a calcification barrier at the apex tip so that the root canal can be properly obturated and the root canal must be free of infection to ensure successful apexification.[5]

Treatment with Mineral trioxide aggregate can shorten the treatment time between the first patient visit and the fabrication of the final restoration. The long-term success rate of apexification with MTA is higher than that of

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apexification using $Ca(OH)_2$.[6] Mineral trioxide aggregate is effective in forming a new hard tissue barrier in the apical area of the teeth and has the ability to stimulate hard tissue around the apex, as an *apical calcific barrier*.[5] MTA also has good sealing ability as well as good biocompatibility and bacteriostatic. Other advantages of MTA include the efficiency of treatment time, tooth restoration can be done immediately so as to prevent root fracture and there is no change in the mechanical properties of the dentin in the root canal as in prolonged use of calcium hydroxide.[7–9] Writing this report aims to show that apexification cases can be performed using MTA on a non-vital right maxillary central incisor.

CASE

A 21-year-old male patient came to the Dental Conservation Clinic at Airlangga University Dental Hospital with complaints of a broken and discolored right maxillary front tooth and the patient wanted his teeth treated. The tooth was broken after falling ± 10 years ago (2013) while playing football, it was swollen and painful, but in the last ± 1 year (2022) it has never hurt again. The patient's medical history revealed no systemic abnormalities. Objective examination of tooth 11 class IV ellis fracture, percussion (-), *bite test* (-), gingiva around normal, mobility (-). The radiographic appearance of tooth 11 shows that the apex of the tooth is open and wide. Radiolucent appearance at the root tip. The vitality of the non-vital teeth, then it was concluded that tooth 11 was diagnosed with pulpal necrosis accompanied by asymptomatic apical periodontitis. The treatment plan is endodontic treatment in the form of apexification with MTA material. The obturation technique was performed using *warm thermoplastic* (*backfill*) and accompanied by a fixed restoration using a fiber post and *all porcelain* crown with a good prognosis for patient care.

Figure 1. Preliminary clinical photo (A); Preliminary radiographic photo (B).

CASE MANAGEMENT

At the first visit, the determination of the diagnosis, DHE/KIE, *inform to consent* and *informed consent* was carried out. Followed by isolating the work area using a *rubber dam*. *Access opening* of tooth 11 using an *endo access bur*, then negotiating the root canal using k-file no.10-15 with 19% EDTA gel. The working length was measured using an *apex locator* and the working length of Tooth 11 was 23 mm. *Apical gauging* was carried out and *tug back* was obtained in k-file 60, followed by cleaning of necrotic tissue using K-file #60 with *circumferential filling motion* and irrigation with 2.5% NaOCl, sterile distilled water, 17% EDTA and 2 ml of sterile distilled water, The root canals were dried using a *suction endo tip* and *paper points*. Next, the root canal dressing uses $Ca(OH)_2$ and the teeth are temporarily filled. Figure 1A show the clinical photo and radiographic photo before treatment can be seen in Figure 1B.

On the second visit, from the anamnesis and clinical examination, the patient had no complaints, temporary fillings were in good condition and percussion (-), *bite test* (-), gingiva around the teeth looked normal. Followed by

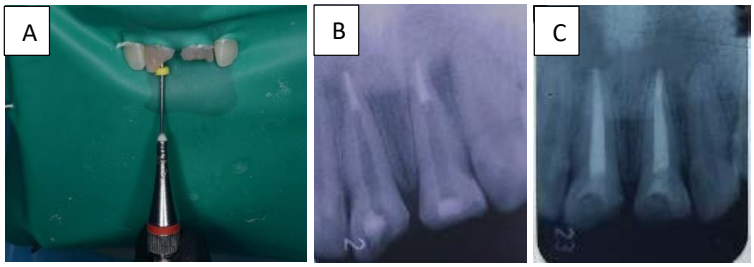

Figure 2. MTA Application (A); MTA filling confirmation photo (B); Obturation's photo (C).

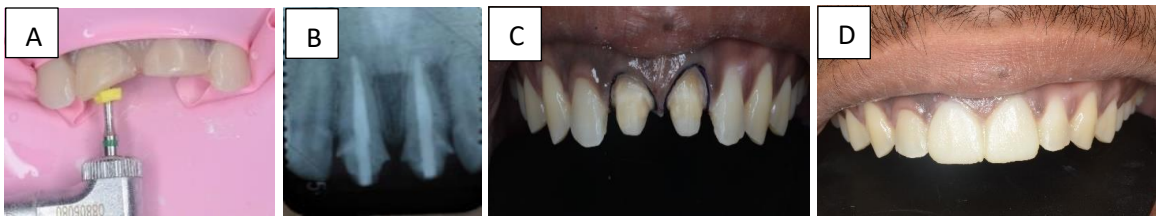

Figure 3. Gutta percha reduction (A); X-ray photo of post insertion (B); Crown preparation (C); Temporary crown installation (D).

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Figure 4. Crown insertion (A); Radiology photo during control (B).

isolating the work area using a *rubber dam* and temporarily cleaning the fillings. Irrigation using 17% EDTA and sterile distilled water with *sonic activation*. The root canals were then dried using a *suction endo tip* and sterile *paper points*. Filling 3-4 mm of MTA in the apical 1/3 using MTA *carrier* (MAP One) and plugger for condensation (Figure2A). Moist cotton is placed over the MTA, then the tooth is closed with a temporary filling, the patient is instructed to take an X-ray to confirm the filling of the MTA (Figure 2B).

On the third visit, from the anamnesis there were no complaints, the temporary filling was in good condition, percussion and *bite test* (-), the gingiva around the teeth looked normal. Isolating the work area using a *rubber dam* and proceed with dismantling the temporary filling. Irrigation using sterile distilled water and root canals, followed by obturation of the root canals using *thermoplastic injection* (*backfill*) technique. Furthermore, the teeth are temporarily filled and post-obturation photos are taken (Figure 2C).

On the fourth visit, isolation of the work area was carried out using a rubber dam and dismantling of the temporary filling followed by matching the size of the fiber post with the template. Taking *gutta-percha* using a *penetration drill and calibration drill* (Figure 3A). Followed by post trial and confirmation using radiographic photos (Figure 3B). Followed by insertion of dowels using *light cured self adhesive resin cement*, then *core build-up* using *dual cured resin*. Determination of tooth enamel color using AD *shade* guide A3 with Ivoclar shade, followed by *crown* making with *deep champer* preparation (Figure 3C). Impression of the maxilla with a two-step technique uses a *double impression elastomeric* impression material, for impressions of the mandible using *irreversible hydrocolloid*. *Bite registration* was made using *polyvinyl siloxan*, followed by insertion of a temporary crown and the patient was instructed to return 1 week later (Figure 3D).

On the fifth visit, isolation of the work area was carried out using a rubber dam, after which the temporary crown was removed and continued with a try on *lithium disilicate* crown (IPS Emax) together with checking occlusion and articulation. Etch the porcelain restoration using 9% *buffered hydrofluoric acid* for 30 seconds, then rinse, dry and cover with *silane* and leave for 1 minute. Etch teeth with 37% *phosphoric acid* for 20 seconds, irrigate, dry and cover with *bonding*, air spray, light for 20 seconds. Insert the *lithium* disilicate crown using dual cure resin cement then light curing for 40 seconds (Figure 4A). Patients were instructed to control 2 weeks later.

On the sixth visit, control was carried out after 2 weeks. The patient anamnesis procedure was carried out and the results on tooth 11 had no complaints, the gingiva around the teeth appeared normal, the marginal fit was good, for percussion and bite tests the results were negative. From the results of obturation radiographic examination it appears that the filling of the root canal is hermetic (Figure 4B).

DISCUSSION

In this case it was reported that the patient had trauma to the right maxillary central incisor when he was 11 years old. Often, traumatized teeth show pulpal necrosis. When trauma occurs, the growth of the root of the central incisor is still not perfect. This will interfere with root development and create a wide-open apex and brittle dentin walls which are difficult to treat with conventional endodontic treatment. In addition, pulp degeneration can cause residual debris and endodontic material in the pulp chamber which will cause tooth discoloration.[10,11]

Tooth discoloration can occur due to the composition of the pulp tissue, bleeding after pulpal extirpation, drugs, and filling materials. Discoloration caused by blood penetration into the dentinal tubules followed by hemolysis of red blood cells. Furthermore, the process of releasing hemoglobin and its decomposition results in a yellowish-brown appearance. The degradation of the iron pigment to iron sulfide is responsible for the appearance of the discoloration.[12]

Such cases require a treatment that requires apical closure through apexification followed by root canal treatment. Apexification is a non-surgical method aimed at inducing *a calcific barrier* at the exposed root apex of a non-vital tooth.[13,14]

The use of sodium hypochlorite as an irrigation solution is often used in root canal treatment procedures because it has anti-bacterial properties and can dissolve organic tissue. The concentration of sodium hypochlorite that can be used as a root canal irrigation solution is 0.5% -5.25%. The higher the concentration of sodium hypochlorite, the higher its ability to dissolve organic tissue. The use of sodium hypochlorite must be combined with EDTA because sodium hypochlorite cannot dissolve inorganic tissues.[15] This is in accordance with what was said by Mulyani et al, that the NaOCL material is antibacterial and can dissolve organic tissue, so NaOCL is combined with EDTA to remove inorganic tissue.[16]

The use of MTA was chosen in the treatment of apexification because it has good *sealing*, is biocompatible and besides being used as a *barrier* it also helps in the formation of bone and periodontium in these teeth. In addition, MTA exhibits antibacterial properties because it has an alkaline pH similar to calcium hydroxide.[10] Additional advantages include more efficient treatment times when compared to using calcium hydroxide and good *apical seal* development.[17]

Despite these advantages, the walls of the root canal in these teeth will remain thin, weak and prone to fracture.

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In this case, a material with a modulus of elasticity similar to that of dentin is required to allow an even distribution of forces along the root canal wall. Materials that can be used are fiber pegs. The fiber post has a *flexural modulus* like dentin so that cracks and fractures are less likely to occur.[13]

After the root canal treatment is complete, a crown is made. The ceramic E-Max or lithium silicate crown was chosen, because it is a type of crown that has an aesthetic appearance, has *high strength* 470 MPa, is *translucency*, does not cause a gray metal line around the cervical line which is characteristic of PFM crowns. Less accumulation of plaque and bacteria was reported on porcelain margins when compared to metal margins.[18] The control was carried out two weeks after the crown was placed and there were no complaints. Then, periodic control is carried out for 1 month, 3 months and 1 year.

In conclusion, apexification with MTA accompanied by post placement and IPS Emax crown restoration is an effective and efficient treatment option that can be performed on immature right maxillary central incisors, with a good success rate. Treatment in these cases can restore both the esthetics, shape and function of the teeth according to the stomatognathic system.

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