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Application of the Mineral Trioxide Aggregate (MTA) in Apexification – Case Reports

Zastosowanie Mineral Trioxide Aggregate (MTA) w procedurze apeksyfikacji – opis przypadków

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Abstract

Background. The purpose of apexification is to finish root end formation or stimulatation of mixed periodontal-pulpal tissue to form mineralized barrier closing root canal.
Objectives. The aim of the work was to assess application of MTA in apexification in 2 patients in developmental age.
Material and methods. Apexification with use of MTA was carried out in 2 patients with immature central maxillary incisors. Root canals were instrumented with step-down technique. The layer of MTA (3–4 mm of thickness) contacting with radiological apex were applied under control of endodontic microscope and with the aim of special applicator. Root canals were obturated using vertical condensation with AH plus and gutta-percha points and crowns were restored with composite material.
Results. Control x-rays after 3, 6 and 12 months showed correct condition of root end and no pathological lesions in periapical tissues.
Conclusion. Until now results of researches show that MTA might be used in apexification with very good result (**Dent. Med. Probl. 2009, 2, 00–00**).

Key words: apexification, MTA.

Streszczenie

Wprowadzenie. Apeksyfikacja to procedura mająca na celu zakończenie procesu formowania wierzchołka korzenia lub pobudzenia mieszanej tkanki miazgowo-ozębnowej do wytworzenia zmineralizowanej bariery zamykającej światło kanału korzeniowego. **Cel pracy.** Ocena zastosowania preparatu MTA w procesie apeksyfikacji u dwóch pacjentów w wieku rozwojowym.
Materiał i metody. Apeksyfikację z zastosowaniem preparatu MTA wykonano u 2 pacjentów w niedojrzałych zębach siecznych centralnych szczęki. Kanały korzeniowe opracowano techniką *step-down*. Pod kontrolą mikroskopu endodontycznego i za pomocą specjalnego podajnika nakładano warstwę 3–4 mm preparatu MTA stykającą się z wierzchołkiem radiologicznym. Kanały wypełniono metodą kondensacji pionowej z wykorzystaniem preparatu AH plus i ćwieków gutaperkowych, a korony zębów odbudowano materiałem kompozytowym.
Wyniki. Kontrolne zdjęcia RTG po 3, 6 i 12 miesiącach wykazały prawidłowy stan wierzchołka korzenia i brak zmian patologicznych w tkankach okołowierzchołkowych. **Wnioski.** Dotychczasowe wyniki badań wskazują, iż materiał MTA może być wykorzystywany z bardzo dobrym rezultatem w procedurze apeksyfikacji (**Dent. Med. Probl. 2009, 2, 00–00**).

Słowa kluczowe: apeksyfikacja, MTA.

Apexification is a way of root canal treatment in the case of irreversible pulpitis or pulp necrosis in immature teeth. During this procedure, there might be some problems caused by absence of apical constriction, thin root walls and root canal with the shape of diverted cone. It makes huge difficulties while preparation and final obturation of the root canal. Apexification conduces to stimulating further root formation or creating hard tissue at the apex. Until today, in this method, the best known and the most widely used materials are those based on the calcium hydroxide. Despite many benefi-

cial features, such as: antiseptic, bacteriostatic and odontotropic action, these materials are increasingly criticized because of disintegration in tissue liquids and poor adhesion to tooth tissues. Although these materials are very effective in apexification they have fundamental defect. The treatment is long-lasting what is conducive to accidental fracture of weakened root, and sometimes immediate restoration of damaged tooth hard tissues can not be done [1].

In many research centers, clinicians try to shorten apexification time by the use of agents that might be "artificial apical stop" and enable immediate final root canal obturation. Until now, (were used) dentin chips, calcium hydroxide, hydroxyapatite, TCP and other [2, 3]. Authors deal with this topic dishonor them. MTA (Mineral Tioxide Aggregate) is a modern material recommended for apexification. Material is built of hydrophile particles of calcium, magnesium, silicone, ferrum oxides that in wet conditions create colloidal gel. The aim of the work was to assess application of MTA in apexification in 2 patients in developmental age.

Review of Cases

Apexification with the use of MTA was carried out in 2 patients in central maxillary incisors. Instrumentation of root canal with step-down technique were made after fixation of rubber dam and determination of working length with Ingle`s method. Root canal was rinsed with 0.1% sodium hypochlorite and 3% hydrogen peroxide. Final rinse was carried out with physiological salt solution in order to clean root canal from other liquids. Calibrated paper points to the working length were used to dry root canal. About 3–4 mm layer of MTA was applied at the apex under control of endodontic microscope and with the aid of special applicator. Then, sterile, wet cotton pellet was inserted into root canal for 24 hours and crown was restored with glass-ionomer cement. After this period remaining part of root canal was obturated with lateral condensation with use of AH plus and gutta-percha points, glass-ionomer based material was applied and crowns restored with composite material.

Case 1.

Patient K.W., aged 8, called for Pediatric Dentistry Department of Silesian Medical University (SUM) because of injury of tooth 11 and 21. The injury was on the playground. As a result of injury crowns were fractured in the area of enamel and dentine. At the day of injury, teeth were in the initial phase of eruption. Additionally, tooth 11 was in the II degree of wobbling, and the tooth 21 in the III degree of wobbling. After taking first control x-ray the root fracture was suspected (fig.1A). Restoration of crowns was postponed for 3 months in order to wait for further eruption of crowns and ability testing pulp vitality. The dentine surface was secured with glass-ionomer cement Interface®. After one week, tooth 21 changed color for dark red and was sensitive to percussion. The decision for root canal treatment and apexification was made. After obtaining an access cavity and determining working length root canal was instrumented and cleaned by rinsing with 1% NaOCl, 3% H_2O_2 and 0.9% NaCl. The apical part of the root canal was filled with MTA (3–4 mm) under control of endodontic microscope (fig.1B). Additionally, the quality of the procedure was controlled with taking x-ray. Next for 24 hours wet, sterile cotton pellet was inserted into root canal and crown was filled temporarily with glass-ionomer cement Inofill Molar®. Root canal was obturated with vertical condensation tech-

a) b) c)

Fig. 1. A) Patient K.W. tooth 21 – first, **B)** Tooth 21 – control after control x-ray before endodontic treatment application of MTA; **C)** Tooth 21 –after 12 months of observation

Ryc. 1A) Pacjent K.W. Ząb 21 – pierwsze zdjęcie RTG przed leczenim endodontycznym; **B)** Ząb 21 – po zastosowaniu MTA; **C.** Ząb 21 – 12 miesięcy po leczeniu, widoczna bariera zmineralizowana w okolicy wierzchołkowej

nique. Restoration of fractured crown was made with composite material Charisma® (Kulzer). After 3, 6 and 12 months from procedure, control x-ray was taken and the condition of periapical region was estimated (fig.1C). The clinical condition of the tooth was also controlled on every visit.

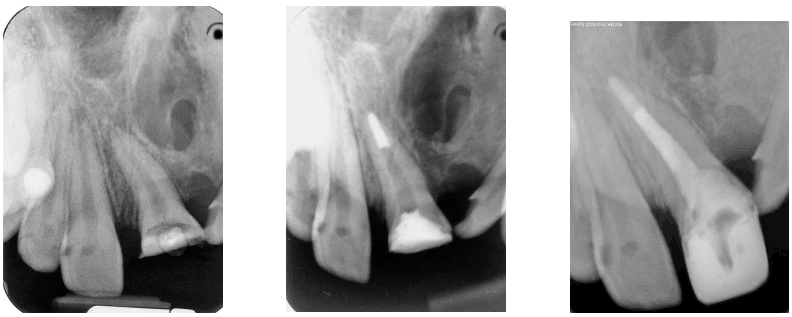
Case 2.

Patient Ś.A., aged 13, called for Pediatric Dentistry Department of SUM because of tooth 21 crown fracture. This girl was treated in SUM Orthodontic Department because of cleft palate. An x-ray showed immature roots of teeth 11 and 21 and distal inclination tooth 21 (fig. 2A). On the first visit, after local anesthesia with Septanest 1: 200, the pulp was extirpated, root canal was rinsed and instrumentated with step-down method. Root canal was filled with Biopulp – material based on the calcium hydroxide, for 3 weeks. Under control of endodontic microscope 3 mm of apical part was filled with MTA (fig. 2B). The cotton pellet infiltrated with 0.9% NaCl was inserted into root canal for 24 hours. After this period root canal was filled using vertical condensation technique with AH plus as sealer. On the next, visit gingival cauterization was made – subgingival palatal part of root was exposed, anatomical impressions were made and the occlusion was noticed. Crown was restored with the use of fiber glass post Glassix® (Nordin) and composite material in the compromise situation between position of tooth and esthetic location in the dental arch. After 3, 6 and 12 months, control x-rays were made (fig. 2C).

Discussion

The purpose of apexification is to finish root end formation or stimulation of mixed periodontal-pulpal tissue to form mineralized barrier closing root canal. Until recently, in this procedure, mostly materials based on calcium hydroxide were used. Their anti-inflammatory feature, antiseptic action, neutralizing acid by-products, activating alkalized phosphate are used in the apexification. However, the necessity of replacing this material every 2–3 months is conducive to reinfection and aborting treatment by patients. In addition long time of waiting for hard barrier formation (3–21 months) causes that final obturation of root canal can not be done, what increases susceptibility to fracture [4, 5]. Long-lasting treatment is also conducive to delaying restoration of missed hard tissue of the tooth crown. For prophylaxis of malocclusion and ensuring patient`s comfort in esthetics of front region of dentition, the clinician has to prepare temporary prosthetic restoration. In the researches of various authors we observed numerous trials of shortening treatment time by one-time application of material in the apical area of the root to isolate root canal from periapical region. It might enable final obturation of the canal and restoration of the crown. However, materials mentioned above used for this procedure did not fulfilled every conditions in achieving the best results in apexification.

MTA (Mineral Trioxide Aggregate) is a modern material used in biological treatment of the pulp. Clinical use of this material is: direct pulp capping, apexification, fixing root perforations, retrograde filling of the root end, root canal obturation, treatment of resorptions. It contains hydrophile particles of calcium, magnesium, silicone, ferrum oxides that in wet conditions create colloidal gel. MTA is biocompatible, resistant to compression and is not cytotoxic [6]. Setting time is about 3–4 hours, while working time – about 5 minutes [7]. After connection with water, (arises) highly alkaline (pH 12.5) colloidal gel, which



a) b) c)

Fig. 2A) Patient Ś.A. Tooth 21 – first noticeable mineralised barrier in apical region control x-ray before treatment; **B)** Tooth 21 – control after; **C)** Tooth 21 – after 12 month of application of MTA observation noticeable mineralised barrier in apical region

Ryc. 2A) Pacjent S.A. Ząb 21 – pierwsze zdjęcie RTG przed leczeniem; **B)** Ząb 21 – kontrola po zastosowaniu MTA; **C)** Ząb 21 – 12 miesięcy po leczeniu, widoczna bariera zmineralizowana w okolicy wierzchołkowej

when hardening, gives insoluble barrier. High pH is important at inhibition of many bacteria, also of resistant *Enterococcus faecalis* [5]. Strength to compression after 21 days from setting is 70 MPa. This value is comparable with results of IRM and SuperEBA and concurrently clearly less from amalgam – 311 MPa [8]. Powder should be mixed with distilled water directly before use in 3:1 proportion till wet sand consistency. Specially designed applicator for MTA facilitate applying. Working time for MTA is about 4 minutes, after that it is drained. Another addition of water extends working time and improve consistency [9].

Many authors [10–18] confirm effectiveness of MTA used in various dental procedures, also in apexification. According to Shabahang et al. [19] MTA, stimulates creating of bone and cementum, additionally these authors observed less inflammation after its use than other tested materials.

Koch et al. [20, 21], in researches on human osteoblasts, showed that MTA stimulates cytokines release. Cytokines coordinate bone metabolism by stimulating proliferation bone cells. These results suggest possibility of stimulating hard tissue formation by MTA. While examining MTA seal (microleakage), some authors concluded that bacterial leakage is less in the case of MTA in the compare with SuperEBA, IRM and amalgam [22–24]. On the basis of our research and those conclusions, the undoubted advantage of MTA is the possibility of use in one-time method in opposition to materials based on $Ca(OH)_2$. It is also confirmed by researches included in this work. MTA placed in the apical part of the root makes hard barrier that effectively seal root canal and the final obturation of the root is possible without moving obturating material into the periapical tissues. Radiological control made in 3, 6 and 12 months after procedure also confirmed excellent biocompatibility of MTA with periapical tissues, that structure on the x-ray has not changed. Additionally, it ensures increased resistance of the root to potential injuries, because of good connection with root tissues.

Torabinejad and Chivian [8] recommend before application of MTA initial use of calcium hydroxide for a week in order to bring under control bleeding from periapical region. Authors of this work also applied disinfection insert with calcium hydroxide.

Endodontic microscope significantly facilitates apexification due to visualization of root end, and also the MTA applicator that helped in precisely sealing periapical area. In the second case in accordance with recommendation of Taito et al. [25] thin root walls were reinforced with fiber glass post.

It should be remembered that final effect and time of closing apex not only depends on kind of used material but also on factors connected with treatment process, well right diagnosis, instrumentation method and root canal disinfection. General health condition of patient is also very important because regeneration abilities of periodontal structures depend on him.

The authorst concluded, until now results of researches show that MTA might be used in apexification with very good result. It is confirmed by control x-rays after 3, 6 and 12 months that show correct condition of apex and absence of inflammation in periapical tissues.

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