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Management of Ellis Class III and Class IV Fracture of Young Permanent Central Incisors with Recent Biocompatible Material: A Clinical Case Report

[1]Dr Vinay Bal Singh Thakur, Associate Professor, Department of Pedodontics and preventive dentistry, Himachal Dental college and Hospital, Sundernagar

[2]Dr Karan Thakur, Pg student, Department of Pedodontics and preventive dentistry, Himachal Dental College and Hospital, Sundernagar

[3]Dr Munnasha Uppal, Pg student, Department of Pedodontics and preventive dentistry, Himachal Dental College and Hospital, Sundernagar

[4]Dr Diksha Sharma, Pg student, Department of Pedodontics and preventive dentistry, Himachal Dental College and Hospital, Sundernagar

[5]Dr Pallavi Mishra, Ex house surgeon, Himachal Dental College And Hospital, Sundernagar.

Corresponding Author: Dr Munnasha Uppal, Pg student, Department of Pedodontics and preventive dentistry, Himachal Dental College and Hospital, Sundernagar

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Abstract

Traumatic injuries to the teeth are most common among all facial injuries. Though this can occur in any age group, thirty percent of traumatic injuries to the dentition occurs during childhood. Majority of these injuries occur before the completion of root formation. Premature loss of vital pulp results in a frail tooth with a compromised crown-root ratio, thin dentinal walls and open apex. Management of Non- vital teeth with open apices is a challenge to Dental practitioners. It is difficult to maintain the obturation material within the confines of root canal without encroaching to periapical area. Also, a thin dentinal walls of canal is a matter of concern. Apical barrier formation by conventional treatment with calcium hydroxide requires many appointments and not accepted by many patients. This case report presents traumatized upper anteriors. The radiographic evaluation revealed open apices with blunderbuss canals. The canals of 21 were cleaned using intracanal instruments and saline (0.9%w/v). To obtain canal disinfection slurry of triple antibiotic paste was temporized in the canal. In subsequent appointments, 4-5mm apical plug was created with MTA and allowed to set. Subsequently, root canals were obturated. The application of partial pulpototmy

procedures in immature permanent teeth with complicated crown fractures has resulted in the formation of hard tissue barrier and complete root development. Here we report a case of immature maxillary central incisor 11, which has been treated by MTA partial pulpotomy. This procedure consists of pulp tissue removal to a depth of 2mm, then capping the pulpal wound with MTA, followed by immediate restoration. The teeth was assessed clinically through pulpal sensitivity tests and radiographically for periapical healing. At each recall (24hrs, 30 days, 3, 6, 12, 18 months) no spontaneous pain was observed, pulp showed signs of vitality and absence of periapical radiolucency after 18 months.

Keywords: Mineral Trioxide Aggregate, Apexification, Open apex, Triple Antibiotic Paste Pulpotomy.

Introduction

Dental injuries to anterior teeth in children hamper mastication speech, aesthetics and create a psychological impact due to loss of tooth structure at an early age. Depending on severity and intensity of trauma to teeth, pulpal necrosis ensues and consequently root development ceases.[1] Root canal treatment of these immature permanent teeth with wide open apices usually takes a long period of time, and prognosis is always of uncertain severity.[2] One of the aims of root canal treatment is to completely fill root canal system in order to prevent reinfection. In teeth with incomplete root development as a consequence of pulp necrosis through trauma or caries, absence of a natural constriction at the end of root canals makes control of filling material difficult.[3]

Apexification can be defined as a method to induce a calcific barrier in a root with open apex or the continued apical development of teeth with incomplete roots and a necrotic pulp.[3] Various materials have been used for apexification which include calcium hydroxide as an intracanal dressing to achieve apexification, use of custom made gutta percha cones and more recently use of Mineral Trioxide Aggregate (MTA).[4]

Calcium hydroxide has been widely used to induce the hard tissue barrier. However this material requires 5-20 months to form hard tissue barrier[5] and a number of dressings are needed for complete closure of apex. It has also been shown that use of calcium hydroxide weakens the resistance of the dentin to fracture.[6] In recent time, Mineral Trioxide Aggregate (MTA) has gained widespread popularity for the apexification procedure. It produces apical hard tissue formation with significantly greater consistency than calcium hydroxide.[7] MTA has the advantages over calcium hydroxide that it can be accomplished in a single visit procedure. Apexification using MTA has several advantages as it neither gets resorbed nor weakens root canal dentin also sets in wet environment. MTA helps in the formation of cementum and osteoid- like tissue because of its alkaline pH and release of calcium and phosphorus ion[8.]

Thus, the present case report demonstrate the successful use of MTA to induce root end closure in traumatised young permanent central incisor.

The importance of pulp vitality preservation can never be overstated. Cvek's partial pulpotomy helps to salvage traumatically exposed pulps preventing the need for further endodontic treatment. It consists of removal of inflamed pulp tissue beneath an exposure to a depth of 1-3 mm, use of bactericidal irrigants to control pulpal bleeding, placement of a biocompatible material (MTA in this case) to promote healing and maintain vitality of remaining pulp tissue. It is usually undertaken in teeth with open apices or thin dentinal wall to promote root development.[9]

Case Report

A 9 years old male patient accompanied by his mother reported to the Department Of Pedodontics And

Preventive Dentistry, Himachal Dental College Sundernagar, Himachal Pradesh with a chief complaint of pain and swelling in upper front teeth. Detailed History revealed that patient had fallen while playing at home, fracturing his upper right and left central incisors 2 days back. On clinical examination, it was found that there was crown fracture (Ellis Class IV) in relation to left maxillary central incisor (21) associated with swelling and (Ellis Class III) fracture in relation to right maxillary central incisor (11). Radiographic examination showed an incompletely formed apex in relation to 11 and 21.

Thereafter, written consent was obtained from patient's parents. After rubber dam isolation following Local Anesthesia (0.6ml Lignocaine), access opening was done wrt 11 & 21 on the same day, starting up with the procedure, idea was to carry out pulpotomy procedure in both traumatised central incisors so as to maintain the vitality of the remaining pulp tissue, in 11 pulpal haemorrhage was easily controlled but 21 showed uncontrolled pulpal haemorrhage indicating sign of pulpal infection and the need to carry out apexification. On examination of 11 there was Ellis Class III fracture with clinical pulp involvement. Exposed pulp appeared light pink in colour. Patient experienced momentary pain in having cold drinks which was relieved once stimulus was removed. Radiographic examination revealed no periapical pathoses and incomplete formed apex. After the access opening as mentioned earlier the pulpal haemorrhage was controlled easily within a time period of 5 minutes. These signs and symptoms signified healthy status of pulp. Hence, partial pulpotomy procedure was carried out for 11. Access cavity was performed and part coronal portion of the pulp chamber was removed to a depth of 2mm using sterile round diamond high speed bur under copious water coolant. Associated bleeding from radicular pulp signified healthy status of pulp. Remaining surface of pulp was irrigated with isotonic saline along with gentle application of small sterile cotton pellets for 5 min until bleeding was arrested. Freshly mixed MTA (Angelus Londrina, PR, Brazil) was placed with a spatula shaped hand instrument and then moist cotton pellets were used to adapt it onto exposed pulp area, 3mm thick layer of MTA was placed over exposed pulp sand restored with composite filling on the same appointment. Periodic follow ups were carried out at 24 hrs, 1 week, 30 days, 3, 6, 12, 18 months following was checked

1. Tenderness on percussion.
2. Electronic pulp testing.
3. Radiograph to check for evidence of root resorption or widening of PDL space.

After the access opening of 21 the working length radiograph was taken with bent file at the tip (0.5-1mm) to 90 degree using an endodontic gauge (Dentsply Maillefer). The canals were prepared with nickel titanium rotary files- Protaper Gold. The orifices and the coronal parts were prepared with S_x file and canals were irrigated with saline (0.9%w/v). The canals were dried with sterile absorbent paper points and Triple antibiotic paste (containing minocycline, ciprofloxacin and metronidazole ratio (1:1:1) with propylene glycol as vehicle was placed for disinfection of root canals and the access cavity was sealed with cavit. Patient was recalled after 2 weeks. On the second visit, the Triple antibiotic paste was removed with copious irrigation of normal saline and the apical portion of the canals were prepared with F1 and F2 files. The canals were thoroughly dried by absorbent paper points. White MTA Angelus (Angelus, Londrina, PR, Brazil) was mixed according to manufacturer's guidelines and was placed with MTA carrier in the apical portion of the canal, subsequent increments were condensed with minimal pressure using broad end of appropriate sized paper points till a thickness of 4-5mm. Due to its

hydrophillic nature, MTA adapts well to periapical tissues. A check radiograph was obtained to evaluate the apical seal. A sterile cotton pellet moistened with sterile water was placed over the canal orifice and access cavity was sealed with cavit. The next appointment was scheduled after 24 hours wherein the hard set of MTA was confirmed and the remainder root canal was obturated using lateral condensation technique with F2 gutta percha cone with respect to 21 followed by composite build up.

Results

Teeth in which pulpotomy was carried out was asymptomatic and did not develop any tenderness to percussion. EPT revealed vital response in tooth treated using MTA at the end of 18 months. There was well defined radio opaque barrier with normal PDL Space.

Fig.1: pre-operative

Fig.2: Pre-operative IOPA

Fig. 3: Working length

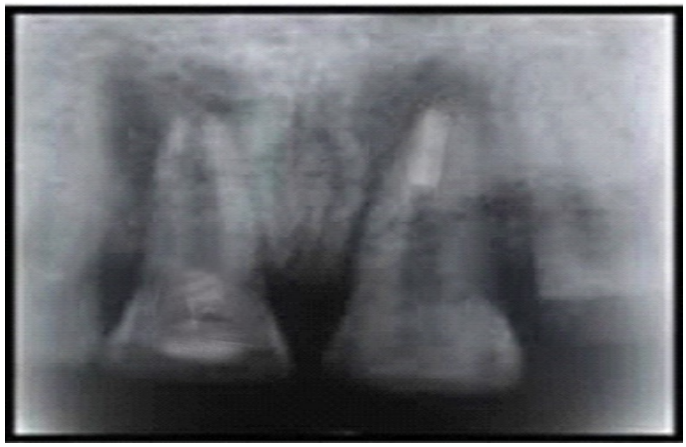

Fig.4: MTA Plug

Fig. 5: Tooth Fragment

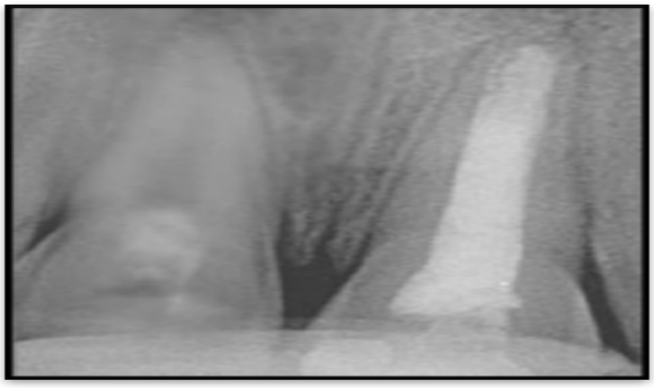

Fig: 6: Post obturation

Fig.7: Post-operative

Discussion

Traumatic injury to a tooth before root development results in destruction of hertwig epithelial root sheath as it is most sensitive to inflammatory reaction. This does not however mean that there is an end to deposition of hard tissue in the region of root apex as hard tissue formation by cementoblast cells can be stimulated. Also the fibroblasts of dental follicle and periodontal ligament can undergo differentiation after an injury to become hard tissue producing cells. Apexification procedure intends to form a mineralized barrier in the root apex against which gutta percha can be condensed in the canal space.[10] However, the conventional apexification material calcium hydroxide has shown inherent disadvantages such as long treatment time, the need for multiple appointments, several radiographs and possible canal infection as crown is sealed with only temporary material for a long time, cervical fracture and root fracture also the barrier formed may be porous.[11] In 1990 Torabinejad and his coworkers developed MTA at Loma Linda University and is available as grey and white MTA. Its constituents are Tricalcium silicate, Tricalcium aluminate, Tetracalcium alumina ferrite, calcium sulphate dehydrate and silicate oxide. Radiopacity is due to the presence of bismuth oxide. Powder has hydrophilic particles that sets in the presence of moisture. Hydration of powder results in colloidal gel with a pH of 12.5 that will in 3 hours.[12]

MTA provides a favourable environment for cementum deposition due to the presence of calcium and phosphorous ions which leads to cementoblastic activity. The US food and drug administration approved MTA in 1998 as a therapeutic endodontic material for humans.[13-14.]

The microhardness of 2mm and 5mm thickness of GMTA and WMTA was investigated when the materials were used as an apical barrier. Regardless of the formulation of MTA or placement technique used, a 5mm thickness was found to be significantly stronger with less leakage then a 2mm thickness. A scientific article investigated displacement of MTA as an apical barrier material in teeth with open apices, showing that 4mm thickness of the apical barrier offers significantly more resistance to displacement than 1mmthickness. This suggests that the thickness of MTA directly affects its hardness, sealing ability and displacement when used as an apical barrier. So, in accordance with previous studies in our case report 4-5mm of MTA apical plug was placed.[15]

Aminoshashariae et al evaluated MTA placement using hand and ultrasonic condensation technique and found that hand condensation leads to better adaptation and fewer voids than ultrasonic condensation method. Accordingly, in this case hand condensation was done to compact MTA at the apex.[15]

Maroto et al have reported successful apexification with MTA in a tooth that did not respond favourably after 3 years of therapy with calcium hydroxide .In a comparative study on effectiveness of MTA and calcium hydroxide in apexification of traumatised young permanent incisors, MTA demonstrated good success and effective option for apexification with advantage of reduced treatment time, good sealing ability, being biocompatible and provides barrier for immediate obturation. However, MTA is much expensive and more difficult to work with during

placement in a root canal due to its sandy consistency when hydrated.[15]

In case of MTA plug formation technique, before placing MTA, root canals must be disinfected with Triple antibiotic paste for 2 weeks. This is so, because chemo-mechanical preparation alone is not effective for complete elimination of microorganisms.

As the importance attributed to conservative endodontic treatment increases manifold, Pulp revascularisation represents a recent and promising therapy for immature teeth, highly recommended as an alternative to apexification in cases of endodontic treatment of irreversible pulpitis, pulp necrosis whether or not associated with periapical lesion and in trauma to immature teeth.

There are few limitations to this approach-

1. Multiple appointments are required to carry out Revascularisation protocol.
2. Long term clinical results are as yet not available, and source of regenerated tissue has not been identified.
3. Revitalized tooth may be susceptible to further pulp disease and may require retreatment, It is possible that entire canal may be calcified, compromising aesthetics.
4. In case, post and core are the final restorative treatment plan, revascularization is not the right treatment option because vital tissue in apical two thirds of canal cannot be violated for post placement.[16]

Many Treatments have been proposed for the management of exposed vital pulp in traumatized teeth such as direct pulp capping and partial or total pulpotomy. This report discusses application of partial pulpotomy in maxillary central incisor 11 with complicated crown fracture. Cvek's pulpotomy was scheduled to preserve vitality of the remaining pulp and promote complete root formation. MTA is a biocompatible material used for wide clinical applications. A recent randomized clinical study reported favourable clinical and radiographic outcomes for Cvek's pulpotomy performed with MTA. Despite favourable outcomes, coronal discoloration is one of potential drawback of MTA formulations. The use of other alternatives such as bioceramic based cements has been reported. A good restoration that prevents bacterial penetration into tooth is essential for success of partial pulpotomy. Investigators examined the success of reattaching the fractured crown fragment to remaining tooth. Results showed that combination of flowable and hybrid resin composite used to reattach the tooth's fractured incisal part was successful.[17]

Conclusion

MTA has wide range of applications in endodontics from apexification to pulpotomy. MTA provides several advantages which includes reduced number of appointments, excellent biocompatibility and formation of proper apical seal. MTA sets in presence of moisture so does not need moisture free environment. Also completion of lamina dura was significantly faster with MTA. So MTA apexification is a new boon in effective management of teeth with open apex.

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