Prostho-Pedo Approach to a Non Vital Immature Tooth: A Case Report

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Introduction

Injury to anterior teeth is one of the most common cause for the children's first visit to dentist. Treating an inflamed anterior tooth with immature root is a challenge faced by many dentists. In such situations, the absence of a natural constriction at the end of the root canal makes control of filling materials difficult. Due to the lack of an apical constriction, an alternative to standard root canal treatment, apexification or root end closure has been advocated.

Many materials are recommended for apexification out of which MTA is considered superior. MTA a biocompatible material has shown superior results compared to calcium hydroxide in recent studies in case of Apexification procedures. The major advantage is that unlike calcium hydroxide MTA doesn't require long treatment duration, and it has less leakage and better antibacterial properties[(1)]. After the root preservation procedure the restoration of crown must be given importance in order to provide better strength to the teeth and stretch a good prognosis for the treated teeth. This article is about a detailed review of MTA (Mineral Trioxide Aggregate), its mechanism, properties that makes it a material of choice for root end filling material, and a case report of apexification with MTA, restored with all ceramic crown (IPS E.maxlidisi crown).

Root End Filling Materials

Ideal Requirements: Gartner AH and Doran SO[(1)] has discussed the ideal requirements of a root end filling material as;

1. The most important requirement of a root end material is that it should be biocompatible and non-toxic, as it placed in direct contact with vital soft tissue.
2. It should provide a biological seal. i.e. It should promote cementum deposition on the cut root surface.
3. It should adhere to tooth structure.
4. It should be insoluble in tissue fluids.
5. It should be dimensionally stable.
6. It should be non resorbable.
7. It should be radio opaque.

Root End Filling Materials Then And Now

Amalgam has been first material of choice for a root end filling for several years, due to its workability, self sealing capacity, radio opacity and insolubility in tissue fluids. Rhein in 1897 used amalgam to seal the pulp canal after complete root resection[(2)]. But some studies have shown that amalgam has a poor sealing ability and also when amalgam is freshly mixed it has free mercury due to which it remains toxic. The toxicity reduces as the amalgam hardens with time.[(2)(3)]. Because of these reasons, later, the use of amalgam as root end filling material was not preferred.

IRM and Super EBM then came into use as root end filling materials. These are modifications of zinc oxide eugenol cement and they have good sealing ability. .Coleman and Kirk in 1965 first recommended the use of EBA as root end filling material. Super EBA has high compressive strength, high tensile strength, neutral pH, adheres to tooth even in moist conditions, minimal leakage and promotes good healing[(4)].A recent study shows that both IRM and super EBA have less biocompatibility than assumed earlier[(5)].

GuttaPercha was also recommended as root end filling material. Thermoplasticizedguttapercha has a better sealing ability when compared to amalgam. It absorbs moisture from the periapical region and expands initially, which is later followed by contraction. This contraction leads to poor marginal adaptation and leakage[(6)].

Glass Ionomer Cement had been tried as a root end filling material as it has good handling properties and there is no adverse tissue reactions. But some studies has shown the cytotoxic effect of freshly mixed GIC[(7)] although it reduces with time[(8)].

Light cure resin modified GIC has also been tried as a root end filling material and shows less microleakage and acceptable healing[(9)].

Composite resin is also recommended as a root end filling material for it has good sealing abilty. It leaks less than amalgam. Later, this was not chosen as an option for root end filling as it gets easily contaminated with moisture and blood, losing its bond strength and increases leakage. Studies also say that it may have some cytotoxic potential which is directly proportional to the amount and nature of the leachable materials[(10)].

Retroplast [Retroplast trading, Denmark]is a dentin bonding composite resin system is also a material of choice for root end filling. Studies have shown that it is well tolerated and promotes good healing response. Healing shows deposition of cementum in the root surface and regeneration of periodontium including insertion of sharpy'sfibers[(11)].

Geristore(Densply Tulsa dental)&Dyract (Denmat corporation) are a combination of resin and glassionomer combining various properties of both the materials. Studies have shown that Geristore has the potential of regenerating periradicular tissues. Histological evidence of cellular attachment is seen[(12)].In vitro leakage studies of Geristore and Dyract indicates that these materials leak lesser than IRM, amalgam or Super EBA. Geristore has the leakage pattern that of MTA.

These materials are sensitive to moisture than conventional glassionomer cements. Dry environment produces strong bonds[(11)].

MTA (Mineral Trioxide Aggregate) emerged as a revolutionary material in dentistry, satisfying all the ideal requirements of a root end filling material. It is a Portland cementwhich has become one of the widely studied endodontic material. Mineral Trioxide Aggregate (MTA) was introduced by MohmoudTaorabinejad at Loma Linda University, California, USA in 1993[(13)] and was given approval for endodontic use by the U.S. Food and Drug

Administration in 1998[14].ProRoot MTA, White ProRoot MTA,

Chemical compound	GMTA (wt%)	WMTA (wt%)
Calcium oxide (CaO)	40.45	44.23
Silicon dioxide (SiO_2)	17.00	21.20
Bismuth trioxide (Bi_2O_3)	15.90	16.13
Aluminium oxide (Al_2O_3)	4.26	1.92
Magnesium oxide (MgO)	3.10	1.35
Sulfur trioxide (SO_3)	0.51	0.53
Chlorine (Cl)	0.43	0.43
Ferrous oxide (FeO)	4.39	0.40
Phosphorus pentoxide(P_2O_5)	0.18	0.21
Titanium dioxide (TiO_2)	0.06	0.11
Carbonic acid (H_2O+CO_2)	13.72	14.49

MTA-Angelus (Grey), MTA (White), MM MTA, Ortho MTA, Retro MTA, EndoCem MTA, MTA Plus, EndoCemZr, EndoSeal, MTA Fillapex are some of the commercially available MTA.

Mineral Trioxide Aggregate

MTA is available in two types. They are Grey MTA and White MTA. The compositions of these are discussed by ChiragMacwan et al [15]as given in table 1.

Table.1. Chemical composition of GMTA and WMTA.

Setting Reaction

Sluyk et al[16], Torabinejad et al[17] and Schmitt et al[18]advocated that the powder water ratio for MTA should be 3:1(P: W). Mixing can be done on paper pad or on a glass slab using a plastic or metal spatula to achieve putty like paste consistency. This mix should be cover with moistened cotton pellet to prevent dehydration of mix..When MTA powder is mixed with water,hydration takes place.Hydration of the powder produces a colloidal gel that solidifies into a hard structure consisting of discrete crystals in an amorphous matrix.The crystals are composed of calcium oxide and the amorphous region composed of 33% calcium,49% phosphate,2% carbon,3% chloride and 6% silica.

Traditional ProRoot MTA takes about 2 to 3 hours to set. MTA Angelus sets within 15 minutes of being prepared. The reduced setting time of MTA Angelus is a result of reducing the concentration of calcium sulfate, which is the substance responsible for the longer setting time in the original formulation[19].MTA being hydrophilic requires moisture to set. Presence of moisture during setting improves the flexural strength of the set cement. Unused MTA powder must be kept tightly closed to avoid degradation by moisture.

MTA may be placed into the desired location using ultrasonic condensation, plugger, paper point or specially designed carriers and messing gun. Aminoshariae et al[20]compared hand condensation and the ultrasonic method and found that a better adaptation of MTA to the walls with less voids in hand condensation compared to the ultrasonic method.Nekoofar et al[21] compared the method and pressure of condensation and found that condensation pressure may affect the strength and hardness of MTA.

Properties

1. pH-Initially pH is of 10.2, which raises to 2.5, three hours after mixing. pH is about 9.5 at 168 hours after mixing[15].
2. MEAN PARTICLE SIZE is 10µm.Range of particle size is from 0.1 µm to 100 µm[22].
3. Compressie Strength- at 24 hours 40.0 MPa and at 21 days 67.3MPa; and in comparison between GMTA and WMTA result showed that compressive strength of Gray MTA > White MTA[23].
4. Radio Opacity- mean radio opacity of MTA is 7.17 mm of equivalent thickness of aluminium, which is adequate to make it easy to visualize radiographically[23].
5. Solubility- The set MTA shows no signs of solubility. But, if more water is used during mixing the MTA it may results into increased solubility.
6. Marginaladaptation- has excellent sealing ability which may occur because MTA expands during setting reaction. About 4-mm thickness of MTA is sufficient to ensure a good sealing[24].
7. Antibacterial Effect- MTA has antibacterial effect especially against Enterococcus faecalis and Streptococcus sanguis[25].
8. Biocompatability- MTA is well tolerated by tissues and is biocompatible. It shows osteolast - like cell response[26]and has good interaction with periapical and periradicular tissues. It increases the production of both proinflammatory and anti inflammatory cytokines from osteoblasts[11] and produces interlukin[27].
9. Tissue Regeneration- MTA is potential to activate the cementoblasts and eventually cementum production. MTA also allows the overgrowth of PDL fiber over its surface[22].
10. Mineralization- MTA stimulates reparative dentin formation along with maintaining the integrity of the pulp.

Apart from root end filling MTA can also use for pulp capping, pulpotomy, root canal filling, perforation repair, resorption repair, repair of fracture, apical barrier for tooth with necrotic pulp and open apex, coronal barrier for regenerative endodontics, root canal sealer[15].

Restoration of endodontically treated teeth is an important aspect of dental practice that involves a range of treatment options of varying complexity. These teeth are unique subset of teeth requiring restoration because of several factors such as dehydrated dentin, decreased structural integrity and impaired neuro sensory feedback mechanism when compared to a vital tooth[28]. Thus perfection of a root canal procedure to preserve the tooth also depends on the treatment plan done to preserve the remaining crown. This article explains the placement of all ceramic crown (IPS E.maxlidisi crown) after apexification of immature root with MTA.

Case Report

This a case report of a 10 year old female patient named Samiksha, who reported to the Department of Pedodontics, Kalka Dental College, Meerut, complaining about the upper lip swelling since 4 days. On detailed questionnaire, it was understood that she had trauma on upper front tooth region before 2 months and did not undergo any treatment for that. Now she has dull pain and unable to eat properly since 4 days. She also feels unesthectic due to swelling of upper lip. Now she has taken self medication for the pain from last 2 days.

There was facial asymmetry with edema of upper lip. On intra oral examination, there was swelling in the labial mucosa in relation to 11 and 21 involving the labial frenum.The 21 tooth was fractured and had pain on percussion (Fig.1).

The patient was referred to take intra oral periapical radiograph in relation to 11 and 21. On examining the IOPA, there was fracture of 21 involving enamel, dentin and pulp. Widening of periodontal ligament in relation to 21 was seen. There was an open apex in 21 indicating incomplete root formationof the tooth (Fig.2).

When pulp vitality test was done in 21, it showed negative

response. With the history, intraoral findings and radiographic examination, the case was diagnosed as Elli's class III fracture in 21. Keeping the main treatment objective as to relieve the pain of the patient, the treatment was planned. The diagnosis and treatment plan were explained in detail to the patient's parents and informed concert was signed by them.

Access opening was done in 21 under Local Anesthesia. The canal was well irrigated to drain the pus. Open dressing was done in 21. Patient was prescribed antibiotics and analgesics after the post-operative instructions. Patient was recalled after 3 days for next appointment.

During the second visit review, it was noticed that edema was well reduced and there was no prominent facial asymmetry. The working length of 21 tooth was determined (Fig.3). Cleaning and shaping of canal (21) was done (Fig.4) with surplus irrigation using 5.25% sodium hypochlorite. The canal was dried using paper points. Mineral Trioxide Aggregate paste was placed at the apical end (Fig.5) of the canal and closed dressing was given. Patient was recalled on the next day and obturation with GuttaPercha was done (Fig.6). The crown build up done using composite restoration. Patient was advised to go for a all ceramic crown (IPS E.maxlidisi crown) in 21 and referred to the Department of Prosthodontics, Kalka Dental College.

Patient reported after 2 days. Crown preparation was done in 21 and upper and lower alginate impressions were made. Patient was recalled the next day. Then the all ceramic crown (IPS E.maxlidisi crown) was cementedusing resin cement.(Fig.7-9) . High points and occlusion were checked. Post-operative instructions were given and the patient was recalled after 1 week for review. There was no history of pain or discomfort and the patient was happy and comfortable with clinically healthy teeth.

Discussion

Depending on the vitality of the pulp after trauma, the treatment option varies either apex genesis or Apexification.The aim of apexification is to seal a sizeable communication present between the root canal system and the periradicular tissue and provide a barrier against which obturation material can be compacted[29].

Although there are many materials for apexification, The treatment of a necrotic pulp in an immature root has always presented a challenge to clinicians due to the lack of an apical stop. This has classically been addressed with long term calcium hydroxide treatment which may require several years of treatment time, involve multiple visits and theoretically at least, increase the fracture potential of the root involved[30]. MTA has become an excellent predictable alternative to address these issues by creating a biocompatible apical plug in a single visit.

The probability of root fracture of endodontically treated is higher than that of vital tooth. The main reason for this is stress concentration in the brittle root[31][32]. Thus the remaining tooth has to be preserved using proper restoration, crown or post and core. This allows the restoration of remaining tooth structure. The clinical results will also be promising with the expected prognosis.

Conclusion

Apexification with MTA produces promising results, which is stated by many studies. MTA has more favorable properties for which it is preferred and considered as the gold standard for the future of root end filling materials. Restoring the crownendodontically treated teeth must also be considered equally important as preserving the root of immature teeth. These can be achieved with the combined consideration of endodontics, periodontics and prosthodontics.

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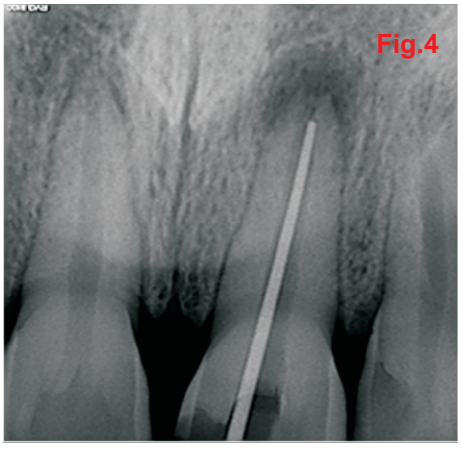
Fig.1


Fig.2


Fig.3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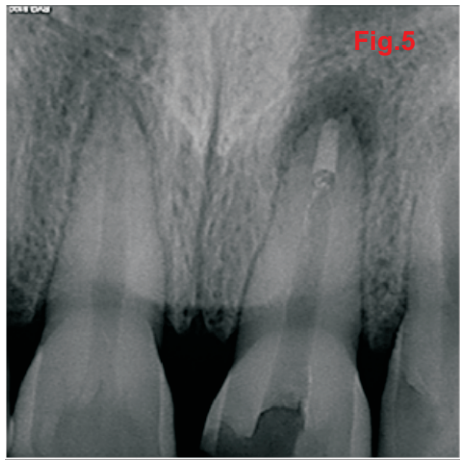
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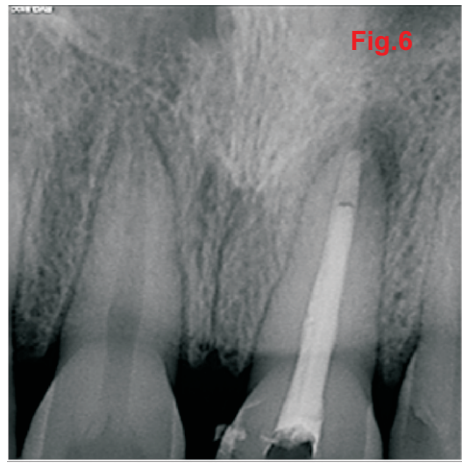
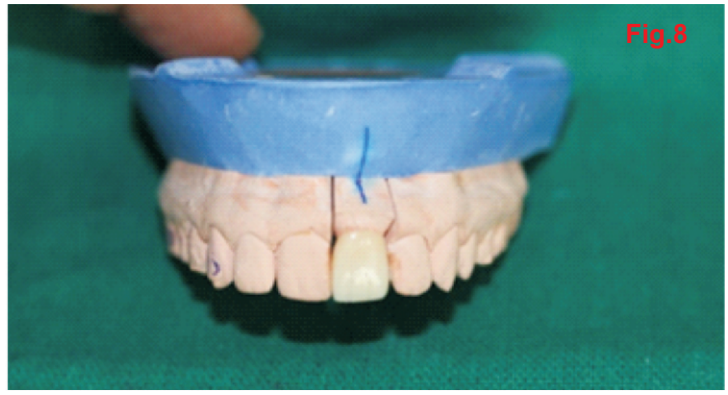


Fig.6


Fig.7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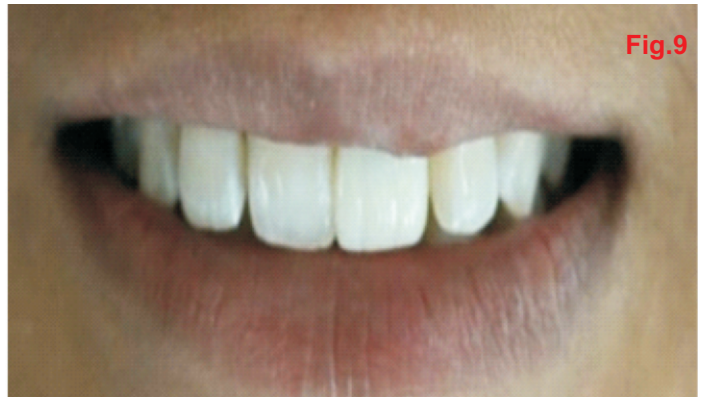
Fig.9