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An Innovative Technique to Restore the Non Vital Teeth with Wide; Open Canals- A Clinical Study

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Abstract: *Immature teeth with necrotic pulp and periapical lesion are difficult to treat via conventional endodontic therapy. Though revascularization & natural repair of root anatomy is the ideal outcome, it is not always feasible due to the prolonged treatment timeinvolved. Apexification followed by the reinforcement of weakened root structures with fiber post is an attractive option. Biodentine and MTA are two successful materials used for apexification procedures. Biodentine is superior in its handling properties, fast setting time and push out bond strength. Multiple fiber posts bonded together bycomposite resin can be used to strengthen the weakened tooth structure. Anatomical fiber post is the tactic of choice for reinforcing structurally weakened roots by lowering risk of catastrophic failures and better stress distribution. This article describes two case reports in which non-vital teeth with wide open canals were managed usingBiodentine and MTAas apexification agents respectively. Original root canal shape was configured with the help of anatomical fiber posts to enhance the fracture resistance of maxillary central incisors.*
Keywords*: Anatomic fiber post, Apexification, Biodentine, MTA*

I. Introduction

Dental injuries to the young permanent incisors are frequent following orofacial trauma. Prevalence of traumatized permanent anterior teeth varies from 2.6% to 30%. The majority of these incidents occurs before root completion takes place and may have grave consequences like pulp necrosis, pulp canal obliteration, root resorption, open apex and above all psychological trauma.The absence of an apical constriction makes root canal treatment difficult because of the inability to obtain a seal with conventional obturation techniques.More over the thin root canal walls render it susceptible to fracture [1].

Regenerative endodontics is the ideal approach for managing this problem which allows continued root development and root elongation, thickening of dentinal wallsand induce closure of root apex, thereby reducing the risk of fracture during tooth function.Butthis may takeprolonged treatment time which is a major disadvantage. Another successful alternative is the apexification of the involved teeth followed by reinforcing them with anatomical fiber posts.

Biodentine and MTA are two successful materials used for apexification procedures. Both of them have good biocompatibility and adequate sealing property. But Biodentine is superior in its handling properties, fast setting time and push out bond strength [2]. Anatomical fiber posts are multiplefiber posts bonded together with composite resin are used recreate the lost root dentine thereby strengthening the weakened tooth structure.

This article describes two case reports in which non-vital teeth with wide open canals were managed using Biodentine and MTA apexification followed by the use of anatomical fiber posts in order to enhance the fracture resistance in maxillary central incisors.

II. Case Reports:

Case 1

A young 21-year-old male patient reported to the department of conservative dentistry and endodontics with the chief complaint of broken, discolored tooth with pus discharge in upper front region (Fig. 1). Dental history revealed a trauma 13 years back and he hadn't undergone any treatment at that time. Intra oral examination showed middle third crown fracture and discoloration of maxillary left central incisor and a sinus tract in the periapical region of tooth no. 21 Patient was symptomless for a long time but in due course developed dull continuous pain and now since 3 weeks had noticed intermittent pus discharge. Radiographic examination showed incompletely closed root apex and a wide canal with periapical radiolucency in relation to

tooth no.21 (Fig. 2). Taking into consideration the current guidelines, reinforcement of the root with anatomical fiber post along with MTA apexification to achieve apical seal and to strengthen the root was planned.

After obtaining the patient consent, under rubber dam isolation tooth no.21 was endodontically accessed. The canal was then located and working length established radiographically 1 mm short of the radiographic apex. Root canal was disinfected with 5.25% Sodium Hypochlorite (VIP,Vensons India Pvt. Ltd., Bengaluru, India)and a side vent needle used to avoid the possibility of extrusion of irrigant. After drying the canal with paper points, triple antibiotic paste containing Ciprofloxacin 500mg (Ciplox 500 mg, Cipla Ltd., Sikkim, India), Metronidazole 400mg (Metrogyl 400mg, J.B. Chemicals & Pharmaceuticals Ltd., India)and Minocycline 100 mg (Ranbaxy Laboratories Ltd., Solan, India)was placed as an intracanal medicament. Patient was recalled after 3 weeks. Canal was irrigated with normal saline for removal of triple antibiotic paste and dried with paper points.

MTA (MTA Angelus, Angelus, Londrina–PR, Brazil) was mixed according to manufacturer's guidelines to a thick creamy consistency. It was then deposited into tooth no. 21, 1-1.5 mm short of the working length with MTA carrier and compacted using Schilder's plugger.Thickness of apical plug (3-4mm) was confirmed radiographically. Access cavity sealed with temporary filling material (Protemp)after placing a cotton pellet inside the canal. After 1 week, tooth was accessed as before, a hand plugger tapped against MTA plug to confirm hardened set. MTA served as an apexification and obturation material in this case.

Fig. 1 Case 1 Pre-operative photograph

Fig. 2 Case 1 Pre-operative IOPA

Fig. 3 Case 1 Anatomical fiber post

Fig. 4 Case 1Monobloc unit after cementation

Fig. 5 Case 1 Post-operative photograph

Case 2

A young 17-year-old male patient reported to the department of conservative dentistry and endodontics with the chief complaint of broken, discolored tooth in upper front region (Fig. 6). Dental history revealed a trauma 9 years back. Intra oral examination showed a cervical third crown fracture with discoloration of maxillary left central incisor. Radiographic findings include incompletely closed root apex and a wide canal with periapical radiolucency in relation to tooth no.21 (Fig. 7). The tooth did not show any response to cold and electrical pulp testing.History, radiographic and clinical findings were suggestive of pulp necrosis and chronic apical periodontitis in relation to maxillary left central incisor.The treatment plan included SingleVisit Apexification with biodentine followed by reinforcement with anatomical fiber posts. An informed consent was taken from the patient and his parents.

Conventional coronal access was prepared and absolute isolation was obtained with rubber dam. The canal was then located and the working length was determined with radiographic method. The canal was irrigated with 2.5% Sodium Hypochlorite (VIP, Vensons India Pvt. Ltd., Bengaluru, India) and aside vent needle to avoid the possibility of extrusion of irrigant. Triple antibiotic paste used to ensure the sterilization of the canal as in the first case. After three weeks, patient recalled and normal saline was used as an irrigant to remove the triple antibiotic paste and canal dried with paper points.

Biodentine™ (Septodont, St. Maur- des- Fossés, France) was manipulated according to manufacturer's instructions. The prepared mixture of Biodentine was carried into tooth no. 21 with MTA carrier and condensed with root canal plugger. Several increments were required to form an apical barrier of 5 mm thickness. A sterile cotton pellet was placed in the canal for 15 minutes and a hand plugger tapped against Biodentine plug to confirm hardened set. Here biodentine has dual functions: both as an obturation and as an apexification material.

The postspace impressions for case 1 and case 2 were made with light body and putty consistency addition polyvinyl silicone impression material (Photosil, Dental Products of India, Mumbai) and study models were prepared. For both case1 and case 2, one Master fiber post (size 3 = 1.5mm) and one accessory fiber post (size 1 =1.1mm)(Coltene) were selected to adapt the canals on study model. Clinical review of the fit of the selected posts checked in the following appointment. After etchingwith 37% phosphoric acid (Maestro® Power Etch™), bonding agent(Monobond S, IvoclarVivadent AG) was applied to the selected fiberposts and

wasbonded to each other by resin cement(Multilink Speed, IvoclarVivadent AG) in both case 1(Fig. 3) and case 2 (Fig. 8). Composite (DenFil, Vericom Co Ltd., Korea)augmentation wasdone on these fiber posts unit to compensate remaining space of the canal. Thus a canal configured anatomical post was created. These anatomical posts were again etched, silane coupling agent (Monobond Plus, IvoclarVivadent AG)and bonding agent applied and the posts were cemented using resin cement into the canals and light curedfor both case 1(Fig. 4) and case 2 (Fig. 9). Core build up was done with composite (DenFil, Vericom Co Ltd., Korea) up to coronal third of crown in both cases. All ceramic full crowns were fabricated in order to fulfill the aesthetic requirementsfor both case 1(Fig. 5) and case 2 (Fig. 10).

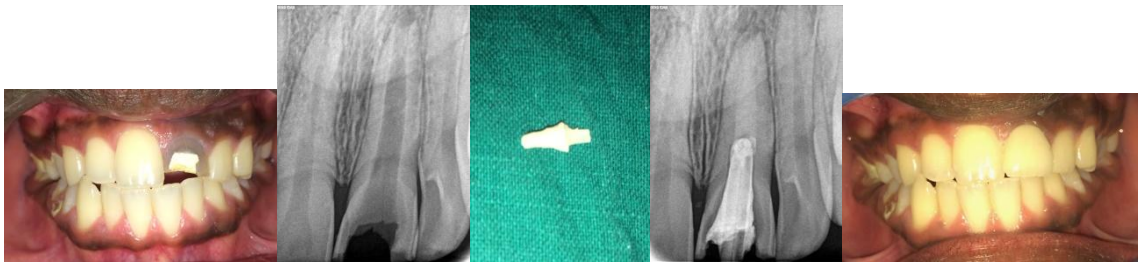

Fig. 6 Case 2 Preoperative photograph

Fig. 7 Case2 Preoperative IOPA

Fig. 8 Case 2 Anatomical fiber post

Fig. 9 Case2 Monobloc unit after cementation

Fig. 10 Case2 Post- operative photograph

Revascularization& repair of root anatomy is the ideal treatment of choice for necrotic nonvital teeth with wide open canals but it is not always feasible due to prolonged treatment time required. Apexification followed by reinforcementof weakened root structures with fiber post is viable option. Here we opted,MTAand Biodentine as apexification agents followed by reinforcing teeth with anatomical fiber posts.

Nowadays MTA is considered as one of the most suitable material for single visit apexification because of its biocompatibility, less cytotoxicity, osteoconductive properties, bioremineralisation abilities and hydrophilic nature[1,2]. When compared to $Ca(OH)_2$ apexification, MTA apexification can be completed very quickly.Many of the disadvantages associated with $Ca(OH)_2$like prolonged treatmenttime, risk of recontamination of the root canal system and chance of cervical tooth fracture during treatmentcan be avoided [3, 4].

Biodentine, a recently introduced bioactive dentine substitute based on "Active Biosilicate Technology" is stable, less soluble, non-resorbable and easy to prepare and place, needs less setting time, and produces a tighter seal. It provides good biological seal and excellent marginal adaptation, having better handling properties and with fast setting time compared to MTA. in comparison with other materials, physical properties like compressive strength, elasticity modulus and microhardness of Biodentine are more identical to that of natural dentine, hence an ideal material for apexification [2].In the cases presented, both Biodentine and

MTA placed as apical barriers strengthen the root canal walls in the apical portion of the canal.

For restoring the teeth with thin canal walls a master fiber post and an accessory post selected and bonded to each other with the help of bonding agent and resin cement. They were made into a single unit (MONOBLOC) that follows the canal configuration by augmenting composite to it. Finally this anatomically adapted post was cemented to the canal with resin cement.

In the cases presented cast posts were not opted because their use might increase the occurrence of root fractures via wedge effect [5]. Forces in the tooth restored with a fiber post are evenly distributed to the restored complex in a manner that does not put stress on the vulnerable root structure whereas a metal post-and core system transferred higher stresses to the root, which might cause a higher incidence of vertical root fractures [6]. Cast posts are associated with inferior aesthetics, low resilience, corrosion and do not match the elastic modulus of the tooth structure.Fiber posts have more flexibility and good aesthetics in contrast to metal posts [7].

Adaptation of posts to the canal walls is an important element in the biomechanical performance of the prosthetic restoration. Advantages of anatomical fiber posts include greater post-to-canal adaptation in the apical and coronal half of the canal, good post retention and minimal tooth structure removal during canal reshaping [8].

Canal configured fiber posts need minimal thickness for cementing medium thus reducing polymerization stress caused by a great amount of cement around the post [9]. The concept of adhesive fixation of a post and core in order to retain the tooth can both increase post retention as well as resistance of the tooth. Scanning electronmicroscope evaluationof bonding of fiber post to the dentinal walls with resin cement has demonstrated formation of hybrid layer, resin tags and an adhesive lateral branch.Successful bonding can minimize the wedging effect and reduce dentine stresses [10].

Thick posts demonstrate higher fracture resistance of the root- post- core- crown system than thin posts.More over excess preparation and subsequent weakening of the remaining root dentin is also at the same time avoided. The greater thickness of the coronal portion of the anatomically adapted post could preserve the margin on the tension side from opening during cyclic load and the margin on the compressive side from crushing cement and dentin, maintaining marginal integrity under function. The strength of adhesive interfaces and design of the post system determines the load bearing capacity [11].

The MONOBLOC philosophy must be expandable, with techniques and products to accommodate the wide, flared canal, while also considering the other existing variables, such as C-Factor and S-Factor (stress associated polymerization shrinkage) and even micro leakage [12].

The C-Factor and S-Factor are at their highest with post cementation, because of the high number of involved surfaces and no unbounded surfaces [12].With this anatomical post, any composite shrinkage takes place in free space, not between the tooth and the restoration, neutralizing the S-Factor effect. The cement thickness will be minimal and uniform. If the air-inhibited layer on the build-down is not intact, the excess cement and remaining tooth structure can be refreshed before the bonding agent and core build-up composite are applied [13].

Resin based composite core build up offers an aesthetically pleasing material especially in the anterior under an all ceramic restoration. It demonstrates good strength characteristics and low solubility.

IV. Conclusion

MTA or Biodentineapexification followed by tooth strengthening using anatomical fiber posts and composite resin is a successful alternative to cast post and core in necrosed teeth with wide open canals, because of the lower risk of catastrophic failures and better stress distribution. Canal configured anatomic fiber post is the tactic of choice for reinforcing structurally weakened roots, and the function and prognosis of the restored root is improved, compared to the use of one single, inadequately fitting post.

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