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RESEARCH ARTICLE

MANAGEMENT OF FRACTURED ANTERIOR TEETH WITH OPEN APEX – A CASE REPORT

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ABSTRACT

Traumatic injuries to young permanent teeth result in pulpal inflammation or necrosis & subsequent incomplete development of dentinal wall & root apices. Immature teeth that have lost substantial amount of crown structure and have wide root canals with weak root dentinal walls and thin radicular dentin are difficult to restore both esthetically & functionally. An apical barrier is necessary in such cases to facilitate proper endodontic treatment. Apexification using MTA can provide a good apical seal. The use of Biological Dentin Post can be considered as a novel alternative technique for the management of such cases. Biological post obtained through extracted teeth from another individual-represent a low-cost option for the morpho-functional recovery and intra-radicular rehabilitation of extensively damaged anterior teeth. This case report addresses the management fractured maxillary central incisors with open apices.

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INTRODUCTION

Trauma to the anterior teeth is commonly seen in children and adolescents and can result in their fracture, which in turn leads to functional, aesthetic, and psychosocial problems.(1) Onetto et al. reported that 16–30% of children and adolescents sustain dental trauma more than once.(2) Traumatic injuries to young permanent teeth result in pulpal inflammation or necrosis and subsequent incomplete development of dentinal wall & root apices.(3) Management of necrosed immature teeth with open apices presents with a plethora of challenges, the main being the formation an apical barrier. MTA (mineral trioxide aggregate) has gained increased popularity with one visit apexification technique as it can induce cementum like hard tissue when used adjacent to the periradicular tissues, is relatively non-toxic and can produce an osteoconductive apical barrier.(4) Immature teeth that have lost substantial amount of crown structure and have wide root canals with weak root dentinal walls and thin radicular dentin are difficult to restore both aesthetically & functionally.(5) A proper coronary reconstruction along with adequate intra-canal retention using post and coreis the only satisfactory treatment option when more than half of coronal structure is lost (6,7).

Pre-fabricated posts cannot imitate the wide canal anatomy of such cases, necessitating the requirement of a thick layer of luting cement to compensate for the gap between the post and the root dentin which will ultimately lead to the debonding of the post and failure of the restoration.(8)A cast metal post, on the other hand, would have a wedging effect resulting in root fracture (9). An improved alternative option for such cases may be the use of biologic dentin post made from natural, freshly extracted and sterilized teeth. The use of biological posts is a feasible option for strengthening root canals with the potential advantages such as: (1) Does not promote undue stress on dentinal walls, (2) preserves the internal dentin walls of the root canal, (3) presents total biocompatibility and adapts to conduct configuration, favoring greater tooth strength and greater retention of these posts as compared to prefabricated posts, (4) presents resilience comparable to the original tooth, and (5) offers excellent adhesion to the tooth structure and composite resin, (6) at a low cost (10). The following case report highlights the nonsurgical management of maxillary central incisors with immature apices by apexification using MTA as an apical barrier, followed by the intra-radicular and coronal rehabilitation of an extensively compromised crown structure using biological post and core.

CASE REPORT

A 19-year-old male patient reported to the department of Conservative Dentistry & Endodontics with chief complaint of fractured upper front teeth and pain with upper right front tooth. He presented with a history of trauma 10 years back due to a fall and complained of spontaneous pain with the maxillary right central incisor (11) in the past 1 week. Clinical examination revealed crown fractures with maxillary central incisors, i.e. 11 and 21, and severely compromised crown structure (loss of more than half of coronal structure) with 21.11 was tender on percussion and the mobility of the teeth were within normal physiological limits. Intraoral periapical radiograph revealed presence of an open apices with flared canals with respect to 11 and 21 and associated periapical lesion with 11. (Fig. 1)

Fig. 1. Intraoral periapical radiograph with 11 and 21

A provisional diagnosis of Ellis class IV fractures with 11 and 21, acute exacerbation of chronic periapical lesion with 11, pulpal necrosis and open apices with 11 and 21 was established. The patient was given detailed information regarding the advantages and disadvantages of all the feasible treatment options. The patient wanted a feasible treatment plan with aesthetic results and minimum chair-side time. Hence, it was decided to proceed with apexification of the concerned teeth using MTA as an artificial root – end barrier. Aesthetic rehabilitation of 11 was planned using composite resin restoration whereas rehabilitation of 21 was to be done using intra-radicular biological dentin post followed by porcelain fused to metal crown fabrication. As the patient presented with pain with 11, emergency access opening was done with the same under rubber dam isolation. After the working length was determined (Fig. 2), very light filing was performed using a #25 K-file, along with copious irrigation with 0.5% sodium hypochlorite, to smoothen the canal walls without enlarging it any further.

Fig. 2. Working length determination with 11

A lower concentration of sodium hypochlorite was used because of the danger of extruding the solution beyond the open apex. The canal was dried with paper points and anintracanal dressing of calcium hydroxide (Neocal,Orikam Healthcare, India) was given (Fig. 3).

Fig. 3. Intracanal dressing with 11

The patient was recalled after 2 weeks, where he still presented with pain with 11. Radiographic examination revealed apical washing out of the calcium hydroxide intracanal medicament. Root canal treatment of 21 was initiated under rubber dam isolation and working length was determined for the same (Fig. 4).

Fig. 4. Working length determination with 21

Cleaning and shaping of 21 was done using the same protocols as that was used for 11. After drying the canal with paper points,intracanal calcium hydroxide dressing was given with 21 and the calcium hydroxide intracanal dressing was changed with11 (Fig. 5).

Fig. 5. Intracanal dressing with 11 and 21

After 2 more weeks, both 11 and 21 were asymptomatic. Under rubber dam isolation (Fig. 6), the teeth were re-accessed, and the canals were irrigated copiously with 0.5% sodium hypochlorite solution followed by 17% EDTA solution. Final irrigation was done using sterile saline.White Pro root MTA was then mixed according to manufactures instructions and placed up to the apices of 11 and 21 using a fine tipped MTA carrier. This procedure was repeated until MTA apical plugs of approximately 3-4mm thickness were achieved with 11 and 21 (Fig. 7).

Fig. 6. Rubber dam isolation

The remaining canal space with 11 was obturated using thermoplastic injection-molded obturation technique (Fast Fill 3D Obturation System, Eighteeth, Orikam Healthcare, India). 2mm gutta-percha was placed coronal to the MTA plug with 21 using the same obturation technique (Fig. 8). In the next appointment, restorative management of the teeth were proceeded with. Composite resin restoration was done with 11 and crown preparation was done with 21. (Fig. 9) The remaining canal space with 21 was smoothened using H-file (Dentsply/Maillefer, Ballaigues, Switzerland) as the canal was already wide with thin root dentin walls. A direct wax impression of the post space was made.(Fig. 10) Following which, the post space impression was placed within the canal and a putty impression of the maxillary arch was made along it (Fig. 11.a and Fig. 11.b) A cast was poured using dental stone.

Fig. 7.

Fig. 8.

Fig. 9. Composite resin restoration with 11 and crown preparation with 21

Fig. 10.

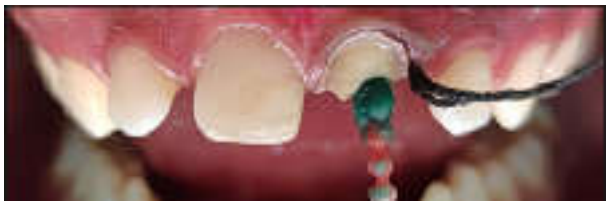

Fig. 11. a – Post space impression placed within canal

Fig. 11.b. Maxillary arch impression along with post space impression

Fig. 12. Dental stone model

In the dental stone model (Fig. 12), mock post was established to evaluate the adaptation. It was used as a reference to establish the length, thickness & shape of the biological post. A freshly extracted, intact maxillary canine tooth was chosen (Fig. 13.a) and subjected to autoclaving at 121°C for 15 minutes. The tooth was then sectioned bucco-lingually along the long axis using a diamond disk.The cementum was removed by abrasion, using diamond drills, and each part of the root was cut in such a way as to form the biological post (Fig. 13.b).

Fig. 13.a – Freshly extracted and autoclaved maxillary canine

Fig. 13.b – Biological dentin post

Fig. 14.a – Intra-canal fit of post checked

Fig. 14.a – Cementation of post

The dentin post was checked for satisfactory adaptation clinically & radiographically on patient (Fig.14.a), after which, the post was cemented in the canal (Fig.14.b) using dual cure Rely X U100 self – adhesive universal resin cement (3M ESPE, ST. Paul, Germany). Core build-up was done using Luxa Core Z dual (DMG, America), followed by finishing with minute detailing for proper adaptation.(Fig. 15) Impression was made using addition silicone impression material and a porcelain fused to metal crown was fabricated and luted using same dual cure resin cement (Fig. 16).

Fig. 15. Core build-up and finishing

DISCUSSION

The modulus of elasticity of glass fiber posts is ~ 40 GPa, whereas the modulus of elasticity of root dentin is ~ 14.2 GPa and of core material is ~ 13.5 GPa,(11)This difference might create stresses at different interfaces and the possibility of post separation and failure.(11) Barjao-Escribano et al., showed that posts possessing elastic modulus similar to that of dentin and core have a better biomechanical performance (12). The use of a dentin post provides biocompatibility, a resilience that is comparable to the original tooth, excellent adhesion to the dental structure and composite resin, at a low cost, as dentin posts are made from extracted natural teeth.(13) Dentin has a complex structure & modulous of elasticity 13- 18 GPa which varies in different locations and direction providing a mechanism that inhibits crack propagation.(11) To add to the advantages, dentin post closely resembles root dentin in all physical properties like modulous of elasticity, viscoelastic behaviour, compressive strength, thermal expansion, etc.(11) Furthermore, the formation of a sole biomechanical system (monoblock) with adhesive joining of dental structures, the cement agent, and the dentin post allows for a better distribution of stress along the root, minimizing the rate of adhesive and cohesive failure.(14) Also, the similarity in elasticity of a dentin post to root dentin may allow post flexion to mimic tooth flexion so that the postacts as a shock absorber, transmitting only a part of the stress placed upon the tooth to the dentinal walls (11).

Due to its proper adaptation to the root canal space, the individualized post is surrounded by thin and uniform layer of resin cement ultimately creating the ideal condition for post retention (8). Faria P et al.(16) have reported a successful aesthetic and functional recovery of extensively damaged maxillary central incisors through the preparation and adhesive cementation of biological posts and crowns in a young patient.Ambica K et al.(11) and Kathuria A et al.(12) conducted in vitro studies evaluating the fracture resistance of different post systems and reported that biological posts have higher fracture resistance as compared to Carbon Fibre and Glass Fibre post system. Craig et al.(17) reported that teeth restored with intraradicular solid dentinal posts exhibited higher fracture resistance than those restored with Fiber reinforced composite posts.

CONCLUSION

Biological Dentin Post can be considered as a promising alternative technique for the rehabilitation of open apex cases with wide canals and thin radicular dentin. Further long-term evaluations and studies are required to ensure more predictable outcomes.

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