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Dentinal Wall Reinforcement of a Traumatic Tooth – Case Report

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Abstract

Trauma to a tooth at an early age causes interruption in root development leading to incomplete root formation with thin dentinal walls. The long-term prognosis is related to the stage of root development and the amount of root dentine present at time of injury. In mature teeth with complete root formation, decreased amounts of remaining sound tooth structure before or after root canal treatment or coronal restoration is indicative of compromised mechanical integrity. Pericervical dentin (PCD) is an area roughly 4 mm coronal to Crestal bone and 4 mm apical to Crestal bone. It acts as the neck of the tooth and transfers masticatory forces to the root and the bone. Adhesive materials with optimal strength and good bonding ability to dentin can provide good reinforcement to Pericervical Dentin and thus improve fracture resistance of tooth. This report presents the case of a 16-year-old male patient who reported to the Department of Conservative dentistry and Endodontics with a chief complaint of discoloration in front teeth.

Upon oral examination revealed, Ellis class 3 fractures with 21, Ellis class 4 fractures with 11. RVG revealed a fully formed apex but thin dentinal walls in 21 and a periapical radiolucency with 11. Treatment plan was formulated where routine root canal treatment was done with 11 and root canal treatment followed by sectional obturation and dentinal wall reinforcement with 21. When the weakened area at pericervical dentin is internally rebuilt with suitable adhesive dental materials, the root is dimensionally and structurally reinforced to support and retain a post and core for the continued function of the tooth. Thereby, increasing the fracture resistance and long-term retention of the tooth.

Keywords: Pericervical Dentin, Dental Trauma.

Introduction

Dental traumatic injuries are more prevalent among children aged 7-12years. The most affected teeth are the upper maxillary central incisors that are erupting and have a periodontal ligament with minimal resistance to an extrusive force and a thin buccal alveolar plate. Maxillary central incisors erupt at the age of 7-8 years with complete crown formation but with 2/3rd of the root formation, which completes at the age of 10 years.1It has been reported that approximately 35% of all trauma occur before the age of 9, i.e., usually before full incisor root development, where the effects of traumatic injury can be verydestructive.[2] HERS causes the differentiation of radicular dental papilla cells into odontoblast which lays down the first layer of radicular dentin. Any interference in the function of HERS disrupts the formation of the root and subsequently in the formation of dentin as well. The increasing frequency of fractures with decreasing stages of root development may be explained by the thinner walls left after pulpal death offering less resistance to fracture than the mature teeth, especially in the cervical area.[3]

While the apex of the root can be amputated, and the coronal third of the clinical crown can be removed and replaced prosthetically, the dentin near the alveolar crest is irreparable. This critical zone is SACRED, roughly 4 mm above the Crestal bone and extending 6 mm apical to the Crestal bone.[4] The dentin in this critical area of the tooth is called as Peri-Cervical Dentin (PCD). The research is unequivocal: long-term retention of the tooth and resistance to fracturing are directly related to the amount of PCD.[5] The aforementioned facts clearly indicate that one major goal of endodontic therapy should be reinforcement of the residual tooth structure, more importantly PCD.[6]

Case Report

A 16-year-old male patient reported to the Department of Conservative dentistry and Endodontics with the chief complaint of a broken upper front tooth. He had met with an accident 3 years ago where he fractured his left central incisor, for which he did not seek any treatment. The intraoral examination revealed, Ellis Class 3 fracture of tooth #21, Ellis Class 4 fracture of tooth #11. The patient showed no response to sensibility tests. The radiographic examination revealed a closed apex along with diminished dentinal walls in tooth #21 and a periapical radiolucency with tooth #11. CBCT was done to analyse the linear measurements of coronal and apical dentin, which showed a large pulp chamber of #21 compared to #11. Hence, it was decided to perform root canal treatment on maxillary central incisors, followed by reinforcement of the pericervical dentin with resin modified GIC in #21.

Treatment Plan

Routine endodontic treatment was done in #11 followed by aesthetic correction.

A three-step treatment plan was formulated for #21 after initial access preparation –

1. Disinfection – Chemo mechanical preparation followed calcium hydroxide dressing for 7 days
2. Replacement – reinforcement of pericervical dentin with GIC.
3. Aesthetic – core buildup with composite followed by prosthesis.

Treatment Done

Under local anaesthesia with 2% lidocaine containing 1:100,000 epinephrine, rubber dam was placed on the involved teeth. Access opening was done in both incisors using an Endo-Access bur (Dentsply Maillefer, Ballaigues, Switzerland), and apical patency was obtained with # 15 K-file. Working length was determined using an apex locator (J Morita) and confirmed by an intraoral periapical radiograph. Routine biomechanical preparation was done in #11. The canal was cleaned and shaped with and H-files (minimally) to disrupt bacterial biofilm on the canal walls in #21. Root canal irrigation was done with 3% sodium hypochlorite (Hyposol; Prevest DenPro, India), followed by 17% EDTA (SEPTODONT) and saline. All irrigation was done with two-sided vented needles (RCTwents; Prime Dental, India) and the root canal was then carefully dried with sterile paper points. Calcium hydroxide (RC Cal; Prime Dental) was placed for a week for disinfection of both teeth, access cavity was sealed with sterile cotton pellet and temporary restorative material (Neotemp; Orikam, India).During the next appointment, the patient was found asymptomatic. Following too this olation, calcium hydroxide medicament was removed with copious amount of 3%NaOCl irrigation. After that, sterile paper points were used to dry the root canal. Obturation was done with tooth #11. In #21, selection of a fiber post (light transmitting) (DENTSPLY, GT fiber post) was done complying to the coronal width of the canal. Sectional obturation was done (DOWN PACK GUTTA SMARTCORDLESS). Fiber post was coated with separating media to maintain the patency ofthe canal while placement of rmGIC (PREVEST, Denpro Fusion I seal) and curing was done. The post was removed, treated with silane, and placed in the canal using dual cure (MULTILINK, IVOCLAR). Core build up material was used and cured (MULTICORE, IVOCLAR).

Discussion

With improved understanding of the forces responsible for fracture of teeth, the focus, nowadays, has shifted from the coronal to the cervical area of the tooth. There are 3reasons for this 1) ferrule 2) fracture 3) dentin tubule orifice proximity from inside to out.7Preserving the pericervical dentin to create a ferrule is important for better biomechanical behavior of restored tooth. To reinforce roots, stress concentration at the dentin-material interface should preferably be minimized by using materials with a modulus of elasticity similar to that of dentin, which is about 14–16 gigapascals. When restoring root canal treated tooth, especially when the remaining root dentine is thin, it is preferable to opt for material shaving an elastic modulus similar to that of dentin. This allows better stress distribution and thus reduces the risk of root fractures.[9] According to Goldberg, RMGIC has high flexural strength and elastic moduli values that is similar to dentin which is 10–14 GPa. Hence, it has the potential to withstand significant amounts of stress before it transmits the forces to the root. It also forms a chemical bond with the root dentin and confers more strength at dentin-cement interface, hence used for reinforcement of PCD_{10}. Biocompatible material like RMGIC was used as intracanal material because of the better bonding of the material, which will lead to formation of a continuum starting from the apical part of restoration to the most coronal part resulting in a

significant increase of fracture resistance of tooth.[11] Secondly, the filler loading (69% by weight) with nano-filled particles must have contributed to increase strength values. Higher filler loading in nRMGIC resulted in lower polymerization shrinkage and lower coefficient of thermal expansion, thus improving long term bonding to tooth structure. Mono block effect was created using resin-based sealer, self-cure resin lutingcement, fibre post, resin-modified GIC and the core material. The Mono block created is thought to reinforce the radicular dentin as well as reduce the incidence of microleakage.[11]

Conclusion

Restoration of teeth with excessive dentin loss presents a challenge to clinicians. Resistance to fracture of root is directly related to the thickness of the remaining dentin. Quality and quantity of the remaining tooth structure are the most important factors affecting fracture resistance. Preserving intact coronal and radicular tooth structure and maintaining cervical part to create a ferrule effect are considered to be crucial to optimize the biomechanical behavior of the restored tooth.

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Legend Figures