MAVEN

CASE REPORT

MANAGEMENT OF FRACTURED TEETH WITH FIBER-REINFORCED COMPOSITE SPLINT

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Abstract

Injuries to the dentoalveolar complex are fairly common and can be caused by a number of reasons. There are many techniques for repositioning and stabilizing traumatically luxated or avulsed teeth. Many of the splinting techniques previously advocated were time-consum- ing. Not only were the splints difficult to fabricate and difficult to remove, they also contrib- uted to injury of the soft and hard supporting tissues. Ribbond is basically a reinforced ribbon which is made from ultrahigh molecular weight polyethylene fiber having an ultra- high modulus. It is used in dentistry for various purposes. The use of Ribbond appears to be an adequate and easy method for stabilization and fixation. It can be used in the treat- ment of dental injuries. In this article, the use of Ribbond for the treatment of dental injuries is described. (2018, Vol. 02; Issue 01: Page 13 - 21)

Keywords: Fiber reinforced composite, Ribbond, Polyethylene fiber.

Introduction

Traumatic injuries in young children and adolescents are a common problem that usually results from accidents, contact sports, falls, and violence. In the perma- nent dentition, the peak age of trauma in- cidence is between 8 and 10 years and the most commonly affected teeth are the maxillary central incisors. Dental frac- tures account for 26-76% of dental inju- ries in the permanent dentition.

The most common types of injuries affect- ing periodontal tissues are luxations, whose prevalence varies from 15 to 61%.

Luxation diagnosis depends on clinical and radiographic findings; laterally lux- ated teeth often have their crowns dis- placed palatally, which usually results in fracture of the labial alveolar bone and considerable injury to the periodontal lig- ament. Although luxation can be clinically diagnosed, a radiographic examination must be done to ensure that it is the only injury (1).

A splint has been defined as an apparatus, appliance or device employed to prevent movement or displacement of fractured or movable parts (2). In dentistry, splinting

or tooth stabilization usually refers to join- ing teeth together either unilaterally or bi- laterally, to transmit increased stability to the entire restoration. However, the rea- sons to stabilize periodontally compro- mised teeth include decreased patient dis- comfort, increased occlusal and mastica- tory function and improved prognosis of mobile teeth (3).

According to Tarnow & Fletcher, the pri- mary reasons to control tooth mobility with periodontal splinting are primary oc- clusal trauma, secondary occlusal trauma, and progressive mobility, migra- tion and pain on function (4-6).

Over the years, different methods have been employed for splinting teeth. The most conservative of these involve use of adhesives and composite resins. In the past, direct stabilization and splinting of teeth using an adhesive technique re- quired the use of wires, pins, or mesh grids (7, 8). These materials could only mechanically lock around the resin restor- ative. Because of this there was the poten- tial of creating shear planes and stress concentrations that would lead to fracture of the composite and premature failure. With the introduction of fiber reinforced technology, many of the problems with older types of reinforcement were solved (9, 10). A variety of reinforcement fibers such as glass fibers, polyethylene fibers, carbon fibers etc. are available in different widths and sizes for the purpose of tooth splinting (8, 11-14). In 1995, Miller and others reported a case that involved the placement of an immediate and indirect periodontal, prosthetic splint using of gas- plasma-treated, woven polyethylene fabric to reinforce composite resins used for per- iodontal splinting (15).

The initiative to place a thin but strong composite resin based splint was met with the introduction of a high strength, bond- able, biocompatible aesthetic, easily ma- nipulated, neutral colour fiber that could be embedded into a resin structure. This led to the development of fiber reinforce- ment systems. Fiber reinforcement sys- tems are chemically consisting of two groups - Ultra high molecular weight pol- yethylene fibers and Long and short glass fiber reinforcement (16).

Advantages of fiber reinforced composite splinting are: a) ease of application with minimal tooth preparation, b) low to mod- erate cost as compared to crown and bridge stabilization, c) reversibility: can easily be removed when splinting is no longer considered necessary, d) ease of re- pair in case of failure through rebonding and reapplication of new material, e) facil- itating more aggressive treatment modali- ties on teeth with questionable prognosis prior to long term stabilization, f) high aes- thetic value and g) ease of accommodation of daily home oral hygiene practices (17- 19). This paper reports the management of periodontally involved mandibular ante- rior teeth stabilization using a fiber rein- forced composite splint.

Case report

Case 1

A female patient aged 45 years presented with the chief complaint of mobile front tooth after an accident in the morning of the same day. Intraoral examination re- vealed that there was lateral luxation and mobility of 41 (Fig 1A). Clinically, there were no signs of alveolar fractures or seg- mental mobility on palpation. Tooth 41 was found to be tender on percussion.

A radiograph indicated complete root for- mation and a closed apex with no periap- ical radiolucency and did not show any other fracture or injury on the adjacent

tooth (Fig 1B).

No relevant medical history was revealed by the patient. A treatment plan was for- mulated to allow stabilization of the mo- bile teeth. At the initial consultation, the plan of extending the splint from canine to canine in the mandibular region was care- fully explained to the patient. It was de- cided to perform periodontal splinting us- ing glass fiber-reinforced composite in- volving the mobile central incisors. The teeth were cleaned on the facial and lin- gual surfaces using a prophylaxis cup with a non-fluoridated pumice paste. The teeth were then thoroughly rinsed and dried. The proximal tooth surfaces were prepared using medium-grit finishing strips. As per the manufacturer's instruc- tions, a channel of about 0.5 mm deep and 2 mm wide was prepared on the labial as- pect of each tooth. A piece of dental floss was laid onto the labial surface at the level of the proximal contacts and cut to re- quired length. With the cut floss, section of fiber splint was taken and cut to an equal length as the floss using a sterile scissor. The fiber splint section was lightly wetted with unfilled resin (Filtek Flow, 3M ESPE, USA). Then the section was kept away from light until it could be embedded into the composite resin on the teeth. Both the proximal and labial aspects of the teeth were acid etched with 37% phos- phoric acid (Scotchbond Etchant, 3M ESPE, USA) for a period of 30 seconds (Fig 1C). Care was taken so that the etchant flows in the interdental areas of the teeth to be splinted. The teeth were then copi- ously irrigated to remove all acid residues, gently dried and isolated. A resin adhesive (Single Bond, 3M ESPE, USA) was applied to the etched enamel surfaces and light-cured for 10 seconds (Fig 1D).

A thin layer of microhybrid composite resin (Filtek Z250, 3M ESPE, USA) was placed on the labial surfaces of the teeth and extended slightly to the proximal sur- faces of each tooth. The wetted fiber splint section was gently pressed into the com- posite resin and any excess resin was adapted for achieving a smooth surface. It was then light-cured for 40 seconds for each tooth from the labial and proximal di- rections (Fig 1E).

A smoothening layer of composite resin was applied over the surface especially covering loose ends of the fiber splint to prevent fraying and then light-cured for20 seconds for each tooth. The occlusion was checked for any interference and adjusted. Esthetic contouring was done with the help of finishing burs and diamonds. Fin- ishing and polishing were performed using aluminium oxide sandpaper discs (Sof Lex, 3M ESPE, USA) and composite resin polishing paste (Fig 1F).

The patient was given strict instructions on maintaining meticulous oral hygiene by using an interdental brush on a daily ba- sis, in addition to routine oral hygiene practices.

On the same day, endodontic treatment of the central incisor was initiated under lo- cal anaesthesia. Adequate anesthesia was achieved for the tooth by infiltration tech- nique.

Access cavity was prepared with no. 2 round bur in an airotor hand piece, access cavity was refined with endo Z bur (Fig 2A). A number 15K file was used to deter- mine working length (Fig2B). Pulp tissue was extirpated. The root canal was cleaned, shaped with ProTaper Next rotary file systemup to 0.5mm short of the radio- graphic apex. Irrigation was done with So- dium hypochlorite (2.5%) and normal sa- line respectively (Fig 2C). Root canals were dried with sterile paper points. Canal was obturated with gutta-percha & AH Plus sealer using lateral compaction technique

(Fig 2D & E).

The patient remained asymptomatic for the next four weeks, at which time she re- turned for removal of the splint. Compo- site splinting was removed with ultrason- ics (Fig 2F). After removal, tooth surface was polished and finished with aluminium oxide sand paper discs (Sof Lex, 3M ESPE, USA) and composite resin polishing paste. She had no complaint and no change in probing depths or in results of clinical tests. The tooth was not tender to percus- sion. The patient's postoperative course was uneventful.

At a four-month recall visit, the right cen- tral incisor was asymptomatic and re- sponded normally to percussion, palpa- tion and pressure, but remained slightly mobile (Fig 3A & B).

Case 2

A 19 year-old male patient reported in the Department of Conservative Dentistry and Endodontics, Guru Nanak Institute of Dental Sciences and Research with a chief complaint of pain and fracture with mo- bility of upper four anterior teeth. History revealed that he met with a road traffic ac- cident one month back. The extra-oral ex- amination revealed no significant findings. The post-traumatic neurological and or- thopedic status of the patient was non- contributory. Intraoral clinical examina- tion revealed the presence of Class III frac- ture in#11 and Class I fracture in #12,#21,#22 with Grade I mobility in #11, #12,#21,#22 (Fig 4A & B). Medical and dental history was non- contributory. Electric pulp test and heat test with a gutta-percha stick on #11 were nonre- sponsive and #12, #21, #22 were found to be vital. Radiological examination revealed radiolucency involving enamel, dentin continuous with the pulp chamber in #11 (Fig 4C). There was complete root for- mation with a closed apex in #11 with no periapical radiolucency. Thus a diagnosis of pulpal necrosis with symptomatic Api- cal Periodontitis was made in#11. There was only enamel fracture in #12, #21, #22 thus excluding the need of any endodontic treatment in these cases. Immediate Fiber splinting was done under rubber dam iso- lation in #11,#12,#13#21,#22,#23 with thinner polyethylene fibers of Ribbond (Ribbond Inc., Seattle, WA,) to restrict the mobility during functional movement. The length of the Ribbond is decided by adapt- ing it to the surfaces of the teeth to be in- cluded and pushing into embrasures to simulate the final position of the fibers and this length is then cut using sharp scissors. Etching of the tooth surfaces was done for 15 sec with 37%ortho-phosphoric acid (Fig 4D). The recommended enamel etching time for surface-retained areas is 45 to 60 seconds. Rinsing is done with wa- ter and the tooth surfaces were air dried after etching. The bonding agent was ap- plied to the entire area to be bonded (Fig 4E). Light-cure of the bonding agent was done for 20 sec on each tooth (Fig 4F).

Then the splint was bonded in place from #13 to #23 with flowable composite (Te Econem, IVOCLAR VIVADENT) (Fig 5A).

Then endodontic treatment of #11 was in- itiated. After administration of local an- aesthesia Lignox 2% (Lignocaine) (Indoco Remedies Ltd) access cavity preparation was done with Endo access bur (Dentsply Endo Access Bur (Cutting Head) FG 2. Working length was estimated with no 30 K file (Mani K-File 25mm Size 30) (Fig 5B). After that thorough bio-mechanical prep- aration was done by ProTaper Universal Files. The root canal was irrigated with combination of 3% sodium hypochlorite (Hyposol, Prevent Denpro) and saline so- lution and finally with 0.2% chlorhexidine.

The canal was dried with sterile paper points and sectional obturation was done with gutta-percha cone (F4) using AH Plus sealer (Fig 5C). The canal was prepared with 1.1 mm TENAX drill (Fig 5D). The prepared post space was then cleaned with saline, air dried and acid etched with 37% phosphoric acid for 15 seconds. This space was rinsed and air dried with oil- free compressed air. A light-cured bonding agent was brushed on the etched surface and uniformly dispersed by a compressed air blast. It was then light cured with for 20 seconds. Light cured flowable compo- site resin was then inserted into the canal chamber after which the glass-fiber-rein- forced post (1.1mm, TENAX Fiber Trans Post) GFRC post was inserted (Fig 5E). The fiber post and composite were then cured together for 60 seconds. The coronal por- tion of the glass fiber reinforced composite post was splayed to increase the surface area for the retention of the core. The cor- onal enamel was then etched for 20 sec- onds, rinsed with water and air dried fol- lowed by application of bonding agent which was then light cured. The coronal post was then covered with the flowable composite for core build up, followed by light curing it for 60 seconds, and finally teeth were restored with composite resin (Z-100, 3M ESPE). The final finishing was done with finishing burs. Occlusal inter- ferences in normal and paranormal man- dibular movements were removed. Frac- tured parts of #12, #21, #22 was also build up with composite resin (Fig 5F & 6). Mar- gins were properly finished with diamond burs. Patient was advised to report after 6 weeks for further evaluation.

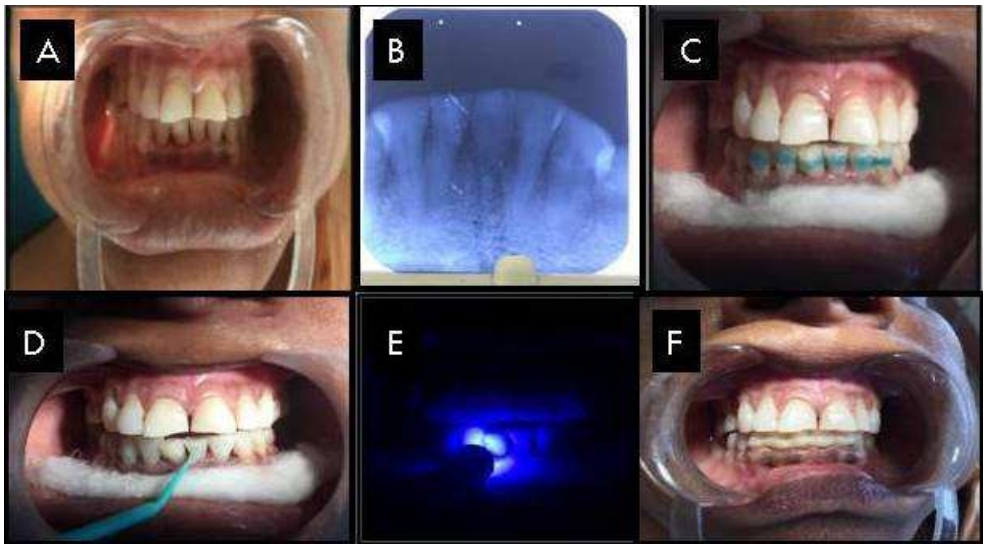

Fig 1: A- Intraoral view; B- Diagnostic radiograph; C- Acid etching with 37% phosphoric acid; D- Application of resin adhesive; E- Light cure; F- Finishing and polishing.

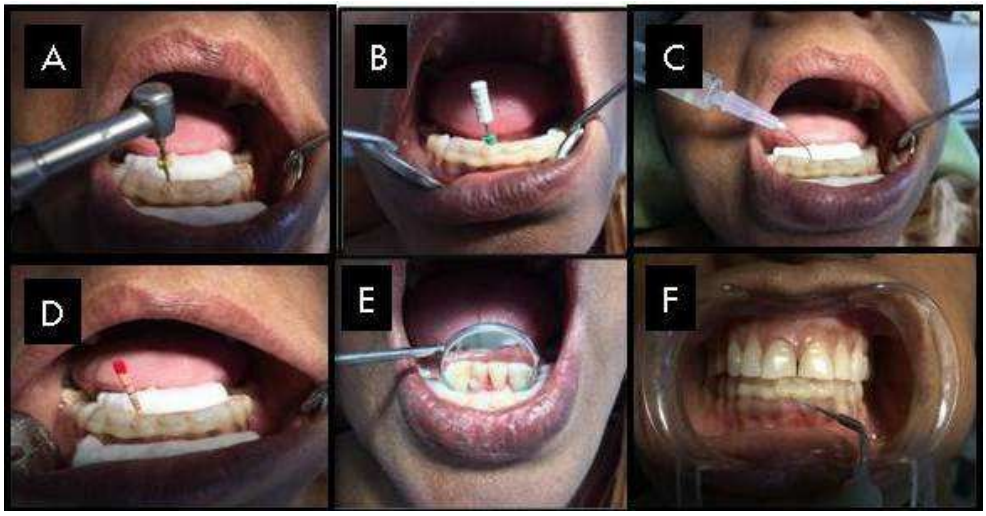

Fig 2: A- Access cavity; B- Working length determination; C- Irrigation; D- Obturation, E- Restoration; F- Removal of composite splint.

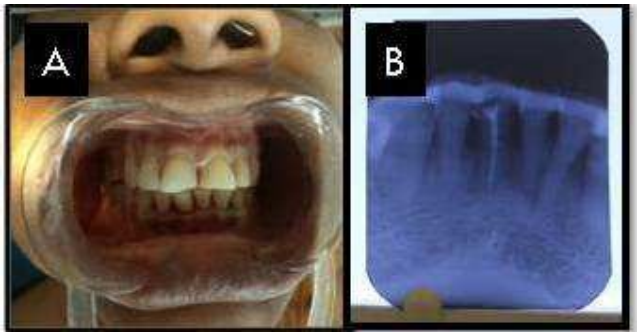

Fig 3: Four months follow up.

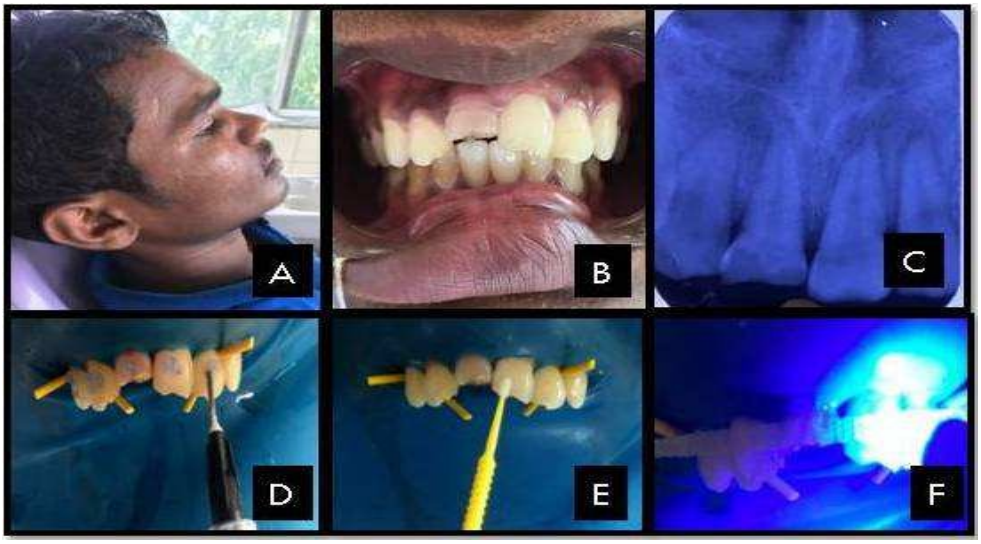

Fig 4: A- Extraoral view; B- Intraoral view; C- Diagnostic radiograph; D- Application of etchant; E- Application of bonding agent; F- Application of flowable composite and curing.

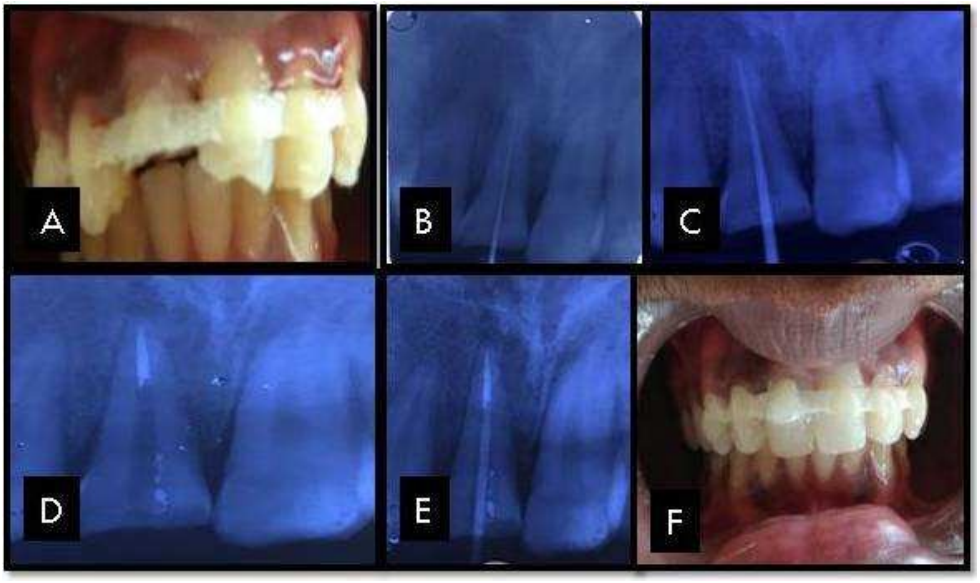

Fig 5: A- Fiber splinting from #13 to #23; B- Working length of #11; C- Sectional obtura- tion in #11; D- Post space preparation; E- Placement of fiber post; F- Fractured parts of #12, #21, #22 build up with composite resin.

Fig 6: Placement of PFM crown in #11.

Discussion

Dental trauma and associated fracture of tooth often has a severe impact on the psy- chological well being of a patient. This condition requires immediate atten- tion/consideration for reestablishing both esthetics and function. Conventional ap- proaches to rehabilitating fractured ante- rior teeth include composite restorations and post-core-supported prosthetic resto- rations when the tooth had pulpal expo- sure and extensive fracture of the crown. Tooth mobility has been described as an important clinical parameter in predicting prognosis. Thus splinting has been the recommended therapy for stabilizing the mobile teeth. In the past, direct stabiliza- tion and splinting of teeth using an adhe- sive technique required the use of wires, pins, or mesh grids. These materials could only mechanically lock around the resin restorative. Because of this there was the potential of creating shear planes and stress concentrations that would lead to fracture of the composite leading to prem- ature failure. With the introduction of bondable, polyethylene woven ribbons, many of the problems with older types of

reinforcement were solved. Follow-up vis- its are critically important for all trau- matic injuries (1, 4, 7). The patient should
be followed for 3, 6, 12 months and yearly for 5 years. Aesthetics, tooth mobility and periodontal status should be confirmed both clinically and radio-graphically on these follow up visits (1).

Conclusion

Though being clinically asymptomatic is one of the major criteria of success of en- dodontically treated teeth, simultaneous aesthetic rehabilitation is another most important criteria to restore the diseased tooth in form and function. Thus the man- agement of fractured tooth by conservative approach is one of the most common trends of today and its future is promising.

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