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Endodontic retreatment and rehabilitation of a mutilated mandibular molar using laser surface treated glass fiber post: A case report

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Abstract
Microorganisms are the major cause of failure of endodontic treatment. Newer modalities of root canal disinfection have been researched of which LASER is one such advancement. Diode laser has been proven to completely eliminate microorganisms from root canal. Restoration of a mutilated tooth requires a post to aid in retention of the final restoration. The failure of fiber post occurs mainly due to loss of retention and subsequent debonding. Surface treatment of the fiber post using diode laser increases the surface roughness thus increasing the bonding of the fiber post with resin cement. This case report presents successful management of a mutilated mandibular molar following endodontic retreatment and rehabilitation using diode laser surface treated fiber post.

Keywords: Endodontic retreatment, fiber post, diode laser, surface treatment, disinfection

1. Introduction
The goal of endodontic treatment is thorough debridement and cleaning of the root canal system and filling with an inert material thus preventing or minimizing any chances of reinfection. Failures occur when the endodontic treatment falls short of the standard clinical principles [1]. A myriad of factors have been implicated in the failure of endodontic treatment which include persistence of bacteria, inadequate filling of the root canal, overextensions of root filling materials, improper coronal and apical seal, anatomic complexities and procedural errors [1-3]. Lin *et al*. found a correlation between the presence of bacterial infection in the canals and periradicular rarefaction in endodontic failures [3]. Bacteria present in the periradicular area are inaccessible to the current disinfection procedures [4]. In order to overcome this drawback various newer disinfection methods have been introduced, of which one of the most promising is laser.

Laser has wide range of applications in endodontics which include, determining pulp vitality, cleaning and shaping of the root canal, disinfection of the root canal system, surface treatment of biomaterials, apicoectomy etc. [5-7] Laser usage in endodontics initiated by Weichman and Johnson in 1971, can penetrate to a depth of >1000 μm into dentinal tubules [8]. Laser assisted disinfection in endodontic retreatment seems acceptable since the microflora of failed endodontic teeth is more challenging to eliminate owing to their ability to survive in the root canal after endodontic treatment using conventional irrigants [9]. Various authors have reported complete disinfection of the root canal using diode laser *in vitro* [10, 11].

Mutilated tooth is the tooth which is grossly weakened and badly broken down where the amount of remaining tooth structure is less than the amount of tooth loss. Such teeth require placement of post to aid in retention of the final restoration [12]. The major cause of failure of endodontically treated teeth restored with fiber post is inadequate retention and gradual debonding of intracanal post from root dentin. Rezaei-Soufi *et al*. have reported that surface treatment of root dentin and fiber post using laser can increase the retention of fiber post to root dentin [5]. The purpose of the present article is to report successful endodontic retreatment and rehabilitation of a mandibular first molar with diode laser surface treated glass fiber reinforced post.

2. Case report

A 17 year old male patient reported to K.V.G Dental College and hospital, Sullia with a chief complaint of broken tooth in the lower right back tooth region since 6 months. Patient gave a history of undergoing root canal treatment of the said tooth 2 years back. Medical history was non-contributory. On clinical examination, extensive loss of coronal tooth structure on the lingual aspect and a fractured composite restoration on the buccal aspect was observed (Fig. 1). Tooth was not associated with pain, periodontal pocket, and mobility. Radiographic examination revealed radioopacity with voids in the root canal space of mesiobuccal, distobuccal, mesiolingual and distolingual canal suggestive of inadequate obturation. The obturating material terminated approximately 5mm short of the radiographic apex. Periapically, an ill- defined radiolucency measuring about 3mm in diameter was seen involving the mesial and distal root (Fig. 2). Based on the clinical and radiographic examination diagnosis was made as persistent apical periodontitis in relation to 46. The treatment plan was formulated as nonsurgical endodontic retreatment using disinfection with diode laser, followed by fiber post cementation and restoring the tooth with an all ceramic crown. The treatment plan addressed inadequate obturation, bacterial leakage via coronal and apical region, extensive loss of tooth structure. The complete procedure was explained and a written consent was taken from the patient.

Fig 1: Pre-operative clinical photograph

Fig 2: Preoperative radiograph

2.1 Procedure

The pre- endodontic buildup was done using type IX glass ionomer cement, following removal of soft caries from the pulp chamber floor for adequate isolation (Fig. 3). Local anaesthesia was administered and access was regained into the pulp chamber. The gutta-percha from the root canal was removed using Protaper retreatment files (Dentsply Sirona) and Hedstrom files. The Protaper retreatment files were used in a crown down sequence at a speed of 500 rpm as recommended by the manufacturer. The canal patency was regained using # 8 K file. The working length was established and chemomechanical preparation was carried out using Protaper Gold rotary files (Dentsply) in crown down sequence along with copious irrigation using 3% NaOCl, 17% EDTA and saline. Final disinfection of the canal was carried out using 810 nm diode laser.

Fig 3: Pre endodontic build up and access cavity

2.2 Protocol of disinfection using diode laser

The root canals were irradiated with the light supply of Denlase diode laser using a wavelength of 810 nm at 1.2 W power in continuous wave mode. Laser beam was directed into the canal by the fiber optic cone with a diameter of 200 µm for 10 sec each for 40 sec. The tip of the fiber optic cone was placed in the canal 1mm short of the working length and optic fiber was led in slow, circular, spiral-forming movements from the apical to the coronal part, while the laser was activated (Fig.4). The endodontic treatment was completed in the subsequent visit (Fig. 5).

Fig 4: Disinfection of the root canal using 810 nm diode laser

Fig 5: Completion of endodontic retreatment

2.3 Surface treatment of glass fiber post using diode laser and post endodontic restoration

Fiber post placement was planned in the mesiobuccal canal. Post space preparation was done with minimal enlargement using peeso reamer leaving an apical gutta percha of 5 mm. Fiber post fit was checked radiographically. The post surface was irradiated using diode laser in continuous contact mode set at 1.5 W for 15 sec. This was followed by silanization and cementation of the fiber post in the root canal using dual cure resin cement. (Fig 6- 9). Post endodontic build up was done using universal composite followed by tooth preparation for an all ceramic crown. Impression was made with polyvinyl siloxane silicone of light and putty consistency using a double-mix single-stage technique. The fabricated all ceramic crown was cemented intraorally using a dual cure resin cement (Fig. 11) Follow up after 3 months showed satisfactory healing of the periapical lesion (Fig. 12). The preoperative periapical index score (PAI) was 3, whereas 3 months follow up showed a PAI score of 2.

Fig 6: Checking fiber post fit radiographically

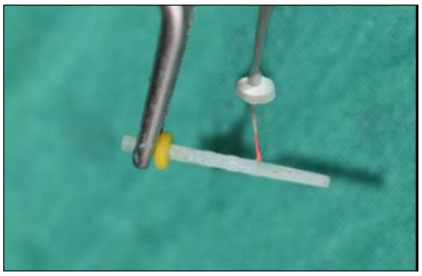

Fig 7: Surface treatment of fiber post using diode laser

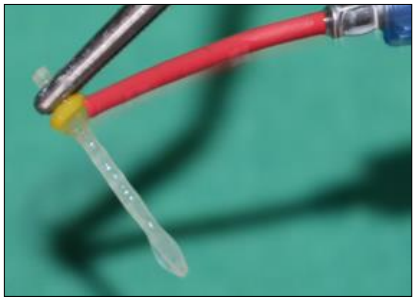

Fig 8: Application of silane coupling agent

Fig 9: Fiber post Cementation

Fig 10: Tooth preparation

Fig 11: Cementation of the all ceramic crown

Fig 12: 3 month follow up

3. Discussion

The reason for endodontic failure in the present case could be attributed to bacterial leakage from oral cavity due to improper coronal seal and apical leakage from periradicular region due to inadequate obturation of the root canal system. In the present case, the obturating material was short of the apex by approximately 5mm. Kuttler recommended that root canal obturation should terminate 0.5 mm short of the apical foramen which is nearest to the apical constriction [13]. Tronstad *et al*. have stated that the quality of root canal obturation is the most important factor in the success of the endodontic treatment. Voids present within the obturating material can harbor bacteria which can cause persistent infection [14]. Hoen *et al*. reported poor quality obturation lead to 65% of endodontic treatment failure [15]. Contrary to this, Lin *et al*. reported that the apical extent of the root fillings did not have any significant correlation with treatment failures.[3] Therefore, a well obturated root canal system is necessary for preventing apical leakage, which makes the need for endodontic retreatment necessary in case of inadequately obturated root canal.

Persistent microorganisms are the major cause of failure of endodontic treatment. Complete eradication of these microorganisms from the root canal system is essential for the success of endodontic treatment [16]. The high surface tension of conventional root canal irrigants allows penetration only to a depth of 100–300 µm into dentinal tubules, while bacteria can colonize as deeply as 1100 µm from the canal lumen [6]. Diode laser is a newer modality which has been introduced in the field of endodontics. Sohrabi *et al.* showed that 980 nm diode laser effectively reduced 96.56% of *Enterococcus faecalis (E. faecalis)* in root canals [17]. Preethee *et al.* and Vatkar *et al* reported complete eradication of *E. faecalis* using

diode laser [10, 11]. The antibacterial effect of laser is dependent on its thermal and photodisruptive effects [18].

The success of a nonsurgical root canal retreatment is governed by the removal of previous obturating material and /or necrotic tissue [1]. The decision for nonsurgical retreatment should be made only if the following concerns are met; the patients desire to retain the tooth, periodontally healthy teeth which can endure an endodontic retreatment. A well-sealing coronal restoration is essential after the completion of obturation as it would prevent the ingress of any microorganisms, which are present in the ambient environment [19]. Swanson, Madison, Ng *et al*. Ray and Trope *et al*. emphasized that coronal leakage should be considered as a potential factor resulting in endodontic failure [20-22].

In the present case, the restorative phase included cementation of fiber post followed by restoration of form and function using an all ceramic crown. According to Peroz *et al*. tooth with one cavity wall remaining requires fiber post for retention of crown [23]. Hence, a glass fiber post was placed in the mesiobuccal canal due to the extensive tooth structure loss on the mesial aspect. Also, the mesiobuccal root appeared relatively straight. The post space preparation was carried out taking care that at least minimum of 1mm of dentin remains around the canal. Mesiobuccal canal was selected instead of mesiolingual canal as more amount of dentin is present at the danger zone area in mesiobuccal canal [24].

The most common cause of failure of fiber post is loosening of the post in the canal due to loss of cement and debonding. To avoid this, the root canal wall dentin and the fiber post was surface treated using 810nm diode laser in the present case. Strefezza *et al*. reported that dentin to post bond strength was enhanced by the diode laser irradiation of root canal wall either on continuous or pulsed modes. This was due to the removal of smear layer and remaining gutta-percha and endodontic sealer from the root canal wall which improved the bonding of the resin cement to root canal wall dentin [25].

In addition to this, surface treatment of fiber post using laser has shown to increase its surface roughness [5]. Siqueira *et al*. found that diode laser irradiation of the fiber post produced significant rough surface thus increasing the bond with the resin cement. The energy from diode laser heats the irradiated surface, melts the polymeric matrix, and fuses it to the fibers [26]. These factors combined increase the retention of the fiber post in the root canal. An all ceramic crown was given due to its superior esthetics and fracture resistance. The adhesive bonding provides good seal and less degradation of cement over time.

4. Conclusion

Non surgical endodontic retreatment is a speciality treatment that requires attention to details to improve the endodontic quality and maximize the success. Diode laser has proven to be effective in eliminating the persistent microbial flora from the root canals of teeth with endodontic failure. Regular follow ups aid in assessing the outcome and should be done at least on a yearly basis to monitor any changes. Clinical thoroughness during the treatment phase can potentially benefit the clinician and the patient in the long run.

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