Introduction

Endodontically treated teeth are more susceptible to fracture than vital teeth,[1] becoming a challenge for Restorative Dentistry.[2] This susceptibility has been attributed to substantial structure loss and changes in the architecture of the crown-root complex,[3,4,5] due to caries, fracture, preparation and instrumentation during endodontic treatment,[2,6,7] with loss of reinforcing structures as marginal ridges, enamel bridges, pulp chamber roof and all structure above it.[8,9]

Restoring endodontically treated teeth with complicated crown or crown root fractures requires profound knowledge in endodontics, periodontics and operative dentistry.[10] If the fracture extends further subgingivally, it might be necessary to expose the fracture line[5] per gingivoplasty and osteotomy procedures, or per orthodontic extrusion of the apical fragment, converting the subgigival fracture to a supragingival one and enabling restoration.[11,12]

There are many alternatives to restore fractured crowns, being the original fragment reattachment the most indicated because cavity preparation is not required and also esthetic and functional outcomes are facilitated.[13,14] The esthetic is obtained once the anatomic form, color, bright, and original surface texture are maintained. Furthermore, incisal edge of the dental fractured will suffer similar wear to adjacent teeth over time;[15] this technique is faster than direct or indirect restoration techniques and provides results quite predictable in the long term.[14]

In endodontically treated teeth with great structure loss, the pulp chamber space might be used as an internal reinforcement with adhesive materials[16], avoiding any other wear in order to achieve greater resistance to fracture. The use of a glass fiber post promotes the fragment retention[10,17,18,19] and might enable tooth reinforcement.[9,20]

The objective of this study is to present a case report of restoration of an weak endodontic treated tooth fractured due to occlusal overload. The clinical sequence includes tooth fragment stabilization and reattachment and insertion of glass fiber post, periodontal assessment and occlusal adjustment with 6 months follow up.

Case report

The patient, 21 years old, search dental care after right lateral incisor fracture during normal masticatory function. The patient reported that the tooth had been submitted to endodontic treatment for more than 5 years ago, before orthodontic treatment. Clinically, it was observed that the fragment was represented by entire dental crown, which remained in place because of subgingival periodontal ligament attachment. Figure 1 shows the purplish appearance of supporting periodontal tissues as a result of an inflammatory episode after fracture; however, the fragment was intact and looking good at vestibular side. Patient teeth showed demineralized white spots from remineralized enamel caries after orthodontic treatment. Radiographic analysis (Fig 2) revealed fracture near the bone, requiring correction of biological distances.

In order to allow periodontal surgery procedures to expose the fracture line, tooth #12 should be fixed at its original position, adopting the following technique. After perfect adaptation of the fragment, a polyvinilsiloxane matrix (Futura AD, Nova DFL, RJ, Brazil) was manufactured (Fig 3) to hold the tooth in position during procedures for adhesive anchorage.

Teeth #11, #12 and #13 were etched with 37% phosphoric acid (Alpha Etch, Nova DFL) for 15s and a dentine bonding agent (Adper Single Bond 2, 3M-ESPE, USA) was applied in two layers with gentle air in their palatal surfaces. Before photopolymerization, the matrix was positioned and then light exposition performed for 20s in each tooth. A composite resin layer (Natural Look, color A1E, Nova DFL) with an average thickness of 2 mm was used and light cured for 40 seconds per tooth (Fig 4).

Figure 5 shows the tooth #12 fixed to #11 and #13, and removal of the composite resin from pulp chamber. It is possible to verify the fracture line with perfect adaptation to the remaining root after the fixation procedures, and also the reduced presence of dentine inside the fragment, characterizing its increased friability. The root canal was prepared leaving 5 mm in length of root filling at apical region, and prepared with drill #3 of Exact Translucent fiberglass post system (Angelus, Londrina, PR, Brazil) in order to have a close fit between the walls of the root canal and the fiber post.

After preparation, the post was cleaned with alcohol and etched with 37% phosphoric acid for 1 minute, then silanized in hot air for 2 minutes and received a thin adhesive layer (Adhesive, Fusion Duralink, Angelus). The inner of the root canal was protected with a cotton ball and the coronal cavity

Figure 1. Initial image of darkened tooth #12 and inflammation of supporting tissues due to subgingival fracture.

Figure 2. Periapical radiograph showing fracture line and endodontic treatment well executed.

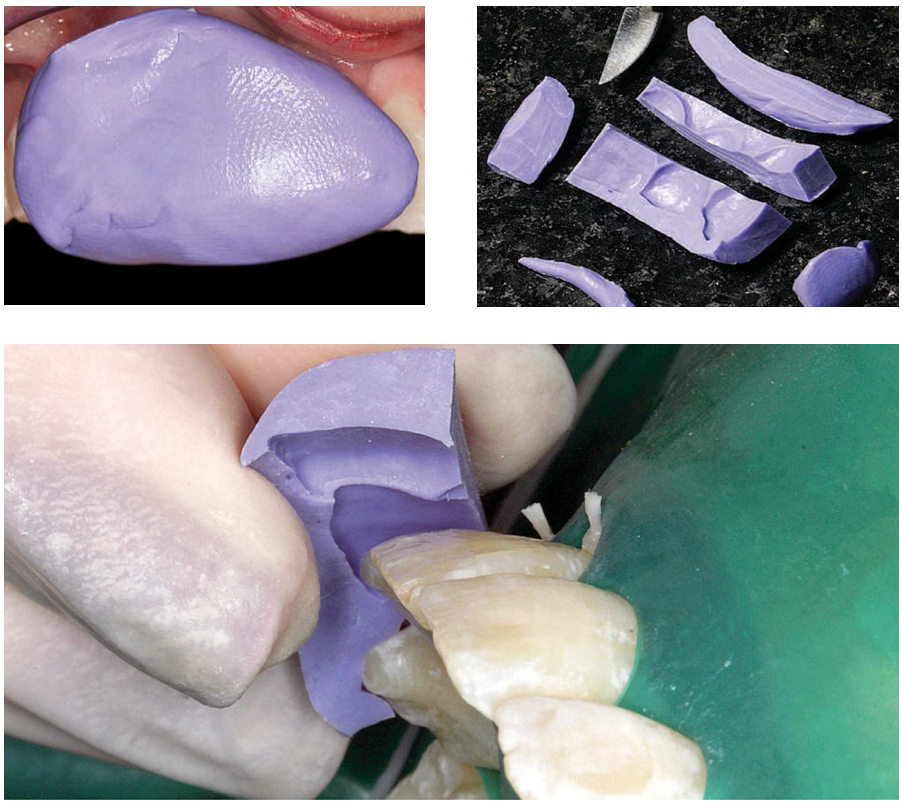

Figure 3. Direct impression of properly re-positioned teeth for producing the polyvinilsiloxane matrix. The matrix was cut with a scalpel blade maintaining the incisal portion to be used for fragment fixation.

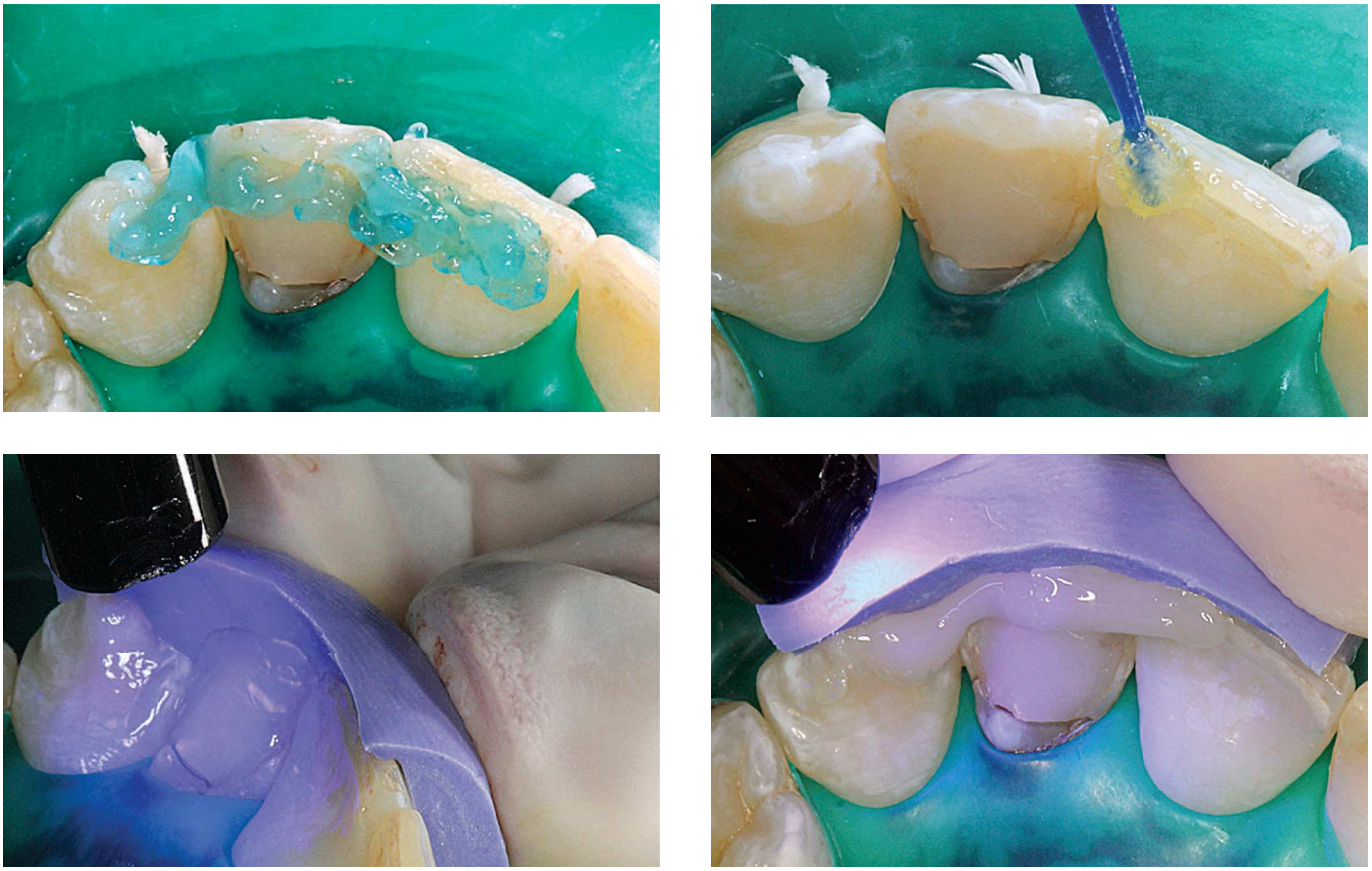

Figure 4. Adhesive technique for fixation of the fragment on adjacent teeth. For the fixation, the silicon matrix must be kept in place during the photopolymerization of the bonding agent and composite resin.

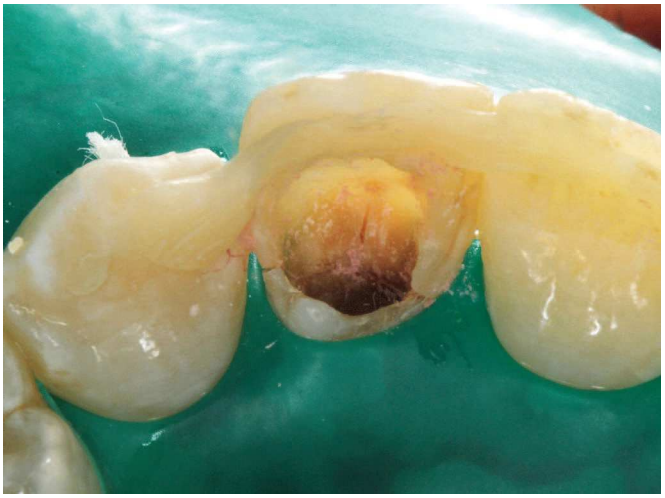

Figure 5. Tooth #12 fractured. Note the fracture line traversing the entire crown and the tooth fixed to the adjacent teeth allowing the restorative procedure.

etched for 15s with 37% phosphoric acid, application of two layers of primer and one layer of adhesive (Fusion Duralink, Angelus). The cotton ball was removed and the interior of the root canal filled with a self-etch adhesive resin cement (U-100, 3M-ESPE, USA); then, the fiber post was inserted. After 5 minutes, the cement was photopolymerized for 40 seconds on each side, and the pulp chamber incrementally restored with a nanoparticulate composite resin Z350XT (3M-ESPE), color A2B (Fig 6).

In Figure 6 it is possible to see the immediate restoration with a lighter appearance of gingival tissue and restored tooth. The patient was referred for periodontal evaluation, and during surgery it was noticed the perfect adaptation of the reattached fragment. Figure 7 shows excursive mandibular movements of protrusion (upper images) and right laterality (lower images), showing the correct occlusal adjustment, relieving any contact on the restored tooth and maintaining balanced contacts. Figure 8 shows 6 months follow-up, with gingival health and maintenance of the initial result.

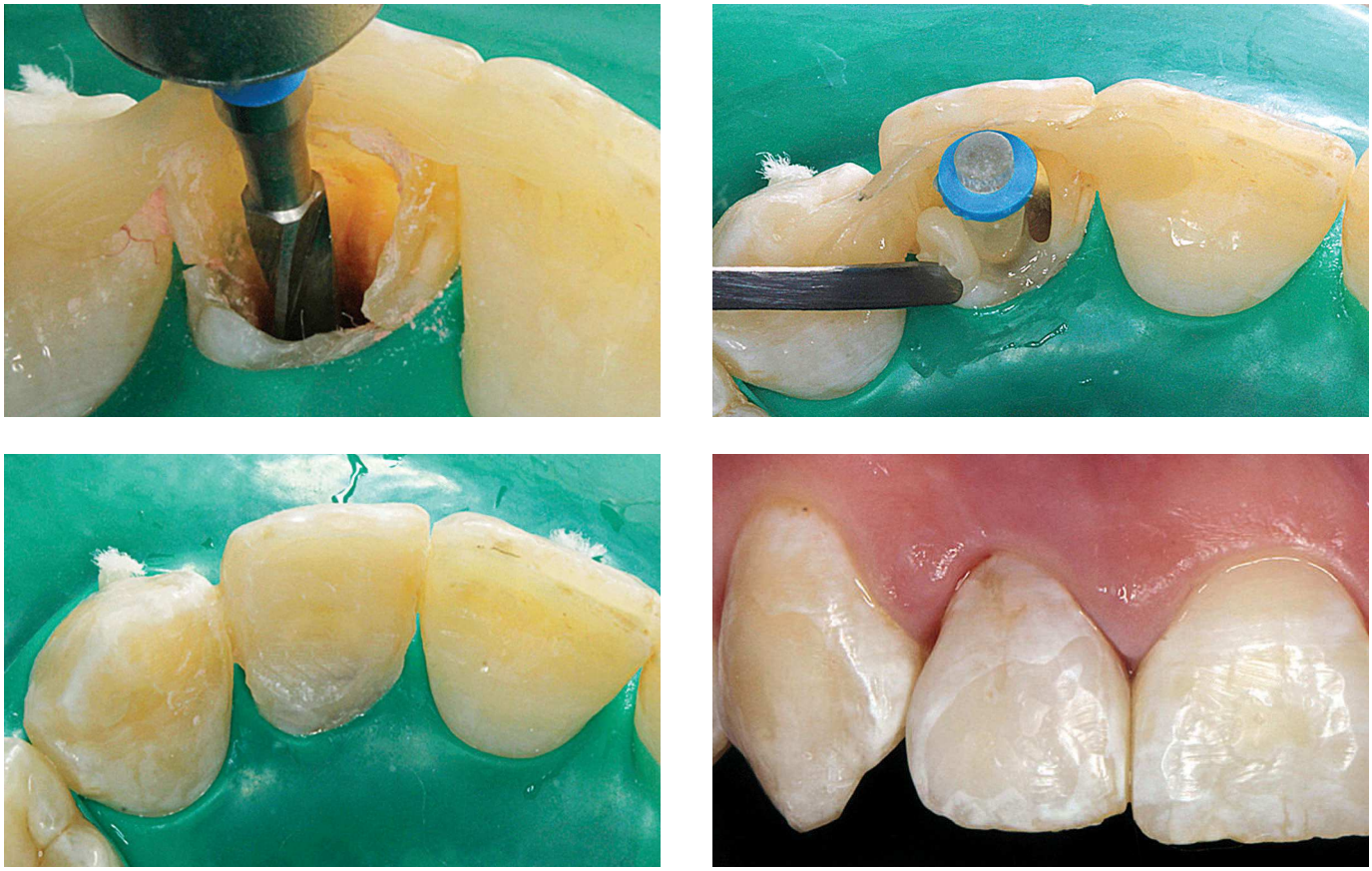

Figure 6. Root canal preparation and luting of fiberglass post with subsequent composite resin restoration. It can be verified the immediate result of fragment reattachment and fiber post insertion.

Discussion

The employed technique promotes immediate resolution for cases in which fragments possess optimal adaptation to the remaining tooth structure. However, it is difficult to determine its survival rate, even though the scientific literature reports many cases of successful reattachments[10,19,21] and restorations with glass fiber posts.[20,22] The survival rate of reattachments depends on fragment's fractured size,[23] and some studies report up to six years of successful follow-up.[10,19] Fokkinga et al[22] reported in a clinical trial, after 17-years follow up, that the survival rate of endodontically treated teeth with glass fiber posts ranged from 71% to 80% when the remaining tooth presents residual coronary walls.

Loguercio et al[24] investigated, in a *in vitro* laboratory study, the performance of some techniques for tooth fragment reattachments in endodontically treated teeth and reported that the placement of a post prior to reattachments of the fragment does not promote tooth reinforcement. However, in this laboratory study the fragment had a small size and the endodontic treatment did not produced a great loss of sound structure.

In the present case an extensive fracture occurred during normal masticatory function as a result of the fragility of the tooth structure. Therefore, in these situations, the association of a glass fiber post and composite resin in endodontically treated teeth promotes greater fragment retention,[25,26] and may produce greater reinforcement[9,20] since the entire fragment was composed of enamel, which is a friable tissue and more prone to fractures than dentin.[27]

Previous studies have shown that endodontically treated teeth can have the pulp chamber filled with composite resin in order to be reinforced.[14,28] Composite resins show elastic modulus similar to dentin; when properly bonded to the tooth structure there is the creation of a single unit (tooth plus restoration),[29] minimizing stress concentration at the interfaces between

Figure 7. Excursive mandibular movements with anterior guides protecting tooth #12. Upper pictures shows protrusion with absence of contacts in #12, which is also observed in the lower pictures with right laterality.

Figure 8. Image of 6 months follow-up showing the quality of supporting tissues and tooth color.

tooth/resin or resin/post.[29] In the study by Loguercio et al,[24] the fracture resistance of endodontically treated teeth with a bonded fragment was similar to intact teeth filled with composite resin and fiber glass post.

When prefabricated fiberglass post is to be used, the space between the post and root canal walls results in a very thick cement luting line,[30] generating a weak area that can potentially compromise the long-term prognosis.[30] Thus, the use of fitted fiberposts, juxtaposed to the root canal, has been considered important to increase the resistance of restored set,[35] as done in this case.

The present report showed that a crown fragment could be restored with a fiberglass post in order to increase retention and possibly resistance to fracture, considering fragment margins were perfectly adapted and could be accessed. The technique of positioning the fragment with polyvinilsiloxane matrix enabled a greater precision to bonding procedures and resulted in functional and esthetic quality, besides the advantage of ease implementation and low cost.

Conclusion

Extensive crown fractures can occur in endodontically treated teeth with great loss of sound structure. The fragment reattachment requires maintenance of structural integrity of the tooth, in addition to a secure retention. In the present case, the stabilization of the fragment with a polyvinilsiloxane matrix and use of a fiberglass post showed to be a simple and effective procedure.

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Removal of a silver cone by using clinical microscope and ultrasound: Case report

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ABSTRACT

Introduction: The retreatment of teeth with endodontic failure associated with the use of silver cone as filling material is still today a reality in the endodontic practice. The present work reports a case of endodontic failure resulting from the use of silver cone and subsequent endodontic retreatment. **Case report:** The procedure consisted of removing the existing metal-ceramic crown and endodontic retreatment with removal of the silver cone, which was apically sectioned by using ultrasound and clinical microscope. Next, the root canal system was filled and glass-fiber posts and metal-ceramic crown were placed. **Conclusion:** The use of microscope in association with ultrasound was crucial for performing the retreatment, thus allowing the silver cone to be safely removed without unnecessary wear of the dentinal structure.

Keywords: Retreatment. Ultrasound. Microscopy.

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