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Clinical Technique/Case Report

Flared Roots Reinforced With Bulk-fill Flowable Composite — Case Report

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Clinical Relevance

Flared roots are clinical situations in which the root dentinal walls are thin and consequently more prone to fracture. Clinicians must be aware of the treatment modalities and should consider bulk-fill flowable composite as a good alternative.

SUMMARY

This article presents a case report for the treatment of a patient with a flared root. The patient was treated with a bulk-fill flowable composite. This innovative approach seems to be efficient in reinforcing flared roots. The advantages and disadvantages of the technique are presented.

INTRODUCTION

Endodontically treated teeth may have weakened roots for several reasons, such as over instrumentation, internal resorption, immature development, tooth decay, previous restoration with an excessively large post, and fractures. The literature describes many techniques for restoring these teeth using different materials such as cast metal post-and-core and fiberglass posts associated with composite resin or cements. Although different treatment modalities have been described for the rehabilitation of flared roots, treatment is always a great challenge to clinicians.

Bulk-fill composites have an advantage in that they can be used in increments up to 4 mm thick.[1] This class of material shows low polymerization shrinkage stress and can be divided into groups with different rheological properties—low and high viscosity materials.[2] Bulk-fill composites contain a polymerization modulator that results in a slower modulus development, thereby reducing stress without decreasing the degree of conversion[2-4] and while keeping a good percentage of fillers; this makes their mechanical properties similar to those of conventional hybrid composites. Considering that the root canal is a cavity with a high configuration factor, we decided to use a bulk-fill flowable composite to reinforce flared roots and decrease the shrinkage curing stress. Therefore, the aim of the present case report is to demonstrate a technique that consisted of the reinforcement of a flared root with bulk-fill

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flowable composite, a glass fiber post, and a lithium disilicate glass ceramic crown (IPS e-max Press, Ivoclar Vivadent, São Paulo, Brazil).

CLINICAL CASE REPORT

A 50-year-old female patient showed up at the School of Dentistry (University of Pernambuco) reporting that she was dissatisfied with the appearance of the right lateral incisor. Clinical examination revealed that there was a temporary crown on the tooth, showing poor dental esthetics. Radiographic examination did not reveal any periapical lesions or periodontal damage, but showed a flared root caused by overinstrumentation during endodontic treatment. Since the root walls were thin (Figure 1), the need was evident to reinforce this root and improve the longevity of the tooth.

An initial periapical x-ray revealed that the working length had been set 1 mm short of the apex. A Gates Glidden drill size 4 was used to remove gutta-percha, leaving 4 mm of the material in the apical third and no gutta-percha on the lateral root walls, which was confirmed by another periapical x-ray.

Rehabilitation treatment consisted of root reinforcement with a bulk-fill flowable composite shade A1 (Filtek Bulk Fill Flowable Restorative, 3M ESPE, Sumaré, Brazil), a glass fiber post (White Post DC size 2, FGM, Joinville, Brazil), and the subsequent fabrication and cementation of a lithium disilicate glass ceramic crown (IPS e-max Press, Ivoclar Vivadent). Bulk-fill giomer and self-adhering flowable composite could have been used as an alternative to the bulk-fill flowable composite.

The temporary crown was removed, and the root dentin walls and remaining coronal structure were etched with 35% phosphoric acid etching gel (Scotchbond Universal Etchant, 3M ESPE) for 15 seconds, rinsed thoroughly with water, and dried with paper tips. Scotchbond Universal DCA was then mixed with Scotchbond Universal Adhesive (3M ESPE) in a ratio of 1:1 (drops) for five seconds immediately before application. Adhesive was applied to the entire tooth structure and rubbed in for 20 seconds (Figure 2). The excess was removed with paper tips and a gentle stream of air for about five seconds. The adhesive was then light-cured for 20 seconds using Optilight Max (Gnatus, Ribeirão Preto, Brazil). The light-curing unit had an intensity of 1200 mW/cm^2. Filtek Bulk Fill Flowable Restorative (3M ESPE) was inserted in the root canal to reinforce the flared root (Figure 3); then, a fiber post (White Post DC size 2), previously lubricated with glycerin gel, was inserted in the composite resin (Figure 4). Light activation was done on the top of the translucent post for 60 seconds. The fiber post was removed from the resinous root canal (Figure 5), and additional light activation was completed for 40 seconds, keeping the tip of the light-curing unit in contact with the entrance to the root canal.

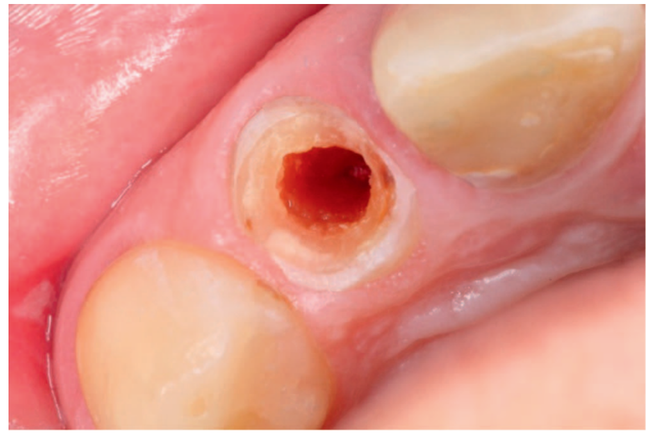


Figure 1. *Initial view of the flared root.*

The post was rinsed with water, dried with water-free and oil-free air, etched with Scotchbond Universal Etchant for 15 seconds, rinsed with water, and dried again. Since Scotchbond Universal Adhesive contains silane, there was no need to apply silane separately on the post. A disposable applicator was used to apply Scotchbond Universal Adhesive over the entire post surface to be luted, and it was light-cured for 20 seconds (Figure 6). The canal was copiously rinsed with water to remove the lubricant gel. The dual-cured resin cement RelyX Ultimate (3M ESPE) was applied on the post and in the canal, and the post was placed in the root reinforced with bulk-fill flowable composite (Figure 7). After removing the excess, the cement was polymerized through the translucent post for 40 seconds.

The coronal portion was built-up with Filtek Bulk Fill Flowable Restorative (Figure 8). After tooth preparation, a dual-mixed impression technique with a vinyl polysiloxane (Express, 3M ESPE) was used for the prepared lateral incisor; then, a lithium disilicate glass ceramic crown (IPS e-max Press) was fabricated.

Regarding the adhesive cementation, the inner surface of the lithium disilicate glass-ceramic restoration was etched with 10% hydrofluoric acid etching gel (FGM) for 20 seconds, rinsed thoroughly with water for 60 seconds, and dried with oil-free compressed air. Scotchbond Universal Adhesive was then applied to the entire surface to be luted

Figure 2. *Application of the adhesive to the root walls.*

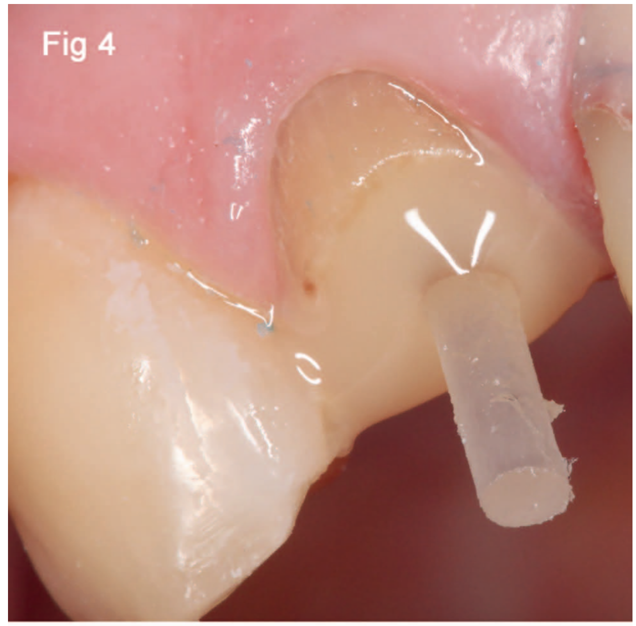
Figure 3. *Insertion of the bulk-fill flowable composite.*

and allowed to react for 20 seconds. A gentle stream of air was directed over the liquid for about five seconds. The etch-and-rinse technique was used for the pretreatment of the coronal portion as described previously. To cement the metal-free crown, a small amount of RelyX Ultimate was dispensed on the inner surface of the restoration, which was seated to the prepared tooth, and the excess luting cement at the margin was removed. Two sides of the tooth were polymerized for 60 seconds (Figure 9). The materials used are listed in Table 1.

DISCUSSION

A flared root may show compromised longevity due to the thin remaining tooth structure. The treatment options vary considerably depending on the amount of remaining dentin for retaining the crown and the internal nature of the root structure. The most common options advocated in the literature include cast metal post-and-core, fiber post plus accessory posts, direct anatomic post (fiber post relined with composite resin), and indirect anatomic post.[5]

The dowel relining technique is a way of reducing the cement thickness in flared roots, decreasing the polymerization shrinkage stresses.[6,7] The impor-



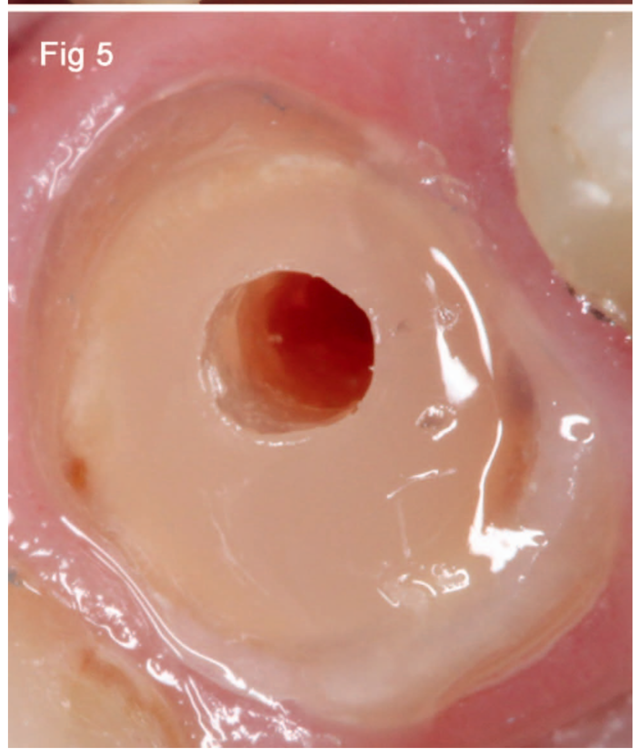


Figure 4. *Fiber post in the bulk-fill flowable composite.*

Figure 5. *Resinous root canal.*

tance of glass fiber–reinforced dowels relined with composite resin in flared roots is corroborated by other studies.[8,9] Amin and others[9] concluded that the group restored with glass fiber–reinforced dowels relined with composite resin in flared roots showed significantly higher fracture strength values

Table 1: Materials Used	
Material	**Manufacturer**
35% phosphoric acid (etching gel)	3M ESPE (St Paul, MN, USA)
Scotchbond Universal Adhesive	3M ESPE (St Paul, MN, USA)
Optilight Max (light-emitting diode unit)	Gnatus (Ribeirão Preto, Brazil)
Filtek Bulk Fill Flow	3M ESPE (Sumaré, Brazil)
White Post DC (fiber post)	FGM (Joinville, Brazil)
RelyX Ultimate (resin cement)	3M ESPE (St Paul, MN, USA)
Express (vinyl polysiloxane)	3M ESPE (St Paul, MN, USA)
IPS e-max Press (Lithium disilicate-reinforced ceramic)	Ivoclar Vivadent (São Paulo, Brazil)
10% Hydrofluoric acid (porcelain etching gel)	FGM (Joinville, Brazil)

than the group restored with glass fiber–reinforced dowels and a thick layer of luting cement.

A case report[10] showed the rehabilitation of a flared root canal using a direct anatomic post (resin composite combined with a prefabricated glass-fiber

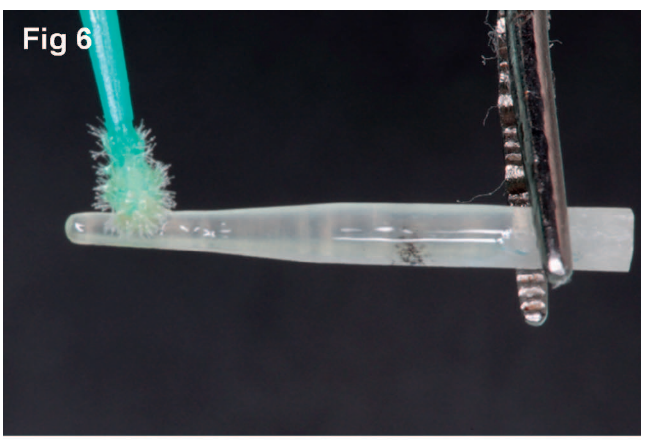


Figure 6. *Application of the adhesive on the post.*

Figure 7. *Fiber post cementation.*

Figure 8. *Core build-up.*

Figure 9. *Final clinical result.*

post) associated with a metal-free ceramic restoration. The success of the treatment was noted after 3 years. Constâncio and others[11] presented a case report of the rehabilitation of anterior teeth with weakened roots. The authors used the direct anatomic post technique that consisted of inserting in the previously lubricated root canal a self-cure composite resin and then a fiber post plus accessory posts. The anatomic posts were cemented, and ceramic crowns were fabricated and placed on the prepared teeth. After six years, radiographic follow-up was conducted. The authors observed that the anatomic posts were in good condition and were biocompatible with the tooth and the restorative material; they concluded that the technique is low cost and saves time in the dental practice.

A finite element analysis study that simulated a maxillary incisor with excessive structure loss and flared root canals tested the effect of different restorative techniques on stress distribution in flared root canals. The researchers concluded that increasing the thickness of the root walls with composite resin produced less stress on the remaining root dentin structure but still showed higher total stress accumulation values at dentin compared with the anatomic post model. According to the results, anatomic posts maintained the stress inside the post body and generated less stress on the remaining root structure. The authors stated that anatomic posts may be safely used in roots with flared canals.[12]

Another study investigated whether fiber posts could lower the risk of post debonding and root fracture. Stress was analyzed in a three-dimensional finite element model of a premolar restored with a metallic or a fiber post. The fiber post produced lower stresses along the interface and higher stresses in the root. Therefore, fracture was less likely to occur in the root with the fiber post because its core and post fracture indices were higher.[13]

The first marketed light-curing bulk-fill resin composite (QuiXfil, Dentsply De Trey, Konstanz, Germany), a highly translucent material, was clinically tested for 4 years and showed satisfactory results.[14] Bulk-fill composite is a new class of material that can be inserted in the cavity in thick layers ranging from 4 mm to 5 mm due to their higher depth of curing.[15] In the present case report, we decided to reinforce the flared root canal with a bulk-fill flowable composite because it is a low-viscosity material that can be injected in the canal, saving time in the dental practice and avoiding bubble formation. The flow of Filtek Bulk Fill Flowable Restorative allows for easy adaptation in the root canal, which makes the technique faster than conventional methods. Another advantage is that this class of material shows low polymerization stress[16,17] because the composition includes modulators, which contributes to the decrease of bonding interface failures.

In the present case report, we used a bulk-fill flowable composite that combined triethylene glycol dimethacrylate (TEGDMA) and bisphenylglycidyl dimethacrylate. TEGDMA is a low-viscosity monomer, and this association of monomers promotes a fast propagation of the polymerization reaction by increasing the polymerization temperature. It facilitates the internal mobility of the monomers, which easily reach the reactive sites, thus increasing the degree of conversion (DC).[18] In addition, Filtek Bulk fill Flowable Restorative has about 10% to 20% of urethane dimethacrylate, a low molecular weight monomer incorporating an amino acid group which is responsible for chain transfer reactions that provide an alternative path for the continuation of polymerization.[19]

In addition to changes in the organic matrix composition of bulk-fill composites, two approaches have been adopted to increase conversion in depth.[20] The first is to increase translucency.[1] The second is to improve photoinitiator efficacy by incorporating additional photoinitiators, including trimethylbenzoyl-diphenylphosphine oxide (TPO) derivatives (Lucerin-TPO, Irgacure-819, GC, Tokyo, Japan) or benzoyl germanium compounds (Ivocerin, Ivoclar Vivadent), providing a synergistic effect to camphorquinone.[21] Li and others[22] compared the DC of bulk-fill composites with conventional that of composites and found that Filtek Bulk Fill Flowable Restorative (3M ESPE) the same composite used in the present case report, and Ever X Posterior (GC, Tokyo, Japan) showed the highest DC followed by SDR (Dentsply De Trey), Tetric EvoCeram Bulk Fill (Ivoclar Vivadent), and Herculite XRV Ultra (Kerr, Orange, CA). Bulk-fill composites have shown great light transmission compared with conventional composites.[23]

One of the questions that could arise regarding the technique used in this case report would be whether the bulk-fill flowable composite would have been properly light-cured in the apical region. It should be pointed out that the total root length was 11 mm. The post length was 6 mm in the root and 4 mm in the coronal portion. Considering that 4 mm of gutta-percha was left in the apical third and the working length was set 1 mm short of the apex, it must be concluded that no bulk-fill composite reached the apical root third. The composite remained in the cervical and middle root third.

A translucent post (White Post DC) was selected for the present case report. Morgan and others[24] assessed the luminous energy transmitted through different translucent fiber posts with a digital photometer. Blocks, consisting of posts in black resin, were submitted to sequential cuts at depths of 16 mm, 12 mm, 8 mm, and 4 mm. The results showed significant differences between different posts and depths. Comparing the posts, White Post DC exhibited the highest value of light transmission in the apical third (12-mm depth). In the middle third (8-mm depth), the group without the post (control) showed higher value of light transmission than the other groups. This suggests the importance of removing the post and light-curing the composite resin without the post as described in the present case report. The results for the cervical third showed that the group without the post and the White Post DC group did not differ statistically.

The use of prolonged curing time and a decreased distance between the curing light and the composite to be polymerized produce a more effective curing.[25] This explains the importance of the additional light polymerization without the post, as presented in this case report. Durner and others[26] as well as Frauscher and Ilie[27] concluded that proper polymerization time (20 seconds and 40 seconds, respectively) with moderate irradiation (about 1000 mW/cm^2) is essential to ensure that the composite resin is properly polymerized and that a prolonged polymerization time (more than 40 seconds) resulted in a significant increase in the DC.

We carried out a laboratory study with extracted bovine teeth in order to evaluate the DC of bulk-fill composites (SDR and Filtek Bulk Fill Flowable Restorative) using Fourier transform infrared analysis under the same conditions of the technique presented. Four depths were tested: 4 mm, 6 mm, 9 mm, and 11 mm. There was no statistically significant difference at depths of 4 mm, 6 mm, and 9 mm. At the 11-mm depth there was a reduction in the DC for both composites. This demonstrates that the White Post DC has the ability to transmit light, without great dispersion, up to a depth of 9 mm. As the length of the post within the root in the present case report was 6 mm, it can be concluded that there was adequate light transmission by the post. This finding is consistent with the study by Taneja and others,[28] which demonstrated that when using translucent fiber posts there was insufficient light emission only in the apical third.

Seyam and Mobarak[29] evaluated the strengthening effect of resin composite cured by a modified layering technique for teeth with flared root canal. The materials used to reinforce the flared root canals were flowable resin composite, self-adhering flowable resin composite, dual-cure cement, and a translucent fiber post. A light-curing unit (800 mW/cm^2) was used that, according to the manufacturer, has the ability to keep good polymerization up to 7 mm depth. The degree of cure for each tested material was indirectly measured using microhardness at different root levels (cervical, middle, and apical), and fracture load results showed that there was no statistically significant difference from non-weakened teeth for either flowable composite. For each tested material, no significant difference was detected for microhardness values at different root levels.

While the present case report does not identify any disadvantage to using bulk-fill flowable composite to reinforce flared root canals, we suggest that in long flared roots, where polymerization is necessary in the apical third, dual-curing bulk-fill flowable composites need to be developed. Proper diagnosis and good treatment planning are essential to obtaining a good result for rehabilitation of patients with flared root canals. The technique presented in this article is innovative as bulk-fill flowable composites have not been tested for the purpose of reinforcing flared root canals. For this reason, more *in vitro* and *in vivo* studies are needed.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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