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Case Report

Posterior Reinforced Endodontic Composite Restoration

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Abstract

When restoring large cavities in posterior endodontically treated teeth, usually are treated with indirect laboratory-fabricated onlays or crowns. If the patient for any reason, after being informed of the various treatment options and costs, desires to have the restoration done within one appointment, a direct reinforced restoration might be the best choice.

The purpose of this article suggests the use of two different materials; polyethylene fibers and resin composite to treat endodontic treated tooth offering a high strength restoration within one appointment. The polyethylene fibers, besides offering the proper strength to the mastication forces, as well reduce the risk of fractures and micro filtration.

This procedure demonstrated some advantages over the usual conventional more expensive alternatives that may take more than one visit.

Keywords: Dental materials; Fiber reinforced composites; Composite resin; Bulk composite; Polyethylene fibers; Flexural properties

Clinical Relevance

Traditionally restoring endodontic treated teeth involves the combination of the endodontic material, a prefabricated or laboratory-made metal post and a conventionally cemented complete crown.

Generally speaking posterior cavities that need extensive restoration are usually treated with laboratory-made onlays, semi-direct restorations or complete crowns. This two cases demonstrates immediate reconstruction, with a direct adhesive restoration of composite. When used correctly, it has many advantages over other restorative methods.

For more than four decades, composites have been used on posterior teeth. Unfortunately, the initial clinical benefit of the first later composites was not ideal [1]. Today, composites have improved their physical, mechanical and adhesive properties [2]. Although wear and marginal micro-filtration remain a concern [3].

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Recent long-term clinical studies show that composites are an acceptable alternative for posterior teeth, following certain clinical parameters [4]. If clinicians are adequately skilled and familiar with most of the adhesive dentistry secrets, then they will extend the indication for direct restorations into a more destroyed tooth [5].

The placement of a Class II composite restoration is often associated with undesirable contraction effects, such as the formation of an interdental space [6] sometimes, due to the shrinkage of the composite, the material is separated from the wall of the cavity during polymerization [7]. This can contribute to the formation of a micro space, which allows the entry of bacteria and oral fluids [8] resulting in hypersensitivity, pigmentation of the margins and recurrent cavities [9]. The first research, on the stability of resin-dentin adhesion, found that there is a reduction in adhesion over time. Tooth-resin adhesion can be degraded by chemical and physical stress (10)

However, the mechanism of that degradation was unknown until its publication in 2004. As a result of long-term exposure in a humidity environment, the hybrid layer degrades and the resin-adhesive dentin bonds are weakened, [11] if sclerotic dentin is present, the resistance values of the bonds decrease significantly. [12].

An indirect restoration manufactured in laboratory (onlay or crown) is considered the treatment of choice when a cusp is lost, [13] CAD/CAM technology can also be used for inlay and onlay[14] both alternatives offer advantages and disadvantages, and both are complex and costly treatments. Total crowns are highly invasive and expensive as well. The full crown should always be the last treatment option, as it is the most invasive and traumatic restorative procedure [15].

Many of the teeth that in the past were placed complete crowns, may have been treated with less aggressive restorations, [16] direct options such as composite or amalgam restorations are acceptable, as both are a single appointment procedure and have a similar prevalence in the cusp fracture [17]. Amalgam has a long history of clinically successful use and has been an effective restorative material for Class 1 and Class II preparations.But its use has decreased because patients and dentists select mercury-free and more aesthetic adhesive restorative materials. The literature supports that the polyethylene fiber-reinforced composite increases the fracture resistance of weakened marginal ridges in molars [18]. Fibers also increase tolerance to damage of a tooth; can be used to provide additional support to weakened cusps and micro fractures [19]. In applications such as cusp reconstruction, multidirectional reinforcement can stop cracks and prevent their spread in the cervical direction [20]. The bibliography mentions from laboratory data on how polyethylene fibers increase the strength of extensive composite restorations [21]. They offer efficient load distribution and also make the structure extremely impact resistant. This results in a successful aesthetic integration of the restoration.

Because retention in adhesive restorations is based on adhesion, no macro retention elements [22] are required. Therefore posts are unnecessary when there is sufficient

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healthy dental structure for restoration, such as molars that have the highest amount of dentin for adhesion. In addition, the placement of posts require removal of healthy dental structure. In a study on marginal adaptation, retention and fracture of adhesive restorations. The results suggest that treating less damage non-vital teeth, the minimum invasion restorative adhesive option is promising [23].

Case Report One

A 52-year-old male patient's in good general heath came in complaining about a fractured tooth and pain on the right side of his mandibule. He asked to be treated and finished within that same visit. Clinical examination presents a fractured composite restoration with loss of the distal-buccal cusp on the first lower mandibular molar, which was previously endodontically treated (Figure 1).

Figure 1: Male patient with extensive restoration Class II resin fractured.

The procedure was performed with a rubber dam placed to achieve total insulation. This technique is essential no other method of insulation provides better control over oral fluids and moisture contamination [24]. After completing the removal of defective restoration and infected tissue, all internal angles should be rounded to reduce stress concentration [25]improving the adaptation of the composite to the dental structure. No bevels were placed in the occlusal or on the gingival margin.

Each surface is micro sand blasted with 27micron aluminum oxide (Crystal Air, Crystalmark Dental Systems Inc. Glendale CA). 2% chlorhexidine (Cavity Cleanser Bisco, Inc. Schaumburg IL) was used to disinfect the preparation and lightly dried with oil-free air. Selective etch technique was chosen. Phosphoric acid (Select HV Etch, Bisco, Inc. Schaumburg IL) is applied only to the enamel for 15 seconds (Figure 2), then rinsed thoroughly and dried. Next the primer of OptiBond XTR (Kerr, Corporation. Orange CA) was applied by rubbing under moderate pressure for 30 seconds (Figure 3) followed by drying with warm air to dilute the layer and evaporate the solvent. Immediately afterwards the OptiBond XTR adhesive (Kerr, Corporation, Orange, CA) was used with a slight stirring for 15 seconds.

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Figure 2: After completing the removal of the infected tissue and applying a sectional matrix, the entire surface is micro sanded and the selective atch technique is used.

Figure 3: Immediately after disinfecting, the primer is applied generously.

A thin 0.5 mm layer of a thick, sticky composite (Ribbond Securing Composite, Seattle, WA) was placed on the pulpal floor, which is in addition with high opacity (Figure 4).

Figure 4: After applying the adhesive agent, a thin layer of a high opacity thick composite is applied.

Polyethylene fibers (Ribbond. Seattle, WA), are moistened with a non-load bonding adhesive agent and excess is removed with a lint-free gauze. Adapted and pressed as close to the pulpal floor as possible (Figure 5), and then are photopolymerized.

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Figure 5: Through the unpolymerized flowable composite the polyethylene fibers are adapted to the pulp floor as much as possible.

In one study, SEM was found when the fibers were inserted into the depth of the proximal box. Little or no microfiltration took place [26] and increased the micro traction resistance of dentin in cavities with a high C-factor [27].A ball shaped nitride coating instrument us used to form thigh inter-proximal contact burnishing the sectional metal band (Garrison Dental Solutions) (Figure 6).

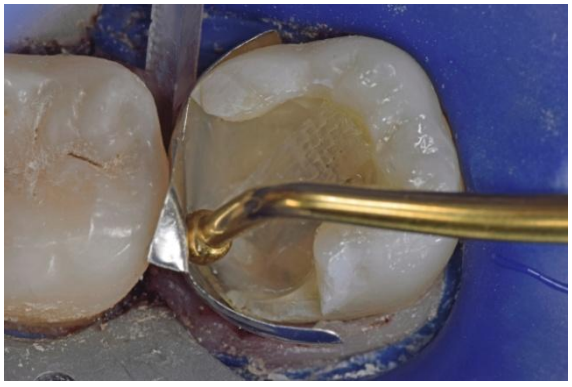

Figure 6: The proximal contact is formed burnishing the sectional band with a ball shaped tip nitride-coated instrument.

Another composite layer (Figure 7) and more polyethylene fibers (Ribbond. Seattle, WA.) were placed (Figure 8) laterwas applied the last increment of about 4mm of composite using Composite bulk SonicFill(Kerr, Corporation, Orange, CA) (Figure 9).

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Figure 7: A composite bulk is placed to form the inter proximal wall.

Figure 8: Another section of polyethylene fibers is adapted.

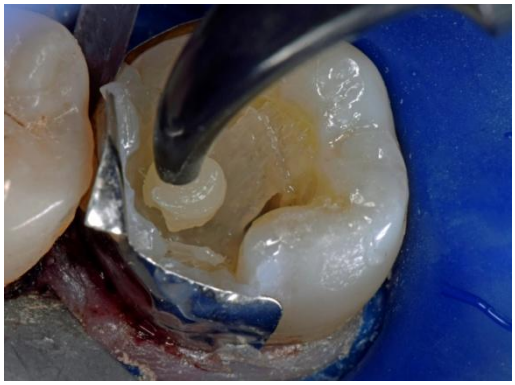

Figure 9: The rest of the preparation is sealed in a single increment of the bulk composite.

That produces the lowest polymerization shrinkage compared to other materials [28].This technique is being used by many dentists, because the restoration is performed faster, in addition the risk of trapping impurities and less air pockets [29].

Tints were placed (Color Plus, Kerr, and Corporation. Orange, CA) to create the anatomy, then glycerin was placed on each surface (Figure 10) and photopolymerized.

Figure 10: Before polymerizing, the anatomy is sculp and dyes are applied to create a more natural aesthetic restoration.

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The rubber dam is removed and the occlusion is inspected in all eccentric movements to avoid any premature contact (Figure 11). Now the restoration has been contoured and begins to polish at low speed with intraoral polishing paste (DiaShine by VH technologies, Lynnwoood, WA) maintaining slight constant contact with the restoration (Figure 12) to provide a superior brightness (Figure 13).

As a preventive measure for occasional bruxism, the patient is provided with a night-time protector [30]. In this particular situation, the direct adhesive reinforced composite restoration was the ideal choice.

Figure 11: Immediately after removing the rubber dam, occlusion is checked in all movements, to avoid occlusal contacts.

Figure 12: Intraoral diamond paste is placed for maximum luster.

Figure 13: Immediate satisfactory outcome.

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Case Report Two

A 25 year old male presents with story of sharp pain to the mastication, requesting a tooth colored restoration, He wishes a single appointment treatment because he lives from 5 hours drive to get to our office.Clinical examination, exhibit a defective amalgam with a recurrent carious lesion in maxillary right first molar (Figure 14).

Figure 14: Preoperative condition.

Figure 15: Finished the root canal.

To the Rx the carious lesion extend very deep close to pulp. A rubber dam was placed to achieve total isolation. After the amalgam removal root canal was performed by Endodontist, (Figure 15) after that the preparations iscompleted with all internal angles rounded to reduce stress concentration and improving the adaptation of composite resin to dental structure. No bevels were placed either on occlusal or on the gingival margin. After sand blasting (MicroEtcher. Danville Materials Inc., San Ramon, CA) with 27microns (Crystal Air, Crystalmark Dental Systems Inc. Glendale CA) the tooth structure to increase the bond strength, [31] a cotton swab dampened withTubulicid Red (Gloval Dental Products, Bellmore, NY) is usedto clean all surfaces, them a thin layer ofresin modified ionomer (Geristore, DentMat Santa Maria Ca) (Figure 16) and light cured.

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Figure 16: A thin layered resin modified ionomer.

Figure 17: After every surface was sandblasted, we perform a total etch with Phosphoric Acid.

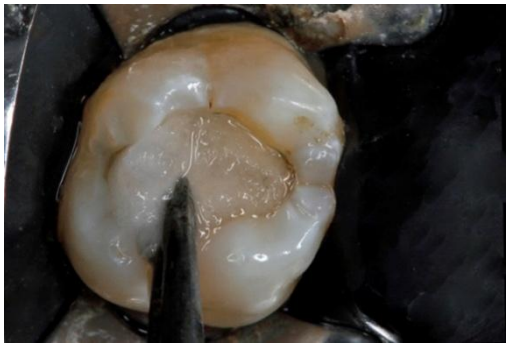

Figure 18: An anti-bacterial agent, such as Chlorhexidine 2% (Cavity Cleanser, Bisco Schaumburg, IL) is applied for 30 seconds.

35% Phosphoric Acid (Select HB Etch, Bisco. Schaumburg, IL) is applied for 15 seconds (Figure 17) washed thoroughly.To avoid bond strength degradation [32] an anti-bacterial agent, such as Chlorhexidine 2% (Cavity Cleanser, Bisco Schaumburg, IL) is applied for 30 seconds (Figure 18). Now the excess is eliminated with sterile sponges. In this case etch rinse adhesive (Optibond FL Kerr, Corporation Orange, CA.) has been used, multiple layers of primer are applied (Figure 19), then live without disturbing for 40 seconds, now carefully dry to evaporate the solvent.A thin layer of bonding adhesive is applied and light cured (Figure 20). A dual composite layer (Duo-link Universal Bisco, Schaumburg, IL) is placed in the pulpal floor, next we cut two pieces of high strength polyethylene fibers with special scissors (Ribbond Inc.) and blotted with an

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unfilled bonding adhesive, the excess is eliminated with a lint-free gauze.

Figure 19: Multiple layers of Primer. (Optibond FL. Kerr).

Figure 20: Adhesive application. (Optibond FL. Kerr).

One of the polyethylene fibers piece (Ribbond Inc) it is firmly inserted in to the uncured composite mesio-distal direction the other piece of polyethylene fibers (Ribbond Inc.) is firmly inserted in to the uncured composite buco-lingual direction (Figure 21). The Ribbond fibers are adapted and pressed to the pulpal floor as possible(Figure 22) and light cured.The final build up was done with a warmed filled restorative composite (TetricEvoCeram, IvoclarVivadent. Amherst, NY) to increase durability [33]. Tints (Color Plus, Kerr Corporation, Orange CA) were placed to create a tertiary anatomy (Figure 23), and light cured. After the rubber dam, the occlusion is adjusted, remained very light centric contacts. The pointy cusps of opposing teeth are smoothed to reduce tensile forces [34].

Figure 21: A dual composite (Duo-link Universal Bisco, Schaumburg, IL) and polyethylene Fibers. (Ribbond. Seattle WA).

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Figure 22: Ribbond embedded in the dual composite (Bisco).

Now the restoration has been contoured and we spread with intraoral polishing paste (DiaShine by VH technologies, Lynnwood, WA) (Figure 24) using latch brush and keeping light constant contact with the restoration, to provide a higher surface luster (Figure 25).

A sealant layer (OptiGuard Kerr, Corporation Orange, and CA.) is applied to seal the small cracks due by finishing procedures (Figure 26). As a preventive measure for occasional bruxism the patient is provided with a night guard [35].

Figure 23: Enamel composite layer (TetricEvoCeram, IvoclarVivadent. Amherst, NY) at the same time the anatomy is created.

Figure 24: Intraoral polishing paste (Diashine by VH Technologies).

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Figure 25: Immediate final result, after removing the rubber dam and occlusion equilibrated.

Conclusion

By using the current generation of restorative materials that simulate the physical properties and other characteristics of natural tooth in combination with proper design principles, the clinician can develop a tooth-restorative complex with optimal functional and esthetic results [36].

No retention or resistance was used in cavity preparation. Restoration retention was based on adhesion technique and polyethylene fibers. It is of paramount importance to leave the restoration strong enough to withstand occlusal challenges. Particularly if the restoration is subject to the same forces that initiated the failure of the original restoration.

As oral health providers, we are always looking for the best treatment options for our patients [37].Whatever the real advancement in the field of modern endodontic-treated teeth is the presentation of adhesive techniques, especially with the presentation of efficient dentin adhesives [38].High strength polyethylene fibers (Ribbond, Seattle WA) are an excellent reinforcement material in restoration, it can improve the long-term prognosis of a tooth. The results are a successful aesthetic integration of restoration and can be easily repaired if ever needed. In some clinical situations, repair is an advantageous and practical alternative to a replacement and can significantly increase the lifespan of these restorations. Treating extensivecusp-coated lesions with direct subsequent restorations may represent a valid alternative to conventional indirect options. The literature indicates that composites are a restorative material of sensitive technique that can be used in extensive lesions, provided that they are carried out with adequate handling and effective insulation [39].Posterior adhesive restoration requires an increased attention to detail and the main reason for failure over time would be secondary caries and fractures [40].

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