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Resin Composite Restorations of Permanent Incisors with Crown Fractures: A Case Report with a Six-year Follow-up

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Clinical Relevance

The teeth in this report were restored with a two-step self-etch adhesive system and a microhybrid resin composite. The teeth present with an excellent clinical performance and patient acceptance at the end of a six-year recall.

ABSTRACT

Using resin composite for the restoration of permanent incisors that have crown fractures is a conservative, timely and economical treatment option. Presented in this case report is a 41-year old female patient with resin composite restorations of anterior teeth that had crown fractures. This manuscript presents the clinical success of these resin composite restorations of permanent incisors after six-years.

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INTRODUCTION

Coronal fracture of anterior teeth is an important topic for esthetic dentistry. Such fractures may jeopardize esthetics, function, tissue biology and occlusal physiology, thus endangering tooth vitality and integrity. Coronal fractures resulting from dental trauma most frequently occur to the maxillary anterior teeth of adolescents and less frequently to mandibular teeth.[1] Adult teeth may also suffer traumatic fracture, although less frequently than for adolescents.[2]

Direct and indirect restorations are clinically successful treatment options for fractured anterior teeth. Direct restorations are performed without laboratory phases. They usually involve enamel/dentin acid-etching techniques with adhesive systems and one or more

types of resin composites.[3-4] Indirect restorations require multiple visits and expense due to laboratory procedures. Resin composites, porcelain and metal-ceramics are materials from which a practitioner can choose to perform these anterior tooth restorations. These restorations can be bonded to teeth via enamel/dentin acid-etch techniques and resin adhesive systems.

This report determined the clinical success of resin composite restorations of permanent incisors that had crown fractures with six-year follow-up.

CASE REPORT

Patient and Diagnosis

A 41-year old female patient with an esthetic complaint regarding fractured maxillary central incisors was referred to the author's clinic. Her medical history had no significant data. The patient's dental history revealed dental trauma and fracture when she was eight-years old. The patient had unrestored teeth for 27 years, as she did not want to sacrifice any remaining tooth structure.

During the intraoral examination, the fracture zone in both maxillary central incisors was classified as Class IV. In the cervical area of the facial surface, there was intact enamel beginning from the gingival margin and extending coronally 0.5 mm in tooth 11 and 1.5 mm in tooth 21 (Figure 1). The patient's oral hygiene level was scored as 0 according to an oral hygiene index,[5] and the patient had a type 1 occlusion with no parafunctional movements. Both of the fractured anterior teeth were asymptomatic and responded within normal limits to cold and electric pulp tests. No periapical disease or root fracture was diagnosed during radiographic examination.

The treatment procedure was performed as follows: a bevel was placed on the whole facial surface, beginning from the gingival margin, to allow for a gradual increase in the thickness of the resin composite. Incisal edges and corners were rounded and the bevel was extended to a 1 mm periphery on the palatal surface. A diamond bur (Bur #806 314 290 014, Acurata, Thurmansbang, Germany) was utilized on the enamel surface while the dentin was cleaned with tungsten carbide burs (Bur #500 204 001 291 018, 500 204 001 291 012, 500 204 001 291 010, Acurata). The remaining enamel and dentin surfaces were irregular and scalloped.

The enamel was etched with 37% phosphoric acid (Scotchbond Etchant, 3M ESPE, St Paul, MN, USA) for 15 seconds and rinsed thoroughly with water. Excess water was removed with an air syringe.

The teeth were restored using a two-step self-etch adhesive system (AdheSE, Ivoclar-Vivadent, Schaan, Liechtenstein). The primer was applied to the cavity and gently dried with an air syringe for five seconds. Adhesive was then applied to the enamel and dentin and the preparation was gently air-dried for five seconds, leaving a shiny surface. The adhesive was then light

Figure 1. *Clinical appearance of the teeth before restoration.*

Figure 2. *Clinical appearance of the teeth after restoration.*

Table 1: *The Composition and Manufacturers of the Materials*

Products	Type	Composition	Manufacturer
AdheSE	two-step self-etch adhesive	**Primer**: Mixture of dimethacrylates, phosphoric acid acrylate, water, initiators and stabilizers **Adhesive**: Mixture of dimethacrylates, HEMA, highly dispersed silicon dioxide, initiators and stabilizers	Ivoclar-Vivadent Schaan, Liechtenstein
Miris	highly filled microhybrid composite	Ingredients: Bis-GMA, Bis-EMA, TEGDMA **Filler**: Strontium glass, silanized Barium glass, silanized Amorphous glass, hydrophobed Average filler particle size: 0.6 µm Range of particle size: 0.04-2.5 µm	Coltène-Whaledent Altstätten, Switzerland

**HEMA: hydroxyethyl methacrylate*
Bis-GMA: bis-phenol A diglycidylmethacrylate
Bis-EMA: bis-phenol A polyethoxylated dimethacrylate
TEGDMA: triethyleneglycol dimethacrylate

polymerized for 20 seconds. The teeth were restored with a microhybrid resin composite (Miris, Coltène-Whaledent, Altstätten, Switzerland).

Finishing and polishing procedures were performed by discs (Sof-Lex, 3M ESPE) and diamond burs (Bur #806 314 250 514 018, 806 314 250 504 018, Acurata) and a second polishing procedure was performed at the one week recall (Figure 2). The composition and manufacturers of the materials are presented in Table 1.

Table 2: *The United States Public Health Service (USPHS) Criteria for Evaluating Resin Restorations*

Category	Scores	Criteria
Retention	Alpha	No loss of restorative material
	Charlie	Any loss of restorative material
Color Match	Alpha	Matches tooth
	Bravo	Acceptable mismatch
	Charlie	Unacceptable mismatch
Marginal Discoloration	Alpha	No discoloration
	Bravo	Discoloration without axial penetration
	Charlie	Discoloration with axial penetration
Secondary Caries	Alpha	No caries present
	Charlie	Caries present
Anatomic Form	Alpha	Continuous
	Bravo	Slight discontinuity, clinically acceptable
	Charlie	Discontinuous, failure
Marginal Adaptation	Alpha	Closely adapted, no detectable margin
	Bravo	Detectable margin, clinically acceptable
	Charlie	Marginal crevice, clinical failure
Surface Texture	Alpha	Enamel-like surface
	Bravo	Surface rougher than enamel, clinically acceptable
	Charlie	Surface unacceptably rough

Clinical Evaluation

Recalls were performed at the end of two years (Figure 3) and six years (Figure 4), respectively. Rebonding was performed following polishing during both visits. Results of the two-year follow-up were found to be excellent (Alpha scores were observed for all evaluation criteria) in terms of retention, color match, marginal discoloration, secondary caries, marginal adaptation and surface texture, according to the United States Public Health Service (USPHS) criteria[6] (Table 2). The restorations were found to be successful, although slight marginal discoloration (Bravo score) was observed at the six-year recall. Alpha scores were observed for other evaluation criteria at the end of six years and the patient considered the results as satisfactory.

DISCUSSION

Dental trauma occurs most frequently to the maxillary central incisors, and the fracture zone may involve both enamel and dentin.[7] The current case offers a conservative, time saving, inexpensive treatment option of a common type of esthetic problem following dental trauma.

The level of oral hygiene and type of occlusion, as well as the type of fracture, are initial factors upon which a treatment plan should be made. The patient in this case report had excellent oral hygiene, a type 1 occlusion, no parafunctional movements and was looking for a treatment option that was as conservative as possible. Considering these factors, a direct resin composite restoration technique was performed.

When a fracture creates a need for restoration, if there is no carious or pulpal involvement, a bevel is often the only preparation necessary.[8] A bevel preparation offers a well defined marginal area for ease of finishing and reduced risk of having "white lines" at the margins. A bevel preparation also improves the etching pattern, causing transverse exposure of enamel prisms and increasing the area available for acid etching. The exposure of the subsurface enamel layer is favorable to adhesion, possibly resulting in increased bond strength for the restoration and a better marginal seal. In the current case, the surface left after reduction was irreg-

Figure 3. *Clinical appearance of the composite restoration at the end of two years.*

Figure 4. *Clinical appearance of the composite restoration at the end of six years.*

ular, allowing for the restorative material to blend harmoniously with the tooth for esthetic reasons. On the palatal surface, the bevel was extended no more than 1 mm, as esthetic requirements are less important in this aspect and further extention has been shown to provide no additional strength.[9] The incisal edge was wrapped palatally. The practitioner should be sure that the resin composite has enough thickness facio-palatally.

A microhybrid resin composite was selected because of having superior polishability due to a smaller particle size.[10] A second polishing procedure was performed at the one-week recall, as most water sorption has been reported to occur during the first week.[11] Another advantage of this procedure was to reduce chair time during the first visit.

The finishing and polishing process can affect many aspects of the final restoration, including surface staining, plaque accumulation and wear characteristics of the resin composite. Therefore, finishing and polishing procedures are of primary importance in terms of esthetics and clinical success of the restoration.

The direct resin composite restoration technique continues to be popular for the restoration of fractured anterior teeth, as it is a conservative, less expensive, more simple procedure when compared to the prosthetic approach. Despite the tremendous amount of improvements, resin composites still present some shortcomings, such as shrinkage upon curing,[12] discoloration over extended periods of time[11] and insufficient fracture resistance of the restoration.[13-14] More importantly, there is a lack of well-controlled, independent and adequately-powered long-term randomized clinical trials on the restoration of fractured anterior teeth with contemporary adhesives and composites.

CONCLUSIONS

The current case indicates that the direct resin composite restoration technique presented excellent clinical performance, with the exception of slight marginal discoloration after a service time of six years. It is important to note that the patient-related conditions of a sufficient amount of remaining tooth structure, excellent oral hygiene and no excessive occlusal forces were optimal in this case.

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