

Re-attachment of Anterior Tooth Fragment using a Self-etching Adhesive: A Case Report

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Abstract

Aim: The purpose of this case report is to describe the re-attachment of an anterior tooth fragment using a self-etching adhesive.

Background: Fracture of anterior teeth by trauma is a common problem in children and teenagers due to their active lifestyle. Restoration of these teeth often presents a challenge because of the large pulp in young teeth and open apical foramen depending on the age of the child. New dental adhesive materials offer an alternative solution for the treatment of some anterior tooth fractures.

Report: A 17-year-old female patient presented for treatment of a fractured maxillary left central incisor. The clinical examination revealed the exposure of dentin, but there was no exposure of the pulp. The patient saved the tooth fragment making it available for re-attachment to the remaining tooth structure. Under local anesthesia and rubber dam isolation the tooth fragment was re-attached using a self-etching adhesive and a microhybrid composite.

Summary: The re-attached tooth fragment was assessed clinically, radiographically, and using photographs at one, six, 12, 24, and 36 month intervals. The tooth remained vital, and there was no change in the color of the tooth at the three-year recall.

Keywords: Trauma, tooth fragment, re-attachment, self-etching adhesive, resin composite restoration

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Introduction

Coronal fracture by trauma has been reported to account for up to 92% of all traumatic injuries to permanent dentition.¹ The most affected teeth are maxillary incisors (80% central incisors and 16% lateral incisors) due to their anterior position and protrusion caused by the eruptive process.² Gender also plays a major role on the incidence of traumas. It has been reported males are more frequently affected than females, particularly in the maxillary incisors.^{3,4} In the past fractured teeth were restored using acrylic resin or with complex ceramic restorations associated with metals.⁵ Now progressive improvements in the field of adhesive dentistry allow clinicians to re-attached a broken tooth fragment to the remaining tooth structure mechanically and chemically.

Re-attachment of a tooth fragment should be the first choice to restoring fractured teeth when a usable fragment is available.^{6,9} This technique offers several advantages over conventional composite restorations. Improved esthetics can be achieved since the original shape, color, brightness, and surface texture of the enamel are maintained. In addition, the incisal edge of the tooth fragment wears at a similar rate to the adjacent teeth, whereas a composite restoration will likely wear more rapidly. Re-attachment is also much more economical.^{10-14,15} Less chair side time is required for the re-attachment of an incisal edge than for contouring an incisal edge of a composite resin.

Self-etch adhesives have recently become available and combine the functions of primer and adhesive components which has eliminated the need for separate acid etch and rinsing steps.¹⁵



Figure 1. Clinical appearance of the tooth before treatment.

One disadvantage is self-etch adhesives are not able to etch the enamel as deeply as phosphoric acid.¹⁶ Many dentists prefer to etch the enamel to obtain retention for self-etch adhesives even without clinical evidence of efficacy.¹⁷ In this study the enamel was etched with phosphoric acid.

The present case report describes the re-attachment of an original tooth fragment using a self-etching adhesive with three-year follow-up.

Case Report

Diagnosis

A 17-year-old female presented with a fractured maxillary left central incisor which resulted from a fall (Figure 1). The trauma was classified using a clinical examination as an enamel/dentin fracture without pulpal exposure. The tooth was found to be vital and exhibited no mobility. The tooth fragment (Figure 2) was retained by the patient in a paper tissue and adapted favorably to the remaining tooth structure. There was no deformation around the tooth. The fractured fragment was disinfected with NaOH and rinsed thoroughly with water.

Treatment

After administration of local anesthesia, a rubber dam was placed to isolate the fractured tooth. Tooth dentin and fractured part dentin was cleaned with a tungsten carbide bur. After beveling the enamel surface using Accurata G+K diamond burs (Mahnhardt Dental, Thurmansbang, Germany), etching of both the remaining tooth surface and the fragment was carried out for 15 seconds using 37% phosphoric acid then



Figure 2. Labial view of the detached incisal fragment.

rinsed thoroughly with water. Next, AdheSE™ self-etching adhesive (Ivoclar-Vivadent, Schaan, Liechtenstein) was applied on the etched surfaces and light cured for 20 seconds using a PolyLUX II™ halogen light curing unit (KaVo Dental GmbH, Biberach, Germany).

Filtek Z250™ microhybrid composite (3M ESPE, St. Paul, MN, USA) was then applied to the opposing surfaces and the fragment was fitted to the remaining tooth. Polymerization using the Poly Lux II™ light curing unit was carried out from both buccal and lingual directions for 20 seconds. Finishing and polishing procedures were performed with Sof-Lex™ disks (3M ESPE, St. Paul, MN, USA) (Figure 3). The repaired area was barely visible, and the esthetic result was excellent. The palatal view of the restoration is shown in Figure 4.

In accordance with the United States Public Health Service (USPHS) criteria,¹⁸ the clinical status of the repaired tooth was confirmed successful after assessment at one, six, 12, 24 and 36 month intervals. The assessment was done in terms of retention, color match, marginal discoloration, secondary caries, anatomic form, marginal adaptation, and surface texture (Table 1). Restoration was considered successful at the end of three years (Figure 5). The vitality of the tooth was checked at the first, second, and third year recalls and the tooth remained vital.

Discussion

The following re-attachment strategies have been advocated for re-attaching a detached tooth fragment to the remaining tooth:

- Placement of a circumferential bevel before re-attaching the fragment^{7,19,20}
- Placement of an external chamfer at the fracture line after bonding²¹
- Use of a V-shaped enamel notch²²
- Placement of an internal groove^{12,20}
- Leaving a superficial overcontour of restorative material over the fracture line^{5,23-26}

In the present case the enamel beveling technique was used. This technique has claimed to improve fragment retention since enamel beveling alters the orientation of enamel prisms which facilitates the achievement of a more effective acid etching pattern.²⁷



Figure 3. Labial view of the repaired left maxillary incisor immediately after treatment.



Figure 4. Palatal view of the repaired left maxillary incisor immediately after treatment.



Figure 5. Clinical appearance of the repaired left maxillary incisor at the end of three years following treatment.

Shear bond strength estimations of dentin bonding agents used for re-attachments were initially reported using sheep and bovine incisors *in vitro*.²⁶ The study found, regardless of the dentin bonding agent used, the fracture strength did not vary significantly and was about 50-75% of an intact incisor.²⁶

Reis et al.⁵ investigated the fracture strength of various re-attachment techniques. They found the use of a superficial overcontour over the fracture line, placement of an internal groove, and the resin composite restoration itself provided fracture strength as high as those observed in sound teeth. However, only 37% of the strength of an intact tooth was recovered when a dual

Table 1. Modified USPHS criteria.

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 unacceptable rough

cure luting cement was utilized for a simple re-attachment without any additional tooth preparation, and 60% when a buccal chamfer was placed over the fracture line.⁵

It has been reported²⁸ placement of any type of tooth preparation failed to improve the fracture strength of fragment-bonded teeth when compared with attachments done without any

tooth preparation. The investigators observed incisal edge re-attachment restored approximately half the fracture resistance of sound teeth.

Reis et al.²⁹ found the chamber technique provided a better strength recovery than simple re-attachment and both were inferior to a resin composite restoration that can be used to restore the original tooth fracture.

In the present case endodontic therapy was not required because the pulp chamber was not exposed. In addition, there was no periapical pathology at the end of three years (Figure 6).

When a tooth fragment is recovered, an autogenous re-attachment can be performed using an adhesive system and, if required, restoring the fragment-tooth interface with resin composite.³⁰ There are some advantages of tooth fragment re-attachments such as good esthetic and functional results. If the pulp is exposed, endodontic treatment is required; if the biologic space is affected, it is normally recovered before or simultaneously with the re-attachment procedure.³⁰

Most concerns about re-attachment techniques have been related to fracture strength. As a result, it is reasonable to expect clinicians to seek re-attachment techniques resulting in a fracture strength similar to sound teeth.¹⁰ The amount of strength recovery needed to keep the fragment in position for a long-term is not known. Perhaps fracture strengths as low as 50% to 60% may be sufficient.¹⁰ Further clinical investigations are definitely required to reach a definitive conclusion.

The quality of fit between a detached tooth fragment and the remaining tooth structure is an important factor to be considered. When the segments fit together with no discernible disruptions or defects, techniques that prevent resin composite from being exposed to the oral environment, such as placement of an internal groove, would be preferable. This is true with the exception of a simple re-attachment, due to the low fracture strength recovery associated with this technique.⁵ On the other hand, when enamel structure is lost during a traumatic event, it may be more convenient to use an overcontour technique so esthetics can be achieved simultaneously with an increase in adhesion.⁵ In pulpless teeth, part of the pulp chamber has been used for additional mechanical retention.⁹ In the present case there was an adequate fit between the detached tooth fragment and the remaining tooth structure.



Figure 6. Periapical radiographic view of the repaired tooth at the end of three years.

Another important consideration is fracture pattern. It has been reported 80% of traumatized incisors fracture in an oblique fashion from the labial toward the lingual with the fracture line proceeding in an apical direction.³¹ This is an unfavorable fracture pattern that exhibits low resistance to labially applied forces.³²

The use of viscous materials have been suggested when adhesive systems are used along with microhybrid and microfilled light-cured resin composites.^{9,12,19,22} In the present case microhybrid composite was used in order to successfully re-attach the fractured tooth fragment to the remaining tooth structure.

Conclusion

Reattaching a tooth fragment with self-etching adhesives may be successfully used to restore fractured teeth with adequate strength, but long-term follow up is necessary in order to predict the durability of the tooth-adhesive-fragment complex and the vitality of the tooth.

Clinical Significance

The clinical performance of a re-attached tooth using a self-etching adhesive was found successful after three years. This result is encouraging as clinicians continue to seek an efficacious and cost effective technique to restore fractured anterior teeth.

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