A modified technique on the reattachment of permanent tooth fragments following dental trauma. Case report.

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Fractured anterior teeth can be restored by adhesive bonding of the fractured fragment to the remaining tooth structure. One of the major challenges for the practitioner treating traumatized anterior teeth with immediate fragment reattachment is disguising the fracture line, through the correct use of masking and restorative resins to make the restorations imperceptible to the eye as well as improve the retention of the restoration. This paper discusses a modified technique for reattaching a permanent tooth fragment following dental trauma. The initial procedure involved simple reattachment using light cured composite resin between the fragment and the remnant part of the tooth, without additional preparation. The surplus resin was spread across it in an attempt to optimize marginal seal and improve the aesthetics of the restoration. Finally, after taking into account the occlusion, the lingual surfaces of the teeth were veneered with microfilled composite to improve the retention of the reattached fragments.

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INTRODUCTION

Coronal fractures in the permanent dentition comprise the most frequent type of traumatic dental injury. 26% to 76% of all injuries involve loss of hard dental tissue.[1-3] The treatment of a patient with a traumatically fractured maxillary incisor pose a serious challenge to the skills of the dental practitioner, who needs to incorporate form and dimensions, shade, opacity and translucency as well as fluorescence and opalescence.[4] These can all be achieved using materials now available in conjunction with an appropriate technique.[5]

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The ideal would be to attain restorations that are not only as strong as natural teeth themselves but unnoticeable, even to dentists and those more demanding patients.[5] Since the development of resin composites and bonding systems, there are many clinical situations where the reattachment of tooth fragments has become a preferable alternative to a restoration.[7-9] Tooth fragment reattachment provides advantages over resin-composite restoration. It is a conservative technique combining minimal tooth loss with the financial advantages of a one-visit treatment. A better esthetic result can be obtained in less time, i.e. the original shape, color, translucency, brightness, surface texture and occlusal contacts are maintained. In addition, the incisal edge wears at a similar rate to adjacent teeth, whereas a composite restoration will wear more rapidly.[10, 11, 12] It can be achieved both in relatively simple cases, and in more complex situations where the pulp and biologic width are involved.[13,14,15] Moreover, the positive emotional effects resulting from fragment bonding increases the patient's self-esteem.[13]

The aim of this case report is to present a modified technique on reattachment of tooth fragment following dental trauma.

Techniques of fragment reattachment

Chosack and Eidelman (1964)[16] published the first case report where they reattached the crown segment of a 12-year-old boy's amputated anterior crown using a cast post. The acid-etch technique was not applied. On the contrary, conventional dental cements were used to

simultaneously cement the post and fractured crown to the remaining tooth. Spasser (1977)[17] described reattaching an anterior tooth fragment with 3 interlocking minipins (0.021 inch), composite and a light-cured resin. Other reports followed on fragment reattachment using enamel etching and resin composites.[18-20]

Descriptions of a series of techniques have been published using a variety of enamel beveling, enamel groove, enamel chamfer, dentin groove, enamel overcountour or even simple reattachment techniques.

Enamel beveling
Simonsen (1979)[20] was the first to publish a case report with enamel beveling of the fragment and the remaining crown prior to bonding. Other supporters of this technique followed with very good aesthetics results.[10,21,22,23] A variation of this technique was described by Simonsen (1982)[24] where the enamel beveling was limited to the lingual surface instead of the whole fracture line.

External Chamfer
Davis, Roth and Levi (1983)[25] suggested reattachment of the fragment prior to placing an external chamfer in the fracture line with a diamond round bur. They recommend the use of the enamel chamfer when the fracture line is still evident after one week. Andreasen et al (1991)[26] prefer a circumferential chamfer around the whole extension of the fracture line whereas Reis et al 2001[27] chamfered only on the buccal surface.

V-shaped internal enamel groove
Simonsen (1982)[24] first introduced a groove limited to the labial enamel on both fractured incisal edge and the remaining portion of the tooth. Diangelis and Jungbluth (1992)[28] used the same technique and a V-shaped notch was placed circumferential in the enamel of the tooth fragment and the tooth with the edge of a number 35 inverted cone bur.

Internal Dentin Groove
Instead of placing a bevel in the enamel, an internal dentin groove can be performed. An internal groove can be placed in the dentin of the fragment and the remaining tooth.[10,27] If the fracture extends close to the pulp horns and chamber, a direct pulp-capping agent that prevents placement of an internal groove in the remnant may be necessary, thus an internal groove would be placed only in the fragment.[28]

Overcontour
After bonding the fragment, a superficial preparation (about 0.3 mm deep) is placed on the buccal surface using a cylindrical diamond-finishing bur extending about 0.5 mm coronally and apically from the fracture line. This area is the filled with a thin composite layer.[27,29,30]

Simple Reattachment
Finally some authors attempted to reattach fragments using simple reattachment.[31,32]

Materials used on fragment reattachment
Another controversial issue regarding the fragment reattachment is the material to be used for bonding. Andreasen et al (1993)[31] mentioned that materials with relatively high-mechanical properties, like resin, should be used in conjunction with adhesive instead of the application of adhesive only in order to resist the functional stresses. Faric et al (2002)[33] support the idea that most fifth-generation bonding agents increase the fracture resistance of re-attached coronal fragments when used in conjunction with an unfilled resin. A chemically cured material might be necessary to overcome problems in completing polymerization of the resin with light-curing units through dental tissues when the fracture is extensive enough to involve a large area of dentine. Dean et al (1986)[34] and Reis et al (2002)[35] found no significant differences between light- or chemically cured composites in re-attaching fractured teeth.

CASE REPORT

A 9-year-old boy attended our private practice complaining of fractured maxillary right and left central incisors. The boy had been elbowed in the mouth accidentally by a peer. The patient presented 2 hours after the trauma with the incisal halves of both maxillary central incisors fractured (Figure 1). The intact fragments of the two teeth resulting from the accident were recovered by the parents and brought in with the patient. The clinical examination revealed uncomplicated crown fractures of both of the traumatized teeth with the radiographic evaluation using two periapical radiographs from two different angles showing complete root development, closed apices, no perapical pathology of 11, 21, and an absence of root or alveolar bone fractures (Figure 2). To avoid dehydration patient's parents were advised during the initial communication by phone to store the fracture portions of the teeth in 100% humidity such as saline or milk.

Local anesthesia was applied (Articaine 4% with 1:200000 epinephrine) labially and palatally to avoid upsetting the young patient through the sensitivity of the exposed dentin pending the etching procedure and the application of a wooden wedge between the central incisors. In order to achieve superior moisture control a rubber dam was placed on all the maxillary incisors after the proper shade selection before the field was isolated, as dehydrated enamel whitens considerably.[1] The fragments were then glued to sticky wax to facilitate handling. Since more than 0.2 mm thickness of dentin remained between the pulp and the exposed surface on both of the traumatized central incisors, it was decided not to use any kind of liners for pulp protection.[36] The broken pieces of crown were fitted to

ascertain that they would still go back into place and both were found to fit perfectly (Figure 3). A sectional matrix was fixed on the mesial surfaces of the central incisors with a wooden wedge in anticipation of an ideal composite application on the inaccessible mesial contact points of the teeth. The fractured surfaces of the fragments were treated with 37% orthophosphoric acid gel followed by delicate rinsing before applying the adhesive system to the etched surface. The fractured teeth in the oral cavity were treated with a 'total etch technique', i.e. 30 seconds of enamel etching and 15 seconds for dentin, using 37% orthophosphoric acid gel, and the adhesive system was also applied to the segments.[14] The layer of the bonding material on both surfaces was further thinned and penetration of the material into dentinal tubules was encouraged by a gentle air stream for several seconds and cured. A photoactive microfilm composite resin was placed in a thin layer across the fractured surface of the tooth so as to allow for a small excess of material when the fragment was repositioned. After careful repositioning and alignment of each fragment, excess material oozing from the fracture line was spread across the fracture line using a small brush with unfilled resin (Figure 4). With the fractured pieces in place composite resin was light cured for 60 seconds labially and palatally. Bearing in mind the particular patient's occlusion, the restorations were reinforced using composite resin material across the entire palatal surfaces of the affected teeth (Figure 5). The restorations were given a final finish and polish, labially, palatally and proximally, using finishing diamonds and soflex discs (3m)®. Clinical and radiographic examination at 1, 3, 6, and 12 months after the dental trauma showed no periodontal or periapical pathology and the restorations were functionally acceptable and aesthetically gratifying (Figures 6 and 7).

Figure 1. Intraoral view of fractured 11 and 21

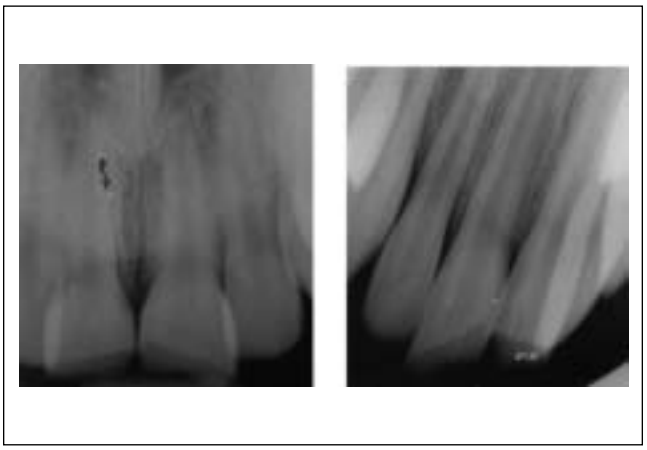

Figure 2. Radiographic examination of fractured 11 and 21

Figure 3. Trying the fragment to ensure fitting

Figure 4. Spreading the excess composite resin across the fracture line using a small brush with unfilled resin

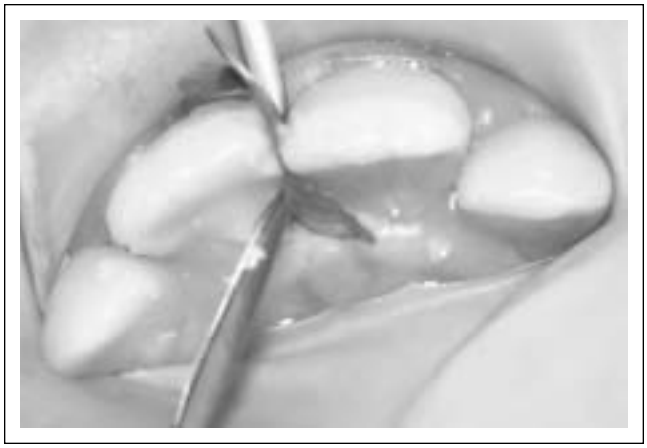

Figure 5. Placing composite resin on the whole palatal surface of the tooth

Figure 6. The restorations were functionally and aesthetically acceptable 12 months after dental trauma

Figure 7. Radiographic examination 12 months after dental trauma showed no periodontal or pulpal lesions

DISCUSSION

Aesthetic, biological and functional restoration of a fractured incisor represents a clinical challenge. The clinician treating a young patient with a crown fracture of a maxillary incisor faces difficulties stemming from the less than ideal results, in terms of contour, color match and incisal translucency, produced by conventional composite resin restoration. A reference guide in a silicone material is made out of a 'composite mock-up' allowing the clinician to assess the thickness and the size of different increments of composite to be applied, from a more opaque composite in the dentin region to a more translucent one in the incisal edge region.[4] However Robertson et al (1997)[37] mention that 19% of restorations were judged unsatisfactory at the final examination. Regarding the failure modes affecting these restorations, the main reasons relate to the adhesive system used, e.g. bond failure leading to fracture of the composite, marginal failure and marginal discoloration. Other reasons either concern the materials and techniques used: cohesive composite fracture, shade instability, recurrent caries, or are independent of the materials and techniques used like tooth fractures. Mean age of replacement of class IV restorations is about 5 years.[38] Composite restorations are characterized by lower hardness compared to enamel,[39,40] while water absorption and wear properties constitute further drawbacks,[41,42] compared to class III and V restorations. Class IV shows the highest failure rates.[43] When variables like large pulpal sizes, progressive eruption and gingival margin instability are also taken into account, prosthetic restorations in young patients can become dubious propositions.

Andreasen and Andreasen 1993[1] state that the reattachment procedures may serve as an important transitional treatment alternative for pre-teen or teenage patients in order to be able to postpone final treatment until an age when gingival margin contours are relative stable. This option could be preferred over composite build-ups under certain conditions: the fragment is available, adaptation to the tooth surface is accurate, size is reasonable (the larger the fragment, the easier to manipulate). Multiple fragments were shown to be difficult to manage.[4] In a multi-centre clinical study of the long-term survival of fragment bonding, Andreasen et al (1995)[44] concluded that the good fragment retention, acceptable esthetics, and pulp vitality observed indicated that re-attachment of a coronal fragment was a realistic alternative to the placement of conventional resin-composite restorations. Even if the reattachment technique for fractured anterior teeth is regarded as a semipermanent solution, it is to be preferred, especially for children, because it helps preserve the dental tissues during tooth development[45,46] while all other restorative options, such as adhesive ones, veneers, and crowns, remain open in the event of reattachment failure.[23] This technique is probably less traumatic to the injured tooth than a procedure involving the preparation and cementation of a crown.[33]

In the modified technique for reattaching a permanent tooth fragment following dental trauma described

here, the initial procedure involved simple reattachment using light cured composite resin between the fragment and the remnant part of the tooth, without additional preparation. The surplus resin discharged at the labial aspect of the fracture line was spread across it in an attempt to optimize marginal seal and improve the aesthetics of the restoration. Finally, after taking into account the occlusion, the lingual surfaces of the teeth were veneered with microfilled composite to improve the retention of the reattached fragments.

Both tooth fragments fitted their counterparts perfectly with no noticeable shortcoming across the fracture line. This technique does not compromise the accuracy of the fit between the two parts of the tooth, preparing the enamel with a circumferential external bevel,[10, 20, 21, 22, 23, 24] chamfering[25] or V-shaped notches limited to the enamel of the avulsed fragment and the enamel of the remaining tooth before reattachment is achieved,[24, 28] can all adversely affect accurate repositioning of the tooth fragment.[20, 24] According to Reis et al 2001,[27] the most favorable esthetic situation exists when there is minimal disruption of enamel at the labial fracture site, and the segments fit together with no discernible defects. This facilitates an accurate apposition of the fragment and minimizes any enamel/composite interface. However using the modified technique described here, the existence of any noticeable or barely noticeable inadequacy (i.e. enamel cracks) across the fracture line, will be masked by the spreading of a small amount of resin across the buccal part of the fracture line. This cannot be considered as a significant exposure of resin composite to the oral environment which might compromise the long-term esthetics due to the abrasion and discoloration that occurs to composites with time,[27, 44, 47] Reis et al (2001)[27] mention that the extensive exposure of composite resin following the over-conture technique constitutes a major drawback, even if the fracture resistance of the restored teeth is close to sound teeth.

Spreading the small amount of oozed resin across the labial aspect of the fracture line provides an exceptional marginal seal. It is questionable though if this marginal seal regarding microleakage can be achieved by applying the simple reattachment technique using adhesive systems only or in association with other materials such as flowable composites, chemically or light cured resins. Say et al (2004),[48] in order to inhibit microleakage due to the enamel cracks and enhance retention, veneered the entire labial surface of the teeth with microfilled composite disregarding esthetic results.

The retention of the tooth remnant and fragment was further reinforced by veneering the whole palatal surface of the tooth with resin composite. It is the present author's opinion that reinforcing the palatal surface of the tooth provides superior retention, however there is, as yet, no related study to support this. Bevels, chamfers, grooves, and undercuts, techniques that are well documented and studied regarding their contribution to the improvement of retention were avoided since they present serious esthetic problems. Worthington et al (1999)[12] observed that internal and external bevels did not increase the fracture strength of the teeth relative to strength values of groups without bevels. In addition, the internal enamel groove is clinically difficult to perform due to the limited enamel thickness of anterior teeth.[49] On the other hand, there are claims that internal dentin grooves compromise esthetics, as the internal resin composite modifies the shade of teeth[50] and the fracture line continues to be evident even when the segments approximate well. It requires then a superficial buccal preparation around the fracture line to improve esthetics of the restoration.[25] Several studies demonstrated that neither bevelling nor the various different materials were able to produce the fracture resistance obtained from intact teeth.[12, 51, 52] Reis et al (2001)[27] verified that specimens prepared by chamferring and bonding, or simply bonding, had a fracture resistance of 37% and 60% respectively, when compared to intact human incisors. These authors have also verified that other restorative techniques such as internal grooving, overcontouring and resin composite restoration achieved more than 90% of the fracture resistance of the intact teeth.

To conclude, using the modified technique suggested, there is no preparation of the tooth fragment before or after reattachment: both tooth remnants and fragments are reunited intact. This, in association with the spreading of oozed resin composite across the labial fracture line is reflected in the quality of the esthetic results provided by this technique. The spreading of the resin composite also provides a very good marginal seal. However the most prominent aspect of our technique is the improvement in the retention and stability of the reattached segments achieved with the palatal resin composite reinforcement. Even in the absence of clinical or laboratory studies, the author's experiences in applying this technique to 34 teeth during the last 9 years have not resulted in any case of failure with the exception of one due to another trauma. Additionally, the aesthetics have been fully acceptable on follow up recalls with insignificant resin discoloration and wear.

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