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Tooth Fragment Reattachment: The Natural Restoration

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Clinical Relevance

This technique is a conservative and predictable approach to restore fractured anterior teeth.

SUMMARY

The aim of this manuscript was to discuss some important considerations about tooth fragment reattachment and report the success of a clinical case in which a tooth fragment and direct composite resin were used to restore a fractured anterior tooth. Clinical and radiographic examination 12 months after trauma showed good esthetics and periodontal health.

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INTRODUCTION

One in four people suffer from some kind of oral trauma during childhood or youth, especially males.[1] The impact during trauma transfers a large amount of energy to a limited part of the tooth crown, leading to fracture of tooth structure. Motor vehicle collisions, sports, and home accidents are the most common causes of anterior tooth fractures. Because of their vulnerable position in the dental arch, upper central incisors are the most affected.[3] The risk of tooth fracture is further increased when an individual has severe overjet/overbite or anterior open bite.[4]

Dental fractures are classified by the World Health Organization as uncomplicated (cracks and/or enamel and dentin fractures) or complicated (with pulp exposure and/or periodontal involvement). Fortunately, uncomplicated fractures are more frequent and require less complex treatment.[2,5]

Dentists are often required to treat (usually as an emergency situation) the esthetic, functional, and emotional discomforts that tooth fractures can cause. Treatment strategies range from simple enamel polishing to prosthetic rehabilitation. The restorative choice is based on various factors, such as the extent of the fracture, a patient's age, dental eruption and root formation, occlusion, esthetic expectations, amount and quality of remaining

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tooth, and pulpal and periodontal involvement.[6–8] If pulp becomes exposed, the priority of restorative care is to preserve vitality using a conservative approach (pulp capping, pulpotomy, or curettage), depending on the degree of bacterial contamination, root formation, pulp consistency, and bleeding.[2] When periodontal biologic width is compromised, surgical modification of the support tissues or orthodontic movement (extrusion) are necessary to enable restorative procedures and promote periodontal health.[9–11] However, a single anterior tooth osteotomy can result in poor esthetics (considering the bony architecture of the adjacent teeth), postoperative sensitivity (root exposure), and periodontal pockets.[12,13] Extrusion also has disadvantages, such as reduced cervical diameter (in relation to adjacent teeth), time required for stabilization (restraint), incisal abrasion to adjust the cervical-incisal tooth length, and consequent loss of optical characteristics.[11,14]

A perfect reproduction of the natural dental color, optical properties (such as translucency, opalescence, and fluorescence), shape, and surface texture is a challenge and requires great skill and dexterity when performing a direct composite restoration. Therefore, when a tooth fragment is viable and presents good adaptation to the remaining dental structure, it should be the first restorative option, with the restorative procedures performed immediately (just after fracture) or later (under more favorable conditions).[6,8] Although the first report of fragment reattachment dates from 1964, adhesive restorations were not possible until the late 1970s (without pin retention) using enamel/dentin etching associated with an adhesive system and composite resin.[16,17] Adhesive reattachment requires minimum healthy tooth reduction, has a predictable esthetic result, is usually faster than a complete composite restoration, and triggers a strong emotional effect because the patient feels relief by keeping one's own natural tooth.[8,18]

Modifications to both tooth and fragment prior to bonding have been proposed, with an estimated recovery of fracture resistance up to 97%.[19] Theoretically, these techniques (dentin groove, bevel, chamfer, or overcontour) remove fractured enamel prisms and retain prisms that are in a favorable position for effective etching.[17] Preparations can also be performed after bonding to improve esthetics by grinding the buccal fracture line and masking it with composite.[18,20,21] Indeed, restorations might result in fragment misfit or deficient composite esthetics over time because of composite abrasion or discoloration.[8,17,22] Simple reattachment recovers approximately 37–50% of the tooth fracture resistance.[23,24] Nevertheless, this procedure is feasible because retention relies on hybridization.[8,15,18,21,25,26] Similar bonding results are achieved with the use of adhesives alone or in combination with composites. However, there is a trend of improving fracture resistance when adhesives are associated with composite resin because they would fill possible interface gaps.[24]

Sometime after bonding, a fragment might exhibit a lighter shade (white) than the remaining. This occurs because of possible dentin dehydration and breakdown of collagen fibers.[27] To avoid discoloration, the patient should be instructed to store the tooth fragment in water immediately after trauma. Furthermore, hydrophilic adhesives require proper dentin hydration for optimal bonding.[28] If a tooth fragment is maintained in a dry state for more than one hour, it will achieve lower bond strength[29] and must be rehydrated for at least 30 minutes before bonding.[20] Complete rehydration and color match usually occurs after one week but could be delayed by several months or may never occur.[6,30,31]

Fragment debonding happens because of repeated trauma, nonphysiological use of the tooth, or horizontal pulling of the tooth.[22] The risk of debonding is higher for children since they have restricted control of incisive function and greater exposure to traumatic situations.[8] Some authors have demonstrated long-term reattachment prognoses that are better than composite restorations, reaching a 90% success rate after five years.[3,22] While the fracture line becomes undetectable in some cases, the patient should be informed about treatment limitations and future interventions.[32]

The following case report describes the management of anterior fractured teeth with periodontal involvement, where a fragment was used as the main restorative material.

CLINICAL CASE REPORT

A 13-year-old boy presented to the Federal University of Santa Catarina with fractured anterior teeth (#8, #9, and #10) as a result of a fall that occurred three months before (Figure 1). Radiographic evaluation of tooth #9 revealed an apical lesion and pulp necrosis. An enamel and dentin fracture, with subgingival extensions, was observed on tooth #8 (Figure 2), and the patient was in possession of the fragment. The provided fragment was stored in distilled water during the clinical examination.

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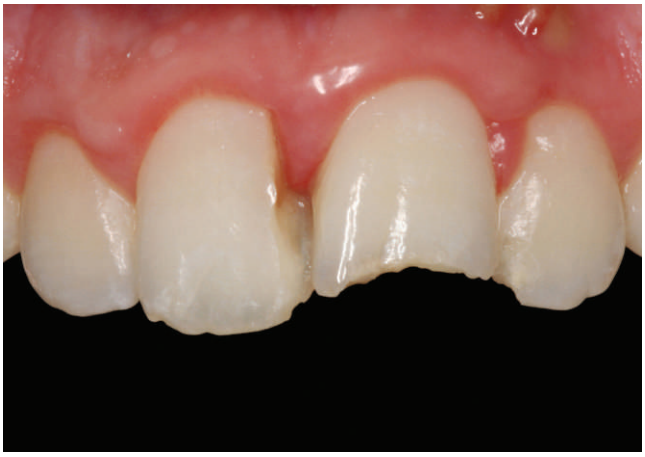

Figure 1. *Preoperative clinical image of fractured anterior teeth.*

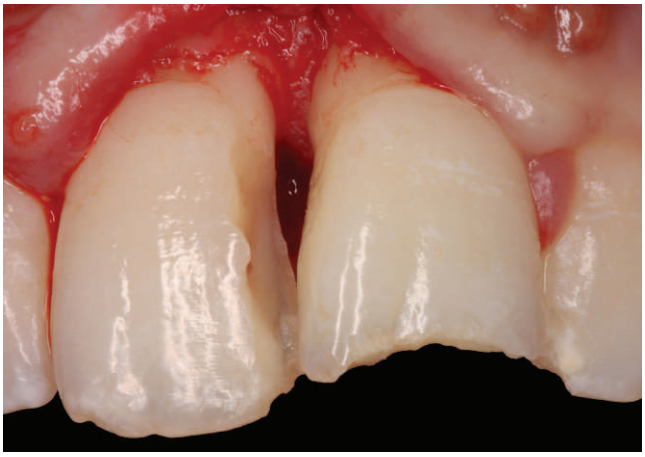

Figure 3. *Gingival flap enabled observation of fracture limit.*

An intrassulcular incision was made on teeth #8 and #9. A gingival flap was obtained to evaluate the relation between the fracture margin and alveolar bone, to provide adequate isolation of the operative field (essential for bonding procedures), and to verify the fit of the fragment. The fracture margin was located at the cementoenamel junction; therefore, an osteotomy was not necessary (Figure 3). After rubber dam isolation, excellent fragment adaptation was observed, and it was determined that the best treatment plan was to reattach the fragment (Figure 4). The fragment and tooth were etched with 35% phosphoric acid (Table 1) for 15 seconds and rinsed. The enamel was air dried while the dentin was maintained in a moist state using a cotton pellet. Two adhesive coats were then applied without light curing (Figure 5). A composite resin increment was placed over the entire fractured surface, and the fragment was positioned and properly adjusted (Figure 6). After the excess resin composite was removed, the restoration was light cured for 40 seconds each on the buccal and palatal surfaces using an LED unit with a 900 mW/cm^2 output (Figure 7). Polishing was performed using abrasive discs and polishing paste. The gingival flap was repositioned, and the papillae were sutured (Figure 8). After 10 days, the stitches were removed, and improved gingival health was observed (Figure 9). Tooth #9 was endodontically treated, and direct composite resin restorations were performed on the other fractured teeth. A clinical and radiographic examination 12 months after trauma showed the absence of a visible fracture line and good periodontal health (Figure 10).

Potential Problems

The development of effective adhesives and composite resins has made fragment reattachment the main

Figure 2. *Incisal view suggesting biological width involvement of tooth #8.*

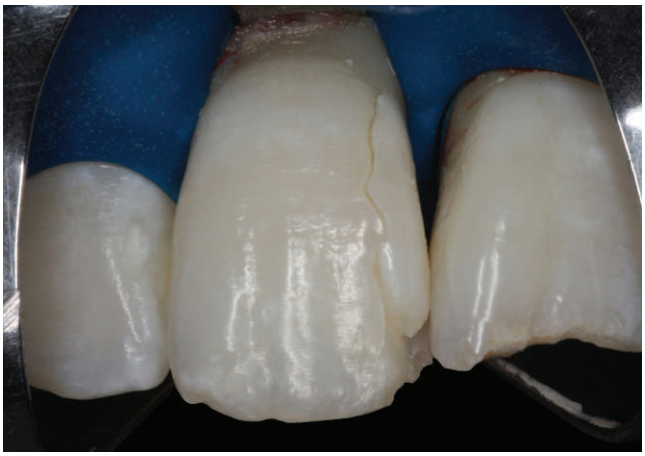

Figure 4. *Tooth fragment exhibited excellent adaptation, and it was used as the main restorative material.*

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Table 1: *Materials Used*	
Etchant Gel (phosphoric acid gel 35%)	Coltène/Whaledent, Altstätten, Switzerland
Adper™ Single Bond 2 (etch&rinse two-step adhesive)	3M ESPE, St. Paul, MN, USA
KG Brush Fine (disposable applicator)	KG Sorensen, Cotia, SP, Brazil
Flash Lite 1401 (LED unit)	Discus Dental, Culver City, CA, USA
Composites 4 Seasons (composite resins)	Ivoclar Vivadent, Schaan, Liechtenstein
Sof-Lex (polishing discs)	3M ESPE, St. Paul, MN, USA
Diamond Excel (polishing paste)	FGM, Joinville, SC, Brazil
Diamond Flex (felt discs)	FGM, Joinville, SC, Brazil

choice for rehabilitating fractured anterior teeth, especially in young patients.[6] Because of its conservative nature, this technique reduces the need for a further restorative approach, as the fragment behaves similarly to the remaining tooth in regard to physiological wear and does not present signs of deterioration as early as composite resins (staining and surface texture loss).[3,15]

Clinicians who wish to master the technique and provide favorable esthetics and long-term results to their patients must have a working knowledge of the variations of the technique since some cases require a multidisciplinary approach, such as surgery or endodontics. In the presented case, it would not be prudent to utilize reattachment without surgical exploration to determine the extent of the fracture and to ensure a clean and dry operating field provided by rubber dam isolation. The success of the bonding protocol would be impaired by blood contamination from the gingival flap.[12] In order to facilitate fragment handling and prevent reattachment in an improper position, there are some strategies that can be utilized, such as fragment stabilization with low-fusion compound, gutta-percha, wax, or acrylic or silicone index, which maintains a reference of the adjacent teeth.[8,33] In the present case, the use of an index was not necessary because of the excellent fit between the fragment and remaining tooth structure.

According to the patient, the fragment was maintained intraorally and in position since the trauma occurred (three months). Even though the

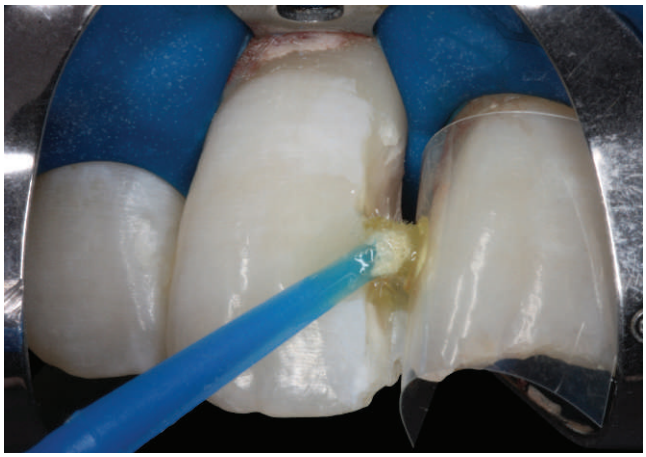

Figure 5. *Two adhesive layers were applied on etched substrates.*

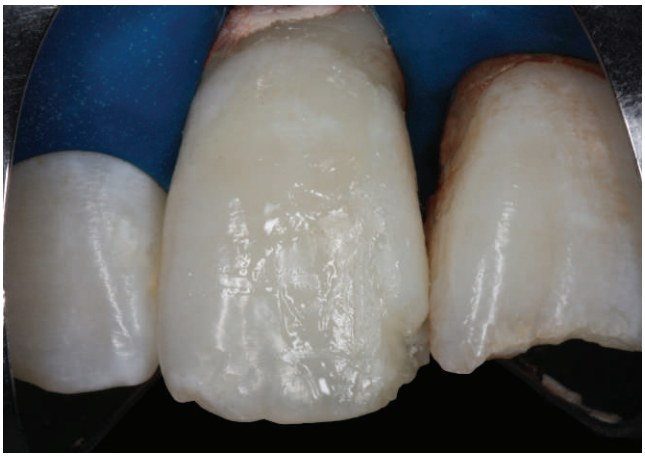

Figure 6. *Fragment adapted after remove of resin composite excess.*

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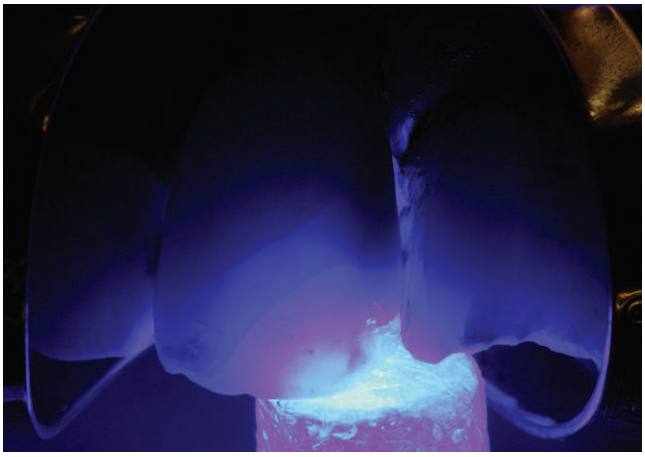

Figure 7. *Dental cracks on tooth #8 were observed during palatal light curing.*

fragment had been kept hydrated by saliva, the fragment was immersed in distilled water for 30 minutes prior to bonding to ensure adequate hydration and superior bond strength.[20,29] Mechanical preparation of the fragment was not performed before bonding, and its retention was based solely on hybridization.[8,15,21,25,26] Even with the possibility of using an adhesive system[24] only for fragment reattachment, composite resin was applied to fill possible gaps between the fragment and the remaining tooth structure and to improve the adaptation of the two pieces.

After three months, tenuous color mismatch was still observed between the fragment and tooth, but the patient was satisfied. However, even in cases where the fragment remains dehydrated for long periods of time and presents a contrasting color, reattachment has great value since complete rehydration may still occur.[31] One year after reattachment, the patient was pleased with the appearance of his anterior teeth, and no other esthetic treatment was necessary.

Figure 9. *After 10 days, improved gingival health was observed.*

In order to maintain oral health, reattachment cases must be followed for two years with clinical examination, vitality testing, periodontal probing, and radiographs.[8] It is very important that patients and their families understand the limitations of reattachment and take care to prevent fragment displacement. However, it is a dentist's responsibility to diagnose deleterious habits or traumatic activities that the patient may present and offer some protection, such as the use of a custom mouthguard.[4,34]

Advantages

- Conservative treatment
- Low cost and faster than direct restorative procedures
- Predictable esthetic result

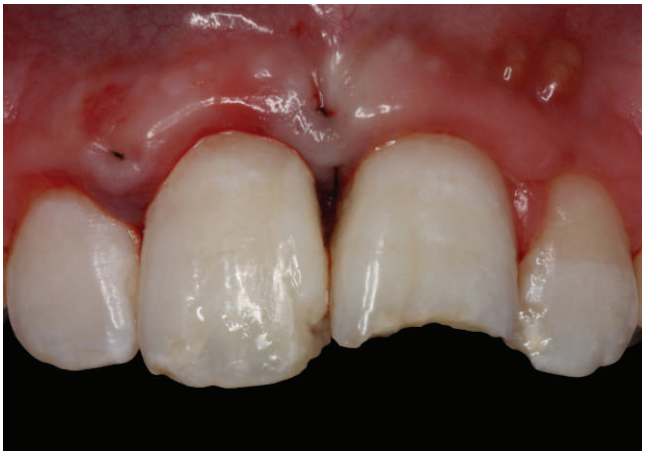

Figure 8. *Immediate view after gingival flap suture denotes tenuous color mismatch between the fragment and tooth #8.*

Figure 10. *Clinical view 12 months after trauma (composite direct restorations were realized on teeth #8, #9, and #10).*

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Limitations

- Possible fragment debonding
- Incomplete fragment rehydration and color mismatch

CONCLUSIONS

- Considering the high incidence of dental fractures as a result of trauma, the working knowledge of the dentist regarding treatment possibilities is essential.
- Tooth fragment reattachment should be performed whenever possible because it is a simple, fast, and affordable procedure and presents a predictable esthetic result.

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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