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Clinical Technique/Case Report

Tooth Fragment Reattachment: A Case Report

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Clinical Relevance

The reattachment of a fractured tooth fragment offers a viable option for the dental clinician. Function and esthetics may be restored with the use of this conservative and low-cost approach.

SUMMARY

The aim of this article is to present a case report for the multidisciplinary treatment of anterior tooth fractures with invasion of the biologic width and pulpectomy. Successful esthetic and functional results were achieved by bonding the crown fragment, without any form of preparation or the utilization of intra-canal posts.

INTRODUCTION

Crown fractures are the most common consequences of traumatic injuries that mainly occur in the anterior permanent dentition. It is estimated that a quarter of the population suffers a minimum of one dental traumatic injury related to coronal fractures of the anterior teeth before the age of 18 years, the most common of which are attributed to falls, high-impact sports, and motor vehicle accidents.[1, 2]

Most traumatic tooth injuries merely involve damage to the enamel and dentin without pulp exposure.[3] Crown-root fractures represent only 0.3% to 5% of these injuries and require a complex and multidisciplinary treatment.[4,5] Choosing the correct treatment to be followed is based on the age of the dental patient; the extent of the fracture (severity and location of the invasion of the biologic width); the presence or absence of endodontic involvement; the presence/absence of the tooth fragment and its condition of use; the occlusion and esthetics; and time and patient expectations.[6-12] A review of the possible treatments can be found in Table 1.

In the case of fractures that involve invasion of the biologic width, restorations of the biological distance and access to the remnant's margins are required for the purpose of allowing for the correct isolation of the operatory field and determination of the fracture extent.[7,11,13,14] Advantages and disadvantages of the different treatments are listed in Table 2.

The choice of the esthetic restorative treatment of fractured anterior teeth remains the biggest challenge for the dentist. Treatment options include composite resin restoration, fragment reattachment, and ceramic restorations (full crowns, laminate veneers, or ceramic fragments). When the

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Table 1: *Type of Fractures, Treatment of the Pulp, and Restorative Protocol*

Type of Fracture	Tissue Involved	Pulp Treatment	Restorative Protocol
Enamel fracture	Enamel	None	Protocol 1: incisal edge wear Protocol 2: direct adhesive restoration
Enamel and dentin fracture (without pulp involvement)	Enamel Dentin	None	Protocol 1: direct adhesive restoration Protocol 2: fragment reattachment
Enamel and dentin fracture (with pulp involvement)	Enamel Dentin Pulp	Pulp vitality and root apex in formation 1. Small exposure, up to 2 h after trauma, hemostasis: direct pulp capping 2. Small to medium exposure, more than 2 h after trauma, hemostasis: pulp curettage 3. Large exposure, more than 2 h after trauma, hemostasis: pulpotomy Pulp vitality and root apex formed 1. Presence of hemostasis: pulpotomy 2. Absence of hemostasis: pulpectomy Absence of vitality 1. Pulpectomy	Protocol 1: direct adhesive restoration Protocol 2: fragment reattachment Protocol 3: ceramic restorations (ceramic veneers, fragments, crowns)
Crown-root fracture (with or without invasion of the biologic width)	Enamel Dentin Cementum Periodontal ligament Alveolar bone	Pulp may or may not be involved Pulp involvement: following the above protocol	Protocol 1: direct adhesive restoration Protocol 2: fragment reattachment Protocol 3: ceramic restorations

tooth fragment is present and in good working condition, the best option for the treatment of a coronal fracture fragment is reattachment.[15] Proposed as a simple and conservative option, fragment reattachment restores the morphological, functional, and esthetic aspects of the dentition, while maintaining the shape, contour, texture, color, and alignment of the natural teeth. Furthermore, fragment reattachment can be considered a fast and low-cost treatment solution, creating a positive emotional and psychological response in the patient.[3,4,9,11,16-19]

Table 2: *Treatments of Crown-root Fractures*

Clinical Situation	Type of Treatment	Advantages	Disadvantages
Crown-root fracture without involvement of the biologic width	Gingivectomy: margin exposure with removal of excess gum tissue	Easy to perform Rapid healing	Change in the gingival level and alignment
	Gingival flap: margin exposure without removing gum tissue	Facilitates isolation of the operative field Easy to perform Rapid healing	Gingival alteration in the esthetic area
Crown-root fracture with involvement of the biologic width	Flap technique: gingival flap displacement + osteotomy and osteoplasty	Safe and effective technique	Compromised bone support of the adjacent tooth Increased clinical crown Reducing the cervical diameter
	Extrusion dental: orthodontic extrusion of the apical portion until the fracture margin is exposed	No change in the gingival level and alignment No removal of bone tissue	Slow technique Stabilization time Appearance of black space Edge wear to incisal length adjustment Loss of shape and optical characteristics of the tooth
	Flapless technique: osteotomy without gingival flap	Safe and effective technique Rapid healing	Change in the gingival level and alignment

Figure 1. *Initial view of the fractured element.*

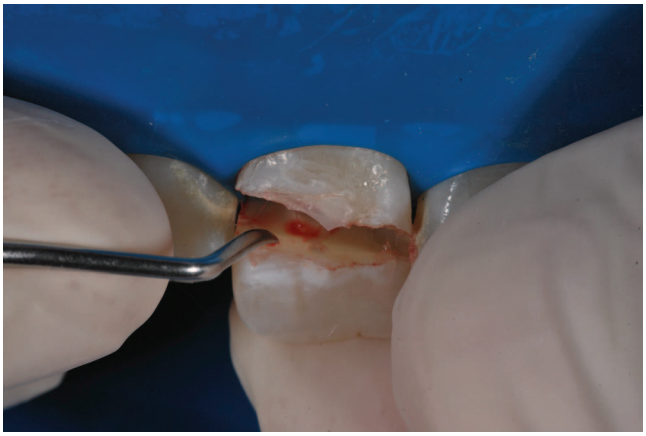

Figure 2. *Fragment dislocation, followed by bleeding.*

This technique was first published in 1964, when Chosak and Eidelman described a case involving the reattachment of a natural tooth fragment. Since then, different preparation techniques (bevel, circumferential chamfer, buccal chamfer, overcontour, internal dentin groove) as well as adhesive materials have been described throughout the literature, designed to increase the chemical and mechanical retention of fragments.[20,21] However, dentists are still seeking consensus over which preparation method and which materials are best to achieve the best results using the fragment reattachment technique.[22]

The following case report describes the management of a crown-root fracture of a maxillary central incisor treated in a multidisciplinary manner, in which the dental fragment was used as the main restorative material.

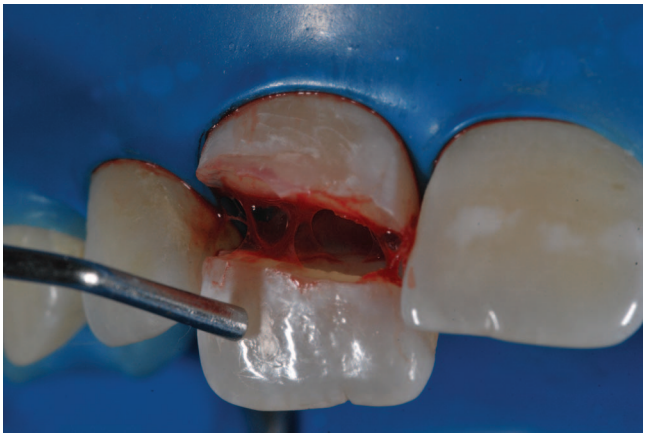

Figure 3. *Fragment retained by palatal gingival tissue.*

Figure 4. *Gingival flap allowing visualization of the fracture line.*

CLINICAL CASE REPORT

A 21-year-old patient presented to the clinic with a coronal fracture of the maxillary central incisor caused by a domestic fall. Through clinical evalua-

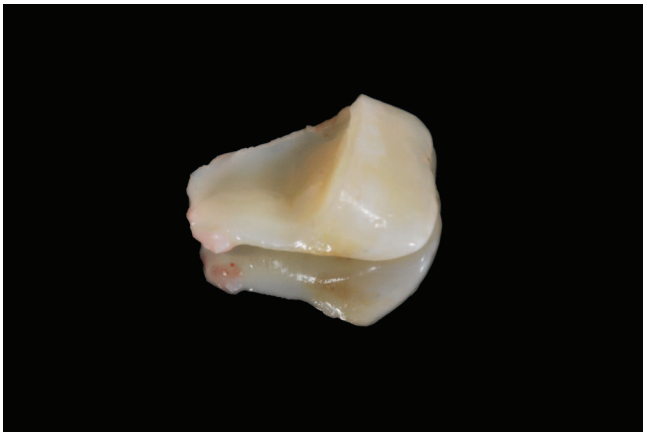

Figure 5. *Dental fragment.*

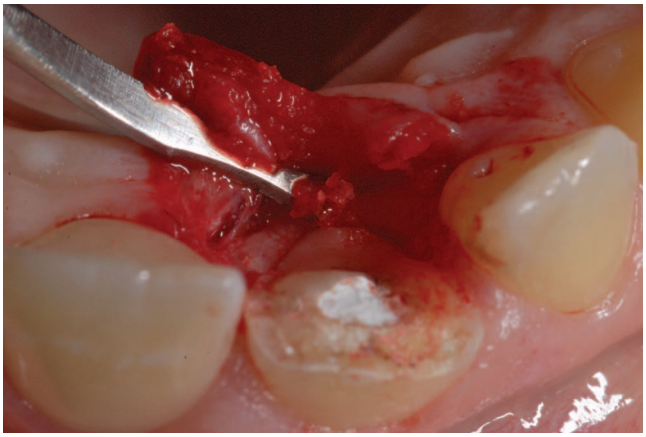

Figure 6. *Osteotomy and osteoplasty of the palatal region.*

tion it was observed that the dental fragment was in position, stabilized by an increment of composite resin that had been placed by a dentist in an emergency office. There were no signs of pulp involvement, and the fracture line was subgingival (Figure 1). Under rubber dam isolation, the composite resin was removed and the tooth fragment was displaced, causing pulp exposure followed by bleeding (Figure 2). During its removal, it was observed that the fragment was retained by the palatal gingival tissue (Figure 3). Thus, it was necessary to perform an intrasulcular incision followed by a gingival flap in order to remove the fragment (Figure 4). The tooth fragment was then frozen in distilled water during the clinical examination, for a period of about six hours (Figure 5). When exposing the fracture margin it was observed that the location of the fracture line was located intraosseously, invading the biological space. Therefore, it was necessary to perform osteotomy and osteoplasty of the palatal region, removing approximately 1 mm of bone tissue (Figure 6).

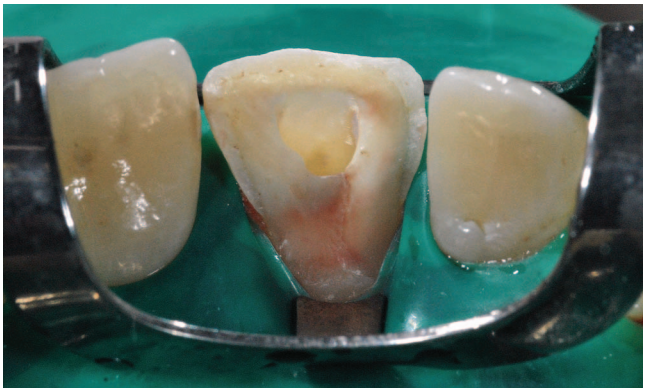

Figure 7. *Isolation of the operative field.*

Figure 8. *Dental fragment repositioned and exhibiting excellent adaptation.*

Rubber dam isolation was performed using a #212 retraction clamp in order to expose the fracture margin and to keep the area clean and dry, providing favorable conditions for the restorative treatment (Figure 7). The clinician opted to perform an invasive procedure of the pulp (pulpectomy) followed by a single-session endodontic treatment. The selection of a less invasive treatment would prejudice the process of the functional recovery of dental pulp.

The tooth fragment was thawed in water for 30 minutes before being repositioned. After repositioning the tooth fragment it was possible to observe excellent adaptation. Considering this result, the best treatment choice was the fragment reattachment technique (Figure 8). The tooth fragment was positioned and stabilized with an increment of composite resin and then the adjacent teeth were isolated with petroleum jelly. Lastly, an acrylic resin guide was fabricated (Figure 9). This technique allows for the correct insertion and cementation of

Figure 9. *Acrylic guide made with the fragment in position.*

Table 3: *Materials Used*	
Rubber dam	SSWhite (Rio de Janeiro, Brazil)
#212 Retractor clamp	SSWhite (Rio de Janeiro, Brazil)
DuraLay (acrylic resin)	Reliance Dental Mfg (Worth, IL, USA)
Phosphoric acid 37% (etching gel)	BM4 (Florianópolis, SC, Brazil)
Adper Single Bond (adhesive)	3M ESPE (St Paul, MN, USA)
Empress Direct (composite resin)	Ivoclar Vivadent (São Paulo, Brazil)
Variolink Veneer (resin cement)	Ivoclar Vivadent (São Paulo, Brazil)
Bluephase (LED unit)	Ivoclar Vivadent (São Paulo, Brazil)
Sof-lex (polishing discs)	3M ESPE (St Paul, MN, USA)
Diamond Flex (felt disc)	FGM (Joinville, SC, Brazil)
Diamond Excel (polishing paste)	FGM (Joinville, SC, Brazil)

the fragment, facilitating its manipulation and adaptation. The fragment was etched with 37% phosphoric acid beyond the margins for 15 seconds and rinsed with air/water spray. After being dried, two layers of the adhesive system were applied and thinned with air jets. The fragment was preserved, without light activation, protected from the ambient light.

The tooth and the root canal were both etched with 37% phosphoric acid for 15 seconds. After being rinsed for 30 seconds, the enamel surface was left completely dry, while dentin was left slightly moist. Two layers of an adhesive (Table 3) were applied and mild air jets were applied until a shiny appearance was observed on the uncured surface. After light curing the adhesive, the root canal opening was sealed with an increment of composite resin in close contact with the filling material, without interfering with the repositioning of the fragment (Figure 10).

A small amount of dual resin cement was applied over the whole surface of the tooth fragment. Then it was correctly positioned with the aid of the acrylic guide (Figure 11). After the excesses were removed, the resin cement was light cured for 20 seconds using an LED unit (900 mW/cm^2 output). The guide was then removed and a final light curing was performed for 60 seconds on each aspect of the tooth. Finishing and polishing of the buccal and palatal surface were carried out with abrasive discs, felt discs, and polishing pastes. After the removal of the rubber dam, the gingival flap was repositioned and the papillae sutured (Figure 12).

In a follow-up clinical evaluation conducted four months after the trauma, the fracture line was not visibly observable and satisfactory periodontal health was exhibited (Figure 13).

POTENTIAL PROBLEMS

The development of adhesive restorative materials has provided new perspectives for the treatment of fractured teeth. Common restorative treatments, such as ceramic laminates or crowns, tend to sacrifice large amounts of tooth structure, making the color matching to the adjacent teeth difficult.[23] The variety of materials, such as adhesive systems

Figure 10. *Root canal opening being sealed.*

Figure 11. *Fragment reattachment.*

Figure 12. *View after the papillae were sutured.*

and composite resins, combined with the skill and knowledge required to mimic the shape, color, and texture of a tooth make the realization of direct composite resin restorations difficult.[8] Thus, fragment reattachment becomes a fast, simple, and conservative technique that provides excellent rehabilitation of the esthetics and function.[16] However, in order to make feasible the most favorable long-term results, the dental clinician needs to have knowledge of the materials and follow the correct treatment protocol by first performing periodontal procedures, followed by the endodontic treatment, and, lastly, by facilitating fragment reattachment.[14]

Dehydration of the fragment may result in a change in dental color and a decrease in the fracture strength of the tooth. Proper rehydration of the fragment has the capability of restoring both color and strength.[8,12] Farik and others[24] evaluated the fracture resistance of dehydrated and rehydrated teeth over different periods of time. When the fragment remains dehydrated for more than one hour, the fracture resistance decreases significantly. In the same study, the authors observed that when the specimen remains dehydrated for more than 24 hours, the optimal rehydration time given was a period equal to, but not less than, 24 hours. This will ensure the maintenance of the adhesive strength. Similar results were observed by Shirani and others[25] in their latest study. The authors evaluated the adhesive strength of dental fragments dehydrated for different time periods with posterior rehydration time periods of 30 minutes or 24 hours. They concluded that the final results were independent of the dehydration time and that 24-hour rehydration periods result in greater adhesive strength when compared to the 30-minute rehydration periods.

Figure 13. *Clinical view four months after the trauma.*

However, when the fragment dehydration time is 30 minutes or less, rehydration for 30 minutes is sufficient enough to obtain significant improvement of the adhesive strength.[25]

When endodontic treatment is indicated, the use of intraradicular posts, with the aim of reinforcing the tooth structure, becomes dubious. A recent study[21] evaluating the fracture strength of three fragment bonding techniques associated or not associated with fiber glass posts concluded that the use of intraradicular posts in endodontically treated teeth did not provide any reinforcement of the dental structure, making it unnecessary when the bonding technique is chosen.

There is not any consensus in the literature regarding the realization of any type of preparation and regarding the long-term effectiveness of the strengthening of the dental structure after fragment reattachment. It has been found that making a preparation increases the fracture strength of the tooth when compared to direct bonding without any type of preparation.[20,21,26-28] However, neither direct bonding nor the use of preparations reaches the initial fracture strength of the dental element. In addition, it has been argued that the adhesive is ultimately responsible for the bond strength of the fragment to the tooth and that the preparation is less important.[22,29] In the case presented, the fragment was well adapted, and for this reason there was not any additional preparation and the retention of the fragment was achieved only through hybridization of the dental tissue. We opted for the use of resin cement and not composite resin, considering that the shade, viscosity, and dual-cure mechanism of these cements facilitate the insertion and polymerization, while the innermost portions of the luting interface may not be light cured. If the fragment does not exhibit good

adaptability and if there is a loss of continuity, composite resin is indicated for filling any volume loss.

It is the dentist's responsibility to undertake periodic follow-up consultations and to perform clinical, radiographic, and periodontal examinations as well as pulp vitality tests in order to ensure the integrity, the esthetics, and the functional health of the fractured element.[6]

Advantages

The advantages of fragment reattachment are as follows:

- It offers faithful reproduction of the shape, contour, and texture of the natural tooth;
- It offers unchanged color and optical characteristics; and
- It is a predictable, quick, conservative, and low-cost method.

Disadvantages

The disadvantages of fragment reattachment are as follows:

- It may result in a change in color due to inadequate rehydration of the fragment; and
- It carries the possibility of detachment of the fragment.

CONCLUSION

- Complex coronary fractures require a specialized interdisciplinary treatment and must be carefully assessed by the dental clinician to achieve the best possible outcome.
- Bearing in mind that it is a simple, fast, affordable, and esthetically predictable technique, tooth fragment reattachment should always be the treatment method of choice when the fragment is present and is in good condition, even if a perfect adaptation is not observable.

Human Subjects Statement

This work was completed at the Universidade Federal de Santa Catarina, Campus Universitário Trindade, Florianópolis, Brazil.

Conflict of Interest

The authors 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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