

Reattachment of Anterior Teeth Fragments: A Conservative Approach

GEORGIA V. MACEDO, DDS*

PATRICIA I. DIAZ, DDS, PhD[†]

CARLOS AUGUSTO DE O. FERNANDES, DDS, MS, PhD[‡]

ANDRÉ V. RITTER, DDS, MS[§]

ABSTRACT

Coronal fractures of the anterior teeth are a common form of dental trauma that mainly affects children and adolescents. One of the options for managing coronal tooth fractures when the tooth fragment is available and there is no or minimal violation of the biological width is the reattachment of the dental fragment. Reattachment of fractured tooth fragments can provide good and long-lasting esthetics (because the tooth's original anatomic form, color, and surface texture are maintained). It also restores function, provides a positive psychological response, and is a relatively simple procedure. Patient cooperation and understanding of the limitations of the treatment is of utmost importance for good prognosis. This article reports on two coronal tooth fracture cases that were successfully treated using tooth fragment reattachment.

CLINICAL SIGNIFICANCE

Reattachment of fractured tooth fragments offers a viable restorative option for the clinician because it restores tooth function and esthetics with the use of a very conservative and cost-effective approach.

(J Esthet Restor Dent 20:5–20, 2008)

INTRODUCTION

Coronal fractures of the anterior teeth are a common form of dental trauma that mainly affects children and adolescents.^{1,2} The majority of dental injuries involves the anterior teeth, especially the maxillary incisors (because of its position in the arch), whereas the mandibular central incisors and the maxillary lateral incisors are less

frequently involved. Dental injuries usually affect only a single tooth; however, certain trauma types such as automobile accidents and sports injuries involve multiple tooth injuries.³

Several factors influence the management of coronal tooth fractures, including extent of fracture (biological width violation, endodontic

involvement, alveolar bone fracture), pattern of fracture and restorability of fractured tooth (associated root fracture), secondary trauma injuries (soft tissue status), presence/absence of fractured tooth fragment and its condition for use (fit between fragment and the remaining tooth structure), occlusion, esthetics, finances, and prognosis.^{4–6} Patient

*Graduate student, Department of Operative Dentistry, University of North Carolina at Chapel Hill, NC, USA

[†]Graduate student, Department of Periodontology, University of North Carolina at Chapel Hill, NC, USA

[‡]Associate professor, Department of Operative Dentistry, Federal University of Ceara, Fortaleza, Brazil

[§]Associate professor, Department of Operative Dentistry, University of North Carolina at Chapel Hill, NC, USA

cooperation and understanding of the limitations of the treatment is of utmost importance for good prognosis. When there is a substantial associated periodontal injury and/or invasion of the biological width, the restorative management of the coronal fracture should follow the proper management of those associated issues. Coronal fractures must be approached in a systematic way to achieve a successful restoration.

One of the options for managing coronal tooth fractures, especially when there is no or minimal violation of the biological width, is the reattachment of the dental fragment when it is available.⁷ Tooth fragment reattachment offers a conservative, esthetic, and cost-effective restorative option that has been shown to be an acceptable alternative to the restoration of the fractured tooth with resin-based composite or full-coverage crown.^{6,8-10} Reattachment of a fragment to the fractured tooth can provide good and long-lasting esthetics (because the tooth's original anatomic form, color, and surface texture are maintained),⁹ can restore function, can result in a positive psychological response, and is a reasonably simple procedure.¹¹ In addition, tooth fragment reattachment allows restoration of the tooth with minimal sacrifice of the remaining tooth structure. Furthermore, this technique is less time-consuming and provides a

more predictable long-term wear than when direct composite is used.¹² Clinical trials and long-term follow-up have reported that reattachment using modern dentin-bonding agents or adhesive luting systems may achieve functional and esthetic success.^{6,13}

Several aspects may govern the choice of a reattachment technique. Studies have reported that the primary cause of fragment loss is new dental trauma or the nonphysiological use of the restored tooth.⁶ Therefore, most concerns about reattachment techniques have been directed toward the fracture strength of the restored tooth.^{5,14}

Clinicians have employed an assortment of bevel designs, chamfers, dentinal and enamel grooves, and choices of resin composite materials and techniques for the reattachment of tooth fragments. Reis and colleagues⁵ have shown that a simple reattachment with no further preparation of the fragment or tooth was able to restore only 37.1% of the intact tooth's fracture resistance, whereas a buccal chamfer recovered 60.6% of that fracture resistance; bonding with an overcontour and placement of an internal groove nearly restored the intact tooth fracture strength, recovering 97.2 and 90.5% of it, respectively.

In cases of complicated fractures, when endodontic therapy is

required, the space provided by the pulp chamber can be used as an inner reinforcement, thus avoiding further preparation of the fractured tooth.^{15,16} However, in such cases, esthetics may become an important issue as pulpless teeth lose part of their translucency and brightness.

This article reports on two coronal tooth fracture cases that were successfully treated using tooth fragment reattachment.

CASE REPORTS

Case 1

A 17-year-old patient presented at the emergency clinic at the University of North Carolina School of Dentistry after sustaining a complicated crown fracture to her maxillary left central incisor during sports activities (Figures 1 and 2). The fractured tooth fragment was recovered by the patient at the site of the injury and maintained in a storage media (Save-a-tooth, Phoenix-Lazerus Inc., Pottstown, PA, USA) (Figure 3).

Clinical and radiographic examination revealed a complicated oblique crown fracture that extended subgingivally on the mesiopalatal area (Figures 4 and 5).

After endodontic therapy, the patient was referred to the Graduate Operative Dentistry Clinic (Figure 6).



Figure 1. Preoperative—smile view.



Figure 2. Preoperative—frontal view.



Figure 3. Storage media (Save-a-tooth, Phoenix-Lazerus Inc., Pottstown, PA, USA).



Figure 5. Preoperative—occlusal view.



Figure 4. Radiographic image of the fractured tooth.

Upon examination, the treatment options were presented to the patient and to her legal guardian, including (1) no treatment, (2) post-and-core and crown, (3) crown buildup restoration with a resin-based composite, and (4) reattachment of the tooth fragment. After some deliberation about the advantages, disadvantages, prognosis, and cost of every treatment option, the patient and the patient's mother opted to have the tooth fragment

reattached. It is important to note that the reattachment option was presented only after confirming that the fragment was in good condition and that it fit reasonably well on the fractured tooth.

One important complication of this case was the subgingival extension of the fractured margin on the mesiopalatal area as mentioned earlier. The gingival aspect of the fractured site revealed a shallow,

knife-edge subgingival fracture margin. Upon probing this area during the clinical examination, it was determined that the biological width was only minimally invaded and that bone recontouring via crown lengthening would not be indicated or required as long as the restorative margin were placed at or above the level of the cemento-enamel junction. As depicted in Figure 7, the tooth fragment comprised two pieces, one of which



Figure 6. Radiographic image of the root canal treatment.

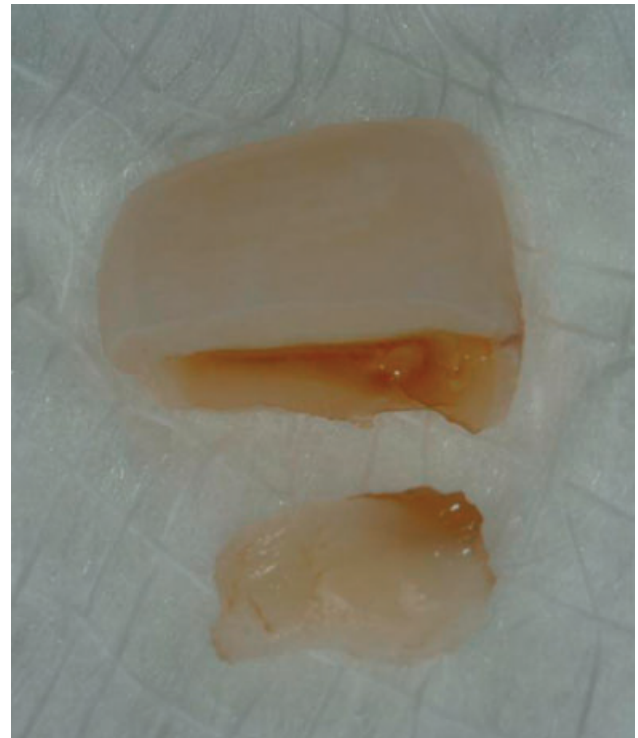


Figure 7. Fragments.

consisted of the majority of the coronal aspect, and the other was a small and thin fragment corresponding to the gingival aspect of the fracture site. After consultation with a periodontist, the strategy followed consisted of discarding the small gingival fragment, recontouring the shallow, knife-edge fractured area in the root of the tooth, and reattaching the coronal fragment.

To gain access to the subgingival fracture line and verify that the fracture did not extend apically, a lingual flap was raised. A 1-mm tissue collar was removed from the mesiopalatal aspect of the tooth. The root surface was then recontoured with a finishing bur to obtain a smooth surface and facilitate tissue healing (Figure 8).

The operating field was isolated with a rubber dam (Figure 9) to

ensure moisture control. The endodontic temporary restorative material was removed from the pulp chamber, and the entrance of the root canal was sealed with a glass ionomer plug (Vitrebond, 3M ESPE, St. Paul, MN, USA) (Figure 10). The pulp chamber, dentin, and enamel were etched with a 37% phosphoric acid gel, rinsed, and coated with an ethanol-based adhesive system (Adper Single Bond Plus, 3M ESPE) (Figures 11 and



Figure 8. Lingual surface was smoothed with a finishing bur.

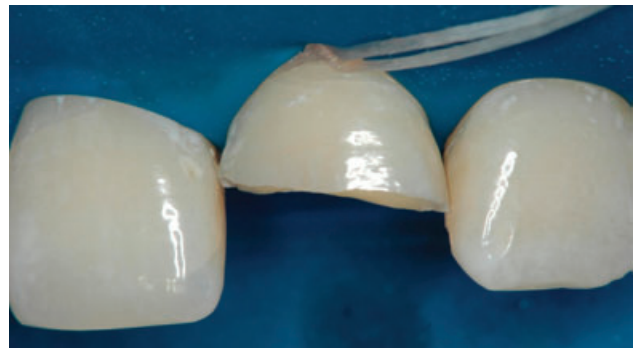


Figure 9. Rubber dam isolation—frontal view.

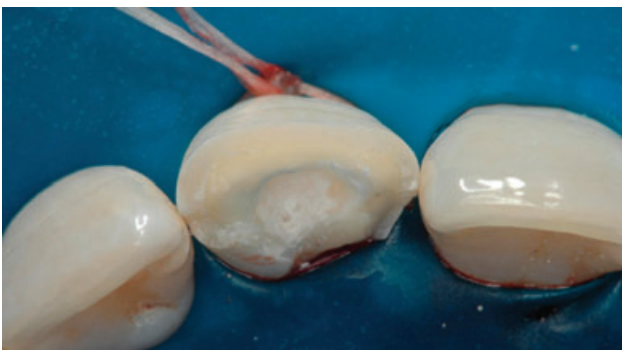


Figure 10. Rubber dam isolation—occlusal view.



Figure 11. Phosphoric acid-etching of the tooth.

12). The adhesive was not light-cured at this point.

The coronal tooth fragment was secured by a “pick-and-stick” device in order to facilitate handling (Figure 13), and the fractured surface of the fragment was treated with 37% phosphoric acid gel for 30 seconds (Figure 14), followed by delicate rinsing. The adhesive system was then applied to the etched surface (Figure 15).

Composite resin (Venus, Heraeus Kulzer, Dormagen, Germany) was applied to both fragment and tooth surfaces. The fractured segment was then accurately placed on the tooth, paying special attention to the fit between the segments (Figure 16). When the original position had been reestablished, excess resin was removed and the area was light-cured for 40 seconds on each surface, making sure that no displacement of the fragment

occurred before adhesive/resin polymerization was complete (Figures 17 and 18).

The margins were properly finished with diamond burs and polished with a series of Sof-Lex disks (3M ESPE) and diamond polishing paste.

The rubber dam was removed, and the gingival tissues were repositioned and sutured (Figure 19).

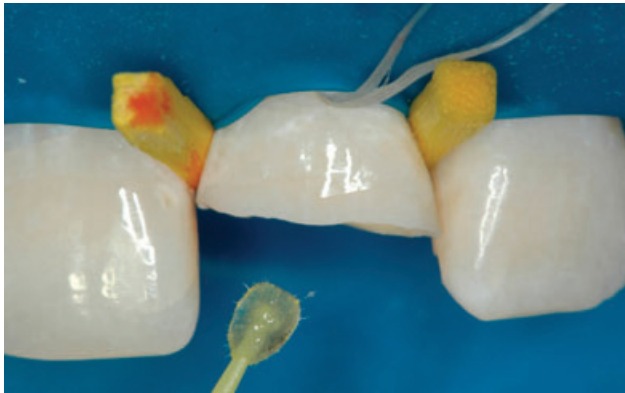


Figure 12. Application of bonding agent on the tooth surface.



Figure 13. Fragment attached to a “pick-and-stick” device.



Figure 14. Phosphoric acid-etching of the fragment.



Figure 15. Application of bonding agent on the fragment.

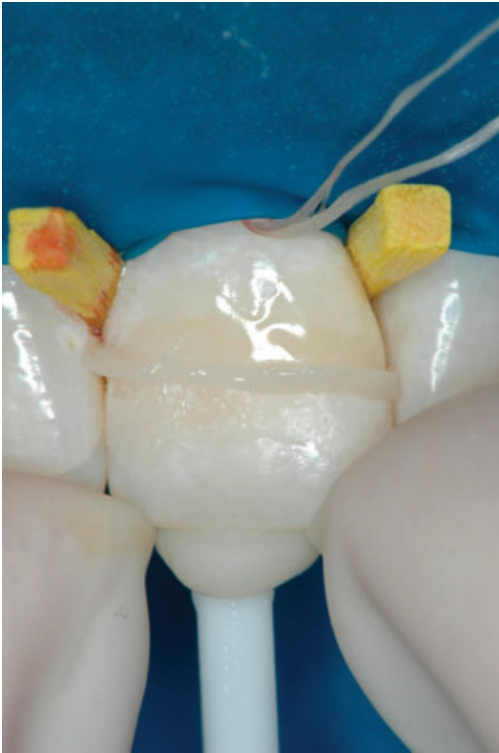


Figure 16. The fractured segment was accurately placed on the tooth, paying special attention to the fit between the segments. Finger pressure was used for better adaptation.

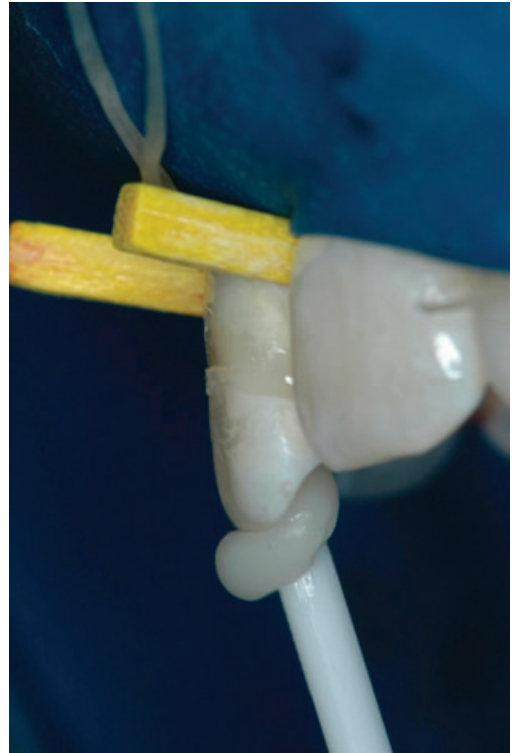


Figure 17. Profile view to ensure that the original position had been reestablished.



Figure 18. Composite resin was light-cured for 40 seconds on each surface.



Figure 19. Immediate postoperative. Rubber dam was removed, and the gingival tissues were repositioned and sutured.

The occlusion was carefully checked and adjusted, and the patient was dismissed after receiving instructions to avoid exerting heavy function on this tooth and to follow regular home care procedures relative to oral hygiene. The patient and the patient's mother were informed that the reattachment line might be visible, and, if necessary, this could be managed in future visits. Most importantly, an athletic mouth guard was fabricated for the patient to use while involved in sports activities (Figure 20).

The patient returned for 1-, 6-, and 14-month follow-ups (Figures 21–25), and it was observed that both endodontic and restorative treatments remained clinically acceptable for the entire time. Although the reattachment line can be noted in a close-up view, the patient was very satisfied with the results and opted not to have the line masked with a partial composite veneer.

Case 2

A 12-year-old patient was injured and suffered an uncomplicated

crown fracture to his maxillary central incisors and left lateral incisor (Figures 26 and 27). The fractured tooth fragments were recovered at the site of the injury and stored in water until his time of appointment in the Operative Dentistry Clinic, Federal University of Ceará, Brazil.

Upon examination, the treatment plan of choice was to reattach the dental fragments of the teeth. The fragments were analyzed (Figure 28) and tried in intraorally to check for proper positioning and fit with the fractured coronal structure.



Figure 20. Athletic mouth guard was fabricated.



Figure 21. One-month follow-up—smile view.



Figure 22. One-month follow-up—close-up view.



Figure 23. One-month follow-up—occlusal view. Note the adequate healing of soft tissues.



Figure 24. Six-months follow-up—frontal view.



Figure 25. Fourteen-months follow-up—frontal view.



Figure 26. Preoperative—smile view.



Figure 27. Preoperative—frontal view.



Figure 28. Fractured segments.

They were then stabilized in place by small composite increments on the facial surfaces of each tooth (Figure 29), and a positioning stent was fabricated with green compound (Figures 30 and 31).

The operating field was isolated with a rubber dam (Figure 32) in order to prevent saliva or gingival fluids that negatively affect the bonding procedures.

At chairside, the fractured surfaces of the fragments were cleaned with flour of pumice (Figure 33), treated with 37% phosphoric acid gel for 30 seconds, followed by rinsing (Figure 34). The adhesive system (Adper Single Bond Plus, 3M ESPE) was then applied to the etched surfaces (Figure 35). The fragments were kept away from light until the fragment was to be reattached to the tooth.

Dentin and enamel were cleaned with flour of pumice, etched with a 37% phosphoric acid gel (Figures 36–38), rinsed, and coated with an ethanol-based adhesive system (Adper Single Bond Plus, 3M ESPE).

Composite resin (Z-100, 3M ESPE) was applied to both fragment and tooth surfaces. The fractured segments in the stent were checked for



Figure 29. Fragments were stabilized in place by small composite increments on the facial surfaces of each tooth.



Figure 30. Positioning stent was fabricated with green compound.



Figure 31. Fragments were stabilized with the stent.

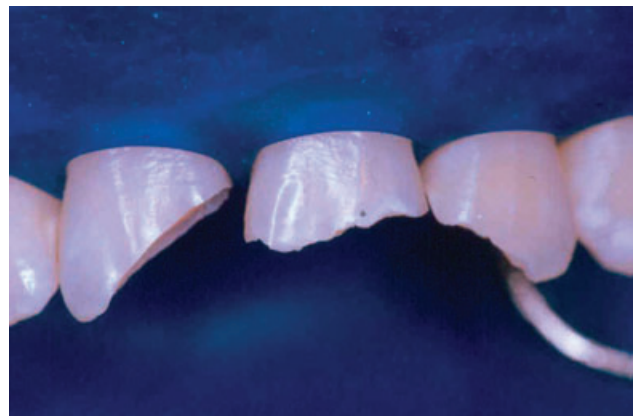


Figure 32. Rubber dam isolation—frontal view.



Figure 33. Fragments were cleaned with flour of pumice.



Figure 34. Fragments were etched for 30 seconds.



Figure 35. Adhesive was applied to the fragments.



Figure 36. Fractured surfaces were cleaned with flour of pumice.

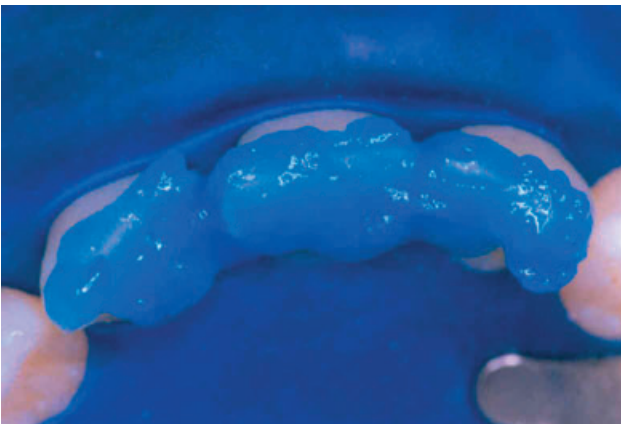


Figure 37. Fractured surfaces were etched for 30 seconds.

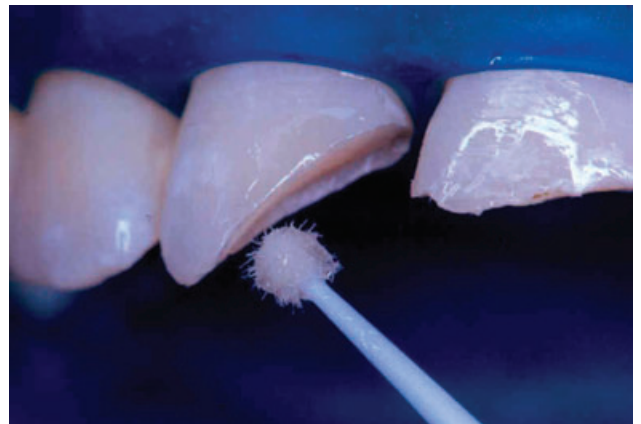


Figure 38. Adhesive was applied to the fractured surfaces.

correct positioning. When the original position had been reestablished for all three fragments, excess resin was removed and the area was light-cured for 40 seconds (Figure 39), making sure that no displacement of the fragment occurred before adhesive/resin polymerization was complete. Additional composite was placed after the first cure in order to restore any undercountoured areas (Figures 40 and 41).

Margins were properly finished with diamond burs and polished with a series of Sof-Lex disks (3M ESPE) and diamond polishing paste (Figure 42).

The immediate postoperative view (Figures 43 and 44) shows adequate esthetic results with restored functionality by the use of a very conservative and cost-effective approach.

DISCUSSION

The techniques described in these case reports are reasonably simple, while restoring function and esthetics with a very conservative approach. However, the professional has to keep in mind that a dry and clean working field and the proper use of bonding protocol and materials is the key for achieving success in adhesive dentistry. Reports and clinical

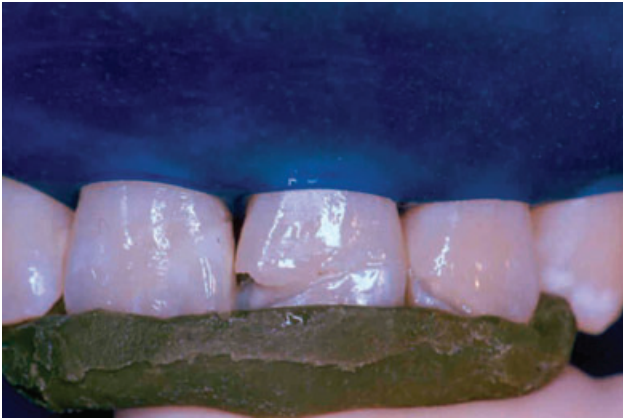


Figure 39. The fractured segments in the stent were checked for correct positioning.



Figure 40. Additional composite was placed after the first cure in order to restore any undercountoured areas.



Figure 41. Postoperative—lingual view.



Figure 42. Margins were properly finished and polished.



Figure 43. Immediate postoperative—frontal view.



Figure 44. Immediate postoperative—smile view.

experience indicate that the reattachment of fractured coronal fragments results in successful short- and medium-term outcomes.^{10,12,13}

Fabrication of a mouth guard and patient education about treatment limitations may enhance clinical success as reattachment failures may occur with new trauma or parafunctional habits.⁶

With the materials available today, in conjunction with an appropriate technique, esthetic results can be achieved with predictable outcomes. Thus, the reattachment of a tooth fragment is a viable technique that restores function and esthetics with a very conservative approach, and it should be considered when treating patients with coronal fractures of the anterior teeth, especially younger patients.

DISCLOSURE

The authors do not have any financial interest in the companies whose products are included in this article.

REFERENCES

1. Dietschi D, Jacoby T, Dietschi JM, Schatz JP. Treatment of traumatic injuries in the front teeth: restorative aspects in crown fractures. *Pract Periodontics Aesthet Dent* 2000;12(8):751–8, quiz 760.
2. Hamilton FA, Hill FJ, Holloway PJ. An investigation of dento-alveolar trauma and its treatment in an adolescent population. Part 1: the prevalence and incidence of injuries and the extent and adequacy of treatment received. *Br Dent J* 1997;182:91–5.
3. Andreasen JO, Andreasen F, Andersson L. Textbook and color atlas of traumatic injuries to the teeth. 3rd ed. St Louis (MO): Mosby; 1994.
4. Olsburgh S, Jacoby T, Krejci I. Crown fractures in the permanent dentition: pulpal and restorative considerations. *Dent Traumatol* 2002;18(3):103–15.
5. Reis A, Francci C, Loguercio AD, et al. Re-attachment of anterior fractured teeth: fracture strength using different techniques. *Oper Dent* 2001;26(3):287–94.
6. Andreasen FM, Noren JG, Andreasen JO, et al. Long term survival of fragment bonding in the treatment of fractured crowns. *Quintessence Int* 1995;26:669–81.
7. Baratieri LN, Ritter AV, Junior SM, Filho JCM. Tooth fragment reattachment: an alternative for restoration of fractured anterior teeth. *Pract Periodont Aesthet Dent* 1998;10:115–27.
8. El-Askary FS, Ghalab OH, Eldemerdash FH et al. Reattachment of a severely traumatized maxillary central incisor, one-year clinical evaluation: a case report. *J Adhes Dent* 2006;8(5):343–9.
9. Reis A, Loguercio AD, Kraul A, Matson E. Reattachment of fractured teeth: a review of literature regarding techniques and materials. *Oper Dent* 2004;29(2):226–33.
10. Rappelli G, Massaccesi C, Putignano A. Clinical procedures for the immediate reattachment of a tooth fragment. *Dent Traumatol* 2002;18(5):281–4.
11. Maia EA, Baratieri LN, de Andrada MA, et al. Tooth fragment reattachment: fundamentals of the technique and two case reports. *Quintessence Int* 2003;34(2):99–107.
12. Baratieri LN, Monteiro S Jr., Andrada MAC. Tooth fracture reattachment: case reports. *Quintessence Int* 1990;21(4):261–70.

13. Oz IA, Haytac MC, Toroglu MS. Multidisciplinary approach to the rehabilitation of a crown-root fracture with original fragment for immediate esthetics: a case report with 4-year follow-up. *Dent Traumatol* 2006;22(1):48-52.
14. Farik B, Munksgaard EC, Andreasen JO. Impact strength of teeth restored by fragment-bonding. *Endod Dent Traumatol* 2000;16(4):151-3.
15. Diangelis AJ, Jungbluth M. Reattaching fractured tooth segments: an esthetic alternative. *J Am Dent Assoc* 1992;123(8):58-63.
16. Ehrmann EH. Restoration of a fractured incisor with exposed pulp using original tooth fragment: report of case. *J Am Dent Assoc* 1989;118(2):183-5.

Reprint requests: Dr. Georgia Macedo, UNC School of Dentistry, Department of Operative Dentistry, 429 Brauer Hall, Chapel Hill, NC 27599-7450. Tel.: 919-843-9743; Fax: 919-966-5660; e-mail: Georgia_macedo@dentistry.unc.edu