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Periodontal Healing of a Horizontal Root Fracture: A Case Report with a Two-year Follow-up

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Clinical Relevance

Scientific rationale for this case report: Traumatically-induced tooth loss due to root fractures necessitates time-consuming and expensive prosthetic rehabilitation measures. To date, however, the appropriate use of minimal invasive periodontal surgery, in combination with adhesive dentistry, may allow cost-effective, reliable therapeutic options for the treatment of root fractures even below the gumline.

Principal findings: The coronal part of a fractured lower incisor was reattached to the apical fragment using the periodontal flap technique, endodontic therapy and adhesive fixation measures. Uncompromised aesthetics and function, and periodontal health, were maintained over a two-year observation period.

Practical implications: Data on the long-term stability of the proposed approach is scarce. However, in treatment planning for teeth with horizontal root fractures, re-bonding of the coronal part using flap surgery may be considered a treatment option.

SUMMARY

Background: For traumatized teeth exhibiting crown-root fractures, there is a growing body of evidence that re-fastening the coronal part may result in successful treatment. However, data on the long-term impact of these bonding procedures on the periodontium are scarce. A case report of a young female patient presenting with an isogingivally- and horizontally-fractured lower incisor with a two-year follow-up is presented.

Methods: The tooth fragment was reattached to the remaining root using an adhesive technique after flap elevation and endodontic therapy. No attempt was made to splint the coronal fragment to the neighboring teeth.

Results: Despite the subgingival location of the bonding surface, uneventful periodontal healing was clinically monitored during the observation period. The coronal fragment was retained successfully for a period of more than two years.

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Conclusions: Even for tooth fractures below the gingival margin, the combined approach of surgery and adhesive techniques can be used successfully to restore a severely traumatized tooth.

INTRODUCTION

Horizontal root fractures of permanent teeth have been shown to occur in less than 10% of traumatic injuries to teeth.[1-3] In most cases, the etiologic cause is either brawl or casualty. As crown-root fractures involve enamel, dentin and root structure, the periodontal tissues are compromised inevitably. Treatment options for those types of fractures vary widely according to the localization of the fracture line and the possibility of reattaching the coronal tooth fragment. If proper repositioning is assured and the fracture line is located in the middle third of the tooth, attempts to stabilize the fragments by splinting for four weeks seem to be indicated.[4] Root fractures in the apical portion should be accompanied by four months of splinting.

The localization of a root fracture may serve as an important predictor of treatment success. If the fracture occurs in the gingival third of the root, most often the coronal fragment is detached from the root segment and pulp tissue is exposed. The combination of these two factors substantially worsens the estimated prognosis, with a long-term success rate of only 40%.[5] Since most crown-root fractures occur in front teeth, treatment failures leading to chronic or acute infection may cause substantial aesthetic impairment. Immediate implant placement may, therefore, be an alternative treatment option. However, besides the cost and time alotted for implant treatment, reliable restoration of the natural dentition, while allowing tooth preservation, should remain a major goal in dental treatment. In the current case, it was, therefore, decided to treat the traumatized tooth using a multidisciplinary approach.

CASE REPORT

Case History and Clinical Examination

A 21-year-old woman presented to the emergency unit of Munster University Clinic late at night. She had received a traumatic injury to her lower jaw from an elbow while dancing in a discotheque. Her further medical history was non-contributory.

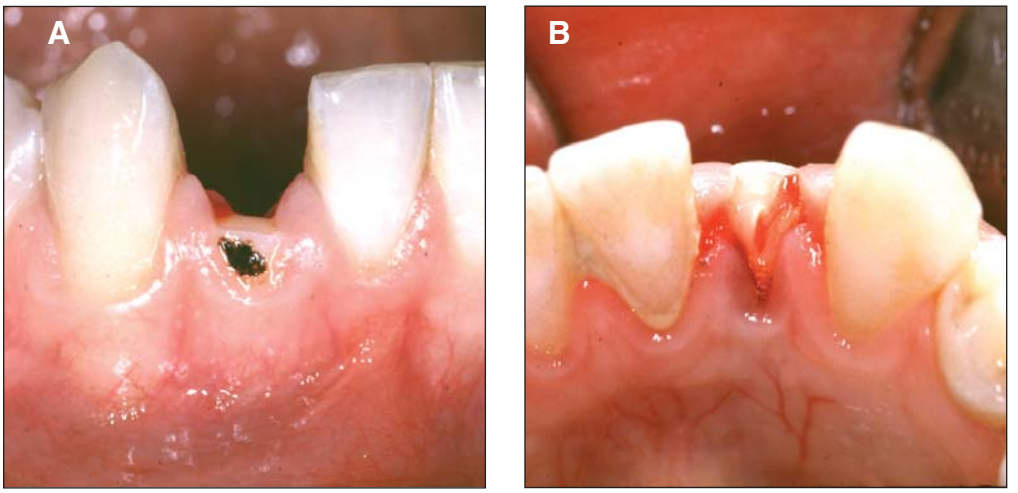

Figure 1. *Buccal and lingual view of the clinical site immediately after trauma.*

The extraoral examination revealed a 15 mm-long laceration of the lower lip. Intraorally, a horizontal root fracture of the second lower incisor on the right was diagnosed. Pulp tissue was exposed, and the fracture line extended subgingivally into the lingual region of the affected tooth. The patient had kept the tooth fragment inside her mouth to prevent it from running dry.

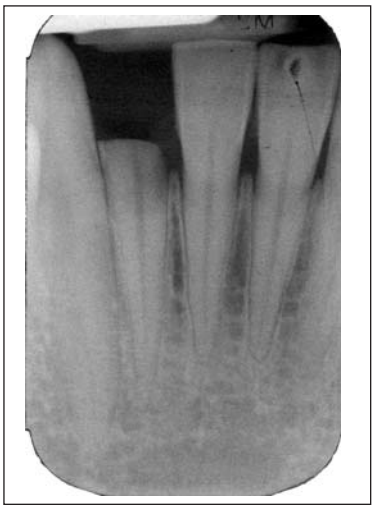

Figure 2. *Radiograph showing the fracture line. Fractures in the infrabony part of the root were excluded as far as possible.*

The radiographic examination confirmed the clinical diagnosis. However, apart from the trauma to this specific tooth, no sign of fracture was seen, either on the intra- or extra-oral radiographs.

Surgical Treatment

Following local anesthesia (Ultracain DS, Sanofi-Aventis, Frankfurt, Germany), the remaining pulp tissue was extirpated and a calcium hydroxide dressing was put into the root canal. Then, the tooth was closed provisionally. The lacerated lip was sutured using 6.0 monofilic sutures (Prolene Suture, Ethicon, Norderstedt, Germany). All further dental treatment was postponed until the next morning. The coronal tooth fragment was cleaned mechanically using rubber cups, disinfected with 0.2% Chlorhexidine solution and stored overnight in Chloramin-T (Synonym:

Tosylchloramidnatrium) solution.[6]

The next morning, a full-thickness periodontal flap was raised under local anesthesia. After careful degranulation and inspection, approximately one millimeter of alveolar bone was resected around the root fragment in order to verify fitting accuracy of the two fragments. A rubber dental dam was applied and endodontic therapy completed. The pulp tissue of the coronal fragment was carefully removed and the remaining pulp chamber was filled with resin composite (Tetric Flow, Schaan, Liechtenstein). Both fragments were then prepared for adhesive fixation by application of 40% phosphorous acid (40 seconds). Using a dentin bonding system (Optibond System, Kerr Hawe, Bioggo, Switzerland) and soft light curable composite material (Tetric Flow), the coronal fragment was fixed to the root fragment. Any excess material was carefully removed and the flap was repositioned using 6.0 monofil suture material (Prolene Suture, Ethicon, Norderstedt, Germany). The occlusion was checked and any immoderate occlusion was ruled out by careful clinical practice. The sutures were removed one week after surgery.

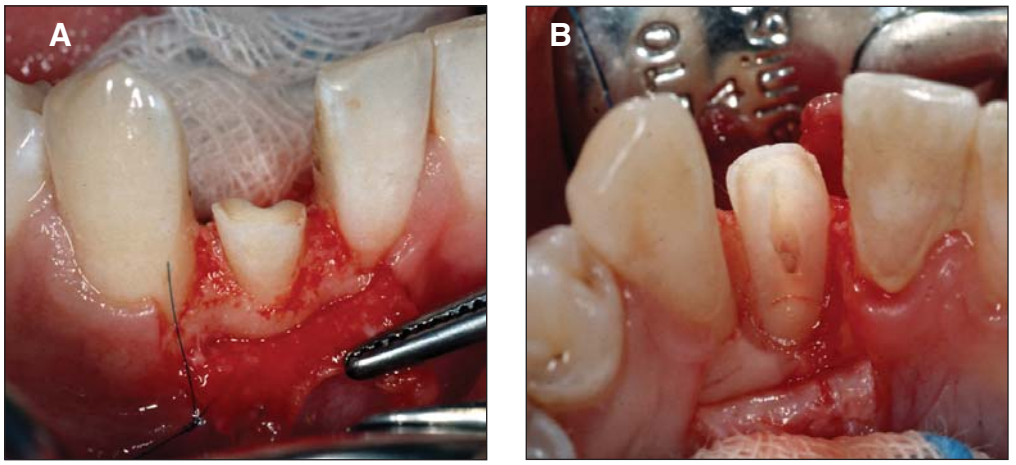

Figure 3. *Buccal and lingual view after flap elevation.*

Clinical and Periodontal Follow-up

The patient was sent recalls every three months during the first year after surgery to allow for periodontal examination and radiographic check-ups. Within the monitored observation period of two years, the situation remained stable and the tooth was functioning. No signs of gingival or periodontal disease were found. The pocket probing depth did not exceed three millimeters, there was no overt sign of gingival recession and the radiographic examination showed a stable bone level.

Discussion: Advantages, Disadvantages and Potential Problems

Fractures of caries-free lower anterior teeth have a rather low incidence rate of approximately 0.5 fractures per 1,000 teeth/year and occur in less than 10 per 1,000 persons/year.[7] Therefore, reliable data on the long-term success of the various treatment options proposed in the literature are scarce. In addition, the types of trauma may vary greatly and thereby may act as an additional confounding factor.

Thus, although the evidence of a single case report is definitely low, the information gathered may be helpful to other clinicians or researchers when choosing a treatment option. In this particular case, further evidence that re-attachment of tooth fragments may be a successful alternative to laborious and costly treatment options, such as implants, orthodontic extrusion or crown and bridge treatment, was proven. Nevertheless, it should be pointed out that long-term success of the approach described is strongly dependent on tooth type and the course of the fracture line. Due to the advantageous occlusal and static circumstances in the anterior mandible, as described here, the likelihood of long-term stability is much higher than, for example, in the premolar region or even in the anterior maxillary dentition. Also, the fracture line corresponding to a Type B, according to Dean's classification of oblique root fracture without damage to the infrabony part of the root, may have enhanced success. Undoubtedly, the position of the fracture line and its relationship to the base of the gingival crevice are the most important factors in determining the long-term prognosis for the tooth.[8]


Figure 4. *Radiograph after root canal filling using a rubber dental dam.*

Data on the long-term survival of reattached tooth fragments show a half-life of about 2.5 years for restoration in the supragingival area. However, most cases of failure were due to repeated trauma or continued misuse of the teeth.[9] The current case corroborates these data and is in contrast to the judgments made by Heda and others[10] or Cengiz and others,[11] in whose opin-

ion a reattachment procedure would only represent a temporary treatment approach.

A major factor contributing to long-term success—as seen in this case—is the possibility of performing the bonding procedure in a well-controlled operation site using appropriate bonding systems.[12-13] Rubber dental dam isolation prevented unwanted contamination with blood or saliva and enabled repositioning with clear visibility on the fracture line. Also, removing the pulp as far as necessary, and conditioning, bonding and filling the coronal part of the pulp chamber may also have enhanced the strength of the reattachment, leading to a comparable situation as described by Reis and others,[14] where an internal groove was made and filled with a resin composite. Data on that technique indicates that more than 90% of the original fracture resistance may be attained for lower central incisors.[14] Also, the appropriate storage and handling of the fragment may have been important: As the dentinal parts were prevented from running dry by storing them in a Chloramin-T solution overnight, a possible collapse of the collagen network was prevented, which may have enhanced the strength of the bonding.[15] Since Chloramin-T may not be available in a routine dental practice setting, most likely, storage in an alcohol-free Chlorhexidine solution may be a valid alternative to the use of Chloramin-T: Both substances unfold their disinfecting effect by releasing Chloride.

The subgingival application of resin composite and bonding systems may nevertheless be considered critical, since they contain a variety of monomers and additives that may be released, particularly in the case of suboptimal conversion, for example, if proper light curing is not possible.[16-18] Recent research has shown that resin monomers may have the ability to alter cellular hemostasis and may exert genotoxic effects.[19] While these important biological effects must be studied further, from a purely clinical viewpoint, the subgingival location of cured and well-finished composite seems irrefutable. Used appropriately in a patient with good oral hygiene and if surface roughness is avoided, a favorable soft tissue response can be expected.[20-22] Under these conditions, not even an increase in markers of gingival inflammation, such as IL-1 α and IL-1 β or IL-1Ra, is expected.[23] All these aspects may account for the continued periodontal health around the traumatized tooth.

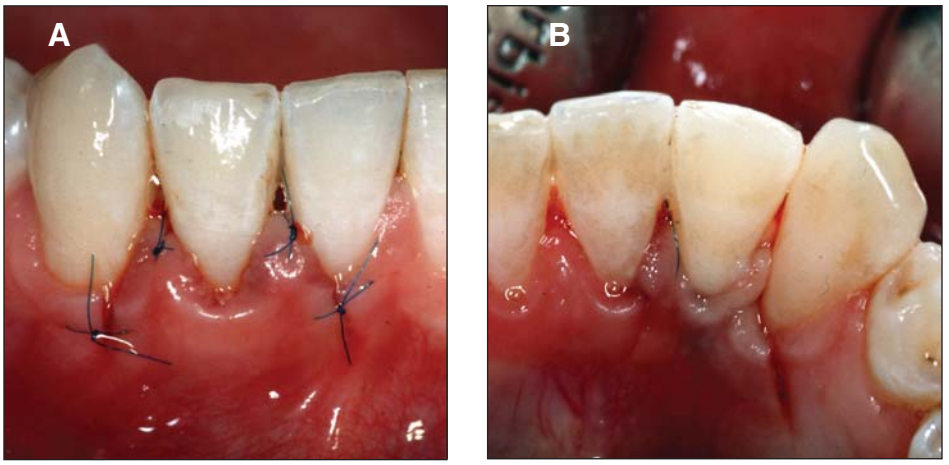

Figure 5. *Buccal and lingual view after flap closure.*

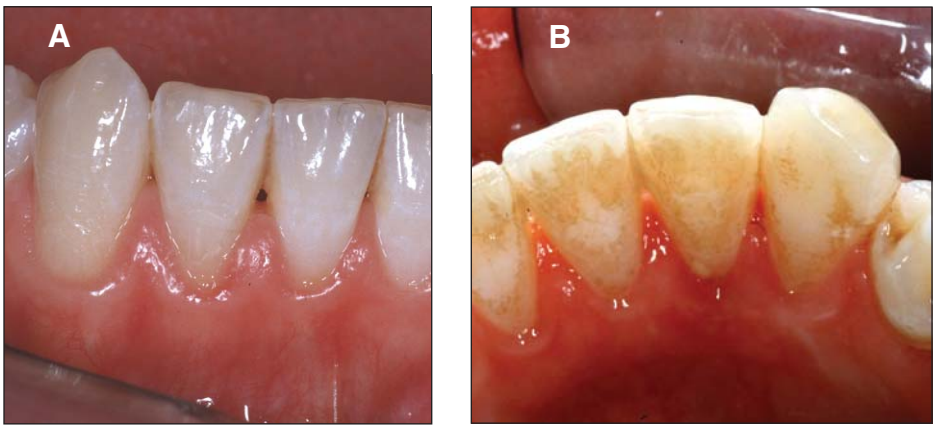

Figure 6. *Buccal and lingual view after two years of maintenance.*

CONCLUSIONS

In conclusion, in individual cases, the described approach may allow for conservation of the tooth substance in a cost-efficient and biologically-oriented manner. The course of the fracture line, and the possibility of creating an optimal environment for surgical treatment using a periodontal flap, can be considered the most important factors for success.

Figure 7. *Radiograph at two-year follow-up.*

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References

1. Andreasen JO (1970) Etiology and pathogenesis of traumatic dental injuries. A clinical study of 1,298 cases *Scandinavian Journal of Dental Research* **78(4)** 329-342.
2. Birch R & Rock WP (1986) The incidence of complications following root fracture in permanent anterior teeth *British Dental Journal* **160(4)** 119-122.
3. Järvinen S (1979) Fractured and avulsed permanent incisors in Finnish children. A retrospective study *Acta Odontologica Scandinavica* **37(1)** 47-50.
4. Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, Barnett F, Bourguignon C, DiAngelis A, Hicks L, Sigurdsson A, Trope M, Tsukiboshi M, von Arx T & International Association of Dental Traumatology (2007) Guidelines for the management of traumatic dental injuries. I. Fractures and luxations of permanent teeth *Dental Traumatology* **23(2)** 66-71.
5. Welbury R, Kinirons MJ, Day P, Humphreys K & Gregg TA (2002) Outcomes for root-fractured permanent incisors: A retrospective study *Pediatric Dentistry* **24(2)** 98-102.
6. Haller B, Hofmann N, Klaiber B & Bloching U (1993) Effect of storage media on microleakage of five dentin bonding agents *Dental Materials* **9(3)** 191-197.
7. Bader JD, Martin JA & Shugars DA (2001) Incidence rates for complete cusp fracture *Community Dentistry and Oral Epidemiology* **29(5)** 346-353.
8. Feiglin B (1995) Clinical management of transverse root fractures *Dental Clinics of North America* **39(1)** 53-78.
9. Andreasen FM, Norén JG, Andreasen JO, Engelhardtsen S & Lindh-Strömberg U (1995) Long-term survival of fragment bonding in the treatment of fractured crowns: A multicenter clinical study *Quintessence International* **26(10)** 669-681.
10. Heda CB, Heda AA & Kulkarni SS (2006) A multi-disciplinary approach in the management of a traumatized tooth with complicated crown-root fracture: A case report *Journal of the Indian Society of Pedodontics and Preventive Dentistry* **24(4)** 197-200.
11. Cengiz SB, Kocadereli I, Gungor HC & Altay N (2005) Adhesive fragment reattachment after orthodontic extrusion: A case report *Dental Traumatology* **21(1)** 60-64.
12. Farik B, Munksgaard EC, Andreasen JO & Kreiborg S (2002) Fractured teeth bonded with dentin adhesives with and without unfilled resin *Dental Traumatology* **18(2)** 66-69.
13. Farik B, Munksgaard EC & Andreasen JO (2000) Impact strength of teeth restored by fragment-bonding *Endodontics & Dental Traumatology* **16(4)** 151-153.
14. Reis A, Francci C, Loguercio AD, Carrilho MR & Rodriques Filho LE (2001) Re-attachment of anterior fractured teeth: Fracture strength using different techniques *Operative Dentistry* **26(3)** 287-294.
15. Farik B, Munksgaard EC, Kreiborg S & Andreason JO (1998) Adhesive bonding of fragmented anterior teeth *Endodontics & Dental Traumatology* **14(3)** 119-123.
16. Sigusch BW, Völpel A, Braun I, Uhl A & Jandt KD (2007) Influence of different light curing units on the cytotoxicity of various dental composites *Dental Materials* **23(11)** 1342-1348.
17. Geurtsen W (1998) Substances released from dental resin composites and glass ionomer cements *European Journal of Oral Sciences* **106(2)** 687-695.
18. Jontell M, Hanks CT, Bratel J & Bergenholtz G (1995) Effects of unpolymerized resin components on the function of accessory cells derived from the rat incisor pulp *Journal of Dental Research* **74(5)** 1162-1167.
19. Schweikl H, Spagnuolo G & Schmalz G (2006) Genetic and cellular toxicology of dental resin monomers *Journal of Dental Research* **85(10)** 870-877.
20. Martins TM, Bosco AF, Nóbrega FJ, Nagata MJ, Garcia VG & Fucini SE (2007) Periodontal tissue response to coverage of root cavities restored with resin materials: A histomorphometric study in dogs *Journal of Periodontology* **78(6)** 1075-1082.
21. Dragoo MR (1997) Resin-ionomer and hybrid-ionomer cements: Part II, human clinical and histologic wound healing responses in specific periodontal lesions *International Journal of Periodontics & Restorative Dentistry* **17(1)** 75-87.
22. Blank LW, Caffesse RG & Charbeneau GT (1979) The gingival response to well-finished composite resin restorations *The Journal of Prosthetic Dentistry* **42(6)** 626-632.
23. Konradsson K & van Dijken JW (2005) Interleukin-1 levels in gingival crevicular fluid adjacent to restorations of calcium aluminate cement and resin composite *Journal of Clinical Periodontology* **32(5)** 462-466.