

Andreasen on Root Fractures

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Healing of 400 intra-alveolar root fractures. 1. Effect of pre-injury and injury factors such as sex, age, stage of root development, fracture type, location of fracture and severity of dislocation.

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This retrospective study consisted of 400 root-fractured, splinted or non-splinted incisors in young individuals aged 7-17 years (mean = 11.5 +/- 2.7 SD) who were treated in the period 1959-1995 at the Department of Pediatric Dentistry, Eastman Dental Institute, Stockholm. Four hundred of these root fractures were diagnosed at the time of injury; and 344 teeth were splinted with either cap-splints, orthodontic appliances, bonded metal wires, proximal bonding with composite resin or bonding with a Kevlar or glass fiber splint. In 56 teeth, no splinting was carried out for various reasons. In the present study, only pre-injury and injury factors were analyzed. In a second study, treatment variables will be analyzed. The average observation period was 3.1 years +/- 2.6 SD. The clinical and radiographic findings showed that 120 teeth out of 400 teeth (30%) had healed by hard tissue fusion of the fragments. Interposition of periodontal ligament (PDL) and bone between fragments was found in 22 teeth (5%), whereas interposition of PDL alone was found in 170 teeth (43%). Finally, non-healing, with pulp necrosis and inflammatory changes between fragments, was seen in 88 teeth (22%). In a univariate and multivariate stratified analysis, a series of clinical factors were analyzed for their relation to the healing outcome with respect to pulp healing vs. pulp necrosis and type of healing (hard tissue vs. interposition of bone and/or PDL or pulp necrosis). Young age, immature root formation and positive pulp sensibility at the time of injury were found to be significantly and positively related to both pulpal healing and hard tissue repair of the fracture. The same applied to concussion or subluxation (i.e. no displacement) of the coronal fragment compared to extrusion or lateral luxation (i.e. displacement). Furthermore, no mobility vs. mobility of the coronal fragment. Healing was progressively worsened with increased millimeter diastasis between fragments. Sex was a significant factor, as girls showed more frequent hard tissue healing than boys. This relationship could possibly be explained by the fact that girls experienced trauma at an earlier age (i.e. with more immature root formation) and

their traumas were of a less severe nature. Thus, the pre-injury or injury factors which had the greatest influence upon healing (i.e. whether hard tissue fusion or pulp necrosis) were: age, stage of root development (i.e. the size of the pulpal lumen at the fracture site) and mobility of the coronal fragment, dislocation of the coronal fragment and diastasis between fragments (i.e. rupture or stretching of the pulp at the fracture site). Copyright Blackwell Munksgaard, 2004.

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Healing of 400 intra-alveolar root fractures. 2. Effect of treatment factors such as treatment delay, repositioning, splinting type and period and antibiotics.

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This is the second part of a retrospective study of 400 root-fractured permanent incisors. In this article, the effect of various treatment procedures is analyzed. Treatment delay, i.e. treatment later than 24 h after injury, did not change the root fracture healing pattern, healing with hard tissue between fragments (HH1), interposition of bone and/or periodontal ligament (PDL) or pulp necrosis (NEC). When initial displacement did not exceed 1 mm, optimal repositioning appeared to significantly enhance both the likelihood of pulpal healing and hard tissue repair (HH1). Significant differences in healing were found among the different splinting techniques. The lowest frequency of healing was found with cap splints and the highest with fiberglass or Kevlar splints. The latter splinting procedure showed almost the same healing result as non-splinting. Comparison between non-splinting and splinting for non-displaced teeth was found to reveal no benefit from splinting. With respect to root fractures with displacement, too few cases were available for analysis. No beneficial effect of splinting periods greater than 4 weeks could be demonstrated. The administration of antibiotics had the paradoxical effect of promoting both HH1 and NEC. No explanation could be found. It was concluded that, optimal repositioning seems to favor healing. Furthermore, the chosen splinting method appears to be related to healing of root fractures, with a preference to pulp healing and healing fusion of fragments to a certain flexibility of the splint and possibly also non-traumatogenic splint application. Splinting for more than 4 weeks was not found to influence the healing pattern. A certain treatment delay (a few days) appears not to result in inferior healing. The role of antibiotics upon fracture healing is questionable. Copyright Blackwell Munksgaard, 2004.



Healing and prognosis of teeth with intra-alveolar fractures involving the cervical part of the root.

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Healing and long-term prognosis of 94 cervical root fractures were evaluated. The teeth were divided into two groups according to type of fracture: transverse fractures limited to the cervical third of the root (51 incisors) and oblique fractures involving both the cervical and middle parts of the root (43 incisors). Neither the frequency nor the type of fracture healing differed significantly between the two groups. In the material as a whole, healing of the fracture with hard tissue formation was observed in 17 teeth (18%), and healing with interposition of periodontal ligament (PDL) and, in some cases, hard tissue between the fragments in 62 teeth (66%). Fifteen teeth (16%) showed no healing and a radiolucency adjacent to the fracture. Statistical analyses revealed that incomplete root formation and a positive sensibility test at the time of injury were significantly related to both healing and hard tissue repair. The same applied to concussion or subluxation compared with dislocation of coronal fragment, as well as optimal compared with suboptimal reposition of displaced coronal fragments. The type and duration of splinting (or no splinting) appeared to be of no significance for frequency or type of healing of cervical root fractures. During the observation time (mean = 75 months), 19 (44%) of the teeth with transverse fractures and 3 (8%) of those with oblique fractures were lost after healing. In conclusion, fractures in the cervical part of the root had a healing potential and the predictive parameters identified for fractures in other parts of the root seemed to be valid for the healing of cervical root fractures. Transverse fractures appeared to have a significantly poorer long-term prognosis compared to oblique fractures, apparently due to a marked post-treatment mobility, which often led to new luxation caused by even minor impacts.



Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture.

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It has been proposed (Cvek 1992) that immature teeth are weakened by filling of the root canals with calcium hydroxide dressing and gutta-percha. The aim of the present study was to test the hypothesis that dentin in contact with calcium hydroxide would show a reduction in fracture strength after a certain period of time. Immature mandibular incisors from sheep were extracted and divided into two experimental groups. Group 1: the pulps were extirpated via the apical foramen. The root canals were then filled with calcium hydroxide (Calasept) and sealed with IRM(R) cement, and the teeth were then stored in saline at room temperature for 0.5, 1, 2, 3, 6, 9, or 12 months. Group 2: the pulps were extirpated and the root canals were filled with saline and sealed with IRM(R) cement. The teeth were then stored in saline for 2 months. Intact teeth served as controls and were tested immediately after extraction. All teeth were tested for fracture strength in an Instron testing machine at the indicated observation periods. The results showed a markedly decrease in fracture strength with increasing storage time for group 1 (calcium hydroxide dressing). The results indicate that the fracture strength of calcium hydroxide-filled immature teeth will be halved in about a year due to the root filling. The finding may explain the frequent reported fractures of immature teeth filled with calcium hydroxide for extended periods.

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Healing of 208 intra-alveolar root fractures in patients aged 7-17 years.

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This retrospective study consisted of 208 root-fractured, 168 splinted and 40 not splinted incisors in young individuals (aged 7-17 years) treated in the period 1959-1973 at the Pedodontic Department, Eastman Institute, Stockholm. Clinical and radiographic analyses showed that 69 teeth (33%) had developed hard tissue (fusion) healing of fragments. Interposition of periodontal ligament (PDL) and bone between the fragments was found in 17 teeth (8%). Interposition of PDL alone was found in 74 teeth (36%). Finally, non-healing with pulp necrosis and inflammatory changes between fragments was seen in 48 teeth (23%). Various clinical factors were analyzed for their relationship to the healing outcome with respect to healing/no healing and type of healing (hard tissue versus interposition of bone and/or PDL). Immature root and positive pulp sensitivity at time of injury was found to be significantly related to both pulp healing and hard tissue repair of the fracture. The same applied to concussion or subluxation of the coronal fragment compared to luxation with displacement (extrusive or lateral luxation). This relation was also represented by the variable millimeter diastasis between fragments before and after repositioning. Repositioning appeared to enhance the likelihood of both pulp healing and hard tissue repair. A positive effect of splinting, splinting methods (cap splints or orthodontic bands with an arch wire)

or splinting periods could not be demonstrated on either pulp healing or type of healing (hard tissue versus interposition of bone and/or PDL). In conclusion, the findings from this retrospective study have cast doubts on the efficacy of long-term splinting and the types of splint used for root fracture healing. It is suggested that the role of splinting and splinting methods be examined in further studies.

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Evaluation of the effect of delayed management of traumatized permanent teeth.

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This investigation studied the complication that could arise from delayed management of traumatized permanent teeth. Patients reported to the primary care clinic at the College of Dentistry, King Saud University, seeking treatment of traumatized anterior teeth were evaluated. Esthetic consideration (64 patients) and pain, swelling, or discomforts (50 patients) were the main reasons the patients came to the clinic. Clinical and radiographic examinations, as well as history of the trauma, were recorded. It was found that most of the patients had a treatment delay exceeding 1 month. Initial pulp exposure resulted in 100% pulp necrosis. When a fracture involved both enamel and dentin, the frequency of pulp necrosis was 53%. External root resorption and pulp calcification were seen in few teeth. It was concluded that the figures for pulp necrosis could be misleading, because there might have been a bias when only patients with problems sought treatment. In addition, a trauma awareness educational program should be developed to encourage parents and the public to seek immediate dental treatment. Furthermore, a proper diagnostic test for pulp and periodontal complication should be done in patients with initially nontreated dental injuries.

Endod Dent Traumatol. 1989 Feb;5(1):11-22.

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Prognosis of root-fractured permanent incisors--prediction of healing modalities.

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A population of 85 patients, comprising 95 root-fractured permanent incisors followed up to 11 years, was studied prospectively for the type of fracture healing that occurred (i.e. union of the fragments by interposition of hard tissue (HT) or connective tissue (CT), or nonunion characterized by interposition of granulation tissue between the fragments (GT)). Initial treatment was provided according to established treatment guidelines by the attending oral surgeon at the emergency room. Follow-up examination and treatment were provided by 2 of the authors. It appeared that GT could be diagnosed after approximately 3 weeks, while HT or

CT could be diagnosed approximately 6 weeks after trauma. Many factors considered one at a time were found to have a significant or nearly significant effect on the type of fracture healing that occurred. However, a multivariate regression analysis revealed that the following factors were significantly related to fracture healing by HT: a large diameter of the apical foramen and severity of luxation of the coronal fragment (concussion/subluxation greater than lateral luxation greater than extrusion); fracture healing by CT: the presence of restorations in the injured teeth at the time of injury and the presence of marginal periodontal disease; and fracture nonhealing by GT: type of fixation (i.e. orthodontic band fixation versus acid etch or no fixation), antibiotic therapy, a constricted apical foramen, increased loosening of the coronal fragment, and stage of root development (GT never occurred in teeth with open apices). It was previously demonstrated following luxation injuries that type of luxation, stage of root development and type of fixation (orthodontic bands versus acid etch or no fixation) determined the prognosis of pulp survival. It therefore appears that the general factors that are able to predict the type of healing seen after root fracture are the same as those after luxation injuries, supporting the hypothesis that root fractures are another form of luxation injury, this time of only the coronal fragment.