

Long-term followup of traumatized incisors treated by partial pulpotomy

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Abstract

The purpose of this study was to assess the long-term success of partial pulpotomy in traumatized permanent incisors. Seven years before this examination, 63 teeth that had been treated by partial pulpotomy six months to four years earlier were examined. At that stage, four teeth had pulp necrosis. The remaining 59 cases were recalled for re-examination. Of these, 40 were available for assessment 7.5 to 11 years after the partial pulpotomy treatment. Thirty-five of these teeth were successful, while the remaining five had root canal fillings, and three of them were restored by post and crowns. Of these, two were root treated in consequence of new trauma, and the other two for esthetic purposes. The fifth tooth has probably been root treated for similar reasons, as the patient reported not having had any pain or problem with the tooth. The high frequency of long-term success justifies recommending partial pulpotomy as the treatment of choice for traumatic pulp exposures in crown-fractured permanent incisors. (Pediatr Dent 15:334-36, 1993)

Introduction

Treating traumatized incisors with exposed pulps is frequently a challenge, particularly in young patients. According to Andreassen and Andreassen,¹ the treatment choice depends upon the pulpal healing potential, and on the desirability of maintaining a vital pulp. They state that "a profound crown fracture of a mature tooth might dictate pulp extirpation, to permit restoration with a post-retained crown." In young patients, the main objective is to select a treatment procedure designed to maintain pulp vitality.²⁻⁵ By using an appropriate wound dressing, this treatment should create the conditions that would enable the pulp to heal, demarcate itself with a hard tissue barrier, and protect itself from inflammation. Calcium hydroxide is most commonly recommended as a pulp dressing material.⁶

A considerable change took place in the last two decades in the rationale of treating complicated crown fractures. Thus, up until the late 1970s, a fractured tooth was treated either by pulpectomy and root canal filling, pulpotomy, or pulp capping. The choice between these treatments depended on the degree of root development, the size of the exposure, and the time elapsed from the injury to emergency treatment. Capping was recommended in teeth with small exposures when treatment was performed soon after the injury. When the exposure was large, or the interval between injury and treatment was long, the pulp was removed in mature teeth while in immature teeth it was treated by cervical pulpotomy.^{2,7} This treatment was regarded as temporary, to be followed by pulpectomy when root development was complete. An alternative technique for treating vital exposures has been known as partial pulpotomy. In contrast to the cervical pulpotomy, where all the coronal pulp is removed, partial pulpotomy

implies the removal of the pulp tissue only to a depth of 1–2 mm. Cvek⁴ has demonstrated a high success rate (96%) when pulp exposures in crown-fractured incisors were treated by partial pulpotomy. He observed that neither the size of the exposure nor the time between the accident and the treatment was critical for the recovery of a primarily healthy pulp. These results were corroborated by Klein et al.,⁸ followed by Fuks et al.⁵ Although the success rates following partial pulpotomy are high,^{4,5,8} very little information is available in the literature concerning the long-term effects of this treatment.

The purpose of this study was to assess the long-term success of partial pulpotomy in traumatized permanent incisors.

Methods and materials

Ninety-two young traumatized permanent incisors with pulp exposure were treated by partial pulpotomy at the Emergency Clinic of the Department of Pediatric Dentistry, Hadassah Faculty of Dental Medicine in Jerusalem, from 1980 to 1983. In 1984, 63 of them presented for examination upon recall. The follow-up time ranged from six months to four years, and the results were described previously.⁵ The time elapsed from the injury until the emergency treatment varied from 2 hr to three weeks. Healing occurred in 59 of the 63 teeth, and pulp necrosis was diagnosed in the remaining four teeth. At the end of 1991, all 59 patients with successfully treated teeth were recalled for assessment. Of these, 40 presented for examination, and comprised the material reported in the present study. These teeth had been treated by partial pulpotomy between 7.5 and 11 years previously, using the technique recommended by Cvek.^{2,4} Briefly, after local anesthesia

and isolation of the tooth with the rubber dam, the pulp was amputated with surrounding dentin to a depth of 2 mm using a diamond or carbide bur on a high-speed turbine with water cooling.⁹ Bleeding was controlled with a sterile saline solution. The pulpal wound was dried with cotton pellets and covered with Calxyl™ dental preparation (Otto & Co., Frankfurt/Main, FRG), a calcium hydroxide product. The cavity was sealed with a zinc-oxide eugenol cement (ZOE) and the tooth was restored with composite material. In cases of deep fractures, where the gingival tissue could cause moisture contamination and failure of the composite restoration, the fractured teeth were covered by a stainless steel basket crown, cemented with a ZOE paste. The teeth were examined clinically and radiographically at three-month intervals during the first year. At the 1984 assessment, some patients were followed for four years, while others for no longer than one year. Healing was considered to have taken place when the tooth fulfilled the following criteria:

1. Absence of clinical symptoms
2. Radiographic evidence of dentin bridge formation
3. No intrapulpal or periapical pathosis was evident radiographically
4. Continued root development and closure of the apex in immature teeth (Figs 1 & 2)
5. Normal dental apposition in mature teeth
6. Positive response to electrical pulp tester.

Results

Table 1 summarizes the results of partial pulpotomy at the two recall examinations (1984 and 1991). Pulp healing



Immature mandibular central incisor with exposed pulp treated by partial pulpotomy. Fig 1. (left) Preoperative radiograph. Notice the incomplete root formation and the open apex.

Fig 2. (right) Periapical radiograph 11 years post treatment. Healing of the pulpal wound resulted in normal root development, apical closure, and normal root canal width. Radiolucency of the restoration is due to a moderately filled composite resin.

was observed in 59 (94%) of the 63 teeth examined at the first recall assessment. Pulp necrosis was observed in four teeth, one after three weeks, two after three months, and the fourth, six months after treatment.

Of the 40 teeth examined at the second recall, 35 were successful (87.5%). Of these, one tooth was treated one week after the accident and four between two and four days after the exposure. In addition, concussion was diagnosed in five teeth and one was subluxated at the time of the exposure. The remaining five teeth had root canal fillings, and three of them were restored by post and crowns. Of these, two were root treated in consequence of new trauma, and the other two for esthetic purposes, as the patient was unhappy with her discolored composite restorations. The fifth tooth has probably been root treated for similar reasons, as the patient reported not having had any pain or problem with the tooth. As we could not contact the patient's dentist, we could not confirm this.

Discussion

The results of this investigation reinforce Cvek's findings^{4,6} that the interval between injury and treatment has little or no bearing on the outcome. Success was observed after 10 years or more in teeth treated by partial pulpotomies several days after the exposure (Figs 1 & 2), and in cases where subluxation and concussion were diagnosed in addition to the pulp exposure (Table 1).

Extensive research on pulp biology in the last decades increased our knowledge of pulp tissue responses to various injuries and of the healing process after treatment.⁶ Two findings are particularly relevant in the modern concept of treating an exposed pulp. First,

by employing a gentle surgical technique using a diamond or tungsten bur and high speed for cutting, injury to the underlying tissue is minimal.^{9,10} A slowly rotating round bur causes more injury to the pulp than the exposure itself. The second important finding is that the normal responses of the pulp exposed by a crown fracture frequently are proliferative and not degenerative. This is due to continuous salivary rinsing, which does not permit accumulation of debris, eventually leading to regressive changes and abscess formation. Proliferative changes have been observed in a clinical study in humans⁴ and in histologic studies in monkey teeth.^{11,12} In one of these studies, where pulps were exposed by fracture or grinding, the depth of inflammation did not exceed 2 mm from the exposure site.¹¹ Also, it has been demonstrated that calcium hydroxide, the most appropriate and commonly used pulp dressing, has no

Table. Distribution of crown-fractured incisors treated with partial pulpotomy according to the time interval between pulp exposure and treatment, the outcome of the treatment, and follow-up time.

| Interval Exposure to Treatment (days) | First Recall (1984) Follow-up Time (years) 1/2 to 4 | | Second Recall (1991) Follow-up Time (years) 7-1/2 to 11 | |
|---------------------------------------|---|---------------|---|---------------|
| | Healing of the Pulp | Pulp Necrosis | Healing of the Pulp | Pulp Necrosis |
| < 1 | 42 | 2* | 30 [†] | 3 |
| 1 - 4 | 9 | 1* | 4 [‡] | 2 |
| > 4 | 7 | 1* | 1 | — |
| Not known | 1 | — | — | — |
| Total | 59 | 4 | 35 | 5 |

* Diagnosed not later than six months after treatment.

[†] 5 teeth had concussion and pulp exposure.

[‡] 1 tooth had subluxation and exposure.

beneficial effect on inflamed pulps.¹³ Therefore, the surgical removal of inflamed or lacerated tissue to a depth of 2 mm, as is recommended in partial pulpotomy, allows the calcium hydroxide to contact healthy tissue, thus enhancing healing.

Direct pulp capping has been demonstrated to be an acceptable treatment, with success rates ranging from 72 to 88%.¹⁴⁻¹⁶ This success rate has shown to be even higher in immature teeth.¹⁷ Despite the high success rate in these teeth, partial pulpotomy might still be preferable for several reasons. Partial pulpotomy, in addition to allowing a better wound control than pulp capping, offers a more effective protection of the area since the calcium hydroxide dressing is covered by the ZOE seal. The deleterious effect of bacteria due to marginal microleakage resulting in an inadequate seal has been widely demonstrated.^{18,19}

Although the success rates of cervical and partial pulpotomy are similar, there are several advantages of partial pulpotomy when compared with cervical pulpotomy:

1. The cell-rich coronal pulp tissue is preserved, providing a better healing potential
2. Physiologic apposition of dentin in the cervical area is maintained (which is lost and dentinal walls are weakened by cervical pulpotomy)
3. There is no need for subsequent endodontic treatment, as it was frequently recommended after cervical pulpotomy
4. The natural color and translucency of the tooth is preserved
5. It is possible to perform sensitivity testing.

The high frequency of long-term success in the present study reinforces previous findings and justifies recommending partial pulpotomy as the treatment of choice for traumatic pulp exposures in crown-fractured permanent incisors.

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