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Treatment of aggressive external root resorption with calcium hydroxide medicaments: a case report

CASE REPORT

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Abstract – Intrusive luxation is an injury involving the axial displacement of a tooth into the alveolar socket. This paper describes apexification using calcium hydroxide medicaments of an immature permanent central incisor in which spontaneous re-eruption as well as severe inflammatory external root resorption was observed following traumatic intrusion. A 10-year-old boy was referred to the Department of Pediatric Dentistry 3 days after having fallen at school. Intraoral examination revealed intrusive luxation and an enamel-dentin crown fracture of the maxillary left central incisor (Tooth 21). The tooth was not sensitive to percussion and responded positively to electric pulp test. Radiographic examination indicated that the tooth had an open apex and had been intruded approximately 3–4 mm relative to the cemento-enamel junction of the adjacent right central incisor. The tooth was left for possible spontaneous re-eruption. The crown fracture was temporarily restored using glass ionomer cement, and the patient was scheduled for recall in 2 weeks, at which time intraoral examination revealed spontaneous re-eruption of the tooth. However, radiographic examination also showed inflammatory external root resorption. The root canal was accessed and filled with a calcium hydroxide paste; however, follow-up examination indicated continuing resorption after 1 month. Calcium hydroxide plus points (CHPP) was chosen as an alternative treatment. At the end of 6 months of CHPP treatment, examination showed no further progression of external resorption and complete apexification of the tooth. After a 24-month follow-up period, no signs of pathosis were observed.

Intrusive luxation is an injury in which the tooth is axially displaced into the alveolar socket (1). Clinical signs of intrusive luxation are reduced clinical crown length and expansion of the labial alveolar bone (2). Radiographically, the periodontal space appears to be absent or reduced (2, 3). Other consequences of intrusive luxation include pulp necrosis, inflammatory external or internal root resorption, dento-alveolar ankylosis, loss of marginal bone support, partial or total pulp canal obliteration and gingival retraction (3–5).

The optimal treatment for intruded permanent teeth has yet to be determined (1, 2). Depending on the stage of root development, treatment may involve either waiting for spontaneous re-eruption or surgical or orthodontic repositioning (4, 6–10). Waiting for spontaneous re-eruption is indicated for immature permanent teeth because of their high potential for eruption and pulp repair (4, 7). If pulp necrosis is diagnosed during re-eruption, endodontic treatment is required. Teeth with immature root formation require apexification prior to definitive root filling (1). $Ca(OH)_2$ paste is used in apexification treatment (11). Another purpose of calcium hydroxide treatment of traumatized teeth is to achieve arrest of inflammatory root resorption and healing of the adjacent periodontal ligament (PDL) (12).

Until recently, $Ca(OH)_2$ paste has been the most widely used material for endodontic management of the pulpless young permanent tooth prior to definitive root filling (13). Although calcium hydroxide plus points (CHPP) (Calcium Hydroxide Plus Points, Roeko, Langenau, Germany) have been found to be successful in short-term root canal disinfection (14), there have been no tests of CHPP in long-term root-canal treatments such as apexification.

This paper describes apexification with calcium hydroxide medicaments of an immature permanent central incisor in which spontaneous re-eruption as well as severe inflammatory external root resorption occurred following traumatic intrusion.

Case report

A 10-year-old boy was referred to the clinic 3 days after having fallen at school. There was no significant medical history. Intraoral examination revealed intrusive luxation and an enamel-dentin crown fracture of the

Fig. 1. (a and b) Clinical appearance of the intruded maxillary left central incisor, 3 days after trauma.

maxillary left central incisor (Tooth 21). The gingiva around the tooth was red and swollen; however, the tooth was not sensitive to percussion and responded positively to electric pulp test. No mobility was observed (Fig. 1a and b).

Radiographic examination indicated that the tooth had an open apex and was intruded approximately 3–4 mm relative to the cemento-enamel junction of the adjacent right central incisor (Fig. 2). No root or alveolar bone fractures were observed. The tooth was left for possible spontaneous re-eruption. The crown fracture was temporarily restored using glass ionomer cement, and the patient was scheduled for recall in 2 weeks. In the meantime, immediate treatment consisted of oral hygiene instruction, daily rinsing with 0.12% chlorhexidine and a soft diet.

After 2 weeks, intraoral examination revealed spontaneous re-eruption of the tooth. However, radiographic examination revealed the presence of inflammatory external resorption in the coronal, medial and apical portions of the root (Fig. 3). The root canal was accessed, following instrumentation and irrigation with 2.5% sodium hypochlorite, filled with a calcium hydroxide paste (Kalsin, Aktu, Turkey). The patient was given 1 week of antibiotic therapy consisting of tetracycline 25 mg/kg/day bid, which has been reported to have anti-resorptive properties in addition to its anti-microbial action (15, 16). The patient was scheduled for weekly recalls, during which the paste was reapplied due to its resorption. However, at the end of 1 month, radiographic findings indicated continuing resorption of the tooth (Fig. 4). At this point, CHPP, which has been reported to increase dentine pH more rapidly than calcium hydroxide paste, was initiated as an alternative treatment (17). The appropriate size of point was selected such that it reached the full working length 1 mm short from the radiographic apex. A point one size smaller was also placed passively as the manufacturers indicated. The coronal ends of the

Fig. 2. Radiograph of the intruded maxillary left central incisor, with open apex.

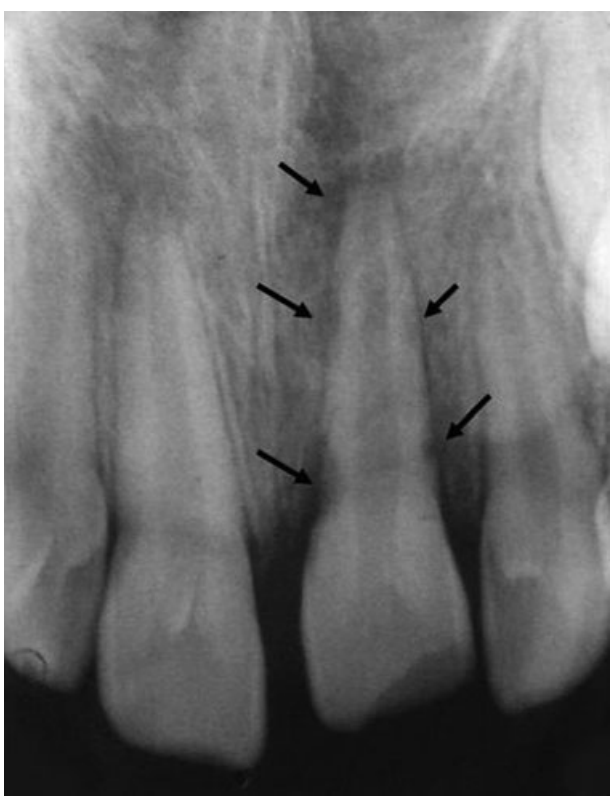

Fig. 3. Spontaneous re-eruption of the left central incisor 15 days after trauma, with inflammatory external resorption in the coronal, medial, and apical portions of the root.

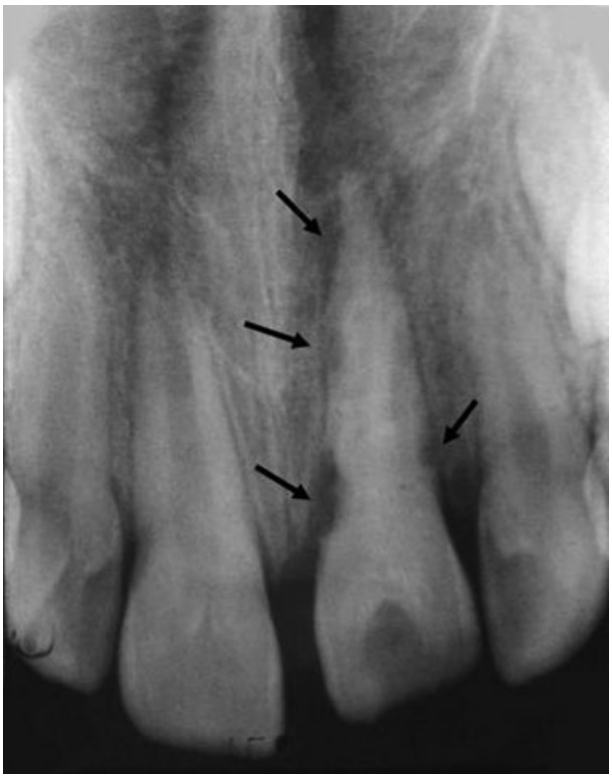

Fig. 4. Continuing resorption of the root, 1 month after calcium hydroxide paste treatment.

points were cut to size with scissors, and the access cavity sealed with IRM over a dry cotton pledget over the canal entrance. At 1-week follow-up, no further progression of the external resorption was observed. In line with the manufacturer's instructions, the points were changed every 3 weeks until an apical barrier formed. At the end of 6 months of CHPP treatment, apexification of the tooth was complete. The canal was obturated with gutta-percha and a root-canal sealer (AH Plus, Dentsply, Konstanz, Germany), and final restoration was completed with composite resin (3M ESPE Filtek^{TM} Supreme XT, St Paul, USA) (Fig. 5a and b).

No signs of pathosis were observed after 12 and 24 months of follow-up (Fig 6a and b). The treatment was considered to be both esthetically and functionally successful.

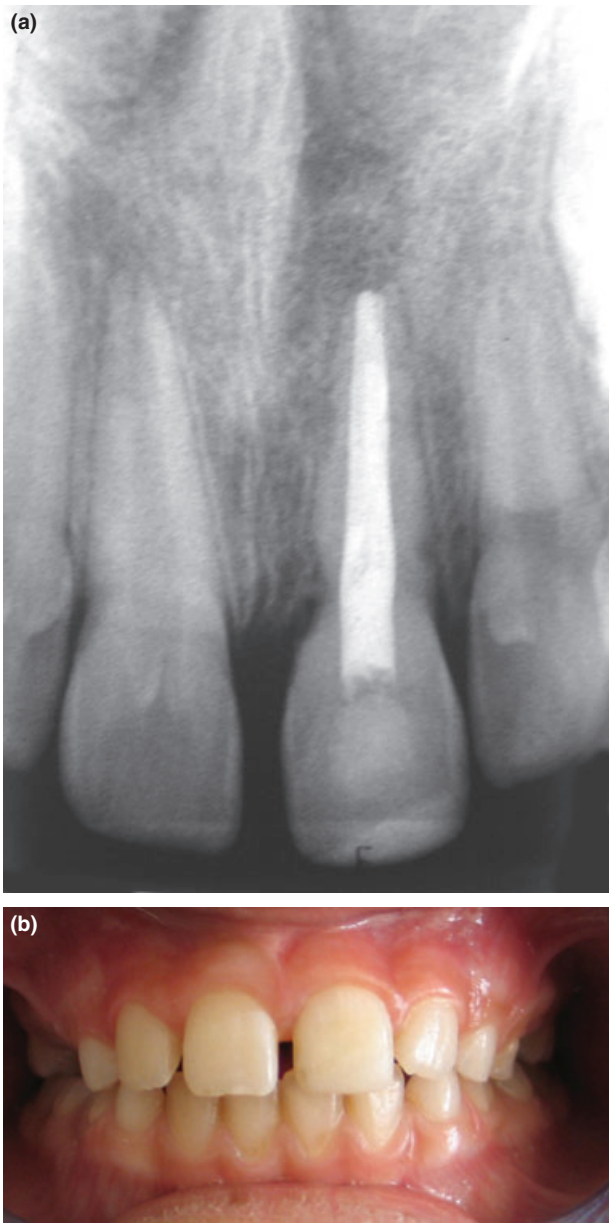

Fig. 5. (a) Radiograph of the tooth at the end of the treatment with CHPP. (b) Final restoration with composite resin.

Discussion

The main concern in the treatment of dental luxation should be periodontal repair (4, 18). For this reason, it is preferable to allow intruded teeth to spontaneously re-erupt rather than re-position them surgically or orthodontically (2, 4, 19). In line with this principle, treatment of intruded immature permanent teeth in our clinic involves orthodontic repositioning only in cases where teeth do not show any sign of re-eruption within several months or when endodontic treatment is required (2, 3).

The case presented here is similar to five cases reported by Saroğlu et al. (2) in which intruded immature permanent incisors re-erupted spontaneously; however, unlike our case, these cases conserved their vitality and continued their root development.

Andreasen et al. (20) reported that pulp necrosis and periodontal healing is very strongly related to the stage of root formation at the time of the injury, with teeth with immature roots having a better prognosis than those with more mature root development. In the case reported here, pulp necrosis and inflammatory root resorption was observed, despite an open apex.

Both mature and immature teeth have been reported to re-erupt spontaneously and return to their normal position within 3–7 months following intrusive trauma (3, 4, 6, 20). In the present case, re-eruption started after 2 weeks, and the intruded tooth returned to its normal position in 4 months.

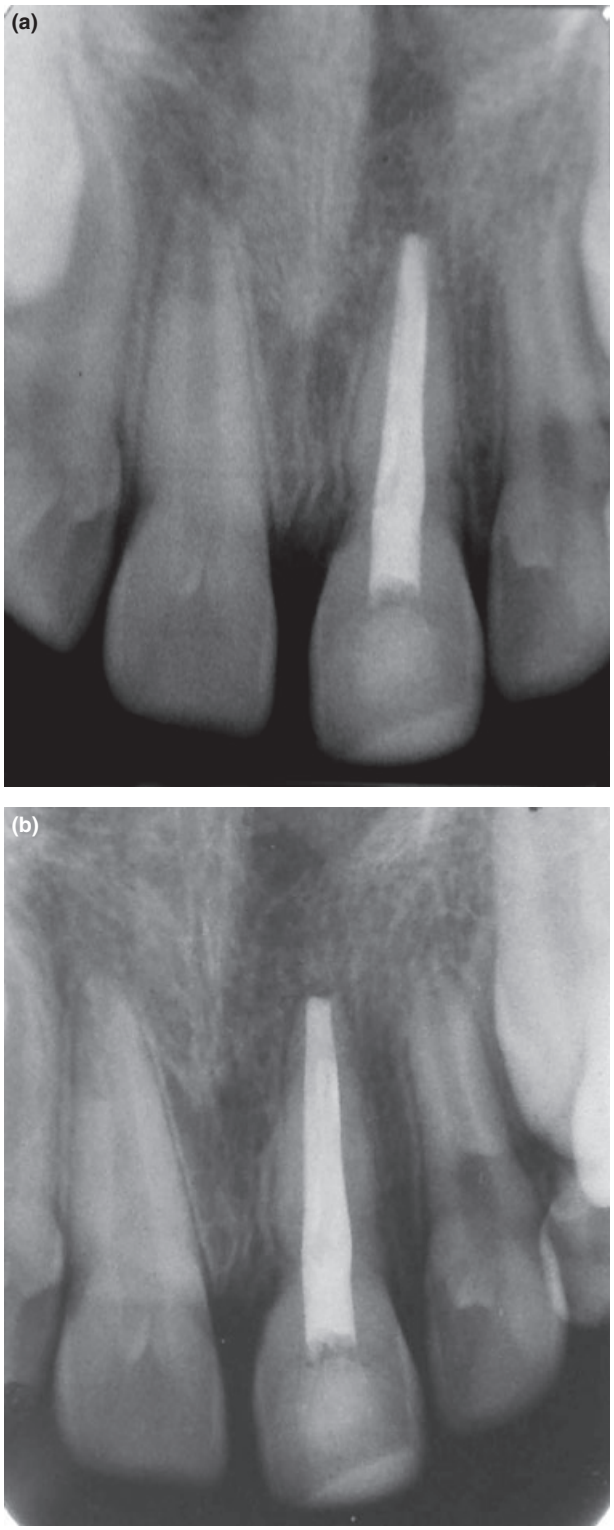

Fig. 6. (a) 12 months follow-up. Repair of mineralized tissues appears to have taken place. (b) 24 months follow-up.

The incidence of inflammatory root resorption following intrusive luxation injuries with an open apex has been reported to be 41% (21). The etiology of root resorption is related to mechanical injury of non-mineralized tissues covering the external surface of the root after dental trauma. It is reported that a radiographic defect affecting both the external root surface of the dentin and adjacent bone is the sign of external inflammatory root resorption (1, 22). According to Andreasen et al. (20), the risk of complication is lower in cases with immature root formation. This finding may be a reflection of the softer bone surrounding teeth with immature root development compared to more developed roots, which may permit intrusion with less trauma to the PDL. However, in our case, severe inflammatory external root resorption progressed despite the immaturity of the root formation.

Cvek (12) evaluated 885 luxated, non-vital maxillary incisors with respect to healing of periodontal tissues including inflammatory root resorption and other pathologies. In this study, inflammatory root resorption was present in 193 teeth (145 immature and 48 mature). Ninety-seven percent of these teeth were reported to be successfully treated with calcium hydroxide.

In experimental animal studies, tetracycline has been shown to be effective in the prevention or attenuation of external root resorption when applied systemically and/or topically (15). Chappuis and von Arx (16) used topical and systemic tetracycline for replantation of 45 avulsed permanent teeth. They stated that one of the reasons for favorable treatment outcome was tetracycline treatment. In this case reported here, aggressive external resorption was present, so antibiotic treatment was started with tetracycline.

In our case, after 1 month calcium hydroxide paste application, the treatment of external resorption and apexification of the tooth was continued with CHPP. These points was chosen based on the reported ability of calcium hydroxide points (CHP) to achieve greater increases in the pH of outer dentin compared to that of inner dentin at the cervical and mid-root levels (17). Pierce (23) reported that the alkalinization of the outer dentin is important to achieve in situations where the aim is reserve the acid environment necessary for root resorption by osteoclasts. Ho et al. (17) recommended application of CHPP in these situations. This mechanism may account for the arrest of inflammatory resorption following CHPP application in this case report.

Lambrianidis et al. (24) reported that depending on the method of removal, between 25% and 40% of the root canal wall will remain contaminated with calcium hydroxide paste. Residual calcium hydroxide can impede the activity of endodontic sealers and their dispersion into lateral canals (25, 26). CHP represent a temporary treatment modality that offers the efficiency of calcium hydroxide in a matrix of bio-inert gutta-percha. These endodontic points have been introduced to address the handling and application of conventional calcium hydroxide paste (14, 27). However, it was shown that the capacity of CHP to provide active ions is limited and that CHP can alkalize dentine or maintain alkaline pH within the root canal for approximately 1 week (27–30). Recently, new $Ca(OH)_2$ plus points [Calcium Hydroxide Plus Points, (CHPP), Roeko] have been introduced additionally containing sodium chloride and tensides. CHPP is able to maintain a high pH over a longer period (14, 27). Lohbauer et al. (27) found a threefold higher

Ca^{2+} release from CHPP compared with CHP for over 40 days. However, there are no reports of its use in long-term root-canal treatments such as apexification. The disadvantages of these endodontic points are; the necessity to replace them every 3 weeks and associated added cost for prolonged treatment.

Healing of inflammatory root resorption was considered to have occurred if the adjacent periodontal space was re-established and the resorption process arrested. A higher risk of cervical root fractures was reported within the first 3 years. Thus, strengthening of teeth with composite materials and long follow-up is suggested (12). In the case reported here, apexification and arrest of external resorption was successfully achieved using calcium hydroxide paste and additionally CHPP. However, longer follow-up for this case is required to be sure of success.

Conclusion

We conclude that, CHPP, points containing calcium hydroxide, may be used for periodontal healing following inflammatory resorption and apexification. However, long-term clinical trials with this material are required.

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