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Case Report

Bone-Like Tissue Growth in the Root Canal of an Immature Permanent Avulsed and Replanted Central Incisor

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Abstract

Background: Avulsion is considered one of the most serious dental injuries known. Among the parameters studied with respect to the pulpal healing were development of pulp necrosis, pulp canal obliteration (PCO) and the ingrowth of bone into the root canal.

Case Report: This study discusses an immature avulsed permanent maxillary left central incisor which was replanted within 2 hours after stored in a physiologic medium of an eight-years-old boy. Thirteen months after avulsion, a radiopaque material was observed inside the root canal. Six months later, 19 months after avulsion, the root canal was filled completely with bone-like tissue with an internal PDL-like structure surrounding.

Follow-up: The tooth was followed up 3 years after the replantation with bony metaplasia inside the root canal and no other clinical and radiographic findings.

Conclusion: The bony metaplasia is reviewed less than other types of healing. Important to know, it is related to regaining vitality and could comprise partial root's development, in which endodontic treatment should not be consider and therefor follow ups are acceptable, of course when no other pathological signs exist.

Keywords: Pulp Necrosis; Pulp Canal Obliteration (PCO); Root Canal; Bone like tissue; Avulsion

Background

Avulsion is considered one of the most serious dental injuries known. Although rare, with a prevalence of 0.5 - 3% of all traumatic injuries to the permanent dentition, it comprises multiple damage to all dental tissues including dental pulp, alveolar bone, periodontal ligament (PDL), cementum and the gingiva [1].

Several factors influence tooth survival after the severe trauma of avulsion. The most significant factors that affect healing in a situation of replantation of an immature tooth are: Extra oral dry time, the type of medium in which the tooth was kept, length of root and width of apex. Minimizing the dry time is critical for survival of the PDL cells. After an extra-alveolar dry time of 30 minutes, most PDL cells are non-viable [2-4]. IADT updated guidelines [2] divide extra oral dry time in to 3 groups: Immediate, meaning within 15 minutes, where PDL cells are most likely viable and 2 other groups with longer extra oral dry time. Less than an hour, where PLD cells may be viable but compromised and of over an hour, where PDL cells are likely to be without vitality. Long extra oral dry time and non-physiologic storage (e.g. tap water, chloramine, chlorhexidine and alcohol) are harmful and have a strong association with compromised pulp healing [1]. In descending order of preference, milk, HBSS,

saliva or saline are suitable and convenient storage mediums. Although water is a poor medium, it is better than leaving the tooth to air-dry [2]. When there is no infection or minimal contamination, host response will allow sufficient connective tissue to revascularize the pulp space through a large apical foramen, the success of revascularization has been shown to increase with correlation to the size of the apical foramen [5,6]. The revascularization process may be arrested by infection and hence the greater the distance to be revascularized, the greater the chance of infection [7,8]. A width smaller then 1.0mm also appears to be a limiting factor [5,9].

Andreasen., *et al*. reported the outcome of replanted permanent incisors with incomplete root formation in monkeys. Among the parameters studied with respect to the pulpal healing were development of pulp necrosis, pulp canal obliteration (PCO) and the ingrowth of bone into the root canal.

Pulp bone (PB) was diagnosed when alveolar bone invaded the root canal. This condition was distinguished radiographically from PCO by the presence of a lamina dura and periodontal ligament (PDL) space within the root canal, which were continuous with the same structures located around the external surface of the root [10].

Pulp healing types diverse. In this case report we present a bone-like growth into the pulp space with partial root development of an immature avulsed tooth which was kept in physiologic medium for 2 hours.

Case Report

An eight-years-old boy was referred to the department of Pediatric Dentistry at the Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, 2 weeks after experiencing avulsion of the maxillary left permanent central incisor and its replantation with splinting after replantation.

The parents reported the boy have fallen in the classroom and hit a table when the tooth was avulsed, it was placed in milk medium within 10 minutes after the fall and the boy was referred for dental first aid at a private dental clinic. The documents received included radiograph and a description of the a infiltration anesthesia of 2 ml Lidocaine 2% containing epinephrine 1:100,000, as opposed to IAPD guidelines [2], before reimplanting the tooth. Replacement of the tooth was preformed within 2 hours and a semi-rigid splint of a composite-wire was placed. Oral Penicillin was prescribed for 7 days.

On the day of arrival, the boy was examined both radiographically and clinically. Radiographically (Figure 1), the CEJ was located coronally and clinically (Figure 2), an extruded clinical presentation was noted compared to a previous clinical picture. Radiographic examination of both the maxillary permanent central incisors revealed immature teeth with wide open apices. Surrounding the left maxillary central incisor was a continuous PDL radiolucent line. The splint was removed according to IAPD guidelines [2]. The tooth was not sensitive to percussion, had a physiologic mobility and was negative to sensitivity test with Ethyl chloride spray, while the right maxillary central incisor was positive to the same sensitivity test. No other pathological signs were observed. The importance of maintaining oral hygiene by teeth brushing properly was emphasized. A follow-up protocol was scheduled.

Figure 1: A periapical radiograph 2 weeks after avulsion. Note the coronal CEJ location of the left maxillary central incisor.

Figure 2: A clinical frontal view on the day of arrival, 2 weeks after avulsion, before splint removal.

Follow-up

On the first recall, 3 weeks after the avulsion, an alginate impression was taken for a mouth guard since the patient was an active football player and wished to return playing. The costumed made mouth guard was delivered to the patient 2 weeks later. No clinical or radiographic changes were recorded in both these recalls.

The patient's father reached the clinic 3 months after avulsion to inform and report on a cold sensation in the replanted tooth while his son was eating a popsicle. Indeed, on the following 4 months recall, a positive sensitivity test was recorded with Ethyl chloride spray. The sensitivity reaction of the left maxillary central incisor was lesser and shorter than the right maxillary central incisor on comparison. Radiograph revealed beginning of apex's closure and possible wall thickening. In addition, the coronal portion of the pulp became obliterated (Figure 3). Similar findings were recorded on the 8 months recall and on the 10 months recall. Neither swelling nor a sinus tract were recorded.

Figure 3: Periapical radiograph of 4 months recall. A beginning of a coronal PCO and of apex closure.

On the following recall, 13 months after avulsion, it was noted that length of the left maxillary central incisor was now shorter than the right one. Additionally, a radiopaque material started to fill the root (Figure 4). Six months later, 19 months after avulsion, the root was filled completely with bone-like tissue with an internal PDL-like structure surrounding (Figure 5). At 25 months and 37 months recalls after avulsion, there were no functional or aesthetic complains on the patient behalf, nor any clinical pathological signs as mobility, sinus tract, swelling or pain. On the last recall (37 months) the apex of the tooth was completely closed (Figure 6).

Figure 4: Periapical radiograph of 13 months recall. Shorter root of the left maxillary central incisor compared to the right one.

Figure 5: Periapical radiograph of 19 months recall. Bone-like material fills the root canal with an internal PDL-like structure surrounding on the left maxillary central incisor.

Figure 6: Periapical radiograph of 37 months and final recall with apex closure of the left maxillary central incisor. Vitality test remained positive.

Discussion

Pulp canal obliteration (PCO) is a common phenomenon after traumatic dental injuries (TDI) and its prevalence ranges broadly between 3.7 - 40%. It has a low chance of a following pulp necrosis and thus prophylactic endodontic therapy is unadvisable [11]. PCO is a replacement of the dental pulp connective tissue with calcified tissue and it is more common in luxation type of injuries and if the tooth's apex is open [12].

Radiographically, PCO will be expressed as apposition of calcified tissue along the root canal and pulp chamber, resembling reparative dentine. Alternatively, the apposition may be diffuse and resemble bone, as metaplastic transformation into bone-like tissue. PCO will not occur after avulsion and replantation that is accompanied by infection and devitalization of the pulp tissue [1,13].

Nishioka., *et al*. proposed that following an injury, bone marrow cells migrate into the pulp lumen. They suggested that this bone-like growth response is more favorable in absence of infection, as similar to PCO. They reached this conclusion, owing to higher frequency of bone-like tissue appearance in germ-free rats compared to conventional rats [14].

Heling., *et al*. was even more meticulous and believed that the absence of infection after the trauma and during the healing process is a prerequisite for this metaplasia of pulp tissue into bone-like tissue [13]. They also stated that a wide open apex (an early stage of tooth development) is an important factor in this phenomenon of bone-like tissue development [15]. In their case series, teeth in which diffuse bone-like tissue has developed have retained their vitality [13]. In our case, the patient regained vitality 3 - 4 months after avulsion and replantation. The usual interval from replantation to diagnosis of pulpal healing as represented by a positive sensibility response is 6 months, with a range from 4 months to 2 years [10].

Andreasen classified three types of root growth based on radiographic appearance; normal (continued root formation) 25%, partial completion (disturbed) 28.5% and arrested 46.4%. Normal (continued) root development was defined if the root of the replanted tooth achieved the same length and form as the contralateral non-injured control tooth; Partial root development (disturbed) was defined if a deformed and usually shorter root developed; and arrested root development was defined if development stopped at the time of injury [16]. Out of 6 teeth which healed with an ingrowth of bone-like tissue into the pulp space, all 6 teeth had pulp healing, 4 teeth root's development was partially completed and only 2 teeth showed total arrest of root formation, one of which developed ankylosis 10 years after injury. None of the teeth root's development was completely normal [16]. In our case, also a disturbed root development had occurred. Although the root's apex had closed completely and spontaneously, the root was shorter than the contralateral non-injured tooth (Figure 6). Differently from cases in which root development have arrested completely and vitality tests are negative, there was no need to consider endodontic intervention [17].

In another study by Andreasen, the effect of damage to the Hertwig's epithelial root sheath (HERS) during autotransplantation was examined in 12 green vervet monkeys. During the transplantation of permanent incisor tooth germs, either half or the entire root sheath was amputated, or a contusion injury was made to the root sheath (against the socket wall). This examination showed variations in root growth among the various experimental groups [15]. This study concluded that arrested root formation with ingrowth of bone could be related to the groups where the entire HERS was amputated or contused. Specifically, in the group of contused HERS, an ingrowth of bone into the pulp canal was a typical finding, while in the group where the entire HERS was removed completely, both bone and PDL invaded the pulp. On the contrary to the arrested root formation group, the group with a formation of a new but diminutive root was related to partial amputation of HERS. The partial amputation did not prevent root formation because there is apparently some regenerative potential in the remaining root sheath. Despite root's development differences, ingrowth of bone into the pulp from the base of the alveolus was a common finding in the partial root formation group as well [15] such as in our case.

Conclusion

This case discuses an immature avulsed tooth which was replanted within 2 hours after stored in a physiologic medium. After regaining its vitality, it has gone through coronal obliteration and a bony metaplasia inside its root canal, assumingly due to HERS partial amputation. At the time being, 37 months after trauma, the tooth withstand steady with a partial root development and with no pathological signs. The tooth grants the patient with both functional and aesthetic benefits without color changing during

puberty. Although exceptions to the prognosis do occur, according to the IADT guidelines [2], all avulsed permanent teeth should be replantation attempted.

The bony metaplasia is reviewed less than other types of healing. Important to know, it is related to regaining vitality and could comprise partial root's development, in which endodontic treatment should not be consider and therefor follow ups are acceptable, of course when no other pathological signs exist.

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Volume 5 Issue 8 August 2021