A Case Report of a Vital Replanted Tooth with Unfavourable Extra-alveolar Condition: A 10-Year Follow-up

V Sae-Lim,* *FAMS, DDS, FADI*

Abstract

This case report describes the survival of a maxillary left central incisor after an avulsion injury under unfavourable extra-alveolar condition, when the patient was 9 years old. At subsequent clinicalfollow-ups, the tooth maintained vitality 10 years after the injury. There was sign of gradual obliteration of the root canal space. Concomitantly, the replanted tooth manifested typical characteristics of ankylosis with minimally detectable resorption complication.

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Key words: Ankylosis, Avulsion injury, Immature tooth, Prolonged extra-alveolar duration, Pulp canal obliteration

Introduction

Tooth avulsion, frequently of the maxillary central incisors, occurs most often in children from 7 to 9 years of age, when the periodontium surrounding the immature erupting teeth is loosely structured, providing minimal resistance to extrusive forces. Falls against hard objects, including those incurred during sports activities, are one of the main causes of avulsion in permanent dentition. The avulsion injury will result in damages to both the pulp and the periodontal tissue. The prognosis of these replanted teeth normally depends on the stage of root development at the time of injury, extra-alveolar duration and / or storage condition, in conjunction with measures in the control of contamination.[1]

This case report demonstrates the survival of a replanted tooth after the considered under-optimal extra-alveolar condition, in which the pulp managed to maintain its vitality while there was concomitant internal "ankylosis" with minimally detectable resorption complication ten years later.

Case Report

A 13-year-old Chinese female presented for the management of a "short" traumatised maxillary left central incisor. Four years prior to her presentation, the tooth sustained an avulsion injury during a fall at the basketball court. The patient was immediately attended to by a school dental nurse. However, the tooth was only retrieved an hour later by her mother who had been notified of the accident. The school dental nurse then cleaned and placed the avulsed tooth in a glass of milk. The tooth was eventually replanted by a dental officer about half an hour later.

After replantation, the tooth remained asymptomatic. At the first presentation, four years post-avulsion, the tooth has already manifested typical signs of ankylosis. The incisal edge of her maxillary left central incisor was infra-positioned. The gingival margin of this tooth was also more apically-positioned. The tooth was firm and exhibited metallic sound upon percussion. Nevertheless, the tooth colour and the pulp vitality response were within normal limit. There was no coronal hard tissue injury in the forms of craze lines nor fractures noted. Radiographically, the root appeared to be approximately one quarter shorter than the contra-lateral central incisor and the apex remained open. There was no observable peri-apical or peri-radicular radiolucency. However, an internal periodontal ligament (PDL), more discernible on the distal root canal wall, as well as bone invasion into the apical root canal system were observed.[1,2] The external PDL at the apical third of the mesial root surface was not as distinct as the rest of the external root surface (Fig. 1). The clinical and radiographic presentations at subsequent follow-ups at 3-month (Fig. 2), 6-month (Fig. 3) and 9-month intervals (Fig. 4) were similar except there was more obliteration of the root canal system. The hard tissue appeared to deposit on the dentinal walls that was lined with internal PDL. On further review at the yearly-interval up to ten years post-replantation, the pulp still maintained vitality. There was continued gradual obliteration of. the root canal system with less pronounced demonstration of the internal PDL. The root

* *Assistant Professor*
Department of Restorative Dentistry
National University of Singapore
Address for Reprints: Dr Varawan Sae-Lim, Department of Restorative Dentistry, National University of Singapore, 5 Lower Kent Ridge Road, Singapore 119074.

Fig. 1. A periapical radiograph at first presentation, 4-years post-replantation.

Fig. 2. A periapical radiograph taken 4 years and 3 months post-replantation.

Fig. 3. A periapical radiograph taken 4 years and 9 months post-replantation.

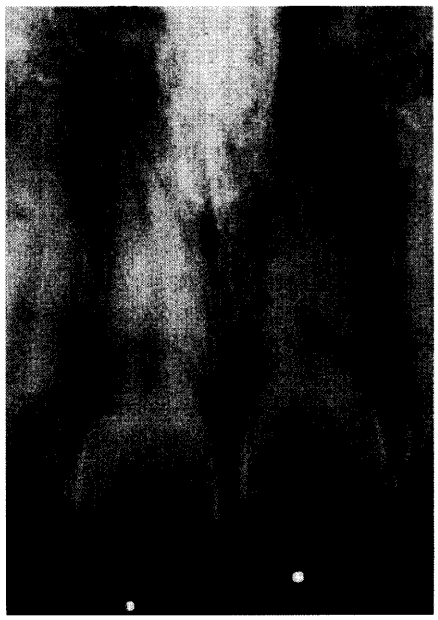

Fig. 4. A periapical radiograph taken 5 years and 6 months post-replantation.

Fig. 5. A periapical radiograph taken IO years post-replantation.

apex appeared to be more matured mesio-distally (Fig. 5). The infra-positioned incisal level was not significantly changed from the first presentation. As the patient was more aesthetically conscious, the incisal edge of the replanted tooth was built up with composite resin to match the contra-lateral right central incisor.

Discussion

This case describes the typical injury pattern in a young patient at the stage of incomplete root formation. Although the periapical radiograph within the first four years post-replantation was not available, by comparing to the non-injured contralateral central incisor, it is conceivable that there was no or not much further root growth after the replantation. The avulsion possibly occurred when the root development was at stage 3 or 4 (i.e. at approximately three-quarters of the anticipated root length) when the apical foramen was still wide open." In addition to this disturbed root growth, there was also sign of gradual maturation of the root apex at

about the same root length as was more discernible in the radiograph taken ten years post-replantation (Fig. 5). It is not clear if this maturation effect was due to the dentinogenesis by odontoblasts from the apical pulp tissue that was left and remained vital in the alveolar socket[1,4] or from that induced by the survived Hertwig epithelial root sheath (HERS) at the root apex[2] or the combination. The trauma of avulsion and replantation, as well as the damage from the unfavourable desiccated extra-alveolar condition in the first hour assumable could have lead to a certain degree of damage to HERS, resulting in arrest of root development." HERS has been postulated to possess preventive function against invasion of PDL-derived cells into the root canal.[6] The presumptive damage to HERS was in line with the findings of the formation of internal PDL and the in-growth within the apical root canal of alveolar bone.[1,2] The latter probably lead to anchorage of the tooth, and thus the clinical manifestation of the typical characteristics of ankylosis, including the presentation of infraocclusion due to the transient disturbance of normal growth of alveolar process in the region.

Despite the adverse extra-alveolar condition in the first hour, the tooth vitality was maintained ten years later. As has been shown, the presence of concomitant hard tissue injuries was significant in determining the negative pulpal outcome of periodontal type of injuries,[7] the absence of coronal hard tissue injuries in this avulsed tooth probably made it conducive to chances of pulpal revascularisation. In addition, the relatively short canal length, and hence the short time taken after the avulsion injury, by vital tissue to repopulate the ischaemic pulp intervening pulpal infection, in conjunction with the wide pulpo-periodontal interface at the apical foramen were also favourable for pulpal healing.[4,8] On the other hand, the degree of pulpal damage and the type of tissue replacing the necrotic pulp appeared to relate to the extra-alveolar storage and duration.[4] The prolonged extra-alveolar dry condition would have detrimental effect on the pulpal cells left at the apical foramen, leading to necrosis.* Coupled with the damage to HERS, the apical necrotic pulp seemed to have been replaced by periapical connective tissue harboring bone progenitor cells,[4] thus the radiographic appearance of bone in-growth to the apical root canal (Fig. 1). With time, the more coronal root canal system was gradually obliterated by the deposition of hard tissue on dentinal walls lined with internal PDL. The type of hard tissue observed radiographically, seemingly different in nature from bony tissue, possibly was formed by the surviving revascularised tissue within the root canal system. It is questionable that the root canal walls were able to protect the more coronally positioned part of the pulp within against the damaging effect of dry storage. Nevertheless, whether the subsequent 30 minutes' milk storage after the prolonged dry storage was beneficial for revascularisation process,[4] is unknown. The hard tissue deposition, thought to be caused by uncontrolled nervous response to trauma,[9] eventually resulted in pulp canal obliteration throughout, masking or superimposing on the internal PDL (Fig. 5).

The presence of vital PDL cells on the root surface of replanted teeth has been found to be important for periodontal healing.[10,11] Soder et al[12] and Patil et al[13] found a significant drop-off in the number of viable PDL cells after extra-alveolar dry time of 60 minutes. Hence, this avulsion case represented a borderline case, which interestingly presented with minimal negative periodontal effect observed. Andreasen et al[1] suggested that, stage of root development in relation to the layer of PDL, which varies from a single cell layer to the full thickness, has the strongest impact on periodontal healing. The more mature the root formation; the thinner is the PDL tissue layer. Thus, it is possible that the immature tooth supposedly with thicker PDL layer could better withstand desiccation, sparing the critical cell layers next to the cementum.[14] The additional rehydration step[15] with milk soaking for 30 minutes prior to replantation of this immature tooth might also have a beneficial effect on the revival of the damaged PDL cells and the clonogenic capacity of the remaining viable PDL cells. On the other hand, infective inflammatory stimuli due to contamination on the root surface or socket walls were thought to result in severe inflammation of the PDL leading to resorption complications.[16-18] Pre-soaking procedure might have served as a "wash out" of the autolytic enzymes and toxic material from necrotic tissue or bacteria.[19] This could also in part explain the survival of this replanted tooth. Whether other unavailable clinical factors, such as the cleansing procedures of the alveolar socket, type and duration of splinting and antibiotic regimen etc, had any impact on the healing of this replanted tooth, cannot be ascertained or excluded.

Conclusion

A young immature tooth stands a higher chance of survival after replantation both in terms of pulpal and periodontal healings.

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