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Retrospective clinical study of 90 avulsed permanent teeth in 58 children

REVIEW ARTICLE

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Abstract – The aim of this study was to find out the causes that lead to dental avulsion in children, to analyze the effectiveness of our treatment and the response of the adults when such incidents occur and finally to determine the occurrence of posttraumatic complications some time after the injury, especially the resorption of the affected teeth root. We analyzed the documentations of a sample of patients containing 57 children who had a total of 90 avulsed teeth and were treated in Dentistry Department of Medical Faculty in Pilsen, Czech Republic, in the years between 1995 and 2005. We discovered that most frequently the children experience dental avulsion in the age between 8 and 11 years old, the most affected teeth are the upper central incisors and the most frequent causes are sports and games which are very common in these ages, in various environments, like schools, sport fields and home. The majority of the children were transferred to the Dentistry Department either quite long after the avulsion incident and without the avulsed teeth, or with the avulsed teeth which were carried in an inappropriate transport medium, indicating that there is insufficient knowledge of adult people, especially the ones who are in daily contact with children, on how to provide first aid in cases of dental avulsion.

Traumatic injuries are very common in young ages, especially in children between 8 and 11 years old (1–5). This study was concentrated on dental avulsion, a situation which is defined as the traumatic expulsion of the tooth from its alveolar socket, during which the neighboring tissues are affected also, and more specifically the periodontal ligaments, the nerves and vessels in the apical area of the root, the gingiva, the alveolar bone and the cement of the root surface (1, 4, 5). It involves mainly teeth with unfinished root development and it belongs among the most serious dental traumas (2) which often results in the loss of the injured tooth. The outcome of the treatment of dental avulsion, as well as the occurrence of future posttraumatic complications depends not only on the time interval between the incident and the dental treatment which ideally should be up to 20–30 min, but also on the transport medium that the avulsed tooth was stored until the visit to the dentist (2–4, 6–9).

The aim of this study was: (i) to find the causes and mechanisms leading to avulsion of permanent teeth, (ii) to determine the frequency of replantation of the avulsed teeth, (iii) to specify the storage medium and the extraoral time and (iv) to analyze any healing events, focusing on the type of the root resorption of the replanted teeth. Moreover, this study was performed in order to evaluate if the response of the adults who were present in such incidents was acute and effective.

Materials and methods

We analyzed 57 young patients' records [38 boys (67%) and 19 girls (33%)] (Fig. 1). These patients were treated in Dentistry Department of Medical Faculty in Pilsen, for avulsion of their permanent teeth, in the years between 1995 and 2005. From these records, the age of the children at the time of the injury, the causes of the avulsion, the type and number of the avulsed teeth and the type of treatment were established. Furthermore, any occurrence of post-traumatic complications, especially various types of resorption of the root were analyzed and the number of the replanted teeth was identified.

Results

Age of the patients at the time of injury

The group of patients of this study included children between 7 and 17 years old. Most frequent ages were between 7 and 12 years old (41 children or 72%). A total of 27 (47.4%) children belonged to the age category between 8 and 11 (Fig. 2).

Causes of injury

Twenty-two out of 57 patients (39%) experienced falls from bicycles and 15 (26%) falls either against the floor or stairs or against an object during walking or running. Five (9%) of the avulsion incidents were results of sports (mostly contact sports like football or hockey), four (7%) of playing and four (7%) of traffic accidents. In one case, a young girl was kicked by a horse (Table 1).

Type and number of avulsed teeth

Fifty-seven children had a total of 90 avulsed teeth. Forty-two (74%) had only one tooth avulsed, 10 (17%)

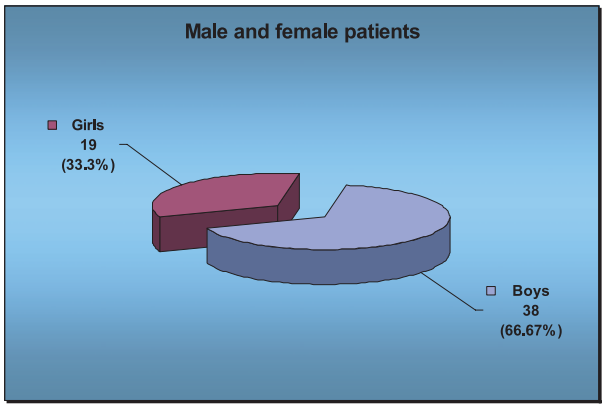

Fig. 1. Sex prevalence in children with avulsion injuries.

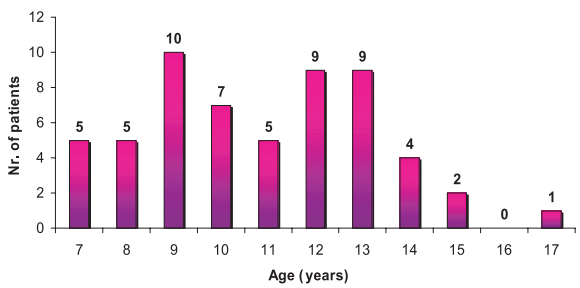

Fig. 2. Age of the patients at the time of the avulsion injury.

Table 1. Causes of the avulsion injury

Causes of dental avulsion		
Causes	No. of causes	%
Bicycle/scooter falls	22	38.6
Fall during walking/running	15	26.3
Sports or physical exercises	5	8.8
Playing	4	7.0
Car accidents	4	7.0
Fighting between students	2	3.5
Kicked by horse	1	1.8
Criminal act	1	1.8
Epileptic episode	1	1.8
Impact of metal object to the orofacial region	2	3.5
Total	57	100.0

had two teeth avulsed and the remaining five (9%) patients had more than two teeth avulsed. In one of these cases a young boy 9 years old avulsed all his upper and lower incisors and a lower right canine after fall against a metal object (Fig. 3). Fifty-one out of 90 (57%) avulsed teeth were upper central incisors. Totally 74 (82%) out of 90 were upper teeth and 16 (18%) were lower.

Type of treatment

Twenty-six (46%) of these patients were treated with replantation of the avulsed teeth. In one of these cases, a young boy immediately replanted the avulsed tooth at the place of the accident. Only in one case we replanted

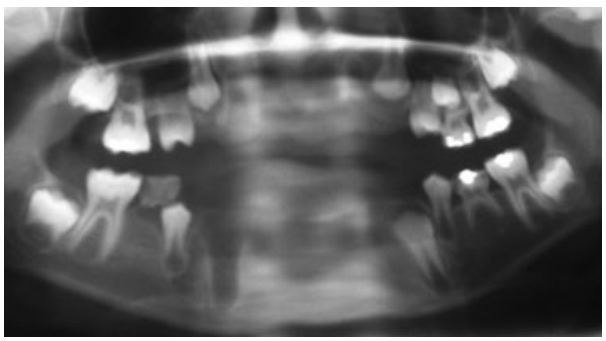

Fig. 3. Panoramic X-ray of a 9-year-old boy who avulsed nine permanent teeth after falling on his face to a metal pipe.

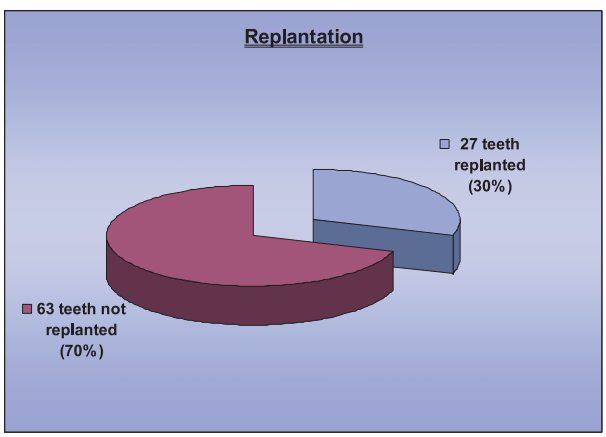

Fig. 4. Type of treatment – replantation.

two teeth. One tooth was treated with definite endodontic filling extraorally before its replantation, 12 h after the injury.

Thirty-one (54%) of our patients were treated without replantation, either because the avulsed teeth were not found, or because they visited the dental department long after the traumatic incident, or finally because they were hospitalized for more serious injuries. So, out of 90 avulsed teeth of this study, only 27 (30%) were replanted (Fig. 4).

Transport medium for the avulsed teeth

In 11 out of 27 (41%) replanted teeth, we could not determine from the records the transport medium that the avulsed tooth was stored until the patient visited the Dentistry Department for treatment. Nine (33%) were stored in dry media, like dry handkerchief, two (7%) in saline, two (7%) in a wet towel and one (4%) in solution with local antibiotics. One patient kept the avulsed tooth in his oral cavity until the visit to the Dentistry Department and another one replanted the tooth himself immediately after the accident. Finally one tooth (4%) was stored in milk (Table 2).

Extraoral period

One patient replanted the avulsed tooth at the place of the accident and in one case the tooth was replanted in

Table 2. Transport media of the avulsed teeth

Transport medium		
Twenty-seven teeth replanted		
Transport medium type	No. of teeth	%
Unknown	11	40.7
Fysiologic solution	2	7.4
Dry media	9	33.3
Wet towel	2	7.4
Framykoin solution (Neomycin sulphate and Bacitracin antibiotic solution)	1	3.7
In oral cavity	1	3.7
Replanted immediately	1	3.7
Total	27	

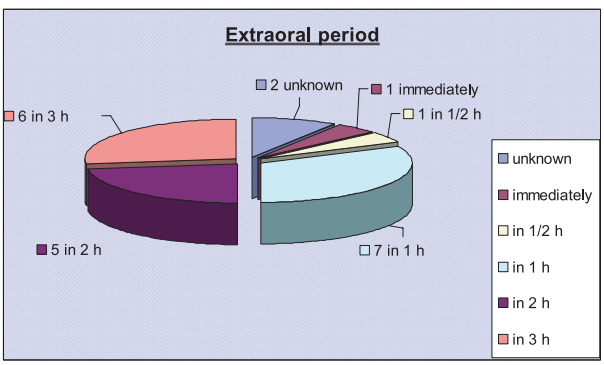

Fig. 5. Extraoral period of the avulsed tooth.

the Dentistry Department 1/2 h after the injury. Seven of the children were transferred to the dental office in 1 h, 11 of them between 1 and 3 h, and four of them in more than 3 h after the traumatic incident. In two cases find the extraoral period of the avulsed teeth could not be traced (Fig. 5).

Splinting

After replantation, acrylic splint was used (for immobilization of the injured teeth). It was prepared on a plaster model after an impression taken. In some cases, a wire fixed to the teeth with composite material was preferred. The avulsed teeth were splinted for a period up to 2 weeks.

Endodontic treatment

Endodontic treatment of replanted teeth comprised extirpation of the necrotic pulp and the filling of the root canal with calcium hydroxide in 23 cases. One tooth was filled endodontically before replantation and for three of the replanted teeth we have no further information, since the patients did not continue their treatment at the department. We did not notice revascularization after replantation of teeth with uncompleted development of their root, except for two replanted teeth which later presented with root canal obliteration.

Type of healing of the replanted teeth

Radiographic controls revealed that 10 replanted teeth presented with arrested inflammatory resorption of the surface of their root, 11 replanted teeth with ankylosis and three teeth with active inflammatory resorption. Seven of the replanted teeth had to be extracted due to advanced resorption of their root. In four of the teeth with replacement resorption, we diagnosed significant infraocclusion. Finally in one patient, a few months after replantation of the avulsed tooth, we diagnosed resorption of the interdental alveolar septum. In two cases, subsequent pulp canal obliteration was investigated some time after the injury.

Discussion

Avulsion of teeth occurs more frequently in the ages between 7 and 11 years old (9). In this study 56% of the patients belonged to that age category. Concerning the sex which is most frequently affected, our results confirm the data in the literature (8, 10) since 67% of our patients were boys and only 33% were girls, so the ratio boys/girls was equal to 2:1.

The most frequent causes of dental avulsion are falls from bicycles, falls during walking and running, sports, playing and traffic accidents. In the literature the most frequent causes for dental injuries are quite similar (10, 11).

In this study, like in all studies in the literature (4, 12, 13) the most frequent affected teeth are the upper central incisors and in most of the cases dental avulsion is accompanied with other injuries, like injuries of the neighboring soft tissues, alveolar bone, etc.

The most critical factor for a successful replantation is the transport medium in which the avulsed tooth is stored until the transport of the child to the dentist and the extraoral time interval (1–4, 6, 14, 15). Extraoral period is the time duration between the traumatic avulsion of the tooth until its replantation and it should ideally be up to 20–30 min (1–5). In this study, only one tooth was replanted 30 min after the injury and in one case the child replanted the tooth itself at the place of the accident. Concerning the transport media, it has been proved that the ideal one is the Hanks Balanced Solution in which the avulsed teeth could be stored even up to 24 h and the vitality of the periodontal ligaments will be saved (8, 10). Apart from that, saline solution or milk can be used with relatively good results. Another way is to save the tooth in the oral vestibulum. Water should be the last choice to store the tooth and only if we can not find the prementioned solutions (10).

After replantation, it is advised by many authors (1–6) to apply semi-rigid splinting of the tooth for 7–10 days. In Dentistry Department in Pilsen the replanted teeth were splinted for 2 weeks in most of the cases. The prolongation of the splinting use may lead to ankylosis of the replanted tooth. It is always on the benefit of the patient to prescribe antibiotics and analgetics, mouth rinses with 0.12% chlorhexidine digluconate solution and finally advise the patient to have good oral hygiene and use soft diet.

For teeth with completed root development, after 2 weeks we performed endodontic therapy, in order to decrease the risk of future appearance of inflammatory resorption of the root (8, 16–18). In cases of avulsed teeth with uncompleted root development we should wait before proceeding to endodontic treatment, because if the tooth is replanted until 1 h after its expulsion from the socket, we could expect pulp revascularization, which in the future X-ray controls will be verified by continuation of root development of the replanted tooth. Endodontic treatment should be performed only when clinical and X-ray controls of the tooth with incomplete root development indicate a necrotic pulp (1–5).

The type of healing of the replanted tooth depends on the reaction of the periodontium and the pulp after replantation (19–22). Superficial resorption is considered to be the favorable type of healing and is due to mechanical injury of the periodontal ligaments and the superficial layer of the cement of the root during avulsion injury. Replacement resorption or ankylosis appears in teeth that their periodontal ligaments have dried, have been destructed or removed from the surface of the root (4, 5, 14, 23). Usually this type of resorption can be seen during radiographic controls, 2 months after replantation. Apart from that, sometimes it may lead to infraocclusion which can be diagnosed clinically. This unpleasant situation can be treated by decoronation, a technique that comprises the separation of the clinical crown from the root with a diamond bur, after the elevation of a mucoperiosteal flap and the removal of the root filling (15, 24). This technique has the advantage that the root is gradually resorbed and replaced by alveolar bone and in this case the bone is preserved and can be used in the future for implant. In advance, the separated clinical crown could be bonded to the adjacent teeth, providing the patient a satisfactory aesthetic result. This technique was used in three patients (12%). Inflammatory resorption is the most serious type of root resorption, having the worst prognosis. It is characterized by resorption of the cement and dentin of the root together with inflammatory changes of the periodontium. This type of resorption is always associated with necrosis and infection of the pulp from where bacteria enter the periodontal space through the dentinal tubules. Inflammatory resorption can appear 3 weeks after replantation, and can progress so fast, the might lead to loss of the affected tooth within 8–12 weeks (4). We met with such a situation in three patients (12%). We suppose that the appearance of inflammatory resorption is always related to endodontic treatment on time and filling of root canal with calcium hydroxide, and this is the reason that the occurrence of this serious complication was relatively low in this study group of patients. Other serious complications are considered to be the resorption of the alveolar septum (found in one case, 4%) and the obliteration of the root canal (found in two cases, 8%).

Conclusion

From 90 avulsed teeth found in our patients' documentations, only 27 were replanted. Most of the replanted teeth either were transported to Dentistry Department of Medical Faculty in Pilsen quite long time after the injury or they were stored in inappropriate transport medium. These facts prove that there is significant insufficiency on the knowledge of adult people who are in daily contact with children, not only on providing first aid, but also on preventing dental injuries. We should focus our efforts on informing and educating all the professionals who are in contact with children, as well as the parents, on how to prevent dental traumas (e.g. promote the use of mouthguards during sport activities) and how to provide ideally first aid in these cases.

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