

# Complexity of Factors Affecting Treatment and Prognosis of Avulsed Teeth

## SUMMARY

*The aim of this study was to investigate some important factors associated with tooth avulsion, type of the treatment, possibilities of replantation, and onset of complications after replantation. The sample consisted of 39 patients suffering avulsion of 50 permanent incisors, whose treatment had been undertaken during the period 1998-2005 at Clinic of Dentistry, Faculty of Medicine, Novi Sad, and Paediatric Dentistry Clinic, Faculty of Dentistry, Belgrade. The study design was prospective, recording history of the accident, data concerning the act of replantation, postoperative treatment of replanted teeth and onset of complications. Observation period ranged from 6 months to 5 years.*

*Traffic accident was the cause of tooth avulsion in 24% cases. Prevalence of avulsion was 7.7%. Average age of patients was 10.7 years. 26 of 50 avulsed teeth could not be replanted. Only 5 replanted teeth were held under wet conditions. The time until replantation ranged between 15 minutes and 9 hours. In one case revascularisation occurred. Timing of detection of complications varied from 3 months to 2 years. Complications had been noticed in 70.8%, and 4 teeth had been extracted.*

*Contemporary treatment of an avulsed tooth is under strong influence of factors that cannot be predicted and that seriously compromise the outcome of replanted teeth.*

**Keywords:** Avulsion; Replantation; Traumatic Injury; Root Resorption

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## Introduction

Despite the advances in treatment of avulsed teeth presented over the past decade, replantation outcomes have not been improved<sup>1-4</sup>. Andreasen found that, under ideal conditions, complete healing of the pulp and the periodontal ligament of avulsed teeth could occur<sup>5</sup>. Numerous laboratory studies support clinical studies in conclusion that only in case of teeth replanted within 15 minutes after avulsion there is a chance of regeneration of the periodontal ligament and consequent normal function<sup>6</sup>. Practically, such ideal conditions rarely occur in cases presented to a clinician; consequently, replantation and further treatment of replanted teeth is followed by complications, inflammation and replacement resorption<sup>7</sup>.

It is no doubt that avulsions are the most complicated traumatic dental injuries, but they are the most contro-

versial as well. The literature has shown that the most critical factors affecting the prognosis of an avulsed tooth after replantation are extraoral dry time and the storage media in which the tooth is placed before treatment is rendered<sup>2,4,5</sup>. However, avulsion injury itself, as well as replantation and further treatment of a replanted tooth is complex and under influence of numerous factors that can seriously influence the outcome of the treatment. The aim of this study was to investigate all the factors associated with avulsion injury itself, possibilities of replantation, type of the treatment, and onset of complications after replantation.

## Materials and Methods

The sample consisted of 39 patients (14 girls, 25 boys) with 50 permanent incisors avulsed, whose injury

had been managed during the period 1998-2005 at the Paediatric Department, Clinic of Dentistry, Faculty of Medicine, Novi Sad, and at the Clinic for Paediatric and Preventive Dentistry, Faculty of Dentistry, Belgrade. The mean age at the time of trauma was 10.7 years (range 7-19 years).

The study design was prospective recording full history of the accident, data about the act of replantation, treatment of replanted teeth, and onset and treatment of complications. Observation period ranged from 6 months to 5 years. Factors that were analysed were: aetiology, presence of concomitant injuries, age of the patient, avulsion/replantation rate, apical maturity of the root, storage medium, time spent in each medium prior to replantation, dry time, total extra-alveolar time, type and timing of endodontic treatment, recall appointments response, and decision making in the treatment of complication.

## Results

Analysis of full history of the accident showed that tooth avulsion was followed with concomitant, regional and distant injuries in all the presented cases. Traffic accident was the cause of tooth avulsion in 24% cases, which is significantly larger incidence compared to all other dental injuries ( $p < 0.001$ ). 26 (52%) of 50 avulsed teeth could not be replanted.

Replantation had been performed with all the teeth brought to clinic in spite of a long extra-alveolar period in several cases (Fig. 1).

Root development of non-replanted teeth was evaluated according to radiographs of opposite or adjacent teeth - determining stage of eruption is a standard diagnostic procedure in initial treatment of avulsion injury. Almost 50% of all avulsed teeth were with uncompleted root development. 12 (50%) replanted teeth were with uncompleted root development (Tab. 1).

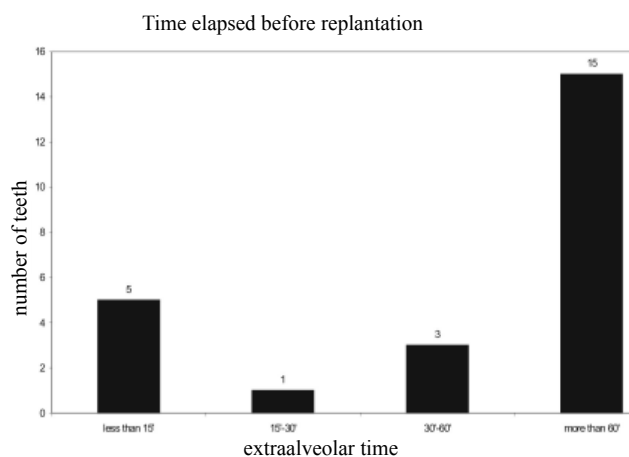


Figure 1. Extra-alveolar time in the replanted teeth

Table 1. Age of the patients and root development at the time of trauma

Mean age	10.7 years (range 7-19)
Avulsed teeth with completed root development	26
Avulsed teeth with uncompleted root development	24
Replanted teeth with completed root development	12
Replanted teeth with uncompleted root development	12

Only 5 (21%) replanted teeth were held under wet conditions: 1 tooth had been placed in saline prior to replantation, and the other 4 teeth had been placed in water. For all 5 teeth, medium dry time was less than 15 minutes. 19 teeth (60%) had been brought to clinic dry, mainly wrapped in tissue paper. There were no changes in storage medium during the transport.

The time until replantation ranged between 0.2 and 9 h (MODE = 1.5 h).

In 14 teeth (58%), endodontic treatment was initiated within 2 weeks after the injury. In 6 replanted teeth (25%), endodontic treatment was delayed because it had been waited for revascularisation to occur. In 1 replanted tooth revascularisation occurred, for other 23 teeth it was not the case. For all these teeth, decision was to undertake long-lasting endodontic treatment with calcium-hydroxide.

In replanted teeth splint had been removed within 2 weeks, except in 4 teeth (17%) where splint could not be removed and endodontic treatment could not be initiated in first 2 weeks, because of the nature of concomitant injuries - multiple skeletal fractures that had to be treated in hospital first.

The time of detection of complications varied from 3 months to 2 years. In this observation period, complications have been noticed in 17 teeth (71%). Regarding the type of resorption, inflammatory resorption has been recorded in 11 teeth, while replacement resorption occurred in 6 cases. After the complications have been noticed, in 13 teeth (76%) it was decided to continue with endodontic treatment of root resorption. For 2 teeth, parents, when informed about the prognosis and possible outcome, insisted in orthodontic treatment and these 2 teeth had been extracted. Other 2 teeth had been extracted due to severe and progressive inflammatory resorption.

Data referring recall appointments response showed that response was 100% in first 8 weeks after injury, 66% 6 months after injury, and only 50% 1 year after injury.

## Discussion

Knowledge of aetiology is always important for treatment and preventive strategy planning. High rate of avul-

sion injury that happened in traffic accidents may be one of the reasons for the delayed treatment and poor prognosis. It is understandable that when serious accident happens, teeth are not the subjects of the greatest interest. Emergency treatment and medical check up after traffic accident is aimed in registering more serious and complicated injuries, and it is long lasting and thorough<sup>8</sup>. In these situations lost teeth is price that has to be paid to misfortune.

Tooth avulsion prevalence has been reported in many studies, and it ranges between 0.5-16% of the 7-10 year age group<sup>9,10</sup>. The main reason for inconsistency and wide range in reported prevalence of tooth avulsion is source from which data had been collected. Larger percentage of tooth avulsions has been noticed in Paediatric Dentistry Clinics, which suggests that tooth avulsions are mainly treated in specialised institutions. Rather large percentage (7,7%) of tooth avulsions, reported in this study, may also indicate that there is reluctance among general dental practitioners to treat the avulsion injury.

The fact that tooth avulsion is always followed by concomitant, local and a distant injury is crucial for explanation why treatment is often delayed. Recognising that the dental injury might be secondary to a more serious injury is essential<sup>8</sup>. Avulsion injury itself looks very dramatically, and when it is accompanied with other injuries, it is of a minor interest for people at the spot of the accident. Because of all circumstances, it is maybe too much to expect that people present at the spot of the accident could manage to replant the tooth. There are number of studies that report very low level of knowledge among people present at the spot of the accident about emergency treatment<sup>8,11-14</sup>. It is necessary to inform parents about the nature of the accident happened, prognosis in order to avoid family drama, and possible legal consequences for people present at the spot of the accident.

Age of the patient and apical maturity of root can influence the treatment in several ways. Completed root development in combination with long extra-alveolar period can worsen the prognosis. Age of patients could influence the treatment in that manner that it is sometimes difficult to provide adequate treatment, especially when child has already been traumatised by injury that happened not long ago. For some of these patients, it is the first time to experience serious dental treatment and local anaesthesia. It is crucial for them to understand the treatment fully and to cooperate. If that cannot be provided, treatment is seriously compromised.

The state of the art in dental traumatology is that replantation should be performed even in cases of prolonged non-physiological extraoral storage<sup>8</sup>, although the probability of developing replacement or inflammatory resorption is high. In spite of the attempt to replant all the teeth brought to our clinics, replantation could not be performed for half of the avulsed teeth. Reasons for non replanting lay mainly in accident details, traffic accidents (40%), lack of awareness about the type of the injury

(27%), and lack of awareness that tooth should be looked for (33%).

The medium in which the tooth has been stored affects the levels of root resorption and pulp healing<sup>7,8</sup>. Prolonged drying of the root, along with the delayed act of replantation, has been accepted to be the most significant factor that can compromise the long-term prognosis of replanted teeth. In situations where replantation cannot be carried out, maintaining the root in a moist environment can improve the outcome. Only 20% of replanted teeth of our patients had been held under wet conditions.

Some studies have found that extended extra-alveolar time is a good predictor of resorption<sup>15-17</sup>. Andreasen and Hjorting-Hansen found that 90% of teeth replanted within 30 min did not develop root resorption when reviewed at an interval ranging between 1 and 13 years, and this finding was based on 10 teeth<sup>15</sup>. Andersson and Bodin found that teeth replanted within 15 min after the avulsion have a favourable long-term prognosis with no resorption<sup>6</sup>. Mackie and Worthington found no significant relationship between the time that the avulsed tooth was out of the mouth and root resorption<sup>18</sup>. Data collected in this study could hardly be compared and analysed regarding extra-alveolar time and favourable healing after replantation because extra-alveolar time was completely inappropriate for almost all the replanted teeth, and it would be too much to expect the favourable periodontal healing, free of complications. Situations presented to clinicians who treated avulsion injuries in this study suggest that treatment procedure should be aimed mainly in solving the problem of complications after replantation, rather than wait for periodontal healing.

There were authors that advocated early removal of the pulp of replanted teeth in order to minimise or prevent inflammatory resorption<sup>19</sup>. Andreasen recommends delaying endodontic treatment for 1 week after replantation to prevent the development of ankylosis and inflammatory resorption, and allow time for reattachment of periodontal fibres<sup>20</sup>. Kinirons suggests that pulp treatment should be delayed in those teeth with wide-open apices that have been replanted promptly, in all other replanted teeth the pulp should be removed as soon as the tooth is stable enough, ideally within 10 days of trauma<sup>4</sup>. If the dentist is confident of complete patient cooperation, long-term therapy with calcium hydroxide remains an excellent treatment method<sup>21,22</sup>. In this study, a long-term calcium hydroxide treatment had been initiated in 60% of the replanted teeth within 2 weeks after injury. In 6 replanted teeth, treatment was delayed because waiting for revascularisation to occur. Revascularisation occurred in just 1 case. Effect of prolonged splinting and delay of endodontic treatment could not be evaluated because of extremely small specimen (only 4 teeth in 2 patients).

Success of endodontic treatment depends on long-lasting and careful check ups many years after injury.

Data collected in this study showed that the interest and responsibility for the replanted tooth decreases from 2 months after injury. It is common for these patients to forget about scheduled appointment, and show up after several months. That factor could be influenced on, and could be one of the targets for preventive strategy planning when tooth avulsion is involved.

The combination of bacteria in the root canal and damage of cementum on the external root surface contribute to the external inflammatory root resorption<sup>8,21</sup>. External inflammatory root resorption can occur rapidly in young teeth because the dentinal tubules are wide and allow the irritants to move freely to the external surface of the root<sup>8</sup>. Root resorption is common, with a reported prevalence of 57-80%<sup>2,17,18</sup>, which completely correspond to complication rate noted in this study (70.8%). Severe inflammatory resorption often leads to rapid tooth loss. In children, replacement resorption leads to loss of ankylosed teeth usually within 1-5 years<sup>8</sup>. In adults, replacement resorption occurs more slowly<sup>20-24</sup>.

Decision making when complications are noticed is very sensitive step in the replanted teeth treatment. While appropriate endodontic therapy is effective in the treatment of external inflammatory resorption, replacement resorption cannot be arrested or repaired<sup>25</sup>. Barrett and Kenny reported that the expected 5-year survival rate of replanted permanent maxillary incisors in children is 57%, and almost all incisors with immature root formation were extracted by 1.5 years after injury<sup>1</sup>. Decision about orthodontic, surgical and/or prosthetic treatment should be brought together with patient and his parents after they were informed about the prognosis and nature of child's injury.

## Conclusion

Contemporary treatment of an avulsed tooth is complex, requesting demanding treatment procedures. The act of injury, replantation, endodontic treatment and treatment of complication are under strong influence of factors that cannot be predicted and that can seriously affect the treatment procedures and outcome of the replanted teeth.

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