

Characteristics of avulsed permanent teeth treated at Beijing Stomatological Hospital

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Abstract – Prevention of dental injury is considered to be more important than its treatment. A study was established to reduce the prevalence and the complications of tooth avulsion. *Aim:* The aim of this study was to investigate the characteristics of tooth avulsion of permanent teeth among patients that visited the Emergency Department of Beijing Stomatological Hospital in China. *Materials and methods:* A retrospective analysis was performed of the dental records of 88 patients with 120 avulsed permanent teeth between 7 and 75 years old who had attended the Emergency Department of Beijing Stomatological Hospital in China during the period 1 July 2008 until 30 June 2009. *Results:* In 88 examined patients, the number of avulsed permanent teeth was 120. In 63 (71.6%) patients, in total 85 avulsed teeth were treated with replantation. In 18 (28.6%) patients, the avulsed teeth were stored in dry media. In only eight cases (12.7%), the avulsed teeth were replanted within 30 min. In approximately half of the cases (49.2%), the replanted teeth were fixed with stainless steel splint and a composite resin. *Conclusions:* It was evident from this study that there were delayed tooth replantations in many tooth avulsion cases. Thus, educational programs should be conducted to create awareness about the importance of immediate replantation, which will entail better prognosis of traumatic avulsed permanent tooth.

Tooth avulsion (exarticulation, total luxation) following traumatic dental injuries implies total displacement of the tooth out of its alveolar socket (1) and is a complicated dental injury (2), often resulting in loss of the injured tooth. A recently presented study in China showed that 8% of all dental injuries were tooth avulsions (3).

The prognosis depends on the measures taken at the place of accident, such as replantation of the avulsed tooth, choice of transport medium and dental treatment performed after the avulsion. Replantation of a tooth beyond 5 min has been defined by Andreasen(4) as delayed replantation that affects tooth survival (5). There are two main reasons for delayed replantation of avulsed teeth. People present at the site of injury are usually lay persons, whose knowledge of how to manage an avulsed tooth is inadequate (6, 7). In addition, soft tissue lacerations and bleeding are almost always associated with injuries to the teeth, which mask the loss of teeth. It is therefore not unusual for avulsion to be overlooked at the time of injury (5).

Avulsions should be emphasized because of prompt and proper initial care (8), long-term clinical and radiographic follow-up (9). On the other hand, the integrity of the periodontal ligament, advocated by many researchers as being essential for the success of replantation, cannot be controlled by the dental professional, as it depends on the interaction of factors, such as extra-alveolar period, storage medium and contamination of the avulsed tooth at the scene of accident (4, 10).

The aim of this study was to investigate the characteristics of tooth avulsion of permanent teeth according to number of avulsed teeth, replantation, transport medium and type of splinting.

Materials and methods

A retrospective analysis was performed of 88 patients with dental records attending the Emergency Department of Beijing Stomatological Hospital in China consecutively treated for a tooth avulsion during the period 1 July 2008 until 30 June 2009.

Information on the patient's age, gender, the causes of tooth avulsion, number of avulsed permanent teeth, accompany injuries, replantation rate, transport media, the period of delayed replantation and type of splint was taken from the dental records. Radiographic examination and clinical pictures were performed to confirm the diagnosis. Data analysis was carried out using personal computer and the Microsoft office Excel 2003. Differences between genders, age groups and causes were analysed using chi-squared test. SPSS statistical package version 17.0 (SPSS Inc., Chicago, IL, USA) was used to analyse the data.

Results

Gender and age

In 88 examined patients, avulsion of a permanent anterior tooth was diagnosed in 55 men (62.5%) and

33 women (37.5%) with a male/female ratio of 1.7:1.0. The age at the time of the injury ranged from 7 to 75 years. In two cases, the age of the men could not be traced. The male and female mean ages were 24.2 and 29.2 years, respectively. The highest frequency of tooth avulsion occurred among 7- to 17-year-old children and adolescents (Fig. 1).

In average, twice as many men as women suffered from a tooth avulsion in the groups of 7–17 and 18–27 years.

Causes

Of 88 patients, 20 (22.7%) patients experienced a fall against floor, stairs or an object during walking or running, while 17 (19.3%) patients fell from a bicycle or a scooter. In 16 (18.2%) cases, the reason was a criminal act (Fig. 2). Other reasons represented in eight cases were a motorcycle accident, a stage performance and a falling against a cart handlebar. In two cases, the causes could not be determined.

In the age interval 7–17 years, seven men experienced a fall. The chi-squared test revealed that there was a statistically significant relationship between age groups and trauma causes ($P < 0.05$). No statistically significant difference was found between men and women concerning causes ($P > 0.05$) (Table 1).

Type and number of teeth

In all, 120 teeth were avulsed: 100 (83.3%) in the upper jaw and 20 (16.7%) in the lower jaw.

The most frequently affected permanent teeth were the maxillary central incisors (Fig. 3). In 61 (69.3%) cases, one tooth was avulsed, while in 22 (25.0%) cases two teeth were avulsed and in the remaining five (5.7%) patients three or more teeth were avulsed at the same time.

Accompanying injuries

In 86 (97.7%) cases, tooth avulsion was accompanied by injuries of the neighbouring teeth, soft tissues or alveolar bone (Fig. 4).

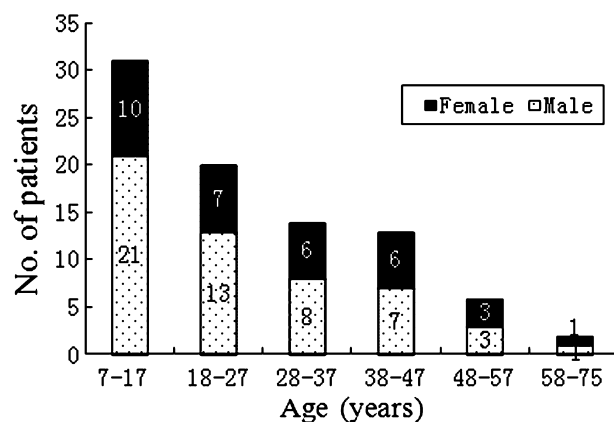


Fig. 1. Distribution of the patients according to age and gender.

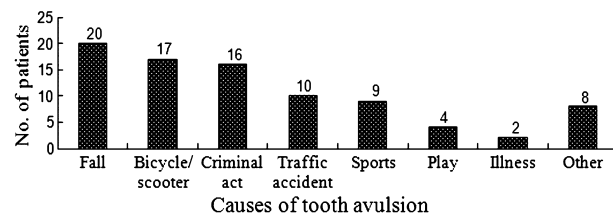


Fig. 2. Distribution of the sample according to the causes of tooth avulsion.

Table 1. Distribution of the causes of tooth avulsion according to age and gender

| Causes | Age and gender | | | | | | Total |
|------------------|----------------|---------|-------|---------|-------------|---------|-------|
| | 7-17 | | 18-27 | | 28 or older | | |
| | Males | Females | Males | Females | Males | Females | |
| Fall | 7 | 2 | 2 | 1 | 3 | 5 | 20 |
| Bicycle/scooter | 1 | 2 | 4 | 2 | 2 | 6 | 17 |
| Criminal act | 0 | 0 | 2 | 1 | 10 | 2 | 15 |
| Traffic accident | 3 | 2 | 1 | 0 | 1 | 3 | 10 |
| Sport | 5 | 1 | 1 | 1 | 0 | 1 | 9 |
| Play | 1 | 1 | 0 | 1 | 1 | 0 | 4 |
| Illness | 1 | 0 | 0 | 0 | 0 | 1 | 2 |
| Other | 3 | 1 | 4 | 0 | 0 | 0 | 8 |
| Unknown | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 22 | 9 | 14 | 6 | 17 | 18 | 86 |

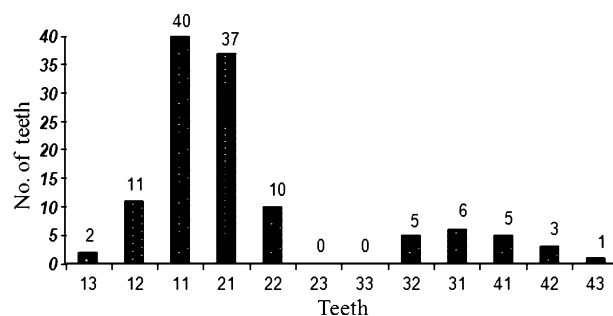


Fig. 3. Distribution of avulsed permanent teeth according to tooth type.

In 12 cases, the avulsed teeth also included crown fractures, root fractures or crown-root fractures.

In one of these cases, a patient avulsed his right upper canine (Fig. 5a) and also received crown-root fractures of right upper incisors, crown fractures of lower incisors and lower right canine and soft tissue injuries from a fall against a metal object (Fig. 5b).

Replantation

In 63 (71.6%) patients, in total 85 avulsed teeth were treated with replantation, while in 25 (28.4%) patients, in 35 avulsed teeth were either lost at the scene of accident,

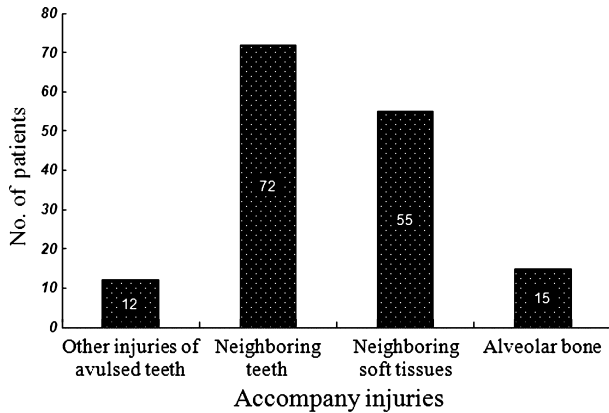


Fig. 4. Distribution of accompany injuries of tooth avulsion.

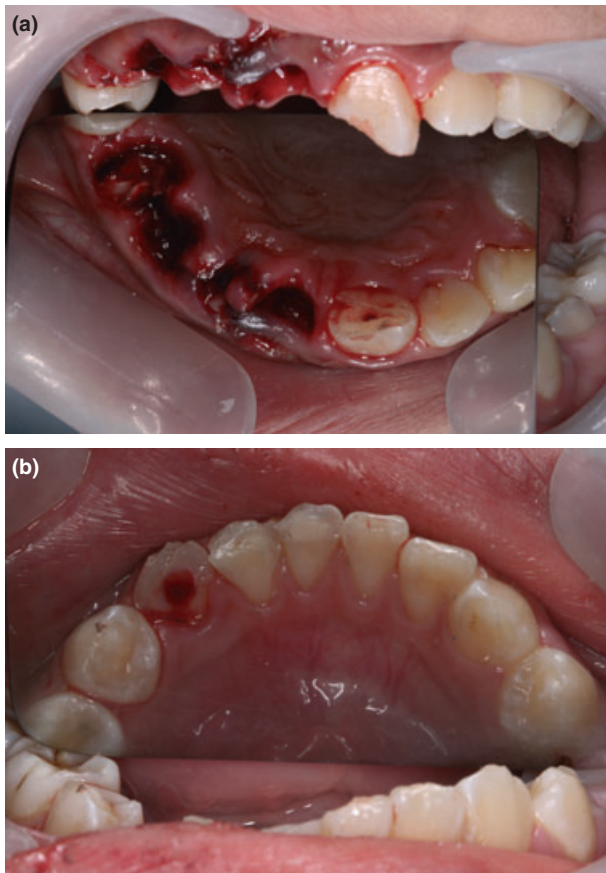


Fig. 5. Clinical pictures of a patient who avulsed the permanent tooth (a) and injured neighbouring teeth and soft tissue (b).

the patient refused replantation or the visit to the hospital was delayed.

Transport medium for the avulsed tooth

In six (9.5%) patients with a tooth replantation, the transport medium could not be determined. In 18 (28.6%) patients, the avulsed teeth were stored in dry

media, like a dry handkerchief or a piece of facial tissue, and in nine (14.3%) patients in saline. Seven (11.1%) patients kept the avulsed tooth in their oral cavity until they reached the Emergency Department, and one (1.6%) patients replanted the tooth himself immediately after the accident. Other transport media were a wet towel, solution with local antibiotics, milk or water (Fig. 6). Eleven (17.5%) patients stored their avulsed tooth in more than one medium. For example, one patient stored his avulsed tooth in a piece of facial tissue for 5 h, and then in his oral cavity for 2 h. Another patient put his left lower central incisor in a piece of facial tissue, and his right lower central incisor in dry media for 2 h and later in milk for one hour.

Period of delayed replantation

The period of delayed replantation was recorded for each patient. In only eight cases (12.7%), the avulsed teeth were replanted in the Emergency Department within 30 min, while in the rest of the cases, the replantation was delayed more than 30 min. In six cases, the extra-oral period could not be determined (Fig. 7).

Splinting

In approximately half of the cases (49.2%), the replanted teeth were fixed with stainless steel splint and a composite resin for immobilization of the injured teeth and in 28 (44.4%) cases with fibre-composite splint. In some cases, wire-composite and flow-composite splints were preferred (Fig. 8).

Discussion

This study examined the data obtained from patients who presented to an emergency dental practice in Beijing, the capital of China following an avulsion to their teeth. There was no data available concerning those patients who did not present to this emergency dental practice. The details of the injuries, such as the time and cause, will depend on the patients' recollections of the events and consequently the accuracy will often depend on factors such as the severity of the condition, the time from the injury to treatment. Despite these limitations, this study is likely to reflect the prevalence and characteristics of tooth avulsion in Beijing.

In the present study, a higher injury rate was found in men compared with women (1.7:1), which agrees with other epidemiological studies (5, 11). Many factors may influence the male/female ratio such as the social, cultural, geographical and sporting characteristics of

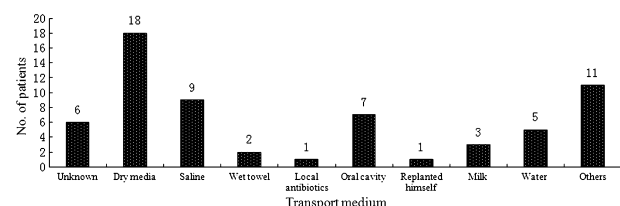


Fig. 6. Transport medium for the avulsed tooth.

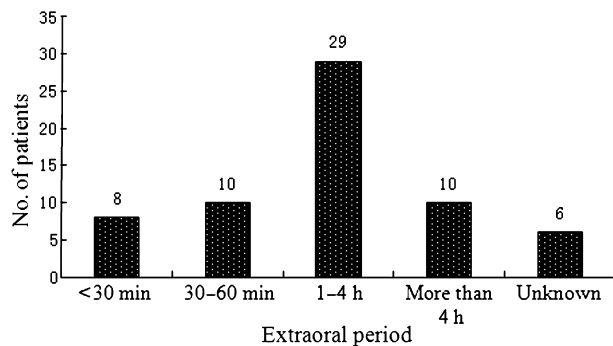


Fig. 7. The period of delayed replantation.

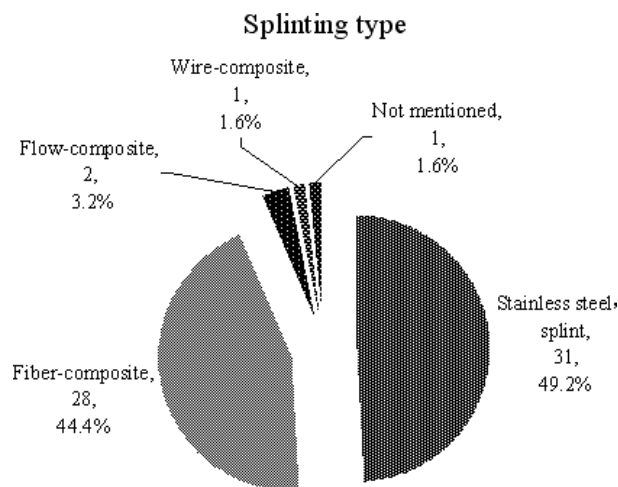


Fig. 8. Splinting type of the avulsed tooth.

the cohort of patients. A high male/female ratio of 2:1 and a high incidence of 7–17- and 18–27-year-old men are confirmed by other studies (12, 13). More men in this age group participate in sport and night time social activities that appeared to result in more injuries because of assaults (14). Many studies also support the premise that more men than women usually engage in sports that are more aggressive in nature (15, 16).

In this study, the age of patients suffering tooth avulsion ranged from 7 to 75 years. Comparisons of age group characteristics between studies are difficult to perform because of the diversity of age groupings used by the various researchers. In this study, the highest frequency of tooth avulsion occurred in the 7- to 17-year age group followed by the 18- to 27-year group. The reasons may be explained that children and adolescents are usually more active in this period of life and the high number of participants within all kinds of sports, games and bicycles (17). Apical maturity of the root presents an important factor that determines the outcome of the replanted tooth. Although a tooth with uncompleted root development possesses a strong reparatory potential and thicker periodontal ligament that may desiccate more slowly, the post-replantation outcome is usually worse compared with the mature tooth (5). Andreasen

et al.(4) reported higher failure rates in teeth with open apices.

The most frequent causes of tooth avulsion are falls against the floor or stairs or against an object during walking or running, falls from bicycles or scooters, criminal acts, traffic accidents, sports and playing. This is consistent with almost all literature reviewed (13, 18). The number of tooth avulsion arising from accidents with criminal acts was also noted in this study and the other study (19). There may be some subjectivity and variations associated with assessing and classifying the causes of injuries. There is no standard classification of the causes of tooth avulsion and therefore reports will depend on the individual clinician who records the incident and such descriptions may be interchangeable among different clinicians. Unusual or uncommon causes were grouped as 'other' to simplify the results.

As to the type of the total traumatized avulsed teeth, the results representing the highest percentage (64.1%) of the avulsed upper central incisors show similarities between our sample and some other countries studies (19, 20). In general, high percentage of traumatic dental injuries to the maxillary teeth can be explained by the prominence of these teeth. The maxillary central incisors are sometimes in a protrusive position and often inadequately covered by the upper lips, which could possibly amortize the strike (21). Unlike the lower teeth and the canines, the latter, considered as the strongest teeth in the jaw, are usually better protected by the lips and not so prone to injury (21, 22). Considering the number of the avulsed tooth, the results of this study are similar to those of some recent studies (23–25).

Most frequently, avulsion involves a single tooth; but multiple avulsions are occasionally encountered (4, 9, 26, 27). Other types of injuries are often associated with avulsions; among these, fractures of the alveolar socket wall and injuries to the lips are the most common (1). In two of 88 (2.3%) patients has only one avulsed tooth, the others has many accompanied injuries. This result can prove an outcome avulsion of permanent teeth is the most serious of all dental injuries (2).

Replantation is the treatment of choice, but cannot always be carried out immediately (2, 28). In most situations, replantation of the avulsed tooth, even with a dubious prognosis, can be performed, and the tooth considered as a temporary restoration until such time as definitive treatment planning, often following specialist consultation, can be carried out (1). In this study, replantation was performed to most of the avulsed tooth (85/120), and avulsed teeth in this sample could be replanted. A low replantation rate has been reported (14/32) by Kinoshita et al.(29) (27/90) by Tzigkounakis et al.(11) and (32/62) by Petrovic et al.(5).

The most critical factors for a successful replantation are the transport medium in which the avulsed tooth was stored until the patient was treated with replantation and the period of delayed replantation (1, 2, 30, 31), especially whether the tooth has been kept dry or under physiological conditions. For every replanted tooth, total transport medium and the period of delayed replantation were analysed. Both the transport medium and the period of delayed replantation have to be discussed at same time.

Avulsed tooth should always be replanted as soon as possible and if this is not possible, a physiological storage medium such as saliva, saline or milk should be used to store the replanted tooth. The patient should visit a dentist emergency service as soon as possible (1). Some researchers considered saline as appropriate or at least preferable compared with other storage media observed in their sample (5). The Hanks Balanced Solution has been proved the ideal one in which the avulsed tooth could be stored even up to 24 h, and the vitality of the periodontal ligaments will be saved (18, 32). A commercial tissue culture medium (ViaSpan®; Bristol-Myers Squibb Pharma Company, Garden City, NY, USA) could be used for extra-alveolar storage. *In vitro* experiments have shown it to be effective even for several days of storage (1). In this study, it can be found that many patients did not keep the avulsed tooth under physiological conditions. The reasons may be that the patients are lack of the knowledge of how to store the avulsed tooth. Moreover, commercial storage media are usually not available at the site of accident. Studies have demonstrated that replantation of avulsed tooth occurs most frequently between 1 and 4 h after avulsion (33, 34). The result of this study is consistent with these studies.

According to the IADT Guidelines for management of avulsed permanent teeth, replanted permanent teeth should be splinted up to 2 weeks. Wire-composite splint has been used to stabilize avulsed tooth (2). Berthold et al. (35) concluded that flexible or semi-rigid splints are appropriate for splinting teeth with dislocation injuries. Ideally, a splint should localize the tooth in the original position without further trauma, orthodontic forces or gingival injury, and allow adequate oral hygiene (32). Semi-rigid or flexible splinting allows physiologic tooth movement as functional stimuli assist healing (36). A functional splint retains the tooth in the socket but is flexible enough to allow functional stimulation of the periodontium (37). Guidelines are useful for dentists in delivering the best care possible in an efficient manner. In this study, fibre-composite splint has been widely used because it allows good oral hygiene and are well tolerated by the patients.

Conclusion

It was evident from this study that most patients were subjected to delayed replantation. Thus, educational programs for lay persons should be conducted to create awareness about the importance of immediate replantation of traumatic avulsed teeth, which will entail better prognosis of avulsed tooth. Besides the technical knowledge and clinical experience acquired, which direct the treatment of tooth avulsion, the dental professional plays another important role in society, to offer preventive care and educational information. Integration of these factors may positively influence the prognosis of tooth replantation.

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