Dental Traumatology 2006; doi: 10.1111/j.1600-9657.2005.00448.x

DENTAL TRAUMATOLOGY

Knowledge of oral health professionals of treatment of avulsed teeth

Cohenca N, Forrest JL, Rotstein I. Knowledge of oral health professionals of treatment of avulsed teeth. © Blackwell Munksgaard, 2006.

Abstract – The management and immediate treatment of an avulsed permanent tooth will determine the long-term survival of the tooth. The aim of this study was to evaluate the knowledge of oral health professionals on the new guidelines for emergency treatment of avulsed teeth. A 12-item questionnaire was distributed among general dentists, specialists, dental hygienists and dental assistants attending Continuing Education courses at the School of Dentistry, University of Southern California, between 2003 and 2004. This study reports only on the general practitioners who comprised 83% of the participants. The results revealed an uneven pattern of knowledge among them regarding the emergency management of an avulsed tooth. Statistically significant associations were related to the participants' previous dental trauma education and their age. In conclusion, there is a need to improve the knowledge of general dentists in the current guidelines for emergency treatment of avulsed teeth.

Nestor Cohenca[1,2], Jane L. Forrest[3], Ilan Rotstein[1]

[1]Division of Surgical, Therapeutic & Bioengineering Sciences, School of Dentistry, University of Southern California, Los Angeles, CA; [2]Department of Endodontics, School of Dentistry, University of Washington, Seattle, WA; [3]Division of Health Promotion, Disease Prevention and Epidemiology, School of Dentistry, University of Southern California, Los Angeles, CA, USA

Key words: avulsion; knowledge; health professionals

Dr Nestor Cohenca, Department of Endodontics, School of Dentistry, University of Washington, POB 357448, Seattle, WA 98195-7448, USA
Tel.: +1 (206) 543 5044
Fax: +1 (206) 616 9085
e-mail: cohenca@u.washington.edu

Accepted 7 September, 2005

In recent years the incidence of accidents associated with traumatic dental injuries has increased. The incidence of dental trauma as a result of falls, bicycle accidents, skateboards and other sports activities is higher in children and adolescents and maxillary incisors are the teeth most commonly affected (1–4). More than 30% of accidents occur at home and about 25% occur in school (2). Overjet, maxillary incisor exposure and interlabial gap are predisposing factors that increase the risk of trauma-associated dental injuries (5, 6).

Avulsed teeth represent about 16% of dental injuries (1). When a tooth is avulsed, extensive damage to the pulp and the periodontal tissues result in complications such as pulp necrosis, periapical inflammation and root resorption. Replacement root resorption is the most frequent complication associated with replanted avulsed teeth (1). Extra-alveolar dry time and the storage media used to transport the tooth are critical factors for successful and long-term outcomes (7–9). Treatment is often complex, time-consuming, expensive and requires multidisciplinary approaches such as endodontic and periodontal treatment, surgery, orthodontic movements and esthetic coronal restoration (1, 10, 11). Replantation-associated root resorption can often result in complications such as infra-occlusion leading to poor esthetics, tilting of adjacent teeth, loss of function and eventually loss of the affected teeth (1, 10). The benefit of tooth replantation in such cases is mainly the time gained to establish an optimal permanent treatment plan and preservation of the width of the alveolar bone.

Recently, the guidelines suggested by the American Association of Endodontists (AAE) and the International Association of Dental Traumatology (IADT) for treatment of avulsed teeth have been updated, with significant changes from previous versions (12, 13). It is expected that oral healthcare professionals be familiar with these recommendations in order to provide the most effective treatment for their patients and to take part in the education of their communities. Several studies have attempted to assess the knowledge of different populations including dentists, physicians, schoolteachers, parents and sports coaches (14–19) regard-

ing the emergency treatment of avulsed teeth. Most of these studies highlighted the need for better communication between dental professionals and the community and for effective implementation of educational campaigns.

In light of dental professionals having a primary role in treating dental traumas, the purpose of this study was to assess their knowledge of the new guidelines for emergency treatment of avulsed teeth. In doing so, associations between knowledge of recommended treatment modalities for an avulsed tooth and previous dental trauma education, age of participants, and number of years of clinical experience were examined.

Material and methods

A 12-item questionnaire was distributed among general dentists, specialists, dental hygienists and dental assistants attending Continuing Education courses at the School of Dentistry, University of Southern California, between 2003 and 2004. The questionnaire included four items on practice and demographics and eight multiple-choice questions regarding dental trauma background and knowledge (Table 1). Over a period of 4 months, 1200 questionnaires were distributed. Questionnaires were individually distributed and confidentiality was assured, as participants were not required to give their names or any other identifying information. Participation was voluntary and data obtained from returned questionnaires were entered into an SPSS database and statistically analyzed using the Pearson chi-square test at $P < 0.05$ level of confidence.

Table 1. Questions used in the survey questionnaire

1	Please indicate your profession. If you are a specialist, please indicate your specialty
2	Please specify your age
3	Years of professional experience
4	Practice hours/week
5	Have you ever received advice or education on what to do in the event of an accident where a permanent tooth has been avulsed?
6	Have you ever treated an emergency trauma case immediately after a permanent tooth was knocked out?
7	Should an avulsed permanent tooth be replanted?
8	How urgent is it to seek professional help if a permanent tooth has been avulsed?
9	You were informed by telephone that a child was injured and a permanent tooth was avulsed. Which of the following treatments would you recommend?
10	Do you think that a primary tooth that has been avulsed should be replanted?
11	If a permanent tooth to be replanted had fallen onto the ground and was covered in dirt, what would you recommend?
12	If a tooth could not be replanted on the site of injury, how would you recommend transporting it to the dental office?

Results

Frequency of responses is reported as a percentage of the total number of respondents for each question, and for questions 9–13, a percentage within groups also is provided. Of the 1200 questionnaires, 202 were completed and returned. Of these, 167 participants (82.7%) were general practitioners and 35 participants (27.3%) were other oral health professionals (Table 2). Because the sample size for the remaining groups was as small as 0.5%, data are presented only for the 167 general dentists. Of these, over 85%, were between the age of 35 and 64, with 64% having more than 16 years of experience and practicing at least 30 h per week (Table 3). Ninety percent of participants responded that they had previously received education regarding the management of an avulsed permanent tooth, with nearly half reporting it was more than 5 years ago.

Table 2. Distribution of oral health professionals completing the questionnaires ($n = 202$)

Group	*n* (%)
General dentists	167 (82.7)
Pedodontists	13 (6.4)
Dental assistants	6 (3)
Periodontists	5 (2.5)
Dental hygienists	4 (2)
Orthodontists	3 (1.5)
Oral surgeons	2 (1)
Endodontists	1 (0.5)
Prosthodontists	1 (0.5)

Table 3. Percentage distribution of age, years of experience and weekly practice hours of the oral health professionals included in the study

	%
Age	
<35	3.6
35–44	31.9
45–54	33.7
55–64	19.3
>65	11.4
Years of experience	
<5	2.9
5–10	13.6
11–15	19.3
16–20	15.0
>20	49.3
Weekly practice hours	
<10	3.7
10–19	6.7
20–29	15.6
30–40	62.2
>40	11.9

The majority of participants (53.3%) correctly responded that they would not replant an avulsed permanent tooth *in every case*, while 29.3% responded that they would (Table 4). Regarding replantation of an avulsed *primary* tooth, 85.3% correctly responded that they would not replant, while 14.7% responded that they would. Most participants (81.3%) recognized the urgency for seeking professional care in <30 min with an additional 16.9% recognizing this should occur within 1 h of tooth avulsion (Table 5). When asked what would they recommend over the phone when informed of such an injury, the majority (68.9%) incorrectly recommended placing the tooth in milk and seeking care, whereas only 24.4% accurately recommended replanting the tooth back into its socket as soon as possible and seeking care immediately (Table 6). Over 60% correctly recommended washing an avulsed tooth gently with water when it falls onto the ground (Table 7) and over 53% correctly identified that when the tooth *could not be replanted* in the site of injury it should be transported to the dental office in fresh milk (Table 8). Interestingly, 30% of participants responded incorrectly that they would recommend transporting the avulsed tooth in the patient's mouth.

Cross tabulations were then examined between knowledge of emergency treatment and participants' previous dental trauma education, age, and years of experience. Four statistically significant associations were found. The first two were between *previous dental trauma education* and

1 having ever treated an emergency trauma case immediately after a permanent tooth was knocked out (Q6) ($\chi^2(3) = 12.948$, $P < 0.005$);
2 the urgency in seeking professional help (Q8), ($\chi^2(3) = 18.984$, $P < 0.025$).

The last two significant associations were found between *age* and

3 what to do in the event of an accident where a permanent tooth has been avulsed and recommended treatment provided via telephone (Q9) ($\chi^2(8) = 18.807$, $P < 0.016$) (Table 9);
4 recommended emergency treatment on how to transport a tooth *when could not be replanted* (Q12) ($\chi^2(16) = 37.185$, $P < 0.002$) (Table 10).

In the case of the first significant finding, only 60%, including those reporting no education, reported having ever treated an emergency involving a traumatic dental injury associated with an avulsed permanent tooth. In the second significant association, the majority of those in each group recognized the need to seek care within the first 30 min. Although statistically significant, in the third case of recommended treatment provided via telephone, the overwhelming majority answered incorrectly by recommending the tooth be put in cold milk. Also, this response was independent of age group (Table 9). However, in examining trends among the age groups, a higher percentage of

Table 4. Percentage distribution of responses whether an avulsed permanent tooth should be replanted (question 7)

Response	%
Yes, in all cases	29.3
Yes, except in cases of avulsion of multiple teeth	6.0
Yes, except in cases of an unconscious patient	10.8
Not in all cases	53.3
Never	0.5

Table 5. Percentage distribution of responses regarding urgency to seek professional help once a tooth has been avulsed (question 8)

Response	%
As soon as it happens, <30 min	81.3
Within 30–60 min	16.9
Within a couple of hours	0.6
Within 24 h	1.2

Table 6. Percentage distribution of responses of the recommended emergency treatment for an avulsed permanent tooth on site of injury given over the phone (question 9)

Response	%
Wrap the tooth in a clean gauze and seek care	6.7
Replant tooth as soon as possible into socket and seek care	24.4
Place tooth in cold fresh milk and seek care	68.9

Table 7. Percentage distribution of responses of recommended treatment on site of injury in case an avulsed tooth has fallen onto the ground (question 11)

Response	%
Scrub tooth gently with tooth brush	3.2
Wash tooth gently with water	60.5
Rinse tooth with chlorhexidine or another antiseptic	11.5
Put tooth as is back to the socket	1.3
Keep tooth in patient's mouth until arrival to dentist	20.4
Place tooth in milk	1.9
Rinse tooth with saline	0.6
None	0.6

Table 8. Percentage distribution of responses of recommended transport media of an avulsed tooth from the site of injury to the dental office (question 12)

Response	%
Water	3.9
Patient's mouth	30.1
Paper tissue	2.0
Fresh milk	53.6
Alcohol	0
Saline solution	10.5

Table 9. Association between age of participants and recommended emergency treatment for an avulsed permanent tooth provided over the telephone

	Wrap in gauze		Replant into socket		Place in milk	
Age of participants	% of total	% within group	% of total	% within group	% of total	% within group
<35	0	0	1.2	40.0	1.8	60.0
35–44	0.6	1.9	9.2	28.8	22.1	69.2
45–54	1.2	3.6	9.8	29.1	22.7	67.3
55–64	1.8	9.4	3.7	18.8	14.1	71.9
>65	3.1	26.3	0.6	5.3	8.0	68.4

$\chi^2(8) = 18.807$, $P < 0.016$.

Table 10. Association between age of participants and the three most recommended transport media in case an avulsed permanent tooth could not be replanted on site of injury

	Patient's mouth		Fresh milk		Saline	
Age group	% of total	% within group	% of total	% within group	% of total	% within group
<35	0.7	20.0	2.6	80.0	0	0
35–44	10.5	33.3	19.7	62.5	0	0
45–54	11.8	34.6	15.1	44.2	5.3	15.4
55–64	7.2	37.9	9.2	48.3	3.4	0.7
>65	0	0	6.6	55.6	4.6	38.9

$\chi^2(16) = 37.185$, $P < 0.002$.

Table 11. Years of experience of participants and recommended emergency treatment for an avulsed permanent tooth on site of injury given over the phone

	Wrap in gauze		Replant into socket		Place in milk	
Years of experience	% of total	% within group	% of total	% within group	% of total	% within group
<5	0	0	0	0	2.9	100
5–10	0	0	0.7	5.3	13.1	94.7
11–15	1.2	6.9	6.6	34.6	10.9	57.7
16–20	0	0	3.6	26.3	10.2	73.7
>20	5.6	10.6	8.8	17.4	35.0	69.6

younger participants answered correctly. Conversely, a lower percentage of older participants answered correctly.

The last statistically significant finding was between the age of participants and recommended emergency treatment on how to transport a tooth *when could not be replanted* (Table 10). In this case, the majority answered correctly by recommending the tooth be transported in cold milk, followed by a substantial percentage (30%) within the age groups indicating they would transport an avulsed tooth in the patient's mouth. The one exception to selecting this mode of transportation was those over the age of 65.

Years of experience were not found to be statistically significant. However, in terms of recommended treatment, whether *the tooth could be replanted or not*, over half recommended placing the avulsed permanent tooth in milk (Tables 11 and 12). When the tooth *could be* replanted into the socket, <20% recommended doing so. Very few respondents recommended wrapping the tooth in gauze. When the tooth *could not be* replanted, the second choice was to transport the tooth in the patient's mouth. This was followed by transporting the tooth in saline solution. Although no significant associations were found, those with more recent education, i.e., the percentage within each group, appear to correctly recommend replanting the tooth (Table 13).

Discussion

Treatment guidelines for avulsed teeth are required to assist dentists, as well as other oral healthcare professionals, in delivering the best care possible and in the most efficient manner (13). In addition, knowledge of the appropriate treatments can reduce stress and anxiety for both patients and the dental team. Therefore, it is important to promote awareness and up-to-date information among professionals as well as groups at risk regarding prevention and emergency treatment modalities. Correct application of these techniques immediately after the traumatic injury should improve both short- and long-term outcomes (13).

Table 12. Years of experience of participants and the three most recommended transport media in case an avulsed permanent tooth could not be replanted on site of injury

	Patient's mouth		Fresh milk		Saline	
Years of experience	% of total	% within group	% of total	% within group	% of total	% within group
<5	0	0	3.2	100	0	0
5–10	2.4	17.6	9.5	70.6	0.8	5.9
11–15	4.8	24.0	11.9	60.0	1.6	8.0
16–20	7.1	52.9	3.2	23.5	1.6	11.8
>20	12.7	25.4	27.0	54	7.1	14.3

Table 13. Previous dental trauma education and recommended emergency treatment for an avulsed permanent tooth on site of injury given over the phone

	Wrap in gauze		Replant into socket		Place in milk	
Years from last education (%)	% of total	% within group	% of total	% within group	% of total	% within group
<3 (25.7)	0.6	2.4	9.1	35.7	15.9	61.9
3–5 (16.2)	0.6	4.0	4.9	32.0	9.8	64.0
>5 (48.5)	4.3	8.6	10.4	21.0	34.8	70.4
No education (9.6)	1.2	12.5	0	0	8.5	87.5

The results of this study revealed an uneven pattern of knowledge among the participating general dentists regarding the emergency management of an avulsed tooth. The vast majority of participants reported that they would not replant an avulsed *primary* tooth. This response is in accordance with the current guidelines and recommendations of the IADT (13). This also is in agreement with the findings of Stokes et al. (15) who reported 83% of dentists unwilling to replant primary teeth. Regarding permanent teeth, most participants in this study responded that they would not replant an avulsed permanent tooth in every case, an approach that also was recommended by the AAE and IADT (12, 13). It has been recognized that avulsed teeth presenting extensive caries, or severe root damage, should not be replanted. In addition, it has been recommended not to replant teeth with open apices that remained in dry conditions for more than 1 h (13). However, almost 30% of our participants responded that they would replant a permanent tooth in every case (Table 4). Other studies showed even a higher tendency for dentists to replant a permanent tooth in every case (15). It seems that the tendency of general dentists to save teeth at any cost may have increased their willingness to replant teeth in every case.

The majority of participants, 81%, were aware of the urgency to seek help as soon as possible, within 30 min of the accident. This is in agreement with findings reported also in other studies (15, 16) and with the current recommended guidelines of the AAE and IADT (12, 13). It has been well established that preservation of the periodontal ligament vitality and avoidance of unnecessary additional damage to the root will enhance the prognosis of the replanted tooth (7–9). However, when asked for their preference for emergency treatment (Table 6), almost an average of 69% of our participants incorrectly recommended placing the tooth in cold milk, while <25% correctly recommended replanting the tooth back into its socket as soon as possible. Replanting the tooth appears to be more common with more experienced dentists (Table 11) and with those who received education regarding dental trauma within the last 3 years (Table 13). In this regard, it is clear that professionals who did not receive any previous education in management of dental trauma did not consider this alternative at all. In addition, it seems apparent that some confusion exists among study participants regarding the immediate treatment of the avulsed tooth. Although, placing the avulsed tooth in fresh cold milk may be a good strategy for transporting the tooth from the site of injury to the dental office, the current guidelines clearly recommend that, whenever possible, the avulsed tooth should be replanted back into its socket as soon as possible (12, 13).

The majority of our study participants followed the recommended guidelines for treatment of the avulsed tooth in case it has fallen onto the ground (Table 7). In such cases, a gentle wash of the contaminated surface with water is recommended prior to replantation. In addition, more than half of the participants chose fresh milk as the transport medium when the tooth could not be replanted on the site of injury (Table 8). This is in agreement with the current guidelines. However, Hamilton et al. (16) reported that in their study more than 90% of participants suggested milk as the best storage

medium for avulsed teeth. Our findings do not agree with those of Stokes et al. (15) who reported that professionals were equally divided between cold milk and tap water. Interestingly, 30% of our participants replied that they would transport the tooth in the patient's mouth, a modality that does not follow the current guidelines and at the same time carry the risk of having the tooth inhaled or swallowed by the patient on his way to the dental office.

There were several limitations to this descriptive study, including the use of a convenience sample and lack of a control group. Although results may be similar to other studies, extrapolation of these results to other oral healthcare providers either in the United States or in other countries should be done with extreme caution. In addition to the above limitations, the participants comprise a specific group of general dentists, those who attend Continuing Education courses. Also, most of them reported receiving previous education regarding dental trauma. Finally, the return rate of the completed questionnaires was low.

Conclusions

In conclusion, there is a need to improve the knowledge of oral health professionals in the current guidelines for emergency treatment of avulsed teeth. Knowledge improvement is mandatory as such injuries present multiple challenges for the dental team as well as complications to the patient that can result in life-long, time-consuming and costly treatments and maintenance. Recently, knowledge-based systems, derived from artificial intelligence technology, also were suggested to assist in clinical situations involving traumatized teeth where the dentist has limited experience or knowledge (20). This system uses a computer program that contains human knowledge, is capable of giving advice by inferring from this knowledge, can justify the advice given, and the knowledge can be maintained independent of the program. Oral health professionals should use all means to enhance their knowledge of existing treatment strategies and consequently improve patient's quality of life following dental trauma.

References

1. Andreasen JO, Andreasen FM. Textbook and color atlas of traumatic injuries to the teeth, 3rd edn. Copenhagen: Munksgaard; 1994.
2. Blinkhorn FA. The aetiology of dento-alveolar injuries and factors influencing attendance for emergency care of adolescents in the north west of England. Endod Dent Traumatol 2000;16:162–5.
3. Hamilton FA, Hill FJ, Holloway PJ. An investigation of dento-alveolar trauma and its treatment in adolescent population. Part 1: the prevalence and incidence of injuries and the extent and adequacy of treatment received. Br Dent J 1997;8:91–5.
4. Kvittem B, Hardie NA, Roettger M, Conry J. Incidence of orofacial injuries in high school sports. J Pub Health Dent 1998;58:288–93.
5. Brin I, Ben-Bassat Y, Heling I, Brezniak N. Profile of an orthodontic patient at risk of dental trauma. Endod Dent Traumatol 2000;16:111–5.
6. Kania MJ, Keeling SD, McGorray SP, Wheeler TT, King GJ. Risk factors associated with incisor injury in elementary school children. Angle Orthod 1996;66:423–32.
7. Trope M, Chivian N, Sigurdsson A, Vann WF Jr. Traumatic injuries. In: Cohen S, Burns RC, editors. Pathways of the pulp, 8th edn. St Louis: CV Mosby; 2002. p. 603–49.
8. Andreasen JO. Periodontal healing after replantation of traumatically avulsed human teeth: assessment by mobility testing and radiography. Acta Odontol Scand 1975;335:325–35.
9. Andreasen JO, Kristerson L. The effect of limited drying or removal of the periodontal ligament: periodontal healing after replantation of mature permanent incisors in monkeys. Acta Odontol Scand 1981;39:1–13.
10. Malmgren B, Malmgren O. Rate of infraposition of reimplanted ankylosed incisors related to age and growth in children and adolescents. Dent Traumatol 2002;18:28–36.
11. Glendor U. On dental trauma in children and adolescents. Incidence, risk, treatment, time and costs. Swed Dent J 2000;140(Suppl.):1–52.
12. American Association of Endodontists. Recommended guidelines for the treatment of traumatic dental injuries. Chicago: American Association of Endodontists; November 2004.
13. Flores MT, Andreasen JO, Bakland LK, Feiglin B, Gutmann JL, Oikarinen K et al. International Association of Dental Traumatology. Guidelines for the evaluation and management of traumatic dental injuries. Dent Traumatol 2001;17:193–8.
14. Raphael SL, Gregory PJ. Parental awareness of the emergency management of avulsed teeth in children. Aust Dent J 1990;35:130–3.
15. Stokes AN, Anderson HK, Cowan TM. Lay and professional knowledge of methods for emergency management of avulsed teeth. Endod Dent Traumatol 1992;8:160–2.
16. Hamilton FA, Hill FJ, Holloway PJ. An investigation of dento-alveolar trauma and its treatment in an adolescent population. Part 2: dentists' knowledge of management methods and their perceptions of barrier to providing care. Br Dent J 1997;182:129–33.
17. Holan G Shmueli Y. Knowledge of physicians in hospital emergency rooms in Israel on their role in cases of avulsion of permanent incisors. Int J Paediatr Dent 2003;13:13–9.
18. Pacheco LF, Filho PFG, Letra A, Menezes R, Villoria GEM, Ferreira SM. Evaluation of the knowledge of the treatment of avulsions in elementary schoolteachers in Rio de Janeiro, Brazil. Dent Traumatol 2003;19:76–8.
19. Levin L, Friedlander LD, Geiger SB. Dental and oral trauma and mouthguard use during sports activities in Israel. Dent Traumatol 2003;19:237–42.
20. Robertson A, Noren JG. Knowledge-based system for structured examination, diagnosis and therapy in treatment of traumatised teeth. Dent Traumatol 2001;17:5–9.