Initial management of paediatric dento-alveolar trauma in the permanent dentition: a multi-centre evaluation

H. Zaitoun,[1] S. North,[2] S. Lee,[3] S. Albadri,[4] S. T. McDonnell,[5] and H. D. Rodd[6]

IN BRIEF

- There is a recognised delay in presentation to tertiary centres following paediatric dental trauma.
- There is a need for paediatric dentistry staff to be proactive in providing regular dental trauma related teaching for their local A&E personnel.
- Priority should be given to more effective teaching to increase knowledge and confidence in dental trauma management.

RESEARCH

Objective To investigate the time lapse prior to provision of emergency dental care and appropriateness of earliest treatment provided for children with dental trauma. **Design** A multi-regional prospective and cross-sectional survey. **Setting** Paediatric dental departments of Liverpool, Manchester and Sheffield. **Subjects** One hundred and fifty referred or emergency paediatric patients with trauma to the permanent incisors. **Results** One hundred and fifty subjects were recruited. Mean age of the subjects was 11.1 years (SD = 2.6; range = 6.2-16.6); 100 were male and 50 were female. The mean time interval from injury until initial presentation to a health care professional was 22.6 hours (SD = 76.1; range = 0-672). Thirty-six percent of children (n = 54) first presented to a general dental practitioner whilst 30% (n = 45) presented to accident and emergency medical staff. Following initial assessment, a further mean time lapse of 8.1 hours (SD = 43.7; range = 0-504) was incurred in 25% of cases prior to dental referral. In 39% of subjects (n = 58/150), treatment was considered inappropriate. The most frequent example of inadequate management was failure to protect exposed dentine, which was found for 71% (n = 24/34) of complicated crown fractures and 40% (n = 25/62) of uncomplicated crown fractures. **Conclusion** This study identified marked delays in the management of some paediatric dental trauma to permanent incisor teeth which, in itself, could be suboptimal. Greater educational and clinical support would seem to be warranted in this area of service provision.

INTRODUCTION

Dental trauma is a common occurrence in childhood, despite a declining prevalence reported by the 2003 National Survey of Children's Dental Health in the UK.[1] Where dental trauma has occurred, expedient management can lead to a good prognosis.[2] Unfortunately, UK studies have shown that, in cases where dental trauma required treatment, up to 50% of patients were not provided with any emergency care.[3–5] Furthermore, in 59% of cases, treatment was deemed inadequate.[3] A recent Brazilian study of 87 traumatised teeth revealed that only 28% had received any interventions, but the investigators did not comment on the adequacy of this treatment.[6] Numerous barriers have been identified to the provision of emergency care for dental trauma, including: lack of experience; inadequate fee provision within the general dental service and the view that treatment for trauma occupied too much clinical time.[7] A recent review of provision of dental trauma care in Australia reiterated these key perceptions.[8] A UK study reported that despite apparently inadequate remuneration, dentists did not believe that this factor prevented them from treating trauma patients.[9] Practitioners strongly agreed they had a responsibility to manage dental trauma in primary care but time constraints were perceived as a barrier to long-term management of complex trauma cases. The dentists reported a lack of confidence in their ability to treat emergency dento-alveolar trauma in children and would welcome the use of management aids.[9]

Even when emergency dental treatment is available, there can be significant delays in care provision which may be detrimental to the prognosis of the traumatised teeth.[2] Expedient intervention is particularly critical in the management of avulsed teeth, where the periodontal ligament cells rapidly lose their potential to regenerate.[10] An Australian study which set out to quantify the treatment delay for paediatric dento-alveolar trauma in a tertiary referral hospital established that there was, on average, a 9.6 hour delay between injury and treatment.[11] The greatest delays related to high transit times from outside practitioners to hospital and waiting times within the hospital itself. Not surprisingly, delays in developing countries have been found to be considerably greater, with at least half of the patients attending hospital more than one month after sustaining an injury.[12,13]

To date, no studies have investigated delays in receiving emergency dental care for patients who initially present to primary, secondary or tertiary health care systems. The aim of this study, therefore, was to investigate the time lapse in provision

[1*,2,6]Department of Paediatric Dentistry, Charles Clifford Dental Hospital, Wellesley Road, Sheffield, S10 2SZ; [3,4]Department of Paediatric Dentistry, Liverpool University Dental Hospital, Pembroke Place, Liverpool, L3 5PS; [5]Unit of Paediatric Dentistry, University Dental Hospital of Manchester, Higher Cambridge Street, Manchester, M15 6FH
*Correspondence to: Halla Zaitoun
Email: halla.zaitoun@sth.nhs.uk

Online article number E11
Refereed Paper – accepted 7 October 2009
DOI: 10.1038/sj.bdj.2010.254

of emergency care for children with dentoalveolar trauma according to where they initially presented. A further objective was to consider whether the management was appropriate.

SUBJECTS AND METHOD

Data were collected prospectively, over an 18-month period (October 2006 – April 2008), for 150 consecutive, referred and emergency dental trauma patients attending the dental hospitals and children's hospitals of Liverpool (n = 50), Manchester (n = 50) and Sheffield (n = 50). Subjects were included if they had suffered trauma to the upper and/or lower permanent incisors and were under 16 years of age at initial presentation. Only subjects who had attended for emergency dental treatment, or had been referred following acute trauma, were included in the study. Follow-up patients, who had sustained trauma prior to this period, were not included to minimise any recall bias. The project was registered with the respective local audit and clinical governance organisations.

A data collection sheet was devised and piloted across the three centres prior to final modifications. Recorded variables included demographic details, time lapse from the trauma incident, source of referral and whether any advice was sought by telephone. The grade, specialty and organisation of the initial dental care provider were also noted. Data were also collected regarding tooth notation and nature of dental injuries. Any initial treatment, provided prior to the hospital attendance, was noted and assessed by the investigators as being adequate or otherwise according to criteria drawn up by the study group. These criteria were informed by best available evidence including the International Association for Dental Traumatology Guidelines[14,15] and the British Society for Paediatric Dentistry Guidelines and Policy Documents.[16–18] The results from the three centres were recorded and analysed using the Statistical Package for Social Sciences (SPSS Inc. version 14). A one-way analysis of variance (ANOVA) was used on normalized data to determine significant differences in numerical data, and a chi-squared test used to determine significant differences in categorical data. Significance levels were set at $p < 0.05$.

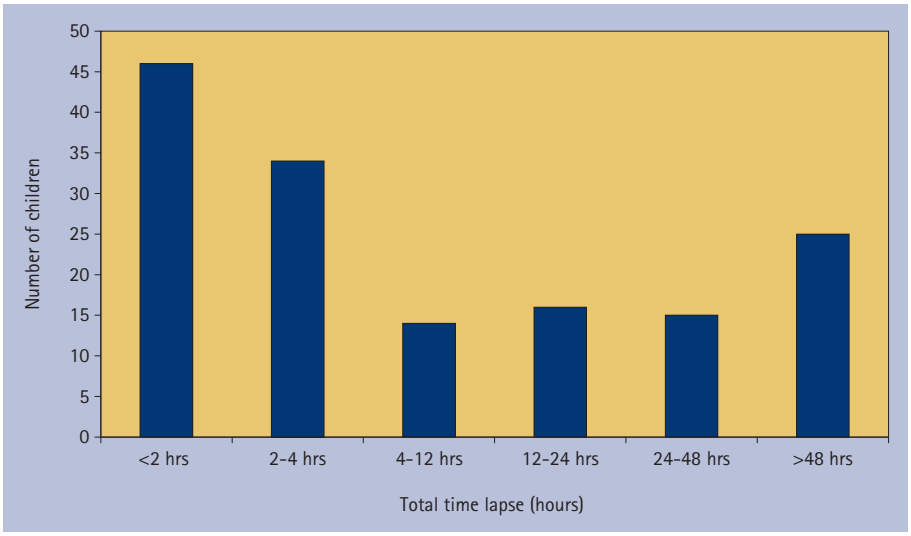

Fig. 1 Bar chart to show the total time delay between dental injury and provision of initial dental care for 150 children

Table 1 Healthcare professional providing initial trauma care

Person who undertook initial care	Frequency	
	n	%
GDP/access centre/CDS practitioner	58	38.7
A&E dental practitioner (within working hours)	47	31.3
Maxillofacial surgery staff (out of hours)	24	16.0
A&E medical practitioner (both during and out of hours)	21	14.0
Total	150	100

GDP = general dental practitioner, CDS = community dental service, A&E = accident and emergency
A&E dental includes all patients seen under the supervision of a consultant paediatric dentist

RESULTS

Patient characteristics

The mean age of the 150 children was 11.1 years (SD = 2.6; range = 6.2-16.6); 100 were male and 50 were female. One patient was over 16 years of age and was included as he was a pre-existing patient having already sustained dental trauma. Seventy-nine percent of subjects reported seeing their own dentist within the past six months.

Referral pathway

Nearly half the children (47.3%) were referred to one of the three tertiary centres by their general dental practitioner (GDP), whereas 23.3% were self-referrals and 11.3% were referred from accident and emergency medical services (A&E medical), 8.7% were from A&E dental (seen under the supervision of a consultant paediatric dentist) and the remaining 9.4% included referral from the community dental service, schools and specialist practice. Ninety-one percent of patients knew the date and time of trauma: there were no peak times for trauma episodes with accidents occurring throughout the week.

Time lapse

The mean time interval from injury until initial presentation to a health care professional was 22.6 hours (SD = 76.1; range = 0-672). The main reason for this delay was a prolonged transit time in 44.7% of cases, followed by: delays in A&E (14.7%), GDP reportedly not being available (11.3%), and parental influences such as parental availability for appointments (10.6%). There was no delay reported in 9.3% of cases and other non-identified factors accounted for the remaining 9.3%. A further mean time lapse of 8.1 hours (SD = 43.7; range = 0-504) was incurred by 25.3% of subjects prior to dental management. The main cause for this was the time taken for the patient to be referred

from A&E medical (in 50.2% of cases). The mean total time lapse (n = 150) from injury until provision of emergency dental care was 30.7 hours (SD = 87.4; median = 3.1; range = 0-672). Figure 1 illustrates the distribution of time interval, with the majority of cases being managed within 24 hours and nearly half within two hours.

To more accurately reflect the time lapse for cases managed on a true emergency basis, further analysis was undertaken where outliers presenting over 48 hours after injury were excluded.[11] In this subgroup, the mean total time lapse was a much reduced 6.8 hours (SD 8.4, range 0-36 hours). There was some variation between the three centres for the overall time lapse, but this was not statistically significant (Manchester = 22.4 hours, SD = 32.6; Liverpool = 22.6 hours, SD = 57.7; Sheffield = 47.2 hours, SD = 135.8; p = 0.33, ANOVA). It should be noted that the one individual who had experienced a delay of 672 hours (28 days) was seen at Sheffield dental school, which would account for the overall higher mean time lapse until patients were seen in this centre.

Initial care provider

Advice over the telephone was sought in 22.7 % of cases (n = 34). This was most commonly from a GDP (11.3%) and A&E medical (4.7%). NHS Direct, access centre, A&E dental, and 'other' accounted for the remaining 6.7%. In the majority of cases where advice was given, the patient was directed to attend their GDP (32.0%), A&E Dental (29.4%) or attend a hospital dental service (22.3%). In 67% of cases, the parents reported that their children were initially managed within working hours. Initial care was undertaken by a dental primary care practitioner (GDP, access centre or CDS) in 38.7% of subjects. A further 33.4% of children were initially seen by A&E dental (dental hospital A&E, paediatric dentists and Alder Hey maxillofacial surgery SHOs). The remaining 16% were seen out-of-hours by maxillofacial surgery SHOs (Table 1).

Injuries sustained

The most frequent presentation was a single tooth injury in 48.7% (n = 73) of cases, two teeth in 40.7% (n = 61), the remaining 10.7% (n = 16) had three or more injured teeth.

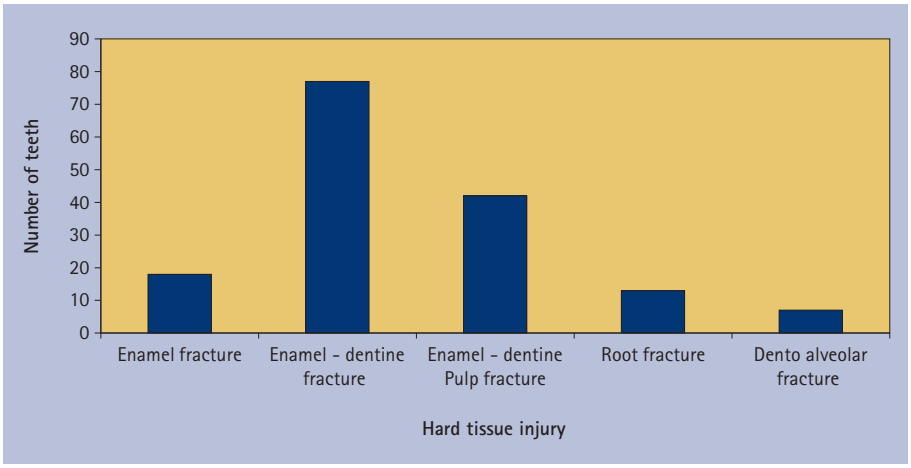

Fig. 2 Bar chart to show the frequency of different types of hard dental tissue injury sustained by the study group, n = 263

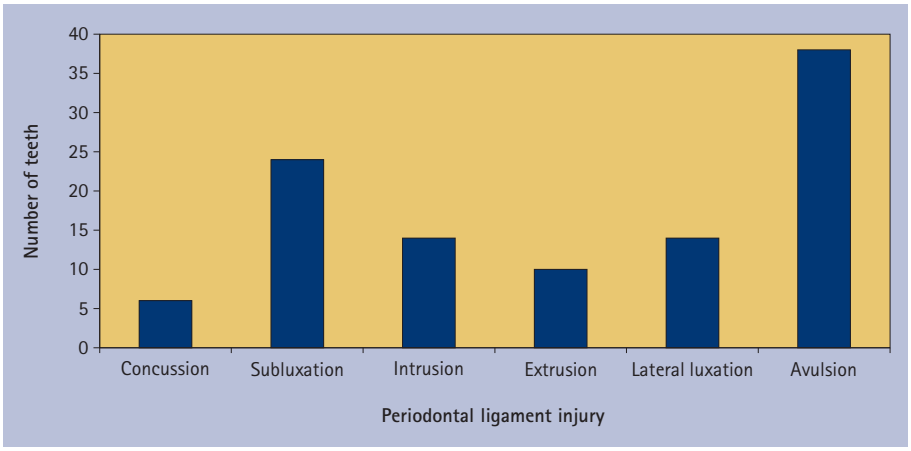

Fig. 3 Bar chart to show the frequency of different types of periodontal ligament injury sustained by the study group, n = 263

The upper left central incisor was the most commonly affected tooth, being injured in 66.7% of the study group (n = 100) closely followed by the upper right central incisor in 64.7% (n = 97). Of the 150 patients who had sustained trauma, there were a total of 263 injured teeth. As can be seen in Figure 2, the most common hard tissue injury was an enamel-dentine fracture (77 teeth, 29.3% of injuries, which occurred in 62 subjects, 41.3%) and an enamel-dentine pulp fracture (42 teeth, 16% of injuries, which occurred in 34 subjects, 22.7%). The most common periodontal ligament injury was avulsion (38 teeth, 14.4% of injuries, which occurred in 30 subjects, 20%), see Figure 3.

Initial care received

Overall 82.7% (n=124) of children received emergency treatment. Nearly one tenth of subjects had more than one category of treatment. The most common item of treatment provided for patients was a composite bandage (26%, n = 39), followed by replanting and splinting (16%, n = 24) and repositioning and splinting (14.7%, n = 22). Additional treatments included glass ionomer bandages (14%, n = 21) and elective root canal therapy (6%, n = 9), and replant/repositioned with no splint (2.7%, n = 4). Advice and reassurance was provided for 14% (n = 21) and no treatment provided for 17.3% of subjects (n = 26).

Appropriateness of treatment

According to the criteria drawn up by the study group, 39% of patients were deemed to have received inappropriate treatment. The most frequent example of inappropriate management was for complicated crown fractures due to either incorrect pulp management and/or inadequate protection of exposed dentine which was noted for 70.6% of subjects (n = 24/34). Similarly, 40% (n = 25/62) of uncomplicated crown fractures were found to have inadequate protection of exposed dentine. In terms of

avulsion injuries, 20% subjects (n = 6/30) were managed inappropriately due to delays in treatment where patients waited between 2.5 and 7.3 hours in an accident and emergency department (16.7%, n = 5/30) or inadequate/lack of splinting (3.3%, n = 1/30). There were no significant differences between centres according to the appropriateness of treatment received by patients (p = 0.31, chi-squared test).

The initial care provider had the greatest influence on the appropriateness of the care provided, as shown in Table 2. The difference was found to be highly statistically significant with more cases managed appropriately within a dental hospital service under consultant supervision (p <0.001, chi-squared test).

Table 2 Appropriateness of trauma management according to initial care provider

Person who undertook initial care	Appropriate n (%)	Not appropriate n (%)
GDP/access centre/CDS practitioner (n = 59)	29 (49.2)	30 (50.8)
A&E medical practitioner (both during and out of hours) (n = 21)	10 (47.6)	11 (52.4)
A&E dental practitioner (within working hours) (n = 46)	40 (87.0)	6 (13.0)
Maxillofacial surgery staff (out of hours) (n = 24)	13 (54.2)	11 (45.8)
Total (n = 150)	92 (61.3)	58 (38.7)

DISCUSSION

The aim of this study was to assess the time lapse and appropriateness of emergency treatment received by patients with dentoalveolar injuries who subsequently attended one of three UK dental teaching hospitals. The mean age of the subjects (11.1 years) and the gender distribution of 2:1 male to female are characteristic for children who sustain dental trauma.[5,19] Encouragingly, almost 80% of patients reported they had seen their own dentist within the past six months. Indeed around 50% were actually referred to the dental hospital by their own GDP. These findings are consistent with those reported by the 2003 National Survey of Child Dental Health in the UK, where over 80% of children reportedly attended the dentist regularly.[20]

The majority of subjects, or their parents, were able to recall the date and time of trauma. Analysis of these data revealed that two-thirds of patients/parents reported they were initially seen within working hours, thus dental services should make adequate provision within their daily schedules for this eventuality. Nearly one quarter of subjects sought advice over the telephone, mainly from the GDP and accident and emergency services. This finding reinforces the need for all staff to be competent in the verbal provision of dental first aid advice and have access to relevant protocols.[21]

A key finding from this study was the considerable time lapse from injury until receipt of emergency care for some patients, which is an area for concern. In the majority of cases, the longest time intervals were incurred when patients were referred to another practitioner within or outside the institution where the patient first attended. However, there were also extended time periods prior to receipt of care where parents appeared unaware of the implications of their child's injury and the need for immediate treatment. With avulsion injuries, where expedient management is most critical,[2] 16.7% of children waited between 2.5 and 7.3 hours in an accident and emergency department. In this situation the tooth should ideally be replanted by medical personnel before the arrival of maxillofacial or dental professionals. For the less severe injuries, the most common reason for delay was transit time to the hospital from another dental practitioner. It is therefore speculated that educational initiatives to improve undergraduate and postgraduate competency in dental trauma management could significantly improve the outcome of treatment if practitioners felt more able to provide emergency treatment themselves.[22,23] In addition, school personnel and parents are often the first people to deal with an acute dental injury, therefore continued efforts should be made to increase public awareness and confidence in applying the principles of dental first aid.

The consequences of treatment delay on pulpal and periodontal healing following traumatic dental injuries have been highlighted in a comprehensive review.[2] For complicated crown fractures, a significant relationship between pulp necrosis and treatment delay of over 24 hours has been demonstrated, emphasising the importance of expedient management. Similarly, for uncomplicated crown fractures, a significant increase in pulp necrosis was found where injuries were managed more than three days after the injury.[2] It is also important to consider the economic and resource implications of delayed or inappropriate treatment.[24,25] Furthermore, there is a growing body of evidence to suggest that dental trauma in children may adversely affect their quality of life with far reaching psychosocial effects.[26,27]

Overall, 82.7% of children in this investigation received emergency treatment, which is a higher level of care than reported in previous studies.[3-6] However it must be remembered that a high proportion of participants in this study had sustained complex dental injuries and thus were more likely to have received some emergency care prior to presentation at a tertiary paediatric dentistry service.

According to the criteria drawn up by the study group, 39% of subjects were deemed to have received inappropriate treatment, reiterating the findings of a previous British study.[3] The 2003 UK Child Dental Health Survey[5] reported no statistically significant difference in the proportion of treated fractured incisors since 1993 amongst 12 and 15-year-olds. It appears, therefore, that there have been relatively few improvements in the quality of care provided for paediatric dental trauma over the past decade.

Seventy-one percent of complicated crown fractures and 40% of uncomplicated crown fractures received unsatisfactory care. Based on the current available literature, the criteria employed by this study considered only a composite bandage or other bonded restorative material an efficient dentinal seal. This seal is essential to prevent further bacterial invasion of the pulp which may otherwise compromise the pulp's ability to elicit its physiological defence mechanisms and thus healing.[24] This is supported in the literature

where complicated crown fractures with a dubious coronal seal had a poorer outcome than those restored with a bonded material.[25] The main limitation of materials such as glass ionomer cements for the repair of fractured incisors is their lower shear resistance and durability.[28,29]

Twenty percent of avulsion cases (6/30 cases) were managed sub-optimally. In five cases the time lapse was found to be over 2.5 hours (range 2.5-7.3) even though the patient had attended a medical accident and emergency department as their first port of call. Furthermore, in one case the tooth was repositioned but not splinted and in another case the tooth was sub-optimally repositioned so that it was in traumatic occlusion, thus emphasising the need for further training in this area.

As would be expected, the person who undertook the initial treatment largely dictated the adequacy of care. The best level of care was delivered within dental hospitals where care is provided by clinicians of various training grades overseen by a consultant in paediatric dentistry. Some caution must be exercised in interpreting the apparent low level of appropriate initial care provided in primary care settings: this study only included patients ultimately seen in a dental hospital who are not representative of all dental trauma patients seen within primary care. It should be appreciated that many of the children presenting to dental hospitals have sustained complex injuries that GDPs may not be confident to manage.

More than half of the patients who attended and A&E medical unit in the first instance received inappropriate care. This is not a surprising finding as treatment decisions, such as whether to make an urgent referral to maxillofacial surgery or advise the patient to attend their own GDP the following day, requires prior knowledge of dental trauma first aid which has been shown to be deficient in accident and emergency healthcare workers.[21]

CONCLUSION

In conclusion, a substantial time interval was found between injury and treatment of acute paediatric dental trauma. Furthermore, 39% of children subsequently received sub-optimal care. Greater education and clinical support is required within primary dental care and A&E services to improve management and, thus long term outcomes for children who sustain dental trauma.

Thanks are given to all members of the Northern Alliance Paediatric Dentistry Audit Group for their support and input to this study.

1. *National Child Dental Health Survey*, 2003. London: The Office for National Statistics 2005.
2. Andreasen J O, Andreasen F M, Skeie A, Hjorting-Hansen E, Schwartz O. Effect of treatment delay upon pulp and periodontal healing of traumatic dental injuries - a review article. *Dent Traumatol* 2002; **18:** 116–128.
3. Hamilton F A, Hill F J, Holloway P J. An investigation of dento-alveolar trauma and its treatment in an adolescent population. Part 1: The prevalence and incidence of injuries and the extent and adequacy of treatment received. *Br Dent J* 1997; **182:** 91–95.
4. Maguire A, Murray J J, Al-Majed I. A retrospective study of treatment provided in the primary and secondary care services for children attending a dental hospital following complicated crown fracture in the permanent dentition. *Int J Paediatr Dent* 2000; **10:** 182–190.
5. Chadwick B L, White D A, Morris A J, Evans D, Pitts N B. Non-carious tooth conditions in children in the UK, 2003. *Br Dent J* 2006; **200:** 379–384.
6. Traebert J, Bittencourt D D, Peres K G, Peres MA, de Lacerda J T, Marcenes W. Aetiology and rates of treatment of traumatic dental injuries among 12-year-old school children in a town in southern Brazil. *Dent Traumatol* 2006; **22:** 173–178.
7. Hamilton F A, Hill F J, Holloway P J. An investigation of dento-alveolar trauma and its treatment in an adolescent population. Part 2: Dentists' knowledge of management methods and their perceptions of barriers to providing care. *Br Dent J* 1997; **182:** 129–133.
8. Yeng T, Parashos P. Dentists' management of dental injuries and dental trauma in Australia: a review. *Dent Traumatol* 2008; **24:** 268–271.
9. Jackson N G, Waterhouse P J, Maguire A. Management of dental trauma in primary care: a postal survey of general dental practitioners. *Br Dent J* 2005; **198:** 293–297.
10. Andreasen J O, Borum M K, Jacobsen H L, Andreasen F M. Replantation of 400 avulsed permanent incisors. 4. Factors related to periodontal ligament healing. *Endod Dent Traumatol* 1995; **11:** 76–89.
11. Batstone M D, Waters C, Porter S A, Monsour F N. Treatment delays in paediatric dento-alveolar trauma at a tertiary referral hospital. *Aust Dent J* 2004; **49:** 28–32.
12. Ekanayake L, Perera M. Pattern of traumatic dental injuries in children attending the University Dental Hospital, Sri Lanka. *Dent Traumatol* 2008; **24:** 471–474.
13. Al-Nazhan S, Andreasen J O, Al-Bawardi S, Al-Rouq S. Evaluation of the effect of delayed management of traumatised permanent teeth. *J Endod* 1995; **21:** 391–393.
14. Flores M T, Andersson L, Andreasen J O *et al.* Guidelines for the management of traumatic dental injuries. I. Fractures and luxations of permanent teeth. *Dent Traumatol* 2007; **23:** 66–71.
15. Flores M T, Andersson L, Andreasen J O *et al.* Guidelines for the management of traumatic dental injuries. II. Avulsion of permanent teeth. *Dent Traumatol* 2007; **23:** 130–136.
16. Gregg T A, Boyd D. Treatment of avulsed permanent incisor teeth in children. UK National Clinical Guidelines in Paediatric Dentistry. Royal College of Surgeons, Faculty of Dental Surgery. *Int J Paediatr Dent* 1998; **8:** 75–81.
17. Mackie I C. UK National Clinical Guidelines in Paediatric Dentistry. Management and root canal treatment of non-vital immature permanent incisor teeth. Faculty of Dental Surgery, Royal College of Surgeons. *Int J Paediatr Dent* 1998; **8:** 289–293.
18. Kinirons M J. UK National Clinical Guidelines in Paediatric Dentistry. Treatment of traumatically intruded permanent incisor teeth in children. *Int J Paediatr Dent* 1998; **8:** 165–168.
19. Andreasen J O, Andreasen, F M, Andersson L. *Textbook and colour atlas of traumatic injuries to the teeth.* 4th ed. Blackwell Munksgaard, 2007.
20. Morris A J, Nuttall N M, White D A, Pitts N B, Chestnutt I G, Evans D. Patterns of care and service use amongst children in the UK 2003. *Br Dent J* 2006; **200:** 429–434.
21. Addo M E, Parekh S, Moles D R, Roberts G J. Knowledge of dental trauma first aid (DTFA): the example of avulsed incisors in casualty departments and schools in London. *Br Dent J* 2007; **202**: E27.
22. Kostopoulou M N, Duggal M S. A study into dentists' knowledge of the treatment of traumatic injuries to young permanent incisors. *Int J Paediatr Dent* 2005; **15:** 10–19.
23. Yeng T, Parashos P. An investigation into dentists' management methods of dental trauma to maxillary permanent incisors in Victoria, Australia. *Dent Traumatol* 2008; **24:** 443–448.
24. Olsburgh S, Jacoby T, Krejci I. Crown fractures in the permanent dentition: pulpal and restorative considerations. *Dent Traumatol* 2002; **18:** 103–115.
25. Jackson N G, Waterhouse P J, Maguire A. Factors affecting treatment outcomes following complicated crown fractures managed in primary and secondary care. *Dent Traumatol* 2006; **22:** 179–185.
26. Cortes M I, Marcenes W, Sheiham A. Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12-14-year-old children. *Community Dent Oral Epidemiol* 2002; **30:** 193–198.
27. Fakhruddin K S, Lawrence H P, Kenny D J, Locker D. Impact of treated and untreated dental injuries on the quality of life of Ontario school children. *Dent Traumatol* 2008; **24:** 309–313.
28. van Dijken J W. Durability of new restorative materials in Class III cavities. *J Adhes Dent* 2001; **3:** 65–70.
29. Piwowarczyk A, Ottl P, Lauer H C, Büchler A. Laboratory strength of glass ionomer cement, compomers, and resin composites. *J Prosthodont* 2002; **11:** 86–91.