Dental Traumatology 2004; 20: 123–133
Printed in Denmark. All rights reserved

DENTAL TRAUMATOLOGY

Socio-economic burden of permanent incisor replantation on children and parents

Nguyen P-MT, Kenny DJ, Barrett EJ. Socio-economic burden of permanent incisor replantation on children and parents. Dent Traumatol 2004; 20: 123–133. © Blackwell Munksgaard, 2004.

Abstract – This study describes the socio-economic burden and attitudes of children and their parents following replantation of avulsed incisors. Records of 80 patients with 99 avulsion injuries treated in a teaching hospital clinic from 1988 to 1999 were reviewed. Mean age at time of injury was 10.6 years (range = 6.6–17.7 years). Complete records for a minimum of 1 year were obtained for 43 patients with 60 replanted incisors. Mean treatment procedures provided during the first year included 5.5 diagnostic periapical radiographs, 1.9 occlusal radiographs, 1.3 pulpectomies, and 2.7 pulp medicament applications. The mean estimated treatment cost and direct time (dentist) for first-year post-trauma management was $1465 CAD and 7.2 h, respectively. Treatment costs were significantly higher during the first year post-trauma for patients who had their incisors extracted ($P = 0.04$), but there was no significant difference in direct treatment time between the two groups ($P = 0.19$). Twenty-one patient–parent pairs were surveyed for a number of qualitative factors. Ninety per cent of patients and 86% of parents reported that school and work time was lost. Even after having gone through the painful experience of replantation, the demands of recall, and in some cases, extraction, the majority of patients (67%) and parents (81%) stated that they would have still made the same (replantation) decision. Patient and parent responses were not statistically different ($P = 0.453$). Almost half the parents stated they would be willing to pay over $2000 CAD to save an incisor. Patients rated retention of an incisor as significantly more important than infraocclusion. This is the first study to quantify the treatment burden of replantation of avulsion injuries exclusively in the pediatric population. This study describes the socio-economic burden and responsibilities of patient/parent and dentist and their role in informed consent.

Phu-My T. Nguyen, David J. Kenny, Edward J. Barrett

The Hospital for Sick Children and University of Toronto, Toronto, Ontario, Canada

Key words: avulsion; replantation; socio-economic costs; quality of life

Dr David J. Kenny, Department of Dentistry, The Hospital for Sick Children, 555 University Ave, Toronto, Ont., Canada M5G 1X8
Tel.: +1 416 813 6010
Fax: +1 416 813 6375
e-mail: dkenny@sickkids.ca

Accepted 11 September, 2003

The avulsion of a permanent tooth is a rare occurrence that most frequently affects children and preadolescents (1–3). Consequently, other family members are involved, and the subsequent effects of adolescent growth and dental rehabilitation affect the family for years. Although outcome and survival studies of replantation have been published (4–6), the social and financial burden of the decision to replant a tooth has not been adequately investigated.

Hamilton et al. (7) found that in the UK, the major barrier to care for dental trauma was financial as 86% of clinicians in private practice felt that the fees for trauma management were inadequate. Similarly, salaried dentists in public clinics felt that time expended for trauma management was disruptive to other patient services (7). North Americans most often receive emergency care in private offices or hospital clinics, where professional fees are billed to parents

or insurance plans on a fee-for-service basis. While the paying agent for time/treatment may vary, clinical procedures and time requirements for replantation are remarkably consistent throughout Scandinavia, the UK, and North America (8–10).

Glendor et al. (11) investigated the time spent on dental injuries in two complementary studies. Their first (retrospective) study reported the number of visits and time utilized for trauma management. The majority of time (8.5 h) occurred within the first year. This included history, examination, registration, referrals, and clinical treatment. This study did not address patient behavior or maturity as time-sensitive variables.

A second (2-year prospective) study by Glendor et al. (12) investigated the total direct (dentist) and indirect (non-clinical) time used for management of dental injuries in children and adolescents. Data were derived from insurance claims, trauma records, and telephone interviews with patients or their parents. Mean direct clinical time for all visits that pertained to permanent tooth trauma were 2.6 h (range = 0.2–15.8 h). Mean total time spent by patients and companions for complicated permanent tooth trauma was 13.9 and 8.5 h, respectively. Transportation consumed the most (30%) indirect time.

Some treatment options must be delayed until skeletal maturity is achieved in young adulthood (13, 14) as infraocclusion depends upon alveolar growth (15, 16). Despite information that incisors replanted beyond 5 min ultimately fail (4–6, 17), parents continue to request replantation at the emergency visit. Clinicians do not know what an individual parent will perceive as an 'acceptable' outcome, even though evidence shows that immature teeth have reduced survival prospects (5) and that ankylosis, root resorption, and infraocclusion are inevitable outcomes of delayed replantation in preadolescents (6, 15, 17). Nevertheless, the clinician's role is to provide information on prognosis, rehabilitation expectations, and costs at the emergency visit so that patients and their families can make informed decisions whether or not to have the tooth replanted.

This study was designed to identify the social and economic burden of a series of incisor replantations through data from dental records and telephone interviews with patient–parent couplets.

Method

Subjects

Subjects were drawn from the dental trauma database of the Department of Dentistry at The Hospital for Sick Children, Toronto. All patients who had permanent maxillary incisors replanted between 1988 and 1999 were considered for inclusion. Patients who were medically compromised and/or developmentally delayed were disqualified.

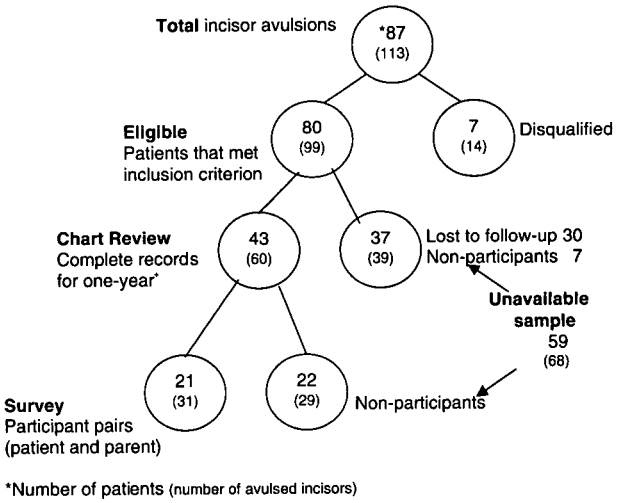

Fig. 1. Distribution of sample population.

Charts of all patients who met the inclusion criterion (eligible sample; Fig. 1) were reviewed. When patients had multiple incisors replanted with one subsequently extracted, treatment burden was calculated up to the time of extraction of the first incisor and included initial prosthetic replacement. Comprehensive care (orthodontics, fixed prosthodontics, implants) was beyond the scope of this study. Patients who formed the eligible sample and who had complete records for at least 1 year were contacted to request consent for release of records from their family dentist. Those who were located and consented became the chart review sample (Fig. 1). Consent was also requested from these parent(s) and patients to participate in a telephone interview and, if both agreed, they became the survey sample (Fig. 1). The consent package was based upon Woodward & Chambers recommendations (18). Data for the eligible sample included date of injury, activity involved, location, extra-alveolar duration, storage conditions, gender, age at time of injury, age at time of extraction, dental insurance status, number of teeth replanted, and stage of root development. The chart review sample provided the emergency and follow-up treatment burden of cases for 1 year or more. The number of dental visits and the treatment provided were collected from clinic notes and cost and time allotments derived from *The Ontario Dental Association (ODA) Suggested Fee Guide for General Practitioners 2000* (19) were assigned. Telephone surveys were designed to identify patient and parental expectations separately. Matching surveys were developed, one for the parent and a shorter one for the patient (Appendix 1). Questions that pertained to the psychosocial and functional effects of the injury and treatment were included. Questions modified from the study by Robertson & Noren (20) for the

current survey include biting function, dental fear, school and work time missed, anxiety regarding losing/breaking denture, color/form of traumatized tooth, information provided regarding prognosis, and effects on social life. The format of the surveys was yes/no, multiple choice, and short answer of both open- and close-ended formats, and scaled responses were based on the Likert scale with seven categories (21).

One individual (P.-M.N.) conducted all interviews. Structured scripts were followed so that all interviews were consistent. To test content, comprehension, and flow of the surveys, two pairs of trial interviews (18, 22) were conducted with parent–patient couplets who had teeth replanted in private offices (not part of the study population). Parents were interviewed first and the patients were interviewed immediately after to ensure there was no collaboration on answers.

Statistical methods

The mean and age range, gender proportions, and extra-alveolar duration for the available sample/subsample and unavailable sample were calculated. Student's *t*-test and Fisher's exact test were used to determine significant differences between the chart review and the unavailable samples, and between the survey and the unavailable samples. McNemar's tests were used for comparison between patient and parent responses. A critical *P*-value of 0.05 was used for all statistical tests in the study. Some patients experienced multiple avulsions; therefore, extra-alveolar storage and duration of these incisors were not independent. In these cases, only one incisor was considered when calculating means for each patient.

Hypothesis testing was performed (McNemar's test, critical $P = 0.05$) to compare patient and parental responses. Hypothesis generation with correction for multiple testing using an adjusted critical $P = 0.025$ was performed on secondary objectives.

Results

Study population

The study population was distributed into eligible, chart review, and survey samples (Fig. 1). During 1988–1999, 80 eligible patients had their teeth replanted. Complete records for a minimum of 1 year were available for 43 patients (chart review sample). Thirty patients could not be contacted (22 moved and 8 had incorrect phone numbers). Seven patients indicated that they were not interested in participating. Twenty-one patients and parents consented to participate in the survey. Attempts to recruit the remaining 22 patients were unsuccessful. The unavailable sample of 59 included those lost to follow-up (30 patients) and refusals (29 patients).

Eligible sample

Eighty patients (57 males, 23 females) with 99 avulsed and replanted maxillary permanent incisors formed the eligible sample.

Sixty-five per cent of the injuries were the result of sporting activity. Bicycling was the most common activity (29%) followed by baseball (17%) and hockey (4%). Other activities included basketball, soccer, swimming, skateboarding, and skating. Eleven per cent of avulsions occurred during school hours and almost half of the avulsions occurred during weekends and holidays (39 patients). The majority of avulsions occurred during the spring and summer months.

The mean age at avulsion was 10.6 years (SD = 2.7; range = 6.6–17.7 years). The ratio of immature to mature root apices was 3:7. The majority (79%) had one avulsed incisor. The mean extra-alveolar duration was 100 min (SD = 77; range = 0–420 min). Two-thirds of avulsed incisors were replanted in excess of 1 h, 11% (11/99) were replanted within 15 min, and none of the incisors were implanted immediately (<5 min).

Thirty-five per cent of the patients presented to a community hospital and were subsequently referred for treatment. Incisors were replanted at the community hospital before referral in 11 cases. Fifty-three patients had private insurance coverage. Twenty-four patients reported no insurance coverage. Three patients were covered by social assistance.

Chart review sample

Complete records for a minimum of 1 year were obtained for 43 patients (29 males, 14 females) with 60 avulsed incisors. There were no significant differences between the chart review population and the unavailable population for male:female ratio, age, or extra-alveolar duration (Table 1). The chart review

Table 1. Comparison of available and unavailable sample for chart review

Demographic information	Available sample	Unavailable sample	*P*-value
Patients (*n*)	43	37	
Ratio (M:F)	29:14	28:9	0.466†
Age (years)			
Mean	10.2	11.1	0.120‡
Range	6.9–17.7	6.6–16.9	
SD	2.7	2.7	
Extra-alveolar duration (min)			
Mean	93.1	108.6	0.351‡
Range	0–225	0–420	
SD	57.0	89.2	

Critical $P = 0.05$.
†Fisher's exact test.
‡Student's *t*-test.

sample was investigated for root maturity and time from injury to extraction. The ratio of immature to mature apices was 1:2. Mean time to extraction was 2.2 years (range = 0.1–5.7 years). Mean age at time of extraction was 11.8 years (range = 7.2–19.1 years).

The majority of treatment occurred during the first year following injury. The mean number and type of dental visits were 1.2 emergency examinations and 4.8 reassessment examinations. Mean treatment procedures provided for an individual in the first year included 5.5 periapical radiographs, 1.9 occlusal radiographs, 1.3 pulpectomies, and 2.7 intracanal medicament applications. Pulpectomies were performed on 93% (56/60) of the replanted teeth. Within the first year, conventional gutta percha obturation was completed for 30% (18/60) of replanted incisors. Thirty-three per cent of the patients required additional speciality consultations (other than pediatric dentistry).

Eighteen per cent (11/60 incisors, seven patients) of replanted incisors were extracted in the first year. Patients whose incisors failed early were generally younger at the time of injury (9.6 years vs. 10.8 years); however, this was not significant. Over time, 23 patients had 31 incisors extracted. Mean number and type of dental visits in extraction cases included 1.4 emergency examinations, 6.2 reassessment examinations, and 1.4 speciality consultations. The radiographic burden included 6.6 periapical and 2.9 occlusal radiographs. Six patients (eight incisors) had conventional endodontic treatment with gutta-percha obturation. Following extraction, 21 patients received interim partial dentures and two received Maryland-type bridges. The mean number of dental visits per individual in the first year was 9.1 (SD = 2.6; range = 4–15). The majority (96%) of visits (mean = 8.8; SD = 2.4; range = 4–15) involved trauma management. Mean treatment time per individual was estimated to be 7.2 h in the first year and the approximate cost was $1465 CAD. The mean first year cost of a replantation/extraction case including interim prosthesis was $1780 CAD (SD = 563; range = $924–2529 CAD). Treatment costs were significantly higher (Student's *t*-test, $P = 0.04$) in the first year for the extraction subsample than for those with retained incisors.

Survey sample

Consent to participate in the survey was obtained from 21 pairs of patients (14 males, 7 females) and parents (3 fathers, 18 mothers). Survey and unavailable samples (Table 2) were compared according to gender proportions, ages, and extra-alveolar duration. There was no significant difference between the two groups in extra-alveolar duration or gender proportions. The mean age of patients who participated in the study (9.5 years) was significantly less than the non-participants (11.0 years; $P = 0.027$).

Table 2. Comparison of available and unavailable sample for survey analysis

Demographic information	Available sample	Unavailable sample	*P*-value
Patients (*n*)	21	59	
Ratio (M:F)	2:1	43:16	0.780†
Age (years)			
Mean	9.5	11.0	0.027*,‡
Range	6.9–15.1	6.6–17.7	
SD	2.1	2.8	
Extra-alveolar duration (min)			
Mean	93.0	102.8	0.602‡
Range	3–225	0–420	
SD	64.8	76.8	

*Critical $P = 0.05$.
†Fisher's exact test.
‡Student's *t*-test.

Of the 43 patients in the chart review sample, 23 had a replanted incisor extracted. No statistical difference in extraction age was demonstrated between survey participants ($n = 21$) and non-participants ($n = 22$) or in survival time.

The primary objective of this study was based upon informed consent and parental decision-making. Patients and parents were asked, 'If you knew what you know now, would you prefer to have the incisor replanted or left out?' A majority of patients and parents indicated that they would still elect to have the incisor replanted (67% (14/21) and 81% (17/21), respectively). Patient and parental responses showed no significant difference (McNemar's test, $P = 0.453$). This attitude was consistent even in cases where the incisor was subsequently extracted (Fisher's exact test, $P = 0.638$ and 0.827, respectively).

Secondary objectives were based on economic considerations, information and expectations, treatment outcomes, and esthetics. Patients were asked how much they were willing to spend to save one incisor. Almost half of the parents (10/21) reported that they would be willing to pay over $2000 CAD. Parents' perception of value and their insurance status did not demonstrate significant difference ($P = 1.0$). A majority of parents reported that they were informed at both the emergency and follow-up appointments that long-term treatment would be costly and several appointments would be required. The majority of parents reported that they were not informed of the duration for incisor survival or potential for failure. Just over half of the parents reported that they were not informed of the need for endodontic treatment.

Parents were asked to rank the three most important aspects of emergency care. 'Getting the child out of pain' was the most important aspect of first-aid treatment followed by 'prompt treatment' and 'replanting

the incisor so that the child will still have a front tooth for school' (return to normalcy).

Patients and parents were asked to rate acceptability of treatment outcomes. Patients rated retention of the replanted incisor as significantly more important than infraocclusion (Tukey-Kramer HSD (honestly significant difference) test). That is, patients would rather have an infraoccluded incisor than a lost tooth. This was significant using the corrected critical *P*-value for multiple testing.

Ninety per cent of patients and 86% of parents reported loss of school and work time. One-way travel to the hospital ranged from 30 to 60 min. Twenty-nine per cent of patients reported that the injury affected other activities such as discontinuing sports, restriction from recess or gym for several months, and self-consciousness when eating in public. In addition, 57% (12/21) of patients reported that they missed school for 1–2 weeks after the accident because of swelling, pain, and difficulty eating.

Dental anxiety was not evident in the survey sample. All patients denied having dental fears. Patients who wore partial dentures worried about losing or breaking their denture. Patients preparing for extraction of the replanted incisor and/or implant surgery reported anxiety about the impending surgery.

The interim postextraction rehabilitation choice was a removable denture. The permanent rehabilitation choice was most commonly endosseous implants. At the time of the survey, 8/12 patients had or were preparing for implants. Two additional patients expected to have their replanted incisor extracted and replaced with an implant. Therefore, implants were the permanent rehabilitation choice for 10/21 patients. Fixed bridges were uncommon treatment choices as one patient had a conventional bridge and one patient had a resin-bonded bridge. Orthodontic treatment was required prior to rehabilitation for 7/21 patients.

Discussion

Clinical outcome studies (4–6) have provided dentists, patients, and parents with the ability to predict replantation outcomes based on extra-alveolar duration, yet the social and economic impacts of the replantation decision have not been investigated in depth.

Eligible sample

Transit time (and waiting time at peripheral hospitals) often increased the extra-alveolar duration of the incisors. However, when the extra-alveolar duration is beyond 5 min, the chances of regeneration of periodontal ligament are very slight and become less than half by 15 min (4).

After-hours treatment of dental injuries often involves one dentist working alone (no auxiliaries), and this prolongs treatment. The fee schedule described allows at most 30 min for emergency examination and replantation and 30 min for splinting (19). Although the current study did not record the time for individual procedures, emergency appointments for avulsion injuries require at least 2 h for one dentist working alone (based on patient arrival and discharge time noted in hospital emergency records). The fee schedule provides billing/identification codes for after-hour premiums and for additional time requirements, but dental insurance companies seldom reimburse such codes (19). At this hospital, such codes were never charged because the fees could rarely be collected. This supports the contention that institutions subsidize dental trauma treatment through clinician time and materials (7, 11).

The cost of avulsion/replantation management in the first-year post-trauma was significantly higher ($P = 0.03$) for patients who had incisors extracted than for those whose incisors survived, but this difference simply reflects additional procedures (extraction and interim denture).

Despite extensive treatment requirements and in some cases, extraction, the majority of patients (67%) and parents (81%) indicated that they would still have elected to replant the avulsed incisor. Although more parents were committed to their replantation choice than patients, the difference was not significant. One hundred and thirty-eight patient and parent (matched pair) surveys would be required (McNemar sample size estimation, $\alpha = 0.05$; $\beta = 0.2$; two-tailed) to detect differences in patient/parent responses. It is clear that, given the same information, parents and/or adolescents will continue to request replantation. Parents/patients who retrospectively chose against replantation indicated that their reasons were pain (replantation and subsequent extraction), root-canal therapy, poor esthetics following replantation, inevitable failure, and the option to have an endosseous implant(s). As implants are not recommended until skeletal maturity, three patients chose to wear a denture and wait for an implant.

A removable prosthesis is generally the treatment of choice to replace missing teeth in children and adolescents. One parent pointed out that private dental insurance only covers a new denture every 5 years. Children often require a number of dentures through adolescence and youth, and this expense is often borne by the parents.

Information given to parents during the emergency appointment appeared to be heavily skewed towards time and cost expectations with less information on prognosis. Survival data (4–6) were available for only the last 4 years of this study (1995–1999). Likewise, as there were no time/cost studies for replantation at that time, almost all parents reported that they were told that treatment would be costly and many

follow-up appointments would be required, but noted that no dollar approximation was given. Robertson & Noren (20) reported in 1997 that 61% of patients claimed that they were not informed of the prognosis of traumatized teeth. In this study, the majority (81%) of parents requested or chose to have an incisor replanted, even though they were informed that it would be costly with no guarantee of survival.

Robertson & Noren (20) reported that 21% of patients indicated that several school hours were missed and 31% of parents took time off work. This is a much lower percentage than this study, where all patients (90%) reported missing school and parents reported (86%) missing work for follow-up appointments. Over half of the patients missed school for 1–2 weeks. This inability or reluctance to go back to school may be because of facial injuries and not specifically the replanted incisor (extra-oral lacerations, pain from concomitant injuries, esthetics of splints).

Prosthetic replacement of extracted teeth in this sample was different from the study by Robertson et al. (23). Their retrospective study included 22 avulsions among a range of injuries. After 15 years, 81% of replanted teeth were extracted. Full coverage prosthesis was the replacement of choice (12/18) followed by resin-bonded bridge (4/18). None of the patients had an implant or orthodontic treatment to close the space. By contrast, in this sample, 12/21 patients had the replanted incisor(s) extracted and, in all cases, interim dentures were worn. Endosseous implants were the anticipated permanent rehabilitation choice for more than half of the patients and this is consistent with current expectations (24). Although patients and parents understand that an implant may be the final outcome, they were often unaware of the process. Many incisors fail because of ankylosis, and require surgical extraction that involves a mucogingival flap and bone removal. As incisors may be extracted several years before implant placement, bone grafts are often required prior to implant placement because of lost alveolar bone.

The total number of dental visits (9.1) in the first year of this study approximates the 11.9 visits reported by Glendor et al. (12) for his mixed sample of 'complicated' injuries that included both avulsions and luxations. However, in this avulsion/replantation sample, a larger number of visits involved direct management (8.8 vs. 5.3) compared with Glendor et al. There may have been more visits for replacement of calcium hydroxide in immature incisors in this study. Mean total treatment time per individual for replantation was 7.2 h in the first year of this study. This is a conservative estimate as radiographs were not included in the time estimate. These results are similar to those of Glendor et al., who reported 1.7 h for emergency treatment and 6.9 h for planned visits. This amounts to a total of 8.6 h of treatment time for complicated trauma per individual.

Glendor et al. (12) reported that the indirect (non-clinician) time of both patients and parents is increased in hospitals because of institutional registration procedures (15–30 min per visit). In this study, transportation time was varied, and one-way travel took 30–60 min. Combining non-trauma-related treatment with trauma management was seldom possible in the current investigation. Patients were followed exclusively for trauma management and were referred to their family dentist for routine care. This suggests that patients followed at this teaching hospital required more dental visits than those treated privately.

It was not possible to calculate the costs per individual because of changes in the fee schedule over the 11 years of data collection. As the treatment protocol had not changed over the 11 years of data collection, we applied current descriptor codes and times. The mean first year cost of $1465 CAD supports the choice of greater or less than $2000 CAD used in the secondary objective. This calculation can be used to inform parents approximate first-year costs for management of replanted teeth.

It is speculated that dentists provide a number of injury-related procedures and adjustments pro bono. Not all reassessment examinations are billed, particularly when they are combined with other treatments such as splint removal. In a number of cases, patients were billed only a laboratory fee for denture repairs, despite the observation, assessment, and adjustment time required. There were no additional charges for 'exceptional' patients or for 'unusual time and responsibility'.

The actual costs of replantation are likely underestimated despite the fact that they are much higher in this study than previously reported (11, 12). Time and procedures appear to be common resources to investigate the direct costs of dental injury management in countries that follow similar treatment guidelines (8–10).

Clinical application

The desire to have incisors replanted is very strong. Even after having gone through the painful experience of replantation, the demands of recall and, in some cases extraction, the overwhelming majority of patients and parents would have made the same (replantation) decision. Almost half of the parents were willing to pay over $2000 CAD to maintain one incisor; yet, failure is often predictable. The majority of time required for treatment of avulsion injuries occurred in the first year. Parents ranked pain relief, prompt treatment, and return to normalcy in order of importance when obtaining emergency treatment.

The present study suggests that the indirect time burden on patient, parent, and practitioner and pro bono services provided by the dentist are often not considered when electing for replantation. Patients felt that immediate replantation of the incisor (normalcy) was more important than long-term effects of infraocclusion (esthetics; $P = 0.01$). Dentists often have difficulty convincing teenagers to consent to extractions, when submerging incisors compromise the success of future implants. Dentists can now include information regarding outcomes, prognosis, direct and indirect time expectations, and costs of the replantation decision. This enhanced information may temper the enthusiasm for replantation that has been based on optimism rather than the burden of patient/parent/dentist responsibilities and outcomes.

Acknowledgements – The Dental Trauma Research Database is supported by the Toronto Academy of Dentistry Crown and Bridge Study Club.

References

1. Oikarinen K, Kassila O. Causes and types of traumatic tooth injuries treated in a public dental health clinic. Endod Dent Traumatol 1987;3:172–7.
2. Kaste LM, Gift HC, Bhat M, Swango PA. Prevalence of incisor trauma in persons 6–50 years of age: United States 1988–1991. J Dent Res 1996;75(Spec Iss):696–705.
3. Glendor U, Halling A, Andersson L, Eilert-Petersson E. Incidence of traumatic tooth injuries in children and adolescents in the county of Västmanland, Sweden. Swed Dent J 1996;20:15–28.
4. Andreasen JO, Borum M, Jacobsen H, Andreasen F. Replantation of 400 avulsed permanent incisors. Part 4. Factors related to periodontal ligament healing. Endod Dent Traumatol 1995;11:76–89.
5. Barrett EJ, Kenny DJ. Survival of avulsed permanent maxillary incisors in children following delayed replantation. Endod Dent Traumatol 1997;13:269–75.
6. Kinirons MJ, Boyd DH, Gregg TA. Inflammatory and replacement resorption in replanted permanent incisor teeth: a study of the characteristics of 84 teeth. Endod Dent Traumatol 1999;15:269–72.
7. 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 barriers to providing care. Br Dent J 1997;182:129–33.
8. Andreasen JO, Andreasen FM. Avulsions. In: Andreasen JO, Andreasen FM, editors. Textbook and color atlas of traumatic injuries to the teeth, 3rd edn. Copenhagen: Munksgaard; 1994. p. 383–425.
9. Gregg TA, Boyd DH. Treatment of avulsed permanent teeth in children. UK National Guidelines in Paediatric Dentistry, Royal College of Surgeons, Faculty of Dental Surgery. Int J Paediatr Dent 1998;8:75–81.
10. American Association of Endodontists. Treatment of the avulsed permanent tooth: recommended guidelines of the American Association of Endodontists. Chicago, IL.: American Association of Endodontists; 1995 (available from URL: http://www.aae.org/guidelines.html).
11. Glendor U, Halling A, Andersson L, Andreasen JO, Klitz I. Type of treatment and estimation of time spent on dental trauma – a longitudinal and retrospective study. Swed Dent J 1998;22:47–60.
12. Glendor U, Halling A, Bodin L, Andersson L, Nygren A, Karlson G, et al. Direct and indirect time spent on care of dental trauma: a 2-year prospective study of children and adolescents. Endod Dent Traumatol 2000;16:16–23.
13. Thilander B, Odman J, Jemt T. Single implants in the upper incisor region and their relationship to the adjacent teeth. An 8-year follow-up study. Clin Oral Implants Res 1999; 10:346–55.
14. Steiner DR. Timing of extraction of ankylosed teeth to maximize ridge development. J Endod 1997;23:242–5.
15. Ebeleseder KA, Friehs S, Ruda C, Pertl C, Glockner K, Hulla H. A study of replanted permanent teeth in different age groups. Endod Dent Traumatol 1998;14:274–8.
16. Kawanami M, Andreasen JO, Borum MK, Schou S, Hjørting-Hansen E, Kato H. Infraposition of ankylosed permanent maxillary incisors after replantation related to age and sex. Endod Dent Traumatol 1999;15:50–6.
17. Andersson L, Bodin I. Avulsed human teeth replanted within 15 minutes – a long-term clinical follow-up study. Endod Dent Traumatol 1990;6:37–42.
18. Woodward CA, Chambers LW. Guide to questionnaire construction and question writing. Ottawa: Canadian Public Health Association; 1995. p. 1–21.
19. ODA. Suggested fee guide for general practitioners. Toronto, Canada: The Ontario Dental Association; 2000.
20. Robertson A, Noren JG. Subjective aspects of patients with traumatized teeth. A 15-year follow-up study. Acta Odontol Scand 1997;55:142–7.
21. Streiner DL, Norman GR. Scaling responses. In: Health measurement scales. A practical guide to their development and use, 2nd edn. New York: Oxford University Press; 1995. p. 28–53.
22. Shaul JA, Fowler FJ Jr, Zaslavsky AM, Homer CJ, Gallagher PM, Cleary PD. The impact of having parents report about both their own and their children's experiences with health insurance plans. Med Care 1999;37(Suppl. 3): MS59–68.
23. Robertson A, Robertson S, Noren JG. A retrospective evaluation of traumatized permanent teeth. Int J Paediatr Dent 1997;7:217–26.
24. Andersson L, Emami-Kristiansen Z, Hogstrom J. Single-tooth implant treatment in the anterior region of the maxilla for treatment of tooth loss after trauma: a retrospective clinical and interview study. Dent Traumatol 2003;19: 126–31.

Appendix 1. Parent/patient questionnaire

Parent questionnaire

Demographics

1. What is your relationship to (*pt*)?
2. What is your birth date?
3. What is your husband/wife's birth date?
4. What was your occupation at the time of the accident?
5. Were you working full or part-time?
6. What was your husband's occupation at the time of the accident?
7. Was he working full or part-time?
8. Has there been a major change in yours or your husband's occupation during the time of ongoing dental treatment for the accident?

Etiology

Next I would like to ask a few questions regarding (*pt's*) accident on (*date*). Try to remember as well as you can, but if you cannot recall, please let me know

9. Where did the accident happen?
10. What time of day did the accident happen (morning, afternoon, evening)?
11. How did the accident occur?
12. Where did you go for the emergency treatment?
13. Why did you choose this hospital clinic?
14. Who came with (*pt*) for the emergency treatment?
15. What time of day did you get to the hospital/clinic?
16. Did you have to leave work to get to the hospital/clinic?
17. Did (*pt*) have to leave school to get to the hospital/clinic?

Functional variables

The next questions are about how *(pt)* functioned with the replanted front tooth during treatment and follow-up visits. Please rate the following questions on a scale of 1 (no difficulty) to 7 (very difficult)

18. In the first 6 months after the accident, how much difficulty did (*pt*) have biting any kind of food?
19. Is the replanted tooth still in the mouth? Y/N
    (a) If yes: How much difficulty does (*pt*) have biting any kind of food now? Please rate the difficulty on the same scale of 1–7.
    (b) If no: What is in its place now?
    (c) How much difficulty does (*pt*) have biting any kind of food with the replacement tooth on the same scale of 1–7?
20. On a scale of 1–7 (1 being not at all concerned, 7 being extremely concerned)
    (a) How concerned were you in the past about something happening to the front teeth when biting?
    (b) Please describe
21. On the same scale,
    (a) How concerned are you now about something happening to the front teeth when biting?
    (b) Please describe

Personal variables

22. Do you remember what the dentist did to treat (*pt's*) injured teeth?
    (a) Y/N
    (b) What did s/he do?
23. How long did it take for the dentist to see you,
    (a) For the emergency treatment?
    (b) For the follow-up appointments?
24. How long did the emergency treatment take?
25. Do you think about the trauma?
    (a) Y/N
    (b) How often?
26. On a scale of 1–7 (1 being not very anxious and 7 being extremely anxious), how anxious do you feel about the future of (*pt's*) injured teeth or their replacement?

Social variables

27. Has the injury to (*pt's*) teeth affected any activities or plans?
    (a) Y/N
    (b) Please explain
28. Did (*pt*) have to stay home from school right after *his/her* accident?
    (a) Y/N
    (b) How much time?
    (c) Why?
29. Did (*pt*) have to take time out of school for dental appointments?
    (a) Y/N
    (b) Approximately how much time? Please choose from one of the following:
        (i) ☐ 1–2 h
        (ii) ☐ Half a day
        (iii) ☐ Full day
30. Did you or your spouse have to take time off work or usual activity to take (*pt*) to *his/her* appointments?
    (a) Y/N
    (b) How much time? Please choose from one of the following:
        (i) ☐ 1–2 h

Appendix 1. continued

(ii) ☐ Half a day
(iii) ☐ Full day

31. What was the travel time it takes for you to bring (*pt*) to the hospital?
32. How did you get to the hospital?
(a) ☐ Car
(b) ☐ Public transportation
(c) ☐ Taxi
(d) ☐ Walk
(e) ☐ Other
33. Who was the main person who brought (*pt*) to dental appointments dealing with *his/her* injured teeth or was it equally shared with another adult?

If tooth is still present:

34. On a scale of 1–7 (1 being very dissatisfied and 7 being very satisfied),
(a) How satisfied are you with the color of the tooth?
(b) What do you like about the tooth?
(c) What do you not like about the tooth?

If the teeth have been extracted:

35. Does (*pt*) have a problem with wearing a replacement tooth?
(a) Y/N
(b) Please describe

If patient is wearing removable partial denture:

36. On a scale of 1–7 (1 being very worried, 7 being not at all worried),
(a) How worried about (*pt*) losing the denture?
(b) Why?
37. On the same scale of 1–7,
(a) How worried are you about *(pt)* breaking the denture?
(b) Why?
38. On a scale of 1–7 (1 being very dissatisfied, 7 being very satisfied)
(a) How satisfied are you with the appearance of the denture?
(b) Why?

Information

39. At the time you presented to the hospital for emergency treatment, did the dentist explain to you about (Y/N):
(a) How long the tooth would be in the mouth?
(b) Did s/he tell you about long-term costs?
(c) Did s/he explain about the need for root-canal treatment?
(d) Did s/he explain about the number of appointments that you would be expected to attend?
(e) Did s/he explain about the potential for loss of the replanted tooth?
40. At the follow-up appointments, were you told again of (Y/N)
(a) How long the tooth would be in the mouth?
(b) Long-term costs?
(c) The need for root-canal treatment?
(d) The number of appointments that you would be expected to attend?
(e) The potential for loss of the replanted tooth?
41. If you knew at the time of the accident what you know now, would you have requested the incisor be replaced in the mouth or left out?
42. If the tooth was extracted after the accident,
(a) Do you wish you had it removed sooner? Y/N
(b) Why?
43. How did the dentist who performed the emergency treatment assist your decision-making?
44. The following is a list of aspects of first aid treatment. Please choose the three most important aspects of emergency treatment
(a) Trust in your dentist
(b) Prompt treatment
(c) Information regarding outcome of injured teeth
(d) Getting your child out of pain
(e) Replanting the tooth so that your child will still have a front tooth for school
45. Is there anything you wish you were informed of:
(a) During the emergency treatment?
(b) Please explain
46. Is there anything you wish you were informed of:
(a) At follow-up visits?
(b) Please explain

Subjective

47. What were your long-term expectations for tooth failure?
48. On a scale of 1–7 (1 being strongly disagree and 7 being strongly agree), please rate the following statements:
(a) It is important that the injured tooth is in the mouth through the critical teenage years
(b) It is acceptable that the injured tooth is slightly different colour than the other teeth
(c) It is acceptable that the injured tooth is 'shorter' than the adjacent teeth
49. Please choose from one of the following. How much are you willing to spend to save one front tooth?
(a) ☐ Less than $500

Appendix 1. continued

(b) ☐ $500–1000
(c) ☐ $1000–2000
(d) ☐ Over $2000

50. Who paid for your child's:
(a) Emergency treatment of the injured teeth? (insurance, self, government program or combination)
(b) Follow-up treatment (root canals, fillings/crowns, surgery, dentures, etc.)?
51. This concludes the 1st part of the survey. Are there any concerns or additional comments you would like to add?

Now, I would like to speak with (*pt*) for the 2nd part of the survey. It is best if you not be present during *his/her* interview. You are free to discuss the interview with each other when both interviews are complete. Could you please transfer the phone to (*pt*)?

Patient questionnaire

Demographics

1. Do you have any brothers and sisters?
2. How many and where do you stand in the family?
3. What grade were you in when you had your accident?
4. What grade are you in now?

Etiology

Next I would like to ask a few questions about your accident on *date*. Try to remember as well as you can, but if you cannot recall, please let me know

5. Where did the accident happen?
6. How did the accident occur?
7. Why did you choose this hospital clinic?
8. Who came with you for the emergency treatment?
9. What time of day did you get to the hospital?
10. Did your mom or dad have to leave work to get your to the hospital?
11. Did you have to leave school to get to the hospital?

Functional variables

The next questions are about how you are able to function with the replanted front tooth during treatment and follow-up visits. Please rate the following questions on a scale of 1 (no difficulty) to 7 (very difficult)

12. In the first 6 months after the accident
(a) How much difficulty did you have biting any kind of food?
(b) What types of foods gave you difficulty?

From parent survey, if tooth still in mouth:

13. How much difficulty do you have biting any kind of food now? Please rate the difficulty on the same scale.

If tooth no longer in mouth:

14. How much difficulty do you have biting any kind of food with the replacement tooth on the same scale 1–7?

Personal variables

15. What happened right after the tooth was knocked out?
16. Who looked after:
(a) You at the time of the accident?
(b) The tooth at the accident site?
17. What did you do with the tooth before you got to the hospital?
18. Do you remember what the dentist did to fix your front teeth?
(a) During the emergency treatment?
(b) Please describe
(c) During follow-up treatments?
(d) Please describe
19. On a scale of 1–7 (1 being never, 7 being always),
(a) How often do you think about the trauma?
(b) Do you have dental fears? Y/N
(c) Did the trauma contribute to it? Y/N
20. On a scale of 1–7 (1 being not very worried, 7 being extremely worried), how worried are you about the future of your front teeth or their replacement?

Social variables

21. Has the injury to your teeth:
(a) Affected any activities or plans? Y/N
(b) What type of plans?
22. Did you have to take time out of school
(a) Immediately after the accident?
(b) How much time?
(c) For dental appointments?
(d) Y/N
(e) How much time? Please choose from the following:
(i) ☐ 1–2 h
(ii) ☐ Half a day
(iii) ☐ Full day

If the teeth have been extracted:

23. Do you have a problem with wearing a flipper/denture?
24. Do you have a fear of losing the removable denture?

Appendix 1. continued

25. Do you have a fear of breaking the removable denture?
26. Are you satisfied with its appearance?
27. What do you expect to happen to your tooth (or the space) in the future?
28. What was the worst thing about the accident?
29. Were there any good things about the accident?
30. Do you use a mouthguard now when you play sports?

Esthetic evaluation

If tooth still present

31. On a scale of 1–7 (1 being very dissatisfied and 7 being very satisfied)
    (a) How satisfied are you with the color of your replanted tooth?
    (b) On the same scale of 1–7, how satisfied are you with the position of your replanted tooth?

If patient has prosthetic tooth

32. On a scale of 1–7 (1 being very dissatisfied and 7 being very satisfied)
    (a) How satisfied are you with the color of the false tooth?
    (b) On the same scale of 1–7, how satisfied are you with the shape/position of the false tooth?
33. On a scale of 1–7 (1 being strongly disagree and 7 being strongly agree), please rate the following statements:
    (a) It is important that the injured tooth is in the mouth through the critical teenage years.
    (b) It is acceptable that the injured tooth is slightly different color than the other teeth.
    (c) It is acceptable that the injured tooth is 'shorter' than the adjacent teeth.
34. If you knew at the time of the accident what you know now, would you request the tooth be replaced in the mouth or left out?
35. This ends our survey. Are there any comments you would like to add?