*Dental Traumatology* 2008; **24**: 146–150; doi: 10.1111/j.1600-9657.2008.00573.x

# Effectiveness of dental trauma education for elementary school staff

**Judy D. McIntyre[1], Jessica Y. Lee[2], Martin Trope[1], William F. Vann Jr[3]**

[1]Department of Endodontics; [2]Departments of Pediatric Dentistry and Health Policy Analysis; [3]Department of Pediatric Dentistry, UNC School of Dentistry, Chapel Hill, NC, USA

Correspondence to: Jessica Y. Lee, DDS MPH PhD, Department of Pediatric Dentistry, UNC School of Dentistry, Brauer Hall, CB #7450, Chapel Hill, NC 27599, USA
Tel.: +1 919 966 2739
Fax: +1 919 966 7992
e-mail: jessica_lee@dentistry.unc.edu

Accepted 27 September 2006

**Abstract** – The purpose of this study was to assess the knowledge of elementary school staff members regarding the management of traumatic dental injuries (TDI) before and after an educational intervention aimed to increase TDI knowledge. Using a newly developed reliable survey instrument, we tested our elementary school staff participants about TDI before ($time_0$), immediately after ($time_1$), and three months after ($time_2$) the intervention. Schools were randomized into three groups: no intervention/control (C), pamphlets (P), and pamphlets + lecture (P + L). Outcomes of interest were TDI knowledge over time relative to the interventions vs controls. Statistical analysis involved a repeated measures linear model. At $time_0$, TDI knowledge was low among all three groups. At $time_1$, knowledge increased among all groups and is given by P > P + L > C. For $time_2$ vs $time_1$, the P + L group retained the knowledge while in both the C and P groups the knowledge level decreased. Between $time_1$ and $time_2$, significant differences were found between both intervention groups when compared with the control (P vs C and P + L vs C: both $P < 0.05$). In summary, both P and P + L groups significantly improved TDI knowledge among elementary school staff, and this difference held up over time. These interventions have the potential to improve TDI management by elementary school staff when faced with such injuries.

Treatment time, costs, and the life-long consequences of traumatic dental injuries (TDIs) have been well-documented (1). It is known that many TDIs occur at school or during after school activities where school personnel are the first-responders for children involved in dental-related accidents. While international studies (2–16) have found that school staff have little TDI knowledge, this research question has received little attention in the USA.

Recently, we reported (17) on the knowledge of elementary school staff about TDIs in North Carolina (NC). Our findings revealed that the majority of our well-educated and experienced school staff respondents were not well-versed in TDIs, proper TDI management or the benefits of early and timely management. At the same time, our participants reported a keen interest in receiving more TDI information and training. This study is a follow up of our previous study and expands upon our interest in educating non-dental professionals about TDIs. The purpose of the current study is to report on two educational interventions that were structured to increase the knowledge of TDIs among elementary school staff.

## Background

Beyond in-office communications between the dental staff and parents/patients, educational pamphlets are by far the most popular approach employed for communicating and underscoring take-home messages to dental patients. Regarding TDIs, a plethora of TDI pamphlets are available from all the major dental organizations that represent the interests of children and adolescents. These educational pamphlets are available widely in dental offices and community dental clinics. Although we could find no specific TDI pamphlets aimed at elementary school staff, the popularity and convenience of this method for lay public education was highly appealing, so we chose TDI educational pamphlets as one of our two educational interventions.

Based on the theoretical rationale that a brief lecture with a question and answer session would enhance the educational impact of a pamphlet, we employed our educational TDI pamphlet and a short (10-minute) lecture designed to elaborate on the pamphlet with a face-to-face real time question and answer session with the school staff for our second intervention. Our rationale for the second intervention was that such an elaboration might have a more powerful instructive impact than mere reading of a pamphlet. Although such an educational strategy required valuable contact time involving both a dental professional with TDI expertise and school personnel, we reasoned that this intervention might offer more long-term learning value than the pamphlet alone. We believed also that the pamphlet + lecture would be practical in the elementary school environment.

## Methods

### Study design

We relied upon a longitudinal, time-series research design that surveyed all public elementary schools in the Orange County school district in NC. Our design involved a participant survey at baseline (pre-intervention/time$_0$), immediately postintervention (time$_1$) and 3 months postintervention (time$_2$). Our study proposal was reviewed and approved by the Biomedical Institutional Review Board at the University of North Carolina at Chapel Hill. All eligible participants were required to give written informed consent for study participation and all maintained their right to withdraw from the study at any juncture.

### Study participants

All seven public elementary schools in Orange County, NC participated. An estimated 175 public elementary school teachers, teachers' assistants (TA), and nurses for the Grades 2–5 were recruited. The only exclusion criterion was the ability to read and understand English.

### Study group assignments

From seven schools, we randomly assigned two schools to serve in the control group (C), two schools to serve in the pamphlet-only intervention group (P), and three schools to serve in the pamphlet + lecture intervention group (P + L).

### Survey instrument

During the conceptualization of our study, we realized that the fundamental building block would be the development of a TDI survey instrument that would be valid yet practical and convenient. Questions were derived in part from previously published surveys (2, 7, 9, 10). After evaluation by a professional panel, we incorporated many revisions and field-tested our survey among several lay individuals, dental students, and TDI experts. Our final survey contained questions with a response construct similar to the 5-Point Likert Scale. The survey evaluated the subjects' knowledge about crown fractures, avulsions, and TDI-related management. The development and reliability testing of the survey instrument has been reported previously (17).

### Survey reliability assessment

We tested the new survey instrument for reliability by calculating Cronbach's alpha (CA, 18–20). CA is a statistical index associated with the variability because of the underlying characteristic being measured and it is considered as a measure of internal reliability for new survey instruments. CA values range from zero to one and a measure of $\geq 0.6$ indicates acceptable reliability (20). We felt it essential to establish the reliability of our survey instrument because to our knowledge it was the first time that such a survey in US had been undertaken. It was our intention that the development of this survey would be useful for further research as well as educating and testing other populations.

### Logistics of data collection

We distributed the consent form and demographic questionnaire to all staff during August 2004 and their completed questionnaire served as a confirmation of participation. In September 2004, all participants were assembled at each of the seven respective schools to complete the baseline (time$_0$) TDI survey. Participants were assigned confidential, unique identifiers that correlated to their school and their job descriptions: teacher, TA or school nurse.

Following collection of baseline (time$_0$) survey data for the three study groups, the non-intervention control group (C) completed the postintervention (time$_1$) survey after a 15-minute refreshment break. The participants in the pamphlet-only intervention group (P) were given 20 min to read and review their pamphlet, after which they completed the postintervention (time$_1$) survey. The pamphlet + lecture intervention group (P + L) read their pamphlet under the same scenario, after which they were given the short lecture with question and answer for several minutes followed by a postintervention (time$_1$) survey. Three months following the day after both the baseline (time$_0$) and postintervention (time$_1$) surveys were taken, the participants completed the postintervention (time$_2$) survey instrument.

### Data analyses

Data obtained from the responses to the TDI surveys were entered for analysis using Microsoft Access (Microsoft Corporation, Redmond, WA, USA). Analyses were performed by the Biometrics Laboratory in the UNC-CH School of Public Health. Because our major research question was to examine changes in TDI knowledge by educational intervention over time, we created a Total TDI Knowledge Score (TTKS) variable. Eleven items were used to determine the TTKS for each subject. To facilitate interpretation, the TTKS consisted of dichotomized responses to these 11 survey items regarding crown fractures and avulsion injuries. For a given survey item, participants were assigned 1-point for correct responses and no points for incorrect responses, yielding a maximum TTKS score of 11. A TTKS measure for each subject was calculated for each time period: time$_0$, time$_1$ and time$_2$.

Ultimately, our correlated data set was tested using a repeated measures analysis and a mixed linear effects model that accounted for correlation between responses. Repeated measures analysis was chosen because it allowed us to detect both differences between the intervention groups and the pattern of changes in TTKS over time. With this methodology, we were able to determine: (i) if our interventions were effective in a short term, and (ii) if the change in knowledge was retained over time. We set a *P*-value of 0.05 as the level of significance for all statistical tests.

## Results

### Study participants

Of the 175 potential participants, 135 volunteered and 111 submitted all the required components including the consent form, demographic questionnaire, and at least one to three of the surveys. Our random participants' assignment resulted as follows: no intervention control (C: $n = 45$), pamphlet-only (P: $n = 37$), and pamphlet + lecture (P + L: $n = 29$). Our overall sample size ($n = 111$) at $time_0$ held up strongly at $time_1$ ($n = 110$) and at $time_2$ ($n = 102$) with acceptable sample sizes in all cells at all time intervals.

Our power analysis confirmed that our sample size was more than adequate to find any significant differences that might exist. A detailed breakdown of the three study groups and three time intervals is illustrated in Table 1.

### TDI knowledge results

The mean TTKS scores for each period by intervention group are presented in Table 2. The three study groups were essentially identical at $time_0$. At $time_1$, group P was statistically superior to both the C and P + L groups. At $time_2$, both groups P and P + L were statistically superior to the C group, with no difference between P and P + L.

### TDI knowledge outcomes over time

The findings for the effects on TTKS over time are illustrated in Fig. 1 and Table 3. At $time_0$, mean total-TDI knowledge scores were low among all groups. From $time_{0 \rightarrow 1}$, knowledge increased as follows: P > P + L > C. From $time_{1 \rightarrow 2}$, groups C and P decreased in knowledge while group P + L maintained their level of knowledge.

Between $time_{0 \rightarrow 1}$ and $time_{0 \rightarrow 2}$, knowledge gained in group P vs C was significant ($P = 0.004$ and $P = 0.015$, respectively). Between $time_{1 \rightarrow 2}$ and $time_{0 \rightarrow 2}$, significant knowledge differences were found between group P + L vs C, ($P = 0.019$ and $P = 0.002$, respectively). Lastly, knowledge comparison of group P vs P + L was significant ($P = 0.05$) during $time_{1 \rightarrow 2}$ only. Overall, the change in mean TTKS between $time_{0 \rightarrow 2}$ was significantly different between groups C vs P ($P = 0.015$) and P + L ($P = 0.002$) but not between group P vs P + L ($P = 0.4$).

*Table 1.* Demographics of study population by intervention group

| | Intervention group | | | |
|---|---|---|---|---|
| | None/Control | Pamphlet | Pamphlet + Lecture | Overall |
| Position in OC schools | n | n | n | n |
| Teacher | 30 | 26 | 13 | 69 |
| Teacher Assistant | 13 | 8 | 14 | 35 |
| Nurse | 2 | 3 | 2 | 7 |
| Total | 45 | 37 | 29 | 111 |

OC, Orange County; n, sample size.

## Discussion

### Study sample

We targeted the staff members who supervise the age group of the children most affected by TDIs (21–23). When TDIs occur at school or during sports, injured children may make contact first with a teacher or coach and ultimately, a school nurse. While educating the school children themselves may be beneficial, evaluating them *en masse* is logically difficult and the educational psychology of TDI information for elementary school children is unproven. In focusing our school teachers, TA, and nurses, we indirectly targeted the audience and focused the health message on the individuals who would/could most likely impact the management of TDI.

Our goal was to recruit all 175 targeted staff members in our sample. The excellent support of this school district, its associate superintendent, its Healthful Living Coordinator and the school's head nurse encouraged maximum participation. We performed a sample size calculation (24) and determined that a final sample size of 100 subjects or greater would be more than adequate to detect statistically significant differences in knowledge scores over time between study groups. These changes were our main outcomes of interest. Randomization of the subjects into three intervention groups allowed an approximately equal number of participants in each intervention group, which is essential for study design for data analysis.

### Findings

Generally, there was a decrease in knowledge score from $time_{1 \rightarrow 2}$. Clearly, knowledge gained through education

*Table 2.* Average total TDI Knowledge Score by intervention group and survey time

| | $Time_0$ | | | $Time_1$ | | | $Time_2$ | | |
|---|---|---|---|---|---|---|---|---|---|
| Intervention | *n* | Mean | Standard | *n* | Mean | Standard | *n* | Mean | Standard |
| None/Control | 45 | 8.84 | 1.770 | 45 | 9.44 | 1.486 | 43 | 8.93 | 1.993 |
| Pamphlet | 37 | 8.97 | 1.848 | 36 | 10.61 | 1.536 | 31 | 10.23 | 1.309 |
| Pamphlet + Lecture | 29 | 8.83 | 2.122 | 29 | 10.03 | 1.955 | 28 | 10.43 | 1.034 |
| Total | 111 | | | 110 | | | 102 | | |

The maximum TTKS was 11 points.

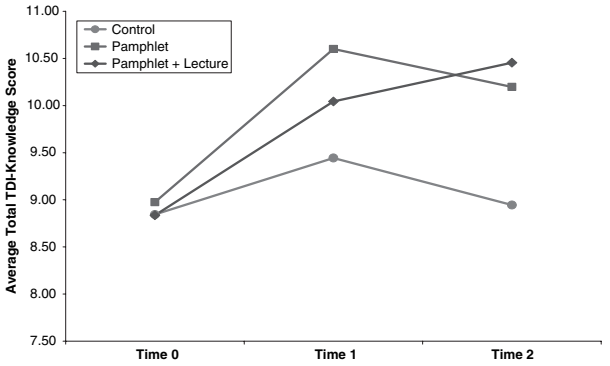


*Fig. 1.* Average total TDI Knowledge Score by survey time and intervention group.

*Table 3.* Summary of significant knowledge results between the intervention groups and time intervals

| Groups being compared: | Time intervals | | |
|---|---|---|---|
| | Time 0 → 1 | Time 0 → 2 | Time 1 → 2 |
| C vs P | Y | Y | N |
| C vs P + L | N | Y | Y |
| P vs P + L | N | N | Y |

C, Control; P, pamphlet only; P + L, pamphlet + lecture; Y, yes; N, no.

is time limited, this knowledge can decrease over 3 months without continued education. It is probable that a continued increase in time since the intervention would further reduce the knowledge gained and retained, but this was not examined. While the changes in knowledge observed in this study were statistically significant, a number of demographic variables may explain some of the changes witnessed. However, although we controlled for age, the results of the intervention were still significant.

From $time_{0 \rightarrow 2}$, group C increased its mean TTKS overall by 0.09 points; this is an extremely small increase which may possibly be attributed to chance/coincidence or to guessing while taking the test. From $time_{1 \rightarrow 2}$, the only group whose mean TTKS score did not decrease 3 months later was that of group P + L. During this period, this group increased its mean TTKS even though no structured additional education was given–possibly because of a latent knowledge gain inherent in the P + L dual-intervention design, or the lecture's visual component. As the lecture included pictures of dental trauma, this component may have left memorable impressions regarding certain topics, such as avulsion injury management. Another explanation for this finding may be that P + L 'retained' the knowledge learned while group P did not. A final explanation may be that the P + L participants found the topic more intriguing and as a result did more reading or research on TDIs at some point over the 3 months.

The unanticipated increase in the mean TTKS among group C from $time_{0 \rightarrow 1}$ may be explained by knowledge gained through education, answers memorized, or solely from the survey administration, even though our design intended to diminish this impact. From $time_{0 \rightarrow 2}$, group C made an overall increase knowledge, but the gain was only 0.09 points and was neither statistically nor practically significant. From $time_{0 \rightarrow 1}$, the mean TTKS of group P increased more than the increase observed in group P + L, a change we attribute to the group P participants being able to return to their $time_1$ survey more quickly than those in group P + L.

#### Strengths and limitations

The major strength of this study is the inclusion of a no-intervention control group. Because the populations were similar at baseline, our design permitted direct comparison between groups over time from start to finish over the 3 months. The findings illustrate the absolute necessity of such a design in studies that rely upon knowledge acquisition as retention of knowledge is an important variable.

Our survey was field-tested among non-dental and dental professionals such as the pre-doctoral students and other residents at the UNC School of Dentistry from the disciplines of endodontics and pediatric dentistry. However, we did not field-test the survey among a population similar to that of our subjects. Consequently, our initial TDI knowledge scores may have been skewed too much in the positive direction, leaving us a reduced leeway for educational gain by the participants. This is a phenomenon that should be considered in future studies.

#### Implications

Educating individuals who supervise and care for children and would be near the accident site of TDI has been advocated widely, but evaluation of such education has been limited. Moreover, published evaluational studies focus primarily on avulsion injuries. The results of this investigation address the impact of education regarding TDIs and their emergency management for non-dental professionals who frequently supervise and/or care for children. This investigation will be the first published effort in the USA literature to evaluate changes in knowledge regarding the emergency management of TDI among elementary school staff members.

Our findings indicate positive and statistically significant changes in knowledge scores in both the P and P + L intervention groups, underscoring that the dissemination of information regarding the emergency management of TDI can influence knowledge of non-dental professional caregivers. It is our hope that this research will attract media attention as one avenue to increase awareness and education about TDIs and their management among non-professionals, especially school staff members. Our findings could then be implemented in other school districts in other states and regions. It is our vision that eventually, similar to the American Heart Association's Cardio-Pulmonary Resuscitation program, individuals such as all school staff and athletic coaches will be required to have an annual mandatory seminar regarding the proper management of TDIs.

## Conclusions

Our TDI pamphlet is an effective educational resource for elementary school staff to acquire knowledge regarding TDIs and their management. Our TDI lecture, when used in conjunction with the pamphlet added no additional benefit. Our findings urge to develop future partnerships between dentistry and caregivers of children to educate this latter group regarding TDI and their emergency management so as to avoid the detrimental sequelae that most frequently results when proper emergency management is not rendered.

## Acknowledgements

Special thanks to Jamie Perrin, Susan Ganther, and Dr. Eric Rivera for their help with this research project.

## References

1. Wong FS, Kolokotsa K. The cost of treating children and adolescents with injuries to their permanent incisors at a dental hospital in the United Kingdom. Dent Traumatol 2004;20:327–33.
2. Pacheco LF, Filho PF, Letra A, Menezes R, Villoria GE, Ferreira SM. Evaluation of the knowledge of the treatment of avulsions in elementary school teachers in Rio de Janeiro, Brazil. Dent Traumatol 2003;19:76–8.
3. Panzarini SR, Pedrini D, Brandini DA, Poi WR, Santos MF, Correa JP, et al. Physical education undergraduates and dental trauma knowledge. Dent Traumatol 2005;21:324–8.
4. Andersson L, Al-Asfour A, Al-Jame Q. Knowledge of first-aid measures of avulsion and replantation of teeth: an interview of 221 Kuwaiti schoolchildren. Dent Traumatol 2006;22:57–65.
5. Al-Jundi SH, Al-Waeili H, Khairalah K. Knowledge and attitude of Jordanian school health teachers with regards to emergency management of dental trauma. Dent Traumatol 2005;21:183–7.
6. Caglar E, Ferreira LP, Kargul B. Dental trauma management knowledge among a group of teachers in two south European cities. Dent Traumatol 2005;21:258–62.
7. Blakytny C, Surbuts C, Thomas A, Hunter ML. Avulsed permanent incisors: knowledge and attitudes of primary school teachers with regard to emergency management. Int J Paediatr Dent 2001;11:327–32.
8. Hamilton FA, Hill FJ, Mackie IC. Investigation of lay knowledge of the management of avulsed permanent incisors. Endod Dent Traumatol 1997;13:19–23.
9. Sae-Lim V, Lim LP. Dental trauma management awareness of Singapore pre-school teachers. Dent Traumatol 2001;17:71–6.
10. Chan AW, Wong TK, Cheung GS. Lay knowledge of physical education teachers about the emergency management of dental trauma in Hong Kong. Dent Traumatol 2001;17:77–85.
11. Sanu OO, Utomi IL. Parental awareness of emergency management of avulsion of permanent teeth of children in Lagos, Nigeria. Niger Postgrad Med J 2005;12:115–20.
12. Sae-Lim V, Chulaluk K, Lim LP. Patient and parental awareness of the importance of immediate management of traumatised teeth. Endod Dent Traumatol 1999;15:37–41.
13. 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.
14. Raphael SL, Gregory PJ. Parental awareness of the emergency management of avulsed teeth in children. Aust Dent J 1990;35:130–3.
15. Newman LJ, Crawford PJ. Dental injuries: ''first aid'' knowledge of Southampton teachers of physical education. Endod Dent Traumatol 1991;7:255–8.
16. Lang B, Pohl Y, Filippi A. Knowledge and prevention of dental trauma in team handball in Switzerland and Germany. Dent Traumatol 2002;18:329–34.
17. McIntyre JD, Lee JY, Trope M, Vann WF Jr. Elementary school staff knowledge about dental injuries. Dent Traumatol 2007 (in press).
18. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16:297–334.
19. Cortina JM. What is coefficient alpha? An examination of theory and applications. J Appl Psychol 1993;78:98–104.
20. Nunnally JC. Psychometric theory, 1st edn. New York: McGraw-Hill; 1967.
21. Andreasen JO, Ravn JJ. Epidemiology of traumatic dental injuries to primary and permanent teeth in a Danish population sample. Int J Oral Surg 1972;1:235–9.
22. Holland T, O'Mullane D, Clarkson J, O'Hickey S, Whelton H. Trauma to permanent teeth of children, aged 8, 12 and 15 years, in Ireland. J Paediatr Dent 1988;4:13–6.
23. Skaare AB, Jacobsen I. Etiological factors related to dental injuries in Norwegians aged 7–18 years. Dent Traumatol 2003;19:304–8.
24. Hulley SB, Cummings SR. Designing clinical research: an epidemiological approach. Baltimore: Williams & Wilkins; 1998.