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Impact of educational posters on the lay knowledge of school teachers regarding emergency management of dental injuries

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Abstract – The purpose of this study was to investigate the knowledge of school teachers about the emergency management of dental trauma, after an educational poster campaign. A total of 1000 questionnaires were sent to 100 schools in the area where the poster had been distributed. This was compared to another 100 schools (1000 questionnaires) in an area, Where the poster had not been distributed. The questionnaire surveyed demographic data, basic knowledge of emergency management of tooth fracture, luxation and avulsion injuries. A total of 511 questionnaires were returned (25.5%) and analyzed. Results showed differences between the two assessed areas. Teachers, who worked in the area with poster distribution, had better knowledge in handling tooth injuries. For the management of tooth fractures the portion of teachers, who knew the correct handling procedure, was 78.9% (area with poster campaign) vs 72.1% (area with no poster campaign), for the management of tooth luxation it was 87% vs 84% and for the management of tooth avulsion it was 71% vs 54%. In the area with the poster campaign 49% ($n = 90$ out of 185) of the teachers stated to have gained some knowledge about this topic beforehand. Out of these, 75 teachers (75/90 = 83%), had gained their information from the educational poster. Out of the 75 teachers, who had seen a poster on this topic, 68 (68/75 = 91%) would have managed such an emergency correctly. The present study shows the positive effect of educational poster campaigns. It therefore should encourage professionals in this field to embark on similar projects.

Injury to both primary and permanent teeth and their supporting structures is one of the most common dental problems seen in children. Falls are the main cause of dental injuries in children (1–3). It has been suggested that the frequency of dental trauma may soon exceed other dental problems such as caries or periodontal diseases (4). In Scandinavia, 30% school children experienced trauma in the primary dentition and 22% in the permanent dentition (2, 5, 6). Another study showed that in the 7–30 year old population, oral injuries are the fourth most common type of reason for dental attendance (7). Dental injuries can result in functional and esthetic impairment and lead to great concern for parents and children.

The prognosis of injured teeth may also depend on the appropriate emergency management by lay people such as parents and school teachers. Studies on avulsion injuries have shown that the prognosis depends on the viability of the periodontal ligament remaining on the root surface of an avulsed tooth (8, 9). In animal models it showed that the most important factors for the outcome are the appropriate handling of the avulsed tooth, the extra-oral storage medium and time duration out of its socket (10–14). Several studies have assessed the correlation of the time lag between trauma and reimplantation and the prognosis the affected tooth (8, 9, 15–17). They showed that reimplantation should be done as soon as possible, ideally within minutes after trauma. If laypeople do not feel comfortable to perform this procedure, they can place the tooth in a special storage medium and consult the nearest dentist immediately. In order to find media suitable for storage of avulsed teeth, the survival rate of periodontal cells in different media has been analyzed *in vitro* (8, 12, 13, 15, 18–27) (Table 1). Up to now, no *in vivo* randomized controlled trials on this topic are available.

Multiple studies have investigated the lay knowledge of teachers with regards to dental injuries (28–35). The majority of the teachers appeared to have only rudimentary knowledge of emergency management. The recommendation of these studies was to invest in the training of lay people in the handling of dental emergencies.

In 2001, the Department of Oral Surgery and Stomatology of the University of Bern published a poster about the emergency management of injured teeth. The title was 'Dental injuries, what should you do?'. The poster presented guidelines for lay people for the emergency

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Table 1. Rating of storage media and duration for an avulsed tooth according to *in vitro* and *in vivo* studies

Media	Correct	Incorrect
Dry storage (8, 14–17)	Up to 1 h	>1 h
Water (8, 10, 11, 15, 18)	Up to 1 h	>1 h
NaCl (8, 15, 37)	Up to 2 h	>2 h
Saliva (11, 12, 19, 20, 37)	Up to 2 h	>2 h
Milk, Dentosafe® (Medice®; Iserlohn, Germany) (10, 11, 19–24, 27, 38, 39)	Up to 6 h	>6 h
Disinfectant (15)		Always

Rating of storage media and duration of storage for an avulsed tooth according to *in vitro* and *in vivo* studies published in English literature and in accordance with the IADT (International Association of Dental Traumatology) treatment guidelines for dentists in dental traumatology.

treatment of injured teeth (Fig. 1). The poster was sent to each school in the Canton of Bern in the year 2001.

The purpose of this study was to evaluate Swiss school teachers' knowledge of the emergency management of injured teeth after the educational poster campaign. The data was collected by means of a questionnaire in 2006. For comparison, the same numbers of this questionnaire were sent to schools in the Canton of Bern and in two other Cantons, where school teachers had not been exposed to the information campaign.

Material and methods

The educational poster used for this study was edited by the Department of Oral Surgery and Stomatology (School of Dental Medicine, University of Bern, Switzerland) in 2001. The goal was to improve the knowledge of emergency management of dental injuries by school teachers. It was divided into three sections: the correct management of simple tooth fractures, tooth dislocation and avulsion. The poster was sent to 155 schools in the Canton of Bern (965 000 inhabitants) (Group IC, information campaign).

To assess the impact on the knowledge of the teachers 5 years after the poster campaign was conducted, a survey using questionnaires was undertaken. All headmasters were contacted by mail, asking for permission to perform the questionnaire survey and explaining the purpose of the study. Subsequently, a sample size of 100×10 envelopes was estimated to provide a representative sample of the 155 schools, which were enrolled in the poster campaign in 2001. A region with similar basic demographics and a comparable number of schools was selected [Cantons of Lucerne and St. Gallen (812 000 inhabitants), Group NC, no information campaign]. Hundred envelopes, each containing 10 questionnaires for teachers, were sent to the headmaster of each participating elementary school, high school and college in both regions (i.e., a total of 2000 questionnaires). A pre-paid reply envelope was included with each pile of questionnaires and all responses were kept anonymous. In addition, a cover letter was enclosed asking to return the forms within 1 month. The survey was performed between June 2006 and September 2006. In order to optimize the response rate, telephone contact was made to each headmaster after 1 month as a reminder.

When editing the questionnaire, data from previous studies on the evaluation of lay knowledge were used (29,

Dental injury, what should you do?

Dental injuries can occur at home, in your time off or during sports.
If treated inappropriately the chances of a good outcome are reduced.
Permanent teeth can often be saved!

In case of dental injury, the following steps should be taken:
1. Keep calm and act prudently
2. In cases of profuse bleeding bite on a swab or a cotton tissue and apply ice externally
3. Treat dental injuries as described below
4. Consult a dentist or a dental hospital immediately

Tooth fracture:
Look for the fractured piece and put it in water or preferably cold milk

Mobile or displaced tooth:
Do not manipulate the tooth. It is only advised to bring the teeth together carefully, as long as it brings the injured tooth back into its original position.

Tooth knocked out:
Look for the tooth and hold it by the crown only, do not touch the root. Do not clean the tooth, even if it's dirty! Store the tooth as soon as possible in humid conditions, such as cold milk, sterile saline solution (from your GP or pharmacy) or in a designated safety box (Dentosafe®).

Thereafter, consult your dentist or a dental hospital immediately.

Fig. 1. Translation of educational poster.

30, 36). The questionnaires consisted of nine questions (Appendix).

These questions included demographic data and emergency handling of crown fractures, luxation injuries, and avulsion injuries.

Answers to questions 7 a to 8 b – concerning the management of tooth avulsion – were classified as correct or incorrect according to recommendations of the current literature (Table 1) (8, 10–12, 14–24, 27, 37–39), including the IADT guidelines (International Association of Dental Traumatology) (40). These guidelines advise the dentist how to perform treatment with regards to the extra-oral dry time of an avulsed, non-replanted tooth. On the basis of these guidelines, the extra-oral dry time was rated as 'correct' when it was up to 1 h and as 'incorrect' when it was more than 1 h.

Finally the questionnaire data of the different groups (IC vs NC) were analyzed and compared, to assess the impact of the poster information campaign.

Results

A total of 511 questionnaires were returned (25.5%). Out of these 185 were from the Bernese teachers (IC: 185/511; 36.2%) and 326 from the teachers of the Cantons of Lucerne and St. Gallen (NC: 326/511; 63.8%). Due to the lower response rate from the Bernese schools, the data is presented in a descriptive form.

The demographic data (in total and in reference to the two investigated areas) of the survey are listed in Table 2 and Fig. 2.

Concerning the emergency management of crown fractures 78.9% (n = 146) of the IC group vs 72.4% (n = 236) of the NC group agreed, that the fractured piece of tooth should be brought back to the dentist for re-fixation. Out of these, 72.6% (n = 106) of the IC group vs 52.8% (n = 124) of the NC group chose a wet transport medium, as proposed by the educational poster.

In case of tooth luxation injuries 87% (n = 160) vs 84% (n = 274) of the teachers (IC vs NC) stated that they would not do digital manipulation. 10% (IC n = 18) vs 11% (NC n = 36) believed that they may be repositioned by asking the student to bring the teeth together carefully.

With regards to the emergency management of avulsed teeth, 60% (n = 309) of the teachers gave the correct response. Immediate reimplantation was chosen as treatment option by 61% (n = 113) of the teachers in the IC groups vs 48.1% (n = 157) in the NC group. The preferred storage medium and the method of handling an avulsed tooth in relation to the different groups are shown in Tables 3 and 4.

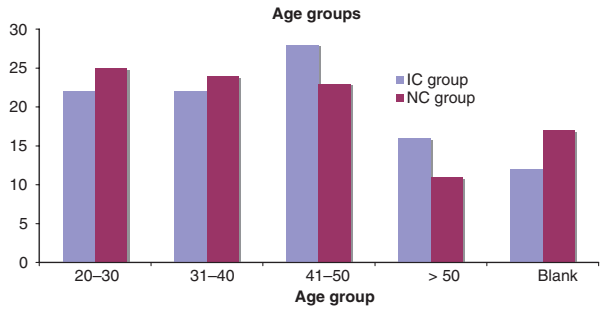

Fig. 2. Age groups of teachers.

Regarding the overall treatment of an avulsed, non-replanted tooth, 71% (n = 132) of the teachers in the IC group reacted correctly, and 29% (n = 53) inappropriately, whereas in the NC group percentages were 54% (n = 177), and 46% (n = 149) respectively.

Table 3. Preferred storage medium for an avulsed tooth (n)

	Group	
Medium	IC (185)	NC (326)
Milk	47% (86)	32% (104)[1]
Others: Dentosafe® (Medice®; Iserlohn, Germany)	17% (32)	4% (13)[1]
Sterile saline solution	4% (8)	5% (17)[2]
Others: saliva	2% (3)	1% (4)[2]
Moist paper or plastic bag	2% (4)	9% (28)[3]
Tap water	5% (10)	7% (23)[3]
Ice-water	1% (1)	5% (16)[3]
Dry	12% (22)	19% (63)[3]
Disinfectant	2% (4)	3% (10)[4]
Blank	8% (15)	15% (48)

Preferred storage medium for an avulsed tooth in regard to the two groups [information campaign (IC) vs no information campaign NC)].
The shading marks the usability of the storage media in regard to the maximum storage time:
[1]Usable up to 6 h.
[2]Usable up to 2 h.
[3]Usable up to 1 h.
[4]Useless as storage media.

Table 2. Socio-demographic data of the participating teachers (n)

	Gender		Schools			
Group	Male	Female	Elementary	High	College	Others
IC (n = 185)	43% (80)	57% (105)	48% (89)	15% (27)	33% (62)	4% (7)
NC (n = 326)	43.5% (142)	56.5% (184)	44% (144)	13% (43)	24% (78)	19% (61)
Total (n = 511)	43% (222)	57% (289)	46% (233)	14% (70)	27% (140)	13% (68)

Distribution of participating teachers in regard to the two groups Information campaign (IC) vs no information campaign (NC), gender and school-level.
Age of pupils regarding school-level: elementary school: 7–12; high school: 13–16; college: 16–20.

Table 4. Handling of avulsed tooth (*n*)

Handling	Group	
	IC (185)	NC (326)
No cleaning	87% (161)	75.5% (246)
Rinse in water	10.3% (19)	21.1% (69)
Brush	0.5% (1)	0.3% (1)
Disinfect	1.1% (2)	2.5% (8)
Blank	1.1% (2)	0.6% (2)

Preferred handling of an avulsed tooth (when tooth is not replanted) in regard to the two groups [Information campaign (IC) vs no information campaign (NC)].
The rows with shading represent the interventions that were regarded as incorrect.

In the IC group, 49% ($n = 90$) of the teachers stated that they had been informed about emergency management of tooth trauma, vs 19% ($n = 63$) of the teachers in the NC group. The source of information of the IC teachers was mainly from the educational poster (78%, $n = 75$), followed by oral instruction (15.5%, $n = 14$), journals (6.5%, $n = 6$) and the internet (1%, $n = 1$). In comparison, teachers in the NC group stated that their main source was oral instruction (51%, $n = 35$) followed by posters (26%, $n = 18$), health courses (7%, $n = 5$), TV (6%, $n = 4$), journals (6%, $n = 4$) and radio (4%, $n = 3$).

Comparing the information status (informed/not informed) with regards to the handling of an avulsed tooth, that has not been replanted (correct vs incorrect) showed, that in the IC group 60% (79 out of 132) of the correctly responding teachers were informed about the emergency treatment (Table 5). This was in contrast to the NC group, where 74.5% (132 out of 177) of correctly responding teachers declared not to be informed. When analyzing the overall results of both groups (IC and NC), it showed that the likely hood of inappropriate treatment was reduced in the informed group (124 vs 29), compared to the not informed group (185 vs 173).

Of the IC teachers, who stated to have gained their knowledge from the poster, 91% ($n = 68$) chose the correct management, and 9% ($n = 7$) the incorrect management.

Comparing the method of handling regarding reimplantation or extra-alveolar storage vs the age of the teachers, no difference was found between the ages of 20–50 years. Teachers over the age of 50 performed worse. This difference was not seen in the Canton of Bern with the poster campaign (IC group).

Discussion

The response rate of this questionnaire survey was rather low (25.5%). An important factor for this is certainly due to the method of distribution. The questionnaires were not sent to teachers individually but were sent to the headmasters as a package for further distribution. Whether the questionnaires that were not returned equal non-responders is therefore unclear. Some comparable questionnaire surveys in this field were sent to physicians, dentists or teachers individually and showed higher response rates (41–44), others however, which were performed in a similar way than this study, had response rates between 17 and 35% (31, 45). Although we tried to optimize the response rate by pre-informing the responsible headmasters, by enclosing pre-paid reply envelopes and reminding the headmasters after 1 month by phone, the response rate was low. As a consequence of this and the unequal response rates between the two groups (185 vs 326), care should be taken in the interpretation of the results.

The prognosis of traumatized teeth depends on appropriate emergency treatment, which often relies on lay people such as school teachers. The purpose of this study was to investigate the knowledge of school teachers about the emergency management of dental trauma after an educational poster campaign. Different surveys incorporating teachers, physical education teachers, physicians and dentists have been published in the literature (28–36, 40, 41, 45, 46). They all reported inadequate levels of knowledge within these groups regarding emergency treatment. To improve this situation, most authors suggested that education regarding dental emergencies should be performed. Up to now, only a few studies have assessed the effect of tutorials, mailed guidelines or educational posters (29, 31, 32). A study by Hamilton et al. evaluated the effect of a

Table 5. Correlation between information status[1] and treatment management in case of an avulsed and non-replanted tooth (*n*)

Groups	Information status		Correct management	Incorrect management
IC (185)	Informed	49% (90)	88% (79/90)	12% (11/90)
	Not informed	51% (95)	56% (53/95)	44% (42/95)
Subtotal IC (*n*)			71% (132)	29% (53)
NC (326)	Informed	19% (63)	71.5% (45/63)	28.5% (18/63)
	Not informed	81% (263)	50% (132/263)	50% (131/263)
Subtotal NC (*n*)			54% (177)	46% (149)
IC and NC (511)	Informed	30% (153)	81% (124/153)	19% (29/153)
	Not informed	70% (358)	51.5% (185/358)	48.5% (173/358)
Total (*n*)			60.5% (309)	49.5% (202)

Correlation between information status and treatment management in case of an avulsed, non-replanted tooth in regards of the two groups [Information campaign (IC) vs no information campaign (NC)].
[1]With regard to the question 9 on the questionnaire: 'Have you already be informed about the emergency treatment management in tooth injuries?'. If the teacher had answered in the affirmative, he was classified as 'informed'.

poster campaign carried out in the UK (29). The study investigated the lay knowledge of teachers 7 years after the distribution of the poster. Although the overall knowledge was poor, the highest knowledge scores were found in the respondents who recalled receiving advice from sources such as posters, magazines, and newspapers. Kahabuka et al. compared the outcome of a campaign informing teachers by mailed guidelines vs tutorials (32). Although the knowledge was stated as poor in both groups, the outcome in the group that had attended tutorials was clearly better. In the present study, teachers who worked in the area, where the educational poster has been distributed, clearly appeared to be better informed about handling of dental trauma compared to teachers with no access to the poster campaign.

It has been estimated that approximately one quarter of the population under the age of 18 years sustains a traumatic injury in the form of anterior crown fracture (2, 5, 6). Several authors suggested that reattachment of a fractured fragment to the remaining tooth by adhesive techniques is preferable to restoring fractured teeth when the fragment is available (47–51). They felt that there are advantages such as maintenance of the original tooth contours and translucency, the color match of the remaining crown portion and its color stability over time (49). Other possible advantages are efficient treatment of the injured tooth, attaining a result that is equal to the original esthetics and function as well as cost-effectiveness. This ought to postpone further reconstruction, such as resin composite build-up, veneer or crown (49, 50). However, up to date no clinical comparative studies have been conducted to show evidence of this statements. *In vitro* studies on sheep teeth showed, that humid storage seems to play a relevant role for the bonding strength of the fragment (52). In our study 78.9% of the teachers in the IC group would have stored the tooth fragment, and 76.7% of these teachers would have kept it in humid conditions. In the NC group, 72.1% would have kept the fragments and 62.2% of these would have stored them in humid conditions.

Tooth luxations are injuries, in which the tooth is extruded, intruded or laterally displaced. In such cases the tooth still remains in the alveolar socket. The tooth position however, is changed, resulting in possible interference with occlusion and articulation. To avoid additional damage, the authors of the poster recommended having patients bring their teeth together carefully, as long as it leads the injured tooth back into its original position, and advised laypersons not to perform any kind of manipulations. In the IC group 89.7% of the teachers would have refused to manipulate the tooth, vs 86.5% in the NC group.

Tooth avulsions are less frequent than luxations (53) but require a more complex treatment approach. In the treatment of avulsed teeth the periodontal apparatus plays a key role. Concerning prognosis and tooth survival the periodontal cells on the root surface play an essential role. Two factors are crucial for the survival of these cells: the medium, in which the tooth is stored and the duration the tooth is kept in the storage medium and/or outside its socket (8, 10–12, 14–24, 27, 37–40). Incorrect or delayed storage can lead to severe cell damage, resulting in compromised periodontal healing. External root resorption with subsequent ankylosis will eventually result in tooth loss (9, 15–17). When an avulsed tooth is replanted at the place of injury, the extra-oral duration can be reduced to a minimum (9, 15, 39, 54). Reimplantation of the avulsed tooth at the place of accident is the ideal emergency treatment. It is therefore one of the most important messages when educating lay people about dental emergency management. However, immediate reimplantation often remains a management exception due to accident-associated factors such as a child's emotional state at the time of injury, confidence of acute caregivers, and consent issues (29, 40). The authors of the educational poster therefore felt, that in their experience, most lay people refused to reimplant a tooth and rather brought it to the dentist for treatment. Therefore, the educational poster gave no information about immediate reimplantation by laypeople.

Nevertheless immediate reimplantation was given as a treatment option in this survey, in order to assess the knowledge of the teachers. It was interesting to see that in the present study 61% in the IC groups vs 48.1% in the NC group responded that an avulsed tooth could be replanted immediately. The reason for this difference is unclear to us. Especially since to our knowledge no other regional education on dental injuries was given in the assessed regions. Although no question was put up regarding one's own way of handling, some teachers [IC 25 (13.5%), NC 27 (8%)] stated that an efficient reimplantation is ideal, but that only specialized staff should perform this procedure.

According to the literature, 71% of the teachers of the IC group gave correct answers regarding storage and transportation of an avulsed tooth. In the NC group the outcome was less ideal, with 54% acting in a correct way. In the IC group 83% ($n = 75$) of the teachers, who stated to have had some kind of information about this topic beforehand, had gained their information from an educational poster. Positive also the fact, that out of the 75 teachers, that had seen a poster on this topic, 91% would have managed such an emergency in a correct way. In the NC group only 27% (out of 63 informed teachers) stated to have been informed by a poster.

Conclusion

Achieving an increased awareness amongst teachers was the aim of the poster campaign conducted in 2001. The outcome of this study shows the benefit of educational poster campaigns. It therefore should encourage professionals in this field to embark on similar projects.

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Appendix

Mail questionnaire

Knowledge on management of dental trauma survey of Swiss teachers

Please answer Part I–II of the questionnaire

Part I: Personal and professional information

1) Gender: ☐ male ☐ female
2) Age: _____years
3) Work place:
☐ Elementary school ☐ High school ☐ College

Part II: emergency management of dental injuries (if not noted differently, please tick one box only)

What would you do?

5a) A piece of the tooth is broken off:
The Tooth fragment...
☐ can be reused
☐ is no longer usable
☐ others:_____

b) *If reusable*:
The fragment can be stored...
☐ in dry condition
☐ in wet condition

6) If the tooth is displaced or extruded but still attached, you would:
☐ do no manipulation
☐ let the subject carefully clench one's teeth
☐ others: _____

7a) Can a knocked-out tooth be repositioned right away?
☐ yes
☐ no

b) *If yes*: how quickly has it to be done?
☐ within 5 min after the accident
☐ within 15 min after the accident
☐ 15–60 min after the accident
☐ 1–5 h after the accident
☐ there is no time limit

c) *If no*: how would you transport/store the tooth, that was knocked out:
☐ in dry condition
☐ in moist condition (paper/plastic bag)
☐ in a sterile balanced saline solution (pharmacy)
☐ in tap water
☐ in ice water
☐ in a disinfectant solution
☐ in milk
☐ others: _____

d) Would you clean a knocked-out tooth?
☐ Yes
☐ No

if yes, how:
☐ rinse it in water
☐ brush it gently with a soft toothbrush
☐ with disinfectant
☐ others: _____

8a) After a dental trauma would you consult
☐ your family doctor
☐ a hospital
☐ your dentist
☐ others: _____

b) *If you do* consult someone, within what time period should the consultation occur?
☐ immediately
☐ up to 2 h after accident
☐ 2–6 h after accident
☐ 6–12 h after accident
☐ 12–24 h after accident
☐ within 1–2 days after accident
☐ within 2–7 days after accident

9) Have you already be informed about the emergency treatment management in tooth injuries?
☐ Yes
☐ No

If yes, in which way (*multiple answers possible*):
☐ TV
☐ journals
☐ radio
☐ poster
☐ internet
☐ orally
☐ others: _____