A Survey of Swiss Swimming Pool Attendants' Knowledge of First-Aid Treatment after Lip and Dental Injuries

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Summary Although dental injuries are common occurrences at swimming pools, there are very few publications about them. The purpose of this study was to interview pool attendants at public swimming pools/bathing resorts in Switzerland on lip and dental injuries in 2007. The questions focussed on their knowledge of first aid, the frequency and accident site of lip and tooth trauma, as well as the storage medium for avulsed teeth. Questions were also asked about the presence of a "dental first-aid kit" and the poster on dental first aid. 606 public pools were contacted, and one pool attendant per pool was interviewed by telephone. 553 individuals participated; 53 declined to take part. The results show that in 2007, 40% of the interviewed pool attendants (n=221) had witnessed at least one lip injury, and 36.9% (n=204) at least one tooth trauma. At pools with slides, accidents were more frequent ($p<0.001$), and the waterslide was the most common accident site. The pool attendants provided satisfactory answers on their actions after lip and dental injuries. However, 68.7% could not adequately answer the questions on storage of avulsed teeth. Only 74 pool attendants had a dental first-aid kit. Of these, only 68 used the kits as the storage medium for avulsed teeth. 59 pool attendants were in possession of the poster on dental first aid. Overall, it was shown that pool attendants who had a dental first-aid kit and a dental first aid poster gave better answers on how to handle tooth trauma.

Introduction

Many dental accidents among children and adolescents happen at school or during after-school activities. During this time, they are often under the supervision of adults other than their parents/guardians (Mcintyre et al. 2008). The responsible adults are seldom familiar with the proper course of action in case of dental trauma. Several studies have reported that teachers and other lay persons are not adequately informed about first aid after dental injuries (Hamilton et al. 1997, Pacheco et al. 2003, Al-Jundi et al. 2005, Al-Asfour et al. 2008, Mcintyre et al. 2008). Other studies have shown that even dentists, doctors, and emergency personnel do not possess sufficient knowledge of first aid after dental trauma (Lin et al. 2006, Yeng & Parashos 2008). Up to now, guidelines on responding to trauma in the oral region have been underrepresented in the first-aid literature (Zadik 2007). However, the correct response at the scene of the accident crucially influences the healing and long-term prognosis of avulsed and replanted teeth. Whether healing results in restored function or not depends on the extra-oral storage of the avulsed tooth (Kirschner et al. 2006). Cytophysiological extra-oral storage is available thanks to special dental first-aid kits that were developed based on cell nutrient media (SOS Zahnbox, Miradent, Duisburg, Germany; Dentosafe®, Medice, Iserlohn, Germany; EMT Toothsaver, Gering, Nebraska (USA); Curasafe, Curaden International, Kriens, Switzerland). These dental first-aid kits are available without a prescription at all pharmacies and provide good

conditions for the temporary storage of avulsed teeth (Pohl & Kirschner 1994, Pohl et al. 1999, Pohl et al. 2005, Kirschner et al. 2006, Filippi et al. 2008). They do not contain antibiotics and have a shelf life of up to three years at room temperature (Kirschner et al. 2006).

Dental injuries associated with various types of sports have often been described in the literature. There, too, the dental first-aid kit is not well enough known or widespread (Lang et al. 2002, Perunski et al. 2005, Persic et al. 2006, Fasciglione et al. 2007, Müller et al. 2008). Only a few studies have exclusively addressed swimming pools and the injuries incurred there (Malpass et al. 1981, Saunders 1988, Mikkelsen et al. 1994, Ball 1998, Nielsen & Freund 2003). Only one publication described the swimming pool as the site of dental trauma (Fakhruddin et al. 2008). Most swimming pool accidents occurred by falling (Nielsen & Freund 2003). The most severe injuries happened on waterslides (Mikkelsen et al. 1994), when the person slid head first and collided with the slide itself or with another person (Malpass et al. 1981).

Until now, pool attendants' knowledge of first aid for tooth and lip injuries has not been examined. The purpose of the present study was to determine the frequency of lip and dental injuries at Swiss swimming pools/bathing resorts and to evaluate pool attendants' knowledge of the emergency management of these injuries. In addition, the number of swimming pools/resorts equipped with a dental first-aid kit or a dental first-aid poster (e. g., a poster designed by the Center of Dental Traumatology of the University of Basel, which describes the correct response after tooth injury) was recorded. All posters which described emergency management of dental trauma were accepted as a correct answer. Such posters have been shown to have a positive influence on the response of teachers (Lieger et al. 2009).

Materials and Methods

From June to September 2008, 606 pool attendants from all the cantons in Switzerland were contacted by telephone and interviewed about lip and tooth injuries; 553 of them participated. It was not possible to include 50 of the ca. 650 public swimming pools/resorts: they either had no telephone or no pool attendant, or were currently undergoing remodeling. One pool attendant per swimming pool/resort was interviewed about lip and dental injuries during 2007. If a swimming pool employed more than one attendant, the one with the most working hours was interviewed. The same person conducted all telephone interviews according to a questionnaire (Tab. I). Since most of the pool attendants did not keep written records of accidents, they had to rely on their memory.

The pool attendants were asked whether they had a dental first-aid kit and a dental first-aid poster. Questions were also asked about the type of swimming pool or resort. These and the Swiss cantons were compared in terms of the frequency of injuries, response of the person interviewed, and presence of the dental first-aid kit and poster. Results are not presented for all cantons (see below). Accidents occurring in combined indoor/outdoor pools were not differentiated in terms of whether they happened indoors or out.

The spontaneous answers of the pool attendants on how they responded to lip injuries were divided into four groups (A, B, C, and D). These are shown in Table II; multiple answers were possible. In order to compare the cantons and the pool types, every pool attendant received an overall evaluation. The overall evaluation of the answers was subdivided into three categories: "good" (group A and combinations of groups B, C and D), "satisfactory" (group B and C, and combinations of B and D or C and D), and "unsatisfactory" (group D alone). If an overall "good" result was found, the wound treatment was considered adequate. If the overall result was "satisfactory", the treatment approach was correct, but relevant factors of adequate wound treatment were lacking. If the overall result was classified as "unsatisfactory", the wound treatment was absolutely inadequate. Subsequently, the pool attendants were interviewed about their response to dental injuries. Injuries were divided into the types "avulsion", "dislocation", and "tooth fracture", after these terms were defined for the attendant. The type of dentition (primary or permanent) did not play a role. The evaluation of the treatment and the overall

Tab. I Questionnaire

1.	Type of pool/resort (indoor pool, outdoor pool, lakeside resort, riverside resort, combination)?
2.	Number of visitors in 2007?
3.	Slides or diving boards present? Length and height, resp.?
4.	Lip injuries in 2007? If yes, 1–3, 3–5, 5-10, over 10?
5.	If yes, in which age groups (children up to age 12, adolescents up to 18, adults over 18, children and adolescents with equal frequency)?
6.	If yes, injured person female or male?
7.	If yes, accident site lip injuries (slide, diving board, slipping, collisions, accidents in water not involving other person, other)?*
8.	Which treatment was/would be given in case of lip injury?*
9.	Dental trauma in 2007? If yes, 1–3, 3–5, 5–10, over 10?
10.	If yes, in which age group? (see question 5)
11.	If yes, male or female?
12.	If yes, accident site of dental trauma (slide, diving board, slipping, collisions, accidents in water not involving other person, other)?*
13.	If yes, what type of tooth injury (avulsion, dislocation, fracture)?*
14.	Familiar with dental first-aid kit and/or available?
15.	Which treatment was/would be given in case of dental trauma (for avulsion, dislocation, fracture)?
16.	In what were avulsed teeth transported/in what would they be transported?*
17.	Dental first-aid poster present?

* Multiple answers possible

Tab. II Lip/dental trauma first-aid measures performed or intended by pool attendants (lip injuries: 547 attendants, 681 answers: 90 double, 35 triple, 9 multiple answers). Scores for first aid after lip injuries: 3 = good, 2 = satisfactory, 1 = unsatisfactory

Lip injuries			
n	**%**	**Response upon lip injury**	**Score**
210	30.8	A: Temporary wound care, compression, patient sent to doctor	3
248	36.4	B: Do nothing, always immediately send to doctor/if severe, to doctor	2
143	21.0	C: Cool with ice or cold water/staunch bleeding	2
80	11.8	D: Disinfection only/bandage/let injured person rinse/don't know	1
Avulsion			
n	**%**	**Response upon avulsion**	**Score**
437	80.1	– Seek tooth, send it and injured person to dentist	2
46	8.4	– Do not seek tooth, do nothing but send to dentist	1
29	5.3	– Other satisfactoy answers (seek tooth, give it to injured person, staunch bleeding, cool, send to dentist/ follow directions on dental first-aid poster)	2
34	6.2	– Other unsatisfactory answers (do not seek tooth, only give it to injured person if there/dispose of tooth/ don't know what to do)	1
Fracture			
n	**%**	**Response upon fracture**	**Score**
459	84.1	– Seek fragment, send it and injured person to dentist	2
47	8.6	– Send to dentist, do not seek fragment, do nothing	1
5	0.9	– Follow directions on dental first-aid poster	2
35	6.4	– Other unsatisfactory answers (do not seek fragment, only give it to injured person if there/ dispose of fragment/don't know what to do)	1
Dislocation			
n	**%**	**Response upon dislocation**	**Score**
524	96.0	– Do not touch tooth, send to dentist	2
13	2.4	– Don't know what to do	1
8	1.4	– Push tooth back into place, send to dentist	1
1	0.2	– Stabilize tooth with wad of cotton, send to dentist	2
Transport media			
n	**%**	**Transport media for avulsed teeth**	**Score**
125	32.4	– Plastic bag	1
93	17.4	– Water, ice, ice water, damp cloth	1
91	17.0	– Milk	2
82	15.3	– Hand, handkerchief, napkin, box, sterile gauze, dry	1
73	12.7	– Dental first-aid kit	2
40	7.7	– Don't know	1
15	2.8	– Mouth	1
8	1.5	– Sodium chloride 0,9% (saline solution)	2
6	1.1	– Follow instructions on dental first-aid poster	2
6	1.1	– Alcohol	1

evaluation (for the comparison between cantons and type of swimming pool/resort) for each pool attendant were performed according to the criteria "good" and "unsatisfactory". Treatment of an avulsion/tooth fracture was judged as "good" if the attendant looked for or would look for the tooth/the tooth fragment, gave the tooth/the tooth fragment to the injured person, and immediately referred him/her to a dentist's office or dental clinic. To qualify as "good" in terms of dislocations, the attendant had to know that the tooth was not to be touched and that the injured person had to be referred to a dentist. In particular, questions were asked about transport/ storage media for avulsed and fractured teeth. To compare cantons and swimming pool/resort types, an overall evaluation for transport media after avulsion was done, and this was given a score of "good" or "unsatisfactory." Multiple answers including good and unsatisfactory responses received an overall score of "unsatisfactory". A response was judged to be "good" if the survival of periodontal cells on the root surface was ensured for at least one hour. It was assumed that the injured person was usually treated by a dentist within this time frame. Questions about the length of time an avulsed tooth could potentially spend extra-orally were not asked. For dental injuries, the category "satisfactory" was intentionally omitted. The correlation between information available (dental first-aid kit/ poster) and extent of knowledge (choice of storage medium) of the pool attendants was also examined.

The annual number of visitors per year per swimming pool or resort was also considered relevant. The categories were compared in terms of frequency of injuries and the presence of the dental first-aid kit and a dental first-aid poster. It was assumed that the frequency of injuries would be higher at pools/resorts with a large number of visitors, since these tend to be equipped with slides and diving boards, and thus more injuries occur. Further, an evaluation of swimming pool/resort

equipment in terms of the risk factors "slide" and "diving board" was conducted. If the pool attendant mentioned these as an accident site (asked only in case of injuries), the length of the waterslide and the height of the diving board were recorded. Injured persons (lip/tooth injuries) were divided into groups according to age and gender, and lip and tooth injuries were compared on this basis.

In order to analyze correlations between variable categories, results were cross-tabulated and submitted to Fisher's Exact test. A p-value less than 0.05 was considered significant. Because this was an explorative study, p-values were not corrected for multiple comparisons. All evaluations were performed by the statistical software R version 2.7.1 (R Development Core Team, 2008; R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria).

Results

Of 606 pool attendants from as many swimming pools/resorts, 91.3% (n=553/606) participated in the study. In 2007, 40% (221/553) observed at least one lip injury and 36.9% (204/553) at least one tooth injury (Fig. 1). Of the attendants who observed injuries, 26.2% (n=145/553) saw both types. Tooth fractures occurred in 49.6% (n=123/248) of the cases, avulsions in 25.4% (n=63/248), and dislocation injuries in 15.3% (n=38/248). 9.3% (n=23/248) indicated that all types of dental trauma occurred with equal frequency, and 0.4% (n=1/248) did not know the type of dental injury.

Of the participating attendants, 45.9% (n=254/553) worked at outdoor pools (O), 23.9% (n=132/553) at indoor pools (I), 16.5% (n=91/553) at lakeside bathing resorts (L), 11.9% (n=66/553) at combined indoor/outdoor pools (O/I), 1.3% (n=7/553) at riverside bathing resorts (R), and 0.5% (n=3/553) at a combined indoor pool/lakeside resort (I/L). Not all attendants answered all questions. 13.6% (n=74/546) of the swimming pools/resorts had a dental first-aid kit, 10.6% (n=58/546) were merely aware of their existence, and 75.8% (n=414/546) had never heard of them (546 attendants, no answer: 7). Only 10.8% (n=59/545) had a dental first-aid poster (545 attendants, no answer: 8, Fig. 2). Statistically significant differences existed between cantons in terms of the presence of dental first-aid kits (p<0.001). The highest proportions of dental first-aid kits (compared to the number of surveyed swimming pools/resorts) were found in the cantons Basel-Stadt (3/6), Basel-Land (15/17), Zurich (29/110) and Bern (13/81). There were statistically significant differences between cantons in terms of the frequency of the poster (p<0.001). Posters were most frequently found in the cantons Basel-Stadt (3/6), Basel-Land (15/17), Zurich (7/110) and Bern (8/81). The type of swimming pool or bathing resort had no significant influence on the presence of a dental first-aid kit or poster (p>0.05).

547 (no answer: 6) and 546 (no answer: 7) of the attendants answered the question on management of lip injuries and dental trauma, respectively. 515 (no answer: 38) replied to the question about transport media (Tab. II).

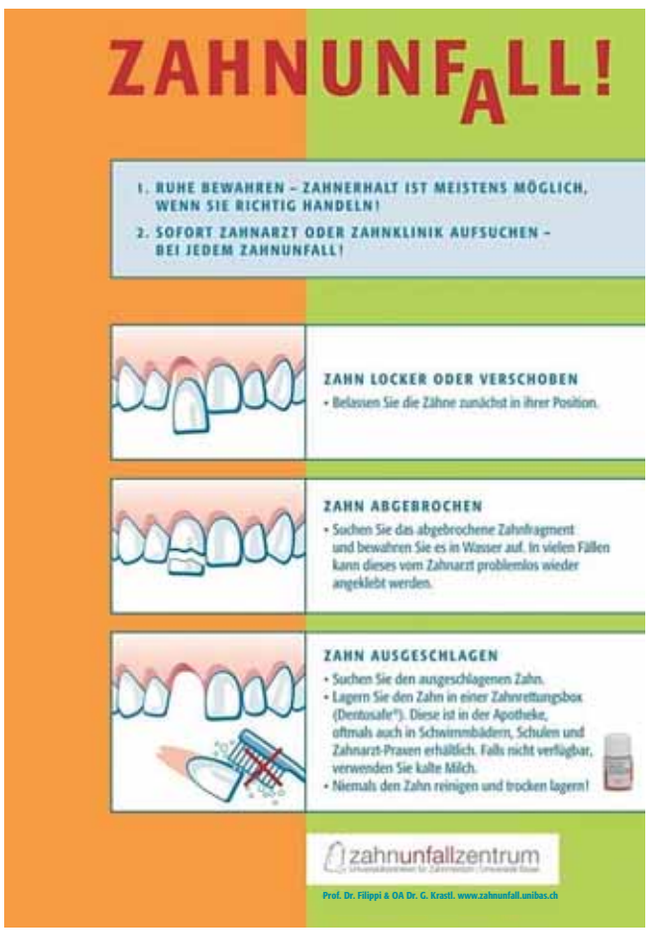

Fig. 2 Dental first-aid poster

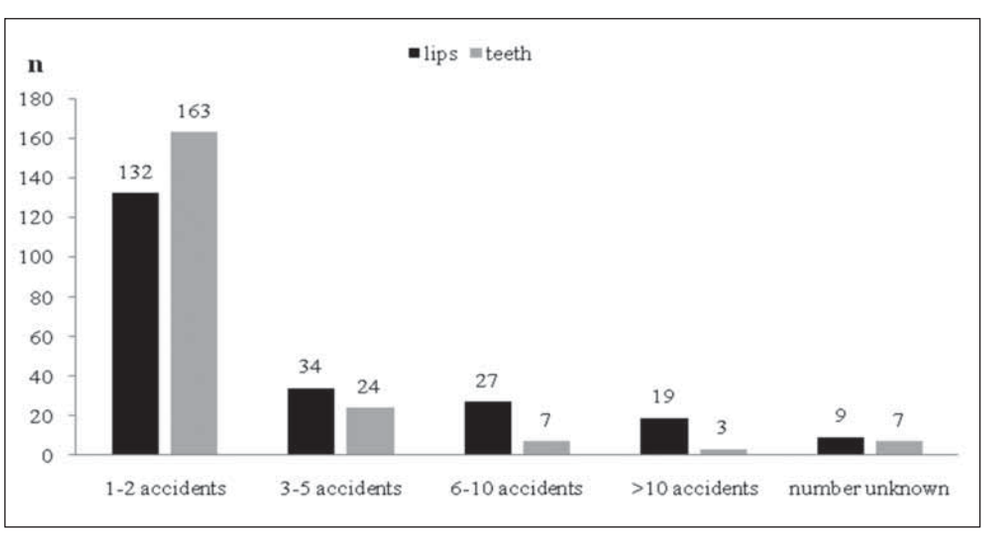

Fig. 1 Number of lip/tooth injuries observed by attendants in 2007 relative to number of pool attendants (n)

Tab. III Overall evaluation of first aid after lip/tooth injuries, per attendant one score

Type of emergency/measure	score	n	%
Lip injuries	Good	238	43.5
	Satisfactory	301	55.0
	Unsatisfactory	8	1.5
Avulsion	Good	466	85.3
	Unsatisfactory	80	14.7
Fracture	Good	464	85.0
	Unsatisfactory	82	15.0
Dislocation	Good	525	96.2
	Unsatisfactory	21	3.8
Transport media for avulsed teeth	Good	161	31.3
	Unsatisfactory	354	68.7

No significant difference ($p>0.05$) was found between cantons in regard to the frequency of lip injuries and the overall evaluation of first-aid measures after lip injuries (Tab. III). In the overall evaluation, the majority of those interviewed in all cantons gave satisfactory (cantons with the highest number of swimming pools/resorts: Aargau: 61.5%, Bern: 50%, St. Gallen: 53.3%, Zurich: 54.1%) to good answers (Aargau: 38.5%, Bern: 47.5%, St. Gallen: 44.4%, Zurich: 45.9%). However, significant differences existed among the types of swimming pools/resorts regarding the occurrence of these injuries ($p<0.001$). Most lip injuries occurred in combined indoor/outdoor pools (Fig. 3). The type of pool/resort had no statistically significant effect on the overall evaluation of the first-aid measures after lip injuries ($p>0.05$, Tab. III). Pool attendants from all pool/resort types gave satisfactory (O: 54.8%, I: 60.3%, L: 52.3%, O/I: 51.5%, R: 42.8%, I/L: 33.3%) to good (O: 43.6%, I: 36.6%, L: 47.7, I/O: 48.5%, R: 57.1%, I/L: 66.7%) responses.

The frequency of tooth injuries did not differ significantly between cantons ($p=0.054$). However, the management of avulsed teeth did ($p<0.05$/overall evaluation, Tab. III). The answers of the pool attendants from all cantons tended to be satisfactory (Aargau: 94.2%, Bern: 93.7%, St. Gallen: 80.0%, Zurich: 90.8%) rather than unsatisfactory. One canton with a small number of interviewed attendants was the exception (Geneva: 42.8%). Significant differences also existed between cantons in the overall evaluation of transport media after avulsion ($p<0.001$/Tab. III). All cantons with a large number of swimming pools/resorts more often gave unsatisfactory answers (Aargau: 67.3%, Bern: 67.5%, St. Gallen: 83.7%, Zurich: 65.7%), and 5 cantons with a small number of interviewees more often gave good answers. The frequency of dental trauma differed significantly between types of swimming pools/resorts ($p<0.001$). Most tooth injuries occurred in combined indoor/outdoor pools (Fig. 3). The overall evaluation of avulsion management differed significantly between types of pools/resorts ($p<0.05$). Pool attendants at all pool/resort types, however, responded adequately more often (O: 84.1%, I: 88.5%, L: 77.3%, I/L: 93.9%, R: 100%, I/L: 66.7%) than inadequately. Pool/resort type had no significant influence on the overall evaluation of the choice of transport media ($p>0.05$). Attendants at all types of pools/resorts gave unsatisfactory responses more often (O: 67.3%, I: 69.6%, L: 78.3%, I/O: 58.5%, R: 57.1%, I/L: 100.0%).

The overall evaluation of transport media after avulsion and the presence of a dental first-aid kit or poster showed statistically significant differences ($p<0.05$). Pool attendants who had a dental first-aid kit or poster at work gave good more often than unsatisfactory answers.

Statistically significant differences ($p<0.001$) were found in the correlation between number of visitors (Fig. 4, 547 attendants; no answer: 6) and the frequency of injuries or the presence of a dental first-aid kit. Pools/resorts with over 100,000 visitors per year had the highest rate of injuries (Fig. 4) and more often possessed a dental first-aid kit (28.2% vs. 17.8% for 50,000–100,000; 10.4% for 10,000 to 50,000; and 0.0% for 0–10,000 visitors; $p<0.001$). The numbers of visitors did not correlate with the presence of a dental first-aid poster ($p>0.05$).

Statistically significant differences existed between lip and tooth injuries depending on age and gender ($p<0.001$). Children were most frequently and adults were seldom injured (Fig. 5). Further, there were gender-dependent differences: boys had dental trauma significantly more often than girls, but the group "both genders" dominated in lip injuries (Fig. 5).

294 pools/resorts had a slide, and 253 did not (no answer: 6). The correlation between the presence of a slide or diving board and occurrence of injuries was significant: there were significantly more lip injures (n=160/294) with a slide than without (n=61/253) ($p<0.001$). 385 pools/resorts had a diving board and 162 did not (no answer: 6). Statistically significant more injuries occurred at pools/resorts with diving boards (n=180/385) ($p<0.001$) than without (n=41/162). Dental trauma was also significantly more frequent when slides (n=151/294) or diving boards (n=164/385) were present ($p<0.001$) than when they were absent (slide: n=53/253, diving board: n=40/162). The waterslide was the most frequently named accident site

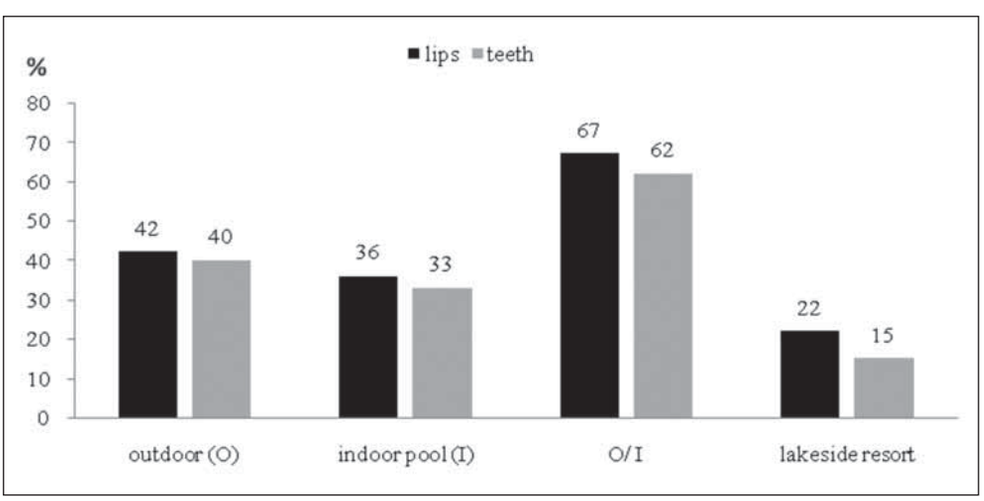

Fig. 3 Percent of lip and tooth injuries indicated by attendants according to type of pool/resort

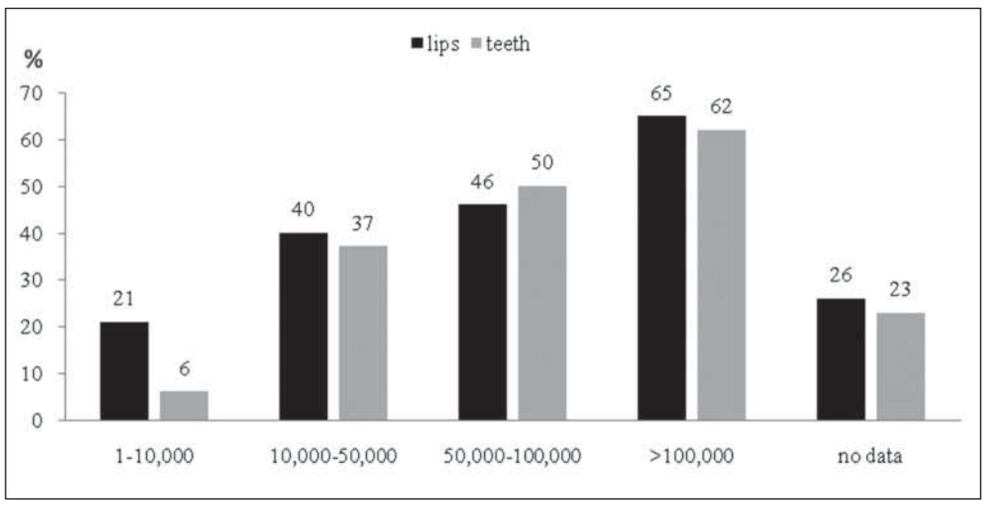

Fig. 4 Percent frequency of attendants who observed injuries (according to annual number of visitors to pool/resort)

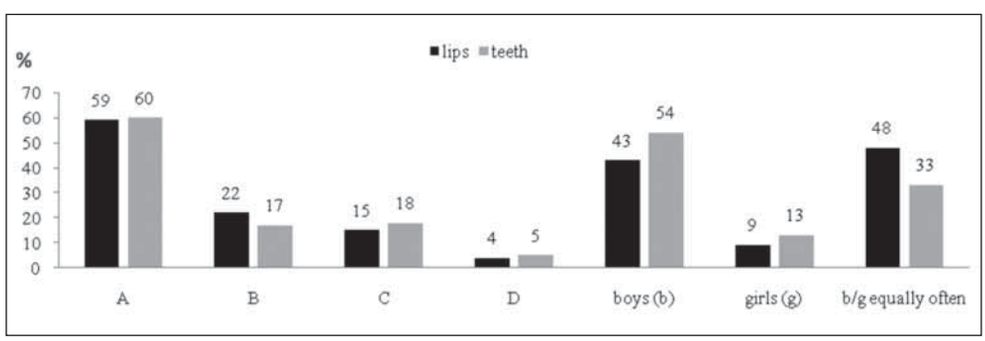

Fig. 5 Percent frequency of attendants who observed injuries (relative to age and gender: A = children up to 12 yrs, B = children and adolescents equally frequently involved, C = adolescents 12 to 18 yrs, D = adults over 18 yrs)

for both lip and tooth injuries (Tab. IV). The majority of the accidents happened on waterslides and 1-meter boards (Tab. V).

Discussion

The present study shows that lip and tooth injuries occur frequently at Swiss swimming pools/resorts due to conditions/equipment which facilitate accidents. The frequency of lip injuries (40%) was somewhat greater than that of dental trauma (36.9%). This was also found in other reports (Persic et al. 2006, Wasmer et al. 2008). Similar studies describe a lower percent of dental trauma (Fasciglione et al. 2007, Soriano et al. 2007, Mcintyre et al. 2008). Tooth fracture was the most commonly (49.6%) mentioned type of tooth injury. This agrees with earlier studies (Robertson et al. 2000, Lang et al. 2002, Perunski et al. 2005, Persic et al. 2006, Mcintyre et al. 2008, Müller et al. 2008). It is, however, possible that this type of injury is the best known among lay persons and is therefore mentioned most often. If that were the case, then the tooth fracture results would be overestimated.

A minority of pools/resorts had a dental emergency box or dental first-aid poster; hence, there is a definite need for more information and better dissemination thereof. The presence of these two items is variously described in the literature (Perunski et al. 2005, Persic et al. 2006, Fasciglione et al. 2007, Müller et al. 2008). The greatest number of dental first-aid kits and posters was found in the cantons Basel-Land, Basel-Stadt, Zurich and Bern. This might be due to the fact that these cantons have university dental clinics. The type of pool/resort played a subordinate role in the presence/absence of a dental first-aid kit or poster.

Injuries were distributed equally across the 26 cantons, but the number of pools/resorts varied enormously (3–110 pools/resorts). Based on the lack of written accident documentation and different numbers of pool attendants employed, it should be borne in mind that the attendants may have unintentionally provided erroneous information or may not have been able to remember all accidents. Nevertheless, the attendants themselves judged the flow of information to be good. Depending on the type of pool/resort, the distribution of injuries differed significantly. The different numbers of pools/resorts made the comparison difficult. Combined indoor/outdoor pools had the highest percentage of injuries (Fig. 3). They are open year-round and thus have the largest number of visitors. Overall, the majority of injuries were reported by attendants at outdoor pools; however, this was also the most common type of pool/resort (254) in the survey.

Most of the pool attendants were able to provide first aid for lip injuries (Tab. II). At all pool/resort types and in the 4 cantons with the highest pool/resort density (Zurich, St. Gallen, Bern, Aargau), the responses were more often satisfactory to

Tab. IV Accident site/Accident cause for lip/tooth injuries

	Lips		Teeth	
Accident site/description	**%**	**n**	**%**	**n**
Slide	33.9	95	44.2	103
Slipping on wet floor	26.4	74	22.3	52
Diving board	11.8	33	11.2	26
Accident in water not involving other person	10.0	28	9.0	21
Collision in water	7.2	20	5.2	12
Playground	6.1	17	4.7	11
Other	4.6	13	3.4	8

Tab. V Left half: frequency of different slides and diving boards/right half: percent distribution of accident sites

With slide: 294 pools/resorts (53.7% of 547 answers)			**Slide named as accident site**			
			Lips: 95		**Teeth: 103**	
Slide length	**%**	**n**	**%**	**n**	**%**	**n**
1–10 m (slides in water and on land)	24.1	71	11.1	11	15.2	16
10–50 m (waterslides)	36.7	108	44.4	42	41.3	42
>50 m (waterslides)	27.6	81	36.7	35	38.0	39
No information on length	11.6	34	7.8	7	5.5	6
With diving board: 385 pools/resorts (70.4% of 547 answers)			**Diving board named as accident site**			
			Lips: 33		**Teeth: 26**	
Diving board height	**%**	**n**	**%**	**n**	**%**	**n**
1 m	20.8	80	100	33	95.7	25
1 m/3 m (combinations)	79.2	305	0.0	0	4.3	1

good than unsatisfactory. The reason for this may be that lip injuries are similar to skin injuries, and lay people are better able to deal with such. The majority knew that, in case of avulsion, the tooth had to be sought and immediately sent along with the injured person to a dentist (Tab. II). The overall evaluation of the response to avulsion did not differ by canton but by the type of pool/resort. All cantons and pool/resort types more often gave good than unsatisfactory responses. The exception was a canton and/or pool/resort type with a low number of interviewed attendants. The lakeside resorts had the highest percentage of unsatisfactory answers, 22.7%. According to some studies, the immediate replantation of an avulsed tooth by the lay person is the method of choice (Sterenborg et al. 1999, Flores et al. 2007), but lay persons usually do not do this (Trope 2002). A recent review article states that 80% of those questioned would be reluctant to replant an avulsed tooth themselves due to lack of training and practice (Glendor 2009). Because lay persons can easily use a dental first-aid kit, they should be established as standard equipment at swimming pools/resorts (Pohl et al. 2005). No pool attendant in the present survey mentioned replantation as first aid for avulsion. In cases of dislocation injuries, most of the attendants would not touch the injured tooth. In this instance, ignorance tended to prompt the right reaction.

The prognosis of an avulsed tooth depends on the storage medium (Blomlöf & Otteskog 1980, Kirschner et al. 2006, Filippi et al. 2008). Non-physiological storage leads to replacement resorption after replantation and culminates in tooth loss (Pohl et al. 1999). For this reason, the tooth should be placed in a cytocompatible, cytophysiological medium as soon as possible (Pohl et al. 1999, Pohl et al. 2005, Kirschner et al. 2006). The various transport media have been examined by different authors. The following are somewhat suitable, although not physiological: milk, Hanks balanced salt solution, saliva, wrapping in plastic wrap (Trope & Friedman 1992, Huang et al. 1996, Sterenborg et al. 1999, Pohl et al. 1999, Glendor 2000, Pohl et al. 2005, Cohenca et al. 2006, Sonoda et al. 2008). The present study showed that pool attendants' knowledge of storing teeth is inadequate. The most commonly mentioned transport medium was a conventional plastic bag, but the survival of root surface cells is severely limited by drying out (<60 minutes). The reason for this common choice could be the ubiquity of plastic bags. Milk was the third most commonly mentioned storage medium and was evaluated as sufficient. Cells on the root surfaces survive here for about 60 minutes. Dry storage and storage in water or saliva were classified as unsatisfactory due to unfavorable osmolarity. Overall, significant differences existed between cantons in terms of suitable transport media. All cantons with a high pool/resort density more often gave unsatisfactory answers, and 5 cantons with a very low number of interviewees largely gave good responses. Thus, most swimming pools/resorts (the type was irrelevant) are inadequately informed about the correct storage of avulsed teeth. 68 (91.9%) of 74 attendants who had a dental first-aid kit used or would have used it in case of an avulsion. If a dental first-aid kit or poster were present, the attendants' answers about transport media were better. The poster too thus seems to have an informative effect (Lieger et al. 2009).

The assumption was confirmed, that proportionally more injuries occurred at large pools/resorts (i.e., pools with a large number of visitors annually). Such pools are more likely to have waterslides and diving boards, and larger crowds make collisions more frequent. The size of the pool/resort was a decisive factor for the presence of a dental first-aid kit: it was more likely to be present at large pools/resorts. Inexplicably, this was not true of the poster.

Both types of injuries were most frequent in children. One reason could be that it is largely children who visit swimming pools/resorts. The results on age groups agree with other studies (Nielsen & Freund 2003, Shayegan et al. 2007, Lin et al. 2008, Fakhruddin et al. 2008). In contrast, one publication show that accidents on waterslides occurred most often among 14- to 21-year-olds (Malpass et al. 1981). The fact that adults were least involved may be due to their more careful behavior. Lip injuries were approximately equally frequent in both genders. Dental trauma was more common in boys, as confirmed in other publications (Otuyemi 1994, Glendor 2000, Lin et al. 2008, Lin & Naidoo 2008, Yeng & Parashos 2008, Sgan-Cohen et al. 2008, Wasmer et al. 2008). Although girls suffer accidents as frequently as boys, their injuries are less severe. Boys tend to be wilder and more eager to take risks.

Slides are a source of increased risk of facial injuries (Malpass et al. 1981). According to the pool attendants, most accidents happen by climbing up the chute and thus causing collisions. It has been reported that the risk of such accidents on slides increases with the number of visitors (Ball 1998), as confirmed by this study. The slide, particularly the waterslide, was the most commonly mentioned accident site, which agrees with other authors (Mikkelsen et al. 1994). In the current survey, pools/resorts with slides had a higher percentage of injuries than those without. Wet floors are also responsible for injuries in the orofacial area. Falls are a common cause of injury at swim-

ming pools/resorts (Nielsen & Freund 2003). Diving boards were the third most frequently reported accident site, particularly the 1-meter board. Puddles of water on the boards facilitate slipping, and the low height entices children to use it in pairs or groups. Using higher diving boards may demand increased concentration, or the users are older.

Conclusion: The purpose of the present study was to evaluate the knowledge of pool attendants in terms of lip and tooth injuries. It was shown that lip injuries and dental trauma occur frequently at Swiss swimming pools/bathing resorts. In addition, the need for information on transport media for avulsed teeth is great. The distribution of dental first-aid kits and dental first-aid posters at Swiss pools/resorts was inadequate at the time of the survey. These should be distributed to all pools/resorts in Switzerland, in order to improve the prognosis of accidentally injured teeth. This could also help avoid costly post-injury consequences. Suggestions for implementing these recommendations have been made in cooperation with the Swiss Pool Attendants Association, but they still require refinement and must yet be published in the association's journal "Bäderrevue" ("Swimming Pool and Bathing Resort Review").

Résumé

Des accidents dentaires arrivent fréquemment dans les piscines. Ils n'ont été étudiés que dans très peu de publications. Le but de cette étude était d'interroger des maîtres-nageurs au sujet de blessures de lèvres et d'accidents dentaires survenus pendant l'année 2007. L'intérêt était, avant tout, de connaître les premiers soins prodigués, la fréquence et le lieu de l'accident provoquant des blessures labiales et des accidents dentaires, ainsi que le moyen de conservation des dents avulsées. L'investigation comprenait également la question sur la présence ou l'absence d'une trousse de secours dentaires, ainsi qu'une affiche «accident dentaire» dans les piscines. 606 piscines publiques ont été contactées et interrogées. Un maître-nageur par piscine a été interviewé par téléphone. 553 personnes ont participé à cette étude; 53 ont refusé d'y prendre part. Les résultats montrent qu'en 2007, 40% des maîtres-nageurs ont été témoins d'au moins une blessure aux lèvres, 36,9% d'un accident dentaire. C'est dans les piscines ayant un toboggan, que les accidents ont été les plus fréquents. Les maîtres-nageurs ont donné des réponses satisfaisantes concernant leur comportement dans le cas d'une blessure labiale ou d'un accident dentaire. 68,7% des réponses concernant la conservation des dents avulsées ont été insatisfaisantes. 74 maîtres-nageurs étaient en possession d'une trousse de secours dentaires. 68 des 74 maîtres-nageurs interrogés ont précisé qu'ils utilisaient cette trousse pour conserver les dents avulsées. Seul 59 maîtres-nageurs possédaient l'affiche «accident dentaire». Dans l'ensemble, on a pu constater que les maîtres-nageurs en possession d'une trousse de secours dentaires et de l'affiche «accident dentaire» ont donné de meilleures réponses concernant leur comportement lors de traumatismes dentaires.

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