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Retrospective study on traumatic dental injuries in preschool children at Kyung Hee Dental Hospital, Seoul, South Korea

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Abstract – The purpose of this study was to analyse the traumatic dental injuries (TDI) of Korean preschoolers by investigating the occurrence, type, area, cause, injured region, seasonal variation and the interval between injury and treatment. In this study, data from 1856 preschoolers aged 4 months to 6 years and 11 months (mean age : 3.6 ± 1.6) were used, out of a total of 2761 patients who attended the Department of Pediatric Dentistry, Kyung Hee Dental Hospital for TDI between January 1998 and December 2007. All the data were statistically analysed using the ANOVA and chi-square statics. Most of the patients were 1–2, 2–3 years old (24.5%, 25.4%) and boys were 1.67 times more likely to have TDI. The most common cause, location and seasonal variation of the trauma, were respectively falling (50.8%), at home (48.8%) and late spring. The treatment intervals usually occurred within a day. Most of the injuries involved single (47%) or double (38%) tooth/teeth. However, car accidents or sports trauma often involved multiple teeth. In both primary and permanent dentition, the most common teeth injured were maxillary central incisors (72.6%), and periodontal injury was caused by subluxation or concussion. Among the various types of hard tissue injuries, enamel fracture in the primary dentition (35.0%) and enamel-dentin fracture in the permanent dentition (45.8%) were the most common types.

Trauma to the oral region occurs frequently and comprises 5% of all injuries for which people seek treatment (1–3). Especially in preschool age children, head injuries make up as much as 40% of all somatic injuries (4). Traumatic dental injuries (TDIs) in preschoolers have been reported by many authors and the frequency of TDIs affecting the primary dentition of children has been reported in different parts of the world (5–8). Preschoolers showed a high prevalence of TDIs because of underdevelopment in physical and emotional growth (9); moreover, parents' and guardian's lack of knowledge of TDIs makes for the higher prevalence of TDIs in this period.

TDIs in the preschool years have an effect on the completion of the primary dentition, development of permanent teeth and change of permanent dentition. Despite these facts, many studies reported that 30–40% of children have experienced at least one TDI (6–8). TDIs can frequently lead to tooth lesions, affecting both supporting dental structures and hard tissues (10). Besides these, local injuries and dental trauma can, directly or indirectly, influence children's lives, affecting their appearance, speech and position of teeth (10), which reinforces the assertion that TDIs may cause functional, aesthetic, psychological and social problems (11).

Andreasen et al. argued that few professionals are interested in studying TDI and hence the only information available is from treated cases and little is known about the long-term complications resulting from TDI (1). To ensure effective care, the dentist requires sufficient knowledge of the various types of TDI as well as the recommended treatment for each of these TDI. Many cases of unsuccessful treatment result from negligence on the part of the dentist at the initial consultation, inadequate follow-up and overtreatment (8). In addition, many problems arise because professionals fail to provide parents with clear instructions for the necessary care of the child who has suffered TDI and fail to communicate the importance of periodic visits after the first consultation (1).

The purpose of this study is to analyse the TDI of Korean preschoolers by investigating the occurrence, type, area, cause, injured region, seasonal variation and the interval between injury and treatment. This information will be used for the exact diagnosis and consultation for other professionals and the instruction of parents and guardians.

Materials and methods

This study involved 1856 preschoolers aged 4 months to 6 years and 11 months, out of a total of 2761 patients who attended the Department of Pediatric Dentistry, Kyung Hee Dental Hospital, Seoul, Korea for TDI between January 1998 and December 2007. Based on the trauma chart, the data were carefully organized by age, gender, scene of trauma, cause, injured region, type, seasonal variation and the interval between injury and treatment. Radiographs were also utilized to classify the periodontal, hard and/or soft tissue damage.

The classification was based on the method described by Andreasen et al. (1) and Garcia-Godoy and Pulver (12). TDI was divided into three main categories: soft tissue injuries, hard dental tissue injuries and periodontal tissue injuries. The each category was classified as follows:

1 Injuries to the soft tissue: abrasion, laceration and contusion;
2 Injuries to the hard tissue and the pulp: enamel crack, enamel fracture, enamel-dentin fracture without pulp exposure, enamel-dentin fracture with pulp exposure, enamel-dentin-cementum fracture without pulp exposure, enamel-dentin-cementum fracture with pulp exposure and root fracture;
3 Injuries to the periodontal tissue: concussion, subluxation, displacement, intrusion, extrusion and avulsion.

Cases with incomplete information were excluded from the study. If more than one type of injury occurred on a specific tooth, the trauma was classified according to the most serious damage. Statistical analysis was carried out by ANOVA and chi-square statics with the significance level set as $P < 0.05$.

Results

During the 10-year period from January 1998 to December 2007, a total of 1856 children with traumatic dental injuries visited the Department of Pediatric Dentistry, Kyung Hee Dental Hospital. Of this group, 1161 were boys and 695 were girls, the male/female ratio being 1.67:1. The age range was 4 months to 6 years and 11 months. The mean age was 3.6 ± 1.6 years. The most prevalent age group for both genders was 2–3 year olds, followed by 1–2 year olds ($P < 0.05$). The distribution and prevalence of trauma sustained by individual age groups for boys and girls is shown in Table 1. The results indicate that the prevalence among age groups is similar for both boys and girls.

Table 1. Distribution of traumatic dental injuries by age and sex Male, Female, Total would be a centre of cell

Age (year)	Male		Female		Total	
	n	%	*n*	%	*n*	%
0–1	50	4.3	29	4.2	79	4.3
1–2	296	25.5	159	22.9	455	24.5
2–3	302	26.0	170	24.5	472	25.4
3–4	196	16.9	116	16.7	312	16.8
4–5	145	12.5	87	12.5	232	12.5
5–6	100	8.6	84	12.1	184	9.9
6–7	72	6.2	50	7.2	122	6.6
Total	1161	100	695	100	1856	100

The main cause of injury was fall (50.8%) and most of the injuries occurred at home (48.8%) ($P < 0.05$) (Figs 1 and 2). Treatment interval between the moment of injury and the time of treatment corresponds closely with many factors: age, type of injury, day of the week and location. A majority (62.8%) of preschoolers were treated on the same day (all included 30 min, 1 h and 1day) of TDIs and 32.1% of injuries were treated within 1 h. Comparing the type of injuries, the soft tissue and the periodontal tissue injuries received treatment faster than the hard dental tissue injuries ($P < 0.05$). In addition, the distribution of injury types with respect to time elapsed between injury and treatment is given in Table 2.

Most injuries occurred between the months of May and July, and the fewest number of injuries occurred between December and February (Fig. 3). But there was no statistical difference in the monthly distribution between the occurrence of injury and the years.

The maxillary arch was the most area affected (in the primary dentition: 89%; in the permanent dentition: 63%) without any significant differences between age and gender. Comparing the maxilla with the mandible,

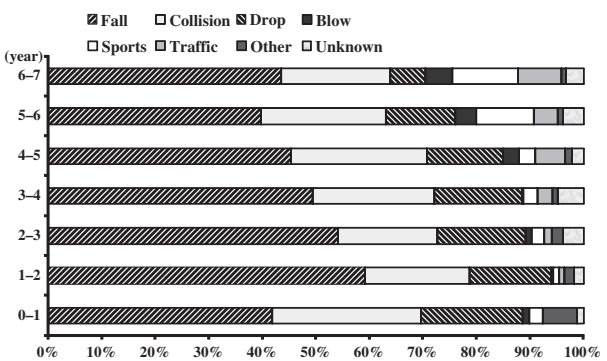

Fig. 1. Causes of TDIs according to the age.

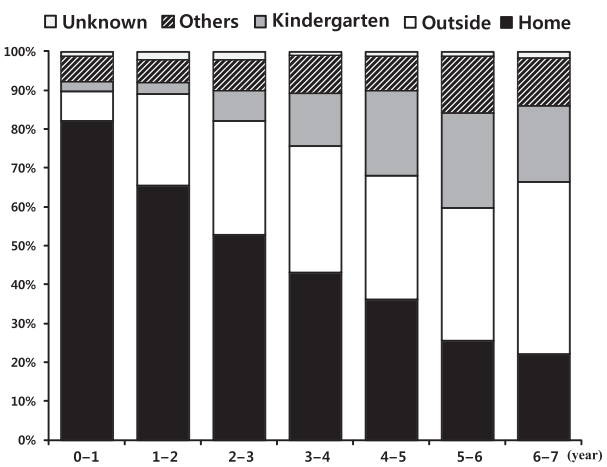

Fig. 2. Distribution of TDIs according to place of occurrence and age.

Table 2. Distribution of trauma types with respect to elapsed time to treatment after injury

	Time elapsed									
	30 min		1 h		1 day		>I day		Total	
Type of injury	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Injuries to the hard dental tissue and the pulp										
Enamel crack	0	0.0	3	21.4	7	50.0	4	28.6	14	100
Enamel fracture	32	7.2	47	10.6	84	18.9	282	63.4	445	100
ED fracture w/o pulp exposure	16	8.2	28	14.4	56	28.9	94	48.5	194	100
ED fracture with pulp exposure	32	8.2	27	6.9	86	22.1	244	62.7	389	100
EDC fracture w/o pulp exposure	1	4.0	4	16.0	8	32.0	12	48.0	25	100
EDC fracture with pulp exposure	7	10.6	11	16.7	28	42.4	20	30.3	66	100
Root fracture	12	7.4	31	19.0	57	35.0	63	38.7	163	100
Total	100	7.7	151	11.7	326	25.2	719	55.5	1296	100
Injuries to the periodontal tissue										
Concussion	35	9.3	59	15.7	76	20.2	206	54.8	376	100
Subluxation	79	11.5	168	24.5	253	36.8	187	27.2	687	100
Displacement	57	17.0	70	20.9	108	32.2	100	29.9	335	100
Intrusion	40	14.3	49	17.6	100	35.8	90	32.3	279	100
Extrusion	12	19.0	13	20.6	14	22.2	24	38.1	63	100
Avulsion	37	17.0	50	22.9	68	31.2	63	28.9	218	100
Total	260	13.3	409	20.9	619	31.6	670	34.2	1958	100
Injuries to the soft tissue										
Abrasion	8	9.8	20	24.4	33	40.2	21	25.6	82	100
Laceration	112	22.8	149	30.3	164	33.4	66	13.4	491	100
Contusion	30	11.3	72	27.1	117	44.0	47	17.7	266	100
Total	150	17.9	241	28.7	314	37.4	134	16.0	839	100
Total	510	12.5	801	19.6	1259	30.8	1523	37.2	4093	100

ED, enamel-dentin; EDC, enamel-dentin-cementum; w/o, without.

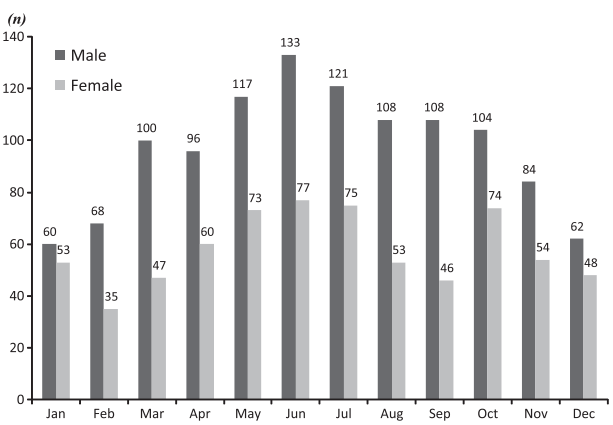

Fig. 3. Distribution of dental injuries frequency in both gender according to months during 10 years.

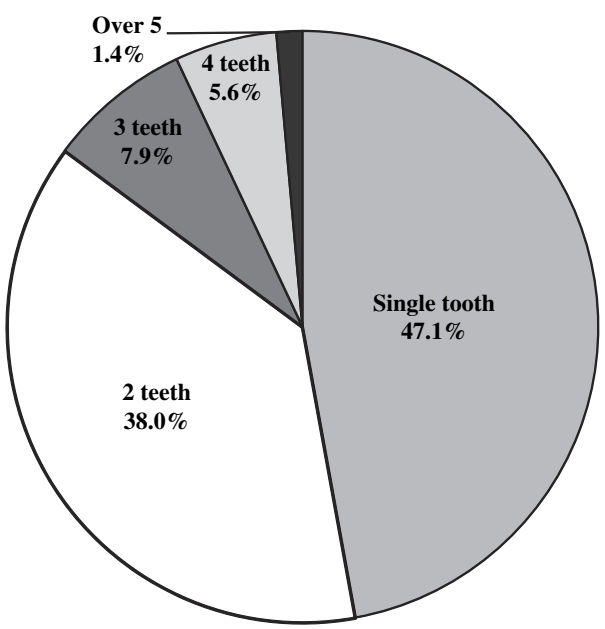

Fig. 4. Distribution of the number of traumatized teeth during each injuries.

prevalence in the maxilla was nine times higher than in the mandible in the primary dentition. In the primary dentition, the maxillary primary central incisors were the most commonly affected teeth (72.6%), followed by the maxillary primary lateral incisors (15.2%). In the permanent dentition, the maxillary central incisors were the most commonly affected teeth (56.4%), followed by the mandibular central incisors (37.3%) ($P < 0.01$) (Table 3). By analysing the number of teeth damaged during each incident, we found that 47.1% of preschoolers suffered from trauma in one tooth and 38.0% suffered from trauma in two teeth (Fig. 4).

In the soft tissue injuries, laceration was the most common type of injury (58.5%), followed by contusion (31.7%) and abrasion (9.8%) ($P < 0.01$). In the hard dental tissue and pulp, the most commonly observed TDIs in primary dentition was enamel fracture (35.0%)

Table 3. Distribution of traumatized teeth according to area of injury

Area of injury (primary teeth)	Male (%)	Female (%)	Total (%)	Area of injury (permanent teeth)	Male (%)	Female (%)	Total (%)
Upper central incisor	1207 (74.2)	675 (69.9)	1882 (72.6)	Upper central incisor	32 (59.3)	30 (53.6)	62 (56.4)
Upper lateral incisor	241 (14.8)	154 (16.0)	395 (15.2)	Upper lateral incisor	0 (0.0)	1 (1.8)	1 (0.9)
Upper canine	20 (1.2)	6 (0.6)	26 (1.0)	Lower central incisor	19 (35.2)	22 (39.3)	41 (37.3)
Upper molar	0 (0.0)	3 (0.3)	3 (0.1)	Lower lateral incisor	3 (5.6)	4 (7.1)	7 (6.4)
Lower central incisor	96 (5.9)	76 (7.9)	172 (6.6)				
Lower lateral incisor	45 (2.8)	34 (3.5)	79 (3.0)				
Lower canine	10 (0.6)	11 (1.1)	21 (0.8)				
Lower molar	8 (0.5)	6 (0.6)	14 (0.5)				
Total	1627	965	2592	Total	54	56	110

Table 4. Distribution of dental injuries by types of trauma to the hard dental tissue and the periodontal tissue in both dentition

	Dentition					
	Primary		Permanent		Total	
Type of trauma	*n*	%	*n*	%	*n*	%
Injuries to the hard dental tissue and the pulp						
Enamel crack	14	1.1	0	0.0	14	1.1
Enamel fracture	437**	35.0	8	16.7	445	34.3
ED fracture w/o pulp exposure	172	13.8	22**	45.8	194	15.0
ED fracture with pulp exposure	378**	30.3	11	22.9	389	30.0
EDC fracture w/o pulp exposure	24	1.9	1	2.1	25	1.9
EDC fracture with pulp exposure	65	5.2	1	2.1	66	5.1
Root fracture	158	12.7	5	10.4	163	12.6
Total	1248	100	48	100	1296	100
Injuries to the periodontal tissue						
Concussion	362	19.2	14	19.2	376	19.2
Subluxation	641**	34.0	46**	63.0	687	35.1
Displacement	329	17.5	6	8.2	335	17.1
Intrusion	278	14.7	1	1.4	279	14.2
Extrusion	63	3.3	0	0.0	63	3.2
Avulsion	212	11.2	6	8.2	218	11.1
Total	1885	100	73	100	1958	100

ED, enamel-dentin; EDC, enamel-dentin-cementum; w/o, without, $^{**}P < 0.01$.

followed by enamel-dentin fracture with pulp exposure (30.3%), but in the permanent dentition, enamel-dentin fracture without pulp exposure(45.8%) was the most common occurrence followed by enamel-dentin fracture with pulp exposure(22.9%). Subluxation was also the most common type of periodontal tissue injury in the both dentition (Table 4) ($P < 0.01$).

Discussion

This investigation was carried out at the Department of Pediatric Dentistry, the Kyung Hee Dental Hospital, Seoul, South Korea. This study was investigated on preschoolers' TDIs who mostly have primary dentition and a few children, aged 6–7 years, who have mixed dentition. As a result, this study does not thoroughly analyse the epidemiology of the permanent dentition. The results of this study extend and are consistent with earlier results regarding certain epidemiological characteristics of TDIs in preschool children (5–8, 12–15).

Recent studies have shown that gender will probably be of less importance to TDIs compared with other factors such as environment, activity and socioeconomic status (16) and some authors reported that there was no difference in the primary dentition between genders (15, 17, 18). But, in the present investigation, boys had a higher rate of TDIs than girls. These results are in concordance with other studies that showed a higher incidence of TDIs in boys (5, 8, 13, 14). This high TDIs ratio might be attributed more to boys being aggressive, energetic and inclined towards vigorous outdoor activities than to girls (11, 19).

The literature reports that the highest incidence of TDIs is observed in children aged 1–4 years, because children of this age are gaining mobility and independence, but motor coordination is not yet fully developed (9, 15). Harrington et al. (20) reported that the highest incidence of trauma occurs between 1 and 2 years of age and Ravn (21) found that TDI prevalence was the highest in boys from 2 to 4 years of age and in girls from 2 to 3 years of age. According to Garcia-Godoy (13) and

Sanchez and Garcia-Godoy (22), children between 4 and 5 years of age experience the most injuries, regardless of gender. These results are in concordance with our study. Children between the ages of 1 and 2, 1 and 3 years accounted for half of the TDI patients in this study.

Falls down were the most common aetiological factor, followed by collision with other children and these results are in concordance with previous studies (13, 16, 23, 24). As shown in Fig. 1, children at 1–2, 2–3 years of age are higher incidence of fall. This might be because children of this age start to walk and run, which results in frequent falls.

As demonstrated by other authors, most injuries occurred at home and school, this finding corroborates results of previous research (13, 15, 20). Injuries among preschoolers occur more often at home or inside, but injuries among school-aged children occur more often at school, on the playground or outside (20, 22, 25). These results are in agreement with our study. As shown in Fig. 2, the location of the TDIs varied according to the age group. In particular, the main location for the occurrence of TDIs until age 2–3 was at home, while outside and kindergarten were the main places of TDIs for the age group over 4 years old. Therefore, there is a need for preventive educational programmes directed at parents, kindergarten students and school teachers about the importance of immediate dental treatment after traumatic dental injuries (26).

By analysing the amount of time that elapsed between sustaining the injury and receiving dental assistance, it was observed that 62.8% of the children were brought to the hospital or clinic within 24 h of the injury. The children who had TDIs to the soft tissue and periodontal tissue were brought to dental clinics faster, because of bleeding tendency. Dental treatment is probably sought rapidly because parents tend to be more anxious about bleeding, multiple injuries and young children, even after small accidents (Table 2).

Regarding the relationship between dental trauma and seasonal variation, more traumas occurred between May and July, when children are more inclined towards outdoor activities. The weather in Korea is warm enough for children to play outside in late spring and early summer. Many authors have reported that there is an increase in frequency of TDIs in warm weather relative to a cold weather (19, 23, 27). Their findings were in agreement with our results in preschoolers' TDIs. Comparing with both genders, there is no significant difference in seasonal variation (Fig. 3).

In the present investigation, the maxillary central incisors were the most frequently injured teeth and the prevalence of injuries to the supporting structures, the alveolar bone and periodontal ligament, was up to 1.5 times higher than for hard dental tissue injuries. As demonstrated by other authors, subluxation was the most frequent injury of the supporting structures (7, 13–15, 20). Among all TDIs reported in this study, injuries to the periodontal or soft tissue occur considerably more often than injuries to the hard tissue, because of the resilience of the facial skeleton and alveolar bone pattern (1). However, in the permanent dentition, the eruption sequences generated a different data set in this study.

Conclusion

Several studies have reported that the prevalence of dental trauma among preschoolers has increased during the past few decades. Continuous epidemiological studies are necessary for understanding the complexities of dental trauma.

The most frequent injuries in this study occurred on the upper central incisors at an age of 1–3 years at home. Particularly, periodontal tissue and soft tissue injuries were more often than hard dental tissue injuries. Korean boys suffered from TDIs significantly more often and more related to warm weather than girls.

As apparent from this study, there is a need for an educational programme specifically directed at parents and school teachers to inform them about the benefit of home care, outdoor activities and immediate dental treatment in case of non-bleeding TDIs. Studies on the problems that can arise from neglecting or delaying dental treatment are also necessary. These results should be utilized to inform the public about methods to prevent and minimize dental injuries among preschoolers.

Acknowledgements

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