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Traumatic dental injuries in children with attention deficit/hyperactivity disorder

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Abstract – The aim of this study was to assess the frequency and distribution of traumatic injuries in 247 children with attention deficit/hyperactivity disorder (ADHD) who were 7–16 years old and attended the Ondokuz Mayıs University Medical Faculty (Department of Child Psychiatry, Samsun, Turkey). Each psychiatric diagnosis was based on criteria from the Diagnostic and Statistical Manual of Mental Disorders (4th edn, Washington, DC: American Psychiatric Association, 1994). Traumatic dental injuries were recorded using the classification of the World Health Organization, which was slightly modified by Andreasen and Andreasen (Textbook and color atlas of traumatic injuries, 3rd edn. Copenhagen, Denmark: Munksgaard; 1994. p. 151). Thirty-two percent (78/247) of the ADHD children presented 103 traumatized teeth. The frequency of dental injuries peaked in children who were 10–12 years of age, and showed no significant difference between subtypes of ADHD or gender. The maxillary central incisors were the most vulnerable to injury, and there were no differences between the right and the left sides in terms of susceptibility. Uncomplicated crown fracture (52.4%) and complicated crown fracture (16.6%) were the most commonly encountered types of injury. The main causes of dental injury were falls, collisions with objects, violence, and traffic accidents, and there was no difference in the frequencies of these causes between subtypes of ADHD, age, or gender. Only 5.1% (4/78) of the ADHD children sought treatment within the first 24 h of the injury. In conclusion, children with ADHD experience dental injuries more frequently than was previously described.

Traumatic dental injuries are a serious dental public health problem among children and adolescents. The important risk factors for dental injuries are gender, incisal overjet, inadequate lip coverage, status of socioeconomic background, obesity, physical and sporting activities (1–10). In addition to these factors, neurodevelopmental disorders may play an important role in the occurrence of traumatic dental injuries among children (11–14).

Neurodevelopmental disorders affect 10% of the general child population (15). The most common developmental psychiatric disorder is attention deficit hyperactivity disorder (ADHD), which is defined according to a specific set of symptoms – inattention, hyperactivity and impulsivity – as described in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (16, 17). According to the symptom presentation, three subgroups of ADHD may be coded as predominantly inattentive, predominantly hyperactive-impulsive and combined (16). The prevalence of ADHD has been reported to be 2–20% of all school-age children (18). According to the study of Ersan et al. (19), ADHD occurs in 8.2% of 6–15 aged Turkish children.

In spite of its common occurrence, there is little reported in the literature on the dental trauma of children with ADHD (12–14, 20, 21). The only clinical study, which explored the relationship between traumatic dental injuries and ADHD, has provided significant results (14). The findings of this study implicated a significant association between ADHD and dental trauma, and proposed an explanatory model. A population-based survey study by Lallo et al. (11) has shown that hyperactivity was significantly associated with the occurrence of major injuries affecting the face and/or teeth. In disagreement with these studies, some researchers have suggested no relationship between traumatic dental injuries and emotional symptoms, conduct disorder, or hyperactivity (13, 21).

Previous research has suggested that an important feature of ADHD is accident proneness, which may occasionally put children with ADHD at risk of serious bodily injury (22–24). Furthermore, disruptive behavioral disorders that develop from ADHD may increase the risk of injury because of the likelihood of increased violence. All of these conditions may lead to dental injuries (14). Thus, the purpose of this study was to analyze data from children with ADHD with respect to gender, age, cause, and the number and type of traumatized teeth and compare the results with similar studies previously reported.

Methods

This study consisted of 247 children with ADHD between the ages of 7 and 16 years who were referred to the Department of Child Psychiatry (Medical Faculty,

Ondokuz Mayıs University, Turkey) over the last 2 years. Psychiatric diagnoses of these children were based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria (17) and carried out by a child psychiatrist and a psychologist. None of the children had previously been treated with pharmacological or non-pharmacological therapy.

This study was approved by the Ethical Committee of Ondokuz Mayıs University. Written information about the study was provided to the parents of the pediatric patients prior to the examinations. To ensure the anonymity of the patients, their names were substituted with registration numbers.

A clinical dental examination was performed for each child in the Pediatric Dentistry Clinic at the University of Ondokuz Mayıs of Dental Faculty using dental mirrors and explorers under artificial light. Periapical radiographs and/or occlusal radiographs were obtained for making the diagnosis of traumatic events. The following information was collected for each patient: age at the time of trauma, gender, type, cause and location of traumatic injury, and number of teeth injured. Traumatic dental injuries were recorded using a version of the classification of the World Health Organization (WHO) that was slightly modified by Andreasen and Andreasen (25, 26). This modified version includes:

- Injuries to the hard dental tissue and the pulp: crown infraction, uncomplicated and complicated crown fracture, complicated and uncomplicated crown-root fracture, and root fractures.
- Injuries to the periodontal tissues (luxation injuries): concussion, subluxation, lateral luxation, extrusive and intrusive luxation, and avulsion.

Each child's evaluation was reviewed by both of the investigators. There was no disagreement between the examiners.

Statistical methods

All of the data were analyzed using a chi-square test in the statistical analysis program SPSS 13 (SPSS Inc., Chicago, IL, USA). The level of significance was set at $P \leq 0.05$.

Results

As shown in Table 1, of the 247 children enrolled in the study, 65.2% were boys and 34.8% were girls. The mean age of the girls and boys were 11.7 ($\pm$2.5) and 11.2 ($\pm$1.8) years, respectively ($P = 0.72$).

Table 1. Distribution of the subtypes of ADHD in children according gender [% (*n*)]

	Gender		
Subtypes of ADHD	Boys	Girls	Total
Combined	31.2 (77)	16.6 (41)	47.8 (118)
Inattentive	18.6 (46)	10.2 (25)	28.8 (71)
Hyperactive-impulsive	15.4 (38)	8.0 (20)	23.4 (58)
Total	65.2 (161)	34.8 (86)	100 (247)

The distribution of dental injuries, in terms of the subtypes of ADHD, is presented in Table 2. The 31.6% of injured children (78/247) presented 103 traumatized teeth. The highest frequency of dental injuries occurred in the combined-type group (32.1%) followed by the inattentive-type group (29.5%). There was no statistical difference between gender ($P = 0.28$).

The main etiological factors were unspecific falls (46.2%), collisions with objects (19.2%), violence (16.7%), traffic accidents (10.3%) and sports (6.4%). No statistical difference was observed among gender and age groups concerning the etiology ($P = 1.93$). The 14.1% (11/78) of the children affected by dental injury had previously experienced a previous dental injury that affected the same tooth. The percentage of children with previous dental injuries did not differ between genders.

Ninety-eight percent (101/103) of the traumatized teeth were maxillary teeth. Regarding the mandibular arch, one right and one right mandibular central incisor were affected by traumatic injury, with each one representing 0.9% of all injured teeth. As shown in Table 3, the most affected tooth was the maxillary central incisor (88.4%), followed by maxillary lateral incisor (9.7%). The differences between the number of dental injuries affecting the right (52.4%) and the left (47.6%) sides of the mouth and between subtype groups were not statistically significant ($P = 0.37$).

The distribution of dental injuries, according to Andreasen's classification, is summarized in Table 4. The injuries did not differ in type between the subtype groups of ADHD or age groups. Uncomplicated crown fracture (52.4%) and complicated crown fracture (16.6%) were the most commonly encountered types of injury in all subtype groups. The 14.9% of the children presented with a soft tissue injury.

It was observed that 35.6% of the children received dental assistance within 1–3 months after the incident. Only 5.1% of the children sought treatment within the first 24 h. In 14.1% cases, it was not possible to determine the time that elapsed between the event and the first visit to a dentist.

Discussion

Although ADHD is the most commonly diagnosed childhood behavioral and emotional syndrome in children (17), the epidemiological data on dental injuries in children with this disorder are limited. The major result of the present study is the children with ADHD experience dental injuries more frequently than was previously described (Table 5) (14, 20, 21). This difference might be explained in two ways. First, in our study a clinical dental examination was performed for each child and traumatic dental injuries were recorded using a version of the classification of the WHO that was slightly modified by Andreasen and Andreasen in the Pediatric Dentistry Clinic. Only in a study of Bimstein et al. (20), clinical examination was reviewed by the faculty members at the paedodontic clinic. However, no intra and inter-examiner reliability were done because of the retrospective nature of this study. In other studies (12, 21), dental traumatic injuries were compiled based on

Table 2. Distribution of traumatic injuries regarding the subtypes of ADHD, gender and age [% (*n*)]

	Subtypes of ADHD						
	Hyperactive-impulsive		Inattentive		Combined		
Age Group (in age)	Boys	Girls	Boys	Girls	Boys	Girls	Total
7–9	5.1 (4)	3.9 (3)	6.4 (5)	5.1 (4)	7.7 (6)	5.1 (4)	33.3 (26)
10–12	6.4 (5)	5.1 (4)	6.4 (5)	3.9 (3)	9.0 (7)	6.4 (5)	37.2 (29)
13–16	5.1 (4)	3.9 (3)	7.7 (6)	2.5 (2)	6.4 (5)	3.9 (3)	29.5 (23)
Total	16.7 (13)	12.8 (10)	20.5 (16)	11.5 (9)	23.1 (18)	15.4 (12)	100 (78)

There was no statistical difference between gender ($P = 0.28$).

Table 3. Distribution of affected teeth according to subtypes of ADHD group and age [% (*n*)]

	Subtypes of ADHD			
Number of teeth	Hyperactive -impulsive	Inattentive	Combined	Total
11	12.6 (13)	15.5 (16)	17.5 (18)	45.6 (47)
21	12.6 (13)	13.6 (14)	16.5 (17)	42.7 (44)
12	1.9 (2)	1.9 (2)	1.9 (2)	5.8 (6)
22	1.9 (2)	–	1.9 (2)	3.9 (4)
31	–	–	0.9 (1)	0.9 (1)
41	0.9 (1)	–	–	0.9 (1)
Total	30.1 (31)	31.1 (32)	38.8 (40)	100 (103)

The differences between subtype groups were not statistically significant ($P = 0.37$).

notes in the dental records. Sabuncuoğlu et al. (14) used questionnaire method regarding the presence of traumatization in the permanent teeth. In none of these studies, traumatic dental injuries were recorded using any classification. In addition, in only two studies, radiographic diagnoses were obtained for making the diagnoses of traumatic events (13, 20).

Second, the differences particularly related to our sample size. As shown in Table 5, most of previous studies included both ADHD ad other neurodevelopment disorder. Only in a study of Bimstein et al. (20) was included ADHD population which sample size ($n = 28$) very small. In addition, it should be noted that diagnosis of ADHD involves a clinical diagnosis based on parent and child interviews, observations of the parent and child, behavior rating scales, physical and neurological examinations, and cognitive testing; similarly, the most reliable data, with regard to research, may be obtained in this way (22, 27).

The frequency of dental injuries involving children with ADHD was compared to that reported in previous investigations of healthy children. Our results showed that the frequency of dental injuries was higher among our ADHD patients than in the healthy children (2, 3, 28–33). Since ADHD is the most prevalent behavioral disorder associated with accidental injuries in children and adolescents (34–37), it is not surprising to find an elevated prevalence of dental injuries in subjects suspected of having ADHD compared to healthy children (22). In addition, Karatekin et al. (38) suggested that the reduced motor skills of ADHD children provide another behavioral dimension to the disorder.

We found that 14.5% of the ADHD children had experienced previous dental trauma. It is now accepted that ADHD is a chronic condition that persists over an individual's life span, but with different manifestations. Thus, as the background risk factor persists, multiple trauma episodes may be expected (30). As mentioned by Cardoso and de Carvalho Rocha (39), histories of

Table 4. Distribution of types of injury regarding the subtypes of ADHD [% (*n*)]

	Subtypes of ADHD			
Type of injury	Hyperactive-impulsive	Inattentive	Combined	Total
Hard tissue injuries	24.3 (25)	25.2 (26)	29.1 (30)	78.6 (81)
Crown infraction	3.9 (4)	0.9 (1)	–	4.9 (5)
Uncomplicated crown fracture	14.6 (15)	17.4 (18)	20.4 (21)	52.4 (54)
Complicated crown fracture	4.9 (5)	4.9 (5)	6.8 (7)	16.6 (17)
Uncomplicated crown-root fracture	–	1.9 (2)	0.9 (1)	2.9 (3)
Complicated crown-root fracture	–	–	0.9 (1)	0.9 (1)
Root fracture	0.9 (1)	–	–	0.9 (1)
Periodontal tissue injuries	5.8 (6)	5.8 (6)	9.7 (10)	21.4 (22)
Concussion	1.9 (2)	–	–	1.9 (2)
Subluxation	1.9 (2)	–	2.9 (3)	4.9 (5)
Lateral luxation	–	1.9 (2)	0.9 (1)	2.9 (3)
Intrusive luxation	0.9 (1)	–	0.9 (1)	1.9 (2)
Extrusive luxation	1.9 (2)	1.9 (2)	2.9 (3)	6.8 (7)
Exarticulation (avulsion)	0.9 (1)	–	1.9 (2)	2.9 (3)
Total	30.1 (31)	31. (32)	38.8 (40)	100 (103)

Table 5. Dental trauma in children with ADHD, neurodevelopment disorder (ND) and normal population (N) reported by previous studies

Author/year	Population	Country	Age (in years)	Sample	Dental trauma prevalence (%)
Lalloo (11)	ADHD	England	4–15	625	2.3
Bimstein et al. (20)	ADHD	USA	7–8	23	26
Blomqvist et al. (41)	ND + ADHD	Sweden	1–10	155	28
Sabuncuoglu et al. (14)	ADHD + ND	Turkey	8–17	475	6.7
Soriano et al. (2)	N	Brazil	12	1046	10.5
Traebert et al. (28)	N	Brazil	12	297	17.3
Canakci et al. (29)	N	Turkey	13–17	2180	13.4
Traebert et al. (30)	N	Brazil	12	307	18.9
Tapias et al. (31)	N	Spain	10	470	17.4
Nicolau et al. (32)	N	Brazil	13	652	20.4
Skaare et al. (33)	N	Norway	7–18	1275	1.8

dental trauma were obtained from case history which may underestimate previous injuries because traumas may occur at school or when children are with other people.

In agreement with the previous studies (14), it was observed in all subtype groups, there was no statistical gender difference ($P > 0.05$). The fact that there are more boys with the diagnosis of ADHD (40,41), should have no bearing on the prevalence of trauma injuries to boys with ADHD when compared to girls with ADHD.

In agreement with previous studies (42–45), we show that the main causes of dental injuries in children with ADHD were unspecific falls, followed by collisions, which further indicate accident proneness in ADHD (23). Our results show that 16.7% of dental injuries are caused by violence. According American Academy of Child and Adolescent Psychiatry (46), of all the clinically referred children with ADHD, up to 30–50%, may meet the criteria for conduct disorder, which is closely related to violent behaviors (47–49). Odoi et al. (13) suggested that children who had peer relationship problems, such as being picked on or bullied by other children were more likely to have traumatic dental injuries. It was noted in this study as an interesting finding that driving accidents were the cause of dental injuries in 10.2% of all children. In a previous study, Woodward et al. (50) reported that young people with ADHD have been found to be at greater risk of involvement in driving accidents.

The present results show that dental traumas commonly occurred in the maxilla and maxillary central incisors, which is consistent with the findings of previous studies (1, 42–45). This observation probably relates to the preventive effect of the maxilla on the mandible during the occlusion and protrusion of maxillary central incisors (1–3, 51). The second most frequently traumatized teeth were maxillary lateral incisors. This result is compatible with the results of the majority of studies (42–45). In contrast, Forsberrg and Tedestam (52) reported that the mandibular central incisors were the second most frequently traumatized teeth. This study examined, for the first time, the distribution of dental injuries according to their type. Uncomplicated crown fracture was found to be the most frequent type of dental injury, which is similar to the results reported by previous studies that evaluated healthy children (30, 42, 43, 45).

One of our most interesting findings is the apparent delay in treatment for these dental injuries. The 46.2% of the children first received dental assistance within 1–3 months after the incident. The percentage of children who attended the dental clinic on the day of the trauma was very low when compared with previous studies (40, 53, 54). The major reason of this result was that there is no pediatric dentistry clinic except the University of Ondokuz Mayıs of Dental Faculty in this region. Although there are many general practitioners in this area, most of them prefer not to treat children with ADHD in their dental clinic. In addition, according to Kırzıoğlu et al. (55), children and their parents do not believe traumatic dental injuries to be urgent, as they have a tendency to attend to them after a period of time has elapsed or when acute symptoms of inflammation or aesthetic problems have developed.

Conclusion

This study concluded that:

- Thirty-two percent of the ADHD children presented 103 traumatized teeth.
- There was no statistical difference between genders.
- Ninety-eight percent of the traumatized teeth were maxillary teeth.
- The 46.2% of the children received first dental assistance within 1–3 months after the incident.
- The most common type of injury was seen as uncomplicated crown fracture (52.4) followed by complicated crown fracture (16.6).
- These findings suggest that traumatic dental injuries are a common problem in children with ADHD population.

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