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Relationship between traumatic dental injuries and attention-deficit/hyperactivity disorder in children and adolescents: proposal of an explanatory model

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Abstract – The objective of the present study was to determine the association between attention-deficit/hyperactivity disorder (ADHD) and traumatic dental injuries in a child psychiatric clinical population in Istanbul. A total of 475 consecutive children aged 8–17 years were enrolled in the study. Children and their parents were interviewed about the presence of traumatic dental injury and if a positive response was obtained further questions were inquired regarding the time and cause of the injury, and whether treatment had been sought. Child psychiatric diagnosis was based on Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) criteria. Of the 475 children, 32 reported a traumatic dental injury (6.7%) with statistically significant association with ADHD ($\chi^2 = 26.90$, d.f. = 1, $P = 0.0001$; odds ratio = 17.41, 95% CI: 4.11–73.55). On the Conners Teacher Report Questionnaire, children with dental trauma group differed significantly from the non-ADHD group but not from the ADHD group ($F = 17.02$, d.f. = 2, $P = 0.0001$). Among children with ADHD and dental fracture, the most common subtype was combined ADHD (90%). This is the first study describing a significant association between dental fractures and ADHD which contributes to an explanatory model on dental traumas among children. According to us, awareness of this association is essential at child psychiatry and pediatric dentistry settings and we recommend preventive efforts to be directed at the treatment of ADHD.

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Previous epidemiological studies worldwide have found high prevalence of traumatic injury to permanent teeth in children and adolescents which indicates an important public dental health problem (1). Anterior teeth fractures, which account 96% percent of cases, lead to both functional and esthetical, therefore psychological consequences (2). Possible sequelae may include tooth discoloration, loss of vitality, root resorption and/or abscess formation (1). The main causes of injury were described as falls and collisions with other children possibly experienced during sports and

games (3, 4). In this regard, boys are injured more frequently as reflected in previous studies. Among the structural factors considered, incisor overjet of more than 3 mm and incompetent lips were described as significantly predisposing (5). Obesity was implicated as a risk factor suggesting that obese children, being less skilful, are more likely to have their anterior teeth traumatized (6). Adverse psychosocial environment was among the factors, which was found to predispose dental injuries (7). Other than these factors, hyperactivity was reported to be associated with the occurrence of major injuries affecting the face and/or teeth (8, 9). Hyperactivity is a symptom of several behavioral disorders such as attention-deficit/hyperactivity disorder (ADHD), anxiety disorders and mania and should be considered along with age appropriate hyperactivity.

The ADHD is the most common neurobehavioral developmental disorder which affects up to 4–12% of all schoolchildren (10). Hyperactivity, inattentiveness and impulsivity are the core behavioral characteristics of this disorder. According to the symptom presentation, ADHD may be coded as predominantly inattentive, predominantly hyperactive-impulsive and combined type (11). The condition is three times more common in boys than in girls. One of the distinctive features of ADHD is accident proneness which may occasionally put these children into the risk of serious bodily injury (12). Furthermore, developing on the basis of ADHD, disruptive behavioral disorders may bring extra risks of injury because of the likelihood of increased violence. All of these conditions may lead to teeth fractures as might be expected. However, there's no available clinical study on the association of teeth fractures with ADHD up to date.

The aim of the present study was to examine the role of ADHD in the occurrence of traumatic dental injuries in children and to discuss the findings in an explanatory model.

Methods

This was a prospective clinical study designed to determine the relationship between traumatic dental fractures and ADHD. The study was carried out at a private child psychiatric setting where all admissions consisted of self-referrals. A total of 475 children aged 8–17 years were enrolled in the study in 2001/2002. This age range was preferred in order to make sure that all permanent dentation had been achieved and children were cognizant enough to report the accidents of traumatization.

A comprehensive psychiatric and psychological evaluation of every child was performed by a child psychiatrist (O.S.) and two psychologists. Child psychiatric diagnosis were based on Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria (11). As it would not be ethical and gentle to ask for a dental examination in admission which may stimulate anxious responses, a brief child and parents informant questionnaire was applied at the end of every initial sessions. Both child and parents were questioned regarding the presence of traumatization in the permanent teeth. If a positive response was elicited further questions were proceeded such as time and causes of injury, and whether treatment had been sought. Only the information that the child and the parents were in agreement was included in the study. Basic demographic information was derived from the personal files of the patients.

The total score of Turkish version of Conners Teacher Questionnaire (CTQ) was determined for ADHD children, non-ADHD children and children with dental trauma (13, 14). CTQ is a 28-item teacher report which consists of statements regarding attention, activity level and oppositional behavior of children.

At the end of the study a database was prepared. The Statistical Package for the Social Sciences version 10.0 was used for statistical analysis. Chi-square, binary logistic regression (odds ratios) and one-way ANOVA tests were conducted for the analysis of the data. The level $P < 0.05$ was taken as the cutoff value for significance.

Results

Of the 475 children included in the study, 73.5% were boys and 23.5% were girls. The mean age of the entire sample was 11.95 ± 2.83 and there was no significant difference in the mean age of boys and girls ($F = 1.70$, d.f. = 1, $P = 0.19$).

The mean length of time after the injury was reported to be 16.87 ± 9.32 months. Only 6.2% had the opportunity for dental evaluation. All but two cases reported one teeth to be fractured. Those two cases had both maxiller incisors fractured (6.6%). The main causes of injuries were identified as falls and collusions with other people and objects experienced during games or sports (87%) whilst the rest of the group could not identify the cause.

The prevalence of dental injury in the sample was 6.7% ($n = 32$) . Within this subgroup of children, no statistically significant difference of gender distribution regarding the overall sample was observed (27 boys and five girls; $\chi^2 = 2.09$, d.f. = 1, $P = 0.14$; odds ratio = 2.02, 95% CI: 0.76–5.39). The mean age of children with traumatized teeth was significantly less than children who had no history of dental trauma (10.78 ± 2.77

and 12.04 ± 2.82, respectively; $F = 5.95$, d.f. = 1, $P = 0.015$).

Principal diagnosis with comorbid conditions are presented in Table 1. When all the cases were dichotomized as ADHD and non-ADHD children, 235 children with ADHD (49.5%) and 240 children with non-ADHD (50.5%) were identified.

Table 2 shows the distribution of psychiatric diagnosis in children with a positive history of dental injury. A high percentage of accumulation was reached in ADHD when children with a history of dental trauma were distributed as ADHD and non-ADHD (Fig. 1). Chi-squared testing revealed a very significant association of dental trauma injuries in ADHD subjects ($\chi^2 = 26.90$, d.f. = 1, $P = 0.0001$; odds ratio = 17.41, 95% CI: 4.11–73.55). Therefore, the prevalence of dental injuries in the ADHD group was found to be 12.8%. No association was shown between mental retardation, affective disorders and dental trauma.

The distribution of subtypes of ADHD in children with both ADHD and dental trauma is presented in Table 3. These results are in parallel with the ADHD subtype distribution in the entire sample.

Table 1. The distribution of principal diagnosis in the overall sample

Diagnosis	Gender [*n* (%)]		Total [*n* (%)]
	Male	Female	
ADHD	121 (25.5)	19 (4.0)	140 (29.5)
ADHD with comorbid states	78 (16.4)	17 (3.6)	95 (20)
Pervasive developmental disorder	5 (1.1)	3 (0.6)	8 (1.7)
Mental retardation	26 (5.5)	6 (1.3)	32 (6.7)
Depressive disorder	12 (2.5)	10 (2.1)	22 (4.6)
Anxiety disorder	23 (4.8)	19 (4.0)	42 (8.8)
Learning disorder	5 (1.1)	5 (1.1)	10 (2.1)
Disruptive behavior disorder	5 (1.1)	0 (0.0)	5 (1.1)
Psychosis/mania	3 (0.6)	1 (0.2)	4 (0.8)
Problems related to adolescence	11 (2.3)	9 (1.9)	20 (4.2)
Family problems	5 (1.1)	6 (1.3)	11 (2.3)
Anxiety/depression	23 (4.8)	17 (3.6)	40 (8.4)
Non-ADHD with comorbid states	25 (5.3)	8 (1.7)	33 (6.9)
Other disorders	7 (1.5)	6 (1.3)	13 (2.7)
Total	349 (73.5)	126 (26.5)	475 (100)

Table 2. The distribution of diagnosis in children with dental traumas

Diagnosis	Dental trauma [*n* (%)]
ADHD	9 (28.1)
ADHD, mental retardation	6 (18.8)
ADHD, learning disorder	6 (18.8)
ADHD, anxiety disorder	5 (15.6)
ADHD, disruptive behavior disorder (DBD)	2 (6.3)
ADHD, DBD, family problems	1 (3.1)
ADHD, family problems	1 (3.1)
Learning disorder	1 (3.1)
Mental retardation, other disorders	1 (3.1)
Total	32 (100)

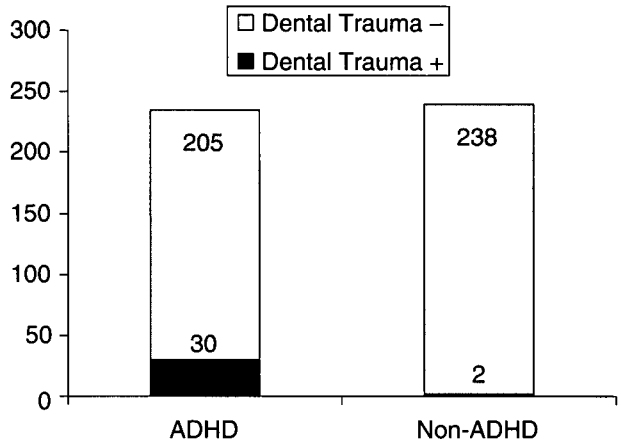

Fig. 1. Distribution of dental traumas in the ADHD and non-ADHD groups.

Table 3. Subtypes of ADHD in the dental trauma group

Subtype of ADHD	*n* (%)
Combined	27 (90)
Hyperactive-impulsive	1 (3.3)
Inattentive	2 (6.7)
Total	30 (100)

The CTQ total scores were obtained from ADHD and non-ADHD group children matched for age, sex and sample size with the group of children with dental trauma. Mean CTQ scores were 37.96 ± 12.95, 23.18 ± 11.87 and 39.40 ± 12.07 for the ADHD, non-ADHD and children with dental trauma groups, respectively (Fig. 2). In comparison, children with dental trauma group differed significantly from the non-ADHD group

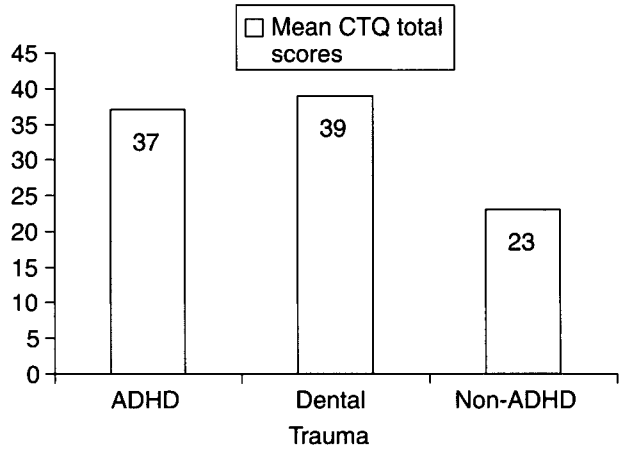

Fig. 2. Mean Conners Teacher Questionnaire (CTQ) total scores.

but not from the ADHD group ($F = 17.02$, d.f. = 2, $P = 0.0001$; group significance was tested with *post hoc* Bonferroni).

Discussion

This study aimed to find out whether ADHD and traumatic dental injuries are associated and showed a very significant association between these two clinical conditions. Until today, no clinical study was able to focus in this area and with the gained insight, various implications are likely to be put forth. Despite some recent studies commenced (8, 9) hyperactivity-dental fracture association, exact clinical definition remained to be lacking. Hyperactivity as mentioned above, is a symptom that can present in several behavioral disorders and it is misleading to consider it as the sole factor in the occurrence of teeth fractures. Another behavioral characteristic of ADHD, impulsivity or acting with no thought as to the consequences may also pose serious dangers. Moreover various attentional problems may limit a child's anticipation of physical traumas. The poor motor skills of ADHD children is another behavioral dimension which increase the likelihood of traumatization (15).

The findings of this study implicate the proposal of a model to explain the etiology of traumatic dental injuries in the pediatric age group. According to us, this study bridges the gap between the child psychiatry and pediatric dental traumatology disciplines, as well as with possible connections to adult forms of these problems. Awareness of ADHD in dental traumatization should guide dental clinicians to seek child psychiatric consultations either at emergency or routine settings. This approach will enable the evaluation of the underlying disorder and if treatment of ADHD is indicated, will prevent the risk of retraumatization. In addition, children with teeth fractures may be particularly vulnerable to other severe forms of bodily traumatization. A fractured teeth may also be interpreted as a warning sign about the risk of direct physical traumas to the skull that may affect the brain. Therefore when a child with accidentally fractured teeth is admitted to any setting, referral should almost always be considered.

One of the important questions worth raising is whether comorbid disorders have a worsening impact on the risk of occurrence of traumatization. Although no significant correlation exists between mental retardation and dental fractures in the present study, comorbidity with ADHD means extra risk as motor problems have higher prevalence in both conditions. The same is true for anxiety problems that a developed anxiety disorder with agitation on the basis of ADHD may worsen the already vulnerable state. Anterior teeth fractures, actually a complication, may also be taken as a clinical sign of ADHD, given the high prevalence in the present study.

High rate of falls and collusions accounting the cause of injuries in our study is a supportive finding of accident proneness in ADHD which has been pointed out above (12). On the contrary, high rate of untreated dental injuries may be because of parental expectation of retraumatization.

A limitation of this study was the lack of dental examinations which was avoided for the reasons stated above. If the children had been examined, a higher percentage of dental fractures would have been spotted. Self-assessment was found to be not useful in evaluating individual dental treatment need but be of value in assessing the needs of adult communities (16). Anyway, this is a methodological problem awaiting further solution.

As the mean age of the children with dental trauma is significantly less than the entire sample, we can conclude that traumatization occurs before adolescence. However, the exact pattern of traumatization across childhood and adolescence with regard to ADHD needs to be delineated. A developmental perspective is essential in explaining adversities in childhood psychopathology. Further clinical and population based studies can shed light on this emerging topic.

Basically, preventive efforts should focus into treating the underlying condition. Both pharmacological and non-pharmacological therapies are used to treat children with ADHD. Psychostimulants are the drug of first choice in ADHD with a well-established therapeutic efficacy. Alonge's report of relatively low prevalence of fractured incisal teeth (2) might be related to the higher rate of psychostimulant medication in the United States. However, it should be kept in mind that psychostimulants may not always cover a child's risky times as for instance, drug holidays are part of long-term pharmacotherapy. Further, rebound phenomena, an excess hyperactivity observed in off-drug hours may bring extra risks as well as missed doses which is quite frequent in ADHD pharmacotherapy. As it is already known that non-compliance rates are high with psychostimulant treatment, to what extent psychostimulants may produce a preventive effect needs to be investigated.

Conclusion

The present study suggests that ADHD in children is a predisposing factor for traumatic dental injuries and proposes an explanatory model. This is the first study drawing attention to this association with various clinical implications. It is essential that both

child psychiatrists and pediatric dentists be aware about this common presentation of ADHD for early identification, treatment and prevention. Once the gap of knowledge between both professions is filled, collaboration will definitely serve to the betterment of children.

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