Prevalence of bruxism in children receiving treatment for attention deficit hyperactivity disorder: a pilot study

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The objective of this study was to evaluate reported bruxism among children affected by attention deficit hyperactivity disorder (ADHD). Thirty children diagnosed with ADHD and 30 healthy age and gender matched controls participated in the study. All subjects were examined for dental attrition, and the parents were asked for signs and symptoms of bruxism in their children using a questionnaire. Prevalence of oral parafunction was evaluated comparing ADHD children taking medications, ADHD children not taking medications, and controls. Subjects affected by ADHD and pharmacologically treated showed higher occurrence of bruxism compared to subjects affected by ADHD not taking medicines and controls; and within the ADHD group taking medications, CNS-stimulants have been associated with such side effect more frequently than the other drugs.
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INTRODUCTION

Attention-deficit-hyperactivity disorder (ADHD) is a common, but controversial syndrome characterized by developmentally inappropriate hyperactivity, impulsivity, and inattention. Prevalence in the population has been reported to range from 1.7% to 17.8%. Substantial clinical evidence shows an association between sleep problems and ADHD in children. Sleep disorders in children are not a unitary clinical problem. They are commonly classified in the following groups:

1. Dyssomnias e.g. insomnia and circadian rhythm sleep disorders,
2. Sleep-related involuntary movements e.g. bruxism, periodic limb movement disorder and sleep talking,
3. Sleep-related breathing disorders e.g. obstructive sleep apnea,
4. Non-rapid eye movement (NREM) parasomnias e.g. sleep walking and sleep terrors. Most of the sleep research in ADHD has focused on dyssomnias and sleep related involuntary movements. However, as it was concluded that the association between ADHD and sleep problems is intricate, and treatment with stimulant medications can be a confounding factor.

Psychostimulant drugs are the treatment of choice for children with ADHD. There is often an immediate and dramatic improvement in the conduct and academic performance of children with behavioral disturbances after administration of the medication. These findings have been long-established by many controlled short-term clinical studies of children, adolescents, and adults; an estimated 70% of the subjects responded to methylphenidate, dextroamphetamine, and pemoline, eliminating most debate over at least the short-term efficacy and safety of these drugs. Gillberg *et al*.[9] reported similar findings in a recent long-term study, although in a diverse group of patients.

Bruxism has been associated with sleep disorders and has been reported to be aggravated by the consumption of alcohol and some types of medications, it has also been observed in individuals with disturbances of the central nervous system. Bruxism is defined by the American Academy of Orofacial Pain as: "A diurnal or nocturnal parafunctional activity including clenching, bracing, gnashing and grinding of the teeth". The American Sleep Disorders Association defines bruxism as: "Tooth grinding or clenching during sleep plus one of the following: tooth wear, sounds or jaw muscle

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discomfort in the absence of a medical disorder". Bruxism affects 15% to 100% of the population and seems to be related to local/mechanical factors, systemic/neurological factors and psychological factors.

The role of stress in the pathophysiology of bruxism is anecdotal, yet it is probably the factor to which most often the etiology of oral parafunctions is attributed. Some investigators have suggested that bruxing is in fact a type of sleep disorder and is linked to dreaming during sleep cycles, daytime emotional expression, anxiety induced responses, or the anticipation of stressful situations.

Bruxism can result in excessive tooth wear, muscular pain, degenerative temporomandibular joint disease, muscular hypertrophy, headache and periodontal tissue injury. While tooth wear is visible to the dentist, the effects of bruxism on the orofacial muscles, ligaments and joints are not easily recognized; nonetheless, they are often painful for the patient and have serious long term consequences.

STUDY OBJECTIVES

The objective of this study was to investigate bruxism in subjects diagnosed with ADHD, and evaluate the relationship between bruxism and the medications used for the treatment of ADHD.

MATERIALS AND METHODS

Patients seeking dental treatment attending the outpatient dental clinic at Franciscan Children's Hospital were asked to participate in the study. All young patients between the age of 5 years to 15 years, and diagnosed with ADHD were recruited. Thirty patients were diagnosed with ADHD, 24 subjects were receiving medications for ADHD and 6 were not receiving medications at the time of the interview and examination. The diagnosis of ADHD was based on medical history. Thirty age and gender matched healthy children attending the dental office for regular treatment served as controls.

The study was reviewed and approved by the Institutional Review Board at Franciscan Children's Hospital. After an informed consent was obtained, parents/guardians were asked to answer "Yes or No" for the following questions:

1. Does your child clench or grind his/her teeth during the day?
2. Does your child clench or grind his/her teeth during sleep?
3. Do you feel that his/her teeth are getting worn down?
4. Does he/she experience jaw clicking while eating, yawing or any other movements?
5. Does he/she complain of facial pain?
6. Does your child wake up in the middle of the night complaining of facial pain?
7. Does you child experience morning headaches?

Subjects were also examined for signs of dental wear (i.e. attrition, erosions and occlusal wear facets) and the severity and number of worn teeth was recorded. To control for intra/inter examiner consistency, one examiner performed the dental examinations.

STATISTICAL ANALYSES

For nominal data Chi square (χ^2) analysis was performed to evaluate whether a statistical relationship exists between the groups. ANOVA was used to compare significant differences among the three groups for the number of worn teeth, followed by pair wise comparisons. Dunnett-T3 correction method was used to correct for type-I error. Regression analysis was used to assess the relationship between the use of medications and tooth attrition. Fisher's exact test and Student's t-test were used where appropriate. Data are presented as mean ± standard error of the mean (SEM). Analyses were conducted using the Statistical Package for the Social Sciences (SPSS Inc, Chicago, IL).

RESULTS

A total of 60 subjects (48 males and 12 females) were enrolled in the study, 30 diagnosed with ADHD (mean age 10.6±0.5) and 30 controls (mean age 10±0.4).

The results of the questionnaire showed that ADHD subjects reported more grinding during the day ($\chi^2 = 10.4$, p=0.002), more clenching or grinding during sleep ($\chi^2 = 6.2$, p=0.025) and the parent/guardian felt that the subject's teeth are getting worn down more frequently when compared to the control group ($\chi^2 = 11.9$, p=0.001). No significant differences were observed for the remaining questions investigating morning headaches, face pain, jaw clicking and face pain during the night (p>0.05) (Table 1).

When evaluating the number of teeth with attrition/wear facets between the groups, independent Student's t-test showed that ADHD subjects had more teeth with attrition/wear facets than controls, mean = 6.1±1.2 and 1.5±0.5 respectively, $t_{df=58} = 3.6$, p=0.001.

Since 6 subjects in the ADHD group were not on medication, the ADHD group was further divided into two groups, ADHD receiving medications and ADHD not receiving medications.

ANOVA was conducted to evaluate significant differences between the numbers of worn teeth (teeth with attrition/wear facets) among the three groups (ADHD receiving medications, ADHD not receiving medications and controls). There was a significant difference between the groups ($F_{df = 2, 56, } = 10.0$, p<0.0001). Follow-up tests were conducted to evaluate pair wise differences among the means. ADHD children receiving medications had a significant higher number of worn teeth (mean=7.2±1.4) compared to ADHD children not receiving medications (mean = 1.8±0.8) and controls (mean=1.5±0.5), p=0.008 and

Table 1. Results of the chi-square tests (χ^2) for the answers to the questionnaire given to the Parents/guardians.

	Groups		
	ADHD (n=30)	Control (N=30)	P Value
Does your child clench or grind his/her teeth during the day?	11 (36.7%)	1 (3.3%)	0.002
Does your child clench or grind his/her teeth during sleep?	14 (46.7%)	5 (16.7%)	0.025
Do you feel that his/her teeth are getting worn down?	12 (40.0%)	1 (3.3%)	0.001
Does he/she experience jaw clicking while eating, yawing or any other movements?	5 (16.7%)	2 (6.7%)	NS
Does he/she complain of facial pain?	3 (10.0%)	0 (0.0%)	NS
Does your child wake up in the middle of the night complaining of facial pain?	0 (0.0%)	0 (0.0%)	NS
Does you child experience morning headaches?	5 (16.7%)	1(3.3%)	NS

Values are number of subjects who answered yes and percentage. NS indicates not significant

Table 2. Summary of the medications used by the ADHD subjects during the interview.

Medication Class	Name	No. of Subjects (percentage)	Total percentage
CNS-Stimulants (Amphetamines)	Methylphenidate	12 (50%)	75%
	Dextroamphetamines	6 (25%)	
Selective Serotonin Reuptake Inhibitors (SSRI's)	Sertralines	3 (12.5%)	25%
	Clomipramine	2 (8.3%)	
	Bupropion	1 (4.2%)	
α_2 Adrenergic Blockers	Clonidine	6 (25%)	33.3%
	Guanfacine	2 (8.3%)	
Dopamenergic	Haloperidol	1 (4.2%)	20.8%
	Risoeridone	4 (16.7%)	
Other medications	Lithium	1 (4.2%)	33.3%
	Valporate	2 (8.3%)	
	Trazodon	2 (8.3%)	
	Nortriptyline	1 (4.2%)	
	Alprazolam	1 (4.2%)	
	Buspirone	1 (4.2%)	

p=0.002, respectively. The difference between the number of worn teeth for the ADHD children not receiving medications was not significantly different from the controls (p>0.1) (Figure 1).

Since ADHD subjects receiving medications exhibited significantly higher number of worn teeth compared to the other two groups, it was of interest to find which medication could be associated with bruxism.

Regression analysis was conducted using the number of worn teeth as the dependant variable. The results showed that there was a significant association between the use of CNS-stimulants (e.g. methylphenidate, amphetamines) and tooth wear ($p<0.05$). Moreover, subjects receiving CNS-Stimulants had more teeth with attrition (mean = 8.9±1.5) compared to subjects not using these medications (mean = 3.0 (0.9), $t_{df=22} = 3.4$, $p<0.01$, Figure 2.

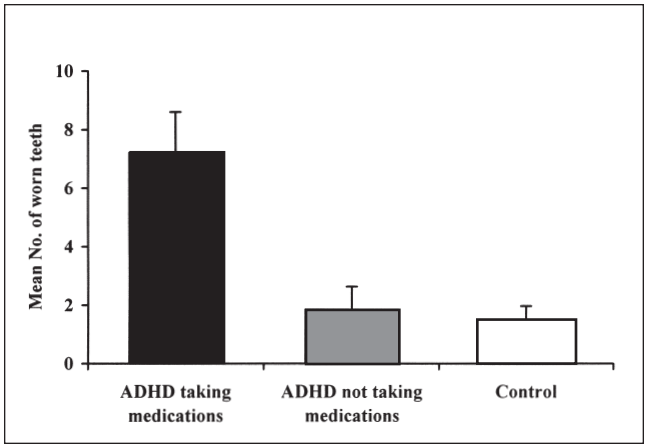

Figure 1. Comparison between the number of worn teeth for the ADHD children receiving medications, ADHD children not receiving medications and the control group.

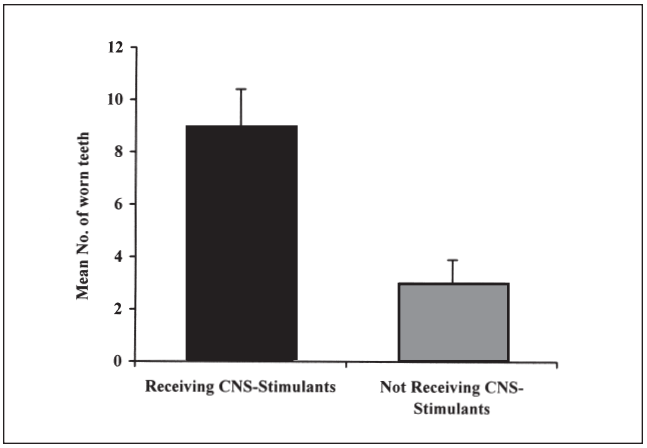

Figure 2. Comparisons between the mean number of worn teeth for Subjects receiving CNS-stimulants and subjects who do not in the ADHD group receiving medications.

DISCUSSION

In 1993, the number of prescriptions in the United States for methylphenidate (a CNS-stimulant) for children with ADHD was 2.5 times higher than in 1990. This increase aroused concern about abuse or over prescribing. These stimulants cause muscular hyperactivity and dyskinesia. Nonetheless, the value of stimulant drugs in reducing symptoms of ADHD is widely accepted. The value in children with relatively mild symptoms or with coexisting disorders is less clear. The drugs can be safely administered to children with ADHD and epilepsy and methylphenidate, but not dextroamphetamine, gives positive results in children with ADHD and tic disorders decreasing disruptive behavior without necessarily worsening the tics.

Selective serotonin reuptake inhibitors (SSRIs) are also medicines used for the treatment of ADHD. They are widely prescribed anti-depressants that enhance serotonin neurotransmission. The use of SSRIs has been associated with the occurrence or worsening of several extra-pyramidal reactions such as dyskinesia, restless leg syndrome, dystonia and bruxism. Fitzgerald and Healy observed diurnal bruxism secondary to SSRI medication in 5 of 6 patients. Bruxism persisted in 2 of the patients after the drug was discontinued. Also Amir *et al.*[33] found acute bruxism and akathisia occurring as an early side effect of antipsychotic drug for the treatment of 2 patients.

The present study evaluated the possible parafunctional habits among children diagnosed with ADHD especially the ones receiving medications for this disorder. It was also found that there was a higher prevalence of day and night grinding among the ADHD children treated with medication when compared to the other two groups. When evaluating the number of worn teeth it was found that the ADHD group receiving medications had significantly more signs of attrition compared to the other two groups. After realizing that ADHD children receiving medications had higher prevalence of tooth attrition and more daytime grinding, we compared ADHD children using CNS-stimulants to children using other medications, and a significant difference was found: children using CNS-stimulants had a 2.5-fold higher number of worn teeth.

The results of this study seem to agree with the previously reported studies where occurrence of bruxism was noticed after administration of SSRIs and antipsychotic drugs. Also another study showed the marked effect of methylphenidate on oral parafunctions, although associated to valproic acid for the treatment of ADHD and epilepsy, confirming what was observed in the present study. On the other hand, whether the use of ADHD medications is the cause of such symptoms cannot be confirmed because of some limitations of the study. One limitation is due to the fact that we did not evaluate the effect of different dosages of each medication on bruxism. The use of higher or lower dose of the drug administered might have biased the results of the comparison between methylphenidate and the other medicines. Table 2 summarizes the medications used by the ADHD subjects included in the study and the percentage of subjects using each drug.

The second limitation consists in the small number of ADHD children not receiving medications, only six children, making a clear association between ADHD children taking medications and bruxism difficult. This limited number of ADHD children not treated with medicines could be attributed to the fact that these children are put on medications as soon as they are diagnosed with ADHD.

The present report suggests that there could be an association between ADHD medications and parafunctional activity, especially focusing on the use of CNS-stimulants (e.g. methylphenidate or amphetamines). This association could be further established by increasing the sample size, especially in the ADHD group, who do not

receive medications, and controlling for the type of medication used and the different dosages. This would give a clearer picture of the eventual associations and improve the discriminating power of the statistical analyses. However, although oral parafunctional activities are common occurrences and vary with each individual, in some patients enrolled in the study they were extremely destructive and resulted in extremely frustrating problems for the dentist. It is therefore appropriate not to overlook the problem, regularly examining ADHD patients, especially those taking medications and in particular CNS-stimulants, and eventually intervening to avoid damage to the oral structures.

REFERENCES

1. Diagnostic and statistical manual of mental disorders: DSM-IV Washington, D.C.: American Psychiatric Publishing, Incorporated; 1994. (First MBa, Pincus HA, eds. Diagnostic and Statistical Manual of Men).
2. Taylor EA, *et al*. Hyperkinetic disorders: prevalence, definition and association. In: Eric A. Taylor, *et al*. eds. The epidemiology of childhood hyperactivity. Oxford, England: Oxford university Press, 93-113, 1991.
3. Baumgaertel A, Wolraich ML, Dietrich M. Comparison of diagnostic criteria for attention deficit disorders in a German elementary school sample. J Am Acad Child Adolesc Psychiatry 34: 629-38, 1995.
4. Owens JA, Maxim R, Nobile C, McGuinn M, Msall M. Parental and self-report of sleep in children with attention- deficit/hyperactivity disorder. Arch Pediatr Adolesc Med 154: 549-55, 2000.
5. Anders TF, Eiben LA. Pediatric sleep disorders: a review of the past 10 years. J Am Acad Child Adolesc Psychiatry 36: 9-20, 1997.
6. Corkum P, Moldofsky H, Hogg-Johnson S, Humphries T, Tannock R. Sleep problems in children with attention-deficit/hyperactivity disorder: impact of subtype, comorbidity, and stimulant medication. J Am Acad Child Adolesc Psychiatry 38: 1285-93, 1999.
7. Pliszka SR. The use of psychostimulants in the pediatric patient. Pediatr Clin North Am 45: 1085-98, 1998.
8. Spencer T, Biederman J, Wilens T, Harding M, O'Donnell D, Griffin S. Pharmacotherapy of attention-deficit hyperactivity disorder across the life cycle. J Am Acad Child Adolesc Psychiatry 35: 409-32, 1996.
9. Gillberg C, Melander H, von Knorring AL, *et al*. Long-term stimulant treatment of children with attention-deficit hyperactivity disorder symptoms. A randomized, double-blind, placebo-controlled trial. Arch Gen Psychiatry 54: 857-64, 1997.
10. Attanasio R. An overview of bruxism and its management. Dent Clin North Am. 41: 229-41, 1997.
11. Okeson JP. Orofacial Pain: Guidelines for assessment, diagnosis and management Chicago, Quintessence Publishing, 1996.
12. Thorpy MJ. Diagnostic classification steering committee. In: Association ASD, ed. The International Classification of Sleep Disorders: Diagnostic & Coding Manual. Rochester, MN, Allen Press, 1990.
13. Seligman DA, Pullinger AG, Solberg WK. The prevalence of dental attrition and its association with factors of age, gender, occlusion, and TMJ symptomatology. J Dent Res 67: 1323-33, 1988.
14. Melis M, Abou-Atme YS. Prevalence of bruxism awareness in a Sardinian population. Cranio 21: 144-51, 2003.
15. Glaros AG, Rao SM. Bruxism: a critical review. Psychol Bull 84: 767-81, 1977.
16. Okeson JP. Etiology of functional disturbances in the masticatory system. In: Okeson JP, ed. Management of temporomandibular disorders and occlusion. 4th ed. St. Louis: Mosby Year Book, pp. 149-179, 1998.
17. Pierce CJ, Chrisman K, Bennett ME, Close JM. Stress, anticipatory stress, and psychologic measures related to sleep bruxism. J Orofac Pain 9: 51-6, 1995.
18. Goulet JP, Lund JP, Montplaisir JY, Lavigne GJ. Daily clenching, nocturnal bruxism and stress and their association with TMD symptoms [abstract]. J Orofac Pain 75: 120, 1993.
19. Westrup DA, Keller SR, Nellis TA, Hicks RA. Arousability and bruxism in male and female college students. Percept Mot Skills 75(3 Pt 1): 796-8, 1992.
20. Hicks RA, Conti P. Nocturnal bruxism and self reports of stress-related symptoms. Percept Mot Skills 72(3 Pt 2): 1182, 1991.
21. Rugh JD, and Solberg WK. Psychological implications in temporomandibular pain and dysfunction. In: Zarb GA, and Carlsson GE, eds. Temporomandibular joint function and dysfunction. Copenhagen: Munksgaard, p. 255, 1979.
22. Faulkner KD. Bruxism: a review of the literature. Part I [see comments]. Aust Dent J 35: 266-76, 1990.
23. Cannistraci AJ, Friedrich JA. A multidimensional approach to bruxism and TMD. N Y State Dent J 53: 31-4, 1987.
24. Rugh JD, Ohrbach R. Occlusal parafunction. In: Mohl ND, Zarb GA, Carlsson GE, and Rugh JD, eds. A textbook of occlusion. 3rd ed. Chicago, Quintessence, 249-261, 1991.
25. Swanson JM, Lerner M, Williams L. More frequent diagnosis of attention deficit-hyperactivity disorder. N Engl J Med 333: 944, 1995.
26. Ellsworth AJ, Witt DM, Dugdale DC, Oliver LM. Mosby's medical drug reference. St. Louis, Mosby, 1999.
27. Gross-Tsur V, Manor O, van der Meere J, Joseph A, Shalev RS. Epilepsy and attention deficit hyperactivity disorder: is methylphenidate safe and effective? J Pediatr 130: 670-4, 1997.
28. Castellanos FX, Giedd JN, Elia J, *et al*. Controlled stimulant treatment of ADHD and comorbid Tourette's syndrome: effects of stimulant and dose. J Am Acad Child Adolesc Psychiatry 36: 589-96, 1997.
29. Gadow KD, Sverd J, Sprafkin J, Nolan EE, Ezor SN. Efficacy of methylphenidate for attention-deficit hyperactivity disorder in children with tic disorder. Arch Gen Psychiatry 52: 444-55, 1995.
30. Gadow KD, Nolan E, Sprafkin J, Sverd J. School observations of children with attention-deficit hyperactivity disorder and comorbid tic disorder: effects of methylphenidate treatment. J Dev Behav Pediatr 16: 167-76, 1995.
31. Lobbezoo F, van Denderen RJ, Verheij JG, Naeije M. Reports of SSRI-Associated Bruxism in the Family Physician's Office. J Orofac Pain 15: 340-346, 2001.
32. Fitzgerald K, Healy D. Dystonias and dyskinesias of the jaw associated with the use of SSRis. Hum Psychopharmacol 10: 215-219, 1995.
33. Amir I, Hermesh H, Gavish A. Bruxism secondary to antipsychotic drug exposure: a positive response to propranolol. Clin Neuropharmacol 20: 86-9, 1997.
34. Gara L, Roberts W. Adverse response to methylphenidate in combination with valproic acid. J Child Adolesc Psychopharmacol 10: 39-43, 2000.