

Sleep Bruxism and Orthodontic Appliance among Children and Adolescents: A Preliminary Study

Ivana Meyer Prado, Marcela Oliveira Brant, Sheyla Márcia Auad, Saul Martins Paiva, Isabela Almeida Pordeus and Junia M Serra-Negra*

Department of Pediatric Dentistry and Orthodontics, Federal University of Minas Gerais, Belo Horizonte, Brazil

*Corresponding author: Junia Maria Serra-Negra, Department of Pediatric Dentistry and Orthodontics, Federal University of Minas Gerais, Belo Horizonte, Brazil, Tel: +553124092433; E-mail: juniaserranegra@hotmail.com

Received date: February 18, 2016; Accepted date: March 10, 2016; Published date: March 18, 2016

Copyright: © 2016 Prado IM, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Objective: The aim of this study was to evaluate the association between sleep bruxism and orthodontic treatment in children and adolescents.

Methods: Analysis was performed both before and during such treatment. A retrospective cross-sectional study was undertaken in two groups of seven to 15-year-old patients from the orthodontic clinic of a public university in Belo Horizonte, Brazil. The first group contained 22 patients with a mean age of ten years (SD = 2.058) who were awaiting orthodontic treatment.

The second group contained 44 patients with a mean age of nine years (SD = 1.79) undergoing orthodontic treatment. Data collection was performed using a questionnaire completed by parents/caregivers and data from the medical records of the clinic. Diagnosis of bruxism was determined in accordance with American Academy of Sleep Medicine criteria. Descriptive analysis and Chi-square test were used for statistical analysis.

Results: Sleep bruxism was observed in 27.3% of patients who were awaiting orthodontic treatment. Regarding the group undergoing treatment, 36.4% had sleep bruxism prior to the start of treatment and 25% continued to suffer from the Para function following placement of an orthodontic appliance.

Among those who had sleep bruxism before treatment, 75% reported that the Para function ceased after placement of the appliance. There was an association between the presence of sleep bruxism among parents/caregivers and among patients ($p = 0.035$). Interceptive orthodontics was associated in 77% of sleep bruxism stop during treatment ($p = 0.029$). The corrective orthodontics was in 22.8% patients with sleep bruxism only after fitting orthodontic appliance compared to 9% with interceptive orthodontic treatment ($p = 0.002$).

Conclusion: There was an association between sleep bruxism in parents/caregivers and the presence of the Para function among children/adolescents. The type of orthodontic treatment influenced the time that sleep bruxism appeared. The interceptive orthodontic treatment was associated with the cases which sleep bruxism stopped during treatment.

Keywords: Adolescents; Bruxism; Children; Para function; Corrective orthodontics; Interceptive orthodontics; Orthodontic treatment

Introduction

Sleep bruxism is a movement disorder characterized by the gnashing and/or grinding of teeth during sleep [1,2,3].

It manifests itself as rhythmic muscle contractions with a strength greater than that used in normal chewing [1,2,4].

An accurate etiology of sleep bruxism has not been clearly identified and the para function is considered multifactorial [3,5].

Some studies have highlighted an association with emotional factors [6-11], while one study highlighted the influence of genetics on sleep related problems during childhood and adolescence, and also the presence of the condition among parents [12].

Teeth grinding is a major concern for dentists because of its consequences, such as tooth wear, fracture of dental restorations, periodontal problems, exacerbation of temporomandibular disorders, stress induction leading to headaches, and grinding sounds, which may interfere with the sleep of family members or partners [1,3,4].

The prevalence of this nocturnal disorder in children is significant. Percentages vary depending on the diagnosis method used, and range from 8% to 38% [6,13,14].

The condition is usually diagnosed in children and adolescents from the reports of parents and caregivers [13,14].

Orthodontics is the area of dentistry that cares for preventing, intercepting and correcting dental irregularities and skeletal discrepancies [15-17].

The intercepted orthodontics is the treatment for preventing or reduces severe malocclusion installation, generally used to correct

abnormal habits that can interfere with the growth pattern of the jaws and teeth position [16].

Usually the interceptive treatment is performed in younger patients with mixed dentition [16]. Corrective orthodontics is the treatment of malocclusions and growth patterns already installed, mainly using fixed mechanisms, like orthodontic appliance [15,17].

Orthodontic treatment is sought by a large number of children and adolescents. Some authors have identified a relationship between the use of orthodontic appliances and its negative impact on oral health related quality of life [18], and have described the discomforts that come with the appliances, such as difficulty in speaking, difficulty in cleaning and dental mobility problems [19].

From these works it is unclear whether there is a relationship between sleep bruxism and emotional factors associated with the use of braces.

A search of the PubMed and Scopus databases in November 2015 using the key words: bruxism, orthodontic treatment and malocclusion did not reveal any published scientific studies of this subject.

Given the above, the aim of the present study was to analyze the prevalence of sleep bruxism among children and adolescents before and during orthodontic treatment and the possible association of this para function with the type of orthodontic treatment, corrective or interceptive.

Method and Material

A retrospective epidemiological survey was undertaken. The study was conducted at the Orthodontic Clinic of the Dental School of Federal University of Minas Gerais (FOUFMG) in Belo Horizonte, Brazil.

The parents/caregivers of patients yet to receive treatment and of those already being treated in the second half of 2014 were contacted. A total of 135 individuals were contacted.

Of these, 66 were included in the study, 44 of whom had children undergoing orthodontic treatment and 22 of whom had children who were waiting for treatment.

A convenience sample was used. The patients awaiting orthodontic treatment had been evaluated by clinical orthodontists and all had dental records.

All parents/caregivers and patients signed a Free and Informed Consent Form (FICF).

Parents responded to a questionnaire prepared in accordance with the criteria of the American Academy of Sleep Medicine (AASM) [13]. Thus, bruxism was diagnosed if parents/caregivers reported that their child had the habit of grinding or clenching his/her teeth during sleep and exhibited sounds associated with sleep bruxism [13].

The parent's questionnaire questions considered the development of children, sleep quality and characteristics, and the presence or absence of sleep bruxism before and after placement of an orthodontic appliance [20].

A single dentist who had undergone a training and calibration exercise with satisfactory kappa values conducted the clinical examinations. The participation of parents/caregivers was voluntary.

Data relating to the occlusal characteristics of patients undergoing treatment was collected from the documentation and orthodontic records of the clinics using a separate form.

Changes in anterior overlap, over jet and overbite were based on criteria described in literature: normal overbite was defined as when the upper incisors overlapped the lower incisors by no more than 3 mm, and normal over jet was defined as no more than 2 mm. Changes of more than 3 mm were considered altered over jet and overbite [21,22].

The methodology of the study was tested in a pilot study involving 20 parents/caregivers of patients undergoing orthodontic treatment at FOUFGM. These participants were not included in the main study.

This study was approved by the Human Research Ethics Committee of the Universidade Federal de Minas Gerais (COEP/UFMG) (protocol ETIC 03205).

All data was analyzed using the SPSS 21.0 software program. Descriptive data analysis and the chi-square test were used to analyze the correlations between the dependent variable "sleep bruxism" and the other variables collected, with a 5% significance level.

Results

A total of 135 parents/caregivers were contacted. Of these, 108 agreed to participate (80%), but only 66 (61.1%) were included in the study. The loss of 42 participants (39%) was the result of a failure to fully complete the questionnaire and/or incomplete information available in the medical records consulted.

Participants were divided into two groups. The first group consisted of 44 patients undergoing orthodontic treatment, which 29 were male (65.9%). The second group consisted of 22 patients awaiting orthodontic treatment, the majority were male (72.7%).

Patients undergoing orthodontic treatment

The participants in the study were patients aged from seven to 15 years (Table 1) with a mean age of 10.6 years (SD = 2.058). The age range of the parents/caregivers of the patients ranged from 18 to 69 years (Table 1), with a mean age of 42 years (SD = 9.77). Not all parents/caregivers responded to the item "age".

Among the 44 patients already undergoing orthodontic treatment, 36.4% suffered from sleep bruxism before orthodontic treatment (Table 1).

The other results referring to sleep bruxism before treatment among patients are at Table 1. The prevalence of sleep bruxism among parents/guardians was 15.9% (Table 1).

Most patients slept in various positions at night (31.8%), according to the reports of parents/caregivers (Table 1).

Some parents/caregivers reported that patients frequently slept in more than one position, and these were counted separately in statistical analysis.

There was no significant association between the presence of sleep bruxism, before and after treatment, and the type of malocclusion (Table 2).

Variables	Case Group		Control Group	
	N	%	N	%
Bruxism Before Treatment				
Yes	16	36.4	6	27.3
No	28	63.6	16	72.7
Bruxism Continued After Treatment				
Yes	4	25		
No	12	75	-	-
Bruxism Only After The Beginning Of Orthodontic Treatment				
Yes	4	9.1	-	-
No	40	90.9		
Parent/Caregiver Experienced Bruxism				
Yes	7	15.9	7	31.8
No	37	84.1	15	68.2
Hours of Sleep per Night				
>8 hours	38	86.4	18	81.8
<8 hours	6	13.6	4	18.2
*Patient's Sleep Position				
On side	13	29.5	3	13.6
On back	13	29.5	9	40.9
On stomach	11	25	4	18.2
Various Positions	14	31.8	6	27.3
Age of Patients Undergoing Treatment				
07 to 10 years	22	50	15	68.2
11 to 15 years	22	50	7	31.8
Age of Parents/Caregivers of Patients Undergoing Treatment				
18 to 42 years	23	56.1	14	63.6
43 to 69 years	18	43.9	8	36.4
Patients That Drool During Sleep	17	38.6	13	59.1
Patients Complaining of Pain in TMJ	3	6.8	1	4.5
Patients Using Medication				
Yes	6	13.6	5	22.7
No	38	86.4	17	77.3
Type of Parent/Caregiver				
Father	3	20.5	7	31.8
Mother	31	10.5	13	59.1

Grandmother or Grandfather	9	6.8	1	4.5
Brother/Sister	1	2.3	-	-
Aunt/Uncle	-	-	1	4.5

Table 1: Descriptive analysis of studied variables in children and adolescents patients undergoing orthodontic treatment and patients yet to receive orthodontic treatment at the orthodontic clinic of a public university in Belo Horizonte, Brazil. *Parent/caregiver could describe more than one sleeping position.

	Bruxism before beginning of treatment		P*	Bruxism after beginning of treatment		p*
	No	Yes		No	Yes	
Malocclusion	n (%)	n (%)		n (%)	n (%)	
Crowding	3 (60%)	2 (40%)	0.962	5 (100%)	0 (0%)	0.433
Jaw Atresia	1 (100%)	0 (0%)	0.418	1 (100%)	0 (0%)	0.739
Class II canine	0 (0%)	1 (100%)	0.206	1 (100%)	0 (0%)	0.739
Class II	4 (100%)	0 (0%)	0.092	4 (100%)	0 (0%)	0.489
Altered overjet	5 (55.6%)	4 (44.4%)	0.706	9 (100%)	0 (0%)	0.264
Altered overbite	4 (57.1%)	3 (42.9%)	0.819	7 (100%)	0 (0%)	0.339
Class III	2 (66.7%)	1 (33.3%)	0.834	2 (66.7%)	1 (33.3%)	0.153
Midline Deviation	2 (100%)	0 (0%)	0.246	2 (100%)	0 (0%)	0.634
Anterior Open Bite	3 (75%)	1 (25%)	0.545	4 (100%)	0 (0%)	0.489
Diastema	1 (100%)	0 (0%)	0.418	1 (100%)	0 (0%)	0.739
Anterior Crossbite	9 (53%)	8 (47%)	0.375	14 (82.4%)	3 (17.6%)	0.152
Bilateral Posterior Crossbite	4 (66.7%)	2 (33.3%)	0.757	5 (83.3%)	1 (16.7%)	0.537
Unilateral Posterior Crossbite	2 (50%)	2 (50%)	0.636	4 (100%)	0 (0%)	0.489

Table 2: Presence of bruxism compared to type of malocclusions presented by children and adolescents patients undergoing orthodontic treatment at an orthodontic clinic of a public university in Belo Horizonte, Brazil. *Chi-squared test; p = Probability value. Note: some patients suffered from more than one type of malocclusion.

There was no association between gender and sleep bruxism before starting treatment, but there was a higher percentage of the parafunction among women (46.7%, $p = 0.307$). A high percentage of patients with sleep bruxism (71.4%) had parents/caregivers that also suffered from the condition ($p = 0.035$) (Table 3).

When compared the type of treatment, interceptive or corrective, with the moment that sleep bruxism manifested in patients the result found was: interceptive orthodontic treatment was present in 77% of the cases that sleep bruxism stopped during treatment ($p = 0.029$); corrective orthodontic treatment was present in 22.8% of patients which sleep bruxism started only after the beginning of orthodontic treatment, comparing to 9% of patients having interceptive treatment ($p = 0.002$) (Table 3).

Patient awaiting orthodontic treatment

A total of 27.3% of the 22 patients awaiting orthodontic treatment had sleep bruxism (Table 1). The age of these patients ranged from

seven to 14 years, with an average age of 9.1 years (SD = 1.79) (Table 1). The average age of parents/caregivers was 38.8 years (SD = 8.9), with the youngest aged 24 and the oldest 58 years old (Table 4).

According to information supplied by parents/caregivers, 40.9% of patients slept on their backs (Table 1), while only one patient (4.5%) complained of pain in the TMJ. The majority of the parents/caregivers (59.1%) reported that patients drooled during sleep (Table 1).

A total of 33.3% of parents/caregivers said that they ground their teeth at night. When parents/caregivers with sleep bruxism were compared with patients with the parafunction, the result found was 57.14% ($p = 0.035$) (Table 3). It was observed that 72.72% of patients had frequent headaches. Among these patients, 33.3% grinded their teeth at night ($p = 0.350$) (Table 3).

Anterior crossbite was the most prevalent malocclusion among patients undergoing orthodontic treatment (41.5%) (Table 4). Many patients had more than one type of malocclusion.

Variables	Case Group		P*	Control Group		P*
	Bruxism before beginning of treatment			Bruxism in patients before treatment		
	No (%)	Yes (%)		No (%)	Yes (%)	
Headache						
No	17 (73.9%)	06 (26.1%)	0.138	06 (85.7%)	01 (14.3%)	0.35
Yes	11 (52.4%)	10 (47.6%)		10 (66.7%)	06 (33.3%)	
Parent/Caregiver with Bruxism						
No	26 (70.3%)	11 (29.7%)	0.035	13 (86.7%)	02 (13.3%)	0.035
Yes	02 (28.6%)	05 (71.4%)		03 (42.9%)	04 (57.1%)	
Gender						
Female	08 (53.3%)	07 (46.7%)	0.307			
Male	20 (68.9%)	09 (31.1%)				
Type of Orthodontic Treatment						
Interceptive	19 (52.7)	17 (47.3)	0.097			
Corrective	21 (47.7)	23 (52.3)				
	Bruxism stop during treatment		p*			
	No (%)	Yes (%)				
Type of Orthodontic Treatment						
Interceptive	03 (23.0)	10 (77.0)	0.029			
Corrective	25 (92.5)	02 (7.5)				
	Bruxism only after beginning of orthodontic treatment		p*			
	No(%)	Yes(%)				
Type of Orthodontic Treatment						
Interceptive	20 (91.0)	02 (09.0)	0.002			
Corrective	17 (77.2)	05 (22.8)				

Table 3: Relationship between sleep bruxism before the start of orthodontic treatment and studied variables in children and adolescents patients undergoing orthodontic treatment and patients yet to receive treatment at an orthodontic clinic of a public university in Belo Horizonte, Brazil. *Chi-squared test; p = Probability value. Not all questions were answered in orthodontic records. Not all questions were answered by all parents.

Discussion

The true etiology of the bruxism remains controversial in literature [3,5], with the most likely cause of the parafunction being linked to emotional factors and genetics [6,11,12]. The prevalence of sleep bruxism in patients undergoing orthodontic treatment before starting the treatment (36.4%) in the present study were similar to those found in literature [14,20].

An association was found between parents/caregivers with bruxism and patients with sleep bruxism in both groups, which corroborates the findings of other studies [12,23]. The association found between patients with sleep bruxism and parents/caregivers also with the parafunction confirms potential familial relationship [23-25].

No genetic evaluations made between the groups. So, we can't call with word "heredity". However, as exists a strong influence of behavioral factors and the environment in which he lives the bruxer perhaps this explains the same behavior between parents and children [24]. This aspect deserves further study. An evaluation of the possible relationship between sleep bruxism and type of orthodontic treatment found a high percentage of participants for whom the parafunction ceased following treatment (75%).

Patients who continued to suffer from sleep bruxism following the beginning of orthodontic treatment (25%) are perhaps those whose quality of life was impacted most by the discomforts of the appliance, or who had a very high expectation of aesthetic change following

orthodontic correction, which subsequently generated some emotional frustration [18,19].

These findings referring to an association of sleep bruxism and the type of orthodontic treatment, corrective or interceptive, is unprecedented in literature, showing the importance to dedicate in further investigation.

A comparison of the relationship between sleep bruxism both before and after the beginning of treatment and the type of malocclusion suffered by patients undergoing treatment showed that there was no statistical association between these factors, a finding which disagreed with another Brazilian study [26].

Malocclusion	n	%
Anterior Crossbite	17	41.5
Accentuated Overjet	9	22
Accentuated Overbite	7	17.1
Bilateral Posterior Crossbite	6	14.6
Crowding	5	12.2
Anterior Open Bite	4	9.8
Class II	4	9.8
Unilateral Posterior Crossbite	4	9.8
Class III	3	7.3
Midline deviation	2	4.9
Atresia	1	2.4
Class II Canine	1	2.4
Diastema	1	2.4

Table 4: Most frequent types of malocclusion in children and adolescents patients undergoing orthodontic treatment at an orthodontic clinic of a public university in Belo Horizonte, Brazil. Note: Some patients had more than one type of malocclusion.

This result may have been influenced by the small sample size of the present study and the fact that data regarding malocclusions was collected from medical records of patients. As the present study was undertaken in a university environment, many students record information in these files, with diagnostic criteria varying from student to student, even when under the supervision of a professor.

In addition, it was observed that a higher percentage of parents responded to the questionnaire in this other Brazilian study. The present study had a lower adherence rate, with many blank questionnaires blank due to parents saying they had a lack of time to complete the questionnaire.

This behavior was different to that recorded in another study conducted at the same institution which evaluated the knowledge of parents/caregivers, and where mothers made up the largest group of parents/caregivers participating. Perhaps as a result, there was greater compliance and lower loss in said study [23].

The use of more accurate diagnosis, by electronic means or through the use of polysomnography and electromyography, may generate a more accurate diagnosis. However, this was an epidemiological study based on the AASM criteria [6]. Parents/caregivers responsible for caring for their children at night are often able to identify the noise made during the parafunction studied [14].

The main aim of the present study was to find a possible association between sleep bruxism and the type of orthodontic treatment. An association with the interceptive and corrective orthodontic treatment

was proven in this study and in a 2011 study, Costa et al. found an association between the use of orthodontic appliances and their impact on the quality of life of children [18].

Other studies have sought to identify an association between malocclusion and oral health related quality of life [21,26]. These studies raise questions regarding the emotional influence attributed to the use of orthodontic appliances and the treatment itself, such as how a patient will react to the prospect of orthodontic treatment.

The association between quality of life and the use of orthodontic appliances can be something related to the prevalence of sleep bruxism among children and adolescents during orthodontic treatment since in our study we found that corrective orthodontic treatment was more related to beginning of sleep bruxism after placing the appliance (22.8%) when compared to interceptive treatment (9%).

The association between sleep bruxism and orthodontic treatment is something to be observed in other studies since this find can, with further investigation, influence the choice of orthodontic treatment in children and adolescents.

We need to be very careful when treating children and adolescents with emotional problems and distress once the orthodontic treatment can interfere negatively in their quality of life.

It's a preliminary study. For this hypothesis to be proven, longitudinal studies with larger sample groups and monitoring of the

patient from the pre-treatment phase until the end of treatment will be required.

Acknowledgement

The present study received financial support from the following Brazilian funding agencies: Conselho Nacional de Pesquisa (CNPq), Fundação de Amparo à Pesquisa de Minas Gerais (FAPEMIG) and Pró-reitoria de Pesquisa da Universidade Federal de Minas Gerais (PRPq/UFMG).

Authors Contribution

Conceived and designed the experiments: IMP; SMA; JMSN. Performed the experiments: IMP; MOB. Analyzed the data: SMA; SMP; IAP; JMSN. Contributed reagents/materials/analysis tools: SMP IAP. Wrote the manuscript: IMP; MOB; JMSN. Final edition of the manuscript: JMSN; SMA; SMP; IAP.

References

1. Laat AD, Macaluso GM (2002) Sleep bruxism as a motor disorder. *Mov Disord* 17: 67-69.
2. Gonçalves LVP, Toledo AOD, Otero AS (2010) The relationship between bruxism, occlusal factors and oral habits. *Dental Press J Orthod* 15: 97-104.
3. Lavigne GL, Shoury S, Abe S, Yamaguchi T, Raphael K (2008) Bruxism physiology and pathology: an overview for clinicians. *J Oral Rehabil* 33: 476-494.
4. Nishigawa K, Bando E, Nakano M (2001) Quantitative study of bite force during sleep associated bruxism. *J Oral Rehabil* 28: 485-491.
5. Behr M, Hahnel S, Faltermeier A, Bürgers R, Kolbeck C, et al. (2012) The two main theories on dental bruxism. *Ann Anat* 194: 216-219.
6. Serra-Negra JM, Paiva SM, Seabra AP, Dorella C, Lemos BF, et al. (2010) Prevalence of sleep bruxism in a group of Brazilian schoolchildren. *Eur Arch of Paediatr Dent* 11: 192-195.
7. Ferreira-Bacci AV, Cardoso CL, Díaz-Serrano KV (2012) Behavioral Problems and emotional stress in children with bruxism. *Braz Dent J* 23: 245-251.
8. Manfredini D, Landi N, Romagnoli M, Bosco M (2004) Psychic and occlusal factors in bruxers. *Aust Dent J* 49: 84-89.
9. Clark GT, Rugh JD, Handelman SL (1980) Nocturnal masseter muscle activity and urinary catecholamine levels in bruxers. *J Dent Res* 59: 1571-1576.
10. Vanderas AP, Menenkuo M, Kouimtzi TH, Papagiannoulis L (2009) Urinary catecholamine levels and bruxism in children. *J Oral Rehabil* 26: 103-110.
11. Giraki M, Schneider C, Schäfer R, Singh P, Franz M, et al. (2010) Correlation between stress, stress-coping and current sleep bruxism. *Head Face Med* 6: 1-8.
12. Moore M, Slane J, Mindell JA, Burt AS, Klumb KL (2011) Genetic and environmental influences on sleep problems: a study of preadolescent and adolescent twins. *Child Care Health Dev* 37: 638-641.
13. Castelo PM, Gavião MBD, Pereira LJ, Bon Jardim LR (2005) Relationship between oral parafunctional/nutritive sucking habits and temporomandibular joint dysfunction in primary dentition. *Int J Paediatr Dent* 15: 29-36.
14. Cheifetz AT, Osganian SK, Allred EM, Needleman HL (2005) Prevalence of bruxism and associated correlates in children as reported by parents. *J Dent Child* 72: 67-73.
15. Guimarães CH, Henriques J, Janson G, Moura WS (2015) Stability of interceptive/corrective orthodontic treatment for tooth ankylosis and Class II mandibular deficiency: A case report with 10 years follow-up. *Indian J Dent Res* 3: 315-319.
16. Sandoval P, Bizcar B (2013) Benefits of Implementation of Orthodontics Interceptive in the Children's Clinic. *Int J Odontostomat* 7: 253-265.
17. Patel MP, Henriques JFC, Almeida RR, Pinzan A, Janson G, et al. (2013) Comparative cephalometric study of class II malocclusion treatment with Pendulum and Jones jig appliances followed by fixed corrective orthodontics. *Dental Press J Orthod* 6: 58-64.
18. Costa AA, Ferreira MC, Serra-Negra JM, Pordeus IA, Paiva SM (2011) Impact of wearing fixed orthodontic appliances on oral health-related quality of life among Brazilians children. *J Orthod* 38: 275-281.
19. Marques LS, Paiva SM, Vieira-Andrade RG, Pereira LJ, Ramos-Jorge ML (2014) Discomfort associated with fixed orthodontic appliances: determinant factors and influence on quality of life. *Dental Press J Orthod* 19: 102-107.
20. Serra-Negra JM, Paiva SM, Flores-Mendoza CE, Ramos-Jorge ML, Pordeus IA (2012) Association among stress, personality traits, and sleep bruxism in children. *Pediatr Dent* 34: 30-34.
21. Gois EGO, Ribeiro-Junior HC, Vale MPP, Paiva SM, Serra-Negra JMC, et al. (2008) Influence of nonnutritive sucking habits, breathing pattern and adenoid size on the development of malocclusion. *Angle Orthod* 78: 647-654.
22. Góis EG, Vale MP, Paiva SM, Abreu MH, Serra-Negra JM, et al. (2012) Incidence of malocclusion between primary and mixed dentitions among Brazilian children. A 5-year longitudinal study. *Angle Orthod* 82: 495-500.
23. Serra-Negra JM, Tirsá-Cosra D, Guimarães FH, Paiva SM, Pordeus IA (2013) Evaluation of parents/caregiver knowledge about the bruxism of their children: family knowledge of bruxism. *J Indian Soc Pedod Prev Dent* 31: 153-158.
24. Serra-Negra JM, Paiva SM, Auad SM, Ramos-Jorge ML, Pordeus IA (2012) Signs, symptoms, parafunctions and associated factors of parent-reported sleep bruxism in children: a case-control study. *Braz Dent J* 23: 746-752.
25. Serra-Negra JM, Paiva SM, Fulgêncio LB, Chavez BA, Lage CF, et al. (2014) Environmental factors, sleep duration, and sleep bruxism in Brazilian schoolchildren: a case-control study. *Sleep Med* 15: 236-239.
26. Sousa RVD, Ribeiro GL, Firmino RT, Martins CC, Granville-Garcia AF, et al. (2014) Prevalence and associated factors for the development of anterior open bite and posterior crossbite in the primary dentition. *Braz Dent J* 25: 336-342.