Relationship between Mandibular Condyle Position and Dental Wear Pattern in Individuals with Sleep Bruxism Clinical Diagnosis *

Relación entre la posición del cóndilo mandibular y el patrón de desgaste dental en personas con diagnóstico clínico de bruxismo del sueño

Relação entre a posição do côndilo mandibular e o padrão de desgaste dentário em indivíduos com diagnóstico clínico de bruxismo do sono

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ABSTRACT

Background: Sleep *bruxism* (SB) is an oromandibular activity with teeth grinding and clenching and a masticatory muscle activity. It generates temporomandibular dysfunction (TMD), tooth wear and mobility, as well as other clinical findings. It is important to analyze occlusion and TMJ to determine how it is affected by the biomechanical load generated by bruxism. **Purpose:** To establish the relationship between the condylar position of the temporomandibular joint (TMJ) using cone beam computed tomography (CBCT) with the dental wear patterns determined with the BruxChecker®, in subjects with a clinical diagnosis of sleep bruxism. **Methods:** Observational, descriptive, cross-sectional study in 45 patients with clinical diagnosis of sleep bruxism, according to the bruxism diagnostic criteria of the AASM (American Academy of Sleep Medicine), with an average age of 34.9 ± 8.6. The CBCT were analyzed, measuring the spaces of the TMJ in the sagittal plane: anterior, superior and posterior (SA, SS, SP) and in the coronal plane: lateral, superior and medial (Cl, CS, CM). The pattern of dental wear was classified with the BruxChecker® by dividing the subjects into: Group 1, canine pattern (CP) with 19 subjects and Group 2, molar pattern (MP) with 26 subjects. **Results:** No significant differences were observed between the measurements of the joint spaces of each group nor in the comparison between the PC vs PM patterns. The sagittal position of the condyle posterior/anterior(P/A) was posterior and the coronal medial/lateral (M/L) was medial for the two groups, when evaluating the ratios. Significant difference (P <0.00) was found in right pattern CP and MP, when estimating the difference between averages of medial and lateral spaces. **Conclusions:** The position of the condyle was found posterior and medial in the

articular fossa, in the right CP and in the left MP. A significant right lateral condyle position was evidenced in PC and PM. These findings indicate an altered condylar position in subjects with bruxism, which can be associated with joint distraction, possibly generated by constant eccentric mandibular movements during bruxism.
Keywords: BruxChecker®; cone-beam computed tomography; dentistry; mandibular condyle; sleep bruxism; temporomandibular joint; temporomandibular disorders

RESUMEN

Antecedentes: El bruxismo del sueño (BS) es una actividad oromandibular con rechinamiento y apretamiento dental y una actividad muscular masticatoria. Genera disfunción temporomandibular (DTM), desgaste y movilidad dental, así como otros hallazgos clínicos. Es importante analizar la oclusión y la ATM para determinar cómo se afecta por la carga biomecánica generada por el bruxismo. **Objetivo:** Establecer la relación entre la posición condilar de la articulación temporomandibular (ATM) utilizando tomografías computarizadas de haz cónico (TCHC) con los patrones de desgaste dental determinados con el BruxChecker®, en sujetos con diagnóstico clínico de BS**. Métodos:** Estudio observacional, descriptivo, transversal, en 45 pacientes con diagnóstico clínico de bruxismo del sueño, según los criterios de diagnóstico del bruxismo de la AASM (American Academy of Sleep Medicine), con edad promedio de 34,9 ± 8,6. Se analizaron las TCHC, midiendo los espacios de la ATM en el plano sagital: anterior, superior y posterior (SA,SS,SP) y en el plano coronal: lateral, superior y medial (CL,CS,CM). Se clasificó el patrón de desgaste dental con el BruxChecker® dividiendo los sujetos en: Grupo 1, patrón canino (PC) con 19 sujetos y Grupo 2, patrón molar (PM) con 26 sujetos. **Resultados**: No se observaron diferencias significativas entre las medidas de los espacios articulares de cada grupo ni en la comparación entre los patrones PC vs PM. La posición sagital del cóndilo posterior/anterior (P/A) fue posterior y la coronal medial/lateral (M/L) fue medial para los dos grupos, al evaluar las ratios. Se encontró diferencia significativa (P<0,00) en los patrones PC y PM del lado derecho, al estimar la diferencia entre promedios de espacios medial y lateral. **Conclusiones**: La posición del cóndilo se encontró posterior y medial en la fosa articular, en los patrones PC derecho y PM izquierdo. Se evidenció una posición condilar lateral derecha significativa, en los patrones PC y PM. Estos hallazgos indican una posición condilar alterada en los sujetos con bruxismo, que se puede asociar con un desplazamiento del cóndilo dentro de la fosa articular, generada posiblemente por los movimientos excéntricos mandibulares constantes durante la actividad de bruxismo.
Palabras clave: articulación temporomandibular; BruxChecker®; bruxismo del sueño; cóndilo mandibular; odontología; tomografía computarizada de haz cónico; trastornos temporomandibulares

RESUMO

Antecedentes: O bruxismo do sono (SB) é uma atividade oromandibular com ranger e apertar os dentes e atividade muscular da mastigação. Gera disfunção temporomandibular (DTM), desgaste e mobilidade dentária, além de outros achados clínicos. É importante analisar a oclusão e a ATM para determinar como ela é afetada pela carga biomecânica gerada pelo bruxismo. **Objetivo:** Estabelecer a relação entre a posição condilar da articulação temporomandibular (ATM) por meio da tomografia computadorizada de feixe cônico (TCCT) com os padrões de desgaste dentário determinados pelo BruxChecker®, em indivíduos com diagnóstico clínico de SB. **Métodos:** Estudo observacional, descritivo, transversal em 45 pacientes com diagnóstico clínico de bruxismo do sono, segundo os critérios diagnósticos de bruxismo da AASM (American Academy of Sleep Medicine), com idade média de 34,9 ± 8,6. Os TCHC foram analisados, medindo-se os espaços da ATM no plano sagital: anterior, superior e posterior (SA,SS,SP) e no plano coronal: lateral, superior e medial (CL,CS,CM). O padrão de desgaste dentário foi classificado com o BruxChecker®, dividindo os sujeitos em: Grupo 1, padrão canino (PC) com 19 sujeitos e Grupo 2, padrão molar (PM) com 26 sujeitos. **Resultados:** Não foram observadas diferenças significativas entre as medidas do espaço articular de cada grupo ou na comparação entre os padrões PC vs PM. A posição sagital do côndilo posterior/anterior (P/A) foi posterior e a posição coronal medial/lateral (M/L) foi medial para ambos os grupos, quando avaliadas as relações. Foi encontrada diferença significativa (P<0,00) nos padrões PC e PM do lado direito, ao estimar a diferença entre as médias dos espaços medial e lateral. C**onclusões:** A posição do côndilo foi encontrada posterior e medial na fossa articular, nos padrões PC direito e PM esquerdo. Uma posição condilar lateral direita significativa foi evidente nos padrões PC e PM. Esses achados indicam uma posição condilar alterada em indivíduos com bruxismo, que pode estar associada a um deslocamento do côndilo dentro da fossa articular, possivelmente gerado por movimentos mandibulares excêntricos constantes durante a atividade de bruxismo.
Palavras-chave: articulação temporomandibular; BruxChecker®; bruxismo do sono; côndilo mandibular; distúrbios temporomandibulares; odontologia; tomografia computadorizada de feixe cônico

INTRODUCTION

BS is an oromandibular activity with tooth grinding and clenching. Likewise, it is considered a masticatory muscle activity (CMMA) related to brain activations, and as a movement disorder during sleep (1–3).

Individuals with BS have been described to experience jaw pain and fatigue of the masticatory muscles with or without temporomandibular dysfunction (TMD) (4). BS is an important factor in the onset and persistence of temporomandibular pain. It is a common source of microtrauma that generates alteration of the capsular ligaments, thinning of the articular disc and lack of muscle coordination (5). It presents tooth wear and mobility, as well as other clinical findings, such as in the tongue or cheeks, muscle hypertrophy, pain in the temporomandibular joint (TMJ), headaches and pain or fatigue of the chewing muscles (6).

It is important to analyze the occlusion to determine how it is affected by the biomechanical load generated by bruxism (5). Examining the tooth wear pattern during BS and understanding the relationship between bruxism activity and individual occlusion patterns are important in clinical dental practice. The clinical examination is the most used method to assess occlusal patterns but has the limitation of being performed while awake. To categorize wear facets, the BruxChecker® was developed, a device that allows, through visual inspection, to establish tooth contact patterns during mandibular dynamics without altering muscular and occlusal activity (7–11). Through it, it has been shown that subjects with TMJ symptoms had more posterior and mediotrusive contacts during BS, suggesting that posterior interferences potentially cause deflective effects on TMJ function (10). The faceted patterns of incisor-canine-premolar-molar wear between buccal and lingual cusps on the working side; with or without coincident type wear between functional cusps on the non-working side are at greater risk of producing TMD, because bruxism generally results in alteration of the capsular and disc ligaments, thinning of the articular disc, which together with the Lack of muscular coordination leads to lateral displacement and greater translational condylar movement(10).

It is mentioned that BS can change the spatial relationships of the condyle within the fossa; Therefore, determining the condyle-fossa relationship is important to establish TMJ involvement (12) and among the imaging techniques to achieve this goal, cone beam computed tomography (HCCT) stands out, as it provides high-quality images. of bone components in all planes and allows measurements to be made with high precision (13–16). Determination of the position of the condyle in the joint cavity with HSCT has been performed in healthy subjects and normal values have been established in the coronal and sagittal planes (17–19). The centric position of the condyle in the glenoid cavity has been observed as the most common (92.5 %) (19). The condylar position has also been evaluated in people with malocclusions and TMD and has shown variations with respect to healthy TMJ (12,20–22) .

The condylar position depends on several factors such as occlusion, craniocervical posture, and the shape and position of the articular disc. The latter sagittally has a biconcave shape with a thicker posterior and anterior part and a thinner central part. During movement it can adapt to the functional demands of the articular surface and preserves its morphology unless destructive forces or structural changes occur in the joint, which leads to morphological alterations in a reversible manner, producing mechanical changes during its function. 23,24). The articular disc can only be assessed with magnetic resonance images, therefore with HCCT we are only assessing the space between the condyle and the articular fossa without knowing the real condition of the disc.

Determining the condylar position and its relationship with the wear pattern will provide more elements for planning and control during treatments with occlusal changes. In this way, a more personalized procedure can be performed where the loads on the TMJ, generated by the eccentric condylar positions, are balanced. If adverse articular and occlusal factors are controlled, greater long-term stability will be obtained and the structures of the stomatognathic system will be protected.

Although BS is a widely reported topic, previous studies have limitations in the information on the relationship of the dental wear pattern determined by the use of the BruxChecker®, with the condylar position, determined by measuring the spaces. temporomandibular joints with TCHC. Therefore, the question arises: Are there changes in the condylar position of the TMJ related to the type of dental wear pattern during BS?

Taking this background into account, the objective of this study was to establish the relationship between the condylar position of the TMJ, through TCHC, and its relationship with dental wear patterns determined with the BruxCheker®, in people with a clinical diagnosis of BS. The dentist will have at his disposal a novel and easy-to-use tool to visualize the dynamics of tooth movement that can be complemented with the CTHC analysis, having individual information for occlusal treatment.

MATERIALS AND METHODS

A descriptive study with a cross-sectional observational design was conducted. The starting point was an existing sample of 50 medical records of patients who attended private consultation for TMD in Bogotá, Colombia, and who included in their clinical history a clinical diagnosis of BS, HSCT of TMJ and use of BruxChecker®, during the study period. January 2014 to October 2018. This study was approved by the UniCieo Research Bioethics Committee on October 23, 2017. All participants approved the handling of their data and examinations for inclusion in the study by signing the consent form. informed.

The type of sampling was non-probabilistic for convenience. The sample size was established from the measurements of a pilot study with seven subjects for each wear pattern group, defining the sample size with Epidat 4.1 (25) with a formula for comparing independent means, with a power of 90 % and a confidence level of 95 %. The standard deviation for the canine pattern was 0.760 and for the molar pattern was 1.080; with a minimum difference of 0.03 mm; The result obtained was 19 tomography scans per study group.

All study subjects had a clinical diagnosis of sleep bruxism according to the criteria of the American Academy of Sleep Dysfunctions (3) and met the inclusion criteria: adults over 18 years of age, men and women, with at least six teeth per hemiarch and existence of canine contact in maximum intercuspation. Those with orthodontic or rehabilitation treatments at the time of the tomographic recording, cervical trauma (6 months before), alterations in the central nervous system, consumption of hallucinogenic drugs or medications that generate changes in the central nervous system, systemic degenerative diseases, alterations of the cranial-mandibular growth and frequent oral habits.

To classify the wear pattern, the clinical application of the BruxChecker® (9) was conducted, a thin plate to evaluate dental wear patterns during sleep bruxism, by observing the wear of the revealing ink. Impressions of the upper jaw were taken with Orthoprint® alginate (Zhermack®) and the models were obtained by casting in Whip Mix® brand type III plaster, on which the BruxChecker® was pressed in the Biostar® machine at a temperature of 220 °C. , for 15 s, with a pressure of 2.5 bar. This plate was trimmed 2 mm from the gingival margin on the buccal and palatal side. The models were marked with the full name of each person and delivered in individual boxes, with instructions for use explained and provided. When the BruxChecker® were received, they were placed in the mouth and the contacts in maximum occlusion were marked with black Accu-film® articulating paper. The classification of the wear facet pattern was carried out by first analyzing the relationship between buccal and lingual cusps on the working side with two options: canine pattern (PC) when the wear area includes canines and incisors and molar pattern (PM) when the wear area includes incisors, canines, premolars and molars; Secondly, the wear between functional cusps on the non-working side of the first and second molars called mediotrusive wear (MD) was determined, as described by Onodera, *et al*. (9). (Figure 1).

FIGURE 1
Preparation, application and classification of BruxChecker®. Canine pattern (PC) with mediotrusive wear (DM), molar pattern (PM) with mediotrusive wear (DM).

To establish the condylar position in the articular fossa, CTHC scans of the craniocervical area were used, taken with the same equipment, in natural head posture, using the Planmeca ProMax® 3D Mid tomograph and the Planmeca Romexis® Viewer volume representation software. The dose protocol for taking the skull was C4, 90 Kv, 6 Ma, 253 mAs, 18s, FOV O200 X 180, an effective dose of 87 uSv. Tomographic measurement of the temporomandibular spaces was performed in the sagittal and coronal planes bilaterally, with prior standardization of the level of the cuts in the axial plane following the major condylar axis from the medial to the lateral pole, considering the condylar center. The cut level was independent for each joint (Figure 2A).

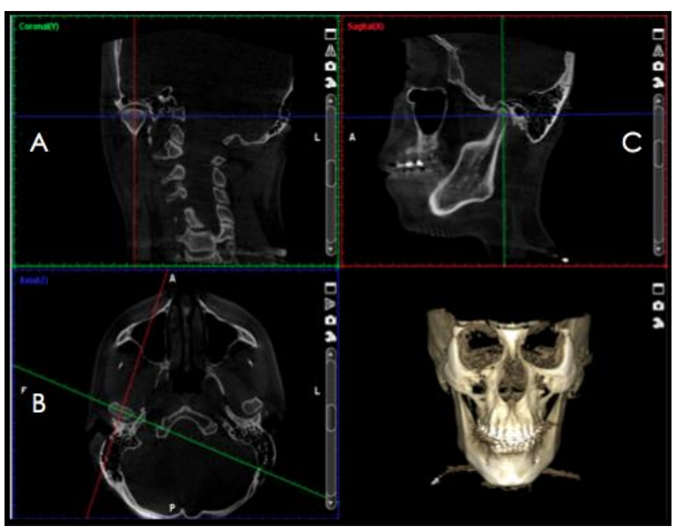

FIGURE 2.
A Coronal section, B axial and C sagittal to standardize the level of section to measure temporomandibular articular spaces.

According to the description of Henriques *et al.* (20) Reference lines for measurements were drawn in millimeters. In the sagittal plane: Line 1- connects the most inferior-posterior part with the most anteroinferior part of the mandibular fossa. Line 2- superimposition on the condyle of line 1; mean reference point (MRP) - corresponds to the middle of line 2; superior sagittal line (LSS)- the line drawn from the PMR point at 90º in relation to line 1; posterior line (LP) - corresponds to the posterior line drawn from the PMR point at 45º in relation to line 1; anterior line (LA) - corresponds to the anterior line drawn from the PMR point at 45º in relation to line 1. Then the joint spaces were measured that correspond to the distance between the highest point of the condyle and the innermost point of the mandibular fossa, which was superimposed on the LSS, LP and LA lines, thus obtaining the values for the SS-superior sagittal, SP-posterior sagittal and SA-anterior sagittal spaces respectively (Figure 3).

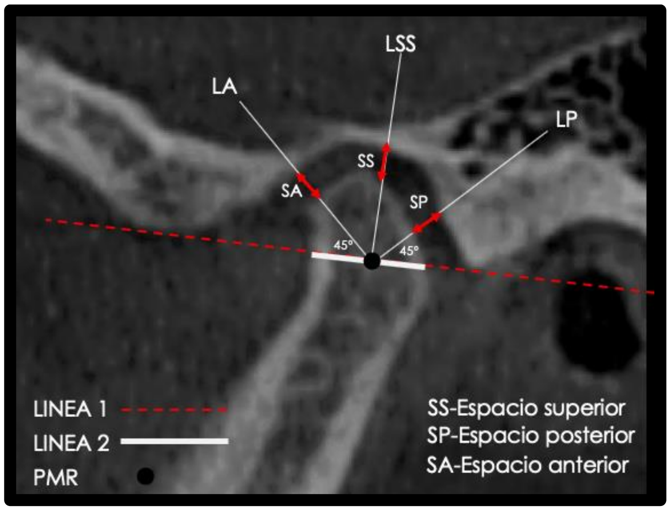

FIGURE 3
Tomographic sagittal measurement of articular spaces

In the coronal plane the following lines were drawn: Line A- connects the most lateral part with the most medial part of the condyle; Mid reference point (PMR): corresponds to the middle of line A. Superior coronal line (LSC): the line drawn from the PMR point at 90º in relation to line A; Line M (LM): corresponds to the line drawn medially from the PMR point at 45º in relation to line A. Line L (LL): corresponds to the line drawn laterally from the PMR point at 45º in relation to the line A. The joint spaces that correspond to the distance between the highest point of the condyle and the closest internal point of the mandibular fossa that overlapped the LSC, LM and LL lines were measured, thus obtaining the values for the CS-spaces. superior coronal, CM-medial coronal and CL-lateral coronal, respectively. (Figure 4).

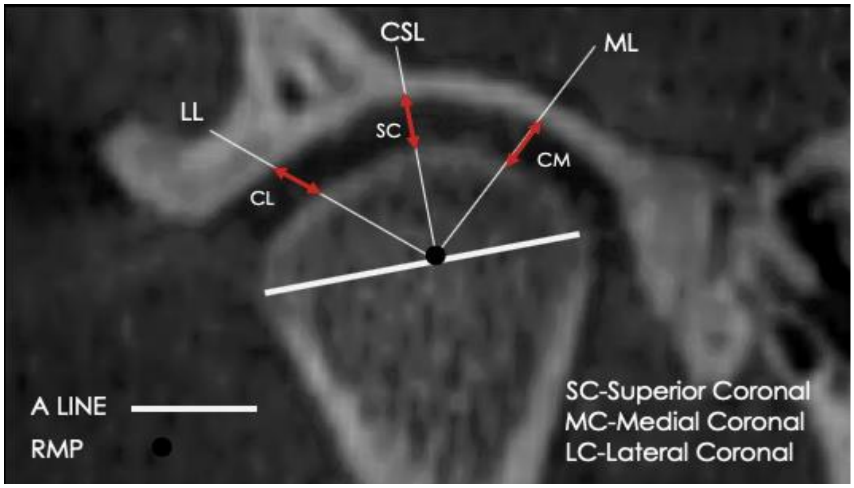

FIGURE 4
Temporomandibular articular spaces taken in coronal view

The statistical analysis was conducted using Minitab software version (17.2.1) and Excel 2010, with an exploratory data analysis using graphic and analytical methods, with the ANOVA technique. The quantitative variables are described with mean ± standard deviation and comparisons were made using the Student t test, setting a probability value P = 0.05 as the level of significance.

RESULTS

The reproducibility of the study was evaluated on 10 tomography scans by the operators. The error of the method was measured with the Dahlberg test that determined the maximum interoperator error of 0.25 mm (CSI) and the systematic error with the Houston T test showed no significant differences between initial and final measurements (P>0.05). Agreement was also measured with the Bland and Altman method, which established that the operators' measurements are within 95 % confidence

TABLE 1
Intraoperator reproducibility, pilot test

	Intraoperator 1 First measurement		Second measurement			Intraoperator 2 First measurement		Second measurement		
Variable	□	S.D	□	S.D	*P**	□	S.D	□	S.D	*P**
ASR	0,00	0,075	0,03	0,07	0,967	0,02	0,037	0,02	0,079	0,167
SSR	0,01	0,07	0,03	0,07	0,728	0,01	0,045	0,03	0,07	0,343
PSR	0,04	0,075	0,02	0,074	0,126	0,01	0,055	0,02	0,074	0,781
ASL	0,02	0,069	-0,04	0,084	0,513	-0,02	0,103	-0,04	0,084	0,594
SSL	-0,02	0,091	0,02	0,047	0,506	-0,03	0,062	0,02	0,047	0,234
PSL	0,04	0,052	-0,02	0,078	0,052	-0,01	0,034	-0,02	0,078	0,343
LCR	-0,02	0,085	0,04	0,138	0,591	-0,01	0,022	0,04	0,138	0,343
SCR	0,00	0,091	0,05	0,071	0,892	-0,03	0,102	0,05	0,071	0,321
MCR	0,04	0,058	-0,02	0,092	0,069	0,01	0,044	-0,02	0,092	0,343
LCL	-0,01	0,049	0,04	0,12	0,62	0,02	0,086	0,04	0,12	0,574
SCL	0,00	0,052	-0,01	0,18	0,815	0,02	0,037	-0,01	0,18	0,127
MCL	0,00	0,106	0,03	0,073	1	0,01	0,037	0,03	0,073	0,343

* t test

The sample was 45 subjects classified into 2 groups: Canine-PC pattern group n= 19 subjects, PM molar pattern group n= 26 subjects. (Table 2).

TABLE 2
Description of the groups

		Age			Sex			
					M		F	
PATTERN	n	□	S.D	*P**	%	n	%	n
CP	19	36,32	9,16	0,54	42,1	8	57,9	11
MP	26	34	8,35	0,55	26,9	7	73,1	19
TOTAL	45							

CP: canine pattern MP: molar pattern. M: male. F: female * t test.

Table 3 shows the mean values and standard deviation (SD) of the sagittal (SA, SS, SP) and coronal (CL, CS, CM) joint spaces of each wear pattern. No significant differences were observed between the averages of the joint space measurements of each group or in the comparison between the PC vs PM patterns.

TABLE 3
Measurements average of the temporomandibular joint spaces (mm) in the groups of study

Articular space	Canine pattern			Molar pattern			CP vs MP
	□	S.D	*P**	□	S.D	*P**	*P**
AS							
Right.	2,30	0,89	0,73	2,25	0,77	0,09	0,95
Left.	2,21	0,63		2,20	0,78		0,76
SS							
Right	2,83	0,80	0,45	2,43	0,68	0,93	0,85
Left	2,64	0,74		2,45	0,62		0,96
PS							
Right	2,24	0,95	0,93	2,17	0,71	0,96	0,63
Left	2,26	0,90		2,18	0,71		0,72
LC							
Right	2,31	0,81	0,06	2,05	0,60	0,35	0,42
Left	2,83	0,86		2,22	0,69		0,83
SC							
Right	2,71	0,87	0,99	2,41	0,63	0,30	0,99
Left.	2,71	0,66		2,61	0,73		0,65
MC							
Right	3,20	0,75	0,93	2,91	0,79	0,45	0,90
Left.	3,04	0,81		2,72	1,06		0,54

* t test. AS: anterior sagittal. SS: superior sagittal. PS: posterior sagittal. LC: lateral coronal. SC: superior coronal. MC: medial coronal. CP: canine pattern. MP: molar pattern.

The condylar position of each group was compared in ratios; it was found that the position of the condyle in the posterior/anterior sagittal plane (P/A) was posterior, and the medial/lateral coronal plane (M/L) was medial for the two groups, with no difference between the right and left sides, or between the two groups. By averaging the right and left sides, P/A 1.13, S/A 1.35, M/L 1.34 was obtained in the canine group and P/A 1.12, S/A 1.22, M/L 1.40 in the molar group. (Table 4).

TABLE 4
Comparison of condylar position. Right and left ratios per group

Ratio	Canine pattern			Molar pattern			CP vs MP
	□	S.D	*P**	□	S.D	*P**	*P**
P/A							
Right	1,10	0,63	0,85	1,07	0,46	0,57	0,81
Left	1,15	0,68		1,16	0,66		0,96
S/A							
Right	1,40	0,58	0,56	1,17	0,44	0,51	0,16
Left	1,29	0,46		1,27	0,59		0,86
M/L							
Right	1,50	0,54	0,06	1,50	0,45	0,17	0,96
Left	1,18	0,47		1,29	0,63		0,51

* t test. P/A: posterior/anterior. S/A: superior/anterior. M/L: medial/lateral. CP: canine pattern. MP: molar pattern.

The condylar position was evaluated in the sagittal and coronal plane, through the difference between the averages of the anterior and posterior spaces, which did not present significant differences (Table 5); However, when estimating the difference between the averages of the medial and lateral spaces, a significant difference (P<0.00) was found in the CP and PM on the right side. (Table 6).

TABLE 5
Condylar sagittal position in the two groups (average difference)

Pattern	Anterior space		Posterior space			
	□	S.D	□	S.D	Difference	*P**
CP						
Right	2,30	0,89	2,24	0,95	0,06	0,68
Left	2,21	0,63	2,26	0,90	-0,05	0,93
MP						
Right	2,25	0,77	3,20	0,90	-0,95	0,70
Left	2,20	0,78	2,18	0,71	0,02	0,94

CP: Canine pattern. MP: Molar pattern. * t test.

TABLE 6
Coronal condylar position in the two groups (average difference)

Pattern	Lateral space		Medial space			
	□	S.D	□	S.D	Difference	*P**
CP						
Right	2,31	0,81	3,20	0,95	-0,89	0,00**
Left	2,83	0,86	3,04	0,90	-0,21	0,51
MP						
Right	2,05	0,60	2,91	0,79	-0,86	0,00**
Left	2,22	0,69	2,72	1,06	-0,53	0,05

CP: canine pattern.MP: molar pattern. * t test ** $P < 0,05$

DISCUSSION

This study in subjects with sleep bruxism explored the relationship of the canine (PC) and molar (PM) dental wear pattern with the condylar position in the sagittal and coronal planes. The averages observed for the measurements of the temporomandibular joint spaces of PC and PM bilaterally did not present significant differences; However, a greater average was evident in the medial coronal space in the two patterns, which may suggest a tendency for a more lateral position of the condyles in this type of patients (Table 3). Henriques *et al*. (20) also did not find significant differences when calculating the condylar variations found between CR (centric relation) and MI (maximum intercuspation) positions in young asymptomatic patients with complete dentitions, who presented different occlusion patterns. However, the values of the medial coronal spaces in our study are higher in the canine pattern and lower in the molar pattern on the left side when compared to those reported by them. When comparing the averages with those obtained by Ikeda *et al.* (17) performed in young asymptomatic patients with joints in optimal function, we found higher values in our study in the medial and lateral space.

Dalili *et al.* (19) mention the concentric condylar position as the most common in healthy subjects with 92.5 %, while Uzel *et al* (22) found the anterior position as the most significant in patients with class II division 1 malocclusion; These findings contrast with those of our study that indicated a more posterior and medial condylar position (Table 4) in subjects with sleep bruxism. But they coincide with what was reported by Alves (12) and Shokri (26) who concluded that the posterior position was the most common in individuals with TMD compared to healthy individuals. Alterations in the concentric position of the condyle during bruxism may be due to the fact that eccentric dental clenching leads to deviation of the mandible, even when the mandible is in the vicinity of the resting position, as concluded by Minagi *et al.* (27).

In the present study, the P/A, S/A and M/L ratios were 1.13, 1.35 and 1.34 for PC and 1.12, 1.22 and 1.40 for PM, while Dalili *et al*. (19) reported values of 1.2, 1.7 and 1.3 respectively in healthy subjects; The P/A and S/A ratios being higher when compared with our study. This indicates that the position of the condyle in the two patterns presents different dimensions when compared with healthy subjects; this type of change may be associated with the type of wear pattern as mentioned by Kawagoe *et al.* (28) by finding a positive relationship between the classification of occlusal wear during sleep bruxism and signs of temporomandibular dysfunction, considering contacts on the non-working side as a key point in the possible role of occlusal factors during sleep bruxism. Sleep as risk indicators in the genesis of TMD.

In the sagittal plane, we did not find significant differences between the averages of the anterior and posterior joint space in any of the patterns (Table 5), but the values are higher than those found by Ganugapanta *et al.* (21) in the study carried out on subjects with a deep bite, reporting in the anterior space (1.91mm right and 2.01mm left) and in the posterior space (1.95mm right and 2.04mm left). We also noticed the anterior space with higher values in the two patterns (PC-2.26 mm and PM-2.23 mm), in relation to what was reported by Ikeda *et al*. (17) with a value of 1.3 mm and the posterior space on the right side (PC-2.23 mm and PM-2.17 mm) and with values lower than those reported by Dalili *et al.* (19); both studies carried out in asymptomatic subjects. But when the condylar position was analyzed with the difference between averages (Table 6), in the coronal plane it was found that it was significant on the right side in the PC (-0.89 mm) and in the PM (-0.86 mm), evidencing more clearly a right lateral condylar position in both patterns. These findings indicate an altered condylar position in subjects with sleep bruxism and a tendency to have larger spaces that may be associated with condylar displacement, possibly generated by constant eccentric mandibular movements during bruxism activity (29). With this preliminary study, it can be shown that the condylar position in patients with sleep bruxism tends to be altered that can lead to a three-dimensional deviation of the jaw (30).

The data obtained from the assessment of the joint space in the sagittal and coronal plane is particularly important because there must be a minimum space to contain the disc and the supra- and infradiscal spaces with synovial fluid. Finding a very small space indicates the existence of areas of compression due to overload on the TMJ and can lead to triggering or perpetuating disc displacements and subsequently degenerative diseases. Therefore, reducing compressive loads on the TMJ is one of the objectives in the treatment of BS.

It must be considered that the results of this study were based on the questionnaire plus the clinical examination for the diagnosis of bruxism, for this reason the subjects of this study were classified with a diagnosis of "Probable" (1). When comparing the diagnostic criteria of the international classification of sleep disorders ICSD-3 to diagnose BS with polysomnographic studies, they had an agreement between 0.55 and 0.75; The best was having a frequency of bruxism four times a week, combined with dental wear and morning jaw pain or fatigue (31). Therefore, the recognition of bruxism based on clinical findings has its limitations and should be performed with polysomnographic studies, which is the Gold standard (32). The inclusion of etiological factors of BS such as micro-arousals, neurochemicals such as dopamine (2) and stress level were not considered; nor how they influence the magnitude of bruxism. For future research, it is proposed that the diagnosis of bruxism be made with polysomnography, for a better characterization of the individuals in the sample, thus obtaining a definitive diagnosis, which allows comparisons to be made with a control group, establishing true differences and additionally finding etiological relationships.

The occlusal wear pattern during sleep bruxism has been used as a diagnostic tool to determine the health status of the TMJ. In this study, we worked with subjects who only had a canine and molar pattern with mediotrusive wear, with PM being the most frequent. Onodera *et al.* (9) reported this type of contact during sleep bruxism, suggesting that subsequent interferences cause deflective effects on TMJ function, and Kawagoe *et al*. (28) found that subjects with a greater increase in mediotrusive contact had a significant impact on the prevalence of signs and self-awareness of sleep bruxism; Therefore, it is important to evaluate dental wear patterns during sleep bruxism. The best benefit of the BruxChecker® is to visualize the real facets during BS clearly for the professional and the patient. Sugimoto *et al*. Based on electromyographic studies of bruxism activity and occlusal wear pattern, they mention that the dental wear pattern must be controlled to prevent severe bruxism and thus control muscle activity (29). When diagnosis and treatment planning of occlusal reconstructions are being made, the information from the BruxChecker® reduces the need for reconstructive treatment and allows the results of this to be verified (10,28).

This study provides additional useful elements for the diagnosis and treatment planning of BS, but caution must be exercised in the interpretation of the findings. On the one hand, the condylar position also depends on the occlusion of other factors such as disc displacements and craniocervical postural alterations; and on the other hand, the sample size is a limitation for the findings to have greater validity. It is recommended to include all wear patterns during bruxism with a sufficient sample size and to combine the findings from CTHC images with magnetic resonance imaging (MRI), to observe the disc and surrounding bone structures simultaneously, significantly improving reliability. and diagnostic accuracy (33); and perform clinical and craniocervical imaging assessments in natural posture, to determine the influence of these factors on each individual. Diagnostic tools such as the BruxChecker® can be used and complemented with tomographic analysis of the TMJ when treating patients with BS in clinical practice. Determining the condylar position and relating it to the dental wear pattern will allow for more elements in planning treatments with occlusal changes in general dentistry, oral rehabilitation and orthodontics. In the search for an accurate diagnosis and interdisciplinary work, the clinician must examine all the links of the stomatognathic rupture (teeth, periodontal tissue and orofacial structures), to control all the variables (34) and the loads that are generated during bruxism. in each patient (9). If the factors at the articular and occlusal level are controlled, greater long-term stability will be obtained and the structures of the stomatognathic system will be protected.

CONCLUSIONS

When comparing the sagittal and coronal condylar position with CTHC images in two groups of dental wear patterns obtained with the BruxChecker®, it was found that the condylar position of each pattern in ratios is more posterior and medial, there is a significant asymmetry which generates a lateral condylar position on the right side, thus demonstrating an alteration in the condylar position. There is no evidence of symmetry in the condylar position.

The data obtained from the assessment of the joint space in the sagittal and coronal plane is particularly important because there must be a minimum space to contain the disc and the supra- and infradiscal spaces with synovial fluid. Finding an exceedingly small space could indicate the existence of compression areas that can lead to disc thinning or displacement and subsequently to degenerative joint diseases. Therefore, reducing compressive loads on the TMJ is important and if bruxism is the cause of these, it should be treated to reduce them and prevent further damage.

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