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Severity of temporomandibular dysfunction and its relationship with body posture

Severidade da disfunção temporomandibular e sua relação com a postura corporal

Gravedad de la disfunción temporomandibular y su relación con la postura corporal

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ABSTRACT | This study aimed to identify if there is a correlation between temporomandibular dysfunction (TMD) severity and body posture, as well as to show the differences in body posture in different degrees of severity. Seventy-one women aged 18-35 years were assessed for TMD severity and body posture and were divided into: Group without TMD and Group with TMD. We used the Mandibular Function Impairment Questionnaire and the Digital Image-Based Postural Assessment software for postural evaluation by photogrammetry. Statistical analysis was performed with one-way ANOVA and Kendall's Tau B correlation test ($\alpha<0.05$). The groups with and without TMD presented statistical differences, with large effect size ($\eta^2>0.528$), for: cervical lordosis, drive and pelvic tilt. Regarding the correlation of posture with TMD severity, weak but significant indexes were found: cervical lordosis angle ($\tau=0.250$), dorsal kyphosis angle ($\tau=0.192$), pelvic tilt angle ($\tau=-0.222$) and pelvic drive measurement ($\tau=0.283$). These results indicate that cervical lordosis and pelvic drive are increased according to the severity of the TMD, while the pelvic tilt angle decreases, tending to a retroversion. Despite the weak correlations, the results show some relationship between body posture and TMD.

Keywords | Temporomandibular Joint Dysfunction Syndrome; Posture; Photogrammetry.

RESUMO | O objetivo deste estudo foi identificar se existe correlação entre a severidade da disfunção temporomandibular (DTM) e postura corporal, bem como evidenciar as diferenças existentes na postura corporal nos diferentes graus de severidade. Foram avaliadas 71 mulheres de 18 a 35 anos quanto à severidade da DTM e à postura corporal, sendo divididas em grupo sem DTM e grupo com DTM. Foram utilizados o questionário *Mandibular Function Impairment Questionnaire* e o software Digital Image-Based Postural Assessment de avaliação postural por fotogrametria. Foi realizada análise estatística com ANOVA de um fator e teste de correlação Tau B de Kendall ($\alpha<0,05$). Os grupos com e sem DTM apresentaram diferenças estatísticas, com tamanho de efeito grande ($\eta^2>0,528$), para: lordose cervical, pulsão e inclinação da pelve. Quanto à correlação da postura com a severidade da DTM, índices fracos, mas significativos, foram encontrados: ângulo da lordose cervical ($\tau=0,250$), ângulo da cifose dorsal ($\tau=0,192$), ângulo de inclinação pélvica ($\tau=-0,222$) e medida de pulsão da pelve ($\tau=0,283$). Esses resultados indicam que a lordose cervical e a pulsão da pelve se apresentam em aumento da lordose e da pulsão conforme o acréscimo da severidade da DTM, enquanto o ângulo de inclinação se apresenta em menor grau, tendendo à retroversão. Apesar das correlações fracas, os resultados evidenciam alguma relação da postura corporal com a DTM.

Descritores | Síndrome da Disfunção da Articulação Temporomandibular; Postura; Fotogrametria.

RESUMEN | El objetivo de este estudio fue identificar si existe una correlación entre la gravedad de la disfunción

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temporomandibular (DTM) y la postura corporal, así como mostrar las diferencias en la postura corporal en diferentes grados de gravedad. Se evaluó la la postura corporal de 71 mujeres de 18 a 35 años, divididas en dos grupos: sin DTM y con DTM. Se utilizó el cuestionario *Mandibular Function Impairment Questionnaire* y el software Digital Image-Based Postural Assessment de evaluación postural por fotogrametría. Se realizó análisis estadístico con Anova de un factor y prueba de correlación Tau B de Kendall (α<0,05). Los grupos con y sin DTM presentaron diferencias estadísticas, con tamaño de efecto grande (η^2>0,528) para: lordosis cervical, pulsión e inclinación de la pelvis. En cuanto a la correlación de la postura con la gravedad de la DTM, índices débiles pero significativos fueron encontrados: ángulo de la lordosis cervical (τ=0,250), ángulo de la cifosis dorsal (τ=0,192), ángulo de inclinación pélvica (τ=−0,222) y medida de pulsión de la pelvis (τ=0,283). Estos resultados indican que la lordosis cervical y la pulsión de la pelvis aumentan según la gravedad de la DTM, mientras que el ángulo de inclinación se presenta en menor grado, tendiendo a la retroversión. A pesar de las correlaciones débiles, los resultados evidencian cierta relación de la postura corporal con la DTM.

Palabras clave | Trastorno de la Articulación Temporomandibular; Postura; Fotogrametría.

INTRODUCTION

Temporomandibular dysfunction (TMD) is defined as a set of disorders that affect the joint, masticatory muscles and/or adjacent structures of the stomatognathic system[1,2]. This dysfunction has aroused scientific interest because of its high prevalence (up to 60% of the Brazilian female population)[3] and the great impact it generates on individuals[2]. According to the National Institute of Dental and Craniofacial Research of the United States[4], it is the second largest musculoskeletal condition causing pain.

TMD generates a set of signs and symptoms, such as joint noises, range of motion deficits, deviations in the mouth opening, preauricular pain, temporomandibular joint (TMJ) or masticatory muscles and headache[5]. From these signs and symptoms, the diagnosis of TMD is performed, as well as the degree of its severity[5].

Since TMD is considered a multifactorial condition, it has been accepted that there is a relationship between body posture and TMD due to the influence of muscle chains on the masticatory system[6-8]. Ayub et al.[9] discussed how head anterioration leads to mandibular positioning and functioning disorders, gradually increasing the tension in the masticatory muscles, generating TMD. However, few studies have related the severity of the pathology to the body posture[10,11]. The main evidence is that the higher the position of anteriority of the head, the greater the severity of TMD[11] and the greater the cervical lordosis, the greater the difficulty to open the mouth[12].

In this context, it seems reasonable to think that a mechanical disturbance can generate an asymmetry in the mobility of the joints, being able to evolve to a muscular pathology, causing muscle spasms proportionally worse according to the severity of the disturbance[12]. Therefore, we speculate that there is a relationship between postural changes and the severity of TMD. This study aimed to identify the level of correlation between TMD severity and body posture, as well as to show the differences in body posture in different degrees of severity.

METHODOLOGY

This is an observational study with a correlational design, approved by the research ethics committee of the Universidade Federal do Rio Grande do Sul (CAAE: 55897216.6.0000.5347). The sample consisted of women[13] aged between 18 and 35, selected between June 2016 and June 2017, divided into two groups: group with TMD and group without TMD. The sample size was determined using the G*Power software 3.1.7, based on the family of z tests (correlation test for two dependent samples), admitting a unicaudal test, assuming as null hypothesis the correlation of 0.2, a α=0.05, the effect size 0.5 (Cohen's effect size) and 85% power, resulting in a minimum sample of 67 participants. The sample was selected in a consecutive way, with the participants coming from two projects of the Universidade Federal do Rio Grande do Sul. The group with TMD participated in an umbrella research project and the group without DTM was formed by individuals enrolled in a university extension project.

For the group without TMD, the inclusion criterion was to obtain the classification "without TMD" (score from 0 to 15) in the Fonseca Anamnestic Index[14,15], which has a specificity of 91.9%[16]. For the group with TMD, the inclusion criteria was its diagnosis, obtained from the axis I of the Research Diagnostic Criteria for

Temporomandibular Disorders (RDC/TMD). This clinical evaluation instrument for the diagnosis of TMD[17] measures jaw movement amplitudes, observes the pain at palpation and the presence of cracking or crackling of the movement.

For both groups, the exclusion criteria were: body mass index (BMI) greater than 35kg/m^2; diagnosis of other pathologies of the stomatognathic system, such as tumors; history of any surgical procedure on the face, teeth and spine; severe vertebral pathologies (fractures, inflammatory diseases or tumors); intellectual disability or inability to provide consistent information; current use of dental appliance or dental prosthesis; history of trauma in the face and temporomandibular joint and/or temporomandibular joint dislocation episode in the last six months; vestibular changes that may interfere with balance and/or continuous medication for pain or inflammation; individuals undergoing treatment for TMD and/or during the gestational period.

Two evaluations were performed: TMD severity and static body posture in the sagittal plane. Each of these evaluations was conducted by a different professional, trained and experienced in their evaluation and blinded to the other evaluation.

To determine the severity of TMD, the Mandibular Function Impairment Questionnaire (MFIQ) questionnaire, applied only in the TMD group, was used. This instrument is composed of 17 multiple choice questions about the degree of difficulty that the individual presents in situations in which the TMD interferes[15,18]. It aims to indicate the degree of functional impairment (FI), which ranges from 0 to 5[15,18]. From this index of FI, the severity of TMD is classified into three categories: I low (FI from 0 to 1), II moderate (FI from 2 to 3), III severe (FI from 4 to 5)[15,18].

For the static postural evaluation, a digital camera (Samsung, model L100) and Digital Image-Based Postural Assessment (DIPA©) software were used. This evaluation was carried out in both groups and consisted of palpation and marking of anatomical reference points (AP) for the right sagittal plane photographic record, followed by the scanning of these points in the DIPA©[19] software. Participants were barefoot and wore swimsuits, and all procedures followed the DIPA©[19] software protocol.

The DIPA© software provides angular and linear postural variables. In this study, a linear variable was analyzed, the pelvic drive, given by the horizontal distance between a vertical line passing through the lateral malleolus and the greater trochanter, and six angular variables: (1) angle between tragus and C7 in relation to the horizontal, determining the position of the head, and, as this angle decreases, the head is further ahead; (2) cervical lordosis angle, defined by the angle between the tangent lines C1 and C7; (3) dorsal kyphosis angle, defined by the angle between the tangent lines T2 and T12; (4) lumbar lordosis angle, defined by the angle between the tangent lines L2 and S2; (5) pelvic tilt angle , defined by the angle between a line connecting the posterolateral iliac spine and the anterior superior iliac spine and a horizontal line; and (6) knee angle, defined by the angle between the greater trochanter of the right femur, the lateral tuberosity of the right femoral condyle, and the right lateral malleolus[20] (Figure 1).

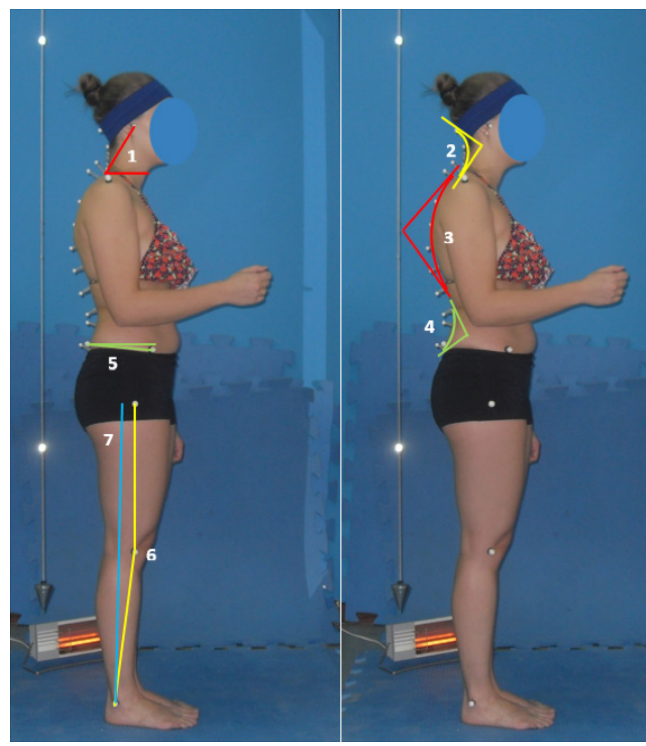

Figure 1. Posture variables evaluated: (1) head position angle; (2) cervical lordosis angle; (3) dorsal kyphosis angle; (4) lumbar lordosis angle; (5) pelvic tilt angle; (6) knee angle; (7) pelvis drive.

Statistical analysis was performed in the Statistical Package for the Social Sciences 2.0 software. Normality of the data was tested with the Kolmogorov-Smirnov test. One-way Anova was performed, followed by the Bonferroni *post-hoc* test, in addition to the Kendall Tau B correlation test (τ). The correlation coefficient τ was classified as: strong (above 0.5), moderate (between 0.5 and 0.3) and weak (below 0.3)[19]. The square eta (η^2) was classified as: small (0.02), medium (0.13) and large (0.26)[21]. The significance level established was 0.05.

RESULTS

Seventy-one participants were divided into: group without TMD (n=37), group with low TMD (n=19) and group with moderate TMD (n=15). The three groups presented homogeneous characteristics of age, stature and body mass (Table 1).

Regarding body posture, the results of the comparative analyzes between the three groups showed a difference for: cervical lordosis angle, pelvic tilt angle and pelvic drive (Table 2), with large effect (η^2>0.26) of the group on these variables. *Post-hoc* analysis found that all significant difference results were obtained by comparing the group without TMD and the group with moderate TMD II (Table 2). The group with moderate TMD II had a higher cervical lordosis angle, a tendency to pelvic retroversion and pelvic antepulsion.

Regarding the Kendall Tau-b correlation test, the cervical lordosis angles, dorsal kyphosis and pelvic tilt, as well as the pelvic drive measurement, presented a weak and significant correlation with the severity of TMD (Table 3).

Table 1. Group characteristics

Anthropometric variable	Group without DTM Mean±SD	Group with TMD I – Low Mean±SD	Group with TMD II – Moderate Mean±SD	Anova	
				F	p
Age (years old)	25.68±4.22	28±6.22	27.07±5.80	1.36	0.26
Body Mass (kg)	63.11±10.83	65.53±9.27	60.93±5.88	0.98	0.39
Height (cm)	164.78±6.72	164.63±7.40	164.77±7.32	0.00	1.00

Table 2. Comparison of the postural characteristics of the groups in the right sagittal plane

Postural variable	Group without DTM Mean±SD	Group with TMD I – Low Mean±SD	Group with TMD II – Moderate Mean±SD	ANOVA		
				F	p	η^2
Head position angle (°)	53.2±5.3	53.5±5.5	53.4±4.1	0.014	0.986	0.264
Cervical lordosis angle (°)	41.7±11.1+	43.6±6.7	49.5±7.8+	3.571	0.034*	0.528
Dorsal kyphosis angle (°)	44.1±9.3	43.1±5.8	49.1±6.5	2.766	0.070	0.365
Lumbar lordosis angle (°)	46.5±5.2	45.1±4.9	45.9±6.6	0.420	0.659	0.338
Pelvic tilt angle (°)	14.0±5.1+	13.7±4.1	9.9±4.6+	4.301	0.017*	0.822
Pelvis drive (cm)	6.8±2.8+	8.1±2.3	8.9±2.4+	4.081	0.021*	0.751
Knee angle (°)	176.8±6.5	177.9±3.1	177.7±3.9	1.282	0.284	0.335

*Significant difference; effect size (η^2); +Significant difference between groups (*post-hoc* result)

Table 3. Correlation between postural variables and TMD severity

MFIQ Score x	Kendall Tau b correlation (τ)	
	τ	p
Head position angle (°)	0.11	0.913
Cervical lordosis angle (°)	0.250	0.009*
Dorsal kyphosis angle (°)	0.192	0.043*
Lumbar lordosis angle (°)	−0.063	0.508
Pelvic tilt angle	−0.222	0.018*
Pelvis drive (cm)	0.283	0.003*
Knee angle (°)	0.095	0.328

*Significant correlation.

DISCUSSION

The difference between cervical lordosis angle, pelvic tilt angle and pelvic drive measurement among women without TMD and with moderate TMD indicates that, on average, women with moderate TMD have higher cervical lordosis, retroversion, and pelvic antepulsion (Table 2). Also, for these postural variables and for dorsal kyphosis, there was a weak correlation with the severity of TMD.

The severity of TMD is an important finding to evaluate the progression and impact of dysfunction in the life of the affected individuals[15,18]. However, to the best of our knowledge, the design of studies involving TMD and body posture generally only associates postural conditions with the presence of dysfunction[6-8,12] and it does not seek to investigate this relationship with TMD severity.

Milanesi et al.[10] observed that the higher the anterior position of the head, the greater the severity of signs and symptoms related to mandibular movements and masticatory muscles. In the review by Chaves et al.[7], of the 20 articles that investigated the craniocervical posture, ten found postural changes of this segment in the TMD group. Among these ten, three found lower anterior head angles related to the presence of TMD. However, these results do not corroborate this study, which found no correlation between head positioning and TMD severity. We speculate that our result is related to the limitation of the study regarding the sample, which did not present participants with severe TMD III.

Regarding the cervical lordosis angle, we found a difference between the group without TMD and the group with moderate TMD II, and the effect size showed that moderate TMD influenced the value of the cervical lordosis angle by 52.8% (Table 2). In addition, this variable correlated with the severity of TMD, suggesting that an increased cervical lordosis is related to a greater severity of the dysfunction.

Some studies corroborate our results, demonstrating that there are possible correlations between the severity of the TMD and the cervical spine. Ferreira et al.[22], point to the correlation between increased cervical lordosis and TMD. The explanation for this finding may be related to the shortening of the suboccipital, semispinalis, splenius muscles of the head and upper trapezius found in the TMD population[23]. Olivo et al.[24] found a strong association between cervical spine and TMD, showing that people with greater cervical disability also have greater disability in TMJ. Disabilities were measured by questionnaires on the perception of pain and limitation in daily activities of the cervical and TMJ. Now, Viana et al.[11], detected a moderate correlation between cervical lordosis and the difficulty of opening the mouth, and the higher the cervical lordosis, the greater the difficulty to open the mouth. In this case, the difficulty to open the mouth is a functional finding directly related to the severity of TMD, because it affects the daily tasks of the joint. Based on these studies, we assume that there is a connection between the two structures (TMJ and cervical spine) and that, probably, one affects reciprocally the other. This understanding supports our findings that increased cervical lordosis is related to a greater severity of TMD.

Regarding the most distant segments of the TMJ, we found a weak and significant correlation between the dorsal kyphosis and the pelvic tilt angle with the TMD severity, and the higher the dorsal kyphosis and the more retroverted the pelvis (the lower pelvic angle), the worse the functional involvement of the TMJ. The effect size showed that moderate TMD influenced 37% and 82% the dorsal kyphosis and pelvic tilt angles, respectively. However, no correlation was confirmed for lumbar lordosis.

Some studies of morphological context sought to correlate the positioning of the facial bones and the curvatures of the vertebral column. Lippold et al.[25] found a correlation between lumbar lordosis and pelvic tilt with craniofacial measurements, so that the greater the lumbar lordosis and the more anteriorly the pelvis, the greater the angles of the face and the inclination of the mandible. Saito et al.[26] compared the body posture of ten participants with TMD with disc displacement and 16 healthy participants. Their results showed that there were postural differences between groups, with a higher frequency of lumbar hyperlordosis (90%), rectification of thoracic kyphosis (70%), posterior pelvic rotation (50%) found in the disc displacement group. Ferreira et al.[22] found that the decrease in lumbar lordosis correlates with migraine and TMD. These findings suggest that there is no tendency in the literature to find a specific posture of TMJ-distant body segments that is related to TMD. Thus, it can be inferred that global body posture is complexly TMD-related, tending to the reasoning that postural changes in the most distant TMJ segments that correlate with dysfunction will not always follow a pattern and possibly be influenced by other factors.

The pelvic drive presented a positive correlation, demonstrating that the antepulsion is related to the worst severity of TMD. The knee angle was not different between the groups, nor did it show any correlation with the severity. Also, in our study, all the women presented the knee angle within a normality reference, around 180°[19]. These are variables that have not attracted attention of the researchers of this theme. However, Sakaguchi et al.[27] demonstrated that occlusion pressure center changes lead to changes in the center of body pressure and vice versa. This supports the idea that there is a chain of events that involve global body posture, both upward and downward[28].

The limitations of this study are: absence of differentiation in the diagnosis of TMD in the group with TMD; use of different instruments for insertion of the participants in each group; lack of information about the presence of prognathism/retrognathism, since these characteristics may influence the positioning of body structures, especially of the head and cervical spine.

In summary, this study allows to infer that some postural alterations may be present in the female population with TMD, being directly related to this dysfunction. Therefore, we understand that our results contribute both scientifically and clinically, with researchers and professionals who work with individuals with TMD. Specifically, our results support the need for global postural assessment as part of the clinical assessment protocol for patients with TMD. Nevertheless, we believe that each individual will compensate for the biomechanical disadvantages of his postural alterations differently, according to their muscular chains and bone/joint formation[23]. Furthermore, we believe that it is important to conduct studies aiming to evidence the effects of postural treatment versus conventional treatment of the stomatognathic system structures, whose outcomes were symptoms, functional impairment and changes in body posture.

CONCLUSION

There is a weak correlation of TMD severity with cervical lordosis, thoracic kyphosis, pelvic drive and tilt. A greater degree of cervical and thoracic curvature, as well as a greater value of retroversion and pelvic antepulsion, are associated with a greater value of TMD severity. However, the relationship of the body posture of segments more distant from the stomatognathic system with TMD should still be better studied.

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