

Effects of therapies for temporomandibular disorder on the craniocervical posture: A randomized clinical trial

Efeitos das terapias para disfunção temporomandibular na postura craniocervical: Um ensaio clínico randomizado

Efectos de las terapias para los trastornos temporomandibulares en la postura craneocervical: Un ensayo clínico aleatorizado

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Abstract

Objective: The present study searched evaluate whether the occlusal splint, physiotherapy and counseling therapies used in the treatment of temporomandibular disorders (TMD) alter the craniocervical posture and pain. **Methods:** Controlled, randomized, blinded study that included individuals previously diagnosed with TMD through the RDC/TMD (Research criteria for temporomandibular disorders). The patients were randomly selected from four treatment groups: occlusal splint (OS, n = 17), physiotherapy (P, n = 19), counseling (C, n = 15) and occlusal splint associated with counseling (OSC = 14), totaling 65 individuals. For the postural analysis, a teleradiography was performed at the baseline and 1 month after the application of the therapy, in order to observe the occiput-atlas distance (OAD), the craniocervical angle (CCA) and the positioning of the hyoid triangle (HT). CorelDraw X6 software (2012 Corel Corporation, Canada) was used in the images. The data obtained was submitted to several paired T tests ($\alpha = 5\%$) and for the pain variable the SPANOVA test was applied. **Results:** Except for the OSC group in the CCA variable ($p = 0.003$), the results showed that there was no statistically significant difference for the analyzed variables regarding the different therapies over time. However, it can be observed that all the treatment groups allowed a reduction of the patients' pain ($p = 0.013$) over time. **Conclusion:** It is concluded that the therapies applied have little influence on craniocervical posture but are effective for the relief of painful symptoms.

Keywords: Temporomandibular disorders; Temporomandibular Joint; Posture; Pain; Radiography.

Resumo

Objetivo: O presente estudo buscou avaliar se a placa oclusal, a fisioterapia e o aconselhamento utilizados no tratamento das disfunções temporomandibulares (DTM) alteram a postura craniocervical e a dor. **Métodos:** Estudo controlado, randomizado e cego que incluiu indivíduos com diagnóstico prévio de DTM por meio do RDC/TMD (Research Criteria for Temporomandibular Disorders). Os pacientes foram selecionados aleatoriamente de quatro grupos de tratamento: placa oclusal (OS, n = 17), fisioterapia (P, n = 19), aconselhamento (C, n = 15) e placa oclusal associada ao aconselhamento (OSC=14), totalizando 65 pessoas. Para a análise postural, foi realizada telerradiografia no início e 1 mês após a aplicação da terapia, a fim de observar a distância occipital-atlas (OAD), o ângulo craniocervical (CCA) e o posicionamento do osso hióide (HT) o software CorelDraw X6 (2012 Corel Corporation, Canadá) foi usado nas imagens. Os dados obtidos foram submetidos a diversos testes T pareados ($\alpha = 5\%$) e para a variável dor foi aplicado o teste SPANOVA. **Resultados:** Com exceção do grupo OSC na variável CCA ($p = 0,003$), os resultados mostraram que não houve *diferença* estatisticamente significativa para as variáveis analisadas em relação às diferentes terapias ao longo do tempo. Porém, pode-se observar que todos os grupos de tratamento permitiram uma redução da dor dos pacientes ($p = 0,013$) ao longo do tempo. **Conclusão:** Conclui-se que as terapias aplicadas têm pouca influência na postura craniocervical, mas são eficazes no alívio dos sintomas dolorosos.

Palavras-chave: Transtornos da articulação temporomandibular; Articulação temporomandibular; Postura; Dor; Radiografia.

Resumen

Objetivo: El presente estudio buscó evaluar si la placa oclusal, la fisioterapia y el asesoramiento utilizados en el tratamiento de los trastornos temporomandibulares (DTM) alteran la postura craneocervical y el dolor. **Métodos:** Un estudio controlado, aleatorizado y ciego que incluyó a individuos con un diagnóstico previo de TMD utilizando RDC/TMD (Research Criteria for Temporomandibular Disorders). Los pacientes fueron seleccionados al azar de cuatro grupos de tratamiento: placa oclusal (SG, n = 17), fisioterapia (P, n = 19), asesoramiento (C, n = 15) y placa oclusal asociada con el asesoramiento (OSC = 14), totalizando 65 personas. Para el análisis postural se realizó telerradiografía al inicio y 1 mes después de la aplicación de la terapia, con el fin de observar la distancia occipital-atlas (OAD), el ángulo craneocervical (CCA) y la posición del hueso hioides (HT) utilizando el software CorelDraw. En las imágenes se utilizó X6 (2012 Corel Corporation, Canadá). Los datos obtenidos se sometieron a varias pruebas T pareadas ($\alpha = 5\%$) y se aplicó la prueba SPANOVA a la variable dolor. **Resultados:** Con excepción del grupo OSC en la variable CCA ($p=0.003$), los resultados mostraron que no hubo diferencia estadísticamente significativa para las variables analizadas en relación a las diferentes terapias a lo largo del tiempo. Sin embargo, se puede ver que todos los grupos de tratamiento permitieron una reducción del dolor de los pacientes ($p = 0,013$) con el tiempo. **Conclusión:** Se concluye que las terapias aplicadas tienen poca influencia en la postura craneocervical, pero son efectivas para aliviar los síntomas dolorosos.

Palabras clave: Trastornos de la articulación temporomandibular; Articulación temporomandibular; Postura; Dolor; Radiografía.

1. Introduction

Among the alterations that affect the stomatognathic apparatus, we can mention temporomandibular disorder (TMD). TMD includes all functional disorders of the masticatory system, so they may involve TMJs, chewing muscles or both, as well as their associated structures (Okeson, 2013; Nassif et al., 2003; Cooper et al., 2007; Rocha et al., 2013).

The etiology of TMDs is complex, since it has a multifactorial character (Costa et al., 2016; Okeson, 2013; Rocha et al., 2013; Chaves et al., 2014; Mininghelli, Kiselova, Pereira, 2011; Souza et al., 2014). Neuro-muscular, biopsychosocial, biomechanical and neurobiological aspects may contribute to the disorder directly or indirectly (Chaves et al., 2014; Souza et al., 2014; Suvinen et al., 2005). The influence of each factor on the triggering or perpetuation of TMD differs between individuals. The commonly associated factors are: parafunctional habits (Luther, 2007), stress, joint trauma, unilateral mastication, poorly adapted restorations and prostheses, poor body posture, among others (Okeson, 2013; Mcneill, 1997; Monteiro et al., 2011).

There are few studies (Rocha et al., 2013; Cesar et al., 2006; Armijo-Olivo et al., 2011; Viana et al., 2015) that address the impact that different TMD treatments have on the craniocervical posture of individuals. The treatments for the TMD aim at the control of the painful symptomatology and re-education of the individuals. These can be conservative (cognitive-behavioral counseling, medication, physiotherapy and occlusal splint) or invasive (surgery and occlusal

adjustments) (Stohler & Zarb, 1999; Tuncer, 2013; Souchart, 1986). It is important to note that these therapies probably involve changes in the individual as a whole, including the posture of the head and cervical spine.

The few articles that address this theme do not present satisfactory methodologies to determine if the treatments performed improve or not the patients' craniocervical posture. Thus, the objective of this study was to evaluate whether the occlusal splint therapies, manual therapy and counseling, used for the treatment of temporomandibular disorder (TMD), alter craniocervical posture.

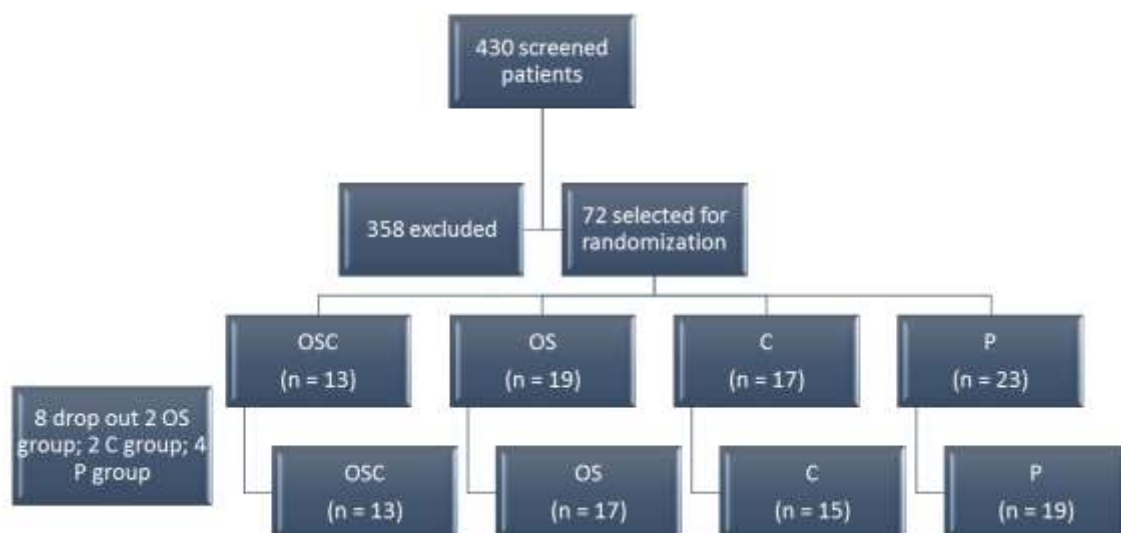
2. Methodology

It was a blinded, prospective and interventional randomized controlled clinical trial where the effects of occlusal splint, physiotherapy and counseling on the craniocervical posture of individuals with TMD were analyzed, the same methodology of de Resende et al (2021) study was adopted.

The study was previously submitted and approved by the research ethics committee of the Federal University of Rio Grande do Norte (CEP-UFRN), under the number of 2,052,863. All participants signed the Informed Consent Term. The sample was calculated by convenience and consisted of 65 TMD patients diagnosed by the RDC/TMD axis I (Diagnostic Criteria for Temporomandibular Disorders) (Dworkin & LeResche, 1992).

The patients were divided into four treatment groups: counseling (C), physiotherapy (P), occlusal splint (OS) and splint associated with counseling (OSC) (Flowchart 1). For the randomization, the first patient included in the research would be submitted to one therapy, and the others were allocated following a pre-established order. The established sequence was: OS, P, C, OSC. For example, if the first patient was from the OSC group, the second patient would be OS, the third P, the fourth C, and so on. For the postural evaluation of the patient, teleradiographies were obtained before starting the treatment and 1 month after the end of the treatment.

Flowchart 1. Description of the sample - OSC (splint and counseling); OS (occlusal splint); C (counseling); P (physiotherapy).



Source: Authors.

Inclusion criteria:

- Positive diagnosis of TMD performed through axis I of RDC/TMD (Dworkin & LeResche, 1992).
- Last treatment for TMD with a minimum interval of 3 months;

- Pain in the orofacial region in the last 3 months.

Exclusion Criteria:

- Impaired cognitive ability, being unable to understand the questionnaires;
- History of head trauma that is related to the etiology of orofacial pain, confusing the diagnosis of TMD;
- Intracranial disorders or headache;
- Use of medications in the last 3 months to treat TMD or that interfere with pain, such as: muscle relaxants, antidepressants and anxiolytics;
- Other causes of orofacial pain such as caries, periodontal diseases, neuropathies and fibromyalgia.

Postural analysis (Telerradiography)

Radiographic shots were obtained from the Department of Dentistry of UFRN, using the "Kodak 8000C Digital Panoramic and Cephalometric Extraoral Imaging System", with exposure of 0.5 seconds at 80 KV and 10 mA by the same professional. The patients positioned themselves standing, laterally to the X-ray apparatus, with relaxed body, separated feet and upper limbs throughout the body.

The marks of the images were performed using CorelDraw X6 Software (2012 Corel Corporation, Canada). The anatomical points of interest were observed and followed by two researchers calibrated individually. After the measurements, the researchers compared their results with each other and in case of any difference, the average between the distances was considered. Both researchers did not know which therapy the patient was undergoing.

The cephalometric analysis was maintained according to the one described by Rocabado (1983), marking the following anatomical points:

Occiput-atlas distance: linear measurement of the base of the occiput (point O - lowest point of the base of the occiput) to the posterior arch of the Atlas (point A – the most superior point of the posterior arch of the first cervical vertebra - Atlas) (Figure 1). The normal OAD is between 4 and 9mm (Rocha et al., 2013). A posterior rotation of the occipital to the cervical will occurs when this distance is less than 4mm and a distance greater than 9mm refers to an anterior rotation of the occipital to the cervical.

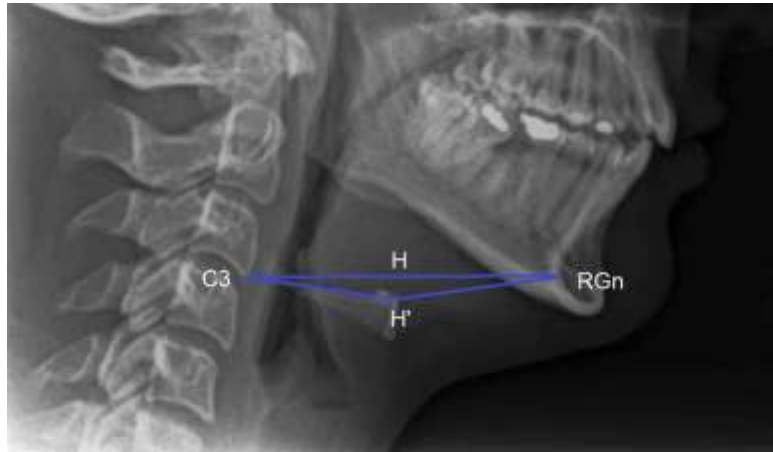
Figure 1. Occiput-atlas distance trace.



Source: Authors.

Hyoid triangle: formed by the union of points C3 (the most anterior and inferior point of the third cervical vertebra), H (the most anterior and superior point of the hyoid bone) and the point RGn (the most posterior and inferior point of the mentonian symphysis) (figure 2). The union of the points C3 and RGn forms the line H' (Figure 2). The normal H-H' distance is 5mm with the apex downwards (Rocha et al., 2013). When the value is greater than 5mm, with the apex down, the hyoid bone is low. If the vertex is up, the hyoid is high.

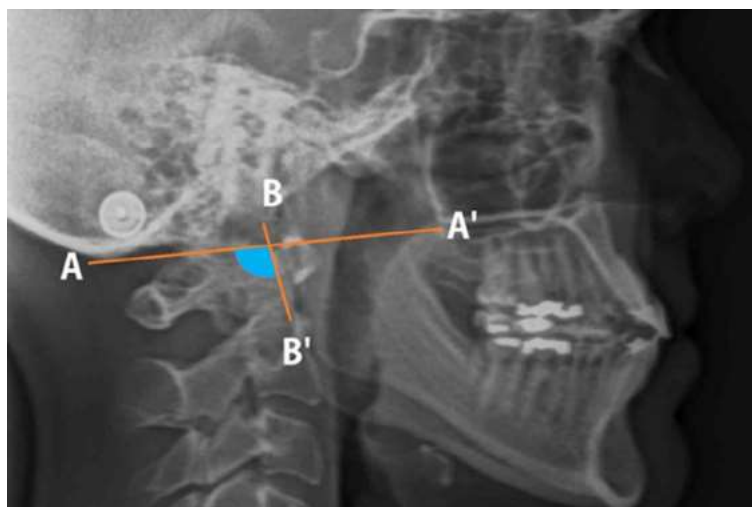
Figure 2. Hyoid triangle trace.



Source: Authors.

Craniocervical Angle: Intersection of the McGregor plane (line connecting the base of the occiput - A - to the posterior nasal spine - A') with the odontoid plane (line crossing the anterior inferior angle of the odontoid - B' - with its apex - B) (Figure 3). The normal angle is between 96° and 106° (Rocha et al., 2013). An angle smaller than 96° corresponds to the head extension and greater than 106° corresponds to the head flexion.

Figure 3. Craniocervical trace.



Source: Authors.

Pain assessment

To assess pain intensity, patients were instructed to complete the visual analogue scale (VAS). This method consists of a graduated line from 0 to 10, where 0 corresponds to no pain and 10 the worst pain imaginable by the patient. The patient

was instructed to mark on the visual scale the number that represents the intensity of the pain at that moment, before and after 1 month of the end of the therapies.

Therapies

Occlusal Splints: The occlusal splints were made by three previously trained researchers, following the technique described by Okeson (2013). The same laboratory manufactured all the splints with resin. In the consultation for the installation of the splint, the following aspects were observed: adaptation and stability, vertical dimension with the splint, which should not exceed the vertical dimension at rest, and also the phonetic aspects with the splint in use.

Patients received guidance on nighttime use of the splint and also care and hygiene. The control session was completed after 15 days and after 1 month of splint's installation.

Physiotherapy: The therapeutic regimen consisted of 8 sessions lasting 40 minutes, performed twice a week for 4 weeks. The physiotherapeutic treatments proposed in the study involved thermal agents (thermotherapy) and therapeutic exercises, such as: self-relaxation exercises with diaphragmatic breathing, masseter and temporalis massage, coordination exercises, resistance exercises and stretching exercises.

Counseling: Counseling was done by oral guidance directly to patients by 4 calibrated researchers. Also, a written guideline was given containing information about diet, habits that can be avoided, posture, sleep hygiene, physical exercises incentive, among others. After 15 days a reinforcement was performed.

Statistical analysis

Statistical analysis of the data was performed through SPSS 23.0 (Statistical Package for the Social Science). The descriptive analysis of the data was initially performed with absolute values. In order to analyze if there were alterations of the variables over time, paired T test ($\alpha = 5\%$) was performed. The same test made it possible to visualize the differences between the treatment groups. For the variable intensity of pain, the SPANOVA test was performed.

3. Results

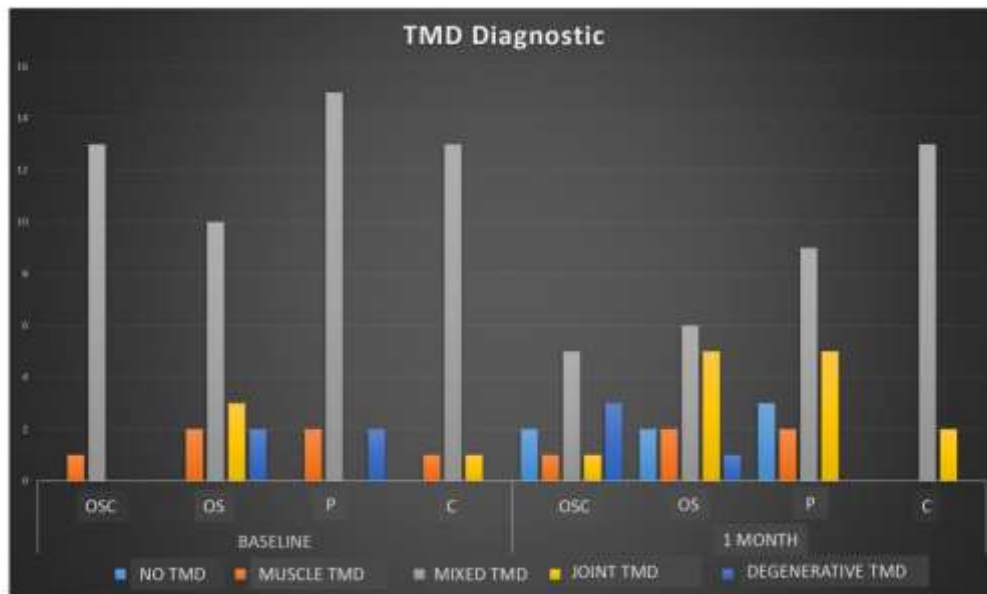
The final sample consisted of predominantly female patients (80%, $n = 52$). The age range varied between 17 and 52 years of age, establishing an average of $28.52 (\pm SD = 8.49)$. Regarding ethnicity, 52.3% ($n = 34$) declared themselves white, 40% ($n = 26$) brown, 6.2% ($n = 4$) black and only 1.5% ($n = 1$) yellow.

Regarding marital status, 75.4% ($n = 49$) of the participants were single or never married. As for educational level, there was a predominance of secondary education (52.3%), followed by higher education (33.8%). The other levels (postgraduate, fundamental and without schooling) accounted for 13.9% of the sample. In relation to professional occupation, the analyzed data showed that 30.8% of the patients were employed, 29.2% ($n = 19$) were students, 16.9% ($n = 11$) were students and employed, 10.8% ($n = 7$) worked with home duties, 10.8% ($n = 7$) were unemployed and only 1.5% ($n = 1$) were retired.

TMD Diagnostics

The data were grouped as muscular TMD for those who had a diagnosis of group I, joint TMD for those who had a diagnosis of group II, degenerative TMD for those belonging exclusively to group III and mixed TMD for those diagnosed in more than one group (Graph 1).

Graph 1. Diagnosis of TMD at baseline and after 1 month.



Source: Authors.

Sample Calculation

For the calculation of the sample, we used the difference between the means. With a power of 80% and a confidence level of 95%, the study sample was able to detect a minimal difference between the groups of 2.46 for the OAD variable, 6 for the HT variable and 5.4 for the variable CCA.

Analysis of cefalometric data

According to the data analysis, all groups presented averages within the standard of normality for the OAD variable, both in the baseline and in the control period. For the variable HT, the mean of the C and P groups, although they remained outside the normal range, approached the normal value. Regarding the CCA variable, the P group obtained a reduction of the mean reaching a measure compatible with what was considered normal (baseline 106,31; 1 month 105,60). The remaining groups remained altered, but tended to reach the normality parameter over time.

Distance from the base of the occiput to the posterior arch of the atlas (OAD)

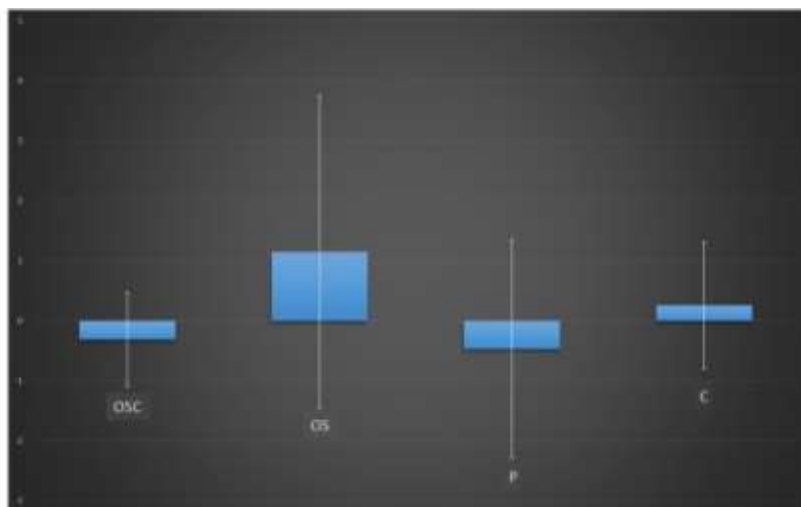
Regarding the variable O-A distance, after the analysis, it was observed that none of the treatment groups resulted in statistically significant changes of the individuals over time ($p < 0,05$) (Table 1, Graph 2). It can be observed in the graph 2 that the OS group was the one that obtained the biggest difference of its mean, that is, change of measurement between the baseline and after 30 days of therapy.

Table 1. O-A distance (occiput-atlas distance) over time for the groups studied. Mean difference values, standard deviation, 95% confidence interval and p value. Natal / RN, 2018. *Paired T test.

Groups	n	O-A distance			*p
		Paired differences			
		Mean	SD	CI95%	
Splint + Counseling	14	-0,31	0,78	-0,76; 0,14	0,161
Splint	17	1,15	2,60	0,63; -0,18	0,086
Physiotherapy	19	-0,47	1,82	-1,35; 0,40	0,269
Counseling	15	0,26	1,06	-0,32; 0,85	0,358

Source: Authors.

Graph 2. Graphical representation of the mean difference and standard deviation for the OAD variable over time.



Source: Authors.

Hyoid triangle (HT)

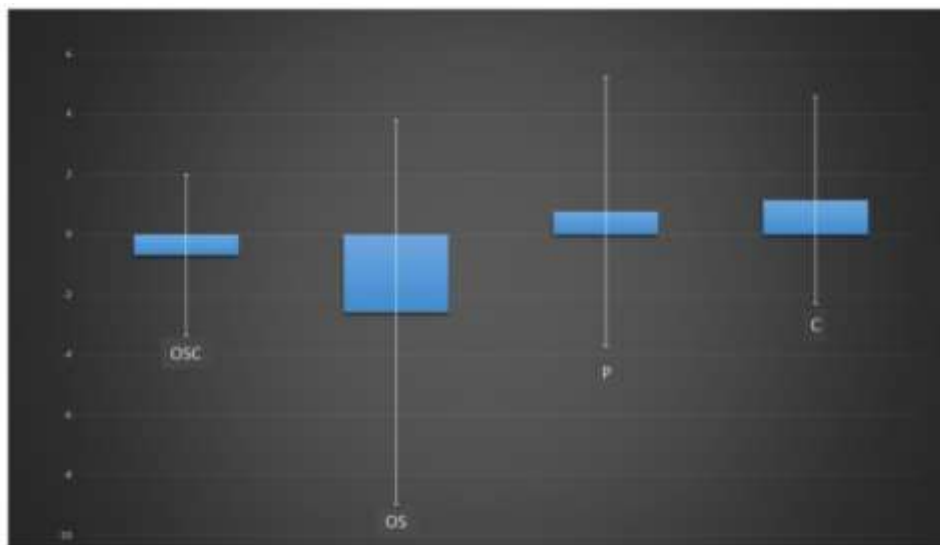
For the treatment groups studied, the results obtained for the HT variable were not statistically significant (OSC, $p = 0.346$, OS, $p = 0.114$, P, $p = 0.498$, C, $p = 0.219$). That is, there was no significant change in the distance that establishes the hyoid triangle over time (Table 2, Graph 3).

Table 2. Behavior of the hyoid triangle over time for the groups studied. Values of mean difference values, standard deviation, 95% confidence interval and *p* value. Natal / RN, 2018. *Paired T test.

Hyoid triangle (normal 5mm with the apex downwards)					
Groups	Paired differences				
	n	Mean	SD	CI95%	* <i>p</i>
Splint + Counseling	14	-0,69	2,67	-2,24; 0,84	0,346
Splint	17	-2,59	6,38	-5,8; 0,69	0,114
Physiotherapy	19	0,76	4,48	-1,15; 3,08	0,498
Counseling	15	1, 14	3,44	-0,76; 3,05	0,219

Source: Authors.

Graph 3. Graphical representation of the mean difference and standard deviation for the HT variable over time.



Source: Authors.

Craniocervical angle (CCA)

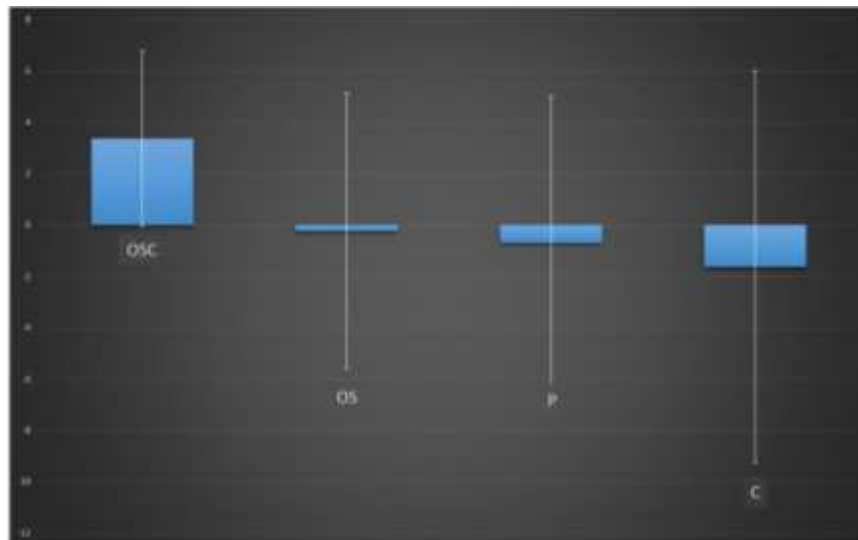
Differently from the OS, P and C groups, OSC therapy had a statistically significant result in altering CCA measurement ($p = 0.002$), that is, it was the only group that the therapy was significantly able to modify the variable over time (Table 3, Graph 4). As can be seen in the table, this statistical difference occurred between the OSC group (CI: 1.61, 5.53) and the C group (CI: -4.81, 1.56).

Table 3. Behavior of the variable CCA over time for the groups studied. Values of mean difference values, standard deviation, 95% confidence interval and *p* value. Natal / RN, 2018. *Paired T test.

Craniocervical angle					
Groups	n	Paired differences			* <i>p</i>
		Mean	SD	CI95%	
Splint + Counseling	14	3,37	3,40	1,61; 5,54	0,002
Splint	17	-0,23	5,37	-2,78; 2,73	0,986
Physiotherapy	19	-0,70	5,72	-3,46; 2,05	0,596
Counseling	15	-1,62	7,63	-4,81; 1,56	0,293

Source: Authors.

Graph 4. Graphical representation of mean difference and standard deviation for the variable CCA over time.



Source: Authors.

Effect of the therapies on pain

Although the therapies did not result in statistically significant changes, except for the OSC group in the CCA variable, it can be observed that all the treatment groups allowed a reduction of the patient's pain ($p = 0.03$) over time (Table 4).

Table 4. Comparison of the painful symptomatology obtained by the Visual Analogue Scale (VAS) between groups and over time. Natal / RN, 2018.

Time	Treatment group	n	Mean	Standard deviation	p	Over time	Between groups	
						Eta partial squared	p	Eta partial squared
q\ Baseline	Splint + Counseling	14	3,15	2,76	0,013	0,045	0,439	0,101
	Splint	17	2,93	2,91				
	Physiotherapy	19	3,21	2,34				
	Counseling	15	4,06	3,19				
1 month	Splint + Counseling	14	2,84	2,82	0,013	0,045	0,439	0,101
	Splint	17	1,66	1,34				
	Physiotherapy	19	1,68	2,18				
	Counseling	15	3,73	3,21				

Source: Authors.

4. Discussion

The sample consisted of predominantly female patients (80%, n = 52), with a mean age of 28.52 years, corroborating with findings in the literature demonstrating that TMD affects more women and young adults (Gauer & Semidey, 2015). Oliveira et al (2008) also obtained similar results, where the predominance of female participants was 93%.

Regarding the professional situation, it was observed that the vast majority of patients were employed (30.8%) or were students (29.2%). This finding was also observed in the study proposed by Reiter et al (2015), where 63% of the participants were employed. Although the relationship between occupation and disorder is not yet established in the literature, can mention that, due to the multifactorial nature of the disorder, the individuals belonging to these groups are more likely to develop factors that can corroborate with the development and perpetuation of TMD, such as anxiety and stress.

The results of the study confirm that the therapies for disorder do not alter the participants' craniocervical posture. Corroborating this finding is the study by Câmara-Souza et al (2018). In this study, 80 students of the dentistry course were evaluated, using profile radiographs with the same tracings used in the present study and it was concluded that there is no relation between cervical posture and TMD in the sagittal plane. The study by Faulin et al (2015) presented the same outcome, despite using photographs as a analyze measurement.

In the present study only the splint associated with counseling group in the variable craniocervical angle was statistically significant in the change in the position of the head relative to the neck over time. However, despite this finding, we can observe that patients who had this alteration already had parameters considered normal (between 96° and 106°) for this variable.

On the other hand, Chaves et al (2014) concluded that there is strong evidence of craniocervical postural changes in myogenic TMD, moderate evidence of cervical postural misalignment in arthrogene TMD and no evidence of absence of craniocervical postural misalignment in patients with mixed TMD or of global postural misalignment in patients with TMD.

However, the methodology of the studies included is of low quality.

The only randomized controlled clinical trial in the literature that addresses the influence of some types of treatment for postural dysfunction is that of Tuncer et al (2013). In their study, the researchers compared the short-term efficacy of home physical therapy alone with manual therapy in conjunction with home physical therapy performed for four weeks in patients with TMD. The authors visualized that after the therapy, both groups improved posture. This outcome may be challenged due to the technique used to measure the postural alteration, since they performed the measurement on the patient without using radiographs or precise programs for the analysis.

After the analysis it was also noticed that all the therapies reduced the pain level of the patients. It can be seen that in the evaluation of pain, performed by the VAS, there was a significant reduction ($p = 0.013$) over time in all groups. In addition, no group was superior to the other in reducing pain symptomatology ($p = 0.439$).

This finding was different when compared to the study by Michelotti et al (2012). In this study, the researchers aimed to compare the effect of education therapy (corresponding to counseling) with the occlusal splint in the treatment of muscular TMD. As a result, they found that the education was more effective than the occlusal splint in reducing the painful symptomatology. The study by Qvintus et al (2015), which evaluated 80 patients in relation to pain using VAS after splint, counseling and masticatory exercises at a follow-up of 1 year, obtained a similar result to the present study, which was evaluated in the short term.

Maluf et al (2008) also evaluated the reduction of pain after performing TMD therapies. The treatments used were postural reeducation and stretching exercises. With these they obtained equal reduction of the intensity of the pain. Conti et al (2012), evaluated three therapeutic modalities, among them the use of splint associated with counseling. The authors observed that all strategies resulted in improvement of the pain.

There are few studies that attempt to demonstrate the relationship between craniocervical posture and the therapies employed for the treatment of disorder. They have low methodological quality, mainly regarding the way to diagnose TMD. Therefore, it is necessary to develop more better delineated studies to prove this interaction.

Because it is a blinded randomized controlled clinical trial with well established standards, such as the use of RDC/TMD for diagnosis of disorder, the present study presents good methodological quality. However, it has some limitations, such as: short time of analysis of the treatment effect on the craniocervical posture patients and reduced sample. These factors interfere in the external validity of the study.

5. Conclusion

Based on the study, it can be concluded that the use of occlusal splint, counseling, physiotherapy and counseling-associated therapies, in the short term, do little to alter craniocervical posture. In addition, they are equally effective in relieving painful symptoms. Therefore, in view of the limitations of the study it is necessary to develop new studies aimed at elucidating this relationship.

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