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ORIGINAL ARTICLE

Occurrence and severity of neck disability in individuals with different types of temporomandibular disorder

Isaac Newton de Abreu Figueirêdo[1] · Maria das Graças de Araújo[1] · Jader Barbosa Fonseca[1] · Carolina Natália Lima Vieira[1] · Juliana Avelino Santiago[1] · Catarina Nicácio dos Santos[1] · Carla Raquel de Melo Daher[1] · Ana Paula Lima Ferreira[1,2]

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Abstract

Background Healthcare professionals need to know the degree of disability and severity of their patients to determine actions and therapy needed to minimize potential harm, improve their patient condition, and maximize clinical outcomes.

Objectives To evaluate the occurrence and severity of neck disability in individuals with muscular, joint, and mixed temporomandibular disorder (TMD).

Materials and methods Cross-sectional study with individuals divided into four groups: muscular TMD (n=20), joint TMD (n=20), mixed TMD (n=20) and control (n=20). For diagnosis and classification of TMD, it was used the Research Diagnostic Criteria (RDC) and to assess the severity of neck dysfunction the Neck Disability Index (NDI).

Results Moderate neck disability was frequent in all individuals with TMD; high scores of neck disability index were evidenced in the mixed and joint TMD groups; there was a moderate positive correlation between the severity of neck disability and TMD severity (r=0.7; CI=0.32–0.78; p<0.03).

Conclusion The gravity of neck disability and the severity of TMD are directly proportional in the group of individuals with mixed TMD.

Keywords Temporomandibular joint disorder · Neck pain · Stomatognathic system · Temporomandibular joint

Introduction

Temporomandibular disorder (TMD) is a musculoskeletal condition that affects the temporomandibular joint (TMJ) and/or the masticatory muscles, besides adjacent structures that are part of the stomatognathic system. This disorder can be classified according to its origin as joint, muscular, or mixed disorders [1, 2]. Individuals with TMD may present with significantly compromised mandibular functions, which may result in functional and social interaction limitations [3, 4].

Regarding the prevalence of TMD symptoms, over 75% of the affected population are individuals aged between 20 and 40 years old. Women are the most affected ones, in a 5:1

✉ Ana Paula Lima Ferreira
apllima@yahoo.com.br

Isaac Newton de Abreu Figueirêdo
aniltinho81@gmail.com

Maria das Graças de Araújo
mrodriguesaraujo@hotmail.com

Jader Barbosa Fonseca
jader_jbf@hotmail.com

Carolina Natália Lima Vieira
carolinavieira831@gmail.com

Juliana Avelino Santiago
juju_avelinos@hotmail.com

Catarina Nicácio dos Santos
catarina_nds@hotmail.com

Carla Raquel de Melo Daher
carladaher.fisio@gmail.com

[1] Department of Physical Therapy, Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil

[2] Departament of Physical Therapy, Federal University of Pernambuco, Av. Prof. Moraes Rego, 1235 - Cidade Universitária, Recife, PE CEP: 50670-901, Brazil

females/males ratio [5]. Others epidemiological surveys have reported that the etiology of such disorder has not been clearly understood, yet due to its multifactorial nature [6].

Studies have demonstrated a significant association and high prevalence of symptoms of neck disability in individuals with TMD, thus reinforcing the functional and anatomical relationship between mandibular and head-neck systems [7, 8]. Therefore, some authors [9, 10] revealed high overload on the temporomandibular joint as a result of postural changes in the spine and head function, being a causal factor for TMD installation [11, 12]. Therefore, assessing the cervical spine in TMD evaluation is important and necessary.

In view of this, disorders that affect one system may cause pain and/or dysfunction in another system, by the existence of the connectivity reflex that communicates head and neck anatomical regions [13]. According to Ferraz et al. (2004), the jaw position can influence the head position and vice versa. In addition, some authors observed that the structures of the stomatognathic system display a causal relationship regarding postural changes [14]. For Bricot et al (2004), an individual with head anteriorization may present with jaw function and positioning disorders. Such anteriorization may be explained due to the overload of masticatory muscles, causing shortening of posterior neck muscles and elongation of anterior muscles [15].

Although a close relationship between cervical spine and TMJ region has been evidenced, there is still no consensus about the relationship between neck disability and types of TMD, i.e., it was not elucidated if this relationship is the same for all types of TMD (joint, muscle, and mixed). Therefore, this study aimed to evaluate the occurrence and severity of neck disability in individuals with muscle, joint, and mixed TMD.

Materials and methods

Study type and ethical considerations

A cross-sectional study was carried out following the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) [16]. A convenience sample composed 80 individuals was established, being distributed into four groups of 20 subjects each: muscular TMD, joint TMD, mixed TMD, and control group.

Initially, 80 individuals presenting with TMD complaints and 30 controls were recruited. All volunteers were contacted and selected to participate in this study through phone calls, posters, posters on social media, and e-mails. The volunteers were scheduled and forwarded to the Laboratory of Kinesiotherapy and Manual Therapeutic Resources, located in the Department of Physiotherapy at Federal University of Pernambuco, where they were evaluated by the team responsible for the consultations and the research, composed of eight qualified professionals who were trained twice a week for 3 weeks in the laboratory prior to recruiting the patients. The training aimed to improve the criteria application, through theoretical-practical classes and professional development courses.

The study was approved by the Ethics Committee of Federal University of Pernambuco (UFPE) under the no. 2.321.586. After the research purpose and objectives were clarified, the volunteers were informed about the procedures, benefits, and risks of the study and, in case of agreement, they provided signed consent form. At the end of the study, individuals with TMD were referred to a physiotherapy clinic, where they underwent their treatments.

Inclusion and exclusion criteria

The eligibility criteria included both men and women aged between 18 and 45 years old, without TMD (control group) or presenting with muscle, joint, or mixed TMD. Volunteers presenting with orthopedic and/or rheumatic pathologies in any part of the body, as well as surgical procedures performed in head and neck region, previous history of facial trauma, and neurological diseases were excluded from the study. Besides, individuals using a functional orthodontic/orthopedic appliance or administering any medication at the time of data collection were also excluded.

Data collection and procedures

Diagnosis of temporomandibular disorder

The diagnosis of TMD was performed according to the criteria of the Research Diagnostic Criteria (RDC), developed by Dworkin and Leresche (1992) [17], translated and validated to Portuguese by Pereira Júnior (2004) [18]. A qualified and trained researcher was the only responsible for carrying out the physical evaluation following the RDC criteria.

The RDC/TMD is a gold standard diagnostic criteria in evaluating temporomandibular disorders. The criteria of RDC are divided into two axes: axis I provides standardized criteria for the diagnosis of TMD, which facilitates its application performance and with good intra- and inter-examiner reproducibility. Axis II measures the psychological assessment and disability related to the pain. It is noteworthy that in this study, only axis I was used in the revised version of RDC/TMD, as described by Shiffman et al. (2010) [19].

The main reason of using the RDC/TMD in this study is due to the fact that these criteria determine whether the patient's TMD origin is predominantly muscular, joint, or mixed, in addition to clearly determining the most affected anatomical and biomechanical components of the stomatognathic system in each case.

Temporomandibular disorder classification

The results obtained from RDC/TMD were used to generate the Temporomandibular Index (TMI) proposed by Pehling et al. (2002), where the severity of TMD is observed [20].

The TMI has demonstrated an excellent internal consistency value of 0.99, with a 95% confidence interval (CI), and Cronbach's alpha = 0.92. The TMI is composed of three sub-indexes: Functional Index (IF), Muscle Index (IM), and Articular Index (AI). The IF comprises 12 items related to the range of mandibular movements, which characterize pain or limitation and deviation of the mandible during mouth opening movement; the MI measures pain associated with bilateral digital palpation of intra- and extraoral masticatory muscles, with a maximum score of 20 points; Finally, AI includes 8 pain-related items, caused by two-point digital palpation for each TMJ, as well as noise occurrence in each of them.

The IF, IM, and AI were calculated by dividing the sum of positive findings by the number of total signs assessed (e.g., IF has 12 items; and if there are 6 positive findings, then a functional index of 6/12 was determined). In the end, the TMI score was calculated, with the average scores obtained by the three sub-indexes previously mentioned. Each score of the TMI and sub-indexes (IF, IM, and AI) varies between 0 and 1, with 1 being the highest possible score [20].

Assessment and classification of neck disability

To assess neck function and disability, the Neck Disability Index (NDI) Questionnaire was used. This questionnaire was developed by Vernon and Mior (1991) [21] to assess disability and pain in the cervical spine region and consists of ten questions with six possible answers that represent 0 to 5 points each, totaling a maximum score of 50 points. The following criteria were used to interpret the severity of neck disability: 0–4 points = no neck disability; 5–14 points = mild neck disability; 15–24 points = moderate neck disability; 25–34 points = severe neck disability, and > 34 points = complete neck disability [22, 23].

The NDI was adapted and validated for Portuguese by Cook et al. (2006) [24], and its psychometric properties that have been extensively tested and well documented for reliability (values between 0.9 and 0.93) and internal consistency (values of 0.74 and 0.93).

Statistical analysis

Statistical analyses were carried out using the Bioestat 5.0 Program. The normality of variables was tested using Kolmogorov-Smirnov test, and no impediment to use of parametric tests was found for any of the parameters evaluated. Descriptive analysis was performed and descriptive variables were presented in frequencies. Values were also presented as mean (X) and standard deviation (SD).

Initially, to analyze the measurements between the groups and age, body mass index (BMI), and Temporomandibular Index, one-way ANOVA test was conducted, whereas chi-squared test was used to analyze the variables sex and neck disability. To compare the severity of neck disability between groups, one-way ANOVA (≥3 groups) was used, followed by Tukey's test. The inter-groups analysis was preceded by Levene test.

Pearson's linear correlation test was used as a secondary measure to assess the interaction between severity of cervical disability and TMD severity between muscle, joint, and mixed groups. The reference values considered were (r) 1 and −1 with r> 0.8 for strong correlation; between 0.6 and 0.8 for moderate correlation; 0.3 to 0.5 for weak correlation; and r<0,3 for uncorrelated. Negative values reproduce an inversely proportional correlation, while positive values reproduce a directly proportional correlation [25]. The levels of significance for all tests were 5%.

Results

Of the 80 individuals with TMD initially recruited, there was a loss of 20 individuals; 15 for not meeting the inclusion criteria for the study; and 5 for not attending the evaluation session. Of the 30 individuals in the control group, 10 did not attend the assessment. The characterization of the sample regarding age, BMI, temporomandibular index, sex, and neck disability are displayed in Table 1, which displays homogeneity of variables between the TMD and control groups. Also, it was observed that neck disability was frequent in individuals with TMD and higher percentages of moderate neck disability were evidenced in the joint and mixed TMD groups with a percentage of 60% and 65%, respectively.

Regarding the severity of neck disability in individuals with different types of temporomandibular disorder and asymptomatic ones, as demonstrated in Fig. 1, the severity of neck disability was higher in groups of individuals with joint and mixed TMD.

When assessing the correlation between variables severity of neck disability and temporomandibular index in individuals with different types of TMD (Table 2), it was observed that only mixed TMD volunteers demonstrated a significant correlation. For this group, the severity of cervical disability was directly proportional to the Temporomandibular Index with moderate correlation (between 0.6 and 0.8) and p <0.05.

Discussion

The main findings of this present study were [1] moderate neck disability was frequent in all individuals with TMD

Table 1 Characterization of the sample

	TMD muscular (*n*=20)	TMD joint (*n*=20)	TMD mixed (*n*=20)	Control (*n*=20)	*p* value
Age[b]	23.7±3.7	23.2±2.8	22.9±2.5	23.1±3.2	0.81
Sex[a]					
Male	6 (30%)	5 (25%)	5 (25%)	6 (30%)	0.84
Female	14 (70%)	15 (75%)	15 (75%)	14 (70%)	0.83
BMI[b]	23.1±2.4	23.9±2.1	22.8±2.5	22.9±3.6	0.92
Cervical disability[a]					< 0.05*
None	3 (15%)	2 (10%)	1 (5%)	12 (60%)	
Mild	9 (45%)	3 (15%)	1 (5%)	6 (30%)	
Moderate	6 (30%)	12 (60%)	13 (65%)	2 (10%)	
Severe	2 (10%)	3 (15%)	5 (25%)	0 (0%)	
TMI[b]	0.46±0.12	0.52±0.15	0.54±0.14	-	0.81

BMI body mass index, *TMI* temporomandibular index

[a] Chi-squared test

[b] ANOVA one-way compared TMD with control

*statistically significant

(regardless of muscle, joint, or mixed type); [2] higher scores of neck disability index were identified in those with joint and mixed TMD; [3] individuals with mixed TMD demonstrated moderate positive correlation between severity of neck disability and severity of TMD.

The association between neck disability and TMD found in this study has been pointed out in previous research as a consequence of disarrangement between psychological, anatomical, and/or neuromuscular factors [26]. Coexistence rates of abnormalities of the cervical spine in individuals with TMD are high and have been extensively researched in current literature. Biomechanically, it can be inferred that this association is related to functional binding and neural synchronization between structures of the craniocervical and orofacial regions from the cervical trigeminal nucleus [27].

Regarding the severity of neck disability, high scores of neck disability index were found in joint and mixed types of TMD. These findings corroborate with a previously conducted study that pointed out the presence of discomfort in the cervical region as a concomitant factor to a functional imbalance in the craniomandibular joint, which can be enhanced when associated with muscle TMD [28].

Another result observed in this study was a moderate positive correlation between the severity of TMD and the severity of neck disability in individuals with mixed TMD, since there are muscles and joint functional impairment somatized in this group. The association between these two variables might be related to the fact that the TMJ and the cervical spine belong to the same anatomical-neural-physiological system. Two hypotheses explain the relationship between temporomandibular joint and cervical spine: the first one is related to biomechanics, where connections between anatomical structures such as tendons, muscles, ligaments, and fascia are observed; and the second one is the neurological hypothesis, which explains

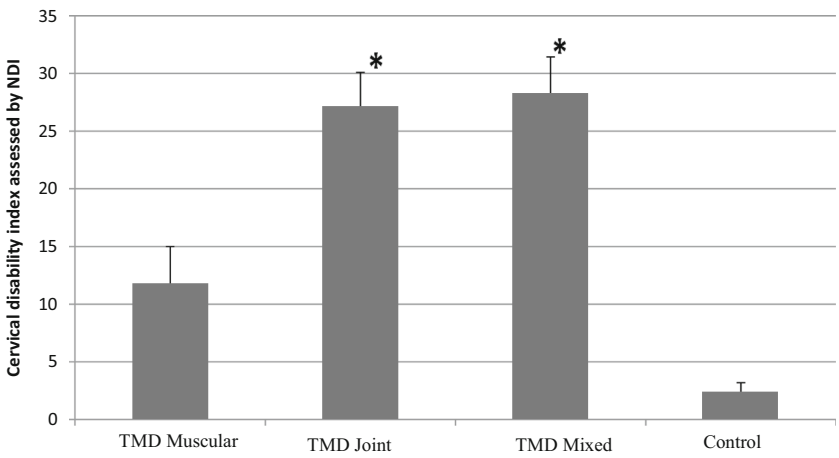

Fig. 1 Severity of cervical disability in individuals with different types of temporomandibular disorders and control. **ANOVA* one-way test with post hoc Tukey, $p < 0.001$

*ANOVA One-Way test with post-hoc Tukey, p < 0.001

Table 2 Correlation between severity of cervical disability and Temporomandibular Index (TMI) in individuals with different types of TMD

Types of TMD	*r* (CI) 95%	*p* value
Muscular TMD (*n*=20)		
Cervical disability × TMI	0.35 (0.10–0.69)	0.12
Joint TMD (*n*=20)		
Cervical disability × TMI	0.22 (0.29–0.63)	0.26
Mixed TMD (*n*=20)		
Cervical disability × TMI	0.70 (0.32–0.78)	0.03*

*Pearson correlation coefficient $p \leq 0.05$

how connections between two domains converge sensorially and through the trigeminocervical nucleus system, i.e., symptoms of cervical region can be referred to orofacial region [1, 29].

As reported, individuals with mixed TMD have a double functional impairment, which explains the correlation between the severity of neck disability and the severity of TMD. However, Silveira (2015) pointed out that the correlation between cervical and temporomandibular disability does not express a cause-and-effect relationship; therefore, longitudinal studies should be carried out with a follow-up of the individual over a certain period [1].

The moderate positive correlation found in this study can be explained by the strong connection between structures of the head and neck and mandibular system; thus, mandibular region disorders can be explained by findings in the cervical region and vice versa [30]. This provides relevant information about the importance of assessing individuals globally, analyzing two anatomical domains when designing conducts and methodologies in clinical practice.

Regarding the limitations of this study, a non-probabilistic convenience sample was recruited; therefore, it is not possible to use statistical tools such as margin of error and assess the level of confidence to measure the reliability of the results. Differences between those individuals who seek and those who do not seek support and health care introduce a potential selection bias for research.

In addition, professionals are expected to be aware of the degree of disability and severity of their patients in order to determine the therapeutic management necessary to reduce such impairments. The findings of this study contribute to clinical practice by providing substantial and evidence-based information, which can lead professionals in assessments to correlate anatomical structures of the cervical, head, and mandibular domains. Furthermore, the results imply the need for new clinical strategies to improve the evolution of TMD patients, thus obtaining significant and satisfactory clinical results that will guide other researches and propaedeutics.

The multidisciplinary approach is of paramount importance for the success of the assessment and treatment of TMD, since it presents multifactorial etiology. In view of this, the conservative physiotherapeutic treatment is an excellent option in reducing pain and allowing greater mouth opening, being a practical and non-invasive solution that helps in improving patients' well-being.

Conclusion

The results of this study displayed that neck disability was frequent in individuals with TMD, and the presence of a moderate neck disability does not depend on the type of TMD analyzed. It was also observed that the severity of cervical disability and the severity of TMD are moderately correlated in the mixed TMD group. As future perspectives, further studies should be conducted to investigate the relationship between the severity of neck disability in different types of TMD associated with other factors such as impaired sleep, catastrophic thoughts, depression, stress, and/or anxiety.

Declarations

Ethical approval All procedures performed in studies were in accordance with the 1964 Helsinki declaration and was approved by the ethics committee of the Federal University of Pernambuco (UFPE) under the no. 2.321.586.

Informed consent For this type of study, informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare that they have no conflict of interest.

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