EFFECT OF DISC DISPLACEMENT TEMPOROMANDIBULAR JOINT DYSFUNCTION ON THE MAXIMUM ISOMETRIC STRENGTH OF THE CERVICAL RETRACTORS

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ABSTRACT

Background: Temporomandibular dysfunction (TMD) is a major and complicated health problem affects 20-25% of the population that affects the temporomandibular joint (TMJ) and muscles of mastication, resulting in pain and disability. Objective: to investigate the effect of TMD on cervical retractor muscles maximum isometric strength among adults.

Methodology: Twenty-two participants of both genders with moderate to severe disc displacement TMDs diagnosed according to revised Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) algorithm (group A) and 22 healthy subjects (group B) who had no problems in the TMJ or facial pain. The pain intensity was assessed by the Arabic version numerical pain rating Scale and the Lafayette Hand held dynamometer was used to assess the isometric muscle strength.

Results: There was a statistically significant difference between the two groups in the mean value of retractors’ force; the disc displacement group had lower retractor strength. Conclusion: There is a significant effect of the disc displacement temporomandibular dysfunction on the strength of cervical retractors.

Key Words: Temporomandibular disorders, temporomandibular dysfunction, muscle strength, cervical spine, cervical retractors.

INTRODUCTION

A considerable percentage of population ranged from 20 to 25% has symptoms of TMD (Ingawale and Goswami, 2009). Symptoms of TMDs include pain in the TMJ, periauricular area and/or masticatory muscles. It can disturb social behavior, increase living costs, and limits
patient’s activities (De Magalhães et al., 2009 and Durham et al., 2011). Individuals with TMD have a lower quality of life and higher levels of depression, anxiety and sleep disturbance (Conti et al., 2012; Dubrovsky et al., 2017; Gumay et al., 2017; Natu et al., 2018 and Ekici, 2020).

Common symptoms of TMD are joint pain, clicking, and lateral deviation during opening and limited mouth opening less than 3 finger-widths (Catanzariti et al., 2005). TMD are divided to three subgroups myogenous, disc displacement or internal derangement and articular disorders (Molinari et al., 2007; Tanaka et al., 2008; Armijo-Olivo & Magee, 2012 and Poveda-Roda, et al., 2012). Women have TMD 4 times more than men (Chisnoiu et al., 2015).

The temporomandibular joint is directly connected with the cervical and scapular area through a common neuromuscular system. Afferents of the masticatory system project to the accessory nerve nucleus, which innervates the sternocleidomastoid and trapezius muscles (Gangloff et al., 2000).

Convergence of primary afferents of the first 3 cervical roots with those of the trigeminal within the spinal tract of the trigeminal nucleus and subnucleus caudalis of the medulla. The upper cervical nerves supply the mandibular angle. That means a structural relationship exists between the trigeminal and cervical afferents (Yin et al., 2007 and Iwata, et al., 2017).

A pathophysiological link exists between the masticatory system and cervical spine (Catanzariti et al., 2005). Occlusal interference or other masticatory problems may be an underlying factor of some chronic cervical complaints and vice versa (Yin et al., 2007).

Till the author’s knowledge very limited number of studies about cervical strength deficits in TMDs patients was founded; only 5 studies have been identified. Armijo-Olivo et al., 2010 & 2011 found no significant association between maximal cervical flexor strength and TMDs, they stated that studies are required to evaluate other groups’ strength such as cervical extensors, rotators, and lateral flexors, and in more severe degree of jaw disability.

MATERIALS AND METHODS:

Design of the Study:
The study design was Cross-sectional study- observational analysis.

Subjects:
According to a pilot study and G power analysis; Twenty two participants of both genders with moderate to severe disc displacement TMDs diagnosed according to revised RDC/TMD algorithm (Schiffman et al., 2010) and 22 healthy subjects who had no problems in the TMJ or facial pain. Their age ranged from 18-45. They were assigned to the
study groups. Those patients referred to the Department of Oral and Maxillofacial Surgery of the faculty of dentistry, Cairo University and out clinic of the faculty of physical therapy, Cairo University Giza, Egypt at the 21st of December 2021 till 30th January 2022. Each participant signed informed consent before starting the study. The Ethical committee approval number is (No: P.T.REC/012/003520). All subjects signed an informed consent prior to the beginning of assessment for ethical issues. Subjects recruited based on the following inclusion and exclusion criteria:

**Inclusive criteria:**
1- Participants with myogenic and disc displacement TMD of both genders.
2- Age of participants between (18 - 45) (Lövgren et al., 2016).
3- Moderate or severe pain in the masticatory muscles, pain score of ≥3 on the numerical rating scale (NRS) (Armijo-Olivo et al., 2010).
4- Chronic TMJ and or masticatory muscles pain (lasting at least for 3 months) (Grondin et al., 2015 and Gil-Martínez et al., 2016).
5- Body mass index (18:25) (Armijo-Olivo et al., 2012).

**Exclusive criteria:**
1- Recent acute trauma, previous fracture or major surgery to the TMJ.
2- Active inflammatory cause (rheumatoid arthritis), or previous infection (Armijo-Olivo et al., 2010).
3- Cognitive deficits (Greghi et al., 2018).
4- Severe cervical spine conditions (radiculopathy, acute herniation, degenerative lesion).
5- Recent physical therapy for cervical spine disorder (Ferreira et al., 2019).
6- Systemic disease that is may affect the mobility of the cervical spine such as ankylosing spondylitis (Greenbaum et al., 2017).
7- Posture deformities except mild degrees of forward head posture.
8- Medication intake (analgesics, anti-inflammatory or muscle relaxant drugs).

**Instrumentation:**

(A) Evaluation instrumentation:
1- Arabic version numerical pain rating Scale (ANPRS):

The Arabic numerical pain rating scale is a valid and reliable scale for measuring pain level; good to excellent reliability (ICC value 0.89) and (SEM 0.71) and (MDC 1.96). The ANPRS was highly correlated (r ¼ 0.93–0.94) with the visual rating scale and verbal rating scale, can evaluate the pain level. (Alghadir et al., 2016). The NRS is easy to be administered verbally and is a familiar clinical tool; it has shown an
acceptable level of validity for assessing pain intensity (Bijur et al., 2003 and Miró et al., 2009).

2-Hand held dynamometer (HHD):

Hand held dynamometer (Model 01163, Lafayette Instrument Company, Indiana) is an easy device to assess cervical maximal isometric strength in both clinical and research settings, showed good to excellent reliability with ICCs were 0.86 (95% CI, 0.72–0.93) for neck flexion, 0.93 (95% CI, 0.85–0.97) for neck extension, 0.82 (95% CI, 0.65–0.91) for right lateral flexion and 0.73 (95% CI, 0.50–0.87) for left lateral flexion (Vannebo et al., 2018).

The standard error measurement ranged from 0.43 to 1.81 and the MDC from 1.49 up to 4.61 (De Oliveira et al., 2018). Intra-rater correlation coefficient (1, 1) of the hand held and isokinetic dynamometer measurements as shown in figure (1) (Hirano et al., 2020).

Figure (1): Lafayette Handheld dynamometer

Evaluation Procedures:

1- Assessment of pain intensity:

Patients was asked to record the severity of pain by reporting a number that closely represented it, on a ‘horizontal scale’” of 0–10 in Arabic numerals with two ends, the left (0 representing no pain at all) and right (10 representing the worst pain ever) as shown in appendix number (I) (Bijur et al., 2003 and Alghadir et al., 2016).

2-Assessment of isometric cervical muscle strength using the (HHD):

During assessment of isometric cervical retractor strength, participants assumed the supine position. To prevent the upper body movement during the test 2 straps was used one placed across the chest at the 6th thoracic vertebrae (T6) level and the anterior superior iliac spine
level. One strength test was performed for each direction to avoid the potential for fatigue and recorded in kilogram unit (Shahidi et al., 2012). The dynamometer was resettled before each test. To encourage the participant the examiner said the word push 3 times, the attempt maintained for 5 seconds (Strimpakos et al., 2004).

Participants were positioned in supine with their limbs extended. The HHD was placed below the most prominent area of the occipit. Risers were positioned under the device if required to maintain the patient looking straight up using the nose - ear orientation; the nose perpendicular on the ear lobe. Then they were asked to retract their head and neck into the HHD under the instructions to draw your chin and head down into the plinth as shown in figure (2) (Tudini et al., 2019).

Statistical analysis:
- One Way ANOVA-test was conducted for comparison of age and BMI between the two groups.
- Fisher exact test was conducted for comparison of sex between the two groups.
- One Way ANOVA was carried out to compare retractors force between the two groups.
- Chi squared test was conducted for comparison of forward head posture distribution between the two groups.
- The level of significance for all statistical tests was set at p < 0.05.
- All statistical tests were performed through the statistical package for social studies (SPSS) version 25 for windows. (IBM SPSS, Chicago, IL, USA).
RESULTS

- General characteristics and demographic data of the subjects:

**Group A:**
Twenty-two subjects with disc lesion were included in this group. Their mean ± SD age and BMI were 25.18 ± 6.44 years and 23.95 ± 1.74 kg/m² respectively. (Table 1).

**Group B:**
Twenty-two normal subjects were included in this group. Their mean ± SD age and BMI were 23.45 ± 3.07 years and 23.32 ± 1.83 kg/m² respectively. (Table 1).

Comparing the general characteristics of the subjects of the two groups revealed that there was no significance difference between the two groups in age and BMI (p > 0.05).

**Table 1. Comparison of age and BMI of the group A and B.**

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>F-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>25.18 ± 6.44</td>
<td>23.45 ± 3.07</td>
<td>0.83</td>
<td>0.44</td>
<td>NS</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.95 ± 1.74</td>
<td>23.32 ± 1.83</td>
<td>0.69</td>
<td>0.5</td>
<td>NS</td>
</tr>
</tbody>
</table>

Sex distribution:

The sex distribution of the group A revealed that there were 21 (95.5%) females and 1 (4.5%) male. Women have 4 times more signs and symptoms of TMD than men (Chisnoiu et al., 2015). The sex distribution of the group B revealed that there were 20 (91%) females and 2 (9%) males. The sex distribution of the group C revealed that there were 20 (91%) females and 2 (9%) males. There was no significant difference in sex distribution between group A, B, and C (p = 1). (Table 2).

**Table 2. The frequency distribution and Fisher Exact test for comparison of sex distribution between group A and B.**

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>χ² value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>20 (91%)</td>
<td>20 (91%)</td>
<td>0.61</td>
<td>1</td>
<td>NS</td>
</tr>
<tr>
<td>Males</td>
<td>2 (9%)</td>
<td>2 (9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparison of retractors’ force between group A and B:

The mean value ± SD of retractors’ force of group A and B were 4.49 ± 2.29 and 7.8 ± 3.17 kg respectively. There was a significant difference between the two groups in the mean value of retractors’ force (p = 0.0001). (Table 3).
The mean difference between group A and B was -3.31 kg. There was a significant increase in retractors’ force of group C compared with that of group B (p = 0.0001). (Table 3).

Table 3. Comparison of retractors’ force between group A and B:

<table>
<thead>
<tr>
<th>Retractors’ force (kg)</th>
<th>X ±SD</th>
<th>F- value</th>
<th>p- value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>4.49 ± 2.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group B</td>
<td>7.8 ± 3.17</td>
<td>9.42</td>
<td>0.0001</td>
<td>S</td>
</tr>
</tbody>
</table>

Post hoc test (Tukey): MD -3.31 p-value 0.001 Sig S

Table: Mean SD: Standard deviation MD: Mean difference
p value: Probability value S: Significant NS: Non significant

- Association between forward head posture and cervical condition:

14 (64%) subjects of group A had forward head posture and 11 (50%) subjects of group B had forward head posture. There was no significant association between forward head posture and cervical condition (p = 0.65). (Table 4).

Table 4. Association of forward head posture and cervical condition.

<table>
<thead>
<tr>
<th>Forward head posture</th>
<th>Group A</th>
<th>Group B</th>
<th>χ² value</th>
<th>p - value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward head posture</td>
<td>14 (64%)</td>
<td>11 (50%)</td>
<td>0.86</td>
<td>0.65</td>
<td>NS</td>
</tr>
<tr>
<td>Normal head posture</td>
<td>8 (36%)</td>
<td>11 (50%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ²: Chi squared value p value: Probability value NS: Non significant

DISCUSSION:

The purpose of the study was to assess the effect of chronic disc displacement TMD with moderate to severe pain intensity on the cervical retractors isometric strength. The pain intensity was measured by ANPRS and the isometric strength by the Lafayette HHD. The findings of this study revealed that there was a significant difference between disc displacement TDM and healthy individuals; they had lower retractor muscles strength.

Active trigger points (TrPs) for temporalis, masseter, upper trapezius and sternocleidomastoid and suboccipital muscles which radiate pain to the surrounding structures (Fernández et al., 2010 and Alonso-Blanco et al., 2012).

It also can be explained by central inhibition as; the experimental induced muscle pain is centrally mediated and inhibits maximal isometric force by central mechanisms (Graven et al., 2002). High levels of muscle tenderness in upper trapezius and temporalis muscles correlated with high levels of jaw and neck dysfunction (Silveira et al., 2015). Muscle pain
causes a gradual decrease of motor unit firing rates and induces a reflex central inhibitory mechanism (Farina et al., 2004). Also a neural link exists between the neck, jaw, and masticatory muscles all have common neural innervation and closely related anatomical structures (Speciali and Dach, 2015). Nociceptive neurons in the C1 receive excitatory afferent from trigeminal and cervical (Mørch et al., 2007).

The majority of the disc displacement TMD patients had ligamentous laxity and hypermobility. In generalized joint hyperlaxity (GJH); more elastic and fragile connective tissue and it leads to associated with muscle weakness, (Scheper et al., 2013). Ligament laxity is associated with deficits in power and proprioception (Witchalls et al., 2013). There is agreement with this study with Shahidi et al., 2012; they found that neck pain patients have greater neck disability index (NDI) scores and lower cervical muscles isometric strength. The NDI was higher in the moderate/severe TMD. The more dysfunction and pain in the TMJ region, the greater level of the neck dysfunction on some neck functional tests (von Piekartz et al., 2016).

Isometric craniocervical flexion test (CCFT) is impaired in neck pain patients (O’Leary et al., 2007). Women with TMDs, showed limited ROM of the flexion and extension, poor deep cervical flexor performance and limited upper cervical spine mobility (Ferreira et al., 2019).

Generalized hyperlaxity syndrome may adversely affect the function of connective tissue. It is the most common cause of chronic pain and one of the most challenging to treat (Grahame, 2009). Hyperlaxity is considered a sort of instability (Johnson and Robinson, 2010).

In contrast with this study, (Armijo-Olivo et al., 2010&2012) founded that there is no significant difference between mixed and myogenous TMD patients and healthy subjects in the cervical flexor strength.

**Limitations**

This study has a few limitations. First; this study lacked a blind assessor. Second; the cross-sectional study design (assessment has been done once), adopted in this study. It is required to assess through repeated times to confirm the consistency of the results. There may be variations in test performance across days due to fluctuation of symptom severity. Third; the exclusion of patients with chronic diseases, that we cannot draw any conclusions for those patients.

**CONCLUSION:**

There is a statistically significant effect of the disc displacement temporomandibular dysfunction on the strength of cervical retractors.
Recommendation
It is recommended to investigate the following issues in the future studies:
1- Effect of TMD on the cervical rotator isometric strength.
2- Effect of TMD on the dynamic cervical muscle strength.
3- Replication of the study on the other subgroups of the TMD.
4- Replication of the study on the mild pain intensity level or acute and subacute patients.
5- Cohort type of study and measuring in different situation to confirm the consistency of results and the association between TMD and cervical dysfunction.

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تأثير الخلل الوظيفي لانزلاق غضروف مفصل الفك الصدغي على القوة العظمى للعضلات الساحبة للعنق

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الخلفية: تعد مشكلة الخلل الوظيفي لمفصل الفك الصدغي من أهم المشكلات الصحية المعقدة حيث أنها تصيب نحو 20-25% من البشر، وتؤثر على مفصل الفك وعضلات المضغ، وينتج عنها الألم والتهيج. الهدف: دراسة تأثير الخلل الوظيفي لمفصل الفك الصدغي على القوة العظمية للعضلات الساحبة للعنق بين البالغين. الطريقة: شارك 22 شخص البالغين من الأمام بسبب إزلاق العضروف الداخلي لمفصل الفك (مجموعة A)، وذلك تم تشخيصهم بواسطة معايير التشخيص السحري/اضطرابات الفك الصدغي المعقدة واستمارة الدراسة، تمت الأبحاث على 22 شخص لا يعانون من أي مشاكل بمفصل الفك أو الام بالوجه (مجموعة B)، تتراوح أعمارهم من 18-45 عام. تم قياس كلة الأذن باستخدام السمعة العالية من مقياس التقييم الرقمي وقياس قوة العضلات باستخدام الدينامومتر لافاييت. النتائج: يوجد اختلاف واضح بين المجموعتين في متوسط قوة العضلة الساحبة حيث أن مجموعات الزيادة الغيرفي لديهم قوة عضلية أقل. الخلاصة: هناك تأثير قوي لخلال الوظيفي لانزلاق غضروف مفصل الفك الصدغي على القوة العظمية للعضلات الساحبة للعنق.