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Research Article

Impact of the Implementation of the Neuromuscular Technique on Muscles: Sternocleidomastoid, Quadriceps, Gluteus Maximus and Medius in Mandibular Movement

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Abstract

Neuromuscular Technique (NMT) is one manual techniques for temporomandibular joint (TMJ) dysfunctions treatment. However, there are very few studies on NMT associated with myofascial chain and TMJ function. The aim of this study was to investigate the correlation between NMT applied bilaterally in sternocleidomastoid, quadriceps and gluteus (maximus and medius) and the vertical opening amplitude of the mouth, the lateral movement of the lower jaw and the comfort-satisfaction scale during these movements, assessed by the visual analog scale (VAS). Seventy-nine asymptomatic healthy subjects (18 - 65 years) of both sexes were divided in 3 groups: NMT in sternocleidomastoid and (G1) quadriceps; (G2) gluteus maximus or (G3) gluteus medius. Each group was divided due to the difference in the slip direction of the technique: cephalo-caudal (A) or caudo-cephalic (B). G1B decrease the opening of the mouth after the NMT and G3B increase when compared to the other direction. Almost all groups exhibited an increase in the left lateral movement of the lower jaw, while only G3B exhibited an increase in the right side after the NMT. Only G3B exhibited an increase in VAS. The maneuvers directions interfered in the results after the intervention. It may be due to the sense of muscle origin insertion that favors certain movements, such as the mouth opening. This study aimed to demonstrate the possible efficacy of NMT as a therapeutic element as a complement to the different protocols of subsequent therapeutic intervention, considering its possible durability, low cost, slight degree of pain and harmful effects.

Keywords: Neuromuscular Technique; Temporomandibular Joint; Sternocleidomastoid; Gluteus

Introduction

Temporomandibular disorders (TMD) are very frequent and affect between 30% and 50% of the population, with a higher prevalence among women than men [1,2]. Temporomandibular joint (TMJ) dysfunctions are now classically included in the Dysfunctional Pain Syndrome, with a strong occlusal-muscular-psychogenic etiological component, or by organic changes originating in the TMJ itself [1,2].

The stomatognathic system or masticatory system constitutes a functional unit composed of the teeth, periodontium, oral mucous membranes, jaws, temporomandibular joints, oral and masticatory muscles, salivary glands, vessels and the nerves [3]. This network of structures intervenes in functions as fundamental as chewing, swallowing, phonation, breathing, taste, expression of feelings, some of which are also visible in animals, albeit with different evolutionary characteristics and stages [4].

One of the many manual techniques for TMJ treatment is the Neuromuscular Technique (NMT) initially developed by Stanley Lief, a method of simple diagnostic and therapeutic value in its application with remarkable effects and applicable to any part of the body, to any physiological and physical dysfunction and to joint and soft tissue injuries [5,6]. Sentamans., *et al*. evaluated the effects of NMT on the sternocleidomastoid and quadriceps muscle on the TMJ movement range and found that the group that received NMT in both muscles had a more effective result, pointing out a relation between these two muscles since they are part of the same myofascial chain. In this way, a therapeutic intervention has no local effect only and may have repercussions for the myofascial sequence [7].

Several authors who work on the functional integration between the temporomandibular and cranio-cervical neuromuscular systems explain that there is a functional rhythmic coupling between the head and the mandible integrated within the structure of the joint action of movements in the articulations of the atlanto-occipital, temporomandibular and cervical spine [8-13]. According to Stecco., *et al.* the sternocleidomastoid muscle is included in the myofascial antepulsion sequences (which includes the digastric muscle, the main muscle of the opening of the mouth) and lateropulsion (which encompasses the masticatory muscles, masseteric fascia and the superficial cervical fascia prolongation) [14]. However, there are very few studies on NMT associated with myofascial chain and TMJ function. In view of the lack of research, the aim of the current study was to investigate the correlation between NMT applied bilaterally in sternocleidomastoid, quadriceps and gluteus (maximus and Medius) and the vertical opening amplitude of the mouth, the lateral movement of the lower jaw and the comfort-satisfaction scale during these movements, assessed by the visual analog scale (VAS).

Methods

Subjects

Seventy-nine asymptomatic healthy subjects between 18 and 65 years of both sexes able to respond to the questionnaires in portuguese volunteered to study. Exclusion criteria were:

1) Constitutional or acquired malformations in the temporomandibular and/or the coxofemoral joint;
2) Degenerative and/or inflammatory changes, contusions, sprains, dislocations, recent fractures, surgical interventions of the temporomandibular and/or the coxofemoral joint;
3) Infections, rheumatic diseases;
4) Tumors, osteitis;
5) Use of orthosis or prosthesis in the tooth and/or in the total or partial coxofemoral joint;
6) Be subject to psychological or psychiatric treatment;
7) Receive another treatment during the study;
8) Absenteeism during the study.

The subjects' assignment to the groups was randomized and controlled in order to homogenize the groups, as well as the maximum possibility of comparing them according to the anthropometric variables, age and sex. The study was carried out entirely at the Physiotherapy outpatient clinic of UNIFRAN, in Franca, Brazil. The participants were fully acquainted with the nature of the study prior to giving written informed consent to participate and completing the questionnaire. Ethical approval was granted from Universidad de Franca ethics committee (protocol number 170/08).

Procedures

The dependent variables measured were the vertical opening of the mouth (VOM), the lateral movement of the lower jaw (bilaterally) and the visual analog scale (VAS) for comfort-satisfaction of the movements of the mouth before and after the treatment. Anthropometric measurements were performed using a stadiometer with millimeter scale and a balance with 100 grams precision. Opening of the mouth and the lateral movement of the lower jaw were considered according to Kapandji., *et al.* and Bienfait., *et al*. [15,16]. During the measures, the patient was in the supine position with the arms along the body, the head resting on the stretcher in a relaxed position.

To measure the movements, a Vernier caliper was used, and the inter-incisive distance was measured on three successive occasions separated by a 30 second interval between each measurement, between which the patient closed the mouth. For the lateral movement of the lower jaw, the subject opened the mouth and pushed the jaw to the side, holding it up during the measurement and then closing it. The inter-incisive distance (left and right) was measured with a pachymeter on three successive occasions at 30-second intervals. The VAS for comfort-satisfaction was applied according to Farias., *et al.* to assess the patient's comfort level during the movements of the mouth and their evolution throughout the study [17].

Neuromuscular technique (NMT)

Volunteers were treated at ambulatory, in a room specially prepared for the procedures. The volunteer was in the supine position with the arms along the body, the head resting on the stretcher in a relaxed position for the volunteer. NMT was performed by one osteopath specially trained, who did not know which group the volunteer belonged to throughout the procedure. Every session of the study took place at the same time of day. NMT was performed one time according to the group that the volunteer was designated:

- G1: NMT bilaterally in the sternocleidomastoid and quadriceps muscles;
- G2: NMT bilaterally in the sternocleidomastoid and gluteus maximus muscles;
- G3: NMT bilaterally in the sternocleidomastoid and gluteus medius.

Each group was divided into 2 subgroups due to the difference in the slip direction of technique application: cephalo-caudal (A) or caudo-cephalic (B). Therefore, we obtained 6 subgroups:

- G1: A and B;
- G2: A and B;
- G3: A and B.

Statistical Analysis

Results are presented as mean ± SD. Normality test was performed and confirmed by Kolmogorov-Smirnov test. For analyses between groups was used Anova followed by Tukey and for intra-group analyses was used Student t-test. Statistical analysis and figures were performed using GraphPad Prism software version 7.00 for Windows (GraphPad Software, San Diego, California, USA). The acceptance level of significance was set at $p < 0.05$.

Results

The results were obtained by the pre- and post-intervention comparison. No difference was observed in the opening of the mouth before and after the procedure, but G1B shows a decrease when compared to G1A and G3B shows an increase when compared to G3A (Figure 1). For the left lateral movement of the lower jaw, the groups G1A, G2B, G3A and G3B exhibited an increase after the intervention (Figure 2). For the right lateral movement of the lower jaw, only G3B exhibited an increase after the intervention. Only G3B shows an increase in the VAS after the protocol (Figure 3) (Table 1).

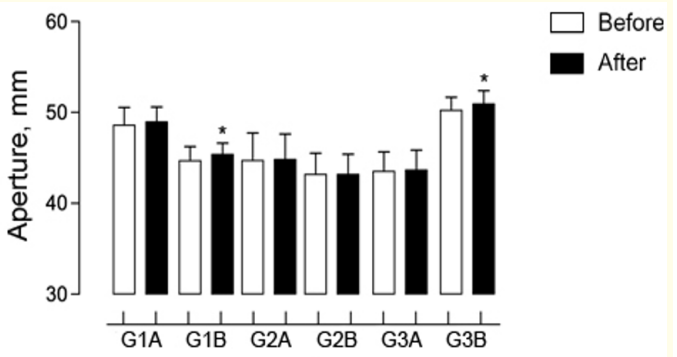

Figure 1: Opening of the mouth before and after the procedure. *p < 0.05 A vs. B.

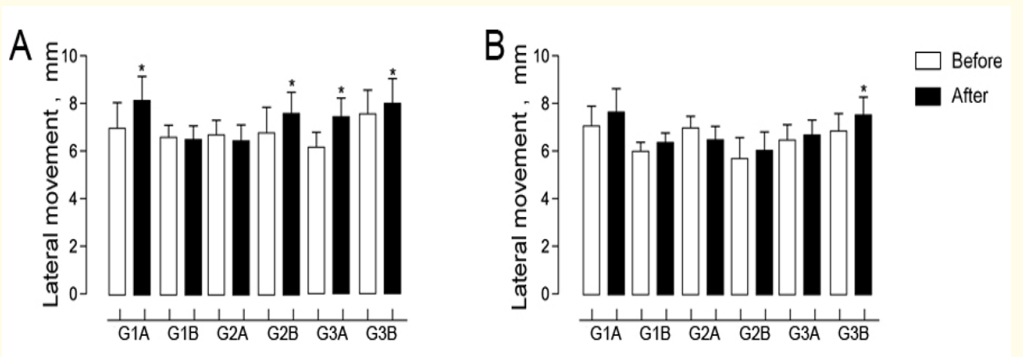

Figure 2: Lateral movement of the lower jaw. (A) left and (B) right. *p < 0.05 before vs. after.

Groups	Subgroup	n	Age	Men	Women	Height (m)	Weight (Kg)	BM (Kg/m²)
1	A	13	22	4	9	1.64 + 0.03	56 + 5.20	21 + 1.00
	B	14	20	5	9	1.71 + 0.02	62 + 3.90	22.3 + 1.00
2	A	10	23	3	7	1.64 + 0.02	59.5 + 3.60	20.6 + 1.30
	B	10	23	2	8	1.65 + 0.02	62 + 7.10	22.6 + 2.10
3	A	17	23	9	8	1.69 + 0.02	63 + 3.90	22A + 0.90
	B	15	23	4	11	1.67 + 0.02	66 + 3.20	222 + 1.10

Table 1: Subject descriptive variables (mean ± SD).

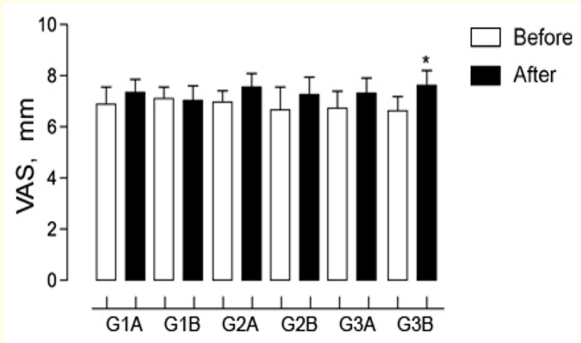

Figure 3: Visual analog scale (VAS) for comfort-satisfaction of the movements of the mouth.
*p < 0.05 before vs. after.

Discussion

A good cervical posture of the head and trunk is important to maintain a good range of movements of the mouth, since the regulation of the orthostatic posture gathers multiple receptors (cutaneous, ligamentous, capsular and muscular) and supraspinal as starting points (labyrinths and oculomotors) [18-20]. A correct posture must always comply with maximum efficiency and minimum energy expenditure [21]. This is only possible through a harmonic functioning of the different body segments with respect to the mechanical axis of the body and maintained through a minimum tension of the muscular system and the control of the nervous system [21]. The maintenance of the vertical position depends on the visual, vestibular and proprioceptive systems, considering that teeth, occlusion and dysfunctional temporomandibular joints are capable of disturbing posture as well as any other organ or sense organ [22]. Each gesture is made from a set of actions that complement each other to achieve a final goal, so an initial tension is responsible for a succession of associated tensions [22]. Occlusal problems lead to postural derangements, temporomandibular disturbances (TMD), trismus, bruxism, dental clenching, facial muscle tensions, are reflected in the functioning of the cervical spine [8,23-25].

Postural changes of the head and the rest of the body may lead to a process of biomechanical disadvantage of the TMJ region due to its close relationship with the musculature of the cervical region and the shoulder girdle. The alterations of some segment of the body cause a chain reaction in the rest of the body and, as a consequence, in its adequate motor functions. Patients with some type of TMD may show postural alterations such as protrusion of the head, reduction of the tibio-tartar angle, hyperextension of the knee, anterior pelvic version, as well as decreased mobility of the trunk and cervical spine [22,25,26].

The cephalocaudal (A) or caudo-cephalic (B) maneuvers directions interferes in the results after the intervention, both intergroup and intragroup. Although the groups had a homogeneous distribution in terms of sex, height and BMI, we obtained intragroup differences according to the orientation of the NMT. It is not well explained why this difference occurs, but it may be because it is in agreement with the sense of origin insertion of the muscle that favors certain movements such as the opening, for example, when applied to sternocleidomastoid within the anterior cervical band in the cephalon-caudal direction (A).

Szentpetery., *et al.* and Hirsch., *et al*. state that the mouth movements range varies greatly from one individual to another and is conditioned by sex and age [27,28]. In our study group, we observed individual differences in size and mouth opening, but this was not our object of study. On the other hand, our groups and sub-groups had an average age of less than 25 years, being mostly young individuals.

Celic., *et al*. points out that BMI influences mandibular movements, a fact that was not reflected in our study [29]. This may be due to the fact that our sample is more homogeneous with variables such as BMI, more distributed among the groups, since we do not aim to verify the influence of BMI on opening and laterality of the mouth, but the initial differences found between the groups suggest that there may be some influence. The increase in the vertical opening of the mouth after working with muscles at a distance (sternocleidomastoid, quadriceps, gluteus maximus) may have been due to an indirect relaxation of masseters and other muscles responsible for closing the mouth.

A limitation of the study is the difficulty to recruit volunteers. This reflected an uneven number between men and women under the age of 25. Another limiting factor was that the volunteers were asymptomatic, unable to confirm the effect of the technique in case of temporomandibular dysfunction.

Conclusion

This study is not intended to support the treatment of clinical entities or syndromes as complex as dysfunctions of the stomato-

gnathic complex with this unique technique, but to demonstrate its possible efficacy as a therapeutic element, that is, as a complement to different protocols of subsequent therapeutic intervention, considering their possible durability, low cost, slight degree of pain and harmful effects derived from their application.

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