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SINGLE CASE STUDY

Effectiveness of global postural reeducation in the treatment of temporomandibular disorder: Case report

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Summary The aim of the present study was to evaluate the effectiveness of global postural reeducation in the treatment of temporomandibular disorder through bilateral surface electromyographic (EMG) analysis of the masseter muscle in a 23-year-old volunteer. EMG values for the masseter were collected at rest (baseline) and during a maximal occlusion. There was a change in EMG activity both at rest and during maximal occlusion following the intervention, evidencing neuromuscular rebalancing between both sides after treatment as well as an increase in EMG activity during maximal occlusion, with direct improvement in the recruitment of motor units during contractile activity and a decrease in muscle tension between sides at rest. The improvement in postural patterns of the cervical spine provided an improvement in aspects of the EMG signal of the masseter muscle in this patient. However, a multidisciplinary study is needed in order to determine the effect of different forms of treatment on this condition and compare benefits between interventions. Therefore, this study can provide a direction regarding the application of this technique in patients with temporomandibular disorder.

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Introduction

Temporomandibular disorder (TMD) is defined as a neuromuscular dysfunction of a syndromic nature (Cauás et al., 2004). Current statistical data demonstrate that at least half of the world population has some type of TMD, with a predominance of women between 20 and 30 years of age (Vasconcelos et al., 2002). The main causes of this dysfunction are morphological alterations in the dental arch and postural problems (Bailey, 1995). According to Tommasi (1997), spasms in the muscles of mastication are the main cause of pain symptoms in TMD and, according to Liu (2002), account for 80% of the etiology of this disorder.

Studies have addressed the influence of posture in the genesis of TMD. According to a number of researchers, the occurrence of this condition may be linked to a failure in the positioning of the cervical spine, especially in cases in which there is forward head lean. The end product of this compensatory pattern is the forward projection of the mandible (Munhoz et al., 2004). In a complementary fashion, the premature contact of the dental arch may generate asymmetrical degrees of muscle tension, which at times leads to pain symptoms due to a unilateral increase in myofascial stress (Christensen and Rassouli, 1995). Considering the muscle action responsible for the maintenance of contact between the surfaces of the temporomandibular joint, changes in the positioning of the head and body may alter the response patterns of the mandibular musculature stemming from proprioceptive stimuli of the teeth (Kimmel, 1994).

The existing forms of therapy physiologically address the issue of pain symptoms, especially headaches. However, there is no emphasis on correcting the underlying problem, such as a postural change in the cervical spine that leads to compensatory changes in the temporomandibular joint (Rocabado et al., 1983). According to Souchard (1987), active muscle stretching is one of the treatment options for improving posture through the stretching of a set of muscles while respecting the construction of "muscle chains." This method is denominated global postural reeducation (GPR).

Electromyography (EMG) has been shown to be an effective method in the assessment and treatment of muscle disorders (Barros et al., 2006). In recent years, EMG has been used on the muscles of mastication in the diagnosis of TMD to determine muscle function and dysfunction during rest, occlusion and mastication.

Due to the association between postural alterations, especially in the cervical spine, and the development of TMD, a postural reeducation program is believed to result in adequate, symmetric activation of the muscles of mastication and an improvement in pain among individuals with TMD. Thus, the aim of the present study was to assess the effectiveness of postural reeducation in the treatment of TMD using bilateral surface EMG analysis of the masseter muscle.

Materials and methods

Sample

This paper is a case report involving a 23-year-old female (height: 1.6 m; body mass: 59 kg; body mass index: 21.0) with a diagnosis of temporomandibular disorder on the right side. With regard to the diagnosis of dysfunction related to posture, the subject had evident signs of pelvic anteversion, lumbar hyperlordosis, thoracic hyperkyphosis and cervical hyperlordosis.

All steps of the experiment and treatment were conducted at the Physiotherapy Laboratory located on Campus I of the *Faculdade de Pindamonhangaba*, *Fundação Universitária Vida Cristã*, Brazil. The study complied with the guidelines and norms of Resolution n° 196/96 of the Brazilian National Board of Health and received approval from the local ethics committee under process no 027/2007.

Surface electromyographic (EMG) analysis

The electromyographic data was acquired from the masseter muscle (both sides). The selection of the masseter muscle was based on the reported discomfort and pain upon palpation, as well as its anatomic accessibility. The electromyographic study was performed using a 16-channel analog-input electromyographic signal recording system (EMG Sistema do Brasil®) with an amplification gain of 2000 times, band frequency from 20 to 500 Hz and a 16-bit analog-digital converter. The sampling frequency was 2000 Hz per channel. Disposable self-adhesive bipolar differential surface electrodes were used, with a pre-amplification of 20 times (active), common rejection mode $>$ 100 db, output impedance $>$ 10 mΩ and the pressure button on the end of the Medtrace® 10 mm in diameter and separated by a distance of 2 cm. The electrodes were positioned in the direction from the angle of the mandible to the corner of the eyes, parallel to the muscle fibers. The motor point was located in the center of the belly of the muscle, as indicated by hypertrophy of the masseter muscle in contraction. The skin was cleaned with ethyl alcohol (70%) prior to the placement of the electrodes in order to reduce impedance.

Signals referring to maximal occlusion (OCLmax) were rectified with "full-wave rectification" using the module function (ABS), thereby obtaining a positive absolute value referring to the tracing of the EMG signal. The signal was smoothed using the "moving average" method, with a 20-ms time window.

Aspects inherent to muscle recruitment were analyzed for the baseline (at rest) and OCLmax values based on the amplitude of the signal using the root mean square (RMS) of the current throughout the entire wavelength. The analysis of RMS values provides greater information on the amplitude of the EMG signal based on the number of motor units recruited and the form of the action potential of the motor units in relation to their area (Basmajian and De luca, 1985).

Rehabilitation protocol

The participant was submitted to TMD treatment using global postural reeducation (GPR), beginning with the first square position (FSP). The subject was instructed to lie in the supine position on an appropriate physical therapy table for the application of the technique. From this position, the therapist performed sacral tension, the central idea of which was to generate a pull on the sacroiliac block in the caudal direction, with the aim of correcting the lumbar spine. The subject was asked to flex her hips at a 90° angle and extend her knees bilaterally until reaching the limit of passive tension imposed by the hamstring muscles (Fig. 1). In a complementary fashion, she made contact with the inside edge of the heel bone, with slight external rotation of the hips and dorsi-flexion of the ankle joint complex, taking into account the limit of passive tension imposed by the gastrocnemius and soleus muscles. Terminating this procedure, the therapist sat at the head of the table and intermittently added a new traction component in the cervical region in the cranial direction to rectify this physiological curve. From this same position, the therapist repositioned the neck and removed the tension in the muscles of the stomatognathic complex. It is noteworthy that, from this position, the therapist guided the postural adjustments to be performed. These adjustments were related to maintaining the positioning of shoulders symmetrically and harmoniously at 40° abduction with external rotation while maintaining the diaphragm breathing pattern in order to avoid respiratory blockage. Fig. 1 displays the final position of this posture during the treatment.

Sessions of approximately 30 min were held three times a week for eight weeks (total of 24 sessions).

The electromyographic collections were performed before and after the application of the global stretching technique. The division of the EMG signal into temporal phases allows identifying the behavior of the same magnitude in different temporal phases. For example, when analyzing the signal amplitude, taking into consideration the beginning and end of EMG activity, one can identify a change in amplitude toward greater or lesser, but one will not know which part of the signal made this change. By fragmenting the analysis of the signal into phases, there is a greater chance of recognizing any change in the EMG signal, correlating the patterns of the signal with the clinical condition. Each 1-s phase represents an arithmetic mean between one thousand analyzed points. Each point is consistent with the electrical impulses generated by the masseter muscle at rest and during maximal occlusion. Thus, each temporal phase is the product of the mean of 1000 electrical stimuli captured and interpreted in 1 s, totaling 5000 pieces of information on activity before intervention and 5000 pieces of information on activity after intervention. From a mathematical standpoint, this made the analysis more reliable regarding the identification of changes in patterns of electrical activity in the muscle examined.

Figure 1 "First square position" used to treat patient.

Results

Baseline

The individual evaluated in the present study experienced no physical complications stemming from the rehabilitation or experimentation procedures employed.

The EMG of the baseline (at rest) amplitude underwent a reduction on the hyper-activated side (in this case, the right side) following the intervention. The analysis of the difference between sides prior the intervention revealed a significantly higher amplitude of the signal on the affected side[1] in comparison to the contralateral side, whereas no significant differences were found between sides following the intervention. Table 1 displays the baseline analysis before and after the posture correction procedure. Fig. 2 graphically illustrates the behavior of this variable prior to and following the intervention (upper quadrant).

Maximal occlusion

The analysis of the EMG signal during OCLmax revealed a bilateral increase in amplitude following the intervention. The amplitude of the signal on the affected side was significantly higher prior to the intervention in comparison to the contralateral side, whereas there were no differences between sides following the intervention and there was an increase in the EMG signal on both sides. Table 2 displays OCLmax analysis before and after the posture correction procedure. Fig. 2 graphically illustrates the behavior of this variable prior to and following the intervention (lower quadrant).

Discussion

Posture plays an important role in the genesis of TMD. A good example of the impact of posture is related to alterations on the sagittal plane, in which the head of patients with this condition tends to incline in an anterior direction (forward lean of the head and neck) (Janda, 1981). The

[1] *Affected side*: In this text, affected side refers to the side on which patients reported complaints such as headaches, sensation of tiredness and pain during biting; analogous to the side on which the EMG signal was hyper-activated at both baseline and during maximal occlusion (in this case, the right side).

Table 1 Baseline data in an individual with temporomandibular disorder.

Baseline analysis					
Phases	Time (s)	RMS/before (1000 points analyzed)		RMS/after (1000 points analyzed)	
		Rb	Lb	Ra	La
1st phase	0.1—1.1	20	16.75	15.2	15.15
2nd phase	1.2—2.2	20.35	16.8	15.65	15.12
3rd phase	2.3—3.3	20.42	16.9	15.02	15.18
4th phase	3.4—4.4	21.02	16.88	14.43	15.13
5th phase	4.5—5.5	20.5	16.7	15.1	15.15

Legend: Rb — right side before, Ra — right side after, Lb — left side before, La — left side after.

studies cited demonstrate how the forward lean of the head changes the behavior of the electrical activation of the masseter muscle, leading to a neuromuscular imbalance between sides (Ayub et al., 1984). The clinical result of this imbalance is demonstrated by the incidence of facial pain and headaches among all patients in the pre-treatment period. The authors previously carried out another study on asymmetry of the shoulders found in patients with TMD, which is thought to be a later process of bodily adaptation. These adaptive mechanisms are related to the hyperactivity of the muscles of mastication and increase in cervical lordosis. The increase in this muscle activity is thought to alter the positioning of the shoulders, which may be protracted and raise on the same side as the affected temporalmandibular joint.

Another important postural alteration is associated with the positioning of the cervical spine. Shimazaki et al. (2003) compared the effect of the displacement of the cervical spine on the imbalance in the muscles of mastication between sides on the occlusal plane and found a relationship between these variables. The morphological and functional characteristics during the lateral movement of the mandible generate a compensatory mechanism for the maintenance of postural control in this joint. Although the study cited does not directly address TMD, it demonstrates an indirect relationship between the positioning of the cervical spine and orofacial alterations.

Amantéa et al. (2004) offer two theories of a mechanical origin to explain the genesis of TMD. The first states that the forward lean of the head is responsible for the incorrect positioning and function of the mandible, causing continual tension in the muscles of mastication, the end result of which is TMD. The second theory states that an alteration in the activity of the muscles of mastication causes an imbalance in the action of the neck muscles, leading to a stretching of the anterior muscles and shortening of the

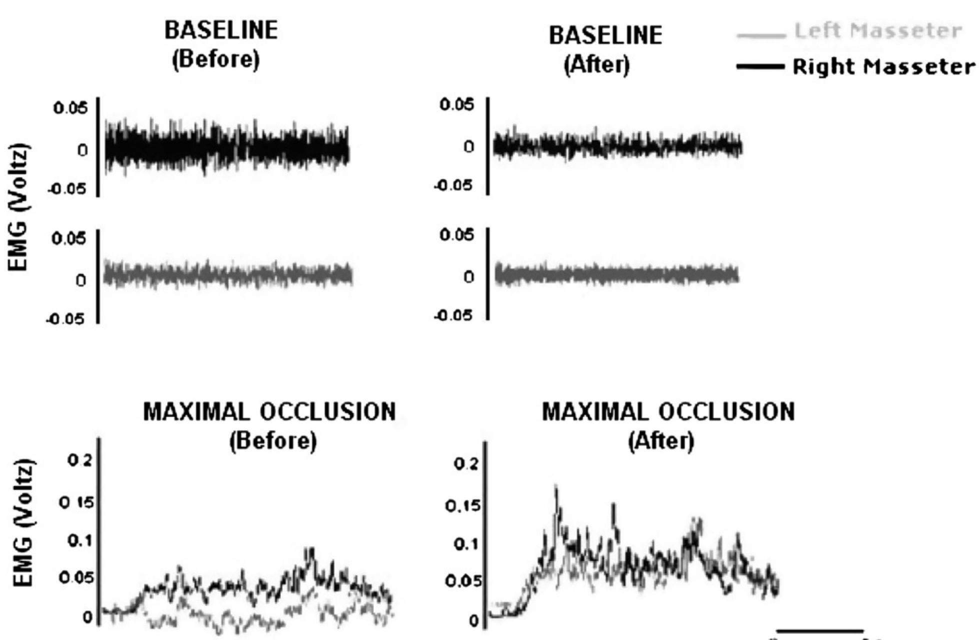

Figure 2 Temporal series of data analyzed in an individual with temporomandibular disorder; upper images represent baseline on right (black) and left (gray) sides. Lower images represent EMG signal during sustained maximal occlusion for 5 s. Left-hand column shows values before intervention and right-hand column shows values after intervention (global postural reeducation).

Table 2 Maximal occlusion data in an individual with temporomandibular disorder.

Maximal occlusion data					
Phases	Time (s)	RMS/before (1000 points analyzed)		RMS/after (1000 points analyzed)	
		Rb	Lb	Ra	La
1st phase	0.1—1.1	77.02	52.35	94.73	93.17
2nd phase	1.2—2.2	76.58	53.41	93.12	92.39
3rd phase	2.3—3.3	77.69	55.12	92.02	91.14
4th phase	3.4—4.4	78.41	51.20	91.37	91.28
5th phase	4.5—5.5	78.50	50.30	90.98	91.09

Legend: Rb — right side before, Ra — right side after, Lb — left side before, La — left side after.

posterior muscles, which triggers an excessive forward lean of the head. This is explained by the center of gravity of the head projected forward, accompanied by the temporomandibular joint. Thus, the maintenance of the craniocervical position is partially achieved by the synergic work of the muscles of the neck, head and shoulder girdle. Any anatomic and/or biomechanical alteration in one of these structures leads to muscle imbalance. This further stresses the need for postural correction in individuals who suffer from TMD. The fact that the individual in question achieved significant improvement both in EMG activity patterns and pain symptoms is directly related to the intervention performed. With global posture reeducation, the myofascial system is addressed through neuromuscular chains. This subject had a shortening in her posterior chain, circling upward (thoraco—cervico—cranio—facial). This circuit is mainly formed by the scapular spine, skull and face, which were worked symmetrically with the application of this technique. After 15 sessions, the improvement in the positioning of the shoulders, neck and head was evident in the patient. Moreover, she reported an improvement in pain symptoms.

Note

It is necessary to bear in mind that muscle imbalance generated by a postural alteration is not the only factor responsible for the appearance of TMD, as the structural configuration of the temporomandibular joint is involved as well. According to Akçam and Köklü (2004), even when there are no differences between the anatomic configuration of the head and its natural postural pattern, its configuration may indirectly alter this relationship. Thus, the efficacy of postural correction is limited when TMD stems from craniofacial morphology, as GPR does not modify the form of the joint complex and therefore will have more success in cases in which the TMD is of a postural origin. The current literature does not describe many specific treatments of postural correction, such as GPR, for patients with this disorder. We found only one paper that directly addresses this issue that demonstrated significant results stemming from the postural correction of patients with TMD (Wright et al., 2000). The authors cited suggest that the effects of postural correction would be more efficient if associated to the instruction of self-correction. Both the study cited and the present investigation demonstrate a reduction in pain symptoms due to an improvement in posture among individuals with TMD. However, the technique presented by Wright et al. (2000) demonstrated no specificity with regard to working neuromuscular chains, as described in the present study.

Conclusion

In the present study, global postural reeducation led to a reduction in electrical activity in the muscles evaluated and proved to be an important tool in the treatment of TMD. Further studies are needed to confirm the benefits of GPR in this population. Moreover, a multidisciplinary study is needed to determine the effects of different forms of treatment for TMD.

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