Surface electromyography of masticatory muscles in individuals with temporomandibular disorder submitted to acupuncture

Avaliação eletromiográfica dos músculos da mastigação de indivíduos com desordem temporomandibular submetidos a acupuntura

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ABSTRACT

Purpose: To assess the effect of acupuncture on the electromyographic activity of masticatory muscles in patients with temporomandibular disorder (TMD). **Methods:** Forty women, from 20 to 40 years old, with TMD diagnosis were assessed using the electromyography of the masseter and temporal (anterior fascicle) muscles. Participants were distributed into study group (SG), which received acupuncture treatment soon after the first assessment, and control group (CG), which received the treatment five weeks after this assessment. The electromyography was accomplished at the first evaluation (Av), immediately after one session of acupuncture (R1), and after ten sessions (R10) in the SG. The CG was evaluated at the beginning (Av) and after five weeks (R10), while waiting for the treatment. The acupuncture was carried out twice a week, for five uninterrupted weeks. Results were statistically analyzed. **Results:** At the rest mandibular position, the SG showed a significant decrease in the left temporal muscle activity in R1, and in the right and left temporal muscles in R10. In the CG, the activity increased in the left temporal muscle after five weeks (R10). During chewing, the activity decreased in the right masseter in the SG. **Conclusion:** Acupuncture reduced the temporal muscles activity at rest mandibular position, providing better muscular balance between these and masseter muscles. There was not a uniform effect of the acupuncture on the assessed muscles assessed during maximal intercuspal position and chewing, showing no improvement in the quality of their activity.

Keywords: Electromyography; Temporomandibular joint disorders; Acupuncture; Masticatory muscles; Stomatognathic system

INTRODUCTION

The temporomandibular disorder (TMD) is characterized by pain in the region of the temporomandibular joint (TMJ), pain and/or fatigue in the craniocervicofacial muscles, particularly in the mastigatory muscles, mandibular movements limitation and/or deviation, tinnitus and articular noise during function[1,2]. Its etiology involves multifactorial causes related to postural, structural and psychological factors[3].

The use of the surface electromyography (sEMG) has the aim to assist the diagnosis and therapeutic of the orofacial motor diseases, the breathing, chewing, swallowing and speech alterations, and temporomandibular disorders. The sEMG has been important withing orofacial myology therapies for being an objective quantitative method[4].

Currently, the TMD treatment includes the patient's education, behavioral therapy, physical therapy (ultrasound, transcutaneous electrostimulation, laser, exercises, massage, mobilizations), acupuncture, speech-language therapy, myorelaxant splints, oclusal adjustments, surgery and medicines[5,6].

In the last decades, the acupuncture became more popular and partly accepted in the occidental countries due to its po-

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sitive effects on the chronic and acute pain relief[7]. The use of acupuncture in TMD patients is considered eficacious to increase the amplitude of temporomandibular joints range of movement, activating the release of serotonin, encephalin and endorphin, thus providing masticatory muscles relaxation and pain decrease[8].

As a result, several authors refer the acupunture as an alternative for the treatment of the painful symptoms of TMD[9-12].

The present study had the aim to assess the effect of acupuncture in the elcetromyographic activity of the masticatory muscles (masseter and temporal, bilaterally) in patients with temporomandibular disorder (TMD).

METHODS

In order to take part in the study, 161 individuals were interviewed and evaluated, and the following inclusion criteria were used for selection: female gender, age between 20 and 40 years, pain report in the temporomandibular joint region and masticatory muscles, and diagnosis of TMD according to the Research Diagnostic Criteria for the Temporomandibular Disorder (RDC-TMD)[13,14] (Table 1). Volunteers with missing teeth, reumathological disease or who were under odonthological, physical therapeutic or clinical treatment were excluded.

Fifty two individuals fullfilled the inclusion criteria to take part in the study. The first 32 women were submitted to acupuncture twice a week for five uninterrupted weeks and were then reassessed. Only 20 participants concluded the treatment and comprised the study group (SG). The other volunteers comprised the control group (CG); their data were collected in the beginning and after five weeks with no treatment, and after that they were included in the treatment.

The present study was approved by the Research Ethics Committee of the Universidade Federal de Santa Maria, under protocol number 23081.018541/2007. All participants agreed to take part in the study and signed the free and informed consent form.

Procedures

Electromyographic recordings of the masseter and temporal muscles (anterior fascicle), bilaterally, were collected in the rest mandibular position, maximal intercuspal and during right and left unilateral chewing and rythmic usual chewing. For each position, three acquisitions were carried out and, among these, the one with the best quality signal was selected for data analysis[15].

During the recordings, the subject remained seated, in a comfortable position, oriented to maintain the column erect, relaxed arms, foot in the floor and glancing to the horizon line.

First, it was captured the EMG signal during rest mandibular position during 20 seconds. The maximal intercuspal position was incentivated by the examiner with the verbal comand “clench, clench, clench...”. The subject carried out a maximal clenching with a paraffin paper (Parafilm®) placed between the premolars, first and second molars lower and upper teeth, bilaterally. The contraction time recording lasted five seconds with ten seconds of interval between each recording, controlled by a chronometer[16].

The usual rythmic chewing, right and left unilateral chewing recordings were obtained in concentric contractions controlled by a digital metronome (Cherub® – WSM 001), with 60 bpm[16]. The volunteer was oriented to chew a bubble gum during five seconds in order to obtain a uniform consistency before the EMG collection and, after these, the EMG signal was acquired during ten seconds[17] .

The equipment used was an eight-channel electromyograph (Lynx® *Tecnologia Eletrônica* Ltda.) with analog-digital conversion board of 16-bit model CAD 10/26, sampling frequency of 2 kHz, Butterworth filter with cut-off frequency, high-pass of 10 Hz and low-pass of 1 kHz. The acquisition software BioInspector® developed by Lynx Electronic Technology Ltda. was used.

The EMG results were quantified in RMS (root mean square) by the data acquisition software, expressed in microvolts, and were stored in a portable computer without connection to electricity in order to avoid interference in the electromiographic signal.

The electrodes were placed in the muscular belly of the masseter and temporal (anterior fascicle) muscles, bilateraly. Its placement was defined based on each muscle’s function test[16]. The reference electrode was placed in the patient’s right grasp, avoiding noise interference. To facilitate the electrical potential conduction, the skin was cleaned and rubbed with cotton and alcohol 70% in order to remove dead cells before the electrodes were placed.

The EMG results were processed in RMS and normalized for the comparison between groups. This procedure is recommended when the comparison is done between subjects, days, muscles or different studies in order to reduce the variability due to intrinsic and extrinsic factors and to enable comparisons. The normalization aims to reduce the difference between recordings of the same subject, mainly after the electrodes removal, or between subjects, thus obtaining a reprodutible data interpretation. So, the data normalization in this study was carried out as following: the right and left and the usual chewing by the value obtained in the first masticatory cycle, the

Table 1. TMD diagnosis in the different subgroups, according to RDC/TMD – Axis I

Group		Subgroups RDC/TMD – Axis I (%)					No diagnosis
		I	I and III	III	I, II, III	I and II	
SG	Av	5	45	0	45	5	0
CG	Av	0	45	15	35	5	0

Note: SG = Study group; CG = control group; Subgroup I = myofascial disorder; Subgroup II = disc derangement; Subgroup III = artrhalgia; Av = initial evaluation of the SG and CG

mandibular resting by mean value of the maximal intercuspal and the maximal intercuspal by its maximal peak value.

For the results analysis it was considered the data obtained in the initial evaluation (Av), in the evaluation immediatly after only one acupuncture session (R1), and after ten acupuncture sessions (R10) in the SG. In R10, the EMG results of 20 women who completed the ten sessions were analyzed. In R1, the EMG results of 38 volunteers were analyzed: 32 women who initiated treatment (12 did not concluded), and six from the CG, who waited five weeks to receive the treatment and were evaluated soon after the first session of acupuncture.

The acupuncture treatment was accomplished with disposable needles (0.25 x 0.15 mm) inserted in respective points at the skin previously cleaned with cotton and alcohol 70%. During therapy, each volunteer remained lying on a litter in dorsal decubitus. Ten acupuncture sessions were carried out twice a week during 30 minutes, over five uninterrupted weeks. The techinque was performed by one of this author's study and the points for treatment were selected according to the literature as points for TMD and anxiety treatment.

Therefore, the points selected were the following: ST7 (xiaguan: anterior to the ear, in a depression between the zygomatic arch and the mandibular notch, with mouth closed); ST5 (daying: anterior to the angle of the mandible on the anterior border of the masseter muscle in a groove-like depression, with cheeks bulged); TH17 (yifeng: posterior to lobule of ear in the depression between the mandible and the mastoid process); ExHN5 (tayang: situated in a depression about 1.0 cun posterior to the midpoint between the lateral end of the eyebrow and the outer corner of the eye); GB43 (xiaxu: on the dorsum of the foot between the fourth and fifth toes): LI4 (hegu: on the dorsum of the hand, between the first and second metacarpal bones, in the middle of the second metacarpal bone on the radial side) and EXHN3 (yntang: between the medial end of the eye-brows[12-18] (Figures 1 e 2).

Data normality was verified by the Lilliefors test. The obtained values of the EMG signal were analyzed by the Student T test, with significance level of 5% ($p<0.05$).

RESULTS

The EMG results observed in R1 at rest mandibular position demonstrated difference only in the left temporal muscle ($p=0.0062$) with decrease in the electrical potencial immediatly after only one acupuncture session. The results of the EMG signal in the SG demonstrated higher activity in the temporal than in the masseter muscles at rest mandibular position. After treatment, all muscles decreased the EMG values at rest, with difference in the temporal muscles. The CG presented higher electrical activity in the temporal muscles in the initial evaluation and, in R10, the left masseter and left temporal muscles had a significant increase in the EMG activity, with predominance of the left temporal. It was not observed difference in the electrical activity of the masticatory muscles in CG and SG (R1 *versus* R10) during maximal intercuspal position (Tables 2 and 3).

In the usual chewing, the SG presented lower EMG activity in the right masseter muscle after treatment (Table 4).

Figure 1. Acupuncture points E7, E5, TA17, VB3, tayang e yntang

Figure 2. GB43 (xiaxu)

Comparison between the SG values obtained in the evaluation (Av) and after acupuncture (R10) showed decrease in the electrical activity of the left temporal muscle during unilateral left chewing. The CG did not present difference, but the electrical activity in the right and left temporal muscles were higher in R10. In R1, there was no difference in the EMG activity in the assessed muscles (Table 4).

The electrical potencial values for the unilateral right chewing did not present difference for both groups in R1 and R10 (Tables 4 and 5).

DISCUSSION

The results obtained in the analysis of the EMG signal of masticatory muscles showed a muscular asynchrony common in TMD patients[19]. In the R1 of the SG, the muscular electrical activity decreased in the left temporal muscle in the mandibular rest position. With that, the asynchrony observed in the left side was corrected after the application of acupuncture.

The better synchrony obtained in the left side with only one acupuncture session is important for the symptomatological improvement of TMD patients because, according to some authors, the temporal muscle (anterior fascicle), mainly in the left side, is the one with greater activation frequency at mandibular rest, particularly in patients who suffer from

Table 2. Normalized values (%) of the EMG signal of masticatory muscles at mandibular rest and maximal intercuspal position

Position			Mas Right Mean ± SD	Mas Left Mean ± SD	TA Right Mean ± SD	TA Left Mean ± SD
Rest	SG	Av	3.34 ± 9.40	2.35 ± 3.00	2.75 ± 3.52	3.51 ± 5.79
		R1	1.68 ± 0.89	2.44 ± 2.57	2.56 ± 2.61	2.37 ± 1.24
		p-value	0.427	0.527	0.943	0.0062*
	CG	Av	1.82 ± 1.33	1.98 ± 1.13	2.26 ± 1.18	2.73 ± 1.27
		R10	1.32 ± 0.76	1.62 ± 1.03	1.60 ± 0.89	2.22 ± 2.08
		p-value	0.391	0.151	0.002*	0.009*
		Av	1.62 ± 1.43	2.16 ± 2.82	2.73 ± 2.86	2.82 ± 1.88
		R10	2.58 ± 3.11	3.59 ± 5.7	2.68 ± 2.27	3.59 ± 1.91
		p-value	0.12	0.036*	0.374	0.016*
MI	SG	Av	69.73 ± 15.57	71.32 ± 15.83	72.9 ± 13.59	74.02 ± 15.47
		R1	72.19 ± 6.9	72.56 ± 7.31	73.65 ± 6.9	75.41 ± 11.12
		p-value	0.074	0.339	0.491	0.527
	CG	Av	73.03 ± 7.02	73.70 ± 5.59	73.62 ± 6.5	78.82 ± 6.74
		R10	70.58 ± 11.31	71.09 ± 7.73	75.49 ± 6.6	76.03 ± 9.84
		p-value	0.306	0.166	0.391	0.238
		Av	71.71 ± 8.01	74.14 ± 12.48	80.66 ± 12.65	81.11 ± 17.24
		R10	70.36 ± 14.02	73.02 ± 12.17	78.00 ± 10.38	76.07 ± 10.07
		p-value	0.648	0.650	0.395	0.313

* Significant values (p<0.05) – Student's t test

Note: Mas = masseter; TA = temporal anterior; CG = control group; SG = study group; Av = initial evaluation; R1 = reassessment imediatially after one only acupuncture session; R10 = reassessment of the CG after five weekes and the SG after ten acupuncture sessions; MI = maximal intercuspal; SD = standard deviation

Table 3. EMG results in RMS (expressed in microvolts) of the masticatory muscles at mandibular rest and maximal intercuspal position

Position			Mas Right Mean ± SD	Mas Left Mean ± SD	TA Right Mean ± SD	TA Left Mean ± SD
Rest	SG	Av	2.88 ± 1.05	2.95 ± 1.14	3.65 ± 1.30	3.99 ± 1.22
		R1	2.48 ± 0.77	2.86 ± 0.93	3.25 ± 1.23	2.86 ± 0.93
		p-value	0.086	0.393	0.094	0.00*
	CG	Av	2.75 ± 1.08	2.88 ± 1.00	3.75 ± 1.47	4.00 ± 1.07
		R10	2.59 ± 0.87	2.61 ± 0.85	2.78 ± 0.72	2.76 ± 0.68
		p-value	0.595	0.236	0.026*	0.001*
		Av	2.71 ± 1.73	3.31 ± 2.12	3.80 ± 2.97	3.89 ± 1.25
		R10	3.09 ± 2.54	3.27 ± 4.1	3.98 ± 1.45	4.52 ± 2.27
		p-value	0.041*	0.254	0.090	0.027*
MI	SG	Av	227.30 ± 162.68	210.54 ± 153.02	213.53 ± 132.23	173.85 ± 121.78
		R1	210.50 ± 145.80	202.26 ± 155.91	194.53 ± 101.12	164.80 ± 98.70
		p-value	0.0271*	0.640	0.441	0.428
	CG	Av	230.53 ± 158.71	222.78 ± 175.53	206.29 ± 95.60	186.72 ± 83.19
		R10	250.45 ± 179.32	212.71 ± 164.41	219.41 ± 128.83	172.69 ± 68.80
		p-value	0.156	0.940	0.411	0.654
		Av	244.02 ± 140.89	241.67 ± 127.89	204.51 ± 135.67	177.08 ± 98.76
		R10	219.13 ± 174.87	198.05 ± 102.76	217.84 ± 143.00	161.86 ± 134.56
		p-value	0.031*	0.530	0.021*	0.560

* Significant values (p<0.05) – Student's t test

Note: Mas = masseter; TA = temporal anterior; CG = control group; SG = study group; Av = initial evaluation; R1 = reassessment imediatially after one only acupuncture session; R10 = reassessment of the CG after five weekes and the SG after ten acupuncture sessions; MI = maximal intercuspal; SD = standard deviation

headache. The activation of the temporal muscles can also induce the mandible to a retrusive position, producing pain in the temporomandibular joints[19].

After treatment (R10), it was observed decrease in the electrical potential at mandibular rest in the left and right temporal muscles, providing better muscular balance between masseter and temporal muscles and suggesting improvement of the TMD in these patients. However, the electrical potentials

Table 4. Normalized values (%) of the EMG signal of masticatory muscles during usual, left and right unilateral chewing

Chewing			Mas Right Mean ± SD	Mas Left Mean ± SD	TA Right Mean ± SD	TA Left Mean ± SD
Usual	SG	Av	31.90 ± 20.96	40.43 ± 30.12	46.33 ± 25.27	40.52 ± 27.57
		R1	54.15 ± 26.49	42.44 ± 28.08	51.76 ± 25.54	44.68 ± 24.89
		p-value	0.19	0.755	0.298	0.38
	GC	Av	119.24 ± 47.87	161.83 ± 135.91	148.07 ± 132.21	107.50 ± 41.97
		R10	102.65 ± 25.68	121.90 ± 67.33	105.21 ± 29.30	117.32 ± 26.90
		p-value	0.045*	0.146	0.269	0.573
	SG	Av	50.50 ± 33.57	48.35 ± 33.10	45.66 ± 33.67	50.59 ± 33.09
		R10	48.60 ± 36.86	50.43 ± 27.40	51.05 ± 37.11	48.98 ± 24.10
		p-value	0.789	0.754	0.691	0.765
Left	SG	Av	39.93 ± 38.49	94.29 ± 73.11	49.94 ± 51.94	42.69 ± 73.57
		R1	45.99 ± 51.00	94.56 ± 68.85	51.94 ± 30.02	69.70 ± 38.72
		p-value	0.264	0.638	0.290	0.456
	CG	Av	108.40 ± 32.44	112.77 ± 27.96	108.40 ± 31.53	121.28 ± 53.27
		R10	132.29 ± 86.07	114. 94 ± 25.73	111.27 ± 65.10	106.15 ± 5.73
		p-value	0.209	0.815	0.892	0.298
	CG	Av	31.61 ± 19.94	66.51 ± 41.38	38.26 ± 25.73	52.00 ± 32.13
		R10	35.21 ± 22.25	69.19 ± 43.00	44.00 ± 24.49	60.05 ± 33.69
		p-value	0.176	0.215	0.244	0.239
Right	SG	v	94.54 ± 58.71	94.29 ± 73.11	82.31 ± 39.00	73.57 ± 42.69
		R1	84.11 ± 59.17	94.56 ± 68.85	74.03 ± 33.88	69.70 ± 38.72
		p-value	0.61	0.337	0.57	0.29
	CG	Av	117.17 ± 10.58	105.30 ± 34.63	116.78 ± 34.55	100.03 ± 31.14
		R10	100.36 ± 20.15	100.30 ± 32.80	108.58 ± 32.11	91.83 ± 24.84
		p-value	0.154	0.664	0.416	0.355
	CG	Av	101.99 ± 18.88	101.93 ± 20.18	100.22 ± 14.76	97.33 ± 15.15
		R10	102.52 ± 28.57	101.39 ± 18.88	121.36 ± 73.38	105.42 ± 29.94
		p-value	0.948	0.941	0.240	0.202

* Significant values (p<0.05) – Student's t test

Note: Mas = masseter; TA = temporal anterior; CG = control group; SG = study group; Av = initial evaluation; R1 = reassessment imediatially after one only acupuncture session; R10 = reassessment of the CG after five weekes and the SG after ten acupuncture sessions; MI = maximal intercuspal; SD = standard deviation

of the temporal muscles were still higher than that of the masseter muscles. The hyperactivity of the masticatory muscles corresponds to a great parcel of the etiology of TMD[20]. In the individuals in this study, there was a decrease in the electrical activity of the masticatory muscles bilaterally, indicating smaller contribution of this etiological to the TMD.

Many authors[21-23] have confirmed the higher electrical activity at rest of the masticatory muscles, particularly temporal (anterior fascicle), in subjects um TMD, as it was found in the present study. This muscular behavior is explained by the greater muscular recruitment needed in the patients with TMD and myofascial pain in a mandibular rest situation[24,25]. In the present study, there was a decrease in pain and in electrical activity of temporal muscles at rest, indicating possible association between the factors pain and electrical activity increase.

In this study, there was a tendency of better balance between the EMG activity values of masseter and temporal muscles after the acupuncture treatment, however, the activity of temporal muscles still predominated over masseters. These findings suggest that the number of acupuncture sessions might have been insufficient, and that this treatment should be associated with other therapeutic modalities.

In CG there was higher electrical activity at rest in temporal muscles when compared to masseters in Av; in R10, this condition increased significanly in the left temporal and left masseter muscles. Such findings evidenced worsen of the TMD in this group after the five-week period while they were waiting for treatment.

In this study, despite the increased EMG activity in the temporal muscles, they did not achieved muscular hyperactivity levels in both groups. It is considered hyperactivity when the mandibular rest values are above 10% of the maximal voluntary contraction, i.e, maximal intercuspal position[25]. Corroborating these findings, a study[26] verified higher electrical activity at rest in the masticatory muscles of TMD patients than in a control group. However, the activity levels were lower than those considered for muscle hyperactivity, which was considered an indicative sign of TMD.

Variable results regarding the acupuncture effect were found during maximal intercuspal. Unlike the present study,

Table 5. EMG values in RMS (expressed in microvolts) of masticatory muscles during usual, left and right unilateral chewing

Chewing			Mas Right Mean ± SD	Mas Left Mean ± SD	TA Right Mean ± SD	TA Left Mean ± SD
Usual	SG	Av	31.86 ± 21.82	36.81 ± 28.00	43.95 ± 24.62	37.00 ± 25.21
		R1	55.31 ± 27.20	38.67 ± 25.27	50.13 ± 25.81	41.83 ± 23.42
		p-value	0.17	0.790	0.271	0.269
	CG	Av	59.57 ± 27.25	57.04 ±71.98	59.72 ± 31.05	51.27 ± 40.60
		R10	45.65 ± 36.64	57.78 ± 84.18	42.22 ± 30.23	40.47 ± 40.80
		p-value	0.149	0.753	0.066	0.028*
	SG	Av	50.50 ± 33.57	48.35 ± 33.10	45.66 ± 33.67	50.59 ± 33.09
		R10	48.60 ± 36.86	50.43 ± 27.40	51.05 ± 37.11	48.98 ± 24.10
		p-value	0.789	0.754	0.691	0.765
Left	SG	Av	39.20 ± 39.13	90.94 ± 71.90	47.68 ± 29.57	72.23 ± 42.75
		R1	45.70 ± 51.84	90.64 ± 66.52	50.44 ± 29.33	68.76 ± 39.02
		p-value	0.734	0.428	0.393	0.382
	CG	Av	106.97 ± 66.82	44.98 ± 39.93	87.52 ± 40.01	46.77 ± 20.48
		R10	41.41 ± 32.18	106.55 ± 72.18	51.15 ± 30.47	73.92 ± 444.22
		p-value	0.00*	0.003*	0.002*	0.005*
	SG	Av	31.61 ± 19.94	66.51 ± 41.38	38.26 ± 25.73	52.00 ± 32.13
		R10	35.21 ± 22.25	69.19 ± 43.00	44.00 ± 24.49	60.05 ± 33.69
		p-value	0.176	0.215	0.244	0.239
Right	SG	Av	94.90 ± 59.68	40.49 ± 87.33	80.70 ± 38.61	43.55 ± 20.87
		R1	83.93 ± 60.17	45.40 ± 44.67	72.84 ± 33.73	41.12 ± 24.71
		p-value	0.789	0.587	0.753	0.645
	CG	Av	227.98 ± 162.02	218.61 ± 179.64	200.87 ± 103.45	180.85 ± 91.11
		R10	116.93 ± 67.00	47.12 ± 36.44	90.21 ± 43.14	49.26 ± 29.40
		p-value	0.001*	0.000*	0.00*	0.00*
	SG	Av	70.33 ± 52.82	43.02 ± 34.19	75.22 ± 58.37	50.14 ± 39.91
		R10	74.73 ± 48.97	36.32 ± 26.85	79.09 ± 45.96	43.96 ± 33.53
		p-value	0.703	0.249	0.874	0.654

* Significant values (p<0.05) – Student's t test

Note: Mas = masseter; TA = temporal anterior; CG = control group; SG = study group; Av = initial evaluation; R1 = reassessment imediatially after one only acupuncture session; R10 = reassessment of the CG after five weekes and the SG after ten acupuncture sessions; MI = maximal intercuspal; SD = standard deviation

authors[27] who evaluated TMD patients using EMG after ten acupuncture sessions observed lower activity during clenching and pain decrease after treatment. The authors explained that these patients spend more effort to perform the force movements, probably due to the muscular unbalance, difficulting the normal function. Another study[26] also verified less pain and electromyographic activity of temporal muscles and increase in the activity of masseter muscles during maximal intercuspal after the use of the TENS® in patients with myogenic TMD.

In accordance with this study, others[28] reported that TMD can negatively influence the chewing behavior. They verified that the performance of masticatory muscles did not change after treatment with occlusal device and physical therapy (self-management program), but the pain, as well as the bite force and chewing cycle duration presented significant improvement.

On the other hand, a study[27] that evaluated individuals with TMD using EMG demonstrated an increase in the electrical activity of the right masseter and right temporal muscle during usual chewing of peanuts and raisings after ten sessions of acupuncture, and decrease of EMG activity in the left temporal and masseter muscles after treatment. The greater EMG activation in the right side muscles after acupuncture might have been caused by preferential chewing on this side, since it is known that the muscular activity is higher on the work side. The authors also used an adapted dinamometer to evaluate bilateral force, which increase after treatment, showing that acupuncture leads to a decrease in pain that contributes to increase the bite force.

Reinforcing the results of the present study, other authors[19] observed, in TMD patients, higher activity potentials during chewing in the temporal rather than in the masseter muscles, which should be more recruited as they are muscles of masticatory potency. Therefore, the temporal muscles quit their main function of condyle positioners becoming hyperactive in the chewing function, while the masseter muscles can be considered hypofunctional. Our study showed an important asynchrony between masseters and temporal muscles that decreased after acupuncture therapy (R10), providing greater balance between the electrical potentials of these muscles.

There is some evidence that the following treatments can

be efficient in TMD pain relief: occlusal devices, acupuncture, behavioral therapy, mandibular exercises, postural training, and pharmacotherapy. Evidences regarding the effects of electrotherapy and surgery are insufficient, and the occlusal adjustments seems not to have an effect[13,29].

Some studies[13,29] have found evidence that acupuncture is better than no treatment, and it is better in comparison to other types of conservative treatment. Our study corroborates this idea, since the CG did not present improvement, but rather worsening, with higher muscular activity in the left temporal muscle. Nonethless, due to methodological deficiencies, researchers[29] have recommended specific guidelines to improve the quality of this intervention, and further studies are substantial to determine the efficacy of acupuncture.

The findings regarding the asynchrony between masseter and temporal muscles in the maximal intercuspal and chewing situations suggest a limitation of acupuncture as the only therapeutic method, and demonstrate the need of its combination with other therapeutic modalities, mainly the orofacial therapy, which might help the maintanance of positive results for TMD patients, besides heping to overcome the asynchrony found in the results.

CONCLUSION

Acupuncture reduced the electrical activity of the temporal muscles at mandibular rest position, providing better balance between temporal and masseter muscles.

The effect of acupuncture was not uniform over masticatory muscles in the situations of chewing and maximal intercuspal, and did not obtain improvement in the quality of these situations.

The positive results obtained with acupuncture may be attributed to its approach that emphasized both physical and emotional aspects present in the TMD. It is a fast and low-cost method with rapid application and no adverse effects that can also be used as coadjuvant with other therapeutic modalities.

RESUMO

Objetivo: Avaliar o efeito da acupuntura na atividade eletromiográfica dos músculos mastigatórios em pacientes com desordem temporomandibular (DTM). **Métodos:** Quarenta mulheres, de 20 a 40 anos e com diagnóstico de DTM foram avaliadas por meio da eletromiografia dos músculos masseter e temporal (fascículo anterior). As participantes foram distribuídas em grupos de estudo (GE), cujo tratamento com acupuntura foi aplicado logo após a avaliação inicial, e de controle (GC), que recebeu o tratamento após cinco semanas desta avaliação. Os registros eletromiográficos foram coletados na avaliação inicial (Av), imediatamente após uma sessão de acupuntura (R1) e ao final de dez sessões (R10) no GE. O GC foi avaliado no início (Av) e após cinco semanas (R10), enquanto aguardava o tratamento. A acupuntura foi realizada duas vezes na semana, por cinco semanas ininterruptas. Os resultados foram analisados estatisticamente. **Resultados:** Na posição de repouso mandibular, o GE apresentou redução significativa da atividade eletromiográfica do músculo temporal esquerdo em R1 e nos músculos temporal direito e esquerdo em R10. No GC, a atividade no músculo temporal esquerdo aumentou após cinco semanas. Na mastigação, houve redução da atividade no músculo masseter direito no GE. **Conclusão:** A acupuntura reduziu a atividade elétrica dos músculos temporais na posição de repouso mandibular, proporcionando melhor equilíbrio muscular entre estes e os músculos masseteres. Não houve um efeito uniforme da acupuntura sobre os músculos avaliados durante a máxima intercuspidação e a mastigação, não apresentando melhora na sua qualidade.

Descritores: Eletromiografia; Transtornos da articulação temporomandibular; Acupuntura; Músculos mastigatórios; Sistema estomatognático

REFERENCES

1. Bonjardim LR, Gavião MB, Pereira LJ, Castelo PM, Garcia RC. Signs and simptoms of temporomandibular disorders in adolescents. Braz Oral Res. 2005;19(2):235-9.
2. Munhoz WC, Marques AP, de Siqueira JT. Evaluation of body posture in individuals with internal temporomandibular joint derangement. Cranio. 2005;23(4):269-77.
3. Suvinen TI, Kemppainen P. Review of clinical EMG studies related to muscle and occlusal factors in healthy and TMD subjects. J Oral Rehabil. 2007;34(4):631-44.
4. Rahal A, Pierotti S. Eletromiografia e cefalometria na fonoaudiologia. In: Ferreira LP, Befi-Lopes DM, Limongi SC, organizadores. Tratado de fonoudiologia. São Paulo: Roca; 2004. p.237-53.
5. Goudot P, Jaquinet AR, Hugonnet S, Haefliger W, Richter M. Improvement of pain and function after arthroscopy and arthrocentesis of the temporomandibular joint: a comparative study. J Craniomaxillofac Surg. 2000;28(1):39-43.
6. Cho SH, Whang WW. Acupuncture for temporomandibular disorders: a systematic review. J Orofac Pain. 2010;24(2):156-62.
7. Wong T. Use of electrostimulation of acupuncture points in general dental practice. Anesth Prog. 2001;36(4-5):243-4.
8. Lee MH, Liao SJ. Acupuntura em fisiatria. In: Kottle FJ, Lehmann JF. Tratado de medicina física e reabilitação de Krusen. 4ª ed. Vol.1. São Paulo: Manole; 1994. p.
9. Smith P, Mosscrop D, Davies S, Sloan P, Al-Ani Z. The efficacy of acupuncture in the treatment of temporomandibular joint myofascial pain: a randomised controlled trial. J Dent. 2007;35(3):259-67.
10. Shin BC, Ha CH, Song YS, Lee MS. Effectiveness of combining manual therapy and acupuncture on temporomandibular joint dysfunction: a retrospective study. Am J Chin Med. 2007;35(2):203-8.

11. Okeson JP. Dor orofacial: guia de avaliação, diagnóstico e tratamento. 6a ed. São Paulo (SP): Quintessence; 2008.
12. Dallanora LJ, Faltin PP, Inoue RT, Santos VM. Avaliação do uso de acupuntura no tratamento de pacientes com bruxismo. RGO (Porto Alegre). 2004;52(5)333-9.
13. List T, Axelsson T. Management of TMD: evidence from systematic reviews and meta-analyses. J Oral Rehabil. 2010;37(6):430- 51.
14. De Felício CM, Sidequersky FV, Tartaglia GM, Sforza C. Electromyographic standardized indices in healthy Brazilian young adults and data reproducibility. J Oral Rehabil. 2009;36(8);577-83.
15. De Luca C. The use of surface electromyography in biomechanics. J Appl Biomech. 1997;13(2):135-63.
16. Borini CB. Análise da atividade eletromiográfica de músculos mastigatórios em portadores de DTM durante mastigação [Dissertação]. Piracicaba: Universidade Estadual de Campinas; 2005.
17. Hanawa S, Tsuboi A, Watanabe M, Sasaki K. EMG study for perioral facial muscles function during mastication. J Oral Rehabil. 2008;35(3):159-70.
18. Rosted P, Bundgaard M, Pedersen AM. The use of acupuncture in the treatment of temporomandibular dysfunction – an audit. Acupunct Med. 2006; 24(1):16-22.
19. Bérzin F, Sakai E. Fundamentos da eletromiografia (EMG): da teoria à técnica. In: Fiúza SC, Martins NS, Dominguez-Rodrigues GC, Grimberg J, Pereira CB, Corrêa J, et al, organizadores. Nova visão em ortodontia e ortopedia funcional dos maxilares. São Paulo: Ed Santos; 2004. p.311-30.
20. Yi LC, Guedes ZC, Vieira MM. Relação da postura corporal com a disfunção da articulação temporomandibular: hiperatividade dos músculos da mastigação. Fisioter Bras. 2003;4(5):341-7.
21. Pedroni CR, De Oliveira AS, Guaratini MI. Prevalence study of signs and symptoms of temporomandibular disorders in university students. J Oral Rehabil. 2003;30(3):283-9.
22. Castroflorio T, Icardi K, Becchino B, Merlo E, Debernardi C, Bracco P, et al. Reproducibility of surface EMG variables in isometric sub-maximal contractions of jaw elevator muscles. J Electromyogr Kinesiol. 2006;16(3):498-505.
23. Boderé C, Téa SH, Giroux-Metges MA, Woda A. Activity of masticatory muscles in subjects with different orofacial pain conditions. Pain. 2005;116(1-2):33-41.
24. Venezian GC, da Silva MA, Mazzetto RG, Mazzetto MO. Low level laser effects on pain to palpation and electromyographic activity in TMD patients: a double-blind, randomized, placebo-controlled study. Cranio. 2010;28(2):84-91.
25. Finsterer JF. EMG-interference pattern analysis. J Electromyogr Kinesiol. 2001;11(4):231-46.
26. Rodrigues D, Siriani AO, Bérzin F. Effect of convencional TENS on pain and electromyographic activity of masticatory muscles in TMD patients. Braz Oral Res. 2004;18(4):290-5.
27. Rancan SV, Bataglion C, Bataglion SA, Bechara OM, Semprini M, Siéssere S, et al. Acupuncture and temporomandibular disorders: a 3-month follow-up EMG study. J Altern Complement Med. 2009;15(12):1307-10.
28. Pereira Júnior FJ, Favilla EE, Dworkin S, Huggins K. Critérios de diagnóstico para pesquisa das disfunções temporomandibulares (RDC/TMD). Tradução oficial para a língua portuguesa. JBC J Bras Clin Odontol Integr. 2004:8(47):384-95.
29. MacPherson H, White A, Cummings M, Jobst KA, Rose K, Niemtzow RC, et al. Standards for Reporting Interventions in Controlled Trials of Acupuncture: the STRICTA recommendations. J Altern Complement Med. 2002;8(1):85-9.