

EVALUATION OF MICROCURRENT ELECTRICAL NERVE STIMULATION (MENS) EFFECTIVENESS ON MUSCLE PAIN IN TEMPOROMANDIBULAR DISORDERS PATIENTS

AVALIAÇÃO DA EFETIVIDADE DA ESTIMULAÇÃO NEURAL ELÉTRICA POR MICROCORRENTE (MENS) NA DOR MUSCULAR EM PACIENTES COM DESORDEM TEMPOROMANDIBULAR

Paulo Renato Junqueira ZUIM¹, Alicia Rosalino GARCIA¹, Karina Helga Leal TURCIO², Marcelo Matida HAMATA²

1- Assistant Professor of Department of Dental Materials and Prosthodontics of Araçatuba Dental School, UNESP – São Paulo State University.

2- Graduate Student, Department of Dental Materials and Prosthodontics of Araçatuba Dental School, UNESP.

Corresponding Address: Department of Dental Materials and Prosthodontics of Araçatuba Dental School, UNESP - Rua José Bonifácio, 1193 - Araçatuba - São Paulo - Brazil - Cep.: 16015-050 - Phone/Fax: 55 18 3636 3245 - e-mail: prjzuim@foa.unesp.br

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ABSTRACT

The effect of Microcurrent Electrical Nerve Stimulation (MENS) was evaluated and compared with occlusal splint therapy in temporomandibular disorders (TMD) patients with muscle pain. Twenty TMD patients were divided into four groups. One received occlusal splint therapy and MENS (I); other received splints and placebo MENS (II); the third, only MENS (III) and the last group, placebo MENS (IV). Sensitivity derived from muscle palpation was evaluated using a visual analogue scale. Results were submitted to analysis of variance ($p < 0.05$). There was reduction of pain level in all groups: group I (occlusal splint and MENS) had a 47.7% reduction rate; group II (occlusal splint and placebo MENS), 66.7%; group III (MENS), 49.7% and group IV (placebo MENS), 16.5%. In spite of that, there was no statistical difference (analysis of variance / $p < 0.05$) between MENS and occlusal splint therapy regarding muscle pain reduction in TMD patients after four weeks.

Uniterms: Temporomandibular joint disorders; Occlusal splints; Electric stimulation therapy.

RESUMO

A efetividade da Estimulação Neural Elétrica por Microcorrente (MENS) foi avaliada e comparada à terapia por Placas Oclusais em pacientes com distúrbios temporomandibulares (DTM) de origem muscular. Vinte pacientes foram divididos em quatro grupos. Um recebeu a terapia por placas interoclusais e MENS (I); outro, placas e MENS placebo (II), o terceiro, somente MENS (III) e o último grupo, MENS placebo (IV). Os resultados obtidos foram submetidos a uma análise de variância ($p < 0,05$). Houve redução dos níveis de dor em todos os grupos: o grupo I (placas e MENS) obteve uma taxa de redução de 47,7%; o grupo II (placa e MENS placebo), 66,7%; o grupo III (MENS), 49,7% e o grupo IV (MENS placebo), 16,5%. Apesar disso, não se verificaram diferenças estatisticamente significantes entre MENS e utilização de placas interoclusais em relação à diminuição de dor muscular em pacientes com DTMs após 4 semanas.

Unitermos: Transtornos da articulação temporomandibular; Placas oclusais; Terapia por estimulação elétrica.

INTRODUCTION

Headache, earache, muscle and TMJ pain are considered consequences of muscle hyperactivity or alteration in occlusal vertical dimension^{4,7,25}. Headache may be associated to macrotrauma, unilateral chewing and bruxism⁸. Moreover, it is also related to problems in muscle physiology as in

occlusal interferences and tensional discharge²³.

Nervous system control, normal rhythmic contraction and relaxation of muscles depend on the availability of nutrients from arterial blood and removal of metabolites by venous blood. Intramuscular pressure during contraction can exceed the blood pressure and stop arterial flow¹. In muscles that are isometrically contracted for a prolonged

period of time (chewing or bruxism) there is interference with normal blood circulation and therefore interference with ionic interchange at the cells membranes; increase of pyruvic and lactic acid; glycogen depletion; oxygen debt; and decrease of metabolites clearance^{1,23,27}.

Epidemiological studies about Temporomandibular Disorders (TMD) signs and symptoms in young subjects indicated that 48% of them present muscle sensitivity and the frequency was higher in females²².

Muscle pain reduction may be obtained by physical therapy, drugs, psychotherapy and occlusal therapy. Physical therapy aims at muscle relaxation and increase of lymphatic and blood circulation to reestablish the muscle physiology²⁰.

Electricity can be used as physical therapy to reduce muscle pain. The earliest written records of using it come from the Greeks³. Transcutaneous electrical nerve stimulation (TENS) is one type of physical therapy employed to TMD treatment. The use of TENS is based on several interrelated theories on the mechanisms of pain transmission and blocking of those mechanisms³. The first of these theories was the gate control theory and it was introduced by Melzack and Wall in 1965.¹⁷ This theory suggests that stimulation of thick, myelinated, sensory fibers (A-fibers) blocks the impulses of thin pain-modulating fibers (C-fibers) and closes the gate to pain signals at their level of entry into spinal cord¹⁷.

Another theory is related to endogenous release of morphine-like substances after electrical stimulation. These substances would have analgesic properties¹⁸.

A third way of action of TENS is related to automatic and involuntary contraction of muscles. Repetitive depolarizations of skeletal muscle at a rate less than 100/min in the presence of an adequate supply of high-energy phosphate reduces fatigue contracture²⁶. Mild, rhythmic muscle movement increases the local circulation of blood and lymph, which reduces the interstitial edema and accumulation of noxious tissue metabolites^{13,26,27}.

Wessberg, et al.²⁶ evaluated the clinical effectiveness of a neuromuscular approach including TENS to the management of 21 myofascial pain-dysfunction syndrome subjects. The subjects complained of having had facial pain symptoms for up to 1 year. Results showed 95% success immediately after therapy and an 86% success one year after therapy. The authors suggest that discrepancies in the transverse and anteroposterior position of the mandible relative to centric occlusion are not well tolerated. Elimination of pain through TENS and adjustment or occlusal splint therapy seems to promote the long-term relief of muscle symptoms.

TENS effects on temporalis muscles, masseter muscles and digastric muscles electromyography was studied by Cooper¹⁰. This author observed an electrical activity decrease of these muscles of about 36.7% in rest position after TENS application. On the other hand, there was an increase of about 89.8% and 53.6% in masseter and temporalis muscles, respectively, during clenching.

Mjøystad, et al.¹⁸ evaluated and compared the effect of

TENS with placebo TENS in 19 patients with orofacial functional pain and rheumatic disease involving the temporomandibular joint. Pain was measured using a Visual Analogue Scale (VAS). Results demonstrated that TENS and placebo treatment were effective.

TENS stimulus are in order of milliamps (sensorial and motor stimulus). It produces a maximum metabolic effect on protein synthesis and benefits the cell physiology^{6,18}.

Besides TENS, an alternative method of pain control, which has received little attention in dentistry, is the microcurrent electrical nerve stimulation (MENS). It provides currents lower than 1000 microamps (μ A). They are considered microcurrent units and do not stimulate motor fibers¹¹. Byl, et al.⁵ stated that many clinicians are using microamperage stimulation to relieve pain and facilitate wound healing. This author studied the microamperage stimulation effects for soft tissue wound repair. There was no wound healing acceleration, however no negative effects were found.

Lambert, et al.¹⁴ evaluated MENS effects on symptoms of muscle damage. The muscles of non-dominant arms of thirty healthy men were damaged using an eccentric-exercise protocol. Fifteen received electro-membrane microcurrent therapy (membranes which provide electric stimulation) and the other fifteen received placebo membrane. The membranes were well tolerated by subjects in both groups without any adverse effects. Electro-membrane microcurrent therapy reduced the severity of damage symptoms but did not alter pain perception or arm swelling. According to the authors¹⁴, the microcurrent mechanisms of action are unknown but are likely related to maintenance of intracellular Ca^{2+} homeostasis after muscle damage. Increasing in intracellular calcium concentration may influence changes in membrane integrity and/or cause morphological alterations in the contractile machinery of muscle reducing its function²⁶.

In TMD treatments, Dupont¹¹ presented a MENS protocol to localization and treatment of trigger points. This author suggested that microcurrent is an effective modality for identifying and treating myofascial and temporomandibular disorders. MENS is accomplished with probes individually or in combination with pads. The probes are used to treat small areas, individual muscles and for very short-time treatments. Pads can be used for longer treatment times and larger areas¹¹.

Bertolucci and Grey² (1995) performed treatment in TMD patients, comparing the effect of MENS, Mid Laser and Placebo treatment, for three weeks, verifying the efficacy of the MENS and Laser therapies on alleviation of pain with subsequent enhancement of joint mobility.

Unfortunately, there is a lack of scientific researches using MENS to TMD treatment or comparing its effects, if any, with other treatment methods.

The purpose of this study was to compare the effectiveness of microcurrent electrical nerve stimulation (MENS) and occlusal splint therapy on masticatory muscles pain in TMD patients.

MATERIALS AND METHODS

Subject Selection

This study was in accordance with the ethical standards of the committee on human experimentation (Process number: 2003-00556).

For the study, twenty TMD patients, 2 men and 18 women, aged 13 to 47 years old, were selected from patients who came for treatment at the Temporomandibular Disorders Diagnostic and Treatment Center.

The criteria used for subject selection included: muscle pain could be elicited by palpation and verified over six months, chronic pain; there was no more than one missing tooth per quadrant; and no patient was wearing any removable restorations. Patients meeting these requirements were asked to participate in the research project. The criteria used for subject exclusion were in accordance with microcurrent contraindications. The following areas or conditions are contraindicated: conditions with unknown etiology; conditions which demand cardiac pacemakers; areas over cancer lesions or the carotid sinus and the transcerebral area. Safety has not been established for use in cases of pregnancy, seizures or heart patients, pain of central origin, epilepsy, or with some skin and vascular disorders¹¹. Patients with articular involving were also excluded.

Groups and Therapies

The patients were divided into four groups. Microcurrent therapy was effectively accomplished in two groups. One received occlusal splint therapy and the other received only MENS. In two other groups, a MENS therapy simulation (placebo) was performed with the apparatus turned off¹⁸. In the same way, one group received occlusal splint therapy and the other only placebo treatment. Thereby, the patients were randomly placed in one of four treatment modalities: group I (occlusal splint therapy and MENS), group II (occlusal splint therapy and placebo MENS), group III (MENS) or group IV (placebo MENS).

For this study the authors used a microcurrent stimulator apparatus (Model Micro Master S-10 / Bio Therapeutic Computers Inc., Hong Kong) for MENS therapy. The frequency was set at 0.3 Hz and the amplitude at 40 μ A¹¹. The applications were performed twice a week during four weeks, adding up to eight applications of ten minutes each.

Microcurrent applications on affected muscles were made using conductive pads or probes. When the access was extraoral, conductive gel and pads were used. Before application, the treatment area was washed with water and soap and cleaned with alcohol to remove the skin oils. On the other hand, when the access was intraoral, the application was performed using wet probes with salt water¹¹.

Maxillary and mandibular alginate impressions were taken for groups I and II subject for fabrication of maxillary occlusal splint. Impressions were poured using special gypsum type IV (Durone, Dentsply) and the casts were

mounted in semi-adjustable articulator. Occlusal splints were fabricated from heat cured acrylic resin. The occlusal splints provided even, simultaneous, bilateral, multiple posterior contacts. Adequate canine guidance was provided to disarticulate all posterior teeth during eccentric movement. Each patient was evaluated at weekly intervals for necessary adjustments of the splint.

In group II and IV, the placebo MENS therapy was performed through simulation of application. Conductive pads or probes were positioned on the affected muscle area, but with the apparatus turned off. Subjects did not detect it because the microcurrent stimulus is subsensorial.

Record of Pain Levels

On entering the research project, a history of symptoms and clinical examinations was achieved. The clinical examination was completed on each patient to determine the degree of pain or tenderness by palpation. A digital pressure of about 2 Kgf was used for palpation of affected muscles. The evaluation method in the present study was based on subjective measurement. Pain measurements were made using a 0 to 10 Visual Analogue Scale. The patients were asked to record their pain on the 10 cm VAS line between the two extremes: zero was no pain and 10, the highest (ever perceived) possible pain^{16,18}.

Muscle tenderness to palpation was evaluated before and after treatment by the same operator. In this way, therapy effect on muscle symptoms was verified in each group.

Final evaluation was made after four weeks of treatment. Results were obtained through the mean of pain reduction of five subjects of each group.

RESULTS

The data collected for subjects in the four groups are summarized in Tables 1, 2, 3 and 4.

Group I, composed of subjects treated by occlusal splint therapy and microcurrent electrical stimulation, demonstrated a 47.7% pain level reduction rate. In group II, composed of subjects in whom occlusal splints were installed and MENS was applied through the apparatus turned off (placebo), a 66.9% pain reduction rate was observed. In group III, for whom only MENS was applied, this rate was 49.7%. In group IV treated by placebo, there was the smallest pain reduction rate. In this group, we could note decrease in muscle symptoms in three subjects. One subject did not show difference before and after the study. Nevertheless, in one patient, there was an increase in pain originated from muscle palpation. The mean found in reduction of muscle pain was 16.5%.

Pain reduction rate was calculated to each subject comparing the initial and final situation. The data collected were used in statistical test (analysis of variance / $p < 0.05$). There were no statistical differences between the four groups or between occlusal splints and microcurrent.

DISCUSSION

The use of MENS in dentistry has received only limited attention. There is not enough research about MENS use in temporomandibular disorder treatment to make an adequate evaluation. This study appraised and compared MENS and the occlusal splint effectiveness on muscle pain in TMD patients.

Objective measures are often the basis for conclusions in treatment evaluation. The pain evaluation relies on the subjective judgment of the patient, because “objective pain” does not exist¹⁸. Pain is an extremely personal experience. Different individuals submitted to identical stimulus feel

several ways of pain and react with different suffering levels. Patients feeling a little pain can suffer a lot, while others with a significant pain can suffer less. The more severe the symptom and the more the patient is affected, the more emotional will be their answers and the larger the impact on his or her functional capacity¹⁵. Pain intensity by physical lesions is related to given attention at the moment. Clinicians have a mission to collect patient information and to be able to interpret the symptoms characteristics and their significance to the patient¹⁹.

Pain can be important since the lesion consequences induce concern and anxiety feelings related more to treatment and repair processes than to the hurt²⁴. Anxious

TABLE 1- Pain level of patients before and after treatment in group I (MENS and Occlusal Splint) using a Visual Analogue Scale

GROUP I		PAT 1	PAT 2	PAT 3	PAT 4	PAT 5
MENS and Occlusal Splint	Initial Appointment	6.7	4	6.3	4.5	8
	Final Appointment	0	4	3	4.0	2
	Pain Reduction Rate (%)	AVERAGE 47.7	100	0	52.4	11.1

TABLE 2- Pain level of patients before and after treatment in group II (MENS placebo and Occlusal Splint) using a Visual Analogue Scale

GROUP II		PAT 1	PAT 2	PAT 3	PAT 4	PAT 5
MENS placebo and Occlusal Splint	Initial Appointment	8	5.5	7	10	10
	Final Appointment	3.5	0	5	2	3
	Pain Reduction Rate (%)	AVERAGE 66.9	56.2	100	28.6	80

TABLE 3- Pain level of patients before and after treatment in group III (MENS) using a Visual Analogue Scale

GROUP III		PAT 1	PAT 2	PAT 3	PAT 4	PAT 5
MENS	Initial Appointment	3	7.7	8.5	7	7.7
	Final Appointment	2	5.3	3	3	2
	Pain Reduction Rate (%)	AVERAGE 49.7	33.3	31.1	64.7	57.1

patients and patients with chronic painful diseases are more likely to respond positively to placebo therapy. The greater the need for treatment, the greater the placebo effect¹⁸.

Dupont¹¹ recommended palpating for pain levels in the involved areas and noting it for comparison after treatment. The patient behavior is the sole way that clinicians have to receive the painful experience. It is related to their visible and audible actions. It is important to recognize that the information is not the nociception, but their painful behavior¹⁹.

Thus, pain quantification is a difficult task and we should have caution to analyze results of experiments studying pain phenomenon. Although it is possible to compare pain processes through the Visual Analogue Scale, the individual painful behaviors are different¹⁹. Quantitative analysis of symptoms through the analogue scale is an auxiliary procedure in the clinical approach. Results of this study serve as an indication about the effectiveness of the different therapeutic modalities appraised. Therefore, it is difficult to derive any comparative conclusions regarding the effectiveness of a given therapy on symptoms²¹. However, more studies are necessary about this subject.

In this study, although the symptoms of patients decreased after the 4-week treatment period, statistical analysis did not show significant difference between treatment methods employed. However, groups must be evaluated with the understanding that pain measurement is influenced by subjective factors.

It was observed that even in the subjects submitted to placebo treatment (Group IV), there was 16.5% of reduction in the muscle pain levels. However, one subject of this group presented an increase in pain level. The action mechanism of placebo treatment to pain decrease could be explained pharmacologically by endogen opioid mechanisms¹². Instead of ignoring psychophysiologic factors, clinicians should be reminded of their importance. Møystad, et al.¹⁸ recommended that clinicians should use the placebo effect and consider the possible use of this effect in the evaluation of new treatment modalities before claiming that one treatment is better than another.

The more expressive results related to decrease of pain levels were found in group II. In this group, treated by occlusal splints and without MENS, the reduction in pain level was 66.9%. In group I that associated MENS and occlusal splint therapies, the mean was 47.7%. One subject

of this group was indifferent to treatment. This result suggests that MENS does not improve the occlusal splint effectiveness. On the other hand, the occlusal splint effectiveness to decrease the muscle symptoms may be explained by some manners: proprioception adjustment by splint and even lessen it to mitigate proprioceptive output; establishment of “ideal occlusal scheme” (simultaneous, bilateral and multiple posterior tooth contact with excursive guidance on the canine and/or anterior teeth), short term effects of vertical dimension increase, muscle skeletal stabilization and placebo effect^{9,12}.

In group III (MENS without occlusal splint), there was also reduction of pain levels in all analyzed subjects (mean of 49.7%). However, there was no significant difference between the analyzed groups.

CONCLUSION

According to the results obtained through the methodology of this study, there was no statistically significant difference between MENS and occlusal splints effectiveness on pain reduction of masticatory muscles in TMD patients, and it was verified that the least decreasing pain percent occurred when only MENS placebo was employed.

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TABLE 4- Pain level of patients before and after treatment in group IV (MENS placebo) using a Visual Analogue Scale

GROUP IV		PAT 1	PAT 2	PAT 3	PAT 4	PAT 5
MENS placebo						
	Initial Appointment	7.5	8	8	10	5
	Final Appointment	6	7	8	3	6
Pain Reduction Rate (%)	AVERAGE	20	12.5	0	70	-20
		16.5				

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