J Acupunct Meridian Stud 2017;10(2):104—108

Available online at www.sciencedirect.com

Journal of Acupuncture and Meridian Studies

journal homepage: www.jams-kpi.com

RESEARCH ARTICLE

Use of Magnetic Neurostimulator Appliance in Temporomandibular Disorder

Marcelo Rossiti Florian [1,2,*], Vera Lucia Rasera Zotelli [3], Maria da Luz Rosário de Sousa [4], Larissa Angélica Bachir Polloni [5]

[1] *CETN/Faculty of Libertas, Sorocaba, Sao Paolo, Brazil*
[2] *Trainee in the Acupuncture Clinic of the Piracicaba Dental School/UNICAMP, Sao Paolo, Brazil*
[3] *Post-Graduation Program in Dentistry, Piracicaba Dental School, State University of Campinas/UNICAMP, Sao Paolo, Brazil*
[4] *Department of Social Dentistry, Piracicaba Dental School, UNICAMP, Sao Paolo, Brazil*
[5] *Post-Graduation Course in Acupuncture, CETN/Integrated Faculties of Libertas, Sorocaba, Sao Paolo, Brazil*

Available online 27 March 2017

Received: May 25, 2016
Revised: Feb 17, 2017
Accepted: Feb 21, 2017

KEYWORDS
acupuncture;
facial pain;
magnetic field therapy;
temporomandibular joint disorders

Abstract
Temporomandibular disorder (TMD) is ranked the second leading cause of orofacial pain after toothache, and there is no effective standard treatment for all cases. Therefore, much research has been conducted in the therapeutic areas of TMD, such as acupuncture and electrotherapy, for this purpose. The aim of this research was to evaluate application of the neuromagnetic stimulator device Haihua model CD-9, used within the precepts of acupuncture in treating TMD-related pain symptoms and limited mouth opening. Analysis and discussion of this study were based on pain intensity index and range of mouth-opening evaluation before and after each session. Nine patients diagnosed with muscle TMD, referred by the surgery sector of Center Dental Specialties (CEO — I) in Piracicaba-São Paulo participated in this research. Considering the simplicity of the technique and good results obtained, use of this device is suggested as an additional therapeutic tool for relief of TMD symptoms.

* Corresponding author. Avenida Limeira, 901 — Areião Piracicaba — São Paulo 13414-018, Brazil. Tel.: +55 (19) 2106 5209; Fax: +55 (19) 2106 5218.
E-mail: teloflorian@gmail.com, luzsousa@fop.unicamp.br (M.R. Florian).

pISSN 2005-2901 eISSN 2093-8152
http://dx.doi.org/10.1016/j.jams.2017.02.008

1. Introduction

Temporomandibular disorder (TMD), comprising muscular and joint problems in the orofacial area, is characterized by pain, joint noises, and irregular or limited functions during mandibular movement. Considered a subgroup of musculoskeletal and rheumatological disorders, TMD is the main cause of pain of nondental origin in the orofacial region [1,2].

Muscle parafunctional habits, traumas, facial and cervical skeletal discrepancies, joint problems, and other systemic factors may lead to reduction in mouth opening, clicking, subluxation, and luxation or locking of the temporomandibular joint, and particularly pain in the affected structures, causing great harm to the patient's daily routine and quality of life [1,2].

Acupuncture is a body of theoretical and empirical knowledge of traditional Chinese medicine (TCM), envisaging the therapy and cure of diseases by application of needles, moxibustion, and other techniques and materials to circulate energy through channels denominated meridians, by diverse forms of therapeutic stimulations in acupuncture [3—8].

According to the acupuncture theory, all body structures tend to be in a state of dynamic balance by the actions of the opposing but complementary Yang and Ying energies. Imbalance between these energies leads to onset of the disease process that is first manifested in the energy field. In its continuity, it passes to the physiological and material fields of the body. Acupuncture has the purpose of identifying where the imbalance is and why it is occurring, and stimulating the body to seek reestablishment of energy balance to leave the state of disease [3—7].

At present, there are many studies and researches involving conventional acupuncture, auriculotherapy, and electroacupuncture for TMD treatment [9—14]. However, the use of the Haihua appliance for this specific purpose has not yet been found in the literature.

A transcutaneous electric nervous stimulation (TENS)-type magnetic neurostimulator of Haihua brand was chosen for this research because it uses two combined forms of treatment, magnet therapy and transcutaneous stimulation. When this appliance is used within the precepts of acupuncture and TCM, it has been demonstrated to be effective in remission of symptoms of other muscular and skeletal dysfunctions [15].

The aim of this study was to evaluate the results of a new treatment method to benefit patients with pain in the orofacial region and reduced mouth opening—two symptoms commonly found in TMD—in order to restore their well-being and quality of life.

2. Materials and methods

This study was approved by the FOP-UNICAMP Research Ethics Committee (protocol number 099/2008). The research included four men and five women, aged between 15 years and 68 years, referred by the surgery sector of the Dental Specialties Center of Piracicaba (CEO — I), with symptoms of TMD of muscular origin. They were evaluated and treated with the Haihua CD-9 appliance (Dandong, People's Republic of China) by the researcher (M.R.F.) from June to September 2011, with each volunteer patient receiving at least three sessions in total.

Haihua, an electrotherapy appliance, categorized as a TENS type magnetic neurostimulator, was created in the 1990s, and combines electrotherapy and magnet therapy, using the principles of TCM and acupuncture. It has been used in cases of chronic and acute pain, with the following advantages: rapid applications, painless treatment, no risk and complications, simple function and application, and good effectiveness of the results [16].

According to the guidelines in the manufacturer's manual, needles are replaced by two electrodes that conduct an electromagnetic wave through the body. The action of each electrode is equivalent to simultaneous stimulation by 132 acupuncture needles, unobstructing meridians, activating blood circulation, and balancing the body's vital energy. Its electrodes, made of very powerful neodymium magnets that release electromagnetic charges, themselves perform stimulation of points of the human body, as do the needles in conventional acupuncture. In this case, the stimulus by transcutaneous electrotherapy is potentiated [17—19].

During application, the cell tissue receives charges from the magnet electrodes and changes, balancing the proportion between the sodium and potassium ions. The stimulus the appliance emits activates various chemical substances in the body, which promote unobstruction of the meridians, activate blood circulation, and revitalize the body's vital energy, promoting analgesia and favoring recovery of the affected tissues. The action of the appliance, which may be used with the magnet electrodes on fixed points, moving one of them, or in both ways, is processed on the indicated locations and also involves and stimulates neighboring points, and thus good results may be obtained. The pulsing current of energy produces a magnetic field with the shape of an audio frequency wave (approximately sinusoidal). The appliance may be used in a wide range of diseases and dysfunctions, including TMD [16,18].

The following are the technical specifications of the appliance used: Haihua CD-9 (Fig. 1), manufactured by Dandong Haihua Applied Technics Development Co., Ltd; origin: Dandong, People's Republic of China; power source: 110 V or 220 V AC; form of output wave: pulsating audio frequency wave (approximately sinusoidal); output frequency: 500—8000 Hz; maximum output voltage: 80 V

Figure 1 Material used in the research—Haihua CD-9.

40 mA; load resistance value: 1000 Ohm; output power: 2.6 W; dimensions: 170 × 120 × 70 mm^3 (length × width × height); weight: 650 g; working temperature: −10°C to 40°C; humidity: ≤80%; and magnetic intensity: >0.2 T (>0 G) [15,18].

In this study, points were selected according to the TCM principles, using the local–distant acupuncture technique on the points of the affected meridians in each case, based on the local points of greatest pain (called A-Shi points), and the trajectories of the meridians involved. North pole magnet electrodes were used on the local point and south pole ones on the distant point of the same meridian (located in the arms, hands, legs, or feet). As our purpose was to perform treatment of pain symptoms and mouth-opening limitation, the local–distant technique was most appropriate for unblocking energy and pain relief. In acupuncture, pain is understood as stagnation of Qi (energy) and Xue (blood) in the meridians, and the purpose of the mentioned technique is to unblock this stagnation, thereby promoting improved circulation in the affected meridian. In addition, this unobstruction of the meridians involved provides local muscle relaxation, which may therefore improve the amplitude of mouth opening [3,7,8,16,19,20].

In practice, during attendances, the required recommendations and care were followed before using the appliance on the patient [17,18,20].

2.1. Intervention protocol

On first contact with the patient, after reading and signing the terms of free and informed consent, the diagnosis was confirmed. For the purpose of a comparison between the values before and after the application, a numerical visual pain scale (NVS) was used and explained to the patient as follows: "We would like you to evaluate the intensity of your pain from zero (0) to (10) at this time, using the following comparison: zero would be complete absence of pain, and ten, unbearable pain, or the worst you have ever felt. How do you evaluate your pain at this moment?" The pain reported by the patient is informed on the chart in the field initial NVS [21].

Afterward, maximum mouth-opening amplitude was measured with a millimeter ruler. We asked the patient to open the mouth as much as possible in a safe and comfortable way. Immediately, Level 0 of the millimeter ruler was placed on the midpoint of the mandibular arch, between the mandibular central incisors, and directed toward the central point of the maxillary arch, between the maxillary central incisors. The value found was noted on the chart in the field initial opening.

After this, a test was performed with the electrodes on the patient's index fingers, so that he/she could feel the effect of stimulation that would be used (a small electric shock), with the intention of minimizing possible initial psychological stress.

The electrodes were applied for approximately 1 minute on each pair of points in each session for three sessions. The intensity of the current applied ranged from 20 V to 70 V, and it was regulated by guidance from the patient, who reported if the intensity that was applied at the point was very low, so that it could hardly be felt, and consequently, the desired therapeutic effect would not be achieved; or very high, when the pain sensation could be excessively uncomfortable. The mean of eight pairs of points were used, with the most sensitive points, their contralateral points, and distant points of the same meridian being selected. When the same point was used bilaterally, the electrode with the north pole magnet was placed on the most painful side and that with the south pole magnet on the opposite side. When the trajectory of the meridian was used with a local and a distant point, the north pole magnet was used on the local point and the south pole magnet on the distant point, generally on the upper or lower limbs.

After application of the sequence of points for approximately 8 minutes of stimulation on the total number of points, the patient was asked to inform us of the value attributed to pain at this time. We noted this value on the chart in the field final NVS.

Afterward, interincisor mouth opening was again measured, and the value noted on the chart in the field final opening.

At subsequent consultations, we began by asking the patient how he/she had been on the first days after the previous consultation, and how he/she felt at the present time. Then we followed the protocol of the first consultation.

3. Results

Nine patients presented themselves for the first treatment session, with an initial NVS score between 1 and 9.5, with a mean of 5.2. On conclusion of treatment, only one patient presented with a painful condition; however, the patient's NVS score was reduced to 3.0 from an initial value of 9.5 (Table 1).

There was a mean reduction of 51% in the NVS score in the first session, 61% in the second session, and 80% in the third session. The total sum of the three treatment sessions used to calculate the means between the initial and final NVS values showed an improvement of 94.2%.

As regards mouth opening, in a total of 27 consultations, 59.3% patients presented an increase, and in 11.1% the increase exceeded 3 mm. Table 1 demonstrates the evident fall in the pain patterns of the two groups as a whole; however, when comparing the pain values of the high-pain-intensity group with those who had low pain intensity in the return sessions, the former group showed a less intense reduction in pain values than the latter group.

4. Discussion

As TMD is an increasingly common problem nowadays in the area of dentistry, particularly taking into consideration the patients affected by a high prevalence of emotional and physical stress in the modern world, it is important to study new therapeutic solutions. The treatment of TMD is complex and multidisciplinary, and there is no single mode of treatment. However, the use of highly complex invasive resources, due to high cost and risk, as well as pharmacological resources, due to their inconveniences

Table 1 Mean and standard deviation of pain and mouth-opening results before and after Haihua sessions in patients with TMD. Results were generated in Piracicaba, 2011.

Application of Haihua appliance in TMD																		
Patient	Initial and final NVS									Initial and final mouth opening (mm)								
	Session 1			Session 2			Session 3			Session 1			Session 2			Session 3		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
1	7.5	3	4.5	1	1	0	0	0	0	45	45	0	45	45	0	46	46	0
2	6	4	2	7	3	4	0	0	0	21	23	2	17	22	5	23	25	0
3	9.5	5	4.5	9	5	4	7	3	4	40	44	4	42	42	0	42	44	2
4	6	3	3	4	2	2	2	0	2	45	45	0	45	45	0	45	45	0
5	7	4	3	4	2	2	0	0	0	44	46	2	45	45	0	48	50	2
6	5	3	2	1	0	1	0	0	0	43	46	3	42	42	0	43	45	2
7	3	1	2	3	0	3	3	0	3	40	40	0	39	40	1	38	40	2
8	2	0	2	2	0	2	1	0	1	39	41	2	40	41	1	40	41	1
9	1	0	1	2	0	2	2	0	2	32	33	1	30	32	2	32	32	0
Mean	5.2	2.6	2.7	3.7	1.4	2.2	1.7	0.3	1.3	39	40	1.6	38.3	39.3	1	39.7	40.9	1
SD	2.8	2	1.2	3	2	1.3	2	1	1.5	8	8	1.4	9	7.6	1.7	8	7.8	1

SD = standard deviation; TMD = temporomandibular disorder; NVS = numerical visual scale.

and side effects, is far from being a definitive solution to the problem.

An analysis of the initial and final NVS results within each consultation demonstrated that patients reported a significant improvement in pain before and after the application.

The initial NVS value of patients at the second consultation was lower than it was at the first consultation, before treatment. The results shown before and after this second consultation also demonstrated a significant improvement in the pain index.

At the third consultation, a larger portion of the patients began this consultation with an NVS score of 0 or close to 0. As the appliance was used within the precepts of acupuncture and TCM, we may explain this improvement by attributing it to the fact that we identified where the imbalance was and why it was occurring, and by stimulating the body seeking to re-establish the energy balance to help the patient leave the state of disease [1,3,6,7].

At the end of the three consultation sessions, all the patients had a final NVS score of 0, except one patient, who nevertheless had significant reduction in pain intensity. Perhaps this patient would need more sessions for total remission of pain.

With regard to mouth-opening amplitude, we also obtained good results as shown in Table 1.

Although it was not the aim of this study, it is also interesting to point out that a large portion of the patients felt that their facial muscles were more relaxed, and generally speaking, they felt more relaxed and tranquil. This demonstrated the intimate relationship between pain symptoms and limited mouth opening related to TMD, considering the muscular and psychological stress that these patients are subjected to.

When comparing the results obtained in the research with the existent literature encompassing the symptoms of TMD and the diverse treatment modalities, such as the occlusal plate [2,22,23], traditional acupuncture [9—13,24], and use of analgesic and anti-inflammatory medications [2,25], the authors were very encouraged by the effectiveness of the proposed treatment.

The results obtained in this study revealed that the patients with TMD may have yet another noninvasive therapeutic and nonpharmacological tool at their disposal to attenuate the pains and muscular and joint discomfort resulting from their dysfunction, with the additional advantage of being free of side effects and complications.

Our study proposed to deal with the symptoms of TMD; however, a more complete and holistic approach is necessary—one that takes into account the psychosocial aspects of each individual who has the dysfunction. Only thus we will be able to attain and maintain an organic balance, particularly of the stomatognathic system of patients, which would enable us to reduce the occurrence of symptoms and interrupt the vicious cycle in which patients generally find themselves.

As this is a unique study, with a small sample and a reduced number of sessions, further studies are necessary to consolidate the good results obtained with the Haihua CD-9 appliance used as a therapeutic tool to help with the management of this most complex dysfunction—namely, TMD.

5. Conclusion

The use of the TENS-type magnetic neurostimulator appliance Haihua CD-9 was satisfactory in the management of pain symptoms and mouth-opening limitation in patients diagnosed with TMD of muscular origin.

Conflict of interest

There is no conflict of interest.

References

[1] Okeson JP. *Treatment of Temporomandibular Disorders and Occlusion*. 4th ed. São Paulo: Artes Médicas; 2000.

[2] Oliveira W. *Temporomandibular Disorders*. 1st ed. São Paulo: Artes Médicas; 2002.

[3] Maciocia G. *Acupuncture Channels—Clinical Use of the Secondary Channels and Eight Marvellous Vessels*. São Paulo: Roca; 2007.

[4] Maciocia G. *The fundamentals of Traditional Chinese Medicine: A Comprehensive Text for Acupuncturists and Physiotherapists*. São Paulo: Roca; 2007.

[5] Auteroche B, Navailh P. *Diagnosis of Chinese Medicine*. São Paulo: Organização Andrei; 2002.

[6] Ross J. *The Organ Systems of Traditional Chinese Medicine*. 2nd ed. São Paulo: Roca; 1994.

[7] Wen TS. *Classic Chinese Acupuncture*. 1st ed. São Paulo: Cultrix; 2006.

[8] Yamamura Y. *Traditional Acupuncture: The Art to Insert*. 2nd ed. São Paulo: Roca; 2001.

[9] Florian MR, Meirelles MP, Sousa ML. Temporomandibular disorders and acupuncture: an integrative and complementary therapy. *Odontol Clin Cient*. 2011;10:189—192.

[10] Fortinguerra ML, Grillo CM, Meirelles MP, Sousa ML. Temporomandibular dysfunction: acupuncture as an alternative treatment. A case report. *Rev Paul Odontol*. 2011;33:19—23.

[11] Grillo CM, Meirelles MP, Sousa ML. Treatment of temporomandibular dysfunction with acupuncture: case report. *Rev Paul Odontol*. 2010;32:31—33.

[12] Quaggio AM, Carvalho PSM, Santos JFF, Marchini L. Using acupuncture in craniomandibular disorders. *JBA J. Bras Oclusão ATM Dororofac*. 2002;2:334—337.

[13] Meirelles MP, Gonçalo CS, Sousa ML. Management of orofacial pain through acupuncture treatment. *Rev Odontol UNESP*. 2009;38:379—382.

[14] Sobral ACS, Rocha LF, Figueiredo KS, Araujo MR, Sekito FM, Poubel WA. Acupuncture and dry needle in orofacial pain control. Available at: www.oclusao.com.br/monitores/acupuntura.pdf [Date accessed: May 20, 2011].

[15] Thiesen J. *Electroacupuncture in Physical Therapy, Monograph for Course Conclusion*. Curitiba: PUC-PR; 2004.

[16] CETN. Natural Therapies Study Centre, apostille of the graduate acupuncture course, class taught by Professor Roger Oliva Suguitani about stimulator device Haihua, Sorocaba, 2011.

[17] Costa R. *Electroacupuncture and Other Electronic Resources Applicable to Traditional Chinese Medicine*. São Paulo: Plêiade; 2002.

[18] *Therapeutic Apparatus Haihua CD9. Manufacturer's Manual*. 2009. China.

[19] Birla GS, Hemlin C. *Magnetotherapy*. São Paulo: Pensamento; 1999.

[20] Bastos SRC. *Treaty of Electroacupuncture: Perspectives Scientific, Theory and Practice*. Numem, Rio de Janeiro: Numem; 1993.

[21] Ciena AP, Gatto R, Pacini VC, Picanço VV, Magno IMN, Loth EA. Influence of pain intensity on the unidimensional scales responses of pain measurement in an elderly and young adults population. *Semin Cienc Biol Saude*. 2008;29:201—212.

[22] Portero PP, Kern R, Kuszma SZ, Grau-Grullón P. Occlusal splints for the treatment of temporomandibular disorder (TMD). *Rev Gest Saúd*. 2009;1:36—40.

[23] Barbosa GAS, Fernandes Neto AJ. The role of occlusal splints in temporomandibular disorders, revision. *Rev ABO Nac*. 2007—08;15:1—19.

[24] Branco CA, Fonseca RB, Oliveira TRC, Gomes VL, Fernandes Neto AJ. Acupuncture as a complementary treatment option to temporomandibular dysfunction: review of the literature. *Rev Odontol UNESP*. 2005;34:11—16.

[25] Melo GM. Pharmacotherapy in temporomandibular disorders: a brief review. *Rev Dent Online*. 2011;10:35—40.