Influence of Chemical Therapeutical Methods on Manducatory Muscles

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Muscular relaxation offers the opportunity of muscular reconditioning by means of physical chemical therapies with the establishment of new neural-muscular engrams and, implicitly, of new patterns of mandible dynamics. Our study aims was the investigation of different methods of treatment through physical factors, the assessment of action and efficiency, along with the integration of these methods within a therapeutic algorithm that would finally, lead to stomatognathic system and cephalic musculature homeostasis.

Keywords: stomatognathic system, myorelaxation, hydro-therapy, electrotherapy, laser-therapy

The muscles of stomatognathic system are often involved, as etiologic or promoting factor, in producing the dysfunction, by the deformation of proprioceptive information, with a role in muscular contraction regulation. All modern etiopathogenic theories incriminate stomatognatic system muscles in producing the dysfunction, regardless of the action of the causative agent, on systemic or over-systemic level. The etiology of temporomandibular disorder (TMD) involves craniofacial morphology, head posture, stress, psychological factors, trauma, joint hyper mobility and infections as risk or contributing factors [1-5]. In addition, the occlusion plays a key role on the temporomandibular joint as it may influence the functional activity of masticator muscles, resulting in fatigue and muscular pain [6, 7]. Despite this, previous studies focusing on muscle activity in TMD patients have not provided convincing evidence that muscle hyperactivity occurs [8-11]. Thus, the relationship between malocclusion and muscle morphofunctional aspects in the masticator system is not yet fully understood [12].

The methods of aquatic physical therapy used in dentistry represented an unknown and misconsidered domain for a long time. The systematization of these methods was accomplished in the volumes of *Prosthetic Dentistry*, published in 2011 [13]. The forward publication of many studies determined the reconsideration of these aquatic physical therapy techniques and, as a result, of precise recommendations; the successful implementation of these techniques in complex rehabilitation therapy of stomatognathic system had been achieved.

Aquatic physical kinetic therapy is a branch of medicine that uses natural and artificial physical factors in therapeutic purpose. In many countries balneotherapy is used for treatment, but inconsistent with the frequent use of this remedy, is the small number of clinical studies to confirm its specific efficacy. Studies about the properties of balneotherapies are afflicted by methodological difficulties, for example, in the choice of suitable controls. Numerous studies published in the past decade, however, document the efforts to fulfill the demands of evidence-based medicine [14, 15].

Muscular relaxation offers the possibility of muscular reconditioning by methods of aquatic physical therapy with the establishment of new neural-muscular engrams and, implicitly, of new patterns of mandible dynamics, the aim of this study being: the investigation through physical factors, of different methods of treatment, the assessment of action and efficiency, along with the integration of these methods within a treatment algorithm that would finally lead to stomatognathic system and cephalic musculature equilibrium. The increased incidence of stomatognathic system muscular dysfunctions reported along with the epidemiological studies constitutes the foundation for establishing mandatory applied aquatic physical therapy, within the complex rehabilitation of stomatognathic system.

The great number of these factors determined the dissemination between numbers of special therapeutic branches depending on the agent that was used: aquatic therapy, hydrotherapy, electrotherapy, thermotherapy, laser therapy, ozone therapy and many others.

Experimental part

Materials and methods

Our clinical experimental study was carried out on 63 patients with affliction of muscular activity, as a result of decreasing or increasing of muscular tonus, or as a result of muscular contraction alterations. From a total of 81 subjects initially included into our study and investigated by electromyography between October 1st 2009 and March 1st 2012, the evaluation of our patients was performed during the dental treatment, and also during the hospitalization.

Gender distribution of this study batch included 34 female subjects and 29 male individuals, aging between 16 and 83 years, which presented clinical signs of muscular dysfunction, a decrease or an increase of muscular tonus, with a keen interest regarding the affliction of stomatognathic system and a heighten concern considering the recuperation of the already reduced functions of the system. This alternative was deliberately selected, in order to avoid dropouts of patients from the present study.

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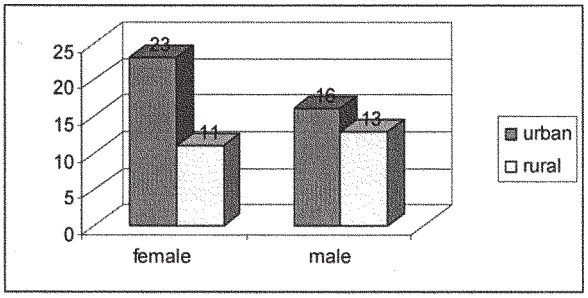

Fig. 1. Distribution of the patients by the provenance of the studied group

Also, this distribution is justified by the presence of women at the dental office, as early as possible in the first stages of disease evolution and by the fact that the female patients generally respect the indications of treatment and oral hygiene. Regarding the addressability of urban and rural population at dental treatment, we can note a higher preponderance in the urban than in the rural environment (fig. 1).

Maximum of addressability exists in the population group of 40-60 years, without neglecting the age groups of 20-40 and 60-80 years (fig. 2).

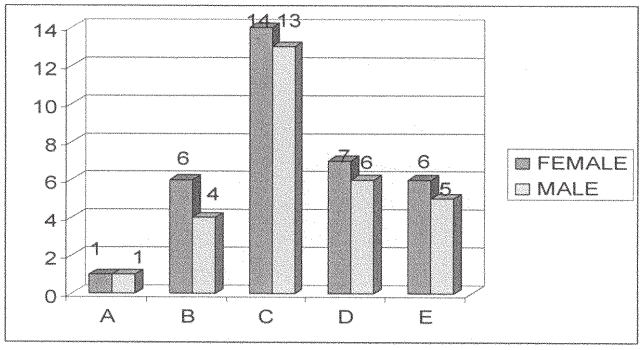

Fig. 2. Distribution by the age of the group under study: A - 16-20 years old, B- 20-40 years old, C - 40-60 years old, D - 60-80 years old, E - over 80 years old

Inclusion criteria for the patients in our study were represented by the presence of muscular tonus and muscular contraction alterations, clinically and para clinically distinguished based on electro-myographic exams and on T-scan analysis. Also, there were included subjects that displayed signs and symptoms of muscular dysfunction such as: pain at the level of stomatognathic system and cephalic extremity, muscular hypertonia, muscular hypertrophy, limitation of mouth opening and deviation of mandible from the medial line during the opening, fatigue at cephalic extremity muscles level and functional alteration of stomatognathic system.

The exclusion criteria of the patients took into consideration the presence of joint affliction, of the third molar pathology, osteoarthritis, patients that exhibited signs of neoplastic changes

We have applied various treatment options, with mono and multiple therapy, through physical factors, targeted to stomatognathic system and cephalic extremity, along with other systemic elements, as a result of interconnections settled at systemic and over systemic level. Despite advances in pharmacological therapy, physical treatment continues to be important in the management of treatment and it is essential to evaluate the effects and tolerability of combined spa therapy and rehabilitation. Most of the evaluation indices were significantly improved at the end of the spa treatment, as well as at the 3 and 6 months follow-up assessments. Thermal treatment was found to be well tolerated and none of the patients had disease relapse [16].

Results and discussions

Hydrotherapy implies methodical delivery of water at various temperatures and various states of aggregation (solid, liquid, and gaseous) with prophylactic and curative aim. Hydrotherapy (aquatic therapy) is the use of water in a pool heated to 32-34°C as a therapeutic modality. It is used to treat joint disorders, musculoskeletal disorders, acute injuries, post-surgical conditions and head injury [17].

Hydrotherapy was considered among the techniques that would be easily understandable and applied and thus was recommended to all the 63 subjects of the batch.

The method provides spasmolytic action upon the striated musculature by direct and indirect myorelaxing action, and indirect analgesic and non-specific side effects (through complex actions upon various involved mechanisms). Hydrothermal therapy applications were recommended in 10-12 sessions daily (or within 2 days), for about 20 min per session. The patients received an hydrotherapy treatment consisted of three individual sessions and three sessions of aquatic exercises. In the pre-treatment phase the disability, severity and pain were evaluated by means of the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). In addition, the range of active mobility of the neck was measured with tape. The tests were measured pre and post-treatment. The vasodilatation that takes place during the application of mud packs and thermal baths could, moreover, increase tissue blood flow and exert an anti-inflammatory effect by

Efficiency over spasm	*Good*	*2*
	Medium	*1*
	Null	*0*
Efficiency over muscular tonus	*Good*	*2*
	Medium	*1*
	Null	*0*
Efficiency duration	*>3 days*	*2*
	1-3 days	*1*
	<3 days	*0*
Side effects	*Yes*	*0*
	No	*1*
Evolution (after more than one applications)	*Amelioration*	*1*
	Deterioration or no improvements	*0*
Pain	*Total suppression*	*2*
	Partial suppression or amelioration	*1*
	Lack of efficiency	*0*

Table 1
CLASSIFICATION CRITERIA FOR CLINICAL ASSESSMENTS

Table 2
PATIENT'S SCORE FOLLOWING HYDROTHERMAL THERAPY

Number of patients	*Score (0-10 scale)*
8	*9*
24	*8*
18	*7*
11	*6*

removing algoid metabolites, free radicals, and other pro-inflammatory substances from the tissues [17].

The following classification *Soulayrol and co.,* criteria were used in order to assess the clinical therapeutic results.

The results obtained following the evaluation post-hydrothermal therapy procedures delivery were according to table 2.

One can observe from several studies that the best evaluation rating was achieved when the method was associated with other treatment options; efficiency period does not exceed 3 days, during which , the pain was ameliorated reinforcing physical and psychological comfort of the patients. No side effects were noticed. The range of active mobility of the neck improved in all movements: flexion, right and left lateralization, and right rotation and left. The outcomes of a pilot study show that hydrotherapy can be related a positive influence and balance improvements and pain decrease [17].

Although the beneficial effects of balneotherapy, is available on the biological mechanisms underlying them and the subjective feelings of increased well-being and mood, thermal balneotherapy with ozonyzed water, as compared with a similar group that underwent a bath in non-mineral water.

In spa therapy the use of water for medical treatment is probably as old as mankind. Until the middle of the last century, spa treatment, including hydrotherapy and balneotherapy, remained popular but went into decline especially in the Anglo-Saxon world with the development of effective analgesics. However, no analgesic, regardless of its potency, is capable of eliminating pain, and reports of life-threatening adverse reactions to the use of these drugs led to renewed interest. Over 30 years of research demonstrates that exercises in general, and specifically aquatic exercises, are beneficial for reducing pain and disability in many musculoskeletal conditions demonstrating small to moderate effect sizes ranging between 0.19 and 0.32 [18].

Electrotherapy uses the electric current, electro-magnetic waves or quantum energy for prophylactic or curative purposes. Electrotherapy can be directly applied to the surface of the body under the form of disjunctive or alternative current, of low, medium and high frequency, or indirectly, by means of transforming the electric energy in caloric or light radiant energy. Facial paralysis refers to a condition in which all or portions of the facial nerve are paralyzed. The facial nerve controls the muscles of facial expression, paralysis which results in a lack of facial expression which is not only an aesthetic issue, but has functional consequences as the patient cannot communicate effectively.

Electrotherapy was administered to 28 patients, the effect of augmentation on the local metabolic processes, the analgesia of painful zones and muscular relaxation having thus beneficial effects both, on long and short term. Until the end of the 19th century, the treatment of this condition involved non-surgical means such as ointments, medicines and electrotherapy.

Table 3
PATIENT'S SCORE FOLLOWING ELECTROTHERAPY

Number of patients	*Score (0-10 scale)*
1	*8*
5	*7*
19	*6*
3	*5*

The results obtained within the 28 subjects following the electro-therapeutic procedure application were according to table 3.

In the treatment of muscular-joint disorders at the level of stomatognathic system, one can use laser sources of low emission energy.(LLLT) Laser is a source of electromagnetic radiation with an emission in the visible spectrum domain or very close to this one (infrared and ultraviolet). LLLT is known as a new therapeutic approach used for TMD treatment. It stimulates the microcirculation, acts on tissue repair to reduce edema and pain [19, 20]. In addition, LLLT keeps the intensity of the force during muscle contraction and may delay its fatigue, and this may increase intracellular ATP levels sufficient to maintain muscle physical effort. [21]. However, Gam et al. (1993) [22] have not shown efficiency of LLLT on musculoskeletal disorders [23].

After using such a treatment plan option in our patients, we observed the alleviation of the pain, a good efficiency in increasing the muscular tonus and reducing the spasms, while duration of efficiency was frequently beyond 3 days, with the highest efficiency recorded on the application of disjunctive low frequency current.

The results obtained following the evaluation and secondary to laser therapy procedures administering were according to table 4.

Table 4
PATIENT'S SCORE AFTER LASER THERAPY

Number of patients	*Score (0-10 scale)*
2	*9*
17	*8*

After three applications with He-Ne laser, we recorded full amelioration (in 100% patients): the absence of pain in 15 patients and the substantial amelioration of pain perception in 4 patients. Moreover, pain sensation was suppressed, the duration of efficiency frequently exceeded 5 days, while no side effects were noted (fig. 3).

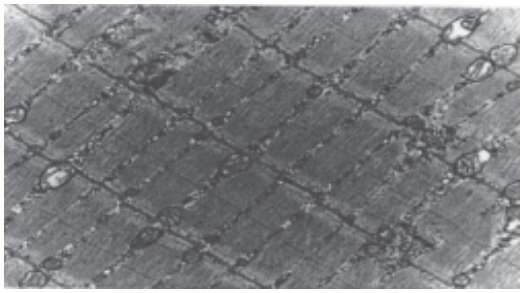

Fig. 3. Normal aspect (20.000X) of the muscle tissue

In the laser group few alterations of muscle tissue could be found. Only sparse muscle fibers showed moderate mitochondrial swelling, although the myofibrils with thick Z lines; mitochondria located in pairs at the level of the Z lines and well-developed sarcoplasmatic reticulum.

For laser therapy there were no statistical differences between the experimental periods, and these findings are similar to previous studies that demonstrated beneficial action of the laser on muscular TMD [24-28].

Using infrared spectrum, Kato et al. [29] and Kogawa et al., 2005 [30] were successful in reducing pain in patients with TMD and increasing active range of motion on the masticatory muscles. It is possible that LLLT and skeletal muscle relaxant play a positive influence on the masseter muscle under occlusal wear, as morphological changes are more evident in occlusal wear group. Thus, the results did not show a cause effect relation between occlusion and TMD, although signs of muscle tissue injury were more evident, indicating moderate action of LLLT and skeletal muscle relaxant as therapeutic agents.

Due to these aspects, several modalities of therapy have been approached for patients with temporo-mandibular joint (TMJ) dysfunction and chronic orofacial pain [31], in order to maximize their complementary actions. Among the therapies currently in use, muscle relaxants and low level laser therapy (LLLT) have been reported [32-34]. It was observed, in most of the studies, that the laser decreases the painful symptoms of the patient after application through its analgesic and/or a placebo effect: the main justification for the use of lasers in laser therapy dysfunction is its analgesic effect, which was observed in most studies in the literature [35, 36].

Compared to hydrothermo-therapy alone, the association between etiologic therapy and muscular relaxation treatment resulted in significant increase efficiency, higher after three days, with alleviation of pain and no noticed side effects.

Conclusions

The stomatognathic system functions are mainly based on the neuromuscular activity that ensures the mandible static and dynamics, relaxation, re-equilibration, and functional re-education being mandatory for complex rehabilitation of stomatognathic system.

Aquatic-physical-electro-therapeutic methods aim muscular relaxation, the toning up or the decrease of muscular tonus, improvement in mandible functionality, improvement in functionality at the temporo-mandibular level of joints, along with improvement in local circulation. Aquatic-physical-electro therapy techniques elaborate the site of muscular dysfunction and of its effects, along with advance diagnostic and treatment base.

The relatively easy procedures are used in acute dysfunction rehabilitation, but also in chronic dysfunctions, but with changes at the level of techniques regarding the degree, duration, frequency and direction of applied movements. They provide a facile way of administration, and can be thus followed by the patient himself, through adequate comprehension of the technique.

Aquatic-physical-kinetic-therapy treatment is mandatory, taking into consideration the step-by-step process and within the frame of therapeutic diagram used within the Department of Dental Prosthetics, but better not applied as monotherapy. Only in these conditions, one can talk about the rehabilitation of stomatognathic system musculature function.

Applying a single therapeutic method, which acts by only one mechanism, becomes insufficient for muscular relaxation and adequate positioning of cephalic extremity, the etiologic treatment being sustained and improved by the symptomatic therapy which will create the necessary conditions for the relaxation. The association of these treatments is to be preferred versus monotherapy.

Regarding the investigated individuals, we have achieved variable results from very good to satisfactory: from total remission of muscular symptoms (pain, restriction of mouth opening, muscular spasm, muscular hypertonia, alteration of mandibular dynamics trajectories), partial remission of symptoms to no alteration of symptoms. The quantification of the results was accomplished by means of an easy implementing classification. We have observed that, on short term, the best results could be seen in patients in which the aquatic-physical-kinetic-therapy was associated with etiologic and symptomatic therapy.

References

1.EGERMARK, I., MAGNUSSON, T., CARLSSON G.E., Angle Orthod, **73**, 2003, p. 109-.

2.LILJESTRÖM, M.R., LE BELL, Y., ANTTILA, P., AROMAA, M., JÖMSÖ, T., METSOHONKALA, L., HELENIUS, H., VIANDER, S., JÖPPILÖ, E., ALANEN, P., SILLANPÖÖ, M., Cephalgia, **25**, 2005, p. 1054-.

3.NIEMI, P.M., LE BELL, Y., KYLMÖLÖ, M., JÖMSÖ, T., ALANEN, P., Acta Odontol. Scand., **64,** 2006, p.300

4.PRASAD, K.C., SREEDHARAN, S., PRASAD, S.C., CHAKRAVARTHY, Y., Otolaryngol. Head Neck Surg., **137**, 2007, p. 974

5.VASLUIANU, R.I., UNGUREANU, D., JITARU, D., IOANID, A.D., FORNA, N.C., Revista Romana de Medicina de Laborator, **20** (2), 2012, p. 173.

6.GESH, D., BERNHARDT, O., MACK, F., JOHN, U., KOCHER, T., ALTE, D., Angle Orthod., **74,** 2004, p. 512-.

7.SONNESEN, L., SVENSSON, P., Eur. J. Orthod., **30**, 2008, p. 621-.

8.ISSA, J.P., VITTI, M., DA SILVA, A.M., SEMPRINI, M., REGALO, S.C., Electromyogr. Clin. Neurophysiol., **46**, 2006, p. 263.

9.OKANO, N., BABA, K., IGARSHI,Y., J. Oral Rehabil., **34**, 2007, p. 679.

10.RODRIGUES, K.A. , FERREIRA, L.P., Rev. Dent. Press Ortodon. Ortoped. Facial**, 8**, 2003, p.107.

11.SUVINEN, T. I. , KEMPPAINEN, P., J. Oral Rehabil., **34**, 2007, p. 631.

12.BANI, D., BANI, T., BERGAMINI, M., J. Dent. Res., **78**, 1999, p.173.

13.FORNA, N. et all., Protetica Dentara, Vol. I and II, Ed. Enciclopedica, Bucuresti, 2011

14.FINK, M., KLAPAKCIOGLU, B., BERNATEK, M., GUTENBRUNNER, C., Aktuelle Rheumat, **36,** 3, 2011, p. 157.

15.CERNAT R. I., MOCANU R. D., POPA E., SANDU I., OLARIU R. I., ARSENE C., Rev Chim. (Bucharest), **61**, no. 11, 2010, p. 1125.

16.LUCA , C., LO NIGRO, A., RIZZO, M., GAVA , A., Rheumatology Int**., 33**, 1, 2013, p. 241.

17.KRON, J., J. Complem. Medicine**, 6,** 6, 2007, p. 46.

18.VERHAGEN, A.P, CARDOSO, J.R, BIERMA-ZEINSTRA, S.M.A, Best Practice & Research in Clin. J. Rheumat., **26,** 3, 2012, p.335.

19.MAZZETTO, M.O., CARRASCO, T.G., BIDINELO, E.F., PIZZO, R.C.A., MAZZETTO R.G., J. Craniomandib. Pract., **25**, 2007, p. 186.

20.SUVINEN, T.I., KEMPPAINEN, P., J. Oral Rehabil., **34**, 2007, p.631.

21.LOPES-MARTINS, R.A.B., MARCOS, R.L., LEONARDO, O.S., PRIANTI, A.C. Jr., MUSCARA, M.N., AIMBIRE, F., FRIGO, L., IVERSEN, V.V., BJORDAL, J.M., J. Appl. Physiol., **101**, 2006, p. 28.

22.GAM, A.N., THORSEN, H., LONNBERG, F., Pain, **52,** 1993, p. 63-6.

23.LISBOA, M.V., PINHEIRO, A.L.B., DOD SANTOS, M.A.V., BAPTISTA, A.F.B., DE SOUSA, A.P.C., VALENCA NETO, A., DOS SANTOS, J.N., Int. J. Morphol., 30, (3), 2012, p. 999

24.VAN SELMS, M. K. A., LOBBEZOO, F., VISSCHER, C. M., Naeije, M., J. Oral Rehabil., 35, 2008, p. 4552

25.AMARAL, A.C, SALVINI, T., Lasers Med. Sci., 16, 2001, p. 44.

26.COSTARDI, C.H.Z., TAMACHIRO, C., ESTEVES JUNIOR, I., GOMES, A.C., Fisioter. Mov., **2**1, 2008, p. 21.
27.FARIAS, V.H.A., Dissertation Thesis; Vale do Paraíba University, 2005.
28.FRARE, J.C., NICOLAU, R.A., Ver. Bras. Fisioter**., 1**, 2008, p. 37.
29.KATO, M.Y., KOGAWA, E.M., SANTOS, C.N., CONTI, P.C.R., J. Appl. Oral Sci., **14,** 2006, p. 130.
30.OGAWA, E.M., KATO, M.Y., SANTOS, C.N., CONTI, P.C.R., J. Appl. Oral Sci., **13**, 2005, p. 280.
31.TURP, J.C., JOKSTAD, A., MOTSCHALL, E., SCHINDLER, H.J., WINDECKER-GETAZ, I., ETTLIN, D.A., Clin. Oral Impl. Res., **18**, 2007, p. 189-.
32.BANI D. & BERGAMINI L., J. Dent. Res., **80**, 2001, p. 1990.
33.CARRASCO, T.G., MAZZETTO, M.O., MAZZETTO, R.G., MESTRINER W. Jr., Cranio, **26**, 2008, p. 274.
34.EMSHOFF, R., BOSCH, R., PUMPEL, E., SCHONING, H., STROBL, H., Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., **105**, 2008, p. 452.
35.SANTOS, T.D., PIVA, M.R., RIBEIRO, M.H. et al., Brazil. Otorhin., **76**, 3, 2010, p. 294.
36.NASH, D., RUOTOISTENMAKI, J., ARGENTIERI, A., BARNA, S., BEHBEHANI, J., BERTHOLD, P., CATALANOTTO, F., CHIDZONGA, M., GOLDBLATT, L., JAAFAR, N., KIKWILU, E., KONOO, T., KOUZMINA, E., LINDH, C., MATHU-MUJU, K., MUMGHAMBA, E., HUSSEIN, N. NIK, PHANTUMVANIT, P., RUNNEL, R., SHAW, H., FORNA, N., ORLIAGUET, T., HONKALA, E., European Journal of Dental Education, **12**, 2008, p. 111

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