



# Complex Intraoral Rehabilitation with Collagen Supplements and Biomedical Infrared Radiation Reliance in TMJ Disorders

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**Abstract.** *Techniques of balneo-physio-kinetotherapy and complex oral rehabilitation are general measures approach, which are addressed to all patients for maintaining the homeostasis of the whole body and also of the cephalic extremity, as well as specific measures, targeted in our case at the level of the stomatognathic system. These kind of approach treatments are in accordance with an individualized therapeutical scheme and gradually complying with the principles and concepts of complex oral rehabilitation. Infrared radiation and masotherapy is a form of balneo-physiotherapy medicine in adjuvant and increased results of benefits of classic treatment in temporo-mandibular disorders. The association of these treatments, is favored above monotherapy.*

**Keywords:** *infrared radiation, TMDs, dental treatments, rehabilitation, collagen, massage*

## 1. Introduction

The dysfunctional syndrome of the stomatognathic system (SDSS) may present different clinical forms established at the debut of the syndrome on one single element of it or looking of the system as a whole, through symptoms that localise the dysfunction on one single element, no matter the involvement of the others, which implies the corroboration of different treatment techniques [1,2]. In this complex context, several papers which studied this domain appeared and showed that the precise indications regarding the polytherapeutical approach in the rehabilitation of the stomatognathic system were successful [3,4]. The adjuvant therapeutic methods based on balneo-physio-kinetotherapy (for this issue, balneotherapy is a branch of medicine that uses physical factors, natural and artificial, for therapeutic purposes) represent an important step in the rehabilitation of the muscle functions of the cephalic extremities, as they are indicated in a prophylactic purpose, based on the stimulating action of the natural physical factors over the defence mechanisms, increasing the capacity of some functions or the organism itself to adaptation [5]. They have an important position in therapy as they may prevent the evolution of some disorders also [6].

Patients with chronic temporo-mandibular disorders (TMDs) usually present associated psychological factors that should be managed with specific interventions [7,8]. Cognitive behavioral therapy, is one of the treatments proposed to manage patients' thoughts, behaviors, and/or feelings that might exacerbate pain symptoms and this kind of negative thinking patterns increase the emotions, thoughts, that are considered adverse. It is a noninvasive therapy and have non adverse effects, reclame a pshychological interaction.

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The literature reports that cognitive behavioral therapy alone is not better than other interventions, but it is a good complement, the meaning, give to their experience impacts whether they will become, when we try adapting the treatment to the psychological characteristics of the patient [9].

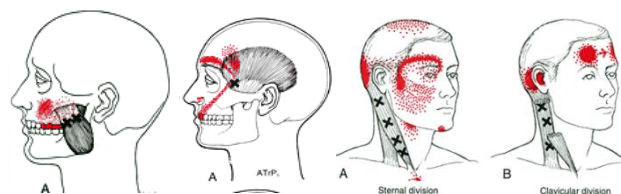
Given the progress made in the domain of nature and means of treatment of the cranial-mandibular dysfunctional syndrome it is obvious that the biofeedback and other forms of psycho-physiological therapy will play an important role in this complex therapeutic arsenal [10,11].

Oro-facial dyskinesia is present as hemiparesis, paresis or paralysis and determines complications of muscle contractions, spasms affecting the muscles of the stomatognathic system [12]. The dysfunctional syndrome of the stomatognathic system presents a multifactorial etiology and a complex symptomatology closely functional and morphological correlated so, that the damaging of one of the links in the system entails the disturbance of the other [13]. It would seem that the muscles of the stomatognathic system are incriminated, in the majority of the cases, in the production of the stomatognathic system's dysfunctions, according to the muscle dental, physiological and psychophysical theories [14]. Forna N.C., 2011, considered that the spasm of the masticatory muscle is the main factor responsible for signs and symptoms of the TMDs [11]. The psych-physiological theory of the cranial-mandibular dysfunctional syndrome is based on the same mechanism by which stress leads to miospasm physiopatological interaction mechanism [15]. This theory explains the origin of various signs and symptoms, considering occlusal disharmonies rather a result than the cause.

There have been a series of researchers whose work has been a pioneering domain in the study of pain with myofascial nature, according literature [16]. The appearance of muscle dysfunction is due to heterogeneous activation of muscle fibers, this hypothesis being considered an adequate explanation of the effects of pathogenic and therapeutic rehabilitation of muscle function. As a result of the change in muscle tone and muscle contraction, changes occur in local circulation, bring spasms, fatigue and muscle pain. The increased prevalence of muscle dysfunctions of the stomatognathic system, as demonstrated by epidemiological studies are the base for the establishment of programs for balneo-physio-therapy, compulsory applied in complex rehabilitation of the stomatognathic system.

Muscle relaxation offers the possibility of using balneo-physio-kinetotherapy methods of muscle refurbishment through establishing new neuro-muscular engrams and new patterns of dynamic study of mandibular, the purpose being the study of different methods of treatment by physical factors, of the action and their efficiency, alongside integration methods in a treatment algorithm which in the end will lead to the balancing of stomatognathic system and cephalic end muscles.

Travell Janet is credited with the concept of the myofascial trigger points (Figure 1), between 1942-1990 she has published over 40 articles on myofascial trigger points [16].



**Figure 1.** Trigger-point images of Myofascial Pain and Dysfunction

Source: Travell Janet, Simons S. Lois. *The Trigger Point Manual/Masseter, temporal, the sternocleidomastoid.* Vol. 1– Upper, 2019

"The masseter muscles are among the first to contract in persons who are in a state of extreme emotional tension and they remain contracted for abnormally long periods of time" said literature by Travell [17]. Various etiological factors of the myogenic dysfunction may cause similar symptoms. The ideas of founders of the neuro-muscular therapy were taken up in the second half of the twentieth century



by a series of specialists in various medical domains, who created the contemporary neuro-muscular therapy programs for prevention, correction and restoration of TMDs.

### **Aim and objective**

The aim of our study was to evaluate the therapeutic efficacy of infrared radiation treatment and also another adjuvants supports like, medical massage, in patients with chronic TMDs. The treatment with infrared radiations were applied for antalgic purpose on 2-3 days intervals for 10-15 min, in 1-3 min appearing of caloric erythema and active hypothermia, useful for warming up muscles in order to apply the others methods of physiotherapy, in our cases the medical massage procedures.

The main objective foreseen throughout the study is to improve and functionalize the existing situation of the patients areal with this type of pathologies and the effectiveness of the process at all level persued, including biochemical parametres.

The wide range of existing data in the literature on the use of collagen in the biomedical field requires applicability and evaluation considering the presence of collagen in almost all body structures, including the joint.

## **2. Material and methods**

Our clinical study was appllied on a sample of 32(61.54%) patients presenting impaired muscle activity as a result of the decrease or increase in muscle tone, or changes in muscle contraction, from a total of 52 people that were taken and investigated in this study in terms of a normal clinical examination, completed with electromyographycal examinations during the period october 2017–october 2019, the assessment from the point of view of the objectives being carried out both during dental treatment and during the placement.

In this context, the strategies of treatment plan in the rehabilitation of muscle of the stomatognathic system aims to reduce even eliminate the pain, restoring functionality within limits of the stomatognathic system, homeostasis and improving living quality conditions.

They shall be in accordance with an individualized therapeutical schema and gradually complying with the principles and concepts of complex oral rehabilitation.

Muscle relaxation trays are the ones which offer the muscle the opportunity to come back to the functional parameters. They represent artificial occlusal relief, realized with the aim of suppressing the abnormal proprioceptive reflexes with a departure point in the periodontal area. Its have as purpose the occlusal superelevation, ensuring a limited overextension of the manducatory muscles, thus determining a reflex adjustment of the muscle tonus and a muscular relaxation.

The occupation of the Donders space by a palatal plate contributes to the lowering of the mandible and implicitely to the relaxation of the muscles. Muscular relaxation trays are realized in centric relation and may be with total or partial coverage of the arch, usually maxillary, conferring the patient a new occlusal relation, considered as optim. It also eliminates, in the same time, the cranial-mandibular instability, no matter what caused it. It is indicated in: the hyperactivity of the manducatory muscles, muscular spasm, muscular pain, parafunctional activities which manifest especially in the stressful moments.

We applied in single or multiple therapy, different treatment methods with physical factors, addressing both the stomatognathic system muscles and cephalic end and other elements, as a result of systemic interconnections which are implemented at the systemic and over systemic level. As physical factors we used the methods of infrared ratiation and medical massage therapy.

The use of radiant energy luminous action on the body in the artificial form (light irradiation Spectra-provided and issued under certain conditions) is a relatively rare practice applied in stomatology. The main therapeutic factors behind phototherapy are infrared and ultraviolet radiation. Infrared radiations are located outside of the visible spectrum, in the area of radiation with greater wavelengths. Infrared radiations with short wavelength are tolerated up to 43.8°C, while those with long-wavelength up to 45.5°C.

The molecular mechanism, the physiology of light interactions with tissue by spot the photoacceptor molecules can produce physiological effects assuming the causes to two main types of photoacceptor like cytochrome C oxidase and intracellular water. Photon absorption change the light into signals that increase biological processes modulate signaling pathways, producing ATP (adenosine triphosphate),  $\text{Ca}^{2+}$ , efficiency of reactive oxygen species (ROS), ATP (adenosine triphosphate), NO, and inositol phosphates group.

Infrared radiation will cause the appearance of nappy (arterial and capillary vasodilation) which is associated to mucus layer and dermal papillae edema and outflow of perivascular leucocytes which increase intercellular exchanges. Erythema is installed without latency period and disappears after 30-40 min. Deep circulation and nervous system activation takes place (penetrating A radiation), modifying the general metabolism. Extended irradiation may cause irregular pigmentation. Infrared radiation induces a reduction of inflammation and the effect could be the miorelaxation and an important pain relieves effect.

On applying the therapeutical procedures reliance we've consider care and conscientiousness not to produce burns, to irradiate the anesthesia area or putting the source too close.

It is necessary to use protective glasses to avoid impairment of the visual analyzer.

In the area of chronic or sub-acute inflammatory processes, synovitis and tenosynovitis traumatic, inflammatory ailments, mucous membranes, peripheral circulation disorders, scars, eczema, ulcerations can benefit from this type of treatment.

The method is used in this study and applied in case the equipment, the infrared methodology, is a modern one of current interest acquired by the CFR Iasi Hospital and in collaboration with them, we can notice a difference in efficiency and applicability considering it as an evolution in compassion with studies made on the devices of 10-15 years ago.

Massage -manual maneuver -represents the assembly of movements which methodically mobilizes tissues or body segments.

Skeletal muscle massage has a certain impact in the context of medical massage, being widely applied and requested, with a real functional and anatomical importance, an therapeutic efficacy, prophylactic, curative and rehabilitation.

Muscles can be processed on specific muscle groups and regions purposed for "targeted" therapeutic delimitation, generally, for the purpose of maintaining somatic muscles. Using any techniques and maneuvers for muscles we obtain improvement of properties, capacity and its performance.

We applied – inspired by the Oakworks, facility demonstrating TMJ massage techniques, from Louisiana Institute of Massage -Susan Salvo, and the patients experienced alleviation of pain because of its unique ways, the jaw and face discomfort had just about vanished.

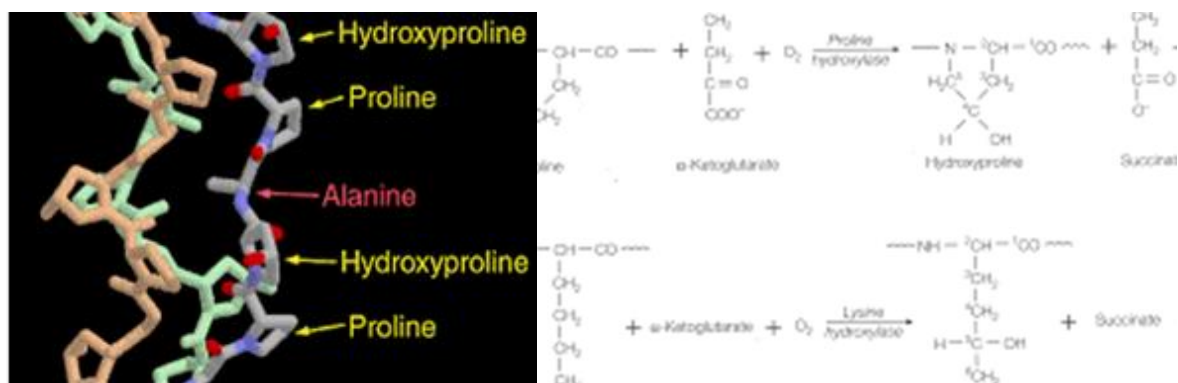
The patient's position is horizontal, comfortable, and the therapy consists in applying the massage on 3 muscular units: masseter, medial pterygoid and temporal. For the masseter, the location is the zygomatic bone, the fingers are applied with pressure first on one side with the other hand placed for support and then the other. The practitioner inserted his thumb into patients mouth, pointing it at his cheek, and trying to massage it externally with the other fingers outward. In more severe cases, very important mobilization movements are not performed, these movements are omitted, but if it is not the case, it is positioned on the occipital area with one hand and the mandible is grabbed with the other and the area moves and vibrates. Afterwards, the fingers are applied at the PORION- craniometrical point - level and the patient is invited to open and close the mouth slightly for functionalization.



**Figure 2.** The currency of application of therapy with infrared therapy (images from the clinical case, Clinical Hospital of CFR, IASI)



In the manner literature demonstrates specific organizational, anatomic, and developmental modified structure of TMJ from other joints, degenerative diseases of the TMJ occur from inadequate balance of anabolic and catabolic processes involving chondrocyte initiation and accompanied by enhanced levels of inflammatory mediators. This issue can explain desire and necessity for biomedical research to find an appropriate strategies approach and modern rehabilitation. For associative medication are used antiinflammatory tolerated for each patient and the clinical specificities and indicated by the rheumatologist and collagen substitutes. Oral administration of Kollagen supplements that are based on hydrolyzed collagen vitamins chondroitin sulfate, tested that is a very efficient treatment and is done for 3 months / 21 days during each month./one ampoule per day per month. It can be repeated every year.



**Figure 3.** The chemical structure of collagen  
(<https://www.pianetachimica.it.Collagene,and COLLAGENO unife.it>)

Collagen is important for articular sistem, muscular,skin and not only and is a proteic substance insoluble and is composed of fibers, that regular decrease with age.

It has influence in cell and connective tissue regeneration. There are 28 types of collagen and only type I and II are important for the muscular and cartilaginous system.

Chemically, collagen is made up of a number of amino acids such as glycine, proline hydroxyproline and arginine (Figure 3). Collagen-containing supplements can interfere with the amount of painkillers needed to reduce pain, as collagen plays a role in reducing pain and relieving symptoms of joint stiffness (Figure 4).



**Figure 4.** Associative medication -Kollagen supplements

### 3.Results and discussions

For clinical results appreciation, we used the classification shown in the Table 1:

**Table 1.** Souleroy Scale

Efficiency over spasms	Good	2
	Average	1
	Null	0
Efficiency over muscle tone	Good	2
	Average	1
	Null	0
Lasting effectiveness	> 3 days	2
	1-3 days	1
	< 3 days	0
Side effects	Yes	0
	No	1
Evolution (after several applications)	Improvement	1
	Worsening or without	0
Pain	Total suppression	2
	Partial suppression or	1
	Lack of efficiency	0

For clinical results appreciation after application of infrared radiation therapy (Figure 2) we used the classification shown in the Table 1. So, the results at the level of batch study obtained following the evaluation and secondary to administering therapy procedures (Table 2), were:

**Table 2.** The results of the infrared radiation therapy

Number of patients	Score (0-10 scale)
6 (18. 75%)	8
11(34. 37%)	7
8 (25. 00%)	6
4 (12. 50%)	5
3 (9. 38%)	4

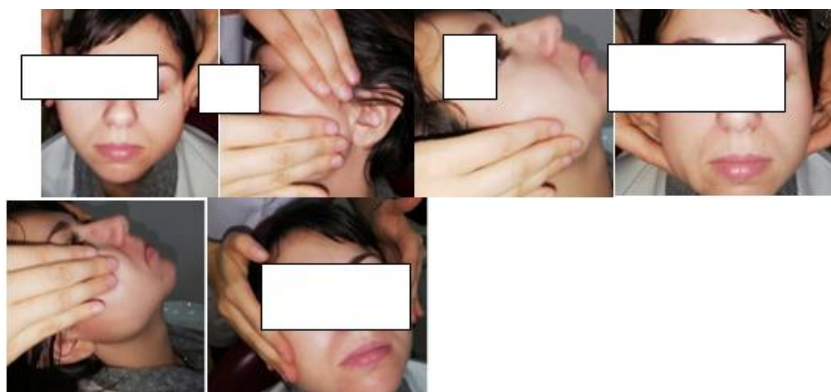
We observed the alleviation of the pain, a good efficiency and balanced the muscular tonus and reducing the spasms, the duration of efficiency is frequently beyond 10-12 days.

The results of the study at the level of the batch, obtained from the evaluation after the implementation procedures with medical massage therapy (Table 3), were as follows:

**Table 3.** The results of the medical massage therapy

Number of patients	Score (0-10 scale)
4 (12. 50%)	8
7 (21. 88%)	7
9 (28. 12%)	6
6 (18. 75%)	5
4 (12. 50%)	4
2 ( 6. 25%)	3

We found that the best score for the assessment was obtained when the method has been associated with other treatment techniques, duration of effectiveness is not more than 5 days, the pain was relieved, which gives patients psychological and physical comfort. We haven't recorded any side effects (Figure 5).



**Figure 5.** The technical modality and the clinical applicability of the maneuvers of medical massage therapy (Images from the clinical case, -CFR Hospital – and Clinical Base of Dental Education Mihail Kogalniceanu, IASI)

For the therapeutic purpose to have effect superficial on skin structures, pressure is reduced. For influencing the subcutaneous tissues, labor is carried out with overlapping hands, increasing the contact force gradually depending on the anatomical structure.

For deep muscle movement strong maneuvers are used, while the lymphatic circulation is stimulated by slow and pressed movement, which will be executed to avoid influencing the arterial circulation.

The massage works by mechanical, reflex and metabolic mechanisms, massage procedures have effects on numerous free nerve terminations from the skin and muscles, which are interconnected with receptors for temperature, pressure and the glands and blood vessels. By direct mechanical actions, and indirect reflex mechanisms, it maintains and improves elasticity and suppleness of constituent elements and fosters mobility of bone-joint and joint-muscular apparatus, develops tone and stamina of these elements, and can combat phenomena of retraction and the contraction and changes affecting the connective tissue.

The beneficial effects of massage on the skeletal muscle occur and are explained by several mechanisms:

- depending on the technique, order of procedures and maneuvers, either an increase in muscle tone and muscle contraction or a relaxation of unwanted contractions or hypercontractions of muscle can be realized (by influencing the muscular and proprioceptors endings, with the adequate response at the periphery);

- by activating the structure's rich vascular muscles of the capillaries, veins, arteries, lymphatic vessels. An increase in blood flow and lymph circulation is achieved, by intensifying metabolic processes, increasing glycogen intake, oxygen and other substances, fostering of catabolism and competing to rebuild the energy of fatigued muscles.

Also, through local action, medical massage has direct vasoactive effect upon its circulatory network. Just like the skin, the good consequence, in this way, is to stimulate local nutritional trade and facilitate/accelerate metabolic elimination of residues.

The new technique applied for TMJ massage was made only to the patients in the study and only to observe the difference compared to the usual methods and an important efficiency was registered due to the new method.

In a plastic way, we can also appreciate, with the help of open-ended questionnaires, the biochemistry changed and at an empathic level. We recorded in the patients studied a low level and score at the beginning of treatment and positive results towards the environment even in an important part of them which means that important reactions can be obtained with the way of thinking and hoping changing favorably direction.

Also the rehabilitation treatment meaning, the esthetics restorations 4(12.50%), retreatments and varios pulpectomy in prosthetical purpose meaning endodontical treatments 43.75% and also prosthetical treatments: fixed 40. 63%, mobile 53. 13% and mixt were restored and want their time



tracking to quantify treatment results. These patients with chronic TMDs usually present associated psychological factors that should be managed with specific interventions [18].

Study patients have also benefited from this associated medication treatment kollagen supplements and antiinflammatory medication and was registered an improvement of the joint mobility objectified by the in a acceptable percentage 14(43.75%). There was an improvement remarqued in stilling pain and a decrease in the frequency of anti-inflammatory use (Table 3) [19-21].

**Table 3.** The results of the Kollagen supplements and antiinflammatory medication

Number of patients	Score (0-10 scale)
2 (6.25%)	9
7 (21.87%)	8
14 (43.75%)	7
5 (15.62%)	6
3 (9.38%)	4

### Clinical Management of TMJ disorders(TMD)

The main issues (other than odontogenic pain) facing the dentist in practice are: intracapsular disorders and masticatory neuromuscular dysfunctions. From a practical standpoint, differentiating the two main categories of dysfunction is essential for establishing the diagnosis, as the therapeutic conduct is different [22].

Muscular activity is also influenced by stress, which may be found among the etiological factors of the muscle dysfunction. It can affect the function of the muscles by increasing the level of the muscle tonus, the appearance of bruxism or the activation of the nervous sympathetic system [23].

It is fundamental that the dentist understand this etiological factor, so that the treatment can be correctly realized but, unfortunately, the dentist does not have enough knowledge and experience in the domain of psychology and psychiatry [24].

Extrapostural malrelations may be of pure functional cause and are due to the changes in tonic antigravific balance from the Brodie's scheme or of morphological cause, inflammatory, traumatic, or tumor causes [25].

Compared to the resulting of the action of the manducatory muscles, affected by the increasing or decreasing of the postural tone, the mandible will be moved outside of the relationship of posture. Depending on the direction of the travel, extrapostural malrelation can be produced by the rotation of the saggital plan (by lifting or lowering the jaw), in horizontal plan (with deviation to the right or left mandible), by anterior or posterior and mixt translating the mandible, reuniting in an unsystematic way any of the above forms [26].

The management of all patients with TMDs aims to: (1) reduce or eliminate pain, (2) restore normal jaw function, (3) reduce the need for future health care, and (4) restore normal lifestyle functioning. Specific interventions and their sequencing parallel treatment of musculoskeletal disorders in general [27]. A key factor of success in chronic pain management is the success in educating the patient about the disorder to enhance adherence to the self-care aspects, including jaw exercises, habit change, and proper use of the jaw [28-31].

Literature shows that presence of oral pathology, can scientifically proven by correlations and complications in the oral bacteria and initiated developments of pneumonia and all all sorts of other complications of respiration that can degenerate, air supply, tissue nutrition, circulation, vascularization and air exchange and moreover increases mortality rate among these patients as in our specific pandemic nowadays. Same risk was mentioned in other studies for some of the patients that experienced swallowing inconvenience and not the confortable overnight mobile prosthesis wearing [32-35].





## 4. Conclusions

Muscle rehabilitation through methods of balneo-physio-kinetotherapy will be done by raising the patient's awareness of changes in the cephalic extremities and at the level of the stomatognathic system, learning some new patterns of movement and their repetition, with mandatory medical supervision at the beginning of the treatment, but also the direct involvement of the patient and their environment, after the therapy methods have been properly learned.

Methods of balneo-physio-kinetotherapy focused by toning or muscle relaxation, reduction in muscle tone, improving functionality of the mandible, optimized functionality of the TMJ pathologies and facilitating biochemical mechanism of vasodilatation and also blood circulation.

In clinical experience this biphasic dose response effect is necessary for optimal clinical results. The results that were obtained from the batch of patient, from very good to satisfactory videliced from total remission of symptoms (muscle pain, limitation of mouth opening, muscle spasm, muscle hypertonia, alteration of mandibular dynamics trajectories), partial remission of symptoms up to no change in the symptoms and also adequate oral rehabilitation of endodontical and prosthetical point of view and all general associated pathology specially respiratory level one and also psychological. Quantification of results was done according to a classification that is easy to apply. It was observed that in the short term the best results were achieved in patients who associated balneo-physio-kinetotherapy, etiological and also symptomatic therapy, in our case the benefits of polytherapy and the positive influence of collagen supplements.

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