

Laser Bioenergetics and Biosynergetics phenomena in prosthodontics

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Abstract

Introduction Electromagnetic energy of laser light has some typical properties which are found to be a premise for discussions on laser irradiation abilities to control the severe and chronic disorders in TMJ. In world literature PDT application is recommended when soft tissues in TMJ are damaged, in cases of degenerative diseases of discus articularis, medial and lateral distensions of joint ligaments, chronic inflammatory processes in TMJ, occlusion trauma, etc

The main goal of our clinical study was to analyse the theoretical achievements up to now in depth and basing on our clinical observations suggest new methods guaranteeing high therapeutic efficacy of Photodynamic therapy. The aim of this clinical study was to build our own original scientific and working hypotheses and to suggest a new approach for treatment of the functional pathology of the masticatory system, that to guarantee a PDT high healing effectiveness for the achievement of a full aesthetic, functional and neurosensory mouth and masticatory system rehabilitation and restoration.

Material and methods We applied the method of building of model of optimum laser stimulation based on models of clinical situations and then classified them into categories. We studied electromyographic activity, energy metabolism and the state of increased activity of masseters, as well as TMD etiology, diagnosis and therapy. Methods for TMJ treatment, approved by us: PDT+TENS , PIFBM, LA and TENS, Bio-synergy method - our original method.

Results and conclusion Laser-assisting treatment of TMJ disorders has a high degree of therapeutic efficacy and can be applied widely in daily dental practice. The approved four methods of LT enable to achieve the following therapeutic effects: rapid affection of pain syndrome (neurogenetic pain, fibromyalgia, trigeminal and migraine pain, myofascial pain syndrome, neck and low back pains), provoked by functional TMJ disorders and treatment of degenerative diseases of discus articularis, medial and lateral extensions of joint ligaments, of acute and chronic inflammatory processes in TMJ, occlusion

trauma, electrogalvanic phenomenon and psychosomatic disorders, achieving a favourable lymphatic drainage, vasodilatative effect, significant reduction of neural sensitivity and muscle cramps and myorelaxation effect.

Keywords: TMJ, PDT, TENS.

Introduction

Prosthetic treatment is a highly responsible process in the Dental medicine because of its main purpose – the achievement of a full aesthetic functional and neurosensory rehabilitation of the masticatory system, where the most important task is to be harmonized and synchronized the interdental contacts, the temporo – mandibular joint (TMJ) elements, the muscle activity and the mandibular movement, without to be damaged the periodontal and the bone structures and to be saved the health and the integrity of the soft tissues, which have contact with the prosthetic appliances. This task can be solved with the help of the laser photodynamic therapy (PDT) in one or another degree, in dependence from the degree of the achieved PDT biostimulating effect.

Contemporary tendencies in the scientific and the experimental work about the laser biostimulation effectiveness provoked by PDT, are in the field of the bioenergetics achievement not only in the target and regions, but also in the transfer of the inserted in the human organism laser light throughout the whole human body. It is well known that the laser light even if applied locally has the opportunity to be transported throughout the human body in different levels. A large number of experimental data has been collected and many authors have discussed the depth of the laser beam penetration in the targeted tissues and about its transmission, which is essential for the determining of the PDT dose. [1-18] The newest tendencies of this development are targeted to the clinical application of the Bioenergetics and

Biosynergetic phenomenon of the laser radiation over the whole human organism at all levels of its biological organization. The base for the new paradigm development are the following mostly important up to this moment theories – The Biosynergetics theory of Aging, proposed by – Prigogine about energy donated PDT to the biological phenomena, [13,14]; the Cable Hypothesis, as well as the theories of Grotthuss Mechanism, [4,11]; and Soliton Mechanism, [2,3,18]; which are referred to the autooscillating energetic and wave processes in the human organism, the receptor regulation of the cellular mitochondria and the phenomenon of energy accumulation in dissipative systems in the human body, and also energy emission from different organs.

An important advantage of this new approach is the resonance photoacoustic effect of the laser radiation over the bioenergetic organ structures, which main effect is the provoking of the corresponding biological response. Still, however, the mechanisms of the laser beam organ and system interactions are not sufficiently researched in order to be determined the exact dosage in each clinical case and the patient's risk. The biochemical mechanisms, that lie in the base of the positive effects of the laser radiation are not completely cleared and understood, which is a reason for the complexity of the exact choice of the physical parameters of the different laser systems. The classification and the specification of the sources of the healing light in wide spectrum is systematized (Various sources of radiation technical classification and specification) . [1] The Golden standards are being suggested under the form of therapeutic protocols. They are only a direction for an incipient approach in the laser therapy. It is known, that the human body has an individual optic characteristics and because of that the search is targeted to

improvement and unification of the standards, not to discussions of doses and their complex calculation. Until recently the Golden standards for the dosing of the laser Energy for PDT where categorical – optimal dose =4J/cm² for intraoral application in CW mode, 8J/cm² for the TMG dysfunctions treatment and 0,1J/cm² for laser acupuncture therapy. These standards where build from the Sweden school of Jan Tuner and Lars Hode, as well as from the Norway Laser Academy from Marita Luomanen. [1,6,7,9,10,15,17] . Tiina Karu revised these values and pointed that these doses are not sufficient enough for achievement of an effective biostimulation and recommended they to be raised. [1,6, 7, 17].

Many of the achieved experimental and clinical results are already published and discussed in our earlier publications. [19, 20, 21]. In the recent work we will pay special attention to the choice as the most correct approach in the laser therapy.

Goal and tasks

The aim of this clinical study was to build our own original scientific and working hypotheses and to suggest a new approach for treatment of the functional pathology of the masticatory system, that to guarantee a PDT high healing effectiveness for the achievement of a full aesthetic, functional and neurosensory mouth and masticatory system rehabilitation and restoration.

For this goal we build the following tasks:

1. To build our own working hypothesis about the mechanisms of laser radiation interaction effect over the human organism accordingly to its individual optical and bioenergetics characteristics, based on established theories and paradigms.
2. To create our own method of frequency – resonance laser therapy that to be used for prophylactics and

treatment of the functional pathology of the masticatory system.

3. One of our main tasks was to build a new method for combining and synergetic action of the Bioenergetic phenomenon of several laser sources with different wavelengths for provoking of a specific biological response.
4. To be created fundamental clinical and practical situation for building of frequency - therapy standards system, based on the Curriculum guidelines for Laser Education, ALD, USA in consideration with the conditions in our country. [15]

Materials and Methods

For a period of 6 years we have been working for 2 scientific projects on the PDT application in Prosthodontics. We examined and treated 1500 patients (757[50,4%] female and 743[49,6%] male in average age of 47 years) suffering from functional pathology disorders of the masticatory system. The patients were divided into 5 groups accordingly to the specific pathological functional disorders. The patients in each group were further distributed into two - working and control groups. The main clinical criteria for all groups were the occlusal trauma in its different manifestations. In each group of patients were included approximately 300 people (at round 150 for the working group and 150 – for the control group with the same diagnosis). The patients in all working groups (750 people [50,0% of all patients] – 385 female [25,7%] and 365 [24,3%] male) were treated with resonance LT using our original new approach. The patients from the control group (750 people [50,0 %] - 372 [24,8%] female and 378[25,2%] male) were treated with the classical healing methods, without the usage of laser radiation.

The patients groups distribution according to two clinical signs – the type of manifested pathology in working and control groups and according to their sex is presented in Table.1

Table 1: Distribution of the examined and treated patients in groups according their pathology and sex.

METHOD	LELT = TENS		PIBPM		LASER BIOSYNERGETH CS		CTP	
	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE
WORKING GROUP	37	36	41	42	37	40	38	39
CONTROL GROUP	38	39	34	33	38	35	37	36
PATIENT'S NUMBER	75	75	75	75	75	75	75	75
TOTAL	150		150		150		150	

In group 1 are included approximately 300 randomly gathered patients (149 female [9.93% for all 1500 people] and 151 male [10,07% from all 1500 people]), who were distributed in two groups of about 150 people [10% of all 1500 people] each. These patients were diagnosed and treated for occlusal trauma, clinically manifested with perio damage in a moderate degree and presence of periapical bone lesions. For the second group the main clinical sign was occlusal trauma with manifested horizontal, vertical and combined bone resorbtion and alveolar ridge atrophy. As seen from Tabl.1 in these group were classified 154 female [10, 26% from all 1500 people] from all two subgroups – working and control and 146 male [10, 74% from all 1500 people]. In Group 3 were included patients with diagnose occlusal trauma combined with myofascial pain, migraine type of headache, and reflected neck and back pain. From them 146 female [10,74% from all 1500 people] and 154 male [10,26% from all 1500 people]. The patients distribution in group 4 was conducted according to the clinical sign of OT and consequent trigeminal nerve neuralgia. In this group

were included 156 female [10,4% from all 1500 people] all together for the two subgroups working and control and 144 male [9,6% from all 1500 people]. In Group 5 were placed patients with manifested OT combined with TMJ disorders. It was consisted from approximately 300 people for the two subgroups – working and control, and similarly to the other groups – 152 female [10,13% from all 1500 people] and 148 male [9,87% from all 1500 people].

For an greater accuracy in the determination of the doses for optimal laser stimulation the patients from the working groups - 75 души [(50, 0 %) from the whole number] were divided in 2 groups according to characteristic clinical symptoms – the first group consisted patients with manifested acute inflammatory reactions and the other one with chronic disorders. The patient’s complaints distribution is represented on Fig.1 and Fig.2

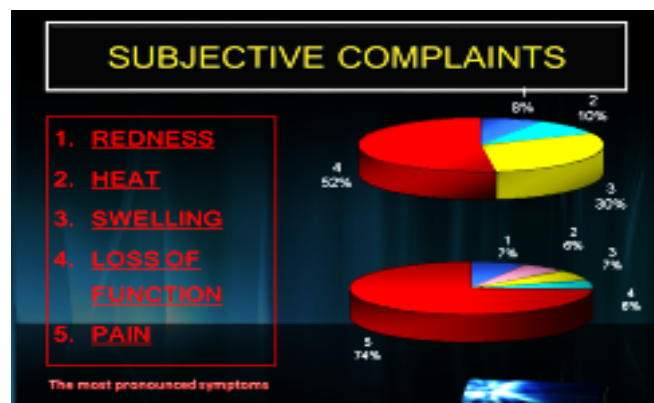


Figure 1

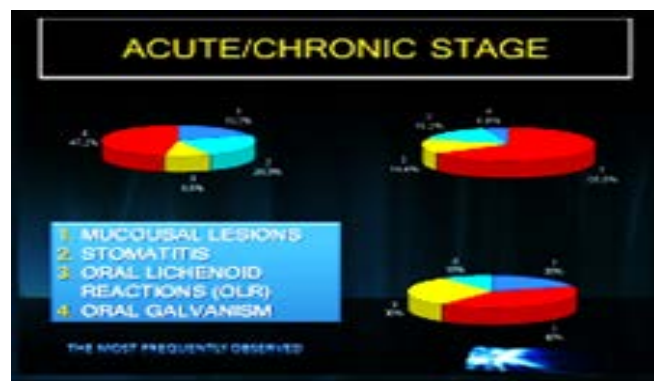


Figure 2

The first task that we solved was the creation of a working hypothesis for the bioenergetics transformation and the biosynergetics effects of the laser radiation over the whole organism.

We built our original hypothesis experimentally. During the 6 years we created several our original experimental models of the situation of the oral cavity and investigated the influence of the intrinsic and extrinsic factors, as well as the electrochemical processes, which might influence the direction of distribution and transmittion of the laser beam – electrolytic model , model for measurements of the magnetic induction and homogenometry and also a model for investigation of the transmembrane transport which we have described in details in our previous publications. [18,19,20]

The second task was solved by the construction of a model for achievement of optimal laser stimulation. Our approach was individual for each of the laser treated 750 patients [50, 0 % from all number] and the optimal treatment dose was determined in several stages byophysiological, therapeutic, functionally – diagnostic and etiologic model until the most appropriate model for optimal laser stimulation is built. The investigated process included biosynergetics estimation of three types of laser systems with different laser light sources , as follows : LLLT diode system a - Six Touch Screen, (Atlantis, Plovdiv, BG) - Red probe ($\lambda= 680 \text{ nm}$, output power - 30mW, in CW mode of emission , coherent light), IR probe ($\lambda= 904\text{nm}$, 18W per pulse, in pulse mode up to 4000Hz, coherent light), multidiode magnetic cluster probe ,($\lambda=904 \text{ nm}$ IR coherent light \, output power - 18W, noncoherent light sources – 3 LED - $\lambda= 830\text{nm}$, 3 LED - $\lambda= 740 \text{ nm}$). High power diode laser system – Six Lancet (Atlantis, Plovdiv, BG) - $\lambda=980\text{nm}$, output power - 7W. High

power Er:Cr/ YSGG - Biolase, USA and output power - 6W.

The greatest attention in our scientific works was paid to the photoinfrared photobiomodulation with LLLT diode Ga-As 904nm Six Touch Screen, (Atlantis, Plovdiv, BG).

On the Fig.3 and Fig.4 are shown pictures of the used laser devices, arranged by the way of their combined usage for achievement of bioenergetics stimulation and biosynergetics effect.



Fig.3 Low power and high power Diode laser devices - Six Touch Screen and Six Lancet (Atlantis, Plovdiv, BG)



Fig.4 Biosynergetics complex Biolase Laser Machine, Six Touch Screen (Atlantis, Plovdiv, BG)

All the 750 people [50,0 % from the whole number] from the five working groups were treated as follows: extraoral laser magnet therapy – magnet ring 50H, optimal dose $O\Delta = 8,5 \text{ J/cm}^2$ – sedation of the biosynergetics effect of the coherent red laser light in

combination with 3 IR non - coherent diode light sources. The radiation was directed from right to left following the Wolkevitz lines or the Fall's fields. The next stage was a neuromuscular relaxation of the masticatory muscles by applying TENS – trigger electric acupuncture with frequency of - 60Hz. [20]

Before the main prosthetic treatment we performed a laser assisted prophylaxis of the soft tissues with two main purposes: pain management and minimal bleeding during the process of abutments preparation or preprosthetic treatment. For the purpose of the preprosthetic treatment we used 3 types of laser systems – high power laser acupuncture for micro invasive painless and wound free and bloodless procedures oral hygiene prophylaxy Er:Cr/ YSGG, Biolase Whitening, USA: treatment of caries lesions , endotreatment of abutments which are with periapical lesions , laser assisted perio management (in accordance with the Golden standard - LANAP), laser surgical gingival correction , esthetical shaping of the gingival line, frenectomies, no flap crown lengthening, alveolar ridges correction and others. [1,15]

The third task was solved by the following approach – leading sign for solving this main task was the newest paradigm of the modern biosynergetics – application of different laser light sources with different wavelengths so that the common treatment effect to be achieved by their combined usage. On the all 750 patients from the five working groups we applied a combined LT, using low power and high power diode laser systems in biosynergetics effect according to our own clinical approach for intraoral sedation red laser light in CW mode for 7 ' along one of the jaws and laser IR tonification with 40 Hz - 3' per jaw – total dose – red sedation by scanning method for

14' for the both jaws – optimal dose =3,5 - 5J/cm² and IR notification – OД = 2-4 J/cm².

Two months after the described procedures we applied vibration photoinfrared photobiomodulation in two stages – 20,40,400 and 900Hz, 7' for a jaw with scanning movements for each of them always from right to left, for the maxilla, and after that in the same order for the mandible with an optimal dose = 3,5 – 7,5J/cm². For the next four days we applied vibration photoinfrared photobiomodulation on acupuncture method. For each patient we prepared an individual recipe for combined of different types of acupuncture points – the acupuncture of the far body points we made with 20Hz,20" in each point – optimal dose = 0,8 - 1,0J/cm². The face acupuncture points were treated with 40Hz, 40" each. We examined the healing effectiveness of the following wavelengths – 680, 780, 830, 904 and 980 nm.[19, 20]

Our clinical observations were randomized and systematized in an exact order and this gave as the opportunity to solve the forth task according following sings: changes of the functional indicators dynamics, produced by the resonance effects of stimulation of the electromagnetic waves on the human body; we also investigated the healing effect of the different frequencies of the laser radiation in the visible spectrum and the near IR light over the main powerful subjective symptoms of OT – pain, dysfunction, myalgia , neuralgia and periodontal damage.[18,19,20]

We registered the corresponding biological response of the separated working patients groups with manifested characteristic symptomatic by instrumental analysis and we evaluated it in accordance of the necessity of medication treatment, immunosuppressive and local treatment – anti-inflammatory, antimicrobial, poly – vitamins therapy and others. We performed scientific

researches over the effectiveness of the laser radiation in accordance to the biological biochemical indicators before, during and after the treatment, which allowed us to do a diagnostic prognosis for the direction of the healing biostimulative processes in accordance of two clinical signs – early and late evaluation of the healing effect of the laser light in the different regions of the light spectrum. [19]

Results and discussion

Based on the Skulachev W., Prigogine I., Pogodin S. i Sovage S., we had the knowledge and the experience, necessary for the construction of a model for an optimal laser stimulation for treatment of functional pathology of the masticatory system. [12,13,14,16, 18, 19, 20] The new in our paradigm is the application of the combined laser therapy for rehabilitation of the maxillo – facial region in terms of the reflex processes and the harmonic function between the masticatory system, the temporo – mandibular joint elements, the muscle activity and the neuro – sensory regulation of the movements of the mandible during their function, as well as for prophylactics and threatment of the occlusal trauma and the trauma, resulting from parafunctions. [19,20] With the use of the photoinfrared resonance influence of the laser light the reparative processes and the lymph circulation are being accelerated and autooscilating processes in the brain and the other human organs are being modulated. While Tiina Karu accepts, that the most – important mechanism of the healing effect of the laser radiation is the cascade energy transformation in the oxidation – reduction system and the increase of the energy content in the mitochondria, we accept, that the high effectiveness of the laser therapy can be achieved only if a cascade energy transformation of the laser beam over the whole body is produced.

The received results are giving us ground to point the combinative laser therapy, which includes resonance and informational PDT as a highly effective approach, which provokes a fast and an adequate clinical response and is distinguished with a durable healing effect. For the upper mentioned 6 years we achieved in all of the patients in the five working groups a full rehabilitation of the masticatory system, a harmonization of the occlusal relationships between the teeth rows of both of the jaws and a synchronization of the function of the elements of the TMJ. [18,19,20] After only 4 procedure we observed complete healing, successful epithelisation after the laser preprosthetic surgical treatment and attenuation of the powerful subjective symptoms in all of the 750 patients. The randomized clinical studies showed, that up to the fifth year after the treatment are not observed recedives or secondary damage. [19,20, 21]

The results showed that if we apply only intraoral methods of radiation during the PDT we cannot perform the maximal photobiostimulation. Only with the combined laser therapy with different light sources, and by combining the effect of multiple light sources with a coherent and a non – coherent radiation, and with the usage of the synergetic application of a suitable resonance regime, we can achieve a high efficiency for short time with long lasting effect.

On figures 5, 6 and 7 are presented the therapeutic protocols for PDT of the gingiva and the periodontium of the teeth during a full prosthetic and aesthetic rehabilitation of the masticatory system.



Fig.5: Treatment protocols for gingivitis and occlusal trauma caused TMD



Fig.6 Treatment protocols for early periodontitis and occlusal trauma caused TMD



Fig.7: Treatment protocols for severe periodontitis and occlusal trauma caused TMD

On the schemes are shown the methods of radiation – scanning, in points, garland – shaped, as well as the regions of application of the laser beam. In the tables are represented some of the most – important recommended physical parameters of the laser radiation, such as output power (P)[mW]), regime of radiation and the fluence [J/cm²], which we accepted as an optimal dose. As seen from the figures above the recommended from us doses are a bit higher than the Golden standard, but are very well tolerated by the patients. We support the position given from Tiina Karu and accept, that the optimal dose for PDT in the prosthodontics must be higher than the golden standard (optimal dose = 2-4[J/cm²]) or optimal dose at around 3,5 -8,5 J/cm² for intraoral therapy along

the two jaws – scanning radiation or garland – shaped, radiating the gingival from right to left and optimal dose = 8,5 -12,5 J/cm² for the treatment of the TMJ. As the most appropriate dose for the PDT of the muscles in cases of muscle pain and contractures with a light from the visual red spectrum, we can recommend the optimal dose of 4-6 J/cm². If for the purposes of the prosthodontics is necessary to be achieved muscle relaxation, the optimal dose for the near infrared laser light can be increased to 7,5 J/cm².

Conclusions

1. Our working hypothesis for the application of the laser light in the prosthodontics postulate that the laser beams by the mechanism of ion transformation through the biomembranes transfer the energy in the masticatory muscles, which decreases their muscle activity and consequently the masticatory pressure. These processes of biostimulation and muscle relaxation are favorable for the periodontal complex and the bone structure of the jaws and help for the harmonization and the synchronization of the elements of the TMJ.
2. The resonance and the informational PDT produces a fast and an adequate clinical response and is being distinguished with a very high treatment effectiveness. We recommend a new approach for application of the Biological medicine as a modern branch of the prosthodontics at several levels: PDT – red / infrared laser biostimulation – optimal dose = 4-6 J/cm², photo dynamic intraoral laser therapy – optimal dose = 3,5 -8,5 J/cm², infrared PDT – resonance photo bio modulation – optimal dose = 8,5 -12,5 J/cm², red / infrared laser acupuncture up to 1 J/cm² – laser bioenergetics.
3. The combinative PDT in bioenergetic and biosynergetic aspect is the most effective, fast and successful method up to this moment, that we recommend for application in the prosthodontics for

treatment of the occlusal trauma and the functional pathology of the masticatory system.

Further publications will follow, which will import more clarity and will reveal the new biosynergetic approach in all aspects of its application.

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