

## BIMEO – sistem za dvoročno in enoročno vadbo z zgornjimi udi

Izr. prof. dr. **Matjaž Mihelj**, univ. dipl. inž. el.<sup>1</sup>, **Matic Trlep**, univ. dipl. inž. el.<sup>1</sup>, dr. **Aleš Hribar**, univ. dipl. inž. el.<sup>1</sup>, doc. dr. **Urška Puh**, dipl. fiziot.<sup>2</sup>, prof. dr. **Marko Munih**, univ. dipl. inž. el.<sup>1</sup>

<sup>1</sup>Fakulteta za elektrotehniko in <sup>2</sup>Zdravstvena fakulteta, Univerza v Ljubljani, Slovenija

**Korespondenca/Correspondence:** Matjaž Mihelj; e-pošta: matjaz.mihelj@robo.fe.uni-lj.si

**Uvod:** Največji vpliv na okrevanje gibanja ima vadba v prvih šestih mesecih po okvari živčno-mišičnega sistema (1). Pacienti so ob odpustu iz bolnišnične oskrbe pogosto motivirani, da bi vadbo nadaljevali tudi v domačem okolju (2). BiMeo rehabilitacijski inštrument je namenjen pacientom pri rehabilitaciji zgornjih udov v kliničnem in domačem okolju. Pacienti lahko samostojno, s pomočjo zdravega uda, izvajajo vadbo z okvarjenim oziroma poškodovanim udom. Namen: Pogosti težavi v rehabilitaciji sta dostopnost terapevtov in pomanjkanje objektivnih meritev. Prva težava je povezana z omejenim časom, ki ga ima terapevt na voljo, s čimer je povezana omejena dolžina intenzivne vadbe posameznega pacienta. Druga težava je pomanjkanje merilnih orodij in postopkov za objektivno merjenje, ki so ključnega pomena za spremljanje stanja in napredka pacientov ter prilagoditev vadbe potrebam posameznika. S sistemom BiMeo želimo odgovoriti na obe težavi. **Metode:** BiMeo je pasivna naprava, ki vsebuje le senzorje gibanja in sile, zato je povsem varna za uporabo. Za izvedbo gibanja se izkoriščajo preostale motorične sposobnosti uporabnika – pacienta. Neokvarjeni ud lahko pomaga pri gibanju okvarjenega uda, pri čemer se prispevek neokvarjenega uda meri in vrednoti. Vsi zajeti podatki iz senzorjev, nameščenih na uporabniku, se brezžično prenašajo na osebni računalnik. Uporabnik je v interakciji z navideznim okoljem, v katerem igra računalniške igre, ki so prirejene vadbi v rehabilitaciji. S prilagajanjem scenarija računalniških iger se maksimira aktivacija bolj okvarjenega uda. S sistemom BiMeo je bila opravljena študija uporabnosti na Univerzitetnem rehabilitacijskem inštitutu RS – Soča, kjer je 25 pacientov z različnimi okvarami živčno-mišičnega sistema enkrat na teden izvajalo vadbo. Pacienti so vadbo izvajali poleg standardne rehabilitacije. Vsak pacient je opravil dve različni nalogi, od katerih je vsaka trajala deset minut. Najprej je pacient z bolj prizadeto roko izvajal enoročno (razbremenitveno) vadbo na mizi. Po nekajminutnem premoru je opravil še dvoročno vadbo v vertikalni ravnini. **Rezultati:** Na podlagi zajetih podatkov o gibanju (koti, sile, hitrosti in pospeški) smo določili različne parametre, iz katerih je bil izračunan indeks uspešnosti gibanja ( $I$ ). Indeks objektivno vrednoti uspešnost izvedbe celotne naloge. Pri zdravih osebah je povprečni indeks  $I \cong 6$ . Pri pacientih so bile izmerjene vrednosti v razponu od 1,8 do 6,5. Rezultati povsem sovpadajo s stopnjo motorične okvare posameznih pacientov. **Zaključki:** Vsi pacienti so uspešno izvedli tako enoročne kot dvoročne naloge. Če je bilo treba, so si pri gibanju pomagali z roko manj okvarjenega uda. Sistem se je izkazal kot primeren za vadbo pacientov z različnimi patologijami in stopnjami motoričnih okvar. Indeks uspešnosti gibanja objektivno ovrednoti pacientove motorične sposobnosti in podaja kvalitativno oceno stanja pacienta.

**Ključne besede:** zgornje ekstremitete, indeks uspešnosti gibanja, objektivne meritve, dvoročna vadba.

## BIMEO – a system for bimanual and unimanual training of upper extremities

**Background:** Recovery of the neuromuscular system is the fastest in the first six months after injury (1). Patients are often motivated to continue their training at home, after being discharged from hospital care (2). Rehabilitation instrument BiMeo is designed for training of upper extremities in clinics and at patients' homes. Patients alone can perform rehabilitation tasks of their impaired or injured limb with the help of their healthy limb. Purpose: Common problems of motor rehabilitation are accessibility of therapists and the lack of objective measurements. The first problem is a consequence of a therapist's limited time, which affects the duration of intense training of individual patients. There is also a lack of tools and methods for objective measurements that are essential for monitoring patient's condition and progress, and adapting training to their individual needs. With the BiMeo system we want to address both of these problems. **Methods:** BiMeo is a passive device consisting only of movement and force sensors, and it is therefore entirely safe to use. In order to promote movement, the system exploits the preserved patient's motor functions. The less impaired limb can assist the movements of the more impaired limb, while its contribution is measured and evaluated. All collected data from the sensors attached to the user are wirelessly transmitted to a computer. The user interacts with a virtual environment in which he plays games adapted to rehabilitation training. Activation of the impaired limb is maximized by adaptation of the training game scenario. A preclinical study has been carried out at the University Rehabilitation Institute, Republic of Slovenia. The study included 25 patients with different impairments of the neuromuscular system. Training with BiMeo was performed alongside the patients' standard rehabilitation. Every patient executed two different 10 minute-long tasks. First, a unimanual task on a table was performed. After a short break the training continued with a bimanual task in a vertical plane. **Results:** From the collected movement data (angles, forces, velocities and accelerations) we defined different parameters from which a movement performance index ( $I$ ) has been computed. This index objectively assesses the performance of the whole task. For healthy subjects the average index is  $I \cong 6$ . The patients had the index  $I$  in the range from 1.8 to 6.5. The results fully coincide with the level of patients' motor disabilities. **Conclusions:** All patients could successfully execute both unimanual and bimanual tasks. If it was necessary the less impaired arm assisted during the movement. The BiMeo system has proven to be suitable for training of patients with different pathologies and levels of motor disabilities. The movement performance index objectively assesses the patients' motor abilities and gives a qualitative assessment of patients' states.

**Keywords:** upper extremities, movement performance index, objective measurements, bimanual training.

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## Uporaba metode Brain gym® v fizioterapiji

**Marjeta Krejči Hrastar**, viš. fiziot.

Rehabilitacijski center Hrastar, Ljubljana, Slovenija

**Korespondenca/Correspondence:** fiziorch@gmail.com

**Uvod:** Metoda Brain gym® je program pedagoške kineziologije. Njena utemeljiteljica sta dr. Paul in Gail Dennison, ki sta v 80. letih s skupino sodelavcev preučevala odnos med gibanjem in zaznavanjem ter učinek gibanja na področja človekovega delovanja. Program s 26 enostavnimi vajami omogoča doseganje integriranega delovanja možganov in telesa v okviru treh dimenzij telesnega gibanja (1, 2). Metoda Brain gym® omogoča, da z opazovanjem posameznikovega gibanja razumemo delovanje njegovih možganov. To je skladno s hipotezo, da ciljno gibanje spodbuja nastanek novih živčnih povezav (2, 3). Metoda Brain gym® bi lahko dopolnjevala standardne fizioterapevtske postopke, saj omogoča oceno koordinacije gibanja posameznega pacienta, razširi nabor vaj in pripomore k določanju ciljev fizioterapije (2, 3). Namen raziskave je bil ugotoviti, ali je uporaba metode Brain gym® smiselna tudi v standardni fizioterapiji. **Metode:** Pogovor s pacienti, pri katerih je bila uporabljena metoda Brain gym®. Zaradi specifičnosti metode rezultatov nismo merili s standardnimi testi. **Rezultati:** Metoda Brain gym® je bila uporabljena pri 325 pacientih, od tega 33,9 % moških (od 15 do 91 let; povprečno 53,1 leta) in 66,1 % žensk (od 13 do 87 let; povprečno 58,6 leta) z različnimi patologijami (starostna degeneracija sklepov, vrtoglavica, poškodbe, kronične bolečine, pooperativna fizioterapija), in sicer poleg standardne kinezioterapije. Trajanje obravnav z Brain gym® je variiralo od 2 do 6 tednov, od 2- do 5-krat na teden, posamezna obravnava pa je trajala 30 minut. Večina pacientov (92 %) je poročala o občutnem izboljšanju stanja težave, zaradi katere so obiskovali terapijo. Razlika je bila še posebno izrazita na področju funkcionalnih in mentalnih dejavnosti. **Zaključki:** Metoda Brain gym® se je izkazala kot zelo primerna za uporabo v fizioterapiji, in sicer za celostno obravnavo pacientov vseh navedenih starostnih skupin. Kaže, da poleg izboljšanja gibalnih sposobnosti pripomore tudi k izboljšanju mentalnih sposobnosti, vendar bi bilo treba za potrditev teh učinkov narediti raziskave visoke kakovosti.

**Ključne besede:** Brain gym®, telovadba za možgane, ravnotežje.

## Use of Brain gym® in physiotherapy

**Background:** The Brain Gym® method is a program of educational kinesiology. Its founders are Paul Dennison, Ph.D. and Gail Dennison. In the 1980s they, together with a team of colleagues, researched the relations between movement and perception and the movement's effect on fine motor, mental and communication skills. They dedicated three decades to extensive research into the fields of learning and psychology as well as neural and muscular functioning. To integrate the functioning of the brain and the body within the three dimensions of movement the unique program offers 26 simple activities (1, 2). The Brain Gym® method enables us to understand the functioning of one's brain by simply observing the person's movement. This model of educational kinesiology supports the hypothesis congruent with the latest discoveries of neuroscience. They suggest that intentional movement is essential for the formation of new neural connections (2, 3). This simple fact based on the functioning of the brain can be an excellent complementary method in physical therapy. It enables us to get to know each patient's condition faster than usually; it widens our set of possible exercises and is incredibly effective in setting and achieving the goals of the rehabilitation process (2, 3). **Purpose:** Applying the Brain Gym® methods and principles to patient treatment at the physical therapy clinic. To determine the applicability of the Brain Gym® approach in classic physical therapy. **Methods:** Examination of published materials, discussions with patients with whom the Brain Gym® approach has been used. **Results:** In addition to the standard kinesiotherapy, the Brain Gym® method has been used with 325 patients of which 33,9% were men (from 15 to 91 years; average 53,1 years) and 66,1% women (from 13 to 87 years; average 58,6 years) with diverse pathologies (old age degenerative joint disease, vertigo, injuries, chronic pain, postoperative physical therapy etc.). Patients have attended Brain Gym® sessions 2-5 times a week, over the period of 2-6 weeks. Each session lasted 30 minutes. The majority of the patients (92%) reported of considerable improvements as the problems that made them undergo the therapy diminished. The improvements have been most notable in areas of functional and mental activities. **Conclusion:** In terms of holistic treatments of patients of all age groups the Brain Gym® method proved to be a valuable addition to physical therapy. It seems that, in addition to better movement skills, the method contributes to improved mental abilities. Yet, to support these effects, further high quality research should be conducted.

**Keywords:** Brain gym, action balance.

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## Aktivnosti in terapija s pomočjo psov: uporaba v fizioterapiji

Tjaša Knific, dipl. fiziot.<sup>1</sup>, pred. Mojca Divjak, viš. fiziot., univ. dipl. org.<sup>2</sup>

<sup>1</sup>Inštitut za varovanje zdravja Republike Slovenije, Center za krepitev zdravja in obvladovanje kroničnih bolezni, Ljubljana, Slovenija; <sup>2</sup>Zdravstvena fakulteta, Univerza v Ljubljani, Slovenija

**Korespondenca/Correspondence:** Tjaša Knific; e-pošta: tjasa.knific@ivz-rs.si

**Uvod:** Aktivnosti in terapijo s pomočjo psov (ATP) vključujemo v obravnavo bolnikov z motoričnimi, senzoričnimi ali senzomotoričnimi motnjami. Prizadeti osebi tako omogočamo fizično, socialno, kognitivno in tudi emocionalno sprostitev oziroma napredovanje (2). Ločimo aktivnost in terapijo s pomočjo psov, ki se razlikujeta v načrtnosti, zahtevnosti in globini vplivanja (2). Aktivnosti s pomočjo psov (AP) dajejo možnost za motivacijske, izobraževalne, sprostitvene in terapevtske koristi, ki izboljšujejo kakovost življenja. Enake aktivnosti lahko ponavljamo z različnimi uporabniki oziroma skupinami. V tem programu ni točno določenega cilja. Gre za obliko druženja s psom (2). Terapija s pomočjo psov (TP) pa je ciljno usmerjeno posredovanje, pri katerem so psi, ki ustrezajo določenim kriterijem, pomemben del terapevtskega procesa. Program je skrbno načrtovan in zastavljen po korakih za doseg terapevtskega cilja. Terapevtski proces mora biti v celoti ovrednoten in dokumentiran, imeti mora merljive cilje (3). Namen prispevka je predstaviti primer ATP v fizioterapiji, prikazati način uporabe ter vrste in učinke terapije s psi. **Metode:** V okviru prispevka o izvajanju ATP so predstavljeni pogoji, ki jih je treba zadovoljevati, če želimo uspešno izvajati program. Pred izvedbo programa ATP so potrebne priprave, ki vključujejo pripravo terapevtskega psa, vodnika, interdisciplinarnih članov tima in ciljne skupine. Če želimo sestaviti dober program TP, je treba dobro oceniti pacientove težave, ovrednotiti njegovo stanje in upoštevati dogovorjene cilje fizioterapije. Fizioterapevt, ki se je odločil za uporabo TP, naj bi imel poglobljeno znanje o tem, kako, zakaj in kdaj uporabiti terapevtski par pri obravnavi posameznika. Pri izvajanju TP je zato potreben začetni pogovor z vodnikom psa in bolnikom, pri čemer se določijo cilji terapije. Pri tem se upoštevajo bolnikove želje, njegove trenutne sposobnosti, kontrolne točke in načini evalvacije terapije, ki pa morajo biti kompatibilni z dogovorjenimi cilji fizioterapije. Ko so zbrane vse potrebne informacije, se pripravi načrt o poteku srečanj, načrt obravnave, izberejo se namenske aktivnosti, opredelijo se kratkoročni in dolgoročni cilji. Terapija s pomočjo psa naj bi potekala v času fizioterapevtske obravnave posameznega pacienta. Najpogosteje se pes pri terapiji uporablja kot spremljevalec pri hoji prizadete osebe ali za trening ravnotežja in vertikalizacije najzahtevnejših bolnikov. **Zaključki:** Zaradi pomanjkanja randomiziranih kontrolnih študij o učinkovitosti ATP pri večji populaciji različnih pacientov o učinkovitosti ATP še ne moremo govoriti. Dejstvo je, da se svetovni trendi uporabe ATP uveljavljajo tudi v Sloveniji. ATP je dobrodošla dopolnitev kompetentne fizioterapevtske obravnave in rehabilitacije pacienta, saj povečuje bolnikovo motivacijo za delo. Pes je medij med bolnikom in terapevtom ter tako olajša delo rehabilitacijskemu timu, saj bolniki tako hitreje pridobijo zaupanje v terapevta. Prihodnji interes terapevtskih timov bi moral biti usmerjen v izvedbo več kontrolnih kliničnih študij o vplivu in učinkih TP.

**Ključne besede:** aktivnosti in terapija z živalmi, terapija s psi, pasji terapevti, integralna fizioterapija, rehabilitacija s pomočjo psov.

## Dog assisted activity and treatment: use in physiotherapy

**Background:** Dog-assisted activities and therapy are included in the treatment of patients with motoric, sensoric or intellectual sensomotoric disorders and enable physical, social, cognitive and emotional release and progress to disabled persons (2). We distinguish between activity and therapy with dogs, which vary in planning, complexity and extent of influence (2). Dog assisted activity give us an opportunity for motivational, educational, relaxing and therapeutic benefits that improve quality of life. The same activity can be repeated with different users or groups. It is a form of socializing with dogs. This program is not objectively well-defined (2). Therapy in which we use dogs is a targeted intervention in which we use dogs who meet specific criteria. They are an important part of the therapeutic process. The program is carefully designed and set-by-step to achieve a therapeutic goal. Therapeutic process must be fully evaluated and documented with measurable objectives. The purpose of the contribution was to present dog-assisted activities and therapy in physiotherapy, to show how to use this type of therapy in practice and to show the types and effects of dog therapy. **Methods:** In the framework of the presentation of dog-assisted activities and therapy in physiotherapy, the required conditions, which are necessary for successful program implementation, are presented. Certain preparations, such as the preparation of the therapeutic dog, guider, interdisciplinary team members and patients, are necessary prior to the implementation of dog-assisted activity and therapy program. In order to create a successful dog-assisted therapy program, it is crucial to assess patients problems, evaluate his condition and compliance with agreed physiotherapy program. The physiotherapist, who has decided to use the TP should have in-depth knowledge of how, why and when to use a therapeutic pair in the treatment of a patient. In the implementation of TP that requires an initial conversation with a dog guider and patients, where pledge goals of therapy, the patient's wishes, his current ability, control points and methods of evaluation are pointed. All this must be compatible with the agreed goals of physiotherapy program. When all the necessary information have been collected, we have to prepare a plan of progress meetings, treatment plan, choose the dedicated activities and identify short-term and long-term goals. Dog-assisted therapy should take place during physiotherapy, which is assigned to each patient. The most commonly used therapy with a dog is a walking therapy or balance training and verticalisation of complex patients. **Conclusions:** The lack of randomized controlled studies on the effectiveness of ATP to a larger population of different patients can not speak truly about effectiveness of ATP. The fact is that the global trends in ATP have also been introduced in Slovenia. ATP is a great addition to a competent physiotherapy treatment and rehabilitation of the patient, as it increases the patient's motivation. A dog is a medium between a patient and a therapist in order to facilitate the work of the health team, because patients in this way quickly gain confidence in the therapist. Future interest in the therapeutic team should be focused on the performance of several controlled clinical studies on the effectiveness of TP.

**Keywords:** animal-assisted activities and therapy, dog therapy, integral physiotherapy, rehabilitation with dogs.

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## Koristi terapevtskega potapljanja v moderni hidroterapiji

**Branko Ravnak**, inštruktor potapljanja CMAS M2<sup>1,2</sup>, **Alenka Fidler**, prof. ped. in biol. <sup>1</sup>

<sup>1</sup>Mednarodna zveza društev IAHD Adriatic, Maribor, Slovenija; <sup>2</sup>Terme Zreče, Slovenija

**Korespondenca/Correspondence:** Branko Ravnak; e-pošta: branko.ravnak@siol.net

**Uvod:** Potapljanje je lahko del rehabilitacije in rekreacije za ljudi s posebnimi potrebami. Primerno je tako za posameznike po poškodbi hrbtenjače kot tudi za ljudi z duševnimi in fizičnimi omejitvami, kot so cerebralna paraliza, živčno-mišična obolenja, multipla skleroza, astma, amputacije, diabetes, slepota in gluhost. V določenih segmentih je potapljanje primerno tudi za starejšo zdravo populacijo, ki želi obnoviti, ohraniti ali izboljšati kakovost svojega življenja. **Metode:** Od leta 2002 je <sup>1</sup>Mednarodna zveza društev IAHD Adriatic razvila veliko programov, v katere so bile vključene omenjene skupine, ki so jih skrbno spremljali zdravstveni in potapljaški strokovnjaki z vsega sveta. Programi se izvajajo v bazenih kot del moderne hidroterapije in v odprtih vodah kot osnovno in napredno usposabljanje za potapljače. **Rezultati:** V zadnjih desetih letih smo opazili, da so bili vplivi potapljanja majhni, vendar zelo koristni. Hidroterapija je zaradi redne telesne dejavnosti, izboljšane socialne interakcije in psiholoških prednosti precej pripomogla k izboljššanemu zdravstvenemu stanju in k večji kakovosti življenja invalidnih potapljačev. **Zaključki:** Čeprav invalidi, ki so bili do zdaj vključeni v naše programe, niso imeli omembe vrednih zdravstvenih zapletov, smo prepričani, da je še naprej treba nameniti veliko pozornost kakršnim koli spremembam. Sistematično zbiranje, dokumentiranje in obdelava pridobljenih podatkov povečujejo naše znanje in prispevajo k temu, da je potapljanje postalo dostopnejše in varnejše za vse več ljudi s posebnimi potrebami.

**Ključne besede:** hidroterapija, terapevtsko potapljanje, poškodba hrbtenjače, invalidnost, duševne motnje.

## The benefits of therapeutic scuba diving in modern hydrotherapy

**Background:** Scuba diving can be a part of rehabilitation and recreation for groups of people with disabilities. It is suitable for individuals after spinal cord injury and also for others with mental and physical restrictions like cerebral palsy, nerve and muscular disorders, sclerosis multiplex, asthma, amputations, diabetes, blindness and deafness. To a certain extent it can be used for the healthy older population who needs to recover, preserve or improve their quality of life. **Methods:** Since 2002<sup>1</sup> International association for handicapped divers Adriatic has developed a wide range of programs in which all the mentioned groups have been included and carefully monitored by medical and diving specialists worldwide. Programs are performed in swimming pools as a part of modern hydrotherapy and in open water as basic and advanced diving training. **Results:** For the last ten years we have noticed that immediate effects of diving are minor and mainly beneficial. However, improved health and quality of life of disabled divers could be the result of hydrotherapy, regular physical activity, improved social interactions, psychological benefits of achievements and fulfilled life. **Conclusions:** In spite of the fact that up until now disabled participants have not had any noteworthy medical complications, we believe that vigilance must be maintained. Systematic data collection, their analysis and documentation of experiences increase our knowledge and contribute to dive safety for people with disabilities.

**Keywords:** hydrotherapy, therapeutic diving, spinal cord injury, physical disabilities, mental disabilities.

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## Primerjava termičnih in hemodinamskih odzivov v koži in mišicah na ogrevanje z električnim in magnetnim poljem

**Karmen Glažar**, dipl. fiziot.; asist. dr. **Nina Bogerd**, dipl. fiziot.; asist. **Tina Grapar Žargi**, MSc, dipl. fiziot.; doc. dr. **Alan Kacin**, dipl. fiziot.

Zdravstvena fakulteta, Univerza v Ljubljani, Ljubljana, Slovenija

**Korespondenca/Correspondence:** Alan Kacin; e-pošta: alan.kacin@zf.uni-lj.si

**Uvod:** Raziskave kažejo, da elektromagnetna diatermija povzroči povišanje temperature površinskih in globokih tkiv, kadar je povprečna intenziteta dovedene energije zadostna (1, 2). Dvig temperature sproži različne fiziološke odgovore v tkivih (3). Kolikšni so dejanski toplotni učinki različnih oblik diatermije na kožo in spodaj ležeče mišice, še ni podrobno raziskano. Namen raziskave je bil primerjati termične in hemodinamske odzive v koži in mišicah na ogrevanje z električnim (EP) in magnetnim (MP) poljem. **Metode:** V raziskavi je sodelovalo 11 zdravih prostovoljcev (6 moških in 5 žensk). Vsak preiskovanec je bil na volarnem predelu podlakti izpostavljen 20-minutnemu ogrevanju z EP ali MP z najmanj 48-urnim razmikom. Terapija je bila aplicirana na levem zgornjem udu, medtem ko je desni ud služil kot kontrola. Intenziteta dovedene energije je bila določena z zgornjo mejo toplotne tolerance preiskovanca. Merili smo kožno in timpanično temperaturo, frekvenco srčnega utripa in kinetiko oksigeniranega in deoksigiranega hemoglobina v mišici z infrardečo spektroskopijo. Preiskovanci so pred in med ogrevanjem ter med ohlajanjem ocenili občutenje in ugodje toplote na ogrevanem udu. **Rezultati:** Med 20-minutnim ogrevanjem z EP je temperatura kože narasla za  $8,0 \pm 1,3$  °C in z MP za  $8,1 \pm 1,3$  °C. Povečalo se je občutenje toplote, in sicer za  $3 \pm 1$  pri ogrevanju z EP in za  $2 \pm 1$  pri ogrevanju z MP. Prav tako se je spremenilo temperaturno ugodje pri ogrevanju z EP za  $1 \pm 1$ , pri ogrevanju z MP pa ni prišlo do značilnih sprememb. Minutna poraba kisika je narasla za  $0,02 \pm 0,02$  ml·min<sup>-1</sup>·100g<sup>-1</sup> pri ogrevanju z EP in za  $0,06 \pm 0,04$  ml·min<sup>-1</sup>·100g<sup>-1</sup> pri ogrevanju z MP. Prav tako se je med ogrevanjem z EP povečal minutni pretok krvi za  $0,27 \pm 0,25$  ml·min<sup>-1</sup>·100ml<sup>-1</sup> in pri ogrevanju z MP za  $0,72 \pm 0,61$  ml·min<sup>-1</sup>·100ml<sup>-1</sup>. Vse navedene razlike so bile statistično značilne ( $p < 0,05$ ). **Zaključki:** Pri enakem povišanju temperature kože ima ogrevanje z MP nekaj prednosti pred ogrevanjem z EP, in sicer je dvig temperature kože bolj postopen in zato za preiskovance bolj ugoden, poleg tega povzroči za ~ 42 % večji porast krvnega pretoka in porabe kisika v mišičnem tkivu. V primeru ciljane obravnave mišičnega tkiva je torej primernejša oblika diatermije z MP.

**Ključne besede:** radiofrekvenčna elektromagnetna diatermija, termični učinki, hemodinamski odzivi, mišična kinetika kisika.

## Comparison of thermal and hemodynamic responses in the skin and muscles to heating with electric and magnetic field

**Background:** It has been demonstrated in humans that electromagnetic diathermy of sufficient energy output causes temperature elevation of surface and deep tissues (1, 2). The increase in tissue temperature triggers various physiological responses (3). However, little is known about the differences in responses elicited by various techniques of diathermy application. **Purpose:** To compare thermal and hemodynamic responses in the skin and muscles of the forearm to diathermy applied with predominant electric (EF) or magnetic field (MF). **Methods:** Eleven healthy volunteers participated (6 men and 5 women) in the study. They received one 20-minute diathermy session with EF and another one with MF, applied to the volar aspect of the forearm. The minimum interval between the two sessions was 48 hours. The energy output in each session was determined by the volunteer's pain tolerance. Measurements of skin and tympanic temperature, heart rate and muscle oxyhemoglobin and deoxyhemoglobin kinetics by near infrared spectroscopy (NIRS) were performed. Subjective heat perception and comfort at the experimental arm were also evaluated. **Results:** The skin temperature increased by  $8.0 \pm 1.3^{\circ}\text{C}$  and  $8.1 \pm 1.3^{\circ}\text{C}$  during the 20-minute application of diathermy with EF and MF, respectively. The thermal perception increased by  $3 \pm 1$  during EF and  $2 \pm 1$  during MF application. The thermal comfort changed by  $1 \pm 1$  point during EF application, while no significant changes were noted during MF application. Minute muscle oxygen consumption increased by  $0.02 \pm 0.02 \text{ ml}\cdot\text{min}^{-1}\cdot 100\text{g}^{-1}$  during EF and  $0.06 \pm 0.04 \text{ ml}\cdot\text{min}^{-1}\cdot 100\text{g}^{-1}$  during MF application. Likewise, minute muscle blood flow increased by  $0.27 \pm 0.25 \text{ ml}\cdot\text{min}^{-1}\cdot 100\text{ml}^{-1}$  during EF and  $0.72 \pm 0.61 \text{ ml}\cdot\text{min}^{-1}\cdot 100\text{ml}^{-1}$  during MF application. All reported differences were statistically significant ( $P < 0.05$ ). **Conclusions:** Despite an almost identical increase in skin temperature, the application of diathermy with magnetic field was perceived more comfortable by the subjects. This can be largely attributed to a slower rate of heat accumulation in the skin. Furthermore, the increase in both minute muscle blood flow and oxygen consumption was  $\sim 42\%$  higher compared to the diathermy with EF. Therefore, when muscle is the target tissue for therapy, a diathermy with magnetic field is a technique of choice.

**Keywords:** radio-frequent electromagnetic diathermy, thermal effects, hemodynamic responses, muscle oxygen kinetics.

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## Sistem svetlobne terapije Bioptron

**Marta Kastelic**, svetovalka za svetlobno terapijo Bioptron

Zepter Slovenica d.o.o., Slovenj Gradec, Slovenija

**Korespondenca/Correspondence:** Marta Kastelic; e-pošta: kastelic.marta@siol.net

**Uvod:** Svetloba ima v našem življenju zelo pomembno vlogo, saj vemo, da brez svetlobe ni življenja. Svetloba je bistveni del našega naravnega biološkega sistema, ki je potreben za ustrezno delovanje presnove in imunskega sistema. Večina encimov, hormonov in vitaminov za ustrezno delovanje potrebuje svetlobo (1). Pomanjkanje svetlobe ima lahko resne stranske učinke na naše telo in na normalne fiziološke procese, ki potekajo v njem. Kadar koli so normalni fiziološki procesi in ravnovesje med njimi moteni, nastopi bolezen. Predstavljen je sistem svetlobne terapije Bioptron, ki je vznemirljiva in inovativna tehnologija, ki omogoča poceni in učinkovito zdravljenje številnih bolezenskih stanj, uporabljamo pa jo lahko v medicini, fizioterapiji ali v udobju svojega doma. Optične naprave Bioptron oddajajo posebno vrsto svetlobe, ki združuje ugodne lastnosti naravne sončne svetlobe brez UV-sevanja in njegovih možnih škodljivih učinkov. Zaradi biološko spodbujajočih učinkov svetlobe pri osvetljevanju kože ta spodbudi za svetlobo občutljive znotrajcelične strukture in molekule. Svetlobna terapija Bioptron deluje naravno, tako da spodbuja obnovitvene zmogljivosti telesa in mu tako pomaga sproščati njegov potencial za zdravljenje. **Tehnologija:** Bioptron je medicinska naprava za svetlobno terapijo s specifično optično enoto, ki oddaja svetlobo, podobno delu elektromagnetnega spektra, ki ga naravno proizvaja sonce. Razlika je v tem, da nima UV-sevanja. V zgodnjih osemdesetih letih je skupina znanstvenikov odkrila pomen polarizirane polikromatske svetlobe. Na podlagi te raziskave je bil izdelan sistem svetlobne terapije Bioptron. Ta torej temelji na več kot dvajsetletnih izkušnjah in ga uporabljajo zdravniki in medicinske sestre v bolnišnicah, fizioterapevti ter družine in posamezniki doma. Prav vsi imajo koristi od pozitivnih učinkov, ki jih ima sistem na človeško telo. Patentirana tehnologija lahko pri preprečevanju in zdravljenju različnih zdravstvenih težav prinese klinični uspeh z neverjetnimi trajnimi rezultati. Visokokakovostna tehnologija in inovativni dizajn omogočata enostavno uporabo brez znanih negativnih stranskih učinkov. **Uporaba:** Svetlobna terapija Bioptron se lahko uporablja kot dopolnilno zdravljenje za podporo konvencionalnim metodam zdravljenja, za nekatere indikacije pa se lahko uporablja kot monoterapija. Svetlobna terapija Bioptron izboljšuje mikrocirkulacijo, harmonizira presnovne procese, okrepi človekov obrambni sistem in spodbuja regenerativne procese v celotnem organizmu. Certificirana področja uporabe so celjenje ran (2), zdravljenje preležanin, opekline (3), lajšanje bolečin ter športne poškodbe (4), revmatizem, sezonske razpoložnjske motnje (zimski depresija), bolezni novorojenčkov, kožne bolezni (5), otroške bolezni (5), lepota in dobro počutje. **Prednosti:** Široko področje uporabe, preprosto upravljanje, varna in neinvazivna terapija, zdravljenje je kratko in brez bolečin, ni UV-sevanja, ni negativnih stranskih učinkov, je stroškovno učinkovita terapija, ki prinaša sproščujočo in pomirjujočo izkušnjo. **Zaključki:** Leta izkušenj in raziskav so potrdila pozitivne učinke svetlobne terapije Bioptron in privedla do širokega spektra uporabe na številnih področjih medicine. Terapija je po svetu postala sprejeta kot nova oblika zdravljenja pri preprečevanju, zdravljenju in rehabilitaciji. Ekipa znanstvenikov podjetja BIOPTRON AG iz Švice stalno sodeluje s strokovnjaki, znanstveniki in zdravniki v številnih državah in skupaj preučujejo značilnosti ter terapevtsko učinkovitost svetlobne terapije Bioptron.

**Ključne besede:** svetloba, zdravilni učinki, neinvazivna terapija, medicinska naprava.

## The bioptron light therapy system

**Background:** The light plays an extremely important role in our lives and, as it is well known, there is no life without light. The light is an essential part of our bio-natural system, needed for the adequate functioning of digestive and immune system. A large number of enzymes, hormones and vitamins need light for their proper functioning (1). The lack of light can bring about serious secondary effects on human body and on normal physiological processes which take place inside of it. Whenever the normal physiological processes and the balance between them are disturbed, illness appears. The article presents the Bioptron light therapy system, an exciting and innovative technology offering an inexpensive and efficient treatment for numerous medical conditions, which can be used in medicine, physiotherapy or in the comfort of one's home. Bioptron optical devices emit a special kind of light which combines the positive properties of natural sun light without the UV radiation and its potential harmful effects. The biostimulative effects of light on the skin stimulate light-sensitive intracellular structures and molecules. The Bioptron light therapy acts in a natural way by stimulating the regenerative capacity of the body, thus helping it release its own healing potential. **Technology:** Bioptron is a medical device applied in the light therapy, composed of a specific optical unit, spreading light in a similar way as the electro-magnetic spectrum does, a spectrum naturally produced by the sun. The difference is the lack of UV radiation. In the early 80s, a group of scientists discovered the meaning of polychromic polarized light. Based on this research, the Bioptron light therapy system was created. This technology lays on a 20 years' experience and is used today by doctors and nurses in hospitals, physiotherapists, individuals and families at home. All with no exception can enjoy the positive effects the method has on human body. The patented technology can bring about a clinical success with unbelievable lasting results in the prevention and treatment of different diseases. The high quality technology and innovative design empower a simple use with no known secondary effects. **Way of use:** The Bioptron light therapy can be used as additional treatment supporting the conventional treatment methods. For certain indications, however, it can also be used as a mono therapy. The Bioptron light therapy enhances the micro-circulation, harmonizes digestive processes, strengthens human defensive system and stimulates regenerative processes in the whole body. The certified applying areas are as follows: wounds healing (2), treatment of decubitus and burns (3), aches and sport injuries relief (4), rheumatism, seasonal dispositional disturbs (winter depression), skin problems (5), newborns diseases (5), beauty and well being. **Advantages:** large sphere of use, easy handling, safe and non-invasive therapy, short and painless treatment, no UV radiation, no negative secondary effects, reasonable therapy from the point of view of expenses, a therapy which brings along a calming and relaxing experience. **Conclusions:** Many years of experience and numerous researches have confirmed the positive effects of Bioptron light therapy and lead to a large spectrum of use in different medicine areas. Worldwide the therapy is being accepted as new treatment form applied in preventive, healing and rehabilitation goals. The BIOPTRON AG Company researching team from Switzerland constantly cooperates with specialists, scientists and doctors from different countries. Together they study the characteristics and therapeutic efficiency of Bioptron light therapy system.

**Keywords:** light, healing effects, non-invasive therapy, medical device.

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