

E-ISSN 2536-2682

September 2019, letnik 27, supl. 1

# FIZIOTERAPIJA



Združenje fizioterapevtov Slovenije  
**STROKOVNO ZDRUŽENJE**  
Slovenian Association of Physiotherapists  
**ČLAN WCPT - WCPT MEMBER**  
1000 Ljubljana, Linhartova 51  
Slovenija

18. Kongres fizioterapevtov  
Slovenije

**Fizioterapija v koraku s časom**

18. Congress of Slovenian  
Physiotherapists

**Physiotherapy in step with the  
times**

**Zbornik povzetkov / Book of abstracts**

Laško, 27. in 28. september 2019  
Laško, September 27<sup>th</sup> and 28<sup>th</sup> 2019

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Slovenian Association of Physiotherapists  
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Kataložni zapis o publikaciji (CIP) pripravili v Univerzitetni knjižnici v Mariboru COBISS.SI-ID 97258241 ISBN 978-961-91966-8-7
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## **(Mobile) technology in physiotherapy: 21st century healthcare skills for physiotherapists**

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The society is changing. In the past 20 years, we have seen enormous rise in the use of technology and how this affects our behaviour and our society functions. As of this day, we have more mobile phones in the world than we have people on this planet (1). The rise of technology also means that our patients are changing. A patient used to have complete trust in you as a physiotherapist, but now they can look up their injuries and symptoms and gain insight in their own matter within minutes. Patients have made the shift from being dependent on the physiotherapist to self diagnosing and even self treatment.

Not only technology has changed in the past years, also physiotherapy has changed drastically. We are slowly moving away from a hands-on approach to a more hands-off approach where you as a physiotherapist coach a patient to better outcomes. With the rise of internet, smartphones and other mobile technology patients know their way around apps and technology to monitor and work on their health or injuries with self management tools.

These developments change the way we should look at our patients. Treatments need to be supported by evidence and we physiotherapists have a more coaching role than before. With that change, technology can make sure we keep our profession future proof. For example, we see several research projects that support blended physiotherapy; the combination of on site care with patient engagement tools (2).

During this lecture we will discuss recent and future developments of healthcare and technology. We will go back 20 years and discuss developments that have changed healthcare and that will change healthcare on short notice, like the rise of mobile applications, wearables, virtual reality and the influence of major corporates like Google, Apple and Amazon. We want to discuss this both from a patient perspective and from the physiotherapist's perspective.

In the end we will present concrete examples of how we can make physiotherapy future proof and how we can see technology as an opportunity to enhance the profession of the physiotherapist.

**Key words:** Mobile technology, smartphones, apps for health, self-management

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## Robotika in navidezna resničnost v rehabilitaciji – tri desetletja uporabe in izkušnje

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**Uvod:** V 80. letih 20. stoletja so se pojavili prvi robotski pristopi k rehabilitaciji pacientov po možganski kapi. Izjemen razvoj je sledil v 90. letih s prvim klinično uporabljenim robotom MIT-Manus (1). Hkrati z razvojem rehabilitacijskih robotov so se razvijale metode navidezne resničnosti, ki so dopolnjevale robotsko podprto vadbo, omogočale pa tudi senzorno podprto vadbo brez robotov. Hitremu razvoju pa ni sledila uporaba novih tehnologij v klinični praksi. Največja ovira za uvajanje in uporabo robotsko podprte rehabilitacije ter navidezne resničnosti je bilo pomanjkanje dokazov o učinkovitosti vadbe. **Metode:** Tri desetletja intenzivnega razvoja, preizkušanja in izpopolnjevanja tehnologij so omogočila varno, pacientom prilagojeno in učinkovito vadbo, ki je po rezultatih lahko primerljiva z intenzivno standardno terapijo. V desetletjih uporabe robotov in navidezne resničnosti so bile izvedene številne klinične raziskave za objektivno vrednotenje učinkov vadbe. **Rezultati:** Robotsko podprta vadba zgornjih udov lahko izboljša izide rehabilitacije v primerjavi z običajno, ne pa z intenzivno terapijo (2, 3). Elektromehanska in robotska vadba lahko tudi izboljša dejavnosti vsakodnevnega življenja pri ljudeh po možganski kapi ter funkcijo in mišično jakost okvarjenega zgornjega uda. Pri tem ni pričakovati resnih neželenih učinkov, kot so poškodbe in bolečine, kot posledico robotske vadbe (4). Dokazano je, da lahko elektromehansko podprta vadba v kombinaciji s fizioterapijo poveča izboljšanje samostojne hoje pri pacientih po možganski kapi v primerjavi s samo fizioterapijo. Pacienti v prvih treh mesecih po kapi in tisti, ki ne morejo hoditi, imajo lahko največjo korist od tovrstne vadbe (5). Uporaba navidezne resničnosti v splošnem ni učinkovitejša od standardnih terapevtskih pristopov pri izboljšanju funkcije zgornjih udov, vendar pa je lahko učinkovita pri izboljšanju funkcije zgornjega uda in vsakodnevnih dejavnostih, ko se uporablja kot dopolnilo k običajni vadbi (za povečanje obsega vadbe). Čas od nastopa možganske kapi, stopnja okvare in vadbena naprava ne vplivajo bistveno na izid rehabilitacije. Priporočljivi so daljši čas trajanja vadbe in prilagojene naloge v navidezni resničnosti (6). **Zaključki:** Ob pravilni uporabi in ustrezni intenzivnosti vadbe lahko robotsko podprta rehabilitacija in/ali vadba s pomočjo navidezne resničnosti izboljšata motorične funkcije zgornjih oziroma spodnjih udov pri ljudeh po možganski kapi. Izboljšanje je primerljivo rehabilitaciji s standardno terapijo. Uporaba sodobnih tehnologij se priporoča kot dopolnitev standardne terapije za povečanje obsega in intenzivnosti vadbe.

**Ključne besede:** rehabilitacijska robotika, navidezna resničnost, gibanje

## Robotics and virtual reality in rehabilitation – three decades of use and experience

**Background:** In the 1980s, the first robotic concepts appeared for the purpose of rehabilitation of patients after stroke. Extreme development followed in the 90s with the first clinically-used robot MIT-Manus (1). Simultaneously with the development of rehabilitation robots, virtual reality methods were developed, complementing the robot-supported exercises, and also enabling sensor-based training without robots. However, rapid technological development was not followed by the use of new technologies in clinical practice. The greatest obstacle to the deployment and use of robot-supported rehabilitation and virtual reality was the lack of evidence of the therapy effectiveness. **Methods:** Three decades of intensive development, testing and advancing of technologies today enable safe, patient-specific, and effective rehabilitation, which can be comparable to intensive conventional therapy. In three decades of using robots and virtual reality, numerous clinical studies have been performed to objectively quantify the effects of technology-supported therapy. **Results:** Upper limb robot-assisted therapy may improve rehabilitation outcomes as compared with usual care but not with intensive therapy (2, 3). Electromechanical and robot-assisted arm training can improve activities of daily living in people after stroke, and function and muscle strength of the affected arm. No serious adverse events, such as injuries and pain, as result of robot-assisted should be expected (4). Evidence was found that electromechanical-assisted gait training combined with physiotherapy when compared with physiotherapy alone may improve recovery of independent walking in people after stroke. Specifically, patients in the first three months after stroke and those who are not able to walk appear to benefit most from this type of intervention (5). The use of virtual reality is not more beneficial than conventional therapy approaches in improving upper limb function. However, it may be beneficial in improving upper limb function and activities of daily living when used as an adjunct to usual care (to increase overall therapy time). Time since onset of stroke, severity of impairment, and the type of device do not strongly influence the outcome. However, higher training dose may be preferable as are customized virtual reality programs (6). **Conclusions:** With proper use of technology and adequate training intensity, robot- and/or virtual reality-supported rehabilitation can help to improve motor functions of upper or lower limbs in people after stroke. The improvement is comparable to conventional therapy. The use of modern technologies is recommended as a complement to conventional therapy to increase training duration and intensity.

**Key words:** rehabilitation robotics, virtual reality, motor rehabilitation

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## Indeks premičnosti de Morton ima dobre merske lastnosti za ocenjevanje odraslih z mišično-skeletnimi okvarami na rehabilitaciji

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**Uvod:** Indeks premičnosti de Morton (angl. de Morton mobility index – DEMMI) je standardizirano merilno orodje, s katerim ocenjujemo premikanje na postelji, stolu, statično ravnotežje, sposobnost hoje in dinamično ravnotežje (skupno število točk: 0–100) (1). Je zanesljivo in veljavno za ocenjevanje pri starejših z različnimi ravnmi funkcioniranja od akutne bolnišnične obravnave do rehabilitacije (2). Slovenski prevod DEMMI ima odlično zanesljivost med preiskovalci in je razumljiv (3). Namen prispevka je predstaviti izsledke raziskave, v kateri smo za ocenjevanje z DEMMI ugotavljali konvergentno veljavnost, odzivnost, najmanjšo klinično pomembno razliko ter učinka tal in stropa pri pacientih z mišično-skeletnimi okvarami na rehabilitaciji, ne glede na starost. **Metode:** S slovenskim prevodom DEMMI, razvrstitvijo funkcijske premičnosti, testom hoje na 10 metrov in 6-minutnim testom hoje smo ocenili 30 priložnostno izbranih pacientov z mišično-skeletnimi okvarami. Preiskovanci so bili stari od 22 do 84 let (povprečno 54 let). Ocenjevanje je potekalo ob sprejemu na rehabilitacijo in po štirih tednih obravnave. Izračunali smo Spearmanov koeficient korelacije ( $r_o$ ) med ocenami DEMMI in izidi drugih merilnih orodij, velikost učinka (Cohenov  $d$ ) in najmanjšo klinično pomembno razliko. Učinka tal in stropa smo ugotavljali z izračunom deleža preiskovancev ( $>15\%$ ), ki so dosegli najnižje in najvišje število točk. Raziskavo je odobrila komisija za medicinsko etiko URI - Soča. **Rezultati:** Povprečna ocena DEMMI ob sprejemu je bila 34 točk (SO 10) in po štirih tednih 57 točk (SO 13). Med ocenami DEMMI in razvrstitvijo funkcijske premičnosti je bila povezanost ob sprejemu zelo dobra ( $r_o = 0,84$ ), pri drugem ocenjevanju pa dobra ( $r_o = 0,74$ ). Tudi s testom hoje na 10 metrov je bila povezanost najprej zelo dobra ( $r_o = 0,75$ ) in nato dobra ( $r_o = 0,74$ ). S 6-minutnim testom hoje pa je bila povezanost zelo dobra, tako pri prvem ( $r_o = 0,80$ ) kot pri drugem ocenjevanju ( $r_o = 0,77$ ). Ocena velikosti učinka za DEMMI je 1,97 in najmanjša klinično pomembna sprememba 5 točk. Pri obeh ocenjevanjih nihče od preiskovancev ni bil ocenjen z 0 točk DEMMI. Prav tako nihče ni prejel 100 točk ob sprejemu, po štirih tednih obravnave pa jih je dosegla ena preiskovanka. **Zaključki:** Izsledki o dobri oziroma zelo dobri povezanosti s funkcijsko razvrstitvijo premičnosti, testom hoje na 10 metrov in 6-minutnim testom hoje potrjujejo konvergentno veljavnost DEMMI pri odraslih z mišično-skeletnimi okvarami na rehabilitaciji različne starosti. Ima veliko odzivnost za spremembe med rehabilitacijo. Učinka tal in stropa za DEMMI nismo ugotovili. Fizioterapevtom ga priporočamo za uporabo pri odraslih ljudeh z zmanjšano sposobnostjo premikanja, na nižji in osnovni ravni funkcioniranja.

**Ključne besede:** DEMMI, konvergentna veljavnost, odzivnost, najmanjša klinično pomembna sprememba, premičnost

## De Morton mobility index has good measurement properties for assessment of adults with musculoskeletal impairments at rehabilitation

**Background:** de Morton mobility index (DEMMI) is a standardized measurement tool, which assesses moving in bed, chair, static balance, walking ability and dynamic balance (total score: 0–100) (1). It is reliable and valid for assessment of older adults with different functioning level from acute hospital treatment to rehabilitation (2). Slovenian translation of DEMMI has excellent inter-rater reliability and is comprehensible (3). The aim is to present results of the study, in which convergent validity, responsiveness, minimal clinically important difference and floor and ceiling effects of DEMMI in patients with musculoskeletal impairments at rehabilitation, regardless of age, were established. **Methods:** Thirty conveniently selected patients with musculoskeletal impairments were assessed with Slovenian translation of DEMMI, functional ambulation category, 10-meter walk test and six-minute walk test. Their age ranged from 22 to 84 years (mean = 54 years). Assessment was performed at admission and after four weeks of rehabilitation. Spearman's correlation coefficient ( $\rho$ ) between DEMMI scores and other measurement tools, effect size (Cohen  $d$ ) and minimal clinically important difference were calculated. Floor and ceiling effects were established by calculation of percentage of participants (>15 %) with the minimal and maximal scale score. The research was approved by the Ethics Committee of URI - Soča. **Results:** At admission, the mean DEMMI score was 34 (SD 10) and after four weeks of rehabilitation it was 57 (SD 13). Correlation with functional ambulation category was very good at admission ( $\rho = 0.84$ ) and good at the second assessment ( $\rho = 0.74$ ). Correlation with 10-meter walk test was also very good at first ( $\rho = 0.75$ ) and good after that ( $\rho = 0.74$ ). Correlation with six-minute walk test was very good at first ( $\rho = 0.80$ ) and at the second assessment ( $\rho = 0.77$ ). Effect size of DEMMI was 1.97 and minimal clinically important difference was 5 points. No participant was score with 0 points on DEMMI at both assessments. Also no participant achieved 100 points at admission, but one got it after four weeks of rehabilitation. **Conclusions:** Good to very good correlations with functional ambulation category, 10-meter walk test and six-minute walk test confirm convergent validity of DEMMI in adults of all ages with musculoskeletal impairments at rehabilitation. It is highly responsive for changes during rehabilitation. No floor and ceiling effects were identified. We recommend DEMMI for mobility assessment in adults at low and basic functioning level.

**Key words:** DEMMI, convergent validity, responsiveness, minimal clinical important difference, mobility

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## Povezanost L-testa s testi vstajanja s stola pri pacientih po amputaciji spodnjega uda v protetični fazi rehabilitacije

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**Uvod:** Vstajanje in sedanje sta poleg hoje pomembni komponenti premičnosti. Za paciente po amputaciji spodnjega uda sta to zaradi zmanjšane mišične zmogljivosti in proprioceptivnih informacij precej zahtevni nalogi (1). Za kvantitativno ocenjevanje sposobnosti vstajanja se najpogosteje uporabljata test petih vstajanj (5TSTS) in 30-sekundni test vstajanja s stola (30SSTS) (2). L-test je modifikacija časovno merjenega testa vstani in pojdi in je namenjen oceni premičnosti. Pri pacientih po amputaciji spodnjega uda smo ugotovili odlično zanesljivost (3). Namen prispevka je predstaviti izsledke raziskave, pri kateri smo za L-test ugotavljali diskriminacijsko in sočasno veljavnost s 5TSTS in 30SSTS pri pacientih po amputaciji spodnjega uda v protetični fazi rehabilitacije. **Metode:** V raziskavi smo uporabili priložnostni vzorec 29 preiskovancev (23 moških, 6 žensk), starih povprečno 64,0 (SO: 12,8) let, ki so bili na bolnišnični rehabilitaciji prvič oskrbljeni s protezo. 22 jih je imelo transtibialno in 7 transfemoralno amputacijo. Vzroki amputacije so bili žilni (n = 25) in drugi (n = 4). Prvo ocenjevanje smo izvedli takoj, ko so bili sposobni samostojno hoditi s protezo, drugo po dveh tednih. Pri prvem ocenjevanju jih je 10 uporabljalo bergli in 19 hoduljo. Po L-testu smo hkrati izvedli oba testa vstajanja. Poleg opisne statistike in Pearsonovih korelacijskih koeficientov ( $r$ ) smo naredili analizo kovariance (1. ocenjevanje). Raziskavo je odobrila komisija za medicinsko etiko URI - Soča (št. 19/2017). **Rezultati:** Povprečen čas izvedbe L-testa pri prvem ocenjevanju je bil 72,1 (SO: 31,5) sekunde, pri drugem ocenjevanju pa 46,1 (SO: 20,0) sekunde. Med skupinama preiskovancev po trans-tibialni in trans-femoralni amputaciji je bila statistično značilna razlika v izidih L-testa ( $F(1, 31) = 5,858$ ;  $p = 0,022$ ). Z regresijsko analizo izidov L-testa glede na raven amputacije smo ugotovili pomembno skupno linearno povezanost z drugimi spremenljivkami ( $R^2 = 0,55$ ;  $p < 0,001$ ). Pri tem so bili potrjeni statistično pomembni vplivi starosti preiskovanca, vzroka amputacije in pripomočka za hojo. Povprečen čas izvedbe 5TSTS pri prvem ocenjevanju je bil 28,1 (SO: 12,4) sekund, ob drugem pa 18,9 (SO: 7,8) sekund. Pri prvem ocenjevanju so pri 30SSTS preiskovanci v povprečju izvedli 6,5 (SO: 2,5) popolnega prehoda v stoječi položaj, pri drugem pa 9,3 (SO: 3,2). Med izidi L-testa in 5TSTS je bila povezanost zmerna pri prvem ( $r = 0,54$ ) in drugem ocenjevanju ( $r = 0,63$ ). Tudi s 30SSTS je bila povezanost zmerna pri prvem ( $r = -0,56$ ) in drugem ocenjevanju ( $r = -0,54$ ). Vse korelacije so bile statistično značilne ( $p < 0,001$ ). **Zaključki:** L-test in testa vstajanja s stola so uporabna merilna orodja pri pacientih po amputaciji spodnjega uda tudi v obdobju protetične faze rehabilitacije. Izid L-testa sovпада s posameznikovo sposobnostjo vstajanja in sedanja. Za določitev, kateri test vstajanja je primernejši, so potrebne nadaljnje raziskave.

**Ključne besede:** L-test, 30SSTS, 5TSTS, premičnost, veljavnost

## Correlation of the L-test with sit-to-stand tests in patients after lower limb amputation in prosthetic phase of rehabilitation

**Background:** Standing up and sitting down are in addition to walking important components of mobility. These tasks are relatively demanding for patients after lower-limb amputation, due to their reduced muscular capacity and proprioceptive information (1). For the quantitative assessment of the ability to stand up, the five times sit-to-stand (5TSTS) and the 30-second sit-to-stand test (30SSTS) are most commonly used (2). The L-test is a modification of the timed up and go test, it is designed to assess mobility. In patients after lower-limb amputation we found excellent reliability (3). The aim is to present the results of the study, in which discriminant validity of the L-test and concurrent validity with the 5TSTS and the 30SSTS, performed by patients after lower-limb amputation in the prosthetic phase of rehabilitation, were established. **Methods:** A convenience sample of 29 subjects (23 male, 6 female), mean age 64.0 (SD: 12.8) years, who underwent an inpatient rehabilitation and were provided with prosthesis for the first time, were included in the study. 22 had trans-tibial and 7 trans-femoral amputation. They were amputated due to vascular disease ( $n = 31$ ) or other medical conditions ( $n = 4$ ). The first assessment was conducted as soon as patients were able to walk independently with prosthesis and the second after two weeks. At the first assessment 10 of them used crutches and 19 a walking frame. After the L-test we conducted both sit-to-stand tests simultaneously. Descriptive statistics, the Pearson's correlation coefficient ( $r$ ) and analysis of covariance (the first assessment) were calculated. The study was approved by The Ethics Committee of URI - Soča (no. 19/2017). **Results:** At the first assessment the mean time of the L-test was 72.1 (SD: 31.5) seconds, and 46.1 (SD: 20.0) seconds at the second assessment. There was a significant difference in mean L-test results ( $F(1, 31) = 5.858$ ;  $p = 0.022$ ) between the subjects following trans-tibial and trans-femoral amputation. Regression analysis of the results of the L-test with respect to the level of amputation revealed an important total linear correlation with other variables ( $R^2 = 0.55$ ;  $p < 0.001$ ). In this regard, statistically significant influences of the age of the subject, the cause of amputation and the walking aid were confirmed. The mean time of the 5TSTS was 28.1 (SD: 12.4) seconds at the first assessment and 18.9 (SD: 7.8) seconds at the second assessment. At the first assessment at the 30SSTS subjects performed 6.5 (SD: 2.5) complete transitions to a standing position and 9.3 (SD: 3.2) at the second assessment. The correlation between results of the L-test and the 5TSTS was moderate at the first ( $r = 0.54$ ) and also at the second assessment ( $r = 0.63$ ). The correlation with the 30SSTS was also moderate at the first ( $r = -0.56$ ) and at the second assessment ( $r = -0.54$ ). All correlations were statistically significant ( $p < 0.001$ ). **Conclusions:** The L-test and both sit-to-stand tests are useful measuring tools in patients after lower-limb amputation during the prosthetic phase of rehabilitation. The result of the L-test coincides with the individual's ability to stand up. Further research is needed to determine which of the sit-to-stand tests is more appropriate.

**Key words:** L-test, 30SSTS, 5TSTS, mobility, validity

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## Najprimernejši izid in zanesljivost posameznega preiskovalca pri ročni dinamometriji po postopku TRICALS pri zdravih odraslih

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**Uvod:** Z ročno dinamometrijo lahko v fizioterapiji na preprost, standardiziran in poceni način ocenimo mišično jakost udov z merjenjem sile pri izvedbi maksimalne hotene izometrične kontrakcije (1). Eden od načinov testiranja je tehnika preloma sile. Zaradi razlik v položajih za merjenje posameznih mišičnih skupin z ročnim dinamometrom in drugih elementov ocenjevalnega postopka so pripravili postopek TRICALS (4). Primarno je namenjen ocenjevanju bolnikov z amiotrofično lateralno sklerozo. Način za določanje izida še ni jasno določen in tudi zanesljivost še ni bila preverjena. **Namen:** Opredeliti najprimernejši način za določanje izida in preveriti zanesljivost posameznega preiskovalca pri merjenju mišične jakosti po postopku TRICALS pri zdravih ljudeh. **Metode:** V raziskavi je sodelovalo 21 zdravih preiskovancev, starih povprečno  $24,8 \pm 6,1$  leta, ki so opravili testiranje z ročnim dinamometrom (MicroFet2, Hoggan Health Industries, ZDA) na zgornjih udih (fleksorji ramena, fleksorji in ekstenzorji komolca, ekstenzorji zapestja in prvi dorzalni interoseus). Pri testiranju mišic spodnjih udov (fleksorjev kolka, fleksorjev in ekstenzorjev kolena in dorzalnih fleksorjev stopala) je sodelovalo 20 preiskovancev, starih povprečno  $30 \pm 8,8$  leta. Za vsako mišično skupino smo izvedli tri meritve. Testiranje je potekalo dvakrat, na zgornjih udih v razmiku 9 ali 17 dni in na spodnjih v razmiku 5 dni. Izvedli smo analizo variance ANOVA s primerjavo več možnih izbir izida ter izračunali standardno napako merjenja. Za zanesljivost posameznega preiskovalca smo izračunali intraklasni koeficient korelacije (ICC 3,1). Raziskavo je odobrila Komisija za medicinsko etiko (št. 0120-370/2017/6). **Rezultati:** ANOVA ni pokazala statistično značilnih razlik ( $p > 0,05$ ) med različnimi izidi pri ročni dinamometriji. V primerjavi z največjo meritvijo smo nižje standardne napake merjenja izmerili pri povprečju treh meritev, zato smo za nadaljnjo analizo uporabili ta izid. Zanesljivost posameznega preiskovalca je bila za zgornji ud na dominantnem udu visoka do odlična (ICC = 0,80–0,96), na nedominantnem udu pa zmerna do visoka (ICC = 0,64–0,93). Za spodnje ude je bila zanesljivost visoka do odlična pri merjenju vseh mišičnih skupin na dominantnem udu (ICC = 0,87–0,97) in zmerna do visoka za vse mišične skupine na nedominantnem udu (ICC = 0,74–0,97). Zmerne vrednosti zanesljivosti pri upoštevanju povprečja meritev so bile ugotovljene za mišice ekstenzorji zapestja (ICC = 0,64) in fleksorji kolena (ICC = 0,74). **Zaključek:** Priporočamo, da se za izid ročne dinamometrije izračuna povprečje meritev. Zanesljivost posameznega preiskovalca za protokol TRICALS pri zdravih preiskovancih je po mišičnih skupinah zmerna do odlična. Za ocenjevanje mišičnih skupin z zmerno zanesljivostjo bi bilo smiselno zmanjšati napako merjenja z uporabo trakov za stabilizacijo ali drugega položaja. Preveriti je treba tudi zanesljivost med preiskovalci za testiranje z ročno dinamometrijo pri zdravih odraslih in zanesljivost pri pacientih.

**Ključne besede:** merjenje mišične jakosti, merske lastnosti, maksimalna izometrična kontrakcija, mišična jakost, zgornji in spodnji udi



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## Best outcome selection and intrarater reliability of hand-held dynamometry in healthy adults using tricals protocol

**Introduction:** Hand-held dynamometry is a simple, standardized and inexpensive method of measuring limb muscle strength by measuring the force required to perform the maximum voluntary isometric contraction (1). A break test is one of the techniques for assessment of individual muscle groups. Due to differences in positions for individual muscle groups measurement and other elements of the assessment process, the TRICALS protocol was proposed. Its aim was primarily the assessment of patients with amyotrophic lateral sclerosis. The method for determining the outcome is not clearly defined, and reliability has not been established. **Purpose:** To identify the most appropriate way to determine the outcome and evaluate the intra-rater reliability of the TRICALS procedure of hand-held dynamometry in healthy people. **Methods:** 21 healthy subjects (aged  $24.8 \pm 6.1$  years) were tested with hand-held dynamometer (MicroFet2, Hoggan Health Industries, USA) on the upper (shoulder flexors, elbow flexors and extensors, wrist extensors and first dorsal interosseous) and 20 subjects (aged  $30 \pm 8.8$  years) on the lower limbs (hip flexors, knee flexors and extensors, dorsal flexors). Three measurements were performed for each muscle group. The test was performed twice, on the upper limbs with 9 or 17 days, and on the lower at a spacing of 5 days. ANOVA was performed by comparing several possible output choices and calculating the standard measurement error (SEM). Intraclass coefficients of correlation (ICC 3,1) were calculated for the reliability of each investigator. The survey was approved by National Medical Ethics Committee (No. 0120-370/2017/6). **Results:** ANOVA showed no statistically significant differences ( $p > 0.05$ ) between various outcomes in hand-held dynamometry. Compared with the maximum measurement, the lower SEM was present at the average of three measurements, and this result was used for further analyses. Intra-rater reliability was good to excellent for the dominant upper limb (ICC = 0.80-0.96) and moderate to good (ICC = 0.64-0.93) for the non-dominant upper limb. For the lower limbs, there was good to excellent intra-rater reliability in muscle groups on dominant side (ICC = 0.87-0.97) and moderate to good for non-dominant side (ICC = 0.74-0.97). Moderate values of reliability were measured for wrist extensors (ICC = 0.64) and knee flexors (ICC = 0.74). **Conclusion:** We recommend calculation of average for the outcome for hand-held dynamometry. Intra-rater reliability for TRICALS protocol in healthy subjects is moderate to excellent. In the future, it would be sensible to reduce the measurement error by using straps or different position, especially at the lower limb. Studies of inter-rater reliability in healthy adults and reliability of the protocol in patients are needed.

**Key words:** muscle strength measurement, measurement properties, maximum voluntary isometric contraction, muscle strength, upper and lower limbs

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## Kakšne so sposobnosti tipanja študentk fizioterapije?

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**Uvod:** Tipanje je fizioterapevtski preiskovalni postopek, s katerim se ocenjuje kakovost, morfološke spremembe in občutljivost tkiva. Natančnost tipanja je odvisna od zaznave z dotikom in izkušeni preiskovalca (1, 2). Test zaznave z dotikom se uporablja za prepoznavanje oblike tipane strukture. Z uporabo tablic z vgraviranimi simboli, ki jih preiskovanec tipa in nato preríše na papir (3), so ugotovili povezavo med številom napak pri prerisovanju simbola in časom, porabljenim za njegovo tipanje (4). Namen naše raziskave je bil ugotoviti, ali poraba časa pri tipanju in prerisovanju narašča s težavnostjo simbola ter ali je težavnost tipanega simbola povezana z večjim številom napak pri njegovem prerisovanju pri študentkah fizioterapije. **Metode:** Sodelovalo je 20 študentk tretjega letnika in magisterija na Zdravstveni fakulteti, Univerze v Ljubljani, starih povprečno 23,7 (SO 3,8) leta, brez poškodb zgornjih udov v šestih mesecih pred raziskavo. Za test zaznave z dotikom (3) smo uporabili tri lesene tablice (tablice 1, 2 in 3) velikosti 13 krat 13 cm, s širino črt simbola/-ov 7 mm in globino 3 mm. V vsako je bil vgraviran simbol različne težavnosti. Preiskovalke so z obema rokama s prekritimi očmi tipale simbol na tablici največ 3 minute in ga nato z odprtimi očmi narisale na list papirja. Merili smo čas tipanja in risanja simbola na list ter število napak na prerisanem simbolu po opisanem postopku (3). Preiskovanke so ocenile težavnost risanja simbola z Likertovo lestvico od 1 do 5. Komisija RS za medicinsko etiko je ocenila, da je raziskava etično primerna (št. 0120-17/2018). **Rezultati:** Tablico 1 so ocenile za najlažjo (težavnost 2:  $n = 11$ ; razpon 1–2), pri prerisovanju naredile najmanj napak ( $\bar{x} = 1,3$ , SO 0,8) in v primerjavi z drugima tablicama za tipanje ter risanje simbola porabile najmanj časa (tipanje  $\bar{x} = 30,7$ , SO 12,4 s; risanje  $\bar{x} = 8,3$ , SO 5 s). Tablico 2 so ocenile kot najtežjo (težavnost 4:  $n = 14$ ; razpon 2–5), naredile največ napak ( $\bar{x} = 1,9$ , SO 0,8) in za tipanje ter risanje simbola porabile največ časa (tipanje  $\bar{x} = 128,5$ , SO 45,3 s; risanje  $\bar{x} = 35,7$ , SO 21,9 s). Tablico 3 so ocenile kot srednje težko (težavnost 4:  $n = 8$ ; razpon 2–5), število napak je bilo  $\bar{x} = 1,6$ , SO 0,9, čas tipanja je bil  $\bar{x} = 91,4$ , SO 40,5 s in čas risanja  $\bar{x} = 27,3$ , SO 17 s. Naknadni t-test za odvisne vzorce z Bonferronijevim popravkom je pokazal, da so pri času tipanja in risanja med vsemi tremi tablicami statistično pomembne razlike ( $p < 0,016$ ). **Zaključki:** Test zaznave z dotikom bi bil lahko uporaben pripomoček za učenje in vrednotenje sposobnosti tipanja med študijem fizioterapije.

**Ključne besede:** zaznava z dotikom, fizioterapija, študenti, težavnost

## What are the palpation skills of physiotherapy female students?

**Background:** Palpation is used in physiotherapy to assess quality, morphological changes and sensitivity of tissue. Tactile perception and previous experience of the investigator is required to properly evaluate structure (1, 2). To assess tactile sensitivity, tactile perception test is used by palpating the engraved symbol in tablets (3). Time used for tactile examination of symbols engraved on tablets and the time for its reproduction by drawing on the piece of paper correlated with accuracy scores (4). The purpose of this study is to determine whether the palpation time, drawing time and accuracy scores increase with difficulty of palpated engraved symbol among female physiotherapy students. **Methods:** Twenty students of 3rd year and a Master's program in the Faculty of Health Sciences Ljubljana, aged average 23.7 (SD 3.8) years without any injuries of upper limb last six months before the study were included. For tactile perception test (3) three wooden tablets (tablet 1, 2, 3) size 13 x 13 cm, width of the symbol lines 7 mm and depth 3 mm were used. Symbols of different difficulties were engraved in each wooden plate. Subject palpated the symbol with both hands with their eyes closed on each tablet separately for maximum of 3 minutes and then reproduced it by drawing on a piece of paper with open eyes. The palpation time, drawing time and accuracy of symbol were scored (3). After finishing the drawing subject was asked to score the symbol difficulty on a 1-5 Likert scale. The study protocol was approved by the Commission of Republic Slovenia for Medical Ethics (No.: 0120-17/2018). **Results:** On average, tablet 1 was rated as the easiest of all three (difficulty 2: n = 11; range 1-2) with accuracy score 1.3, SD 0.8, palpation time 30.7, SD 12.4 s and drawing time 8.3, SD 5 s. Tablet 2 was perceived as the most difficult (difficulty 4: n = 14; range 2-5), with accuracy score 1.9, SD 0.8, and the longest palpation and drawing time (128.5, SD 45.3 s; 35.7, SD 21.9 s, respectively). The difficulty of tablet 3 was rated as medium out of all three tablets (difficulty 4: n = 8; range 2-5). The accuracy score was 1.6, SD 0.9, time needed for palpation and drawing was 91.4, SD 40.5 and 7.3, SD 17 s, respectively. The subsequent t test for dependent samples with Bonferroni correction showed statistically significant differences between the three tablets for palpation and drawing time ( $p < 0.016$ ). **Conclusion:** Tactile perception test may be used as a tool for training and evaluating touch sensitivity among physiotherapy students.

**Key words:** tactile sensitivity, physiotherapy, students, difficulty

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## Bolečina kot večsistemski pojav

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**Uvod:** Doživljanje neprijetne senzorne in čustvene zaznave v povezavi z resnično ali možno poškodbo tkiva se med posamezniki razlikuje (1). Bolečina lahko povzroči pomanjkanje ali odpor do gibanja (2) in vpliva na bio-psiho-socialne komponente zdravja. V raziskavi smo želeli preveriti, ali so posamezniki z bolečino manj telesno dejavni in ali ta vpliva na sposobnosti pomnjenja in psihološko naravnost pri starejših odraslih. **Metode:** Podatke smo zbirali pri premičnih odraslih, starejših od 65 let, z demografskim vprašalnikom, mednarodnim vprašalnikom o telesni dejavnosti (IPAQ) (3) in s kratkim vprašalnikom o zdravju (SF 36) (4), ki nam je dal podatek o intenzivnosti bolečine v zadnjih štirih tednih in s katerim smo preverili, ali vprašani menijo, da se bo njihovo zdravje poslabšalo. S pomnjenjem števil oziroma testom N-DIGIT(5) smo preverjali zmožnosti kratkoročnega delovnega spomina. Podatke smo statistično analizirali s programom Microsoft Office Excel in SPSS. **Rezultati:** Med 80 sodelujočimi (ženske 84 %, moški 16 %), ki so navedli rahle do zmerne bolečine (50 %), velike bolečine (20 %) ali, da bolečin niso imeli oziroma so jih imeli zelo malo (30 %), nismo zaznali statistično značilnih razlik pri telesni dejavnosti in izvajanju testa N-DIGIT. Statistično značilno boljše rezultate ( $p = 0,002$ ) pri delovnem spominu smo ugotovili pri anketiranih, ki ne pričakujejo, da se jim bo zdravje v prihodnje poslabšalo, v primerjavi s tistimi, ki ne vedo, ali pričakujejo poslabšanje zdravja. Anketiranci, ki so menili, da je njihovo zdravje odlično, so dosegli več točk na testu N-DIGIT kot tisti, ki ne menijo, da je njihovo zdravje dobro ( $p = 0,039$ ). V nadaljevanju smo analizirali število dni, ko so bili telesno dejavni, in povezavo z delovnim spominom. Anketiranci, ki so v prostem času telesno dejavni od 1 do 3 dni ( $M = 3,59$ ), so imeli statistično značilno boljše rezultate od anketirancev, ki niso telesno dejavni ( $M = 2,70$ ), in anketirancev, ki so telesno dejavni od 4 do 7 dni ( $M = 4,71$ ),  $p = 0,002$ . **Zaključki:** V naši raziskavi smo ugotovili, da je za kognitivne naloge pomembnejši odnos, ki ga ima posameznik do zdravja, kot bolečina. Bolečina ima vpliv na odnos do zdravja, lahko zmanjšuje količino telesne dejavnosti in posredno vpliva na posamezne komponente delovnega spomina. Pomembna je tudi ustrezna količina telesne dejavnosti.

**Ključne besede:** bolečina, pomnjenje, psihološka naravnost

## Pain as multisystemic phenomenon

**Background:** Experiencing unpleasant sensory and emotional perception in connection with actual or potential damage to tissue varies between individuals (1). Pain can cause deficiency or resistance to movement (2), and affects the bio-psycho-social components of health. In the study, we wanted to check whether individuals with pain are less physical active and whether physical inactivity affects the ability of memory and the psychological orientation in elderly adults. **Methods:** Data collection was carried out in older adults over the age of 65 with the help of demographic questionnaire, an international questionnaire on physical activity (IPAQ) (3) and a short health questionnaire on the quality of life (SF 36) (4), that gave us data of intensity of pain in the last 4 weeks and with which we asked whether they thought their health would deteriorate. Using the numerical memory test (N-DIGIT test) (5), we checked the capabilities of short-term working memory. We analyzed the data statistically with Microsoft Office Excel and SPSS. **Results:** Of the 80 participants (84% women, 16% men) who reported little to moderate pain (50%), severe pain (20%) or none to very little (30%) pain, no statistically significant differences were observed in physical activity and test. Statistically significantly better results ( $p = 0.002$ ) on working memory were found with respondents who do not expect that their health will deteriorate in the future compared to those who do not know whether they expect a deterioration in health. Respondents who thought that their health was excellent had achieved more points in the test than those who did not feel that their health was good ( $p = 0.039$ ). In the following, we analyzed the number of days they were physically active and the connection with working memory. Respondents who were active in their free time from 1 to 3 days ( $M = 3.59$ ) showed statistically significantly better results than respondents who were not active ( $M = 2.70$ ) and respondents who were active for 4-7 days ( $M = 4.71$ ),  $p = 0.002$ . **Conclusions:** In our study, we found that for cognitive tasks, attitude to health is more important than pain. Pain has an impact on health attitudes, it can reduce the quantity of movement and has an indirect effect on certain components of the working memory. A proper quantity of physical activity is also important.

**Key words:** pain, memory, psychological orientation

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## Prepoznavanje, pojavnost in obravnava centralne senzitivacije pri osebah s kronično bolečino

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**Uvod:** S pomočjo sodobne nevroznanosti lahko bolje razumemo mehanizme bolečine. Tako danes vemo, da je kronična bolečina odraz kompleksnega stanja v centralnem živčnem sistemu (1) in da je nevrofiziološko dogajanje, odgovorno za razvoj in vztrajanje kronične bolečine, kompleksno in zapleteno. Pri kronični bolečini, ki je dolgotrajna in pri kateri ni jasnega izvora nocicepcije, je pogosto prisotna centralna senzitivacija – povečana odzivnost nociceptorjev v osrednjem živčnem sistemu. Namen prispevka je opisati fenomen centralne senzitivacije, njeno prepoznavanje in pojavnost, saj lahko razumevanje mehanizmov kronične bolečine pomembno prispeva h kakovostnejši obravnavi pacientov. **Metode:** V podatkovni zbirki Pubmed in dLib so bile pregledane raziskave in pregledni članki, objavljeni med letoma 2009 in 2019, s ključnimi besedami kronična bolečina, centralna senzitivacija, nevroplastičnost in fizioterapija. **Rezultati:** Senzitivacija pripelje do trajnih anatomskih in funkcionalnih sprememb živčnega sistema (2). Te obsegajo spremembe na molekularni ravni in ravni posameznih sinaps. Okrepi se sinaptični prenos v sinapsah in spremeni se število sinaps zaradi sprememb na ravni nevronske mreže. Pri osebah s kronično bolečino in prisotno centralno senzitivacijo slabše funkcionira tudi descendenti mehanizem modulacije bolečine. Neustrezno delovanje tega sistema povzroči pretiran odziv osrednjega živčnega sistema, kar poveča bolečine. Pri določeni populaciji pacientov je lahko centralna senzitivacija poglavitni mehanizem, ki vzdržuje kronično bolečinsko stanje, kot na primer pri fibromialgiji, nihajni poškodbi vratu, kronični utrujenosti in sindromu razdražljivega črevesja. Centralna senzitivacija ni prisotna pri vseh pacientih s kronično bolečino, lahko pa je prisotna pri podskupinah oseb s kronično bolečino v križu, artrozo, nihajno poškodbo vratu, teniškim komolcem, bolečinami v rami in pri glavobolih (3). **Zaključki:** Pri pacientih, ki trpijo za kronično bolečino in pri katerih je prisotna centralna senzitivacija, uporaba metod in tehnik, ki so usmerjene na obravnavo lokalnega telesnega področja, napoveduje slab rezultat in ni učinkovita (4). Bolj so zaželeni centralni pristopi, ki ciljajo možganske in tako imenovane top down mehanizme. Ker je kronična bolečina kompleksna izkušnja, so se po svetu razvile multidisciplinarne obravnave, ki temeljijo na bio-psiho-socialnem modelu razumevanja bolečine. Glavni cilji rehabilitacije po bio-psiho-socialnem modelu so razumevanje kronične bolečine, stopnjevanje aktivnosti, obvladovanje nefunkcionalnih prepričanj o bolečini in katastrofičnega doživljanja bolečine, da bi izboljšali kakovost življenja in povečali vključenost tako v zasebnem kot v poklicnem življenju (5).

**Ključne besede:** kronična bolečina, centralna senzitivacija, fizioterapija, nevroplastičnost, bio-psiho-socialni pristop

## Recognition, occurrence and treatment of central sensitization in chronic pain patients

**Background:** Modern neuroscience gives us a better understanding of pain mechanisms. We know that chronic pain is a reflection of the complex state in the central nervous system (1) and that the neurophysiological events, responsible for the development and persistence of chronic pain are complex and complicated. In persistent chronic pain, where there is no clear origin of nociception, central sensitization –increased responsiveness of nociceptive neurons in the central nervous system – is commonly present. The purpose of this paper is to describe the phenomenon of central sensitization, its recognition and incidence, since the understanding of chronic pain mechanisms can significantly contribute to a better treatment of patients. **Methods:** In Pubmed and dLib databases, research and review articles, published between 2009 and 2019, were reviewed with the key words chronic pain, central sensitization, neuroplasticity, and physiotherapy. **Results:** Sensitization leads to permanent anatomical and functional changes in the nervous system (2). These include changes at the molecular level and at the level of individual synapses, which strengthen synaptic transmission in existing synapses, and changes in the number of synapses and at the level of neural networks, which increase the number of synapses. In patients with chronic pain and the presence of central sensitization, the descending mechanism of pain modulation also works poorly. Inadequate operation of this system causes an excessive response of the central nervous system, which strengthens pain. For a certain population of patients, central sensitization can be the main mechanism for maintaining chronic pain, for example in fibromyalgia, whiplash disorders, chronic fatigue and irritable bowel syndrome. Central sensitization is not present in all patients with chronic pain, but it may be present in subgroups of people with chronic back pain, arthrosis, whiplash, tennis elbow, shoulder pain and headaches (3). **Conclusions:** In patients suffering from chronic pain and in whom central sensitization is present, the use of methods and techniques aimed at addressing the local area of the body predicts a poor result and is not effective (4). Central approaches targeting brain and so-called 'top down' mechanisms are more desirable. Because chronic pain is a complex experience, multidisciplinary treatments have developed around the world, based on a bio-psycho-social model of understanding pain. The main goals of rehabilitation according to the bio-psycho-social model are understand chronic pain, graded activity, managing dysfunctional beliefs about pain and catastrophic pain experiencing with the goal of improving the quality of life and increasing inclusion in both private and professional life (5).

**Key words:** chronic pain, central sensitization, physiotherapy, neuroplasticity, biopsychosocial approach

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## **Fizioterapevtska obravnava pacienta z obsežno opeklino - Poročilo o primeru**

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**Uvod:** Opeklina je posebna vrsta rane, povzročena zaradi delovanja toplotne, kemične ali električne energije na tkivo in povzroča lokalni ali generaliziran edem (1, 2). Opekliška poškodba je posledica dotika kože z vročimi tekočinami ali delovanje toplotne energije zaradi suhe vročine. Posledice težjih opeklin predstavljajo kompleksen problem, ki terjajo dobro organizirano timsko obravnavo pacienta (3-5). Na podlagi z dokazi podprte prakse (4) je protibolečinska fizioterapevtska obravnava z uporabo številnih masažnih tehnik, mandibularne distrakcije in številnih drugih fizioterapevtskih postopkov najučinkovitejša pri zmanjšanju percepcije in intenzivnosti bolečine v akutni fazi opeklino. Prikaz primera: 44 letni pacient z 80 % deležem opeklino v zgodnji fazi obravnave je bil napoten na fizioterapijo. Ob začetku fizioterapevtske obravnave je bila izdelana ocena funkcionalnega stanja, načrt programa fizioterapije z zastavljenimi kratko- in dolgoročnimi cilji z namenom optimalne funkcioniranja pacienta. Glede na oceno so bili izbrani fizioterapevtski postopki za zmanjšanje edema, preprečevanje deformacije sklepov, izboljšanje obsega gibljivosti sklepov in izboljšanja prožnosti mehko tkivnih struktur ter celjenje tkiva. Velik poudarek je bil na obravnavi brazgotine s tehnikami manipulacije fascij. Za podporno terapijo so bile vključene tudi tehnike respiratorne fizioterapije, čiščenju dihalne poti in izboljšanju pljučne funkcije. Uporabljene so bile tudi pasivne in aktivno asistiranje vaje za izboljšanja mišične moči in nadzora nad ostalimi gibalnimi funkcijami. Z zgodnjo mobilizacijo, intenzivnim motoričnim učenjem je bila dosežena reedukacija hoje. V sklopu delovne terapije je pacient prejel statično opornico za desno roko in kompresijsko oblačilo. Ob zacelitvi ran so bile pri pacientu uporabljene tehnike ročne masaže, sklepne mobilizacije in PNF tehnike »zadrži-sprosti«. Pred odpustom je bil s pacientom izveden polstrukturirani intervju glede osebnega doživljanja izida rehabilitacije. Izvedeni so bili postopki meritev obsega edema na ekstremitetah, gibljivosti udov, ocenjena koordinacija gibanja, hoje, ravnotežja ter drže. Obravnava je trajala tri dni v tednu, dva do trikrat dnevno v razmahu treh mesecev. Pacient in svojci so bili deležni zdravstvene vzgoje: o načinu življenja doma, o omejitvah in pomenu nadaljevanja naučenega programa fizioterapevtske vadbe in masaže telesa. Tekom fizioterapevtskega programa je prišlo do izboljšanja rezultatov vseh zgoraj omenjenih meritev. Fizioterapevtski postopki so vplivali na telesno zgradbo in funkcijo od zmanjšanja stopnje bolečine, zmanjšanje edema, na kakovost brazgotine, zmanjšanje srbenja, preprečevanje disfunkcije v mehkih tkivih in nenazadnje na zmanjšanje psiholoških simptomov (depresija, tesnoba, strah). Pacient je izboljšal mišično moč, gibljivost, izboljšanje pljučne funkcije. **Zaključek:** Na podlagi kvantitativnih in kvalitativnih rezultatov ugotavljamo, da je bil fizioterapevtski program pri pacientu z obsežno opeklino uspešen. Kombinacija specifičnih fizioterapevtskih postopkov je pripomogla k izboljšanju stanja na področju telesnih zgradb in funkcij, na področju vsakodnevnega funkcioniranja ter na področju sodelovanja pacienta z obsežno opeklino.

**Ključne besede:** telo, opeklina, celjenje, rehabilitacija



## Physiotherapy management of a patient after burn injury – Case report

**Introduction:** Burn is a special type of wound caused by the action of heat, chemical or electrical energy on tissue and causes local or generalized edema (1, 2). Burning damage is the result of touching the skin with hot fluids or the operation of heat due to dry heat. The consequences of severe burns constitute a complex problem requiring a well organized team treatment (3-5). Based on evidence-based practice (4), antipain physiotherapy treatment using numerous massage techniques, mandibular distraction and many other physiotherapy procedures is most effective in reducing the perception and intensity of pain in the acute phase of burnout. Case report: A 44 year old patient with an 80% share of burns at an early stage of treatment was referred to physiotherapy. At the beginning of the physiotherapeutic treatment, an assessment of the functional state, the plan of the physiotherapy program with the set short and long-term goals was made an optimal functioning of the patient. According to the assessment, physiotherapeutic procedures for the reduction of edema, prevention of deformation of the joints, improvement in the flexibility of the joints and improvement of the flexibility of the soft tissue structures and of tissue healing were selected. A great deal of emphasis was on the treatment with techniques of fascia manipulation. Supportive therapy also included respiratory physiotherapy techniques, airway cleaning and improvement of pulmonary function. Passive and actively assisted exercises were also used to improve muscular strength and control over other motor functions. Early mobilization, intensive motor learning, achieved reeducation of the walk. Within the scope of occupational therapy, the patient received a static shoulder for the right hand and a compression garment. When the wounds were healed, manual massage techniques, concave mobilization and PNF "hold-release" technique were used in the patient. Before the dismissal, we conducted a semi-structured interview with the patient about the personal experience of the outcome of rehabilitation. We measured the extent of edema on the extremities, the movability of the limbs, the evaluation of the coordination of movement and walking, balance and posture. The treatment lasted three days a week, two to three times a day for three months. The patient and relatives received health education: the way of life at home, about the limitations and the importance of continuing the learned program of physiotherapeutic exercise and body massage. During the physiotherapeutic program, the results of all the above measurements were improved. Physiotherapeutic techniques influenced on the body structure and the function of reducing the degree of pain, reducing edema, on the quality of scars, treating itching, preventing the dysfunction in soft tissues as well as reducing psychological symptoms (depression, anxiety, fear). The patient improved muscular strength, flexibility, and improved pulmonary function. **Conclusions:** Based on quantitative and qualitative results, we have established that the physiotherapeutic program was successful in a patient with extensive burnout. The combination of specific physiotherapeutic procedures was improved the situation in the field of body buildings and functions, in the field of daily activity and in the field of patient co-operation with extensive burns.

**Key words:** body, burn, healing, rehabilitation

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## Pet-dnevni intenzivni program za obravnavo pacientov z adolescentno idiopatsko skoliozo na Univerzitetnem rehabilitacijskem inštitutu URI - Soča Ljubljana

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**Uvod:** Adolescentna idiopatska skolioza (AIS) je tridimenzionalna deformacija hrbtenice in trupa, ki se pojavi pri zdravih otrocih v puberteti. Aktivna samopoprava drže in vaje, usmerjene v izvedbo določene naloge, pri pacientih z manjšo skoliozo bolj vplivajo na zmanjšanje deformacije hrbtenice kot tradicionalne vaje za hrbtenico (1). Namen prispevka je ovrednotiti petdnevni intenzivni program za obravnavo AIS, ki smo ga poskusno izvedli na URI - Soča, in ga primerjati z izvajanjem vaj v aktivni samopopravi drže doma, v enotedenskem obdobju. **Metode:** V pilotski raziskavi, ki smo jo opravili leta 2018, smo program izvedli dvakrat. Petdnevni program je vsak dan vključeval 45-minutno fizioterapevtsko obravnavo po znanstveno vadbenem pristopu k skoliozi (Scientific Exercise Approach to Scoliosis - SEAS) (2), 45-minutno hidroterapijo, 60-minut delovne terapije, 60-minut športne aktivnosti in 30-minutno funkcionalno vadbo. V priložnostni vzorec so bili vključeni pacienti z AIS, ki so bili že obravnavani v ambulantno-rehabilitacijski službi (ARS) na URI - Soča in so vsi že imeli petkrat individualno fizioterapevtsko obravnavo po pristopu SEAS ter petkrat vodene vaje v manjši skupini. Pacienti v testni skupini so imeli pred začetkom intenzivnega programa eno uro edukacije o skoliozi. Pacienti v kontrolni skupini so imeli dve fizioterapevtski obravnavi po pristopu SEAS po 45 minut, enkrat na teden, z navodili, da doma vaje izvajajo vsak dan. Pri vseh pacientih smo prvi in zadnji dan obravnave naredili funkcionalno oceno (3), ki je vključevala Rombergov test stoje na eni nogi z odprtimi in zaprtimi očmi, test Fukuda, modificiran klinični test senzorične integracije in ravnotežja (Clinical Test of Sensory Integration and Balance – mCTSIB) na aparaturi Biodex System SD (4) ter oceno estetskega videza trupa z lestvico TRACE (Trunk Aesthetic Clinical Evaluation) (5). V programu Scoliosis Manager smo pripravili program vaj za individualno obravnavo. Analiza podatkov je bila narejena s programom SPSS. **Rezultati:** V testno skupino je bilo vključenih šest pacientk, starih povprečno 12,8 (SD 2,0) leta. Povprečna velikost glavne krivine je bila 20,2° po Cobbu. Ortozo je nosilo pet pacientk, v povprečju 16,2 (SD 5,2) ure na dan. V kontrolno skupino je bilo vključenih šest pacientov (pet deklet in en fant), starih povprečno 14,2 (SD 2,1) leta. Povprečna velikost glavne krivine je bila 29,6° po Cobbu. Ortozo sta nosila dva pacienta, v povprečju 15,5 (SD 0,7) ure na dan. V testni skupini je prišlo do sprememb, ki pa niso statistično značilne ( $p < 0,05$ ), v testih: Fukuda vertikalno ( $p = 0,188$ ), Rombergov test stoje na levi nogi z odprtimi očmi ( $p = 0,188$ ), zaprtimi očmi ( $p = 0,148$ ), mCTSIB ( $p = 0,250-0,798$ ), TRACE se je izboljšal za 0,33 točke na 5,7 (SD 1,6) ( $p = 0,178$ ). V kontrolni skupini je prišlo do izboljšanja pri Rombergovem testu stoje na levi nogi z zaprtimi očmi za 5,8 s, kar ni statistično značilno ( $p = 0,82$ ). TRACE je ostal enak 6,2 (SD 2,3). **Zaključki:** Petdnevni intenzivni program je bolj vplival na spremembe v ravnotežju in estetskem videzu trupa kot samostojno izvajanje vaj doma.

**Ključne besede:** AIS, posebne fizioterapevtske vaje za skoliozo, aktivna samopoprava drže, vaje, usmerjene v nalogo, SEAS

## Five-day intensive scoliosis specific exercise programme for patients with Adolescent Idiopathic Scoliosis at the University Rehabilitation Institute URI - Soča Ljubljana

**Background:** Adolescent idiopathic scoliosis (AIS) has been defined as a three-dimensional deformity of the spine and trunk occurring in healthy pubertal children. The programme of active self-correction and task-oriented exercises is superior to traditional exercises in reducing spinal deformities in patients with mild AIS (1). The objective is to evaluate experimentally performed five-day intensive scoliosis specific exercise programme for patients with AIS at the University Rehabilitation Institute URI - Soča Ljubljana and to compare it with performing exercises in active self-correction at home in one week period. **Methods:** In the pilot study we carried out in 2018 two intensive programs were arranged. A five-day program each day included: 45 minutes of physiotherapy treatment according to SEAS approach (2), 45 minutes of hydrotherapy, 60 minutes of occupational therapy, 60 minutes of sport activity and 30 minutes of task-oriented exercises. In a convenience sample patients with AIS were included which were already treated in an outpatient department at URI - Soča. They all had five individual physiotherapy treatments according to SEAS approach and exercises in a small group five times. Before the start of intensive program patients in the study group had one hour of education about scoliosis. Patients in the control group had two 45-minute physiotherapy treatments according to SEAS approach, once a week with instructions to perform exercises at home every day. On the first and the last day, all patients had functional examination (3) which included: Romberg test on one leg with open and closed eyes; modified Clinical Test of Sensory Integration and Balance (mCTSIB) using Biodex System SD (4) and Trunk Aesthetic Clinical Evaluation (TRACE) (5). An exercise plan for individual sessions using Scoliosis Manger was made. Data were analysed using SPSS. **Results:** There were 6 patients in the study group, mean age 12.8 (SD 2.0). Mean Cobb angle of the major curve was 20.2°. Cheneau-Rigo brace had five patients, mean time of wearing it was 16.2 (SD 5.2) hours per day. There were 6 patients in the control group (5 girls, 1 boy), mean age 14.2 (SD 2.1). Mean Cobb angle of the major curve was 29.6°. Cheneau-Rigo brace had 2 patients, mean time of wearing it was 5.5 (SD 0.7) hours per day. In the study group there were some changes but not statistically significant ( $p < 0.05$ ) in Fukuda vertical test ( $p = 0.188$ ), Romberg test on left leg with open eyes ( $p = 0.188$ ), closed eyes ( $p = 0.148$ ), mCTSIB ( $p = 0.250$  to  $0.798$ ), TRACE improved for 0.33 points on 5.7 (SD 1.6) ( $p = 0.178$ ). In the control group there was an improvement in Romberg test on left leg with closed eyes, for 5.8 s, which was not statistically significant ( $p = 0.82$ ). TRACE remained the same 6.2 (SD 2.3). **Conclusions:** Five-day intensive program for AIS influenced the changes in balance and aesthetics compared to home exercise compliance.

**Key words:** AIS; physiotherapeutic scoliosis-specific exercises, active self-correction, task-oriented exercises, SEAS

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## Dolgotrajno prekinjajoče se sklanjanje poveča refleksne odzive mišic trupa in togost trupa

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**Uvod:** Vse več dokazov iz raziskav na ljudeh in živalih kaže negativne učinke ponavljajočega se in vzdrževanega sklanjanja na pasivne strukture trupa ter uravnavanje gibanja (1). Še zmeraj je primanjkljaj študij, ki hkrati proučujejo mehanske učinke sklanjanja in učinke na senzorično-motorično uravnavanje. Namen naše raziskave je proučiti učinke 60-minutnega prekinjajočega se sklanjanja na stabilnost trupa in preveriti morebiten pozitiven učinek uporabe pasivne podpore za zgornji del trupa med sklanjanjem. Rezultati te študije so bili že objavljeni (2). **Metode:** V študijo je bilo vključenih 21 prostovoljcev (11 moških, starih  $23,2 \pm 2,0$  leti; 10 žensk, starih  $24,3 \pm 4,0$  leta). Študijo je odobrila etična komisija Fakultete za znanosti o gibanju človeka Univerze VU Amsterdam. Vsi preiskovanci so sodelovali prostovoljno in so podpisali izjavo o svobodni privolitvi. Preiskovanci so bili v dveh ločenih obiskih izpostavljeni dvema pogojema: podprtemu in nepodprtemu sklanjanju v sedečem položaju s pokrčenimi koleno. Vsak pogoj je vključeval 40 ciklov po 1 minuto 80-odstotnega največjega upogiba ledvene hrbtenice in 30 s vzravnanege sedenja. Med podprtim sklanjanjem so bili preiskovanci s prsnim košem in rameni naslonjeni na oblazinjeno podporo ustrezne višine. Z uporabo inovativne in ponovljive metode smo pred izpostavljenostjo posameznemu pogoju in po njej z merjenjem sil med dinamičnimi motnjami izmerili podajnost trupa. S hkratno uporabo elektromiografije (REFA, TMSi, Netherlands) smo izmerili refleksne odzive mišic trupa in spremembe ravni mišične aktivacije. Z uporabo inercialnih senzorjev (Xsens Technologies X-bus, Enschede, Netherlands) smo izmerili tudi spremembe v obsegu gibljivosti v smeri upogiba trupa. Podatke smo analizirali z uporabo analize variance za ponovljene meritve. **Rezultati:** Obseg gibljivosti v smeri upogiba ledvene hrbtenice se je povečal po obeh pogojih pri ženskah, toda le po nepodprtem sklanjanju pri moških preiskovancih ( $p = 0,044$ ,  $\eta^2 = 0,20$ ). V nekaterih frekvencah je bilo opaziti obsežnejše zmanjšanje podajnosti trupa po nepodprtem v primerjavi s podprtim sklanjanjem ( $p = 0,039$ ,  $\eta^2 = 0,13$ ). Prekinjajoče se sklanjanje je povzročilo povečanje refleksnih odzivov. Značilen interakcijski učinek kaže večje povečanje refleksnih odzivov po nepodprtem v primerjavi s podprtim sklanjanjem ( $p = 0,025$ ,  $\eta^2 = 0,14$ ). **Zaključki:** Spremembe v podajnosti trupa so v nasprotju s predhodnimi študijami, v katerih so proučevali krajša obdobja sklanjanja, kar podpira hipotezo, da so spremembe odvisne od trajanja sklanjanja (3). Trajanje obdobja obremenitev spodnjega dela hrbta bi bilo torej treba upoštevati pri ocenjevanju kumulativnih obremenitev hrbta. Učinki sklanjanja so bili podobni, vendar značilno manjši ob uporabi pasivne podpore za zgornji del trupa med sklanjanjem. Na tej podlagi bi bilo smiselno priporočiti pasivno podporo med delovnimi nalogami, ki zahtevajo daljša sklanjanja trupa.

**Ključne besede:** senzorično-motorično upravljanje, stabilnost trupa, perturbacije trupa, pasivna podpora za trup

## Prolonged intermittent trunk flexion increases trunk muscles reflex gains and trunk stiffness

**Background** There is a growing body of evidence from animal and human research indicating unfavourable effects of repeated and sustained flexion of the trunk on passive structures and on motor control (1). However, simultaneous investigations of mechanical and neuromuscular control changes following trunk flexion are scarce. The aim of this study was to assess the effect of a 60-minute intermittent trunk flexion. Additionally, the goal was to assess the potential beneficial effects of a passive support of the upper body in the flexed posture. The results of this study were already published (2). **Methods** Twenty-one young volunteers were included in the present study (11 males age  $23.2 \pm 2.0$  years and 10 females, age  $24.3 \pm 4.0$  years). The ethical committee of the Faculty of Human Movement Sciences of the VU University Amsterdam had approved the study protocol and all subjects signed an informed consent statement prior to the experiment. Participants were invited for two visits with two different exposure conditions: supported and unsupported flexion. During each condition participants performed 40 cycles of intermittent flexion (1 minute in 80 % of maximal lumbar flexion followed by 30-second upright sitting). In supported condition participants leaned on the padded support with their chests and shoulders. Before and after exposure to each condition innovative and reliable method was used to assess trunk admittance using force sensors and reflex gains using electromyography (REFA, TMSi, Netherlands) during small-amplitude trunk perturbations. Furthermore, changes in muscle activation and lumbar flexion range of motion were analysed (Xsens Technologies X-bus, Enschede, Netherlands). RMANOVA was used to check for potential differences. **Results** Maximal flexion range of motion increased following both conditions in female subjects but only following unsupported condition in male participants ( $p = 0.044$ ,  $\eta^2 = 0.20$ ). Stronger reduction of admittance gain was shown after unsupported than after supported flexion at certain frequencies ( $p = 0.039$ ,  $\eta^2 = 0.13$ ). Intermittent trunk flexion resulted in increased reflex gains with reflex gains also overall being higher in the unsupported condition. A significant interaction effect indicated a stronger increase in reflex gain after unsupported flexion at all analysed frequencies but the lowest ( $p = 0.025$ ,  $\eta^2 = 0.14$ ). **Conclusions** The change in admittance is in contrast with results of previous studies that used shorter lasting interventions, therefore supporting the idea of a time-varying response to lumbar viscoelastic deformation (3). Therefore, the duration of the spinal loading should be considered when assessing cumulative low back loading and its effects. The effects of trunk flexion were similar but significantly smaller when external passive support for the upper body was used. For this reason, the use of upper body support would be recommended in occupational settings requiring flexed postures.

**Key words:** neuro-muscular control, trunk stability, trunk perturbations, passive upper body support

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Raziskava je bila izvedena v okviru raziskovalnega gostovanja na Vrije Universiteit Amsterdam, sofinanciral ga je Javni sklad Republike Slovenije za razvoj kadrov in štipendije

## Pojavnost mišično-kostnih okvar pri glasbenikih in glasbenicah – pregled literature

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**Uvod:** Mišično-kostne okvare, na katere vpliva oziroma jih povzroča igranje inštrumenta, imenujemo z igranjem povezane mišično-kostne okvare. Zaradi delovnega okolja in prisilne telesne drže, ki jo morajo poklicni glasbeniki vsak dan zadrževati tudi več ur, so mišično-kostne okvare pogost pojav (1, 4, 5). Povzročajo lahko bolečine, nezmožnost opravljanja dela na najvišji ravni in celo prenehanje dela (2, 3). Namen prispevka je pregledati objavljene rezultate raziskav o pojavnosti in dejavnih tveganja za mišično-kostne okvare med glasbeniki in glasbenicami ter načine za njihovo preprečevanje. **Metode:** V pregled literature so bila vključena prosto dostopna polna besedila raziskav o pojavnosti in dejavnih tveganja za mišično-kostne okvare med poklicnimi glasbeniki simfoničnih orkestrrov, objavljena od leta 2000. Literaturo smo iskali v podatkovnih zbirkah PubMed, CINAHL, PEDro. Uporabljene ključne besede so bile musculoskeletal disease AND musician, musician AND risk factor AND musculoskeletal problems. **Rezultati:** Iskanje literature je dalo 494 zadetkov, 6 od teh je bilo vključenih v analizo. Vse raziskave so bile pregledne presečne. Pojavljale so se razlike v definiciji z igranjem povezanih mišično-kostnih okvar, merilnih orodjih, časovnem okviru pojavnosti in podajanju podatkov o izidih raziskav. V raziskavah je sodelovalo 1645 preiskovancev. Pojavnost okvar med glasbeniki v zadnjem letu je bila od 83- do 97-odstotna, kadarkoli v življenju pa od 84- do 89,5-odstotna. Najpogosteje prizadeti predeli so bili vrat, ramena, zgornji del hrbta in križ. Med ženskami in godalci so se pogosteje pojavljale mišično-kostne okvare. Drugi dejavniki tveganja so bili biomehanski dejavniki (ekstremna telesna drža, pretirana mišična aktivacija, ponavljajoči se gibi, statično in dinamično breme), zaznano fizično okolje (glasnost zvoka, temperatura, vlažnost, prezračenos in osvetljenost koncertnih prostorov ter prostorov za vadbo), veliko ur igranja na inštrument, težnja po somatiziranju, trema pred nastopanjem in depresija. **Zaključki:** Z igranjem povezane mišično-kostne okvare imajo med glasbeniki visoko pojavnost. Zaradi strahu, da bi izgubili spoštovanje kolegov in delovno mesto, jih prizadeti pogosto zamolčijo. Potrebne so dodatne visokokakovostne raziskave, v katerih bi vsi avtorji uporabili enako definicijo z igranjem povezanih mišično-kostnih okvar in enaka standardizirana merilna orodja.

**Ključne besede:** mišično-kostne okvare, bolečina, poklicni glasbeniki, dejavniki tveganja, pojavnost

## Incidence of musculoskeletal disorders in musicians – literature review

**Background:** Musculoskeletal disorders that are affected or caused by playing an instrument are addressed as playing-related musculoskeletal disorders. Musculoskeletal disorders are common phenomenon among musicians due to their working environment and forced body postures they have to retain every day for up to several hours. They can cause pain, inability to perform on maximum level and even termination of work. The aim of the article was to review published results of studies that investigated incidence and risk factors for musculoskeletal disorders among musicians and to determine ways of preventing them. **Methods:** Studies investigating incidence and risk factors for musculoskeletal disorders among professional musicians employed in symphonic orchestra which were published from year 2000 onwards and with access to full text were included in this review. Literature was searched in databases PubMed, CINAHL and PEDro. Keywords used in literature search were musculoskeletal disease AND musician, musician AND risk factor AND musculoskeletal problems. **Results:** The initial literature search strategy resulted in 494 hits, six of which were included in analysis. All studies were cross-sectional. Differences in definitions of playing-related musculoskeletal disorders, measuring tools, time frame of incidence and presentation of results were present in studies. Total number of participants included in all studies was 1645. Year prevalence of disorders among musicians ranged between 83–97 % and life prevalence ranged between 84–89,5 %. Most common pain regions were neck, shoulders, upper back and lower back. Women and string players had higher incidence of musculoskeletal disorders. Other risk factors were biomechanical factors (extreme body postures, excessive muscle activation, repetitive movements, static and dynamic loading), perceived physical environment (sound intensity, temperature, humidity, ventilation and illumination in the concert and rehearsal halls), many playing hours, somatizing tendency, performance anxiety and depression. **Conclusions:** Playing-related musculoskeletal disorders have high prevalence among musicians. They often conceal them, fearing that they might lose the appraisal of their colleagues and their job. There is need for more high quality studies in which all authors would use the same definition of playing-related musculoskeletal disorders and same measuring tools.

**Key words:** musculoskeletal disorders, pain, professional musicians, risk factors, incidence

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## Vpliv elastičnih lepilnih trakov na izboljšanje prekrvavitve preostalega uda pri bolnikih po amputaciji spodnjega uda zaradi žilnega vzroka

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**Uvod:** Večina bolnikov po amputaciji noge ima zaradi periferne arterijske bolezni (PAB) večje ali manjše spremembe ožilja tudi na preostalem udu (1). Pri kroničnih okvarah s klavdikacijsko bolečino je poleg zdravljenja z zdravili priporočena intervalna vadba, ki pa je pri bolnikih po amputaciji zaradi omejene možnosti gibanja neizvedljiva, zato se v tem obdobju uporabljajo različne druge metode fizikalne terapije, na primer elektrostimulacija, vakuumska terapija, intermitentna kompresija, hiperbarična terapija idr. (2). Pri uporabi elastičnih lepilnih trakov so ugotovili takojšnje ugodne učinke na bolečino in gibljivost sklepov, zmanjšanje edema in v nekaterih pilotnih študijah tudi povečanje pretoka na ravni mikrocirkulacije pri zdravih preiskovancev (3, 4). Namen raziskave je bil ugotoviti kratkoročen vpliv elastičnih lepilnih trakov na izboljšanje prekrvitve preostalega uda pri bolnikih po amputaciji vzroka. **Metode:** Do zdaj je bilo v pilotno raziskavo vključenih osem bolnikov, ki so bili naključno razvrščeni v dve skupini. Pacienti v testni skupini so imeli poleg rednih fizioterapevtskih programov elastični lepilni trak nameščen čez podkolensko jamo na dvoglavo mečno mišico in skupino upogibalk kolena. Uporabili smo tehniko za razbremenjevanje. Izvedene meritve pred vključitvijo so bile skozižilna oksimerija na standardnem mestu stopala, volumen spodnjega uda do kolena po protokolu za opredelitev limfedema, 6-minutni test hoje z določitvijo klavdikacijske razdalje in število možnih ponovitev dviga na prste in peto. Meritve smo ponovili po dveh in štirih tednih. Raziskavo je etična komisija URI - Soča odobrila 8. januarja 2018, številka 8/2018. **Rezultati:** Povprečna vrednost TcPO<sub>2</sub>-10 min je znašala 21,00 mm Hg in TcPO<sub>2</sub>-20 min 32,5 mm Hg. Povprečen volumen spodnjega uda do kolena je znašal 1566,76 cm<sup>3</sup>. Pri TcPO<sub>2</sub> in v volumnu spodnjega uda med prvim, drugim in tretjim ocenjevanjem ni bilo statistično značilnih razlik. Rezultati obeh funkcionalnih testov so se statistično značilno izboljšali od prvega do tretjega ocenjevanja; dvigovanje na prste (povprečje: 42,0; mediana: 29,5), 6-minutni test hoje (povprečje: 95 m; mediana: 45 m). Klavdikacijska bolečina je bila prisotna pri enem pacientu (prvo ocenjevanje – 20 m, drugo ocenjevanje – 27 m), ki pa je popolnoma izzvenela do tretjega ocenjevanja. **Zaključki:** V preostali nogi nismo dokazali klinično pomembnih sprememb v prostornini in tlakih. Za doseg veljavnejših rezultatov je treba v raziskavo vključiti večje število pacientov. Kljub izboljšanju pri kliničnih testih ne moremo zaključiti, da je izboljšanje posledica uporabe elastičnih lepilnih trakov.

**Ključne besede:** prekrvavitve, PAB, elastični lepilni trak



## Influence of elastic adhesive tapes on the improvement of blood circulation in the remaining limb in patients after lower limb amputation

**Introduction:** After lower-limb amputation most patients experience greater or minor changes in the vascular system in the remaining limb due to the peripheral arterial disease (PAD) (1). In addition to treatment with medication in chronic disorders with claudication pain, interval training is also recommended. However, this is not possible in patients who have recently undergone amputation, due to their limited mobility. Therefore, other physical therapy methods are used during this period, such as electrostimulation, vacuum therapy, intermittent compression therapy, hyperbaric therapy, etc. (2). The use of elastic adhesive tapes is beneficial in the reduction of pain and greater flexibility of joints, reduction of oedema, and some pilot studies have shown they increase the flow at the level of microcirculation in healthy subjects (3, 4). The purpose of the study is to determine the short term effects of elastic adhesive tapes on the improvement of blood circulation in the remaining limb in patients after lower limb amputation.

**Methods:** Eight patients were included. Subjects were randomly assigned in two groups. In the experimental group, the patients had, beside regularly prescribed physiotherapy, elastic adhesive tape applied over the popliteal fossa onto the m. gastrocnemius and a group of knee flexors. A disburdening technique was used. Measurements that were carried out prior to the inclusion in the study: transcutaneous oxygen measurement (TcPO<sub>2</sub>), volume (V) of the calf in accordance with the lymphedema definition protocol, 6-minute walk test (6MWT) with the determination of claudication pain and number of repetitions of standing heel-raise. Measurements were repeated after two and four weeks. The study was approved by the URI - Soča Ethic Commission on the eighth of January 2018, number 8/2018. **Results:** The median value of TcPO<sub>2</sub>-10min was 21.0 mmHg and of TcPO<sub>2</sub>-20min was 32.5 mmHg. The volume of the lower limb below the knee was in average 1566.76 cm<sup>3</sup>. There were no statistically significant differences in TcPO<sub>2</sub> and in the volume of the lower limb below the knee in the first, second and third assessment. The results of both functional tests in the first and third tests improved significantly; standing heel-raise test (median: 29.5; 42.0), 6MWT (median: 45 m; 95 m). Claudication pain occurred in one patient (first assessment 20 m, second assessment 27 m), which completely diminished in the 3rd assessment.

**Conclusion:** No clinically significant changes in the volumes and pressures of the remaining lower limb were detected. Therefore, a bigger sample size should be included in the research to obtain more valid results. Despite improving in the functional tests, we can't firmly conclude that the results have improved with the elastic adhesive tape application.

**Key words:** blood circulation, PAD, elastic adhesive tape

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## Učinki vadbe moči in vzdržljivosti inspiratornih dihalnih mišic na telesno zmogljivost pripadnikov Specialne enote Slovenske vojske

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**Uvod:** Namen raziskovalnega dela je bil ovrednotiti učinke vadbe dihalnih mišic s pripomočkom POWERbreathe pri pripadnikih Specialne enote SV. Namestitev bremena na prsni koš namreč omeji ekspanzijo prsnega koša, kar povečuje dihalno delo. Zaradi omejenega širjenja pljuč so dihalne mišice zunaj optimalnih meja svoje dolžinsko-napetostne krivulje. Taka sprememba v mehaniki dihanja pripelje do pospešene utrujenosti dihalnih mišic, kar lahko poslabša delovno zmogljivost posameznika, saj se zmanjša pretok krvi v drugih skeletnih mišicah in poveča zaznavanje napora (1). Raziskava Faghyja in Browna (2) je pokazala, da ta pojav lahko uspešno zmanjšamo s ciljano vadbo inspiratornih dihalnih mišic, vendar ni jasno, kakšen dihalni upor je potreben za optimalen učinek vadbe. **Metode:** Prostovoljce iz Enote za specialno delovanje SV smo z žrebom razdelili v dve skupini. Uvodno in končno testiranje je vključevalo antropometrične meritve, obremenilne teste za dihalne mišice, spirometrijo in test hoje s 25-kilogramskim nahrbtnikom na tekalni stezi. Eksperimentalna skupina je šest tednov vadila s pripomočkom POWERbreathe in z začetnim uporom 60 % MIP, ki smo ga postopno dvignili do 80 % MIP. Kontrolna skupina je vadila z enakim pripomočkom, a le z navideznim dihalnim uporom. Protokol vadbe je bil za obe skupini enak. Vadili so vsak dan v tednu, dvakrat na dan po 30 zaporednih maksimalnih vdihov z uporom, ki je bil prednastavljen na pripomočku. Obe skupini sta vodili dnevnik vadbe. Po končanem programu vadbe so preiskovanci opravili končno testiranje. Raziskavo je odobrila Komisija RS za medicinsko etiko, šifra odobritve 0120/494/2017. **Rezultati:** Izsledki raziskave so pokazali, da je prišlo do statistično pomembnih sprememb v času med skupinama v moči inspiratornih in ekspiratornih dihalnih mišic, kar pripisujemo učinku vadbe. Prav tako je prišlo do statistično pomembnih razlik v času med skupinama v utrujanju inspiratornih in ekspiratornih dihalnih mišic pred testom hoje in po njem. Ocenjena stopnja aerobne zmogljivosti, frekvenca srčnega utripa v mirovanju in med naporom, krvni tlak ter subjektivna ocena mišičnega in dihalnega napora po Borgovi lestvici se z vadbo niso pomembno spremenili. **Zaključki:** Vadba inspiratornih dihalnih mišic z ustreznim uporom izboljša mišično moč dihalnih mišic in zmanjša njihovo utrujanje. Ocenjujemo, da pomembnih razlik v merjenih spremenljivkah med testom hoje nismo zaznali zaradi nekoliko prenizke intenzivnosti uporabljenega testa, ki so ga vsi sodelujoči opravili brez večjega napora. Na podlagi rezultatov menimo, da je vadba inspiratornih dihalnih mišic smiselna za različne skupine telesno zahtevnih poklicev, na primer za terenske vojaške službe, gasilce, službe nujne medicinske pomoči ipd., kot tudi za posameznike, ki pri rekreativnih dejavnostih nosijo nahrbtnike, torej pohodnike, alpiniste, turne smučarje ipd.

**Ključne besede:** nošenje bremena, utrujanje inspiratornih dihalnih mišic, vadba inspiratornih dihalnih mišic, vojaki

## Effects of strength training and endurance of inspiratory respiratory muscles on the physical performance of members of the Slovenian Armed Forces Special Unit

**Background:** The purpose of this research was to evaluate the effects of the IMT with the POWERbreathe device on the members of Slovenian Armed Forces Special Unit. The load mass carrying on the chest wall limits the chest expansion, which increases the work of breathing. Because of the limited lung movement, the respiratory muscles are beyond the optimal limits of their longitudinal-tension curve. Such change in respiratory mechanics leads to an accelerated fatigue of the respiratory muscles that can worsen the capacity of the individual, by reducing blood flow to other skeletal muscles and increasing the perception of effort (1). The research conducted by Faghy and Brown (2) showed that this phenomenon can be successfully reduced by targeted training of the inspiratory muscles, but it is not clear what is the optimal respiratory resistance for the optimal effect of exercise. **Methods:** The volunteers from the Slovenian Armed Forces Special Unit were divided into two groups by lot. Introductory and final testing included: anthropometric measurements, fatigue tests for respiratory muscles, spirometry, and a walk test with a 25-kg backpack on the treadmill. For six weeks, the experimental group trained with the POWER breathe device with an initial resistance of 60% MIP, which gradually increased to 80% MIP. The control group exercised with the same device, but with sham respiratory resistance. The training protocol was the same for both groups. They trained every day of the week, twice a day with 30 consecutive maximum breaths with resistance that was pre-set on the device. Both groups were keeping the exercise diary. After completion of the exercise program, the subjects completed the final testing. The research was approved by the Medical Ethics Commission of the Republic of Slovenia, approval code 0120/494/2017. **Results:** The results of the study showed that there were statistically significant changes in time between the groups in the power of the inspiratory and expiratory respiratory muscles, which is attributed to the effect of IMT. Also, there were statistically significant differences in time between the groups in tiredness of the inspiratory and expiratory respiratory muscles before and after the walking test. The estimated aerobic capacity, heart rate at rest and during exercise, blood pressure, and subjective assessment of muscle and respiratory effort on the Borg scale did not statistically significantly change after training. **Conclusions:** The exercise of the inspiratory respiratory muscles with appropriate resistance improves the muscular strength of the respiratory muscles and reduces their fatigue. We estimate that significant differences in the measurements during the walking test were not detected due to the somewhat low intensity of the test used, which all participants performed without effort. Based on the results, we believe that IMT is appropriate for different groups of physically demanding occupations (e.g., field military services, firefighters, emergency medical services, etc.) as well as for individuals who wear backpacks in hiking activities (hikers, alpinists, mountain skiers, etc.).

**Key words:** load mass carrying, inspiratory muscles tiring, inspiratory muscle training, soldiers

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## Izboljšanje prehojene razdalje v šestih minutah pri pacientih po amputaciji spodnjega uda po odpustu z rehabilitacije

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**Uvod:** Prehojena razdalja v šestih minutah je dober pokazatelj submaksimalne funkcijske telesne zmogljivost bolnikov, ki kaže raven vsakodnevne telesne aktivnosti. Šestminutni test hoje uporabljamo tudi za oceno hitrosti in vzdržljivosti hoje pri osebah po amputaciji spodnjega uda (1). Namen raziskave je bil ugotoviti, ali pacienti po amputaciji spodnjega uda napredujejo pri šestminutnem testu hoje od konca rehabilitacije do prvega kontrolnega pregleda. **Metode:** Izvedli smo pregled medicinske dokumentacije pacientov po enostranski amputaciji spodnjega uda, ki so bili od 1. januarja do 31. decembra 2017 na rehabilitaciji na Univerzitetnem rehabilitacijskem inštitutu Republike Slovenije - Soča v Ljubljani. Za vse paciente, ki so bili prvič na bolnišnični rehabilitaciji oziroma prvič oskrbljeni s protezo, smo zbrali podatke o izidih šestminutnega testa hoje ob odpustu in ob prvi kontroli po odpustu. Raziskavo je odobrila etična komisija URI - Soča (št. 13/2018). **Rezultati:** V raziskavo je bilo vključenih 35 preiskovancev (32 moških, 3 ženske), ki so bili ob odpustu povprečno stari 64 (SO:  $\pm 16,6$ ; razpon: 21–86) let. Sedem preiskovancev je bilo po transfemoralni (80 %) in 28 (20 %) po transtibialni amputaciji. Prehojena razdalja v šestih minutah se je povprečno izboljšala za 59 (SO:  $\pm 100$ ; razpon: 20–980) metrov. Pripomoček, ki je bil najpogosteje uporabljen med hojo, sta bili dve bergli (37 %). Rezultati so pokazali, da je med obema testiranjema v povprečju minilo 207 dni (SD:  $\pm 80$  dni, razpon: 66–407 dni). Ugotovili smo, da število dni med obema testiranjema nima statistično pomembnega vpliva na izboljšanje prehojene razdalje ( $r = -0,28$ ,  $p = 0,105$ ). S starostjo je bilo izboljšanje pri prehojeni razdalji manjše. **Zaključek:** Ugotovili smo, da se je prehojena razdalja v šestih minutah po odpustu z rehabilitacije do prve kontrole povečala. Nadaljnje raziskave bi morale vključevati večji vzorec pacientov, v katerega bi vključili več dejavnikov, ki pomembno vplivajo na izide šestminutnega testa hoje.

**Ključne besede:** amputacija, šestminutni test hoje, spodnji ud, premičnost, proteza, hoja

## Improvement in six-minute walking distance in patients after lower-limb amputation after discharge from rehabilitation

**Background:** The walking distance in six minutes is a good indicator of the submaximal functional body capacity of patients, reflecting the level of daily physical activity. The six-minute walk test is also used to assess walking capacity and endurance of gait in subjects after lower-limb amputation (1). The purpose of the study was to determine to what extent patients after the lower-limb amputation improved at six-minute walk test in the period after discharge from rehabilitation to the first control examination. **Methods:** We examined the medical documentation of patients with unilateral lower-limb amputation, which were hospitalized at the University Rehabilitation Institute, Republic of Slovenia - Soča, Ljubljana, from 1 January 2017 to 31 December 2017. For all patients we collected the results of six-minute walk test after discharge and at the first control examination. The research was approved by the Ethics committee of URI - Soča (13/2018). **Results:** The study included 35 subjects (32 men, 3 women) following lower limb amputation, aged 64 years on average (SD: 16.6; range: 21-86 years). The seven involved transfemoral (80%) and 28 (20%) transtibial amputation. The device most commonly used during walking was 2 crutches (37%). The distance walked in six minutes improved by an average of 59 m (SD: 100) (range: 20-980 m). The results showed that between the two tests, on average 207 days passed (SD: 80 days, range: 66-407 days). We found that the number of days between the two tests has no statistically significant effect on the improvement of the walk distance ( $r = -0.28$ ,  $p = 0.105$ ). With age, the improvement at the walk distance was lower. **Conclusions:** In the study we found that the walk distance in six minutes increased. Further research should include a larger sample of patients in which several factors would be included which significantly influence the outcome of the six-minute walking test.

**Key words:** amputation, six-minute walk test, lower limb, mobility, prosthesis, walking

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## Sporno določilo za skrajšanje čakalnih dob v fizioterapiji leta 2018

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**Uvod:** Splošni dogovor za pogodbeno leto 2018 (1) je prinesel v osnovnem zdravstvenem varstvu novo, sporno določilo, na katero izvajalci nimajo vpliva. Določil je, da morajo za priznanje celotnega programa doseči normativ dela v utežeh in izvesti obravnavo 250 različnih zavarovanih oseb na en fizioterapevtski tim. Število različnih zavarovanih oseb je Zavod za zdravstveno zavarovanje Slovenije (ZZZS) izvajalcem določil individualno, glede na število fizioterapevtskih timov. V primeru nedoseganja števila različnih zavarovanih oseb bo manjkajoče število procentualno odšteto od celotnega programa, ovrednotenega v utežeh. Novembra 2018 je vlada potrdila tudi Aneks številka 2 k Splošnemu dogovoru za pogodbeno leto 2018 (2), ki s ciljem skrajševanja čakalnih dob omogoča plačilo do 20 odstotkov preseženega programa nad načrtom storitev. **Metode:** Raziskava z uporabo retrospektivne analize rezultatov vključuje 158 (3) izvajalcev fizioterapije, s katerimi je imel ZZZS leta 2018 sklenjeno pogodbo za izvajanje fizioterapevtskih storitev na področju osnovnega zdravstvenega varstva. Program za 558,37 fizioterapevtskega tima je bil porazdeljen med 45 zdravstvenih domov, 11 bolnišnic, 10 zdravilišč, 90 koncesionarjev in 2 socialna zavoda. Izvajalci so obravnavali 165.935 vseh zavarovanih oseb, od tega 145.711 (4) različnih zavarovanih oseb. **Rezultati:** ZZZS je z izvajalci sklenil pogodbe za program v vrednosti 329.259,69 uteži s hkratno zahtevo po realizaciji obravnav 139.209 različnih zavarovanih oseb in naknadno omogočil plačilo dodatnih 65.851,94 uteži s pogojem, da bodo obravnavali dodatnih 27.968 različnih zavarovanih oseb. Sedmim izvajalcem je do realizacije osnovnega letnega programa zmanjkalo 647,71 uteži (0,20 %). 151 izvajalcev je program preseгло za 34.657,10 uteži (10,55 %). Pogodbeno potrebnega števila različnih zavarovanih oseb ni uspelo doseči 14 zdravstvenim domovom (1327 oseb premalo), štirim bolnišnicam (471 oseb premalo), trem zdraviliščem (320 oseb premalo) in trem koncesionarjem (42 oseb premalo). ZZZS tem izvajalcem ni plačal presežnega dela v utežeh, poleg tega pa jim je odtegnil tudi plačilo osnovnega programa zaradi nedoseganja števila različnih zavarovanih oseb: zdravstvenim domovom v vrednosti 3130,393 uteži (5,68 %), bolnišnicam v vrednosti 1111,089 uteži (6,49 %), zdraviliščem v vrednosti 754,880 uteži (5,62 %) in koncesionarjem v vrednosti 99,078 uteži (2,75 %). Za celotno preseženo realizacijo programa je ZZZS vsem izvajalcem skupaj priznal zgolj 15.934,39 uteži (31,15 %). Plačnik je tako prihranil finančna sredstva za realizirano fizioterapevtsko obravnavo kar 10.115 obravnavanih oseb. **Zaključek:** Na podlagi analize omenjene realizacije ugotavljamo, da cilj spornega določila ni bilo skrajšanje čakalnih dob, temveč je šlo kljub realiziranemu povečanemu obsegu dela le za prihranek finančnih sredstev plačnika storitev. Merila so bila moralno sporna in v finančnem delu nezakonita. Za zaščito in napredek fizioterapevtske stroke bi se moralo vodstvo Združenja fizioterapevtov Slovenije – strokovnega združenja poleg vizij dela fizioterapevtov v prihodnosti zavzemati za odpravo vse bolj spornih pogojev dela, s katerimi se več kot polovica njegovega članstva, ki dela v osnovnem zdravstvenem varstvu, spoprijema iz leta v leto.

**Ključne besede:** določilo, uteži, različne številke ZZZS

## A contestable stipulation meant for shortening of waiting times in physiotherapy in 2018

**Introduction:** The General agreement for the contractual year 2018 (1) in basic health care brought a new, contestable stipulation which the practitioners cannot influence in any way. To attain the confirmation of the entire program they have to reach the working norm in »weights« and carry out the treatment of 250 different insured persons per physiotherapeutic team. The Health Insurance Institute of Slovenia (Zavod za zdravstveno zavarovanje Slovenije – ZZZS) defined the number of different insured persons for each practitioner individually, with regard to the numbers of their therapeutic teams. If they don't reach the defined number of different insured persons, the missing percentage will be deducted from the entire program valued in weights. In November 2018 the government also confirmed Supplement No. 2 to the General agreement for the contractual year 2018 (2) which, in order to help shortening the waiting times, enables payment of surplus in the realized program up to 20%. **Methods:** The study with retrospective analysis comprises all 158 (3) practitioners of physiotherapy who had valid contracts with ZZZS in 2018 for physiotherapeutic activity in the field of basic health care. The program for 558.37 physiotherapeutic teams was distributed amongst 45 community health centers, 11 hospitals, 10 health resorts, 90 licensees and 2 social institutions. The practitioners treated a total of 165,935 insured persons, 145,711 (3) of these were different insured persons. **Results:** ZZZS contracted with practitioners a program amounting to 329,259.69 weights, demanding at the same time the realization of treatments of 139,209 different insured persons and enabling later on the payment of additional 65,851.94 weights on condition that additional 27,968 different insured persons would be treat. 7 practitioners failed in realizing the basic annual program by 647.71 weights (0.20%). 151 practitioners exceeded the program by 34,657.10 weights (10.55%). The necessary number of different insured persons stated in the contract was not reached by 14 community health care centers (they were 13,427 persons short), 4 hospitals (471 persons short), 3 health resorts (320 persons short) and 3 licensees (42 persons short). ZZZS did not pay these practitioners' surplus work in weights, and they were also denied the payment of their basic program because they had not reached the necessary number of treatments of different insured persons: the community health centers were denied the payment of 3130.393 weights (5.68%), the hospitals of 1111.089 weights (6.49%), the health resorts of 754.880 weights (5.62%) and the licensees of 99.078 weights (2.75%). ZZZS's payment for the total surplus realization of the program received by all practitioners together amounted to only 15,934.39 weights (31.15%). This way the payer saved up financial means for realized physiotherapeutic treatment of no less than 10,115 treated persons. **Conclusion:** Based on the analysis of the realization it is obvious that the goal of the contestable stipulation was not shortening of waiting times but in spite of the increased workload, just saving of the payer's financial means. The criteria were morally debatable and, in the financial part, illegal. To protect and promote our profession the leadership of the Slovenian Association of Physiotherapists should, besides its future visions of physiotherapists' work, also advocate the elimination of increasingly controversial working conditions by which more than half of the membership in primary health care has been faced year after year.

**Key words:** stipulation, weights, different ZZZS numbers

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# Vpliv različnih programov telesne dejavnosti gibanja specialne olimpijade na komponente telesne pripravljenosti in kakovost življenja odraslih športnikov z intelektualno motnjo

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**Uvod:** Sodobna družba se spoprijema z izzivom, kako ranljivi skupini prebivalstva odraslih športnikov z intelektualno motnjo (IM) v procesu staranja zagotoviti ustrezno podporo pri izboljšanju telesne pripravljenosti, dejavnega življenjskega sloga in kakovosti življenja (1–3). Namen študije je raziskati kratkoročen vpliv treh različnih programov telesne dejavnosti v okviru specialne olimpijade Slovenije (SO) na posamezne komponente telesne pripravljenosti in kakovost življenja starajočih se športnikov z IM ter preučiti povezanost posameznih komponent telesne pripravljenosti s kakovostjo življenja. **Metode:** Uporabljen je bil protokol dvojno slepe stratificirane randomizirane klinične študije, v katero je bilo vključenih 150 telesno nedejavnih odraslih oseb z IM. Razvrščene so bile v dve študijski skupini, in sicer v skupino fun fitness plus v kombinaciji z rednimi treningi SO (N = 50) ter v skupino wellness v kombinaciji z rednimi treningi SO (N = 50) in kontrolno skupino (redni treningi SO). Začetne meritve posameznih komponent telesne pripravljenosti (sklop funkcijskih testov Fun fitness) (4) in ocenjevanje kakovosti življenja s skrajšano različico vprašalnika kakovosti življenja za osebe z IM (angl. World Health Organisation Quality of Life; kratica WHOQOL BREF) (5) so bile izvedene ob začetku in ob koncu štirimesečne raziskave. Uporabljeni sta bili multipla regresijska analiza in diskriminantna analiza. Raziskavo je odobrila Komisija Republike Slovenije za medicinsko etiko (št. 0120-598/2017/7). **Rezultati:** Z F-statistiko (20,260) je postavljeni regresijski model, ki je statistično značilen ( $p \leq 0,001$ ). Popravljen determinacijski koeficient multiple regresije ( $R^2_{pop}$ ) pojasnjuje 53,8 odstotka skupnega prostora med dejavniki telesne pripravljenosti in kakovostjo življenja, kar dokazuje dobro pojasnjenost med spremenljivkami. Na podlagi dobljenih rezultatov obstaja linearna kombinacija merjenih odvisnih spremenljivk s komponentami telesne pripravljenosti. Dobljene razsežnosti so tiste, ki kar najbolj pojasnjujejo razlike v telesni pripravljenosti med udeleženci navedenih skupin. Diskriminantna spremenljivka kaže na podlagi 81-odstotne gotovosti dobro telesno pripravljenost starajočih se odraslih športnikov z IM. **Zaključek:** Študija ima visoko notranjo in zunanjo veljavnost zaradi uporabe strogega raziskovalnega protokola, s katerim se je maksimalno zmanjšal vpliv groženj na veljavnost in zanesljivost. Z omenjenim prispevkom k znanosti se prispeva h globljemu in širšemu razumevanju vpliva različnih programov gibalne aktivnosti (v okviru specialne olimpijade) na posamezne komponente telesne pripravljenosti starajočih se oseb z IM ter na njihovo kakovost življenja.

**Ključne besede:** staranje odraslih oseb z intelektualno motnjo, telesna pripravljenost, specialna olimpijada, kakovost življenja



## The influence of various physical activity programs of the Special Olympics movement on the components of physical fitness and the quality of life of adult athletes with intellectual disability

**Introduction:** A modern society faces the challenge of providing vulnerable groups of adult athletes with intellectual disabilities (ID) in the process of aging with appropriate support in improving physical fitness, active lifestyle and quality of life (1-3). The purpose of our study was to investigate the short-term impact of three different programs of physical activity within the Special Olympics of Slovenia (SO) on individual components of physical fitness and the quality of life of aging athletes with ID and to investigate the connection of individual components of physical fitness with the quality of life. **Methods:** A double-blind, randomized clinical trial (RCT) protocol with stratification was used in which 150 physically inactive adults with ID were classified in 2 study groups, namely fun fitness plus in combination with regular training of SO (N = 50) and wellness team in combination with regular SO training (N = 50), and into the control group (regular training of the SO). Initial measurements of individual physical fitness components (battery of Fun Fitness tests) (4) and quality of life assessment using the shortened version of the quality of life questionnaire for people with ID (5) were carried out at the beginning and at the end of the 4-month study. Multiple regression analysis and discriminant analysis were used. The RCT was approved by the Medical Ethics Commission of the Republic of Slovenia (No. 0120-598 / 2017/7). **Results:** With F-statistic (20,260) a regression model was set up, which is statistically significant ( $p \leq 0.001$ ). Corrected deterministic multi-regression coefficient ( $R^2_{pop}$ ), explains 53.8% of the total space between physical fitness factors and quality of life, which is demonstrated by a good explanation of the variables. Based on the obtained results, there is a linear combination of measured dependent variables with physical fitness components. The obtained dimensions are those that best explain the differences in physical fitness among the participants of the groups. The discriminant variable shows the good physical fitness of aging adult athletes with ID on the basis of 81% confidence. **Conclusion:** The existing RCT has high internal and external validity due to the use of a rigorous research protocol to minimize the impact of threats against validity and reliability. With this contribution to science, it contributes to deeper and broader understanding of the impact of various programs of movement activity (within the framework of the Special Olympics) on the individual components of physical fitness of aging people with ID and their quality of life.

**Key words:** aging of adults with intellectual disability, physical fitness, special olympics, quality of life

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## **Spremembe in zanesljivost 6-minutnega testa hoje, merjenja srčne frekvence in 15-stopenjske Borgove lestvice pri pacientih po možganski kapi – predhodni izsledki**

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**Uvod:** Šestminutni test hoje (angl. six minute walking test – 6MWT) je submaksimalni test aerobne zmogljivosti oziroma splošne telesne vzdržljivosti. Z njim se ocenijo odzivi telesnih sistemov, kot so dihalni, srčno-žilni in živčno-mišični sistem ter mišični metabolizem med hojo (1). Pred in po 6MWT se lahko izmeri tudi srčna frekvenca ter spremlja občuteni napor z Borgovo lestvico (1, 2). Vendar pa obstaja pomanjkanje raziskav o zanesljivosti 6MWT, Borgove lestvice in njune povezanosti s srčno frekvenco pri pacientih po možganski kapi. Namen naše raziskave je ugotoviti izboljšanje prehojene razdalje, zvišanje srčne frekvence in spremembe občutenega napora pri pacientih po možganski kapi. Namen raziskave je tudi ugotoviti zanesljivost med preiskovalci za 6MWT in zanesljivost ponovljenega testiranja za srčno frekvenco ter 15-stopenjsko Borgovo lestvico. **Metode:** V raziskavo je bil do zdaj vključen priložnostni vzorec 15 preiskovancev, starih povprečno 59 (SO 11) let, povprečno 32,3 (razpon 4–126) meseca po možganski kapi, ki so bili na rehabilitaciji. Opravili so 6MWT po standardnih navodilih (1). Pred njim in po njem smo z merilnika (RS800CX, Polar, Finska) odčitali srčno frekvenco. Takoj po testu hoje so preiskovanci ocenili svoj napor na 15-stopenjski Borgovi lestvici (2), prevedeni v slovenščino. Ocenjevanje je izvedel preiskovalec A ob sprejemu na rehabilitacijo. Dva zaporedna dneva ob odpustu pa sta ga izvedla preiskovalca A in B v naključnem vrstnem redu. Razlike v prehojeni razdalji in srčni frekvenci med prvim in drugim ocenjevanjem (preiskovalec A) smo ugotavljali s parnim testom t. Za ugotavljanje zanesljivosti med preiskovalcema smo izračunali intraklasni korelacijski koeficient – ICC (2,1), za zanesljivost ponovnega testiranja pa ICC (3,1). Raziskavo je odobrila komisija za medicinsko etiko URI - Soča (št. 77/2018). **Rezultati:** Med rehabilitacijo se je prehojena razdalja statistično pomembno izboljšala za povprečno 49,33 (SO 54,34) m ( $p = 0,002$ ), med meritvami srčne frekvence pred 6MWT ni bilo statistično pomembne razlike, po njem pa se je povečala za 4,53 (SO 8,95) udarcev/minuto ( $p = 0,035$ ). Mediana ocenjenega napora po Borgovi lestvici je bila pri prvem ocenjevanju 12 (razpon 9–16) točk, ob odpustu pa 13 (razpon 10–15) točk (preiskovanec A) in 13 (razpon 11–17) točk (preiskovanec B). Zanesljivost med preiskovalcema za 6MWT je bila odlična (ICC = 0,97). Zanesljivost ponovnega testiranja za srčno frekvenco pred 6MWT je bila visoka (ICC = 0,81), po njem pa zmerna (ICC = 0,73), za Borgovo lestvico je bila nizka (ICC = 0,46). **Zaključek:** Med rehabilitacijo je prišlo do izboljšanja prehojene razdalje in povečanja srčne frekvence po 6MWT ter ocene napora. 6MWT je zanesljivo merilno orodje pri pacientih po možganski kapi. Dosedanji predhodni izsledki naše raziskave so pokazali, da je zanesljivost ponovnega testiranja za srčno frekvenco visoka oziroma zmerna, za Borgovo lestvico pa nizka. Za ugotavljanje povezanosti in odvisnosti med proučevanimi spremenljivkami je potreben večji vzorec preiskovancev.

**Ključne besede:** 6-minutni test hoje, 15-stopenjska Borgova lestvica, možganska kap, srčna frekvenca, zanesljivost

## Differences and reliability of the 6-minute walk test, heart rate and Borg rating scale of perceived exertion in patients after stroke – preliminary results

**Introduction:** A 6-minute walk test (6MWT) is a submaximal exercise test and overall functional capacity test. It assesses global and integrated responses of body systems, such as respiratory, cardiovascular, nervous and muscular systems and muscular metabolism involved in walking (1). Additionally, before and after 6MWT heart rate can be measured, and effort can be assessed with Borg rating scale of perceived exertion (RPE) (1, 2). However, there is a lack of reliability studies of 6MWT and RPE, and their correlation with physiological measures in patients after stroke. The purpose of this study is to determine the improvement of walking distance, increase of heart rate and change of perceived exertion in patients after stroke. The purpose was also to establish inter-rater reliability for 6MWT, and test-retest reliability for heart rate and RPE (6 to 20 scale). **Methods:** Currently, 15 subjects completed the study. Their mean age was 59 years (SD: 11), and mean time post-stroke was 32.3 months (range 4-126). 6MWT was conducted according to standard guidelines (1). Heart rate was collected before and after 6MWT with the heart rate monitor (RS800CX, Polar, Finland). Immediately after 6MWT, the subjects evaluated their effort on RPE scale of 6 (rest) to 20 (maximum exertion) (2). The evaluation was conducted at admission to rehabilitation (rater A) and two consecutive days at discharge (rater A and B in randomized order). The differences in walking distance and heart rate of the first and second assessment (rater A) were established with the paired t-test. To determine inter-rater reliability, the intraclass correlation coefficient - ICC (2.1), and for test-retest reliabilities ICC (3.1) were calculated. The study was approved by Ethics Committee of URI - Soča (no. 77/2018). **Results:** During rehabilitation, the walking distance statistically significantly increased for an average of 49.33 (SD 54.34) m ( $p = 0.002$ ). There was no difference in heart rate before 6MWT but the heart rate after 6MWT significantly increased, for 4.53 (SD 8.95) beats per minute ( $p = 0.035$ ). The median of RPE at the first assessment was 12 (range 9-16) points, and at discharge it was 13 (range 10-15) points (rater A) and 13 (range 11-17) points (rater B). Inter-rater reliability for 6MWT was excellent (ICC = 0.97). The test-retest reliability of heart rate measurement before 6MWT was good (ICC = 0.81), but moderate after 6MWT (ICC = 0.73), and poor for RPE (ICC = 0.46). **Conclusion:** During rehabilitation, the walking distance improved, and the heart rate after 6MWT and perceived effort increased. 6MWT is a reliable measuring tool in patients after stroke. The preliminary results of our study show good to moderate test-retest reliability of heart rate measurements and poor reliability for RPE. A larger sample of subjects is needed to investigate relationships and dependence of the studied variables.

**Key words:** 6MWT, RPE, stroke, heart rate, reliability

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## **Fizioterapevtska ocena in obravnava pacientke s sindromom Guillain-Barre**

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**Uvod:** Sindrom Guillain-Barre (GBS) je imunsko pogojena bolezen, do katere pride zaradi vnetja perifernih živcev in živčnih korenin. Incidenca obolenosti je ocenjena na 1 do 2 na 100.000 prebivalcev na leto (1). Kaže se kot pareza tako distalnih kot proksimalnih mišic, prizadene lahko dihalne mišice, obrazni živec, senzibiliteto, požiranje in avtonomno živčevje (2). Faza ozdravitve traja od 4 do 18 mesecev, od 10 do 20 odstotkov pacientov ostane huje prizadetih (1, 2). Fizioterapevtska obravnava temelji na izkušnjah z drugih nevroloških področij, saj jasnih smernic, podprtih z dokazili, še nimamo (3, 4). Za spremljanje stanja pacienta so bistvenega pomena fizioterapevtska merilna orodja. Za oceno sposobnosti premikanja in ravnotežja smo na URI - Soča začeli v prakso uvajati indeks premičnosti de Morton (DEMMI). **Metode:** V študijo primera smo vključili 40-letno pacientko s šibkostjo vseh mišičnih skupin in motnjami požiranja. Na rehabilitacijo je bila sprejeta en mesec po začetku bolezni. Aktivnih gibov z zgornjimi in spodnjimi udi ni zmogla. Opravili smo oceno mišične zmogljivosti, oceno premičnosti in ravnotežja z DEMMI, meritve sklepne gibljivosti, pozneje test hoje na 10 metrov in 6-minutni test hoje, stanje smo spremljali z lestvico funkcijske neodvisnosti (FIM). V 18 mesecih je bila pacientka na rehabilitacijsko obravnavo sprejeta trikrat, prvič za štiri mesece, nato sta sledili dve obnovitveni tritedenski rehabilitaciji. Med rehabilitacijo je fizioterapija potekala petkrat na teden po 1 do 2 uri na dan, vključena je bila tudi v program respiratorne fizioterapije in delovne terapije. Fizioterapevtske metode so bile ob prvi rehabilitaciji usmerjene v postopno vertikalizacijo, ohranjanje pasivne gibljivost sklepov in spodbujanje aktivacije mišic. Ob drugi rehabilitaciji smo nadaljevali z opisanimi metodami, povečali smo intenzivnost vadbe za izboljšanje mišične zmogljivosti in kardiorespiratorne vzdržljivosti. Ob zadnji rehabilitaciji smo se osredotočili na učenje hoje in vadbo ravnotežja. **Rezultati:** Po 18 mesecih se je mišična zmogljivost izboljšala v vseh mišičnih skupinah. Po DEMMI je pacientka napredovala z 0/100 točk na 41/100 točk. Sklepna gibljivost je bila v grobem ohranjena, razen manjših kontraktur v kolenskih sklepih (5°) in plantarne kontrakture v levem skočnem sklepu (7°). Z berglami je prehodila krajšo razdaljo (70 metrov), za hojo na daljše razdalje je uporabljala rolator. Zmogla je hojo po stopnicah ob opori. Prisotna je bila utrudljivost. **Zaključek:** Primer pacientke s težjim potekom GBS potrjuje pomembno vlogo fizioterapije pri okrevanju. Pri pacientih z GBS bi bilo poleg uporabljenih fizioterapevtskih merilnih orodij treba ocenjevati utrudljivost, ki je eden glavnih simptomov te bolezni.

**Ključne besede:** pareza, polinevropatija, DEMMI, manualno testiranje mišic, Guillain-Barre

## Physiotherapeutic assessment and therapy in patient with Guillain-Barre syndrome

**Background:** Guillain-Barre syndrome (GBS) is immune mediated disorder that is caused by inflammation of peripheral nerves and nerve roots. The annual incidence is estimated to be 1-2 per 100 000 worldwide (1). It presents itself as paresis of proximal and distal muscles (2). Recovery occurs 4 to 18 months after the appearance of first symptoms (1, 2). There are currently no evidence-based guidelines for physiotherapy and practice is based on experience from other neurological conditions (3, 4). When monitoring the condition of the patient, physiotherapeutic assessment has important value. In order to assess balance and ability to move, our department at URI - Soča began to introduce the de Morton Movement Index (DEMMI) into practice. **Methods:** A 40-year-old patient with severe muscle weakness and swallowing disorder was admitted to rehabilitation 1 month after the onset of the disease. She could not perform active movements with upper nor with lower limbs. We assessed muscle performance, ability to move (DEMMI), measured joint range of motion and used Functional independence measure (FIM), at later stages we did 10-meter and 6-minute walk test. The patient was admitted to our hospital 3 times in 18 months, the first rehabilitation lasting 4 months, followed by two 3-week rehabilitation treatments. During hospital stay physiotherapy took place 5 times weekly for 1-2 hours a day. The patient was also included in respiratory physiotherapy and occupational therapy. At the beginning, physiotherapeutic methods were aimed at gradual verticalisation, maintaining passive range of motion and stimulating muscle activation. At second rehabilitation we continued with the described methods and increased the intensity of exercise for muscle strengthening and endurance. At last, we focused on walking and balance. **Results:** After 18 months, muscular performance improved in all muscle groups. According to DEMMI, the patient progressed from 0/100 points to 41/100 points. Range of motion was mainly preserved, with the exception of contractures in knee joints (5°) and plantar contracture in the left ankle joint (7°). The patient was able to walk short distances with crutches (70 meters), and the roller walker was used for longer distances. She was able to walk the stairs. Fatigue remained a major problem. **Conclusion:** Our case confirms the important role of physiotherapy in recovery of GBS. Fatigue is one of the main persisting symptoms of GBS. In the future we should consider adding fatigue assessment into our practice.

**Key words:** paresis, polyneuropathy, DEMMI, manual muscle testing, Guillain-Barre

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## **Uporabnost lestvice za oceno funkcionalnosti hoje (FGA) pri bolnikih po operativni odstranitvi vestibularnega tumorja**

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**Uvod:** V zgodnjem bolnišničnem obdobju imajo bolniki po operativni odstranitvi vestibularnega tumorja motnje ravnotežja v sedečem in stoječem položaju ter med hojo. Eden izmed najpogosteje uporabljenih kliničnih testov za ocenjevanje bolnikovega ravnotežja in njegove splošne premičnosti je Bergova lestvica za ravnotežje (BLR), ki pa ne opredeljuje bolnikovega dinamičnega nadzora in prilagoditve telesa med hojo (1). Za ta namen je primernejša lestvica za oceno funkcionalnosti hoje (FGA), ki ustreza obsežnim merskim zahtevam in omogoča ocenjevanje bolnikovega dinamičnega ravnotežja (2). Namen raziskave je bil preveriti uporabnost FGA-lestvice kot vadbeno ali merilno orodje v času bolnišnične oskrbe ter ugotoviti stopnjo bolnikove ravnotežne okvare med hojo in ogroženosti za padce. **Metode:** Raziskava je bila zasnovana kot pilotska študija za nadaljnje raziskave z več vključenimi bolniki z enako diagnozo. Raziskavo je odobrila Komisija RS za medicinsko etiko 14. aprila 2015. V raziskavo smo vključili deset hospitaliziranih bolnikov po operaciji vestibularnega tumorja, ki so bili sposobni slediti navodilom in so na kratkem preizkusu spoznavnih sposobnosti dosegli več kot 25 točk izmed 30 možnih. Glede na bolnikovo začetno nesamostojnost pri osnovnih dejavnostih vsakodnevnega življenja smo stopnjo njihove funkcijske neodvisnosti ovrednotili z oceno po indeksu Barthelove, ki je znašala več kot 8 od 20 možnih točk. Ob vključitvi v raziskavo smo vse preiskovance ocenili z BLR, ob odpustu z FGA-lestvico in BLR ter tri mesece po odpustu samo z FGA. V času hospitalizacije so bili vsi bolniki vključeni v specifično usmerjen ravnotežni program fizioterapevtske obravnave. Bolniki so z vajami nadaljevali v domačem okolju, saj so ob odpustu dobili pisna navodila in posnetke vaj na DVD-ju. Zapisovali so tudi število padcev v za to pripravljen obrazec. Dobljene rezultate smo analizirali z metodami deskriptivne statistike. **Rezultati:** Povprečna starost bolnikov (6 žensk, 2 moška, 2 najstnika) je bila 39,5 leta (od 18 do 57 let), hospitalizacija je povprečno trajala 10,5 dneva (od 7 do 14 dni). Klinično pomembna sprememba v izboljšanju statičnega ravnotežja med dvema BLR-meritvama znaša 8 točk (1). V dvotedenski fizioterapevtski obravnavi smo izračunali najmanjšo zaznavno spremembo med dvema meritvama po lestvici BLR, ki je znašala 6 točk, povprečna razlika ocen pa 11,7 točke. Najmanjšo zaznavno spremembo je preseglo 80 odstotkov bolnikov in tako izboljšalo statično ravnotežje, 20 odstotkov bolnikov pa ni doseglo zadostnega napredka. Ob odpustu bolnikov v domače okolje smo z analizo rezultatov FGA ugotovili, da imajo vsi vključeni bolniki hude motnje proprioceptivnega sistema in zmerne motnje vestibularnega sistema ter da so vsi ogroženi za padce. Klinično pomembna sprememba v izboljšanju dinamičnega ravnotežja med dvema FGA ocenama je 5 točk (2). Rezultati naše raziskave kažejo najmanjšo zaznavno spremembo med dvema FGA meritvama 4 točke, povprečno razliko ocen pa 8,6 točke. Minimalno zaznavno spremembo je preseglo 70 odstotkov bolnikov in tako izboljšalo dinamično ravnotežje ter posledično zmanjšalo možnost za padce. **Zaključek:** FGA-lestvica je v zgodnjem pooperativnem obdobju odlično vadbeno orodje za odkrivanje motenj in izboljšanje dinamičnega ravnotežja, saj specifične gibalne spretnosti olajšajo bolnikovo funkcioniranje v domačem okolju. Kot merilno orodje pa FGA-lestvico zaradi popolne nesamostojnosti bolnikov v osnovnih dejavnostih vsakodnevnega življenja v začetku hospitalizacije priporočamo tik pred odpustom bolnikov v domače okolje in za poznejše ambulantno spremljanje bolnikovega napredka.

**Ključne besede:** vestibularni tumor, operativni poseg, ocenjevanje, ravnotežje, hoja

## Usefulness of Functional Gait Assessment Scale (FGA) in patients after vestibular tumor surgery

**Background:** Patients in the acute phase after vestibular tumor surgery frequently experience balance disorders in a sitting and standing position and during gait. One of the most commonly used clinical tests for evaluating the patient's balance and his general mobility is the Berg Balance Scale (BBS), which does not define the patient's dynamic control and adjustment of the body while walking (1). The Functional Gait Assessment (FGA) enables the assessment of the dynamic balance during gait and corresponds to extensive measurement requirements (2). The purpose of the study was to verify the usefulness of the FGA scale as an exercise or measuring tool during hospital care, and to determine the patient's equilibrium malfunction during walking and risk of falls. **Methods:** The research was designed as a pilot study and will serve as a preposition for further research with more included patients with the same diagnosis. The study was approved by Medical Ethics Committee on April 14, 2015. The sample was selected conveniently. The study included 10 hospitalized patients after vestibular tumor surgery, that were able to follow the instructions and reached more than 25 points out of 30 possible on the Mini Mental Test. Given the patient's initial incompatibility in the basic activities of everyday life, we assessed the degree of their functional independence with Barthel Index (BI), which was more than 8 points out of 20 possible. All patients were evaluated at the beginning with BBS, at discharge from the hospital with BBS and FGA and after three months with FGA. During the hospitalization, all patients were included in a specifically directed equilibrium program of physiotherapy treatment. The patients continued their exercises in the home environment, as they received written instructions and DVD recordings on discharge. The number of falls in the prepared form was also recorded by the patients. The results were analyzed using descriptive statistics. **Results:** The mean age of the patients (6 women, 2 men, 2 teenagers) was 39.5 years (from 18 to 57 years), hospitalization lasted for 10.5 days (from 7 to 14 days). A clinically significant change in the improvement of the static equilibrium between two BBS measurements is 8 points (1). The minimum perceptible change for BBS score in a two-week physiotherapeutic treatment was calculated to be 6 points, which was exceeded by 80% of the patients, indicating an improvement in static balance, while 20% of the patients did not achieve sufficient progress. The average difference in two BBS grades was calculated to be 11.7 points. With the release of the patients into the home environment, the analysis of FGA results showed that all the patients involved had severe disorders of the proprioceptive system and moderate disturbance of the vestibular system, and were all at risk of falls. A clinically significant change in improving the dynamic balance between two FGA scores is 5 points (2). The minimum perceptible change for FGA score for the assessment three months after the discharge was calculated to be 4 points and was exceeded by 70% of the patients, indicating an improvement in dynamic balance, and thus lower risk for falls. 30% of the patients did not make enough progress. The average difference of the two FGA ratings was 8.6 points. **Conclusion:** The FGA scale is an excellent training tool for detecting interferences and improving the dynamic balance in the early post-operative period. Specific mobility skills facilitate the patient's functioning in the home environment. As a measuring tool, the FGA scale, due to the complete incapacity of patients in the basic activities of everyday life at the beginning of hospitalization, is recommended just before the release of patients into the home environment and for subsequent outpatient monitoring of the patient's progress.

**Key words:** vestibular tumor, surgery, assessment, balance, gait

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## **Hipoterapija pri mladostnikih s cerebralno paralizo**

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**Uvod:** Hipoterapija je terapevtska obravnava, pri kateri se uporablja konj (1). V prispevku je predstavljen vpliv hipoterapije na senzomotorične mehanizme (nadzor in upravljanje drže, gibanje telesnega težišča, ravnotežja in grobe motorične funkcije) (2, 3, 4) in na psihosocialne učinke (zdravje, zadovoljstvo, anksioznost in negotovost pri gibanju), povezane s kakovostjo življenja mladostnikov s cerebralno paralizo (CP) (5). Gibanju konja sledi gibanje jahačevega telesa, ki izvabi nadzor drže ter gibanje medenice in celega telesa. Jahanje omogoča priložnost za integracijo kinestetičnega, vidnega in vestibularnega priliva. Ponavljajoče se izvabljanje ravnotežnih in vzravnalnih odzivov prispeva k boljšemu nadzoru in upravljanju drže. **Metode:** V randomizirani 12-tedenski klinični raziskavi je sodelovalo 20 mladostnikov, starih od 16 do 22 let. Predhodno so bili izbrani glede na vključitvena in izključitvena merila ter naključno razvrščeni v dve skupini po deset mladostnikov. V raziskovalni skupini je bilo pet deklet in pet fantov, ki so imeli poleg rednih terapevtskih obravnav (fizioterapija in delovna terapija) še hipoterapijo dvakrat na teden po 30 minut. V kontrolni skupini je bilo šest deklet in štirje fantje, ki so imeli poleg rednih terapevtskih obravnav (fizioterapija in delovna terapija) še polurno hojo dvakrat na teden. Opravili smo osnovne meritve, in sicer ocenjevanje senzomotoričnih in psihosocialnih učinkov v povezavi s kakovostjo življenja mladostnikov, izvedene pred raziskavo in po končani raziskavi. Raziskavo je odobrila Komisija RS za medicinsko etiko s številko 97/09/11. **Rezultati:** Pri testih, ki vplivajo na senzomotorične mehanizme, so bile ugotovljene statistično značilne razlike, in sicer pri modificiranem testu senzorične organizacije na stabilometrični plošči ( $p < 0,03$ ), testu stoje na eni nogi ( $p < 0,00$ ) in testu Gross Motor Function Measure ( $p < 0,00$ ). Statistično značilne razlike so bile ugotovljene tudi pri vprašalnikih, ki vplivajo na kakovost življenja mladostnikov s CP, in sicer pri vprašalniku za ugotavljanje negotovosti pri gibanju ( $p < 0,00$ ), pri splošnem vprašalniku o zdravju ( $p < 0,00$ ), pri lestvici zadovoljstva z življenjem ( $p < 0,00$ ) in pri testu anksioznosti kot stanja ( $p < 0,00$ ). Zanesljivost in pristranskost vprašalnikov je bila preverjena s testom zanesljivosti,  $\alpha$ -koeficient po Cronbachu (od ,73 do ,92), korelacija med posameznimi testi pa s Pearsonovim koeficientom korelacije. **Zaključek:** Hipoterapija vpliva na izboljšanje senzorično-motoričnih gibalnih mehanizmov, ki se kažejo prav tako v izboljšanju zdravja, zadovoljstva in kakovosti življenja mladostnikov s CP, kar potrjujejo izsledki raziskave. Na podlagi teh lahko ugotavljamo, da hipoterapija dobro prispeva k vseživljenjski rehabilitaciji mladostnikov s CP.

**Ključne besede:** cerebralna paraliza, drža, ravnotežje, hipoterapija, kakovost življenja



## Hippotherapy in adolescents with cerebral palsy

**Background:** Hippotherapy is a therapeutic treatment using a horse (1). The paper presents the influence of hippotherapy on sensory-motor mechanisms (control and control of body posture, movement of the body's centre of gravity, balance and gross motor function) (2, 3, 4), as well as on the psycho-social effects (health, satisfaction, anxiety and dizziness handicap inventory) associated with the quality of life of adolescents with cerebral palsy (CP) (5). The movement of the horse is followed by the movement of the rider's body, which demands the control of the body posture, movement of the pelvis and the whole body. Riding provides an opportunity for the integration of a kinesthetic, visual and vestibular inflow. The repetitive causing of equilibrium and righting reactions contributes to better control and control of the body posture. **Methods:** In a randomized twelve-week clinical trial, 20 adolescents, aged 16 to 22 years, were involved. They had been previously selected according to inclusion and exclusion criteria and randomly assigned into two groups of 10 adolescents. In the research group there were 5 girls and 5 boys who had, in addition to regular therapeutic treatment, hippotherapy twice a week for 30 minutes. In the control group, there were 6 girls and 4 boys, who, in addition to regular therapeutic treatments, had a half-hour walk twice a week. Basic measurements were done: the assessment of senso-motor and psycho-social effects in relation to the quality of life of adolescents, carried out before and after the completion of the study. The research was approved by the Medical Ethics Commission of the Republic of Slovenia, number 97/09/11. **Results:** In the tests affecting sensory-motor mechanisms, statistically significant differences were found, namely in a modified sensory organization test on the stabilometric platform ( $p < 0.03$ ), in a single leg stance test ( $p < 0.00$ ) and the test of gross motor functions ( $p < 0.00$ ). Statistically significant differences were also found in the questionnaires affecting the quality of life of adolescents with CP, namely in the questionnaire dizziness handicap inventory ( $p < 0.00$ ), the general health questionnaire ( $p < 0.00$ ), in the satisfaction with life scale ( $p < 0.00$ ) and the anxiety inventory test ( $p < 0.00$ ). The reliability and bias of the questionnaires were verified by the reliability test, Cronbach's alpha (from, .73 to .92), and the correlation between individual tests with Pearson correlation coefficient. **Conclusion:** Hippotherapy influences the improvement of sensory-motor movement mechanisms, which are also shown in the improvement of health, satisfaction and quality of life of adolescents with CP, as confirmed by the results of the research. On the basis of these, hippotherapy contributes to lifelong habilitation of adolescents with CP.

**Key words:** cerebral palsy, posture, balance, hippotherapy, quality of life

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## **Uporaba ortoz in funkcionalne električne stimulacije v domačem okolju pri pacientih z okvaro hrbtenjače**

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**Uvod:** Pokončni položaj pri pacientih z okvaro hrbtenjače izboljša psihološki status, ledvično funkcijo in kostno gostoto ter ugodno vpliva na spastičnost, ortostatsko hipotenzijo in gibljivost sklepov (1). Za hojo lahko uporabimo različne pripomočke, kot so ortoze za koleno, gleženj in stopalo, ki stabilizirajo koleno v smeri ekstenzije in skočni sklep v smeri dorzalne fleksije (1). Druga možnost je hoja s funkcionalno električno stimulacijo (FES), pri kateri stimulacija peronealnega živca simulira fazo zamaha, stimulacija mišice kvadriceps femoris pa fazo opore (2). Pacienti poročajo o boljšem počutju po uporabi FES, ne glede na to, ali jo uporabljajo za stoji, hojo ali krepitev mišic (3). Namen raziskave je bil ugotoviti uporabo ortoz in FES v domačem okolju pri osebah z okvaro hrbtenjače, njihov vpliv na funkcijske zmožnosti, kakovost življenja ter pozitivne učinke in neželene lastnosti pripomočka. **Metode:** Anketa je bila poslana 139 pacientom z okvaro hrbtenjače, ki so končali rehabilitacijo na Univerzitetnem rehabilitacijskem inštitutu Republike Slovenije - Soča (URI - Soča) od leta 2013 do leta 2017 ter so ob odpustu prejeli ortoze ali FES za spodnja uda. Anketi sta obsegali osem vprašanj in se razlikovali glede na uporabo ortoz ali FES. Povprečna starost pacientov, ki so jim bile predpisane ortoze, je bila 53,8 leta (SO 16,7). Povprečna starost pacientov, ki so prejeli FES, pa 49 let (SO 13,8). Raziskavo je odobrila komisija za medicinsko etiko URI - Soča (št. 61/2018). **Rezultati:** Od 98 poslanih anket pacientom, ki so prejeli ortoze, smo prejeli 45 izpolnjenih. 39 jih ortoze še vedno uporablja, večinoma za hojo zunaj (37,7 %), od eno do dve uri (33,3 %) do več kot štiri (26,7 %) ure na dan. Od pozitivnih učinkov so najpogosteje navajali boljše počutje (68,9 %), od neželenih lastnosti pa težko in dolgotrajno nameščanje ortoz (37,8 %). Od 41 poslanih anket pacientom, ki so prejeli FES, smo prejeli 18 izpolnjenih. 15 pacientov FES še vedno uporablja, večinoma za hojo zunaj (50 %) in krepitev mišic (22,2 %), od manj kot eno uro (33,3 %) do eno do dve uri (44,4 %) na dan. Od pozitivnih učinkov so najpogosteje navajali izboljšano kakovost življenja (44,4 %), od neželenih pa strah pred padci (50 %). **Zaključki:** Večina pacientov, ki so odgovorili, še vedno uporablja predpisani pripomoček zaradi pozitivnih učinkov na počutje ter kakovost življenja. Ortoze uporabljajo večinoma za hojo zunaj, FES pa za hojo zunaj in krepitev mišic.

**Ključne besede:** okvara hrbtenjače, pripomočki za hojo, anketa, fizioterapija, rehabilitacija

## Use of orthoses and functional electrical stimulation in home environment in patients with spinal cord injury

**Background:** The upright position in patients with spinal cord injury improves their psychological status, renal function, and bone density, positively affects spasticity, orthostatic hypotension and joint range of motion (1). Various assistive devices can be used for walking, such as knee ankle foot orthoses, which stabilizes the knee in extension and ankle in dorsal flexion (1). Another option is walking with functional electrical stimulation (FES), where stimulation of the peroneal nerve simulates the swing phase and the stimulation of the quadriceps femoris muscle simulates the stand phase (2). Patients report to feel better after using FES, regardless of whether they use it for standing, walking or muscle strengthening (3). The aim of this research was to find out the use of orthoses and FES in home environment in patients with spinal cord injury, their impact on patients' functional abilities, quality of life, positive effects and adverse features of usage. **Methods:** The survey was sent to 139 patients with spinal cord injury, who completed rehabilitation at the University Rehabilitation Institute of the Republic of Slovenia - Soča (URI - Soča) from 2013 to 2017, and received orthoses or FES for their lower limb at the time of dismissal. Two surveys contained eight questions and were differed according to the use of either orthoses or FES. The mean age of the patients, who received orthoses, was 53.8 years (SD 16.7). The mean age of the patients, who received FES, was 49 years (SD 13.8). Research was approved by the Medical Ethics Committee of URI - Soča (No. 61/2018). **Results:** Out of 98 surveys sent to the patients, who received orthoses, 45 of them were returned completed. 39 patients continue to use prescribed orthoses, mostly for walking outside (37.7 %), from one to two hours (33.3 %) to more than four hours (26.7 %) daily. Of various positive effects, the most commonly reported was »feeling better« (68.9 %), while the most common adverse feature was difficult and long lasting application (37.8 %). Out of 41 surveys sent to the patients who received FES, 18 of them were returned completed. 15 patients still use FES, mostly with the aim of walking outside (50 %) and muscle strengthening (22.2 %), for less than one hour (33.3 %) to one to two hours (44.4 %) daily. Of various positive effects, the most often reported was the higher quality of life (44.4 %), while fear of falling (50 %) was the most common adverse effect. **Conclusions:** Most patients still use the prescribed device because of various positive effects on their well-being and quality of life. They use orthoses mostly for walking outside, while they use FES for walking outside and muscle strengthening.

**Key words:** spinal cord injury, gait assistive devices, survey, physiotherapy, rehabilitation

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## Primerjava učinkov različnih serijskih ortoz za gleženj in stopalo pri pacientih po možganski kapi: vpliv na funkcijsko mobilnost in mnenje pacientov – predhodni izsledki

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**Uvod:** Ortoze za gleženj in stopalo (OGS) ali ortoze za gleženj (OG) pogosto uporabljamo za izboljšanje gibljivosti v stopalu in preprečevanje padajočega stopala ter z njimi kompenziramo biomehanski primanjkljaj (1, 2). Namen raziskave je bil ugotoviti, kako določene serijske ortoze vplivajo na izvedbo različnih funkcijskih dejavnosti. **Metode:** 13 pacientov po prvi možganski kapi, vključenih v rehabilitacijsko obravnavo, ocenjenih z lestvico za razvrstitev funkcijske premičnosti med 4 in 6, je sodelovalo v dvojno slepem randomiziranem kliničnem poskusu. V drugem tednu rehabilitacije so v treh zaporednih dneh s serijsko OGS, z eno izmed serijskih elastičnih OG (fizioterapevt je izbral najprimernejšo med štirimi različnimi) in brez ortoze v naključnem vrstnem redu opravili test hoje na 10 metrov, 6-minutni test hoje, test hoje po stopnicah navzgor in navzdol ter test petih vstajanj s stola. Ob odpustu je preiskovanec izvedel teste le z izbrano ortozo in brez nje. Med izvedbo testov smo ortozo zakrili z gamašo, da je preiskovalec ne bi prepoznal. Drug preiskovalec je ob koncu ocenjevanja preiskovanca izprašal o njegovih subjektivnih občutkih in zadovoljstvu s posamezno ortozo. Raziskavo je odobrila komisija za medicinsko etiko URI - Soča (18/2017). **Rezultati:** V vseh primerih so bile ob koncu rehabilitacije izbrane OG. Pri obeh ocenjevanjih so bili najboljši povprečni izidi večine testov z OG. Statistično značilne razlike so se pokazale pri testu hoje na 10 metrov in pri 6-minutnem testu hoje. Brez ortoze so pri končnem ocenjevanju hodili 0,16 (SO 0,09) m/s hitreje kot pri prvem ( $p = 0,04$ ). Pri končnem ocenjevanju so z OG prehodili 18,2 (SO 2,2) m daljšo razdaljo kot brez ortoze ( $p = 0,01$ ) ter 38 (SO 46,3) m več kot pri prvem ocenjevanju z OG ( $p = 0,04$ ). Pri testu petih vstajanj s stola in testu hoje po stopnicah navzgor in navzdol parni t-test s Holenovim popravkom ni pokazal statistično značilnih razlik med testnimi pogoji. Preiskovanci so se pri hoji z OG počutili varnejše. Hoja je bila pravilnejša in stopalo se jim je manjkrat zataknilo. Več bi jih tudi raje čez cel dan nosilo OG (85 %) kot serijsko OGS (8 %). **Zaključki:** OG ima pozitiven učinek na hitrost hoje in prehojeno razdaljo. Pri hoji s serijsko OGS je hoja počasnejša in prehojena razdalja krajša kot z OG. Z izbrano OG so bili pacienti zadovoljnejši kot s serijsko OGS. Za jasnejše ugotovitve glede vpliva različnih ortoz ali hoje brez ortoze na premičnost je potreben večji vzorec preiskovancev.

**Ključne besede:** možganska kap, ortoze, primerjava

## Comparison of different serial ankle-foot orthoses in patients after a stroke: effects on the functional mobility and patients' opinion – preliminary results

**Background:** Ankle-foot orthoses (AFO) or ankle orthoses (AO) are frequently prescribed to improve mobility, to restore the *ankle foot* function, and to compensate for biomechanical deficits (1, 2). The aim of this study was to establish how a certain serial made orthosis affects a performance of various functional activities. **Methods:** Thirteen patients after a first hemorrhagic or ischemic stroke, included in rehabilitation, scored with Functional Ambulation Categories (FAC) 4-6, participated in the double blind randomised clinical trial. In the second week of rehabilitation, the 10-meter walk test (10MWT), the 6-minute walk test (6MWT), the Timed up and down stairs (TUDS) and the Five times sit to stand test (FTSTS) were performed randomly in 3 consecutive days with a serial AFO, one of the serial elastic AO (PT has chosen the most appropriate from 4 AO) and without orthosis. At discharge, patients performed tests only with the selected AO and without it. During the tests, type of orthosis was covered to the tester with a protection above the footwear (Fig 3.). Another investigator interviewed the patients about subjective feelings and satisfaction with each orthosis. This study was approved by the Ethics Committee of the University rehabilitation institute, Slovenia (18/2017). **Results:** At the end of rehabilitation in all the cases AO was chosen. In both evaluations the best results are measured with AO. Statistically significant differences were shown in 10MWT and 6MWT. Without orthosis in the last evaluation the patient walked 0.16 (SO 0.09) m/s faster than in the first evaluation ( $p = 0.01$ ). At the second evaluation they walked with AO 18.2 (SO 2.2) m longer distance compared to walking without an orthosis ( $p = 0.01$ ) and 38 (SO 46.3) m more compared to the first testing with AO ( $p = 0.04$ ). For the 5TSTS and TUDS paired t-test with a Holm's correction did not show statistically significant differences between testing conditions. Most of the patients while wearing AO felt more secure, their walking was better and their leg stick less often. More of the patients would wear it throughout the day (85%) compared with a serial AFO (8%). **Conclusions:** The AO has a positive effect on the walking speed and distance. A serial AFO reduced walking speed and distance. Patients were more satisfied with the AO compared with a serial AFO. Future studies with larger sample size are needed for statistical analysis of the tests performance with different types of orthoses and without it.

**Key words:** stroke, orthoses, comparison

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## **Primerjava učinkovitosti vadbe hoje na tekočem traku s hkratno uporabo navideznega okolja in hoje na tekočem traku brez dodanih nalog pri pacientih po možganski kapi**

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**Uvod:** Ponovna vzpostavitev hoje je eden najpomembnejših ciljev pacientov po možganski kapi. Izsledki raziskav kažejo, da ponavljajoča se, v funkcijo usmerjena, visokointenzivna vadba pomembno vpliva na izboljšanje funkcionalnega stanja (1). Ena izmed možnosti tovrstne vadbe je hoja na tekočem traku, pri čemer se vse bolj uveljavlja vadba s hkratno uporabo navidezne resničnosti, saj omogoča večje število ponovitev in spodbuja motorično učenje prek neposredne povratne informacije o izvedeni aktivnosti (2). Namen predstavljene študije je bil ugotoviti, ali vadba hoje na tekočem traku s hkratno uporabo navideznega okolja pomembneje vpliva na izboljšanje ravnotežja in sposobnosti hoje pacientov po možganski kapi kot običajna vadba hoje na tekočem traku. **Metode:** V randomizirano kontrolirano raziskavo je bil vključen priložnostni vzorec 22 pacientov po možganski kapi, sprejetih na obravnavo v URI - Soča, ki so izpolnjevali vključitvena merila. Ocenjeni so bili z lestvico za oceno funkcionalne neodvisnosti (FIM), časovno merjenim testom vstani in pojdi, 6-minutnim testom hoje, testom hoje na 10 m, oceno funkcionalnosti hoje (FGA) in testom korakanja v štirih kvadratih, analiza hoje pa je bila izvedena s pomočjo sistema Zebris. Sledila je vadba hoje na tekočem traku, 20 minut na dan, petkrat na teden, pri čemer je eksperimentalna skupina izvajala hojo s pomočjo nalog v navideznem okolju sistema Zebris, kontrolna pa na tekočem traku Enraf Nonius brez navideznega okolja. Po končanem programu dvajsetih obravnav je bilo izvedeno primerjalno ocenjevanje z enakimi metodami kot ob začetku vadbe. Dobljeni podatki so bili statistično obdelani s paketom IBM SPSS Statistics, različica 22. Porazdelitev podatkov smo preverili s Kolmogorov-Smirnovim z-testom, za ugotavljanje razlik med merjenimi parametri pa smo uporabili Wilcoxonov test predznačenih rangov. **Rezultati:** Skupini se glede na starost ( $z = -1,384$ ,  $p = 0,166$ ) in čas od začetka nastanka kapi ( $z = -0,397$ ,  $p = 0,691$ ) med seboj nista statistično pomembno razlikovali. Po štirih tednih vadbe hoje na tekočem traku so vsi preiskovanci dosegli pomembno izboljšanje vseh merjenih parametrov, kar kaže na izboljšanje funkcionalnih sposobnosti, potrjeno s točkovanjem s pomočjo lestvice FIM. Obenem se je izkazalo, da med skupinama ni prihajalo do statistično značilnih razlik, razen glede zadovoljstva z vadbo, pri kateri je eksperimentalna skupina vadbo ocenila z 8,7 točke (SD 0,7), kontrolna pa s 7,2 točke (SD 0,7);  $p < 0,005$ . **Zaključki:** Na podlagi analize rezultatov ugotavljamo, da je vadba hoje na tekočem traku s hkratno uporabo navidezne resničnosti sicer primerljivo učinkovita kot klasična vadba na tekočem traku, a preiskovanci navajajo večje zadovoljstvo z vadbo v navideznem okolju. Izsledki raziskave so omejeni na vzorec pacientov po možganski kapi v pretežno subakutnem obdobju, smiselno bi jih bilo preveriti na večjem vzorcu oseb po možganski kapi in spremljati tudi dolgoročne učinke vadbe.

**Ključne besede:** vadba hoje, navidezna resničnost, ravnotežje, rehabilitacija, možganska kap

## Effectiveness of virtual reality-based treadmill training in comparison with treadmill training without additional tasks in stroke patients

**Background:** The recovery of walking ability has been recognized as a major goal of stroke rehabilitation. There is an increasing evidence that high-intensity, repetitive, task-specific training might result in better outcome of gait rehabilitation (1). One example of such training is treadmill training, which has been successfully augmented with virtual reality (VR). The use of VR encourages a higher number of exercise repetitions and promotes motor learning through immediate feedback about the performed tasks (2). The purpose of the presented study was to examine whether VR based treadmill training could improve walking and mobility in greater extent than the same duration of treadmill training without using VR. **Methods:** Twenty-two stroke patients, who met the including criteria, participated in the randomized controlled study, conducted at the stroke department of the University Rehabilitation Institute. The participants were evaluated with Functional Independence Measure (FIM), Timed Up and Go Test (TUG), Six-minute Walking Test (6 mWT), 10-meter Walking Test (10 mWT), Functional gait assessment and the Four square step test (FSST). Gait analysis was performed on the treadmill system Zebris. The subjects in the experimental group received VR based treadmill training provided by Zebris, 20 minutes a day, five times a week, for four weeks. The subjects in the control group received treadmill training (Enraf Nonius) of the same frequency, duration, intensity, structure and progressive increase of task demands. At the end of the training all the participants were evaluated with the same assessment tools as at the first assessment. Data analysis was performed with the Statistical Package for the Social Sciences, version 22.0. The testing for normality of the data distribution was performed with Kolmogorov-Smirnov test. Differences for the measured parameters for the experimental and control group were compared by using the Wilcoxon Rank-Sum Test. **Results:** No significant differences in age ( $z = -1.384$ ,  $p = 0.166$ ) and post stroke duration ( $z = -0.397$ ,  $p = 0.691$ ) were observed between groups. Both groups showed statistically significant improvements in all measured variables after four weeks of training, which suggests functional improvement in both groups, confirmed with FIM. But there were no significant changes between the experimental and control group, except higher satisfaction in the experimental group (8.7, SD 0.7) compared to the rate of satisfaction in the control group (7.2, SD 0.7);  $p < 0.005$ . **Conclusions:** Findings of the study support the benefits of treadmill training programs in stroke patients, virtual reality-based training is as effective as treadmill training without additional tasks, but the experimental group reported higher satisfaction with the training. The findings of this study are limited to the sample of mainly subacute patients after stroke. It would be recommendable to investigate long-term effects of training also.

**Key words:** gait training, virtual reality, balance, rehabilitation, stroke

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## **Sposobnost hoje pacientov z nepopolno okvaro hrbtenjače po vadbi hoje na lokomatu: retrospektivna raziskava**

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**Uvod:** Z vadbo hoje na lokomatu se pri pacientih do šest mesecev po nepopolni okvari hrbtenjače v kombinaciji z drugimi fizioterapevtskimi postopki zmanjša potreba po uporabi pripomočkov za hojo in izboljšajo se mišična zmogljivost spodnjih udov, neodvisnost med hojo in prehojena razdalja (1, 2, 3). Vadba na lokomatu ne vpliva na izboljšanje hitrosti hoje do šest mesecev po okvari, prav tako ne vpliva na izboljšanje sposobnosti hoje pri pacientih več kot leto dni po okvari (3). Namen raziskave je bil ugotoviti izid vadbe hoje na lokomatu v kombinaciji z drugimi fizioterapevtskimi postopki pri vseh pacientih, ki smo jih v izbranem obdobju vključili v vadbo na lokomatu. **Metode:** V retrospektivno raziskavo smo vključili vseh 83 pacientov z nepopolno okvaro hrbtenjače, starih povprečno 57,2 leta (SO 17,6), ki so bili med letoma 2014 in 2018 poleg običajne fizioterapevtske obravnave vključeni v vadbo hoje na lokomatu na Univerzitetnem rehabilitacijskem inštitutu Republike Slovenije - Soča (URI - Soča). Sposobnost hoje na začetku in koncu rehabilitacijske obravnave smo ocenjevali s testom sproščene hoje na 10 metrov in s 6-minutnim testom hoje. Mediana števila obravnav na lokomatu je bila 19 (razpon od 1 do 47), povprečna hitrost hoje na lokomatu 0,44 m/s (SO 0,35), povprečna razbremenitev telesne teže 38,5-odstotna (SO 23,6) in povprečno trajanje vadbe 29,3 minute (SO 13). Pri pacientih, ki pred vadbo na lokomatu niso bili sposobni hoje po tleh, ob koncu rehabilitacije pa so hodili, smo izračunali povprečno hitrost hoje in prehojeno razdaljo. Za primerjavo rezultatov pri pacientih, ki so bili sposobni hoje že pred vadbo na lokomatu, smo uporabili parni t-test. Meja statistične značilnosti je bila  $p \leq 0,05$ . Raziskavo je odobrila komisija za medicinsko etiko URI - Soča (št.: 80/2018). **Rezultati:** 23 pacientov ni bilo sposobnih hoditi po tleh na začetku in prav tako ne ob koncu rehabilitacije. Povprečna hitrost hoje 34 pacientov, ki pred obravnavo na lokomatu niso bili sposobni hoje po tleh, je bila ob koncu rehabilitacije 0,35 m/s (SO 0,23), povprečna prehojena razdalja pa 113 metrov (SO 70). Izboljšanje sposobnosti hoje 23 pacientov, ki so bili zmožni hoje že na začetku rehabilitacije, je bilo statistično značilno tako za hitrost hoje ( $p < 0,001$ ) kot za prehojeno razdaljo ( $p < 0,0001$ ). Pri treh pacientih so bili podatki pomanjkljivi, zato smo jih iz analize izločili. **Zaključki:** Ne moremo zaključiti, koliko je k ponovni vzpostavitvi hoje ali izboljšanju sposobnosti hoje prispevala vadba hoje na lokomatu. Pacienti lahko s to napravo vadijo hojo, preden je mišična zmogljivost zadostna za hojo po tleh, pri čemer je nepogrešljiva tudi delna razbremenitev telesne teže. Hitrost hoje in trajanje vadbe na lokomatu v kombinaciji z drugimi fizioterapevtskimi postopki sta morda prispevala k izboljšanju hitrosti hoje in prehojene razdalje.

**Ključne besede:** okvara hrbtenjače, vadba hoje, eksoskelet, rehabilitacija, fizioterapija



## Walking abilities of patients with incomplete spinal cord injury after lokomat training: retrospective research

**Background:** In patients with incomplete spinal cord injury within six months after the onset of injury lokomat training in combination with other physiotherapy procedures diminishes the need for assistive devices and improves muscle strength, independency and walking distance (1, 2, 3). Lokomat training has no effect on increased gait velocity within six months after the onset of injury, neither has the effect on improving walking abilities in patients more than one year after the onset (3). Purpose of the research was to find out the outcome of lokomat training in combination with other physiotherapeutic procedures in all patients, that were included in the lokomat during chosen period of time. **Methods:** All 83 patients with incomplete spinal cord injury, mean age 57.2 years (SD 17.6), were included into retrospective research. Besides the regular physiotherapeutic procedures, they were also included in lokomat training between 2014 and 2018 in the University Rehabilitation Institute of the Republic of Slovenia - Soča (URI - Soča). Walking abilities were assessed before and after rehabilitation period with the 10-meter walk test at comfortable speed and the 6-minute walk test. Median number of sessions on the lokomat was 19 (range from 1 to 47), mean walking speed was 0.44 m/s (SD 0.35), mean body weight support was 38.5 % (SD 23.6) and mean training time was 29.3 minutes (SD 13). In patients that were not able to walk before training, but did walk at the end of rehabilitation, we calculated mean gait speed and distance. For comparison of results in patients that were able to walk before training, we used paired t test. Statistical significance was set to  $p \leq 0.05$ . Research was approved by the Medical Ethics Committee of URI - Soča (No. 80/2018). **Results:** 23 patients were not able to walk before neither after the rehabilitation period. Mean values of walking speed and distance walked at the end of rehabilitation in 34 patients that were not able to walk before training was 0.35 m/s (SD 0.23) and 113 metres (SD 70), respectively. Improvement in 23 patients that were able to walk also before training was statistically significant for gait velocity ( $p < 0.001$ ) and distance walked ( $p < 0.0001$ ). In three patients, data were inadequate, thus we eliminated them from analysis. **Conclusions:** We cannot conclude, how much lokomat training contributed to restoring or improving walking. With the assistance of the lokomat patients can practice walking before strength is adequate, while partial body weight support is indispensable. Gait speed and duration during lokomat training in combination with other physiotherapeutic procedures may have contributed to improving walking velocity and distance walked.

**Key words:** spinal cord injury, gait training, exoskeleton, rehabilitation, physiotherapy

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## Uporaba navidezne resničnosti pri rehabilitaciji roke po možganski kapi

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**Uvod:** Uporaba navidezne resničnosti (VR) pri rehabilitaciji nam omogoča, da povečamo nadzor nad izvajanjem nalog in jih lažje prilagodimo posamezniku. BiMeo je naprava, ki omogoča različne načine rehabilitacije roke v dveh ali treh ravninah v VR. Dosedanje raziskave so pokazale, da je BiMeo koristno orodje pri rehabilitaciji (1). Namen naše raziskave je bil oceniti uporabnost naloge seganja BiMeo za izboljšanje gibanja zgornjega uda. **Metode:** V raziskavo smo vključili 39 bolnikov, ki so se zdravili v zdravilišču po ishemični možganski kapi. Povprečna ocena na modificirani Rankinovi lestvici (mRS) je bila 2,6 s (SO: 1,2 s). Bolniki so opravili vsaj dve vadbi seganja z BiMeo, ki sta trajali v povprečju 123 s (SO 49 s). Bolniki so sedeli pred zaslonom in držali BiMeo v okvarjeni roki. Na zaslonu se je pojavila tarča, ki so jo morali čim hitreje in čim natančneje doseči. Za vsakega pacienta je naprava BiMeo izmerila učinkovitost, čas, hitrost, gladkost, optimalnost in napako seganja. Izračun je bil indeks kakovosti seganja in skupna ocena. Vsi parametri razen skupne ocene so bili normalizirani na lestvici od 0 do 10, pri čemer 10 predstavlja optimalno. Razlike med prvo in drugo sejo smo ugotavljali s parnim t-testom. Izmerjene parametre druge vadbe, indeks kakovosti seganja in skupno oceno smo korelirali (Pearsonov koeficient korelacije) s kumulativnim časom vadbe (vsota trajanja prve in druge vadbe) ter številom dni med prvo in drugo vadbo. Vsi bolniki so bili vključeni v standardizirano fizioterapijo in delovno terapijo. **Rezultati:** Čas vadbe in hitrost posameznega giba se med prvo in drugo vadbo nista razlikovala. Preiskovanci so seganje v drugi vadbi izvedli učinkoviteje, v krajšem času, bolj gladko, z optimalnejšo krivuljo seganja in manjšo napako. Vse skupaj je vplivalo na končni rezultat, izražen v točkah ( $222,1 \pm 111,9$  proti  $257,9 \pm 125,0$ ;  $p < 0,01$ ) in indeksu kakovosti seganja ( $5,6 \pm 1,9$  proti  $6,4 \pm 1,7$ ;  $p < 0,005$ ). Nobena korelacija ni bila statistično značilna. **Zaključek:** Rezultati naše raziskave kažejo, da lahko uporaba BiMea z nalogo seganja v VR izboljša gibljivost okvarjenega zgornjega uda po dveh vadbah. Glede na rezultate korelacij to najverjetneje ni posledica učenja. S prihodnjimi raziskavami je treba ugotoviti optimalno število vadb in njihovo trajanje za izboljšanje gibljivosti zgornjega uda.

**Ključne besede:** možganska kap, rehabilitacija roke, delovna terapija, fizioterapija, navidezna resničnost

## The use of virtual reality in rehabilitation of the arm after stroke

**Introduction:** Rehabilitation in virtual reality (VR) enables us to increase control and to personalize rehabilitation. BiMeo is a device designed for the rehabilitation of the upper limb. It enables different VR rehabilitation programs in two or three planes. Research has shown that BiMeo is a useful tool in rehabilitation (1). The purpose of our study was to evaluate the feasibility of rehabilitation of the arm using BiMeo in the reaching movement. **Methods:** 39 patients who were treated at the medical *rehabilitation centre* were included in the study. All patients suffered from ischemic stroke. The average modified Rankin scale score was 3 (SD 1.2 s). They had at least two sessions using BiMeo. Patients sat in front of the screen and held BiMeo in the affected arm. They were instructed to reach a target on the screen as quickly and as accurately as possible. Each exercise lasted on average 123 seconds (SD 49 s). For each patient effectiveness, time, speed, smoothness, optimality of the movement and accuracy were measured. The movement quality index and total score were calculated. All parameters except the total score were normalized on a scale from 0 to 10, where 10 is optimal. Differences between the first and second sessions were compared with the paired t test. The measured parameters of the second exercise, the index of the quality of the reaching and the overall score were correlated (Pearson correlation coefficient) with the cumulative exercise time (the sum of the duration of the first and second exercises) and the number of days between the first and second exercises. All patients performed standardized physio- and occupational therapy. **Results:** The exercise time and the speed of movement did not differ between the first and the second session. On average, patients performed more efficiently, in a shorter time, smoother, with a more optimal movement curve, and with a minor error in the second session. Better performance was evident in the higher total points ( $222.1 \pm 111.9$  vs.  $257.9 \pm 125.0$ ;  $p < 0.01$ ) and the higher movement quality index ( $5.6 \pm 1.9$  to  $6.4 \pm 1, 7$ ;  $p < 0.005$ ). None of the parameters measured correlated with the cumulative duration of the sessions or the number of days between the individual exercises. **Conclusion:** Results of our study suggest that the use of BiMeo with the reaching task in the VR can improve the movement of the damaged upper limb after two exercises. According to the results of correlations, this is probably not a consequence of learning. In the future, it is necessary to determine the optimal number of the sessions and their duration.

**Key words:** stroke, arm rehabilitation, occupational therapy, physiotherapy, virtual reality

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## **Zanesljivost slovenskega prevoda Wolfovega testa motoričnih funkcij**

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**Uvod:** Wolfov test motoričnih funkcij (angl. Wolf Motor Function Test – WMFT) je veljavno merilno orodje za ocenjevanje funkcijskih zmožnosti zgornjega uda pri pacientih po možganski kapi (1–3). Vključuje 17 nalog, pri katerih se meri čas in ocenjuje kakovost izvedbe funkcijskih gibov zgornjega uda, od katerih se pri dveh testira le mišična jakost (2). Za originalno različico WMFT so ugotovili odlično zanesljivost preiskovalca in odlično zanesljivost med preiskovalci (1). Namen prispevka je predstaviti izsledke o zanesljivosti posameznega preiskovalca in med preiskovalci pri uporabi slovenskega prevoda WMFT. **Metode:** V raziskavo je bil vključen priložnostni vzorec 30 pacientov (16 moških, 14 žensk), v povprečju starih 57,5 (SO 8,5) leta, v obdobju povprečno 28,8 (SO 16,4) tedna po možganski kapi. 17 pacientov je imelo levostransko, 13 pa desnostransko hemiparezo. Pri preverjanju zanesljivosti so sodelovali dva fizioterapevta in pet delovnih terapevtk. Ocenjevali smo kakovost izvedbe 15 testnih nalog z okvarjenim zgornjim udom z uporabo 6-stopenjske lestvice funkcijskih zmožnosti (angl. Functional Ability Scale – FAS), v skladu z metodologijo preteklih raziskav (1, 3, 4). En preiskovalec je za preverjanje zanesljivosti posameznega preiskovalca izvajal testiranje in ocenjeval kakovost izvedbe testnih nalog v živo in iz videoposnetka. Za preverjanje zanesljivosti med preiskovalci je vseh sedem preiskovalcev kakovost izvedbe hkrati ocenjevalo iz videoposnetkov. Za posamezne naloge in za končno oceno smo izračunali interklasne korelacijske koeficiente (ICC 2,1 in ICC 3,1 za zanesljivosti med preiskovalci). Raziskavo je odobrila komisija za medicinsko etiko URI - Soča 16. septembra 2016. **Rezultati:** Ugotovili smo odlično zanesljivost posameznega preiskovalca (ICC 0,97–0,99) in odlično zanesljivost med preiskovalci za celoten test (ICC 0,993–0,998) ter za vse posamezne testne naloge (ICC 0,96–0,99). **Zaključki:** Izsledki kažejo na odlično zanesljivost posameznega preiskovalca in med preiskovalci za slovenski prevod WMFT. WMFT je primerno merilno orodje za raziskovalno dejavnost, za klinično uporabo pa je verjetno ustrežnejša skrajšana različica WMFT.

**Ključne besede:** WMFT, možganska kap, zgornji ud, zanesljivost

## Reliability of the Slovene translation of the Wolf Motor Function Test

**Background:** Wolf motor function test (WMFT) is a valid and reliable outcome measure for upper extremity function for stroke patients (1-3). WMFT consists of 17 timed and functional tasks for the upper extremity, two of which only test muscle strength (2). Wolf Motor Function Test has demonstrated excellent test-retest reliability (ICC 0.9-0.99) and excellent inter-rater reliability (ICC 0.95-0.99). The purpose of this paper is to present the results of test-retest and inter-rater reliability test of the Slovene translation of WMFT. **Methods:** A convenience sample of 30 patients (16 male, 14 female), with the mean age of 57.5 (SD 8.5) years, during the period an average of 28.8 (SD 16.4) weeks after stroke, was included in the study. 17 patients with left-sided and 13 with right-sided (10) hemiparesis were included in the research sample. 2 physiotherapists and 5 occupational therapists took part in the reliability study. We evaluated the quality of movement for the 15 tasks with impaired upper extremity using 6 graded Functional Ability Scale (WMFT - FAS). One of the raters administered the test and assessed the quality of movement live and from the video clip for the evaluation of test-retest reliability. To evaluate the inter-rater reliability seven raters simultaneously assessed the subjects from the video clips. For individual tasks and for the final score we calculated the interclass correlation coefficients (ICC 2.1 and ICC 3.1 for inter-rater reliability). The study has been approved by the Medical Ethics Committee of the URI - Soča (16. 9. 2016). **Results:** We found the excellent test-retest reliability (ICC 0.97-0.99) and excellent inter-rater reliability for the entire test (ICC 0.993-0.998) and for all of the individual tasks (ICC 0.96-0.99). **Conclusion:** Evidence shows excellent test-retest reliability and inter-rater reliability for the Slovenian version of WMFT. The Slovenian version of WMFT is an appropriate outcome measure for the use in research, as for the clinical use a streamlined version of WMFT is more appropriate.

**Key words:** WMFT, stroke, upper extremity, reliability

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## **Sklepna mobilizacija roke in uporaba robotske rokavice gloreha pri pacientih po možganski kapi**

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**Uvod:** V raziskavi smo uporabili robotsko rokavico Gloreha Workstation in metodo sklepne mobilizacije po Kaltenbornu. Namen študije je bil raziskati kratkoročni vpliv terapije z robotsko rokavico Gloreha v primerjavi s standardno fizioterapijo roke po možganski kapi. Zanimala nas je morebitna razlika med skupinama v spremembi obsega gibljivosti (ROM), spastičnosti, jakosti prijema roke in funkcionalnosti roke. **Metode:** Raziskava je bila izvedena v desetih zaporednih delovnih dneh. Sodelovalo je 14 preiskovancev 2,2 leta ( $SD \pm 2,2$ ) po možganski kapi. Preiskovance smo naključno razdelili v študijsko in kontrolno skupino. Za ocenjevanje smo uporabljali modificirano lestvico Tardieu, goniometrijo, dinamometer Jamar, Wolfov test motoričnih funkcij (Wolf Motor Function Test – WMFT), test devetih zatičev (NHPT), vprašalnik za ocenjevanje motorične dejavnosti UE (Motor Activity Log – MAL) in anketo o prijetnosti uporabe robotske rokavice Gloreha. Meritve so bile izvedene pred obravnavami in po desetih obravnavah. Glede na zastavljen protokol smo se v obeh skupinah v prvi uri obravnave posvetili pripravi mehkih struktur zgornjega uda – UE (globinsko pregrevanje tkiva in sklepna mobilizacija po Kaltenbornu). Študijska skupina je v drugi uri obravnave prejela terapijo z robotsko rokavico, kontrolna pa standardno fizioterapijo roke po možganski kapi s specifičnimi elementi z omejevanjem spodbujajoče terapije (CIMT), pristopa Bobath s kombinacijo vaj v zaprti, polodprti in/ali odprti kinematični verigi. Vključena terapija CIMT pri kontrolni skupini je trajala od 10 do 30 minut. Odgovora etične komisije še nismo prejeli. Vsi preiskovanci so podpisali prostovoljni pristanek k sodelovanju v raziskavi. **Rezultati:** Terapija z robotsko rokavico Gloreha je pozitivno vplivala na znižanje spastičnosti, povečevanje jakosti prijema in pasivni obseg gibljivosti v smeri zunanje rotacije glenohumeralnega sklepa ter dorzalne fleksije zapestja ( $p < 0,05$ ). Standardna fizioterapija roke po možganski kapi je bila uspešnejša pri povečevanju PROM v smeri radialne deviacije v zapestju, AROM (aktivni ROM) v smeri abdukcije v GH-sklepu in pri testu NHPT ( $p < 0,05$ ). Ugotovili smo izboljšanje splošnega zadovoljstva in uporabo hemiparetične roke pri obeh skupinah (MAL in WMFT). Strinjali so se s trditvijo, da je terapija z robotsko rokavico Gloreha zabavna, zanimiva, motivacijska in prijetna (ocenili so jo s 7,9 od 10 možnih točk) ter bi jo z veseljem še kdaj ponovili. **Zaključek:** Izkazalo se je, da je kratkoročni vpliv terapije s sklepno mobilizacijo in robotsko rokavico Gloreha uspešneje zmanjšal spastičnost hemiparetične roke, povečal jakost prijema roke in obsega gibljivosti v smeri zunanje rotacije v glenohumeralnem sklepu ter dorzalne fleksije zapestja v primerjavi s standardno fizioterapijo roke po možganski kapi.

**Ključne besede:** možganska kap, robotika, nevrorehabilitacija, roka, robotska rokavica Gloreha

## Manual mobilization of the hand and use of the Gloreha robotic glove in stroke patients

**Background:** In the study, we used the Gloreha Workstation robotic glove and Kaltenborn's manual mobilization of hand. The aim of the study was to research the effectiveness of the Gloreha (the robotic hand rehabilitation glove) on hand rehabilitation in stroke patients in comparison with the standard physiotherapy of hand in stroke patients (conventional neurological hand rehabilitation). We were interested in the difference between the two groups (progress in range of motion, spasticity, hand and pinch grip strength and hand's functionality). **Methods:** The research was conducted over ten consecutive working days. The study included 14 patients 2.2 years ( $SD \pm 2.2$ ) after stroke. The patients were randomly divided into a treatment and a control group. To measure results we used the modified Tardieu scale, goniometry, a Jamar dynamometer, the Wolf Motor Function Test (WMFT), Nine-Hole Peg Test (NHPT), Motor Activity Log (MAL) and a survey about the Gloreha's usage comfort. These measurements were performed before and after ten days of treatment. Following the protocol, the first hour of the treatment in both groups was dedicated to soft tissue preparation (inducing deep heat) and joint mobilization of the upper limb (the Kaltenborn technique). In the second hour, the treatment group was treated with the Gloreha, while the control group received standard physiotherapy of hand in stroke patients combined with the Constraint Induced Movement Therapy (CIMT) and a personalized combination of exercises (closed, semi-opened and/or opened kinetic chain) aligned with the Bobath approach. We used the CIMT technique from 10 to 30 minutes per therapy. The ethics committee's answer has not arrived yet. All patients completed a form confirming voluntary participation. **Results:** The results show that the Gloreha therapy reduced spasticity, improved hand grip strength and positively affected PROM (passive range of motion) in the direction of external rotation in the glenohumeral joint and PROM in the direction of dorsal flexion in the wrist joint ( $p < 0.05$ ). Standard physiotherapy of hand in stroke patients was more successful at improving PROM in the direction of radial deviation in the wrist, AROM (active range of motion) in the direction of abduction in the glenohumeral joint and at the NHPT ( $p < 0.05$ ). The research questions were confirmed, as both groups noticed improved general satisfaction and better use of the paretic arm (the MAL and the WMFT). The therapy, which they would undergo again, was fun, interesting, motivational and pleasant (receiving 7.9 out of 10). **Conclusion:** It turned out that the short-term impact of the therapy with Kaltenborn's manual mobilization and the Gloreha robotic glove effectively reduced the spasticity of the hemiparetic arm, increased hand strength and passive range of motion in the direction of external rotation in the glenohumeral joint and in the direction of dorsal flexion in the wrist joint compared to the standard physiotherapy of the arm after stroke.

**Key words:** stroke, robotics, neurorehabilitation, arm, Gloreha (robotic hand rehabilitation glove).

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## Zanesljivost med preiskovalkami za meritve diastaze preme trebušne mišice pri nosečnicah z uporabo ultrasonografa

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**Uvod:** Diastaza ovijalke preme trebušne mišice je definirana kot čezmeren razmik ovijalke preme trebušne mišice vzdolž bele črte (4). Ultrasonografija je cenovno dostopna, neinvazivna, ponovljiva in varna metoda za meritve čezmernega razmika ter uporabo v nosečnosti (2). Vrednosti, ki jih dobimo s tovrstnimi meritvami, so izražene v milimetrih, takih sprememb pa s palpacijo ni mogoče zaznati (2). Namen raziskave je bil ugotoviti zanesljivost posamezne preiskovalke in zanesljivost med preiskovalkami za meritve diastaze preme trebušne mišice pri nosečnicah z uporabo ultrasonografa **Metode:** V raziskavi je sodelovalo 20 prostovoljk nosečnic. Meritve sta izvajali fizioterapevтки, 4,5 cm nad popkom in 4,5 cm pod popkom (1) ter v položaju sproščenih trebušnih mišic in ob izvedbi rahle fleksije trupa (3). Za meritve smo uporabili ultrasonograf Samsung Medison UGEO H60 in linearno ultrazvočno sondo. Za ugotavljanje zanesljivosti je bil uporabljen medrazredni korelacijski koeficient (ICC). Komisija Republike Slovenije za medicinsko etiko Ministrstva za zdravje je raziskavo odobrila in izdala soglasje 21. junija 2017, številka 0120-353/2017-3. **Rezultati:** Vrednost ICC je bila pri meritvah nad popkom pri sproščenih trebušnih mišicah za prvo preiskovalko ICC = 0,976 in za drugo preiskovalko ICC = 0,924. Pri meritvah pod popkom v položaju sproščenih trebušnih mišic je prva preiskovalka dosegla vrednost ICC = 0,599, pri drugi preiskovalki pa je bila vrednost negativna, in sicer ICC = 5,170. Za meritve nad popkom ob izvedbi rahle fleksije trupa je bil pri prvi preiskovalki ICC = 0,918 in pri drugi preiskovalki ICC = 0,951. Vrednost ICC za meritve pod popkom ob izvedbi rahle fleksije trupa so bile za prvo preiskovalko ICC = 0,535 in za drugo preiskovalko ICC = 0,907. Zanesljivost med preiskovalkami je bila za meritve diastaze ovijalke preme trebušne mišice nad popkom v položaju sproščene trebušne stene ICC = 0,690 in pod popkom ICC = 0,620. Za meritve ob izvedbi rahle fleksije trupa pa je bila zanesljivost nad popkom ICC = 0,754 in pod popkom ICC = 0,753. **Zaključek:** Na podlagi dobljenih rezultatov lahko sklepamo, da je bila zanesljivost posameznih preiskovalk za meritve diastaze ovijalke preme trebušne mišice nad popkom v obeh položajih zelo dobra. Pri meritvah pod popkom je bila zanesljivost povprečna do zelo dobra. Zanesljivost med preiskovalkami je bila za meritve nad popkom in pod njim ter v obeh položajih dobra.

**Ključne besede:** diastaza rekti abdominis, ultrasonograf, medrazredni korelacijski koeficient, zanesljivost, nosečnost



## The reliability of measuring diastasis of the recti abdominis in pregnant women using ultrasound

**Introduction:** Diastasis recti abdominis is defined as an increased separation of the recti abdominis muscle along the linea alba (4). Ultrasonography is a reasonably priced, non-invasive, repeatable and safe method for measuring the excessive separation and use in pregnancy (2). The obtained values are in millimetres; however, such changes cannot be detected by palpation (2). The purpose of this research was to determine the intra-rater and the inter-rater reliability in measuring diastasis recti abdominis in pregnant women with the use of an ultrasound machine. **Methods:** The research included 20 pregnant volunteers. Two physiotherapists performed measurements 4.5 cm above the navel and 4.5 cm below the navel (1), as well as in the position of a relaxed abdominal wall and in performing a crunch (3). Measurements were made using an ultrasound machine Samsung Medison UGEO H60 and linear ultrasound probe. The reliability was assessed with the intraclass correlation coefficient (ICC). The research was approved by the National Medical Ethics Committee of the Ministry of Health, Republic of Slovenia, number 0120-353/2017-3. **Results:** ICC value in measurements above the navel and in position of a relaxed abdominal wall, was ICC = 0.976 for the first rater and for the second rater it was ICC = 0.924. In measurements below the navel and in the position of a relaxed abdominal wall, the first rater reached the value of ICC = 0.599, for the second rater the value was negative, ICC = -5.170. In measurements above the navel in performing a crunch, for the first rater it was ICC = 0.918 and for the second rater it was ICC = 0.951. The ICC value in measurements below the navel in performing a crunch, for the first rater was ICC = 0.535, and for the second one ICC = 0.907. The reliability among raters for measurements in position of a relaxed abdominal wall above the navel was ICC = 0.690 and below the navel, ICC = 0.620. In measurements in performing a crunch above the navel, it was ICC = 0.754 and below the navel, it was ICC = 0.753. **Conclusion:** Based on acquired results, we can conclude that the intra-rater reliability above the navel in both positions was very good. In measurements below the navel, the reliability was average to very good. Reliability among raters in measurements above and below the navel and in both positions was good.

**Key words:** diastasis recti abdominis, ultrasound machine, intraclass correlation coefficient, reliability, pregnancy

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## Fizioterapevtska obravnava pacientke s kronično pelvično bolečino – poročilo o primeru

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**Uvod:** Kronična pelvična bolečina (KPB) je definirana kot nemaligna bolečina v predelu medenice, anteriorni trebušni steni (v višini popka ali pod popkom), lumbosakralni hrbtenici in/ali predelu zadnjice in presredka, traja vsaj šest mesecev (1) in je povezana z negativnimi kognitivnimi, spolnimi in čustvenimi posledicami (2). Prevalenca KPB pri odraslih ženskah je med 14 in 24 odstotki. Diagnosticiranje je težavno, obravnava KPB pa je različna. Pacienti so lahko napoteni h ginekologu, urologu ali kolorektalnemu specialistu, lahko se opravijo številne raziskave in invazivni postopki, na koncu pa se pacientu pove, da »ni nič narobe«, ali pa dobi specifično medicinsko diagnozo ali diagnozo sindroma (3). **Prikaz primera:** 42-letna pacientka je bila napotena na fizioterapevtsko obravnavo s sumom na simfiziolizo in s spremljajočimi diagnozami pelvialgija, cistalgija, sindrom pelvičnih varic in blaga cistokela. Po prvem porodu s carskim rezom leta 2005 je opažala topo bolečino v predelu suprapubične brazgotine. S preiskavami in posegi (ginekološki pregledi, cistoskopija, dve laparoskopiji) so odkrili zarastline, poškodbo fascije zaradi suprapubične brazgotine ter pelvične varice. Kljub adheziozami pooperativnih zarastlin in medikamentoznemu zdravljenju se bolečine niso zmanjšale. Po drugem porodu leta 2008 se je bolečina okrepila, zaradi česar so sumili na endometriozo. Leta 2017 so ji laparaskopsko odstranili maternico in jajcevede ter zarastline ob brazgotini po carskem rezu. Žarišč endometrioze niso našli. Bolečina po posegu je vztrajala v enakem ali večjem obsegu, pacientka je redno jemala različne analgetike. Zdravstvena, gastrointestinalna in anamneza spolne dejavnosti so bile brez posebnosti. Palpacijski test sramnice je bil pozitiven. Fizikalni pregled, ki je vključeval pregled trebuha, hrbta, zadnjice, oceno zunanjih genitalij ter manualni vaginalni pregled je bil brez posebnosti. Sposobnost hotene aktivacije prečne trebušne mišice smo ocenili z UZ in ugotovili, da hotena aktivacija ni pravilna. Pacientka je dobila navodilo, da izvaja aktivacijo prečne trebušne mišice od tri- do petkrat na dan, in sicer deset kontrakcij z zadržkom deset sekund in z desetsekundnimi pavzami, v položaju na hrbtu s pokrčenimi nogami ali leže na boku. Bolečina se je že po nekaj obravnavah zmanjšala. Po treh mesecih oziroma skupno desetih obravnavah je pacientka usvojila pravilno aktivacijo prečne trebušne mišice. Bolečina v suprapubičnem predelu je izzvenela. Jemanje protibolečinskih sredstev ni več potrebno. **Zaključki:** Pacientka je 14 let trpela zaradi kroničnih bolečin, zaradi katerih je imela številne preiskave in kirurške posege. V nekaj tednih smo z zelo enostavnim postopkom, kot je pravilna aktivacija prečne trebušne mišice, dosegli, da je bolečina povsem izzvenela, kakovost življenja, kot je navedla pacientka, pa se je bistveno izboljšala.

**Ključne besede:** kronična pelvična bolečina, fizioterapevtska obravnava, aktivacija prečne trebušne mišice

## Physiotherapy management of a patient with chronic pelvic pain – case report

**Background:** Chronic pelvic pain (CPP) is defined as non-malignant pain in the area of the pelvis, anterior abdominal wall (at the height of the umbilicus or below), lumbosacral spine and/or the region of buttocks and perineum, lasting at least 6 months (1) and is associated with negative cognitive, sexual, and emotional consequences (2). The prevalence of CPP in adult women is between 14% and 24%. Diagnosing is difficult, and CPP management differs. Patients can be referred to a gynaecologist, urologist, colorectal specialist; many tests and invasive procedures can be carried out; in the end, the patient is told "there is nothing wrong" or is given a specific medical diagnosis or the diagnosis of a "syndrome" (3). **Case report:** A 42-year-old patient was referred to a physiotherapist with suspected symphysiolysis with accompanying diagnoses of pelvic pain, cystalgia, pelvic varices and mild cystocele. After her first delivery with a caesarean section in 2005 the patient noticed dull pain in the area of the suprapubic scar. Diagnostic procedures and interventions (gynaecological examinations, cystoscopy, 2 laparoscopies) revealed adhesions, damaged fascia due to suprapubic scarring, and pelvic varices. The pain did not decrease despite adhesiolysis of post-operative adhesions and medication treatment. After the second delivery in 2008 the pain intensified, which led to a suspected diagnosis of endometriosis. In 2017 the patient underwent a laparoscopic removal of the uterus and the fallopian tubes and lysis of adhesions of the caesarean section scar; no endometriosis lesions were found. The pain persisted on the same or greater scale after the procedure, and the patient regularly used different analgesics. Her medical, gastrointestinal, and sexual activity history was uneventful. The palpation test of the pubis was positive. Physical examination, which included an examination of the abdomen, back, buttocks, evaluation of the external genitals and a manual vaginal examination, was unremarkable. The ability to activate m. transversus abdominis was evaluated by an ultrasound and we found that her conscious activation was incorrect. The patient was instructed to activate m. transversus abdominis 3-5 times a day, 10 contractions with a 10 second hold and a 10-second pause, either on her back with her knees bent or lying on the side. The pain decreased after only a few treatments. After 3 months (a total of 10 treatments) the patient successfully correctly activated m. transversus abdominis. The pain in the suprapubic area resolved spontaneously. Analgesic treatment is no longer necessary. **Conclusions:** The patient suffered chronic pain for 14 years, resulting in numerous interventions and surgical procedures. Using a very simple procedure, such as the correct activation of m. transversus abdominis, we have, within a few weeks, managed to achieve that her pain completely disappeared and the quality of life, as per the patient, has improved significantly.

**Key words:** chronic pelvic pain, physiotherapy management, m. transversus abdominis activation

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## Vpliv transkutane stimulacije posteriornega tibialnega živca na simptome fekalne inkontinence (sistematičen pregled literature)

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**Uvod:** Fekalno inkontinenco definiramo kot navajanje nehotene izgube blata (1). Pojavnost fekalne inkontinence v Sloveniji še ni znana. Glede na tujo literaturo se v starosti nad 65 let pojavlja pri 3 do 10 odstotkih ljudi (2). Obravnava fekalne inkontinence je povezana z obravnavo primarne bolezni. Zaradi neustreznega zdravljenja fekalne inkontinence ta pomembno vpliva na znižanje kakovosti življenja (3). Transkutana električna stimulacija posteriornega tibialnega živca je terapevtska možnost neinvazivne obravnave fekalne inkontinence. Predpostavljeno je, da lahko z električno stimulacijo senzoričnih, motoričnih in avtonomnih živčnih vlaken posteriornega tibialnega živca vplivamo na uravnavanje proženja aferentnih živčnih vlaken na ravni sakralnega plečja (4), kar potencialno zavre nehoteno izločanje blata. Namen sistematičnega pregleda literature je bil na podlagi pregleda randomiziranih kontroliranih poskusov ovrednotiti učinkovitost transkutane stimulacije posteriornega tibialnega živca na izboljšanje simptomov in kakovosti življenja oseb, ki trpijo za fekalno inkontinenco. **Metode:** V podrobnejšo analizo so bili po sistematičnem pregledu literature v zbirkah PEDro, CINAHL, MEDLINE in PubMed vključeni štirje randomizirani kontrolirani poskusi. **Rezultati:** Ocena kakovosti vključenih štirih raziskav po lestvici PEDro je med 5 in 6 glede na PEDro. Izsledki raziskav kažejo, da vsaj šest tednov (dvakrat na teden) trajajoča aktivna ali placebo transkutana stimulacija posteriornega tibialnega živca vodi v statistično pomembno zmanjšanja števila epizod fekalne inkontinence v primerjavi z začetnim stanjem. Kljub temu celotno izboljšanje simptomov fekalne inkontinence ob aktivni stimulaciji ni bilo statistično pomembno boljše od placebo stimulacije. Prav tako aktivna stimulacija v primerjavi s placebo stimulacijo ni vodila v statistično pomembno boljšo oceno kakovosti življenja. Enkratna aktivna transkutana stimulacija posteriornega tibialnega živca je povzročila, da imajo vključene osebe statistično pomembno višji maksimalni rektalni pritisk in nižjo varianco rektalnih volumnov v primerjavi s placebo stimulacijo. **Zaključki:** Kakovost pregledanih raziskav je zmerna. Glavni dejavniki pristranskosti so majhno število preiskovancev, odsotnost oslepitve preiskovalcev in nezadostno spremljanje rezultatov. Na podlagi pregleda literature ne moremo potrditi, da je aktivna stimulacija v primerjavi s placebo stimulacijo učinkovitejša. Izsledki kažejo, da bi transkutana stimulacija posteriornega tibialnega živca lahko imela vpliv na anorektalno funkcijo, kar je drugače od predpostavljene. Za potrditev terapevtske učinkovitosti stimulacije so potrebne dodatne visokokakovostne raziskave, izvedene na specifični skupini oseb, ki trpijo za fekalno inkontinenco.

**Ključne besede:** fekalna inkontinenca, transkutana električna stimulacija, posteriorni tibialni živec, kakovost življenja

## Effects of transcutaneous tibial nerve stimulation on symptoms of faecal incontinence (systematic literature review)

**Background:** Faecal incontinence is defined as complaint of involuntary loss of feces (1). Prevalence of faecal incontinence in Slovenia has not yet been described. However, the prevalence of faecal incontinence in people older than 65 years worldwide varies between 3 and 10 percent (2). Initial treatment depends on the disease that had resulted in the symptoms of faecal incontinence. When left untreated, it can significantly reduce the quality of life (3). Transcutaneous electrical stimulation of posterior tibial nerve is one of the non-invasive options for treatment of faecal incontinence. It is proposed that stimulation of sensory, motor and autonomic nerve fibres via the posterior tibial nerve results in indirect modulation of afferent output on the level of sacral plexus (4), which potentially leads to decrease of the symptoms. The purpose of this systematic literature review was to determine the effectiveness of transcutaneous posterior tibial nerve stimulation on the symptoms of faecal incontinence and on the quality of life. **Methods:** Four randomized controlled trials were analysed, all of which were found in the databases PEDro, CINAHL, MEDLINE and PubMed. **Results:** The quality of the included papers is between 5 and 6 based on the PEDro scale. Protocol of transcutaneous electrical stimulation of tibial nerve that lasted at least 6 weeks (two times per week) leads to statistically significant post treatment decrease in number of faecal incontinence episodes. There is no significant difference between decrease of faecal incontinence symptoms in active and placebo group. The improvement of quality of life is not statistically significant different when comparing active and placebo group. A single time active stimulation has a significantly greater effect on increased maximal rectal pressure and lower rectal volume variation, when comparing it to placebo stimulation. **Conclusions:** The quality of the included randomised controlled trials is moderate. The potential biases of the studies were low number of included participants, lack of blinding of the assessors and lack of adequate follow-up. The current systematic review of the literature suggests there is no tangible difference between placebo and active stimulation. A different effect of the intervention to anorectal function is suggested. Further high quality research is needed on specific population to prove if there is any therapeutic effect of the intervention on symptoms of faecal incontinence.

**Key words:** faecal incontinence, transcutaneous electrical stimulation, posterior tibial nerve, quality of life

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## Večdimenzionalna problematika obrezovanja žensk – pregled trenutne literature

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**Uvod:** Obrezovanje žensk je svetovni problem. Do leta 2050 bo lahko obrezanih več kot 63 milijonov deklet po svetu (1). Gre za globoko utrjeno kulturno tradicijo, ki ima v številnih skupnostih simbolični pomen. Izvaja se tako v mestnem kot ruralnem okolju. Čeprav natančnega števila deklet in žensk, ki so bile podvržene obrezovanju, ne poznamo, je teh vsaj 200 milijonov v 30 državah. Obrezovanje žensk je najpogostejše v afriških državah in državah Bližnjega vzhoda ter nekaterih azijskih državah, lahko pa se s tem srečamo tudi v Evropi, Avstraliji in Severni Ameriki zaradi migracij, ki so sledile vojnem, globalizaciji in selitvam na splošno (2). Namen: Namen pregleda literature je bil pregledati trenutno literaturo o obrezovanju žensk in njegovih posledicah, opisati in kritično oceniti teoretične in metodološke pristope k zdravljenju obrezanih žensk ter opisati in oceniti različne metode, katerih cilj je ustaviti ali zmanjšati pogostost obrezovanja žensk. **Metode:** Pregledali smo literaturo, objavljeno v zadnjih desetih letih. Vključena literature je obravnavala teme posledic obrezovanja žensk, možnosti zdravljenja in različne tehnike za prekinitvev ali zmanjšanje nadaljevanja obrezovanja žensk. Iskanje je potekalo na spletnih podatkovnih zbirkah PubMed, PEDro, Cochrane library, CINAHL in Medline. **Rezultati:** Svetovna prevalenca obrezovanja žensk se manjša zaradi zakonskih ukrepov in programov, s katerimi si prizadevajo za spremembo omenjene prakse v skupnosti. Posledic obrezovanja je veliko in razdelimo jih lahko na kratkoročne ter dolgoročne. Možnosti zdravljenja so v literaturi dobro dokumentirane, vendar so objavljene raziskave slabše kakovosti (3). Kljub temu je veliko možnosti zdravljenja in smernic zdravljenja obrezanih žensk. Zdravstveni delavci bi morali biti primerno poučeni za ustrezno obravnavo. Prav tako bi morale biti ženske obveščene o mogočih posledicah in pravnih vidikih obrezovanja (4). Pregled literature o znanju in stališčih študentov ter zdravstvenih delavcev je pokazal, da obstaja velika potreba po izobraževanju in usposabljanju glede razvijanja kulturnih kompetenc, povezanih z obrezovanjem, saj so zdravstveni delavci zelo pomembni pri oskrbi žensk in preprečevanju tega. Družba bi se morala zavedati, da obrezovanje žensk obstaja, in spodbujati odprto komunikacijo, predvsem med moškimi in ženskami, saj se njihovo mnenje navadno ujema (5). **Zaključek:** Pregled literature ponuja nov pogled na obrezovanje žensk, posledice, možnosti zdravljenja tega, kot tudi, kaj lahko naredimo, da ga ustavimo. Mogoče je, da niso bile vključene vse objavljene raziskave, ki so dostopne v drugih podatkovnih zbirkah. Prihodnje raziskave naj bodo boljše kakovosti in se osredotočijo predvsem na možnosti zdravljenja.

**Ključne besede:** obrezovanje žensk, posledice, zdravljenje, deinfibulacija, preprečevanje

## Multifaceted issue of female genital mutilation – recent literature review

**Background:** Female genital mutilation (FGM) represents a global concern as 63 million girls could be subjected to it by 2050 (1). It is a deeply embedded cultural tradition with a symbolic meaning in communities that is practiced in rural and urban areas. The exact number of girls and women who have undergone FGM remains unknown, but at least 200 million in 30 countries have been subjected to it. The practice is concentrated in Africa, the Middle East and some Asian countries, but can also be found in Europe, Australia and North America, due to migration (2). **Purpose:** The objective of this paper was to review the current literature on FGM and its consequences, to describe and critically assess the theoretical and methodological approaches to treatment and to describe and assess different methods that aim to stop or reduce the continuation. **Methods:** We carried out a literature review of articles published in the last 10 years. Included articles studied consequences following FGM, treatment options and different methods to stop or reduce the continuation of FGM. Literature search was conducted on the following databases: PubMed, PEDro, Cochrane library, CINAHL and Medline. **Results:** Globally the prevalence is declining, as many legal actions and community-based programmes are proposed. The consequences of FGM can be divided into short and long term. Treatment options are well documented, but published studies are of poor quality (3). Nevertheless, there are many guidelines on how to treat women with FGM. Health care professionals should be well informed and sensitive to properly treat women. They should also inform women about consequences and legal aspects (4). A literature review of student's and health care professional's knowledge and attitudes regarding FGM showed that there is a need for education and training, since they are vital in the care and prevention of FGM. Society should be informed and encouraged in open communication, especially between men and women, since their opinions usually match (5). **Conclusion:** This article offers a new perspective on FGM, consequences and treatment options as well as what we can do to stop this practice. Limitations of this review include the risk of bias, because it is not possible to identify and retrieve all studies. Future research should be of better quality and should focus especially on treatment options.

**Key words:** FGM, female genital mutilation, consequences, treatment, prevention

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Informacije o predstavitev ali objavah dela pred kongresom: pregled je bil predhodno objavljen v reviji Izzivi prihodnosti. V obliki plakata je bil predstavljen na kongresu WCPT v Ženevi 2019.





# FIZIOTERAPIJA

September 2019, letnik 27, supl. 1

E-ISSN 2536-2682

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