Explaining the beneficial effect of exercise in knee osteoarthritis

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Background: Exercise reduces pain and improves functioning in osteoarthritis of the knee (OAk). Underlying mechanisms are still under debate and better understanding of the pathways involved may contribute to more targeted treatment strategies. This qualitativ

analysis of the literature aims to provide an overview of theoretical models that are put forward to explain the treatment effects of exercise in OAk. **Methods:** *An inductive qualitative approach, based on the 'grounded theory' of Glaser and Straus, was used.* Studies emphasizing on exercise therapy for OAk, collected from three Cochrane reviews and nine guidelines of the Physiotherapy Evidence Database (PEDRO) published between 2000 and 2012, were included. The introduction and discussion parts of these papers were screened for explanations of exercise-induced benefits in OAk patients. **Results:** Twenty-two studies were included and 73 key points were identified which were subdivided into 16 core theoretical concepts. Finally, 5 categories were formed: neuromuscular, peri-articular, intra-articular, and psychosocial components, and general fitness and health. **Conclusion:** Future research on exercise in OAk should allow distinguishing the contribution of different potential pathways to the treatment effects.

Keywords: osteoarthritis, knee, exercise, aetiology, rationale.

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Robotsko merjene anteriorne laksnosti kolenskega sklepa

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Uvod: Anteriorna laksnost kolenskega sklepa je pri nepoškodovanem kolenu dejavnik tveganja za poškodbo sprednje križne vezi (1) in poškodbo kolena (2). Pri poškodovanem kolenu pa je indikator za poškodbo sprednje križne vezi (3, 4). Nov robotski artrometer za merjenje anteriorne laksnosti kolenskega sklepa kolenski artrometer GNRB® (GeNouRoB SAS, Montenay, France) ima nekatere prednosti v primerjavi z nerobotskim kolenskim artrometrom KT. Namen raziskave je bil ugotoviti zanesljivost posameznika pri uporabi kolenskega artrometra GNRB®in predstaviti normativne vrednosti anteriorne laksnosti kolena pri mladih preiskovankah z uporabo artrometra GNRB®. **Metode**: Anteriorna laksnost kolenskega sklepa je bila testirana pri 2 skupinah mladih, nepoškodovanih preiskovank. Med izvedbo testa smo spremljali EMG aktivnost zadnjih stegenskih mišic. Zanesljivost kolenskega artrometra GNRB® je bila testirana v skupini 13 preiskovank, zbiranje normativnih podatkov je potekalo v skupini 23 preiskovank. Anteriorna laksnost kolenskega sklepa (anteriorni odmik golenice) je bila izmerjena pri silah 134 N in 250 N. Rezultati so predstavljeni na nestandardiziran način (brez uporabe dodatne stabilizacije) in standardiziran način (z uporabo dodatne stabilizacije) upoštevajoč stabilizacijsko silo na pogačici. **Rezultati:** Relativna zanesljivost (95-odstotni interval zaupanja) kolenskega artrometra GNRB®je bila pri sili 134 N med 2 in 3 mm. Normativni podatki so pokazali, da je anteriorna laksnost levega kolena skoraj za 1 milimeter večja od desnega kolena. **Zaključki:** Relativna zanesljivost kolenskega artrometra GNRB®je primerljiva s KT kolenskim artrometrom. Kot ugotovljeno na nerobotskem kolenskem artrometru, je tudi pri robotskem artrometru GNRB® anteriorna laksnost kolenskega sklepa večja na levem kolenu v primerjavi z desnim kolenom.

Ključne besede: sprednja križna vez, EMG, sila, artrometer.

Robotic testing of knee anterior laxity

Background: Anterior laxity is a risk factor for anterior cruciate ligament (1) and traumatic knee injuries (2), generally, in the uninjured knee. In the injured knee, it is indicative of anterior cruciate ligament injury (3, 4). A new knee ligament arthrometer for testing knee anterior laxity, the GNRB® knee arthrometer (GeNouRoB SAS, Montenay, France), has been developed and offers additional characteristics that may improve testing as compared to nonrobotic devices such as the KT. Purpose of the study was to evaluate the reliability of the GNRB® knee arthrometer and present normative values of knee anterior laxity using this device on young females. **Methods**: Knee anterior laxity in both knees was tested in two groups of young, uninjured females using the hamstrings electromyography biofeedback feature of the device. There were 13 participants in the group tested for reliability and 23 for the normative study. Knee anterior laxity (mm of movement of the tibia in the anterior direction) was calculated at test forces of 134 N and 250 N with values presented for the unstandardised and standardised (relative to stabilisation force) conditions. **Results:** The relative reliability (95 % limits of agreement) of the device for laxity at a test force of 134 N was 2 to 3 mm. Left knee anterior laxity was almost 1 mm greater than the right. **Conclusions:** The relative reliability of the GNRB® knee arthrometer is comparable to the KT device. In agreement with previous work on the nonrobotic KT arthrometer, the knee anterior laxity values found with the GNRB® knee arthrometer are greater in the left as compared to right knees.

Keywords: anterior cruciate ligament, electromyography, force, arthrometry.

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Izokinetična ocena funkcije kolenskega sklepa po rekonstrukciji sprednje križne vezi

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Uvod: Izokinetična ocena mišične funkcije je po vsem svetu znana in zelo uveljavljena metoda ocenjevanja mišične moči in jakosti, ki se uporablja od leta 1967 (1). Testiranje je pomembno za natančno spremljanje učinka treninga mišične moči in vzdržljivosti v sklopu rehabilitacijskega programa po operaciji sprednje križne vezi (SKV). Namen: V Termah Zreče izvajamo izokinetične meritve od leta 1997, najprej na izokinetičnem dinamometru EN KNEE, zdaj na najsodobnejši aparaturi BIODEX PRO 4. V ta namen smo želeli prikazati naše izkušnje pri izokinetični oceni funkcije kolenskega sklepa po operaciji SKV. V raziskavo smo vključili 80 preiskovancev. Pri 40 preiskovancih je bila rekonstrukcija SKV narejena s presadkom tetiv fleksorjev kolenskega sklepa, in sicer s tetivo mišic semitendinosus in gracilis (skupina STG). Pri 40 preiskovancih pa je bila rekonstrukcija narejena s presadkom patelarnega ligamenta (skupina PT). Predvidevali smo, da je med skupinama STG in PT razlika v mišični moči in vzdržljivosti fleksornih in ekstenzornih mišic kolenskega sklepa. **Metode:** Testirali smo moč in vzdržljivost ekstenzornih in fleksornih mišic kolenskega sklepa. Testiranje na izokinetičnem dinamometru smo izvedli 3 in 6 mesecev po operaciji SKV pri 60°/s in z obsegom giba med 10° in 90°, 6 ponovitev – za test moči in pri 180°/s, z obsegom giba med 20° in 90°, 25 ponovitev – za test vzdržljivosti. Poleg tega smo po testu moči izmerili tudi anteriorni premik golenice na artrometru KT-1000. **Rezultati:** Pridobljene podatke smo statistično analizirali s programom SPSS. Povprečni deficit moči ekstenzorjev pri skupini STG je bil 6 mesecev po operaciji – 13,1 %, pri skupini PT pa 25,2 %. Ugotovljena je bila statistično značilna razlika v moči ekstenzorjev med skupinama STG in PT ($p = 0,00015$). Za moč fleksorjev in vzdržljivost fleksorjev in ekstenzorjev ni bila ugotovljena statistično značilna razlika. Pri testiranju na artrometru KT-1000 smo ugotovili, da je bil povprečni anteriorni premik golenice pri sili 136 N za skupino STG 1,07 ± 1,47 mm in pri skupini PT 0,84 ± 1,64 mm. **Zaključki:** Rekonstrukcija SKV je v obeh skupinah pokazala dobre rezultate pri izokinetičnih meritvah. V literaturi je mogoče razbrati, da je moč ekstenzornih mišic kolenskega sklepa pri skupini PT zmanjšana za 20 % še 2 leti po operaciji. V naši raziskavi smo ugotovili, da je taka razlika pri 6 mesecih po operaciji. Glede na rezultate meritev z artrometrom KT-1000 ugotavljamo, da lahko dosežemo odlično objektivno stabilnost kolenskega sklepa pri uporabi obeh presadkov.

Ključne besede: izokinetične meritve, rekonstrukcija sprednje križne vezi, tetiva mišic fleksorjev, tetiva patelarnega ligamenta, KT-1000 artrometer.

Isokinetic evaluation of knee joint function after anterior cruciate ligament reconstruction

Background: Isokinetic evaluation of muscle function is a worldwide known and well established method for evaluation of the muscle strength and intensity, which has been in use since 1976. Testing is important in order to follow exactly the impact of training muscle power and resistance of rehabilitation program after anterior cruciate ligament (ACL) reconstruction. Purpose: In Unitur Spa Resorts, isokinetic measurements have been performed since 1997, initially on isokinetic dynamometer EN KNEE and now on the most modern apparatus BIODEX PRO 4. Therefore, we wanted to present our experience in the isokinetic evaluation of the knee joint after the ACL reconstruction. The study included 80 patients. In 40 patients, ACL reconstruction was performed by hamstring tendon autograft (semitendionosus and gracilis (STG) group), in the other 40 patients by patellar tendon autograft (PT group). We expected a difference in muscle power and intensity extensors and flexors of the knee joint between STG and PT groups. **Methods:** We tested the strength and intensity of the knee joint muscles. Isokinetic dynamometer testing was performed three and six months after the ACL reconstruction. At three months, the Endurance test has been performed (180°/s velocity with ROM between 20° and 90°; 25 repetitions). At six months, the Endurance and Power test (60°/s velocity and ROM between 10° and 90°; six repetitions) were performed. After the strength tests, we additionally measured the total AP displacement of the tibia with the KT-1000 arthrometer. **Results:** The gained data was statistically analyzed with the program SPSS. The average deficit of extensors strength in STG group at 6 months after ACL reconstruction was 13.1 %, while in the PT group the deficit was 25.2 %. The statistically significant difference was observed in strength extensors between the groups ($p = 0.00015$). For flexors strength and intensity we did not find statistically significant difference. We found that mean 136-N side-to-side difference (arthrometer KT-1000) for STG group was 1.07 ± 1.47 mm and for PT group 0.84 ± 1.64 mm (not significant). **Conclusions:** ACL reconstruction in both groups showed good results in isokinetic measurements. The literature states that the power of extensor muscles of the knee joint in the PT group can be reduced by 20 % in the next 2 years after the ACL reconstruction. However, in our study we found that this difference is at 6 months after the surgery. Our results of KT-1000 measurements prove that we can get excellent objective knee stability using both transplants.

Keywords: isokinetic measurements, anterior cruciate ligament, reconstruction, hamstring tendons, patellar tendon, KT-1000 arthrometer.

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Fizioterapija po artroskopiji kolka z rekonstrukcijo labruma

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Uvod: Utesnitveni sindrom kolka in posledično poškodbe labruma se klinično lahko kažejo z bolečino, zmanjšanim obsegom giba, spremembami v mišični moči in koordinaciji, s slabšo stabilnostjo in izgubo funkcije (1). Za obnovitev skladnosti sklepnih površin kolčnega sklepa se uporablja artroskopija, s katero kirurg popravi kostno geometrijo, labrum in ligamentarne strukture, temu pa sledi proces fizioterapije, ki se spreminja skladno z razvojem operativne tehnike. Pomembno je, da sledimo procesu celjenja tkiva ter da s pravilno izbiro in aplikacijo fizioterapevtskih postopkov telesu omogočamo optimalne pogoje za celjenje. Glede na to, da se tovrstne poškodbe pojavljajo predvsem pri mladi, aktivni populaciji, je pomembno tudi, da upoštevamo individualne lastnosti vsakega pacienta. Glavni cilj posega in pooperativne fizioterapije je povrnitev neboleče in popolne funkcije kolčnega sklepa (2). **Metode:** Pregled literature v bazah Pub Med, Medline in EBSCO z iskalnim kriterijem »rehabilitation hip arthroscopy«, izdane med letoma 2006 in 2012, je izločil 11 člankov. Članki so poleg rekonstrukcije labruma vključevali tudi druge rekonstrukcijske posege na kolku. Zaradi praktične uporabnosti smo se odločili osredotočiti le na protokole, ki so bili vezani na rekonstrukcijo labruma. Na podlagi pridobljenih člankov in svojih praktičnih izkušenj smo pripravili protokol rehabilitacije po artroskopiji kolka z rekonstrukcijo labruma, ki je tudi vpeljan v prakso. **Rezultati:** Protokol rehabilitacije po artroskopiji kolka mora upoštevati načela: upoštevanje procesa celjenja, zmanjševanje otekline in bolečine, zgodnje pridobivanje obsega gibljivosti, omejitev obremenjevanja pri hoji, vzpostavljanje mišične aktivacije in nevromišičnega nadzora, postopna krepitev in ponovna vzpostavitev propriocepcije, kardiovaskularni trening in športno specifični trening (3). Večina literature navaja protokol v štirih fazah (1, 2, 4), mi pa smo se odločili za pripravo protokola, ki vsak teden prikazuje vključevanje posameznih fizioterapevtskih postopkov in je namenjen fizioterapevtom in ne pacientu. Zaradi specifičnosti smo združili le aktivnosti prvih štirih tednov, in sicer za delno obremenjevanje operirane noge in postopno krepitev mišic, v nadaljevanju pa smo se osredotočili na posamezne fizioterapevtske postopke (raztezanje, moč in funkcija mišic, kontrola mišične aktivacije, stabilizacija, kardiovaskularne vaje, hidroterapija, manualna terapija, pliometrija) in znotraj njih na nekaj specifičnih aktivnosti. **Zaključki:** Mehanične težave v kolku se odpravljajo z artroskopijo, funkcionalni primanjkljaj pa pridobimo skozi pooperativni fizioterapevtski proces. Za povrnitev neboleče in popolne funkcije kolčnega sklepa sta pomembna dobro sodelovanje zdravnika kirurga s fizioterapevtom ter motiviran pacient, ki ga mora fizioterapevt educirati. Predstavljeni rehabilitacijski protokol je osnova, ki jo je treba prilagajati stanju pacienta.

Ključne besede: pregled literature, proces celjenja, rehabilitacijski protokol, kolčni sklep.

Rehabilitation after hip arthroscopy with reconstruction of labrum

Background: Pain, loss of motion, changes in muscle strength and motor control, loss of stability and loss of function can be caused by femoroacetabular impingment and labral tear (1). To restore the consistency of joint surfaces of hip joint arthroscopy is used, in which a surgeon corrects bony geometry, labrum and ligament structures, followed by rehabilitation process, which varies in accordance with the development of surgical techniques. It is important to follow the process of healing of tissue, and with the proper selection and application of physiotherapeutic procedures we enable the body optimal conditions for healing. Given that these types of injuries occur mostly in young, active population, it is also important to consider the individual characteristics of each patient. The main objective of surgery and post-operative physiotherapy is to restore pain-free and full function hip joint (2). **Methods:** With a literature review in the databases Pub Med, Medline and EBSCO, the search criteria being "hip arthroscopy rehabilitation", issued between 2006 and 2012, 11 articles were selected. Articles in addition to reconstruction of labrum also included other reconstructive operations on the hip. Due to practical use, we decided to focus only on the protocols that have been linked to the reconstruction of labrum. On the basis of articles and our own practical experiences, we have prepared the "Protocol of rehabilitation after hip arthroscopy with labrum reconstruction", which is also implemented in practice. **Results:** Rehabilitation protocol after hip arthroscopy needs to follow several basic principles: consideration of soft tissue healing constraints, control of swelling and pain, early range of motion, limitation on weight bearing, initiation of muscle activity and neuromuscular control, progressive strengthening and restoration of proprioception, cardiovascular training and sport specific training (3). The majority of literature indicates the protocol in four phases (1, 2, 4). We decided to make a protocol, which shows individual rehabilitation procedures applied at different time of rehabilitation and is designed for physical therapists and not for the patient. Due to the specifics, we combined only the first four weeks of activities that are related to the partial weight bearing on operated leg and gradually strengthening the muscles, later we focused on specific rehabilitation procedures (stretching, strength and muscle function, control of muscle activation, stabilization, cardiovascular exercises, hydrotherapy, manual therapy, pliometrics) and within these on a few specific activities. **Conclusions:** Mechanical problems of the hip are removable with arthroscopy, functional deficit is obtainable through postoperative rehabilitation process. To restore painless and full function of hip joint is important to have a good cooperation between a surgeon and a physical therapist. Also important is well motivated and properly educated and supervised patient. Presented protocol of rehabilitation is a base, which has to be adapted to a patient's individual condition.

Keywords: literature review, tissuehealing, rehabilitation protocol, hip joint.

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Uporaba ravnotežne plošče Wii kot dodatek k standardni fizioterapiji

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Uvod: Sodobni svet in razvoj tehnologije prinašata nove načine, kako spremeniti, izboljšati ali popestriti standardno fizioterapevtsko obravnavo. Dokazano je, da igre spodbujajo raven kognitivnega procesiranja (1), trening v navideznem okolju pa posledično pripelje do izboljšanja izvedbe gibov v realnem svetu (2) in pomeni dodatno motivacijo skozi zabavo pri igri (3). Namen raziskave je bil ovrednotiti izboljšanje procesa rehabilitacije pri različnih poškodbah spodnjih udov z vadbo na ravnotežni plošči Wii. **Metode:** V raziskavi je prostovoljno sodelovalo 95 bolnikov (14 izključenih), starih od 15 do 79 let (44 ± 16,6 leta). Vključili smo bolnike z različno patologijo spodnjih udov akutne ali kronične narave. Zdravljeni so bili operativno ali konzervativno, dovoljena je bila polna obremenitev poškodovanega uda. Bolnike smo naključno razporedili v testirano ali kontrolno skupino. Testirana skupina je v desetih obravnavah izvajala dodatne vaje na ravnotežni plošči Wii, ki so obsegale štiri različne igre. V obeh skupinah smo pred začetkom in po koncu fizioterapevtske obravnave uporabili časovno merjeni test vstani in pojdi, stojo na poškodovanem udu na trdi podlagi pri odprtih in zaprtih očeh, stojo na poškodovanem udu na mehki podlagi pri odprtih očeh ter podatek o projekciji telesnega težišča, pridobljen z ravnotežno ploščo Wii. Ob koncu obravnave smo izvedli anketo o zadovoljstvu z vadbo. Rezultate smo statistično obdelali s t-testom za neodvisne vzorce s programom SPSS 17.0. **Rezultati:** Časovno merjeni test vstani in pojdi, test stoje na eni nogi na trdi podlagi pri odprtih očeh in stoje na eni nogi na mehki podlagi pri odprtih očeh se niso statistično značilno razlikovali med kontrolno in testirano skupino. Rezultat testa stoje na eni nogi na trdi podlagi pri zaprtih očeh je bil v povprečju v testirani skupini po obravnavi boljši za 7,0 s, v kontrolni pa za 2,3 s ($p < 0,01$). Odstotek obremenitve poškodovanega uda se je v testirani skupini povečal za 3,3 %, v kontrolni skupini pa za 1,2 % ($p < 0,05$). Odziv bolnikov na dodatno vadbo je bil zelo pozitiven, tudi rezultati iger so se postopoma izboljševali glede na izhodiščne vrednosti. **Zaključki:** Naši rezultati nakazujejo izboljšanje procesa rehabilitacije z dodatno vadbo na ravnotežni plošči Wii. Taka vadba sicer zahteva nekaj dodatnega časa tako terapevta kot bolnika. Glede na rezultate meritev in stopnjo zadovoljstva bolnikov pa menimo, da vadba s pomočjo Wii ugodno vpliva na rehabilitacijo po poškodbi spodnjega uda.

Ključne besede: fizioterapija, rehabilitacija, spodnji ud, navidezna resničnost, Nintendo.

The use of Wii balance board as a supplement to conventional physiotherapy

Background: The modern world and technology development provide new ways to change, improve or diversify conventional physiotherapy treatment. It is proven that games can help improve visual perceptual processing, balance, and functional mobility (1), while virtual reality based rehabilitation approach assumes that training in virtual environment will lead to corresponding performance improvements in the real world (2). Gaming system can be intended for an enjoyable method of encouraging physical movement (3). Purpose of the study was to determine whether additional training on Wii balance board improves rehabilitation process even more than just conventional physiotherapy in different lower limb injuries. **Methods:** There were 95 voluntary patients involved in this research (14 patients were excluded), aged from 15 to 79 years (mean: 44 ± 16. 6 years). Patients with different lower limb pathologies were included in this study. They had an acute or chronic diagnosis, which was treated conservatively or surgically. A full load of the injured leg was required. The patients were randomly divided into the test and the control group. The tested group performed four additional different game exercises on the Wii balance board each time in 10 sessions. In both groups before and after the physiotherapy treatment measurements were made. Timed up and go test, stance on the injured leg on the firm surface with eyes opened and closed, stance on the injured leg on the soft surface with eyes opened and the projection of the body center of gravity were assessed. A projection was measured with Wii balance board. At the end of the sessions a questionnaire about satisfaction with Wii training was filled up. Results were analyzed with SPSS 17.0. The independent samples t-test was used. **Results:** There were no statistically significant differences between the control and the tested group in timed up and go test, stance on the injured leg on the firm surface with eyes opened and stance on the injured leg on the soft surface with eyes opened. The results when standing on the injured leg on the firm surface with eyes closed improved in the tested group after the rehabilitation program on average for 7.0 s, while the control group improved for 2.3 s ($p < 0,01$). A load percentage of the injured leg increased for 3.3 % in the tested group and 1.2 % in the control group ($p < 0,05$). The patients' responses on additional Wii training were highly positive, while all game results improved according to the starting values. **Conclusions:** Our results indicate that additional training on Wii balance board improves the rehabilitation process. Extra time of a patient and a physiotherapist is needed in case of Wii training, but according to the study results and the patients' satisfaction level we believe that it is worth to continue Wii training after lower limb injuries.

Keywords: physiotherapy, rehabilitation, lower limb, virtual reality, Nintendo.

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