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Wpływ Kognitywnych Terapeutycznych Ćwiczeń na usprawnienie kończyny górnej u pacjenta po udarze mózgu – studium przypadku

Effects of cognitive exercise therapy on upper extremity function in stroke patients – A case study

Testy i ćwiczenia izokinetyczne w praktyce fizjoterapeutycznej

Isokinetic testing and exercises in physiotherapeutic practice

TROMED TRAINING
program szkoleniowy

REHABILITACJA KARDIOLOGICZNA W PRAKTYCE

Szkolenie skierowane do osób zajmujących się problematyką rehabilitacji kardiologicznej, podzielone na dwa moduły.
Moduł I obejmuje zasady rehabilitacji kardiologicznej, metody diagnostyczne i terapeutyczne oraz rolę fizjoterapeuty w procesie rehabilitacji.
Moduł II omawia zagadnienia Kompleksowej Rehabilitacji Kardiologicznej u chorych po ostrym zespole wieńcowym, po zabiegach kardiochirurgicznych, po wszczepieniach kardiostymulatora oraz u chorych z chorobami współistniejącymi.

SCHORZENIA STAWU BARKOWEGO - REHABILITACJA Z WYKORZYSTANIEM ELEMENTÓW TERAPII MANUALNEJ

Szkolenie skierowane do fizjoterapeutów oraz studentów fizjoterapii, obejmujące zagadnienia z anatomii i fizjologii obręczy barkowej, podstaw artro i osteokinematyki, charakterystyki wybranych urazów i uszkodzeń w obrębie obręczy barkowej, profilaktyki schorzeń barku, diagnostyki pourazowej barku oraz praktycznego zastosowania technik manualnych w rehabilitacji

DIAGNOSTYKA I LECZENIE MANUALNE W DYSFUNKCJACH STAWU KOLANOWEGO

Szkolenie skierowane do fizjoterapeutów oraz studentów fizjoterapii, obejmujące zagadnienia z anatomii stawu kolanowego, biomechaniki struktur wewnątrzstawowych, charakterystyki wybranych uszkodzeń w stawie kolanowym, diagnostyki pourazowej stawu kolanowegooraz praktycznego zastosowania technik manualnych w rehabilitacji.

PODSTAWY NEUROMOBILIZACJI NERWÓW OBWODOWYCH - DIAGNOSTYKA I PRAKTYCZNE ZASTOSOWANIE W FIZJOTERAPII

Szkolenie podzielone na dwie części. Zajęcia teoretyczne obejmują zagadnienia dotyczące budowy komórek nerwowych, anatomii i fizjologii obwodowego układu nerwowego i rdzenia kręgowego, pozycji napięciowych i pozycji początkowych testów napięciowych w kończynach oraz kręgosłupie. Zajęcia praktyczne obejmują wykonanie neuromobilizacji dla nerwów obwodowych i opony twardej oraz przykładowe wykorzystania neuromobilizacji w jednostkach chorobowych.

TERAPIA PACJENTÓW Z OBRZĘKIEM LIMFATYCZNYM

Szkolenie podzielone na zajęcia teoretyczne z zakresu anatomii i fizjologii gruczołu piersiowego oraz układu chłonnego, objawów raka piersi, leczenia chirurgicznego, rehabilitacji przed i pooperacyjnej oraz profilaktyki przeciwobrzękowej. Zajęcia praktyczne mają na celu zapoznanie z metodami stosowanymi w terapii przeciwobrzękowej, praktycznym wykorzystaniem materiałów do kompresjoterapii oraz omówieniem zaopatrzenia ortopedycznego stosowanego u pacjentek po mastektomii.

FIZJOTERAPIA W ONKOLOGII - ZASADY POSTĘPOWANIA W WYBRANYCH PRZYPADKACH KLINICZNYCH

Szkolenie obejmuje zagadnienia dotyczące epidemiologii nowotworów i czynników ryzyka, diagnostyki, leczenia oraz następstw leczenia nowotworów (leczenie układowe, chirurgiczne, chemioterapia, radioterapia), podstaw terapii pacjentów leczonych w chorobach nowotworowych piersi, płuc, przewodu pokarmowego, okolicy głowy i szyi, układu moczowo-płciowego, układu nerwowego. Część praktyczna to ćwiczenia oraz metody fizjoterapeutyczne w jednostkach chorobowych.

LOGOPEDIA W FIZJOTERAPII

Szkolenie obejmuje następujące zagadnienia teoretyczne: założenia, zakres działań i uprawnienia terapii logopedycznej, narzędzia diagnozy logopedycznej, grupy pacjentów objętych terapią logopedyczną (dzieci z opóźnionym rozwojem mowy i dorośli, m.in. pacjenci z afazją, SM, chorobą Parkinsona), zaburzenia mowy a globalne zaburzenia rozwoju psychoruchowego, dysfunkcje układu ruchowego narządu żucia, wspólne obszary działania fizjoterapeuty i logopedy.
Część praktyczna obejmuje studium przypadku: ćwiczenia - kształtowanie umiejętności świadomego i prawidłowego operowania oddechem.

INFORMACJE I ZAPISY

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PODSTAWY NEUROREHABILITACJI - UDAR MÓZGU - MODUŁ 1

Szkolenie obejmuje zajęcia teoretyczne omawiające mechanizm udaru mózgu i jego następstwa kliniczne, diagnostyki dla potrzeb fizjoterapii, rokowań, mechanizmów zdrowienia, plastyczności układu nerwowego oraz aktualne zaleceniach dotyczące fizjoterapii pacjentów po udarze mózgu. Zajęcia praktyczne to przykłady terapii pacjentów w okresie wczesnej i wtórnej rehabilitacji, propozycje rozwiązywania problemów strukturalnych i funkcjonalnych oraz wykorzystanie metody Bobathów w rehabilitacji pacjentów po udarze mózgu.

PODSTAWY NEUROREHABILITACJI - UDAR MÓZGU - MODUŁ 2

Szkolenie obejmuje warsztaty praktyczne z zakresu diagnostyki funkcjonalnej pacjentów, podstawowych problemów strukturalnych i funkcjonalnych oraz propozycje terapii: reedukacji funkcji kończyny górnej i dolnej oraz wybranych strategii rehabilitacji. Omawiane jest również zagadnienie dysfagii, w tym objawy zaburzeń połykania, testy i ocena zaburzeń, zasady bezpiecznego karmienia, strategie terapeutyczne, ćwiczenia miofunkcyjne oraz specjalne techniki ułatwiające połykanie.

SCHORZENIA NARZĄDÓW RUCHU U DZIECI I MŁODZIEŻY - ZASADY I KRYTERIA LECZENIA ORTOPEDYCZNEGO

Szkolenie obejmuje zagadnienia wad postawy u dzieci i młodzieży, wad wrodzonych narządów ruchu, wczesnego wykrywania nabytych schorzeń narządów ruchu, naukę badania ortopedycznego oraz zbierania wywiadu oraz praktyczne wskazówki oraz koncepcje w stosowaniu ortez i aparatów ortopedycznych.
Szkolenie skierowane do lekarzy ortopedów, pediatrów, lekarzy rodzinnych, lekarzy rehabilitacji medycznej, fizjoterapeutów oraz średniego personelu medycznego.

WSPÓŁCZESNE METODY LECZENIA WYBRANYCH DYSFUNKCJI STAWU SKOKOWEGO I STOPY

Szkolenie obejmuje zagadnienia z anatomii, biomechaniki stawu skokowego i stopy, metodyki badania stopy, postępowania w leczeniu urazów stawu skokowego i stopy, nabytych zniekształceniach stopy (przyczyny, objawy, sposoby postępowania) oraz pozostałych dysfunkcjach w obrębie stawu skokowego i stopy (entezopatie, przeciążenia, zapalenia, zespoły uciskowe nerwów, gangliony, zmiany zwyrodnieniowe, stopa cukrzycowa, stopa reumatoidalna).

CHOROBA ZWYRODNIENIOWA STAWÓW - ALGORYTM POSTĘPOWANIA DIAGNOSTYCZNO-TERAPEUTYCZNEGO

Szkolenie obejmuje następujące zagadnienia: choroba zwyrodnieniowa stawów - podstawowe pojęcia, algorytm postępowania diagnostyczno-terapeutycznego , nowoczesne metody leczenia w chorobie zwyrodnieniowej stawów, nauka prawidłowej oceny zaawansowania choroby zwyrodnieniowej w oparciu o wywiad, badania ortopedyczne i badania dodatkowe, zastosowanie ortez i aparatów ortopedycznych w chorobach zwyrodnieniowych.
Szkolenie skierowane do lekarzy ortopedów, pediatrów, lekarzy rodzinnych, lekarzy rehabilitacji medycznej, fizjoterapeutów oraz średniego personelu medycznego.

MOBILNOŚĆ I STABILNOŚĆ W SPORCIE I FIZJOTERAPII

Szkolenie obejmuje następujące zagadnienia: znaczenie treningu mobilności i stabilności w sporcie i fizjoterapii, definicja mobilności, przyczyny ograniczeń, strategie postępowania oraz techniki pracy nad zwiększeniem mobilności z użyciem przyborów, definicja stabilności, przyczyny zaburzeń, strategie postępowania oraz trening stabilności w sporcie i fizjoterapii - zajęcia praktyczne.

MÓZGOWE PORAŻENIE DZIECIĘCE - ALGORYTM POSTĘPOWANIA DIAGNOSTYCZNO-TERAPEUTYCZNEGO

Szkolenie obejmuje następujące zagadnienia: MPD - zespół symptomów, etapy leczenia, cele i wskazówki terapeutyczne, kwalifikacje pacjenta do danego etapu leczenia, nauka badania ortopedycznego w Mózgowym Porażeniu Dziecięcym, zastosowanie ortez i aparatów ortopedycznych w MPD.
Szkolenie skierowane do lekarzy ortopedów, pediatrów, lekarzy rodzinnych, lekarzy rehabilitacji medycznej, fizjoterapeutów oraz średniego personelu medycznego.

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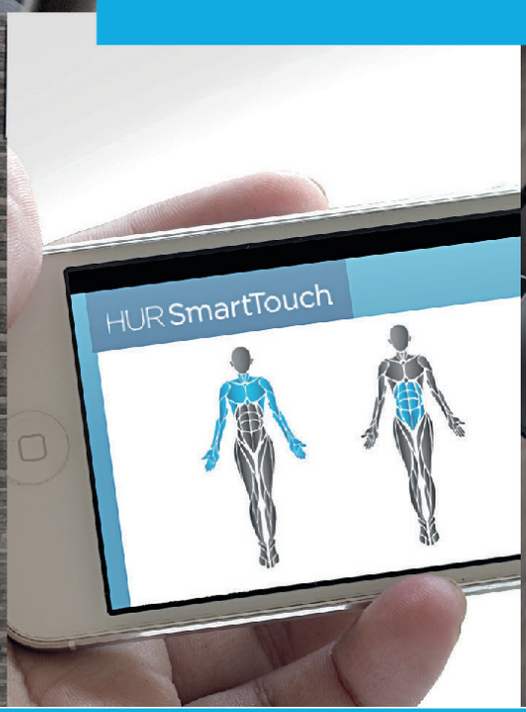

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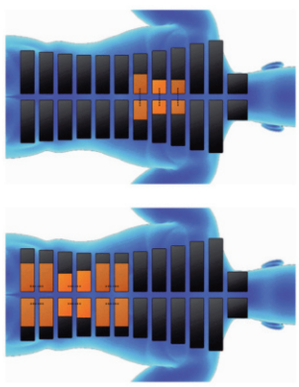
NOWE ROZWIĄZANIE W LECZENIU, TERAPII I PROFILAKTYCE KRĘGOSŁUPA

Na polskim rynku pojawiła się niedawno doskonała mata do leczenia, terapii i profilaktyki schorzeń kręgosłupa i pleców StimaWELL®120MTRS. Technologia oparta jest o najnowsze know-how niemieckiego producenta firmy Schwa Medico GmbH, znanego od 40 lat producenta urządzeń w branży medycyny holistycznej, a w szczególności elektrostymulacji.

StimaWELL®

Wyłączny dystrybutor w Polsce warszawska firma SLOEN Sp. z o.o. wprowadziła we wrześniu 2017 roku matę StimaWELL®120MTRS na polski rynek tuż po zaprezentowaniu jej na tegorocznych targach Rehabilitacja 2017 w Łodzi. Produkt zdobył uznanie specjalistów, którzy uhonorowali go złotym medalem targów! Firma SLOEN, jako sponsor strategiczny, bierze także udział w XIII Konferencji Polskiego Towarzystwa Fizjoterapii, która odbędzie się w dniach 24 i 25 listopada 2017 w Pabianicach, gdzie będzie możliwość zapoznania się z urządzeniem i uzyskania o nim bliższej informacji – serdecznie zapraszamy!



StimaWELL®120MTRS to wysokiej jakości dynamiczny system terapii pleców i kręgosłupa, który został zaprojektowany z wykorzystaniem najnowszych osiągnięć technologicznych w tej dziedzinie. Dwunastokanałowa mata StimaWELL®120MTRS umożliwia teraz pacjentowi wielowymiarowy system leczenia kręgosłupa, każdy zabieg trwa od 20 do 30 minut i jest naprawdę skuteczny. Szczególne znaczenie ma fakt, iż urządzenie to zostało wyposażone w doceniony na niemieckim rynku elektrostymulator StimaWELL® pracujący w zakresie niskich i średnich modulowanych częstotliwości w zakresie od 0 do 100Hz i 2000 do 6000Hz (prąd dwufazowy, symetryczny, prostokątny), które z łatwością pokonują barierę skóry i docierają do najgłębszych warstw mięśni. System został zaprojektowany głównie do terapii bólu, terapii mięśniowej i masażu (4 w 1). Twój pacjent skorzysta ze zwiększonego zakresu opcji, które możesz mu teraz zaoferować! Dodatkowo, należy wiedzieć, że mata została wyposażona w 24 elektrody, który są podgrzewane do 40°C.

System StimaWELL®120MTRS zapewnia kompleksowy pakiet do profilaktyki i leczenia ostrych i przewlekłych chorób pleców. Mata wyposażona jest w szeroki wachlarz możliwości programowania w zależności od modulacji i ustawień uruchamiamy terapię bólu, budowę mięśni, relaksację mięśni, a także różnego rodzaje masaże, takie jak stukanie, gładzenie i ugniatanie. Opatentowana technolgia StimaWELL®120MTRS to dla pacjenta skuteczny, głęboko relaksujący system terapii. Dwie z wielu zalet stymulacji średniej częstotliwości w porównaniu z innymi typami to osiągnięcie wysokiego poziomu kompatybilności pacjentów i kojące uczucie, generowane przez przepływ prądu elektrycznego. Ten proces aktywuje silne skurcze mięśniowe i zapewnia większe obszary leczenia. Zastosowanie średniej częstotliwości w systemie StimaWELL®120MTRS, występującej w zakresie od 2000 do 6000 Hz, impulsy łatwiej pokonują aspekt oporu skóry niż prądy w dolnych zakresach częstotliwości. Oznacza to, że dla pacjenta terapia oparta na przepływie prądu elektrycznego w średnim zakresie częstotliwości jest często doświadczana jako szczególnie przyjemna, a nie drażniąca. System StimaWELL®120MTRS jest niezwykle łatwy w obsłudze i nie wymaga specjalnej preparacji. Sterowanie za pośrednictwem intuicyjnego ekranu dotykowego jest proste i czytelne. Programy można szybko wybrać i jeśli to konieczne, dopasować do konkretnych potrzeb Twojego pacjenta. Dzięki nowemu trybowi automatycznego wyboru programów opartych na wskazaniach przy użyciu diagnozy – kalibracji, użytkownik ma możliwość automatycznego wyboru odpowiedniego programu terapeutycznego zgodnie z danymi anamnestrującymi, które mogą być stosowane w każdej sesji terapeutycznej. Twój pacjent jest w stanie kontrolować poziom prądu elektrycznego za pomocą pilota zdalnego sterowania.

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Testy i ćwiczenia izokinetyczne w praktyce fizjoterapeutycznej

Isokinetic testing and exercises in physiotherapeutic practice

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Streszczenie

Celem pracy było przedstawienie stanowiska na temat zastosowania pomiarów, testów i ćwiczeń wykonywanych w warunkach izokinetycznych w fizjoterapii w oparciu o przegląd literatury i własne doświadczenia. Omówiono podstawowe zagadnienia fizjologii mięśni, rodzajów skurczów i pracy mięśniowej oraz zmian napięcia mięśni. Przedstawiono zasady przeprowadzania pomiarów wartości momentów sił mięśni i oceny innych parametrów biomechanicznych wykonywanych w warunkach maksymalnego napięcia izometrycznego i w warunkach dynamicznych – izokinetycznych. Dokonano charakterystyki ćwiczeń przeprowadzanych w warunkach izokinetycznych oraz przeprowadzanych w warunkach izometrii (statycznych) w różnych obszarach fizjoterapii klinicznej. Zwrócono także uwagę na wskazania i przeciwwskazania w zakresie stosowanie tego rodzaju testów i ćwiczeń w praktyce fizjoterapeutycznej w powiązaniu z innymi dziedzinami medycznymi.

Słowa kluczowe:
kinezyterapia, izometria, dynamika, rehabilitacja

Abstract

The aim of the paper was to present the attitude to measurements and exercises performed under isokinetic conditions during physiotherapeutic procedures, based on the literature review and the authors' experience. The authors discuss basic issues of the physiology of muscles, types of muscle contractions and activity, and changes in muscle tension. They presents the principles of torque value measurement and the assessment of other biomechanical parameters, carried out under conditions of maximal isometric tension tone as well as under dynamic-isokinetic conditions. The exercises performed under isokinetic conditions and isometric (static) conditions are described in various aspects of clinical physiotherapy. Attention is focused on the indications and contraindications to using such kind of tests and exercises in physiotherapy, as related to other branches of medicine.

Key words:
kinesitherapy, isometry, dynamics, rehabilitation

Introduction

Skeletal muscles are excitable, contractile and their tension changes. They generate force or torque. Muscles can also inhibit,to some extent determined by physiology, excessive external forces exerted on the human body. In isolate muscles, or more often, in groups of muscles, can change their tension (isometry) or length (isotony).

Muscle e tensioning, smoothly transformed into a dynamic contraction, generates movement or locomotion. We owe this to auxotonic contractions [1].

Auxotonic muscle contractions are present in most of our everyday activities. This type of contraction assures, on one hand, maintaining the vertical body position, enabling at the same time movement performance. If the torque value during a dynamic contraction is higher than the external values (resistance, gravity), the direction of lever movement in the joint is in accordance with the direction of

muscle contraction and concentric contraction is generated. During eccentric contraction, in turn, the value of external forces is higher than muscle torque value and the direction of lever movement in the joint is in accordance with the direction of external force, opposite to muscle contraction [1, 2].

In our everyday life, our muscles perform multiple alternating concentric-eccentric and eccentric-concentric contractions during such activities as walking, going up and down stairs, or during household and occupational activities, thanks to the multi-level regulation of neuromuscular control within the nervous system.

In the process of physiotherapy – rehabilitation, after immobilization and the required unburdening of a limb ,, e.g. the lower limb, there are cases of muscular atrophy, resulting in the decrease in muscular strength level and disturbance of agonist to antagonist muscle ratio. Such cases are frequently accompanied by neuromuscular coordination disorders. It is possible to restore adequate levels of muscular strength in patients with simple atrophies thanks to the introduction and adaptation of special exercises and kinesitherapy approaches, which are applied individually, according to the patient's clinical picture. Restoring the optimum level of muscular strength is possible through stimulation of two-stage physiological processes. Through adequately selected exercises applied during the first stage, it is possible to increase the number of simultaneously activated motor units [2, 3]. This means that the mechanisms of proprioceptive neuromuscular facilitation (PNF) assure a better synchrony of neuromuscular coordinatiom, muscle tension, and next, muscle contraction, increasing this way muscular strength. This is, however, a functional process, not a structural one. At this stage, muscle mass does not increase. The systemetically continued exercises during a long period of time with a defined progression, combined with a proper dietary regimen and rest intervals, can trigger another adaptive mechanism, involving an increase in muscle mass (hypertrophy), an increase of muscle transverse cross-section and other possible compensatory mechanisms [4, 5].

The above mentioned structural adaptation of muscles is significantly more durable. Muscle strength is not only improved but it is also maintained for a long time [2, 6, 7]. Mickle et al. (2016) have proved that changes in morphology including muscular strength are age-related [5]. Kornegay et al. (2016) point out that genetic factors that are physiological regulators of muscle growth, play an important role in muscle mass shaping, making people more or less predisposed to its increase or decrease [8].

Under isokinetic (dynamic) conditions, measurements are taken at a constant movement velocity during exercises belonging to the group of active resistance workout [9].

Special measuring systems are used for measurements and exercises performed under isokinetic conditions [9,10, 11]. The tests involving follow up measurements and exercises

can be carried out in closed or open kinematic chains [9,12]. Moreover, the movements performed during this type of workout are similar to natural people's movements in one or several joints.

The measurements taken under isokinetic conditions during concentric muscle contractions are performed with a maximal patients' involvement and provide information about the peak torque (PT) value obtained for the specific preset angular velocity of movement per second (°/s). However, the PT values obtained under isokinetic conditions, as compared with these obtained during the maximal isometric tension are submaximal values. According to Hill's curve, there is a relationship between angular velocity and peak torque: with the increase in angular velocity PT values decrease and the other way round, the decrease in the values of the preset angular velocity per second is directly proportional to the increase in the generated PTvalues [9, 12, 13]. Biomechanical (functional) measurements and analysis of the results, carried out under isokinetic conditions, allow obtaining objective data on PT values, generated by the studied group of muscles, namely PT expressed in newton meters (N*m), Average Peak Torque (Avg PT) expressed in N*m or the values corresponding to the active range of motion (ROM) in the studied joint, performed alternately by the group of agonist and antagonist muscles and expressed in degrees (°). The adequate computer program enables us to obtain data on the total work (TW) or average work (Avg W), performed by muscles and expressed in joules (J) or on the maximum power (P) and average power (Avg P), generated by the muscles and expressed in watts (W). The next parameter which is important for data interpretation is the relative torque (RT) value, obtained by dividing PT by the subject's body mass value, expressed in kg. RT values are expressed in N*m/ kg BM. The values of relative power (RP), expressed in W/kg BM and relative work (RW), expressed in jouls per kilogram of body mass (J/kg BM) are also subject to analysis [9,12]. The relative values of the above mentioned parameters are useful for comparative assessment involving the comparison of the groups of study participants as they allow to exclude the effect of possible between-group differences in body mass values on the obtained result. Such parameters as the angle at peak torque, the preset angular velocity of movement, expressed in angular velocity per second (°/s) or radians (rad) are also analyzed. The analysis of the obtained values also enables the interpretation of the ratio of reciprocal relations and proportions of the obtained biomechanical parameter values between the studied groups of muscles, e,g, the agonist to antagonist PT ratio and many other measured or calculated paameters [9, 12-14]. As for the assessment of physiotherapy progress in patients who sustained injuries of the upper or lower limbs, the above mentioned values of the parameters obtained for the involved side are compared with the results obtained for the uninvolved side and the control group results.

Measurements taken under conditions of maximum isometric tension (static conditions) allow determining isometric torque (IT) values for the studied group of muscles, expressed in N*m, for the defined value of joint angle (°) or the maximal force (MF), measured in newtons (N). Each of the groups of muscles generates PT or force under static conditions, for a defined angle of measuring lever in the joint. It means that there is a relationship between IT value and the defined angle value in each group of muscles. During the analysis and interpretation of physiotherapy progress, also relative torque (RT) values obtained under static conditions are considered; these values are obtained by dividing IT values by the participant's body mass (kg), expressed in N*m/kg/BM.
When interpreting the obtained measurement results, the time of obtaining and maintaining IT, measured in seconds (s) should be considered. The time of IT value decrease, which is usually due to fatique of the studied group of muscles, is also important [15, 16, -17]. Biomechanical tests, carried out under static (isometric) conditions as well as exercise performance by patients under such conditions, in the process of widely understood medical rehabilitation are worthwhile only when their performance is justified from the clinical point of view. Moreover, it is of note that interpretation of the results obtained from biomechanical tests is part of clinical assessment (history taking and medical examination) and an important element of complex objective functional assessment of the patient.

Principles of measurement performance under static and isokinetic conditions

There are principles and various methodological approaches of test and training performance under static and dynamic conditions, both in healthy individuals and patients, in the process of physiotherapy – rehabilitation [9-12, 15-20].
In the case of persons undergoing physiotherapeutic procedures, it is necessary to obtain consent for the study from the physician and the potential participants. It is also necessary to explain the patient who is going to participate in such a procedure and the purpose of the procedure, discuss the approaches to be applied during the procedure and inform the patient that he/she has to withdraw from the test or training when pain or the first symptoms of fatigue are present. Such facts should be included in the documentation. Next, calibration of the atested and operational measurement-rehabilitation system is required. The patient should do warm up exercises, suitable for his/her clinical picture. Next, the test measurement should be taken without engaging the entire developed force. After that, the main measurement is carried out. It is necessary to maintain the same patient's posture and the constant length of the measuring lever arm. The center of the examined joint should be aligned with dynamometer axis. The patient should be stabilized. On the "start" command the patient starts the measurement and interrupts it on the "stop" command. The patient can also interrupt the measurement in cases of discomfort, pain or fatigue. In maximum isometric tension test, the joint angle value is set on the measuring system for

measuring IT of a given muscle group. Most often, 2 to 3 measurements are taken alternately for each muscle group and separately for each examined limb. The result with the highest IT value or the mean value obtained from the measurements are selected for the analysis, The constant angular velocity of the movement per second (°/s) is determined for the isokinetic test as well as the number of repetitions in a series and the length of interval between the series. In the isokinetic test we can obtain peak torque (PT) value, measured in N*m for a specifically preset angular velocity of movement. A PT value is not only affected by the patient's clinical condition, but also by the value of the preset angular movement velocity per second, according to the rule that a decrease in angular velocity per second comes with a proportional increase in PT values. Initially, in the process of rehabilitation, the range of motion in isokinetic tests is adapted to biomechanical and biological determinants of each clinical picture. Besides, the mechanism of the so called „soft final inhibition of the range of motion" is applied. This serves reduction of shearing forces, causing excessive shifts of the joint levers during the test. Also special knee braces, restricting this shift are applied [9-12].

The application of isokinetic tests

Functional studies using isokinetic tests and different forms of isokinetic training, are applied in athlete populations [21, -22]. Hadzic et al. (2010) measured PT in extensor and flexor muscles of the knee joint in volleyball players. The aim of the study was to create the reference group for professional volleyball players [23]. Bamac et al. (2008) studied and compared PT in knee joint extensor and flexor muscles of the dominant limbs in volleyball and basketball players in. The authors found that the specificity of a given sport discipline can influence the extensor to flexor PT ratio [24].

Isokinetic measurements as a part of treatment's monitoring allow determining the deficit level in the measured biomechanical muscle parameter values in the involved limb during physiotherapeutic procedures carried out in patients, as comapared with the control group. The obtained values can also be compared with the normative, reference values [13, 25]. The measurements and training carried out in isokinetic conditions are most often applied in the assessment of current effects of physiotherapy-rehabilitation as well as in late assessment of musculoskeletal injuries and conditions [13, 26-28].

For example, Collado et al. (2010) in their isokinetic tests obtained higher PT values in foot evertor muscles in patients undergoing rehabilitation with an extended eccentric training, as compared with the patients who underwent only concentric training [29]. Hadzic et al. (2009) in their study showed that too high PT values, generated under isokinetic conditions by plantar flexor muscles and their disturbed biomechanical proportions in relation to foot dorsiflexors, in cases of limited foot dorsiflexion can increase the risk of secondary injuries of the talocrural joints [30]. Hartog et al. (2010) applied isokinetic tests for the assessment of the activity of biomechanical parameters of trunk muscles after sur-

gical procedures [31]. Möller et al. (2002) compared the results of isokinetic tests, obtained for two angular velocities under concentric and eccentric conditions from foot plantar flexor and dorsiflexor muscles in patients with damaged Achilles tendons, undergoing conservative and surgical treatment. The results obtained after 6, 12 and 24 months did not show any significant differences in PT values between the studied groups. However, two years following the surgical procedures, the authors atill noted maintaining PT deficits in foot dorsiflexor muscles, even up to about 27%, based on the comparison of the values obtained from the involved and uninvolved lower limbs [32].

The study carried out in patients who underwent surgical procedures using arthroscopy of the glenohumeral joint to obtain rotation of the arm under isokinetic conditions, revealed lower torque values (deficits) in the muscles at the involved side as compared with the uninvolved joints [33, -34]. Hughes et al. (2011), three months following arthroscopic surgery of the damaged glenohumeral joint structures, obtained lower torque values in arm rotator muscles as compared with the values obtained prior to the surgery. The authors emphasize the role of systematic physiotherapeutic procedures. They also report that six months of regular specialist exercises resulted in the improvement of torque and power in the studied group of muscles, so that the values obtained after that are more similar to the baseline values, obtained prior to the surgery [35]. Szuba et al. (2016) [36] also present the problems connected with shortened physiotherapeutic procedures.
Isokinetic measurements have been applied in the assessment of minimally invasive knee joint arthroplasty [37]. Fabiś ((2007) in his study showed that the applied isokinetic training including five 20-minute long sessions five times a week, between the twelfth and twenty fourth week of physiotherapy following anterior cruciate ligament reconstruction (ACLR) resulted in the increase in PT values in extensor and flexor muscles of the knee joint by more than 20 % % [38]. Isokinetic tests were applied in patients with neural conditions including Parkinson's disease or peripheral neuropathy [39-41].
One should exercise caution while applying isokinetic exercises in elderly patients, especially these with diagnosed circulatory and respiratory conditions, due to potentially increased stress, affecting heart function, arterial blood pressure and increasing the risk of cerebral and cardiac hypoxia. Valsalva phenomenon involves physiological response to a preset excessive strength exercise; the consequences of this phenomenon include impairment of the circulatory and respiratory system functions. This is connected with the increase in the values of the small circle of blood circulation, limiting the normal function of central blood circulation. The consequences of the possible response include dangerous hypoxia symptoms in patients with circulatory insufficiency. For this reason, absolute and relative contraindications for this type of exercises are accepted [2]. Indications for strength exercises are clinically restricted in patiens with internal conditions and their participation in rehabilitation procedures and biomechanical studies requires consent from

specialist physicians due to diabetic, cardiac or vascular conditions, which is emphasized in the papers by Stevens et al. (2014), Brünjes at al. (2016) and Stevens at al. (2015) [42- 44].

IIellamo et al.(1997) compared the response of heart rate (HR) and arterial blood pressure (ABP) to the three preset exercises, such as isokinetic, isometric and isotonic exercises including 30 repetitions for each type of exercise. 40% RM load was applied in young participants. The peak systolic and diastolic pressure during the isokinetic test reached high values at the level of about 191 mm Hg and 121.6 mm Hg respectively. During the isotonic tests the corresponding values (systolic and diastolic pressure) were 198 and about 128 mm Hg respectively. During isometric exercises the lowest values of these parameters were obtained, amounting to 168 i 102 mm Hg respectively, however, the values of diastolic pressure were high. Moreover, both under isotonic and isokinetic conditions, the exercises resulted in a dynamic, significantly higher incremental increase in HR values, compared with these obtained during isomteric exercises. The authors noted that despite the applied maximum load, dynamic exercises result in an increased functional stress of the cardiovascular system, which can be dangerous, especially for patients with cardiac conditions [45]. Overend et al. (2000) assessed the effect of submaximal (50% RM) concentric exercises, done under isokinetic conditions, on changes in hemodynamic parameters of circulation (HR, ABP) in elderly and young participants.Concentric exercises resulted in a significantly higher stress in the circulatory system in both studied groups, compared with the effect of eccentric exercises. The authors pointed out that the obtained results can influence the planning of rehabilitation programs [46]. Other authors also analyzed the course of hemodynamic responses from the circulatory system during isokinetic tests [47, 48].

Corvalho et al. ((2010) assessed two different programs of exercises between the twelfth and twenty fourth week in a sample of elderly people, doing standard exercises adapted for their age, compared with the group of elderly people who also participated in an extended exercising program, combined with resistance training. The tests carried out under isokinetic conditions showed a favorable, statistically significant increase in PT values (increase by over 20%) in the studied groups of muscles in elderly participants [49]. In order to reduce the effect of isokinetic exercises, contributing to an excessive increase of hemodynamic cardiac response in middle-aged males, Czamara et al. (2011) modified isokinetic test protocol. They applied fewer exercises for each of the three preset angular velocities in the isokinetic test and prolonged the rest intervals between each series of exercises [50]. Panza et al. (2015) and Loenneke et al. (2015) applied isokinetic and isometric tests in their assessment of the effect of medicines, e.g. statins, on biomechanical parameters of muscles in patients treated for internal diseases [51, 52].

Tanaka et al. (2017) and Lustosa et al. (2017) studied the activity of muscle biomechanical parameters after sarcoma resection and the effect of other oncological conditions on muscular strength [53-54].

Application of tests under static (isometric) conditions

The significant role of the authors of Polish publications should be emphasized as they highlighted the problem of IT measurements in subjects with no injuries of the musculoskeletal system and other issues of widely understood physiotherapy and rehabilitation procedures. Such measurements, carried out in peole with no musculoskeletal injuries, involved in average-level physical activity and in athletes, allow obtaining normative reference values concerning the topography and characteristics of PT, strength of muscle groups and their reciprocal relations. Such measurements were carried out by Professor Dworak, representing the "Poznan Schooll" [55]. Here, we should emphasize the role of such an authority as Professor Kabsch in the development of biomechanics. Professor Bober et al. (1999, 2000), representing the "Wroclaw School of Biomechanics" measured IT values in angle change function for extensor and flexor muscles of the studied hip, knee, glenohumeral and ulnar joints (in the sagittal plane) in a sample of people with no musculoskeletal injuries. The above cited authors measured torque values every 10 degrees in the compartment of 8 to 13 ranges of angular values, depending on the studied joint. Torque values in joint angle function, obtained for all the studied groups of flexor muscles, formed a parabola with the shape and direction opposite to the IT parabola obtained for extensor muscles. Moreover, the authors found that the highest torque values are generated both for flexor and extensor muscles of the ulnar joint in the angle of 60-75 degrees of forearm flexion and that IT values are characterized by a relative balance between the studied groups of muscles. The authors also showed that hip joint and knee joint extensor muscles reach twice as big values at 70° flexion angle, compared with flexor muscles which reached their highest IT values at 20° flexion angle in the studied joint [56, 57]. Trzaskoma (2003) studied IT values in various groups of muscles in subjects with no musculoskeletal injuries, especially among athletes [58]. Here, the substantial insight of the Warsaw Center in the study of "Torque topography under static conditions " should be emphasized " (Wit, Trzaskoma, Wychowański, Urbanik ,, Mastalerz and others). In the Warsaw Center, the biomechanical relations between individual groups of muscles were assessed and muscular strength was analyzed in relation to other motor traits, both in athletes and for the needs of rehabilitation [16, 59- 62].

Czamara et al. (2005) measured torque in internal and external rotator muscles of the arm, depending on different values of arm abduction in 100 subjects with no injuries of the glenohumeral joint. 3200 measurements were taken to obtain normative data, which are reference values for patients undergoing physiotherapeutic procedures after glenohumeral joint injuries. The authors showed that the strength of inter-

nal and external rotators of the arm, both in males and females, depends of arm abduction angle. In the compartment of angular values ranging from 0° do 70 °, the strength of internal rotators of the arm is significantly higher than the strength of external rotators of the arm. At the angle of 90° of abduction, in turn, a relative balance between these two groups of muscles is noted, mainly thanks to the physiological decrease in the strength of internal arm rotators [63]. Dudawski et al. (2008) studied the IT values of the upper limb abductor and adductor muscles. They showed that the muscles abducting the arm in the glenohumeral joint reach PT values for 0o angle of arm abduction and with the increase of this angl to 120°, a significant decrease in IT values is observed, even by 30 %. Conversely, the curve of IT values increases from 0° to about 40° of abduction, where it reaches the highest value, next this value is maintained at about 60o of abduction and falls abruptly with further increase in arm abduction [64]. IT measurements were used under static conditions as the important determinants of complex treatment monitoring in patients, including the assessment of physiotharapy – rehabilitation [9, 12, 17,19-20, 65, 66].

Conclusions

The analysis of the studies on the assessment of muscle function using a dynamometer, presented during the last decade and conducted in patients undergoing treatment after musculoskeletal injuries, concerns most often the values obtained from the tests carried out under isokinetic conditions [21, 25, 29, 31-32, 34, 37, 40, 67-69]. Thanks to isokinetic studies, we obtain valuable information on all possible dynamic characteristics of the studied group of muscles and neuromuscular coordination of the musculoskeletal system. However, the values obtained in these studies have some limitations concerning the interpretation of the equally important characteristics of torque generated under static conditions.

In the specialist reference sources there are few papers assessing and analyzing the changes in both IT and PT values in muscles under static (isometric) conditions as well as during isokinetic measurements which are part of specialist physiotherapeutic procedures, or during late assessment of this process.

Czamara et al. (2011) carried out a study aimed at the assessment of IT and PT value characteristics in the current physiotherapeutic procedure. They showed that a staged specialist physiotherapy program, applied minimum six month following surgery, can result in almost twice as high incremental increase of IT values generated by extensor muscles of the involved knee under isometric conditions and about 40 %% increase of IT values in knee joint flexor muscles. Moreover, the obtained values can be more similar to those obtained for the uninvolved knee joints. The authors also showed a significant increase in PT values under isokinetic conditions, between the seventeenth and twenty fourth week following knee surgery in the same group of patients. However, at the end of the sixth month, the isokinetic tests showed deficits of PT values in extensor muscles of the involved knees (at the level of 9%) for angular velocity of 600/s and were more critical in the assessment of physiotherapy progress [13].

Another study by Czamara et al. (2011) revealed a significant increase in PT values in the muscles responsible for tibial rotation under isokinetic coditions as well as the increase in IT values under static conditions in patients who participated in a systematic six months physiotherapeutic procedure, compared with the sixteenth and thirteenth week following the surgery. The program enabled the patients to obtain PT and IT values of the studied muscles responsible for tibial rotation at the involved knee side, similar to those obtained for the uninvolved knees and the results obtained from the group of males who did not sustain any knee injuries. The authors showed that they obtained significantly better results than the males who sustained injuries on average a year before the study and did not participate in systematic physiotherapy [70]. Moreover, the authors found that both types of tests applied under static as well as under isokinetic conditions are useful for the assessment of physiotherapy progress and are necessary for the analysis of torque deficits in muscles responsible for internal and external tibial rotation. In this study, however, measurements under static conditions turned out more critical in their assessment of torque deficits in the studied groups of muscles as compared with the results of isokinetic tests [70]. The presented data indicate the need of muscular function monitoring, both in static and dynamic conditions, as the functions are not characterized by one-time and one-level velocity of muscle strength recovery and strength-speed characteristics of individual groups of muscles. Moreover, the contemporary research tools allow (provided they are used rationally and safely) the multiplane assessment of the biomechanical function of muscles in the area of joints that are able to perform movement in more than one plane of motion. The data on the condition of biomechanical parameters of the studied group of muscles may be an important supplementation of a complex functional assessment of treatment including widey understood rehabilitation procedures for patients (supplementation of the result of medical examination, subjective assessment of patients' condition concerning sensation of pain, the patient's everyday fitness, various forms of locomotion, neuromuscular coordination, proprioception, physical fitness and capacity, etc.) [71-78].

During the implementation of physiotherapy protocols in patients after injuries, especially these of the musculoskeletal system, regaining a proper level of muscular strength requires two types of tests introduced in the right time, however, two different types of training (including isometric and dynamic workout) should be applied as well. Usually, at the beginning, isometric training is applied. The participants require a consent from a specialist physician, a safe range of the preset measurement angle values and an adequate time period elapsed from the injury/surgical procedure. Based on the IT values obtained from the measurement, the amount of submaximal load – isometric tone with partial resistance (load), the time of isometric tone application and and the time of rest interval are selected. When the patient's clinical condition and the processes of tissue healing and adaptation allow to apply definitely more dynamic loads, we can introduce isokinetic tests, and

next, isokinetic training with submaximal load within the usually limited range of motion (ROM). During the final stage of rehabilitation, training within a full ROM can be introduced with a gradual load increase [79- 83].
It is of note that, on one hand, isokinetic exercises are similar to natural movements performed by people, on the other hand, however, such movements can result in an increased functional stress of the cardiovascular system, which may be dangerous, especially for patients with cardiac conditions and for elderly ones [45]. Moreover, the application of such exercises should be adequately planned by a physiotherapist as part of a physiotherapy protocol. The exercises can be introduced provided the patient's clinical condition is relatively good, the process of tissue healing and adaptation to load is correct and there are no possible biomechanic limitations of the range of movements performed or/and the amount of load applied.

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Piśmiennictwo/ References

1. Lewartowski B. Fizjologia mięśni szkieletowych. Red. Traczyk W Z, Trzebski A. Fizjologia człowieka z elementami fizjologii stosowanej i klinicznej PZWL Warszawa 2009; 71-92.
2. Red. Kozłowski S, Nazar K. Wrowadzenie do fizjologii klinicznej PZWL Warszawa1995.
3. Chabowski A, Górski J. Fizjologia Mięśni Szkieletowych w: Fizjologia człowieka. Podręcznik dla studentów medycyny. Red. Konturek S J. ELSEVIER Urban&Partner Wrocław 2007. Rozd. 13: 1077-1118.
4. Kikukawa K et al. Hypertrophic teres minor restores shoulder strength and range of external rotation in posterosuperior rotator cuff tears. J Shoulder Elbow Surg. 2016 Nov;25(11): 1882-1888. doi: 10.1016/j.jse.2016.04.016. Epub 2016 Jun 30
5. Mickle KJ et al. Effects of Age on Strength and Morphology of Toe Flexor Muscles. J Orthop Sports Phys Ther. 2016 Dec;46(12):1065-1070. Epub 2016 Oct 29.
6. Moritani T, De Vries H. A. Am J Phys. Med. 1979; 58-115.
7. Laurent G. L., Sparrow M. P., Millward D. J.Biochem J. 1978, 176,407.
8. Kornegay J et al. Dystrophin-deficient dogs with reduced myostatin have unequal muscle growth and greater joint contractures. Skelet Muscle. 2016 Apr 4;6:14. doi: 10.1186/s13395-016-0085-7. eCollection 2016.
9. Dvir Z. Isokinetics Muscle Testing, Interpretation and Clinical Applications. Churchill, Livingstone 2004.
10. Biodex Advantage Software, Operations Manual (version 3.29 and 3.30), Biodex Medical Systems, Inc. New York, 2008.
11. CSMI User's Guide. Boston Massachussets 2006.
12.Davies G J. A compedium of isokinetics in clinical usage and rehabilitation techniques 4th Edition, S&S Publishers Wisconsin 1992.
13. Czamara A, Tomaszewski W, Bober T, Lubarski B. The effect of physiotherapy on knee joint extensor and flexor muscle strength after anterior cruciate ligament reconstruction, using hamstring tendon. Medical Science Monitor 2011.
14. Pia Y H, Bryant A L, Steele J R, Newton R U, Wrigley T V. Isokinetic Dynamometry in Anterior Cruciate Ligament Injury mand Reconstruction. Ann Acad Med Singapore 2008; 37: 330-340.
15. Bober T, Zawadzki Z. Biomechanika układu ruchu człowieka Wydawnictwo BK 2001.
16. Wychowański M. Wybrane Metody Oceny Dynamiki Układu Ruchu Człowieka. Studia Monograficzne, AWF Warszawa 2008.
17. Czamara A. Moments of muscular strength of knee joint extensors and flexors during physiotherapeutic procedures following anterior cruciate ligament reconstruction in males. ACTA OF BIOENGINEERING AND BIOMECHANICS. 2008,Vol. 10, No.3; 37-44
18. Czamara A., Królikowska A., Szuba Ł., Widuchowski W., Kentel M. Single- versus double-bundle anterior cruciate ligament reconstruction: a new aspect of knee assessment during activities involving dynamic knee rotation. Journal of Strength and Conditioning Research: February 2015- Volume 29 – Issue 2 – p 489 - 499
DOI: 10.1519/JSC. 0000000000000638 Czamara A, Bugajski A.; Fizjoterapia w zanikach prostych mięśni czworogłowych uda. Medycyna Sportowa. 1998, rok XIV, Nr. 78, 13 – 17
19. Czamara A. Zmiany wartości momentów siły mięśni w programie fizjoterapii po rekonstrukcjach wiązadeł krzyżowych przednich stawów kolanowych. Fizjoterapia Polska, 2002, Vol. 2, nr 7, 263-272.
20. Trzaskoma Ł. Metoda oceny siły mięśni stawu biodrowego. Rozprawa doktorska. AWF Warszawa 2004.
21. Andrade M., Fleury A. M., de Lira C. A. B., Dubas, J. P., da Silva A. C.: Profile of isokinetic eccentric-to-concentric strenght ratios of shoulder rotator muscles in elite female team handball players. Journal of Sports Sciences, 2010, Tom 28, Nr 7:743-749.
22. Dezgun I., Baltaci G., Colakoglu F., Tunay V. B., Ozer D.: The Effects of Jump-Rope Training on Shoulder Isokinetic Strenght in Adolescent Volleyball Players. Journal of Sport Rehabilitation, 2010, Tom 19, Nr 2:184-199.
23. Hadzic V., Sattler T., Markovic G., Veselko M., Dervisevic E. The isokinetic strength profile of quadriceps and hamstrings in elite volleyball players. Isokinetics and Exercise Science. 2010, 18 31–37.
24. Bamaç B., Çolak T, Özbek A., Çolak S., Cinel Y., Yenigün Ö. ISOKINETIC PERFORMANCE IN ELITE VOLLEYBALL AND BASKETBALL PLAYERS. Kinesiology 2008; 40: 2:182-188.
25. Reichard L. B., Croisier J.L., Malnati M., Katz- Leurer M., Dvir Z. Testing knee extension and flexion strength at different ranges of motion : an isokinetic and elektromyographic study. Eur J Appl Physiol. 2005, 95: 371 -376.
26. Rebeyrotte I., Daviet J – C, Oksman A., et al., Isokinetic evaluation of anterior cruciate ligament reconstruction using a free fascia lata graft strengthened by gracillis tendon. Isokinetics and Exercise Science 2005, 13: 20-24.
27. Fernandes L., Storheim K., Nordsletten L., Risberg M. A.: Development of a Therapeutic Exercise Program for Patients With Osteoarthritis of the Hip. Physical Therapy, 2010, Vol 90, Nr 4: 592-601.
28. Andrade M.S., Cohen M., Picarro I.C and Silva A.C. Knee performance after anterior cruciate ligament reconstruction., Isokinetics and Exercise Science 2002,10: 81 -86.
29. Collado H, Coudreuse J M, Graziani F, Bensoussan L, Viton J M, Delarque A. Eccentric reinforcement of the ankle evertor muscles after lateral ankle sprain. Scand J Med Sci Sports 2010: 20: 241–246. doi: 10.1111/j.1600-0838.2009.00882.x.

30. Hadzic V et al. Risk factors for ankle sprain in volleyball players: A preliminary analysis. Isokinetics and Exercise Science 2009;17, 155–160 155. DOI 10.3233/IES-2009-0347.
31. Hartog D., Eker H., Tuinebreijer W., Kleinensink G., Stam H., Lange J.: Isokinetic strenght of the trunk flexor muscles after surgical repair of incisional hernia. Hernia, 2010, 14, Nr 3:243-247.
32. Möller M, Lind K, Movin T, Karlsson J. Calf muscle function after Achilles tendon rupture. A prospective, randomised study comparing surgical and non-surgical treatment. Scand J Med Sci Sports 2002: 12: 9–16.
33. Bigoni M, Gorla M, Guerrasio S, Brignoli A, Cossio A, Grillo P, Marinoni EC. Shoulder evaluation with isokinetics strength testing after arthroscopic rotator cuff repairs. J Should Elbow Surg 2009;18:178-183
34. Cools A, Declerq G,Sneyers C, Witvrouw E. Isokinetic muscle strength and functional restoration following surgical repair of the rotator cuff: A prospective study. Isokinetics and Exercise Science 2006; 14:291–30.
35. Hughes A, Even T, Narwani AA, Atoun E, Van Tongel A, Sforza G, Levy O. Pattern and time phase of shoulder function and power recovery after arthroscopic rotator cuff repair. J Shoulder Elbow Surg (2011) In press, 1-5.
36. Szuba Ł, Markowska I, Czamara A, Noga H. Quantitative analysis of peak torque and power-velocity characteristics of shoulder rotator muscles after arthroscopic labral repair. J Sci Med Sport. 2016 Jan 6. pii: S1440-2440(15)00762-8. doi: 10.1016/j.jsams.2015.12.513
37. Schroer WC, Diesfeld PJ, Reedy ME, LeMarr AR: Isocinetic strenght testing of minimally invasive total knee arthroplasty recovery. The Journal of Arthroplasty, 2010, Tom 252:274-279.
38. Fabiś J. The impact of a isokinetic training program on the peak torque of the quadriceps and knee flexors after anterior cruciate ligament reconstruction with hamstrings. Ortop Traumatol Rehabil. 2007 Sep-Oct;9(5):527-31.
39. Durmus B, Baysal O, Altinayar S, Altay Z, Ersay Y, Ozcan C (2010) Lower extermity isokinetic muscle strenght in patients with Parkinson's disease. J Clin Neurosci 17:893-896
40. Li L., Manor B.: Long Term Tai Chi Exercise Improves Physical Performance Among People with Peripheral Neuropathy. American Journal of Chinese Medicine, 2010, Tom 38, Nr 3:449-459.
41. Nocera JR, Buckley T, Waddell D, Okun MS, Hass CJ (2010) Knee extensor strenght, dynamic stability and functional ambulation: are they related in Parkinson's disease? Arch Phys Med Rehabill 91:589-595.
42. Stevens et al. Mandatory oral glucose tolerance tests identify more diabetics in stable patients with chronic heart failure: a prospective observational study. Diabetol Metab Syndr. 2014 Mar 27;6(1):44. doi: 10.1186/1758-5996-6-44.
43. Brünjes DL at al. Analysis of Skeletal Muscle Torque Capacity and Circulating Ceramides in Patients with Advanced Heart Failure. 2016 May;22(5):347-55. doi: 10.1016/j.cardfail. 2016.02.002. Epub 2016 Feb 12.
44. Stevens at al. Exercise training improves insulin release during glucose tolerance testing in stable chronic heart failure patients. J Cardiopulm Rehabil Prev. 2015 Jan-Feb;35(1): 37-46. doi: 10.1097/HCR.0000000000000092.
45. Iellamo F, Legramante JM, Raimondi G, Castrucci F, Damiani C, Foti C, Peruzzi G, Caruso I (1997) Effects of isokinetic, isotonic and isometric submaximal exercise on heart rate and blood pressure. Eur J App Physiol 75:89-96.
46. Overend TJ, Versteegh TH, Thompson E, Birmingham TB, Vandervoort AA (2000) Cardiovascular Stress Associated With Concentric and Eccentric Isokinetic Exercise in Young and Older Adults. J Gerontol A Biol Sci Med Sci 55:177-182.
47. Degache F, Roche F, Bernard P, Calmels P (2009) Cardiovascular responses during isokinetic knee extension testing in chronic heart failure patients. Isokinet Exerc Sci 17:63-67.
48. Lamotte M, Chevalier A, Jamon A, Brassine E, van de Borne Ph (2009) Hemodynamic response of an isokinetic testing and training session. Isokinet Exerc Sci 17:135-149.
49. Corvalho J., Marques E., Soares J. M., Mata J. : Isokinetic strenght benefits after 24 weeks of multicomponent exercise training and combined exercise training in older adults. Aging. Clinical And Experimental Research, 2010, Tom 22, Nr 1:63-69.
50. Czamara A, Krzemińska A, Szuba Ł. The influence of exercises under isokinetic conditions on heart rate. ACTA OF BIOENGINEERING AND BIOMECHANICS. 2011,Vol. 13 (3),95–104.
51. Panza et al. Changes in muscle strength in individuals with statin-induced myopathy: A summary of 3 investigations. J Clin Lipidol. 2015 May-Jun;9(3):351-6. doi: 10.1016/j.jacl. 2015.01.004. Epub 2015 Jan 28].
52. Loenneke et al. Statin use may reduce lower extremity peak force via reduced engagement in muscle-strengthening activities. Clin Physiol Funct Imaging. 2016 Jun 10. doi: 10.1111/cpf.12375].
53. Tanaka et al. Prediction of muscle strength and postoperative functionafter knee flexor muscle resection for soft tissue sarcoma of the lower limbs. Orthop Traumatol Surg Res. 2017 Aug 4. pii: S1877-0568(17)30212-8. doi: 10.1016/j.otsr.2017.07.005.
54. Lustosa et al. Comparison between parameters of muscle performance and inflammatory biomarkers of non-sarcopenic and sarcopenic elderly women. Clin Interv Aging. 2017 Aug 2;12:1183-1191. doi: 10.2147/CIA.S139579. eCollection 2017].
55. Dworak L B. Strength measuring stand SMS – I for tests of torque of man's liwer leg muscle grup. Biology of Sports. 1987, 4 (1/2): 81-86].
56. Bober T., Hay J.G.; Topografia siły mięśni kończyn człowieka. Wych. Fizyczne i Sport 1990, 3: 3-25.
57. Bober T., Kulig K., Burnfield J.M., Pietraszewski B. Predictive torque equations for joint of the extremities. Acta of Bioengineering and Biomechanics 2002, 4, (2), 50-60.
58. Trzaskoma Z.: Maksymalna siła mięśniowa i moc maksymalna kobiet i mężczyzn uprawiających sport wyczynowo. AWF Warszawa, Studia Monograficzne, 2003.
59. Wit A., Mirowski M.: Biomechaniczna ocena własności dynamicznych mięśni stawu kolanowego. Acta Clinica 2002: 2 (1): 77-85.
60. Urbanik Cz, Mastalerz A (red). Biomechanika sportu i rehabilitacji - Wybrane zagadnienia. AWF Warszawa 2009.
61. Wit A. (Red.) Biomechaniczna Ocena Układu Ruchu Sportowca. Warszawa Instytut Sportu 1992.
62. Trzaskoma Z, Buśko K, Gajewski J. Ocena stanu sportowców na podstawie pomiarów biomechanicznych. W Nałęcz M (red.) Biocybernetyka i Bioinżynieria Biomedyczna 2000. Tom 5: Biomechanika i Inżynieria rehabilitacyjna. Akademicka Oficyna Wydawnicza EXIT, Warszawa 2000, 663-680.
63. Czamara A., Szafraniec R., Tomaszewski W. Zależność siły mięśni rotujących ramię od wartości kąta odwiedzenia ramienia. Ortopedia, Traumatologia, Rehabilitacja. 2005, Vol. 7, Nr 3, 310-316.
64. Duławski G., Bober T., Czamara A., Zaleski A. Momenty sił grup mięśni w funkcji kąta odwiedzenia i przywodzenia ramienia u mężczyzn. Fizjoterapia. 2008, Vol. 16, nr 2, 13-18.
65.Hagner W. Wpływ rehabilitacji na funkcję stawu kolanowego po rekonstrukcji operacyjnej więzadła krzyżowego przedniego. Rozprawa habilitacyjna. AM Bydgoszcz 2001.
66. Hrycyna M, Zieliński J. Torque of the shank rotating muscles in patients with knee joint injuries. Acta Bioeng Biomech. 2011;13(4):77-83.
67. Hanuszkiewicz J, Malicka I, Stefańska M, Barczyk K, Woźniewski M. Body posture and trunk muscle activity in women following treatment of breast cancer. Ortop Traumatol Rehabil. 2011 Jan-Feb;13(1):45-57.
68. Skrzek A, Mraz M, Dąbrowska G. Dynamics of involutional changes of the locomotor system in terms of risk factors for fractures. Ortop Traumatol Rehabil. 2008 Sep-Oct;10(5):449-62.
69. Fabiś J. Isokinetic evaluation of external rotators and abductors of the shoulder before and after arthroscopic decompression of suprascapular nerve due to its neuropathy--preliminary report. Chir Narządu Ruchu Ortop Pol. 2007 Jul-Aug;72(4):283-5.
70. Czamara A, Szuba Ł, Krzemińska A, Tomaszewski W, Wilk-Frańczuk M. Effect of physiotherapy on the strength of tibial internal rotator muscles in males after anterior cruciate ligament reconstruction (ACLR). Medical Science Monitor 2011; 17 (9); 523-531.
71. Braddom R.L.(Eds). Physical Medical Rehabilitation. Saunders Elsevier 2007 (Third Edition).
72. Brotzman B K, Wilk E (Eds). Rehabilitacja Ortopedyczna Tom I i II. Red. Wyd. Pol. Dziak A. Elsevier Urban& Partner, Wrocław 2008.
73. Porter S (Ed,). Tidy's Physiotherapy. Ed. Porter S. Elsevier 2008.
74. Widuchowski J.: Kolano - artroskopia diagnostyczna i operacyjna. Sports & Med, Katowice 2002.
75. Czamara A. Wyznaczniki oceny funkcjonalnej sprawności narządu ruchu u pacjentów po rekonstrukcji więzadła krzyżowego przedniego stawu kolanowego. Fizjoterapia Polska. 2010: 4 (4); Vol. 10, 247-262.
76. Czamara A. Zastosowanie wyznaczników do oceny funkcjonalnej efektów rehabilitacji u pacjentów po rekonstrukcji ACL. Ortopedia Traumatologia Rehabilitacja 2010; 6 (6); Vol. 12, 519 – 533.
77. Czamara A., Tomaszewski W. Kryteria powrotu do treningu sportowego pacjentów po rekonstrukcji więzadła krzyżowego przedniego (ACLR).Medycyna Sportowa 2011; 1 (4); Vol. 27,19-31.
78. Manske R C., Stojak M. Preoperative and Postsurgical Musculoskeletal Examination of the Knee: In Postsurgical Orthopedic Sports Rehabilitation Knee & Shoulder. Red. Manske R C. Mosby Elsevier, St. Louis 2006: 31-53.
79. Czamara A.: Ocena postępowania fizjoterapeutycznego po rekonstrukcji endoskopowej więzadła krzyżowego przedniego stawu kolanowego. (Praca doktorska. AWF Warszawa, 2006).
80. Czamara A. Fizjoterapia po operacjach chrząstki stawu kolanowego. Fizjot. Pol. 2003, Vol. 3, nr 4, 401-411.
81. Czamara A. Physiotherapeutic procedure after injuries of soft tissues of tarsal-crural jont. The Journal of Orthopedics Trauma Surgery and Related Research. 2008, 4, (12), 88-108.
82. Czamara A. Physiotherapeutic treatments after surgery of total Achilles tendon repture. J Orthop Trauma Surg Rel Res 1 (5) 2007, 75 – 93.
83. Czamara A. Program fizjoterapii po zwichnięciach przednich stawu ramiennego. Med. Sportiva. 2003, Vol. 7, 2, 139-150.