

ANALYSIS OF THE PREMEDITATED WORKOUT EFFECTS WITH ON ISOCINETIC LEG STRENGTH

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Systematic review:

Abstract:

The purpose of this review article is to present a systematic overview of different approaches to strength and power of the lower limbs measured and monitored exclusively by isokinetic dynamometer test. The selected papers analyzed in this review cover testing protocol involving a concentric performance of both movements at the speed of 60°/sec and 180°/sec. The problems were related to lowered total leg power to unilateral and bilateral imbalances while knee joints are flexed or extended. The analysis of selected research reveals that individual programmed workouts created based on the data measured on an isokinetic dynamometer can significantly help to fix lack of strength muscle groups stabilizing the knee joint. We can say that appropriately planned workout process including correct control testing protocols causes significant transformations in the knee joint extensors and flexors. The selection of the relevant papers for this study was conducted in data bases Google Scholar, Medline, KoBSON, PubMed, ResearchGate and EBSCOdata with the following keywords: rehabilitation, knee joint, injuries, extension and flexion.

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Introduction

An efficient cooperation between a patient (person doing the workout) and a therapist (coach) with good motivation is very important and without which is impossible for the patient to regain muscle system function or joint and joint with bones stabilizer function without a reaction from the patient the therapist that is an expert-kinesiologist is unable to update the rehab(workout) protocol or apply methods of the workout process.

Theoretical basics of kinesiotherapy are found in kinesiology which studies the laws of controlling the workout process and the consequences of those processes on the human organism (Mrakovic, 1997). As a core component of kinesiology kinesiotherapy has elements of applied kinesiology where a kinesiological operator serves for a health improvement of a certain individual at the same time kinesiotherapy is considered a treatment method in physical medicine (Kosinac, 2005) Recently this branch of medicine has made great strides mostly in the rehabilitation segment whether we're talking about athletes or non-athletes. That's why for many years isokinetic has found a place for itself as a part of rehab and is even used for preventing injuries with

top athletes' Isokinetic diagnostics as one of the most advanced ways of testing any important parameters of the bone and muscle system (Zakas, 2006) represents a technologically advanced and scientifically determined helping system designed to determine the condition of a human body which then helps to plan and program a goal-oriented kinesiotherapy.

Isokinetic dynamometer represents the only sure way to dynamically charge a muscle that is a group of muscles whose job is to stabilize a certain joint by maximizing its potential through a wide array of movement. Whether isokinetic testing is done for rehab or as an addition to a workout program it is imperative to plan these rehab workout protocols with precise diagnostic procedures follow how they were and executed and evaluate results that were achieved (Kovač et al., 2013).

Methods

This paper is a traditional evaluative article Primary sources of research were the following: Google

Scholar PubMed, ResearchGate Scribd with the following keywords: isokinetic testing knee joint injuries extension and flexion knee stabilators peak moment. Initial research revealed 200 possible results after a thorough analysis 188 articles were excluded the 12 that made the cut satisfied a strict criterion which was based on reading and analyzing content

Results

Today throughout the world there is a large number of isokinetic dynamometers which are used in diagnostics workouts and rehabilitation Isokinetic machines are different from resistant based systems Resistance comes from a spring pneumatics hydraulics or electronic robotics (electric engine). Hydraulic systems are often used because it has been shown that they are the most sensitive to fine changes and are also the safest for the person on whom diagnostics workouts or rehabilitation is being done (Desnica and Bakrac, N., 2003).

An analysis has been made of research which was exclusively focused on strength of the lower limbs measured with an isokinetic device done on athletes and nonathletes Research done on `Cybex 1000` isokinetic device which focused on top skiers from 12 to 20 years old showed muscle disbalance Testing was done on knee extensors and flexors as well as on hips and ankles Isokinetic testing has shown that disbalance was great both unilateral and bilateral and that these results should be taken into consideration for workout planning when it comes to top skiers (Bakrač and Desnica N., 2003).

Further research done on athletes was done on football players from Brazil and measured isokinetic power of the thigh strength balance /mm quadriceps as well as a comparison between professional football players futsal players and those playing beach football Research encompassed professional football (n=70) futsal (n=30) and beach football (n=12) The goal was to test knee extensor power in 60 degrees a second in concentric mode both of the dominant and non-dominant sides In the dominant side for their extensor muscles futsal players` had much lower peak torque moments ($223,9 \pm 33,4$ Nm) compared to football players ($250,9 \pm 43,0$ Nm, $p = 0,02$) or beach football players ($253,1 \pm 32,4$ Nm, $p = 0,03$). Peak torque for extensor muscles in the non-dominant part was much lower in futsal ($224,0 \pm 35,8$ Nm) than with beach football players ($256,8 \pm 39,8$ Nm, $p = 0,03$). Quadriceps strength testing done on dominant side for futsal ($57,6 \pm 10,1\%$) football ($53,5 \pm 8,8\%$) and beach football ($56,3 \pm 8,4\%$) hadn` t shown any significant difference between the groups tested but their medium values were lower

than those recommended in literature There was no lack of power with any group when they were compared bilaterally From this we can conclude that beach football players have shown lower quadriceps power when compared to regular football players and at the same time there is quite a difference in knee tendon firmness where beach football players showed high values compared to the others (De Lira 2017).

Research done by Medical School of the Kinesiology University in Hong Kong China on professional football players a total of 169 test subjects participated in a prestige isokinetic power testing after which they began their regular 10 month game season Test protocol involve a concentric performance of both movements knee flexors and extensors at $60^\circ/\text{sec}$ and $240^\circ/\text{sec}$ as well as an eccentric knee flexor performance at $30^\circ/\text{sec}$ Power deficits bilateral differences and a projection ratio of quadriceps firmness was calculated Unique and multivariable logistic regressions were used to identify potential risk factors of HIS To test sensitivity and firmness specifics receptor working characteristic curves were used (ROC). Results based on this research showed that 41 acute HSIs were found with 12% (n=5) in the multivariable analysis connections between risk injury and peak torque eccentric thigh contraction under 2.4 Nmkg^{-1} (OR = 5.59, 95% CI, 2.20-12.92), concentric ratio H/q under 50,5% (OR = 3,14; 95% CI, 1,37-2,22), players with a previous injury HIS (OR= 3,57, 95% CI, 3,13-8,62), ROC analysis showed an under curve area (AUC) of 0,77 which shows a relatively good combination of sensitivity and specifics of the whole prediction model (Lee JWY 2017).

When we take into consideration muscle function alongside balance, a clear picture can be seen in a doctoral dissertation named "Contralateral effects of unilateral strength-based workout on muscle function and balance with physically active women" whose goal was to determine ipsilateral and especially contralateral effects of unilateral strength-based workouts with different speed contractions on muscle function and balance of physically active women. Another goal was to determine the connection between leg strength and balance. Research was done on 45 healthy kinesiology students who were randomly separated into three groups slow (unilateral "slow" isokinetic leg strength workout), fast (unilateral "fast" isokinetic leg strength workout) and a control group. Test subjects had their mass, body composure, one legged balance (computerized circle platform Biodex Stability System) and concentric knee flexors and extensors (at $60^\circ/\text{s}$ and $180^\circ/\text{s}$) as well as their spurn and dorsal flexors (at $30^\circ/\text{s}$ and $60^\circ/\text{s}$, Biodex system 3) measured before and after a 4-week experimental program. Isokinetic concentric

workout of extensor power and knee flexors as well as spurn and dorsal flexions of the non-dominant leg of the same volume (same mechanical work but with different angle speeds (extensors\knee flexors at 180°/s vs 60°/s, spurn\dorsal flexors of the ankle at 60°/s vs. 30°/s) was done on both groups. Both groups produced statistically significant ipsilateral and contralateral training effects ($p < 0,05$) in the space of power testing trained muscle groups in which the average size of effect on an untrained leg was 11% and 27,7% on a trained leg. No statistically significant differences ($p > 0,05$) were determined in the change amount regarding power variables based on contraction speed. Statistically important ($p < 0,05$) and positive ipsilateral and contralateral effects regarding balance were also recorded with there not being a big difference between the slow and fast groups. Finally results showed a moderate, statistically important ($p < 0,05$) connection between absolute\relative leg muscle power and one-legged balance (cumulative percentage of 36-40%). All things considered, results show that lower limb power is very important for creating and maintaining dynamic balance, as well as showing efficiency in applying strength workouts in order to improve balance on both trained and untrained sides of the boy with young, physically active young women (Bradić, J et al., 2012).

Results that were achieved only emphasize findings on the crossed education phenomena that is the phenomena of contralateral effects of strength workouts. Basically, this research's findings show that a short unilateral concentric strength workout, no matter the speed of a contraction, can produce many ipsilateral and contralateral effects regarding a human's motor and locomotor system. It can be said that with physically active women, concentric isokinetic training of ND knee extensors and 60% bend significantly strengthens these muscles' power on a trained and nonfixed limb. This cross education wasn't speed specific and therefore can eliminate the need to use multispeed protocols.

Isokinetic instruments are used most widely in kinesiotherapy. Most authors emphasize that isokinetic testing can primarily be used as a means of power evaluation, ability to advance as well as recovering muscle function. Rehabilitation based isokinetic workouts ,have two advantages over traditional rehabilitation, firstly the ability to passively workout wherein a patient is helped in recovering movement amplitude and strength during the acute phase as well as if a patient were to feel muscle pain it negates resistance, which can have a positive effect on motivation, as well as remove fear one of the most debilitating factors, telling us that this sort of protocol

can be used in the earliest stages of rehabilitation (Kovač, S., 2009).

This research gives the opportunity to people doing research to see valuable information about the effects of rehabilitation workouts which is helped by isokinetic training. Isokinetic dynamometer represents the only sure way of working the muscle, or the group of muscles who stabilize a certain joint and to help them reach their maximum potential through complete movement amplitude. We can say that the final goal is to create a platform for programming rehabilitation protocol after knee joint injury with physically active subjects. Research was done on students of the Faculty of sports and physical education, which considered isokinetic profiles of extensor power and knee flexors. Primary goal was to build a profile of an isokinetic power of female students of Faculty of sports and physical education and to determine H\Q ratio as well as determining the size of starting torque movement provided by knee joint flexors and extensors. With the results an isokinetic dynamic stabilization of knees of physically active women was constructed. Values of peak torque in extension were $148,19 \pm 25,54$ Nm for the dominant and $150,09 \pm 23,81$ Nm for nondominant leg and knee flexion was $76,65 \pm 13,35$ Nm for dominant and $76,14 \pm 16$ Nm for nondominant leg, while the ratio between these two values $0,52 \pm 0,06$ for dominant and $0,51 \pm 0,07$ for nondominant leg. (Abazović, E. 2013).

Ability to achieve complete knee functionality which depends on quadriceps strength can be bet seen through isokinetic testing. Research was done on 39 patients (26 men and 13 women) age from 51 to 88 where it was worked on knee strengthening after a full knee reconstruction.

Isokinetic testing of dynamometers on 180°/seconds with 3 sets of 10 reps in extension and flexing was done by an independent physiotherapist in order to evaluate dynamic concentric peak torque of joints and quadriceps'. F\E ratios were calculated. TKA was done with sub testing (n=20) or middle (n=19). Analysis of surgically approached subgroup, spine pathology (n=11), sex, age, and body mass index were all measured. KSS and range of movement (ROM) were tested during every visit.

Average postoperative relative extended movement was 23 Nm (in a 9 to 43 Nm range) which represents a 38% median growth (range-16 to 100%, $P=0,0267$) from preoperative state. A median rise of 27% was determined (range -15% do 100%, $P=0,0433$) in firm flexibility and average relative flange torque of 19 Nm (range, 8-37 Nm/kg)). Previous operative average range F\E was 0.8 and 0.9 postoperatively ($P=0,3028$). Men showed significantly higher flexibility compared to women (22% vs. 12%, $P<0,001$), but sex was unrelated to

extension advancement (27% to 15%, $P=0.0537$). Postoperative F/E was similar in men (0,8) and women (0,9; $P=0,4454$). Muscle strength reconstruction of quadriceps and under-knee muscles can be expected 1 year postoperatively irrelevant of sex, surgical approach or spine pathology. Further cross research is necessary in order to raise the implants to muscle, knee tendons and quadriceps (Kurowicki J. 2015).

The interesting part in kinetic and isokinetic knee analysis regarding flexion and extension, isokinetic dynamo metrics is considered the gold standard in testing mechanical attributes of a muscle. Data received from a dynamometer can be evaluated directly although there can be some kinetic inaccuracies. There are differences between evaluating isokinetic, untreated info and those based on their own machine software and those with a hybrid kinetic approach. Research was done on 70 healthy men, who did one sided concentric contraction-knee extension and eccentric contraction-knee flexion. Isokinetic raw data encompassed kinetic inaccuracies except movement evasion and anatomical characteristics. Considering that a hybrid kinetic approach is more long lasting it can provide with a more accurate clinical interpretation of result findings (Alt, T. 2017).

It was shown that pilates was effective in muscle growth in senior citizens but some variables weren't fully researched. Research was done on the effects of pilates on isokinetic muscle power of knee flexors and extensors on 60°/s with older women. 32 women were put into random groups control group (CG, $n = 16$, dob $64,2 \pm 0,8$ yrs, BMI = $25,0 \pm 1,2$ kg /m²) and experimental group (EG, $n = 16$, dob $63,6 \pm 1,0$ yrs, BMI = $24,7 \pm 1,3$ kg / m²). Isokinetic evaluation of knee extensors and flexors was done on 60°/s, before and after intervention taking into consideration peak torque (Nm) complete work (J) for left and right limbs. CG participated in static extension and EG in pilates, twice a week during twelve weeks. Results showed a significant improvement in EG ($p < 0,001$) in all tests, when compared pre and post intervention (intragroup) with the amount of effect (Cohen) reaching 2,003 and 1,33 for knee flexors of extension muscles.

Comparing CG and EG (intergroup) post intervention, significant improvement was recorded ($p < 0,001$) with EG being declared the winner in all variables, with the amount of effect (Cohen) reaching 1,059 and 1,15 for knee flexors and muscle extensors. Results have shown that 12 weeks of pilates increases isokinetic muscle power of knee extensors and flexors in senior women and can be prescribed in lieu of physical activity (Oliver, L., 2017).

The goal of this study was to explore the relation between a vertical jump, isokinetic power of knee flexors and extensors and postural status, it was also an attempt to describe a multiple regression model which accounts for the effects of chosen parameters of isokinetic measured power and postural qualities on vertical jump improvement.

Thirty male football players, ages 17 to 20 participated in this research (middle age: \pm SD $18,6 \pm 1,26$, height: $1,78 \pm 0,74$ m and weight: $73,1 \pm 6,77$ kg). Correlation between a knee's isokinetic power, one's ability to jump and postural control was determined through Pearson's correlation quotient. A linear regressive model was used to evaluate the effect of one's spine vertebrate and quadriceps, maximum peak torque of both legs at 60°/sec, both legs' total work at 240°/sec and a postural status regarding jumping ability. Peak torque of the quadriceps at 60°/sec. showed correlation with a counter jump test which is 30 seconds of jumping ($p = 0,005$, $p=0,003$ and $p = 0,007$). A strong relation between the 30 second jumps and peak torque measured at 60°/sec was also noticed. There were no significant correlations between any jump tests and peak torque movements at 60°/sec. In the 30 second jump test there seemed to be a relation between a jumper's endurance and total work of knee flexors for the right and left leg at 240°/sec. (Sliwovski, R. 2017).

Conclusion

Analyzing cited works, which were focused on power transformations or lower limb strength and were measured exclusively by an isokinetic dynamometer test one can make unilateral conclusions. Data given and the conclusion made by the authors themselves help the thesis that programmed, individual workouts created based on the data measured on an isokinetic dynamometer can adequately and significantly help fix any imbalance of the muscle groups which are tasked for stabilizing the knee joint. Imbalances are segmented from a lowered total leg power to unilateral and bilateral disbalances seen on a force distributing curve tasked while knee joints are flexed and extended. All tests shown in this paper, were done in a concentric-concentric protocol at a 60°/sec and 180°/sec speed. Regardless of dynamometers' concentric contractions, most authors, in their training protocol, accentuated eccentric stimulants on focused muscle groups. Next to that a great part of the training process were proprioceptive workout combinations seen through isometric and isotonic contractions. In some part of the paper's rehabilitation value of cross educational effect was lauded, which

was achieved through programmed workouts aiming at lower limbs. Those effects were directly measured with an isokinetic dynamometer with results shown in Nm, which consider the bilateral relation between force exerted during peak torque for certain muscle groups. According to this one can conclude that isolated dynamometric can give relevant information about effects of workout programs on the rehabilitation of a contralateral limb in the earliest stage of injury recovery. When the novelty of analyzed papers is taken into consideration it can be concluded that operators put in such order with correct control testing protocols have caused significant transformations in the knee joint regardless of the heterogeneity of test subjects.

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Submitted: 11.01.2020.

Accepted: 29.10.2020.