

Primus Research References

2022

“The influence of hip flexion mobility and lumbar spine strength on lumbar spine flexion during a squat lift.”

Patterson CS, Lohman E, et al. The influence of hip flexion mobility and lumbar spine strength on lumbar spine flexion during a squat lift. *Musculoskel Science & Practice*. 2022;58 102501
<https://doi.org/10.1016/j.msksp.2021.102501>

ABSTRACT

Study Design: Cross-sectional; Controlled laboratory study.

Objective: To examine the associations among available hip flexion motion, lumbar extensor strength and peak lumbar flexion during a squat lift task.

Summary of Background Data: Lumbar spine flexion during lifting can result in increased strain on spinal structures. Although decreased available hip flexion motion and reduced strength of the lumbar extensor muscles has been proposed to contribute to greater lumbar flexion during lifting, direct relationships have not been explored.

Methods: Fifty healthy young adults participated (23 males and 27 females). Strength of the lumbar extensors was measured using a motor-driven dynamometer. Available hip flexion was assessed using 3D motion capture. Peak lumbar spine flexion and hip flexion were quantified during the descent phase of the squat lifting task.

Results: There was a significant negative association between available hip flexion and peak lumbar spine flexion during squat lifting in females ($r=-0.407$, $p=0.035$) but not males ($r=-0.341$, $p=0.120$). Similarly, peak lumbar spine flexion was negatively associated with lumbar extensor strength in females ($r=-0.398$, $p=0.040$) but not males ($r=-0.310$, $p=0.161$). During the squat lift, peak hip motion was positively associated with available hip flexion for both males and females combined ($r=0.774$, $p<0.001$).

Conclusion: Females with less available hip flexion and lower lumbar extensor strength exhibit greater lumbar flexion when performing a lifting task. Clinicians should be aware of the potential contributions of such impairments when instructing patients into various lifting strategies.

Use of Primus: measure isometric strength of hip extensor muscles

“The influence of hip extensor and lumbar spine extensor strength on lumbar spine loading during a squat lift.”

Patterson CS, Lohman E, et al. The influence of hip extensor and lumbar spine extensor strength on lumbar spine loading during a squat lift. *J Electromyog Kinesiol*. 2022;62 102620
<https://doi.org/10.1016/j.jelekin.2021.102620>

ABSTRACT

Weakness of the hip extensors and lumbar spine extensors has been proposed to contribute to greater demands on the lumbar spine during lifting. The purpose of the current study was to examine the associations among strength of the hip and lumbar spine extensors, lumbar spine extensor moments and lumbar paraspinal muscle activation during a squat lift task. Twenty-seven healthy females participated. Strength of the hip and lumbar spine extensors was measured using a dynamometer. Lumbar spine moments and lumbar paraspinal muscle activity were quantified during the concentric phase of the squat lifting task. There was a significant positive association between lumbar extensor strength and average lumbar extensor moment during lifting ($r = 0.498$, $p = 0.008$). Similarly, hip extensor strength was positively associated with the average lumbar extension moment ($r = 0.382$, $p = 0.049$). Hip extensor

strength was negatively associated with activation of the lumbar paraspinal muscles during lifting ($\rho = -0.382$, $p = 0.049$). Stronger individuals are more likely to use their hip extensors and lumbar spine extensors to perform a squat lift task. In contrast, those with lower strength employ subtle biomechanical changes to reduce lumbar spine demand.

Use of Primus: measure isometric strength of hip and lumbar spine extensor muscles



“Feasibility of using a portable MyotonPRO device to quantify the elastic properties of skeletal muscle.”

Ya-Peng L, Chun-Long L, et al. Feasibility of using a portable MyotonPRO device to quantify the elastic properties of skeletal muscle. *Med Sci Monitor.* 2022;28:e934121
<https://www.medscimonit.com/abstract/index/idArt/934121>

ABSTRACT

Background: The aims of this study were to (1) calculate the correlation between different tensile force levels and corresponding muscle stiffness both in vitro and in vivo; (2) determine whether muscle stiffness assessed using a MyotonPRO myotonometer can be used to accurately estimate muscle activity level; and (3) evaluate the inter-operator reliability of MyotonPRO-based measurement in assessing biceps brachii muscle (BBM) stiffness.

Material/Methods: In Experiment I, muscle stiffness, as measured using the MyotonPRO, was obtained at 0 N, 2 N, 4 N, 6 N, 8 N, and 10 N of applied force on 6 fresh medial gastrocnemius muscle specimens. In Experiment II, 11 healthy subjects were recruited. BBM stiffness, assessed by the same device, was obtained at different tensile force levels, from 0 to 50% of maximal voluntary contraction (MVC). For the reliability test, the score for each subject was quantified by 2 operators (I and II), thrice, at 30-minute intervals on the same day.

Results: A strong correlation was found between the different tensile force levels, which corresponded to muscle stiffness in vitro ($r=0.71-0.95$, all $P<0.05$). In vivo, muscle stiffness increased linearly with an increase of the tensile force levels from 0 to 50% of MVC ($r=0.99$, $P=0.00$) and there was a significant difference in BBM stiffness among the incremental isometric tasks ($F [1.76, 17.60]=91.52$, $P=0.00$). The inter-operator reliability for the measurement of BBM stiffness was good (ICC=0.86).

Conclusions: Our findings indicate that muscle stiffness measured using the MyotonPRO is strongly related to muscle activity level and that the MyotonPRO is a feasible tool for quantifying BBM stiffness as well as for quantifying changes in MVC levels.

Use of Primus: measure isometric strength of flexor muscles of elbow

2021

“Confidence to return to play after anterior cruciate ligament reconstruction is influenced by quadriceps strength symmetry and injury mechanism.”

Della Villa F, Straub RK, Mandelbaum B, et al. Confidence to return to play after anterior cruciate ligament reconstruction is influenced by quadriceps strength symmetry and injury mechanism. *Sports Health.* 2021 DOI: [10.1177/1941738120976377](https://doi.org/10.1177/1941738120976377)

ABSTRACT

Background: Although the restoration of quadriceps strength symmetry is a primary rehabilitation goal after anterior cruciate ligament reconstruction (ACLR), little is known about the potential relationship between quadriceps strength symmetry and psychological readiness to return to play (RTP).

Hypothesis: Quadriceps strength symmetry will be associated with psychological readiness to RTP after ACLR. Secondly, injury mechanism will influence the association between quadriceps strength and psychological readiness to RTP.

Study design: Retrospective cohort.

Level of evidence: Level 3 (cohort study).

Methods: A total of 78 female patients completed strength testing and the Injury-Psychological Readiness to Return to Sport (I-PRRS) scale at an outpatient clinical facility as part of return to sport testing after ACLR. Linear regression analysis was used to assess the relationship between the I-PRRS and the independent variables of interest (quadriceps strength symmetry and injury mechanism).

Results: For all patients combined, a significant symmetry \times mechanism interaction was found. When split by injury mechanism, a significant linear relationship was found between quadriceps strength symmetry and the I-PRRS score in patients who experienced a noncontact injury ($n = 55$; $P = 0.01$; $R^2 = 0.24$). No such relationship was found for those who experienced a contact injury ($n = 23$; $P = 0.97$; $R^2 = 0.01$).

Conclusion: Greater quadriceps strength symmetry was associated with greater psychological readiness to RTP in female athletes after ACLR. This relationship, however, was present only in those who experienced a noncontact injury.

Clinical relevance: Clinicians should consider both the physical and the psychological factors in assessing a patient's readiness to RTP. This may be particularly important for those who have experienced an ACL tear through a noncontact mechanism.

Use of Primus: measure isometric strength of quadriceps to determine quadriceps strength symmetry

“Performance-based physical function correlates with walking speed and distance at 3 months post unilateral total knee arthroplasty.”

Choi JH, Kim BR, Kim SR, et al. Performance-based physical function correlates with walking speed and distance at 3 months post unilateral total knee arthroplasty. *Gait & Posture*. 2021;21:163-169

ABSTRACT

Background: After total knee arthroplasty (TKA), walking speed and distance are main concerns of patients.

Research question: Which physical functions affect walking speed and distance after TKA?

Methods: Cross-sectional data from 149 patients who underwent unilateral primary TKA and completed performance-based physical function tests. Instrumental gait evaluation for spatiotemporal parameters, isometric knee extensor and flexor strength of both knees, 6-minute walk test (6MWT), timed up-and-go (TUG) test, timed stair climbing test (SCT), and knee flexion and extension range of motion (ROM) of surgical knee were examined. Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and EuroQol five dimensions (EQ-5D) questionnaires were also performed.

Results: Univariate analyses revealed that post-operative walking speed showed significant positive correlations with cadence, stride length, propulsion index of surgical and non-surgical knee, peak torque (PT) of the extensor of surgical and non-surgical knee and flexor of surgical and non-surgical knee, 6MWT, EQ-5D, and significant negative correlations with gait cycle duration, TUG, SCT-ascent and descent, and WOMAC-pain scores. Post-operative walking distance had significant positive correlations with walking speed, cadence, stride length, swing phase duration, propulsion index of surgical and non-surgical knee, PT of the extensor of surgical and non-surgical knee, EQ-5D, and significant negative correlation with gait cycle duration, double support duration, TUG, SCT-ascent and descent. In the multivariate linear regression analyses, TUG, cadence, stride length and propulsion index of non-surgical knee were factor correlated with post-operative walking speed. The SCT-ascent and descent, TUG and propulsion index of surgical knee were factor correlated with post-operative walking distance.

Significance: Physical performance factors correlated with walking speed and distance at 3 months after surgery. Based on these observations, rehabilitation of bilateral muscle strength and functional mobility would be important for functional recovery after unilateral TKA.

Use of Primus: measure maximum isometric strength of quadriceps and hamstring muscles

“Concentric and eccentric force changes with elastic band and isotonic heavy resistance training: a randomized controlled trial.”

Folkins E, Sahni S, Ryan J, et al. Concentric and eccentric force changes with elastic band and isotonic heavy resistance training: a randomized controlled trial. *Int J Sports Phys Ther.* 2021;16:756-765

ABSTRACT

Background: Inclusion of resistance training as part of a general fitness program to improve health, and lower risk of disease and injury is well established. Two common options to improve strength are elastic bands and weights. Comparison between elastic bands (as the sole resistance) to isotonic strengthening for concentric and eccentric strength outcomes following the use of low repetitions/heavy resistance has not been reported.

Hypothesis/Purpose: The purpose was to examine the effects of a four-week isotonic low repetitions/heavy resistance strengthening program compared to a low repetitions/heavy resistance elastic band strengthening program on shoulder external rotation, hip abduction, and elbow flexion concentric and eccentric isokinetic force production in college aged untrained females.

Study Design: Randomized Trial

Methods: Twenty healthy females performed pre-and-post isokinetic (60 degrees/second) concentric/eccentric testing of the elbow flexors, shoulder external rotators, and hip abductors. Participants were randomly assigned to a four-week independent low repetitions/heavy resistance strengthening program performed with either elastic bands or isotonic exercises.

Results: A significant ($p < 0.05$) effect of time was found for eccentric elbow flexor and concentric and eccentric hip abduction force production in the elastic band group with post-test values greater than pre-test values. A significant ($p < 0.05$) effect of time was found for elbow flexor concentric and eccentric force production in the isotonic group with post-test values greater than pre-test values. No significant ($p > 0.05$) effect of time was found for shoulder external rotator concentric and eccentric forces for both groups, the isotonic group's hip abduction concentric and eccentric force production and elastic band group's elbow flexion concentric force production. No significant effect of intervention ($p > 0.05$) on concentric or eccentric elbow flexors, shoulder external rotators, or hip abductors force production was found, with pre-test and post-test values being similar between groups.

Conclusion: Health care practitioners and coaches can consider the prescription of a heavy resistance training program with elastic bands or isotonic exercises for an independent exercise program and expect similar concentric and eccentric muscle force changes.

Use of Primus: measure dynamic force production of elbow flexor, shoulder external rotator, and hip abductor muscles



“Acute and chronic effects of static strengthening an 100% versus 120% intensity on flexibility.”

Fukaya T, Matsuo S, Iwata M, et al. Acute and chronic effects of static strengthening an 100% versus 120% intensity on flexibility. *Euro J Applied Physiol.* 2021;121:512-523

ABSTRACT

Purpose: The acute effects of static stretching have been frequently studied, but the chronic effects have not been studied concurrently. Thus, this study aimed to investigate both the acute and chronic effects of static stretching at different intensities on flexibility.

Methods: Twenty-three healthy men were randomly assigned to perform 1 min of static stretching 3 days/week for 4 weeks at 100% intensity ($n = 12$) or 120% intensity ($n = 11$). The acute effects of stretching were assessed by measuring the range of motion (ROM), peak passive torque, and passive

stiffness before and after every stretching session; the chronic effects of stretching were assessed by measuring these outcomes at baseline and after 2 and 4 weeks of stretching.

Results: Compared with the 100% intensity group, the 120% intensity group had significantly greater acute increases in ROM after all 12 sessions, a significantly greater decrease in passive stiffness after 11 of 12 sessions, and a significantly greater increase in peak passive torque after six of 12 sessions. Regarding the chronic effects, ROM was significantly increased in both groups after 2 and 4 weeks of stretching. Peak passive torque significantly increased in the 100% intensity group after 2 and 4 weeks of stretching, and after 4 weeks in the 120% intensity group.

Conclusion: Stretching at 120% intensity resulted in significantly greater acute improvements in ROM, peak passive torque, and stiffness than stretching at 100% intensity. Four weeks of stretching increased ROM and peak passive torque but did not decrease passive stiffness, regardless of the stretching intensity.

Use of Primus: calculate range of motion, peak passive torque, and passive stiffness from the torque-angle relationship measured using PrimusRS

“Graft-augmented repair of irreparable massive rotator cuff tears with latissimus dorsi transfer to treat pseudoparesis.”

Imai S. Graft-augmented repair of irreparable massive rotator cuff tears with latissimus dorsi transfer to treat pseudoparesis. *J Bone Joint Surg.* 2021:e21.00044. <http://dx.doi.org/10.2106/JBJS.OA.21.00044>

ABSTRACT

Background: Irreparable massive rotator cuff tears are characterized by a poor prognosis with high failure rates following repair. Numerous strategies, such as partial repair, graft interposition, latissimus dorsi (LD) transfer, balloon arthroplasty, and superior capsular reconstruction, have been proposed. We have adopted a graft-augmented LD-transfer procedure, in which partial repair, graft interposition, and LD transfer are performed simultaneously.

Methods: Thirty-nine patients underwent the graft-augmented LD-transfer procedure using autologous fascia lata from 2007 to 2016. All patients underwent a 5-year assessment at a mean (and standard deviation) of 54.8 ± 3.5 months. Of 20 patients with a history of >10 years, 14 underwent a 10-year assessment at a mean of 112.6 ± 5.6 months. To characterize the therapeutic effects of the procedure, the patients were divided into 3 groups according to the tear pattern: superior-posterior tears (Group A), superior-anterior tears (Group B), and global tears (Group C).

Results: The overall mean Constant-Murley score improved from 33.8 ± 5.3 preoperatively to 63.1 ± 9.4 at the 5-year assessment ($p < 0.001$). The overall mean active anterior elevation (AE) improved from $57.3^\circ \pm 13.2^\circ$ preoperatively to $131.3^\circ \pm 18.2^\circ$ at 5 years ($p < 0.001$). Preoperatively, AE was significantly different between Groups A and C ($p < 0.001$) and between Groups B and C ($p < 0.001$), reflecting the difference in cuff tear patterns. Postoperatively, AE was significantly higher in Group A than in Groups B ($p < 0.001$) and C ($p < 0.001$). The present study also showed that AE was electromyographically synchronized to the contraction of the transferred LD. The transferred LD was kinetically more potent at a slower speed, but it was easier to exhaust, than the native rotator cuff. Osteoarthritis progression was radiographically found to occur during the first 5 years.

Conclusions: The graft-augmented LD-transfer procedure may be a treatment option for massive rotator cuff tears, especially for active patients who are <60 years old.

Level of Evidence: Therapeutic Level IV.

Use of Primus: increase strength of shoulder muscles using isokinetic mode



“Effect of support surface quality for the squat exercise on vertical jump performance.”

Kim S, Kang H, et al. Effect of support surface quality for the squat exercise on vertical jump performance. *Indian J Public Health Res Develop.* 2021;12:212-217

ABSTRACT

Background: This study investigated the effect of support surface quality, stable vs unstable, for 6-week long squat exercise program on vertical jump performance.

Method: The subjects were 24 healthy students who agreed to participate in this study. They divided into stable support surface group and unstable support surface group randomly. The squat exercise was performed three times of a week for 6 weeks. The height of each jump was measured by the height marked on the grid paper with the middle finger of the subject. Muscle strength was used to measure maximum voluntary isometric and isotonic contraction during knee extension. Balance (eyes-opened and eyes-closed one-leg standing balance tests) was performed alternately on the right and left legs.

Results: Vertical jump was significant difference stable support surface group with unstable support surface group.

Conclusion: These results indicate that vertical jump of stable support surface group was more improved than unstable support surface group.

Use of Primus: measure maximum isometric and isotonic strengths of knee extensor muscles

“Reconstruction with Achilles tendon allograft using the Keyhole Technique for chronic triceps insufficiency after total elbow arthroplasty.”

Kwon BT, Lee SH, et al. Reconstruction with Achilles tendon allograft using the Keyhole Technique for chronic triceps insufficiency after total elbow arthroplasty. *Orthopedics.* 2021;44:e498-e502

ABSTRACT

Total elbow arthroplasty (TEA) is associated with a relatively high incidence of chronic triceps insufficiency, but there is difficulty in treatment. This case series describes reconstruction with Achilles allografts using the keyhole technique in patients with postoperative chronic triceps insufficiency. Fourteen patients who underwent reconstruction for triceps insufficiency after TEA were included in the study. During this procedure, a keyhole-shaped osteotomy was performed on the proximal olecranon, and a fragment of the calcaneal allograft was shaped into a bone plug to fit the olecranon. The clinical outcomes were assessed in all patients 12 months after reconstruction and at last follow-up (range, 13-54 months). After 12 months, patients had a mean Mayo Elbow Performance Score of 84.3 (range, 75-100), and all achieved a marked improvement compared with before reconstruction (mean, 42.7; range, 20-75). Seven, 4, and 3 patients achieved excellent, good, and fair outcomes, respectively. The mean extension peak torque of the operated-on arm was 34.91 Nm (range, 16.3-63.9 Nm), and the percentage of extension peak torque of the operated-on arm to the opposite arm was from 14.5% preoperative to 76.2% 12 months postoperative. This case series suggests that triceps reconstruction with an Achilles tendon using the keyhole technique is a useful treatment option for triceps insufficiency after TEA.

Use of Primus: measure extension peak torque (isometric strength) of elbow extensor muscles

“Influence of hip and knee positions on gluteus maximus and hamstrings contributions to hip extension torque production.”

Liu J, Teng H-L, et al. Influence of hip and knee positions on gluteus maximus and hamstrings contributions to hip extension torque production. *Physiotherapy Theory and Practice.* 2021. <https://doi.org/10.1080/09593985.2021.1975338>

ABSTRACT

Background: Diminished gluteus maximus muscle strength has been proposed to be contributory to various lower-limb injuries. As such, it is of clinical importance to perform hip extensor strength testing in a position that biases torque contribution of the gluteus maximus relative to the other hip extensors (i.e. hamstrings).

Objectives: To determine the relative torque contributions of the gluteus maximus and hamstring muscles in various hip extensor strength testing positions.

Methods: 13 young, healthy participants performed maximum isometric hip extension on a dynamometer in 4 different positions that varied in terms of hip and knee flexion. Surface electromyography (EMG) was used to assess activation of gluteus maximus and hamstrings during the maximum isometric contractions. Normalized EMG data were used as an input to determine individual muscle contribution to hip extension torque production using SIMM modeling software. The gluteus maximus/hamstring torque contribution ratio was compared across the 4 positions using a one-way repeated-measures ANOVA.

Results: The highest gluteus maximus torque contribution value occurred in positions where the hip was flexed to 45°, while the highest hamstring torque contribution occurred in positions in which the knee was fully extended. The gluteus maximus/hamstring torque contribution ratio was highest at 0° of hip extension and 90° of knee flexion.

Conclusion: Testing isometric hip extensor strength at 0° of hip extension and 90° of knee flexion should be considered in order to bias torque production of the gluteus maximus relative to the hamstrings.

Use of Primus: measure isometric hip extensor torque

“Confidence to return to play after ACL reconstruction: an evaluation of quadriceps strength symmetry and injury mechanism in male athletes.”

Straub RK, Della Villa F, et al. Confidence to return to play after ACL reconstruction: an evaluation of quadriceps strength symmetry and injury mechanism in male athletes. *Sports Health*. 2021. DOI: 10.1177/19417381211043854

ABSTRACT

Background: After anterior cruciate ligament reconstruction (ACLR), diminished quadriceps strength symmetry and reduced psychological readiness to return to play (RTP) increase the risk for subsequent injury. Although the relationship between quadriceps strength symmetry and psychological readiness to RTP has been reported to be influenced by injury mechanism in female athletes, it is unclear whether such a relationship exists in male athletes.

Hypothesis: Quadriceps strength symmetry would be positively associated with greater psychological readiness to RTP after ACLR, regardless of injury mechanism.

Study Design: Retrospective cohort.

Level of Evidence: Level 3 (cohort study).

Methods: Sixty male patients completed strength testing and the Injury-Psychological Readiness to Return to Sport Scale (I-PRRS) at an outpatient clinical facility as part of return to sport testing after ACLR. Linear regression analysis was used to assess the relationship between the I-PRRS and the independent variables of interest (quadriceps strength symmetry and injury mechanism).

Results: For all patients combined, no symmetry × mechanism interaction was found ($P = 0.11$). A significant positive relationship was found between quadriceps strength symmetry and the I-PRRS score ($P < 0.001$, $R^2 = 0.31$), after adjusting for time post-ACLR and injury mechanism.

Conclusion: Greater quadriceps strength symmetry was associated with greater psychological readiness to RTP after ACLR in male athletes. In contrast to what has been reported in female athletes, this relationship was independent of injury mechanism.

Clinical Relevance: Given the potential negative consequences of quadriceps strength deficits on one's confidence to RTP, the need to restore quadriceps symmetry during the postoperative period is readily apparent. Low confidence or low psychological readiness to RTP may be indicative of quadriceps strength asymmetry or poor physical function in general.

Use of Primus: measure isometric quadriceps muscle strength

“Effects of wearing of metacarpal gloves on hand dexterity, function, and perceived comfort: a pilot study.”

Woods S, Sosa EM, et al. Effects of wearing of metacarpal gloves on hand dexterity, function, and perceived comfort: a pilot study. *Applied Ergonomics*. 2021;97 103538
<https://doi.org/10.1016/j.apergo.2021.103538>

ABSTRACT

Metacarpal gloves are commonly used in heavy-duty industries such as mining and are typically thicker and bulkier than manufacturing or assembly industrial gloves. This pilot study investigates the impact of wearing metacarpal gloves on hand dexterity, functional capabilities, and perceived comfort. Four types of commercially available metacarpal gloves were selected for evaluation in a randomized controlled trial. Evaluations included turning and placing tests, also grip, pinch, and screwdriver tests, and rating of the perceived level of effort. Dexterity test results showed that metacarpal gloves significantly reduced the ability to perform motor tasks requiring coordination compared to bare hands. Hand functions such as gripping, pinching, and forearm rotations were not significantly affected. However, the perceived level of effort needed to complete those hand functions increased as the metacarpal glove's bulkiness increased. High levels of mechanical protection typically offered by metacarpal gloves can inversely affect hand dexterity and hand exertion.

Use of Primus: measure hand effort (isometric strength) to perform typical job functions (grip, pinch, use of screwdriver)

2020

“Immediate effect of spinal mobilization on lower limb strength in healthy individuals: a pilot study.”

An H, Choi J, Choi T, et al. Immediate effect of spinal mobilization on lower limb strength in healthy individuals: a pilot study. *J Int Acad Phys Ther Res*. 2020;11:2090-2095

ABSTRACT

Background: Spinal Mobilization is one of the manual therapy techniques that clinicians have used to treat pain, however, there is still a lack of research on changes in strength in healthy people.

Objectives: To investigate the effect of posterior-anterior lumbar mobilization on lower limb strength in healthy individuals.

Design: Two-group pretest-posttest design.

Methods: In this study, 23 healthy subjects aged 20 years were assigned to 12 lumbar mobilization group (LMG) and 12 sham group (SG) to perform intervention and measurement through pre- and post-design. Intervention was performed in LMG with grade III~IV on L3-5 of the lumbar spine, and lumbar mobilization was performed for each segment. After intervention, knee flexion and extension strength were measured. To measure the main effect on muscle strength, a comparative analysis was conducted using paired t-test and independent t-test.

Results: In LMG, knee flexor and extensor strength were increased significantly at 60°/s ($P<.05$). In addition, the extensors of LMG and SG were significantly different only at 60°/s, and the flexors were significantly different between groups at both 60°/s and 180°/s ($P<.05$).

Conclusion: In healthy individuals, lumbar mobilization results in improvement of strength of knee flexor and extensor, and additional experiments on the effect of mobilization on the lumbar spine on functional changes in the lower limbs will be needed.

Use of Primus: measure dynamic force production of knee flexor and extensor muscles

“Lower limb biomechanical analysis of healthy participants.”

Bahadori S, Wainwright TW. Lower limb biomechanical analysis of healthy participants. *J Visual Exper*. 2020 doi: [10.3791/60720](https://doi.org/10.3791/60720)

ABSTRACT

Biomechanical analysis techniques are useful in the study of human movement. The aim of this study was to introduce a technique for the lower limb biomechanical assessment in healthy participants using commercially available systems. Separate protocols were introduced for the gait analysis and muscle strength testing systems. To ensure maximum accuracy for gait assessment, attention should be given to the marker placements and self-paced treadmill acclimatization time. Similarly, participant positioning, a practice trial, and verbal encouragement are three critical stages in muscle strength testing. The current evidence suggests that the methodology outlined in this article may be effective for the assessment of lower limb biomechanics.

Use of Primus: measure maximum isometric strength of knee flexor and extensor muscles

“Primary repair of severely retracted nonchronic distal biceps tendon rupture using 2-incision anterior-approach repair.”

DeAngelo N, Thomas RA, Kim HM. Primary repair of severely retracted nonchronic distal biceps tendon rupture using 2-incision anterior-approach repair. *JSES International*. 2020 <https://doi.org/10.1016/j.jseint.2020.01.003>

ABSTRACT:

Background: Primary repair of a severely retracted distal biceps tendon can pose a technical challenge. We sought to describe the method and clinical outcomes of a surgical technique used as an adjunct to the conventional anterior single-incision repair for severely retracted biceps tendons. This technique involves a second anterior incision proximally to retrieve a severely retracted tendon followed by passing the tendon through a soft-tissue tunnel.

Methods: We identified 30 consecutive patients who had undergone a primary distal biceps tendon repair by an anterior-approach cortical-button technique. A phone survey was conducted for patient reported outcomes. Patients returned for bilateral forearm supination strength testing in 2 positions (45° of pronation and 45° of supination). Outcomes were compared between patients who required a second incision and high elbow flexion (>60°) because of severe tendon retraction and those who did not require such interventions.

Results: No significant differences in elbow range of motion, supination strength, or patient-reported outcomes were found between the 2 groups of patients ($P > .05$). Regarding supination strength, the operated side was significantly weaker than the uninjured side in both pronated and supinated positions ($P < .05$). Both the operated and uninjured sides showed significantly higher torque in a pronated position than in a supinated position ($P < .05$).

Conclusions: Severely retracted distal biceps tendons can be successfully repaired using a second incision and high elbow flexion without negative effects on the outcomes. Supination strength was decreased following an anterior-approach cortical-button technique, but patient-reported outcomes were not affected negatively.

Use of Primus: musculoskeletal evaluation of upper extremity muscle strength of individuals with distal biceps tendon rupture with surgical repair. Isometric mode was utilized to measure maximum strength capabilities of the forearm supinators.

“Effect of 4 weeks of anti-gravity treadmill training on isokinetic muscle strength and muscle activity in adult patients with a femoral fracture: a randomized controlled trial.”

Kim P, Lee H, Choi W, et al. Effect of 4 weeks of anti-gravity treadmill training on isokinetic muscle strength and muscle activity in adult patients with a femoral fracture: a randomized controlled trial. *Int J Environ Res Publ Health*. 2020;17:8572 doi:10.3390/ijerph17228572

ABSTRACT

This study aimed to identify the effect of anti-gravity treadmill training on isokinetic lower-limb muscle strength and muscle activities in patients surgically treated for a hip fracture. A total of 34 participants were randomly assigned into two groups: anti-gravity treadmill training group (n = 17) and control group (n = 17). The isokinetic muscle strength and endurance of hip flexor and extensor and the activities of the vastus lateralis (VL), vastus medialis (VM), gluteus maximus (GM), and gluteus medialis (Gm) muscles were measured before and after 4 weeks of the interventions. Significant improvements were observed in isokinetic muscle strength and endurance of hip flexors and extensors in both groups ($p < 0.05$); however, no significant differences were observed between the groups ($p > 0.05$) except for muscle strength of the hip extensor ($d = 0.78$, $p = 0.029$). Statistically significant increases in the muscle activity of VL, VM, GM, and Gm were found before and after the intervention ($p < 0.05$), and significant differences in muscle activities of GM ($d = 2.64$, $p < 0.001$) and Gm ($d = 2.59$, $p < 0.001$) were observed between the groups. Our results indicate that both groups showed improvement in muscle strength, endurance, and activities after the intervention. Additionally, anti-gravity treadmill training improved significantly more muscle strength at $60^\circ/s$ of the hip extensor and gluteus muscle activities than conventional therapy, which may be appropriate for patients with hip fracture surgery

Use of Primus: measure force and endurance of numerous hip muscles



“Association of muscular fitness with rehospitalization for heart failure with reduced ejection fraction.”

Lee CJ, Ryu HY, Chun K-H, et al. Association of muscular fitness with rehospitalization for heart failure with reduced ejection fraction. *Clin Cardiol*. 2020. doi: 10.1002/clc.23535

ABSTRACT

Background: Limited information is available regarding the prognostic potential of muscular fitness parameters in heart failure (HF) with reduced ejection fraction (HFrEF).

Hypothesis: We aimed to investigate the predictive potential of knee extensor muscle strength and power on rehospitalization and evaluate the correlation between exercise capacity and muscular fitness in patients newly diagnosed with HFrEF.

Methods: Ninety-nine patients hospitalized with a new diagnosis of HF were recruited (64 men; aged 58.7 years [standard deviation (SD), 13.2 years]; 32.3% ischemic; ejection fraction, 28% [SD, 8%]). The inclusion criteria were left ventricular ejection fraction $<40\%$ and sufficient clinical stability to undergo exercise testing. Aerobic exercise capacity was measured with cardiopulmonary exercise testing. Knee extensor maximal voluntary isometric contraction (MVIC) and muscle power (MP) were measured using the Baltimore therapeutic equipment system. The clinical outcome was HF rehospitalization.

Results: Over a mean follow-up period of 1709 ± 502 days, 39 patients were rehospitalized due to HF exacerbation. HF rehospitalization was more probable for patients with diabetes and lower oxygen uptake at peak exercise (peak VO_2), knee extensor MVIC, and MP. The Kaplan–Meier survival analysis revealed significantly different cumulative HF rehospitalization rates according to the tertiles of peak VO_2 ($P = 0.005$) and MP ($P = 0.002$). Multivariable Cox proportional hazard model showed that the lowest tertiles of peak VO_2 (hazard ratio (HR), 6.26; 95% confidence interval (CI), 1.93–20.27); and MP (HR, 5.29; 95% CI, 1.05–26.53) were associated with HF rehospitalization. Knee extensor muscle power was an independent predictor for rehospitalization in patients with HFrEF.

Conclusion: Knee extensor muscle power was an independent predictor for rehospitalization in patients with HFREF.

Use of Primus: measure knee extensor maximum voluntary isometric contraction and muscle power

“Physical and physiological determinants of rock climbing.”

Mackenzie R, Monaghan L, Masson RA, et al. Physical and physiological determinants of rock climbing. *Int J Sports Physiol Perform.* 2020;15:168-179 DOI: <https://doi.org/10.1123/ijsp.2018-0901>

ABSTRACT

Purpose: Rock climbing performance relies on many characteristics. Herein, the authors identified the physical and physiological determinants of peak performance in rock climbing across the range from lower grade to elite.

Methods: Forty-four male and 33 female climbers with on-sight maximal climbing grades 5a–8a and 5a–7b+, respectively, were tested for physical, physiological, and psychological characteristics (independent variables) that were correlated and modeled by multiple regression and principal component analysis to identify the determinants of rock climbing ability.

Results: In males, 23 of 47 variables correlated with climbing ability ($P < .05$, Pearson ρ correlation coefficients .773–.340), including shoulder endurance, hand and finger strength, shoulder power endurance, hip flexibility, lower-arm grip strength, shoulder power, upper-arm strength, core-body endurance, upper-body aerobic endurance, hamstrings and lower-back flexibility, aerobic endurance, and open-hand finger strength. In females, 10 of 47 variables correlated with climbing ability ($P < .05$, Pearson correlation coefficients .742–.482): shoulder endurance and power, lower-arm grip strength, balance, aerobic endurance, and arm span. Principal component analysis and univariate multiple regression identified the main explanatory variables. In both sexes, shoulder power and endurance measured as maximum pull-ups, average arm crank power, and bent-arm hang, emerged as the main determinants ($P < .01$; adjusted $R = .77$ in males and $.62$ in females). In males, finger pincer ($P = .07$) and grip strength also had trends ($P = .09$) toward significant effects. Finally, in test-of-principle training studies, they trained to increase main determinants 42% to 67%; this improved climbing ability 2 to 3 grades.

Conclusions: Shoulder power and endurance majorly determines maximal climbing. Finger, hand, and arm strength, core-body endurance, aerobic endurance, flexibility, and balance are important secondary determinants.

Use of Primus: measure maximum isometric strength of arm biceps (upper arm) and grip (lower arm), hand and finger pincer, and open-hand fingers and dynamic power and endurance of shoulder muscles



“Effect of resistance training under normobaric hypoxia on physical performance, hematological parameters, and body composition in young and older people.”

Torpel A, Peter B, Schega L. Effect of resistance training under normobaric hypoxia on physical performance, hematological parameters, and body composition in young and older people. *Front Physiol.* 2020;11 doi:10.3389/fphys.2020.00335

ABSTRACT

Background: Resistance training (RT) under hypoxic conditions has been used to increase muscular performance under normoxic conditions in young people. However, the effects of RT and thus of RT under hypoxia (RTH) could also be valuable for parameters of physical capacity and body composition across the lifespan. Therefore, we compared the effects of low- to moderate-load RTH with matched designed RT on muscular strength capacity, cardiopulmonary capacity, hematological adaptation, and body composition in young and older people.

Methods: In a pre–post randomized, blinded, and controlled experiment, 42 young (18 to 30 year) and 42 older (60 to 75 year) participants were randomly assigned to RTH or RT (RTH young, RT young, RTH old, RT old). Both groups performed eight resistance exercises (25–40% of 1RM, 3 x 15 repetitions) four times a week over 5 weeks. The intensity of hypoxic air for the RTH was administered individually in regards to the oxygen saturation of the blood (SpO₂): ~80–85%. Changes and differences in maximal isokinetic strength, cardiopulmonary capacity, total hemoglobin mass (tHb), blood volume (BV), fat free mass (FFM), and fat mass (FM) were determined pre–post, and the acute reaction of erythropoietin (EPO) was tested during the intervention.

Results: In all parameters, no significant pre–post differences in mean changes (time x group effects $p = 0.120$ to 1.000) were found between RTH and RT within the age groups. However, within the four groups, isolated significant improvements ($p < 0.050$) of the single groups were observed regarding the muscular strength of the legs and the cardiopulmonary capacity.

Discussion: Although the hypoxic dose and the exercise variables of the resistance training in this study were based on the current recommendations of RTH, the RTH design used had no superior effect on the tested parameters in young and older people in comparison to the matched designed RT under normoxia after a 5-week intervention period. Based on previous RTH-studies as well as the knowledge about RT in general, it can be assumed that the expected higher effects of RTH can be achieved by changing exercise variables (e.g., longer intervention period, higher loads).

Use of Primus: measure changes in maximal force of flexor and extensor muscles of the elbow and knee

“Perceived fatigue lower limb muscle force and performance fatigability after a rehabilitation program in Multiple Sclerosis.”

Tramonti C, Di Martino S, Foglia A, et al. Perceived fatigue lower limb muscle force and performance fatigability after a rehabilitation program in Multiple Sclerosis. *Eur J Transl Myol.* 2020;30:9353. doi: 10.4081/ejtm.2020.9353

ABSTRACT

Muscle weakness and fatigue represent frequent disabling symptoms for Multiple Sclerosis (MS) patients. We evaluated the effects of an intensive task-oriented circuit training (TOCT) on perceived fatigue, muscle strength and changes in motor performance fatigability in mildly impaired MS patients. Fifteen MS patients performed different functional scales, self-reported questionnaires and instrumental evaluations before (T0) and after (T1) TOCT. Strength and performance fatigability were analyzed during isometric knee extension and ankle dorsiflexion through an isokinetic dynamometer, recording surface EMG signals of Vastus Medialis and Tibialis Anterior. The Dynamic Gait Index, Multiple Sclerosis Impact Scale-29, Modified Fatigue Impact Scale and Multiple Sclerosis Walking Scale-12 significantly improved after training. An increase of exerted force during isometric knee extension was observed, whereas no significant changes were revealed on mechanical and electrical fatigue. Moreover, the improvement in perceived disability after treatment was related to strength increase in knee mechanical force output. The TOCT positively modifies perceived fatigue, perceived ambulatory function and knee force output in mildly impaired MS subjects, suggesting a virtuous circle between strength levels, recovery of functional skills and improved quality of life.

Use of Primus: measure maximum isometric strength and endurance of knee extensor and ankle dorsiflexor muscles



“Pre-placement examinations for newly recruited health care support staff.”

Wong JYP. Pre-placement examinations for newly recruited health care support staff. *Hong Kong J Occup Ther.* 2020. doi: 10.1177/1569186120979426

ABSTRACT

Objective: While musculoskeletal disorders (MSD) and physical strength have been extensively studied in health care professionals, little attention has been paid to health care support staff, such as patient care assistants and operation patient assistants, whose jobs are physically demanding. The purpose of this paper was to examine the musculoskeletal symptoms and physical strength of newly recruited health care support staff.

Method: Convenience sampling was conducted on 111 newly employed health care support staff in a public hospital. A custom-made pre-placement examination was performed. Data were analyzed using descriptive, correlation, and regression analyses.

Results: Nearly one-third (32%) of the newly recruited health care support staff had experienced musculoskeletal symptoms in at least one body part during the preceding 12 months. Two-thirds (68%) of subjects were physically inactive, and sixty percent was overweight or obese. Handgrip strength was weaker than the local norm. The subjects' dominant handgrip strength, bilateral lifting, pushing, and pulling force were significantly correlated. Only bilateral lifting was significantly associated with MSD among the newly recruited health care workers.

Conclusions: This study reports the baseline prevalence of MSD symptoms in the newly recruited health care support staff. Their sedentary lifestyle and suboptimal physical strength may render them susceptible to occupational injuries and disease. An effective occupational health programme that provides periodic health surveillance should be considered for high-risk health care workers to allow proper interventions in a timely manner.

Use of Primus: measure maximum isometric lifting capacities

“Cosmetic and functional results of a newly reconstructed thumb by combining the phalanx of second toe and the great toenail flap transplantation.”

Yin Y, Tao X, Li Y, et al. Cosmetic and functional results of a newly reconstructed thumb by combining the phalanx of second toe and the great toenail flap transplantation. *J Orthop Surg Res.* 2020;15:458. <https://doi.org/10.1186/s13018-020-01986-y>

ABSTRACT

Background: Microsurgical toe-to-hand transfer is a gold standard when it comes to repairing a thumb defect. Great toenail flap, thumbnail valva flap, free great toe, and second toe transplantation are the common methods in thumb reconstruction. Second toe transplantation achieves good function, but poor esthetics. Great toe transplantation achieves better esthetics, but hindered walking, due to the foot's loss of the great toe and moreover suboptimal thumb function. It is difficult to maintain both functional and esthetic satisfaction in thumb reconstruction.

Methods: We experimented with three different methods of toe to hand transfer. From October 2009 to July 2019, 30 patients with traumatic thumb defects received one of 3 different kinds of thumb reconstruction in our clinic according to their level of amputation. Divided evenly into three groups of ten, group one received a great toe transplantation, group two received a second toe transplantation, and group three received a combined great toenail flap and second toe phalanx transplantation. Each of the patients' thumbs had different levels of amputation at the metatarsophalangeal joint (MPJ) or distal interphalangeal joint (DIPJ).

Results: One patient suffered from a partial flap necrosis and received a groin flap to cover the defect. No other thumbs had any complications. The functional and esthetic results of both the donor and the recipient sites were satisfactory. Results show that, for patients with traumatic thumb defects, the combined transfer of flap and second toe phalanx was the best option.

Conclusions: Compared to the great toe or second toe transfer, combined free transfer of the great toenail flap and second toe phalanx achieved a substantially better functional and esthetic result in the thumb reconstruction.

Use of Primus: increase strength of hand using isokinetic mode



“The effect of mobile wearable waist assist robot on lower back pain during lifting and handling tasks.”

Yin P, Yang L, Du S, et al. The effect of mobile wearable waist assist robot on lower back pain during lifting and handling tasks. *Mobile Networks Appl.* 2020. <https://doi.org/10.1007/s11036-020-01671-8>

ABSTRACT

The rapid growth in nursing demand in P.R.China and the slow increase in the number of qualified nurses has led to a serious increased in workload of existing nurses. Most of their works include heavyweight handling which causes low back pains. Thus a mobile, flexible, comfortable and wearable waist assist device, the Mobile Wearable Waist Assist Robot using pneumatic artificial muscles as power actuators has been developed. The wearer wears the device like a backpack, which can provide wearer the necessary assistance when he lifts loads or performs a static maintenance work, which will reduce the risk of lower back pain. The device is evaluated through an experiment which include three tests - heavy load handling, maximum weight lifting test, and Center of gravity (CoG) trajectory test during static weight lifting. Surface electromyography of erector spinae was recorded during the first test. The *iEMG* is significantly reduced by about 39% and 27%, respectively ($p < 0.05$). The angular velocity significantly decreases until the load reaches 35 kg ($p < 0.05$). When the device is in use, the CoG moving distance is significantly lower than not in use ($p < 0.05$). These three tests well verified the effectiveness of the Mobile Wearable Waist Assist Robot, which provides waist assists and reduces the risk of lower back pain.

Use of Primus: measure maximum isometric lifting capacities

2019

“Distal biceps section and reinsertion for chronic distal biceps tendinopathy.”

Faict S, Van de Meulebroucke B, Van Royen K, et al. Distal biceps section and reinsertion for chronic distal biceps tendinopathy. *Eur J Orthop Surg Traum.* 2019;29:1405-1409. <https://doi.org/10.1007/s00590-019-02470-y>

ABSTRACT

Background: Surgical reinsertion of the distal biceps tendon for acute and chronic tears is a widely accepted procedure, but little is known about surgical treatment of distal biceps tendinopathy.

Methods: Twenty patients underwent a surgical procedure for distal biceps tendinopathy after failure of conservative treatment. The surgery was performed through a single incision. The biceps tendon was detached, debrided and reinserted using a ToggleLoc (Zimmer Biomet) device. Clinical and radiologic evaluation was performed after a minimum follow-up of 1 year. Quick-Dash score, Liverpool Elbow Score, Mayo Elbow Performance Index, Broberg and Morrey Score and Short HSS Scoring System were used, and isokinetic testing was performed.

Results: The outcome of these five clinical elbow scores showed no clinically relevant differences between the affected and non-affected side. Isokinetic testing of peak torque in flexion and supination showed equal strength between both sides. These results indicate good functional outcome and recovery of flexion and supination, compared to the non-operated side and the normal population.

Conclusion: This study demonstrates that distal biceps tendon debridement and reinsertion is a safe and valid option for patients with distal biceps tendinopathy after failure of conservative treatment.

Use of Primus: measure dynamic force of supinator and flexor muscles to compare operated to non-operated upper extremity

“Hamstring stiffness returns more rapidly after static stretching than range of motion, stretch tolerance, and isometric peak torque.”

Hatano G, Suzuki S, Matsuo S, et al. Hamstring stiffness returns more rapidly after static stretching than range of motion, stretch tolerance, and isometric peak torque. *J Sport Rehabil.* 2019;28:325-331.

ABSTRACT:

Objective: To determine the effects of static stretching on the hamstrings and the duration of these effects.

Design: Randomized crossover study. Setting: University laboratory. Participants: A total of 24 healthy volunteers.

Interventions: The torque–angle relationship (ROM, passive torque [PT] at the onset of pain, and passive stiffness) and isometric muscle force using an isokinetic dynamometer were measured. After a 60-minute rest, the ROM of the dynamometer was set at the maximum tolerable intensity; this position was maintained for 300 seconds, while static PT was measured continuously. The torque–angle relationship and isometric muscle force after rest periods of 10, 20, and 30 minutes were remeasured.

Main Outcome Measures: Change in static PT during stretching and changes in ROM, PT at the onset of pain, passive stiffness, and isometric muscle force before stretching were compared with 10, 20, and 30 minutes after stretching.

Results: Static PT decreased significantly during stretching. Passive stiffness decreased significantly 10 and 20 minutes after stretching, but there was no significant pre-stretching versus post-stretching difference after 30 minutes. PT at the onset of pain and ROM increased significantly after stretching at all rest intervals, while isometric muscle force decreased significantly after all rest intervals.

Conclusions: The effect of static stretching on passive stiffness of the hamstrings was not maintained as long as the changes in ROM, stretch tolerance, and isometric muscle force. Therefore, frequent stretching is necessary to improve the viscoelasticity of the muscle–tendon unit. Muscle force decreased for 30 minutes after stretching; this should be considered prior to activities requiring maximal muscle strength.

Use of Primus: musculoskeletal evaluation of lower extremity ROM, passive torque, passive stiffness, and MVIC of the hamstring muscles in healthy individuals.

“Dynamic stretching has sustained effects on range of motion and passive stiffness of the hamstring muscles.”

Iwata M, Yamamoto A, Matsuo S, et al. Dynamic stretching has sustained effects on range of motion and passive stiffness of the hamstring muscles. *J Sports Sci Med.* 2019;18:13-20.

ABSTRACT:

Dynamic stretching (DS) is often performed during warm-up to help avoid hamstring muscle injuries, increase joint flexibility, and optimize performance. We examined the effects of DS of the hamstring muscles on passive knee extension range of motion (ROM), passive torque (PT) at the onset of pain (as a measure of stretch tolerance), and passive stiffness of the muscle-tendon unit over an extended period after stretching. Twenty-four healthy subjects participated, with 12 each in the experimental and control groups. Stretching was performed, and measurements were recorded using an isokinetic dynamometer pre-intervention, and at 0, 15, 30, 45, 60, 75, and 90 min post-intervention. DS consisted of ten 30-s sets of 15 repetitions of extension and relaxation of the hamstrings. ROM increased significantly (range, 7%–10%) immediately after DS, and the increase was sustained over 90 min. PT at the onset of pain also increased immediately by 10% but returned to baseline by 30 min. Passive stiffness decreased significantly (range, 7.9%–16.7%) immediately after DS, and the decrease was sustained over 90 min. Post-DS values were normalized to pre-DS values for the respective outcomes in both groups. ROM was significantly higher (range, 7.4%–10%) and passive stiffness was significantly lower (range, 5.4%–14.9%) in the experimental group relative to the control group at all time points. Normalized PT values at the onset of pain were significantly higher in the experimental group at 0–15 min than in the controls, but the differences were smaller at 30–45 min and not significant thereafter. We conclude that DS increases

ROM and decreases passive stiffness in a sustained manner and increases PT at the onset of pain for a shorter period. Overall, our results indicate that when performed prior to exercise, DS is beneficial for the hamstring muscles in terms of increasing flexibility and reducing stiffness.

Use of Primus: musculoskeletal evaluation of lower extremity ROM, passive torque, and passive stiffness of the hamstring muscles in healthy individuals.

“Glenohumeral joint dynamics and shoulder muscle activity during geared manual wheelchair propulsion on carpeted floor in individuals with spinal cord injury.”

Jahanian O, Schnorenberg AJ, Muqet V, et al. Glenohumeral joint dynamics and shoulder muscle activity during geared manual wheelchair propulsion on carpeted floor in individuals with spinal cord injury. *J Electromyog Kinesiol.* 2019, <https://doi.org/10.1016/j.jelekin.2019.05.019>

ABSTRACT:

This study investigated the effects of using geared wheels on glenohumeral joint dynamics and shoulder muscle activity during manual wheelchair propulsion. Seven veterans with spinal cord injury propelled their wheelchairs equipped with geared wheels over a carpeted floor in low gear (1.5:1) and standard gear (1:1) conditions. Hand-rim kinetics, glenohumeral joint dynamics, and muscle activity were measured using a custom instrumented geared wheel, motion analysis, and surface electromyography. Findings indicated that the propulsion speed and stroke distance decreased significantly during the low gear condition. The peak hand-rim resultant force and propulsive moment, as well as the peak glenohumeral inferior force and flexion moment, were significantly less during the low gear condition. The peak and integrated muscle activity of the anterior deltoid and pectoralis major decreased significantly, while the normalized integrated muscle activity (muscle activity per stroke distance) was not significantly different between the two conditions. Propulsion on carpeted floor in the low gear condition was accompanied by a reduced perception of effort. The notable decrease in the peak shoulder loading and muscle activity suggests that usage of geared wheels may be beneficial for wheelchair users to enhance independent mobility in their homes and communities while decreasing their shoulder demands.

Use of Primus: musculoskeletal evaluation of upper extremity muscle strength of individuals with spinal cord injuries. Isometric mode was utilized to measure maximum strength capabilities of the primary shoulder flexors.

“Effects of lower extremity eccentric-based training on muscle strength and physical function in older adults: a randomized controlled pilot trial.”

Kim DY, Oh SL, Song W, et al. Effects of lower extremity eccentric-based training on muscle strength and physical function in older adults: a randomized controlled pilot trial. *Exerc Sci.* 2019;28:346-354.

ABSTRACT:

Purpose: Reduced muscular strength is a key player in loss of physical function and quality of life in older adults. It has been reported that eccentric training has positive effects on the preservation of eccentric strength, produces less delayed onset muscle soreness, and has a lower metabolic cost for older individuals. Therefore, the present study investigated the effects of eccentric-based training on skeletal muscle strength and physical function in older adults.

Methods: Sixteen healthy older subjects (over the age of 65) participated either in eccentric training group (ETG, n=8) or in conventional resistance training group (CTG, n=8) twice a week for eight weeks. The ETG group performed motorized eccentric training, and the CTG group performed a leg press using air pressure. Physical function and muscular strength assessments were performed before and after 8 weeks. The primary outcomes for physical function included gait speed, stair climbing, and the chair stand test, and the secondary outcomes included muscle strength and power.

Results: The ETG group demonstrated significant improvements in physical function (gait speed and stair climbing) and muscle strength (isokinetic strength and power in knee tests) ($p < .05$) compared to the CTG group after 8 weeks. There were no significant differences for chair stand test ($p > .05$) after 8 weeks.

Conclusions: Motorized eccentric-based training was more effective in improving muscle strength and physical function in aged individuals than conventional resistance training, which suggests that eccentric training may be more beneficial for older individuals to improve overall physical function.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of healthy older adults. Isometric and isokinetic modes were utilized to measure maximum strength and power capabilities of the quadriceps and hamstring muscle groups.

“Changes in flexibility and force are not different after static versus dynamic stretching.”

Matsuo S, Iwata M, Miyazaki M, et al. Changes in flexibility and force are not different after static versus dynamic stretching. *Sports Med Int Open*. 2019;3:E89-E95. DOI <https://doi.org/10.1055/a-1001-1993>

ABSTRACT:

In this study, we examined the effects of static and dynamic stretching on range of motion (ROM), passive torque (PT) at pain onset, passive stiffness, and isometric muscle force. We conducted a randomized crossover trial in which 16 healthy young men performed a total of 300 s of active static or dynamic stretching of the right knee flexors on two separate days in random order. To assess the effects of stretching, we measured the ROM, PT at pain onset, passive stiffness during passive knee extension, and maximum voluntary isometric knee flexion force using an isokinetic dynamometer immediately before and after stretching. Both static and dynamic stretching significantly increased the ROM and PT at pain onset ($p < 0.01$) and significantly decreased the passive stiffness and isometric knee flexion force immediately after stretching ($p < 0.01$). However, the magnitude of change did not differ between the two stretching methods for any measurements. Our results suggest that 300 s of either static or dynamic stretching can increase flexibility and decrease isometric muscle force; however, the effects of stretching do not appear to differ between the two stretching methods.

Use of Primus: musculoskeletal evaluation of lower extremity ROM, passive torque at onset of pain due to stretch, passive stiffness, and muscle strength of healthy young males. Isometric was utilized to measure these parameters of the quadriceps and hamstring muscle groups.

“Early initiation of home-based sensorimotor training improves muscle strength, activation and size in patients after knee replacement: a secondary analysis of a controlled clinical trial.”

Moutzouri M, Coutts F, Gliatis J, et al. Early initiation of home-based sensorimotor training improves muscle strength, activation and size in patients after knee replacement: a secondary analysis of a controlled clinical trial. *BMC Musculoskel Disorders*. 2019;20:231. <https://doi.org/10.1186/s12891-019-2575-3>

ABSTRACT:

Background: There is accumulating evidence for the advantages of rehabilitation involving sensori-motor training (SMT) following total knee replacement (TKR). However, the best way in which to deliver SMT remains elusive because of potential interference effects amongst concurrent exercise stimuli for optimal neuromuscular and morphological adaptations. The aim of this study was to use additional outcomes (i.e. muscle strength, activation and size) from a published parent study to compare the effects of early-initiated home-based rehabilitative SMT with functional exercise training (usual care) in patients undergoing TKR.

Methods: A controlled clinical trial was conducted at the Orthopedic University Hospital of Rion, Greece involving allocation concealment to patients. Fifty-two patients electing to undergo TKR were randomized to either early-initiated SMT [experimental] or functional exercise training [control] in a home-based environment. Groups were prescribed equivalent duration of exercise during 12-weeks, 3–5 sessions of ~ 40 min per week of home-based programs. Muscle strength and activation (peak force [PF]; peak amplitude [Peak Amp.] and root mean square of integrated electromyography [RMS iEMG]), muscular size (including rectus femoris muscle cross-sectional area [CSARF]), and knee ROM were assessed on three separate occasions (pre-surgery [0 weeks]; 8 weeks post-surgery; 14 weeks post-surgery).

Results: Patients undertaking SMT rehabilitation showed significantly greater improvements over the 14 weeks compared to control in outcomes including quadriceps PF (25.1 ± 18.5 N vs 12.4 ± 20.8 N); iPeak Amp. ($188 \pm 109.5\%$ vs $25 \pm 105.8\%$); CSARF ($252.0 \pm 101.0\text{mm}^2$ vs $156.7 \pm 76.2\text{mm}^2$), respectively ($p < 0.005$); Knee ROM did not offer clinically relevant changes (p : ns) between groups over time. At 14 weeks post-surgery, the SMT group's and control group's performances differed by relative effect sizes (Cohen's d) ranging between 0.64 and 1.06.

Conclusion: A prescribed equivalent time spent in SMT compared to usual practice, delivered within a home-based environment, elicited superior restoration of muscle strength, activation and size in patients following TKR.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of individuals post-TKR. Isometric mode was utilized to measure peak force of knee extensors.

“A comparison of glenohumeral joint kinematics and muscle activation during standard and geared manual wheelchair mobility.”

Slavens BA, Jahanian O, Schnorrenberg AJ, et al. A comparison of glenohumeral joint kinematics and muscle activation during standard and geared manual wheelchair mobility. *Med Eng Physics*, <https://doi.org/10.1016/j.medengphy.2019.06.018>

ABSTRACT:

The high prevalence of upper extremity joint injuries among manual wheelchair users is largely attributed to the high repetitive loading during propulsion. The purpose of this study was to evaluate the effects of using geared wheels for manual wheelchair mobility on shoulder joint biomechanics. Fourteen able-bodied participants performed over-ground propulsion and ramp ascension using standard and geared manual wheelchair wheels. Spatial temporal parameters, glenohumeral joint kinematics, and shoulder muscle activity were quantified. Findings indicated that regardless of the level of slope, the propulsion speed and stroke distance decreased significantly ($p < 0.001$), and the stroke frequency increased significantly ($p \leq 0.025$) during geared manual wheelchair propulsion. The glenohumeral joint ranges of motion in the coronal plane ($p \leq 0.005$) and peak joint angles in the coronal ($p \leq 0.023$) and transverse ($p \leq 0.012$) planes were significantly different between standard and geared wheels usage. Shoulder muscle activity was substantially less using the geared wheels with significant findings in the pectoralis major (level floor, $p \leq 0.008$) and infraspinatus ($p \leq 0.014$) peak muscle activity, and the anterior deltoid ($p \leq 0.014$) and pectoralis major ($p \leq 0.015$) integrated muscle activity. However, the shoulder flexor normalized integrated muscle activity (muscle activity per stroke distance) was not different between the wheels.

Use of Primus: musculoskeletal evaluation of upper extremity muscle strength of healthy young adults with no prior wheelchair experience. Isometric mode was utilized to measure maximum strength capabilities of the shoulder musculature.

“Effects of 3 years of ballet training on bone health, body composition, and physical performance in elite adolescent dancers.”

Sommella A, Van den Wyngaert T, Gimigliano F, et al. Effects of 3 years of ballet training on bone health, body composition, and physical performance in elite adolescent dancers. *Clin Cases Mineral Bone Metab.* 2019;16:22-26.

Abstract

Objectives: We aimed to assess the impact of ballet training on multiple parameters of musculoskeletal development in a group of elite adolescent dancers with respect to body and bone composition, mobility and strength, and physical performance over a period of three years.

Design: Subgroup analysis of a prospective cohort study consisting of elite adolescent ballet dancers of the Royal Ballet School of Antwerp, who had longitudinal follow-up data available during their first and third year of training.

Methods: Baseline and follow-up data were available for 10 dancers (mean age at baseline 12.40± 0.38) out of 38 participants in the cohort study. The total body (TB) and upper and lower limb regions bone mineral density (BMD) and bone mineral content (BMC) were assessed using dual X-ray absorptiometry. Physical performance were also assessed.

Results: Compared to baseline in the first year of training, lean mass, BMD total and BMD legs improved significantly over time (P=0.005). There was also a significant correlation between Δ -BMC left and Δ -power both plantar flexors ($\rho=0.721$; P=0.019) and Δ -BMC left and Δ -isometric both plantar flex ($\rho=0.685$; P=0.029).

Discussion: The causal association of changes in musculoskeletal development with ballet training cannot be ascertained because of the lack of a control group and the small size. Insights into the relationships between site-specific bone density and foot strength may guide future studies for a better understanding of the impact of dance training on bone and muscle development.

Use of Primus: measure isometric strength and power output of plantarflexor muscles

“Local in vivo measures of muscle lipid and oxygen consumption change in response to combined Vitamin D repletion and aerobic training in older adults.”

Thomas DT, Schnell DM, Redzic M, et al. Local in vivo measures of muscle lipid and oxygen consumption change in response to combined Vitamin D repletion and aerobic training in older adults. *J Nutrients.* 2019;11:930, doi:10.3390/nu11040930

ABSTRACT:

Intramyocellular (IMCL), extramyocellular lipid (EMCL), and vitamin D deficiency are associated with muscle metabolic dysfunction. This study compared the change in [IMCL]:[EMCL] following the combined treatment of vitamin D and aerobic training (DAT) compared with vitamin D (D), aerobic training (AT), and control (CTL). Male and female subjects aged 60–80 years with a BMI ranging from 18.5–34.9 and vitamin D status of ≥ 32 ng/mL (25(OH)D) were recruited to randomized, prospective clinical trial double-blinded for supplement with a 2 × 2 factorial design. Cholecalciferol (Vitamin D3) (10,000 IU × 5 days/week) or placebo was provided for 13 weeks and treadmill aerobic training during week 13. Gastrocnemius IMCL and EMCL were measured with magnetic resonance spectroscopy (MRS) and MRI. Hybrid near-infrared diffuse correlation spectroscopy measured hemodynamics. Group differences in IMCL were observed when controlling for baseline IMCL (p = 0.049). DAT was the only group to reduce IMCL from baseline, while a mean increase was observed in all other groups combined (p = 0.008). IMCL reduction and the corresponding increase in rVO₂ at study end (p = 0.011) were unique to DAT. Vitamin D, when combined with exercise, may potentiate the metabolic benefits of exercise by reducing IMCL and increasing tissue-level VO₂ in healthy, older adults.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength and endurance of healthy older adults. Isometric and isotonic modes were utilized to measure maximum strength capabilities and endurance/fatigue of the plantarflexors.

2018

“Fracture of the lateral tibial condyle with depression of the articular surface – A case study. Baltic J Health Phys Activity.”

Ficek K, Cyganik P, Strozik M, et al. Fracture of the lateral tibial condyle with depression of the articular surface – A case study. *Baltic J Health Phys Activity*. 2018; 10:14-24. DOI:10.29359/BJHPA.10.2.02

ABSTRACT:

Background: Fractures of the proximal epiphysis of the tibia constitute one of the more frequently occurring types of sports injuries, and at the moment constitute about 1% of all reported bone fractures. They appear mainly as a result of traffic accidents, falls from heights, as well as being observed in groups of physically active people whose disciplines involve high-impact landings. From time to time, improperly executed movements or steps without falling result in injury.

Case study: We present a case study of a 21-year-old male football player with fracture of the lateral tibia condyle with indentation of articular surface. The patient came to the clinic with increasing pain in the knee joint, resulting from torsional injury which occurred the same day.

Conclusions: A quick and accurate diagnosis as well as treatment of fractures of the lateral tibia which includes surgery, rehabilitation and supportive orthobiology, minimize the risk of chronic symptoms of the injury such as limited range of motion and subsequent osteoarthritis.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of healthy older adults. Isometric mode was utilized to measure maximum strength capabilities of the quadriceps and hamstring muscle groups.

“A 6-week hip muscle strengthening and lumbopelvic-hip core stabilization program to improve pain, function, and quality of life in persons with patellofemoral osteoarthritis: a feasibility pilot study.”

Hoglund LT, Pontiggia L, Kelly JD. A 6-week hip muscle strengthening and lumbopelvic-hip core stabilization program to improve pain, function, and quality of life in persons with patellofemoral osteoarthritis: a feasibility pilot study. *Pilot Feasibility Studies*. 2018;4:70, <https://doi.org/10.1186/s40814-018-0262-z> . ClinicalTrials.gov NCT02825238

ABSTRACT:

Background: Patellofemoral joint (PFJ) osteoarthritis (OA) is prevalent in middle-aged and older adults. Despite this, there are minimal studies which have examined conservative interventions for PFJ OA. Weakness of proximal lower extremity muscles is associated with PFJ OA. It is unknown if a hip muscle strengthening and lumbopelvic-hip core stabilization program will improve symptoms and function in persons with PFJ OA. This study examined the feasibility and impact of a 6-week hip muscle strengthening and core stabilization program on pain, symptoms, physical performance, peak muscle torques, and quality of life in persons with PFJ OA.

Methods: Ten females with PFJ OA and ten age- and sex-matched controls participated in baseline tests. PFJ OA participants attended ten twice-a-week hip strengthening and core stabilization exercise sessions. Outcome measures included questionnaires, the Timed-Up-and-Go, and peak isometric torque of hip and quadriceps muscles. Data were tested for normality; parametric and non-parametric tests were used as appropriate.

Results: At baseline, the PFJ OA group had significantly worse symptoms, slower Timed-Up-and-Go performance, and lower muscle torques than control participants. PFJ OA group adherence to supervised exercise sessions was adequate. All PFJ OA participants attended at least nine exercise sessions. Five PFJ OA participants returned 6-month follow-up questionnaires, which was considered fair retention. The PFJ OA participants' self-reported pain, symptoms, function in daily living, function in sport, and quality of life all improved at 6 weeks ($P < 0.05$). Timed-Up-and-Go time score improved at 6 weeks ($P = 0.01$). Improvements in pain and self-reported function were no longer significant 6 months following completion of the intervention.

Conclusions: PFJ OA participants were adherent to the supervised sessions of the intervention. Improvement in symptoms, physical performance, and muscle torque were found after 6 weeks. Participant retention at 6 months was fair, and significant changes were no longer present. Our findings suggest that a hip strengthening and core stabilization program may be beneficial to improve symptoms, function, and physical performance in persons with PFJ OA. Future studies are needed, and additional measures should be taken to improve long-term adherence to exercise.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of individuals with diagnosed painful PFJ OA. Isometric mode was utilized to measure maximum strength capabilities of the knee extensor and hip abductor, extensor, external rotator muscles.

“Do males with patellofemoral pain have posterolateral hip muscle weakness?”

Hoglund LT, Burns RO, Stepany AL. Do males with patellofemoral pain have posterolateral hip muscle weakness? *Int J Sports Phys Ther.* 2018;13:160-170.

ABSTRACT:

Background: Patellofemoral pain is common in physically active adults. Females with patellofemoral pain have been shown to have posterolateral hip muscle weakness, but there is a paucity of research examining hip muscle strength in males with patellofemoral pain.

Hypothesis/Purpose: The purpose of this study was to examine posterolateral hip muscle strength in males with patellofemoral pain compared to asymptomatic males. It was hypothesized that males with patellofemoral pain would have decreased strength of the hip extensor, hip external rotator, and hip abductor muscles compared to healthy, asymptomatic males.

Study Design: Descriptive, cross-sectional.

Methods: Thirty-six adult males with patellofemoral pain and 36 pain-free males participated in the study. The patellofemoral pain group were required to have retropatellar pain reproduced by activities that loaded the patellofemoral joint (squatting, descending stairs, etc.). Peak isometric torque of the hip extensors, hip external rotators, and hip abductors was measured with an instrumented dynamometer. Torque was normalized by body mass and height. Between-group differences were analyzed with parametric or non-parametric tests, as appropriate. The level of significance was adjusted for multiple comparisons.

Results: Hip extensor torque was significantly reduced in the patellofemoral pain group compared to the control group ($p = .0165$). No differences were found between groups for the hip external rotators or hip abductors ($p > .0167$).

Conclusions: Males with patellofemoral pain appear to have weakness of the hip extensors, but unlike females with patellofemoral pain, they do not appear to have weakness of the hip abductors or hip external rotators. The findings of this study suggest that muscle strength factors associated with patellofemoral pain in males may be different from muscle strength factors in females. Clinicians examining and designing plans of care for male patients with patellofemoral pain should consider that the hip abductors and hip external rotators may not be weak in men with this condition.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of healthy males and males with diagnosed painful PFP, age 18 – 45 years. Isometric mode was utilized to measure maximum strength capabilities of the hip abductor, extensor, external rotator muscles.

“Research on ergonomics design of the height and operation force for furniture lockset.”

Hu H, Bai Y, Li Y, et al. Research on ergonomics design of the height and operation force for furniture lockset. VG Duffy (ed.). DHM 2018, LNCS 10917, pp 64-74.

ABSTRACT:

This study investigated the comfortable lockset height and the suitable force to open it. The experiment was designed and carried out with 14 participants. The data were measured by varied experimental tools. The factors that influence the comfort of lockset height such as the angle and body dimensions were analyzed. The results showed that the preferred/comfortable lockset height was below shoulder in 60 cm. The differences between male and female on comfort-able force and maximum force were found. The capacity difference between male and male were significant, but the perception in comfort was almost unanimous. According to Chinese anthropometry data and ergonomics knowledge, the comfort-able lockset height and the comfortable opening force were recommended.

Use of Primus: musculoskeletal evaluation and ergonomic assessment of functional task. The system was used to simulate the lockset height and measure force when opening the lockset. Isometric mode was utilized to assess the rotational force.

“Specificity of training in cardiac rehabilitation to facilitate a patient’s return to strenuous work following aortic valve replacement.”

Jenkins N, Adams J, Bilbrey T, et al. Specificity of training in cardiac rehabilitation to facilitate a patient’s return to strenuous work following aortic valve replacement. PROC (BAYL UNIV MED CENT) 2018;31(1):72–75.

ABSTRACT:

Purpose: To determine if a customized, medically supervised training program can safely and effectively return a relatively younger patient to a level of strength and fitness that enable return to a physically demanding job within 3 months of aortic valve replacement.

Design: Case Study

Methods: 5-week specific physical training program that included 6 exercises simulating his job functions for three 75-minute sessions each week.

Results: The goals set for each of the 6 specific exercises were accomplished and resulted in the patient rapidly regaining his muscular strength through the specially designed training program. The exercise regimen was successfully completed without adverse signs or symptoms and enabled the patient to return to work within approximately 2 months of completion.

Conclusions: A customized, medically supervised training program can safely and effectively return a relatively younger patient to a level of strength and fitness that enable return to a physically demanding job within 3 months of aortic valve replacement.

Use of Primus: musculoskeletal evaluation and treatment of younger adults following aortic valve replacement. Isometric mode was utilized to measure maximum strength capabilities. Isotonic mode using 30% percent of maximum strength was utilized for exercise that focused on 3 required work tasks.



“Anatomy-based MRI assessment of the iliopsoas muscle complex after pertrochanteric femoral fracture.”

Kaniewska M, Schenkel M, Eid K, et al. Anatomy-based MRI assessment of the iliopsoas muscle complex after pertrochanteric femoral fracture. Skel Radiol. 2018, <https://doi.org/10.1007/s00256-018-3048-8>

ABSTRACT:

Objective: To evaluate the quality of the iliopsoas muscle complex after pertrochanteric femoral fracture (PFF), using MRI; to propose an anatomy-based evaluation of the iliopsoas muscle complex; and to determine the inter-reader reliability of two classifications of fatty muscle degeneration.

Materials and methods: We included adult patients with a displaced lesser trochanter following pertrochanteric femoral fracture. Muscle quality was evaluated using the Goutallier and Slabaugh classifications at three levels (L4/L5, L5/S1, and the anterior inferior iliac spine). Two radiologists independently reviewed the MRIs, and force measurement was performed on both hips. Linear mixed-effects models were used to determine the effect of fracture on muscle quality and strength, and Cohen's kappa statistic was used to assess inter-reader agreement.

Results: In the 18 patients included, the iliopsoas muscle complex showed higher grades of fatty muscle degeneration on the fractured side than on the non-fractured side. The mean difference between muscle strength on the fractured vs the non-fractured side was -12 N ($p > 0.05$). Inter-reader agreement for the Goutallier and Slabaugh classifications was good and very good respectively (weighted $K = 0.78$ and 0.85 respectively).

Conclusion: Fatty muscle degeneration of the iliopsoas muscle complex after pertrochanteric femoral fracture was evident using both classification systems; however, fatty muscle degeneration resulted in only a minimal reduction of muscle strength. To provide a thorough assessment of iliopsoas muscle complex quality, we suggest evaluating it at different anatomical levels. Regarding inter-reader agreement, the Slabaugh classification was superior to the Goutallier classification.

Use of Primus: musculoskeletal evaluation of lower extremity muscle performance of patients with a diagnosis of surgically treated PFF. Hip flexion force was measured isometrically in standing position with hip in 0 deg. and 30 deg. of flexion.

“The effects of shoulder stabilization exercises and pectoralis minor stretching on balance and maximal shoulder muscle strength of healthy young adults with round shoulder posture.”

Kim MY, Lee JC, Yoo KT. The effects of shoulder stabilization exercises and pectoralis minor stretching on balance and maximal shoulder muscle strength of healthy young adults with round shoulder posture. *J Phys Ther Sci.* 2018;30:373-380.

ABSTRACT:

Purpose: The purpose of this study was to analyze the effects of pectoralis minor stretching and shoulder strengthening with an elastic band on balance and maximal shoulder muscle strength in young adults with rounded shoulder posture.

Subjects and Methods: Nineteen subjects with rounded shoulder posture were randomly divided into 2 groups: a shoulder stabilization exercise group and a stretching exercise group. The groups performed each exercise for 40 minutes, 3 times a week, for 4 weeks. Static balance (eyes open and closed), dynamic balance (the limits of stability in 4 directions) and shoulder muscle strength in 5 directions were measure before and after the exercises.

Results: The stretching exercise demonstrated a significant difference between the pre- and post-exercise in the static balance with eyes closed and extension and horizontal abduction strength while the stabilization exercise demonstrated significant difference in the left and right directions between the pre- and post-exercise of the dynamic balance and flexion strength. The stabilization exercise demonstrated significant differences shown in the flexion between the pre- and post-test.

Conclusion: The shoulder stabilization and stretching exercises improved the static balance, dynamic balance, and muscle strength.

Use of Primus: musculoskeletal evaluation of upper extremity muscle strength of healthy young adults. Isometric mode was utilized to measure maximum strength of the shoulder musculature (flexion, extension, abduction, horizontal abduction, and horizontal adduction).

“Age- and sex-related differences in myosin heavy chain isoforms and muscle strength, function, and quality: a cross sectional study.”

Oh SL, Yoon SH, Lim JY. Age- and sex-related differences in myosin heavy chain isoforms and muscle strength, function, and quality: a cross sectional study. *J Exerc Nutrition Biochem.* 2018;22:43-50, <http://dx.doi.org/10.20463/jenb.2018.0016>

ABSTRACT:

Purpose: Declining muscle strength and function are hallmarks of the aging process. This study aimed to determine sex-related differences in myosin heavy chain (MHC) isoforms and muscle mass, strength, and quality with aging.

Methods: This cross-sectional study recruited 53 healthy participants (32 men, 21 women) aged 20–85 years who were divided into four groups: young men (n=17, YM, 29.23±4.51), older men (n=15, OM, 71.87±3.42), young women (n=11, YW, 29.64±4.88), and older women (n=10, OW, 68.1±1.91). Body composition and muscle strength and quality were analyzed. Muscle specimens were obtained from the vastus lateralis in all participants to analyze the type of MHC isoforms.

Results: Men showed a greater age-related decline in skeletal muscle mass (18.6%, $p < 0.01$), lean body mass (10.1%, $p < 0.05$), grip strength (35.3%, $p < 0.001$), isometric strength (29.6%, $p < 0.001$), isotonic power (42.5%, $p < 0.001$), isokinetic strength (up to 44.3%, $p < 0.001$), and muscle quality (up to 24.8%, $p < 0.01$). In contrast, women had significantly lower isometric strength (24.2%, $p < 0.05$), isotonic power (36.5%, $p < 0.01$), and upper-body muscle quality (24.7%, $p < 0.001$) with aging. In addition, the proportion of MHC IIa was significantly lower in OM ($p < 0.05$) and OW ($p < 0.05$) than in YM and YW, respectively. However, the proportion of MHC I was significantly higher in OM ($p < 0.01$) than in YM but was high in both YW and OW. MHC I and MHC IIa negatively and positively correlated, respectively, with muscle strength and function.

Conclusion: These results indicate the existence of sex-related differences in muscle mass, strength, and quality and MHC isoform composition with increasing age. The effects on muscle strength and function with aging were significant in men, but not in women. Higher and lower proportions of MHC I and MHC IIa fibers, respectively, were inversely associated with muscle strength and quality. In particular, Korean YW showed lower muscle strength and quality, and the proportion of MHC isoforms was similar to that in the muscles of OW.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of healthy males and females of two different age groups. Isometric and isokinetic modes were utilized to measure strength and power output of the dominant knee flexors and extensors.

“Differential effects of a visuospatial attention task on measures of postural control in young and older adults.”

Peterson J, Keenan K. Differential effects of a visuospatial attention task on measures of postural control in young and older adults. *J Electromyog Kinesiol.* 2018;38:162-167.

ABSTRACT:

The purpose of this study was to examine the influence of a visuospatial attention task on three measures of postural control in young and older adults. 20 young (19–36 years) and 20 older (67–91 years) adults performed a choice stepping response time (CSRT) task, a submaximal dorsiflexion force steadiness task, and quiet standing in 3 bilateral stances. All tasks were performed with and without a visuospatial (VS) attention task that involved visualizing a star moving within a 2 × 2 grid. CSRT increased with the addition of the VS task in both groups ($p < .001$), with a larger increase for older adults than young adults ($p < .001$). Older adults were less steady while performing the dorsiflexion task with the VS task ($p < .001$), while the VS task did not influence steadiness in young adults ($p = .235$). Performance during quiet standing was not influenced by the VS task in any stance ($p > .084$). The findings suggest that visuospatial attention differentially affects postural control in young and older adults and the effect is task-

specific. These findings suggest the need to include stepping and force control tasks to further determine what role visuospatial attention plays in postural control.

Use of Primus: musculoskeletal evaluation of lower extremity strength capabilities of younger and older adults. Isometric mode was utilized to measure MVIC of dorsiflexion muscles.

“Calculation of resistive loads for elastic resistive exercises.”

Picha K, Uhl T. Calculation of resistive loads for elastic resistive exercises. J Sport Rehabil.2018, <https://doi.org/10.1123/jsr.2017-0072>

ABSTRACT:

Context: What is the correct resistive load to start resistive training with elastic resistance to gain strength? This question is typically answered by the clinician’s best estimate and patient’s level of discomfort without objective evidence.

Objective: To determine the average level of resistance to initiate a strengthening routine with elastic resistance following isometric strength testing.

Design: Cohort.

Setting: Clinical.

Participants: 34 subjects (31 ± 13 y, 73 ± 17 kg, 170 ± 12 cm).

Interventions: The force produced was measured in Newtons (N) with an isometric dynamometer. The force distance was the distance from center of joint to location of force applied was measured in meters to calculate torque that was called “Test Torque” for the purposes of this report. This torque data was converted to “Exercise Load” in pounds based on the location where the resistance was applied, specifically the distance away from the center of rotation of the exercising limb. The average amount of exercise load as percentage of initial Test Torque for each individual for each exercise was recorded to determine what the average level of resistance that could be used for elastic resistance strengthening program.

Main Outcome Measures: The percentage of initial test torque calculated for the exercise was recorded for each exercise and torque produced was normalized to body weight.

Results: The average percentage of maximal isometric force that was used to initiate exercises was 30 ± 7% of test torque.

Conclusions: This provides clinicians with an objective target load to start elastic resistance training. Individual variations will occur but utilization of a load cell during elastic resistance provides objective documentation of exercise progression.

Use of Primus: musculoskeletal evaluation of upper and lower extremity muscle strength of healthy males and females. Isometric mode was utilized to measure maximum strength of shoulder external rotators and abductors and hip abductors and extensors.

“The effect of abdominal breathing with muscle strength exercise on balance and strength.”

Roh HL. The effect of abdominal breathing with muscle strength exercise on balance and strength. *Korean J Neurolog Surg.* 2018;1:33-38.

ABSTRACT:

Purpose: The purpose of this study was to effect of balance ability and the low trunk strength when application the low extremity strength exercise with abdominal respiration exercises.

Methods: It was conducted for six weeks with 44 healthy persons (male: 25, female: 19) and they were divided 3 groups; control group(n=15), the lower extremity exercise group(n=14), combined the lower extremity exercise with abdominal respiration(n=15). The exercise program consists of warming up, main exercises and cool down. For each change of motion in the exercise, the experimental group A

proceeded to natural breathing group B for 40 seconds. To see the effect of intervention, using Functional Reaching Test for dynamic balance, One Leg Standing for static balance and Primus RS for the low trunk strength.

Results: Compared before and after the intervention, control group didn't show any differences, but group A and group B were improved static balance, dynamic balance and strength of low trunk. There were no differences in the balance and strength between two groups.

Conclusion: The effect of balance and strength of low trunk were similar to that of the group with abdominal respiration group and did not perform abdominal respiration group. Therefore, the combination of abdominal breathing during strength training did not affect muscle strength and balance.

Use of Primus: musculoskeletal evaluation of lower extremity muscle performance of healthy young adults. Isometric mode was utilized to measure maximum strength and isotonic mode to measure power output of the lower trunk flexion and extension.

“No difference in flexion power despite iliopsoas fatty degeneration in healed hip fractures with large lesser trochanter displacement.”

Schenkel M, Kaniewska M, Buhler T, et al. No difference in flexion power despite iliopsoas fatty degeneration in healed hip fractures with large lesser trochanter displacement. *EU J Orthop Surg Traumatol.* 2018, <https://doi.org/10.1007/s00590-018-220-4>.

ABSTRACT:

Objective: To evaluate iliopsoas atrophy and loss of function after displaced lesser trochanter fracture of the hip.

Design: Cohort study.

Setting: District hospital.

Patients: Twenty consecutive patients with pertrochanteric fracture and displacement of the lesser trochanter of > 20 mm.

Intervention: Fracture fixation with either an intramedullary nail or a plate.

Outcome measurements: Clinical scores (Harris hip, WOMAC), hip flexion strength measurements, and magnetic resonance imaging findings.

Results: Compared with the contralateral non-operated side, the affected side showed no difference in hip flexion force in the supine upright neutral position and at 30° of flexion (205.4 N vs 221.7N and 178.9 N vs 192.1 N at 0° and 30° flexion, respectively). However, the affected side showed a significant greater degree of fatty infiltration compared with the contralateral side (global fatty degeneration index 1.085 vs 0.784), predominantly within the psoas and iliacus muscles.

Conclusion: Severe displacement of the lesser trochanter (> 20 mm) in pertrochanteric fractures did not reduce hip flexion strength compared with the contralateral side. Displacement of the lesser trochanter in such cases can lead to fatty infiltration of the iliopsoas muscle unit. The amount of displacement of the lesser trochanter did not affect the degree of fatty infiltration.

Use of Primus: musculoskeletal evaluation of lower extremity muscle performance of patients with pertrochanteric femoral fracture and displacement of the lesser trochanter (≥ 20 mm). Isometric mode was utilized to measure maximum strength of the hip flexor muscles at 0° and 30° flexion.

“The influence of functional shortening of hamstring muscles and rectus femoris muscle on proprioception of knee joint in patients after ACL rupture.”

Szlęzak M, Likus W, Matuszyny B, et al. The influence of functional shortening of hamstring muscles and rectus femoris muscle on proprioception of knee joint in patients after ACL rupture. *Ann Acad Med Siles.* 2018;72:95-100.

ABSTRACT:

Purpose: The aim of this study is to demonstrate the relationship between functional shortening of the rectus femoris muscle, hamstring muscle and knee proprioception in patients after anterior cruciate ligament (ACL) rupture.

Design: Randomized Controlled Trial

Methods: A group of 35 men with ACL rupture (without ACL reconstruction), aged 18 to 43 years (28 ± 7.4 years) was enrolled in the study. Firstly, the functional shortening of above-mentioned muscles was evaluated in both healthy and injured lower limbs. Knee joint proprioception was assessed using a BTE Primus RS by examining the angular deviation from the center of the kinetic range in the knee joint with and without visual inspection.

Results: A statistically significant positive correlation was found between the functional shortening of the hamstrings and the proprioception of the flexion motion assessed under conditions without visual inspection. In addition, a statistically significant negative correlation was found between the functional shortening of the rectus femoris muscle of the injured lower limb and proprioception of the knee flexion movement assessed under conditions without visual inspection.

Conclusions: A deficit of knee proprioception correlates with functional shortening of the rectus femoris and hamstring muscles. Patients with functional shortening of the rectus femoris have better knee proprioception. Patients with functional shortening of the hamstrings have worse knee proprioception.

Use of Primus: neuromuscular evaluation of lower extremity proprioception of individuals post-ACL rupture. Isotonic mode was utilized to obtain angular measures of knee flexion and extension with eyes open and closed.



“Grip strength feigning is hard to detect: an exploratory study.”

Vollert J, Pasqualicchio C, Papenhoff M, et al. Grip strength feigning is hard to detect: an exploratory study. *J Hand Surg (EU)*. 2018;43:193-198.

ABSTRACT:

Purpose: To compare rapid exchange grip (REG) and isometric grip strength testing in patients with known grip strength impairment and healthy participants feigning weakness.

Design: Randomized Controlled Trial

Methods: Grip strength was assessed on a PrimusRS by way of maximum isometric grip and rapid exchange grip. During the first sequence, all participants were instructed to give 100% maximum grip strength with both hands. The second testing assignment was to give 50% submaximal effort with the affected hand (for patients) or the dominant hand (for healthy participants) and 100% with the contralateral hand. Additionally, depression and anxiety were assessed using the HADS, handedness by the Edinburgh questionnaire, pain and pain-related impairment using the Brief Pain Inventory, and a physical exam of upper extremity performed.

Results: All participants could reduce their force at will. Patients achieved 60–79% of their baseline during feigning (mean and maximum strength and loss of force) and healthy participants a range of 28–70%. Patients achieved 14–93% of their baseline during feigning (mean, maximum strength and loss of force) and healthy controls achieved a range of 18–97%.

Conclusions: The authors were unable to identify a parameter, series of parameters or previously suggested protocol that could discriminate between feigning healthy participants and injured patients at maximum effort.

Use of Primus: musculoskeletal evaluation of upper extremity strength of healthy individuals and individuals with hand injuries. Isometric mode to administer the REG and IGST. In addition to the strength measures, CV and force-time curves provided valuable data in the assessment of performance.



“Effects of a six-month supervised physical exercise program on physical and cardio-metabolic profile and quality of life in patients with prostate cancer on androgen deprivation therapy: a pilot and feasibility study.”

Zabegalina N, Hendrickx M, Lamotte V, et al. Effects of a six-month supervised physical exercise program on physical and cardio-metabolic profile and quality of life in patients with prostate cancer on androgen deprivation therapy: a pilot and feasibility study. *Cent Eur J Urol*. 2018;71:234-241.

ABSTRACT:

Purpose: To evaluate the effect of a six-month supervised physical exercise program on the physical and cardio-metabolic profile and quality of life in patients with prostate cancer on androgen deprivation therapy.

Design: Randomized Controlled Trial

Methods: Twenty-seven patients with prostate cancer on androgen deprivation therapy were included in a physical exercise program. The program consisted of supervised physical exercises during a six-month period (two hours, twice a week). The exercise program contained moderate to high intensity aerobic and resistance exercises: cycling, walking or jogging for 45 minutes at an intensity of $\pm 80\%$ of the individual maximum heart rate, followed by resistance exercises targeting the major lower and upper body muscles. All patients were assessed prior to the exercise program, including anthropometrical parameters, blood analysis, quality of life and physical fitness. Blood analysis was repeated at a three-month follow-up. Anthropometrical parameters, physical fitness and quality of life were recorded at a three-, six- and nine-month follow-up.

Results: The six-month duration, and nine-month follow-up showed significant improvement in quality of life scales and reduced BMI. Resting heart rate, muscle strength and balance showed significant improvement at the three-month follow-up, but then stabilized and showed little change at the six- and nine-month follow-ups.

Conclusions: data indicates that a six-month supervised physical exercise program can be beneficial in preventing androgen deprivation therapy-related side effects in patients with prostate cancer. We emphasize the importance of screening for cardio-metabolic risk factors in patients who are treated with androgen deprivation therapy.

Use of Primus: musculoskeletal evaluation of upper and lower extremities strength of individuals with prostate cancer. Isometric mode was utilized to measure MVIC of elbow flexors and knee flexors and extensors.

2017

“Muscle activity during maximal isometric forearm rotation using a power grip.”

Bader J, Boland MR, Greybe D, et al. Muscle activity during maximal isometric forearm rotation using a power grip. *J Biomech*. 2017, <https://doi.org/10.1016/j.jbiomech.2017.12.011>

ABSTRACT:

This study aimed to provide quantitative activation data for muscles of the forearm during pronation and supination while using a power grip. Electromyographic data was collected from 15 forearm muscles in 11 subjects while they performed maximal isometric pronating and supinating efforts in nine positions of forearm rotation. Biceps brachii was the only muscle with substantial activation in only one effort direction. It was significantly more active when supinating ($m = 52.1\%$, $SD = 17.5\%$) than pronating ($m = 5.1\%$, $SD = 4.8\%$, $p < .001$). All other muscles showed considerable muscle activity during both pronation and supination. Brachioradialis, flexor carpi radialis, palmaris longus, pronator quadratus and pronator teres were significantly more active when pronating the forearm. Abductor pollicis longus and biceps brachii were significantly more active when supinating. This data highlights the importance of including muscles additional to the primary forearm rotators in a biomechanical analysis of forearm rotation. Doing so will further our understanding of forearm function and lead to the improved treatment of forearm fractures,

trauma-induced muscle dysfunction and joint replacements.

Use of Primus: musculoskeletal evaluation of upper extremity strength of healthy individuals. Isometric mode was utilized to measure MVIC of grip in 9 different positions of supination and pronation.

“Effects of elastic taping, non-elastic taping and static stretching on recovery after intensive eccentric exercise.”

Boobphachart D, Manimmanakorn N, Manimmanakorn A, et. al. Effects of elastic taping, non-elastic taping and static stretching on recovery after intensive eccentric exercise. *Res Sports Med.* 2017;25:181-190.

ABSTRACT:

The purpose of this study was to compare the effect of elastic tape (Kinesiotape) to placebo tape or static stretching on delayed onset muscle soreness. Fifty-one untrained healthy female volunteers were randomly assigned to one of three groups (n = 17/group), elastic tape, placebo tape, and stretching group. Muscle soreness was induced by 4 sets of 25 maximal isokinetic ($60^{\circ} \cdot s^{-1}$) eccentric contractions of dominant quadriceps on an isokinetic dynamometer. Compared with placebo tape, the elastic tape participants had less muscle soreness at 72 h post-exercise ($p = 0.01$). The elastic tape also increased isometric strength at 72 h post-exercise compared with the placebo ($p = 0.03$) and stretching group ($p = 0.02$). However, there was little effect between groups for changes in thigh circumference, jumping, pressure pain threshold, rate of perceived exertion, creatine kinase activity and joint motion. Elastic taping increased muscle strength recovery and reduced muscle soreness after intensive exercise.

Use of Primus: musculoskeletal exercise of lower extremity of healthy individuals. Isokinetic mode was utilized to induce DOMS of the knee extensors.

“Application of strength requirements to complex loading scenarios”.

England S, Rajulu S. Application of strength requirements to complex loading scenarios. In Duffy V (ed.) *Advances in Applied Digital Human Modeling and Simulation. Advances in Intelligent Systems and Computing.* Springer, Cham. 2017;481:155-168.

ABSTRACT:

NASA's endeavors in human spaceflight rely on extensive volumes of human-systems integration requirements to ensure mission success. These requirements protect for space hardware accommodation for the full range of potential crew members but cannot cover every possible action and contingency in detail. This study was undertaken in response to questions from various strength requirement users who were unclear how to apply idealized strength requirements that did not map well to the complex loading scenarios that crewmembers would encounter. Three of the most commonly occurring questions from stakeholders were selected to be investigated with human testing and human modeling. Preliminary findings indicate deviation from nominal postures can affect strength requirement compliance positively or negatively, depending on the nature of the deviation. Human modeling offers some avenues for quickly addressing requirement verification questions but is limited by the fidelity of the model and environment.

Use of Primus: musculoskeletal evaluation of muscle strength required by complex functional tasks performed by astronauts. Isometric mode was utilized to measure maximum strength capabilities.

“The effects of new taping methods designed to increase muscle strength”.

Fukui T, Otake Y, Kondo T. The effects of new taping methods designed to increase muscle strength. *J Phys Ther Sci.* 2017;29:70-74.

ABSTRACT:

Purpose: Although there are several studies on the use of elastic tape to influence muscle strength, results are contradictory and controversial. Our previous studies based on the sliding mechanism between superficial fascia and subcutaneous tissue may help the muscle strength. The purpose of this study was to confirm the effects of new taping methods on muscle strength.

Subjects and Methods: Sixteen healthy male participants took part in this study. Tape was applied on the right gluteus maximus and hip extension strength was determined by an isokinetic evaluation (30°/sec, concentric mode, four conditions). Condition 1: Tape was applied from the muscle insertion to origin; Condition 2: Tape was applied from the origin to insertion; Condition 3: Dummy tape with no direction; Condition 4: No tape was applied. [Results] The mean value of conditions 1–4 were 398.2 ± 24.3 Newton (N), 343.7 ± 25.9 N, 363.7 ± 26.4 N, and 371.3 ± 26.3 N, respectively (mean \pm SE). The result of condition 1 was significantly greater compared with the other conditions.

Conclusion: This new method corresponded to a tape direction of insertion-origin may help to increase the muscle strength.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of healthy males. Isokinetic mode was utilized to measure power output of the hip extensors.

“Effect of Elastic Band Exercise on the Plantar Pressure and Maximum Muscle Strength in Female University Students Wearing High Heels.”

Jung B-C, Yoo K-T, Kim Y-H. Effect of Elastic Band Exercise on the Plantar Pressure and Maximum Muscle Strength in Female University Students Wearing High Heels. J Korean Soc Phys Med. 2017;12(4): 83-92

ABSTRACT:

Purpose: To investigate the effect of the elastic band and stretching exercise program on ankle joint maximal voluntary isometric contraction (MVIC) and plantar pressure in high-heel wearing women in their 20s.

Design: Randomized Controlled Trials

Methods: Twenty women in their twenties were randomly assigned to the experimental group (n=10) and the control group (n=10). The experimental group (n=10) performed the elastic band exercise program, while the control group (n=10) performed the stretching exercise program. Both exercise programs were performed three times a week for a total of four weeks. The BTE PrimusRS was used in order to measure the ankle joint MVIC during dorsiflexion, plantar flexion, inversion, and eversion. Maximum pressure (N/cm²), average pressure (N/cm²) were measured using the Pedoscan. SPSS v. 21.0 software was used for all statistical analyses in this study.

Results: The measurement of the ankle joint's MVIC revealed that in inversion, a significant change in both feet was seen in both the experimental and control groups. In eversion, there was a significant change in both feet only in the experimental group. In terms of the rest of the results, no significant changes were visible. With regard to the plantar pressure, no significant results were seen for either foot in the comparison between or within the groups.

Conclusions: Exercise program using elastic band and exercise program using stretching were effective on MVIC of ankle joint muscles, although it had no effect on changes of plantar pressure.

Use of Primus: musculoskeletal evaluation of lower extremity strength capabilities of young females. Isometric mode was utilized to measure MVIC of ankle dorsiflexion, plantarflexion, inversion, and eversion muscles.

“Acute effects of the different intensity of static stretching on flexibility and isometric muscle force.”

Kataura S, Suzuki S, Matsuo S, et al. Acute effects of the different intensity of static stretching on flexibility and isometric muscle force. *J Strength Cond Res.* 2017;31:3403-3410.

ABSTRACT:

In various fields, static stretching is commonly performed to improve flexibility, whereas the acute effects of different stretch intensities are unclear. Therefore, we investigated the acute effects of different stretch intensities on flexibility and muscle force. Eighteen healthy participants (9 men and 9 women) performed 180-second static stretches of the right hamstrings at 80, 100, and 120% of maximum tolerable intensity without stretching pain, in random order. The following outcomes were assessed as markers of lower limb function and flexibility: static passive torque (SPT), range of motion (ROM), passive joint (muscle-tendon) stiffness, passive torque (PT) at onset of pain, and isometric muscle force. Static passive torque was significantly decreased after all stretching intensities ($p \leq 0.05$). Compared with before stretching at 100 and 120% intensities, ROM and PT were significantly increased after stretching ($p \leq 0.05$), and passive stiffness ($p = 0.05$) and isometric muscle force ($p \leq 0.05$) were significantly decreased. In addition, ROM was significantly greater after stretching at 100 and 120% than at 80%, and passive stiffness was significantly lower after 120% than after 80% ($p \leq 0.05$). However, all measurements except SPT were unchanged after 80% intensity. There was a weak positive correlation between the intensities of stretching and the relative change for SPT ($p \leq 0.05$), a moderate positive correlation with ROM ($p \leq 0.05$), and a moderate positive correlation with passive stiffness ($p \leq 0.05$). These results indicate that static stretching at greater intensity is more effective for increasing ROM and decreasing passive muscle-tendon stiffness.

Use of Primus: musculoskeletal evaluation of lower extremity ROM, passive torque, and passive stiffness of the hamstring muscles in healthy individuals.

“Effects of open and closed kinetic-chain exercises on the muscle strength and muscle activity of the ankle joint in young healthy women.”

Kim M-K, Kong B-S, Yoo K-T. Effects of open and closed kinetic-chain exercises on the muscle strength and muscle activity of the ankle joint in young healthy women. *J Phys Ther Sci.* 2017;29: 1903–1906

ABSTRACT:

Purpose: To analyze the effects of open and closed chain exercise on the muscle strength and muscle activity of the ankle joint.

Design: Cohort Study

Methods: Twenty women in their 20s were randomly assigned to two groups: the open kinetic-chain group and the closed kinetic-chain group. Each group performed 5 sets 3 times per week for 4 weeks. Exercise intensity was increased once after two weeks. The muscle activity of the tibialis anterior, gastrocnemius, tibialis posterior, and peroneus longus muscles were measured. The collected data were analyzed with two-way repeated measures ANOVA.

Results: In the results for muscle strength, both groups showed significant differences in dorsiflexion and plantar flexion between the pre-test and post-test. In the results for muscle activity, no significant differences were noted for either group.

Conclusions: Open and closed kinetic-chain exercises can help to improve muscle strength.

Use of Primus: musculoskeletal evaluation of lower extremity strength of healthy young adults. Isometric mode was utilized to measure MVIC of the ankle dorsiflexion, plantarflexion, inversion, and eversion muscles.

“Does patient perception differ following adductor canal block and femoral nerve block in total knee arthroplasty? A simultaneous bilateral randomized study.”

Koh HJ, Koh IJ, Kim MS, et al. Does patient perception differ following adductor canal block and femoral nerve block in total knee arthroplasty? A simultaneous bilateral randomized study. *J Arthroplasty*. 2017;32:1856-1861.

ABSTRACT:

Background: Femoral nerve block (FNB) has been used as part of the multimodal analgesia after total knee arthroplasty (TKA) but leads to weakness in the quadriceps muscles. Recently, adductor canal block (ACB) was reported to provide effective pain relief while sparing the strength of the quadriceps. This simultaneous bilateral randomized study investigated whether patients perceived differences between ACB and the FNB after same-day bilateral TKA.

Methods: We performed a prospective simultaneous bilateral randomized study in 50 patients scheduled to undergo same-day bilateral TKA. One knee was randomly assigned to ACB and the other knee was assigned to FNB. All ACB and FNB were performed using ultrasound-guided single-shot procedures. These 2 groups were compared for pain visual analogue scale, straight leg raising ability and knee extension while sitting, and motor grade. At postoperative week 1, the peak torque for the quadriceps muscle was measured in both knees with an isokinetic dynamometer.

Results: There were no differences in pain levels between ACB and FNB during the entire study period. During the first 48 h after TKA, more of the knees that received ACB could perform straight leg raising and knee extension with greater quadriceps strength compared with FNB. However, no group differences in quadriceps functional recovery were found after postoperative 48 h and isometric quadriceps strength at postoperative 1 week.

Conclusion: This simultaneous bilateral randomized study demonstrates that patients did not perceive differences in pain level, but experienced substantial differences in quadriceps strength recovery between knees during the first 48 h.

Use of Primus: musculoskeletal evaluation of lower extremity strength of individuals scheduled to undergo bilateral TKA. Isometric mode was utilized to measure MVIC of the quadriceps muscle.

“Effect of Plai cream [*Zingiber montanum* (J.Koenig) Link ex A.Dietr. syn. *Zingiber cassumunar* Roxb.] combined with ultrasound on delayed onset muscle soreness.”

Manimmanakorn N, Manimmanakorn A, Boobphachart D, et al. Effect of Plai cream [*Zingiber montanum* (J.Koenig) Link ex A.Dietr. syn. *Zingiber cassumunar* Roxb.] combined with ultrasound on delayed onset muscle soreness. *Ind J Trad Knowl*. 2017;16:442-447.

ABSTRACT:

Plai cream (*Zingiber cassumunar* Roxb.) has been used as a remedy for release pain and inflammation of musculoskeletal problems. The enhancement of the anti-inflammatory effect of Plai cream by phonoporesis or ultrasound therapy is questionable. The aim of this study was to evaluate the effect of Plai cream combined with ultrasound in the treatment of delayed onset muscle soreness (DOMS).

Seventy-five volunteers were randomly allocated into 3 groups; 14 % Plai cream (5 cm long strip), ultrasound treatment (1MHz, 1watt.cm-2) for 5 min, and combined 14 % Plai cream and ultrasound for 5 min. The participants performed eccentric exercise (4 sets of 25 repetitions at a speed of 60°.s-1) of dominant quadriceps using isokinetic dynamometry to induce DOMS. All participants received their allocated treatment once per day for the next 7 days. We found pain score, thigh circumference and serum creatine kinase were increased, while pressure pain threshold and muscle strength were decreased, but small changes of joint motion after intensive exercise (post-exercise day 1, 2, 3 & 7). However, there was no significant difference changes of all outcomes among three groups. In conclusion,

combined 14 % Plai cream with ultrasound had no additional benefit at reducing DOMS compared to either 14 % Plai cream alone or ultrasound alone.

Use of Primus: musculoskeletal evaluation to intentionally induce DOMS via strenuous eccentric exercise of the quadriceps muscles in a healthy population. Isokinetic mode was utilized for this testing. Additionally, isometric mode was used to measure MVIC.

“Reliability and validity of a new method for isometric back extensor strength evaluation using a hand-held dynamometer.”

Park HW, B S, Kim HY, et al. Reliability and validity of a new method for isometric back extensor strength evaluation using a hand-held dynamometer. *Ann Rehabil Med.* 2017;41:793-800.

ABSTRACT:

Objective: To investigate the reliability and validity of a new method for isometric back extensor strength measurement using a portable dynamometer.

Methods: A chair equipped with a small portable dynamometer was designed (Power Track II Commander Muscle Tester). A total of 15 men (mean age, 34.8±7.5 years) and 15 women (mean age, 33.1±5.5 years) with no current back problems or previous history of back surgery were recruited. Subjects were asked to push the back of the chair while seated, and their isometric back extensor strength was measured by the portable dynamometer. Test-retest reliability was assessed with intraclass correlation coefficient (ICC). For the validity assessment, isometric back extensor strength of all subjects was measured by a widely used physical performance evaluation instrument, BTE PrimusRS system. The limit of agreement (LoA) from the Bland-Altman plot was evaluated between two methods.

Results: The test-retest reliability was excellent (ICC=0.82; 95% confidence interval, 0.65–0.91). The Bland-Altman plots demonstrated acceptable agreement between the two methods: the lower 95% LoA was -63.1 N and the upper 95% LoA was 61.1 N.

Conclusion: This study shows that isometric back extensor strength measurement using a portable dynamometer has good reliability and validity.

Use of Primus: to validate measures obtained using new method for measuring back extensor strength using a portable dynamometer.

“Muscle strength and force development in high- and low-functioning elderly men: Influence of muscular and neural factors.”

Pion CH, Barbat-Artigas S, St-Jean-Pelletier F, et al. Muscle strength and force development in high- and low-functioning elderly men: Influence of muscular and neural factors. *Experimental Gerontol.* 2017;96:19-28.

ABSTRACT:

Background: Aging leads to a loss of muscle strength and functional capacity likely resulting from a combination of neural and muscle alterations. The aim of this study was to identify possible disparities in muscle strength and force development profiles in high- and low-functioning elderly men and to investigate muscular and neurophysiological factors that could explain the differences.

Methods: Sixty community-dwelling men in good general health were divided in two groups based on a functional capacity (FC) z-score derived from 6 tests of the Short Physical Performance Battery and Senior Fitness Test (Normal and fast 4 m-walk tests, normal and fast Timed-up and go, chair and stair tests). Extensor strength of the lower limbs (LL) was obtained for concentric (CLES) contraction and combined with lean masses of LL (LLLM) to yield concentric (CLES/LLLM) index. Similarly, extensor strength of the right Quadriceps Femoris (IKES) was obtained during maximal voluntary isometric contraction (MVC) and combined with right thigh lean mass (rTLM) to produce an isometric strength

(IKES/rTLM) index. A muscular profile was obtained from: ascending and descending force slopes during the MVC; Vastus Lateralis (VL) muscle twitches parameters (amplitude, contraction and ½ relaxation times); the knee joint velocity (KV) as well as integrated EMG (iEMG) were determined for a sit-to-stand functional evaluation; muscle phenotype. A neurophysiological profile was established from: the spinal excitability (Hmax/Mmax ratio); motoneuron conduction velocity (CV); the completeness of muscle activation (% of force reserve), median power frequency (MPF) and mean amplitude (MA) of the VL EMG signal during MVC.

Results: Coincidentally, age did not differ between groups. Strength and force indices, descending force slopes for MVC, KV and iEMG during the sit-to-stand evaluation and FC parameters were all significantly ($p < 0.05$) lower in the LoFC group than in the HiFC group. In contrast, no difference was observed between groups in: LLLM and rTLM, Hmax/Mmax ratio, CV, twitch parameters and muscle phenotype.

Conclusion: The lower concentric and isometric strengths found in the LoFC group could not be accounted for by muscular factors. Similarly, peripheral nervous systems alterations could not explain group differences. It can be suggested that modifications within the central nervous system may be responsible for the differences in the functional status of healthy elderly individuals. Finally, more complex and demanding tasks, such as those requiring greater intensity or coordination, may further clarify how healthy elderly individuals with low and high functional capacities differ.

Use of Primus: musculoskeletal evaluation of lower extremity strength of older males. Isometric mode was utilized to measure MVIC of the quadriceps muscle.

“A 2- to 10-year follow-up of the clinical and functional outcomes of knee dislocations: preliminary results.”

Richter D, Gurney AB, Natividad T, et al. A 2- to 10-year follow-up of the clinical and functional outcomes of knee dislocations: preliminary results. *J Exer Physiol online*. 2017;20:147-158

ABSTRACT:

The purpose of this study was to describe the post-surgical knee dislocation (KD), and to present preliminary data concerning the outcomes of these patients after treatment, with a minimum 2-yr follow-up. Sixteen patients who underwent KD repair surgery over an 8-yr period. Subjective measures include the following scales: (a) Lysholm; (b) Tegner activity; (c) VAS; (d) SF-36; (e) IKDC; and (f) psychosocial questionnaire. Patients underwent ligamentous exam, radiographic evaluation, and function including single leg hop testing. Average assessment scores are: SF-36 physical health = 47.1, Lysholm = 75.6, IKDC = 69.2, VAS involved = 32 mm, VAS uninvolved = 15 mm. 38% of patients have returned to heavy or competitive activity. Sixty-three percent of patients had <3 mm of translation on the KT- 1000. Overall hop testing symmetry index was $89.8\% \pm 10.13$. Isotonic quad strength at 60 deg·sec⁻¹ - $84.74\% \pm 24.58$, isotonic ham strength at 60 deg·sec⁻¹ - $100.26\% \pm 19.77$, isotonic quad strength at 180 deg·sec⁻¹ - $89.74\% \pm 18.30$, isotonic ham strength at 180 deg·sec⁻¹ - $96.87\% \pm 26.37$. This study demonstrates that good stability can often be achieved with greater than one-third of the patients returning to sports or heavy activity.

Use of Primus: musculoskeletal evaluation of lower extremity muscle strength of patients post KD. Isometric and isokinetic modes were utilized to measure strength and power output of the knee flexors and extensors.

“Good isometric and isokinetic power restoration after distal biceps tendon repair with anchors”.

Suda AJ, Prajitno J, Grutzner PA, et al. Good isometric and isokinetic power restoration after distal biceps tendon repair with anchors. *Arch Ortho Trauma Surg*. 2017. doi:10.1007/s00402-017-2724-9.

ABSTRACT:

Introduction: Distal biceps brachii tendon rupture can lead to 30–40% power loss of elbow flexion and up to 50% of forearm supination. Refixation of the distal biceps brachii tendon is recommended to warrant an adequate quality of the patient's life. This study reports the isometric and isokinetic results after anchor re-fixation 2.5 years after surgery.

Patients and methods: Between 2007 and 2010, 69 patients with distal biceps brachii tendon tear underwent a suture anchor reattachment. During the follow-up examination, a questionnaire and DASH score were filled in, the circumferences of the arm were measured, range of motion was collected, and different trials were conducted at the BTE Primus RS™ (Baltimore Therapeutic Equipment) on both arms.

Results: 49 patients (71%) were reinvestigated with a follow-up of 32 months (11–58 months). A significant difference was found in the ability of elbow flexion between the affected arm and the opposite side as well as in pronation and supination. In elbow flexion and extension as well as in pronation and supination of the forearm, the strength was significantly diminished.

Conclusions: 32 months after surgical re-fixation of the distal biceps brachii tendon rupture, strength in all exercises is marginally reduced in comparison to the opposite arm. Re-fixation of the distal biceps brachii tendon is an adequate method to return the range of motion and the strength in the elbow joint to an almost normal level and that gives rise to a high level of patient satisfaction.

Use of Primus: musculoskeletal evaluation of elbow and forearm muscle strength of patients post-distal biceps tendon repairs. Isometric and isokinetic modes were utilized to measure maximum strength capabilities and power output of elbow flexors and forearm supinators and pronators.

“Low-load resistance training with hypoxia mimics traditional strength training in team sport athletes.”

Thuwaken W, Hamlin MJ, Manimmanakorn N, et al. Low-load resistance training with hypoxia mimics traditional strength training in team sport athletes. *J Phys Ed Sport*. 2017;17:240-247. doi:10.7752/jpes.2017.01036.

ABSTRACT:

The aim of this study was to investigate the effects of low-load resistance training under hypoxia compared to conventional resistance training. Forty male team sport athletes (20.2 ± 1.7 y, 172.5 ± 5.6 cm, 66.3 ± 9.6 kg) were divided into 4 resistance training groups; normobaric 30% 1RM (CT30), normobaric 80% 1RM (CT80), hypoxic 30% 1RM (HT30), and hypoxic 50% 1RM (HT50). Resistance training included 3 sets of 15 repetitions of knee extensions and 3 sets of knee flexion, 3 day a week for 5 weeks. The hypoxic condition was set at $FiO_2 = 14\%$. Isometric, isokinetic and isotonic maximal voluntary contractions (MVC) along with blood lactate were measured before and after the five-week training program. Compared to CT30, isometric MVC increased substantially in all other groups after training (CT80 $21.0 \pm 14.7\%$, HT30 $16.9 \pm 12.3\%$, HT50 16.7 ± 7.9), however there was no significant difference between groups. Compared to CT30 1RM increased post training in the CT80 and HT50 groups ($23.7 \pm 10.8\%$ and $24.4 \pm 3.8\%$ $p = 0.004$, $p = 0.045$ respectively) with little difference found between CT80 and HT50 groups ($0.6 \pm 8.4\%$). Low-load resistance training under hypoxic conditions (HT50) mimics the strength benefits gained from traditional high load training.

Use of Primus: musculoskeletal evaluation of muscle performance of high performance team sports athletes (males). Isometric, isokinetic, and isotonic modes were utilized to measure maximum strength capabilities, maximum power output, and endurance of the quadriceps and hamstrings.



“Inter-session reliability of isokinetic strength testing in knee and elbow extension and flexion using the BTE PrimusRS”.

Torpel A, Becker T, Thiers A, et al. Inter-session reliability of isokinetic strength testing in knee and elbow extension and flexion using the BTE PrimusRS. *J Sport Rehabil.* 2017.

doi:<https://doi.org/10.1123/jsr.2016-0209>.

ABSTRACT:

Context: The use of isokinetic dynamometers playing an important role in different settings of sports and medicine. Therefore, a high reliability of these devices is required.

Objective: The aim of this study was to examine the inter-session reliability of the dynamometer BTE PrimusRS regarding to the isolated single-joint exercises extension / flexion of the knee and elbow for isokinetic testing.

Design: Inter-session reliability.

Setting: Clinical settings and sports science.

Participants: 16 young male students.

Intervention: The testing protocol includes five consecutive repetitions (concentric/concentric) at a velocity of 60° per second for the exercises.

Main Outcome Measures: Raw data of torque curves were used to determine the peak torque (PT). Reliability was evaluated with the intra-class correlation coefficient (ICC), the limits of agreement (LoA), the bias and the variability of measurements (V) of various evaluation methods of the peak torque, where raw and smoothed data were analyzed.

Results: We found high ICC values (0.954 - 0.991) for the used exercises. However, the LoAs yielded up to over 16 Nm and the V yielded up to nearly 9 % in several testing exercises indicating poor absolute reliability.

Conclusion: The BTE PrimusRS shows good to excellent reliability. However, regarding the absolute measures of reliability, the users must decide as experts in their fields whether this reliability is sufficient for their purposes.

Use of Primus: musculoskeletal evaluation of knee and elbow muscle strength of a healthy population. Isokinetic mode was utilized to measure peak torque (using raw data of torque curves) of the knee and elbow flexor and extensor muscles.

“Effects of strength and neuromuscular training on functional performance in athletes after partial medial meniscectomy”.

Zhang X, Hu M, Lou Z, et al. Effects of strength and neuromuscular training on functional performance in athletes after partial medial meniscectomy. *J Exerc Rehabil.* 2017;13:110-116.

<https://doi.org/10.12965/jer.1732864.432>.

ABSTRACT:

The aims of this study were to determine an effective knee function rehabilitation program for athletes undergoing partial medial meniscectomy. Participants were randomly assigned to neuromuscular training (NT) or strength training (ST) group and subjected to functional assessments before surgery and again at 4, and 8 weeks *post hoc*. Functional knee assessment, such as Lysholm knee scoring, star excursion balance, and BTE PrimusRS isokinetic performance tests were evaluated in each group. All post-operational symptoms were significantly improved after 4 and 8 weeks of NT and ST. Both NT and ST programs showed effective knee function recovery seen as an increase in muscular strength and endurance. However, the NT program showed the most significant functional improvement of dynamic balance and coordination.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring strength of athletes post-partial medial meniscectomy. Isokinetic mode was utilized to measure power output of these muscles.

2016

“Is the arthroscopic modified tension band suture technique suitable for all full-thickness rotator cuff tears?”

Bae KH, Kim JW, Kim TK, et al. Is the arthroscopic modified tension band suture technique suitable for all full-thickness rotator cuff tears? *J Shoulder Elbow Surg.* 2016. <http://dx.doi.org/10.1016/j.jse.2016.01.004>.

ABSTRACT:

Background: We aimed to identify the clinical and structural outcomes after arthroscopic repair of full-thickness rotator cuff tears of all sizes with a modified tension band suture technique.

Methods: Among 63 patients who underwent arthroscopic rotator cuff repair for a full-thickness rotator cuff tear with the modified tension band suture technique at a single hospital between July 2011 and March 2013, 47 were enrolled in this study. The mean follow-up period was 29 months. Visual analog scale scores, range of motion, American Shoulder and Elbow Surgeons scores, Constant scores, and Shoulder Strength Index were measured preoperatively and at the final follow-up. For radiologic evaluation, we conducted magnetic resonance imaging 6 months postoperatively and ultrasonography at the final follow-up. We allocated the small and medium tears to group A and the large and massive tears to group B and then compared clinical outcomes and repair integrity.

Results: Postoperative clinical outcomes at the final follow-up showed significant improvements compared with those seen during preoperative evaluations ($P < .001$). However, group B showed worse clinical results than group A. Evaluation with magnetic resonance imaging performed 6 months postoperatively and ultrasonography taken at the final follow-up revealed that group B showed a significantly higher retear rate than did group A (69% vs. 6%, respectively; $P < .001$).

Conclusion: Arthroscopic repair with the modified tension band suture technique for rotator cuff tears was a more suitable method for small to medium tears than for large to massive tears.

Use of Primus: musculoskeletal evaluation of shoulder muscle strength of individuals post-rotator cuff repair. Isometric mode was utilized to measure maximum strength capabilities of the shoulder abductors, internal rotators, and external rotators.

“Does cruciate-retaining total knee arthroplasty show better quadriceps recovery than posterior-stabilized total knee arthroplasty? Objective measurement with a dynamometer in 102 knees”.

Cho KY, Kim KI, Song SJ, et al. Does cruciate-retaining total knee arthroplasty show better quadriceps recovery than posterior-stabilized total knee arthroplasty? Objective measurement with a dynamometer in 102 knees. *Clinics in Ortho Surg.* 2016; 8:379-385. <https://doi.org/10.4055/cios.2016.8.4.379>

ABSTRACT:

Background: Cruciate-retaining (CR) prostheses have been considered to produce more physiologic femoral rollback, provide better proprioception, and result in better quadriceps recovery than posterior-stabilized (PS) prostheses after total knee arthroplasty (TKA). However, there are very few studies demonstrating these benefits in an objective manner. We investigated whether CR-TKA could result in (1) better quadriceps recovery; (2) a greater proportion of patients with beyond the preoperative level of recovery; and (3) better clinical outcomes than PS-TKA.

Methods: This was a prospective non-randomized comparative study on the results of CR-TKA and PS-TKA. CR prostheses were used in 51 knees and PS prostheses in 51 knees. Quadriceps force was measured with a dynamometer preoperatively and at postoperative 6 weeks, 3 months, and 6 months consecutively. The Knee Society score (KSS) and range of motion (ROM) were also evaluated.

Results: There were no differences between two groups in terms of the objective quadriceps force during the follow-up period. The proportion of patients with beyond the preoperative level of recovery was similar between groups. Moreover, the KSS and ROM were not significantly different between two groups.

Conclusions: CR-TKA did not result in better quadriceps recovery than PS-TKA during the 6-month follow-up. In other words, PSTKA could lead to comparable quadriceps recovery despite greater preoperative weaknesses such as more restricted ROM and more severe degenerative changes of the knee.

Use of Primus: musculoskeletal evaluation of quadriceps strength of individuals post-TKA. Isometric mode was utilized to measure maximum strength capabilities of the quads.

“High-velocity quadriceps exercises compared to slow-velocity quadriceps exercises following total knee arthroplasty: a randomized clinical study.”

Doerfler D, Gurney B, Mermier , et al. High-velocity quadriceps exercises compared to slow-velocity quadriceps exercises following total knee arthroplasty: a randomized clinical study. *J Geriatric Phys Ther.* 2016;39:147-158

ABSTRACT:

Purpose: to compare the effect of high-velocity (HV) quadriceps exercises with that of slow-velocity (SV) quadriceps exercises on functional outcomes and quadriceps power following TKA.

Design: Randomized Controlled Trials Double Blind

Methods: Twenty-one participants who were 4 to 6 weeks post unilateral TKA were randomly assigned to an HV or SV group. Participants performed an evidence-based standardized progressive resistance exercise program in addition to HV quadriceps exercises or SV quadriceps exercises. Participants attended 2 sessions per week for 8 weeks. Before and after the 8-week exercise intervention, participants completed a functional questionnaire, health survey, functional testing, and underwent quadriceps strength and power testing.

Results: Both groups demonstrated improvements in ambulatory outcome measures, strength, speed, and power. The HV group demonstrated significantly greater improvements in distance walked and quadriceps strength than the SV group.

Conclusions: progressive resistance HV quadriceps exercises resulted in greater improvement in the 6-min walk test and quadriceps strength compared with SV exercise. No differences were found between the HV and SV groups for the 10-m gait speed, functional stair test, or balance tests.

Use of Primus: musculoskeletal evaluation of quadriceps strength of older individuals who were 4 to 6 weeks post-TKA. Isometric and isotonic modes were utilized to measure maximum strength and power capabilities of the quadriceps.

“Electromyography-based analysis of human upper limbs during 45-day head-down bed-rest”.

Fu A, Wang C, Qi H, et al. Electromyography-based analysis of human upper limbs during 45-day head-down bed-rest. *J Acta Astro.* 2016; 120:260-269. <http://dx.doi.org/10.1016/j.actaastro.2015.12.007>.

ABSTRACT:

Muscle deconditioning occurs in response to simulated or actual microgravity. In spaceflight, astronauts become monkey-like for mainly using their upper limbs to control the operating system and to complete corresponding tasks. The changes of upper limbs' athletic ability will directly affect astronauts' working performance. This study investigated the variation trend of surface electromyography (sEMG) during prolonged simulated microgravity. Eight healthy males participating in this study performed strict 45-day head-down bed-rest (HDBR). On the 5th day of pre-HDBR, and the 15th, the 30th and the 45th days of HDBR, the subjects performed maximum pushing task and maximum pulling task, and sEMG was collected from upper limbs synchronously. Each subject's maximum voluntary contractions of both the tasks during these days were compared, showing no significant change. However, changes were

detected by sEMG-based analysis. It was found that integrated EMG, root mean square, mean frequency, fuzzy entropy of deltoid, and fuzzy entropy of triceps brachii changed significantly when comparing pre-HDBR with HDBR. The variation trend showed a recovery tendency after significant decline, which is inconsistent with the monotonic variation of lower limbs that was proved by previous research. These findings suggest that EMG changes in upper limbs during prolonged simulated microgravity, but has different variation trend from lower limbs.

Use of Primus: musculoskeletal evaluation of upper limb strength performing functional tasks (single-handed pushing and pulling) of a healthy population. Isometric mode was utilized to measure maximum strength capabilities.

“Semimembranosus release for medial soft tissue balancing does not weaken knee flexion strength in patients undergoing varus total knee arthroplasty.”

Jang SW, Koh IJ, Kim MS, et al. Semimembranosus release for medial soft tissue balancing does not weaken knee flexion strength in patients undergoing varus total knee arthroplasty. *J Arthroplasty*. 2016. <http://dx.doi.org/10.1016/j.arth.2016.04.022>.

ABSTRACT:

Background: The sequential medial release technique including semimembranosus (semiM) release is effective and safe during varus total knee arthroplasty (TKA). However, there are concerns about weakening of knee flexion strength after semiM release. We determined whether semiM release to balance the medial soft tissue decreased knee flexion strength after TKA.

Methods: Fifty-nine consecutive varus knees undergoing TKA were prospectively enrolled. A 3-step sequential release protocol which consisted of release of (1) the deep medial collateral ligament (dMCL), (2) the semiM, and (3) the superficial medial collateral ligament based on medial tightness. Gap balancing was obtained after dMCL release in 31 knees. However, 28 knees required semiM release or more after dMCL release. Isometric muscle strength of the knee was compared 6 months postoperatively between the semiM release and semiM nonrelease groups. Knee stability and clinical outcomes were also compared.

Results: No differences in knee flexor or extensor peak torque were observed between the groups 6 months postoperatively ($P = .322$ and $P = .383$, respectively). No group difference was observed in medial joint opening angle on valgus stress radiographs ($P = .327$). No differences in the Knee Society or Western Ontario and McMaster Universities Osteoarthritis Index scores were detected between the groups ($P = .840$ and $P = .682$, respectively).

Conclusion: These results demonstrate that semiM release as a sequential step to balance medial soft tissue in varus knees did not affect knee flexion strength after TKA.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring strength of patients pre- and post-operative TKA. Isometric mode was utilized to measure maximum strength capabilities of these muscles.

“Discrepancies between skinned single muscle fibres and whole thigh muscle function characteristics in young and elderly human subjects.”

Jee H, Lim JY. Discrepancies between skinned single muscle fibres and whole thigh muscle function characteristics in young and elderly human subjects. *Biomed Res Intl*. 2016;8 pages. <http://dx.doi.org/10.1155/2016/6206959>.

ABSTRACT:

We aimed to analyze the mechanical properties of skinned single muscle fibres derived from the vastus lateralis (VL) muscle in relation to those of the whole intact thigh muscle and to compare any difference between young and older adults. Sixteen young men (29.25 ± 4.65 years), 11 older men (71.45 ± 2.94

years), 11 young women (29.64 ± 4.88 years), and 7 older women (67.29 ± 1.70 years) were recruited. In vivo analyses were performed for mechanical properties such as isokinetic performance, isometric torque, and power. Specific force and maximum shortening velocity (V_0) were measured with single muscle fibres. Sex difference showed greater impact on the functional properties of both the whole muscle ($p < 0.01$) and single muscle fibres than aging ($p < 0.05$). Sex difference, rather than aging, yielded more remarkable differences in gross mechanical properties in the single muscle fibre study in which significant differences between young men and young women were found only in the cross-sectional area and V_0 ($p < 0.05$). Age and sex differences reflect the mechanical properties of both single muscle fibres and whole thigh muscle, with the whole muscle yielding more prominent functional properties.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring strength of healthy population. Isometric, isokinetic, and isotonic modes were utilized to measure maximum strength capabilities, power output, and endurance of these muscles.

“Muscle strength differences in healthy young adults with and without generalized joint hypermobility: a cross-sectional study.”

Jindal P, Narayan A, Ganesan S, et al. Muscle strength differences in healthy young adults with and without generalized joint hypermobility: a cross-sectional study. *BMC Sports Sci Med Rehabil.* 2016;8:12. doi:10.1186/s13102-016-0037-x.

ABSTRACT:

Background: Generalized joint hypermobility (GJH), in the absence of symptoms, is a common clinical finding. The joint instability present due to excessive musculoskeletal flexibility in hypermobile joints impairs the external force production during muscle contraction. However, whether GJH is associated with muscle weakness is unclear. This study evaluated differences in upper and lower limb muscle strengths among asymptomatic young adults with and without GJH.

Methods: One hundred six young adults (53 hypermobile, i.e. 25 male (mean age 22 ± 1.8); 28 female (mean age 21 ± 1.8), and 53 non-hypermobile, i.e. 25 male (mean age 19 ± 1.06); 28 female (mean age 20 ± 1.4) were selected using a cut-off ≥ 4 on Beighton and Horan Joint Mobility Index. Isometric strength of elbow and knee extensors was measured using an isokinetic dynamometer. Independent sample t-tests were done to compare the muscle strengths of hypermobile and non-hypermobile participants. One-way ANCOVA was applied to control the effect of height and body mass on muscle strength.

Results: Male hypermobile participants had significantly less strength than non-hypermobile males in the right (71.7 Nm, SD = 23.1 , vs 97.6 Nm, SD = 47.4 , $p = 0.006^*$) and left (74.8 Nm, SD = 24.3 , vs 97.7 Nm, SD = 45.5 , $p = 0.007^*$) elbow extensors and right knee extensors (188.7 Nm, SD = 83.3 , vs 228.3 Nm, SD = 106.7 , $p = 0.03^*$). In females, both elbow extensors (right: 51.9 Nm, SD = 16.2 vs 48.8 Nm, SD = 17.8 , $p = 0.4$; left: 48.9 Nm, SD = 17.2 , vs 44.7 Nm, SD = 15.1 , $p = 0.2$) and knee extensors (right: 161.3 Nm, SD = 74.9 vs 145.5 Nm, SD = 75.8 , $p = 0.3$; left: 155.2 Nm, SD = 73 vs 124.3 Nm, SD = 69.6 , $p = 0.07$) strength were not statistically different between hypermobile and non-hypermobile participants.

Conclusion: The findings indicate that male participants with GJH have less isometric muscle strength in both elbow extensors and right knee extensors compared to non-hypermobile male participants. Female hypermobile participants did not show any significant differences in muscle strength compared to non-hypermobile female participants.

Use of Primus: musculoskeletal evaluation of elbow and knee flexor and extensor muscle strength of healthy population with and without generalized joint hypermobility. Isometric mode was utilized to measure maximum strength capabilities of these muscles.

“Arthroscopic Lateral Collateral Ligament Repair.”

Kim JW, Kim TK, Kang HJ, et al. Arthroscopic Lateral Collateral Ligament Repair. J Bone Joint Surg. 2016;98:1268-1276.

ABSTRACT:

Background: Lateral ulnar collateral ligament injury following unstable elbow dislocation can induce posterolateral rotatory instability that requires surgery. The aim of this study was to determine the effectiveness of arthroscopic repair of the lateral collateral ligament (LCL) complex in an unstable elbow joint.

Methods: The study group consisted of 13 patients who experienced posterolateral rotatory instability after an unstable elbow dislocation with an injury to the lateral ulnar collateral ligament. The diagnosis was confirmed with computed tomography (CT), magnetic resonance imaging (MRI), and physical examination. The patients underwent arthroscopically assisted surgery between May 2011 and January 2013 and were followed for a minimum of 18 months postoperatively. Coronoid and/or radial head fractures combined with the ligament injury were treated through an arthroscopic technique. Range of motion, pain, outcomes according to the Mayo Elbow Performance Score (MEPS) and Nestor grading system, and surgical complications were evaluated. CT and MRI were performed at 3 months postoperatively, and isometric muscle strength was measured at the time of final follow-up.

Results: At the time of final follow-up, at a minimum of 18 months, all 13 patients reported complete resolution of the instability and average (and standard deviation) extension of $3^{\circ} \pm 1^{\circ}$, flexion of $138^{\circ} \pm 6^{\circ}$, supination of $88^{\circ} \pm 5^{\circ}$, and pronation of $87^{\circ} \pm 6^{\circ}$. The mean MEPS was 92 points and, according to this validated outcome score, the results were rated as excellent in 12 patients and good in 1 patient. According to the Nestor grading system, the results were rated as excellent in 11 patients and good in 2. Complete healing was seen on the 3-month follow-up MRI in 12 patients; however, 1 patient had mild widening of the radiocapitellar joint space with incomplete healing but no instability symptoms. All patients demonstrated normal strength on elbow flexion, extension, pronation, and supination at the final follow-up visit.

Conclusions: Arthroscopic repair of the LCL complex in patients with posterolateral rotatory instability after an unstable elbow dislocation, with or without an intra-articular fracture, is an alternative treatment option for restoring elbow stability and achieving satisfactory clinical and radiographic results.

Use of Primus: musculoskeletal evaluation of upper extremity muscle strength capabilities of individuals with state elbow injury. Isometric mode was utilized to measure MVIC of the elbow flexors and extensors and forearm supinators and pronators.

“The effects of whole-body vibration exercise on isokinetic muscular function of the knee and jump performance depending on squatting position.”

Kim J, Park Y-J, Seo Y, Kang G, et al. The effects of whole-body vibration exercise on isokinetic muscular function of the knee and jump performance depending on squatting position. J Phys Ther Sci. 2016;28:159–161

ABSTRACT:

Purpose: to investigate the effects of whole-body vibration exercise (WBVE) on isokinetic muscular function of the knee and jump performance depending on different squatting positions.

Design: Randomized Controlled Trial

Methods: 12 healthy adult men who did not exercise regularly between the ages of 27 and 34. WBVE was performed with high squat position (SP), middle SP, and low SP. Before and after the intervention, isokinetic muscular function of the knees and jump performance were measured.

Results: Significant difference was seen in the knee flexor strength at $60^{\circ}/s$ and knee muscle endurance at $180^{\circ}/s$ after WBVE intervention in all squatting positions. For the knee extensor strength at $60^{\circ}/sec$, among the squatting positions significant difference was seen only for LS. In addition, jump height was significantly increased in all squatting positions.

Conclusions: This study suggests that WBVE at 26 Hz vibration frequency with 90° angle of hip and knee might be a feasible exercise intervention for sports players.

Use of Primus: musculoskeletal evaluation of lower extremity muscle function of healthy males. Isokinetic mode was utilized to measure work and power capabilities of the quadriceps.

“Occupational rehabilitation – a real opportunity for reintegration and return to former workplace after trauma.”

Kohler H, Harhaus L. Occupational rehabilitation – a real opportunity for reintegration and return to former workplace after trauma. *Intl J Phys Med Rehabil.* 2016;4:4. <http://dx.doi.org/10.4172/2329-9096.1000351>.

ABSTRACT:

After completion of the acute treatment of traumatic injuries many patients still have difficulties returning to their former work. For those patients the German Social Accident Insurance has established a wide variety of inpatient and outpatient occupational rehabilitation programs which all aim to achieve the best possible occupational and social reintegration. One of these programs is a specialized occupational rehabilitation, which focuses on relearning of patients' individual occupational skills and requirements.

Use of Primus: musculoskeletal evaluation and training “with selective specific occupational and therapeutic measures to restore the ability to work”. Scope of functions, specific activities, and equipment (including PrimusRS) are detailed.



“A comparison of nonoperative vs. Endobutton repair of distal biceps ruptures.”

Legg A, Stevens R, Oakes NO, et al. A comparison of nonoperative vs. Endobutton repair of distal biceps ruptures. *J Shoulder Elbow Surg.* 2016;25:341-348

ABSTRACT:

Background: The aim of this study was to compare the outcome of patients who have undergone distal biceps tendon repair by a single-incision Endobutton fixation technique with the results of another cohort of patients who elected not to undergo surgery for distal biceps tendon rupture.

Methods: A retrospective cohort study was performed of patients diagnosed with distal biceps ruptures, repaired with an Endobutton (Smith & Nephew, Andover, MA, USA) technique or treated nonoperatively by the senior surgeon (S.A.S.). With a minimum follow-up of 6 months, a routine elbow examination, radiographs, and functional questionnaires were performed. Isometric supination, flexion, and grip strength was measured using a BTE machine (Baltimore Therapeutic Equipment, Hanover, MD, USA). There were 47 patients available for follow-up with 50 distal biceps ruptures; 40 ruptures have undergone repair, and 10 have been managed nonoperatively. Three patients had sustained bilateral ruptures.

Results: There was a significant difference in flexion and supination isometric strength between the operative and nonoperative cohorts compared with the uninjured contralateral side (92.94% vs. 70.65%, $P = .01512$; 87.91% vs 59.11%, $P = .00414$, respectively). The difference in grip strengths between the 2 cohorts compared with the uninjured side was not significant (100.00% vs. 79.16%; $P = .16002$). The operated cohort had significantly better QuickDASH score, Oxford Elbow Score, and Mayo Elbow Performance Score (6.29 vs.14.10, $P = .02123$; 44.71 vs. 38.70, $P = .00429$; 93.13 vs. 84.50, $P = .01423$).

Conclusion: Repair of distal biceps ruptures using an Endobutton fixation results in nearly normal return of strength and function, which is significantly better than in those managed nonoperatively.

Use of Primus: musculoskeletal evaluation of upper extremity muscle strength of patients post-distal biceps repair. Isometric mode was utilized to measure maximum strength capabilities of elbow flexion, forearm supination, and hand grip.

“Effects of joint effusion on quadriceps muscles in patients with knee osteoarthritis.”

Lim SH, Hong BY, Oh JH, et al. Effects of joint effusion on quadriceps muscles in patients with knee osteoarthritis. *Phys Ther Sport*. 2016;17:14-18.

ABSTRACT:

Objectives: To evaluate the effect of knee effusion on the quadriceps muscle in patients with knee osteoarthritis (OA).

Design: Single-blind, randomized, controlled clinical trial.

Setting: Single medical center.

Participants: Forty subjects with knee OA were assigned to a experimental (n = 20) or control (n = 20) group.

Main outcome measures: Quadriceps torque and root mean square (RMS) values of surface electromyography (EMG) of the vastus medialis and vastus lateralis muscles were measured during a maximal isometric contraction at 60° knee flexion. Thereafter, 20 mL of normal saline was injected into the knee joint of the experimental group. Quadriceps torque and RMS values were again measured.

Results: Five subjects did not complete the study. No significant difference in quadriceps peak torque or RMS of EMG activity was observed at baseline, pre-effusion, or post-effusion measures in either group. The experimental group showed no significant change in quadriceps peak torque or RMS of EMG activity in any period compared with the control group.

Conclusions: These results demonstrate that a 20 ml joint effusion did not affect peak torque or RMS values of the quadriceps muscle in patients with knee OA.

Use of Primus: musculoskeletal evaluation of lower extremity strength of individuals with knee OA. Isometric mode was utilized to measure MVIC of the quadriceps.

“Effects of *Zingiber cassumunar* (Plai cream) in the treatment of delayed onset muscle soreness.”

Manimmanakorn N, Manimmanakorn A, Boobphachart D, et al. Effects of *Zingiber cassumunar* (Plai cream) in the treatment of delayed onset muscle soreness. *J Integrative Med*. 2016;14:114-120. [http://dx.doi.org/10.1016/S2095-4964\(16\)60243-1](http://dx.doi.org/10.1016/S2095-4964(16)60243-1).

ABSTRACT:

Objective: To evaluate the effects of *Zingiber cassumunar* (Plai cream) in either 7% or 14% concentration on delayed onset muscle soreness (DOMS).

Methods: Seventy-five untrained healthy volunteers (28 males and 47 females), performed 4 sets of 25 eccentric repetitions of the dominant quadriceps muscle on an isokinetic dynamometry machine. Participants were then randomized into 3 groups: 14% Plai cream, 7% Plai cream and placebo cream. Two grams of the cream (strips of 5-cm long) were gently rubbed into the quadriceps muscles for 5 min immediately following the exercise and every 8 h thereafter for 7 d in all groups. Muscle soreness, muscle strength, jump height, thigh circumference and creatine kinase were measured before and after eccentric exercise.

Results: Compared to the placebo cream the 14% Plai cream substantially reduced muscle soreness over the 7 d by -82% (95% CI = -155% to -6%, P = 0.03), but had similar muscle soreness effects to 7% Plai cream (-34%, -96% to 27%, P = 0.2). Compared to the placebo cream the 7% Plai cream resulted in a small non-significant reduction in muscle soreness levels over the following 7 d (-40%, -116% to 36%, P = 0.3). Compared to placebo cream there was little effect of Plai cream (7% or 14%) on muscle strength, jump height, thigh circumference or creatine kinase concentration.

Conclusion: Using 14% Plai cream over a 7-day period substantially reduced muscle soreness symptoms compared to 7% Plai cream or a placebo cream. The authors suggest that the administration of 14% Plai cream is a useful alternative in the management of DOMS.

Use of Primus: musculoskeletal evaluation to intentionally induce DOMS via strenuous eccentric exercise of the quadriceps muscles in a healthy population. Isokinetic mode was utilized for this testing.

“Outcome of radial head arthroplasty in comminuted radial head fractures: short and midterm results.”

Moghaddam A, Raven TF, Dremel E, et al. Outcome of radial head arthroplasty in comminuted radial head fractures: short and midterm results. *Trauma Mon.* 2016;21(1):e20201. doi:10.5812/traumamon.20201.

ABSTRACT:

Background: Comminuted radial head fractures are often associated with secondary injuries and elbow instability.

Objectives: The aim of this retrospective study was to evaluate how well the modular metallic head implant EVOLVE® prosthesis restores functional range of motion (ROM) and stability of the elbow in acute care.

Patients and Methods: Eighty-five patients with comminuted radial head fractures and associated injuries received treatment with an EVOLVE® prosthesis between May 2001 and November 2009. Seventy-five patients were available for follow-up. On average, patients were followed for 41.5 months (33.0: 4.0-93.0). Outcome assessment was done on the basis of pain, ROM, strength, radiographic findings, and functional rating scores such as Broberg and Morrey, the Mayo elbow performance index (MEPI), and disabilities of the arm, shoulder and hand (DASH). Our study is currently the largest analysis of clinical outcome of a modular radial head replacement in the literature.

Results: Overall, there were 2 (2.7%) Mason II fractures, 21 (28%) Mason III fractures, and 52 (69.3%) Mason IV fractures. Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification was also determined. Of the 85 patients in our study, 75 were available for follow-up. Follow-up averaged 41.5 months (range, 4 - 93 months). Average scores for the cohort were as follows: Morrey, 85.7 (median 90.2; range 44.4 - 100); MEPI, 83.3 (85.0; 40.0 - 100); and DASH 26.1 points (22.5; 0.0 - 75.8). Mean flexion/extension in the affected joint was 125.7°/16.5°/0° in comparison to the noninjured side 138.5°/0°/1.2°. Mean pronation/supination was 70.5°/0°/67.1° in comparison to the noninjured side 83.6°/0°/84.3°. Handgrip strength of the injured compared to the non-injured arm was 78.8%. The following complications were also documented: 58 patients had periprosthetic radiolucency shown to be neither clinically significant nor relevant according to evaluated scores; 26 patients had moderate or severe periarticular ossification and scored substantially worse according to MEPI and Morrey. Four patients required revisional surgery due to loosening of the prosthesis and chronic pain. In addition, one patient required a neurolysis of the ulnar nerve, one developed a neobursa, and one had extensive swelling and blistering. The time interval between injury and treatment appeared to have an effect on results. Thirty-five patients were treated within the first 5 days after accident and showed better results than the 40 patients who were treated after 5 days.

Conclusions: Comminuted radial head fractures with elbow instability can be treated well with a modular radial head prosthesis, which restores stability in acute treatment. The modular radial head arthroplasty used in this study showed promising findings in short to midterm results.

Use of Primus: musculoskeletal evaluation of elbow/forearm strength of patients post-radial head arthroplasty. Isometric mode was utilized to measure maximum strength capabilities of the elbow flexors and extensors and forearm supinators and pronators.

“Outcome of lateral transfer of the FHL or FDL for concomitant peroneal tendon tears.”

Seybold JD, Campbell JT, Jeng CL, et al. Outcome of lateral transfer of the FHL or FDL for concomitant peroneal tendon tears. *Foot & Ankle Intl.* 2016. doi:10.1177/1071100716634762.

ABSTRACT:

Background: Concomitant tears of the peroneus longus and brevis tendons are rare injuries, with literature limited to case reports and small patient series. Only 1 recent study directly compared the results of single-stage lateral deep flexor transfer, and no previous series objectively evaluated power and balance following transfer. The purpose of this study was to evaluate clinical outcomes, patient satisfaction, and objective power and balance data following single-stage flexor hallucis longus (FHL) and flexor digitorum longus (FDL) tendon transfers for treatment of concomitant peroneus longus and brevis tears.

Methods: Over an 8-year period (2005-2012), 9 patients underwent lateral transfer of the FHL or FDL tendon for treatment of concomitant peroneus longus and brevis tears. All but 1 patient underwent additional procedures to address hindfoot malalignment or other contributing deformity at the time of surgery. Mean age was 56.9 years, and average body mass index was 27.9. Lateral transfer of the FHL was performed in 5 patients, and FDL transfer performed in 4 with mean follow-up 35.7 months (range: 11-94). Eight of 9 patients completed SF-12 and Foot Function Index (FFI) scores, and 7 returned for range of motion (ROM) and manual strength testing of the involved and normal extremities. These 7 patients also completed force plate balance tests, in addition to peak force and power testing on a PrimusRS machine with a certified physical therapist.

Results: All patients were satisfied with the results of the procedure. Mean SF-12 physical and mental scores were 32 and 55, respectively; mean FFI total score was 56.7. No postoperative infections were noted. Two patients continued to utilize orthotics or braces, and 2 patients reported occasional pain with weightbearing activity. Three patients noted mild paresthesias in the distribution of the sural nerve and 2 demonstrated tibial neuritis. All patients demonstrated 4/5 eversion strength in the involved extremity. Average loss of inversion and eversion ROM were 24.7% and 27.2% of normal, respectively. Mean postoperative eversion peak force and power were decreased greater than 55% relative to the normal extremity. Patients demonstrated nearly 50% increases in both center-of-pressure tracing length and velocity during balance testing. There were no statistically significant differences between the FHL and FDL transfer groups with regards to clinical examination or objective power and balance tests.

Conclusion: The FHL and FDL tendons were both successful options for lateral transfer in cases of concomitant peroneus longus and brevis tears. Objective measurements of strength and balance demonstrated significant deficits in the operative extremity, even years following the procedure. These differences, however, did not appear to alter or inhibit patient activity levels or high satisfaction rates with the procedure. Although anatomic studies have demonstrated benefits of FHL transfer over the FDL tendon, further studies with increased patient numbers are needed to determine if these differences are clinically significant.

Use of Primus: musculoskeletal evaluation of ankle eversion strength post-FHL or FDL tendon transfer procedures. Isometric and isotonic modes were utilized to measure maximum strength capabilities and power output.

“Extensive functional evaluations to monitor aerobic training in Becker Muscular Dystrophy: A case report.”

Tramonti C, Rossi B, Chrisari C. Extensive functional evaluations to monitor aerobic training in Becker Muscular Dystrophy: A case report. *Eur J Transl Myol.* 2016;26:81-86

ABSTRACT:

Purpose: To describe the case of a 33 yo BMD male who performed a low-intensity aerobic training program and the effects that training had on muscle strength, endurance, and fatigue.

Design: Case report

Methods: The patient underwent an aerobic training protocol, consisting of walking on a treadmill at a maximal tolerable speed. The rehabilitative treatment lasted 4 weeks, with a frequency of 3 days/week. Extensive functional evaluations were executed to monitor the efficacy of the rehabilitative treatment.

Results: Increased force exertion and an improvement in muscle contraction during sustained exercise were evidenced. An improvement of walk velocity, together with agility, endurance capacity, and oxygen

consumption during exercise were observed. Moreover, an enhanced metabolic efficiency was evidenced, as shown by reduced lactate blood levels after training. Interestingly, CK showed higher levels after the training protocol.

Conclusions: Aerobic training may represent an effective method improving exercise performance, functional status and metabolic efficiency in patients with BMD.

Use of Primus: musculoskeletal evaluation of lower extremity strength capabilities. Isometric mode was utilized to measure MVIC and endurance/fatigue of the hip and knee extensors and ankle dorsiflexors.

2015

“Robot-assisted gait training improves motor performances and modifies motor unit firing in post stroke patients.”

Chisari C, Bertolucci F, Monaco V, et al. Robot-assisted gait training improves motor performances and modifies motor unit firing in post stroke patients. *Eur J Phys Rehabil Med.* 2015;51:59-69

ABSTRACT:

Purpose: To test the efficacy of Lokomat in gait retraining and to investigate the neurophysiological mechanisms underlying the recovery process.

Design: Case Series Study

Methods: Fifteen patients underwent a six weeks rehabilitative treatment provided by Lokomat. The outcomes measures were: Fugl-Meyer Motor Scale, Berg Balance Scale, 10 meters Walking Test, Timed Get Up and Go, 6-Minute Walking Test. Strength and motor unit firing rate of vastus medialis were analyzed during isometric knee extension through an isokinetic dynamometer and surface EMG recording.

Results: An increase of duration and covered distance, a decrease of body weight support and guidance force on the paretic side along the sessions were observed. The FMMS, the BBS, the TUG and the 6MWT demonstrated a significant improvement after the training. No increase of force was observed whereas a significant increase of firing rate of VM was recorded.

Conclusions: The evidence that the improvement of walking ability observed in our study determines a significant increase of firing rate of VM not accompanied by an increase of force could suggest an effect of training on motorneuronal firing rate that thus contributes to improve motor control.

Use of Primus: neuromuscular evaluation and training of lower extremity strength capabilities of individuals post-stroke. Isometric mode was utilized to measure MVIC and pre-defined percentages of MVIC of the quadriceps.



“A service evaluation of the therapy assessments used for preoperative wrist surgery assessments within a single National Health Service Trust.”

Donnison E, Woodbridge S. A service evaluation of the therapy assessments used for preoperative wrist surgery assessments within a single National Health Service Trust. *Hand Therapy.* 2015;20B:124-133.

ABSTRACT:

Introduction: Chronic wrist joint pain is complex and often managed surgically. Where pain predominates, but function and movement are good, conservative or less invasive procedures may be preferable, such as denervation. To aid surgical selection denervation effectiveness can be predicted by a wrist assessment including nerve blocks. While much literature exists for denervation surgery no research to date has explored nerve blocks from a therapy assessment perspective. The purpose of this service evaluation was to establish current assessment practice, provide an important starting point to discuss why assessments may be selected and aid understanding of the assessment service provided.

Methods: A service evaluation was undertaken. The assessments selected by three therapists for cases referred for a preoperative wrist assessment were recorded and analyzed.

Results: Fourteen participants were recruited during a five-month period. The mean age was 57.43 years (range 21–79). Two assessments were terminated to address conservative management. Of the remaining 12 participants, assessments included range of motion, cumulative and resting pain 100% (n = 12), grip and pinch strength 92% (n = 11), function 17% (n = 2) and Baltimore Therapeutic Equipment static and dynamic movements 92% (n = 11).

Conclusion: This time-limited evaluation provides insight into the varied assessments used, by therapists within a single NHS Trust, to simulate activity and/or wrist structures under stress. The assessment is a global patient-centered process which aids identification of strategies for conservative and surgical procedures including denervation surgery. Despite the small sample, trends were noted in the practices of experienced hand therapists.

Use of Primus: musculoskeletal evaluation of forearm/wrist/hand strength in patients with complaints of wrist pain. Isometric and isotonic modes were utilized to measure maximum strength capabilities and work output.

“Motor control performance during rapid voluntary movements of elbow and knee.”

Goel R, Paloski WH. Motor control performance during rapid voluntary movements of elbow and knee. *J Motor Behavior*. 2015. <http://dx.doi.org/10.1080/00222895.2015.1098585>.

ABSTRACT:

Knowledge of motor control differences during rapid goal-directed movements of the upper and lower limbs could be useful in improving rehabilitation protocols. The authors investigated performance and control differences between elbow and knee joints and between different contraction types (concentric vs. eccentric) during rapid movements under externally applied load. There were no significant differences in performance and control with respect to joint (elbow vs. knee) but the performance during concentric contractions was better than eccentric for both the joints. The findings indicate that despite anatomical and functional differences, the CNS is finely tuned for both the joints to maximize the efficiency of movement during a dynamic environment, but there are differences in control strategies between the 2 contraction types.

Use of Primus: musculoskeletal evaluation of elbow and knee strength in a healthy population. Isometric mode was utilized to measure maximum strength capabilities and CPM mode for motor control testing.

“The use of occupation-based assessments and intervention in the hand therapy setting – a survey.”

Grice KO. The use of occupation-based assessments and intervention in the hand therapy setting – a survey. *J Hand Ther*. 2015;28:300-306.

ABSTRACT:

Study design: Descriptive survey.

Introduction: This study specifically explored the use of occupation-based assessments and intervention in the hand therapy setting, but also more generally, current practice trends about all assessments being utilized in this setting, frequency of their use, and therapists’ perceptions about them.

Methods: An online survey was distributed via email to members of the American Society of Hand Therapists (ASHT). The survey consisted of ten questions and was administered via Survey Monkey.

Results: Responses were received from 22% of those surveyed. A descriptive analysis was completed of the results and indicated that over half use occupation-based assessments on a daily basis; most are related to ADL function and used for the development of goals. The primary reason for not utilizing occupation-based assessments is time limitation. Seventy-nine percent believe these measures are

important for the services provided in the hand therapy setting.

Conclusion: Occupation-based assessments and intervention are not utilized as much as therapists would like in the hand therapy setting, primarily due to time constraints. While not formally assessed, the majority of those who responded indicated that they do address occupation in their assessments and interventions.

Use of Primus: musculoskeletal evaluation and treatment of ADLs, functional tasks, work activities, leisure activities, and sports.



“Hybrid diffuse optical techniques for continuous hemodynamic measurement in gastrocnemius during plantar flexion exercise.”

Henry B, Zhao M, Shang Y, et al. Hybrid diffuse optical techniques for continuous hemodynamic measurement in gastrocnemius during plantar flexion exercise. *J Biomed Optics*. 2015;20:125006-1 - 125006-1 http://uknowledge.uky.edu/rehabsci_facpub/54.

ABSTRACT:

Occlusion calibrations and gating techniques have been recently applied by our laboratory for continuous and absolute diffuse optical measurements of forearm muscle hemodynamics during handgrip exercises. The translation of these techniques to the lower limb is the goal of this study as various diseases preferentially affect muscles in the lower extremity. This study adapted a hybrid near-infrared spectroscopy and diffuse correlation spectroscopy system with a gating algorithm to continuously quantify hemodynamic responses of medial gastrocnemius during plantar flexion exercises in 10 healthy subjects. The outcomes from optical measurement include oxy-, deoxy-, and total hemoglobin concentrations, blood oxygen saturation, and relative changes in blood flow (rBF) and oxygen consumption rate (rVO₂). We calibrated rBF and rVO₂ profiles with absolute baseline values of BF and VO₂ obtained by venous and arterial occlusions, respectively. Results from this investigation were comparable to values from similar studies. Additionally, significant correlation was observed between resting local muscle BF measured by the optical technique and whole limb BF measured concurrently by a strain gauge venous plethysmography. The extensive hemodynamic and metabolic profiles during exercise will allow for future comparison studies to investigate the diagnostic value of hybrid technologies in muscles affected by disease.

Use of Primus: musculoskeletal evaluation of ankle strength in a healthy population. Isometric mode was utilized to measure maximum strength capabilities and isotonic mode for therapeutic exercise.

“Is single-radius design better for quadriceps recovery in total knee arthroplasty?”

Kim DH, Kim DK, Lee SH, et al. Is single-radius design better for quadriceps recovery in total knee arthroplasty? *Knee Surg Relat Res*. 2015;27:240-246. <http://dx.doi.org/10.5792/ksrr.2015.27.4.240>

ABSTRACT:

Purpose: Although single-radius (SR) designs have a theoretical advantage in quadriceps recovery following total knee arthroplasty (TKA), there has been a paucity of objective evaluation studies.

Materials and Methods: One hundred and twenty minimally invasive TKAs were prospectively randomized by a single surgeon into 2 groups: SR design TKA group and multi-radius design TKA group. Quadriceps force and power were assessed using a dynamometer, and clinical data were investigated preoperatively and 6 weeks, 3 months, 6 months and 1 year postoperatively.

Results: There were no differences between two groups in quadriceps recovery and clinical results throughout the follow-up period. Furthermore, the proportion of patients whose postoperative quadriceps force and power reached preoperative level was similar in both groups.

Conclusions: Femoral component design itself would not significantly influence quadriceps recovery after TKA.

Use of Primus: musculoskeletal evaluation of lower extremity muscle performance of patients post-single radius TKA. Isometric mode was utilized to measure maximum strength and isotonic mode to measure power output of the quadriceps.

“Effect of isotonic and isokinetic exercise on muscle activity and balance of the ankle joint.”

Kim MK, Yoo KT. Effect of isotonic and isokinetic exercise on muscle activity and balance of the ankle joint. *J Phys Ther Sci.* 2015;27:415-420.

ABSTRACT:

Purpose: This study was performed to examine how the balance of lower limbs and the muscle activities of the tibialis anterior (TA), the medial gastrocnemius (GCM), and the peroneus longus (PL) are influenced by isotonic and isokinetic exercise of the ankle joint.

Subjects: The subjects of this study were healthy adults (n=20), and they were divided into two groups (isotonic=10, isokinetic=10). [Methods] Isotonic group performed 3 sets of 10 contractions at 50% of MVIC and Isokinetic group performed 3 sets of 60°/sec. Muscle activity was measured by EMG and balance was measured by one-leg standing test.

Results: For muscle activity, a main effect of group was found in the non-dominant TA, and the dominant TA, GCM and PL. For balance, a main effect of time was found in both groups for the sway area measured support was provided by the non-dominant side.

Conclusion: In terms of muscle activity, the two groups showed a significant difference, and the isokinetic group showed higher muscle activities. In terms of balance, there was a significant difference between the pre-test and the post-test. The results of this study may help in the selection of exercises for physical therapy, because they show that muscle activity and balance vary according to the type of exercise.

Use of Primus: musculoskeletal evaluation of ankle strength using the isometric mode and exercise on muscle activity and balance in a healthy population. Isotonic and isokinetic modes were utilized by 2 different exercise groups.

“Effects of different types of exercise on muscle activity and balance control.”

Kim MK, Choi JH, Gim MA, et al. Effects of different types of exercise on muscle activity and balance control. *J Phys Ther Sci.* 2015;27:1875-1881.

ABSTRACT:

Purpose: This study analyzed the effects of isotonic, isokinetic, and isometric exercises of ankle joint muscles on lower extremity muscle activity and balance control.

Subjects and Methods: The subjects were 30 healthy adults (15 males) in their 20s who were randomly assigned to three different exercise method groups of 10 people each. The isokinetic exercise group performed three sets at an angular velocity of 60°/sec, including a single rest period after every set of 10 repetitions. The isometric exercise group performed three sets consisting of three 15 repetitions of a 15-second exercise followed by a 5-second rest.

Results: Multivariate analysis of variance revealed that depending on the exercise method, the non-dominant tibialis anterior, gastrocnemius muscle, and peroneus longus showed significant differences in muscle activity for weight-bearing non-dominant sides; when the dominant side was weight-bearing, the dominant gastrocnemius and peroneus longus showed significant differences in muscle activity; and the non-dominant and dominant sides showed significant differences in balance control depending on the duration of support in the area.

Conclusion: Muscle fatigue from the three exercise methods produced a decline in muscle activity and balance control; due to the fatigue before exercise, the side that did not perform the exercises was affected.

Use of Primus: musculoskeletal evaluation of ankle strength using the isometric mode and exercise/treatment on muscle activity and balance in a healthy population. Isometric, isotonic, and isokinetic modes were utilized by 3 different exercise groups.

“The patient’s perception does not differ following subvastus and medial parapatellar approaches to total knee arthroplasty: a simultaneous bilateral randomized study.”

Koh IJ, Kim MW, Kim MS, et al. The patient’s perception does not differ following subvastus and medial parapatellar approaches to total knee arthroplasty: a simultaneous bilateral randomized study. *J Arthroplasty*. 2015. <http://dx.doi.org/10.1016/j.arth.2015.08.004>

ABSTRACT:

This simultaneous bilateral randomized study investigated whether patients would perceive the difference between the subvastus approach (SVA) and the medial parapatellar approach (MPA) after total knee arthroplasty (TKA). In 50 patients scheduled to undergo same-day bilateral TKA, one knee was randomly assigned to SVA and the other to MPA. Patient-reported measures (pain, Western Ontario McMaster University Osteoarthritis Index score, and side preference) and physician-assessed measures (isokinetic muscle strength, range of motion, and Knee Society score) were compared. No differences were observed in the patient-reported measures and physician-assessed measures, with the exception of greater quadriceps strength at postoperative 1 week in knees that underwent SVA. Patients receiving contemporary perioperative management after same-day bilateral TKA do not perceive any difference between knees that underwent SVA or MPA.

Use of Primus: musculoskeletal evaluation of quadriceps strength in patients post-TKA. The isometric mode was utilized to measure maximum strength capabilities.

“Functional outcomes following bridge plate fixation for distal radius fractures.”

Lauder A, Agnew S, Bakri K, et al. Functional outcomes following bridge plate fixation for distal radius fractures. *J Hand Surg*. 2015;40A(8):1154-1662.

ABSTRACT:

Purpose: To determine the functional outcomes of patients treated with dorsal spanning distraction bridge plate fixation for distal radius fractures.

Methods: All adult patients at our institution who underwent treatment of a unilateral distal radius fracture using a dorsal bridge plate from 2008 to 2012 were identified retrospectively. Patients were enrolled in clinical follow-up to assess function. Wrist range of motion, grip strength, and extension torque were measured systematically and compared with the contralateral, uninjured wrist. Patients also completed Quick- Disabilities of the Arm, Shoulder, and Hand and Patient-Rated Wrist Evaluation outcomes questionnaires.

Results: Eighteen of 100 eligible patients, with a minimum of 1 year from the time of implant removal, were available for follow-up (mean, 2.7 y). All fracture patterns were comminuted and intra-articular (AO 23.C3). There were significant decreases in wrist flexion (43° vs 58°), extension (46° vs 56°), and ulnar deviation (23° vs 29°) compared with the contralateral uninjured wrist. Grip strength was 86% and extension torque was 78% of the contralateral wrist. Comparison of dominant and non-dominant wrist injuries identified nearly complete recovery of grip (95%) and extension (96%) strength of dominant-sided wrist injuries, compared with grip (79%) and extension (65%) strength in those with an injured non-dominant wrist. Mean Quick-Disabilities of the Arm, Shoulder, and Hand and Patient-Rated Wrist

Evaluation scores were 16 and 14, respectively. There were 2 cases of postoperative surgical site pain and no cases of infection, tendonitis, or tendon rupture.

Conclusions: Distraction bridge plate fixation for distal radius fractures is safe with minimal complications. Functional outcomes are similar to those published for other treatment methods.

Use of Primus: musculoskeletal evaluation of strength of the upper extremity of patients with distal radius fractures. Isometric mode was utilized to measure maximum strength capabilities or grip and wrist extension.

“Relationship between knee alignment and the electromyographic activity of quadriceps muscles in patients with knee osteoarthritis.”

Lim SH, Hong BY, Oh JH, et al. Relationship between knee alignment and the electromyographic activity of quadriceps muscles in patients with knee osteoarthritis. *J Phys Ther Sci.* 2015;27:1261-1265.

ABSTRACT:

Purpose: We evaluated the relationship between knee alignment and the electromyographic (EMG) activity of the vastus medialis (VM) to the vastus lateralis (VL) muscles in patients with knee osteoarthritis (OA) in a cross-sectional study.

Subjects and Methods: Forty subjects with knee OA were assessed by anatomic radio-graphic knee alignment and the VM/VL ratio was calculated. Surface EMG from both the VM and VL muscles were evaluated during maximal isometric contraction at 60° knee flexion. Simultaneously, peak quadriceps torque was assessed using an isokinetic dynamometer. Subjects were categorized into low, moderate, and high varus groups according to knee malalignment. The peak quadriceps torque and VM/VL ratio across groups, and their relationships with varus malalignment were analyzed.

Results: All subjects had medial compartment OA and the VM/VL ratio of all subjects was 1.31 ± 0.28 (mean \pm SD). There were no significant differences in the peak quadriceps torque or VM/VL ratios across the groups nor were there any significant relationships with varus malalignment.

Conclusion: The VM/VL ratio and peak quadriceps torque were not associated with the severity of knee varus malalignment.

Use of Primus: musculoskeletal evaluation of strength of quadriceps muscle of patients with knee OA. Isometric mode was utilized to obtain peak torque values.

“Changes in force and stiffness after static stretching of eccentrically-damaged hamstrings.”

Matsuo S, Suzuki S, Iwata M, et al. Changes in force and stiffness after static stretching of eccentrically-damaged hamstrings. *Eur J Appl Physiol.* 2015;115:981-991.

ABSTRACT:

Purpose: This study compared responses to static stretching between eccentrically damaged and non-damaged muscles.

Methods: Twelve young men performed 60 maximum knee flexor eccentric contractions of one leg, and received a 300-s continuous passive static stretching at tolerable intensity without pain to both knee flexors at 2 and 4 days after the eccentric exercise. Range of motion (ROM) and passive stiffness during knee extension, passive torque at onset of pain (PT), maximum voluntary isometric (MVC-ISO) and isokinetic concentric contraction torque (MVC-CON), and visual analogue scale (VAS) for muscle soreness were measured before, immediately after, 60 min, 2 and 4 days after exercise as well as before, immediately after, 20 and 60 min after the stretching. Changes in these variables after eccentric exercise and stretching were compared between limbs.

Results: The eccentric exercise decreased MVC-ISO, MVC-CON, ROM and PT, and increased passive stiffness and VAS ($p < 0.05$), suggesting that muscle damage was induced to the knee flexors. ROM and PT increased after stretching for both limbs; however, the magnitude of the increase was greater ($p < 0.05$) for the damaged than non-damaged limb. Passive stiffness decreased for both limbs similarly (4–7 %) at immediately after stretching ($p < 0.05$). Significant decreases in MVC-ISO torque (7–11%) after stretching were observed only for the nondamaged limb ($p < 0.05$), but MVC-CON torque did not change after stretching for both limbs. VAS decreased for the exercised limb after stretching ($p < 0.05$).

Conclusions: These results suggest that the static stretching at tolerable intensity without pain produced greater positive effects on damaged than non-damaged muscles.

Use of Primus: musculoskeletal evaluation of lower extremity ROM, passive torque at onset of pain due to stretch, passive stiffness, and muscle strength of healthy young males. Isometric was utilized to measure these parameters of the quadriceps and hamstring muscle groups.

“Reliability and fatigue characteristics of a standing hip isometric endurance protocol.”

Mutchler JA, Weinhandl JT, Hoch MC, et al. Reliability and fatigue characteristics of a standing hip isometric endurance protocol. *J Electromyography Kinesiol.* 2015;25:667-674.
<http://dx.doi.org/10.1016/j.jelekin.2015.02.003>.

ABSTRACT:

Muscle fatigue is a common consideration when evaluating and rehabilitating athletic injuries. The presence of muscular fatigue has been previously determined by quantifying median frequency (MF) through a power spectral analysis on EMG signals collected throughout an endurance task. Research has not yet determined if a prolonged isometric test in a standing position generates muscular fatigue of the hip. The purpose of this study was to determine the reliability and fatigue characteristics of a standing hip isometric endurance test. Twenty healthy participants completed one 60-s Maximum Voluntary Isometric Contraction of standing hip flexion, extension, adduction, and abduction. MF of the participants' dominant limb rectus femoris (RF), biceps femoris (BF), gluteus maximus (GMax), gluteus medius (GMed) and adductor longus (ADD) was determined via surface electromyography during two sessions, 30-min apart. Reliability values (ICC2,1) were moderate-to-excellent for all time intervals of each action (Flexion_{RF}: >0.80; Extension_{BF}: >0.89; Extension_{GMax}: >0.60; Adduction_{ADD}: >0.78; Abduction_{GMed}: >0.60) and MF significantly decreased over time for all actions. Results suggest the endurance test is a reliable technique to generate muscular fatigue for hip flexion, extension, adduction and abduction. It can be used as a time efficient fatigue protocol specific to the RF, BF, GMax, ADD and GMed.

Use of Primus: musculoskeletal evaluation of strength of hip musculature of healthy males and females. Isometric mode was utilized to measure torque during hip isometric endurance tests.

“Sport-specific training targeting the proximal segments and throwing velocity in collegiate throwing athletes.”

Palmer T, Uhl TL, Howell D, et al. Sport-specific training targeting the proximal segments and throwing velocity in collegiate throwing athletes. *J Athl Train.* 2015;50(6):567-577.

ABSTRACT:

Context: The ability to generate, absorb, and transmit forces through the proximal segments of the pelvis, spine, and trunk has been proposed to influence sport performance, yet traditional training techniques targeting the proximal segments have had limited success improving sport-specific performance.

Objective: To investigate the effects of a traditional endurance-training program and a sport-specific power-training program targeting the muscles that support the proximal segments and throwing velocity.

Design: Randomized controlled clinical trial.

Setting: University research laboratory and gymnasium.

Patients or Other Participants: A total of 46 (age = 20 ± 1.3 years, height = 175.7 ± 8.7 cm) healthy National Collegiate Athletic Association Division III female softball (n = 17) and male baseball (n = 29) players.

Intervention(s): Blocked stratification for sex and position was used to randomly assign participants to 1 of 2 training groups for 7 weeks: a traditional endurance-training group (ET group; n = 21) or a power-stability-training group (PS group; n = 25).

Mean Outcome Measure(s): The change score in peak throwing velocity (km/h) normalized for body weight (BW; kilograms) and change score in tests that challenge the muscles of the proximal segments normalized for BW (kilograms). We used 2-tailed independent-samples t tests to compare differences between the change scores.

Results: The peak throwing velocity (ET group = 0.01 ± 0.1 km/h/kg of BW, PS group = 0.08 ± 0.03 km/h/kg of BW; $P < .001$) and muscle power outputs for the chop (ET group = 0.22 ± 0.91 W/kg of BW, PS group = 1.3 ± 0.91 W/kg of BW; $P < .001$) and lift (ET group = 0.59 ± 0.67 W/kg of BW, PS group = 1.4 ± 0.87 W/kg of BW; $P < .001$) tests were higher at post-intervention in the PT than in the ET group.

Conclusions: An improvement in throwing velocity occurred simultaneously with measures of muscular endurance and power after a sport-specific training regimen targeting the proximal segments.

Use of Primus: musculoskeletal evaluation of maximal peak muscular power using a chop and lift 1-repetition maximum (1RM) power protocol testing in healthy college age throwers. Dynamic muscle power and endurance were measured.



“Evidence of increased axillary blood flow velocity without increased handgrip strength and endurance in persons with a fibromuscular axillary arch.”

Scafoglieri A, De Maeseneer M, Debondt A, et al. Evidence of increased axillary blood flow velocity without increased handgrip strength and endurance in persons with a fibromuscular axillary arch. *Folia Morphol.* 2015;74:486-492.

https://journals.viamedica.pl/fovia_morphologica/article/view/FM.2015.0112/33754.

ABSTRACT:

Background: The purpose of this in vivo study was to compare axillary artery blood flow velocity, and maximal handgrip strength and endurance performance in young subjects with and without an axillary arch (AA).

Materials and methods: One hundred and fifty-six young adults were screened for the presence of an AA on their dominant arm side. After physical examination subjects were checked using diagnostic echography for the presence of an AA. Sixteen subjects with an AA and 15 without an AA had their axillary artery peak systolic velocity quantified in 3 different arm positions using Doppler ultrasound. Maximal handgrip strength and endurance performance was quantified in the same positions using a functional rehabilitation system.

Results: Mean peak systolic velocity was significantly higher in the AA group compared to controls in abduction/external rotation of the arm during muscle relaxation ($p = 0.003$) and contraction ($p = 0.01$). No significant differences between groups were found for maximal handgrip strength and endurance performance.

Conclusions: This study provides evidence for a transient axillary artery compression by the AA in a throwing position. This is not reinforced by additional contraction of the shoulder muscles along with the AA. Axillary artery compression does not influence maximal handgrip strength and endurance performance in symptom-free young adults.

Use of Primus: musculoskeletal evaluation of strength and endurance of grip muscles. Isometric and isotonic modes were utilized to measure peak maximum strength capabilities and muscle endurance.

“Distal Biceps Brachii tendon repairs.”

Shields E, Olsen JR, Williams RB, et al. Distal Biceps Brachii tendon repairs. *Am J Sports Med.* 2015;43:1072-1076.

ABSTRACT:

Background: Distal biceps brachii tendon repairs performed with a tension slide technique using a cortical button (CB) and interference screw are stronger than those based on suture fixation through bone tunnels (BTs) in biomechanical studies. However, clinical comparison of these 2 techniques is lacking in the literature.

Purpose: To perform a clinical comparison of the single-incision CB and double-incision BT techniques.

Study Design: Cohort study; Level of evidence, 3.

Methods: Distal biceps tendon ruptures repaired through either the single-incision CB or double-incision BT technique were retrospectively identified at a single institution. Patients >1 year out from surgery were assessed for range of motion, strength, and complications, and they completed a DASH questionnaire (Disabilities of the Arm, Shoulder, and Hand).

Results: Patients in the CB group (n = 20) were older (52 ± 9.5 vs 43.7 ± 8.7 years; $P = .008$), had a shorter interval from surgery to evaluation (17.7 ± 5 vs 30.8 ± 16.5 months; $P = .001$), and were less likely to smoke (0% vs 28.5%; $P = .02$) compared with the BT patients (n = 21). DASH scores were similar between groups (4.46 ± 4.4 [CB] vs 5.7 ± 7.5 [BT]; $P = .65$). Multivariate analysis revealed no differences in range of motion or strength between groups. More CB patients (30%; n = 6) experienced a complication compared with those in the BT group (4.8%; n = 1) ($P = .04$), and these complications were predominantly paresthesias of the superficial radial nerve that did not resolve. There were no reoperations or repair failures in either group.

Conclusion: Both the single-incision CB and double-incision BT techniques provided excellent clinical results. Complications were more common in the single-incision CB group and most commonly involved paresthesias of the superficial radial nerve.

Use of Primus: musculoskeletal evaluation of upper extremity muscle performance of patients post-biceps tendon repair. Isometric mode was utilized to measure maximum strength of the elbow flexors and forearm supinators.

2014

“Better quadriceps recovery after minimally invasive total knee arthroplasty.”

Cho KY, Kim KI, Umrani S, et al. Better quadriceps recovery after minimally invasive total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2014;22:1759-1764. DOI 10.1007/s00167-013-2556-2

ABSTRACT:

Purpose: The proponents of minimally invasive total knee arthroplasty (TKA) have reported better functional recovery than conventional TKA. In most of the previous studies, the results were shown with the relatively subjective methods. We investigated the objective results with a dynamometry in this prospective randomized study. It was hypothesized that minimally invasive TKA would have a better and earlier recovery of quadriceps force in terms of the objective numeric data.

Methods: Sixty-six TKAs were prospectively randomized into two groups. Thirty-three knees underwent minimally invasive TKA using mini-midvastus approach and 33 knees underwent conventional TKA using medial parapatellar approach. The quadriceps force was assessed using a dynamometer. The data were collected preoperatively and at postoperative 6 weeks, 3 months, 6 months and 1 year consecutively.

Results: The mean of quadriceps force in minimally invasive TKA group at postoperative 6 weeks was greater than conventional TKA after removing the covariate (pre-operative quadriceps force) with analysis of covariance ($P = 0.002$), but thereafter, the difference was not significant till 1 year. Meanwhile, with repeated measures analysis of variance, conventional TKA group had greater quadriceps recovery than

minimally invasive TKA group during postoperative 6 weeks to 3 months ($P = 0.035$). The proportion of patients unable to recover the quadriceps force to their preoperative levels by 1 year postoperatively was similar in two groups.

Conclusion: Minimally invasive TKA has benefit in quadriceps recovery at earlier rehabilitation period although catch-up recovery in conventional TKA was accelerated from the postoperative 6 weeks to 3 months. It may support the concept of early return to full activity after minimally invasive TKA, and patients might get back early to normal life.

Level of evidence: Therapeutic study, Level I.

Use of Primus: musculoskeletal evaluation of quadriceps strength in patients post-TKA. Isometric mode was utilized for assessment of quadriceps strength.

“Analysis of muscle strength using a dynamometer in women’s professional cycling team.”

Fronczek-Wojciechowska M, Kopacz K, Kosielski P, et al. Analysis of muscle strength using a dynamometer in women’s professional cycling team. *J Kinesiol Exerc Sci.* 2014; 68:47-52.

ABSTRACT:

Purpose: There is a need for objective movement analysis in professional sport. The aim of the work was to perform a dynamometric analysis in order to determine the muscular strength of a female professional cycling team.

Basic procedures: The material comprised five female athletes from the TKK Pacific professional cycling team. A Primus RS dynamometer was used to measure isometric muscle strength before and after a maximal exercise stress test performed using Ultima PFX Cardio2 system and 12-channel wireless Mortara ECG. During dynamometry, isometric examination was performed of the flexion and extension of the right and left knee joint muscles, as well as right and left hip joint muscles. Statistical analysis was performed using Microsoft Excel 2010 and Statistica v.10. $p = 0.05$ was accepted as the level of statistical significance.

Main findings: No significant differences in muscle strength were found between the analyses performed before and after the strength tests. However, decreases or increases in muscle strength were confirmed in individual athletes, and advice was given regarding changes in training. Strength imbalances related to the antagonistic muscles of the lower limbs were observed in the case of three athletes.

Conclusion: The objective analysis of muscle strength, as well as the provision of individual examination protocols and interpretation of the results may personalize the training process and reduce the risk of overloads on the musculoskeletal system.

Use of Primus: musculoskeletal evaluation of strength of a female professional cycling team. Isometric mode was used to measure strength pre- and post-maximum effort exercise session to identify effects of fatigue on muscle performance.

“The impact of sagittal plane hip position on isometric force of hip external rotator and internal rotator muscles in healthy young adults.”

Hoglund LT, Wong ALK, Rickards C. The impact of sagittal plane hip position on isometric force of hip external rotator and internal rotator muscles in healthy young adults. *Intl J Sports Phys Ther.* 2014;9(1):58-67.

ABSTRACT:

Purpose/Background: Hip external rotator (ER) and internal rotator (IR) muscle weakness is theorized to be associated with lower extremity injury in athletes including knee ligament tears and patellofemoral

pain. Previous studies investigating hip musculature strength have utilized various sagittal plane hip positions for testing. The relationship between results at these different positions is unknown.

Methods: Eighty healthy, pain-free young adults participated in the study: 40 female, mean age 22.90 (\pm 2.32) years, and 40 male, mean age 23.50 (\pm 2.15) years. Peak isometric torque of bilateral hip ER and IR were tested at 90° and 0° of hip flexion with an instrumented dynamometer. Peak muscle forces were calculated. Peak forces were normalized by body mass. Mean normalized force was calculated for dominant and non-dominant limbs for ER and IR in both positions. Male and female data were analyzed separately with paired t-tests (2-tailed). Reference values for average muscle force and torque were calculated for dominant and non-dominant limbs for both hip positions.

Results: Hip IR normalized peak force was greater at 90° compared to 0° flexion position bilaterally in both genders ($p < .01$). Hip ER normalized peak force was greater at 90° compared to 0° flexion in dominant limbs of both genders and in non-dominant limbs of males ($p < .01$). Non-dominant hip ER normalized force in females was greater at 90° versus 0° flexion; however, it was not significant ($p = .092$). Post hoc analysis of normalized average force (average over 5-second contraction) yielded similar results.

Conclusion: Clinicians and researchers should use consistent positioning for testing of hip ER and IR strength. This will improve certainty of determining if a patient's strength has changed or if differences between groups are present. Reference values reported will be useful in order to determine if weakness is present and to set goals, particularly in cases of bilateral involvement.

Use of Primus: musculoskeletal evaluation of hip muscle strength. Isometric mode was utilized for testing. Reliability of measures was established.

“Quadriceps intramuscular fat fraction rather than muscle size is associated with knee osteoarthritis.”

Kumar D, Karampinos DC, MacLeod TD, et al. Quadriceps intramuscular fat fraction rather than muscle size is associated with knee osteoarthritis. *Osteoarthritis Cartilage*. 2014;22:226-234.

<http://dx.doi.org/10.1016/j.joca.2013.12.005>.

ABSTRACT:

Objectives: To compare thigh muscle intramuscular fat (intraMF) fractions and area between people with and without knee radiographic osteoarthritis (ROA); and to evaluate the relationships of quadriceps adiposity and area with strength, function and knee magnetic resonance imaging (MRI) lesions.

Methods: Ninety-six subjects (ROA: Kellgren-Lawrence (KL) > 1 ; $n = 30$, control: KL = 0, 1; $n = 66$) underwent 3-T MRI of the thigh muscles using chemical shift-based water/fat MRI (fat fractions) and the knee (clinical grading). Subjects were assessed for isometric/isokinetic quadriceps/hamstrings strength, function Knee injury and Osteoarthritis Outcome Score (KOOS), stair climbing test (SCT), and 6-minute walk test (6MWT). Thigh muscle intraMF fractions, muscle area and strength, and function were compared between controls and ROA subjects, adjusting for age. Relationships between measures of muscle fat/area with strength, function, KL and lesion scores were assessed using regression and correlational analyses.

Results: The ROA group had worse KOOS scores but SCT and 6MWT were not different. The ROA group had greater quadriceps intraMF fraction but not for other muscles. Quadriceps strength was lower in ROA group but the area was not different. Quadriceps intraMF fraction but not area predicted self-reported disability. Aging, worse KL, and cartilage and meniscus lesions were associated with higher quadriceps intraMF fraction.

Conclusion: Quadriceps intraMF is higher in people with knee OA and is related to symptomatic and structural severity of knee OA, whereas the quadriceps area is not. Quadriceps fat fraction from chemical shift-based water/fat MR imaging may have utility as a marker of structural and symptomatic severity of knee OA disease process.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring strength in healthy adults with OA of knee. Isometric and isokinetic modes were utilized for testing.

“Effects of closed and open kinetic chain exercises on knee extensor strength and balance in patients with early stroke.”

Kwon OK, Shin WB. Effects of closed and open kinetic chain exercises on knee extensor strength and balance in patients with early stroke. *J Korean Soc Phys Med.* 2014;9:223-231. <http://dx.doi.org/10.13066/kspm.2014.9.2.223>.

ABSTRACT:

Purpose: The aim of this study was to investigate the effect of closed and open kinetic exercises on knee extensor strength and balance in patients with early stroke.

Methods: Thirty patients with early stroke participated in the study. Participants were randomly assigned to three groups: an open kinetic chain (OKC) exercise group (n=10), a closed kinetic chain (CKC) exercise group (n=10), and a control group (n=10). All participants received conventional physical therapy for 30 minutes. In addition, the two experimental groups (OKC and CKC) participated in a 30-minute knee strengthening training program. Training for the experimental groups was carried out three times a week for four weeks. Outcomes such as knee extensor strength and balance ability (Tetrax, Functional Reaching Test, Timed Up and Go Test) were measured before and after training.

Results: There were significant differences in knee extensor strength and balance ability between the pre- and post- treatment of all groups ($p < .05$). The improvement of knee extensor strength was significantly higher in the OKC group than in the other groups ($p < .05$), and the improvement of dynamic balance was significantly higher in the CKC group than in the other groups ($p < .05$).

Conclusion: These results showed that both open and closed kinetic chain exercises are effective in the improvement of knee extensor strength and balance ability. This study suggests that open and closed kinetic exercise training is an effective training for strength and balance in patients with early stroke.

Use of Primus: musculoskeletal evaluation of strength of the quadriceps muscles of patients post-stroke. Isometric mode was used to measure maximum strength capabilities.

“Knee joint position sense in physically active patients after ACL reconstruction.”

Pawlak D, Wysota A, Furmanek M, et al. Knee joint position sense in physically active patients after ACL reconstruction. *Central Europ J Sport Sci Med.* 2014;7:65-72.

ABSTRACT:

The term “proprioception” is defined as the conduction of sensory information deriving from proprioceptors that have an impact on conscious sensations, posture and trans-segmental sense. An ACL injury may lead to functional knee joint instability. According to research, this may result in impaired movement sensation and joint position.

The purpose of this study was to evaluate the joint position sense (JPS) in patients before arthroscopic ACL reconstruction and 5 months after the surgery. The examinations were conducted in a group of twelve specifically selected male patients. The examination procedure consisted of JPS measurement in both lower limbs (the operated and the healthy one) during active extension in a range of angles: 30, 45, 60°. The level of significance was: $p < 0.05$.

The analysis of variance performed for repeated measurements (ANOVA) did not indicate any statistically significant differences of JPS in comparisons made between the operated and the healthy limb. Statistical values for the absolute, relative, and variable errors were $p = 0.7684$, $p = 0.1546$, $p = 0.5694$ respectively. The obtained results do not indicate any limitation of proprioception in patients with ACL injury before the intervention or half a year later.

Use of Primus: neuromuscular evaluation of patients pre- and post-ACL reconstruction. Isotonic mode was utilized to assess proprioceptive sense of the knee joint.

“An ergonomic evaluation of the Extravehicular Mobility Unit (EMU) Spacesuit Hard Upper Torso (HUT) size effect on mobility, strength, and metabolic performance.”

Reid CR, Harvill LR, Norcross JR, et al. An ergonomic evaluation of the Extravehicular Mobility Unit (EMU) Spacesuit Hard Upper Torso (HUT) size effect on mobility, strength, and metabolic performance. *Proceedings of the Human Factors & Ergonomics Society 58th Annual Meeting – 2014.* doi:10.1177/1541931214581332.

ABSTRACT:

Introduction: The objective of this project was to develop a comprehensive methodology to assess the suit fit and performance differences between a nominally sized extravehicular mobility unit (EMU) spacesuit and a nominal +1 (plus) sized EMU.

Method: This study considered a multitude of evaluation metrics including 3D clearances and pressure point mapping to quantify potential issues associated with using off-nominal suit sizes.

Results: There were minimal differences with using a plus suit size.

Discussion: Analysis of the results indicates that future suit size evaluations should consider this ergonomic approach to understand and mitigate potential suit fit and performance issues.

Use of Primus: musculoskeletal evaluation of upper extremity strength of astronauts. Isokinetic mode was utilized to assess the effect of spacesuit design on shoulder and elbow strength.

“The influence of hip strength on lower limb, pelvis, and trunk kinematics and coordination patterns during walking and hopping in healthy women.”

Smith JA, Popovich JM, Kulig K. The influence of hip strength on lower limb, pelvis, and trunk kinematics and coordination patterns during walking and hopping in healthy women. *J Ortho Sports Phys Ther.* 2014;44(7):525-531.

ABSTRACT:

Study Design: Cross-sectional laboratory study.

Objectives: To compare peak lower-limb, pelvis, and trunk kinematics and inter-joint and intersegmental coordination in women with strong and weak hip muscle performance.

Background: Persons with lower extremity musculoskeletal disorders often demonstrate a combination of weak hip musculature and altered kinematics during weight-bearing dynamic tasks. However, the association between hip strength and kinematics independent of pathology or pain is unclear.

Methods: Peak hip extensor and abductor torques were measured in 150 healthy young women. Of these, 10 fit the criteria for the strong group and 9 for the weak group, representing those with the strongest and weakest hip musculature, respectively, of the 150 screened individuals. Kinematics of the hip, knee, pelvis, and trunk were measured during the stance phases of walking and rate-controlled hopping. Hip/knee and pelvis/trunk coordination were calculated using the vector coding technique.

Results: There were no group differences in peak hip, knee, or pelvis kinematics. Participants in the weak group demonstrated greater trunk lateral bend toward the stance limb during hopping ($P = .002$, effect size $[d] = 1.88$). In the transverse plane, those in the weak group utilized less inphase coordination between the hip and the knee during walking ($P = .036$, $d = 1.45$) and more antiphase coordination between the hip and knee during hopping ($P = .03$, $d = 1.47$).

Conclusion: In the absence of pain or pathology, poor hip muscle performance does not affect peak hip or knee joint kinematics in young women but is associated with significantly different lower-limb and trunk/pelvis coordination during weight-bearing dynamic tasks.

Use of Primus: musculoskeletal evaluation of hip strength of healthy young females. Isometric mode was utilized to measure maximum strength capabilities of hip abduction and extension.

“Rehabilitation of a patient following hand replantation after near-complete distal forearm amputation.”

Sturm SM, Oxley SB, Van Zant RS. Rehabilitation of a patient following hand replantation after near-complete distal forearm amputation. *J Hand Ther.* 2014;27(3):217-224.

ABSTRACT:

Study design: Case report.

Introduction: Reports of comprehensive rehabilitation following hand replantation are limited.

Purpose of the study: To describe hand therapy of a patient following hand replantation.

Methods: Right hand dominant 55 year-old male assessed 9 days following left hand replantation to treat distal forearm amputation. Patient presented with dorsal blocking orthotic. Initial status: AROM digits and thumb 0-20° extension, 0-40° flexion; absent light touch sensation; 0-1/5 hand strength. Patient underwent 70 hand therapy sessions over 13 months focusing on A/PROM, therapeutic exercise, neuromuscular re-education, and modalities to address functional limitations.

Results: Hand therapy discharge status: AROM digits and thumb form composite fist, thumb opposition to digit 3, light touch sensation (monofilament) 4.03 (digits 2, 4) and 4.17 (digits 1, 3, 5); 3- to 4-/5 hand strength.

Discussion: Hand therapy allowed for near complete functional return of the hand following replantation.

Conclusion: Comprehensive Hand therapy aided restoration of adequate sensation and strength for functional use of the replanted hand.

Use of Primus: musculoskeletal treatment to increase muscle strength and function of the upper extremity of patient post-hand replantation.



”Analysis of muscle strength using a dynamometer in women’s professional cycling team.”

Wojciechowska M, Kopacz K, Kosielski P, et al. Analysis of muscle strength using a dynamometer in women’s professional cycling team. *J Kinesiol Exerc Sci.* 2014;68:47-52

ABSTRACT:

Purpose: To perform a dynamometric analysis in order to determine the muscular strength of a female professional cycling team.

Design: Case Control study

Methods: A Primus RS dynamometer was used to measure isometric muscle strength before and after a maximal exercise stress test performed using Ultima PFX Cardio2 system and 12-channel wireless Mortara ECG. During dynamometry, isometric examination was performed of the flexion and extension of the right and left knee joint muscles, as well as right and left hip joint muscles. Statistical analysis was performed using Microsoft Excel 2010 and Statistica v.10. $p = 0.05$ was accepted as the level of statistical significance.

Results: No significant differences in muscle strength were found between the analyses performed before and after the strength tests. However, decreases or increases in muscle strength were confirmed in individual athletes, and advice was given regarding changes in training. Strength imbalances related to the antagonistic muscles of the lower limbs were observed in the case of three athletes.

Conclusions: Objective measures of muscle strength using a dynamometer instead of manual muscle testing can help to individualize the athletes training program and reduce the risk of overloads within the musculoskeletal system.



Use of Primus: musculoskeletal evaluation of isometric strength of lower extremities of female cyclists