Evidence-based Practice Initiative – Primus

"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 crewmembers, 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 ± 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.

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

Richter D, Gurney AB, Natividad T, Andrews R, LaBaze D, Schenck RC, Wascher DC: 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% ± 10.13. Isotonic quad strength at 60 deg·sec-1 - 84.74% ± 24.58, isotonic ham strength at 60 deg·sec-1 - 100.26% ± 19.77, isotonic quad strength at 180 deg·sec-1 - 89.74% ± 18.30, isotonic ham strength at 180 deg·sec-1 - 96.87% ± 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 TKD. 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, Tinelli M: 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, Leelayuwat N, Wonnabussapawich P, Boobpachat D, Manimmanankorn A: 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 FiO2 = 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 ± 14.7%, HT30 16.9 ± 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 ± 10.8 % and 24.4 ± 3.8% p = 0.004, p = 0.045 respectively) with little difference found between CT80 and HT50 groups (0.6 ± 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.

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

Torpel A, Becker T, Thiers A, Hamacher D, Schega L: 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 extensor and flexor muscle strength of a healthy population. Isokinetic mode was utilized to measure power output of these muscles.

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

Zhang X, Hu M, Lou Z, Liao B: 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.

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

Bae KH, Kim JW, Kim TK, Kweon SH, Kang HJ, Kim JY, Joo MS, Kim DM: 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 that posterior-stabilized total knee arthroplasty? Objective measurement with a dynamometer in 102 knees".

Cho KY, Kim KI, Song SJ, Bae DK: Does cruciate-retaining total knee arthroplasty show better quadriceps recovery that 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.

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

Fu A, Wang C, Qi H, Li F, Wang Z, He F, Zhou P, Chen S, Ming D: Electromyography-based analysis of human upper limbs during 45-day head-down bed-rest. J Acta Astro. 2015; 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, Kim, JY, In Y: 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 ¼.322 and P ¼.383, respectively). No group difference was observed in medial joint opening angle on valgus stress radiographs (P ¼.327). 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 analyse 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 (Vo) 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 Vo (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, MacDermid JC: 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. Isometric mode was utilized to measure maximum strength capabilities of these muscles.

"A comparison of nonoperative vs. Endobutton repair of distal biceps ruptures."

Legg A, Stevens R, Oakes NO, Shahane SA: **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 *Zingiber cassumunar* (Plai cream) in the treatment of delayed onset muscle soreness."

Manimmanakorn N, Manimmanakorn A, Boobphachart D, Thuwakum W, Laupattarakasem W, Hamlin MJ: 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.

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, Fischer SS, Grutzner A, Biglari B: 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 fur 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 radioluceny 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 ulnaris 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, Short KW, Myerson MS: 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.

"Rehabilitation of the Fingertip."

Austin SL: Rehabilitation of the Fingertip. In Rozmaryn LM (ed.) *Fingertip Injuries*. Switzerland. Springer Intl Publ; 2015;175-188 DOI 10.1007/978-3-319-13227-3_11

Use of Primus: musculoskeletal treatment of fingertip injuries; cited as excellent tool for work simulation, strengthening, and desensitization.

"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 analysed.
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-centred 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, Uhl TL, Thomas T, Xenos ES, Saha SP, Yu G: 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 (rVO_2). We calibrated rBF and rVO_2 profiles with absolute baseline values of BF and VO_2 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.

“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, Kim YH, Yoo KT: 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 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, Jang SW, Park DC, In Y: 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, Allan CH, Hanel DP, Huang JI: 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.

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

Lim SH, Hong BY, Oh JH, Lee JI: Effects of joint effusion on quadriceps muscles in patients with knee osteoarthritis. Phys Ther Sport. 2015. doi:10.1016/j.ptsp.2015.09.001.

ABSTRACT:
Objectives: To evaluate the effect of knee effusion on 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 the 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. Control group (n=20) and experimental group (n=15) were assessed. No significant difference in quadriceps peak torque or RMS of EMG activity was observed in the 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 20ml joint effusion did not affect the peak torque or RMS values of the quadriceps muscle in patients with knee OA.

Use of Primus: musculoskeletal evaluation of strength of quadriceps muscle of healthy females. Isometric mode was utilized to measure maximum strength capabilities.

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

Lim SH, Hong BY, Oh JH, Lee JI: 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 ± 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.

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

Mutchler JA, Weinhandl JT, Hoch MC, Van Lunen BL: 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, Hewett TE, Viele K, Mattacola CG: 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, Boulet C, Tresignie J, De Mey J, Clarys JP: 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/folia_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 forearm flexors (grip). Isometric and isotonic modes were utilized to measure peak maximum strength capabilities and muscle endurance.

“Comfort analysis in EVA Reachable Envelope based on human-spacesuit integrated biomechanical modeling.”

Wang X, Wang C, Wang Z, Li H: Comfort analysis in EVA Reachable Envelope based on human-spacesuit integrated biomechanical modeling. In Stephanidis (Ed.):HCII 2015 Posters, Part I, CCIS 528, pp. 539-545, 2015. Switzerland: Springer Intl Publ; 2015. doi:10.1007/978-3-319-21380-4_92.

ABSTRACT:
We proposed a biomechanical framework for modeling human-spacesuit arm interaction while carrying out EVAs. In the model, there is detailed definition of spacesuit joint rotations, included spacesuit joint stiffness model and a delicate human arm musculoskeletal model in the Anybody Modeling System. The framework is able to predict human joint torque, muscle forces and joint reactions in various positions and postures while wearing spacesuit. Based on the predicted maximum force, we made an evaluation of the comfort scale in various positions in the reach envelope. The predicted most comfortable area was compared to measured most comfortable area for model prediction validation.

Use of Primus: to measure spacesuit joint stiffness using isokinetic mode.

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

Fronczek-Wojciechowska M, Kopacz K, Kosielski P, Padula G: 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: to measure the muscular 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 (± 2.32) years, and 40 male, mean age 23.50 (± 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.
Level of Evidence: 2b

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, Lin W, Nardo L, Li X, Link TM, Majumdar S, Souza RB: 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.

"Traumatic hand injury involving multiple structures."

Kurtz PE: Traumatic hand injury involving multiple structures. In Cooper C (ed). *Fundamentals of Hand Therapy. Clinical Reasoning and Treatment Guidelines for Common Diagnoses of the upper Extremity.* 2nd ed. St. Louis, MO: Elsevier Mosby; 2014:508-523.

Use of Primus: musculoskeletal treatment to increase muscle strength and endurance of patients post-digital amputation and laceration and repair of tendons, nerves, and vessels.

"Trunk stabilizer muscle activity during manual lifting with and without belt use in experienced workers."

Kurustien N, Mekhora K, Jalayondeja W, Nanthavanij S: Trunk stabilizer muscle activity during manual lifting with and without belt use in experienced workers. J Med Assoc Thai. 2014 97(Suppl. 7):S75-S79. http://www.jmatonline.com.

ABSTRACT:
Objective: The present study evaluated the changes in trunk-stabilizer electromyography (EMG) activities during manual lifting with and without a back belt in experienced back belt users.\
Material and Method: Eighteen participants from a warehouse and distribution center in Thailand, aged 22 to 44 years, were assessed for trunk stabilizer muscle EMG activity, including the rectus abdominis (RA), external abdominal oblique (EO), transverse abdominis (TrA), internal abdominal oblique (IO), erector spinae (ES), and multifidus (MF). The EMG data were recorded during (1) rest and (2) the initial phase of manual lifting in a dynamic semi-squat posture. For both conditions, the data were compared with and without wearing a belt.
Results: The results showed that wearing a back belt significantly decreased TrA/IO activity during rest (p<0.01) and significantly increased RA activity during the lifting period (p<0.05) as compared with the condition of no back belt.
Conclusion: The present study does not recommend healthy workers wear a back belt as a protective device for lower back injury, particularly without any lifting activity. However, the back belt can be applied during lifting as it can enhance RA activity, which may help improve abdominal pressure and is less likely to cause weakness of the TrA.

Use of Primus: to simulate lifting work tasks. Torque and velocity were synchronized with an EMG unit.

"Effects if closed and open kinetic chain exercises on knee extensor strength and balance in patients with early stroke."

Kwon OK, Shin WB: Effects if 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, Ficek K, Juras G: 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, Benson EA, England SA, Young K, Rajulu SL: 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:10.11777/1541931214581332.

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 heathy 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 heathy 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 interjoint 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 (digits1, 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.

"Median to radial nerve transfers for restoration of wrist, finger, and thumb extension."

Davidge KM, Yee A, Kahn LC, Mackinnon SE: Median to radial nerve transfers for restoration of wrist, finger, and thumb extension. J Hand Surg. 2013;38A:1812-1827.

ABSTRACT:
Radial nerve injury results in loss of wrist, finger, and thumb extension. Traditionally, radial nerve palsies that fail to recover spontaneously have been reconstructed with tendon transfers or nerve grafts. Nerve transfers are a novel approach to the surgical management of Sunderland grade IV and V radial nerve injuries. We describe our technique for median to radial nerve transfers. In this procedure, the flexor digitorum superficialis nerve is transferred to the extensor carpi radialis brevis nerve for wrist extension, and the flexor carpi radialis nerve is transferred to the posterior interosseous nerve for finger and thumb extension. Our experience with these nerve transfers has demonstrated excellent outcomes up to 10 months after injury. Indeed, unlike tendon transfers, median to radial nerve transfers have the potential to restore normal radial nerve function, including independent finger motion. Tension-free nerve coaptation and postoperative motor re-education are critical factors to achieving these successful outcomes.

Use of Primus: musculoskeletal/neuromuscular treatment for strengthening and functional training of upper extremity of patients post-median to radial nerve transfers.

"Unsupervised virtual reality-based exercise program improves hip muscle strength and balance control in older adults: a pilot study."

Kim J, Son J, Ko N, Yoon BC: Unsupervised virtual reality-based exercise program improves hip muscle strength and balance control in older adults: a pilot study. Arch Phys Med Rehabil. 2013;94:937-43. http://dx.doi.org/10.1016/j.apmr.2012.12.010.

ABSTRACT:
Objective: To assess the effects of an unsupervised virtual reality (VR)-based exercise program on hip muscle strength and balance control in older adults.
Design: Controlled cohort repeated-measures experimental design, a pilot study.
Setting: University research laboratory.
Participants: Ambulatory older adults (N=32) from a local community.

Intervention: The VR group (n=18; mean ± SD, 68.28±3.74y; 4 men) completed the VR-based exercise program, whereas the remaining subjects in the control group (n=14; mean ± SD, 66.21±3.87y, 1 man) were asked to continue their daily routine for 8 weeks.
Main Outcome Measures: Hip muscle strength was measured using a multimodal dynamometer, and ground reaction force using the backward stepping test and the results of the crossover stepping test were recorded using a force platform.
Results: The VR group showed significant improvement in hip muscle strength of the extensors, flexors, adductors, and abductors after 8 weeks (all $P \leq .001$). However, no significant improvement was observed in the control group. The VR group had significantly greater ground reaction force on the backward stepping test (with eyes opened and closed) (all $P <. 005$) and the crossover stepping test (with eyes opened and closed) (all $P \leq .001$) compared with those at baseline. However, no significant improvement was observed in the control group.
Conclusions: The VR-based exercise program includes the role of supervisor and feedback, which is important for older adults. Therefore, a VR-based exercise program may be a useful tool to improve decreased physical function in older adults as a home-based exercise.

Use of Primus: musculoskeletal evaluation of hip muscle strength of ambulatory older adults. Isometric mode was utilized to measure MVIF of hip flexion, extension, adduction, and abduction.

"Changes in ankle range of motion and muscle strength in habitual wearers of high-heeled shoes."

Kim Y, Lim JM, Yoon BC: Changes in ankle range of motion and muscle strength in habitual wearers of high-heeled shoes. Foot Ankle Intl. 2013;414-419.
doi: 10.1177/1071100712468562.

ABSTRACT:
Background: Although cross-sectional biomechanical studies have reported that wearing high-heeled shoes can change the musculoskeletal system of the lower extremities, the long-term effects of wearing such shoes on the ankle remain unknown. The aim of this study was to reveal changes in ankle range of motion and muscle strength in habitual wearers of high-heeled shoes and to provide information for clinicians undertaking functional evaluations of the ankles of such patients.
Methods: Habitual wearers of high-heeled shoes (n = 10; age, 23.9 ± 2.7 years) and wearers of flat shoes (n = 10; age, 23.8 ± 2.1 years) were selectively recruited, and the range of motion, maximal voluntary isometric force, and concentric contraction power of their ankles were measured.
Results: Wearers of high-heeled shoes showed increased ankle range of motion on plantarflexion at 25 degrees and inversion at 10 degrees compared to flat shoe wearers ($P < .05$) but decreased dorsiflexion (about 17 degrees) and eversion (13 degrees; $P < .05$). Concentric contraction power in ankle eversion was also 2 times higher in wearers of high-heeled shoes ($P < .05$).
Conclusions: These subjects had functional deformity of the ankle in a supinated direction and increased eversion power.

Use of Primus: musculoskeletal evaluation of the ankle muscle strength of habitual wearers of high-heeled shoes. Isometric and isotonic modes were utilized to measure MVIF and power of inversion, eversion, plantarflexion, and dorsiflexion.

"Clinical effectiveness of bee venom acupuncture and physiotherapy in the treatment of adhesive capsulitis: a randomized controlled trial."

Koh PS, Seo BK, Cho NS, Park HS, Park DS, Baek YH: Clinical effectiveness of bee venom acupuncture and physiotherapy in the treatment of adhesive capsulitis: a randomized controlled trial. J Shoulder Elbow Surg. 2013;22:1053-1062.

ABSTRACT:
Background: Bee venom acupuncture (BVA) has been used in the treatment of adhesive capsulitis (AC) in the clinical field. This study aimed to investigate whether the addition of BVA to physiotherapy (PT) would be more effective in the management of AC, and whether BVA would have a dose-dependent effect.
Materials and methods: Sixty-eight patients diagnosed with AC were recruited into 3 groups; BV 1 (1:10,000 BVA plus PT), BV 2 (1:30,000 BVA plus PT), and group 3 (normal saline (NS) injection, as a control, plus PT). PT was composed of 15 minutes of transcutaneous electrical nerve stimulation (TENS), transcutaneous infrared thermotherapy (TDP), and manual PT. Treatments were given in 16 sessions within 2 months. Shoulder pain and disability index (SPADI), pain visual analogue scale (VAS), and 3) active/passive range of motion (ROM) were measured before treatment and at 2, 4, 8, and 12 weeks after the treatment.
Results: All 3 groups showed statistically significant improvements in SPADI, pain VAS scores, and active/passive ROM. The BV 1 group showed significantly better outcomes in SPADI at 8 and 12 weeks, in pain VAS (at rest) at 8 weeks, and in pain VAS (during exercise) at 12 weeks than the NS group. No significant differences were found in active/passive ROM among all the groups.
Conclusion: BVA in combination with PT can be more effective in improving pain and function than PT alone in AC. However, the effectiveness of BVA was not shown in a dose-dependent manner.

Use of Primus: musculoskeletal evaluation of shoulder muscle strength of patients diagnosed with AC. Isometric mode was utilized to measure MVIF of shoulder flexion, extension, abduction, and external rotation.

"Outcomes after operative fixation of complete articular patellar fractures: assessment of functional impairment."

Lazaro LE, Wellman DS, Sauro G, Pardee NC, Berkes MB, Little MTM, Nguyen JT, Helfet DL, Lorich DG: Outcomes after operative fixation of complete articular patellar fractures: assessment of functional impairment. J Bone Joint Surg Am. 2013;95:e96(1-8). http://dx.doi.org/10.2106/JBJS.L.00012.

ABSTRACT:
Background: Patellar fractures are debilitating injuries that compromise the knee extensor mechanism and are frequently associated with poor outcomes. The purpose of this study was to quantify the functional outcomes of operative treatment of patellar fractures.
Methods: Functional outcome data on thirty patients with an isolated unilateral patellar fracture were prospectively obtained at three, six, and twelve months postoperatively.
Results: All fractures healed. There were two complications (7%) related to the surgery (wound dehiscence and refracture), and eleven patients (37%) underwent removal of symptomatic implants. The tibial plateau-patella angle demonstrated patella baja in seventeen (57%) of the patients. Anterior knee pain during activities of daily living was experienced by twenty-four (80%) of the patients. Clinical improvement occurred over the first six months. However, functional impairment persisted at twelve months, with objective testing demonstrating that the knee extensor mechanism on the injured side had deficits in strength (-41%), power (-47%), and endurance (-34%) as compared with the uninjured side.
Conclusions: Despite advances in surgical protocols and acceptable radiographic outcomes, functional impairment remains common after treatment of patellar fractures. Rehabilitation strategies following surgical stabilization of these injuries will be a fruitful area for future clinical research.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring muscle performance of patients with an isolated unilateral patellar fracture. Isometric and isotonic modes were utilized to measure maximum strength, dynamic power, and dynamic endurance.

"The advantages and disadvantages of using high technology in hand rehabilitation."

Levanon Y: The advantages and disadvantages of using high technology in hand rehabilitation. J Hand Ther. 2013:26:179-183.

ABSTRACT:
A brief review of the history of occupational therapy shows that the relationship between health and activity was of great concern to the founders of the Occupational Therapy (OT) field, and continues to be of concern to today's occupational therapists. Today, computers and Virtual Reality (VR) take the place of clay and the weaving loom. The goal of this article is to describe both known and innovative computerized equipment being used in interventions for hand rehabilitation and evaluations, as well as answer the question: 'what are the advantages and disadvantages of using technology in hand rehabilitation?' Our conclusion, based on clinical experience and supported by the literature, appears to emphasize that advanced technology can enrich treatment and help patients who are unable to visit the clinic regularly, to get appropriate treatment. However, advanced technology has not been found to be superior to traditional treatment and cannot replace the occupational therapist.

Use of Primus: musculoskeletal evaluation of the upper extremity.

"Oxygenation and blood volume in skeletal muscle in response to external force."

Li H, Wang C, Wang Z: Oxygenation and blood volume in skeletal muscle in response to external force. V.G. Duffy (Ed.): DHM/HCII 2013, Part II, LNCS 8026. Berlin, Germany: Springer-Verlag Berlin Heidelberg; 2013:pp. 359–365.

ABSTRACT:
Oxygenation and blood volume in skeletal muscle have been used to evaluate muscle contraction force. This paper aims to reveal the correlations between local oxygenation, blood volume and external force. Eight subjects per-formed isometric elbow flexion exercise of different force levels and isokinetic elbow exercise. In isometric exercise, oxygenation and blood volume indices were significantly correlated with joint torques; and their relationships could be described by linear equations. Compared with the oxygenation rate, the change of blood volume between rest and muscle contraction was more suitable to evaluate static muscle contraction force than oxygenation. In isokinetic exercise, blood volume demonstrated obvious periodicity in different motion cycles, and had low correlations with joint moments. Oxygenation indices demonstrated obvious differences between the five motion cycles. In conclusion, blood volume was found to be suitable to estimate the static and dynamic muscle contraction force, and validate musculoskeletal system biomechanical model.

Use of Primus: musculoskeletal evaluation of elbow flexion strength of a healthy population. Isometric mode was utilized to assess maximum strength and endurance.

“Comparison of functional walking training using concentric-eccentric resistance on hip muscle strength, balance, and functional mobility in working and retired older adults.”

Maritz CA, McCray S, Bell J: Comparison of functional walking training using concentric-eccentric resistance on hip muscle strength, balance, and functional mobility in working and retired older adults. J Gerontol Geriat Res. 2013;2(3):1-6.

ABSTRACT:
Background: Age-related lower extremity weakness leads to difficulty with stair negotiation, gait, and balance. The purpose of this study was to evaluate and compare the impact of functional walking training on hip strength, balance, and functional mobility among community-dwelling working and retired older adults.
Methods: 12 healthy working adults (10 females and 2 males; mean age 66 years) were recruited from the campus community and 15 retired community-dwelling adults (13 females and 2 males; mean age 75 years) were recruited from a church. Subjects completed pre-post-test measurements: hip strength (flexion, abduction, and extension) were tested using hand held dynamometer; Timed Up and Go test, 30-Second Chair Rise test, and static and dynamic balance tested using the Xeno Walkway System. Subjects completed 8 sessions of functional walking using the BTE™ Primus RS. Subjects were connected to the Primus using cable attachment and waist belt. Primus was set in concentric-eccentric mode and resistance was applied. Subjects walked seven feet in four directions: forward; backward; sideways both directions a total of five times each. Resistance was increased each session.
Results: The working group had significant improvements (p= 0.02-0.0003) in Timed Up and Go, 30-Second Chair Rise test, and hip strength following the intervention. The retired group had significant (p=0.01-0.0002) improvements in Timed Up and Go, 30-Second Chair Rise, hip strength, and dynamic balance. Neither group showed statically significant changes in static balance. Only the Timed Up and Go was significantly different in the amount of change between groups.
Conclusion: A resisted functional walking program resulted in significant improvements in function and strength in both working and retired older adults. Functional walking with resistance allows older adults to benefit without having them assume difficult exercise positions. This exercise protocol can be easily modified for the clinical setting and be used in falls prevention programs.

Use of Primus: musculoskeletal and neuromuscular treatment to improve lower extremity strength of working and retired older adults. Isotonic mode was utilized for resisted walking that impacted hip strength, balance and functional mobility.

“Characteristics of upper limb muscular strength in male wheelchair tennis players.”

Moon HB, Park SJ, Kim AC, Jang JH: Characteristics of upper limb muscular strength in male wheelchair tennis players. J Exerc Rehabil. 2013; 9:375-380. http://dx.doi.org/10.12965/jer.130051.

ABSTRACT:
The purpose of this study was to identify the characteristics of muscular strength in upper limb and to present the preliminary information for development of sports injury prevention program and exercise rehabilitation program in wheelchair tennis players. Participants were 12 male wheelchair tennis players. Muscular strength was measured in shoulder and elbow joints with isokinetic dynamometer. Ipsilateral (IR) and bilateral (BR) balance ratio were calculated with isokinetic strength at 60°/sec. As a result, extension strength (ES) was significantly higher than flexion strength (FS) (P< 0.001), and IR in both sides and BR in ES were maintained within normal range whereas BR in FS was lower than normal range in shoulder joint. In elbow joint FS was significantly higher than ES (P< 0.05), and IR and BR were lower than normal range. Consequently, the different tendency in IR between shoulder and elbow joints and

lower IR and BR in elbow joints could be the characteristics in male wheelchair tennis players. It is suggested that flexor strengthening program in nondominant shoulder joint, extensor strengthening program in both elbow joint, and flexor strengthening program in non-dominant elbow joint should be introduced for male wheelchair tennis players.

Use of Primus: musculoskeletal evaluation of strength of shoulder and elbow muscles of wheelchair tennis players. Isometric mode was utilized to measure maximum strength capabilities.

An ankle proprioceptive control program improves balance, gait ability of chronic stroke patients.

Park YH, Kim YM, Lee BH: An ankle proprioceptive control program improves balance, gait ability of chronic stroke patients. J Phys Ther Sci. 2013;25:1321-1324.

ABSTRACT:
Purpose: Balance and gait ability determine to a large degree the level of independence of daily living which is an important goal of rehabilitation. This study was conducted in order to examine the effectiveness of an ankle proprioceptive control program on ankle muscle strength, balance, and gait of chronic stroke patients.
Methods: Thirteen chronic stroke patients more than six months post-stroke were recruited. All subjects received ankle proprioceptive control training for 30 minutes per session, two days per week, over a period of six weeks. Outcome measures were ankle strength (BTE-Primus), the Timed Up and Go test (TUG), and spatiotemporal parameters measured by a GAITRite instrument.
Results: Significant improvements in ankle dorsiflexor strength, TUG, gait speed and cadence, step length, and stride length were observed on the paretic side.
Conclusion: The results of this study provide evidence in support of incorporation of an ankle proprioceptive control program for effective improvement of both balance and gait ability of chronic stroke patients. The findings of this study suggest the feasibility and suitability of an ankle proprioceptive control program for chronic stroke patients.

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

"Functional and radiographic outcomes of nonoperative treatment of displaced adolescent clavicle fractures."

Schulz J, Moor M, Roocroft J, Bastrom TP, Pennock AT: Functional and radiographic outcomes of nonoperative treatment of displaced adolescent clavicle fractures. J Bone Joint Surg Am. 2013;95:1159-1165.

ABSTRACT:
Background: Studies of adult patients suggest that nonoperative treatment of clavicle fractures may result in functional disability, but this has not been demonstrated in adolescents. The purpose of this study was to determine the functional outcomes after nonoperative treatment of displaced, shortened, midshaft clavicle fractures in adolescents.
Methods: Adolescents ten to eighteen years of age with an isolated, completely displaced, shortened, midshaft clavicle fracture sustained between 2009 and 2011 were recruited for this study. Injury and final radiographs were assessed for displacement, shortening, and clavicle length. Maximal and endurance strength testing was performed with the Baltimore Therapeutic Equipment (BTE) machine, with use of the

uninjured shoulder as an internal control. Shoulder range of motion and clavicle length were assessed clinically, and patient-oriented outcomes were obtained.
Results: Sixteen patients (four of whom were female) with an average age (and standard deviation) of 14.2 ± 2 years and a mean duration of follow-up of 2 ± 1 years were included in the study. Fifteen patients were right-hand dominant and one was ambidextrous, and thirteen of the fractures occurred in the nondominant limb. Compared with the uninjured limb, no differences were noted in range of motion or strength except for an 8% decrease in maximal shoulder external rotation strength (p = 0.04) and a 11% loss of shoulder abduction endurance strength (p = 0.04). Radiographs demonstrated a 100% union rate but significant shortening compared with the uninjured clavicle (p £ 0.001). SANE (Single Assessment Numeric Evaluation), QuickDASH (shortened version of the Disabilities of the Arm, Shoulder and Hand questionnaire), and Constant scores were similar between sides. Fifteen of the sixteen patients were satisfied with the appearance of the clavicle, and all returned to full activity, including the preinjury (or a higher) level of sports participation.
Conclusions: Regardless of patient age, sports participation, and final clavicle shortening, no differences in pain, strength, shoulder range of motion, or subjective outcome scores were found between the injured and uninjured limbs of adolescents treated nonoperatively for a displaced, shortened, midshaft clavicle fracture.

Use of Primus: musculoskeletal evaluation of shoulder muscle strength and endurance of adolescents post-non-operative displaced clavicular fractures. Isometric and isotonic modes were utilized to measure maximum strength capabilities and dynamic endurance.

"Patellar eversion does not adversely affect quadriceps recovery following total knee arthroplasty."

Umrani SP, Cho KY, Kim KI: Patellar eversion does not adversely affect quadriceps recovery following total knee arthroplasty. J Arthroplasty. 2013; 28:591-594. http://dx.doi.org/10.1016/j.arth.2012.06.031.

ABSTRACT:
Although avoiding patellar eversion during a total knee arthroplasty (TKA) has theoretical benefit in quadriceps recovery, there has been paucity of supportive objective clinical results. We prospectively designed the study whether TKA without patellar eversion has better quadriceps recovery in an objective, dynamometer study. Seventy-two knees undergoing TKA with midvastus approach were randomized into two groups according to patellar eversion or not. Clinical data and objective quadriceps recovery using a dynamometer were investigated preoperatively and postoperative at 6 weeks, 3 months, 6 months and 1 year. There were no statistical differences between two groups throughout the follow-up periods in recovery of quadriceps force or power and clinical data. Choosing to evert patella during TKA using midvastus approach would not adversely affect postoperative quadriceps recovery.

Use of Primus: musculoskeletal evaluation of quadriceps performance in patients post-TKA. Isometric and isokinetic modes were utilized to measure force and power at established intervals post-surgery.

"Effects of gastrocnemius and lumbar back muscle exercise on standing balance."

Yoo KT, An MY, Eom SJ, Kim BK, Lee JH, Choi JH, Shin HJ, Moon OK, Choi WS, Min KO: Effects of gastrocnemius and lumbar back muscle exercise on standing balance. J Intl Acad Phys Ther Res. 2013: 4:618-624. http://dx.doi.org/10.5854/JIAPTR.2013.10.25.618.

ABSTRACT:
The purpose of this study was to test the effect of Gastrocnemius and Low Back-muscle isotonic exercise on static • dynamic standing balance during the period of 4 weeks. This study was two groups pretest-posttest design. Nineteen subjects who were over 22 years old were randomly assigned to either the experimental group that received the Gastrocnemius muscle exercise (n=9) or the low back muscle exercise (n=10). The former group performed isotonic exercise (plantar flexion), the latter group performed isotonic exercise (trunk extension) a total of 18 times for three times per week for four weeks. Two groups also performed static and dynamic balance before the exercise and 4weeks after the exercise. The data were analyzed by using the paired t-test and independent t-test. The results were as follows: As compared with change of dynamic balance performance capacity at two groups, a significant difference was shown in the test ($p < .05$), but not in static balance ($p > .05$). Also, a significant difference of balance between groups was not shown in the test. In this study indicated that gastrocnemius and low back muscle isotonic exercise will have positive impact on standing balance.

Use of PrimusRS: musculoskeletal evaluation of strength and therapeutic exercise to increase gastrocnemius muscle strength of a healthy population. Isometric mode was utilized to measure pre- and post-study maximum strength capabilities and determine exercise resistance levels and isotonic mode was used for strengthening exercises.

"The effect of Tai Chi self-help group program for hemophilic arthritis patients."

Bak WS, Yoo MC, Kang HS: The effect of Tai Chi self-help group program for hemophilic arthritis patients. J Muscle Joint Health. 2012;19:71-83. http://dx.doi.org/10.5953/JMJH.2012.19.1.071.

ABSTRACT:
Purpose: The purpose of this study was to develop and evaluate the effects of Tai Chi Self-help program for Hemophilic Arthritis Patients.
Method: A quasi-experimental design was used. The subjects were 48 patients who underwent orthopedic surgery (24 experimental group, 24 control group). The subjects of experimental group were participated in the Tai Chi self-help group program in which 16 times for 8 weeks. The program consisted of health education on hemophilia, Tai Chi exercise, and workshop and its outcomes have been evaluated on WOMAC (Western Ontario and McMaster scale), mobility, pain, fatigue, muscle strength. depression, and quality of Life (SF-36). The obtained data were analyzed by using the t-test or Fisher's exact test of PASW 18.0.
Results: 1) The score of WOMAC, pain, fatigue, and depression decreased significantly in the experimental group as compared to the control group. 2) The score of mobility, muscle strength. and quality of life increased significantly in the experimental group as compared to the control group.
Conclusion: Considering these research results, the program could be useful to improve joint movement, strength and psychological condition for patient with hemophilic arthritis, particularly in those who underwent orthopedic surgery.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring performance of patients with hemophilic arthritis. Isometric and isotonic modes were utilized to evaluate strength and power.

"Intensive aerobic training improves motor performances and oxidative metabolism efficiency in chronic polymyositis: a case report."

Dalise S, Bertolucci F, Simonella C, Rossi B, Chisari C: Intensive aerobic training improves motor performances and oxidative metabolism efficiency in chronic polymyositis: a case report. Neuromusc Disorders. 2012;22:S221–S225.

ABSTRACT:
We describe the case of a 64-year-old woman affected by chronic polymyositis with gait disturbance, fatty replacement and swelling of thigh muscles. She achieved significant clinical improvement after 5 weeks intensive aerobic training. In particular the patient improved in motor performance tests, showed an improvement in the efficiency of oxidative metabolism and quality of life. Furthermore, analysis of creatine phosphokinase levels showed a reduction of muscle damage susceptibility. In conclusion, a specific intensive exercise program can be safely used with beneficial effects on muscle function in patients with chronic polymyositis.

Use of Primus: musculoskeletal evaluation of lower extremity strength of a patient with chronic polymyositis. Isometric mode was utilized to measure maximum strength capabilities.

"Effects of activity type and hip fatigue on knee kinematics in female and male athletes."

Fazio MA, Howard JS, Mattacola CG, Uhl TL, Jacobs CA: Effects of activity type and hip fatigue on knee kinematics in female and male athletes. Athl Train Sports Health Care. 2012;4(4):173-180.

ABSTRACT:
Landing mechanics have been documented as a risk factor for knee injuries in female athletes. This article aimed to determine the effect of hip abductor/external rotator fatigue and activity type on landing kinematics. Selected hip and knee landing kinematics were measured before and after a hip fatigue task in 45 healthy participants regularly performing either multiplanar or uniplanar activities. Across conditions, the multiplanar activity male group demonstrated less knee abduction than the uniplanar (*P* = .001) and multiplanar (*P* = .018) activity female groups. In addition, the uniplanar activity female group demonstrated greater knee abduction than the multiplanar activity female group (*P* = .031). Hip adduction during landing increased post fatigue (*P* = .001); however, fatigue did not affect knee kinematics. Landing kinematics may depend on activity participation, as well as gender. Therefore, it is important to classify research participants based on the type of activity in which they regularly participate.

Use of Primus: musculoskeletal evaluation of lower extremity muscle performance of healthy males and females. Isometric mode was utilized to measure maximum strength and endurance of hip musculature.

"Noninvasive optical quantification of absolute blood flow, blood oxygenation, and oxygen consumption rate in exercising skeletal muscle."

Gurley K, Shang Y, Yu G: Noninvasive optical quantification of absolute blood flow, blood oxygenation, and oxygen consumption rate in exercising skeletal muscle. J Biomed Optics. 2012;17(7):075010-1-075010-10.

ABSTRACT: This study investigates a method using novel hybrid diffuse optical spectroscopies [near-infrared spectroscopy (NIRS) and diffuse correlation spectroscopy (DCS)] to obtain continuous, noninvasive measurement of absolute blood flow (BF), blood oxygenation, and oxygen consumption rate (VO_2) in exercising skeletal muscle. Healthy subjects (n = 9) performed a handgrip exercise to increase BF and VO_2 in forearm flexor muscles, while a hybrid optical probe on the skin surface directly monitored

oxy-, deoxy-, and total hemoglobin concentrations ([HbO_2], [Hb], and THC), tissue oxygen saturation (StO_2), relative BF (rBF), and relative oxygen consumption rate (rVO_2). The rBF and rVO_2 signals were calibrated with absolute baseline BF and VO_2 obtained through venous and arterial occlusions, respectively. Known problems with muscle-fiber motion artifacts in optical measurements during exercise were mitigated using a novel gating algorithm that determined muscle contraction status based on control signals from a dynamometer. Results were consistent with previous findings in the literature. This study supports the application of NIRS/DCS technology to quantitatively evaluate hemodynamic and metabolic parameters in exercising skeletal muscle and holds promise for improving diagnosis and treatment evaluation for patients suffering from diseases affecting skeletal muscle and advancing fundamental understanding of muscle and exercise physiology.

Use of Primus: musculoskeletal evaluation of grip performance of a healthy population. Isometric mode was utilized to measure maximum strength capabilities and muscle endurance.

"Plating of acute humeral diaphyseal fractures through an anterior approach in multiple trauma patients."

Idoine JD, French BG, Opalek JM, DeMott L: Plating of acute humeral diaphyseal fractures through an anterior approach in multiple trauma patients. J Ortho Trauma. 2012;26:9-18.

ABSTRACT:
Objective: We evaluated the clinical and long-term functional outcomes of humeral diaphyseal fractures treated with acute anterior plating in a trauma population.
Design: Single-center, retrospective cohort analysis with long-term prospective follow-up.
Setting: Urban, Level I trauma center.
Patients: Ninety-six patients with high-energy fractures of the humeral shaft were treated over a 10-year period.
Intervention: All patients were treated by a standard surgical protocol of open reduction through an anterior approach with small or large fragment fixation in the supine position.
Main Outcome Measurements: Mechanism of injury, time to union, complications, and range of motion during clinical follow-up were obtained. We also prospectively assessed long-term strength, range of motion, and perceptions of disability using the Disabilities of the Arm, Shoulder and Hand questionnaire.
Results: Mean time to surgery was 5 days (standard deviation, 11 days); 97.5% of patients achieved union in an average of 16.9 weeks (range, 6–56 weeks). Complications included two postoperative infections, two nonunions, and three implant failures. Long-term follow-up (n = 34) averaged 4.75 years (range, 1.4–10.8 years). On average, no significant differences between the injured and uninjured extremities were seen in range of motion at the shoulder and elbow with the exception of shoulder flexion. A modest loss of upper extremity strength in the injured arm was appreciated. The mean Disabilities of the Arm, Shoulder and Hand score was 25.9 (range, 0–79).
Conclusions: A standard anterior surgical approach with small fragment fixation is a safe and effective treatment for humeral shaft fractures in multiple trauma patients. We show a high union rate and few complications, although a modest loss of function and some perceived disability exists in the long-term.

Use of Primus: musculoskeletal evaluation of upper extremity strength of patients post-surgical repair of humeral diaphyseal fractures. Isometric mode was utilized to measure maximum strength capabilities of the shoulder flexors, extensors, and rotators, elbow flexors and extensors. and forearm supinators and pronators.

“The influence of hip abductor muscle performance on dynamic postural stability in females with patellofemoral pain.”

Lee SP, Souza RB, Powers CM: The influence of hip abductor muscle performance on dynamic postural stability in females with patellofemoral pain. Gait and Posture. 2012; 36:425-429.

ABSTRACT:
Hip abductors play an important role in maintaining trunk and pelvis stability during unipedal tasks. The purpose of the study was to compare postural stability between individuals with patellofemoral pain (PFP) and pain-free controls. A secondary purpose was to evaluate the effect of a hip stabilizing brace on postural stability. Twenty females with PFP (27.3 ± 6.3 years) and 19 controls (26.1 ± 4.5 years) participated. Each subject performed a unipedal step-down balance task with the stance leg on a force platform from which center of pressure (COP) excursion was recorded. Quantitative COP excursion patterns (mean and peak displacements) were used as measures of postural stability. For subjects with PFP, postural stability also was quantified following the application of a hip stabilizing brace. Hip abductor strength was significantly lower in PFP group compared to the control group (1.39 ± 0.4 vs. 1.62 ± 0.26 N/kg-BW, $p = 0.046$). Peak and mean medial–lateral COP displacements during the balance task were greater in the PFP group (39.8 ± 6.7 vs. 24.3 ± 3.8 mm, $p < 0.001$; 24.7 ± 16.3 vs. 13.5 ± 4.4 mm, $p = 0.005$). Application of the hip stabilizing brace reduced the peak and mean COP displacement (39.8 ± 6.7 vs. 24.7 ± 4.7 mm, $p < 0.001$; 24.7 ± 16.3 vs. 16.8 ± 15.1 mm, $p = 0.02$). Our results demonstrate that females with PFP exhibit impaired medial–lateral postural stability when compared to control subjects. Application of a hip stabilizing brace significantly improved stability to a level comparable to the controls.

Use of Primus: musculoskeletal evaluation of hip strength of females with PFP. Isometric ode was utilized to measure maximum strength capabilities of the hip abductors.

“Lumbopelvic landing kinematics and EMG in women with contrasting hip strength.”

Popovich JM, Kulig K: Lumbopelvic landing kinematics and EMG in women with contrasting hip strength. Med Sci Sports Exerc. 2012;44:146-153. doi:10.1249/MSS.0b013e3182267435.

ABSTRACT:
Purpose: Hip muscle weakness has been associated with altered lower extremity mechanics and the increased likelihood of receiving treatment for low back problems, although biomechanical injury mechanisms focused on the trunk have not been investigated. The purpose of this study was to compare lumbopelvic kinematic variables and muscle activation of the trunk and gluteal muscles in females with strong and weak hip muscle strength during a demanding single-leg task.
Methods: Twenty-two asymptomatic females were categorized into a strong or weak group (11 per group) as determined by isometric hip extension and abduction dynamometry profiles. Participants performed a single-leg landing task during which three-dimensional lumbopelvic kinematics and trunk (lumbar erector spinae, external obliques, and rectus abdominis) and gluteal (gluteus maximus and gluteus medius) muscle activities were recorded. Peak lumbopelvic angular displacement, total angular excursion, and mean and peak angular velocity during the first 0.5 s of landing were reported. Mean normalized EMG and muscle cocontraction index (between the lumbar erector spinae and the external obliques) were also reported.
Results: Significant between-group differences existed for each of the following: peak displacement, excursion, velocity, and muscle activity. Differences in peak angular displacement occurred in the frontal plane, whereas excursion differences were observed in all planes. Differences in peak velocity were noted in the sagittal and frontal planes. Weaker subjects showed increased muscle activation (across all muscles except the rectus abdominis) and cocontraction index.

Conclusions: Individuals with diminished hip muscle strength exhibit greater lumbopelvic angular displacement, velocity, and muscle activity during the single-leg landing task. Future studies targeting hip strengthening may provide more insight to rehabilitation protocols as well as the relation between hip strength, low back motion, and muscle activity.

Use of Primus: musculoskeletal evaluation of strength of the hip extensor and abductor muscles groups in females with contrasting hip strength. Isometric mode was utilized to measure maximum strength capabilities.

"Biomechanical measurements of forearm pronosupination with common methods of immobilization."

Trocchia Am, Elfar JC, Hammert WC: Biomechanical measurements of forearm pronosupination with common methods of immobilization. J Hand Surg. 2012;37A:989-994.

ABSTRACT:
Purpose: To define the pronosupination arc for various types of forearm immobilization. We hypothesized that these methods of immobilization offer control of forearm pronosupination proportional to the loss of elbow motion, and that the Muenster cast may offer the most practical method of limiting forearm motion without eliminating elbow motion.
Methods: We enrolled 15 subjects in the study. We took measurements using computerized biometrics with the elbow free of immobilization and in a long-arm cast, a Muenster cast, a removable splint set to 90° elbow flexion, and a splint set to allow elbow flexion permissible by the Muenster cast. We recorded measurements for pronation and supination arcs.
Results: We obtained average pronosupination arcs for the unrestricted elbow (189°), long arm cast (11°), Muenster cast (35°), removable splint set to 90° (124°), and splint set to the flexion-extension arc of the Muenster cast (139°). We found statistically significant differences for pronation and supination for all comparisons between immobilization methods, with the exception of the splints compared with each other. The least motion was found in the long-arm cast, whereas the Muenster cast offered the only option allowing minimal pronosupination without strict elbow immobilization.
Conclusions: The Muenster cast offers reasonable immobilization of the forearm without fully immobilizing the elbow. The long-arm cast option offers significantly more forearm stability at the cost of any elbow motion. The 2 splints tested do not effectively immobilize the forearm compared with the other modalities tested.
Clinical relevance: This study provides good biomechanical support for using a Muenster cast when limiting forearm rotation is desirable.

Use of Primus: musculoskeletal evaluation of active ROM of the elbow/forearm/wrist of healthy males and females.

"Correlation between the height and the subjective discomfort ratings and muscle performance at performing the lower arm's pronation and supination according to the changes in height of working table."

Yoo KT, Choi JH, Kim HJ, Lee B, Jung JW, Choi WS, Yun YD, Kim SH: Correlation between the height and the subjective discomfort ratings and muscle performance at performing the lower arm's pronation and supination according to the changes in height of working table. J Intl Acad Phys Ther Res. 2012;3:469-474. http://dx.doi.org/10.5854/JIAPTR.2012.3.1.469.

ABSTRACT:
The purpose of this study is to analyze the correlation between the stature and the muscle performance ratings and the subjective discomfort rations at performing lower arm's pronation and supination according to changes in the height of working table for more efficient performance at designing a working table and performing a work. For the purpose, this study conducted an experiment targeting 40 people in their 20s, who were classified into 4 groups each group composing 10 people at intervals of 5cm from the standard stature of 166.5cm. The experiment measured the maximum isometric pronation and the supination muscular power, and at measuring the factors, the heights of working tables were set as 800mm, 850mm, and 900mm. From the measurement results, it was found that the stature and the maximum muscular power was correlated. That is, as the experiment groups's average stature is higher, the maximum muscular power was higher. For the correlation between the motion patterns (pronation and supination) and the maximum muscular power, it was seen that the maxi-mum muscular power was higher at performing the pronation than the supination. In the correlation between motion patterns and the subjective discomfort ratings, it was seen that the subjective discomfort rating was higher at performing the supination than the pronation. For the correlation between height adjustment and the subjective discomfort ratings, as the height of working table was lower, the subject discomfort rating was lower. Therefore there was no difference in the maximum muscular power according to the height changes of working table, but it was found that as the working table was higher, the user felt more comfortable.

Use of Primus: musculoskeletal evaluation of forearm/wrist muscle performance of healthy individuals. Isometric and isotonic modes were utilized to measure maximum strength capabilities and power output of the supinators and pronators.

“Effects of transcutaneous nerve stimulation (TENS), self-stretching and functional massage on the muscle fatigue by maximum muscular strength.”

Yoon JG, Ryu JJ, Roh HW, Yang HA, Lee SB: Effects of transcutaneous nerve stimulation (TENS), self-stretching and functional massage on the muscle fatigue by maximum muscular strength. J Intl Acad Phys Ther Res. 2012; 3:422-428.

ABSTRACT:
The present study purposed to examine the effects of transcutaneous electrical nerve stimulation, self-stretching and functional massage on the recovery of muscle contraction force for muscle fatigue caused by sustained isotonic contraction. The subjects of this study were 45 healthy students. They were divided into transcutaneous electrical nerve stimulation group(n=15), self-stretching group(n=15) and functional massage group(n=15), and using Primus RS. We observed the pattern of changes in maximal voluntary isometric contraction force(MVIC) after causing muscle fatigue in quadriceps femoris muscle through sustained isotonic contraction. Maximal voluntary isometric contraction force(MVIC) were greatly increased after transcutaneous electrical nerve stimulation, self-stretching and functional massage. In the comparison of recovery rate of muscle contraction force for muscle fatigue caused by sustained isotonic contraction among the treatment groups, it did not show any significant differences. However, it showed that each treatment may be effective in recovery of muscle fatigue caused by sustained isotonic contraction.
Use of Primus: musculoskeletal evaluation of quadriceps muscle performance of healthy students. in the context of the study, isotonic mode was used to create fatigue of the quadriceps muscle. Isometric mode was utilized to measure MVIC pre- and post-treatment session.

“Use of job-specific functional capacity evaluation to predict the return to work of patients with a distal radius fracture.”

Cheng ASK, Cheng SWC: Use of job-specific functional capacity evaluation to predict the return to work of patients with a distal radius fracture. Am J Occup Ther. 2011;65:445-452. doi:10.5014/ajot.2011.001057.

ABSTRACT:
OBJECTIVE: We examined the predictive validity of a job-specific functional capacity evaluation (FCE) in relation to the return to work of patients with a distal radius fracture.
METHOD: Return-to-work recommendations for 194 participants with a distal radius fracture were based on FCE performance. Three months after the evaluation, participants were contacted to ascertain their employment status to examine the predictive validity of each FCE-based rating.
RESULTS: The recommendation return to previous job (94.83%) was correct more often than the recommendations do not work at the moment (60.47%), change job (52.63%), and return to previous job with modifications (9.38%). A longer period from injury to FCE and compensable injury reduces the predictive ability of job-specific FCE.
CONCLUSION: Job-specific FCE shows a better predictive validity in relation to the return to work of patients with a specific injury, such as a distal radius fracture, than of patients with a nonspecific injury.

Use of Primus: musculoskeletal evaluation of the work ability of patients post-distal radius fracture. Isometric or isotonic modes were utilized to measure maximum handgrip strength, dynamic bilateral lifting tests (floor to knuckle, knuckle to shoulder, and floor to shoulder), and bilateral and unilateral pushing and pulling tests.

"Effect of isotonic quadriceps muscle exercises on patellofemoral pain syndrome: An exploratory pilot study."

Eapen C, Nayak CD, Zulfeequer CP: Effect of isotonic quadriceps muscle exercises on patellofemoral pain syndrome: An exploratory pilot study. Asian J Sports Med. 2011;2(4):227-234.

ABSTRACT:
Purpose: There is a decrease in quadriceps muscle strength in subjects with patellofemoral pain syndrome. Various types of strengthening exercises of the quadriceps are done as part of its management, but the effect of isotonic eccentric quadriceps muscle exercises on patellofemoral pain syndrome has not been studied. Hence the aim of this exploratory pilot study was to evaluate the effect of eccentric quadriceps training in patients with patellofemoral pain**.**
Methods: Twenty patients (12 female and 8 male, mean ages, 27.50 +/- 6.6 years) with patellofemoral pain syndrome were treated. The eccentric training of the quadriceps was given using a Baltimore Therapeutic Equipment (BTE) Primus machine. The main outcome measures used were percentage time on target as shown by the BTE primus machine, SF-36 Health questionnaire and patellofemoral pain severity scale. Statistical analysis was performed using SPSS 13**.**
Results: All the outcome measures showed significant improvements ($P<0.05$). Percentage time on target improved with a mean difference of 23.6, the SF-36 questionnaire showed an improvement in physical component score, mental component score and bodily pain with a mean difference of 10.9, 2.6 and 29.2 respectively and pain score when taken using patellofemoral severity scale also improved with a mean difference of 3.4.
Conclusion: Isotonic eccentric training of quadriceps muscles was found to be effective in reducing pain and improving the functional status of patients with patellofemoral pain syndrome and can be suggested as part of the treatment.

Use of Primus: musculoskeletal/neuromuscular treatment of patients with PFP. CPM mode was utilized for isokinetic concentric/eccentric quad exercise with visual feedback/target to reduce pain and improve quadriceps strength and function.

“Structure, sex, and strength and knee and hip kinematics during landing.”

Howard JS, Fazio MA, Mattacola CG, Uhl TL, Jacobs CA: Structure, sex, and strength and knee and hip kinematics during landing. J Athl Train. 2011;46(4):376-385.

ABSTRACT:
Context: Researchers have observed that medial knee collapse is a mechanism of knee injury. Lower extremity alignment, sex, and strength have been cited as contributing to landing mechanics.
Objective: To determine the relationship among measurements of asymmetry of unilateral hip rotation (AUHR); mobility of the foot, which we described as relative arch deformity (RAD); hip abduction–external rotation strength; sex; and medial collapse of the knee during a single-leg jump landing. We hypothesized that AUHR and RAD would be positively correlated with movements often associated with medial collapse of the knee, including hip adduction and internal rotation excursions and knee abduction and rotation excursions.
Design: Descriptive laboratory study.
Setting: Research laboratory.
Patients or Other Participants: Thirty women and 15 men (age = 21 ± 2 years, height = 171.7 ± 9.5 cm, mass = 68.4 ± 9.5 kg) who had no history of surgery or recent injury and who participated in regular physical activity volunteered.
Intervention(s): Participants performed 3 double-leg forward jumps with a single-leg landing. Three-dimensional kinematic data were sampled at 100 Hz using an electromagnetic tracking system. We evaluated AUHR and RAD on the preferred leg and evaluated isometric peak hip abductor–external rotation torque. We assessed AUHR by calculating the difference between internal and external hip rotation in the prone position (AUHR = internal rotation – external rotation). We evaluated RAD using the Arch Height Index Measurement System. Correlations
and linear regression analyses were used to assess relationships among AUHR, RAD, sex, peak hip abduction–external rotation torque, and kinematic variables for 3-dimensional motion of the hip and knee.
Main Outcome Measure(s): The dependent variables were joint angles at contact and joint excursions between contact and peak knee flexion.
Results: We found that AUHR was correlated with hip adduction excursion (R = 0.36, P = .02). Asymmetry of unilateral hip rotation, sex, and peak hip abduction–external rotation torque were predictive of knee abduction excursion (adjusted $R2$ = 0.47, P < .001). Asymmetry of unilateral hip rotation and sex were predictive of knee external rotation excursion (adjusted $R2$ = 0.23, P = .001). The RAD was correlated with hip adduction at contact ($R2$ = 0.10, R = 0.32, P = .04) and knee flexion excursion ($R2$ = 0.11, R = –0.34, P = .03).
Conclusions: Asymmetry of unilateral hip rotation, sex, and hip strength were associated with kinematic components of medial knee collapse.

Use of Primus: musculoskeletal evaluation of hip muscle strength of healthy males and females. Isometric mode was utilized to measure maximum strength capabilities a combined hip abduction and external rotation motion.

“Women with posterior tibial tendon dysfunction have diminished ankle and hip muscle performance.”

Kulig K, Popovich JM, Noceti-Dewit LM, Reischl SF, Dong K: Women with posterior tibial tendon dysfunction have diminished ankle and hip muscle performance. J Ortho Sports Phys Ther. 2011;41(9):687-694.

ABSTRACT:
STUDY DESIGN: Controlled laboratory study using a cross-sectional design.
OBJECTIVES: To characterize ankle and hip muscle performance in women with posterior

tibial tendon dysfunction (PTTD) and compare them to matched controls. We hypothesized that ankle plantar flexor strength, and hip extensor and abductor strength and endurance, would be diminished in women with PTTD and this impairment would be on the side of dysfunction.
BACKGROUND: Individuals with PTTD demonstrate impaired walking abilities. Walking gait is strongly dependent on the performance of calf and hip musculature.
METHODS: Thirty-four middle-aged women (17 with PTTD) participated. Ankle plantar flexor strength was assessed with the single-leg heel raise test. Hip muscle performance, including strength and endurance, were dynamometrically measured. Differences between groups and sides were assessed with a mixed-model analysis of variance.
RESULTS: Females with PTTD performed significantly fewer single-leg heel raises and repeated sagittal and frontal plane non–weight-bearing leg lifts, and also had lower hip extensor and abductor torques than age-matched controls. There were no differences between sides for hip strength and endurance measures for either group, but differences between sides in ankle strength measures were noted in both groups.
CONCLUSION: Women with PTTD demonstrated decreased ankle and hip muscle performance bilaterally.

Use of Primus: musculoskeletal evaluation of hip muscle performance of mid-aged females with PTTD. Isometric and isotonic modes were utilized to measure maximum strength capabilities and endurance of the hip extensors and abductors. Reliability of measures were established.

"Interday reliability of peak muscular power outputs on an isotonic dynamometer and assessment of active trunk control using the chop and lift tests."

Palmer TG, Uhl TL: Interday reliability of peak muscular power outputs on an isotonic dynamometer and assessment of active trunk control using the chop and lift tests. J Athl Train. 2011;46(2):150-159.

ABSTRACT:
Context: Assessment techniques used to measure functional tasks involving active trunk control are restricted to linear movements that lack the explosive movements and dynamic tasks associated with activities of daily living and sport. Reliable clinical methods used to assess the diagonal and ballistic movements about the trunk are lacking.
Objective: To assess the inter-day reliability of peak muscular power outputs while participants performed diagonal chop and lift tests and maintained a stable trunk.
Design: Controlled laboratory study.
Setting: University research laboratory.
Patients or Other Participants: Eighteen healthy individuals (10 men and 8 women; age 5 32 6 11 years, height 5 168 6 12 cm, mass 5 80 6 19 kg) from the general population participated.
Intervention(s): Participants performed 2 power tests (chop, lift) using an isotonic dynamometer and 3 endurance tests (Biering-Sørensen, side-plank left, side-plank right) to assess active trunk control. Testing was performed on 3 different days separated by at least 1 week. Reliability was compared between days 1 and 2 and between days 2 and 3. Correlations between the power and endurance tests were evaluated to determine the degree of similarity.
Main Outcome Measure(s): Peak muscular power outputs (watts) derived from a 1-repetition maximum protocol for the chop and lift tests were collected for both the right and left sides.
Results: Intraclass correlation coefficients for peak muscular power were highly reliable for the chop (range, 0.87– 0.98), lift (range, 0.83 – 0.96), and endurance (range, 0.80 – 0.98) tests between test sessions. The correlations between the power assessments and the Biering-Sørensen test (*r* range, -0.008 to 0.017) were low. The side-plank tests were moderately correlated with the chop (*r* range, 0.528 – 0.590) and the lift (*r* range, 0.359 – 0.467) tests.

Conclusions: The diagonal chop and lift power protocol generated reliable data and appears to be a dynamic test that simulates functional tasks, which require dynamic trunk control.

Use of Primus: musculoskeletal evaluation and treatment of functional tasks that require trunk stability. Healthy males and females were evaluated. Isometric and isotonic modes were utilized to measure maximum strength, power, and endurance capabilities. Reliability of peak muscular power measures was established.

"Effect of training with and without a load on military fitness tests and marksmanship."

Swain DP, RIngleb SI, Naik DN, Butowicz CM: Effect of training with and without a load on military fitness tests and marksmanship. J Strength Cond Res. 2011; 25:1857-1865.

ABSTRACT:
The purpose of this study was to determine whether military-style training performed while carrying a weighted vest and backpack (Load condition) resulted in superior training adaptations (specifically, changes in military fitness and marksmanship) than did more conventional training (No-Load condition). A total of 33 college-aged men and women (16 Load, 17 No-Load) completed all testing and 9 weeks of training (1 $h \cdot d^{-1}$,4$d \cdot wk^{-1}$). No-Load training consisted of military calisthenics, sprints, agility drills, and running. Load training was similar except that running was replaced with stair climbing, and Load increased across the 9 weeks to 20 kg for women and 30 kg for men. Pretraining and posttraining, all subjects performed an uphill treadmill test with full load to determine peak oxygen consumption (VO_2peak), the marine physical fitness test (PFT) and combat fitness test (CFT) without load, other fitness tests, and an indoor marksmanship test using a laser-fitted carbine. The marksmanship test was performed with full load and done before and immediately after a 200-m shuttle run performed in 60 seconds. Both groups significantly improved their VO_2peak, PFT, and CFT scores by similar amounts. Pretraining, shooting score decreased significantly after the 200-m run and then rapidly recovered, with no difference between groups. A similar, but nonsignificant, pattern in shooting scores was seen in both groups posttraining. In conclusion, loaded training did not produce measurable advantages compared with unloaded training in this population. A strenuous anaerobic challenge caused a temporary reduction in marksmanship.

Use of Primus: musculoskeletal evaluation of strength using an upper body simulated climbing task in a healthy population of college age males and females. Isotonic mode was utilized to measure work performance.

"Comfortable pushing/pulling force exertion for design of consumer products."

Tanaka H, Higuchi M, Hisamoto S: Comfortable pushing/pulling force exertion for design of consumer products. 2011 Intl Conference on Biometrics and Kansei Engineering. doi:10.1109/ICBAKE.2011.20.

ABSTRACT:
The purpose of this study is to develop the measurement method of pushing/pulling force exertion for useful ergonomic design of consumer products, and to estimate the approximate force from body weights. In order to measure user-friendly pushing/pulling force exertion, maximal force exertion with one hand without varying posture is regarded as, "comfortable force" (CF). Thirty-four participants (17 males, 17 females, mean age 55.1 yrs, SD 15.5) performed CF exertion and maximal force of free posture (MF) with two types of different height (elbow height and high height (shoulder flexion 135 degrees) respectively. The force ratio of mean values of CF to that of MF ranged from 0.25 to 0.29, and the force ratio of mean values of elbow height to that of high height ranged from 0.57 to 0.61. Concerning the dispersion of data

of force exertion, in all of the measurement conditions, coefficient of variations (CVs) of CFs were smaller than CVs of MFs. Moreover, the CVs of those data normalized to body weights, went smaller. On the whole, the CF of pushing/pulling of elbow height was approximately 0.1 of body weight.

Use of Primus: musculoskeletal evaluation of pushing and pulling strength in a healthy population. Isometric mode was utilized to measure maximum strength capabilities.

"A test case: Does the availability of visual feedback impact grip strength scores when using a digital dynamometer?"

Weinstock-Zlotnick G, Bear-Lehman J, Yu TY: A test case: Does the availability of visual feedback impact grip strength scores when using a digital dynamometer? J Hand Ther. 2011;24:266-276.

ABSTRACT:
A cross-sectional, quantitative study of clinical measurement utility. New technological advances can challenge the efficacy of even the most widely accepted and respected tests. For example, grip strength instruments offer digital or computerized displays, precision scoring, and varied interfaces that differ from traditional Jamar™ dynamometers (Lafayette, IN). This test case explores how the opportunity to view grip strength scores during testing can influence outcomes. One hundred forty-six healthy subjects, aged 18-24 years, were tested for grip strength under visual feedback and no visual feedback conditions, using the JTech Grip Dynamometer (Salt Lake City, UT). Participants achieved a small, yet statistically significant, 1.74 lb stronger grip score with visual feedback ($p<0.002$). The order of grip testing conditions yielded no statistically significant differences ($p = 0.559$). These findings suggest the need to consider how new features, unavailable with the analog Jamar™ dynamometer and unaccounted for in existing clinical guidelines could potentially influence
grip scores.

Use of Primus: musculoskeletal evaluation of grip strength with visual feedback is referenced in the article.

"The predictive validity of job-specific functional capacity evaluation on the employment status of patients with non-specific low back pain."

Cheng ASK, Cheng SWC: The predictive validity of job-specific functional capacity evaluation on the employment status of patients with non-specific low back pain. J Occup Environ Med. 2010;52:719-724.

ABSTRACT:
Objectives: To examine the predictive validity of a job-specific functional capacity evaluation (FCE) on the employment status of patients with nonspecific low back pain (LBP).
Methods: Seven hundred and thirteen patients with nonspecific LBP received job-specific FCE. Based on their performance, return-to-work recommendations were given. Three months after evaluation, all patients were contacted by telephone to find out their employment status to examine the predictive validity of each FCE-based rating.
Results: The correct prediction of employment status from an FCE pass rating was 79.8%; fail rating because of not meeting all the criteria of FCE tasks was 61.7%; and fail rating because of failing all FCE tasks was 68.4%.
Conclusions: Job-specific FCE shows a high level of predictive validity that could be used to evaluate the employment status of patients with nonspecific chronic LBP.

Use of Primus: musculoskeletal evaluation of strength/work ability of patients with nonspecific low back pain. Isometric mode was utilized to measure torso lifting, arm lifting, high-near lifting, and bilateral and unilateral horizontal pushing/pulling strength.

"Effect of knee support brace and lateral wedge in a sole on isokinetic peak torque in osteoarthritis of the knee – a randomized clinical trial."

Girija P, Eapen C, Zulfeequer KS: Effect of knee support brace and lateral wedge in a sole on isokinetic peak torque in osteoarthritis of the knee – a randomized clinical trial. Ind J Physio Occup Ther. 2010;4:25-28.

ABSTRACT:
To investigate and to compare the effect of knee support brace and lateral wedge insole on isokinetic concentric peak torque of quadriceps and hamstrings muscle, pain and functional status in osteoarthritis (OA) of knee.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring muscle performance of patients with OA of the knee. isokinetic mode was utilized to measure peak torque of these muscles.

"Isokinetic strength testing of minimally invasive total knee arthroplasty recovery."

Schroer WC, Diesfeld PJ, Reedy ME, LeMarr AR: Isokinetic strength testing of minimally invasive total knee arthroplasty recovery. J Arthroplasty. 2010; 25:274-279.

ABSTRACT:
Fifty patients underwent isokinetic muscle strength testing before surgery and at 6 weeks, 3months, 6 months, and 1 year after unilateral total knee arthroplasty using the minisubvastus surgical technique. Quadriceps muscle strength returned to preoperative levels by 3 months postoperatively and was 17% stronger at 6 months and 30% stronger at 1 year than preoperative levels ($P < .05$). At 1 year, the quadriceps strength of the involved knee was equivalent to that of the uninvolved knee ($P = .81$). When the entire study population was subdivided by age, weight, sex, and the presence of arthritis in the uninvolved knee, each subgroup still had equivalent quadriceps strength between the involved and uninvolved knees. This prospective study demonstrated that the minisubvastus total knee arthroplasty technique led to a more rapid and more complete recovery of muscle strength than has been previously demonstrated after total knee arthroplasty with a medial parapatellar arthrotomy.

Use of Primus: musculoskeletal evaluation of quadriceps and hamstring performance of patients post-TKA using the minisubvastus surgical technique. Isokinetic mode was utilized to measure peak torque of these muscles.

"Compression of the lower trunk of the brachial plexus by a cervical rib in two adolescent girls: case reports and surgical treatment."

Dahlin LB, Backman C, Duppe H, Saito H, Chemnitz A, Abul-Kasim K, Maly P: Compression of the lower trunk of the brachial plexus by a cervical rib in two adolescent girls: case reports and surgical treatment. J Brach Plexus Periph Nerve Inj. 2009;4:14. doi:10.1186/1749-7221-4-14.

ABSTRACT:
Presence of a cervical rib in children is extremely rare, particularly when symptoms of compression of the lower trunk of the brachial plexus occur. We present two cases with such a condition, where two young girls, 11 and 16 years of age were treated by resection of the cervical rib after a supraclavicular exploration of the lower trunk of the brachial plexus. The procedure led to successful results, objectively verified with tests in a work simulator, at one year follow-up.

Use of Primus: musculoskeletal evaluation of upper extremity strength of two adolescent girls. Isometric and isotonic modes were utilized to measure maximum strength capabilities and muscle endurance.

"Differences in hip kinematics, muscle strength, and muscle activation between subjects with and without patellofemoral pain."

Souza RB, Powers CM: Differences in hip kinematics, muscle strength, and muscle activation between subjects with and without patellofemoral pain. J Ortho Sports Phys Ther. 2009;39(1):12-19.

ABSTRACT:
Study Design: Controlled laboratory study using a cross-sectional design.
Objectives: To determine whether females with patellofemoral pain (PFP) demonstrate differences in hip kinematics, hip muscle strength, and hip muscle activation patterns when compared to pain-free controls.
Background: It has been proposed that abnormal hip kinematics may contribute to the development of PFP. However, research linking hip function to PFP remains limited.
Methods and Measures: Twenty-one females with PFP and 20 pain-free controls participated in this study. Hip kinematics and activity level of hip musculature were obtained during running, a drop jump, and a step-down maneuver. Isometric hip muscle torque production was quantified using a multimodal dynamometer. Group differences were assessed across tasks, using mixed-design 2-way analyses of variance and independent t tests.
Results: When averaged across all 3 activities, females with PFP demonstrated greater peak hip internal rotation compared to the control group (mean ± SD, 7.6° ± 7.0° versus 1.2° ± 3.8°; $P < .05$). The individuals in the PFP group also exhibited diminished hip torque production compared to the control group (14% less hip abductor strength and 17% less hip extensor strength). Significantly greater gluteus maximus recruitment was observed for individuals in the PFP group during running and the step-down task.
Conclusion: The increased peak hip internal rotation motion observed for females in the PFP group was accompanied by decreased hip muscle strength. The increased activation of the gluteus maximus in individuals with PFP suggests that these subjects were attempting to recruit a weakened muscle, perhaps in an effort to stabilize the hip joint. Our results support the proposed link between abnormal hip function and PFP.

Use of Primus: musculoskeletal evaluation of strength of hip muscles of females with and without PTP. Isometric mode was utilized to measure maximum strength capabilities of the hip extensors and abductors.

"Ergonomics and work assessments."

Innes E: Ergonomics and work assessments. In Jacobs K (ed). *Ergonomics for Therapists.* St. Louis, MO: Mosby Elsevier; 2008:48-72.

Use of Primus: in functional and work capacity evaluations.

“Assessment of functional capacity: an investigation on the benefits of combining ability-predicted and work-simulated work samples.”

Lee GK, Tansey TN, Ferrin JM, Parashar D, Frain MP, Tschopp MK, Adams N: Assessment of functional capacity: an investigation on the benefits of combining ability-predicted and work-simulated work samples. Austral J Rehabil Counsel. 2008;14:26-35.

ABSTRACT:
Rehabilitation professionals have long used work samples in assessing the ability and functionality of clients requesting rehabilitation services. Although there has been remarkable development in the type and scope of work samples, the incorporation of work samples into assessment has lagged behind that of other measurement systems. One logical reason is the prolonged time required to administer work samples. Despite this time commitment, work samples have usefulness and value for rehabilitation counselling and vocational evaluation. The purpose of this brief report is to provide evidence to indicate the usefulness of work-simulated work samples versus ability-predicted work samples. The authors discussed the advantages and disadvantages of both assessment approaches in demonstrating the benefits in vocational assessment for clients and professionals.

Use of Primus: in ability-predicted assessment (where movement resembles the task). Describes lifting assessments using BTE Primus lift tests.

“Assessing muscular strength at the hip joint.”

Kollock RO, Onate JA, Van Lunen, B: Assessing muscular strength at the hip joint. Athl Train Today. 2008;13(2):18-24.

ABSTRACT:
Early identification of weakness or strength imbalance at the hip is important. The literature suggests that proximal lower extremity strength deficits may result in hazardous positioning of the knee joint and that early identification of muscular weakness may decrease the incidence of injury. Based on that, the purpose of the article is to present techniques for measurement of hip strength. Three categories that differ in terms of complexity: primary, secondary, and tertiary are defined.

Use of Primus: musculoskeletal evaluation. Cites ability to measure isometric, isotonic, and isokinetic single joint torque associated with either concentric or eccentric contractions for the purpose of evaluation and treatment. Applications for rehab, sports, work through isolated joint and muscle assessment to integrated, functional movements.

“Treating the war casualty: Case reports of polytrauma.”

Smurr LM, Robinson M, Smith-Forbes E: Treating the war casualty: Case reports of polytrauma. J Hand Ther. 2008;21:177-188.

ABSTRACT:
The new generation of wounded Warriors is vastly different from those seen in the past, and military occupational therapists (OTs) must adapt to the challenges to meet the needs of these young men and women. Three case reports will be presented demonstrating the adaptability and flexibility of military OTs serving the combat wounded Warrior. The first case report reviews the rehabilitation process of a Sailor who was hit by an improvised explosive device (IED) and sustained an open shrapnel wound to his left upper extremity. The second case report presents the complex rehabilitation process of a Soldier who sustained an open distal radius and carpal fractures with soft tissue loss to his left hand from a gunshot

wound after his helicopter was shot down. The final case report represents a Soldier who was injured using a table saw while in Iraq and sustained lacerations to his left hand thumb, index, and ring fingers. These case reports represent some of the demands and challenges that military OTs face when treating the war casualty.

Use of Primus: musculoskeletal treatment to increase muscle strength of the upper extremity. (Case #1)

"The efficacy of prolotherapy for lateral epicondylitis: a pilot study."

Scarpone M, Rabago D, Zgierska A, Arbogest J, Snell E: The efficacy of prolotherapy for lateral epicondylitis: a pilot study. Clin J Sport Med. 2008; 18:248-254. doi:10.1097/JSM.0b013e318170fc87.

ABSTRACT:
Objectives: To assess whether prolotherapy, an injection-based therapy, improves elbow pain, grip strength and extension strength in patients with lateral epicondylosis.
Setting: Outpatient Sport Medicine clinic.
Study Design: Double-blind randomized controlled trial.
Participants: Twenty-four adults with at least 6 months of refractory lateral epicondylosis.
Intervention: Prolotherapy participants received injections of a solution made from 1 part 5% sodium morrhuate, 1.5 parts 50% dextrose, 0.5 parts 4% lidocaine, 0.5 parts 0.5% sensorcaine and 3.5 parts normal saline. Controls received injections of 0.9% saline. Three 0.5mL injections were made at the supracondylar ridge, lateral epicondyle and annular ligament at baseline, 4 and 8 weeks.
Outcome Measures: The primary outcome was resting elbow pain (0–10 Likert scale). Secondary outcomes were extension and grip strength. Each was performed at baseline, 8 and 16 weeks. One-year follow-up included pain assessment and effect of pain on activities of daily living.
Results: The groups were similar at baseline. Compared to Controls, Prolotherapy subjects reported improved pain scores (4.5±1.7, 3.6±1.2 and 3.5±1.5 versus 5.1±0.8, 3.3± 0.9 and 0.5±0.4 at baseline, 8 and 16 weeks, respectively); at 16 weeks, these differences were significant compared to baseline scores within and between groups ($p<.001$). Prolotherapy subjects also reported improvement extension strength compared to Controls ($p<0.01$) and grip strength compared to baseline ($p<0.05$). Clinical improvement in Prolotherapy subjects was maintained at 52 weeks. There were no adverse events.
Conclusions: Prolotherapy with dextrose and sodium morrhuate was well tolerated, effectively decreased elbow pain and improved strength testing in subjects with refractory lateral epicondylosis compared to Control injections.

Use of Primus: musculoskeletal evaluation of wrist extension strength in patients with lateral epicondylosis. Isometric mode was utilized maximum strength capabilities.

"Predictors of hip internal rotation during running. An evaluation of hip strength and femoral structure in women with and without patellofemoral pain."

Souza RB, Powers CM: Predictors of hip internal rotation during running. An evaluation of hip strength and femoral structure in women with and without patellofemoral pain. Am J Sports Med. 2008. doi:10.1177/0363546508326711.

ABSTRACT:
Background: Recent studies have suggested that excessive hip internal rotation during dynamic tasks may be associated with patellofemoral pain. Although diminished hip-muscle strength and altered femoral

morphologic characteristics have been implicated in abnormal hip rotation in persons with patellofemoral pain, no study has confirmed this hypothesis.
Hypothesis: Women with patellofemoral pain would demonstrate increased average hip internal rotation, decreased hip-muscle performance, and abnormal femoral shape compared with controls. Furthermore, measures of hip strength and femoral shape are predictive of average hip internal rotation during running.
Study Design: Cross-sectional study; Level of evidence, 3.
Methods: Nineteen women with patellofemoral pain and 19 pain-free controls participated. Lower extremity kinematics during running, hip-muscle performance, and femoral morphologic characteristics on magnetic resonance imaging were quantified. Independent t tests were used to assess group differences. Stepwise linear regression was used to determine whether measures of strength and/or structure were predictive of average hip internal rotation during running.
Results: Participants with patellofemoral pain demonstrated significantly greater average hip internal rotation (8.2° ± 6.6° vs 0.3° ± 3.6°; $P < .001$), reduced hip-muscle strength in 8 of 10 hip strength measurements, and greater femoral inclination (132.8° ± 5.2° vs 128.4° ± 5.0°; $P = .011$) compared with controls. Stepwise regression revealed that isotonic hip extension endurance was the only predictor of average hip internal rotation ($r = –.451$; $P = .004$).
Conclusion: Abnormal hip kinematics in women with patellofemoral pain appears to be the result of diminished hip-muscle performance as opposed to altered femoral structure. The results suggest that assessment of hip-muscle performance should be considered in the evaluation and treatment of patellofemoral joint dysfunction.

Use of Primus: musculoskeletal evaluation of hip strength of females with and without PFP. Isometric, isotonic, and isokinetic modes were utilized to measure maximum torque, endurance, and power output of hip extensors, abductors, and external rotators.

“Computers and assistive technology.”

Weiss PL. Chan CCH: Computers and assistive technology. In Jacobs K (ed). *Ergonomics for Therapists*. St. Louis, MO: Mosby Elsevier; 2008:221-245.

Use of Primus: in functional and work capacity evaluations.

“Hip abductor function and lower extremity landing kinematics: sex differences.”

Jacobs CA, Uhl TL, Mattacola CG, Shapiro R, Rayens WS: Hip abductor function and lower extremity landing kinematics: sex differences. J Athl Train. 2007;42:76-83.

ABSTRACT:
Context: Rapid deceleration during sporting activities, such as landing from a jump, has been identified as a common mechanism of acute knee injury. Research into the role of potential sex differences in hip abductor function with lower extremity kinematics when landing from a jump is limited.
Objective: To evaluate sex differences in hip abductor function in relation to lower extremity landing kinematics.
Design: 2 x 2 mixed-model factorial design using a between-subjects factor (sex) and a repeated factor (test).
Setting: University laboratory.
Patients or Other Participants: A sample of convenience consisting of 30 healthy adults (15 women, 15 men) with no history of lower extremity surgery and no lower extremity injuries within 6 months of testing.

Intervention(s): Landing kinematics were assessed as subjects performed 3 pre-exercise landing trials that required them to hop from 2 legs and land on a single leg. Isometric peak torque (PT) of the hip abductors was measured, followed by an endurance test during which subjects maintained 50% of their PT to the limits of endurance. After a 15-minute rest period, subjects completed a 30-second bout of isometric hip abduction, from which we calculated the percentage of endurance capacity (%E). Immediately after exercise, subjects completed 3 post exercise landing trials.
Main Outcome Measure(s): PT, %E, and peak joint displacement (PJD) of the hip and knee in all 3 planes of motion.
Results: Women demonstrated lower PT values (5.8 ± 1.2% normalized to body weight and height) than did their male counterparts (7.2 ± 1.5% normalized to body weight and height, *P* = .009). However, no sex differences were seen in %E. Women also demonstrated larger knee valgus PJD (7.26º ± 6.61º) than did men (3.29º ± 3.54º, *P* = .04). Women's PT was moderately correlated with hip flexion, adduction, and knee valgus PJD; however, PT did not significantly correlate with men's landing kinematics. Regardless of sex, hip flexion (*P* = .002) and hip adduction (*P* = .001) were significantly increased following the 30-second bout of exercise.
Conclusions: Women demonstrated lower hip abductor PT and increased knee valgus PJD when landing from a jump, potentially increasing the risk of acute knee injury. Furthermore, correlations between hip abductor strength and landing kinematics were generally larger for women than for men, suggesting that hip abductor strength may play a more important role in neuromuscular control of the knee for women.

Use of Primus: musculoskeletal evaluation of hip abductor strength in healthy adults. Isometric mode was utilized for evaluation of maximum strength capabilities and endurance and for treatment using 30 sec. bouts of isometric hip abduction.

"Evaluation of the torque-velocity test of the BTE Primus as a measure of sincerity of effort of grip strength."

Shechtman O, Hope LM, Sindhu BS: Evaluation of the torque-velocity test of the BTE Primus as a measure of sincerity of effort of grip strength. J Hand Ther. 2007;20:326-335.

ABSTRACT: An inverse linear relationship exists between torque and velocity in the mid-ranges of an isotonic maximal contraction in a single joint movement (such as the elbow and knee). We hypothesized that submaximal effort does not produce a linear torque-velocity relationship because replicating a submaximal isotonic contraction requires an enormous amount of proprioceptive feedback and the nervous system may not be able to accurately replicate both force and speed of contraction. If this hypothesis is true, the torque-velocity test of the BTE Primus would be an effective method for assessing sincerity of effort. The purpose of this study was to examine if differences exist in the linear torque-velocity relationship between maximal and submaximal grip strength effort. Due to the fact that a test is not valid unless it is reliable, an additional purpose was to calculate the test-retest reliability of velocity during isotonic contraction using the torque-velocity test of the BTE Primus' grip tool. Participants included 32 healthy, right-hand dominant (16 male, 16 female) persons, aged 20-50 years (mean age 25±8.0), with no history of upper-extremity injury. The subjects participated in two days of grip-strength testing (approximately two weeks apart) and were instructed to exert maximal effort with both hands on one day, and to feign injury with one hand on the other day. Each day included two sessions of testing, which consisted of performing the ''torque-velocity test'' on the BTE Primus grip attachment (#162). We randomly assigned the feigning hand (dominant vs. nondominant) and the effort (maximal vs. submaximal). The test administrator was blinded to the level of effort. On each day, four isotonic grip strength tests were performed at loads of 20%, 30%, 40%, and 50% of isometric test scores. Three repeated isotonic grip strength trials were performed at each load and the average was plotted. One plot was generated for the maximal effort and another for the submaximal efforts. Average torque was plotted

against the average velocity at each of the four loads and for each level of effort (maximal vs. submaximal). The linear relationship of the torque-velocity curve was examined by performing regression analysis, calculating the intercept, slope, correlation coefficient (*r*), and the coefficient of determination (*r*2) for each curve. Paired t-tests were used to compare the intercept, slope, and *r*2 between maximal and submaximal efforts. Bonferroni correction set the alpha level at 0.0167. Sensitivity and specificity values were calculated for linearity (*r*2) and a Receiver Operator Characteristic (ROC) curve was constructed to obtain the optimal sensitivity and specificity combination. In addition, test-retest reliability was determined for velocity of maximal isotonic effort using Intraclass Correlation Coefficient. Significant differences between maximal and submaximal efforts were found for the intercept (t = 5.069; *p*,0.001) and for linearity as expressed by *r*2 (t = 5.414; *p* <0.001). Mean *r*2 was 0.89 for maximal effort and 0.53 for submaximal effort. The slopes of maximal and submaximal efforts were not significantly different (t = 0.14; p = 0.888). The ROC curve revealed the optimal combination of sensitivity (0.69) and specificity (0.72) values. Test-retest reliability of maximal isotonic grip effort for velocity was *r* = 0.843. The differences in intercepts suggested that velocity was greater during maximal effort. Greater *r*2 values indicated greater linearity for maximal efforts than submaximal efforts. These findings suggest that the torque-velocity test of the BTE Primus can distinguish between maximal and submaximal efforts during grip-strength testing. However, the test misclassified 31% of submaximal effort and 28% of maximal error, for a total error of 59%. Therefore, this test does not possess adequate sensitivity and specificity values to justify its use in the clinic.

Use of Primus: musculoskeletal evaluation of grip strength of healthy males and females. Isometric mode was utilized to measure maximum strength capabilities. Reliability of measures were established.

“Radial head fractures – Advanced techniques in surgical management and rehabilitation.”

Bano KY, Kahlon RS: Radial head fractures – Advanced techniques in surgical management and rehabilitation. J Hand Ther. 2006;19:114-136.

ABSTRACT: Radial head fractures are the most common fractures in the elbow, and the treatment of nondisplaced fractures is often straightforward. However, radial head fractures with concurrent injury to the elbow stabilizers may require complex treatment and therapy that are targeted at specifically restoring elbow stability. This treatment of complex radial head fractures has recently improved because of long-term follow-up studies, increased biomechanical research on elbow stability, and improved surgical techniques. With an open line of communication between the surgeon and the therapist, an appropriate therapy plan can be initiated to protect both simple and complex injuries. The therapist should have knowledge of specific tissue healing and treatment techniques, and the patient must be educated in possible outcomes, safe arcs of motions, positioning, and proper splint use. This article summarizes current advanced techniques in the surgical management and rehabilitation of radial head fractures. Comprehensive protocols for decision making and treatment are introduced for both simple and complex radial head fractures.

Use of Primus: musculoskeletal evaluation of strength and treatment for strengthening and functional task training of patients post-radial head fractures.

“Managing the stiff elbow: Operative, nonoperative, and postoperative techniques.”

Davila SA, Johnston-Jones K: Managing the stiff elbow: Operative, nonoperative, and postoperative techniques. J Hand Ther. 2006;19:268-281.

ABSTRACT: Elbow contracture may be caused by intrinsic or extrinsic limitations or a combination of both. Evaluation of the specific structures guides the development of an effective therapy treatment program. Intrinsic contractures are by definition due to joint/intra-articular incongruency, and therefore therapy and splinting cannot provide increase in joint motion. Nonoperative therapy treatment options include heat modalities, myofascial soft tissue mobilization, joint mobilization, muscle energy techniques, passive range of motion, active range of motion, extensive use of corrective splinting, and strengthening exercise. All operative candidates must participate in a preoperative therapy program of six to eight weeks to reduce extrinsic contractures as feasible and to assess patient compliance with an intensive postoperative therapy program. Corrective splinting may be needed for as long as six months to maintain gains made in surgery. The therapy following manipulation under anesthesia and open contracture release is similar. The therapist must know the details of the procedure. Operative treatment for the stiff elbow progresses in a sequential fashion to progressively release tissue structures limiting motion and reconstruct any structures as needed to provide joint stability. Postoperative therapy consists of continuous passive motion, corrective splinting, modalities, and specific exercise techniques to maintain passive gains achieved in surgery. The therapy is extensive and requires full participation from the patient to maximize motion and function. Complications of elbow contracture release include nerve palsy or nerve injury, seroma, joint instability, heterotopic ossification, and recurrence of elbow contracture.

Use of Primus: musculoskeletal treatment for strengthening and improved function of patients with stiff elbows.

"Industrial rehabilitation services."

Keegan DM, Kahlert RC: Industrial rehabilitation services. In Burke SL, Higgins J, McClinton MA, Saunders RJ, Valdata L (eds). *Hand and Upper Extremity Rehabilitation: A Practical Guide.* (3rd ed). St. Louis, MO; Elsevier Churchill Livingstone; 2006:727-738.

Use of Primus: in functional and work capacity evaluations.

"Glenohumeral instability."

Lynch GM: Glenohumeral instability. In Burke SL, Higgins J, McClinton MA, Saunders RJ, Valdata L (eds). *Hand and Upper Extremity Rehabilitation: A Practical Guide.* (3rd ed). St. Louis, MO: Elsevier Churchill Livingstone; 2006:359-367.

Use of Primus: musculoskeletal treatment of patients post-surgery for traumatic instabilities of the shoulder. Closed chain exercises specified.

"Humeral fractures."

Murphy MS: Humeral fractures. In Burke SL, Higgins J, McClinton MA, Saunders RJ, Valdata L (eds). *Hand and Upper Extremity Rehabilitation: A Practical Guide.* (3rd ed). St. Louis, MO: Elsevier Churchill Livingstone; 2006:369-387.

Use of Primus: musculoskeletal treatment of patients post-nonoperative and operative humeral fractures. Use to prepare for return to functional tasks.

“Triangular fibrocartilage injuries.”

Pitts G, Burgess R: Triangular fibrocartilage injuries. In Burke SL, Higgins J, McClinton MA, Saunders RJ, Valdata L (eds). *Hand and Upper Extremity Rehabilitation: A Practical Guide.* (3rd ed). St. Louis, MO: Elsevier Churchill Livingstone; 2006:475-487.

Use of Primus: musculoskeletal treatment of patients post-nonoperative and operative TFCC tears. Use to prepare for return to functional tasks.

“Worth the DRIVE.”

Strzelecki MV: Worth the DRIVE. OT Practice. 2006; Feb:9-10. (And Thesis)

ABSTRACT: This research study, conducted over nine months, used the BTE PrimusRS as a tool with an individual who has a high-level SCI (at the cervical level). The primary goal of this study was to increase the individual’s functional ability so that he may return to driving independently with the least amount of vehicle adaptations. This was the first time that the BTE PrimusRS had been used for this purpose. Other goals of the program were to return to driving in order to: maximize existing musculature; increase global functional ability; minimize necessary adaptations; increase independence, quality of life, return to work, and social participation; and improve health. Using targeted force CPM for steering and braking and accelerating hand control was able to improve work output significantly as well as endurance. Percent increase in work performed during exercise: CW steering = 333%, CCW steering = 205%, push/brake = 694%, and pull/accelerate = 330%. Percent increase in endurance for steering = 736% and for braking-accelerating = 68%. Improvement in ADL Performance Scale scores.

Use of Primus: musculoskeletal/neuromuscular evaluation and treatment using isokinetic concentric/ eccentric UE exercise with visual feedback/target (CPM mode) is effective in improving strength, endurance, and function. Integrated functional movements/task simulations. Progress charting.

“Radial head prosthesis after fracture of radial head with associated elbow instability.”

Wretenberg P, Ericson A, Stark A: Radial head prosthesis after fracture of radial head with associated elbow instability. Arch Ortho Trauma Surg. 2006;126:145-149.

ABSTRACT:
Introduction: Fractures of the radial head and associated elbow instability can be treated with operation with radial head prosthesis. In this study, we evaluate function 1–7 years after implantation and also function after removal of five prostheses.
Material and methods: Eighteen patients with radial head fracture and associated elbow instability were evaluated 3.7 years (1–7) after implantation of a radial head prosthesis. Pain at rest and during activity was measured with a visual analogue scale (VAS). Test of stability and neurological examination was done manually as well as measurement of the range of motion, using a goniometer. Activity of daily living (ADL) was estimated using five questions where the answers were graded between 1 and 3. The patients were asked to grade their general satisfaction according to the following scale; very satisfied, satisfied, not satisfied, disappointed. Plain X-rays were taken and 14 patients agreed to have their elbow strength evaluated using the validated BTE work simulator (Primus).
Results: Five prostheses had been extracted due to poor range of motion. All these patients improved after extraction. All elbows were stable. No patient with extracted prosthesis had VAS score >2. The mean extension defect for this group was 15° (5–25) compared to the mean extension defect for the 13

patients with the prosthesis still in place 15° (0–40). The highest VAS score for the patients with prosthesis was five but the mean as low as 0.8. In the whole group, 13 patients were pain free. ADL function was good in general. The X-rays of the prostheses, still in place, showed radiolucent lines in 7 of the 13 patients. In the whole group, there was a significant decrease in supination, flexion and extension strength (P<0.01,
P<0.01, P<0.05).
Discussion: Radial head prosthesis works as a spacer after fracture of the radial head and associated instability. If range of motion is much restricted post-operatively, the prosthesis can be removed with improved function as result.

Use of Primus: musculoskeletal evaluation of active ROM of the elbow/forearm of patients post-radial head arthroplasty.

"Strength and fatigability of the dominant and nondominant hip abductors."

Jacobs C, Uhl TL, Sterling W, Goodrich L: Strength and fatigability of the dominant and nondominant hip abductors. J Athl Train. 2005;40(3):203-206.

ABSTRACT:
Context: Contralateral muscular imbalances have been suggested to increase the risk of lower extremity injury. Previous groups have assessed strength of the quadriceps and hamstring muscle groups; however, no previous authors have compared bilateral hip-abductor muscular performance.
Objective: To examine the strength and fatigability of the hip abductors in the dominant and nondominant legs.
Design: Single-group, repeated-measures design.
Setting: Musculoskeletal laboratory.
Patients or Other Participants: Forty-two healthy subjects (23 males, 19 females; age = 24.3 ± 2.7 years, height = 173.4 ± 9.8 cm, mass = 73.7 ± 11.6 kg).
Intervention(s): Subjects performed three 5-second maximal voluntary isometric contraction (MVIC) trials of the hip abductors with the dominant and nondominant legs. Following the maximal strength trials, subjects performed a submaximal (50% of MVIC) 30-second fatigue trial with each leg.
Main Outcome Measure(s): Peak torque (PT) was recorded from each MVIC trial. Surface electromyography was used to record muscle activity during the fatigue trials. Power spectral analysis was used to determine the median frequency of each 0.512-second portion of the fatigue trials. Median frequencies were plotted against time, and linear regression was used to determine the median frequency slope (MFslope). Data were analyzed using 2-tailed, paired t tests.
Results: Hip-abduction PT of the dominant leg (81.0 ± 23.7 Nm) was significantly larger than that of the nondominant leg (76.1 ± 9.9 Nm, $P = 0.02$). There was no difference in MFslope between the dominant (20.37 ± 0.29) and nondominant limbs (20.35 ± 0.34, $P = 0.84$). The PT and MFslope were not significantly correlated ($r = 20.07$, $P = 0.53$).
Conclusions: Hip-abduction strength differences exist between the dominant and nondominant legs. Measures of strength and fatigability were poorly related; therefore, clinicians may opt to assess hip strength and fatigability independent of each another.

Use of Primus: musculoskeletal evaluation of hip muscle performance of healthy males and females. isometric mode was utilized to measure maximum strength capabilities and fatigability of hip abductors.

“Anatomic reconstruction of the distal radioulnar ligaments: long-term results.”

Teoh LC, Yam AKT: Anatomic reconstruction of the distal radioulnar ligaments: long-term results. J Hand Surg. 2005;30B:185-193.

ABSTRACT:
Chronic post-traumatic dynamic distal radioulnar joint instability following rupture of the distal radioulnar ligaments may cause disabling and progressive ulnar-sided wrist symptoms. We use a free tendon graft to anatomically reconstruct both dorsal and palmar distal radioulnar ligaments simultaneously. Nine patients who underwent this procedure between 1990 and 1997 were assessed using a modified Mayo Wrist Score. Following surgery, average wrist scores improved from 66 (95% CI, ±3.0) to 92 (95% CI, 92 ± 6.9) and were maintained in the long term (average score, 87 at 9 years). Joint stability was restored and maintained in seven of the nine patients, but two developed recurrent instability. Pain, grip strength and function were better following surgery in the short and long term. Range of supination and pronation decreased slightly from an average of 1691 pre-operatively to 1551 (90% of normal) in the long term. Long-term radiographs show no distal radioulnar or ulnocarpal joint osteoarthritis.

Use of Primus: musculoskeletal evaluation of hand grip strength of patients post-reconstruction of the distal radioulnar ligaments. Isometric mode was utilized to measure maximum strength capabilities.

“Visual analogue scale correlates of musculoskeletal fatigue.”

Leung AWS, Chan CCH, Lee AHS, Lam KWH: Visual analogue scale correlates of musculoskeletal fatigue. Perceptual and Motor Skills. 2004;99:235-246.

ABSTRACT:
Visual analogue scale has been shown to reflect subjective feelings but rarely has it been used for musculoskeletal fatigue so in the present study VAS ratings were used to quantify musculoskeletal fatigue. A total of 20 students underwent a fatigue protocol (M age=21.3 yr., SD= 1.0). A series of randomized external loads at 0, 5, 10, 15, 25, 35, and 50% of the maximum voluntary contraction was generated by the BTE Primus and applied at the distal end of the dominant arm, which was sustained at the 90" forward flexion position. After 60 sec. of force exertion for each loading, the subject marked the scale to reflect their extent of fatigue at the shoulder muscle. Analysis showed fatigue scores were significantly correlated with the percentages of maximum load applied (r = .73, p 5.01). The correlation between higher external loads (25-50% maximum load) and fatigue scores was .57 (p **I** .01) and that for lower external loads (0-15% maximum load) was .44 *(p* 2.01). The validity of using a visual analogue scale as a measure of musculoskeletal fatigue requires further study, particularly for a low load.

Use of Primus: musculoskeletal evaluation of muscle performance of the shoulder of healthy male and female students. Isometric mode was utilized to measure maximum strength capabilities and muscle endurance of shoulder flexors.

“Reliability and validity of the BTE Primus grip tool.”

Shechtman O, Davenport R, Malcolm M, Nabavi D: Reliability and validity of the BTE Primus grip tool. J Hand Ther. 2003;16:36-42.

ABSTRACT:
This study was designed to examine the reliability and validity of the newly designed grip tool of the BTE Primus and to investigate the effects of body position (sit versus stand), handedness, and fatigue on grip

strength. The subjects performed maximal grip strength tests using the Jamar dynamometer and the BTE Primus. Intraclass correlation coefficients were calculated for test-retest reliability and criterion-related validity. A repeated measures analysis of covariance was conducted to reveal differences in grip strength between instruments, body positions, hands, and sessions. The BTE Primus grip tool was found to be reliable (r = 0.97 to 0.98) and valid (r = 0.95 to 0.96). There were no significant differences in grip strength scores between the Jamar and the BTE Primus or between sitting and standing. Grip strength scores of the right hand were significantly greater than those of the left hand, and grip strength scores in the first session were significantly greater than those of the second session. The results of this study indicate that clinicians can use the BTE Primus grip attachment at the second handle setting and know that it is reliable, valid, and comparable to the second handle setting of the Jamar dynamometer.

Use of Primus: musculoskeletal evaluation of grip strength. Reliability of measures and validity of attachments and measures were established.

"The relationship between strength, pain, and community integration in wheelchair users: a pilot study."

Shechtman O, Locklear C, MacKinnon L, Hanson C: The relationship between strength, pain, and community integration in wheelchair users: a pilot study. Occup Ther in Health Care. 2003;17:5-21. http://dx.doi.org/10.1080/J003v17n01_02.

ABSTRACT:
The purpose of this pilot study was to determine the differences between wheelchair users and their matched able-bodied controls in grip strength, pain (as expressed by scores on the McGill Pain Questionnaire [MPQ]), and community integration (as expressed by scores on the Craig Handicap Assessment and Reporting Technique [CHART]). We also explored the relationships among community integration, pain, strength, and demographic variables. Thirteen wheelchair users and 13 able-bodied participants were matched for gender, age, and activity level. The wheelchair-user group had significantly greater scores on the MPQ and significantly lower scores on the CHART. Step-wise multiple regression analyses revealed that the best predictor for pain was age for the wheelchair-user group and activity for the able-bodied group. The best predictor of the CHART for the wheelchair-user group was grip strength. In conclusion, pain was associated with age for the wheelchair-user group and with activity for the able-bodied group. In addition, grip strength was associated with community integration for the wheelchair-user group.

Use of Primus: musculoskeletal evaluation of hand grip strength of wheelchair users. Isometric mode was utilized to measure maximum strength capabilities.

"Treatment of distal radioulnar joint disorders with a modified Sauve-Kapandji procedure: long-term outcome with special attention to the DASH Questionnaire."

Zimmerman R, Gschwentner M, Arora R, Harpf C, Gabl M, Pechlaner S: Treatment of distal radioulnar joint disorders with a modified Sauve-Kapandji procedure: long-term outcome with special attention to the DASH Questionnaire. Arch Ortho Trauma Surg. 2003;123:293-298. doi:10.1007/s00402-003-0529-5.

ABSTRACT:
Introduction: An intact distal radioulnar joint (DRUJ) is essential for normal functioning of the upper limb. Osteoarthritis of the DRUJ often leads to ulnar wrist pain, limitation of forearm rotation and reduced grip strength, all of which limit activities of daily living. Once the joint is damaged, salvage procedures are recommended.

Materials and methods: Between 1986 and 1996 a modified Sauvé-Kapandji procedure was performed in 117 patients with painfully limited forearm rotation and osteoarthritis of the distal radioulnar joint (DRUJ). Of the 117 patients, 73 women and 32 men, whose ages at operation ranged from 22 to 74 years (average 58 years), were retrospectively reviewed clinically and radiologically 8 years (range 5–12 years) after the operation. The DASH questionnaire was used with 53 patients, 43 patients were accepted for the study, and 10 were excluded.
Results: Forearm rotation improved in all patients, ulnar wrist pain was reduced in 97% of the patients, and 9% had mild pain at the proximal ulnar stump. Grip strength improved from a preoperative mean of 38% to a postoperative mean of 55% compared with the contralateral side. The mean DASH score was 28 points (range 0–53 points). In all cases the arthrodesis fused within 8 weeks. The radiographs showed approximation between the proximal ulna stump and the radius compared with the preoperative situation in 74% of the patients.
Conclusion: Our clinical and radiological findings suggest that the Sauvé-Kapandji procedure is indicated in symptomatic, non-reconstructable disorders of the DRUJ. The DASH questionnaire provides a general view of the functional outcome after the Sauvé-Kapandji procedure. The DASH questionnaire is very helpful in evaluating the effect of the Sauvé-Kapandji procedure on the entire upper limb.

Use of Primus: musculoskeletal evaluation of AROM of forearm supination and pronation and hand grip strength of patients post-Sauve-Kapandji procedure.

"Stage 3 Keinbock's Disease: reconstruction of the fractured lunate using a free vascularized iliac bone graft and external fixation."

Gabl M, Lutz M, Reinhart CI, Zimmerman R, Pechlaner S, Hussl H, Rieger M: Stage 3 Keinbock's Disease: reconstruction of the fractured lunate using a free vascularized iliac bone graft and external fixation. J Hand Surg. 2002;27B:369-373.

ABSTRACT:
Eighteen patients with stage 3 Kienbock's disease were treated by debridement of the necrotic core of the lunate and implantation of a free vascularized corticocancellous iliac bone. The wrist was stabilized with an external fixator during healing. The efficiency of the procedure for restoring the structure of the fractured lunate, preventing carpal collapse and improving the clinical outcome was assessed at a mean follow-up of 5 years. The graft became incorporated in the lunate in 16 of the 18 patients and no fracture of the reconstructed lunate or carpal collapse occurred in these cases. The graft did not integrate and was resorbed in the other two patients.

Use of Primus: musculoskeletal evaluation of hand grip strength of patients post-iliac bone graft of lunate fracture.

"Case report and review of the literature: Madelung's deformity."

Villeco J: Case report and review of the literature: Madelung's deformity. J Hand Ther. 2002;15(4):355-362.

ABSTRACT:
The purpose of this article is to familiarize therapists with the diagnosis, clinical presentations, surgical interventions, and therapy considerations for patients diagnosed with Madelung's deformity. Madelung's deformity is a deformity of the distal forearm and wrist caused by premature closing of the palmar and ulnar portion of the distal radius epiphysis. As the radial portion of the physis continues to grow, dorsal and radial bowing of the radius develops. A host of other changes follow, which alter the normal

biomechanics of the distal radioulnar joint and carpus. Consequently, there typically is decreased range of motion for supination, ulnar deviation, and extension and decreased grip strength. The presenting complaint is usually pain, typically on the ulnar side of the wrist.1–3 A variety of surgical approaches exist for this deformity; many of these are discussed later. The cause and radiologic presentation of Madelung's deformity also are reviewed.

Use of Primus: musculoskeletal evaluation and treatment of upper extremity strength of patients with Madelung's deformity.

"Consistency of performance on the functional capacity assessment: Static strength and dynamic endurance."

Lee GKL, Chan CCH, Hui-Chan CWY: Consistency of performance on the functional capacity assessment: Static strength and dynamic endurance. Am J Phys Med Rehabil. 2001;80:189-195.

ABSTRACT:
Objective: To explore the degree of consistency in a subject's performance in physical strength and endurance.
Design: Thirty healthy men, aged 19 to 26 yr, were recruited to participate in protocols to assess static strength and dynamic endurance tests on their upper limbs with the Baltimore Therapeutic Equipment Primus. Retests were conducted 7 days after the initial test.
Results: The intraclass correlation coefficients were 0.71 to 0.97 and 0.32 to 0.90 for static and dynamic endurance strengths, respectively. These results indicated that the consistency of the subjects' performance across occasions was high for testing static strength, although it was more varied for testing endurance strength.
Conclusions: Higher consistency was observed among subjects in the assessment of static strength than dynamic endurance strength. The range of motion traveled by the limb, speed of performance, and ergonomic design of attachments seemed to confound the subjects' performance on the instrument. Stringent assessment protocols, ergonomically designed hardware, and clear instructions and practice trials before the formal testing were essential to maximize the subjects' consistency of performance. The results of this study were applicable and generalized to other performance-based instruments for physical and functional capacity evaluation and work simulators.

Use of Primus: musculoskeletal evaluation of upper extremity of healthy males as part of functional capacity evaluations. Isometric and isotonic modes were utilized to measure muscle strength and endurance required by isolated and integrated functional movements. Reliability of measures was established.

"Work profile and functional capacity of formwork carpenters at construction sites."

Lee GK, Chan CC, Hui-Chan CW: Work profile and functional capacity of formwork carpenters at construction sites. Disabil Rehabil. 2001;23(1):9-14.

ABSTRACT:
PURPOSE: This study established a work profile and functional capacity for formwork carpenters (FCs) working at construction sites.
METHOD: Thirty male FCs aged 19-45 were recruited by convenient sampling from the construction training centres. All FCs participated in an interview/questionnaire and a standardized functional capacity evaluation (FCE) using the Baltimore Therapeutic Equipment Primus (BTE Primus) and Valpar

Component Work Sample (VALPAR19). Thirty male adults (office workers) aged 19-45 participated in the exact FCE for comparison.
RESULTS: The results of the questionnaire indicated that the job demands of formwork carpenters were frequent lifting (46.7%), carrying (50.0%) and handling (60.0%). Significantly higher lifting and carrying capacities were revealed among the FCs, but not in their isometric strengths and the endurance of the upper limbs (chi2 = 6.48, df = 2, $p < 0.05$).
CONCLUSIONS: The dynamic and repetitive sub-maximal nature of the work of formwork carpentry induced an elevation of job-specific lifting and carrying capacities among the FCs. The job and functional capacity profiles would be useful for formulating guidelines for the rehabilitation of injured workers and the training of new workers in the trade.

Use of Primus: musculoskeletal evaluation of muscle strength of healthy males when performing functional/work-related tasks (as is required for an FCE).

"Using the BTE Primus® to measure grip and wrist flexion strength in physically active wheelchair users: An exploratory study."

Shechtman O, MacKinnon L, Locklear C: Using the BTE Primus® to measure grip and wrist flexion strength in physically active wheelchair users: An exploratory study. Am J Occup Ther. 2001;55:393-400.

ABSTRACT:
Objective: The purpose of this study was to establish test-retest reliability values for the newly designed grip and wrist attachments of the BTE Primus® and to determine criterion-related validity of the new grip attachment against the Jamar dynamometer. An additional purpose was to explore the difference in grip and wrist flexion strength between wheelchair users and control participants without disabilities and to examine the effect of body position on strength in persons without disabilities.
Method: Wheelchair users and matched controls (13 per group)) were tested for grip and wrist flexion strength on the BTE Primus and for grip on the Jamar dynamometer.
Results: The BTE Primus grip attachment was found to be valid and reliable. No significant differences were found in static and dynamic grip or wrist flexion strength between the two groups or in the sitting versus standing position for the control group.
Conclusion: The findings suggest that the BTE Primus may be used to assess grip and wrist flexion strength validly and reliably for both wheelchair users and persons without disabilities.

Use of Primus: musculoskeletal evaluation of grip and wrist flexion strength of wheelchair users and control subjects. Reliability of measures and validity of attachments and measures were established.

"A standardized clinical series for work-related lateral epicondylitis."

Chan CCH, Li CWP, Hung LK, Lam PC: A standardized clinical series for work-related lateral epicondylitis. J Occup Rehabil. 2000;10:143-152.

ABSTRACT:
This study was a clinical series to pilot test the benefits of a 6-week standardized program designed for a group of patients with work-related lateral epicondylitis. The program was formulated based on a dose-and-response model. A total of 15 female patients were recruited. All patients were involved in educational sessions, home exercise, and progressive work-hardening training. Patients were assessed at admission, predischarge, and 4th week and 12th week follow-ups. The results indicated significant improvements in pain intensity ($p \cdot .05$), isometric strength and endurance ($p \cdot .01$), self-perceived

performance competence (p · .03), and satisfaction with performance (p · .03) between admission and predischarge. The patients maintained a low pain intensity and high satisfaction within the follow-up period. The program appeared to improve patients' work capacities and satisfaction with performance, but at the same time keep the symptoms at a low level. The control of the pain level and self-initiated optimization of work exposure were important features of a standardized program. Large-scale randomized clinical studies should be conducted to further test its efficacy for this particular patient population.

Use of Primus: musculoskeletal evaluation of upper extremity muscle performance of patients with lateral epicondylitis. Isometric strength and isotonic endurance testing of shoulder flexion, elbow flexion and extension, and wrist extension were included in the study protocol.

"Maximum torque exertion capabilities of Korean at varying body postures with common hand tools."

Kim CH, Kim TK: Maximum torque exertion capabilities of Korean at varying body postures with common hand tools. Proceedings of IEA 2000 - HFES 2000 Congress.

ABSTRACT:
A laboratory experiment was conducted to investigate the effects of body posture and of different types of common non-powered hand tools on maximum volitional torque exertion capabilities of Korean. Fifteen males and 15 females were participated in the experiment. Each subject exerted maximum volitional torque in 15 different body postures while using five different common non-powered hand tools. Results of the data analysis showed that, for both males and females, the magnitude of torque exertion is significantly affected by the type of tools and posture. Also the result indicated that females exerted only about 51.5% of torque when compared to that of males. This result is different with the general findings in the field of ergonomics that muscular strength of female is usually 65% to 75% of male. It suggests that application of same profile of muscular strength of female should be carefully considered in oriental countries since females in this region may possess less physical capability compare to that of western females in terms of percentage muscular strength of males. Profiles of maximum torque capabilities of Koreans are provided.

Use of Primus: musculoskeletal evaluation of upper extremity strength of healthy males and females. Five tools that equated to 5 common non-powered hand tools were used to measure maximum torque exertion in 15 different postures. Isometric mode was utilized to measure maximum torque capabilities.

"Vascularized bone graft from the iliac crest for the treatment of nonunion of the proximal part of the scaphoid with an avascular fragment."

Gabl M, Reinhart C, Lutz M, Bodner G, Rudisch A, Hussl H, Pechlaner S: Vascularized bone graft from the iliac crest for the treatment of nonunion of the proximal part of the scaphoid with an avascular fragment. J Bone Joint Surg. 1999;81A;1414-1428.

ABSTRACT:
Background: It was hypothesized that nonunion of the proximal third of the scaphoid associated with avascular necrosis could be treated successfully with a free vascularized bone graft obtained from the iliac crest.
Methods: Fifteen patients who had a nonunion of the proximal part of the scaphoid that had been present for an average of two years and three months (range, nine months to seven years) were managed with

use of a free vascularized bone graft obtained from the iliac crest. Avascularity of the scaphoid, as assessed on pre-operative radiographs, was characterized by loss of trabecular structure, collapse of subchondral bone, and formation of bone cysts. The results of the procedure were assessed in terms of osseous union, pain, active motion of the wrist, and osteoarthritis. Postoperatively, vascularity of the scaphoid was evaluated with use of magnetic resonance imaging and color Doppler ultra-sonography. The average duration of follow-up was six years and one month (range, two years and one month to eight years and one month).
Results: Preoperatively, one patient had had pain with any movement of the wrist and fourteen had had pain after strenuous manual labor or sports activity. The average pain score, derived with use of a 10-point visual analog scale, was 2.4 points (range, 1.0 to 6.7 points). Postoperatively, union was achieved in twelve patients; six were pain-free, and six had occasional pain during strenuous manual labor or sports activity, or both. The average pain score for these twelve patients was 1.1 points (range, 0.0 to 4.2 points) on the visual analog scale. Preoperatively, osteoarthritis was limited to the region between the radial styloid process and the distal part of the scaphoid in fourteen patients and to the radioscaphoid region in one patient. Postoperatively, the degree of osteoarthritis remained unchanged in seven of the twelve patients who had union and progressed to the radioscaphoid region in five. Vascularity, as seen on the imaging studies, was restored in all twelve patients who had union. The nonunion persisted in three patients, all of whom had progressive osteoarthritis leading to carpal collapse.
Conclusions: The index procedure was successful in twelve of the fifteen patients who had a symptomatic nonunion of the proximal part of the scaphoid associated with avascular necrosis and osteoarthritis that was limited to the radioscaphoid joint.

Use of Primus: musculoskeletal evaluation of the wrist and hand of patients post-bone graft treatment for nonunion of scaphoid. AROM of forearm (supination and pronation) and wrist (flexion, extension, radial deviation and ulnar deviation) and isometric hand grip strength were measured.

“Reflex sympathetic dystrophy: The clinician’s perspective.”

Hardy MA, Hardy SGP: Reflex sympathetic dystrophy: The clinician’s perspective. J Hand Ther. 1997;10:137-150.

ABSTRACT: Theories on the etiology of reflex sympathetic dystrophy (RSD) are reviewed and presented in three categories: peripheral, spinal, and supraspinal. The peripheral pathophysiology involves a prolonged inflammatory response to injury due to the axon reflex with release of vasoactive neuropeptides and sensitized nociceptors. The spinal component of RSD genesis involves nociceptive spinal cord neurons with lowered thresholds due to chronic pain input. These sensitized spinal neurons respond in turn by signaling pain reflexes through the sympathetic system. A physical-emotional diathesis may predispose individuals to respond to stress through autonomic arousal. Autonomic arousal, coupled with injury, signals the supraspinal influence on this syndrome. Since the puzzle of RSD remains to be solved, measurement and treatment strategies are suggested to provide intervention at each level. Measurement techniques should include a battery of static tests and stress tests. Static tests are used to quantify a physiological parameter at one point in time. Stress tests access physiological response to various neurovasomotor challenges. A "hands off" treatment regime is presented that includes pain control, methods to reset sensory thresholds, vasomotor challenges, and an active motion program.

Use of Primus: musculoskeletal treatment of upper extremity of patients with RSD using continuous passive mode (isokinetic mode) for gentle rocking, not stretching, of the least-involved extremity joints to enable early motion without pain.