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Update on PHYSICAL THERAPY™

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Improving Strength and Function With Exercise After Hip Fracture

Hip fractures are a leading cause of disability in older adults. Many patients are discharged from physical therapy despite residual muscle weakness. Functional deficits have been shown to persist, ≥2 years after the hip fracture. The aim of the study conducted by Host et al from Washington University in St. Louis, Missouri, was to determine in frail elderly adults whether a supervised program of progressive resistive training (PRT) and specificity of exercise training would result in improved levels of strength and physical function after surgical repair of hip fracture.

Thirty-one older adults (9 men, 22 women) with a mean age of 79 years and surgical hip fracture repair approximately 3 months before study enrollment completed 2 3-month-long phases of exercise training. During the first 3-month phase, exercises were designed for flexibility, balance, coordination, movement speed and overall major muscle group strengthening. Exercises were made progressively more difficult; sessions lasted from 45–90 minutes.

In phase 2, PRT was added, beginning with a 1-repetition maximum baseline measurement. Resistance and repetitions were increased as per the guidelines of the American College of Sports Medicine. Assessments were completed at baseline, 3 months and 6 months for all major muscle groups: knee extensors, knee flexors and ankle plantar flexors.

At baseline, all muscle groups were weaker in the fractured limb than in the nonfractured

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limb. Following both low- and high-intensity exercise training, subjects had significant gains in strength for all muscle groups of the fractured limb. After 6 months of training, these strength measures were nearly equivalent between fractured and nonfractured limbs (Figure 1).

Contrary to what has been found in previous studies, subjects had strength improvement in the fractured limb across all speeds of testing, despite the fact that the training was only performed at a slow pace. The present study also showed that people who have had a hip fracture and who worked at higher intensity of PRT achieved greater gains as demonstrated through their physical performance (Table 1).

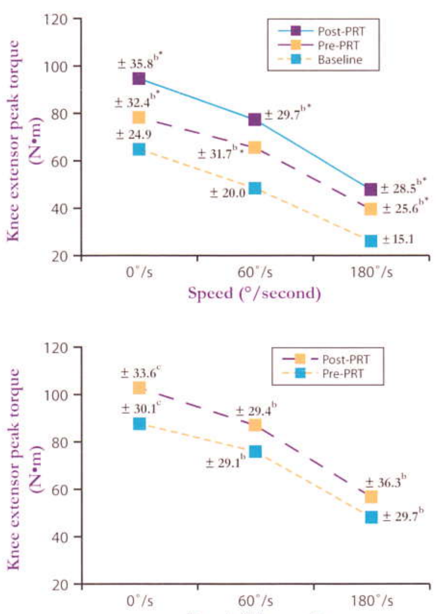

Figure 1. Changes in knee extensor peak torque from baseline to pre-PRT and post-PRT in the fractured limb ($p < .05$ at all levels; **top graph**). Comparison of knee extensor peak torque between fractured and nonfractured limbs after 6 months (**bottom graph**).

Table 1. *Measures of physical function (N = 31)*

Measure	At baseline ($\bar{X} \pm SD$)	Post-PRT ($\bar{X} \pm SD$)	% improvement ($\bar{X} \pm SD$)
PPT score (range, 0–36)	22 ± 5	30 ± 5*	45 ± 9
Preferred walking speed (m/min)	48.4 ± 14.4	66.1 ± 17.7*	40 ± 5
Fast walking speed (m/min)	55.6 ± 17.2	76.7 ± 24.7*	41 ± 6
Timed stair climbed (s)	14.0 ± 5.7	8.4 ± 4.6*	36 ± 4

PPT, Physical Performance Test; Post-PRT, after progressive resistance exercise training; S, seconds.
**p < .01 for baseline vs post-PRT.*

This study provided evidence that frail elderly people can achieve significant strength and functional gains after hip fracture, even after discharge from a rehabilitation program. Higher intensity training resulted in greater strength gains and functional improvement. Bringing the fractured limb to the strength level of the nonfractured limb is an achievable goal for rehabilitation protocols.

Host HH, Sinacore DR, Bohnert KL, et al. Training-induced strength and functional adaptations after hip fracture. Phys Ther *2006;87:292-303.*

Effective Stretching For Posterior Shoulder Tightness

Posterior shoulder capsule tightness has been linked to shoulder impingement syndrome and labral lesions. Abnormal humeral head movement and a subsequent decrease in subacromial space, particularly during overhead activities, may cause or perpetuate symptoms of impingement. Patients frequently present with reduced motion in glenohumeral internal rotation (IR) and adduction. Although stretching exercises are recommended, their effectiveness in improving shoulder motion has not been investigated. McClure et al from Arcadia University, Pennsylvania, compared the effect of 2 commonly prescribed exercises for improving shoulder motion in subjects with limited shoulder IR range of motion (ROM).

Fifty-four asymptomatic subjects (20 males, 34 females; mean age, 23 years) were assigned to either a control group ($n = 24$) or to an intervention group ($n = 30$). The control group had between-shoulder internal ROM differences <10°; and the intervention group had between-shoulder differences ≥10°. Subjects in the intervention group were further stratified in either the "sleeper stretch" group ($n = 15$) or the "cross-body stretch" group ($n = 15$).

The sleeper stretch group performed the stretch while lying on the side to be stretched, elevating the humerus to 90° on the support surface, then passively internally rotating the humerus with the opposite arm. The cross-body stretch was performed by passively pulling the humerus across the body into horizontal adduction with the opposite arm. The stretches were performed once daily for 5 repetitions, holding each stretch for 30 seconds. Shoulder IR with the arm abducted 90° and scapula motion prevented was measured before and after a 4-week intervention period.

After 4 weeks, the cross-body stretch group showed significantly greater IR ROM than subjects in the control group (Figure 2). The cross-body stretch group had a mean increase in stretch of 20°. Although the sleeper group also showed an increase of 12° following the intervention, this finding was not statistically different from the control group or the cross-body group.

Although both groups showed increases in shoulder IR ROM in a relatively short period of intervention, the cross-body stretch appeared to be the most effective to improve motion. This was an unexpected finding, given that the scapula may be better stabilized while performing the sleeper stretch, thus allowing for more specific stretching of the posterior capsule. While increases were still demonstrated in the sleeper stretch group, the small sample size may have limited the statistical power to detect differences. These stretches may be an effective recommendation for throwing athletes as well as for patients with symptoms associated with shoulder tightness.

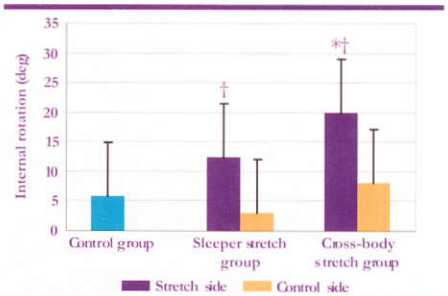

Figure 2. Changes in shoulder IR motion for all groups. Comparisons were made between the stretch side and control group, as well as between the stretch side and the nonstretch (or control) side within each intervention group. $^{*}p < .01$ vs control group; $^{\dagger}p < .001$ vs control side.

McClure P, Balaicuis J, Heiland D, et al. A randomized controlled comparison of stretching procedures for posterior shoulder tightness. J Orthop Sports Phys Ther *2007;37:108-114.*

Risk Factors in Medial Tibial Stress Syndrome

Medial tibial stress syndrome (MTSS) is one of the most frequently diagnosed injuries in recreational runners. It is characterized by continuous or intermittent pain, localized along the distal two thirds of the posterior-medial tibia and often associated with poor foot biomechanics. Excessive navicular drop has been linked to MTSS, although no prospective studies have assessed the relationship of this measurement to injuries in recreational runners. Plisky et al from Rocky Mountain University of Health Professions, Utah, studied the cumulative seasonal incidence and overall injury rate of MTSS, and the relationship between navicular drop and MTSS in high school cross-country runners.

One hundred five runners (46 females, 59 males) between the ages of 14 and 19 years and without current symptoms of MTSS participated. A Daily Injury Report (DIR) was completed by coaches and certified athletic trainers for the entire season. The DIR recorded each runner's practice and cross-country meet participation, absences and time lost from participation due to injury.

The navicular drop of both feet was measured at the beginning of the season and baseline data was collected on the runners' age, gender, height, body mass index (BMI), history of running injury, number of years running, and orthotic or tape use. A follow-up questionnaire was done at the end of the season that assessed the runners' injuries during the season.

Different injury rates were analyzed. The cumulative seasonal incidence was the number of runners who incurred a new MTSS injury divided by the total number of runners. The overall injury rate was the total number of MTSS injuries per 1000 athletic exposures (AEs). An AE was defined as each time a runner participated in practice or a meet without being limited by an injury and thus considered an exposure to injury risk.

During the 13-week cross-country season, 16 runners (15%) incurred 17 MTSS injuries. Girls had a higher MTSS injury rate than boys (4.3/1000 vs 1.7/1000 AEs, respectively), although these differences were not significant. Runners with higher BMIs were more likely to incur MTSS. Most MTSS injuries were characterized as mild, resulting in 1–4 days lost from participation.

The navicular drop failed to significantly predict MTSS in the runners studied. The authors also noted that runners who had reported using orthotics were 3× as likely to incur MTSS and 4× more likely to report a previous injury. It is possible that these runners may have been fitted with orthotics because of previous pain or injury.

The authors proposed that additional risk factors, such as the arch height measurement, should be explored in future prospective studies of MTSS. Orthotic usage also warrants consideration.

Plisky MS, Rauh MJ, Heiderscheit B, et al. Medial tibial stress syndrome in high school cross-country runners: incidence and risk factors. J Orthop Sports Phys Ther *2007;37:40-47.*

Dynamic Postural Stability Deficits in Ankle Instability

Lateral ankle sprain is a common sports-related injury, with a recurrence rate reported of >70%. Mechanical instability may result from ligamentous disruption. Functional ankle instability (FAI), defined as impaired proprioception, strength and postural neuromuscular control with or without ligamentous laxity, also may develop after a lateral ankle sprain. Quantifying these residual deficits is often challenging, yet necessary for improving treatment protocols and prophylactic intervention.

Dynamic postural stability is defined as the ability to maintain balance while transitioning from a dynamic to a static state. In this study, Wikstrom et al from the University of Florida assessed whether a dynamic postural stability index (DPSI) could discern differences in motor control responses between subjects with and without FAI. The DPSI indicates how well a subject can dissipate resultant ground reaction forces from a jump landing.

Data were acquired over a 2-year period on 108 subjects: 54 subjects with stable ankles (stable group) and 54 subjects with FAI (FAI group). Subjects in the stable group were free from lower limb injury for at least 3 months prior to testing. Subjects in the FAI group did not have any acute injury for at least 3 months prior to testing, but reported sensations of weakness and giving way during daily activities and an ankle injury within the previous 3 months.

Subjects performed a single-leg-hop stabilization maneuver in which they stood 70 cm from the center of the force plate, jumped off both legs, touched a marker at a predetermined vertical height then landed on the force plate with a single leg. They were asked to stabilize as quickly as possible and balance for 10 seconds on the test leg.

Stability indices were calculated in 3 principal directions:

1. medial/lateral
2. anterior/posterior
3. vertical

The DPSI is a composite of these 3 directions. Higher index values represent worse dynamic postural stability.

Subjects with FAI demonstrated higher dynamic postural stability scores. Specifically they were worse (higher) for the anterior/posterior stability, vertical stability and DPSI scores when compared with the stable group. These differences may be due to altered muscle activation patterns or alternative nonankle strategies for stabilization that are associated with motor control changes.

The findings of this study support the use of the DPSI as an effective clinical tool to assess dynamic postural stability in conjunction with a functional task: a single-leg–jump stabilization maneuver. Subjects with FAI showed greater deviations in dynamic postural sway in multiple directions, indicating altered motor control responses. These findings may be helpful in directing treatment interventions aimed at reducing the effects of FAI.

Wikstrom EA, Tillman MD, Chmielewski TL, et al. Dynamic postural stability deficits in subjects with self-reported ankle instability. Med Sci Sports Exerc *2007; 39:397-402.*

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Improving function in chronic ankle instability

Rehabilitation outcomes following rotator cuff repair