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Update on PHYSICAL THERAPY™

AUTUMN 2010

Resistance Training Improves Physical Activity in Early Knee OA

Expert consensus on exercise and physical activity for adults with osteoarthritis (OA) recommends aerobic moderate- and vigorous-intensity physical activity (MVPA) and muscle strengthening resistance exercises. For patients with knee OA, resistance training (RT) exercise programs and educational self-management (SM) programs are 2 mainstays of nonpharmacologic treatments. There is a concern, however, that if RT programs are too vigorous, patients may not be able to engage in their other daily physical activities.

A randomized controlled trial by Farr et al from the University of Arizona assessed the effect of a structured RT intervention on overall daily levels of MVPA in patients with early-onset knee OA. Patients who participated in an RT program were compared with those who participated in an SM program and with those who participated in both RT and SM programs.

Participants included 171 patients (74% women, 26% men; mean age, 55 years), with a radiographic status of grade II OA in 1 knee. The RT intervention targeted improvement in stretching and balance, range of motion and flexibility, isotonic muscle strengthening and aerobics. Participants met with certified trainers 3×/week for 9 months, and the intensity of the RT program was progressively increased over this period.

The SM intervention consisted of 12 weekly 90-minute classroom sessions that focused on self-efficacy through a variety of be-

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havioral and educational techniques including coping skills, physical activity recommendations and healthy lifestyle practices. A 24-week structured telephone intervention program reinforced SM skills. Participants in the combined RT and SM groups had both interventions; this group was eventually collapsed into the RT group for final analysis.

MVPA, the primary outcome measure, was assessed using an MTI Actigraph accelerometer that patients wore around their waists. The accelerometer allowed for accurate measurements of daily time spent in activities of varying intensities. Measurements were made at baseline, 3 months and 9 months.

Both the RT and SM groups increased their MVPA at 3 months by 18% and 22%, respectively. However, only the RT group maintained a significant increase in MVPA at 9 months; the RT group showed a 10% increase from baseline, while the SM group showed only a 2% increase (Figure 1).

This study showed that patients with early-onset knee OA can benefit from structured RT programs without compromising aerobic MVPA. Because RT also improves muscle strength and endurance and reduces pain in patients with knee OA, it should be a vital component of knee OA therapy.

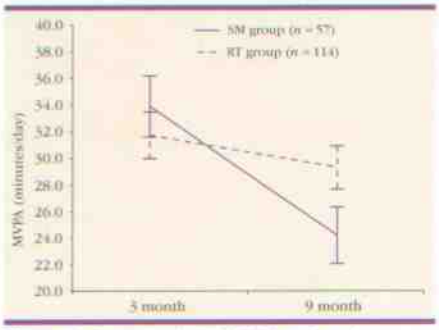

Figure 1. Average daily MVPA at 3 and 9 months for SM and RT groups.

Farr JN, Going SB, McKnight PE, et al. Progressive resistance training improves overall physical activity levels in patients with early osteoarthritis of the knee: a randomized controlled trial. Phys Ther *2010;90:356-366.*

Cognition and Postural Stability in Ankle Instability

Lateral ankle sprains are one of the most common injuries among active individuals, with many people sustaining repeated sprains and a feeling of "giving-way," a condition defined as functional ankle instability (FAI). Recent evidence suggests that cognition and mental practices may also affect postural control. Such effects were the focus of an investigation by Rahnama et al from the University of Social Welfare and Rehabilitation Sciences, Iran.

Participants included 15 recreational athletes with FAI (mean age, 21 years) matched with 15 healthy control participants without FAI. Postural performance was assessed using the Biodex Stability System (BSS), a platform that tilts in multiple planes and can be adjusted to create different levels of postural difficulty. The participants were tested at 2 levels of postural stability (more stable and less stable) while standing on 1 leg and with eyes closed. The cognitive task used in this study was a backward digit span task that consisted of presenting random number sequences to the patients and having them repeat the digits in the exact reverse order.

Three stability indices produced by the BSS were used as measures of postural performance:

- anteroposterior stability index (APSI)
- mediolateral stability index (MLSI)
- overall stability index (OSI)

When assessed alone, postural stability in the FAI group was poorer at the less stable level than in the control group as measured by the MLSI ($p < .01$) and the OSI ($p < .01$). When the cognitive task was introduced to the FAI group, their performance worsened as measured by these 2 indices. The postural performance of the control group was not affected by the cognitive task.

This significant decline in postural stability for patients with FAI implies that more attention is required to maintain balance during single-limb support in this group. These findings promote using a "dual-task" approach that incorporates cognitive loading with postural control evaluation as a means to assess balance and stability. Training may also be enhanced using this approach, but that hypothesis requires additional investigation.

Rahnama L, Salavati M, Akbbari B, Mazaberi M. Attentional demands and postural control in athletes with and without functional ankle instability. J Orthop Sports Phys Ther *2010;40:180-187.*

Table 1. *Results before and after training program*

Test	No. of participants	Before program Mean (SD)	After program Mean (SD)	*p* value*
Systolic blood pressure (mm Hg)	12	142.3 (17.7)	127.6 (14.2)	.005
Diastolic blood pressure (mm Hg)	12	88.0 (10.2)	78.3 (10.3)	.017
Resting heart rate (bpm)	12	70.3 (10.6)	66.9 (11.0)	.27
BMI (kg/m^2)	11	28.9 (4.3)	28.1 (4.3)	.005
6-Minute Walk Test (km/hour)	14	2.1 (1.1)	3.4 (1.3)	<.001
10-Meter Walk Test (seconds)	14	18.9 (12.2)	11.5 (9.1)	.001
Estimated aerobic capacity (mL O_2/min/kg)	5	22.4 (3.8)	26.5 (2.7)	.08
Self-rated maximum walking distance (m)	11	1570.5 (1546.0)	3171.4 (2041.4)	.003

**As determined with the Wilcoxon matched-pairs signed rank test (1-tailed). BPM, beats per minute.*

Intensive Outpatient Training Improves Gait and Function After Stroke

Stroke is one of the leading causes of disability in the world, often leading to loss of strength and dexterity and to poor motor control. Upper and lower limb involvement may cause significant deficits that have an impact on walking speed and endurance, as well as function in daily life.

Jørgensen et al from the University of Copenhagen, Denmark, assessed the effects of intensive physical training on gait and cardiovascular parameters in people with stroke in the chronic stage. Fourteen patients (mean age, 58.4 years; mean time since injury, 24.6 months) with hemiparesis after a cerebrovascular accident participated in a 12-week training intervention, 5×/week for 1.5 hours/session.

The intervention consisted of the following:

- high-intensity body-weight–supported treadmill training (BWSTT)
- progressive resistance strength training
- aerobic exercises

Strength training was emphasized on 3 days per week; cardiorespiratory endurance and functional training were stressed on 2 days per week. Aerobic training included

- BWSTT
- stationary bike paretic leg cycling (bipedal and unipedal)
- paretic arm cycling
- body-weight–supported stair climbing

The main outcome measures were gait performance (6-Minute Walk Test, 10-Meter Walk Test) and aerobic capacity using a submaximal stationary ergometer test. Blood pressure, resting heart rate and body mass index (BMI) were also assessed.

Overall, patients improved on almost all measures of gait and aerobic capacity (Table 1). Gait speed increased 62% in the 6-Minute Walk Test and was associated with improvements in stance and increases in stride length. Cardiovascular improvements led to 10% and 11% decreases in systolic and diastolic blood pressure, respectively. These changes were unrelated to age, chronicity or level of functioning, and no negative side effects were reported.

Given the high recurrent stroke rate, as well as the significant impact of stroke on function and mobility, the findings of this study are encouraging and highly supportive of intensive physical training in people with stroke in the chronic stage. Because this study included only a small, highly motivated group of participants, continued larger scale studies are needed in this area of rehabilitation.

Jørgensen JR, Beeb-Pedersen DT, Zeeman P, et al. Effect of intensive outpatient physical training on gait performance and cardiovascular health in people with hemiparesis after stroke. Phys Ther *2010;90:527-537.*

Shoulder Muscle Activation During Pendulum Exercises And Light Activities

The goal of rehabilitation protocols following rotator cuff surgical repair is to maintain range of motion without stressing the repair. Active motion is generally restricted to prevent retearing the rotator cuff. A passive exercise commonly recommended is the pendulum exercise, also referred to as the Codman exercise. A patient performs this exercise by leaning forward at the waist and allowing the arm to swing like a pendulum, using trunk motion to move the arm in circles. Patients often perform this exercise incorrectly and actively use their shoulder muscles, increasing the stress on the newly repaired shoulder. Common activities of daily living (ADLs) may also increase the tension on the repair, even if patients wear a sling.

Long et al from the University of Michigan measured the muscle activation of the supraspinatus, infraspinatus and deltoid muscles in a group of 13 healthy patients without shoulder pathology. Patients were asked to perform the Codman exercise, tracing a series of concentric circles ranging from 20 cm to 51 cm in diameter. Four types of pendulum exercises were assessed: large correct, large incorrect, small correct and small incorrect. "Correct" was defined as using only trunk motion to move the arm; "incorrect" was defined as using shoulder muscles to cause the arm to move.

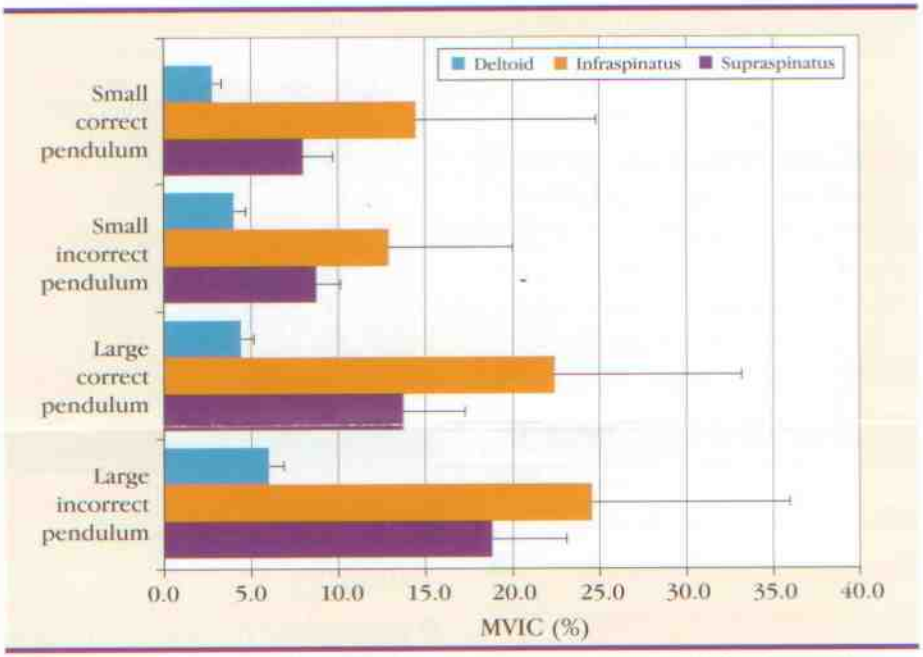

Figure 2. Percentage of maximum voluntary isometric contraction (MVIC) for the pendulum exercises, with standard error.

Muscle activation was also assessed during 3 ADLs (typing, brushing teeth and drinking water from a bottle) while patients wore a sling similar to that worn following rotator cuff repair. Fine-wire electromyography (EMG) assessed supraspinatus and infraspinatus muscles, and surface EMG was used to assess the deltoid.

Study results indicated that large pendulum exercises, performed correctly or incorrectly, resulted in levels of supraspinatus and infraspinatus muscle activation exceeding 15% of maximum contraction values. These levels may be indicative of higher loads than desirable for newly repaired rotator cuffs (Figure 2). Compared with typing, drinking water showed significantly higher muscle activation for all muscle groups measured; brushing teeth showed significantly higher muscle activation for the supraspinatus and deltoid muscles.

The patients in this study had no shoulder pathology, which may limit its results. Postsurgical patients should be instructed in proper technique for performing pendulum exercises and reminded to do the exercises in small circles. Specific restrictions may need to be emphasized for certain common ADLs such as drinking water from a bottle.

Long JL, Thiele RAR, Skendzel JG, et al. Activation of the shoulder musculature during pendulum exercises and light activities. J Orthop Sports Phys Ther *2010;40:230-237.*

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Improving readiness to return to sports post-ACL surgery

Running and the use of real-time visual feedback