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Update on PHYSICAL THERAPY™

SPRING 2008

Biomechanical Factors Linked to Iliotibial Band Syndrome

Iliotibial band syndrome (ITBS) is the primary cause of lateral knee pain in runners. Although this syndrome is believed to result from friction of the iliotibial band as it slides over the lateral femoral condyle, the relationship between this injury and the biomechanics of the hip, knee and foot is not well known. Noehren et al from the University of Delaware prospectively studied a group of female runners who developed ITBS and compared these subjects to healthy controls. Specifically, these investigators sought to determine if preexisting frontal and transverse plane movement patterns were linked to the development of ITBS.

The runners were part of a larger, ongoing study investigating lower extremity injuries in female runners. All women (age range, 18–45 years) ran a minimum of 20 miles/week. At the time of data collection, they were free from injury. Lower extremity kinetic and kinematic data were collected as they ran along an instrumented runway.

Eighteen female runners who were followed over a 2-year period developed ITBS. Eighteen age- and mileage-matched female runners were chosen for the control group. Kinematic variables tested were peak rearfoot eversion, knee internal rotation, hip adduction and knee flexion at heel strike. Kinetic variables assessed included peak rearfoot inversion, knee external rotation and hip abduction moments. In previous

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retrospective studies, these variables have been linked to ITBS.

Results are summarized in Table 1, with comparisons made to the control group of runners. Differences between the groups were found for the kinematic variables. The runners with ITBS showed greater hip adduction and knee internal rotation. The investigators expected that these same individuals would show greater rearfoot eversion than the control group, but this was not found. No differences were found for the kinetic variables.

The findings of this study, which showed greater hip adduction and peak knee internal rotation in women with ITBS, should guide interventions aimed at improving strength and neuromuscular control of the hip. Stretching of the iliotibial band to improve overall compliance is also recommended.

Table 1. ***Biomechanical factors studied***

Kinematic variables different from controls?	
Peak rearfoot eversion	No
Knee internal rotation	Yes
Hip adduction	Yes
Knee flexion at heel strike	No
Kinetic variables different from controls?	
Peak rearfoot inversion moment	No
Knee external rotation moment	No
Hip abduction moment	No

Noebren B, Davis I, Hamill J. Prospective study of the biomechanical factors associated with iliotibial band syndrome. Clin Biomech *2007;22:951-956.*

Treadmill Training Improves Gait in Patients with PD

For people with Parkinson's disease (PD), gait disturbances and instability often lead to falls, a loss of functional independence and reduction in quality of life (QOL). Herman et al from Tel-Aviv Sourasky Medical Center, Israel, examined whether an intensive 6-week program could be effective in improving gait rhythmicity, functional mobility and QOL in patients with PD.

Nine patients (mean age, 70 years; 6 men and 3 women) with mild-to-moderate idiopathic PD were enrolled in the study. All patients were free from serious comorbidities and were independent ambulators. Patients were assessed 3 times: prior to treadmill training; 2–3 days following program completion; and 4–5 weeks following program completion. A battery of tests was administered to assess fall history, mental status, motor performance, QOL (the 39-item Parkinson's Disease Questionnaire [PDQ-39]), balance, fear of falling, mental well-being and self-assessment of gait performance. Gait variables studied included speed, stride length, and stride and swing time variability.

The physical therapy training program consisted of 4 30-minute training sessions/week for 6 weeks. For the first 2 weeks, comfortable overground walking speed was evaluated, and treadmill training speed was adjusted to 80–90% of overground speed. By the third training week, the overground speed was reached, and from there the treadmill speed was gradually increased to 5–10% above the overground walking speed. The physical therapist provided ongoing monitoring and feedback on gait postures during the sessions.

After 6 weeks of training, there was a significant improvement in mobility as measured by increased gait speed, stride length, and self-assessment of gait and balance scores. Swing time variability improved, and scores on the PDQ-39 QOL assessment were also significantly improved. No changes were found in the level of fear of falling or mental well-being scores (Table 2). All participants expressed enthusiasm with the training and a desire to continue with the program.

Seven patients returned for retesting approximately 5 weeks after completion of the treadmill training. Many of the variables (gait speed, functional performance and Parkinsonian motor signs) continued to improve over baseline values.

Although this pilot study had a small sample size, the findings are promising. After 6 weeks of progressive treadmill training, improvements were found in gait rhythmicity, mobility, Parkinsonian symptoms and QOL measures. Many of these improvements were maintained even after 5 weeks following training. The authors concurred with the growing body of evidence that shows rehabilitative gains can be achieved in

Table 2. Measures of pre- and posttreadmill training

Measures	Pre	Post	*p* value
UPDRS motor score	29.0 ± 9.3	22.0 ± 11.1	.043
PDQ-39 score	32 ± 23.1	22 ± 14.3	.014
SPPB score	9.9 ± 1.4	11.1 ± 0.8	.008
GDS score	7.1 ± 5.7	5.4 ± 3.6	NS
ABC scale score	84.9 ± 13.8	84.1 ± 15.8	NS
VAS gait rating	6.3 ± 1.3	7.5 ± 1.9	.026
Gait speed (m/s)	1.11 ± 0.17	1.26 ± 0.16	.014
Stride length (m)	1.17 ± 0.22	1.25 ± 0.22	.012
Stride time variability (%)	2.6 ± 1.2	2.6 ± 2.2	NS
Average swing time (%)	36.0 ± 3.9	36.2 ± 3.8	NS
Swing time variability (%)	3.5 ± 1.9	5.3 ± 3.8	.066

Values are mean ± SD. UPDRS, Unified Parkinson's Disease Rating Scale (Parkinsonian symptoms); SPPB, Short Physical Performance Battery (balance and lower limb capabilities); GDS, Geriatric Depression Scale (mental well-being); ABC, Activities-specific Balance Confidence (fear of falling); VAS, Visual Analogue Scale (subject's perception of his/her gait performance); NS, not significant.

the presence of a neurodegenerative disease such as PD.

Herman T, Giladi N, Gruendlinger L, Hausdorff JM. Six weeks of intensive treadmill training improves gait and quality of life in patients with Parkinson's disease: a pilot study. Arch Phys Med Rehabil *2007;88:1154-1158.*

Exercise Prescription For Scapular Muscle Balance

Increasing evidence is linking shoulder pathology to abnormalities in scapular position and motion (dyskinesis). As a result, current exercise protocols emphasize scapular muscle/shoulder girdle training as an integral component of shoulder rehabilitation programs. However, optimizing scapular muscle balance through muscle control and selective activation of muscles of the shoulder girdle region is a challenge for both clinician and client. Cools et al from Ghent University, Belgium, wanted to determine the muscle activation ratios for a number of commonly used shoulder girdle strengthening exercises. The objective was to determine which exercises would preferentially activate the lower trapezius (LT), middle trapezius (MT) and serratus anterior (SA) muscles, while minimizing activity in the upper trapezius (UT).

Forty-five healthy subjects (mean age, 20.7 years) participated. Surface electrodes were placed over the upper, middle and lower portions of the trapezius muscle and the lower portions of the SA muscle. Electromyographic (EMG) data from each muscle was recorded during 5-second maximum voluntary isometric contractions, and peak EMG values were used as a normalization reference. Mean EMG data from each of the exercise trials were later normalized to the peak EMG values for each muscle.

A ratio was calculated that indicated the relative activity of the UT with respect to the LT, MT and SA. Ratios were calculated by dividing normalized EMG values of the UT by normalized EMG values of the LT, MT and SA, resulting in UT/LT, UT/MT and UT/SA. These values were then multiplied by 100 to obtain relative activity of the UT (in percent) relative to the other scapular muscles. Values <100% reflected muscle activity of the LT, MT and SA being greater than that of the UT—a desirable outcome for these exercises.

Each patient performed a series of 12 exercises selected based on a previous literature review of shoulder exercise programs and relevant to the 3 trapezius muscles. Exercises were performed under controlled conditions of concentric, isometric and eccentric contractions. Resistance for each subject (dumbbells or pulleys) was set according to gender and body weight. Exercises were carried out in a variety of positions, including prone, side-lying, sitting/rowing and standing upright.

Of the original 12 exercises, 3 were selected as optimal exercises with a low UT/LT ratio:

- side-lying external rotation,
- side-lying forward flexion and
- prone horizontal abduction with external rotation.

Optimal UT/MT ratios were found in the side-lying external rotation and side-lying forward flexion exercises, both of which were also recommended for the UT/LT. A third exercise, prone extension, also resulted in an optimal UT/MT ratio.

It is interesting to note that of the 12 exercises originally selected for this study, no exercise met the criteria for optimizing the UT/SA ratio. Further analysis is needed for exercises traditionally recommended for SA strengthening.

The findings of this study suggest that exercises that activate the MT and LT, while at the same time resulting in lower UT activity, may be preferable for shoulder pathology related to scapular dysfunction.

Cools AM, Dewitte V, Lanszweert F, et al. Rehabilitation of scapular muscle balance: which exercises to prescribe? Am J Sports Med *2007;35:1744-1751.*

Aerobic Exercise Beneficial in Breast Cancer Rehabilitation

Improved survival in breast cancer is related to early detection. Nikander et al from the UKK Institute for Health Promotion Research, Finland, assessed the feasibility and efficacy of a vigorous aerobic exercise program in enhancing physical performance in breast cancer patients following adjuvant treatment. The authors also evaluated the potential of these training programs to affect bone mass.

Thirty women with breast cancer (age range, 41–65 years) were randomly assigned to an exercise group or a control group. All patients had received such treatments as chemotherapy, radiation therapy, endocrine therapy or a combination within 6 months of study enrollment. The exercise group attended guided aerobic sessions once/week and were instructed in a 2–3×/week home-training program (Table 3). Members of the control group were advised to continue their normal daily routines and activities throughout this 12-week study.

Adherence to the weekly supervised training sessions was 78%, and home-training programs were performed, on average, 2.1×/week. After the 12-week intervention, positive training-induced effects were found in the treatment group for the figure-8 agility test ($p = .017$) and peak jumping power ($p = .007$) when compared with the control group. The control group had slightly greater improvement in the 2-km walk test ($p = .051$). There were no differences between groups for the isometric leg extension or elbow flexion strength tests.

The acceleration profiles during the circuit training and step aerobics indicated that these training modes produced considerable joint loading. The trainees tolerated the jumping and leaping exercises well, and the magnitude of loading reached and exceeded levels of 4× body weight.

This study showed that relatively vigorous and versatile training, performed at high levels of physical exertion, was well tolerated and resulted in improved lower limb dynamic performance. The secondary benefits on bone mass cannot be overlooked. Careful exercise planning that considers the magnitude, frequency and duration of training should be an integral component of rehabilitation for patients with breast cancer.

Nikander R, Sievänen H, Ojala K, et al. Effect of a vigorous aerobic regimen on physical performance in breast cancer patients—a randomized controlled pilot trial. Acta Oncol *2007;46:181-186.*

Table 3. Aerobic intervention

Guided session (1×/week)
10-minute warm up/cool down
Step aerobics (alternate weeks; 150–180 jumps/leaps per session)
Circuit-training (e.g., rope jumping, skate jumping; alternate weeks; 100–150 jumps/leaps per session)
Self-rated perceived exertion (RPE) progressively increased from 11 or moderate to 14–16 or somewhat hard/hard during 12-week exercise period
Home session (2–3×/week)
10-minute warm up/cool down
Activities similar to those employed in circuit-training (e.g., rope jumping, skate jumping; 100 leaps during each session)
Endurance training (walking, cycling, swimming, etc.) performed at same RPE as during guided session

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Extension approach for low back pain