The Effect of a Six Week Hip Strengthening Program on Pain, Functional Scores, and Gait Biomechanics in Patients with Knee Osteoarthritis

INTRODUCTION:
Although strengthening lower extremity muscles may improve the symptoms associated with knee osteoarthritis (OA), the impact of strengthening specific muscle groups is presently unknown. A recent study implied that reduced hip abductor muscle strength was related to the progression of knee OA [1]. Subsequently, improvements in abductor strength have been proposed to be beneficial. It has been speculated that these improvements are achieved by reducing excessive contralateral pelvic drop, thereby reducing knee joint loading on the stance leg [2]. However, the effect of hip muscle strengthening on gait mechanics has not been well investigated in knee OA patients. Thus, the purpose of this study was to determine the effect of a 6-week hip muscle strengthening program on 1) pain, functional scores, and muscle strength and 2) gait mechanics in patients with knee OA.

METHODS:
Participants: Twenty patients (15 females and 5 males; age: 53.8(8.2) years, mass: 73.2(12.4) kg, height: 167.9(8.8) cm, BMI: 25.9(4.0)) who had been diagnosed with mild to moderate knee OA (Kellgren-Lawrence scale 1-3) by a medical doctor participated in the study. Twenty nine healthy controls (21 females and 8 males; age: 52.2(10.9) years, mass: 68.5(12.4) kg, height: 176.5(9.3) cm, BMI: 24.3(3.2)) were also recruited. Participants completed written informed consent approved by the ethics committee at the University. Functional and pain scores, biomechanical data, and muscle strength data were collected both prior to and after following a strengthening program.

RESULTS:

Figure 1. (a) Data collection of gait biomechanics, (b) Strength measurement, (c) Hip external rotator and abductor exercises.

Functional and pain scores: Visual Analog Scale (VAS) was used to assess pain in the affected knee (0 = no pain, 10 = maximum pain). The Knee Osteoarthritis Outcome Score (KOOS) questionnaire was used to assess symptoms, stiffness, pain, physical function, sport and recreation, and quality of life, with a lower score representing more knee problems and a higher score representing more knee problems. Gait biomechanics: Gait biomechanical data were collected using an eight camera motion analysis system (VICON, USA) while participants walked on a treadmill at a speed of 1.1 m/s for 30 seconds (Fig. 1a). Participants wore laboratory running shoes (Nike Air Pegasus, USA) during the testing. Marker co-ordinate data were filtered at 10 Hz using a forth order low-pass Butterworth filter and joint angles subsequently calculated using Visual 3D software (C-motion Inc., USA). Muscle strength: Maximum isometric voluntary force (MVIF) output was measured using a force dynamometer (Lafayette Ins., USA) using custom-stabilizing straps (Fig. 1b). The average of three MVIF trials of hip abductor and rotator, knee extensor and flexor, and ankle inverter were calculated. MVIF data were normalized by the participant’s mass. Hip strengthening program: Four exercises using Resist-a-band® to strengthen the hip external rotators, abductors, flexors, and crawls were performed daily for six weeks (Fig. 1c). Participants met with a rehabilitation specialist weekly to receive instructions for safe progression. Statistical analysis: Statistical analyses were performed to investigate the effect of the 6-week hip strengthening program on 1) pain, 2) functional scores, 3) muscle strength, and 4) frontal plane gait biomechanics using 1-tailed paired t-tests (α = 0.05). Independent t-tests (1-tailed) were performed to compare muscle strength and gait biomechanics between knee OA patients and healthy controls. The sample size was determined based on pilot data and previous studies (α=0.05, β=0.8).

DISCUSSION:
A 6-week hip strengthening exercise program resulted in improvements in pain, MVIF, and functional scores in addition to significantly altering frontal plane kinematics during walking. However, upon completion of the program, we did not find the hypothesized reduction in contralateral pelvic drop for knee OA patients after strengthening the hip muscles. Furthermore, even following increases in muscle strength, frontal plane kinematics still remained significantly different from healthy controls. A change in hip adduction at heel contact was measured after the 6-week protocol, suggesting that patients develop a unique adaptive strategy after a hip strengthening program. How the reduction in hip adduction during walking after a hip strengthening program in patients influences in-vivo joint loads of the knee requires further investigation.

REFERENCES:

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