Mechanical Energy Efficiency during Stair Negotiation in Persons with Medial Knee Osteoarthritis

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Purpose

Energetic cost contributes to movement impairments observed during stair negotiation in persons with knee osteoarthritis. Specifically, the intersegmental mechanical energy exchange may be diminished in the presence of pathologies. The purpose of this study was to evaluate mechanical energy efficiency during stair negotiation in persons with knee osteoarthritis using mechanical energy analysis.

Methods

Sixteen patients with medial knee osteoarthritis and 16 age–matched controls participated. Three–dimensional motion analysis system and force platforms were used to acquire biomechanical data. The participants were instructed to ascend/descend a 2-step staircase at the controlled pace of 90bpm and repeat it 3 times. The mechanical power exhibited during whole stance phase at the 1st step was computed. Mechanical Energy Expenditure (MEE) was calculated by integral of net joint power at each joint. Mechanical Energy Compensation (MEC) was defined as the proportion of muscle energy compensated by intersegmental energy transfer. Based on energy transfer modes, MEE and MEC were determined separately as three phases: concentric, eccentric transfer, and no–transfer phase. Independent sample t–test was used to compare MEE and MEC at each phase and joint between the groups. All subjects provided written informed consent following approval by the Institutional Review Board.

Results

In stair ascending, persons with knee osteoarthritis performed the task with less MEC (p=0.032) at the ankle joint, which was observed prior to push–off. Patients group displayed less mechanical energy transfer from the shank to the foot segment. Concentric MEC at the hip joint in later stance phase of stair descending was lower in Patients group (p=0.029). Patients demonstrated less mechanical energy transfer from the pelvis to the shank segment.

Discussion

Persons with knee osteoarthritis demonstrated less mechanical energy transfer during stair ascending and descending. These findings provide insights into intervention strategies for persons with stair negotiation difficulties.