

GENDER DIFFERENCES IN KNEE KINEMATICS AND KINETICS DURING STAIR CLIMBING AND LEVELWALKING IN ADULTS WITH OSTEOARTHRITIS OF THE KNEE

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INTRODUCTION

Osteoarthritis (OA) of the knee is a common condition and a frequent cause of pain and disability in older people. Risk factors consistently associated with the disease in cross-sectional studies include older age, female gender, and being overweight. Symptoms of OA include pain, stiffness, and decreased range of motion of the joints. Female gender is a significant risk factor for OA. Felson et al. determined that women have a 1.8 times greater risk of developing OA than men. Adams and Marano concluded that arthritis is more prevalent among women than men at all ages, but the exact etiology for this difference in prevalence is unknown. These gender differences are most prominent when OA affects the knee. One of the common complaints of an individual suffering from OA of the knee joint is pain while climbing stairs. Therefore, this study was performed to quantify and compare gait characteristics of females and males with OA of the knee while walking on a level surface, and ascending and descending stairs.

METHODS

Knee kinematics and kinetics were measured during stair ascent, descent and level walking from 142 adults, 94 females and 48 males, diagnosed with Grade II osteoarthritis of the knee. Females had a mean age of 58 years and males 55 years. Mean weight of the females was 80 kg (± 17), and the males 92 kg (± 15). All of the OA subjects reported having pain in one or both knees on most days and showed radiographic signs of OA,

including hypertrophic changes, marginal spur formation, subchondral sclerosis or cyst formation, or nonuniform joint space narrowing. A set of 24 reflective markers (Helen Hayes marker set) were placed on bony landmarks of each subject. A six camera ExpertVision system was used to collect 3-D marker trajectories at 60 Hz. Stairs consisted of four steps, each with a rise of 18 cm and a run of 25 cm. Handrails were not used by the subjects. A BERTEC force plate was positioned at ground level to measure initial reaction forces. The first and second stairs were independently attached to two separate KISTLER force plates. Kinetic data was collected during stair ascent and descent as previously described (Yu et al.). Joint moments were calculated using Orthotrak 4.0 gait analysis software (Motion Analysis Co, Santa Rosa, CA). Results were calculated from the average of three walking trials. The Shapiro-Wilk W test was used to determine the normality of the data within the subjects. If the data was normally distributed, a two sample t-test was used. If the data was not normally distributed, a Wilcoxon signed rank test was performed.

RESULTS AND DISCUSSION

During both stair ascent and descent, the female subjects (ascending 96.5°, descending 89.9°) had a 6 to 8 degree greater peak knee flexion angle than males (ascending 88.5°; descending 83.5°) ($p=0.001$, figure 1). The females (55.7°) also had a significantly greater peak knee flexion angle during level walking than men (51.6°) ($p=.0159$, figure 1). The

difference in peak knee flexion is most likely due to a significant difference ($p=0.001$) in height between the female and male subjects. The female subjects had a mean height of 162 cm (± 6) while the male subjects averaged 177 cm (± 8). Similarly, the female subjects ($0.24 \text{ Nm/Kg} \pm 0.19$) generated a greater maximum internal knee extension moment than men ($0.18 \text{ Nm/Kg} \pm 0.16$) for all conditions, with only stair ascent demonstrating a significant difference ($p=.0325$, figure 2).

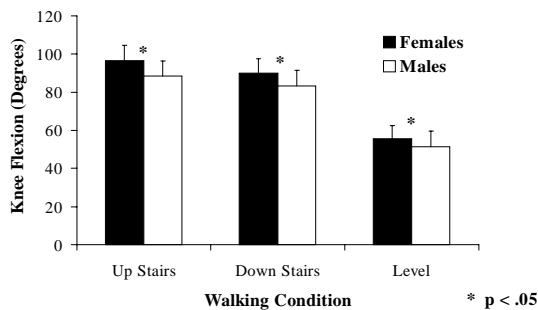


Figure 1: Maximum Knee Flexion Angle

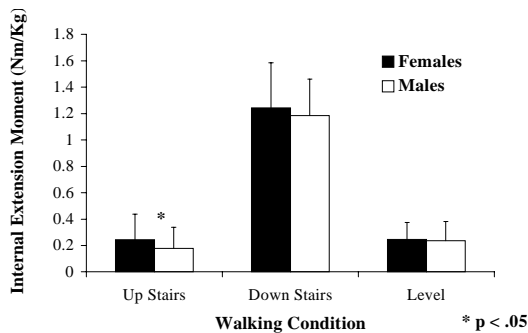


Figure 2: Maximum Internal Knee Extension Moment

SUMMARY

Gender differences are identified in the figures shown (Figures 1 and 2). This gender difference may partially explain the increased prevalence of osteoarthritis in females. Most tests of osteoarthritis treatments are assessed by criteria that do

not reflect functional activities. This study demonstrates that quantified analysis of stair climbing can be used to document locomotor changes in patients with osteoarthritis. To better understand the effect of knee OA on activities of daily living, such as stair ascent and descent, it is important to examine the kinetics of the affected joint. This information may allow us to identify the potential biomechanical effects of OA of the knee. For all grades of radiographic severity of OA, more women than men report knee pain. Among those over age 60 years, women are twice as likely to have symptomatic arthritis than men. The female subjects with OA in this study needed to flex their knees to a significantly greater degree for all conditions of stair climbing and level walking. This resulted in a greater maximum internal knee extension moment being generated by the female subjects. This increased knee loading may be partially responsible for the increased prevalence of OA in females.

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