

these two estimates, it is clear that gravity does play some role in the generation of forward progression and normal gait may be, in part, a controlled fall. However, both constraint models support the previously stated assertions that the ankle plantar flexors actively contribute to forward acceleration even during eccentric plantar flexor activity.

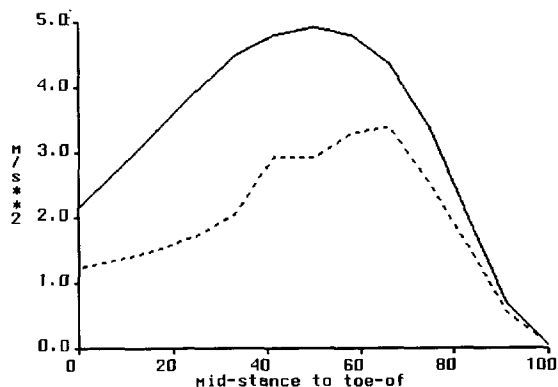


Figure 1. Estimates of the acceleration produced by the right ankle plantar flexors during the interval from right mid-stance to right toe-off (subject 3). The zero rotational constraint data is represented by the solid line and the infinite rotational data is represented in the dashed line.

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15 The Impact of Osteoarthritic Knee Pain on Dynamic Loads during Gait

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Introduction

The mechanical factors influencing the progression of osteoarthritis (OA) at the knee joint are not well understood. In particular, the impact of pain on joint loading could have a significant impact on the progression of osteoarthritis at the knee. One goal in the treatment of OA has been to decrease the pain and inflammation of the involved joints, often times through pharmaceutical intervention. Pain in an osteoarthritic knee during walking is believed to induce a protective biomechanical response that reduces the load on the joint.[1]

The purpose of this study was to test the hypothesis that a relationship exists between pain and joint loading in patients with medial compartment arthrosis of the knee joint.

Methodology

29 patients with knee pain and radiographic evidence of medial compartment osteoarthritis were included in this study. They were 13 males and 16 females with an average age of 61±10 years (range 40-74). The patients for the study were selected from a larger group of patients enrolled in a double blinded study in which patients were given either an NSAID or placebo. The first gait test was performed after patients were taken off any NSAID or analgesics for two weeks. The subjects were then given either an NSAID or placebo and a second gait test was performed two weeks later. IRB approval and informed consent from all subjects were obtained.

The instrumentation included a two-camera optoelectronic system for motion analysis and a multi-component force plate. Measurements of joint reaction moment, intersegmental angles, and temporal relationships were obtained over a range of self-selected walking speeds.[2]

Pain was measured clinically by use of the Hospital for Special Surgery Rating Form (HSS). Based on changes in HSS knee scores, the patients were divided into three groups on the basis of whether their pain was increased by at least ten points, decreased by at least ten points, or unchanged over the two-week trial period. The group with increased pain (n=5) had an average change in pain score of -24±8 out of a possible 50 while the group with decreased pain had an average change in pain score of 19±7 (Figure 1). Higher HSS pain scores actually indicate lower pain levels.

Statistical methods included use of paired t-tests for differences between visits while independent t-tests were utilized for differences between groups. A significance level of 0.05 was used.

Results

An inverse relationship was found between pain and a key determinant of knee joint loading during gait (the external adduction moment). The patients with decreased pain responded

by significantly increasing their adduction moment between the first and second test periods. (p<0.001) The patients with increased pain responded by decreasing their adduction moment. Moreover, the change in adduction moment for the increased pain group was significantly different from the change in the adduction moment for the decreased pain group (p<0.02) (Figure 2).

Discussion

A reduction in pain caused an increase in the loads at the knee in patients with medial compartment arthrosis. The significant increase in knee adduction moment will have a substantial effect on the medial compartment load at the knee. Patients appear to adapt their gait in a manner that reduces the load on a painful area of the joint. Thus, care must be taken in the use of pharmaceuticals directed at reducing pain since it appears that a reduction in pain can be directly related to increased loading on the degenerative portions of the joints.

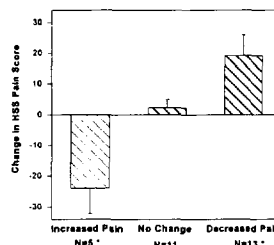


Figure 1. The average change in HSS score between pain groups. * indicates significant difference, p< 0.001

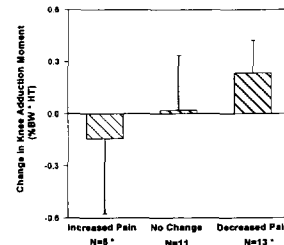


Figure 2. The average change in adduction moment between pain groups. * indicates significant difference, p<0.02.

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16 Force platform measurement of the heelstrike transient in normal walking

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Introduction

The "heelstrike transient" is an acceleration wave which passes up the limb, immediately after initial contact (Simon et al., 1981). It has been suggested that it may cause a variety of disorders, including overuse injuries, chronic backache, osteoarthritis and prosthetic loosening (Pratt, 1989). The present study was devoted to identifying this and other peaks in the ground reaction force (GRF) immediately following initial contact, and to make a preliminary estimate of its magnitude in normal individuals. The study forms part of an ongoing investigation into the heelstrike transient, its measurement, and its attenuation by viscoelastic materials, either in shoe construction or as insoles.

Methodology

A single-case study was performed to determine the characteristics of the GRF immediately following initial contact, in a single individual (male, age 52, weight 70 kg) walking under three conditions: barefoot, in leather street shoes with hard rubber heels, and in the same shoes with "Cambion" viscoelastic insoles (Magister Corporation, Chattanooga). The magnitude of the heelstrike transient in barefoot walking was also measured beneath both feet of 10 normal adults (5 male, 5 female; age range 25-62), during 3 walks each. In both studies, each individual walked at a self-selected speed across a pair of force platforms with a resonant frequency in excess of 600Hz (Bertec, Worthington, Ohio), the outputs from which were sampled by analog-to-digital converter, without filtration, at either 500Hz or 1000Hz. The data from the force platforms were zeroed to the no-load condition, and used to calculate the vector magnitude in the sagittal plane. The beginning and end of the heelstrike were defined, using an algorithm based on the magnitude and rate of change of force. These points were joined by an interpolation line on the force/time plot (Fig. 1), and the heelstrike magnitude was defined as

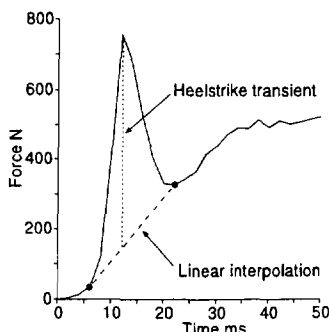


Figure 1: Method of calculating the heelstrike magnitude

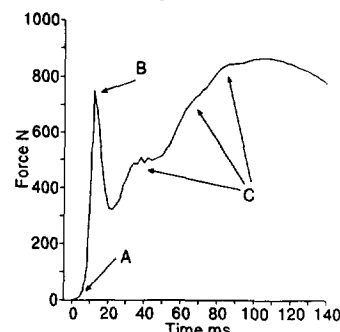


Figure 2: GRF in sagittal plane, barefoot (see text for letter codes)

