Variations in gait patterns: meniscectomy versus normal group.

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Introduction

Knee osteoarthritis (OA) is the most common manifestation of joint disease, producing more disability than any other joint condition (Slemenda, 1992). Consequently, knee OA has received much research attention. However, its aetiology remains largely undetermined.

Mechanical factors are believed to contribute largely to the development of knee OA. In animal models, OA has been experimentally induced with repetitive impact joint loading (Radin & Paul, 1971). The heel strike transient, often present in human gait, has been suggested to provide the mechanism for joint degeneration in OA (Radin et al., 1991).

Meniscectomy patients have a 30 to 90 percent risk of developing knee OA (Sommerlath et al., 1990). Abnormal walking patterns commonly displayed after knee injury can produce large impact forces and knee moments. These type of loads are characteristic of the repetitive, impulsive loads that lead to the development of OA in animal models.

The proposed research is concerned with the increased incidence of knee OA and changes in gait patterns following partial meniscectomy. Identification of the alteration to knee joint loads due to pathological gait patterns following menisical surgery, may provide some insight into the prognosis of meniscectomy patients. In order to identify preventative strategies that abate the social and economic imposition due to knee OA, a better understanding of causative factors is first needed. This study aims to characterise differences in the gait patterns of meniscectomy patients compared to a matched control group.

METHODS

Data collection is currently underway using 120 meniscectomy patients and 50 age-, gender- and body mass index-matched controls. Subjects are aged 20 to 50 years and have been screened for clinical and radiographic evidence of knee OA, previous or current knee joint disease or injury (excepting meniscus tear in patient group), or any other disease or injury that may have an affect on gait.

It is hypothesised that meniscectomy patients are more likely to display pathological walking and running gait patterns. Furthermore, it is predicted that these pathological gait patterns result in faster heel strike loading rates, higher adduction moments and increased leg stiffness, contributing to inappropriate forces applied to the knee joint that may lead to articular changes and knee OA. Kinematic and kinetic parameters of walking and running gait are being measured to determine the presence of abnormal patterns during gait and the effect on knee joint loading. Previous studies have indicated that data gathered for such gait analysis shows little day to day variation (Andrews et al., 1996).

Three-dimensional gait analysis is performed using a 50 Hz, six-camera VICON motion analysis system, with AMTI force platform. Joint kinematics and kinetics are calculated using a custom seven-segment lower limb model.

Gait data compiled for each subject included: three dimensional (3D) joint and segment motion of lower limbs; ground reaction forces in three planes; and 3D moments and forces at the ankle, knee and hip joints. Subjects were categorised using the following parameters; knee adduction and flexion moment peaks during stance, heel velocity prior to heel strike, rate of loading at heel strike. Rate of loading was determined from the first differential of the vertical force traces obtained from force plates during gait trials. Classification into an abnormal gait pattern categories (ie. that may place an individual at greater risk of developing OA) was performed by hierarchical cluster analysis.
RESULTS AND DISCUSSION

Early data analysis demonstrates that both the meniscectomy and control populations can be grouped into ‘high loading’ and ‘normal loading’ subgroups. Figure 1 illustrates approximately 25 percent of the control group exhibit a high adduction moment combined with a high flexion moment. Large knee adduction moments have previously been associated with knee OA in (Koga, 1998; Sharma et al., 1998). Furthermore, a ‘high loading’ subgroup was identified from vertical ground reaction force data. Approximately 12 percent of the control group were found to have large loading rates at heel strike (see Figure 2). Repetitive impact joint loading has been identified as a causative factor in experimentally induced OA using animal models (Radin & Paul, 1971).

It is anticipated that a greater percentage of the meniscectomy group will fit into these ‘high loading’ subgroups related to knee moments and heel strike loads.

References


Acknowledgements

This research is supported by the National Health and Medical Research Council Grant #991134 to D. Lloyd.