A DIRECT TEST OF THE RELATIONSHIP BETWEEN MEDIAL COMPARTMENT LOAD AND THE KNEE ADDUCTION MOMENT USING AN INSTRUMENTED KNEE

INTRODUCTION

A number of clinical studies have reported that the knee adduction moment during walking is associated with the presence (1), severity (2) and rate of progression (3) of medial compartment knee osteoarthritis (OA), and has been used to predict the outcome of treatment interventions for OA (4). These clinical and analytical studies (5, 6) suggest that the adduction moment is a good surrogate measure for the in vivo load on the medial compartment of the knee. However, the relationship between the knee adduction moment and medial compartment load never been tested due to the difficulty with direct measurement of in vivo forces. The recent development of an instrumented total knee replacement offers the opportunity to test this important relationship. In addition, recent studies (7) indicate that footwear can substantially change the adduction moment and permits testing the correlation between adduction moment and load over a meaningful range of values.

The purpose of this study was to test the hypothesis that, in vivo, the peak loads in the medial compartment of the knee are correlated to the first peak external knee adduction moment using an instrumented knee prosthesis. The study used shoes specially designed to cause variations in the adduction moment for a single individual.

METHODS

A custom-designed instrumented knee prosthesis was implanted in the right knee of an 81-yr-old male (170 cm, 633 N) after providing IRB-approved informed consent. The instrumented knee transmitted the compressive load in the medial anterior, medial posterior, lateral anterior, and lateral posterior compartments of the knee from 4 uniaxial load cells embedded in the tibial component at 70Hz. These transmitted forces were recorded on a laptop computer using custom acquisition software (Labview). The sum of the two measurements in the medial compartment was used to estimate total medial compartment compressive loading. Compressive loading was normalized to body weight.

The subject performed 6 walking trials at a self-selected normal speed while wearing his personal shoes and three slightly altered versions of his personal shoes and thus provided a varied loading range to test the correlation. The peak knee adduction moment correlated well with the magnitude of the peak knee adduction moment (Figure 1, R²=0.44). The modified shoes produced a significant reduction in the adduction moment relative to the subject’s personal shoes and thus provided a varied loading range to test the correlation. The peak knee adduction moment showed a significant reduction in both the dual density (p=0.02) and wedged intervention shoes (p=0.02).

DISCUSSION

These results support the hypothesis that there was a direct relationship between the medial compartment compressive loading in vivo and the knee adduction moment during walking. These results confirm clinical studies that indicate a relationship between the adduction moment and the health or degradation of cartilage in the medial compartment of the knee. The instrumented knee used in this study provided invaluable information that provides added confidence that the adduction moment is a valid and simple surrogate for the medial compartment load.

It should be noted that shoes (7) used in this study were quite effective at reducing the medial compartment load relative to the subject’s personal shoes and provide an excellent example of the potential to apply the adduction moment measurements to a broad range of treatment modalities designed to address medial compartment knee osteoarthritis.

REFERENCES

1 Baliunas AJ et al. (2002) Osteoarthritis and Cartilage. 10(7), 573.

** VA Palo Alto Health Care System, Palo Alto, CA
*** Shiley Center for Orthopaedic Research & Education, Scripps Clinic, La Jolla, CA

52nd Annual Meeting of the Orthopaedic Research Society
Paper No: 0608