FUNCTIONAL OUTCOME OF PATIENTS WITH A FEMALE-SPECIFIC TOTAL KNEE REPLACEMENT

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INTRODUCTION

Recent variations to the design of traditional unisex total knee replacements (TKR) have led to the development of the Gender Solutions knee, by Zimmer. This implant is designed to accommodate anatomical differences between the male and female knee. The goal is to improve outcomes of TKR surgery with an implant that conforms more naturally to the female joint. Although changes to implant design are consistent with reported anatomical differences between genders [1,2], there is little to no research exploring how the new gender-specific female (GSF) prosthetic affects post operative outcome. A successful knee implant should reduce compensatory mechanisms in surrounding joints and in turn reduce the likelihood of damage developing in these joints.

The purpose of the study was to evaluate functional outcome during activities of daily living in patients with a GSF TKR, and investigate compensatory mechanisms that occur in lower body joints. Functional outcome was assessed through measures of kinematics, kinetics and patterns of muscle activity. A comparison was also explored between GSF patients and a small group of females with traditional TKRs.

The following hypotheses were tested using gait analysis. This abstract focuses on part a) of each hypothesis:

H1 a: GSF patients will have a reduced knee flexion range of motion (ROM) compared to healthy controls.
b: GSF patients will have an increased ROM compared to traditional TKR patients.
H2 a: GSF patients will have greater external adduction moments in the unaffected limb than healthy controls;
b: This external adduction moment will be reduced in GSF patients when compared to traditional TKR patients.
H3 a: GSF patients will experience compensation in the contralateral limb and the hip and ankle of the affected limb. This will be characterized by larger angular impulses at the hip and a greater imbalance in angular impulse distributions between limbs in GSF patients compared to controls.
b: This compensation will be less drastic in GSF patients than traditional TKR patients.

METHODS

Three groups of female subjects aged 50-76 were recruited for testing. Group 1 consisted of GSF TKR patients, 1 to 2 years post-operative (n=10). Group 2 was made up of aged matched healthy females (n=10), and group 3 was composed of female patients with a traditional, unisex TKR (n=5).

Biomechanics of each subject's movement were evaluated bilaterally, using an eight-camera motion capture system (kinematics) in conjunction with two force plates (kinetics) and surface electromyography (muscle activity). Each subject performed three activities: (1) level walking, (2) stair climbing, and (3) standing from a seated position. Each activity was repeated until 5 trials were available for analysis. Active ROM was also recorded for each subject.

Outcome variables of interest include knee flexion excursion and joint moments at the ankle, knee, and hip of the affected and contralateral limbs, calculated via inverse dynamics. The contribution of individual joint angular impulses (time integral of moments) to the total angular impulse in each leg was calculated to investigate compensatory activity of neighboring joints and asymmetry between limbs. The contribution of each joint was found using the following equation adapted from Yoshida et al. [3]:

$$\%\ Contribution = \frac{Imp_{joint\ of\ interest}}{Imp_{ankle} + Imp_{knee} + Imp_{hip}} \times 100$$

RESULTS AND DISCUSSION

GSF patients were found to have a reduced active range of motion (mean ± SD, 110˚ ± 9˚) compared to controls (mean ± SD, 129˚ ± 9˚). Figure 1 shows the contribution of each joint angular impulse in extension throughout stance, for each group, during the stair climb. This figure indicates a trend with a smaller percentage of impulse than normal being generated from the knee joint of GSF patients and compensation occurring at the hip. Although this figure suggests some compensation, it appears to be relatively small and unlikely to lead to damage in surrounding joints. The same variables calculated for level walking showed little or no difference between limbs or groups.

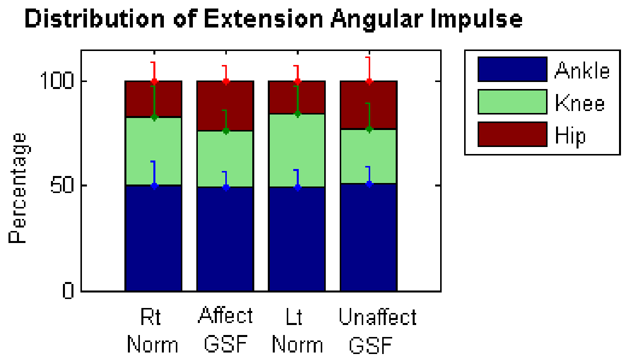

Figure 1: Percent of joint angular impulse from the ankle, knee, and hip during stance for GSF patients and normals

CONCLUSIONS

The sample size in this study is relatively small therefore it may be difficult to draw conclusive results. However, this pilot study provides initial indications of functional outcome in GSF TKR patients and is valuable in identifying variables of interest around which a larger study can be created. It is crucial to evaluate the new GSF implant to ensure patient outcomes that are, at minimum, equal to previous designs.

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