INTRODUCTION

The implant twisting moment (the torque about the implant stem) has been linked to implant loosening in in vitro studies of total hip replacement (THR) stability. In in vivo testing, the implant twisting moment during stair climbing was substantially higher than during walking (Bergmann et al., 1995, 2001). To our knowledge, no one has quantified gait adaptations in subjects with THRs during stair climbing or investigated how possible gait adaptations affect the implant twisting moment during this activity. The objectives of this study were to identify gait adaptations during stair climbing and examine their effect on the implant twisting moment. Specifically the hypotheses tested were that (1) there would be significant differences in dynamic range of motion and external moments during stair climbing in subjects with THRs and normal subjects, (2) the implant twisting moment would be significantly correlated to kinetics measured during gait activities and (3) as a result of the gait adaptations, the implant twisting moment in subjects with THRs would be significantly reduced compared to normal subjects.

RESULTS AND DISCUSSION

Adaptations were present during stair climbing in the THR group (Fig 1). The adduction and external rotation moments were lower in the THR group than the normal group (p \leq 0.020) while the peak extension moment was significantly higher in the THR group (p = 0.012).

The peak implant twisting moment and peak external rotation moment were significantly correlated in both subjects with THRs (R = 0.808, p = 0.001) (Fig. 2) and normal subjects (R=0.891, p = 0.003). There were no other significant correlations between peak implant twisting moment and external moments in either subject group (p \geq 0.419).

The peak implant twisting moment was not statistically different between the two groups (Fig. 3). The first peak contact force was significantly reduced in the THR group.
(p = 0.043). The second peak contact force was similar for the two groups (p = 0.337).

Figure 1: Gait adaptations were present during stair climbing in subjects with THRs. Bars represent significant differences between the THR and normal groups (p < 0.02).

Figure 2: The peak implant twisting moment increased as the peak external rotation moment increased.

Gait adaptations during stair climbing, involved the hip abductors and mirrored those seen during level walking (Foucher et al., 2007). The positive correlation between the external rotation moment and the implant twisting moment suggests that if this moment were normal, implant twisting moments would be even higher.

Stair climbing has been implicated as a high risk activity for THR patients (Bergmann et al., 1995) because of the high implant twisting moments present relative to the overall contact force (Kotzar et al., 1995). According to Bergmann, in vitro studies have shown that THRs can resist a twisting moment of 1 to 5 %BW * m (1995). The implant twisting moments during stair climbing approach or exceed these values.

Figure 3: Hip forces in subjects with THRs and normal subjects. Bar indicates a significant difference (p = 0.043).

SUMMARY/CONCLUSIONS

Although gait adaptations were present during stair climbing, the risk for overloading the implant remains high, as adaptations did not significantly lower the implant twisting moment. The magnitude of this moment reaches values thought to be detrimental to implant longevity.

REFERENCES


ACKNOWLEDGEMENT

Whitaker Foundation