INTRODUCTION

After a hip fracture elderly populations (>65) experience a loss of physical function (>50% loss of lower extremity function) and increased risks of falls despite return of functional independence[1]. Asymmetrical limb loading (lower limb loading of the involved limb) noted in hip fracture subjects may contribute to decreased function and falls risk[2]. However, which knee or hip kinetic patterns explain altered limb loading are not known[3]. Global decreases in joint kinetics (both knee and hip may occur) or joint specific strategies (higher knee dependence) may underlie altered limb loading. Understanding the typical patterns may facilitate targeted rehabilitation programs and improve outcomes. Therefore the purpose of this study was to compare hip and knee kinetics during a sit to stand task in subjects with hip fracture (HF) to elderly controls (EC). The two initial hypotheses are: 1) Hip fracture subjects would demonstrate lower involved side joint kinetics (hip/knee moments/powers), indicating a global decrease (global strategy) in limb function compared the uninvolved side and controls. And 2) hip fracture subjects would demonstrate similar uninvolved side kinetics (hip/knee moments/powers) to the controls. Indicating a higher dependence on the uninvolved limb to achieve rising.

METHODS

Fifteen subjects (3 male, 12 female; age=77 ± 6) post hip fracture and 15 controls (4 male, 11 female; age=73 ± 5) participated in this study. All subjects were community dwelling and recently discharged from home care physical therapy. An Optotrak Motion Analysis System (Northern Digital Inc, CAN) and Motion Monitor Software (Innsport Training Inc, USA) collected kinetic and kinematic data at a sample rate of 60 Hz and a low pass filter rate of 6 Hz. Angles were then produced and calculated from a Cardan angle Z-X-Y sequence of rotations. Hip and knee moments and powers calculated from the appropriate angles and ground reaction force (collected at 1000 Hz using Kistler force plates under each foot). Subjects were asked to perform sit to stand “as fast as possible” three times. Time to rise was calculated from seat off to upright posture. Data were averaged over the three trials and statistically compared across side (involved/uninvolved) and groups (hip fracture/control).

RESULTS AND DISCUSSION

![Figure 1: Hip and knee moments for the involved, uninvolved and control limb.](image1)

![Figure 2: Hip and knee powers for the involved, uninvolved and control limb.](image2)
Subjects with HF have a significantly slower time to rise compared to controls (p<0.001, HF = 1.2 s ± .41 vs EC = 0.72s± .19). The new findings of our study show that individuals with hip fracture have significantly lower hip/knee moments (Figure 1) on the involved limb (p<0.001, HF = 1.0 Nm/Kg ± .23 vs EC = 1.7Nm/Kg ± .23) but not the uninvolved limb (p=0.113, HF = 1.63 Nm/Kg ± .29 vs EC = 1.83Nm/Kg ± .31) compared to elderly controls. Additionally, the HF group had lower hip/knee powers on both the involved (p<0.001, HF = 1.2 W ± .45 vs EC = 3.2W ± .81) and uninvolved limb (p<0.001, HF = 1.8 W ± .71 vs EC = 3.4 W ± .83) (Figure 2). To evaluate the contribution of each joint the percent of the total moment or power was also evaluated (Figure 3). This analysis suggested equal contributions of each joint, irrespective of which limb was assessed (involved, uninvolved, controls). Further, HF subjects tend to use a movement strategy that is reliant on the uninvolved limb (figure 3).

**CONCLUSIONS**

Subjects with hip fracture employed movement strategies that included lower contributions of both the hip and knee on the involved limb supporting the first hypothesis. Because both hip and knee contributions were similar (figure 3) a global strategy (of the involved limb) was used to achieve a sit to stand. This suggests that decreases of the involved limb are interdependent between both the hip and knee joints rather than isolated to only deficits of the hip joint (i.e knee dominant strategy). A higher dependence on the uninvolved limb was shown partially supporting the second hypothesis. Hip and knee contributions were significantly higher on uninvolved limb but this was not equal to controls (Figure 2). The significant decrease in bilateral power suggests the movement strategy employed by subjects with hip fracture is associated with decreased speed to achieve rising during a sit to stand. This finding that global deficits of the involved limb limit overall sit to stand performance may be important in directing rehabilitative care post hip fracture by focusing on global performance of both the hip and knee. Future studies should focus on understanding the interdependence of the hip and knee joints rather than isolated joint specific deficits such as strength.

**REFERENCES**


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