INVESTIGATION OF SIT-TO-STAND PERFORMANCE FOR INDIVIDUALS AFTER TOTAL KNEE ARTHROPLASTY

Catherine A. Stevermer, Shashank Raina, and Jason C. Gillette
Department of Health and Human Performance, Iowa State University, Ames, Iowa, USA; email: ktsteve@iastate.edu

INTRODUCTION

Moving from a seated position to standing is an essential transition for basic activities of daily living and is a prerequisite for ambulation. Many older adults find sit-to-stand to be challenging without additional support [1] due to lower extremity limitations associated with pathology and/or reduced dynamic stability. In contrast to healthy elderly, Cheng, et al. [2] indicated weight-bearing asymmetry and increased postural sway during sit-to-stand may increase the risk of falls in a neurologically impaired population. Before and after total knee arthroplasty, osteoarthritic adults may also have difficulty with this task due to limited range of motion and/or strength deficits [3]. Therefore, sit-to-stand technique may differentiate between standing independently, standing with assistance, or an inability to perform the task.

Janssen, et al. [4] indicated variations in lower extremity positioning, upper extremity assistance, seat height, and movement pattern may affect sit-to-stand performance. Previous research has focused on an assumption of bilaterally equivalent anthropometrics, joint timing and weight-bearing during sit-to-stand. These assumptions may be inappropriate for individuals with weakness and/or mobility limitations due to potential movement asymmetry. The goal of the present study is to determine therapeutic recommendations for foot placement during sit-to-stand in an orthopedic population.

METHODS

Two individuals with total knee arthroplasty (TKA 2 ± 0.5 yr post-surgery) participated in this experiment (2 males, age 72 ± 5 yr, mass 88 ± 12 kg). Two individuals (1 male/1 female, age 70 ± 3 yr, mass 84 ± 15 kg) without any musculoskeletal disorder participated as healthy control subjects. An eight-camera video system (Peak Performance, Englewood, CO) was used to track 10 reflective markers placed bilaterally on each subject. The subjects sat on a bench (height 45 cm) with their feet on separate force platforms (AMTI, Watertown, MA). Two triaxial force sensors (Kistler, Amherst, NY) measured hand forces applied to the bench. Individual knee range of motion and anthropometrics were measured.

The subjects placed their feet at a comfortable width. Initial foot placements included: feet placed bilaterally at 90° of knee flexion (Foot-neutral), the feet more posterior relative to the knees (Foot-back) at an angle of 100° degrees of knee flexion, and a self-selected position with the dominant foot posterior (Staggered). Lower extremity positions were combined with and without upper extremity assistance. Hand support forces were measured and joint torques were calculated for sit-to-stand movements in each condition. Each subject completed three repetitions of the six sit-to-stand conditions for a total of 18 trials.

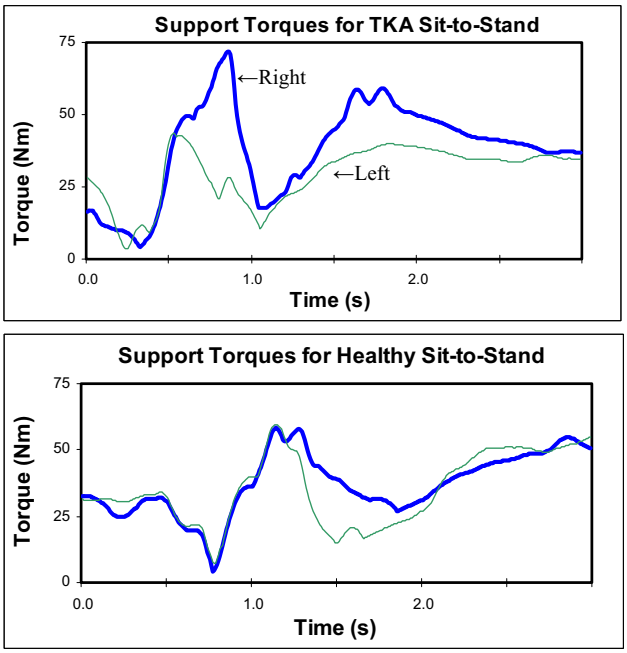

Figure 1: Left/right asymmetry is noted in maximal combined torque during the sit-to-stand ascension phase for an individual after total knee arthroplasty compared to a healthy older adult.

RESULTS AND DISCUSSION

Relative to healthy older adults, TKA subjects demonstrated greater right/left asymmetry (62%/38% in Foot-neutral) in torque production and larger variation in bilateral joint timing across sit-to-stand conditions (Figure 1). TKA subjects also exhibited increased hip flexion torques (38 Nm vs. 14 Nm), indicating they may rely on upper body momentum generation to compensate for lower extremity deficits.

TKA subjects demonstrated greater symmetry in support torques in the Staggered foot position. Healthy older adults demonstrated greater support torque symmetry and improved joint timing in the Foot-back condition relative to the Foot-neutral condition, likely due to increased ankle contributions and reduced hip strength associated with aging. These results indicate appropriate foot placement may compensate for physical limitations in older adults. In addition, alternative foot placements during the sit-to-stand movement may be used for therapeutic goals of improving dynamic stability, enhancing lower extremity strength and maximizing functional independence for individuals following total knee arthroplasty.

REFERENCES

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