STAIR DESCENT KNEE POWER CHANGES FOLLOWING MINIMALLY INVASIVE COMPUTER NAVIGATED TOTAL KNEE ARTHROPLASTY

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INTRODUCTION

Falls on stairs are a leading cause of injury in older adults with most accidents occurring during stair descent (Starzell, et al., 2000). Studies have shown that stair descent moments at the knee are three times those moments measured during level walking (Andriacchi, et al., 1980). Knee flexion angles required to successfully descend stairs are greater than the angles necessary for level walking (McCamley, 2007). The higher demands placed on the knee joint during stair descent can limit the ability of patients with joint deficiencies from performing this activity.

Osteoarthritis causes pain that limits the loads applied to the knee joint. Total knee arthroplasty (TKA) relieves this joint pain. Minimally invasive and computer navigated surgery is becoming an increasingly common form of TKA. This type of surgery produces less disruption to the soft tissues surrounding the knee joint providing the potential for faster recovery than conventional surgery.

The aim of this study was to measure the differences in knee power absorbed during stair descent in patients before and four months after TKA and compare these data with those measured for a group of healthy age-matched individuals.

METHODS

Eleven TKA patients (5 males, 6 females; 73 ± 8.1 years) volunteered to participate in the study. Data were also collected from sixteen healthy age-matched volunteers from the same community (5 males, 11 females; 68 ± 5.8 years).

Motion analysis data were collected using a ten camera motion capture system (Motion Analysis Corp., Santa Rosa, CA) with lower body limb segments defined by 28 reflective markers. The stair system consisted of three steps mounted on two force platforms (AMTI, Watertown, MA) in such a manner that forces could be recorded for all three steps. Data were recorded while the patients and control subjects descended the stairs in a reciprocating manner. A minimum of three trials were recorded for each subject. Mean values for patients prior to and after surgery where compared using a paired t-test. Post surgery values for patients where compared to controls using an unpaired t-test (α = 0.05)

RESULTS

Peak knee power absorbed occurs immediately prior to contralateral foot strike when the stance limb is supporting the full weight of the body while in a flexed position. Table 1 lists the average cadence, peak knee angle, moment and power for the patients prior to, and after surgery, and for the control group. The graphs shown in figure 1 represent the average of values for

the subjects in each group at time points in the normalized gait cycle. Analysis of the data shows that while cadence improved significantly following surgery it remained significantly different to the control group. Significant variations in knee angle are not possible due to the need to position the foot within a defined area on each step. The changes in sagittal plane kinematics following surgery were not significant. There were significant differences between the knee power absorption measured for the control group and the patient group prior to surgery. The results show that while there are improvements in knee motion following TKA these improvements do not immediately restore the ability of patients to descend stairs.

CONCLUSIONS

In another study, measurements of knee power for these same patients while walking were not significantly different from that for the control group (McCamley, 2007). Stair descent is more challenging and provides an opportunity to measure differences not seen while performing other less demanding tasks. Understanding the limitations TKA causes in patients may help in the rehabilitation of these persons enabling them to become more independent sooner after surgery. Further study is necessary to determine if more time is needed for knee kinematic parameters to reach levels similar to those measured in healthy subjects.

REFERENCES

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Table 1: Mean (SD) for Pre-op, Post-op and Control groups; A: paired t-test, pre-op – post-op, B: unpaired t-test, post-op - control.

	Pre-Op n = 11	Post-Op n = 11	Control n= 16	T-test significance A	B
Cadence Steps/minute	42.34 (13.05)	60.15 (8.28)	79.43 (10.03)	**<0.001**	**<0.001**
Knee flexion angle at toe off	86.8 (6.8)	89.3 (5.1)	91.7 (12.6)	0.112	0.609
Peak knee moment (N-m/kg)	0.91 (0.33)	1.04 (0.20)	1.20 (0.22)	0.066	0.079
Peak knee power Abs. (Watts/kg)	-2.06 (0.52)	-2.23 (0.42)	-2.90 (0.61)	0.684	**0.012**

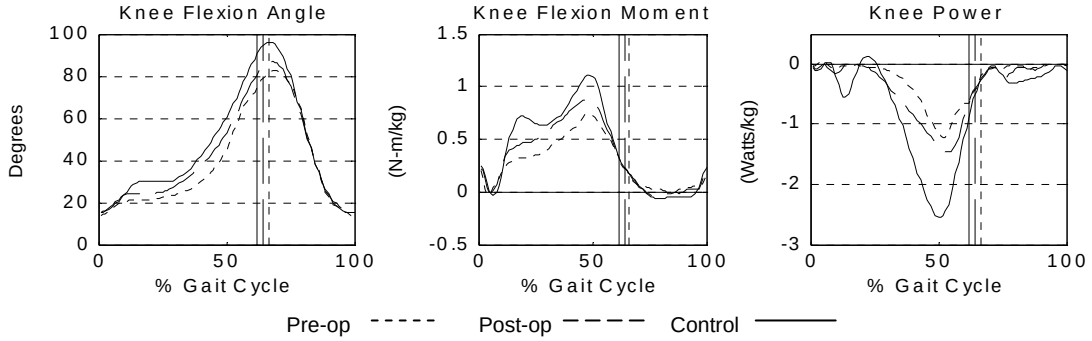

Figure 1: Average knee sagittal angle, moment, and power for the patients' injured knee pre- and post-surgery, and for control subjects over a normalized gait cycle.