**Introduction:** Total knee arthroplasty (TKA) is a surgery commonly used to relieve the pain caused by osteoarthritis at the knee joint. Previous studies have shown patients with degenerative joint disease walk more slowly than normal subjects due to decreases in stride length and cadence (Stauffer et al. 1977). Falls on stairs are a leading cause of injury in older adults (Starzell, et al., 2000). Studies have shown that stair descent moments at the knee are three times 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. The higher demands placed on the knee joint during stair descent can limit the ability of patients with joint deficiencies from performing this activity. TKA is used to restore range of motion to the knee joint and reduce pain. Minimally invasive surgery produces less disruption to the soft tissues surrounding the knee joint providing the potential for recovery of ambulatory ability over a short period of time. The authors of this study hypothesized that the walking and stair descending ability of patients four months after total knee arthroplasty performed using computer navigation and minimally invasive techniques would not be different to the control group.

**Materials and Methods:** Eighteen TKA patients (8 males, 10 females; 73 ± 8.1 years) volunteered to participate in the walking study and eleven of these subjects (5 males, 6 females; 73 ± 7.8 years) participated in the stair descent trials. Data were also collected from fifteen healthy age-matched volunteers from the same community (5 males, 10 females; 69 ± 6.2 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 reflective markers. Subjects were asked to walk at a self selected speed along an eight meter walkway embedded with four force platforms (AMTI, Watertown, MA) and negotiate a stair system consisting of three steps mounted on two of the force platforms. Forces were recorded for all three steps of the stair system. A minimum of five trials were recorded for each subject. Mean values for each of the selected kinematic and kinetic variables were compared using paired t-tests ($\alpha = 0.05$) to compare pre- and post-surgery values and unpaired t-tests to compare post surgery values with controls.

**Results:** Analysis of the results from walking trials showed a significant improvement in cadence ($97.6 \pm 13.8$ steps/min vs. $104.7 \pm 10.3$ steps/min, $p = 0.002$) and velocity following surgery as well as an improvement in maximum knee flexion during swing and maximum vertical ground reaction force. Data for the post-surgery patients and the control group showed the patients had a significantly lower velocity ($97.7 \pm 15.9$ cm/sec vs. $106.8 \pm 11.7$ cm/sec, $p = 0.039$) along with lower maximum knee flexion both in stance and swing and less knee flexion at toe off when walking (Figure 1). The peak in knee power absorption during stair descent occurs immediately prior to contralateral foot strike when the stance limb is supporting the full weight of the body while in a flexed position. Figure 2 shows power absorbed by the knee joint during stair descent for a normalized gait cycle. Peak knee power absorbed following surgery was significantly less than for controls ($2.4 \pm 0.4$ Nm/kg vs. $2.9 \pm 0.6$ Nm/kg, $p = 0.012$). Cadence improved significantly following surgery but was still significantly different to the control group for both walking and stair descent. Significant variations in knee angle are not possible when descending stairs 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 patients prior to surgery and the control group.

**Discussion:** The results show that while there is an improvement in the patients walking ability following surgery, differences still exist between persons who have received TKA and age-matched controls. Patients walk faster following surgery indicating more confidence while the higher ground reaction force suggests less knee pain. Patients following surgery have a high variability in step length while walking possibly due to different rates of recovery. Stair descent is more challenging for older persons 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. The results indicate that while the patients have improved mobility they do not exhibit the same levels as control subjects. Further study is necessary to determine if more time is needed for knee kinematic and kinetic parameters to reach levels similar to those measured in healthy subjects.

**References:**

![Figure 1. Injured knee flexion angles for pre- and post-op patients and control subjects.](image)

![Figure 2. Knee power absorbed during stair descent over a normalized gait cycle.](image)