A Biomechanical Therapy Program for Patients after Total Knee Arthroplasty

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Background

An estimated 27 million Americans suffer from osteoarthritis (OA). Total knee arthroplasty (TKA) is routinely performed for OA of the knee. Over 600,000 TKA procedures were performed in the United States 2008, at a total cost of more than $9 billion. Primary TKA is expected to grow by 673% by 2030 to 3.48 million procedures annually.

While TKA is generally successful, there is increasing evidence that a significant percentage of patients continue to experience chronic pain and functional disability after TKA, leading to poor quality of life and dissatisfaction years after surgery. Only about half of patients achieve an overall good outcome after surgery.

Researchers have found that poor postoperative outcomes in pain and function are associated with poor loading patterns on the knee joint, specifically high knee adduction moment, high knee flexion moment and low knee extension moment. These pathological loading patterns are usually present in these patients prior to surgery and are retained after surgery. With time these loading patterns will lead to degradation of the TKA implant with time in a similar pattern to the way the natural knee joint is degraded. This may explain the high risk for revision surgery over the first decade postoperatively.

The aim of the present study was to design a biomechanical therapy program for patients after TKA that is capable of improving loading patterns on the knee joint during gait. We then applied this program over the course of a year to monitor changes in loading patterns, as well as pain and functional outcomes after surgery.

Methods

We conducted a randomized, controlled, double-blind trial involving fifty patients after unilateral TKA for end-stage knee OA. The active group underwent the designed
biomechanical therapy program using a foot-worn biomechanical device (Fig. 1), while the control group received a similar training program with a sham walking sneaker (SWS). Patients walked with their assigned foot-worn device for 30 minutes per day at the study commencement, increasing up to for several hours per day by the study termination. Patients were examined prior to treatment initiation at two months postoperatively, and after three and nine months of therapy. Knee loading patterns were examined with a three-dimensional gait analysis during barefoot walking to determine how each therapy program changed the natural loading patterns on the knee joint over time. Self-evaluative questionnaires, a VAS scale for pain, a Timed-Up-Go test (TUG) and a Six Minute Walk exam (6MW) were used to examine pain and functional outcome scores.

Results

There were no differences between groups at baseline. The active group showed significant improvements in knee loading patterns over time (Fig. 2). Specifically, there was an increase in knee extension moment and lower peak knee adduction moment (p=0.007). Linear mixed effect models over time showed faster improvements in the active group in stride, cadence, double-limb-support, step-length, knee range of motion and impulses of the knee flexion and extension moments, as well as slower regression of the knee adduction impulse (all p<0.01).

In clinical outcomes both groups improved with time after surgery, but the active group consistently showed significantly better outcomes in VAS scores (p=0.001; Fig. 3), self-evaluative questionnaires (all p<0.001), TUG (p=0.003) and 6MW (p=0.001; Fig. 3). Linear mixed effect models over time showed faster improvements in the active group in all clinical parameters (all p<0.01).

Discussion

The biomechanical therapy program was able to significantly improve the loading patterns on the knee joint. As a result, the active group showed more rapid recovery times in function and in pain in comparison to the control group. The active group also had overall better outcomes than the control group. In the long term this may imply that the active group will have a lesser risk for deterioration of their knee implant and will have less of a need for revision surgery. Considering the massive number of patients undergoing this surgery per year, the results of this study may have a tremendous impact. We believe that all individuals undergoing TKA surgery should undergo such a biomechanical therapy program in order to maximize their outcomes and increase the longevity of their TKA implant.

References


**Figure 1:**