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Original Article

New approach for the rehabilitation of patients following total knee arthroplasty

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ARTICLE INFO

Article history:
Received 10 December 2013
Accepted 15 April 2014
Available online 13 May 2014

Keywords:
Knee
Arthroplasty
Gait
Rehabilitation

ABSTRACT

Purpose: To investigate the effect of a biomechanical therapy on gait, function and clinical condition in patients following total knee arthroplasty (TKA).
Methods: Seventeen TKA patients participated in the study. Patients received a biomechanical therapy AposTherapy). Patients underwent a gait test, clinical examination and an assessment of pain, function and quality of life (QOL). Patients were examined again at one, three and six month follow-ups.
Results: A significant improvement over time was found in most gait measurements. Significant improvements were also found in pain, function and QOL.
Conclusions: The examined biomechanical therapy may help in the rehabilitation process following TKA.

1. Introduction

Total knee arthroplasty (TKA) is the most common treatment for end-stage knee osteoarthritis (KOA). TKA has revolutionized the care of patients with KOA and the number of performed surgeries has dramatically increased over the past decade. With the rise in life expectancy, projected increases in the incidence of KOA and TKA surgery will place an enormous burden on the healthcare system. A study based on the National Hospital Discharge Survey (1996–1999), predicts that in 2030 there will be over 474,000 TKA procedures performed in the U.S. alone.[1]

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http://dx.doi.org/10.1016/j.jor.2014.04.009

TKA surgery succeeds at significantly improving the pain, function and quality of life of KOA patients.[2] Nevertheless, some lower extremity kinematic and kinetic gait abnormalities have been shown to persist and continue to limit subjects' performance and quality of life.[3,4] Even years after TKA, many patients do not achieve a normal gait pattern. They tend to walk with a slower velocity, shorter stride length and longer stance phase than control subjects.[5]

Recent data suggests that the abnormalities in gait parameters seen in patients after TKA are not solely due to the surgical procedure or implant misalignment, but rather can be remnants of patients' pathological gait patterns prior to surgery. Several studies have examined KOA gait patterns pre and post TKA and have shown that gait patterns after surgery mirror the gait patterns prior to surgery.[5,6] These retained pathological gait patterns have dramatic long-term effects on TKA patients aside from immediate functional limitations post-surgery.

Recent research has suggested that the retained pathological gait patterns may significantly influence the function of the contralateral knee and hip. Since these gait patterns remain pathological even after the first TKA, the contralateral limb continues to deteriorate and may even deteriorate more rapidly.[7] This process can be observed in the differences between limbs after TKA. After TKA there is limb asymmetry, in which the operated limb remains more functionally limited than the non-operated limb. Over time this limb asymmetry is reduced; however, instead of the newly operated knee achieving normality, the non-operated knee becomes more pathological.[7]

In light of these findings, there is a need to improve gait patterns after TKA. It has been shown that a biomechanical therapy was able to improve spatiotemporal, kinetic and kinematics gait parameters in patients with KOA,[8] as well as self-evaluation questionnaires of pain, function and quality of life.[9] The present study attempts to apply this therapy to patients after TKA due to end-stage KOA. The study was designed to test the hypothesis that the biomechanical therapy would be able to improve the spatiotemporal parameters, functional scores and self-evaluations scores of these individuals after surgery.

2. Methods

2.1. Participants

This was a prospective study of seventeen patients after unilateral TKA (seven males and ten females). The patients were enrolled to the study three months postoperatively. Patients had a mean age of 70.0 ± 6.1 years, height of 166.2 ± 8.7 cm and weight of 80.8 ± 14.0 kg. Exclusion criteria were severe degenerative changes in other lower extremity joints, except for the contralateral knee, other joint arthroplasties, and any neurological disorders. The study was approved by the institutional review board (NIH registry NCT01266382).

2.2. Intervention

Postoperatively, all patients underwent physical therapy as specified by their physician. At three months postoperatively, all patients enrolled into the study and began the study therapy. The study therapy was carried out in addition to their typical physical therapy regiment. The biomechanical therapy (AposTherapy) used for the present study is designed to combine center of pressure (COP) manipulation in the foot with perturbation during walking. The therapy combines a biomechanical system (Fig. 1) with a specific walking protocol. The system consists of two convex shaped biomechanical elements attached to each of the patient's feet (i.e. 4 elements total). One is located under the hindfoot region and one is located under the forefoot region of each foot. The elements are attached to the patient's foot on mounting rails embedded within the sole of a shoe. The mounting rails enable flexible positioning of each element under each region. The device is calibrated by a physical therapist certified in the AposTherapy methodology.

Once the device was calibrated, the patient was sent home with the device and was requested to train with the device by walking with it indoors during activities of daily living for a specified amount of time each day. During the first two weeks the patient was guided to wear the device for 10 min a day while doing his daily routine and to accumulate a 5 min walk with the device. This was increased gradually to 30 min a day after 4 weeks. After 6 weeks of therapy patients were guided to wear the device for 60 min a day while doing their daily routine and to accumulate 30 min' walk with the device. The patient was also requested to return to the AposTherapy center for follow-up visits after 1 month, 3 months and 6 months. During each visit the patients were evaluated and the device was recalibrated if necessary. Compliance to the therapy was measured with a weekly log and follow-up phone calls.

2.3. Outcome measures

All patients were evaluated at three months postoperatively (baseline), as well as after one month, three months and six months of therapy. Walking speed (cm/s), step length (cm) and single-limb-support (SLS) (% gait cycle (GC)) were

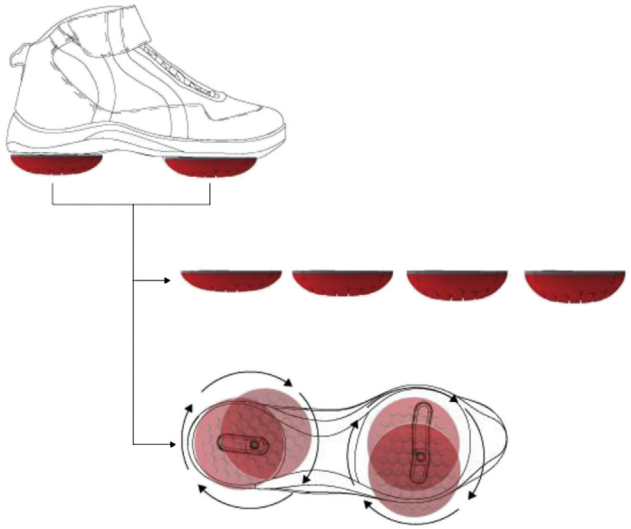

Fig. 1 – Biomechanical device used in therapy.