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ORIGINAL ARTICLE

Guidelines for the Early Restoration of Active Knee Flexion After Total Knee Arthroplasty: Implications for Rehabilitation and Early Intervention

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Abstract

Objectives: To investigate the association between active knee flexion at initial (1−2wk) and final (7wk) outpatient visits after total knee arthroplasty (TKA), and to develop a guide for the expected progression of knee flexion in the subacute postoperative phase.

Design: Prospective case series.

Setting: Rehabilitation clinic.

Participants: Consecutive sample of patients (N = 108) who underwent TKA between December 2007 and August 2012.

Intervention: TKA followed by a standardized, 5-week outpatient rehabilitation program (2 sessions per week) immediately after hospital discharge.

Main Outcome Measure: Active knee flexion was recorded on the patient's first outpatient visit (1−2wk) and then biweekly throughout the patient's 5-week outpatient rehabilitation program.

Results: Active knee flexion at initial (1−2wk) and final (7wk) outpatient visits were significantly correlated ($r = .86$, $P < .001$). Mean active knee flexion significantly improved ($P < .001$) across all patients from 90.4° at initial outpatient visit to 110° at final outpatient visit. At 7 weeks postsurgery, a value of 100° was determined as the cut-off point for an acceptable active knee flexion, which corresponded with 80° of active knee flexion at initial outpatient presentation at 1 to 2 weeks.

Conclusions: Active knee flexion at the initial outpatient visit exhibits a strong correlation with knee flexion at 7 weeks after TKA. These knee flexion guidelines may allow for the provision of individualized rehabilitation, allow practitioners to provide patients with realistic goals of progression throughout the subacute phase, and allow the early identification of patients at risk for poor long-term outcomes who may benefit from further intensive care or other early intervention.

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Articular cartilage injury to the knee is extremely common.[1] Given the poor capacity of cartilage to repair, the inevitable, long-term progression is to osteoarthritis (OA) of the knee.[2] The most common treatment for severe OA of the knee is total knee arthroplasty (TKA).[3] The number of patients with debilitating OA of the knee is increasing; therefore, the number of TKAs is also expected to increase with time.[4-6] The primary goal of TKA is to provide the best possible outcome for a patient.[7] However, it has been reported that up to 15% of patients can have substantial dysfunction for a variety of reasons, including persistent pain and limited knee range of motion (ROM).[8] Indeed, restricted postoperative knee flexion remains one of the most frequent postoperative complications and indicators for patient dissatisfaction after TKA.[9] Previous research has indicated that at least 110° of knee flexion is required to achieve satisfactory function for most patients and to complete most activities of daily living.[9-11] Therefore, in addition to the resolution of pain, studies have shown that the restoration of knee flexion and function are important in determining the success of a TKA.[12-14]

A range of factors have been reported that affect the progression and final postoperative knee flexion after TKA. These may

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include preoperative and postoperative hospital discharge knee flexion, pain, physical activity level, age, body mass index, underlying disease and tibiofemoral varus/valgus angle, surgical technique, implant design, the height of postoperative joint line, patellar diameter, and postoperative physical therapy.[7,8,15-23] Of interest to this study, active knee flexion on hospital discharge has exhibited an association with knee flexion at 12 months.[24,25] This would suggest that if patients can improve their flexion within the early acute inpatient setting, this may translate to improved longer-term outcomes.

There appears to be very little research on the association between active knee flexion at hospital discharge and that exhibited within the subacute phase. It is generally agreed that postoperative improvements will climax at 12 months postsurgery.[12] However, the expected progression toward this endpoint, and whether this flexion endpoint is indeed reached earlier than 12 months, is yet to be determined.[12] Furthermore, we know little about the expected progression of active knee flexion throughout this subacute period.

Tracking the progress of knee flexion after TKA allows for better identification of patients progressing poorly, which may require alternative early intervention. In addition, ensuring that weekly knee flexion goals are met may provide a means of reinforcement and/or reassurance to the patient that they are (or are not) undertaking the work required to increase the chance of a good long-term outcome. This may invariably lead to improved patient confidence and satisfaction in their rehabilitation progression and final outcome. Therefore, the aims of this study were to investigate the association between active knee flexion at the initial outpatient visit (1−2wk) and at 7 weeks postsurgery, to develop a guide for the expected progression of active knee flexion throughout the first 7 postoperative weeks after TKA, and to identify the degree of knee flexion at time of the initial outpatient visit that would invariably be associated with an unacceptable knee flexion at 7 weeks postsurgery.

Methods

We retrospectively evaluated the clinical data of 113 patients who underwent TKA between December 2007 and August 2012. In all patients, surgery had been followed by a standardized, 5-week outpatient rehabilitation program at the Hollywood Functional Rehabilitation Clinic. Patients were excluded from the current analysis if they had been diagnosed with an active infection (n=0), had developed deep vein thrombosis (n=0), or did not have active knee flexion ROM data documented at the initial outpatient visit immediately on hospital discharge and/or twice weekly throughout the 5-week outpatient rehabilitation program (n=5). Therefore, 108 patients (57 men, 51 women) with a mean age of 66.8 years (range, 38−86y) were evaluated. This retrospective analysis had ethical approval from the Hollywood Functional Rehabilitation Clinic. All patients had signed a consent form to allow their clinical data to be deidentified and used for research programs.

List of abbreviations:

OA **osteoarthritis**
ROM **range of motion**
TKA **total knee arthroplasty**

For this retrospective analysis, there was no standardization of orthopedic surgeon, surgical approach, or type of prosthesis used. In total, 6 surgeons referred the 113 patients to the Hollywood Functional Rehabilitation Clinic for routine outpatient postoperative care. However, postoperative inpatient and outpatient rehabilitation was standardized across all patients. Physical therapy was undertaken twice daily for the first 3 postoperative days in hospital and then once daily from day 4 through until hospital discharge. This consisted of teaching of proficient use of crutches and safe ambulation; ambulatory and transfer activities commencing on day 1 and as tolerated; deep breathing and coughing exercises; active dorsi- and plantarflexion of the ankle to encourage lower extremity circulation; and isometric contraction of the quadriceps, hamstrings, and gluteal musculature to maintain muscle tone and minimize muscle loss.

Knee-based exercises were undertaken in supine (active-assisted knee flexion using a bandage, straight-leg raises, and terminal range knee extensions), seated (active-assisted knee flexion using the contralateral limb and inner range quadriceps contractions), and standing (hip and knee flexion, active hamstring curls, lunges on a step, hamstring stretches) postures. These exercises were undertaken 3 times per day and in sets of 10 repetitions. The assigned hospital physiotherapist was present to assist as required on 2 occasions per day for the first 3 postoperative days and then once daily from day 4 until hospital discharge. Cryotherapy was used for 20 minutes at least 3 times daily. Continuous passive motion was used twice daily for 1 hour and was initiated on day 1 postsurgery. The maximum permitted continuous passive motion range was 90° of knee flexion; however, the actual range attained comfortably for patients was not documented and varied depending on what was tolerated by each patient. After hospital discharge, patients were referred to the Hollywood Functional Rehabilitation Clinic for a standardized, outpatient rehabilitation program. This was initiated in all patients at 1 to 2 weeks postsurgery. Sessions were undertaken twice weekly (1−1.5h duration) and consisted of progressive ROM and resistance exercise and hydrotherapy.

Active knee flexion was initially measured on the patient's initial outpatient visit at 1 to 2 weeks (7−14d) postsurgery. It was further measured on a biweekly basis throughout the 5-week rehabilitation program at 2 to 3 weeks (15−21d), 3 to 4 weeks (22−28d), 4 to 5 weeks (29−35d), 5 to 6 weeks (36−42d), and 6 to 7 weeks (43−49d) postsurgery. The highest recorded active knee flexion measure out of the 2 sessions each week was used in this analysis. This was measured using a standard long-arm goniometer, creating an angle made by 3 anatomic landmarks: greater trochanter of the femur at the hip, lateral femoral condyle at the knee, and lateral malleolus at the ankle. The patients initially lay supine with both legs extended. They were then instructed to keep their heel on the bed/plinth at all times and move their foot (ie, flex their knee) proximally toward their bottom as far as possible. This process was undertaken 3 times, and the maximum values were recorded, measured to the nearest degree. There are known limitations with the accuracy of assessing knee flexion using handheld goniometry. It has been reported that the reliability of goniometric measurements improves when the assessment is performed by the same individual using the same measurement tool and in a standardized test position.[26,27] Each patient in this study was assigned to a specific physical therapist. Therefore, although 6 therapists were involved in the assessment of knee