

Matassi F, Duerinckx J, Vandenneucker H, and et al. Range of motion after total knee arthroplasty: the effect of a preoperative home exercise program. Knee Surg Sports Traumatol Arthrosc 2014; 22:703–709.

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Design: Randomized clinical trial

Objective: To evaluate the effects of a 6-week preoperative home exercise on pre- and post-operative range of motion (ROM), and functional recovery after total knee arthroplasty (TKA) and whether this leads to faster postoperative recovery compared with usual care.

Population /sample size/setting:

- A total of 122 participants (59 females, 63 males, mean age 66.5 years) scheduled for primary TKA for the treatment of OA in the Orthopedic Surgery Department of the Pellenberg University Hospital, Belgium were recruited into the study and randomized to a treatment group ($n = 61$) or to a control group ($n = 61$).
- Study design was a prospective randomized, assessor blinded, controlled trial with randomization based on a table of randomized odd and even numbers generated by a computer.
- Inclusion criteria included non-inflammatory osteoarthritis, plan for TKA, moderate to severe pain in the affected knee, 18–90 years of age, patient consent to participate in the study, patient available for 1 year follow-up postoperative, and stable health that allows participation in the preoperative home exercise program.
- Exclusion criteria included BMI > 35, physical activity less than moderate, previous hip or knee replacement surgery, failed total or unicompartmental knee replacement or high tibial osteotomy of the affected knee, active local or systemic infection, physical, emotional or neurological conditions, grade three collateral ligament insufficiency, knee flexion less than 80° , fixed flexion deformity greater than 20° , varus or valgus alignment greater than 10° , immunosuppressive disorder, or auto-immune diseases including inflammatory arthritis, pregnancy, intra-articular steroids within 6 weeks before the baseline assessment, recent fracture, inability to understand the study, and physiotherapy for the affected knee during the preceding 6 months.

Methods/Interventions/Outcome Measures:

- The primary outcome measurement of the study was to evaluate whether the preoperative home exercise program provided the patient with a better passive flexion 1 year after TKA. The secondary outcome was to assess the functional performance and effectiveness of the preoperative exercise program immediately after the exercise period on the osteoarthritic knee, and after TKA during immediate postoperative recovery, and at 6 weeks, and 6 and 12 months postoperatively.
- Length of hospital stay and postoperative duration in days before achieving 90° of knee flexion were also recorded.

- Subjects in both the treatment and control group underwent assessments of knee ROM (passive and active flexion, and extension), and the Knee Society Clinical Rating Score (Knee Score and Patient Function Score) right before the 6-week exercise intervention, just before surgery, and at 6 weeks, 6 months and one year postoperatively. Scores range from 0 to 100 in both knee and patient function scores, with higher scores indicating greater knee and patient function. Knee range of motion (ROM) was measured by using a goniometer. The researcher conducting the outcome assessments was blinded to the group allocation.
- Patients assigned to the treatment group participated in the 6-week preoperative home exercise program for 6 weeks prior to TKA surgery. An individual explanation was given on the exercises and the patient performed them once with the primary researcher during the baseline assessment. Each patient was given instructions on the exercise program for home use with written descriptions and photographic presentation of all the exercises.
- The home exercise program was designed to increase lower extremity muscle strength and flexibility of lower extremity soft tissues. The exercises included quadriceps and hamstring stretching and 4 muscle strengthening exercises for the quadriceps and hamstrings. The subjects were asked to perform the exercises at home 5 days per week for 6 weeks until one day before TKA. The subjects were given a log book with daily check marks to log the exercises performed.
- The patients who had been allocated to the control group continued with their regular activities until surgery.
- After TKA, all patients in both groups participated in the same postoperative rehabilitation protocol.
- Sample size was estimated to be 61 in each group giving 90% power and a p-value of 0.05 to detect a difference of 10^0 in passive flexion between groups. A measurement difference of 10^0 in passive flexion was considered clinically significant.

Results:

- Both groups did not differ significantly in demographic characteristics as well as baseline measurements of all outcome measures.
- No patients were lost for follow-up.
- Patients in the treatment group completed the exercises with a mean of 79.4 % adherence.
- After 6 weeks of home exercises before TKA, there was significant improvement ($p < 0.0001$) of passive and active flexion, extension, and knee score for the exercise treatment group. A non-significant difference was observed for the patient function score.
- There was a significant relation between the percentage of exercise adherence and the change in passive flexion (Spearman rho = 0.34, $p = 0.009$) and the change in Knee Score (Spearman rho = 0.41, $p = 0.0015$).
- Starting at 6 weeks after TKA, passive knee flexion and active knee flexion improved in both groups, but statistically significant differences between groups were not observed postoperatively. There was no evidence for a significant effect of exercise on passive knee flexion or active knee flexion or extension at any of the time points postoperatively.
- There was no evidence of a significant effect of exercise on the knee score or the patient function score postoperatively as measured with the Knee Society Clinical Rating System.

- Hospital stays averaged 9.1 days (± 2.1) for the treatment group and 9.9 days (± 2.3) for the control group. The hospital stay was significantly shorter by almost one day ($p = 0.011$) for the exercise treatment group.
- Patients in the exercise treatment group reached 90° of knee flexion at a mean of 5.8 days (± 2.1) after TKA, and patients in the control group reached this at 6.9 days (± 1.9). This difference between both groups was significant ($p = 0.0016$); After TKA, patients in the exercise treatment group reached 90° of knee flexion one day sooner than patients in the control group.

Authors' conclusions:

- The most important finding of the present study was that the preoperative home exercise program provided better short-term postoperative recovery in terms of reaching 90° of knee flexion sooner after TKA and resulting in a shorter hospital stay after TKA.
- The exercise program also improved knee range of motion before TKA in the presence of osteoarthritis.
- There is no prolonged postoperative effect on knee range of motion or patient function between 6 weeks and 1 year postoperatively.
- Strengths of this study include homogenous treatment and control groups, identical prosthesis and surgical technique in all subjects, and an exercise program that is fairly rigorous, since the patients trained five days per week during a 6-week period.
- One limitation of the present study is that the exercises were performed at home without the guidance of a physiotherapist. This option was chosen primarily because of the high financial costs. Supplementation with intermittent instruction by a physiotherapist may have led to better results.
- Preoperative home exercises provide better recovery after TKA and may be useful in the clinical practice to reduce the time to reach 90° of knee flexion.
- The present study confirms previous reports that an exercise program can have a beneficial effect on mobility and function of patients with degenerative knee problems before TKA and short-term postoperatively.

Comments:

- Tungtrongjit (2012) found results similar to this study. That study found that preoperative quadriceps exercise before TKA resulted in only short-term benefits in the exercise group showing significantly improved quadriceps strength, pain and function scores that were better than the usual care group at 3 months post-TKA. In that study, knee range of motion, flexion, and extension were also not significantly different between the groups at any time points. At the primary endpoint 6 months after TKA, no statistically significant differences were found between groups for any of the outcome measures. The present study also found at the primary endpoint of one year after TKA, no statistically significant differences between groups for any of the outcome measures.
- If preoperative exercise can support patients to reach 90° of knee flexion earlier and shorten their hospital stay, this can be beneficial in terms of hospitalization costs, since this is often an important prerequisite before discharge from the hospital is allowed.

- At 1 year postoperatively (primary endpoint), the results demonstrated no difference in the effect of preoperative exercise. However, when considering improvement from baseline up to 3 months after TKA, this exercise program was associated with greater overall improvement and did result in a statistically significant earlier onset of reaching 90° of knee flexion compared with the control group.
- Even though differences found in outcome measurements between groups was not statistically significant, these differences may prove clinically important when exercise therapy is seen in the light of cost and ease of administration compared to other modalities.
- This earlier overall improvement and earlier onset of postoperative recovery may be valued by some patients and employers. Over half of the participants in this study were aged 66.5 years or less, and hence, potentially still working. It is unknown if earlier onset of recovery was beneficial in terms of faster return to work.
- Other likely benefits of preoperative exercise include the reduced need for inpatient and outpatient postoperative rehabilitation services which may help to reduce costs.
- An important limitation of the study was the exclusion of reporting the raw scores and mean differences for within group and between group differences at each follow-up time point. One can only speculate that the differences within each group were or were not statistically significant improvements over time. This exclusion really limits the interpretability of the results.
- Another important limitation of the study was the lack of information on compliance to the rehab program after TKA for both groups. It is not known if post-TKA if there were any differences in exercise compliance between groups. This could introduce performance bias.
- The authors provided no information on allocation concealment.
- Strengths of this study included assessor blinding, a high rate of patient follow-up at 12 months, and an adequate sample size powered to detect significant differences. This increases our confidence in the internal validity of the study.
- Preoperative exercises constitutes a viable adjunct therapy to knee arthroplasty of interest to individual patients willing to engage in preoperative exercise to achieve earlier onset of postoperative recovery.

Assessment:

- This adequate study provides some evidence that 6-weeks of a home preoperative exercise program prior to knee arthroplasty is more effective in improving range of motion, and knee function before TKA, and in reducing the time to reach functional postoperative recovery (90° of knee flexion) after TKA compared with usual care in patients with knee osteoarthritis, but these effects are not sustained one year after TKA.

References:

Tungrongjit Y, Weingum P, and Saunkool P. The effect of preoperative quadriceps exercise on functional outcome after total knee arthroplasty. J Med Assoc Thai 2012; 95(10):S58-S66.