

Tungtrongjit Y, Weingkum 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.

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Design: Randomized clinical trial

Objective: To evaluate the effects of 3-weeks of preoperative quadriceps exercise on postoperative pain and functional outcomes after total knee arthroplasty (TKA) compared with usual care.

Population /sample size/setting:

- A total of 60 participants (50 females, 10 males, mean age 64.5 years) scheduled for primary TKA for the treatment of OA at Phrae Hospital in Thailand were randomized to a quadriceps strengthening exercise group ($n = 30$) or to a usual care control group ($n = 30$).
- Study design was a randomized, assessor blinded, controlled trial with randomization performed in permuted blocks.
- Inclusion criteria included 50 years of age or older with idiopathic or secondary OA of the knee with grade 2, 3, or 4 radiographic severity defined by the Kellgren and Lawrence classification.
- Exclusion criteria included history of old cerebrovascular accident, history of knee joint infection, postoperative wound infection, dehiscence or knee trauma.

Methods/Interventions/Outcome Measures:

- Patients assigned to the intervention group participated in the preoperative home quadriceps strengthening exercise program for 3 weeks prior to TKA surgery. Patients were initially instructed on the exercise methods which consisted of sitting on a chair and bending the knee and hip joints at 90 degrees and raising the leg up to maximum extension and holding it for at least 6 seconds before returning to the initial 90 degree flexion position. Ten repetitions were performed with 20 second pauses between repetitions. Each set of 10 repetitions were performed 3 times a day. Then once a week before TKA, review instructions were offered by telephone.
- Patients assigned to the usual care group were asked to continue their normal activities until their TKA.
- Sample size was estimated to be 25 in each group giving 90% power and a p-value of 0.05 to detect a 2.5 point difference of knee pain between groups at 6 months.
- After TKA, all patients in both groups participated in the same postoperative rehabilitation protocol.
- Outcome measurements included knee pain, range of motion, quadriceps strength, and a modified (Thai version) of a WOMAC score. Knee pain was assessed using a 10 cm visual analog scale (VAS). Quadriceps strength was measured using a dynamometer.

Knee range of motion (ROM) was measured by using a goniometer. The modified WOMAC score evaluated knee pain, stiffness, and physical functioning.

- The primary outcome measure was the modified WOMAC score at 6 months.
- At 3 weeks prior to TKA, baseline demographic, outcome measurements, and clinical data was collected and assessments conducted. In addition, outcome measurements were assessed at one, 3, and 6 months after TKA.
- Assessors measuring outcomes were blinded to the patients' allocation. Outcome measurements of pain and WOMAC were evaluated by a nurse blinded to treatment assignment. Quadriceps strength and knee ROM were assessed by a physical therapist blinded to treatment assignment.

Results:

- The preoperative demographics and clinical characteristics of the groups displayed no significant differences between the groups.
- At baseline (3 weeks before TKA), outcome measurements did not differ between the groups.
- Radiographic severity of grade-4 according to Kellgren and Lawrence was found in 80% of patients in the exercise group and 67% of patients in the usual care group.
- Mean VAS pain scores and total modified WOMAC scores in both groups improved from baseline and continued to improve at one, 3, and 6 months post-surgery. The exercise group demonstrated greater improvement than the usual care group at 1 and 3 months after TKA showing statistically significant differences of mean VAS scores and mean WOMAC scores between the groups, but significant differences were not present at the 6-month follow-up.
- The average quadriceps strength in both groups decreased from the pre-TKA value at the one month post-TKA as might be expected after TKA. Both groups increased quadriceps strength at 3 and 6 months post-TKA, but the exercise group demonstrated greater improvement than the usual care group. Statistically significant differences between groups were observed only at 1 and 3 months post-TKA and not at the 6-month follow-up in favor of the exercise group.
- Knee range of motion, flexion, and extension were 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.

Authors' conclusions:

- Three weeks of preoperative quadriceps exercise before TKA resulted in short-term benefits in the exercise group showing significantly improved quadriceps strength, pain scores, and modified WOMAC scores that were better than the usual care group at 3 months post-TKA.
- The mean quadriceps strength in the exercise group increased from baseline showing statistically significant differences between groups at 1 and 3 months post-TKA.
- In the exercise group, 63% increased their quadriceps strength before TKA.

- The results show that the exercise group had statistically significant differences of mean VAS scores and mean WOMAC scores between the groups demonstrating significantly greater pain reduction and functional improvement than the usual care group at 1 and 3 months after TKA. The WOMAC results are also clinically significant, but the VAS scores are not.
- These findings indicate the effectiveness of preoperative quadriceps exercise to increase quadriceps strength and improve the WOMAC score before TKA and up to 3 months following TKA.

Comments:

- At 6 months 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 an earlier onset of postoperative recovery in self-reported function and pain compared with the usual care treatment. Although no statistically significant differences were observed at 6 months postoperatively, the statistically significant differences in function, pain, and quadriceps strength at 1 and 3 months postoperatively, support the greater overall improvement seen from baseline to 3 months after surgery for the exercise intervention group.
- The MCID for WOMAC function is 9 to 12 points on a 100 point scale, and the MCID for VAS pain is 17 points. At one and 3 months post-TKA, WOMAC scores in the exercise group were 27 and 18 points lower (better) respectively, than in the usual care group. The WOMAC results in this study are clinically significant, exceeding the MCID. At one and 3 months post-TKA, VAS pain scores in the exercise group were 9 and 10 points lower (better) respectively, than in the usual care group. Even though this difference is less than the MCID, this difference may prove clinically important when exercise therapy is seen in the light of cost and ease of administration compared to usual care. The MCID of the dynamometer used to measure quadriceps strength is not known, but a difference of 2.2 kg between groups at 3 months favoring the exercise group is most likely clinically and functionally relevant.
- 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 65 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 p-values for within 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 home quadriceps exercise program for the exercise group and the rehab program after TKA for both groups. It is unknown if patients in the exercise group logged or recorded their number of pre-TKA exercise sessions. It is not known if post-TKA if there were any differences in exercise compliance between groups. Both could introduce performance

bias. Perhaps the exercise group having practiced 3 weeks of exercise pre-op had better compliance after TKA, and the better adherence to rehab exercises actually helped to improve their pain and functional outcomes more so than the pre-op exercises.

- The authors provided no information on allocation concealment.
- No measures of patient's quality of life or global perceived effect were included in the study that may have helped in the interpretation of the study's results.
- Strengths of this study included assessor blinding, a high rate of patient follow-up at 6 months, and an adequate sample size powered to detect significant differences. However, little information was provided on patient dropouts, and it is not clear which follow-up assessments the 4 patients lost to follow-up were included in. This affects our confidence in the internal validity of the study.
- The study did not measure the success of assessor blinding, but this may not be important, since some primary outcomes were self-reported and thus not subjected to possible assessor bias.
- Preoperative quadriceps strengthening 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 3-weeks of a home preoperative quadriceps exercise program prior to knee arthroplasty is more effective in reducing pain, and improving function and quadriceps strength in the short-term up to 3 months postoperatively compared with usual care in patients with knee osteoarthritis, but these effects are not sustained at 6 months after TKA.