

Villadsen A, Overgaard S, Holsgaard-Larsen A, and et al. Postoperative effects of neuromuscular exercise prior to hip or knee arthroplasty: a randomized controlled trial. *Ann Rheum Dis* 2014; 73:1130–1137.

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Design: Randomized clinical trial

Objective: To evaluate the efficacy of a supervised, 8-week preoperative program of neuromuscular exercise on the 3 month postoperative effects compared with surgery alone prior to hip or knee arthroplasty (TJA).

Population /sample size/setting:

- A total of 165 participants (92 females, 73 males, mean age 67 years) recruited from a single hospital in Denmark scheduled for THA (84) or TKA (81) due to severe symptomatic OA were randomized to a neuromuscular exercise group (EX+TJA, $n = 84$) or to a control group (TJA, $n = 81$).
- Study design was a two parallel group, randomized, assessor blinded, controlled trial (stratified according to the affected joint).
- Inclusion criteria included those who understood Danish, were at least 18 years of age and scheduled for primary unilateral THA or TKA due to severe symptomatic OA.
- Exclusion criteria included current or previous fractures in or adjacent to the joint, inflammatory arthritis and comorbidity, severe heart disease, neurological deficits, conditions contraindicating exercise and testing, and logistics making attendance at exercise sessions unrealistic.

Interventions/Methods:

- Allocation was concealed after baseline assessment using sequentially numbered, opaque and sealed envelopes. The allocation sequence was stratified by gender, municipality ($n=6$), hip or knee and blocked in groups of four to allow for similar recruitment rates into both groups.
- Patients in the intervention group received the standard preoperative educational package in addition to attending a neuromuscular program for 8 weeks prior to surgery (EX+TJA).
- The control group received only the standard preoperative educational package (TJA).
- The neuromuscular exercise program was delivered in a group setting for 1 hour twice a week for 8 weeks. It consisted of a 10-minute aerobic warm-up on a stationary exercise bike followed by a circuit program with 4 main focus areas: core stability/postural control, postural orientation, lower extremity muscle strength and functional exercises. The supervising physiotherapist focused on the quality of the movement (sensorimotor control), including knee over foot alignment, which was evaluated as good quality movement. Progression in training level was made when appropriate. A record was kept on the number of sessions attended and 12 exercise sessions was considered good compliance.

- The standard preoperative educational package given to both groups consisted of written information on the operating procedure, expected postoperative progression and a leaflet on various exercises was handed out at the clinic when the patient was scheduled for THA or TKA.
- Postoperative rehabilitation was offered to all patients in both groups and may have varied among patients.
- Assessment measurements were taken at baseline (before the exercise intervention), 6-weeks and 3-months postoperatively (primary endpoint). Four assessors conducted the physical testing and were blinded to group allocation, and the patients were instructed not to mention the allocation.
- To allow for separate analysis of patients with knee and hip OA, 74 knee patients and 74 hip patients were required to detect a change of 10 points on the HOOS/KOOS ADL subscale (SD 15, power =0.80 and $\alpha=0.05$).
- The project statistician was masked to group allocation and affected joint.
- The intention-to-treat principles were followed in all data analyses.

Main outcome measures/Results:

- The primary outcome measurements were:
 - a physical muscle function measurement of maximal power of hip and knee muscles using the activities of daily living (ADL) subscale of the Hip disability and Osteoarthritis Outcome Score (HOOS) or the Knee injury and Osteoarthritis Outcome Score (KOOS) for patients with hip and knee OA. The HOOS and KOOS are scored on a 0–100 worst to best scale. MCID = 10 points
- Secondary outcomes were;
 - HOOS/KOOS Pain,
 - Symptoms,
 - Sport and Recreation and joint-related Quality of Life subscales,
 - EuroQol 5 Dimension Health Questionnaire (EQ5D)
- The preoperative demographics and clinical characteristics of the groups displayed no differences between the groups.
- At baseline, outcome measurements did not differ between the groups.
- Of the 84 patients in the intervention group, 62 (74%) attended the pre-specified goal of 12 or more exercise sessions.
- Both groups improved immediately after surgery at 6-weeks postoperatively. The exercise group demonstrated statistically significant greater improvement in physical function ($p=0.0488$) (5.2, 95% CI 0.03 to 10.3) and Pain ($p=0.0472$) (5.4, 95% CI 0.1 to 10.8) than did the control group. When stratifying the groups according to affected joint, only the knee OA group demonstrated statistically significant greater improvement in physical function and pain compared to the control group. The hip OA group did not demonstrate these effects.
- At the primary endpoint 3 months after surgery, no statistically significant difference was found between groups for both physical function (4.4, 95% CI -0.8 to 9.5) and pain (4.5, 95% CI -0.8 to 9.9). Stratifying by affected joint also showed no statistical difference.

Authors' conclusions:

- At 3 months postoperatively (primary endpoint), no additional benefits were seen from the preoperative exercise. Seen over the entire time period from baseline to 3 months after surgery, this previously validated and feasible exercise program resulted in an earlier onset of postoperative recovery in self-reported function and pain compared with the standard TJA procedure. Although no statistically significant differences were observed at 3 months postoperatively, the statistically significant differences in function and pain at 6 weeks postoperatively support the greater overall improvement seen from baseline to 3 months after surgery for the exercise intervention group.
- Our results demonstrated no difference in the effect of preoperative exercise at 3 months after surgery. However, when considering improvement from baseline to 3 months postoperatively, neuromuscular exercise therapy was associated with greater overall improvement and earlier onset of postoperative recovery.
- The MCID for HOOS/KOOS function and pain is 10 points. This study observed differences between groups of 5–8 points for function and pain at 6 weeks postoperatively. These differences may prove clinically important when exercise therapy is seen in the light of cost and ease of administration compared to TJA.
- This study found statistically significant differences between groups in hip abduction and hip extension power based on secondary outcome measures favoring the exercise group. These joint movements are of functional importance for normal walking.
- Preoperative neuromuscular exercise constitutes a viable adjunct therapy to hip or knee arthroplasty of interest to individual patients willing to engage in preoperative exercise to achieve earlier onset of postoperative recovery.

Comments:

- This earlier overall improvement and earlier onset of postoperative recovery may be valued by some patients and employers. One-third of the participants in this study were aged less than 65 years, 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.
- No measures of patient's global perceived effect were included that may have helped in the interpretation of the study's results.
- This neuromuscular exercise intervention is specifically targeting dynamic alignment and functional stability and not muscle power per se. This may partly explain the results of this study. If muscle power was not improved from this exercise regimen, the benefits for functional improvement may be limited.
- Strengths of this study include a rigorous study design, conducted and reported according to the CONSORT statement, with adequate sample size to allow for separate analysis for hip and knee OA patients, and a clinically feasible and therapeutically valid intervention.
- No measures were taken to comply with the possible risk of attention bias. However, it is possible that the potential risk of attention bias introduced during the preoperative exercise intervention was minimal following surgery.

- Despite succeeding in including a higher proportion of eligible patients than in comparable studies, this study still included only 30% of those eligible, which diminishes the external validity of the study.
- The study did not measure the success of assessor blinding, but this may not be important, since primary and secondary outcomes were self-reported and thus not subjected to possible assessor bias.
- The study was adequately powered to detect significant differences.

Assessment:

- This adequate study provides some evidence that a supervised, 8-week preoperative program of neuromuscular exercise prior to hip or knee arthroplasty (TJA) is not more effective in reducing pain or improving function 3 months postoperatively compared with surgery alone in patients with severe hip or knee osteoarthritis, but is more effective in improving function and reducing pain 6 weeks after surgery.