CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

For an 86-year-old male patient with knee osteoarthritis undergoing elective total knee arthroplasty, does participation in both pre- and post-operative physical therapy, compared with just post-operative physical therapy, significantly reduce the risk of post-operative complications for 90 days following surgery?

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CLINICAL SCENARIO

Following joint replacement surgery, physical therapists provide rehabilitation care that is essential to the long-term success of the procedure. During my outpatient orthopedic rotation, I worked with an 86-year-old male patient following elective total knee arthroplasty (TKA) due to painful knee osteoarthritis. In the subacute post-operative period, the patient suffered an LCL sprain on the opposite lower extremity while participating in a walking group at his local YMCA. Although the patient had been making good progress towards achieving his PT goals, the injury to his non-surgical limb delayed his recovery as we needed to modify our PT interventions and work at a slower pace.

Preoperative physical therapy or, "prehabilitation", has shown to reduce postoperative pulmonary complications and shorten the length of hospital stay in patients undergoing elective cardiac surgery.[1] Might prehabilitation have reduced this patient's risk of post-surgical complication? Finding evidence-based methods that improve patient outcomes is the foundation to successful delivery of patient-centered, quality health care. Thus, the intention of this appraisal is to review the available research regarding delivery of physical therapy services prior to TKA and determine its clinical applicability in terms of improving this patient's outcomes.

SUMMARY OF SEARCH

- There are currently no published studies that assess the effect of preoperative physical therapy on reducing the risk of post-TKA complications. Searches of 4 electronic databases identified 8 articles that met inclusion/exclusion criteria that assessed the effect of pre-operative physical therapy on post-operative physical function. The two systematic reviews of randomized controlled trials were identified as the "best" available evidence and selected for critical appraisal based on high methodological quality, level 1a evidence, and relevance to the clinical question.
- For patients undergoing TKA, participation in preoperative therapeutic exercise may reduce length of hospital stay and improve short-term pain and functional outcomes; however, any measured effect is too small to be clinically meaningful.
- Future research on this topic should include more randomized controlled trials of higher methodology to improve validity of results and larger, less variable samples to improve reliability. These trials might also consider investigating outcomes related to risk reduction. Other future topics for research include best practice for providing PT services to "oldest-old" older adults undergoing TKA.

CLINICAL BOTTOM LINE

Despite lack of evidence assessing effect of pre-operative physical therapy on risk of post-operative complication, based on best available current research, there is low level of evidence to suggest that prehabilitation does not result in better clinical outcomes following TKA than does standard post-operative PT alone. Therefore, other options for intervention that are effective in terms of both patient outcome and cost need to be explored.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
Knee OA OA Osteoarthritis Knee osteoarthritis total knee arthroplasty TKA total knee replacement TKR	Strength* Balance training Physical therapy Physiotherapy Rehabilitation Exercis* "therapeutic intervention" Preoperative Prehabilitation	*Not applicable*	Injur* Re-injur* complication* Risk* Readmission*

Final search strategy: PubMed

1. "total knee arthroplasty" OR "total knee replacement"
2. osteoarthritis OR OA
3. preoperative OR prehabilitation
4. physiotherapy OR "physical therapy" OR exercis* OR strength* OR "balance training" OR rehabilitation
5. risk OR risks OR complication* OR readmission* OR injur*
6. #1 AND #2 AND #3 AND #4 AND #5
7. ("total knee arthroplasty" [MeSH Major Topic]) OR ("total knee replacement" [MeSH Major Topic])
8. "knee osteoarthritis"[MeSH terms]
9. **#3 AND #4 AND #5 AND #7 AND #8**

Databases and Sites Searched	**Number of results**	**Limits applied, revised number of results (if applicable)**
PubMed	**60**	***Not applicable***
Web of Science	**33**	***Not applicable***
CINAHL	**33**	***Not applicable***
Embase	**14**	***Not applicable***

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
Population of adults with total knee arthroplasty Must include physical therapy or therapeutic intervention in conjunction with this same episode of care
Exclusion Criteria
Opinions Letters to the editor Editorials Abstracts

Dissertations Narrative Reviews Not published in English

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

Author (Year)	Risk of bias (quality score)	Level of Evidence*	Relevance	Study design
Beaupre et al (2004)[2]	PEDro 7/10	Level 1b	high	Randomized controlled trial
Fernandes et al (2017)[3]	PEDro 6/10	Level 1b	high	Randomized controlled trial
Ismail et al (2016)[4]	PEDro 4/10	2b –low quality RCT due to: -Lack of blinding of patients and assessors. -Measures of key outcomes were obtained from less than 85% of initial participants. -Did not complete an intention to treat statistical analysis.	moderate	Randomized controlled trial
Peter et al (2016)[5]	Downs & Black 15/29	Level 2b	low	Retrospective Cohort study
Rooks et al (2006)[6]	PEDro 5/10	Level 2b –low quality RCT due to: -Lack of blinding of patients and assessors -Measures of key outcomes were obtained from less than 85% of initial participants.	high	Randomized controlled trial
Silkman et al (2012)[7]	AMSTAR 9/11	Level 1a	high	Systematic review of randomized controlled trials
Villadsen et al (2014)[8]	PEDro 7/10	Level 1b	high	Randomized controlled trial
Wang et al (2016)[9]	AMSTAR 11/11	Level 1a	high	Systematic review of randomized controlled trials

*Based on Portney & Watkins Table 16.1 (2009)

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- Wang L, Lee M, Zhang Z, Moodie J, Cheng D, Martin J. Does preoperative rehabilitation for patients planning to undergo joint replacement surgery improve outcomes? A systematic review and meta-analysis of randomised controlled trials. *BMJ Open*. 2016;6(2). doi:10.1136/bmjopen-2015-009857.

- This systematic review is of excellent methodological quality based on its 11/11 Amstar score. This systematic review is comprised of 22 randomized controlled trials (RCTs) that were each critically appraised for risk of bias; 20 of the RCTs were included in a meta-analysis, which allows us to quantitatively evaluate the clinical applicability of the results. The results are of high relevance to the clinical question.

- Silkman Baker C, McKeon JM. Does preoperative rehabilitation improve patient-based outcomes in persons who have undergone total knee arthroplasty? a systematic review. *PM R*. 2012;4(10):756-767. doi:10.1016/j.pmrj.2012.06.005.
    - This systematic review is of good methodological quality based on its 9/11 Amstar score. This systematic review is comprised of 7 RCTs that were each critically appraised using the PEDro Risk of Bias Scale. The clinical questions asked in this publication are of high relevance to the clinical question.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of *Does Preoperative Rehabilitation for Patients Planning to Undergo Joint Replacement Surgery Improve Outcomes? A Systematic Review and Meta-analysis of Randomised Controlled Trials* by Wang et al (2016)[9]

Aim/Objective of the Systematic Review:

The objective of this study was to complete a rigorous systematic review and meta-analysis to assess the impact of prehabilitation on post-surgical clinical outcomes in patients planning to undergo total joint replacement surgery.

Study Design

The study is a systematic review and meta-analysis of randomized controlled trials.

Search Strategy

The authors systematically searched PubMed, Embase, and Cochrane Central Register of Controlled Trials (CENTRAL) up to November 10, 2015 using a combination of MeSH and keyword terms that included: exercise, prehabilitation, physiotherapy, physical therapy, activity, weight training, weight lifting, aquatic, swimming, strength training, endurance training, cycling, biking, kinesiotherapy, hydrotherapy, fitness, orthopedic surgery, joint replacement and 'random*'.

No search limitations were placed on date, publication status, or language.

Selection Criteria

Inclusion:

- RCTs of subjects scheduled for total hip or knee joint replacement.
- Trials had to compare prehabilitation intervention with no treatment or an alternative treatment. The authors defined "prehabilitation" as physical therapy or supervised therapeutic exercise and prescribed home exercise with or without additional interventions such as patient education, electrical stimulation, nutritional counselling, or massage.
- Trials had to assess postoperative pain and functional outcomes.

Articles were reviewed by 2 independent reviewers based on article title and abstract. A 3rd reviewer was used in case of disputes, as well as to screen reference lists in identified articles for additional trials.

Methods

Data extraction:

Data extraction was completed by 3 independent reviewers and verified by a 4th reviewer.

Assessment of methodological quality:

The methodological quality of identified studies was assessed by 2 independent readers using the Cochrane Collaboration's tool for assessing risk of bias, with any disagreement to be resolved by a 3rd reviewer. Level of evidence was assessed using the GRADE methodology. Publication bias was assessed graphically with funnel plots and statistically with Egger's test.

Statistical Analysis

Meta-analysis was completed for each outcome of interest using the random effects model. The *P* value for significance (alpha) was set at 0.05 based on a 95% confidence interval (CI). Relative risks (RR) with 95% CI were calculated for discrete outcomes. Weighted mean differences (WMD) with 95% CI were calculated for continuous outcomes. Forest plots were used to visually display outcomes of significance. Based on the assumption of normal data distribution, continuous data from outcomes of interest was also converted to a RR for achieving "patient acceptable symptom state" based on a pre-established threshold.[10] Heterogeneity was calculated using the X^2 test and I^2 statistic. Sensitivity analysis was completed through calculation of standard mean differences (SMD) and ratio of means (RoM).

Setting

19 of the 22 studies were conducted in North America or Europe. The other 3 studies were conducted in developing countries (Thailand, Serbia, and Turkey). Though not specifically stated, based on the patient population, nature of injury, and intervention provided, it can be inferred that trials took place on an outpatient basis in physical therapy clinics.

Participants

Out of the 399 articles generated from the search, 22 RCTs met the inclusion criteria. These studies were published between 1993 and 2014. Twenty RCTs provided quantitative data that could be used in the meta-analysis. In 8 studies, subjects involved patients preparing for total hip replacement; 12 of the studies involved patients preparing for total knee replacement and the remaining 2 studies involved patients preparing for either total hip or knee replacement.

Sample sizes of included studies ranged from 21-165 patients, with a mean sample size of 67.8 subjects and median sample size of 54 subjects. There was a total of 1492 subjects from these 22 RCTs combined. Mean age of subjects was between 51 and 76 years and the ratio of females to males was 3:2.

Intervention Investigated

Control

All included RCTs utilized a control group that did not receive prehabilitation intervention. In 19 studies, the control group received no treatment; in the remaining 3 studies, the control group received patient education, placebo therapeutic exercise focusing on upper body activities, or unsupervised home exercise, respectively.

Experimental

All included RCTs utilized an experimental group that received prehabilitation. Frequency of intervention ranged from once a week to twice daily for a total duration ranging from 4 to 8 weeks. Specific treatment activities and method of delivery was also variable. In 6 studies, the experimental group received supervised therapeutic exercise in the clinic. In 2 studies, the experimental group was prescribed home exercise. In 10 studies, the experimental group engaged in both supervised therapeutic exercise in the clinic and a prescribed home exercise program. In 4 studies, the experimental group received supervised therapeutic exercise in the clinic with education co-intervention.

Outcome Measures

The primary outcomes of interest were postoperative pain and function. Secondary outcomes of interest included postoperative length of hospital stay, postoperative complications or adverse events, total cost of episode, time to resume to prior level of function, patient satisfaction, and quality of life. Outcomes included in the meta-analysis were postoperative pain, function, length of hospital stay, and total cost of episode of care.

Postoperative pain was assessed in 15 studies (n = 1046) using the Visual Analogue Scale (VAS), 10-Grade Pain Scale, Western Ontario and McMaster Universities osteoarthritis index (WOMAC) pain scale, Knee Injury and Osteoarthritis Outcome Score (KOOS), and Hip Disability and Osteoarthritis Outcome Score (HOOS). If individual studies included more than 1 measure of postoperative pain, the WOMAC pain score was preferentially utilized.

The WOMAC is a multi-dimensional disease-specific self-report questionnaire composed of 3 subscales assessing OA-related pain, stiffness, and function. The total WOMAC Score is based on a scale of 0-100, with a higher score indicating a worse outcome. The WOMAC pain score is comprised of 5 items that contribute a total of 20 points to the aggregate score.[11] If the WOMAC pain score was not reported, then the pain score that was reported was converted to a WOMAC pain score. For the purposes of this study, the authors converted the WOMAC pain scores to a 0-100 score, with a higher score indicating a worse outcome; subjects scoring ≤30/100 were considered to have achieved a "patient acceptable symptom state".[10]

Postoperative function was assessed in 16 studies (n = 1118) with the WOMAC function score, Harris Hip Score, SF-36 Physical Component Summary, SF-36 Physical Functioning Score, Hospital for Special Surgery Knee Score, HOOS function in daily living, and KOOS/HOOS ADL scale. Again, WOMAC function scores were preferentially utilized, or else converted to a WOMAC function score based on a scale of 0-100 with a higher score indicating a worse outcome. The threshold of ≤30/100 was used to represent patient achievement of acceptable symptom state.

Length of hospital stay was assessed in 7 studies (n = 507) and measured in days based on date and time of admission prior to surgery to date and time of discharge following surgery.

Total cost of episode of care was assessed in 2 studies (n = 242) and was measured in Canadian dollars.

Main Findings

Effects of prehabilitation on post-surgical outcomes:

	4-weeks post-surgery	*6-8 weeks post-surgery*	*12 weeks post-surgery*	*24 weeks post-surgery*
Pain (WOMAC pain score)	4 studies (n=213): WMD = (− 6.1), 95% CI: (− 10.6, − 1.6)*, (I^2 = 55.3%, p = 0.082);	5 studies (n=488): WMD = (− 1.4), 95% CI: (− 5.5, 2.6), (I^2 = 16%, p = 0.31)	10 studies (n =806): WMD = (− 2.9), 95% CI: (− 6.2, 0.3), (I^2 = 46%, p = 0.05)	3 studies (n=247): WMD = (− 2.5), 95% CI: (− 5.6, 0.6), (I^2 = 33%, p = 0.22)
Function (WOMAC function score)	5 studies (n=257): WMD = (− 3.6), 95% CI: (− 7.7, 0.5), (I^2 = 79%, p < 0.001)	5 studies (n=488): WMD = (− 3.9), 95% CI: (− 7.6, − 0.3)*, (I^2 = 31%, p = 0.21)	12 studies (n = 836): WMD = (− 4.03), 95% CI: (− 7.5, − 0.5)*, (I^2 = 68.4%, p < 0.001)	5 studies (n=345): WMD = (− 0.5), 95% CI: (− 5.8, 4.7), (I^2 = 89%, p < 0.001)
Length of hospital stay (days)	7 studies (n=507): WMD = (− 0.34), 95% CI: (−0.75, 0.06), (I^2 = 0.0%, p = 0.679)		**Total cost (Canadian dollars)**	2 studies (n=242): WMD = ($0.5), 95% CI: (−$384, $393), ($I^2$ = 0.0%, p = 0.99)

*p < 0.05

Subjects that received prehabilitation had significantly reduced pain at 4 weeks postoperatively. Following this time, between-group differences in WOMAC pain scores were no longer statistically significant.

While there was no significant difference between groups in WOMAC function score at 4 weeks postoperatively, measurements at 6-8 weeks and 12 weeks showed that subjects that received prehabilitation had significantly improved function compared to controls. Following 12-weeks post-surgery there was no statistical difference in function between groups.

No statistically significant differences were found in length of hospital stay or total cost of care between subjects that received prehabilitation and those that did not receive prehabilitation.

Original Authors' Conclusions

"Existing evidence suggests that prehabilitation may slightly improve early postoperative pain and function among patients undergoing joint replacement; however, effects remain too small and short-term to be considered clinically-important, and did not affect key outcomes of interest" (pg 1).[9]

Critical Appraisal

Validity

Internal validity

Strengths:

This systematic review is of excellent methodological quality based on its 11/11 Amstar score. A systematic search of the literature was completed, with no search limitations placed on publication status, language, or date. This comprehensive search strategy yielded an additional 7 RCTs that had not been identified in previously conducted systematic reviews. Two independent reviewers selected the studies, with a 3rd independent reviewer for selection consensus. Data extraction was completed by 3 independent reviewers and verified by a 4th reviewer. Based on funnel plots, there is low risk of publication bias.

Sensitivity analysis was completed using SMD, RoM, and thresholds of ≤20/100 and ≤40/100 for patient acceptable symptom state; results were not statistically different from those found in the meta-analysis. No significant differences were found when comparing treatment effects between patients that received TKA and those that received THA.

Weaknesses:

Based on assessment of risk of bias using the PEDro scoring system, 18 of the 22 included studies were considered to have high risk of bias. Most concerning in regards to bias risk is that outcome assessors were blinded in only 12 of the 22 studies. Additionally, 17 studies had incomplete data with only 10 of the 17 studies completing an intention to treat analysis as a result of this missing data. Ten of the 22 studies had loss to follow up > 15%. Sample sizes of included RCTs were small, which reduces the overall power of the results. I^2 statistical analyses of outcomes of interest revealed excessive variability in study results. Indeed, there was a lack of standardization in prehabilitation methods in terms of specific activity, frequency,

and intensity. Due to the very low methodological quality of included RCTs, their small sample sizes, and excessive heterogeneity, the overall quality of the evidence is low.

External validity

Strengths:

Eligibility criteria was specifically stated in the methods section of the article. Only randomized controlled trials were included in the review.

Interpretation of Results

Based on the results of this meta-analysis, prehabilitation did not have significant clinical impact on the post-surgical clinical outcomes of pain, function, length of hospital stay, and total cost of care in patients that received joint replacement surgery. Though the use of prehabilitation had a statistically significant improvement on pain levels at 4-weeks post-surgery, the treatment effect difference of 6.1 points on the WOMAC pain 0-100 subscale is not clinically significant, as the minimal clinically important difference (MCID) for meaningful change in this population after 6 weeks is 9.7 points for the WOMAC pain 0-100 subscale.[12]

When converted to a RR with 95% CI, subjects that received prehabilitation were found to be more likely to achieve an "acceptable symptom state" (WOMAC pain score of ≤ 30/100) at 4-weeks post-surgery than subjects that did not receive prehabilitation. However, based on a RR of 1.09, this likelihood is nominal and not clinically meaningful. Additionally, when considered in terms of the absolute risk difference, there was only an increase of 3.9% for prehabilitation patients achieving this "acceptable symptom state" threshold.

WOMAC function scores on the 0-100 subscale at 6-8 weeks and 12-weeks post-operatively were also statistically significant, though not clinically significant. At 6-8 weeks, the estimated absolute WMD of 3.9 points is almost 50% less than the MCID of 7.9 points after 6 weeks.[12] At 12 weeks, the treatment effect difference of 4.03 points at 6-8 weeks is also not clinically significant, based on the MCID of 19.01 points at 24 weeks for TKR patients.[11] Additionally, the RR with prehabilitation for achieving a "patient acceptable symptom state" (WOMAC function score of ≤30/100) at 6-8 weeks post-surgery was 1.10 with an absolute risk difference of 1.3%, while the RR at 12 weeks was 1.02 with an absolute risk difference of 5.4%. Again, these effects are nominal and cannot be considered clinically important.

Thus, despite the statistical significance of these effects, prehabilitation did not improve postoperative pain and function to a degree that would be considered clinically relevant. Nonetheless, it is important to keep in mind that the results from this meta-analysis are based on RCTs of very poor methodological quality, and thus must be considered in light of these inherent limitations.

Applicability of Study Results

Although this systematic review was rigorous in its methods, there is limited available evidence. As such, the results from the meta-analysis lack certainty in their clinical application. Additionally, though the interventions and outcomes of interest that were analyzed are applicable to the clinical scenario of my patient of interest, my patient's 86-year-old age is well above the mean age of the population studied, which ranged from 51-76 years.

This difference in age further limits the applicability of results. Studies of aging populations have shown marked changes in health status between the ages of 70 and 85. While profiles at 70 years are characterized by high independence in functional status, preserved cognition, and low comorbidity, by age 85 there is often a loss of functional status, high rate of comorbidity, and dramatic increase in cognitive impairment.[13]

While the evidence from this study did not show that prehabilitation resulted in worse outcomes post-surgery, based on the high risk of bias and lack of clinical significance in the measured treatment effects, as well as the difference in subject characteristics, prehabilitation is not an effective use of both the patient and therapist's time, energy, and financial resources for improving post-operative outcomes and reducing risk of post-operative complications following TKA.

(2) Description and appraisal of *Does Preoperative Rehabilitation Improve Patient-based Outcomes in Persons Who Have Undergone Total Knee Arthroplasty? A Systematic Review* by Silkman et al. (2012)[7]

Aim/Objective of the Study/Systematic Review:

The objective of this systematic review was to assess the extent to which preoperative rehabilitation prior to TKA affects patient-based outcomes post-surgery.

Study Design

The study is a systematic review of RCTs.

Search Strategy

The authors completed a systematic search of the PubMed, Ageline, CINHAL, and SPORTDiscuss databases for articles published from 1950 through February 2011. Searches were based on combinations of the terms knee, rehabilitation, arthroplasty, preoperative, and pre-surgical. Results were limited to human trials published in English in peer-review journals. Reference lists of search results were also reviewed to identify other potentially relevant articles.

Selection Criteria

Inclusion:

- Only randomized controlled trials were included.
- Subjects scheduled for total knee arthroplasty due to knee osteoarthritis.
- Trials were required to have an experimental group of subjects receiving therapeutic exercise intervention for the lower extremity preoperatively.
- Trials were required to have a control group receiving either no treatment or an alternative treatment,
- Outcomes of interest had to be re-assessed at 2 to 3 months post-surgery.
- Results had to calculate means and standard deviations (SDs) from outcomes of interest.

The number of independent reviewers and description of consensus procedure was not provided.

Methods

Data extraction:

The number of data extractors and description of the verification process was not described.

Assessment of methodological quality:

The PEDro scale was used to assess the methodological quality and risk of bias in the included studies. Each included study was assessed by 2 independent readers. If the 2 scores were not in agreement, then a consensus score was reached. The Oxford Centre for Evidence-based Medicine Levels of Evidence Taxonomy, was used to assess the level of evidence of the included studies. Funnel plots, the Orwin Fail-Safe N test, and the "trim and fill method" were utilized to assess publication bias.

Statistical Analysis

Hedges' *g* effect sizes, 95% CIs, and pooled estimates were used to assess the effect of treatment on each outcome of interest at 2-3 months post-surgery. Based on a 95% CI, the *P* value for significance (alpha) was set at 0.05. Strength of effect size from pooled estimates was considered in terms of effect size index with values were greater than 0.7 having strong effect, values between 0.41 and 0.7 having moderate effect, and values less than 0.4 having weak effect. To assess the stability of pooled effects of included studies, sensitivity analysis was completed using the 1-study removed method.

Setting

Though not specifically stated, based on the patient population, nature of injury, and intervention provided, it can be inferred that trials took place in outpatient physical therapy clinics.

Participants

Of the 240 articles identified in the search, 7 RCTs met the inclusion criteria. These studies were published between 2003 and 2009. Sample sizes of included studies ranged from 38-143 subjects, with a mean sample size of 89.1 subjects and median sample size of 109 subjects.

There was a total of 624 subjects from the 7 RCTs, from which 299 subjects had engaged in the experimental intervention and 325 subjects had acted as controls. Mean age of subjects in the review was approximately 68.6 years; approximately 62% of subjects in the review were female.

Intervention Investigated

Control

Dependent on the study, control subjects received no treatment or patient instruction, a brochure, or pamphlet on the TKA procedure and post-surgery expectations.

Experimental

All included RCTs utilized an experimental group that received prehabilitation. In 4 studies, the experimental group received supervised therapeutic exercise. In 2 studies, the experimental group was prescribed home exercise. In 1 study, experimental subjects engaged in supervised group therapeutic exercise sessions and were prescribed a home exercise program. Specific treatment activities all focused on lower extremity and functional strengthening, functional mobility, and stretching.

In 6 of the 7 studies, frequency of intervention ranged from once a week to 3 times a week for a total duration ranging from 4 to 8 weeks. In one study, the frequency and duration of intervention was left up to the individual subject.

Outcome Measures

Outcomes of interest were pain, function, knee flexion ROM, knee extension strength, and length of hospital stay.

Pain and function were assessed in 4 studies (n=389) using the Western Ontario and McMaster Osteoarthritis Index (WOMAC). The WOMAC is a disease-specific self-report questionnaire composed of 3 subscales that assess OA-related pain, stiffness, and function. Each subscale score is based on a scale of 0-100, with a higher score indicating a worse outcome.

Goniometry was used to assess knee flexion range of motion in 2 studies (n= 152).

Knee strength was assessed in 2 studies (n= 163) based on quadriceps force production with knee extension.

Four studies (n= 422) measured length of hospital stay in terms of number of days from admission to discharge for the TKA procedure.

Main Findings

Pain and Function

The WOMAC pain, stiffness, and function subscales were analyzed separately to assess magnitude of treatment effect. The authors reported no between-group significant differences in these outcomes at 2-3 months post-surgery. These results were presented in the form of forest plot diagrams. Mean scores, mean differences, confidence interval ranges, treatment effects, and other related numerical values were not included. 95% CIs can be grossly approximated based on the horizontal axis of the graph; however, individual study treatment effects as well as pooled treatment effects for the pain, stiffness, and function score all display 95% CIs that include zero, indicating no differences between the groups in terms of these outcomes.

Knee ROM and Knee Extension Strength

For the outcomes of knee ROM and knee extension strength, the authors reported no between-group significant differences. Again, statistical values were not included as reference, but the individual study and pooled treatment effect sizes are featured on forest plots, which all display 95% CIs that include zero.

Length of Hospital Stay

Subjects that received prehabilitation had a significantly shorter length of hospital stay in comparison with controls. Though the article fails to include these results as numerical values, the forest plot displays a pooled treatment effect in favor of the experimental group with a 95% CI that does not include 0.

Original Authors' Conclusions

"For all outcomes, none was consistently favorable toward preoperative rehabilitation over the alternative for patients undergoing TKA with the exception of LOS in favor of the treatment group" (pg 756).[7]

Critical Appraisal

Validity

Internal validity

Strengths:

This systematic review is of high methodological quality based on its 9/11 Amstar score. All included studies were assessed for risk of bias using the PEDro scoring system by 2 independent readers. Based on an average PEDro score of 5.6/10, the overall methodological quality of the included RCTs was mid-level. Of the 7 included RCTs, 6 were classified as Level 1b evidence, with just 1 study considered to be of a lower level of evidence (level 2b) due to a PEDro score of 4/10. At baseline, there were no statistically significant differences between subjects in the included studies. Interventions provided to experimental groups were similar in that they used therapeutic exercise to address lower extremity impairment and function.

Studies included in the meta-analyses for WOMAC score, knee flexion ROM, and length of hospital stay were all of moderate methodological quality with mean PEDro scores of 6.5/10, 6.5/10, and 6.7/10, respectively. The Z-distribution of the sensitivity analysis indicated that cumulative effects were not overly influenced by a single study ($P < 0.01$), which supports the robustness of results. Based on the symmetry of funnel plot distribution, there is low risk of publication bias affecting results of the review.

Weaknesses:

Results of the search strategy were limited to published articles. The investigators failed to provide details regarding duplication of study selection and data extraction. Based on PEDro scores of included RCTs, the greatest potential risks of bias were related to lack of blinding and poor retention of study participants.

Intervention provided to experimental subjects varied in frequency, intensity, and duration across included studies. Intervention methods provided to controls varied from no intervention to written and/or verbal instruction. There was also lack of standardization in the assessment measures used to measure outcomes of interest. There was low methodological quality of the RCTs included in the meta-analysis for knee extension strength based on a mean PEDro score of 4.5/10.

External Validity

Eligibility criteria was specifically stated in the methods section of the article. Only randomized controlled trials were included in the review.

Interpretation of Results

Based on the results of this systematic review and meta-analysis, subjects that received preoperative rehabilitation prior to TKA did not have significantly improved treatment effect in terms of WOMAC pain and function scores, knee flexion ROM, or knee extension strength at 2-3 months post-surgery, in comparison with subjects that did not receive rehabilitation.

However, there is an overall low level of clinical certainty in the results from the meta-analysis. In particular, no more than 4 studies were analyzed for each outcome. This small sample size reduces the reliability and precision of effect size estimates. The small sample size also reduces the statistical power, thus increasing risk for type II error. Although the 2 studies included in the analysis for knee extension strength both attempted to assess quadriceps force production, in one study, knee extension strength was assessed isokinetically with open chain knee extension, while in the other study knee extension strength was assessed based on isotonic muscle contraction with a closed-chain leg-press exercise. Results from these different testing modes are not comparable,[14] nor are the measurements from open and closed kinetic chain exercises. Thus, the pooled effect size of prehabilitation on this outcome is not of clinical importance.

Subjects that received prehabilitation did have a significantly decreased length of hospital stay following surgery in comparison with controls. Based on the forest plot diagram, the standardized cumulative effect size estimate based on a 95% CI was between -0.4 and -0.01. Utilizing the effect size index described by the authors in the methods section, this result indicates only a weak treatment effect from prehabilitation on length of hospital stay. Thus, despite the statistical significance of the treatment effect, the effect lacks clinical significance due to the small effect size.

Applicability of Study Results

Based on the results from the meta-analysis, there is a lack of sufficient evidence to suggest that prehabilitation may improve my patient's outcome or reduce post-injury complications. However, although this systematic review has good validity in terms of methodological quality, the results from meta-analysis are based on a very small sample of studies. While the intervention and outcomes of interest analyzes in the meta-analysis are of high relevance to my clinical scenario, the lack of standardized intervention and measurement methods in the included studies compromises the ability to make comparisons between studies and reduces the clinical applicability of estimated effects.

Additionally, the mean age of subjects in the included studies (68.6 years) is almost 20 years younger than my patient of interest. This age difference also compromises the applicability of results. Indeed, the musculoskeletal changes that occur with aging impact treatment outcomes and should influence the good clinician's treatment goals. Thus, the measured effects of the prehabilitation intervention provided to this sample population are likely to differ from the effects that my patient might experience. In lieu of providing prehabilitation services to my patient, searching for alternative methods aimed at the subcategory of "oldest-old" adults that are supported by statistically and clinically meaningful evidence would be of greater service to my patient in my goal of improving outcomes and reducing complications post-TKA.

SYNTHESIS AND CLINICAL IMPLICATIONS

Synthesis of Evidence

There are currently no published studies that assess the effect of preoperative physical therapy on reducing the risk of post-TKA complications. A comprehensive literature search yielded two systematic reviews of randomized controlled trials that provide low-level evidence that patients that participate in prehabilitation prior to TKA do not have better post-surgical outcomes than patients that do not participate in prehabilitation. Although the systematic reviews were of high methodological quality based on AMSTAR scores, the results from these meta-analyses are based on under-powered and highly variable RCTs with moderate to high risk of bias.

These results indicated no significant differences in long-term pain and function outcomes, knee flexion ROM, knee extension strength, or total cost of care. Short-term statistical improvement from prehabilitation was measured based on WOMAC pain scores at 4 weeks post-operatively and WOMAC function scores at 6-8 weeks and 12 weeks post-operatively. When considered in terms of clinical significance, the improvements are considered insignificant as they are too small to effect meaningful patient change.

Results regarding the impact of prehabilitation on length of hospital stay were mixed. While the study by Wang et al (2016) found no statistical difference in length of hospital stay,[9] the study by Silkman et al (2012) did find that prehabilitation subjects had a statistically significant decrease in length of hospital stay. Nonetheless, the small effect size further undermines the clinical significance of this result.

Clinical Implications:

These results do not support prehabilitation intervention on an outpatient PT basis prior to TKA. Despite potential statistically significant reduction in length of hospital stay and short-term pain and function, prehabilitation did not improve these outcomes to a degree that would be considered clinically relevant. Based on the mean age of the sample population studies, these results are more applicable to patient of a younger demographic—the "young-old" and "middle-old" older adults. Therefore, prehabilitation is not an effective use of both the patient and therapist's time, energy, and financial resources for improving post-operative outcomes and reducing risk of post-operative complications following TKA.

As such, it is important to seek out alternative intervention methods that prove effective in improving post-operative outcomes and are tailored to fit the needs of my individual patient. Intervention geared towards an 86-year old patient needs to take into consideration the age profile of the "oldest-old" older adult and the effects that aging has on the neuromusculoskeletal systems to guide treatment.

Future Research:

Future research might focus on larger RCTs of more rigorous methodology and utilizing standardized intervention methods and outcome measures. These factors are key to improving the validity of the evidence as well as increase clinical relevancy.

Future research might also focus on post-TKA treatment for different subgroups of older adults. Indeed, TKA is a surgical intervention used to relieve painful knee OA in patients of all older adult age ranges. As such, identifying intervention methods that are most conducive to the patient's stage of life will provide greatest improvement on physical, mental, and emotional aspects of health and recovery.

Finally, the current available evidence is limited to studies measuring outcomes of prehabilitation in terms of physical impairments. Instead, future research might focus on methods for reducing risk of complications following TKA. As stated previously, maintaining standardization and rigor methodology is crucial to ensuring the validity and reliability of research findings.

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