INPLASY

Impact of Preoperative Balance Training on Postoperative Functional Recovery of Patients after Total Knee Arthroplasty: A Systematic Review and Meta-Analysis

INPLASY202410122

doi: 10.37766/inplasy2024.1.0122

Received: 30 January 2024

Published: 30 January 2024

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ADMINISTRATIVE INFORMATION

Support - No funding.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202410122

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 30 January 2024 and was last updated on 30 January 2024.

INTRODUCTION

Review question / Objective Results of previous studies on the impact of preoperative balance training on postoperative functional recovery after total knee arthroplasty (TKA) appeared to be ambiguous. This systematic review and meta-analysis were thus performed to investigate the effects of preoperative balance training on walking ability, balance-specific performance, and other functional indicators in elderly patients post-TKA.

Condition being studied The effects of preoperative balance training on walking ability, balance-specific performance, and other functional indicators in elderly patients post-TKA.

METHODS

Participant or population Studies meeting the following criteria were included in the analysis: (1) Clinical randomized controlled trials; (2) Control group receiving routine rehabilitation training or no specific intervention, while the experimental group received proprioception/balance and neuromuscular training on top of the control group; (3) Elderly individuals (65 years and older) undergoing TKA due to osteoarthritis; (4) Intervention or exposure randomized controlled trials (RCTs) and pilot RCTs examining the effects of implementing balance training after TKA.

Intervention Training interventions encompassed a range of exercises, including balance exercises, as well as interventions referred to as "sensorimotor training" as defined by Taube et al. These interventions aimed to improve proprioception, enhance sensory feedback, and enhance the coordination of sensory and motor responses in individuals undergoing knee rehabilitation afterTKA.

Comparator Comparisons between groups combining balance training with routine rehabilitation training in the control group versus

groups completing only routine rehabilitation training, or comparisons between groups performing only balance training versus groups completing only routine rehabilitation training.

Study designs to be included Patient data were obtained from databases including PubMed, Physiotherapy Evidence Database (PEDro), CINAHL, SPORTDiscus, and Scopus. The inclusion criteria followed the Population-Intervention-Comparison-Outcome (PICO) principle. The assessment process involved meticulous screening, judicious data extraction, and rigorous evaluation of trial method quality, conducted by two independent researchers. Based on standardized mean differences and 95% confidence intervals, meta-analysis was performed employing a random-effects model or fixed-effects model.

Eligibility criteria 2.3 Inclusion CriteriaTo enhance the quality and reliability of the analysis, a stringent academic excellence threshold was established for literature selection. Studies meeting the following criteria were included in the analysis: (1) Clinical randomized controlled trials; (2) Control group receiving routine rehabilitation training or no specific intervention, while the experimental group received proprioception/balance and neuromuscular training on top of the control group; (3) Elderly individuals (65 years and older) undergoing TKA due to osteoarthritis; (4) Intervention or exposure randomized controlled trials (RCTs) and pilot RCTs examining the effects of implementing balance training after TKA. Training interventions encompassed a range of exercises, including balance exercises, as well as interventions referred to as "sensorimotor training" as defined by Taube et al. These interventions aimed to improve proprioception, enhance sensory feedback, and enhance the coordination of sensory and motor responses in individuals undergoing knee rehabilitation after TKA [14]. When authors did not provide such categorization, these were defined as "balance exercises" as they appeared to challenge the primary sensory systems for balance (i.e., visual, vestibular, and/or proprioceptive), or to restore neuromuscular function and motor efficiency. (5) Comparisons between groups combining balance training with routine rehabilitation training in the control group versus groups completing only routine rehabilitation training, or comparisons between groups performing only balance training versus groups completing only routine rehabilitation training.2.4 Exclusion Criteria(1) Case reports; (2) Inability to extract relevant outcome measures such as incidence rates; (3) Included patients with comorbidities. (4) History of surgical treatment in the intervention or control group. (5) Use of other types of treatments in the intervention or control group. (6) No other restrictions on patient age, gender, race, time post-stroke, baseline function, publication date, or language.

Information sources This study strictly adhered to the established guidelines of the Meta-analysis of Observational Studies in Epidemiology (MOOSE). Computer searches were conducted in databases including Cochrane Library, Embase, Web of Science, PubMed, China National Knowledge Infrastructure (CNKI), Chinese Biomedical Literature Service System (CBM), and Wanfang Database. The English search terms used were "proprioception training," "balance training," "sensorimotor training," "neuromuscular training," and "total knee arthroplasty." Additionally, disease-related keywords included "knee joint" and "knee Osteoarthritis." Taking the PubMed database as an example, the search strategy is outlined in Table 1. Furthermore, we manually explored the titles and content of the included studies, along with objective abstract assessments, to ultimately identify other relevant literature.

Main outcome(s) RevMan 5.3 (The Cochrane Centre, Oxford, UK): (1) Binary variables were analyzed using odds ratios (OR) with 95% confidence intervals (CI). (2) Heterogeneity was assessed through Q and I2 tests; when heterogeneity was low, a fixed-effects model was used for analysis. When heterogeneity was high, a random-effects model (RE) was employed for analysis, and the literature was re-evaluated to identify and analyze the source of heterogeneity. Subgroup analysis was conducted if there was substantial heterogeneity with statistically significant differences. Descriptive analysis was performed when the source of heterogeneity could not be explained. $P<0.05$ was considered significantly different.

Quality assessment / Risk of bias analysis Two independent reviewers (RYF, WRR) conducted literature screening, data extraction, and quality assessment, with any discrepancies resolved by a third reviewer (JTB). Data extracted in this study included study design, study population, inclusion and exclusion criteria, intervention measures, treatment methods in the control group, and outcomes. Mean values and standard deviations (SD) were extracted for quantitative data. For randomized controlled trials, the Jadad scale was used for quality assessment, while cohort studies and case-control studies were assessed for quality using the NOS scale.

Strategy of data synthesis RevMan 5.3 (The Cochrane Centre, Oxford, UK): Binary variables were analyzed using odds ratios (OR) with 95% confidence intervals (CI).

Subgroup analysis Subgroup analysis was conducted if there was substantial heterogeneity with statistically significant differences.

Sensitivity analysis RevMan 5.3 (The Cochrane Centre, Oxford, UK): (1) Binary variables were analyzed using odds ratios (OR) with 95% confidence Descriptive analysis was performed when the source of heterogeneity could not be explained. $P<0.05$ was considered significantly different.

Country(ies) involved China.

Keywords Preoperative balance training; Total knee arthroplasty; Stroke; Systematic review; Meta-analysis.

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