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Original Research

Association Between Exercise Therapy Dose and Functional Improvements in the Early Postoperative Phase After Hip and Knee Arthroplasty: An Observational Study

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Abstract

Objective: To determine whether intensity and duration of standard exercise therapy are associated with changes in function after total hip arthroplasty (THA) and total knee arthroplasty (TKA).
Design: Prospective cohort study.
Setting: Orthopedic inpatient rehabilitation center.
Participants: A total of 123 patients 2 weeks after THA (n = 58; age, 62.5 ± 10.4 years) and TKA (n = 65; age, 66.6 ± 7.6 years).
Intervention: Standard rehabilitation (hands-on physiotherapy, group exercise therapy, strength training, cycle ergometer therapy, continuous passive motion therapy, and water exercise therapy).
Main Outcome Measures: The Western Ontario and McMaster Universities Arthritis Index (WOMAC) and hip and knee range of motion (ROM) were assessed before and after inpatient rehabilitation.
Results: The individual rehabilitation period varied between 12-25 days and included 48.1 ± 12.5 (THA) or 41.9 ± 9.7 (TKA) exercise interventions with intensities between 9.6 and 14.0 points on the Borg Rate of Perceived Exertion Scale. WOMAC pain ($P < .001$), stiffness ($P < .001$), and function ($P < .001$), as well as hip ($P < .001$) and knee ($P < .001$) ROM, improved significantly in THA and TKA patients. Analysis of covariance showed that these changes could not be explained by the total duration or mean intensity of exercise therapy.
Conclusions: The findings show a low dose-response relationship between early postoperative exercise therapy and the improvements in function or ROM after THA and TKA. Although the findings raise questions about the efficacy of existing rehabilitation programs, the small sample size, single setting, and geographic differences in postoperative treatment standards limit the generalizability of findings.

Introduction

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are currently two of the most widely performed surgeries throughout the world [1]. They are commonly used for the treatment of osteoarthritis or fractures [2,3]. Because of multiple functional impairments [4-8], exercise therapy is generally considered important for postoperative treatment. Common components of rehabilitation in the early postoperative phase after arthroplasty include strengthening, gait, balance, stretching, and weight-bearing exercises that are performed in water or on dry land [9,10]. Systematic reviews of randomized controlled trials [11-14] indicate that exercise therapy in general is effective. However, to date, no evidence-based recommendations exist for optimal exercise regimens and effective dose parameters. This lack of recommendations can be explained by the small number of studies in this field, as well as the methodological heterogeneity and low sample size in single trials. One of the most under-researched areas in this context is the dose-response relationship of exercise therapy, although its importance has been repeatedly emphasized [13,14]. This lack of research contributes to uncertainty about rehabilitation protocol standards after arthroplasty, including effective exercise types, durations, intensities, and time intervals between sessions [14]. As a consequence, rehabilitation practice and exercise prescriptions are still not specific and seem to be guided more by subjective experiences

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and preferences, personal qualifications, or therapy routines than by evidence-based knowledge [10,13,14]. A survey among rehabilitation experts regarding best practices for postacute rehabilitation after primary hip and knee replacement in Canada and the United States [10] revealed substantial disagreements regarding appropriate interventions and the adequate dose in terms of "how much," "how long," and "how often." Potential reasons for the lack of consensus have been discussed in relation with the variability of effective exercise treatment intensities, durations, and frequencies in the literature [10-14]. Consequently, comprehensive research is needed to identify not only "active ingredients" of effective rehabilitation interventions for THA and TKA [10] but also the optimal dose of repeated exercising. Evidence-based prescriptions regarding minimum and optimal doses required to produce beneficial changes may also help manage potential patient barriers to adherence to regular exercising during rehabilitation. Although little is known about adherence to standard protocols or intensified treatment, the supposition that higher rehabilitation adherence rates are associated with better outcomes after hip replacement seems reasonable [15]. However, the conceptualization of clinical trials for the identification of the potentially effective exercise therapy intensities, frequencies, and durations is limited because uncertainty exists regarding the efficacy of current exercise dosage standards in postoperative rehabilitation practice.

The objective of this study was to examine whether intensity and duration of standard exercise therapy components (consisting of strength, gait, stretching, mobilization, and balance interventions) are associated with changes in self-reported function, pain, and stiffness, as well as range of motion (ROM), in adults who have undergone THA and TKA. The results of this study might help us better understand the importance of different exercise therapy dosage components and could provide a basis for future research in this field.

Methods

Design

A prospective cohort study was conducted in a German orthopedic rehabilitation center. The intention of the observational study design was to identify relevant rehabilitation dosage components responsible for functional improvements in order to provide a more reasonable basis for future randomized, controlled, dose-response trials.

The recruitment period consisted of 2 phases of 3 consecutive months within 1 year between 2010 and 2011. We enrolled consecutive patients with primary hip or knee replacement who entered the rehabilitation setting during this time. The study period for each patient included the time between admission and discharge. This study was exploratory in nature, with the objective of identifying effective dosage components (eg, exercise intensity) of current standard rehabilitation practices. An observational approach was chosen without influencing the current standard rehabilitation protocol and the therapists' decisions.

Participants

Patients with primary hip or knee replacement for osteoarthritis were considered eligible for inclusion. Exclusion criteria were neurologic disorders, severe psychiatric conditions, uncorrected visual acuity or hearing impairments, language difficulties, intraoperative complications, rheumatoid arthritis, patellar ligament injuries, dementia, schizophrenia, depression, Alzheimer disease, revision joint surgery, bilateral replacements, wound healing disturbance, and fractures. All participants gave written informed consent in accordance to the declaration of Helsinki. The study was approved by the local Ethics Committee.

Procedure

Persons who had undergone TKA and THA were recruited immediately after inpatient rehabilitation admission by the rehabilitation physician at the initial medical visit. Persons who expressed interest in participating in the study attended a further meeting with the study coordinator on the same or next day, at which time informed consent was obtained and screening for eligibility was conducted. Eligible patients received study questionnaires and exercise diaries during this meeting. Patients were shown how to complete the questionnaires and diaries, and the study coordinator verbally explained all study details and the use of the Borg Rating of Perceived Exertion (RPE) Scale [16]. Patients were given time to ask questions. An informational paper with detailed descriptions of the RPE Scale and questionnaires was provided. If a participant had difficulties with the exercise diaries or further questions, a second informational meeting was scheduled. Therapists were allowed to assist participants with the completion of exercise diaries but were also instructed not to influence an individual's decision regarding perceived exercise intensities.

Only one exercise diary with 2 different sheets (one for strength training and one for the other exercise components) was used. Patients were asked to complete all fields on intensity, frequency, and duration after an exercise session. No extra diaries were used for the therapists. If discrepancies existed between scheduled exercise sessions (recorded in the institutional database) and reported exercise sessions, the study coordinator asked the patients for the reason for the discrepancy. If the difference was a result of a