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Original article

Does measuring the range of motion of the hip and knee add to the assessment of disability in people undergoing joint replacement?



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ABSTRACT

Background and hypothesis: Range of motion (ROM) is a core component of some commonly used measures of disability, such as the American Knee Society Score and Harris Hip Score. However, the relationship between ROM and function is contested. The aim of this cross-sectional analysis was to investigate the relationship between pre-operative range of motion (ROM) and disability in patients undergoing hip and knee joint replacement.

Patients and methods: Two hundred and forty-nine patients recorded on NHS records as listed for joint replacement completed a range of measures prior to surgery. Pre-operative hip or knee ROM was measured by a trained research nurse using a hand-held goniometer. Joint pain severity was assessed using the WOMAC Pain Scale. Self-report activity limitations and participation restrictions were measured with the WOMAC Function Scale and the Aberdeen Impairment, Activity Limitation and Participation Restriction Measure. Observed activity limitations were assessed through three performance tests: 20-metre timed walk, sit-to-stand-to-sit, and 20-cm step tests.

Results: Pre-operative hip and knee ROM correlated weakly with self-report activity limitations (0.11 to 0.43), observed activity limitations (0.09 to 0.39) and self-report participation restrictions (−0.32 to 0.06). In comparison to ROM, correlations between joint pain and self-report activity limitations and participation restrictions were consistently moderate-high (−0.53 to 0.80). However, patients with restricted knee joint flexion (<110°) had significantly worse pain, activity limitations and participation restrictions than patients with non-restricted flexion (≥110°). Patients with restricted hip joint flexion (<95°) had greater activity limitations on some measures than patients with non-restricted flexion (>95°).

Discussion: This study suggests that modest restrictions of ROM are of little relevance to functional ability but that a certain amount of flexion is required for adequate function. We recommend that ROM is not the best means of assessing patients' disability prior to surgery.

Level of evidence: III – cohort study.

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1. Introduction

Joint replacement for advanced hip or knee osteoarthritis (OA) is the only intervention with evidence of a large effect size [1]. Assessment of outcome after surgery provides evidence effect, but many different measures are used and most lack any theoretical basis [2]. The World Health Organization's (WHO) International Classification of Functioning Disability and Health (ICF) [3] offers a theoretical framework for describing and assessing disability. Disability is conceptualised as comprising impairment, activity

limitation and participation restriction, and the ICF has been applied to joint replacement [2].

Existing assessments of impairment in people with OA include: pain, stiffness, altered joint range of motion (ROM), muscle weakness, instability and measures of structural changes such as x-rays. Activity limitations can be measured through self-report or objective techniques such as accelerometry or clinic based tests such as the 'get-up and go' test, and participation restrictions can be assessed by self-report. Some measures commonly used to assess patients' disability include assessment of ROM, for instance, the American Knee Society Score (AKSS) [4] and Harris Hip Score (HHS) [5]. However, the relationship between ROM and function is contested, with some authors regarding ROM as a determinate of function [6], whilst others report poor correlations [7,8].

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In view of ongoing use of ROM and continuing uncertainty about its relationship with function, this study aimed to investigate the relationship between pre-operative ROM and disability in patients undergoing joint replacement.

2. Patients and methods

The data are from a prospective single-centre UK cohort study comparing functional measures in patients undergoing joint replacement between February 2010–November 2011. Detailed information on study design, ethical approval, patient recruitment and consent, and assessment methods are in the study protocol [9]. Briefly, patients recorded on NHS records as listed for primary or revision hip or knee replacement surgery were eligible. Patients listed for several joint replacement procedures were included to enable assessment of outcome measures across their full range of application. Patients completed a range of functional measures before surgery, and the following measures were included in this analysis.

2.1. Measures of impairment

2.1.1. Range of motion

ROM measurements on the joint to be replaced were made by a trained research nurse using a hand-held goniometer while patients were supine on a couch (except for internal and external hip rotation). Active flexion in patients listed for knee replacement was assessed by measuring how far patients could bend their knee using their own muscle power. Active knee extension was measured as how far patients could flatten their knee onto the couch using their own muscle power. For patients listed for hip replacement, measurement of ROM included hip flexion, abduction, adduction, internal rotation and external rotation. For measurement of hip flexion, patients bent their knee and the examiner brought the patients' knee as close to their chest as possible. Abduction was measured by the examiner moving patients' legs out to the side as far as possible, whilst the pelvis was stabilised. Adduction was measured by the examiner moving patients' leg across the midline, and then anteriorly crossing over their opposite leg. Measurements of hip rotation were made with patients sitting on a couch with their legs hanging down. Internal rotation was measured by the examiner stabilising the thigh and then bringing patients' lower leg out to the side and external rotation by moving patients' lower leg in toward the opposite leg. For analysis, hip abduction and adduction were summed to produce abduction + adduction scores and hip internal and external rotations were summed to produce an arc of rotation score.

The inter- and intra-rater reproducibility of the ROM measurements was assessed in 20 patients (10 patients listed for hip replacement and 10 listed for knee replacement) and 10 healthy controls. ROM measurements were conducted independently by two assessors on the same day and then repeated a week later by one assessor. Concordance correlation coefficients [10] suggested moderate-excellent inter-rater (0.548–0.913) and intra-rater (0.536–0.935) reproducibility.

2.1.2. Joint pain severity

The severity of pain in the joint to be replaced was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index Pain Scale (WOMAC-p) [11], standardised to produce a score from 0–100 (worst to best).

2.2. Measures of activity limitations

2.2.1. Self-report activity limitations

Self-report activity limitations were assessed using the WOMAC Function Scale (WOMAC-f) [11] which produces a standardised score from 0–100 (worst to best) and the Activity Limitations Scale from the Aberdeen Impairment, Activity Limitation and Participation Restriction Measure (IAP-A) [2] which produces a score from 0–68 (best to worst).

2.2.2. Observed activity limitations

Observed activity limitations were assessed through performance tests. If patients were unwilling to attempt any test or the research nurse was unhappy to proceed because of safety concerns, the test was designated as not performed. All tests were performed in the order described below.

2.2.2.1. Timed 20-metre walk. Patients were timed as they walked a 20-metre straight distance at a comfortable speed.

2.2.2.2. Sit-to-stand-to-sit. Patients sat on a stool whose height was adjusted to ensure 90° flexion at the hip and knee. They stood up without using their hands, waited two seconds and sat down again. The recorded outcome was test completion.

2.2.2.3. Step test. Patients stepped up onto a 20-cm high block leading with the index leg, waited two seconds, and then stepped down from the block with the contra-lateral leg leading, without using their arms. The recorded outcome was test completion.

2.3. Measure of participation restrictions

Participant restrictions were measured using the IAP Participation Restriction Scale (IAP-P) [2] which produces a score from 0–36 (best to worst).

2.4. Patient demography

Data were collected in the pre-operative questionnaire on age, gender, socioeconomic status (living arrangements, education level, working status) and joints affected by arthritis. Medical co-morbidities were recorded using the Functional Co-morbidity Index [12] and the Hospital and Anxiety Depression Scale [13] was used to assess psychological status.

3. Statistical analysis

Analyses were conducted separately for patients listed for hip and knee replacement. Spearman's Rank Correlation coefficients were used to assess correlations between continuous variables. Point biserial correlation coefficients were used to assess correlations between continuous and dichotomous variables. These correlation measures range from –1 to +1. The strength of correlation was interpreted as |0.00|–|0.25|=none-little, |0.26|–|0.49|=low, |0.50|–|0.69|=moderate, |0.70|–|0.89|=high, |0.90|–|1.00|=very high [14]. Linear regression was conducted to adjust for the effect of demographic factors (age, gender, socioeconomic status, joints affected by arthritis, co-morbidities, and psychological status) on the relationship between WOMAC-p and self-report activity limitations. To adjust for the effect of demographic factors on the relationship between WOMAC-p and participation restrictions, the IAP-P was transformed with a root square function to comply with the assumptions of the linear model.

To compare functional measures between patients with low and high active flexion, patients were dichotomised into those with

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