

BMJ Open Use of rating of perceived exertion during anterior cruciate ligament reconstruction and knee osteoarthritis rehabilitation: a scoping review protocol

Daniel Germano Maciel , Mikhail Santos Cerqueira, Wouber Héricksen de Brito Vieira

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Neuromuscular Performance Laboratory, Physical Therapy Department, Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil

Correspondence to

Dr Wouber Héricksen de Brito Vieira;
hericksonfisio@yahoo.com.br

ABSTRACT

Introduction Anterior cruciate ligament (ACL) tear and knee osteoarthritis (KOA) are the most prevalent musculoskeletal disorders of the knee. Rehabilitation with progressive resistance training is recommended for both disorders. Rating of perceived exertion (RPE) is widely used to prescribe, monitor, and control exercise load. However, the lack of detailed methodological description and variability in the use of RPE may hinder its validity. This scoping review summarises methodological aspects of the use of RPE in resistance exercises during ACL reconstruction and KOA rehabilitation. We also aim to identify possible methodological issues related to the use of RPE and provide recommendations for future studies.

Methods and analysis This scoping review protocol was developed following the Joanna Briggs Institute and Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement extension for Scoping Reviews. The search will be conducted in Medline/PubMed, Embase, CINAHL, PEDro, Central and SPORTDiscus databases. The terms “anterior cruciate ligament rehabilitation”, “knee osteoarthritis” and “resistance exercise” and their synonymous will be used isolated and combined (boolean operators AND/OR/NOT). Two reviewers will independently conduct title and abstract screening and evaluate full texts of potentially eligible articles. Data related to study design, sample, intervention characteristics and RPE outcomes will be extracted, summarised and qualitatively analysed.

Ethics and dissemination The proposed scoping review does not require ethical approval since it will synthesise information from publicly available studies. Regarding dissemination activities, results will be submitted for publication in a scientific journal and presented at conferences in the field.

INTRODUCTION

Anterior cruciate ligament (ACL) tear is a common orthopaedic knee injury with annual incidence of 68.6 per 100 000 person-years in the US population. ACL reconstruction (ACLR) is the treatment performed in 75% of the cases.¹ Patients with ACL tear, submitted or not to reconstruction, have a relative risk of 3.84 of developing moderate

Strengths and limitations of this study

- This is a novel scoping review to understand how rating of perceived exertion (RPE) is used in anterior cruciate ligament reconstruction and knee osteoarthritis rehabilitation.
- The search strategy will involve five electronic databases including search in the grey literature.
- This study is following the international recommendation for developing a scoping review.
- The methods of this scoping review do not allow concluding whether results of included intervention studies were influenced by methodological inconsistencies related to the use of RPE.

to severe knee osteoarthritis (KOA).² KOA is a multifactorial degenerative joint condition affecting 16% of adults aged over 40 worldwide³ and one of the leading causes of global disability.⁴ In both knee conditions (ACL tear and KOA), patients present quadriceps arthrogenic inhibition,^{5 6} leading to muscle atrophy, strength deficits and impaired physical function.^{7 8}

Resistance exercise is the primary strategy to restore strength and functional independence following ACLR⁹ or KOA.¹⁰ In this context, measures of muscular performance (eg, isokinetic dynamometry, 1-repetition maximum test, 10-repetition maximum test and repetitions to failure) may provide useful information for determining adequate exercise load, thus maximising muscle adaptations while minimising injury/harm risks.^{11 12}

After appropriate measurement, load progression is required to increase muscular capacity,¹³ and its management should consider both external and internal load control.¹⁴ Rating of perceived exertion (RPE) is an internal loading control method widely used for prescribing and monitoring resistance exercise intensity during ACLR^{15–17} and

KOA rehabilitation.^{18 19} RPE is defined as ‘the feeling of how heavy and strenuous a physical task is’²⁰ and it can be measured using scales like Borg 6–20, Category-ratio 10, Category ratio 100, OMNI and repetitions in reserve.

However, in exercise science, methodological inconsistencies of the use of RPE may result in data misinterpretation and hinder measurement validity.²¹ Methodological inconsistencies affecting RPE may include the variety of RPE scales, RPE definitions and terms included within these definitions (eg, fatigue, heavy and discomfort) and RPE acquired from specific muscle groups, cardiorespiratory system or the whole body.²¹ Especially in ACLR and KOA rehabilitation, little attention is given to these inconsistencies. Several studies did not (1) describe instructions given to participants for reporting RPE^{18 22–25}; (2) specify the moment of RPE acquisition (eg, after each set, exercise or session)^{18 24 25} and (3) explain to participants whether they should report local or global RPE.^{26 27}

Poor methodological description and lack of uniformity in the use of RPE across studies may hinder validity of RPE scales in ACLR and KOA rehabilitation and increase the likelihood of under- or overestimating of progressive resistance exercise. Moreover, to the best of our knowledge, no studies verifying the methodological aspects of RPE use in the rehabilitation of ACLR and KOA were found. Therefore, this scoping review will summarise methodological aspects of the use of RPE in resistance exercises during ACLR and KOA rehabilitation. We also aim to identify possible methodological issues related to the use of RPE and provide recommendations for future studies.

METHODS AND ANALYSES

This scoping review protocol was developed following the recommendations of the Joanna Briggs Institute²⁸ and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement extension for scoping reviews.²⁹ This study will follow the methodological framework suggested by Arksey and O’Malley,³⁰ which includes the following stages: (1) identifying the research question; (2) identifying relevant studies; (3) selection of eligible studies; (4) charting the data and (5) collating, summarising and reporting the results. The final protocol was registered prospectively in the Open Science Framework on 2 April 2021 (osf.io/u8qxe).

Stage 1: identifying the research question

The overall research question are:

1. How is RPE used during ACLR and KOA rehabilitation?
2. Are there methodological concerns regarding the use of RPE during ACLR and KOA rehabilitation?
3. Is there methodological uniformity in the use of RPE during ACLR and KOA rehabilitation?

Stage 2: identifying relevant studies: search strategy

A broad systematic literature search will be conducted with no restrictions on language or year of publication.

Medline/PubMed, Embase, CINAHL, PEDro, Central and SPORTDiscus databases will be searched independently by two reviewers. The terms “anterior cruciate ligament rehabilitation”, “knee osteoarthritis” and “resistance exercise” will be used isolated and combined. Search strategies developed for each database are described in online supplemental file 1. Forward and backward citation tracking and citation tracking of the reference lists of the included studies will be conducted, and grey literature (eg, clinical trials registers, conference proceedings and Ph.D. dissertation) will also be investigated.

Stage 3: study selection

Articles must fulfil the following inclusion criteria to be selected: (1) include participants over 18 years old who underwent ACLR (using any type of graft; eg, allograft, hamstrings or patellar tendon) or with KOA according to any diagnosis criteria (eg, American College of Rheumatology, Kellgren and Lawrence system, Osteoarthritis Research Society International), and without restrictions regarding the level of severity; (2) involve resistance training (land or aquatic; for example, using bodyweight, machines, dumbbells, elastic or floaters as external load); (3) use RPE to prescribe, monitor or adjust resistance exercise load and (4) be an intervention study, that is, randomised controlled trial, quasi-experimental study, case study or randomised controlled trial protocol. Studies will be excluded if (1) they are validation studies; (2) multimodal exercises included do not focus on lower limbs and knee muscle strength and (3) report an additional analysis in the same sample of a study already included.

First, articles found in the search strategy will be merged, and duplicates will be removed using Mendeley reference manager software (www.mendeley.com). Second, studies will be screened according to eligibility criteria. Last, the full text of potentially eligible abstracts will be carefully analysed. Two reviewers will independently perform searches, collect and analyse data of the studies. Disagreements will be resolved by discussion between both reviewers or consulting a third reviewer.

Stage 4: charting the data

Relevant data from included studies will be extracted using a customised data extraction form. If necessary, data extraction form will be improved until all reviewers agree with the final version. Reliability of data extraction form will be determined with the first five included studies.³¹ Two reviewers will use the form to independently extract data from 10% of the included studies and determine consistency of data extraction.

Data extraction will be undertaken independently by the same two reviewers. Disagreements will be resolved by discussion or consulting a third reviewer. Tables will be produced to show a summary of included studies, including the following data:

- ▶ *Study information:* author/year.

Table 1 RPE outcomes that will be extracted from included studies

Outcome	Description	Example
Scale type	Which scale was used	Borg 6–20, CR10, CR100, OMNI, repetitions in reserve scale, repetitions to failure scale
Instructions given to participants	Which instruction was given to participants for reporting RPE	–
Used terms	Which terms were used in instructions given to participants	Fatigue, heavy, hard or discomfort
Purpose of using RPE	Which is the purpose of using RPE	Prescribe, monitor or adjust the load
Estimation and production paradigms	Which paradigm was used	Estimation—RPE is reported in response to a predefined load. Production—the participant self-regulated exercise intensity by RPE level proposed by authors
Exercise intensity (when production paradigm was applied)	Targeted internal load proposed by authors	Mild, moderate or high intensity
Strategy for load adjustment	Which strategy was used to adjust load	Increase or reduce external load, no of sets, repetitions or exercises
Local vs global RPE	Participants were instructed to report RPE for which part of the body	Specific muscle groups, cardiovascular system, or whole body
Moment of RPE acquisition	RPE was collected at which moment of the session	After each set, exercise or session
Exercises in which RPE was collected	RPE was collected during which exercises	Leg extension, leg press or squat

CR, category ratio; RPE, rating of perceived effort.

- ▶ *Sample*: sample size; age; gender; knee condition (ACLR or KOA); time from surgery for patients with ACLR; time from beginning of symptoms for patients with KOA; level of severity (eg, Western Ontario and McMaster Universities (WOMAC), Lequesn, Lysholm, ACL-RI).
- ▶ *Intervention*: exercises (eg, leg press, squat and leg extension); training frequency (days per week); training duration (weeks); type of muscle contraction; external load; exercise protocol (number of series and repetitions, and resting period); strategies for load prescription, adjustment, control and progression; other interventions associated with resistance exercises (eg, neuromuscular electrical stimulation).
- ▶ *RPE outcomes*: scale type and purpose; instructions given to participants, including used terms; estimation and production paradigm; exercise intensity; local and global RPE; moment of RPE acquisition; exercises in which RPE was collected. Details of each item can be found in [table 1](#).
- ▶ *Study design*: randomised controlled trial, quasi-experimental study, case study and protocol for intervention study.

Stage 5: collating, summarising and reporting the results

Results regarding RPE outcomes will be summarised using a qualitative descriptive approach.

Patient and public involvement

Patients will not be involved.

ETHICS AND DISSEMINATION

This scoping review will not require ethical approval since it will synthesise information from publicly available studies. Regarding dissemination activities, results will be submitted for publication in a scientific journal and presented at conferences in the field.

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ORCID iD

Daniel Germano Maciel <http://orcid.org/0000-0003-0975-5998>

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