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Abductor muscle strength deficit in patients after total hip arthroplasty for hip osteoarthritis: a protocol for a systematic review and meta-analysis

Petros Ismailidis ,[1,2] Peter Kvarda ,[1,3] Werner Vach,[1] Christian Appenzeller-Herzog ,[4] Annegret Mündermann[1,2,5]

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For numbered affiliations see end of article.

Correspondence to
Dr Petros Ismailidis;
petrosismailidis@gmail.com

ABSTRACT

Introduction Conservation of abductor muscle strength is directly associated with physical function after total hip replacement (THA). Although many studies have tried to explore and quantify a potential abductor muscle strength deficit after THA as well as identify possible causes and treatment options, this topic has not been addressed systematically.

Methods and analysis Human-based studies reporting measurements of hip abductor strength will be included in this review. Studies reporting on hip abductor strength measured manually or isometric measurements at an abduction angle other than 0° will not be considered. No restriction will be placed on study design, publication date operative approach, prosthesis design, age and sex of the patients or severity of OA. Data sources will be Embase via embase.com, Medline ALL via Ovid and the Cochrane Central Register of Controlled Trials. The preliminary search was conducted on 5 May 2019. Data regarding absolute values or torque ratio of hip abductor torque between sides as well as patient demographic data, surgical approaches and rehabilitation protocols will be extracted. The assessment of quality and risk of bias will be performed with the modified Newcastle-Ottawa Scale. The screening, data extraction and quality assessment will be performed by two reviewers independently. Where necessary, a third review author will make a final judgement. Narrative synthesis as well as tabular presentation of the extracted data will be included. Whenever possible, metaregression and subgroup specific meta-analyses will be used to investigate the influence of time since THA and type of measurement (isokinetic or isometric) on the different outcomes. In case of sufficient information, these analyses will be extended to include characteristics such as age, sex, surgical approach or rehabilitation programme.

Ethics and dissemination No ethics approval is required. The results will be disseminated through peer-reviewed publications and conference presentations.

PROSPERO registration number CRD42020153185.

Strengths and limitations of this study

- To the best of our knowledge, this will be the first systematic review examining if abductor muscle strength deficit is present in patients after total hip arthroplasty performed for osteoarthritis.
- The homogeneity of the measurement methods described in the inclusion criteria (no hand-held manometers, isometric measurements only in an abduction angle of 0°) allows the extraction of directly comparable data, suitable for a meta-analysis.
- This review will likely identify factors influencing the abductor strength deficit, hence assisting the choice of the correct surgical methods or rehabilitation protocols.
- A possible limitation is the inclusion of studies only in English or German language.

INTRODUCTION

Osteoarthritis (OA) of the hip is a common degenerative disorder. Despite its high prevalence, to date there is no cure for OA, and the ultimate treatment for severe OA is total hip arthroplasty (THA).[1] Overall, the results of THA appear to be very satisfying with more than 90% of THA patients reporting a good to excellent result.[2] However, patients after THA have been reported to have strength deficits.[3] These deficits have been described in patients with OA and reported to increase as the disease progresses and persist for a longer time after THA treatment.[4] One of the most common strength deficits is that of the abductor muscle group.[4 5]Abductor muscle group deficit after THA can be described compared with a control group of healthy individuals[6] or comparing the affected hip with the contralateral side in case of unilateral THA.[7]

The abductor muscle group mainly consist of the primary hip abductors gluteus medius, gluteus minimus and tensor fasciae latae muscles. Secondary hip abductors include the piriformis, sartorius and rectus femoris muscles.[8] The abductor muscle group abducts the hip and stabilises the pelvis, maintaining the level of contralateral pelvis

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and preventing hip adduction during single leg stance.[9 10] Furthermore, the gluteus medius and minimus have a secondary role in hip rotation.[8]

Damage of the abductor mechanism results in drop of the contralateral pelvis during single leg stance clinically manifested as a Trendelenburg gait.[11] Furthermore, abductor muscle strength deficit has been linked to knee OA,[5 12] patellofemoral pain syndrome[13] and chronic lower back pain.[14] Especially for the elderly population, loss of abduction function can compromise balance and increase the risk of falls.[15] Specifically for THA, abductor muscle function has been shown to be directly associated with physical function[5] and important in limiting limping.[16] Overall, conservation of the abduction muscle strength is important not only for an optimal outcome of THA but also to prevent pain because of other orthopaedic conditions linked to abductor strength deficits.

Many studies have tried to explore and quantify a potential abductor muscle strength deficit after THA as well as identify possible causes and treatment options.[4 5 17] Furthermore, surgical approaches avoiding any damage to the abductor mechanism have been established[18] and rehabilitation programmes have been developed to prevent or reduce this strength deficit.[17 19 20] However, results reported in the literature are controversial, and the factors influencing abductor muscle strength deficit after THA are poorly understood.

The aim of this protocol study was to present an objective and transparent methodology to conduct a systematic review and meta-analysis aimed to increase knowledge regarding the magnitude of abductor muscle strength deficits after THA and to depict, as well as to provide understanding of the associations to external between factors including patient characteristics, surgical methods and rehabilitation programmes and abductor muscle strength deficit after THA and study characteristics

METHODS AND ANALYSES

This protocol is reported according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guideline.[21] The initial preliminary search was conducted on 5 May 2019. The study was submitted for registration in PROSPERO on 2 October 2019 and registered on 26 February 2020. The anticipated completion date is 30 June 2020. The research question was formulated according to the Population, Intervention, Comparison, Outcome, Study design tool (table 1).[22]

Eligibility criteria

Inclusion criteria

Human-based clinical studies reporting on abductor muscle strength after THA performed for OA of the hip will be considered for inclusion. No restriction will be placed on study design, publication date, operative approach, prosthesis design, age and sex of the patients or severity of OA

Table 1 The Population, Intervention, Comparison, Outcome, Study design process

Item	Specification
Population, or participants and conditions of interest	Patients with OA of the hip (any age, any gender and any severity)
Interventions or exposures	Total hip arthroplasty
Comparisons or control groups	For comparison between limps of the same subject: asymptomatic contralateral hip For comparison between patients and heathy individuals: asymptomatic control subjects
Outcomes of interest	Muscle strength of hip abductors
Study designs	Any study design, only published studies, no conference abstracts

OA, osteoarthritis.

Exclusion Criteria

Studies published in a language other than English or German as well as studies not reporting absolute muscle strength values or torque ratios will be excluded. Studies reporting on hip abductor strength measured manually or at an abduction angle other than 0° will not be considered for this review.

Methodological considerations

Studies reporting on hip abductor strength measured manually (with a hand-held manometer or without a manometer) will not be considered because the results are not reliable and not directly comparable with studies using electronic dynamometers. In addition, studies reporting on isometric abductor muscle strength at an abduction angle other than 0° will not be included because torque measurement at other angles cannot be compared with those conducted in 0° abduction and does not reflect the relevant muscle strength during walking and standing.

Information sources and search strategy

Text words (synonyms and word variations) and database-specific subject headings for hip OA, total hip replacement and postoperative performance will be used. We will search the electronic databases Embase via embase.com, Medline ALL via Ovid, and the Cochrane Central Register of Controlled Trials. No language or date restrictions will be applied. All retrieved references will be exported to Endnote V.X9 and deduplicated. To identify possible additional studies that will escape our electronic database searches, the bibliographic references of all included articles as well as the citations of those that are indexed in Scopus or the Web of Science will be screened. An initial search took place on 5 May 2019. The detailed

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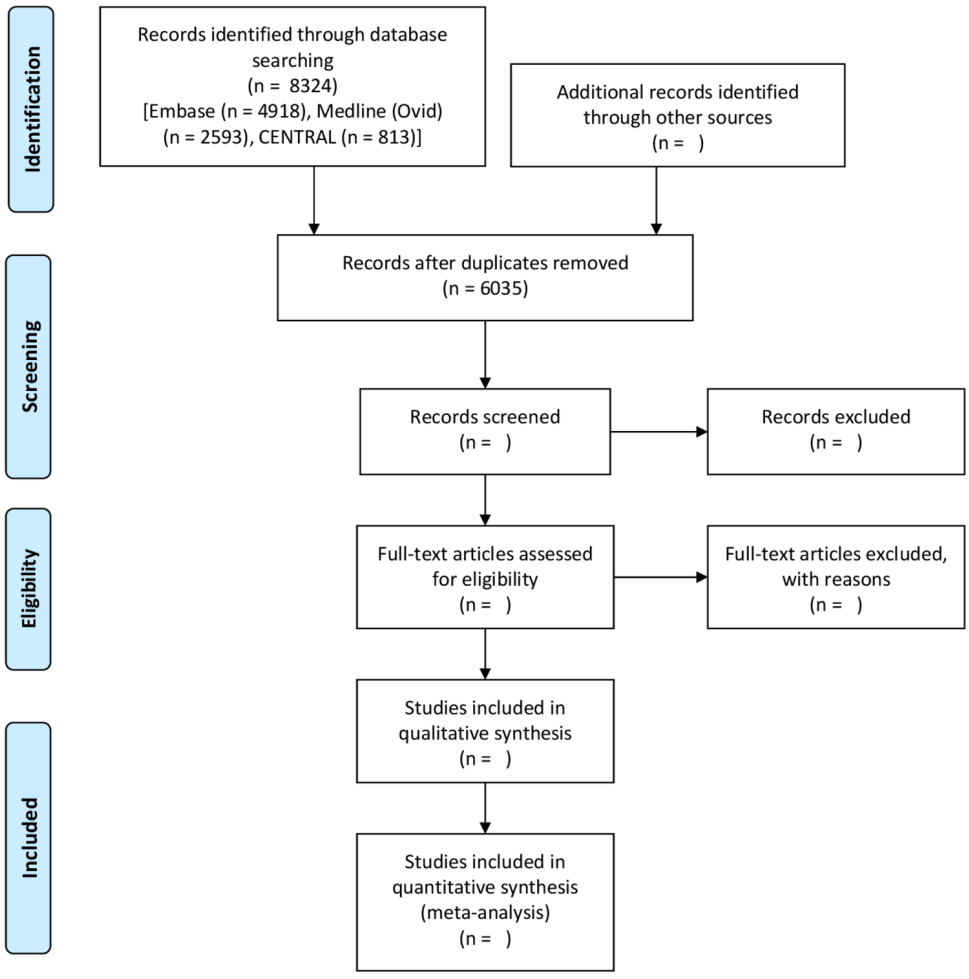

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram. CENTRAL, Cochrane Central Register of Controlled Trials.

search strategy can be found in the online supplementary file a. The search strategy will be presented in form of a PRISMA diagram (figure 1).[23]

Study records: data management, selection process and data collection process

Two reviewers (PI and PK) will independently screen the references based on their titles and abstracts to identify studies that potentially meet the inclusion criteria. All potentially relevant references will be retrieved in full text and independently assessed by two reviewers (PI and PK). Any disagreements over eligibility will be resolved by consensus. Where necessary, a third review author (AM) will make a final judgement. Data from the full texts will be extracted and entered into a standardised form. The information to be extracted can be found in table 2.

Outcomes and prioritisation

The main outcomes include:

1. Absolute values of hip abductor torque in patients after THA, or in asymptomatic control groups.
2. Torque ratio (operated/contralateral hip) of hip abductors in patients after unilateral THA.
3. Change in hip abductor torque/hip abductor torque ratio from baseline to the last available follow-up.
4. Differences in hip abductor torque/torque ratios between patients after THA and healthy control groups.

The secondary outcomes include:

1. Surgical approaches/methods influencing the abductor muscle strength deficits after THA.
2. Patient characteristics influencing the abductor muscle strength deficits after THA.
3. Rehabilitation programmes influencing the abductor muscle strength deficits after THA.
4. Study characteristics influencing the results.

Risk of bias in individual studies

The risk-of-bias assessment will be performed with a modified version of the Newcastle-Ottawa scale (NOS[24]; online supplementary file b) and conducted independently by two reviewers (PI and PK). According to the modified NOS, each study will be valued with 1–6 stars where higher scores indicate higher level of quality. No separate tool will be used to assess the risk of bias of randomised controlled trials (RCTs), since we do not extract estimates

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Table 2 Data that will be extracted from every study included in the review

No.	Description
1	Authors and year of publication
2	Country of study
3	Type of study
4	Study population
5	Study completion rate
6	Diagnosis
7	Surgical approach: lateral/transgluteal (Hardinge/Bauer)[26]/anterolateral (Watson Jones) with or without trochanteric osteotomy[26]/anterior (Smith Petersen)[26]/posterior (Moore/ the southern exposure)[26]/minimally invasive anterolateral (Röttinger)[17]/anterior minimally invasive[26]/minimally invasive posterior (mini-posterior)[27]/2 incision (minimal invasive 2 incision)[28]/posterolateral[29]
8 8a–f	Study population demographics Age, sex, height, body mass, body mass index, comorbidity index
9 9a 9b 9c	Measurement methods Isometric/isokinetic strength measurement Angle of isometric measurement/speed of isokinetic measurement Patient position during the measurement (lying supine, lying lateral recumbent/standing)
10	Comparators: healthy individuals/asymptomatic contralateral side/no comparator
11	Total durations of follow-up (weeks after the operation)
12	Measurement stages (preoperative, follow-up in weeks after the operation)
13	Information regarding the rehabilitation protocols
14 14a 14b 14c 14d	Outcome (mean values, SDs and CIs) Absolute values of hip abductor torque in patients after THA, or in asymptomatic control groups Torque ratio (operated/contralateral hip) of hip abductors in patients after THA Change in hip abductor torque/hip abductor torque ratio from baseline to the last available follow-up Differences in hip abductor torque/torque ratios between patients after THA and healthy control groups.
15	Authors conclusions
16	Information regarding risk of bias

THA, total hip arthroplasty.

of treatment differences from RCTs but use them as a source for observational data.

Data synthesis

For any of the main outcomes, we will extract any information on the location (mean, median, etc) and any information on the population variation (SD, IQR, percentile) or on the precision of the location measure (standard errors, CIs, p values, sample size). If this information is available for several time points, the data will be extracted for all time points.

If results are given for specific patient subgroups, these results will be extracted together with the characteristics of the subgroup. The same applies for comparisons beyond those reflected by the main outcomes. In case that outcomes are not reported directly but indirect information is available on side-specific or time point-specific results, the available information will be transformed accordingly.

If several studies using the same type of measurement (isokinetic or isometric) at the same time period after THA and with the same comparator (asymptomatic contralateral side or group of asymptomatic control subjects) are available, we will pool the results for a meta-analysis.

All results will be presented in tabular format and forest plots. Whenever outcomes are not reported directly but only indirect information is available on side-specific or time point-specific results, the available information will be transformed accordingly.

Metaregression and subgroup-specific meta analyses will be used to investigate the influence of time since THA and type of measurement (isokinetic or isometric) on the different outcomes. In case of sufficient information, these analyses will be extended to include characteristics such as age, sex, surgical approach or rehabilitation programme.

Metabias(es)

To explore potential hints to publication bias or selective reporting, we will investigate the influence of all available study characteristics on the various outcomes.

Confidence in cumulative evidence

The strength of the body of evidence will be assessed with the Grading of Recommendations Assessment,

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Development and Evaluation system (GRADE).[25] GRADE is a method of assessing the certainty in evidence classifying it into one of the four categories: high, moderate, low and very low.[25]

ETHICS AND DISSEMINATION

This study is a protocol for a systematic review and meta-analysis. No human participants will be recruited. No ethics approval is needed. The results will be disseminated through peer-reviewed publications and conference presentations. All data relevant to the study are included in the article or uploaded as supplementary information.

Author affiliations
[1]Department of Orthopaedics and Traumatology, University Hospital of Basel, Basel, Switzerland
[2]Department of Clinical Research, University of Basel, Basel, Switzerland
[3]Department of Orthopaedic Surgery and Traumatology, Kantonsspital Baselland, Bruderholz, Basel-Landschaft, Switzerland
[4]University Medical Library, University of Basel, Basel, Switzerland
[5]Department of Biomedical Engineering, University of Basel, Basel, Switzerland

Twitter Peter Kvarda @Kvarda

Contributors PI, PK and AM conceived this systematic review and meta-analysis. PI registered the protocol in PROSPERO. CA-H reviewed the protocol and was responsible for the search strategy. WV reviewed the protocol and was responsible for the strategy of data synthesis. All authors provided critical feedback, have read and approved the final manuscript.

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ORCID iDs
Petros Ismailidis http://orcid.org/0000-0003-1551-7902
Peter Kvarda http://orcid.org/0000-0002-1623-4712
Christian Appenzeller-Herzog http://orcid.org/0000-0001-7430-294X

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