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Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis: A systematic review and meta-analysis protocol

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ABSTRACT

Introduction:

Reduced hip abductor strength can indirectly lead to changes in knee kinematics and functional impairment and has been reported in patients with patellofemoral pain and knee osteoarthritis (OA). Limited information is available regarding hip abductor strength following total or unicompartmental knee arthroplasty (TKA/UKA). The aims of this systematic review are to collect all available primary research reporting hip abductor strength following TKA/UKA and conduct a meta-analysis.

Methods and analysis:

Embase, Medline, SportDiscus, the Web of Science Core Collection and Scopus will be searched for human based clinical studies investigating hip abductor muscle strength after TKA/UKA for knee OA or avascular necrosis (AVN). Articles studying hip abductor strength after knee arthroplasty for posttraumatic OA will not be considered. No restriction on study design, prosthesis design, surgical approach, patient characteristics or severity of OA/AVN will be applied. We will search articles published between January 1, 1990 the date of our last search. Only articles in English or German language will be considered for inclusion. The assessment of quality and risk of bias will be performed with the modified Newcastle-Ottawa scale (NOS). Studies reporting manually measured muscle strength or measurements performed at hip abduction angles other than 0° will be excluded. References will be screened by two reviewers independently. Where necessary, a third author will make the final decision. Data will be extracted and presented in a tabular form. Depending on availability, comparable subgroup and meta-analyses will be conducted. Patient characteristics such as age, sex and surgical approach or rehabilitation program will be analysed, if sufficient data are available.

Ethics and dissemination:

No ethics approval is required. The results will be published in a peer reviewed journal and as conference presentation.

Registration details:
Registered in PROSPERO, acknowledgement of receipt Nr. 164339.

Keywords: abductor muscle strength, hip abductor, knee replacement, knee arthroplasty knee osteoarthritis, knee avascular necrosis

Strengths and limitations of this study:

- To our knowledge, there is no published systematic review investigating hip abductor muscle strength following TKA/UKA
- The subject and inclusion/exclusion criteria are clearly stated to obtain and present comparable data.
- Possible limitations are the restricted time period of publication and language restriction to English or German.
- Possibility of limited and heterogenous data availability to perform a meta-analysis

INTRODUCTION:

Degenerative diseases of the musculoskeletal system such as osteoarthritis are one of the leading burdens on the health care system, social security system and certainly on individuals. Prevalence of knee OA is estimated to be approximately 10% in men and 13% in women at the age of 60 years or older[1]. OA is expected to be the fourth leading cause of disability by the year of 2020, and the number of knee arthroplasties performed[2,3].

Different static and dynamic biomechanical components influence the functional knee mechanics. Static elements are alignment and bony geometry. The neutral mechanical axis of the lower limb passes through the center of the tibial plateau in the frontal plane in standing, where the femur and tibia mechanical axes are colinear. This axis is altered in valgus or varus deformity[4,5]. Physiologically, during the stance phase of walking, the centre of load is located over the medial condyle creating an adduction moment[6,7]. Ligaments and muscles of the joint form the group of dynamic stabilizers and mainly resist the adduction moment[7]. As the next proximal articulation, the hip joint contributes to knee biomechanics. The hip abductor muscles abduct the hip joint, support pelvic stability during single leg stance and directly affect the tibiofemoral and patellofemoral joint kinematics. Moreover, the hip abductor muscle group controls the internal rotation of the femur [8]. In case of hip abductor muscle strength deficit, the contralateral pelvic side drops while walking, a condition known as “Trendelenburg gait”[9]. This movement initially leads to a shift of the center of mass away from the stance limb, causing an adduction moment. It can be compensated by leaning the trunk toward the stance limb and shifting the center of mass over the stance limb by a higher abduction moment. [8] The protective effect of greater hip abduction moment has also been reported in terms of reduced medial tibiofemoral OA progression[10]. As a result, patellar tracking can be also altered and cause knee pain [11,12,13]. Isokinetic measurements have shown that hip abductor muscle weakness is present in patients with knee OA[14,15].

Reduced hip abductor muscle strength can implicate functional and performance-based outcome after TKA, therefore maintaining and strengthening of the hip abductor muscles form a clinically relevant factor in patient receiving knee arthroplasty[16,17].

The purpose of this protocol is to present a specific methodology for conducting a systematic review and summarizing the available primary research regarding hip abductor muscle strength in patients following TKA/UKA and perform a meta-analysis of the available data. Moreover, we aim to investigate possible influencing factors, such as patient demographics, surgical methods, study methods and rehabilitation programs. We designed the study

question using the PICOS (Population, Intervention, Comparison, Outcome, Study design) strategy (Table 1)[18].

METHODS AND ANALYSES:

The protocol was developed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses Protocols (PRISMA-P) guideline[19](Supplementary a). Bibliographic database searching was initiated on December 19, 2019. The review was submitted for registration prospectively in PROSPERO on January 5th, 2020 and the expected completion date is July 1st, 2020[20].

Eligibility criteria

Inclusion criteria

Human based clinical studies reporting on hip abductor muscle strength after primary TKA/UKA will be considered for inclusion. No restriction regarding the study design, operative approach, prosthesis design, age and sex of the patients or severity of OA/AVN will be placed. Date of publication will be limited to a time period from January 1, 1990 to the date of our last search.

Exclusion criteria

Studies published before 01.01.1990, published in a language other than English or German, not reporting absolute values of hip abductor muscle strength or torque ratios, or reporting on hip abductor strength measured with hand-held manometer/dynamometer or at a hip abduction angle other than 0° will be excluded. Articles reporting posttraumatic indications for TKA/UKA will not be considered for inclusion.

Methodological considerations

Studies reporting hip abductor strength measurements by isokinetic/isometric dynamometers and at a 0° hip abduction angle will be considered for inclusion because manual measurements because the results are not reliable and not directly comparable with studies using electronic dynamometers and abduction angle other than 0° do not show relevant muscle function/strength during walking and standing. Furthermore the exclusion of these studies will allow us to collect standardized, comparable data in order to enable meta-analysis[21].

Information sources and search strategy

Text word synonyms and database-specific subject headings for knee OA, knee arthroplasty, and hip abductor function will be used. We will search the electronic databases Embase via embase.com, Medline via Ovid, SportDiscus via EBSCOHost, the Web of Science Core Collection, and Scopus (Supplementary b). In the primary search no language restrictions will be applied. Time period of the search will be limited to articles published after January 1, 1990. References will be exported to Endnote X9 and deduplicated. The detailed search strategy can be found in the supplementary document.

Study records: data management, selection process and data extraction

Titles and abstracts of all retrieved references will be independently reviewed and screened by two reviewers (PK and PI) to identify studies that potentially meet the inclusion criteria. All potentially relevant references will be collected in full-text and independently assessed by two reviewers (PK and PI). Any disagreements regarding eligibility will be resolved by consensus and by necessity, a third review author (AM) will make a final decision. In order to find possible additional studies, we will screen the bibliographic references of all included articles as well as the citations. Data from the full texts will be extracted and entered into a standardized excel data entry form by PK and PI based piloting extractions. The study selection process will be presented in form of a PRISMA diagram[19]. The information to be extracted can be found in Table 2. We will contact principal investigators and/or corresponding author(s) twice by email, in case of conference abstracts, in order to collect their results. Potential conference abstracts will be considered for inclusion only if appropriate data are available for the outcomes of this study.

Outcomes and priorisation

The main outcomes will be:

1. Absolute values of isometric/isokinetic hip abductor torque in patients following TKA/UKA, or in asymptomatic control groups
2. Torque ratio (ipsilateral hip/contralateral hip) of hip abductors following TKA/UKA
3. Change in hip abductor torque/hip abductor torque ratio from baseline to each follow-up
4. Differences in hip abductor torque/torque ratio between patients after TKA/UKA and healthy control groups.

The secondary outcomes will be:

1. Surgical approaches/methods influencing the hip abductor muscle strength deficits after TKA/UKA
2. Pre- and postoperative knee alignment influencing the hip abductor muscle strength deficits after TKA/UKA
3. Patient characteristics influencing the hip abductor muscle strength deficits after TKA/UKA
4. Rehabilitation programs influencing the hip abductor muscle strength deficits after TKA/UKA

Risk of bias in individual studies

To minimise bias, articles that meet the inclusion criteria will be checked by two reviewers (PK and PI) independently according to a modified version of the NOS[22](Supplementary c). According to the modified NOS each study will be valued with 1 to 6 stars where higher scores indicate higher level of quality. No separate tool will be used to assess the risk of bias of randomized control trials, since we do not extract estimates of treatment differences from RCTs but use them as a source for observational data.

Data synthesis

We will extract any quantitative/qualitative data from all eligible studies according to the main outcomes (mean, median, etc,), on the population (SD, interquartile ranges, percentile), on measurements (standard errors, CI, p-values, sample size), as well as the secondary outcomes for both purposes (systematic review and meta-analyses). Furthermore, all details specific to the review question will be extracted. If the information is available for several time points, the data will be extracted for all time points. The data will be presented in tabular format and forest plots. Depending on availability of appropriate data for comparable specific patient groups with same measurement method in different studies, these results will also be subjected to meta-analysis. Where statistical pooling is not possible, the findings will be presented in narrative form. Meta regression and subgroup specific meta analyses will be conducted to investigate the effect of time since TKA/UKA and measurement type (isokinetic or isometric) on different 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. Meta regression and subgroup specific meta analyses will be used to investigate the influence of time since TKA/UKA and type of measurement (isokinetic or isometric) on the different outcomes. In case of sufficient information, these analyses will be extended to patient characteristics, surgical approach or

rehabilitation program. We will contact corresponding authors when the necessary data is missing or unclear. The data extraction will be cross-checked independently.

Meta-bias(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

Grading of Recommendations Assessment, Development and Evaluation system (GRADE) will be applied[23].

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 study results will be published in a peer reviewed journal and as conference presentation.

Patient and public involvement

There is no patient and/or public involvement planned for this review.

Authors contributions

PI, PK and AM will perform this systematic review and meta-analysis. The protocol has been registered in PROSPERO by PK. The search strategy was designed by CA. CN 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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COMPETING INTERESTS STATEMENT

The authors declare no competing interest.

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Figures and Legends:

Item	Specification
Population, or participants and conditions of interest	Patients with OA or AVN of the knee (any age, gender and severity)
Interventions	TKA/UKA
Comparisons or control groups	For comparison between limbs of the same subject: asymptomatic contralateral hip and knee For comparison between patients and heathy individuals: asymptomatic control subjects
Outcomes of interest	Muscle strength of hip abductors
Study designs	Any study design, published studies, conference abstracts to be considered

Table 1: The Population, Intervention, Comparison, Outcome, Study design (PICOS) process[18].

No.	Description
1	Authors and year of publication
2	Country of origin of the study
3	Type of study
4	Study population
5	Study completion rate
6	Diagnosis
7	Surgical approach: medial parapatellar; modified medial parapatellar according to Insall; subvastus; midvastus; trivector-retaining; lateral; lateral with tuberositas osteotomy[24]
8	Study population demographics

9	Pre- and postoperative frontal and sagittal plane knee alignment
10 10a 10b 10c	Measurement methods Isometric/isokinetic strength measurement Angle of isometric measurement/velocity of isokinetic measurement Patient position during the measurement (lying supine/side-lying/standing)
11	Comparators: healthy individuals; asymptomatic contralateral side; no comparator
12	Total duration of follow up (weeks/months after the operation)
13	Measurement stages (preoperative, follow up in weeks/months after the operation)
14	Information regarding the rehabilitation protocols
15 15a 15b 15c 15d	Outcome (mean values, standard deviations (SDs) and confidence intervals (CIs)) Absolute values of hip abductor torque in patients after TKA/UKA, or in asymptomatic control groups Torque ratio (operated side/contralateral hip) of hip abductors in patients after TKA/UKA Change in hip abductor torque / hip abductor torque ratio from baseline to each follow-up Differences in hip abductor torque / torque ratios between patients after TKA/UKA and healthy control groups.
16	Authors conclusions
17	Information regarding risk of bias

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

Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis - Search strategy

Appendices

Appendix 1: Search strategies

Embase.com

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((('knee osteoarthritis'/de OR (((knee OR femorotibial OR patellofemoral) NEAR/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR 'degenerative joint disease*')) OR 'gonarthrosis'):ab,ti)

AND

('knee arthroplasty'/exp OR 'total knee arthroplasty'/de OR 'arthroplasty'/de OR 'total arthroplasty'/de OR 'knee prosthesis'/de OR 'femoral knee prosthesis'/de OR 'hinge knee prosthesis'/exp OR 'patella prosthesis'/de OR 'patellofemoral prosthesis'/de OR 'tibial knee prosthesis'/de OR 'total knee prosthesis'/de OR 'unicompartmental knee prosthesis'/de OR 'joint prosthesis'/de OR 'endoprosthesis'/de OR 'minimally invasive surgery'/de OR (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR 'artificial knee*' OR TKR OR TKA OR (('minimally invasive' OR mini-invasive OR minimal OR 'minimal access') NEAR/3 (surgery OR 'surgical method*' OR 'surgical procedure*' OR 'surgical technique*' OR operation OR 'operative treatment' OR 'operative intervention' OR 'operative repair' OR 'operative restoration')) OR 'Active UKA' OR 'Advance Medial Pivot' OR 'Advantim' OR 'ALPINA PS' OR 'Anatomic Graduated Component' OR 'Ascent' OR 'ATTUNE' OR 'Bi-Surface' OR 'Duracon' OR 'EMPOWR' OR 'Genesis II' OR 'iBalance Unicondylar Knee' OR 'Insall-Burstein II' OR 'InterSpace Knee' OR 'KineMax' OR 'KineSpring' OR 'Legion' OR 'Marmor' OR 'Maxim' OR 'Maximum Congruent Knee system' OR 'Miller-Galante' OR 'Natural Knee II' OR 'Natural-Knee Flex System' OR 'NexGen' OR 'Optetrak' OR 'OrthoGlide' OR 'Oxinium' OR 'Persona Knee System' OR 'Press-Fit Condylar' OR 'Profix' OR 'Repicci' OR 'Restoris' OR 'Scorpio' OR 'Search Evolution' OR 'Segmental Knee System' OR 'Series 7000' OR 'Sigma' OR 'Triathlon' OR 'Tricon knee' OR 'UniCAP' OR 'Vanguard' OR 'Advance Total Knee' OR 'Alegretto' OR 'EIUS' OR 'UC Plus Solution' OR 'Uni-Knee' OR 'Uniglide' OR '3DKnee' OR 'Advance Stature Knee' OR 'HemiCAP' OR 'Dual Articular 2000' OR 'Endo-Model' OR 'Endo-Modell' OR 'Endomodel' OR 'EnduRo' OR 'LCS Complete' OR 'Oxford' OR 'P.F.C. Sigma' OR 'PFC Sigma' OR 'Rotaflex' OR 'S-ROM Noiles' OR 'Avon' OR 'Regenerex'):ab,ti))

OR

(('knee osteoarthritis'/de OR 'osteoarthritis'/de OR 'avascular necrosis'/de OR 'bone necrosis'/de OR (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR 'degenerative joint disease*' OR 'gonarthrosis' OR ((avascular OR bone) NEAR/3 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis):ab,ti)

AND

('knee arthroplasty'/exp OR 'total knee arthroplasty'/de OR 'knee prosthesis'/de OR 'femoral knee prosthesis'/de OR 'hinge knee prosthesis'/exp OR 'patella prosthesis'/de OR 'patellofemoral prosthesis'/de OR 'tibial knee prosthesis'/de OR 'total knee prosthesis'/de OR 'unicompartmental knee prosthesis'/de OR (((knee OR femorotibial OR patella* OR patellofemoral) NEAR/3 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR 'artificial knee*' OR TKR OR TKA OR 'Active UKA' OR 'Advance Medial Pivot' OR 'Advantim' OR 'ALPINA PS' OR 'Anatomic Graduated Component' OR 'Ascent' OR 'ATTUNE' OR 'Bi-Surface' OR 'Duracon' OR 'EMPOWR' OR 'Genesis II' OR 'iBalance Unicondylar Knee' OR 'Insall-Burstein II' OR 'InterSpace Knee' OR 'KineMax' OR 'KineSpring' OR 'Legion' OR 'Marmor' OR 'Maxim' OR 'Maximum Congruent Knee system' OR 'Miller-Galante' OR 'Natural Knee II' OR 'Natural-Knee Flex System' OR 'NexGen' OR 'Optetrak' OR 'OrthoGlide' OR 'Oxinium' OR 'Persona Knee System' OR 'Press-Fit Condylar' OR 'Profix' OR 'Repicci' OR 'Restoris' OR 'Scorpio' OR 'Search Evolution' OR 'Segmental Knee System' OR 'Series 7000' OR 'Sigma' OR 'Triathlon' OR 'Tricon knee' OR 'UniCAP' OR 'Vanguard' OR 'Advance Total Knee' OR 'Alegretto' OR 'EIUS' OR 'UC Plus Solution' OR 'Uni-Knee' OR 'Uniglide' OR '3DKnee' OR 'Advance Stature Knee' OR 'HemiCAP' OR 'Dual Articular 2000' OR 'Endo-Model' OR 'Endo-Modell' OR 'Endomodel' OR 'EnduRo' OR 'LCS Complete' OR 'Oxford' OR 'P.F.C. Sigma' OR 'PFC Sigma' OR 'Rotaflex' OR 'S-ROM Noiles' OR 'Avon' OR 'Regenerex'):ab,ti)))

AND

('muscle strength'/de OR 'muscle weakness'/de OR 'torque'/de OR 'hip abductor muscle'/de OR 'pelvic movement'/de OR (((muscle OR muscular) NEAR/3 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR 'torsional moment*' OR 'turning force*' OR newton-meter* OR 'hip abduct*' OR gluteus OR 'gluteal muscle*' OR 'abduction motion' OR ((pelvic OR pelvis) NEAR/3 movement*)):ab,ti)

NOT

(('animal'/de OR 'animal experiment'/exp OR 'nonhuman'/de) NOT ('human'/exp OR 'human experiment'/de))

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(((osteoarthritis, knee/ OR (((knee OR femorotibial OR patellofemoral) ADJ5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR degenerative joint disease*)) OR gonarthrosis).ab,ti.)

AND

(arthroplasty, replacement, knee/ OR arthroplasty/ OR arthroplasty, replacement/ OR knee prosthesis/ OR joint prosthesis/ OR "prostheses and implants"/ OR minimally invasive surgical procedures/ OR (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR artificial knee* OR TKR OR TKA OR ((minimally invasive OR mini-invasive OR minimal OR minimal access) ADJ3 (surgery OR surgical method* OR surgical procedure* OR surgical technique* OR operation OR operative treatment OR operative intervention OR operative repair OR operative restoration)) OR Active UKA OR Advance Medial Pivot OR Advantim OR ALPINA PS OR Anatomic Graduated Component OR Ascent OR ATTUNE OR Bi-Surface OR Duracon OR EMPOWR OR Genesis II OR iBalance Unicondylar Knee OR Insall-Burstein II OR InterSpace Knee OR

KineMax OR KineSpring OR Legion OR Marmor OR Maxim OR Maximum Congruent Knee system OR Miller-Galante OR Natural Knee II OR Natural-Knee Flex System OR NexGen OR Optetrak OR OrthoGlide OR Oxinium OR Persona Knee System OR Press-Fit Condylar OR Profix OR Repicci OR Restoris OR Scorpio OR Search Evolution OR Segmental Knee System OR Series 7000 OR Sigma OR Triathlon OR Tricon knee OR UniCAP OR Vanguard OR Advance Total Knee OR Alegretto OR EIUS OR UC Plus Solution OR Uni-Knee OR Uniglide OR 3DKnee OR Advance Stature Knee OR HemiCAP OR Dual Articular 2000 OR Endo-Model OR Endo-Modell OR Endomodel OR EnduRo OR LCS Complete OR Oxford OR PFC Sigma OR Rotaflex OR S-ROM Noiles OR Avon OR Regenerex).ab,ti.))

OR

((osteoarthritis, knee/ OR osteoarthritis/ OR osteonecrosis/ OR (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR degenerative joint disease* OR gonarthrosis OR ((avascular OR bone) ADJ3 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis).ab,ti.)

AND

(arthroplasty, replacement, knee/ OR knee prosthesis/ OR (((knee OR femorotibial OR patella* OR patellofemoral) ADJ3 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR artificial knee* OR TKR OR TKA OR Active UKA OR Advance Medial Pivot OR Advantim OR ALPINA PS OR Anatomic Graduated Component OR Ascent OR ATTUNE OR Bi-Surface OR Duracon OR EMPOWR OR Genesis II OR iBalance Unicondylar Knee OR Insall-Burstein II OR InterSpace Knee OR KineMax OR KineSpring OR Legion OR Marmor OR Maxim OR Maximum Congruent Knee system OR Miller-Galante OR Natural Knee II OR Natural-Knee Flex System OR NexGen OR Optetrak OR OrthoGlide OR Oxinium OR Persona Knee System OR Press-Fit Condylar OR Profix OR Repicci OR Restoris OR Scorpio OR Search Evolution OR Segmental Knee System OR Series 7000 OR Sigma OR Triathlon OR Tricon knee OR UniCAP OR Vanguard OR Advance Total Knee OR Alegretto OR EIUS OR UC Plus Solution OR Uni-Knee OR Uniglide OR 3DKnee OR Advance Stature Knee OR HemiCAP OR Dual Articular 2000 OR Endo-Model OR Endo-Modell OR Endomodel OR EnduRo OR LCS Complete OR Oxford OR PFC Sigma OR Rotaflex OR S-ROM Noiles OR Avon OR Regenerex).ab,ti.)))

AND

(muscle strength/ OR muscle weakness/ OR torque/ OR (((muscle OR muscular) ADJ3 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR torsional moment* OR turning force* OR newton-meter* OR hip abduct* OR gluteus OR gluteal muscle* OR abduction motion OR ((pelvic OR pelvis) ADJ3 movement*)).ab,ti.)

NOT

(exp animals/ NOT humans/)

SportDiscus

(20191219; 283 hits)

((((((TI knee OR AB knee OR TI femorotibial OR AB femorotibial OR TI patellofemoral OR AB patellofemoral) N5 (TI osteoarthriti* OR AB osteoarthriti* OR TI arthriti* OR AB arthriti* OR TI osteoarthrosis OR AB osteoarthrosis OR TI osteoarthroses OR AB osteoarthroses OR TI arthrosis OR AB arthrosis OR TI arthroses OR AB arthroses OR TI arthropathy OR AB arthropathy OR TI

"degenerative joint disease*" OR AB "degenerative joint disease*")) OR TI gonarthrosis OR AB gonarthrosis)) AND (DE "ARTHROPLASTY" OR DE "TOTAL knee replacement" OR DE "ARTIFICIAL joints" OR DE "PROSTHETICS" OR DE "ARTIFICIAL knees" OR (TI replacement* OR AB replacement* OR TI reconstruct* OR AB reconstruct* OR TI arthroplast* OR AB arthroplast* OR TI prosthes* OR AB prosthes* OR TI arthroprosthes* OR AB arthroprosthes* OR TI endoprosthes* OR AB endoprosthes* OR TI implant* OR AB implant* OR TI "artificial knee*" OR AB "artificial knee*" OR TI TKR OR AB TKR OR TI TKA OR AB TKA OR ((TI "minimally invasive" OR AB "minimally invasive" OR TI mini-invasive OR AB mini-invasive OR TI minimal OR AB minimal OR TI "minimal access" OR AB "minimal access") N3 (TI surgery OR AB surgery OR TI "surgical method*" OR AB "surgical method*" OR TI "surgical procedure*" OR AB "surgical procedure*" OR TI "surgical technique*" OR AB "surgical technique*" OR TI operation OR AB operation OR TI "operative treatment" OR AB "operative treatment" OR TI "operative intervention" OR AB "operative intervention" OR TI "operative repair" OR AB "operative repair" OR TI "operative restoration" OR AB "operative restoration")) OR TI "Active UKA" OR AB "Active UKA" OR TI "Advance Medial Pivot" OR AB "Advance Medial Pivot" OR TI Advantim OR AB Advantim OR TI "ALPINA PS" OR AB "ALPINA PS" OR TI "Anatomic Graduated Component" OR AB "Anatomic Graduated Component" OR TI Ascent OR AB Ascent OR TI ATTUNE OR AB ATTUNE OR TI Bi-Surface OR AB Bi-Surface OR TI Duracon OR AB Duracon OR TI EMPOWR OR AB EMPOWR OR TI "Genesis II" OR AB "Genesis II" OR TI "iBalance Unicondylar Knee" OR AB "iBalance Unicondylar Knee" OR TI "Insall-Burstein II" OR AB "Insall-Burstein II" OR TI "InterSpace Knee" OR AB "InterSpace Knee" OR TI KineMax OR AB KineMax OR TI KineSpring OR AB KineSpring OR TI Legion OR AB Legion OR TI Marmor OR AB Marmor OR TI Maxim OR AB Maxim OR TI "Maximum Congruent Knee system" OR AB "Maximum Congruent Knee system" OR TI Miller-Galante OR AB Miller-Galante OR TI "Natural Knee II" OR AB "Natural Knee II" OR TI "Natural-Knee Flex System" OR AB "Natural-Knee Flex System" OR TI NexGen OR AB NexGen OR TI Optetrak OR AB Optetrak OR TI OrthoGlide OR AB OrthoGlide OR TI Oxinium OR AB Oxinium OR TI "Persona Knee System" OR AB "Persona Knee System" OR TI "Press-Fit Condylar" OR AB "Press-Fit Condylar" OR TI Profix OR AB Profix OR TI Repicci OR AB Repicci OR TI Restoris OR AB Restoris OR TI Scorpio OR AB Scorpio OR TI "Search Evolution" OR AB "Search Evolution" OR TI "Segmental Knee System" OR AB "Segmental Knee System" OR TI Series OR AB Series OR TI Sigma OR AB Sigma OR TI Triathlon OR AB Triathlon OR TI "Tricon knee" OR AB "Tricon knee" OR TI UniCAP OR AB UniCAP OR TI Vanguard OR AB Vanguard OR TI "Advance Total Knee" OR AB "Advance Total Knee" OR TI Alegretto OR AB Alegretto OR TI EIUS OR AB EIUS OR TI "UC Plus Solution" OR AB "UC Plus Solution" OR TI Uni-Knee OR AB Uni-Knee OR TI Uniglide OR AB Uniglide OR TI DKnee OR AB DKnee OR TI "Advance Stature Knee" OR AB "Advance Stature Knee" OR TI HemiCAP OR AB HemiCAP OR TI "Dual Articular" OR AB "Dual Articular" OR TI Endo-Model OR AB Endo-Model OR TI Endo-Modell OR AB Endo-Modell OR TI Endomodel OR AB Endomodel OR TI EnduRo OR AB EnduRo OR TI "LCS Complete" OR AB "LCS Complete" OR TI Oxford OR AB Oxford OR TI "PFC Sigma" OR AB "PFC Sigma" OR TI Rotaflex OR AB Rotaflex OR TI "S-ROM Noiles" OR AB "S-ROM Noiles" OR TI Avon OR AB Avon OR TI Regenerex OR AB Regenerex))) OR ((DE "OSTEOARTHRITIS" OR DE "OSTEONECROSIS" OR DE "OSTEOCHONDROSIS" OR (TI osteoarthriti* OR AB osteoarthriti* OR TI arthriti* OR AB arthriti* OR TI osteoarthrosis OR AB osteoarthrosis OR TI osteoarthroses OR AB osteoarthroses OR TI arthrosis OR AB arthrosis OR TI arthroses OR AB arthroses OR TI arthropathy OR AB arthropathy OR TI "degenerative joint disease*" OR AB "degenerative joint disease*" OR TI gonarthrosis OR AB gonarthrosis OR ((TI avascular OR AB avascular OR TI bone OR AB bone) N3 (TI necrosis OR AB necrosis OR TI infarction OR AB infarction)) OR TI osteonecrosis OR AB osteonecrosis OR TI osteoradionecrosis OR AB osteoradionecrosis)) AND (DE "TOTAL knee replacement" OR DE "ARTIFICIAL knees" OR (((TI knee OR AB knee OR TI femorotibial OR AB femorotibial OR TI patella* OR AB patella* OR TI patellofemoral OR AB patellofemoral) N3 (TI replacement* OR AB replacement* OR TI reconstruct* OR AB reconstruct* OR TI arthroplast* OR AB arthroplast* OR TI prosthes* OR AB prosthes* OR TI arthroprosthes* OR AB arthroprosthes* OR TI endoprosthes* OR AB endoprosthes*

OR TI implant* OR AB implant*)) OR TI "artificial knee*" OR AB "artificial knee*" OR TI TKR OR AB TKR OR TI TKA OR AB TKA OR TI "Active UKA" OR AB "Active UKA" OR TI "Advance Medial Pivot" OR AB "Advance Medial Pivot" OR TI Advantim OR AB Advantim OR TI "ALPINA PS" OR AB "ALPINA PS" OR TI "Anatomic Graduated Component" OR AB "Anatomic Graduated Component" OR TI Ascent OR AB Ascent OR TI ATTUNE OR AB ATTUNE OR TI Bi-Surface OR AB Bi-Surface OR TI Duracon OR AB Duracon OR TI EMPOWR OR AB EMPOWR OR TI "Genesis II" OR AB "Genesis II" OR TI "iBalance Unicondylar Knee" OR AB "iBalance Unicondylar Knee" OR TI "Insall-Burstein II" OR AB "Insall-Burstein II" OR TI "InterSpace Knee" OR AB "InterSpace Knee" OR TI KineMax OR AB KineMax OR TI KineSpring OR AB KineSpring OR TI Legion OR AB Legion OR TI Marmor OR AB Marmor OR TI Maxim OR AB Maxim OR TI "Maximum Congruent Knee system" OR AB "Maximum Congruent Knee system" OR TI Miller-Galante OR AB Miller-Galante OR TI "Natural Knee II" OR AB "Natural Knee II" OR TI "Natural-Knee Flex System" OR AB "Natural-Knee Flex System" OR TI NexGen OR AB NexGen OR TI Optetrak OR AB Optetrak OR TI OrthoGlide OR AB OrthoGlide OR TI Oxinium OR AB Oxinium OR TI "Persona Knee System" OR AB "Persona Knee System" OR TI "Press-Fit Condylar" OR AB "Press-Fit Condylar" OR TI Profix OR AB Profix OR TI Repicci OR AB Repicci OR TI Restoris OR AB Restoris OR TI Scorpio OR AB Scorpio OR TI "Search Evolution" OR AB "Search Evolution" OR TI "Segmental Knee System" OR AB "Segmental Knee System" OR TI Series OR AB Series OR TI Sigma OR AB Sigma OR TI Triathlon OR AB Triathlon OR TI "Tricon knee" OR AB "Tricon knee" OR TI UniCAP OR AB UniCAP OR TI Vanguard OR AB Vanguard OR TI "Advance Total Knee" OR AB "Advance Total Knee" OR TI Alegretto OR AB Alegretto OR TI EIUS OR AB EIUS OR TI "UC Plus Solution" OR AB "UC Plus Solution" OR TI Uni-Knee OR AB Uni-Knee OR TI Uniglide OR AB Uniglide OR TI DKnee OR AB DKnee OR TI "Advance Stature Knee" OR AB "Advance Stature Knee" OR TI HemiCAP OR AB HemiCAP OR TI "Dual Articular" OR AB "Dual Articular" OR TI Endo-Model OR AB Endo-Model OR TI Endo-Modell OR AB Endo-Modell OR TI Endomodel OR AB Endomodel OR TI EnduRo OR AB EnduRo OR TI "LCS Complete" OR AB "LCS Complete" OR TI Oxford OR AB Oxford OR TI "PFC Sigma" OR AB "PFC Sigma" OR TI Rotaflex OR AB Rotaflex OR TI "S-ROM Noiles" OR AB "S-ROM Noiles" OR TI Avon OR AB Avon OR TI Regenerex OR AB Regenerex)))) AND (DE "MUSCLE strength" OR DE "MUSCLE weakness" OR DE "TORQUE" OR DE "GLUTEAL muscles" OR DE "GLUTEUS medius" OR DE "GLUTEUS minimus" OR DE "PIRIFORMIS muscle" OR (((TI muscle OR AB muscle OR TI muscular OR AB muscular) N3 (TI strength OR AB strength OR TI power OR AB power OR TI force OR AB force OR TI weakness OR AB weakness OR TI weakening OR AB weakening OR TI insufficiency OR AB insufficiency OR TI fatigue OR AB fatigue OR TI deficit* OR AB deficit*)) OR TI torque OR AB torque OR TI "torsional moment*" OR AB "torsional moment*" OR TI "turning force*" OR AB "turning force*" OR TI newton-meter* OR AB newton-meter* OR TI "hip abduct*" OR AB "hip abduct*" OR TI gluteus OR AB gluteus OR TI "gluteal muscle*" OR AB "gluteal muscle*" OR TI "abduction motion" OR AB "abduction motion" OR ((TI pelvic OR AB pelvic OR TI pelvis OR AB pelvis) N3 TI movement* OR AB movement*))))

Web of Science Core Collection

(20191219; 662 hits)

TS=((((((knee OR femorotibial OR patellofemoral) NEAR/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*")) OR "gonarthrosis") AND (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR "artificial knee*" OR TKR OR TKA OR (("minimally invasive" OR mini-invasive OR minimal OR "minimal access") NEAR/2 (surgery OR "surgical method*" OR "surgical procedure*" OR "surgical technique*" OR operation OR "operative treatment" OR "operative intervention" OR "operative repair" OR "operative restoration")) OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated

Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex")) OR ((osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*" OR "gonarthrosis" OR ((avascular OR bone) NEAR/2 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis) AND (((knee OR femorotibial OR patella* OR patellofemoral) NEAR/2 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR "artificial knee*" OR TKR OR TKA OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex"))) AND (((muscle OR muscular) NEAR/2 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR "torsional moment*" OR "turning force*" OR newton-meter* OR "hip abduct*" OR gluteus OR "gluteal muscle*" OR "abduction motion" OR ((pelvic OR pelvis) NEAR/2 movement*)))

Scopus

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TITLE-ABS-KEY((((((knee OR femorotibial OR patellofemoral) W/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*")) OR "gonarthrosis") AND (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR "artificial knee*" OR TKR OR TKA OR (("minimally invasive" OR mini-invasive OR minimal OR "minimal access") W/2 (surgery OR "surgical method*" OR "surgical procedure*" OR "surgical technique*" OR operation OR "operative treatment" OR "operative intervention" OR "operative repair" OR "operative restoration")) OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak"

OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex")) OR ((osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*" OR "gonarthrosis" OR ((avascular OR bone) W/2 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis) AND (((knee OR femorotibial OR patella* OR patellofemoral) W/2 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR "artificial knee*" OR TKR OR TKA OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex"))) AND (((muscle OR muscular) W/2 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR "torsional moment*" OR "turning force*" OR newton-meter* OR "hip abduct*" OR gluteus OR "gluteal muscle*" OR "abduction motion" OR ((pelvic OR pelvis) W/2 movement*)))

ADAPTED NEWCASTLE - OTTAWA QUALITY ASSESSMENT SCALE
COHORT STUDIES

Selection

1. Representativeness of the patient cohort *
   a) truly representative of the corresponding patient cohort in the general community (e.g. multi center trial with different types of hospitals) *
   b) somewhat representative of the corresponding patient cohort (e.g. single center study in only hospital of the catchment area) *
   c) selected group of patients
   d) no or unclear description of the derivation of the patient cohort
2. Selection of the healthy control cohort (if applicable)
   a) drawn from the same community as the patient cohort *
   b) drawn from a different source
   c) no description of the derivation of the healthy cohort
3. Ascertainment of exposure (not applicable)
4. Demonstration that outcome of interest was not present at start of study (not applicable)

Comparability

1. Comparability of cohorts on the basis of the design or analysis (if applicable)
   a) study controls for age differences between cohorts (e.g. by matching or statistical adjustment for potential confounding) *
   b) study does not control for age differences between cohorts

Outcome

1. Assessment of outcome
   a) independent assessment (e.g. by nurses or researchers not involved in the study) *
   b) assessment by member of the research team
   c) no information given
2. Was follow-up long enough for patients to recover?
   a) yes (follow up at least 12 months) *
   b) no (follow up less than 12 months)

3. Adequacy of follow up of cohorts
    a) complete follow up - all subjects accounted for *
    b) subjects lost to follow up unlikely to introduce bias (e.g. drop out because of medical complications) or at least 90% *
    c) follow up rate < 90 % or no description of those lost or description suggests bias
    d) no statement

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Reported on Page
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	n.a.
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	9
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	n.a.
Support:			
Sources	5a	Indicate sources of financial or other support for the review	9
Sponsor	5b	Provide name for the review funder and/or sponsor	9
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	9
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	4
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	4
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	6
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Supplementary file

Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	2
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	6
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	5-7
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	7
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	8
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	8
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	8
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	8
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	8
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	9
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	9

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

BMJ Open

Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis: a systematic review and meta-analysis protocol

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Complete List of Authors:	Kvarda, Peter; University Hospital Basel, Orthopaedics and Traumatology,; Kantonsspital Baselland, Department of Orthopaedic Surgery and Traumatology Nüesch, Corina; University of Basel, Department of Clinical Research Egloff, Christian; University of Basel, Department of Orthopaedics and Traumatology Appenzeller-Herzog, Christian ; University of Basel, University Medical Library, Basel, Spiegelgasse 5, 4051 Basel, Switzerland Mündermann, Annegret ; University Hospital Basel, Orthopaedics and Traumatology; University of Basel, Department of Clinical Research Ismailidis, Petros; University Hospital Basel, Orthopaedics and Traumatology
Primary Subject Heading:	Surgery
Secondary Subject Heading:	Rehabilitation medicine, Evidence based practice
Keywords:	Knee < ORTHOPAEDIC & TRAUMA SURGERY, Hip < ORTHOPAEDIC & TRAUMA SURGERY, Adult orthopaedics < ORTHOPAEDIC & TRAUMA SURGERY, REHABILITATION MEDICINE

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Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis: a systematic review and meta-analysis protocol

Peter Kvarda [1,6], Corina Nüesch[1,2,3,4], Christian Egloff[1], Christian Appenzeller-Herzog[5], Annegret Mündermann[1,2,3,4], Petros Ismailidis[1,3]

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ABSTRACT

Introduction:

Reduced hip abductor strength may indirectly lead to changes in knee kinematics and functional impairment and has been reported in patients with patellofemoral pain and knee osteoarthritis (OA). Limited information is available regarding hip abductor strength following total or unicompartmental knee arthroplasty (TKA/UKA). The aims of this systematic review are to synthesize the evidence of hip abductor muscle strength deficits in patients following TKA/UKA and to determine influencing factors for these deficits.

Methods and analysis:

Embase, Medline, SportDiscus, the Web of Science Core Collection and Scopus will be searched for human based clinical studies investigating hip abductor muscle strength after TKA/UKA for knee OA or avascular necrosis (AVN). Articles studying hip abductor strength after knee arthroplasty for posttraumatic OA will not be considered. No restriction on study design, prosthesis design, surgical approach, patient characteristics or severity of OA/AVN will be applied. We will search articles published between January 1, 1990 and the date of our last search. Only articles in English or German language will be considered for inclusion. Studies reporting manually measured muscle strength or measurements performed at hip abduction angles other than 0° will be excluded. References will be screened by two reviewers independently. Where necessary, a third author will make the final decision. The assessment of quality and risk of bias will be performed with the modified Newcastle-Ottawa scale (NOS). Data will be extracted and presented in a tabular form. Depending on availability, comparable subgroup and meta-analyses will be conducted. Patient characteristics such as age, sex and surgical approach or rehabilitation program will be analysed, if sufficient data are available.

Ethics and dissemination:

No ethics approval is required. The results will be published in a peer reviewed journal and as conference presentation.

Registration details:

Registered in PROSPERO, acknowledgement of receipt Nr. 164339.

Keywords: abductor muscle strength, hip abductor, knee replacement, knee arthroplasty knee osteoarthritis, knee avascular necrosis

Strengths and limitations of this study:

- To our knowledge, there is no published systematic review investigating hip abductor muscle strength following TKA/UKA.
- The subject and inclusion/exclusion criteria are clearly stated to obtain and present comparable data.
- Possible limitations are the restricted time period of publication and language restriction to English or German.
- Possibility of limited and heterogenous data availability to perform a meta-analysis.

INTRODUCTION:

Degenerative diseases of the musculoskeletal system such as osteoarthritis are one of the leading burdens on the health care system, social security system and certainly on individuals. Prevalence of knee osteoarthritis (OA) is estimated to be approximately 10% in men and 13% in women at the age of 60 years or older.[1] OA is estimated to be the fourth leading cause of disability by the year of 2020, and the most common indication for performing knee arthroplasty.[2,3]

Different static and dynamic biomechanical components influence the functional knee mechanics. Static elements are alignment and bony geometry. A neutral mechanical axis of the lower limb during standing passes through the centre of the tibial plateau in the frontal plane. This axis is altered in valgus or varus deformity.[4,5] Physiologically, during the stance phase of walking, the centre of load is located over the medial condyle creating an external knee adduction moment.[6,7] Ligaments and muscles of the joint form the group of dynamic stabilizers and mainly resist the adduction moment.[7]

As the adjacent proximal articulation, the hip joint contributes to knee biomechanics. The hip abductor muscles abduct the femur, facilitate pelvic stability during single leg stance and walking, and directly affect the tibiofemoral and patellofemoral joint kinematics. Moreover, the hip abductor muscle group controls the internal rotation of the femur.[8] In case of hip abductor muscle strength deficit, the contralateral pelvic side drops while walking, a condition known as “Trendelenburg gait”[9] because the external hip adduction moment cannot be sufficiently balanced by the internal hip abduction moment primarily generated by hip abductor muscles. This can be compensated by leaning the trunk toward the support limb and shifting the centre of mass over the support limb and reduce the hip adduction moment.[8] The protective effect of greater internal hip abduction moment has also been reported in terms of reduced medial tibiofemoral OA progression.[10] Moreover, patellar tracking can be also altered and cause knee pain.[11,12,13] Isokinetic measurements have shown that hip abductor muscle weakness is present in patients with knee OA.[14,15] In a recent systematic review, Deasy et al. reported hip abductor weakness in patients with knee OA.[16]

Despite of extensive efforts of alternative treatment, today the only treatment for severe knee OA is total and unicompartmental knee arthroplasty (TKA/UKA). Reduced hip abductor muscle strength can implicate compromised functional and performance-based outcome after TKA/UKA, and hence maintaining and strengthening of the hip abductor muscles form a clinically relevant factor in patients undergoing TKA or UKA.[17,18,19,] However, to date studies investigating hip abductor muscle strength in patients undergoing TKA or UKA are scarce. In addition to outcome evaluations, quantitative assessment of muscle strength is important to understanding factors influencing surgical outcome. In contrast to knee flexor/extensor muscle strength, the impact of hip abductor muscle strength deficit in patients with TKA/UKA is currently poorly understood. The following questions remain unanswered:

- Do patients after unilateral TKA/UKA experience a muscle strength deficit in their operated compared to their unoperated side?
- How long after TKA/UKA does this deficit persist?
- Does the strength deficit after knee arthroplasty differ between patients with total versus unicompartmental arthroplasty?
- Are hip abductor muscle strength deficits after TKA/UKA influenced by pre- and postoperative knee alignment, patient characteristics or rehabilitation programs?

Therefore, the aim of the proposed systematic review is to synthesize the evidence of hip abductor muscle strength deficits in patients following TKA/UKA and to determine influencing factors for these deficits. The results of the proposed systematic review will provide extended information for physicians in the interest of improving patient management and outcome.

METHODS AND ANALYSES:

The protocol was developed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses Protocols (PRISMA-P) guideline[20](Supplementary a). Bibliographic database searching was initiated on December 19, 2019. The review was submitted for registration prospectively in PROSPERO on January 5th, 2020 and the expected completion date is July 1st, 2020.[21] We designed the study question

using the PICOS (Population, Intervention, Comparison, Outcome, Study design) strategy (Table 1).[22]

Eligibility criteria

Inclusion criteria

Human based clinical studies reporting on hip abductor muscle strength after primary TKA/UKA will be considered for inclusion. Case studies will not be considered for inclusion. No other restriction regarding the study design will be applied to broadly capture all possible appropriate studies. No restriction on operative approach, prosthesis design, age and sex of the patients or severity of OA/AVN will be placed. Date of publication will be limited to a time period from January 1, 1990 to the date of our last search. The limit of follow-up will be set to 24 months postoperatively.

Exclusion criteria

Studies published before 01.01.1990 or in a language other than English or German, not reporting absolute values of hip abductor muscle strength or torque ratios, or reporting hip abductor strength measured with hand-held manometer/dynamometer or at a hip abduction angles other than 0° will be excluded. Articles reporting posttraumatic indications for TKA/UKA or reporting measurements following revision TKA/UKA will not be considered for inclusion.

Methodological considerations

Studies reporting isokinetic or isometric measurements of hip abductor muscle strength at a 0° hip abduction angle using a dynamometer will be considered for inclusion. Manual measurements are not reliable and not directly comparable with measurements taken by electronic dynamometers. Measurements at hip abduction angles other than 0° do not represent relevant muscle function/strength during walking and standing. Moreover, the exclusion of these studies will allow to collect standardized, comparable data facilitating meta-analysis.[23]

Information sources and search strategy

Text word synonyms and database-specific subject headings for knee OA, knee arthroplasty, and hip abductor function will be used. We will search the electronic databases Embase via embase.com, Medline via Ovid, SportDiscus via EBSCOHost, the Web of Science Core Collection, and Scopus (Supplementary b). In the primary search no language restrictions will be applied. Time period of the search will be

limited to articles published after January 1, 1990. References will be exported to Endnote X9 (Clarivate, London, U.K.) and deduplicated. The detailed search strategy can be found in the supplementary document.

Study records: data management, selection process and data extraction

Titles and abstracts of all retrieved references will be independently reviewed and screened by two reviewers (PK and PI) to identify studies that potentially meet the inclusion criteria. All potentially relevant references will be collected in full-text and independently assessed by two reviewers (PK and PI). Any disagreements regarding eligibility will be resolved by consensus and by necessity, a third review author (AM) will make a final decision. To find possible additional studies, we will screen the bibliographic references of all included articles as well as the citations of those that are indexed in Scopus or Web of Science. The study selection process will be presented in form of a PRISMA diagram.[20] Data from the full texts will be extracted and entered into a standardized excel data entry form by PK and PI based on piloting extractions. The information to be extracted can be found in Table 2. We will contact corresponding authors when the necessary data is missing or unclear. Potential conference abstracts will be considered for inclusion only if appropriate data are available for the outcomes of this study. We will contact principal investigators and/or corresponding author(s) twice by email in case of conference abstracts to collect their results. The data extraction will be cross-checked independently.

Outcomes and priorisation

The main outcomes will be:

1. Absolute values of isometric/isokinetic hip abductor torque in patients following TKA/UKA, or in asymptomatic control groups
2. Torque ratio (ipsilateral hip/contralateral hip) of hip abductors following TKA/UKA
3. Change in hip abductor torque/hip abductor torque ratio from baseline to each follow-up
4. Differences in hip abductor torque/torque ratio between patients after TKA/UKA and healthy control groups.

The secondary outcomes will be:

1. Surgical approaches/methods of TKA/UKA
2. Pre- and postoperative knee alignment
3. Patient characteristics

4. Rehabilitation programs after TKA/UKA

Risk of bias in individual studies

To minimise bias, articles meeting the inclusion criteria will be assessed by two reviewers (PK and PI) independently using a modified version of the Newcaste-Ottawa Scale (NOS)[24] (Supplementary c). According to the modified NOS, each study will be valued with 1 to 6 stars where higher scores indicate higher level of quality. No separate tool will be used to assess the risk of bias of randomized control trials because we do not extract estimates of treatment differences from RCTs but use these as a source for cohort data.

Data synthesis

We will extract any quantitative and descriptive data from all eligible studies according to the main outcomes (mean, median, etc,), on the population (SD, interquartile ranges, percentile), on measurements (standard errors, CI, p-values, sample size), as well as the secondary outcomes for both purposes (systematic review and meta-analyses). Furthermore, all details specific to the review question will be extracted. If the information is available for several time points, the data will be extracted for all time points. The data will be presented in tabular format. Visual inspection of the forest plots and I^2-test will be used to assess heterogeneity between studies. Depending on availability of appropriate data for comparable specific patient groups with same measurement method in different studies, meta-analyses will be performed on these data. Meta-analysis will be based on random effects and the results will be illustrated by forest plots. Where statistical pooling is not possible, the findings will be presented in narrative form. Meta regression and subgroup specific meta analyses will be conducted to investigate the effect of time since TKA/UKA and measurement type (isokinetic or isometric) on different 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. Meta regression and subgroup specific meta analyses will be used to investigate the influence of time since TKA/UKA and type of measurement (isokinetic or isometric) on the different outcomes. In case of sufficient information, these analyses will be extended to patient characteristics, surgical approach, subtype of prostheses or rehabilitation program.

Meta-bias(es)

Funnel plots will be used to asses publication bias in our meta-analysis, presenting effect sizes plotted against their standard errors or precisions. To avoid subjective visual inspection of the graph, Egger's regression test will be used to assess the asymmetry. Egger's test regresses the standardized effect sizes on their precisions. In the absence of publication bias, the regression intercept is expected to be zero.

Confidence in cumulative evidence

Grading of Recommendations Assessment, Development and Evaluation system (GRADE) will be applied.[25] The confidence of evidence of randomised controlled trials can be downgraded according to the following factors: study limitations, inconsistency of results, indirectness of evidence, imprecision, publication bias. Non-randomised or observational studies can be upgraded for large magnitude of effect, evidence of a dose-response effect and all possible cofounding factors taken into account. After the grading process, the quality of evidence for each outcome will be rated as high, moderate, low or very low.

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 study results will be published in a peer reviewed journal and as conference presentation.

Patient and public involvement

There is no patient and/or public involvement planned for this review.

Authors contributions

The following work has been developed in contribution of each co-author. The manuscript underwent several revisions with substantial contributions provided by each co-author. PI, PK and AM will perform this systematic review and meta-analysis. The protocol has been registered in PROSPERO by PK. The search strategy was designed by CA. CN reviewed the protocol and was responsible for the strategy of data synthesis. CE cooperated in study design development, as well as in

manuscript editing. All authors gave final approval of the manuscript prior to submission.

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COMPETING INTERESTS STATEMENT

The authors declare no competing interest.

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Figures and Legends:

Table 1: The Population, Intervention, Comparison, Outcome, Study design (PICOS) process[22].

Item	Specification
Population, or participants and conditions of interest	Patients with OA or AVN of the knee (any age, gender and severity)
Interventions	TKA/UKA
Comparisons or control groups	For comparison between limbs of the same subject: asymptomatic contralateral hip and knee For comparison between patients and heathy individuals: asymptomatic control subjects
Outcomes of interest	Muscle strength of hip abductors
Study designs	Any study design, published studies, conference abstracts to be considered

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 origin of the study
3	Type of study
4	Study population
5	Study completion rate
6	Diagnosis
7	Surgical approach: medial parapatellar; modified medial parapatellar according to Insall; subvastus; midvastus; trivector-retaining; lateral; lateral with tuberositas osteotomy[26]
8	Study population demographics
9	Pre- and postoperative frontal and sagittal plane knee alignment
10 10a 10b 10c	Measurement methods Isometric/isokinetic strength measurement Angle of isometric measurement/velocity of isokinetic measurement Patient position during the measurement (lying supine/side-lying/standing)
11	Comparators: healthy individuals; asymptomatic contralateral side; no comparator
12	Total duration of follow up (weeks/months after the operation)
13	Measurement stages (preoperative, follow up in weeks/months after the operation)
14	Information regarding the rehabilitation protocols
15 15a 15b 15c 15d	Outcome (mean values, standard deviations (SDs) and confidence intervals (CIs)) Absolute values of hip abductor torque in patients after TKA/UKA, or in asymptomatic control groups Torque ratio (operated side/contralateral hip) of hip abductors in patients after TKA/UKA Change in hip abductor torque / hip abductor torque ratio from baseline to each follow-up Differences in hip abductor torque / torque ratios between patients after TKA/UKA and healthy control groups.
16	Authors conclusions
17	Information regarding risk of bias

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Reported on Page
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	n.a.
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	9
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	n.a.
Support:			
Sources	5a	Indicate sources of financial or other support for the review	9
Sponsor	5b	Provide name for the review funder and/or sponsor	9
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	9
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	4
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	4
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	6
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Supplementary file

Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	2
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	6
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	5-7
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	7
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	8
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	8
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I_2, Kendall's τ)	8
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	8
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	8
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	9
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	9

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

ADAPTED NEWCASTLE - OTTAWA QUALITY ASSESSMENT SCALE
COHORT STUDIES

Selection

1. Representativeness of the patient cohort *
    a) truly representative of the corresponding patient cohort in the general community (e.g. multi center trial with different types of hospitals) *
    b) somewhat representative of the corresponding patient cohort (e.g. single center study in only hospital of the catchment area) *
    c) selected group of patients
    d) no or unclear description of the derivation of the patient cohort
2. Selection of the healthy control cohort (if applicable)
    a) drawn from the same community as the patient cohort *
    b) drawn from a different source
    c) no description of the derivation of the healthy cohort
3. Ascertainment of exposure (not applicable)
4. Demonstration that outcome of interest was not present at start of study (not applicable)

Comparability

1. Comparability of cohorts on the basis of the design or analysis (if applicable)
    a) study controls for age differences between cohorts (e.g. by matching or statistical adjustment for potential confounding) *
    b) study does not control for age differences between cohorts

Outcome

1. Assessment of outcome

    a) independent assessment (e.g. by nurses or researchers not involved in the study) *
    b) assessment by member of the research team
    c) no information given
2. Was follow-up long enough for patients to recover?
    a) yes (follow up at least 12 months) *
    b) no (follow up less than 12 months)

3. Adequacy of follow up of cohorts

a) complete follow up - all subjects accounted for *
b) subjects lost to follow up unlikely to introduce bias (e.g. drop out because of medical complications) or at least 90% *
c) follow up rate < 90 % or no description of those lost or description suggests bias
d) no statement

Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis - Search strategy

Appendices

Appendix 1: Search strategies

Embase.com

(20191219; 860 hits)

((('knee osteoarthritis'/de OR (((knee OR femorotibial OR patellofemoral) NEAR/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR 'degenerative joint disease*')) OR 'gonarthrosis'):ab,ti)

AND

('knee arthroplasty'/exp OR 'total knee arthroplasty'/de OR 'arthroplasty'/de OR 'total arthroplasty'/de OR 'knee prosthesis'/de OR 'femoral knee prosthesis'/de OR 'hinge knee prosthesis'/exp OR 'patella prosthesis'/de OR 'patellofemoral prosthesis'/de OR 'tibial knee prosthesis'/de OR 'total knee prosthesis'/de OR 'unicompartmental knee prosthesis'/de OR 'joint prosthesis'/de OR 'endoprosthesis'/de OR 'minimally invasive surgery'/de OR (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR 'artificial knee*' OR TKR OR TKA OR (('minimally invasive' OR mini-invasive OR minimal OR 'minimal access') NEAR/3 (surgery OR 'surgical method*' OR 'surgical procedure*' OR 'surgical technique*' OR operation OR 'operative treatment' OR 'operative intervention' OR 'operative repair' OR 'operative restoration')) OR 'Active UKA' OR 'Advance Medial Pivot' OR 'Advantim' OR 'ALPINA PS' OR 'Anatomic Graduated Component' OR 'Ascent' OR 'ATTUNE' OR 'Bi-Surface' OR 'Duracon' OR 'EMPOWR' OR 'Genesis II' OR 'iBalance Unicondylar Knee' OR 'Insall-Burstein II' OR 'InterSpace Knee' OR 'KineMax' OR 'KineSpring' OR 'Legion' OR 'Marmor' OR 'Maxim' OR 'Maximum Congruent Knee system' OR 'Miller-Galante' OR 'Natural Knee II' OR 'Natural-Knee Flex System' OR 'NexGen' OR 'Optetrak' OR 'OrthoGlide' OR 'Oxinium' OR 'Persona Knee System' OR 'Press-Fit Condylar' OR 'Profix' OR 'Repicci' OR 'Restoris' OR 'Scorpio' OR 'Search Evolution' OR 'Segmental Knee System' OR 'Series 7000' OR 'Sigma' OR 'Triathlon' OR 'Tricon knee' OR 'UniCAP' OR 'Vanguard' OR 'Advance Total Knee' OR 'Alegretto' OR 'EIUS' OR 'UC Plus Solution' OR 'Uni-Knee' OR 'Uniglide' OR '3DKnee' OR 'Advance Stature Knee' OR 'HemiCAP' OR 'Dual Articular 2000' OR 'Endo-Model' OR 'Endo-Modell' OR 'Endomodel' OR 'EnduRo' OR 'LCS Complete' OR 'Oxford' OR 'P.F.C. Sigma' OR 'PFC Sigma' OR 'Rotaflex' OR 'S-ROM Noiles' OR 'Avon' OR 'Regenerex'):ab,ti))

OR

(('knee osteoarthritis'/de OR 'osteoarthritis'/de OR 'avascular necrosis'/de OR 'bone necrosis'/de OR (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR 'degenerative joint disease*' OR 'gonarthrosis' OR ((avascular OR bone) NEAR/3 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis):ab,ti)

AND

('knee arthroplasty'/exp OR 'total knee arthroplasty'/de OR 'knee prosthesis'/de OR 'femoral knee prosthesis'/de OR 'hinge knee prosthesis'/exp OR 'patella prosthesis'/de OR 'patellofemoral prosthesis'/de OR 'tibial knee prosthesis'/de OR 'total knee prosthesis'/de OR 'unicompartmental knee prosthesis'/de OR (((knee OR femorotibial OR patella* OR patellofemoral) NEAR/3 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR 'artificial knee*' OR TKR OR TKA OR 'Active UKA' OR 'Advance Medial Pivot' OR 'Advantim' OR 'ALPINA PS' OR 'Anatomic Graduated Component' OR 'Ascent' OR 'ATTUNE' OR 'Bi-Surface' OR 'Duracon' OR 'EMPOWR' OR 'Genesis II' OR 'iBalance Unicondylar Knee' OR 'Insall-Burstein II' OR 'InterSpace Knee' OR 'KineMax' OR 'KineSpring' OR 'Legion' OR 'Marmor' OR 'Maxim' OR 'Maximum Congruent Knee system' OR 'Miller-Galante' OR 'Natural Knee II' OR 'Natural-Knee Flex System' OR 'NexGen' OR 'Optetrak' OR 'OrthoGlide' OR 'Oxinium' OR 'Persona Knee System' OR 'Press-Fit Condylar' OR 'Profix' OR 'Repicci' OR 'Restoris' OR 'Scorpio' OR 'Search Evolution' OR 'Segmental Knee System' OR 'Series 7000' OR 'Sigma' OR 'Triathlon' OR 'Tricon knee' OR 'UniCAP' OR 'Vanguard' OR 'Advance Total Knee' OR 'Alegretto' OR 'EIUS' OR 'UC Plus Solution' OR 'Uni-Knee' OR 'Uniglide' OR '3DKnee' OR 'Advance Stature Knee' OR 'HemiCAP' OR 'Dual Articular 2000' OR 'Endo-Model' OR 'Endo-Modell' OR 'Endomodel' OR 'EnduRo' OR 'LCS Complete' OR 'Oxford' OR 'P.F.C. Sigma' OR 'PFC Sigma' OR 'Rotaflex' OR 'S-ROM Noiles' OR 'Avon' OR 'Regenerex'):ab,ti)))

AND

('muscle strength'/de OR 'muscle weakness'/de OR 'torque'/de OR 'hip abductor muscle'/de OR 'pelvic movement'/de OR (((muscle OR muscular) NEAR/3 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR 'torsional moment*' OR 'turning force*' OR newton-meter* OR 'hip abduct*' OR gluteus OR 'gluteal muscle*' OR 'abduction motion' OR ((pelvic OR pelvis) NEAR/3 movement*)):ab,ti)

NOT

(('animal'/de OR 'animal experiment'/exp OR 'nonhuman'/de) NOT ('human'/exp OR 'human experiment'/de))

Ovid Medline

(20191219; 449 hits)

(((osteoarthritis, knee/ OR (((knee OR femorotibial OR patellofemoral) ADJ5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR degenerative joint disease*)) OR gonarthrosis).ab,ti.)

AND

(arthroplasty, replacement, knee/ OR arthroplasty/ OR arthroplasty, replacement/ OR knee prosthesis/ OR joint prosthesis/ OR "prostheses and implants"/ OR minimally invasive surgical procedures/ OR (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR artificial knee* OR TKR OR TKA OR ((minimally invasive OR mini-invasive OR minimal OR minimal access) ADJ3 (surgery OR surgical method* OR surgical procedure* OR surgical technique* OR operation OR operative treatment OR operative intervention OR operative repair OR operative restoration)) OR Active UKA OR Advance Medial Pivot OR Advantim OR ALPINA PS OR Anatomic Graduated Component OR Ascent OR ATTUNE OR Bi-Surface OR Duracon OR EMPOWR OR Genesis II OR iBalance Unicondylar Knee OR Insall-Burstein II OR InterSpace Knee OR KineMax OR KineSpring OR Legion OR Marmor OR Maxim OR Maximum Congruent Knee system OR Miller-Galante OR Natural Knee II OR Natural-Knee Flex System OR NexGen OR Optetrak OR

OrthoGlide OR Oxinium OR Persona Knee System OR Press-Fit Condylar OR Profix OR Repicci OR Restoris OR Scorpio OR Search Evolution OR Segmental Knee System OR Series 7000 OR Sigma OR Triathlon OR Tricon knee OR UniCAP OR Vanguard OR Advance Total Knee OR Alegretto OR EIUS OR UC Plus Solution OR Uni-Knee OR Uniglide OR 3DKnee OR Advance Stature Knee OR HemiCAP OR Dual Articular 2000 OR Endo-Model OR Endo-Modell OR Endomodel OR EnduRo OR LCS Complete OR Oxford OR PFC Sigma OR Rotaflex OR S-ROM Noiles OR Avon OR Regenerex).ab,ti.))

OR

((osteoarthritis, knee/ OR osteoarthritis/ OR osteonecrosis/ OR (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR degenerative joint disease* OR gonarthrosis OR ((avascular OR bone) ADJ3 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis).ab,ti.)

AND

(arthroplasty, replacement, knee/ OR knee prosthesis/ OR (((knee OR femorotibial OR patella* OR patellofemoral) ADJ3 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR artificial knee* OR TKR OR TKA OR Active UKA OR Advance Medial Pivot OR Advantim OR ALPINA PS OR Anatomic Graduated Component OR Ascent OR ATTUNE OR Bi-Surface OR Duracon OR EMPOWR OR Genesis II OR iBalance Unicondylar Knee OR Insall-Burstein II OR InterSpace Knee OR KineMax OR KineSpring OR Legion OR Marmor OR Maxim OR Maximum Congruent Knee system OR Miller-Galante OR Natural Knee II OR Natural-Knee Flex System OR NexGen OR Optetrak OR OrthoGlide OR Oxinium OR Persona Knee System OR Press-Fit Condylar OR Profix OR Repicci OR Restoris OR Scorpio OR Search Evolution OR Segmental Knee System OR Series 7000 OR Sigma OR Triathlon OR Tricon knee OR UniCAP OR Vanguard OR Advance Total Knee OR Alegretto OR EIUS OR UC Plus Solution OR Uni-Knee OR Uniglide OR 3DKnee OR Advance Stature Knee OR HemiCAP OR Dual Articular 2000 OR Endo-Model OR Endo-Modell OR Endomodel OR EnduRo OR LCS Complete OR Oxford OR PFC Sigma OR Rotaflex OR S-ROM Noiles OR Avon OR Regenerex).ab,ti.)))

AND

(muscle strength/ OR muscle weakness/ OR torque/ OR (((muscle OR muscular) ADJ3 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR torsional moment* OR turning force* OR newton-meter* OR hip abduct* OR gluteus OR gluteal muscle* OR abduction motion OR ((pelvic OR pelvis) ADJ3 movement*)).ab,ti.)

NOT

(exp animals/ NOT humans/)

SportDiscus

(20191219; 283 hits)

((((((TI knee OR AB knee OR TI femorotibial OR AB femorotibial OR TI patellofemoral OR AB patellofemoral) N5 (TI osteoarthriti* OR AB osteoarthriti* OR TI arthriti* OR AB arthriti* OR TI osteoarthrosis OR AB osteoarthrosis OR TI osteoarthroses OR AB osteoarthroses OR TI arthrosis OR AB arthrosis OR TI arthroses OR AB arthroses OR TI arthropathy OR AB arthropathy OR TI "degenerative joint disease*" OR AB "degenerative joint disease*")) OR TI gonarthrosis OR AB gonarthrosis)) AND (DE "ARTHROPLASTY" OR DE "TOTAL knee replacement" OR DE "ARTIFICIAL joints" OR DE "PROSTHETICS" OR DE "ARTIFICIAL knees" OR (TI replacement* OR AB replacement*

OR TI reconstruct* OR AB reconstruct* OR TI arthroplast* OR AB arthroplast* OR TI prosthes* OR AB prosthes* OR TI arthroprosthes* OR AB arthroprosthes* OR TI endoprosthes* OR AB endoprosthes* OR TI implant* OR AB implant* OR TI "artificial knee*" OR AB "artificial knee*" OR TI TKR OR AB TKR OR TI TKA OR AB TKA OR ((TI "minimally invasive" OR AB "minimally invasive" OR TI mini-invasive OR AB mini-invasive OR TI minimal OR AB minimal OR TI "minimal access" OR AB "minimal access") N3 (TI surgery OR AB surgery OR TI "surgical method*" OR AB "surgical method*" OR TI "surgical procedure*" OR AB "surgical procedure*" OR TI "surgical technique*" OR AB "surgical technique*" OR TI operation OR AB operation OR TI "operative treatment" OR AB "operative treatment" OR TI "operative intervention" OR AB "operative intervention" OR TI "operative repair" OR AB "operative repair" OR TI "operative restoration" OR AB "operative restoration")) OR TI "Active UKA" OR AB "Active UKA" OR TI "Advance Medial Pivot" OR AB "Advance Medial Pivot" OR TI Advantim OR AB Advantim OR TI "ALPINA PS" OR AB "ALPINA PS" OR TI "Anatomic Graduated Component" OR AB "Anatomic Graduated Component" OR TI Ascent OR AB Ascent OR TI ATTUNE OR AB ATTUNE OR TI Bi-Surface OR AB Bi-Surface OR TI Duracon OR AB Duracon OR TI EMPOWR OR AB EMPOWR OR TI "Genesis II" OR AB "Genesis II" OR TI "iBalance Unicondylar Knee" OR AB "iBalance Unicondylar Knee" OR TI "Insall-Burstein II" OR AB "Insall-Burstein II" OR TI "InterSpace Knee" OR AB "InterSpace Knee" OR TI KineMax OR AB KineMax OR TI KineSpring OR AB KineSpring OR TI Legion OR AB Legion OR TI Marmor OR AB Marmor OR TI Maxim OR AB Maxim OR TI "Maximum Congruent Knee system" OR AB "Maximum Congruent Knee system" OR TI Miller-Galante OR AB Miller-Galante OR TI "Natural Knee II" OR AB "Natural Knee II" OR TI "Natural-Knee Flex System" OR AB "Natural-Knee Flex System" OR TI NexGen OR AB NexGen OR TI Optetrak OR AB Optetrak OR TI OrthoGlide OR AB OrthoGlide OR TI Oxinium OR AB Oxinium OR TI "Persona Knee System" OR AB "Persona Knee System" OR TI "Press-Fit Condylar" OR AB "Press-Fit Condylar" OR TI Profix OR AB Profix OR TI Repicci OR AB Repicci OR TI Restoris OR AB Restoris OR TI Scorpio OR AB Scorpio OR TI "Search Evolution" OR AB "Search Evolution" OR TI "Segmental Knee System" OR AB "Segmental Knee System" OR TI Series OR AB Series OR TI Sigma OR AB Sigma OR TI Triathlon OR AB Triathlon OR TI "Tricon knee" OR AB "Tricon knee" OR TI UniCAP OR AB UniCAP OR TI Vanguard OR AB Vanguard OR TI "Advance Total Knee" OR AB "Advance Total Knee" OR TI Alegretto OR AB Alegretto OR TI EIUS OR AB EIUS OR TI "UC Plus Solution" OR AB "UC Plus Solution" OR TI Uni-Knee OR AB Uni-Knee OR TI Uniglide OR AB Uniglide OR TI DKnee OR AB DKnee OR TI "Advance Stature Knee" OR AB "Advance Stature Knee" OR TI HemiCAP OR AB HemiCAP OR TI "Dual Articular" OR AB "Dual Articular" OR TI Endo-Model OR AB Endo-Model OR TI Endo-Modell OR AB Endo-Modell OR TI Endomodel OR AB Endomodel OR TI EnduRo OR AB EnduRo OR TI "LCS Complete" OR AB "LCS Complete" OR TI Oxford OR AB Oxford OR TI "PFC Sigma" OR AB "PFC Sigma" OR TI Rotaflex OR AB Rotaflex OR TI "S-ROM Noiles" OR AB "S-ROM Noiles" OR TI Avon OR AB Avon OR TI Regenerex OR AB Regenerex))) OR ((DE "OSTEOARTHRITIS" OR DE "OSTEONECROSIS" OR DE "OSTEOCHONDROSIS" OR (TI osteoarthriti* OR AB osteoarthriti* OR TI arthriti* OR AB arthriti* OR TI osteoarthrosis OR AB osteoarthrosis OR TI osteoarthroses OR AB osteoarthroses OR TI arthrosis OR AB arthrosis OR TI arthroses OR AB arthroses OR TI arthropathy OR AB arthropathy OR TI "degenerative joint disease*" OR AB "degenerative joint disease*" OR TI gonarthrosis OR AB gonarthrosis OR ((TI avascular OR AB avascular OR TI bone OR AB bone) N3 (TI necrosis OR AB necrosis OR TI infarction OR AB infarction)) OR TI osteonecrosis OR AB osteonecrosis OR TI osteoradionecrosis OR AB osteoradionecrosis)) AND (DE "TOTAL knee replacement" OR DE "ARTIFICIAL knees" OR (((TI knee OR AB knee OR TI femorotibial OR AB femorotibial OR TI patella* OR AB patella* OR TI patellofemoral OR AB patellofemoral) N3 (TI replacement* OR AB replacement* OR TI reconstruct* OR AB reconstruct* OR TI arthroplast* OR AB arthroplast* OR TI prosthes* OR AB prosthes* OR TI arthroprosthes* OR AB arthroprosthes* OR TI endoprosthes* OR AB endoprosthes* OR TI implant* OR AB implant*)) OR TI "artificial knee*" OR AB "artificial knee*" OR TI TKR OR AB TKR OR TI TKA OR AB TKA OR TI "Active UKA" OR AB "Active UKA" OR TI "Advance Medial Pivot" OR AB "Advance Medial Pivot" OR TI Advantim OR AB Advantim OR TI "ALPINA PS" OR AB "ALPINA PS" OR TI

"Anatomic Graduated Component" OR AB "Anatomic Graduated Component" OR TI Ascent OR AB Ascent OR TI ATTUNE OR AB ATTUNE OR TI Bi-Surface OR AB Bi-Surface OR TI Duracon OR AB Duracon OR TI EMPOWR OR AB EMPOWR OR TI "Genesis II" OR AB "Genesis II" OR TI "iBalance Unicondylar Knee" OR AB "iBalance Unicondylar Knee" OR TI "Insall-Burstein II" OR AB "Insall-Burstein II" OR TI "InterSpace Knee" OR AB "InterSpace Knee" OR TI KineMax OR AB KineMax OR TI KineSpring OR AB KineSpring OR TI Legion OR AB Legion OR TI Marmor OR AB Marmor OR TI Maxim OR AB Maxim OR TI "Maximum Congruent Knee system" OR AB "Maximum Congruent Knee system" OR TI Miller-Galante OR AB Miller-Galante OR TI "Natural Knee II" OR AB "Natural Knee II" OR TI "Natural-Knee Flex System" OR AB "Natural-Knee Flex System" OR TI NexGen OR AB NexGen OR TI Optetrak OR AB Optetrak OR TI OrthoGlide OR AB OrthoGlide OR TI Oxinium OR AB Oxinium OR TI "Persona Knee System" OR AB "Persona Knee System" OR TI "Press-Fit Condylar" OR AB "Press-Fit Condylar" OR TI Profix OR AB Profix OR TI Repicci OR AB Repicci OR TI Restoris OR AB Restoris OR TI Scorpio OR AB Scorpio OR TI "Search Evolution" OR AB "Search Evolution" OR TI "Segmental Knee System" OR AB "Segmental Knee System" OR TI Series OR AB Series OR TI Sigma OR AB Sigma OR TI Triathlon OR AB Triathlon OR TI "Tricon knee" OR AB "Tricon knee" OR TI UniCAP OR AB UniCAP OR TI Vanguard OR AB Vanguard OR TI "Advance Total Knee" OR AB "Advance Total Knee" OR TI Alegretto OR AB Alegretto OR TI EIUS OR AB EIUS OR TI "UC Plus Solution" OR AB "UC Plus Solution" OR TI Uni-Knee OR AB Uni-Knee OR TI Uniglide OR AB Uniglide OR TI DKnee OR AB DKnee OR TI "Advance Stature Knee" OR AB "Advance Stature Knee" OR TI HemiCAP OR AB HemiCAP OR TI "Dual Articular" OR AB "Dual Articular" OR TI Endo-Model OR AB Endo-Model OR TI Endo-Modell OR AB Endo-Modell OR TI Endomodel OR AB Endomodel OR TI EnduRo OR AB EnduRo OR TI "LCS Complete" OR AB "LCS Complete" OR TI Oxford OR AB Oxford OR TI "PFC Sigma" OR AB "PFC Sigma" OR TI Rotaflex OR AB Rotaflex OR TI "S-ROM Noiles" OR AB "S-ROM Noiles" OR TI Avon OR AB Avon OR TI Regenerex OR AB Regenerex)))) AND (DE "MUSCLE strength" OR DE "MUSCLE weakness" OR DE "TORQUE" OR DE "GLUTEAL muscles" OR DE "GLUTEUS medius" OR DE "GLUTEUS minimus" OR DE "PIRIFORMIS muscle" OR (((TI muscle OR AB muscle OR TI muscular OR AB muscular) N3 (TI strength OR AB strength OR TI power OR AB power OR TI force OR AB force OR TI weakness OR AB weakness OR TI weakening OR AB weakening OR TI insufficiency OR AB insufficiency OR TI fatigue OR AB fatigue OR TI deficit* OR AB deficit*)) OR TI torque OR AB torque OR TI "torsional moment*" OR AB "torsional moment*" OR TI "turning force*" OR AB "turning force*" OR TI newton-meter* OR AB newton-meter* OR TI "hip abduct*" OR AB "hip abduct*" OR TI gluteus OR AB gluteus OR TI "gluteal muscle*" OR AB "gluteal muscle*" OR TI "abduction motion" OR AB "abduction motion" OR ((TI pelvic OR AB pelvic OR TI pelvis OR AB pelvis) N3 TI movement* OR AB movement*))))

Web of Science Core Collection

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TS=((((((knee OR femorotibial OR patellofemoral) NEAR/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*")) OR "gonarthrosis") AND (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR "artificial knee*" OR TKR OR TKA OR (("minimally invasive" OR mini-invasive OR minimal OR "minimal access") NEAR/2 (surgery OR "surgical method*" OR "surgical procedure*" OR "surgical technique*" OR operation OR "operative treatment" OR "operative intervention" OR "operative repair" OR "operative restoration")) OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR

"Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex")) OR ((osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*" OR "gonarthrosis" OR ((avascular OR bone) NEAR/2 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis) AND (((knee OR femorotibial OR patella* OR patellofemoral) NEAR/2 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR "artificial knee*" OR TKR OR TKA OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex"))) AND (((muscle OR muscular) NEAR/2 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR "torsional moment*" OR "turning force*" OR newton-meter* OR "hip abduct*" OR gluteus OR "gluteal muscle*" OR "abduction motion" OR ((pelvic OR pelvis) NEAR/2 movement*)))

Scopus

(20191219; 993 hits)

TITLE-ABS-KEY((((((knee OR femorotibial OR patellofemoral) W/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*")) OR "gonarthrosis") AND (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR "artificial knee*" OR TKR OR TKA OR (("minimally invasive" OR mini-invasive OR minimal OR "minimal access") W/2 (surgery OR "surgical method*" OR "surgical procedure*" OR "surgical technique*" OR operation OR "operative treatment" OR "operative intervention" OR "operative repair" OR "operative restoration")) OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total

Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex")) OR ((osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*" OR "gonarthrosis" OR ((avascular OR bone) W/2 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis) AND (((knee OR femorotibial OR patella* OR patellofemoral) W/2 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR "artificial knee*" OR TKR OR TKA OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex"))) AND (((muscle OR muscular) W/2 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR "torsional moment*" OR "turning force*" OR newton-meter* OR "hip abduct*" OR gluteus OR "gluteal muscle*" OR "abduction motion" OR ((pelvic OR pelvis) W/2 movement*)))

BMJ Open

Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis: a systematic review and meta-analysis protocol

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-038770.R2
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Date Submitted by the Author:	30-Jun-2020
Complete List of Authors:	Kvarda, Peter; University Hospital Basel, Orthopaedics and Traumatology,; Kantonsspital Baselland, Department of Orthopaedic Surgery and Traumatology Nüesch, Corina; University of Basel, Department of Clinical Research Egloff, Christian; University of Basel, Department of Orthopaedics and Traumatology Appenzeller-Herzog, Christian ; University of Basel, University Medical Library, Basel, Spiegelgasse 5, 4051 Basel, Switzerland Mündermann, Annegret ; University Hospital Basel, Orthopaedics and Traumatology; University of Basel, Department of Clinical Research Ismailidis, Petros; University Hospital Basel, Orthopaedics and Traumatology
Primary Subject Heading:	Surgery
Secondary Subject Heading:	Rehabilitation medicine, Evidence based practice
Keywords:	Knee < ORTHOPAEDIC & TRAUMA SURGERY, Hip < ORTHOPAEDIC & TRAUMA SURGERY, Adult orthopaedics < ORTHOPAEDIC & TRAUMA SURGERY, REHABILITATION MEDICINE

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Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis: a systematic review and meta-analysis protocol

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ABSTRACT

Introduction:

Reduced hip abductor strength may indirectly lead to changes in knee kinematics and functional impairment and has been reported in patients with patellofemoral pain and knee osteoarthritis (OA). Limited information is available regarding hip abductor strength following total or unicompartmental knee arthroplasty (TKA/UKA). The aims of this systematic review are to synthesize the evidence of hip abductor muscle strength deficits in patients following TKA/UKA and to determine influencing factors for these deficits.

Methods and analysis:

Embase, Medline, SportDiscus, the Web of Science Core Collection and Scopus will be searched for human based clinical studies investigating hip abductor muscle strength after TKA/UKA for knee OA or avascular necrosis (AVN). Articles studying hip abductor strength after knee arthroplasty for posttraumatic OA will not be considered. No restriction on study design, prosthesis design, surgical approach, patient characteristics or severity of OA/AVN will be applied. We will search articles published between January 1, 1990 and the date of our last search. Only articles in English or German language will be considered for inclusion. Studies reporting manually measured muscle strength or measurements performed at hip abduction angles other than 0° will be excluded. References will be screened by two reviewers independently. Where necessary, a third author will make the final decision. The assessment of quality and risk of bias will be performed with the modified Newcastle-Ottawa scale (NOS). Data will be extracted and presented in a tabular form. Depending on availability, comparable subgroup and meta-analyses will be conducted. Patient characteristics such as age, sex and surgical approach or rehabilitation program will be analysed, if sufficient data are available.

Ethics and dissemination:

No ethics approval is required. The results will be published in a peer reviewed journal and as conference presentation.

Registration details:

Registered in PROSPERO, acknowledgement of receipt Nr. 164339.

Keywords: abductor muscle strength, hip abductor, knee replacement, knee arthroplasty knee osteoarthritis, knee avascular necrosis

Strengths and limitations of this study:

- To our knowledge, there is no published systematic review investigating hip abductor muscle strength following TKA/UKA.
- The subject and inclusion/exclusion criteria are clearly stated to obtain and present comparable data.
- Possible limitations are the restricted time period of publication and language restriction to English or German.
- Possibility of limited and heterogenous data availability to perform a meta-analysis.

INTRODUCTION:

Degenerative diseases of the musculoskeletal system such as osteoarthritis are one of the leading burdens on the health care system, social security system and certainly on individuals. Prevalence of knee osteoarthritis (OA) is estimated to be approximately 10% in men and 13% in women at the age of 60 years or older.[1] OA is estimated to be the fourth leading cause of disability by the year of 2020, and the most common indication for performing knee arthroplasty.[2,3]

Different static and dynamic biomechanical components influence the functional knee mechanics. Static elements are alignment and bony geometry. A neutral mechanical axis of the lower limb during standing passes through the centre of the tibial plateau in the frontal plane. This axis is altered in valgus or varus deformity.[4,5] Physiologically, during the stance phase of walking, the centre of load is located over the medial condyle creating an external knee adduction moment.[6,7] Ligaments and muscles of the joint form the group of dynamic stabilizers and mainly resist the adduction moment.[7]

As the adjacent proximal articulation, the hip joint contributes to knee biomechanics. The hip abductor muscles abduct the femur, facilitate pelvic stability during single leg stance and walking, and directly affect the tibiofemoral and patellofemoral joint kinematics. Moreover, the hip abductor muscle group controls the internal rotation of the femur.[8] In case of hip abductor muscle strength deficit, the contralateral pelvic side drops while walking, a condition known as “Trendelenburg gait”[9] because the external hip adduction moment cannot be sufficiently balanced by the internal hip abduction moment primarily generated by hip abductor muscles. This can be compensated by leaning the trunk toward the support limb and shifting the centre of mass over the support limb and reduce the hip adduction moment.[8] The protective effect of greater internal hip abduction moment has also been reported in terms of reduced medial tibiofemoral OA progression.[10] Moreover, patellar tracking can be also altered and cause knee pain.[11,12,13] Isokinetic measurements have shown that hip abductor muscle weakness is present in patients with knee OA.[14,15] In a recent systematic review, Deasy et al. reported hip abductor weakness in patients with knee OA.[16]

Current non-surgical treatment modalities aiming alleviate and control symptoms, nonetheless today the only treatment for severe knee OA is total and unicompartmental knee arthroplasty (TKA/UKA).[17,18] Reduced hip abductor muscle strength can implicate compromised functional and performance-based outcome after TKA/UKA, and hence maintaining and strengthening of the hip abductor muscles are clinically relevant factors in patients undergoing TKA or UKA.[19,20,21,] However, to date studies investigating hip abductor muscle strength in patients undergoing TKA or UKA are scarce. In addition to outcome evaluations, quantitative assessment of muscle strength is important to understanding factors influencing surgical outcome. In contrast to knee flexor/extensor muscle strength, the impact of hip abductor muscle strength deficit in patients with TKA/UKA is currently poorly understood. The following questions remain unanswered:

- Do patients after unilateral TKA/UKA experience a muscle strength deficit in their operated compared to their unoperated side?
- How long after TKA/UKA does this deficit persist?
- Does the strength deficit after knee arthroplasty differ between patients with total versus unicompartmental arthroplasty?
- Are hip abductor muscle strength deficits after TKA/UKA influenced by pre- and postoperative knee alignment, patient characteristics or rehabilitation programs?

Therefore, the aim of the proposed systematic review is to synthesize the evidence of hip abductor muscle strength deficits in patients following TKA/UKA and to determine influencing factors for these deficits. The results of the proposed systematic review will provide extended information for physicians in the interest of improving patient management and outcome.

METHODS AND ANALYSES:

The protocol was developed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses Protocols (PRISMA-P) guideline[22](Supplementary a). Bibliographic database searching was initiated on December 19, 2019. The review was submitted for registration prospectively in PROSPERO on January 5th, 2020 and the expected completion date is July 1st, 2020.[23] We designed the study question

using the PICOS (Population, Intervention, Comparison, Outcome, Study design) strategy (Table 1).[24]

Eligibility criteria

Inclusion criteria

Human based clinical studies reporting on hip abductor muscle strength after primary TKA/UKA will be considered for inclusion. Case studies will not be considered for inclusion. No other restriction regarding the study design will be applied to broadly capture all possible appropriate studies. No restriction on operative approach, prosthesis design, age and sex of the patients or severity of OA/AVN will be placed. In order to avoid capturing irrelevant, methodologically inappropriate studies the date of publication will be limited to a time period from January 1, 1990 to the date of our last search. The limit of follow-up will be set to 24 months postoperatively.

Exclusion criteria

Studies published before 01.01.1990 or in a language other than English or German, not reporting absolute values of hip abductor muscle strength or torque ratios or reporting hip abductor strength measured with hand-held manometer/dynamometer or at a hip abduction angles other than 0° will be excluded. Articles reporting posttraumatic indications for TKA/UKA or reporting measurements following revision TKA/UKA will not be considered for inclusion.

Methodological considerations

Studies reporting isokinetic or isometric measurements of hip abductor muscle strength at a 0° hip abduction angle using a dynamometer will be considered for inclusion. Manual measurements are not reliable and not directly comparable with measurements taken by electronic dynamometers. Measurements at hip abduction angles other than 0° do not represent relevant muscle function/strength during walking and standing. Moreover, the exclusion of these studies will allow to collect standardized, comparable data facilitating meta-analysis.[25]

Information sources and search strategy

Text word synonyms and database-specific subject headings for knee OA, knee arthroplasty, and hip abductor function will be used. We will search the electronic

databases Embase via embase.com, Medline via Ovid, SportDiscus via EBSCOHost, the Web of Science Core Collection, and Scopus (Supplementary b). In the primary search no language restrictions will be applied. Time period of the search will be limited to articles published after January 1, 1990. References will be exported to Endnote X9 (Clarivate, London, U.K.) and deduplicated. The detailed search strategy can be found in the supplementary document.

Study records: data management, selection process and data extraction

Titles and abstracts of all retrieved references will be independently reviewed and screened by two reviewers (PK and PI) to identify studies that potentially meet the inclusion criteria. All potentially relevant references will be collected in full-text and independently assessed by two reviewers (PK and PI). Any disagreements regarding eligibility will be resolved by consensus and by necessity, a third review author (AM) will make a final decision. To find possible additional studies, we will screen the bibliographic references of all included articles as well as the citations of those that are indexed in Scopus or Web of Science. The study selection process will be presented in form of a PRISMA diagram.[22] Data from the full texts will be extracted and entered into a standardized excel data entry form by PK and PI based on piloting extractions. The information to be extracted can be found in Table 2. We will contact corresponding authors when the necessary data is missing or unclear. Potential conference abstracts will be considered for inclusion only if appropriate data are available for the outcomes of this study. We will contact principal investigators and/or corresponding author(s) twice by email in case of conference abstracts to collect their results. The data extraction will be cross-checked independently.

Outcomes and priorisation

The main outcomes will be:

1. Absolute values of isometric/isokinetic hip abductor torque in patients following TKA/UKA, or in asymptomatic control groups
2. Torque ratio (ipsilateral hip/contralateral hip) of hip abductors following TKA/UKA
3. Change in hip abductor torque/hip abductor torque ratio from baseline to each follow-up
4. Differences in hip abductor torque/torque ratio between patients after TKA/UKA and healthy control groups.

The secondary outcomes will be:

1. Surgical approaches/methods of TKA/UKA
2. Pre- and postoperative knee alignment
3. Patient characteristics
4. Rehabilitation programs after TKA/UKA

Risk of bias in individual studies

To minimise bias, articles meeting the inclusion criteria will be assessed by two reviewers (PK and PI) independently using a modified version of the Newcaste-Ottawa Scale (NOS)[26] (Supplementary c). According to the modified NOS, each study will be valued with 1 to 6 stars where higher scores indicate higher level of quality. No separate tool will be used to assess the risk of bias of randomized control trials because we do not extract estimates of treatment differences from RCTs but use these as a source for cohort data.

Data synthesis

We will extract any quantitative and descriptive data from all eligible studies according to the main outcomes (mean, median, etc,), on the population (SD, interquartile ranges, percentile), on measurements (standard errors, CI, p-values, sample size), as well as the secondary outcomes for both purposes (systematic review and meta-analyses). Furthermore, all details specific to the review question will be extracted. If the information is available for several time points, the data will be extracted for all time points. The data will be presented in tabular format. Visual inspection of the forest plots and I^2-test will be used to assess heterogeneity between studies. Depending on availability of appropriate data for comparable specific patient groups with same measurement method in different studies, meta-analyses will be performed on these data. Meta-analysis will be based on random effects and the results will be illustrated by forest plots. Where statistical pooling is not possible, the findings will be presented in narrative form. Meta regression and subgroup specific meta analyses will be conducted to investigate the effect of time since TKA/UKA and measurement type (isokinetic or isometric) on different 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. Meta regression and subgroup specific meta analyses will be used to investigate the influence of time since TKA/UKA and type of measurement (isokinetic or isometric) on the different outcomes. In case of sufficient information, these

analyses will be extended to patient characteristics, surgical approach, subtype of prostheses or rehabilitation program.

Meta-bias(es)

Funnel plots will be used to asses publication bias in our meta-analysis, presenting effect sizes plotted against their standard errors or precisions. To avoid subjective visual inspection of the graph, Egger's regression test will be used to assess the asymmetry. Egger's test regresses the standardized effect sizes on their precisions. In the absence of publication bias, the regression intercept is expected to be zero.

Confidence in cumulative evidence

Grading of Recommendations Assessment, Development and Evaluation system (GRADE) will be applied.[27] The confidence of evidence of the investigated study can be downgraded according to the following factors: study limitations, inconsistency of results, indirectness of evidence, imprecision, publication bias. Criteria for upgrading are the following: large magnitude of effect, evidence of a dose-response effect and all possible cofounding factors taken into account. After the grading process, the quality of evidence for each outcome will be rated as high, moderate, low or very low.

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 study results will be published in a peer reviewed journal and as conference presentation.

Patient and public involvement

There is no patient and/or public involvement planned for this review.

Authors contributions

The following work has been developed in contribution of each co-author. The manuscript underwent several revisions with substantial contributions provided by each co-author. PI, PK and AM will perform this systematic review and meta-analysis. The protocol has been registered in PROSPERO by PK. The search strategy was designed by CA. CN reviewed the protocol and was responsible for the strategy of data synthesis. CE cooperated in study design development, as well as in

manuscript editing. All authors gave final approval of the manuscript prior to submission.

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COMPETING INTERESTS STATEMENT

The authors declare no competing interest.

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Figures and Legends:

Table 1: The Population, Intervention, Comparison, Outcome, Study design (PICOS) process[24].

Item	Specification
Population, or participants and conditions of interest	Patients with OA or AVN of the knee (any age, gender and severity)
Interventions	TKA/UKA
Comparisons or control groups	For comparison between limbs of the same subject: asymptomatic contralateral hip and knee For comparison between patients and heathy individuals: asymptomatic control subjects
Outcomes of interest	Muscle strength of hip abductors
Study designs	Any study design, published studies, conference abstracts to be considered

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 origin of the study
3	Type of study
4	Study population
5	Study completion rate
6	Diagnosis
7	Surgical approach: medial parapatellar; modified medial parapatellar according to Insall; subvastus; midvastus; trivector-retaining; lateral; lateral with tuberositas osteotomy[28]
8	Study population demographics
9	Pre- and postoperative frontal and sagittal plane knee alignment
10 10a 10b 10c	Measurement methods Isometric/isokinetic strength measurement Angle of isometric measurement/velocity of isokinetic measurement Patient position during the measurement (lying supine/side-lying/standing)
11	Comparators: healthy individuals; asymptomatic contralateral side; no comparator
12	Total duration of follow up (weeks/months after the operation)
13	Measurement stages (preoperative, follow up in weeks/months after the operation)
14	Information regarding the rehabilitation protocols
15 15a 15b 15c 15d	Outcome (mean values, standard deviations (SDs) and confidence intervals (CIs)) Absolute values of hip abductor torque in patients after TKA/UKA, or in asymptomatic control groups Torque ratio (operated side/contralateral hip) of hip abductors in patients after TKA/UKA Change in hip abductor torque / hip abductor torque ratio from baseline to each follow-up Differences in hip abductor torque / torque ratios between patients after TKA/UKA and healthy control groups.
16	Authors conclusions
17	Information regarding risk of bias

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Reported on Page
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	n.a.
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	9
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	n.a.
Support:			
Sources	5a	Indicate sources of financial or other support for the review	9
Sponsor	5b	Provide name for the review funder and/or sponsor	9
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	9
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	4
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	4
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	6
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Supplementary file

Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	2
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	6
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	5-7
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	7
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	8
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	8
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I_2, Kendall's τ)	8
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	8
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	8
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	9
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	9

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

Hip abductor muscle strength in patients after total or unicompartmental knee arthroplasty for knee osteoarthritis or avascular necrosis - Search strategy

Appendices

Appendix 1: Search strategies

Embase.com

(20191219; 860 hits)

((('knee osteoarthritis'/de OR (((knee OR femorotibial OR patellofemoral) NEAR/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR 'degenerative joint disease*')) OR 'gonarthrosis'):ab,ti)

AND

('knee arthroplasty'/exp OR 'total knee arthroplasty'/de OR 'arthroplasty'/de OR 'total arthroplasty'/de OR 'knee prosthesis'/de OR 'femoral knee prosthesis'/de OR 'hinge knee prosthesis'/exp OR 'patella prosthesis'/de OR 'patellofemoral prosthesis'/de OR 'tibial knee prosthesis'/de OR 'total knee prosthesis'/de OR 'unicompartmental knee prosthesis'/de OR 'joint prosthesis'/de OR 'endoprosthesis'/de OR 'minimally invasive surgery'/de OR (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR 'artificial knee*' OR TKR OR TKA OR (('minimally invasive' OR mini-invasive OR minimal OR 'minimal access') NEAR/3 (surgery OR 'surgical method*' OR 'surgical procedure*' OR 'surgical technique*' OR operation OR 'operative treatment' OR 'operative intervention' OR 'operative repair' OR 'operative restoration')) OR 'Active UKA' OR 'Advance Medial Pivot' OR 'Advantim' OR 'ALPINA PS' OR 'Anatomic Graduated Component' OR 'Ascent' OR 'ATTUNE' OR 'Bi-Surface' OR 'Duracon' OR 'EMPOWR' OR 'Genesis II' OR 'iBalance Unicondylar Knee' OR 'Insall-Burstein II' OR 'InterSpace Knee' OR 'KineMax' OR 'KineSpring' OR 'Legion' OR 'Marmor' OR 'Maxim' OR 'Maximum Congruent Knee system' OR 'Miller-Galante' OR 'Natural Knee II' OR 'Natural-Knee Flex System' OR 'NexGen' OR 'Optetrak' OR 'OrthoGlide' OR 'Oxinium' OR 'Persona Knee System' OR 'Press-Fit Condylar' OR 'Profix' OR 'Repicci' OR 'Restoris' OR 'Scorpio' OR 'Search Evolution' OR 'Segmental Knee System' OR 'Series 7000' OR 'Sigma' OR 'Triathlon' OR 'Tricon knee' OR 'UniCAP' OR 'Vanguard' OR 'Advance Total Knee' OR 'Alegretto' OR 'EIUS' OR 'UC Plus Solution' OR 'Uni-Knee' OR 'Uniglide' OR '3DKnee' OR 'Advance Stature Knee' OR 'HemiCAP' OR 'Dual Articular 2000' OR 'Endo-Model' OR 'Endo-Modell' OR 'Endomodel' OR 'EnduRo' OR 'LCS Complete' OR 'Oxford' OR 'P.F.C. Sigma' OR 'PFC Sigma' OR 'Rotaflex' OR 'S-ROM Noiles' OR 'Avon' OR 'Regenerex'):ab,ti))

OR

(('knee osteoarthritis'/de OR 'osteoarthritis'/de OR 'avascular necrosis'/de OR 'bone necrosis'/de OR (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR 'degenerative joint disease*' OR 'gonarthrosis' OR ((avascular OR bone) NEAR/3 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis):ab,ti)

AND

('knee arthroplasty'/exp OR 'total knee arthroplasty'/de OR 'knee prosthesis'/de OR 'femoral knee prosthesis'/de OR 'hinge knee prosthesis'/exp OR 'patella prosthesis'/de OR 'patellofemoral prosthesis'/de OR 'tibial knee prosthesis'/de OR 'total knee prosthesis'/de OR 'unicompartmental knee prosthesis'/de OR (((knee OR femorotibial OR patella* OR patellofemoral) NEAR/3 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR 'artificial knee*' OR TKR OR TKA OR 'Active UKA' OR 'Advance Medial Pivot' OR 'Advantim' OR 'ALPINA PS' OR 'Anatomic Graduated Component' OR 'Ascent' OR 'ATTUNE' OR 'Bi-Surface' OR 'Duracon' OR 'EMPOWR' OR 'Genesis II' OR 'iBalance Unicondylar Knee' OR 'Insall-Burstein II' OR 'InterSpace Knee' OR 'KineMax' OR 'KineSpring' OR 'Legion' OR 'Marmor' OR 'Maxim' OR 'Maximum Congruent Knee system' OR 'Miller-Galante' OR 'Natural Knee II' OR 'Natural-Knee Flex System' OR 'NexGen' OR 'Optetrak' OR 'OrthoGlide' OR 'Oxinium' OR 'Persona Knee System' OR 'Press-Fit Condylar' OR 'Profix' OR 'Repicci' OR 'Restoris' OR 'Scorpio' OR 'Search Evolution' OR 'Segmental Knee System' OR 'Series 7000' OR 'Sigma' OR 'Triathlon' OR 'Tricon knee' OR 'UniCAP' OR 'Vanguard' OR 'Advance Total Knee' OR 'Alegretto' OR 'EIUS' OR 'UC Plus Solution' OR 'Uni-Knee' OR 'Uniglide' OR '3DKnee' OR 'Advance Stature Knee' OR 'HemiCAP' OR 'Dual Articular 2000' OR 'Endo-Model' OR 'Endo-Modell' OR 'Endomodel' OR 'EnduRo' OR 'LCS Complete' OR 'Oxford' OR 'P.F.C. Sigma' OR 'PFC Sigma' OR 'Rotaflex' OR 'S-ROM Noiles' OR 'Avon' OR 'Regenerex'):ab,ti)))

AND

('muscle strength'/de OR 'muscle weakness'/de OR 'torque'/de OR 'hip abductor muscle'/de OR 'pelvic movement'/de OR (((muscle OR muscular) NEAR/3 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR 'torsional moment*' OR 'turning force*' OR newton-meter* OR 'hip abduct*' OR gluteus OR 'gluteal muscle*' OR 'abduction motion' OR ((pelvic OR pelvis) NEAR/3 movement*)):ab,ti)

NOT

(('animal'/de OR 'animal experiment'/exp OR 'nonhuman'/de) NOT ('human'/exp OR 'human experiment'/de))

Ovid Medline

(20191219; 449 hits)

(((osteoarthritis, knee/ OR (((knee OR femorotibial OR patellofemoral) ADJ5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR degenerative joint disease*)) OR gonarthrosis).ab,ti.)

AND

(arthroplasty, replacement, knee/ OR arthroplasty/ OR arthroplasty, replacement/ OR knee prosthesis/ OR joint prosthesis/ OR "prostheses and implants"/ OR minimally invasive surgical procedures/ OR (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR artificial knee* OR TKR OR TKA OR ((minimally invasive OR mini-invasive OR minimal OR minimal access) ADJ3 (surgery OR surgical method* OR surgical procedure* OR surgical technique* OR operation OR operative treatment OR operative intervention OR operative repair OR operative restoration)) OR Active UKA OR Advance Medial Pivot OR Advantim OR ALPINA PS OR Anatomic Graduated Component OR Ascent OR ATTUNE OR Bi-Surface OR Duracon OR EMPOWR OR Genesis II OR iBalance Unicondylar Knee OR Insall-Burstein II OR InterSpace Knee OR KineMax OR KineSpring OR Legion OR Marmor OR Maxim OR Maximum Congruent Knee system OR Miller-Galante OR Natural Knee II OR Natural-Knee Flex System OR NexGen OR Optetrak OR

OrthoGlide OR Oxinium OR Persona Knee System OR Press-Fit Condylar OR Profix OR Repicci OR Restoris OR Scorpio OR Search Evolution OR Segmental Knee System OR Series 7000 OR Sigma OR Triathlon OR Tricon knee OR UniCAP OR Vanguard OR Advance Total Knee OR Alegretto OR EIUS OR UC Plus Solution OR Uni-Knee OR Uniglide OR 3DKnee OR Advance Stature Knee OR HemiCAP OR Dual Articular 2000 OR Endo-Model OR Endo-Modell OR Endomodel OR EnduRo OR LCS Complete OR Oxford OR PFC Sigma OR Rotaflex OR S-ROM Noiles OR Avon OR Regenerex).ab,ti.))

OR

((osteoarthritis, knee/ OR osteoarthritis/ OR osteonecrosis/ OR (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR degenerative joint disease* OR gonarthrosis OR ((avascular OR bone) ADJ3 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis).ab,ti.)

AND

(arthroplasty, replacement, knee/ OR knee prosthesis/ OR (((knee OR femorotibial OR patella* OR patellofemoral) ADJ3 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR artificial knee* OR TKR OR TKA OR Active UKA OR Advance Medial Pivot OR Advantim OR ALPINA PS OR Anatomic Graduated Component OR Ascent OR ATTUNE OR Bi-Surface OR Duracon OR EMPOWR OR Genesis II OR iBalance Unicondylar Knee OR Insall-Burstein II OR InterSpace Knee OR KineMax OR KineSpring OR Legion OR Marmor OR Maxim OR Maximum Congruent Knee system OR Miller-Galante OR Natural Knee II OR Natural-Knee Flex System OR NexGen OR Optetrak OR OrthoGlide OR Oxinium OR Persona Knee System OR Press-Fit Condylar OR Profix OR Repicci OR Restoris OR Scorpio OR Search Evolution OR Segmental Knee System OR Series 7000 OR Sigma OR Triathlon OR Tricon knee OR UniCAP OR Vanguard OR Advance Total Knee OR Alegretto OR EIUS OR UC Plus Solution OR Uni-Knee OR Uniglide OR 3DKnee OR Advance Stature Knee OR HemiCAP OR Dual Articular 2000 OR Endo-Model OR Endo-Modell OR Endomodel OR EnduRo OR LCS Complete OR Oxford OR PFC Sigma OR Rotaflex OR S-ROM Noiles OR Avon OR Regenerex).ab,ti.)))

AND

(muscle strength/ OR muscle weakness/ OR torque/ OR (((muscle OR muscular) ADJ3 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR torsional moment* OR turning force* OR newton-meter* OR hip abduct* OR gluteus OR gluteal muscle* OR abduction motion OR ((pelvic OR pelvis) ADJ3 movement*)).ab,ti.)

NOT

(exp animals/ NOT humans/)

SportDiscus

(20191219; 283 hits)

((((((TI knee OR AB knee OR TI femorotibial OR AB femorotibial OR TI patellofemoral OR AB patellofemoral) N5 (TI osteoarthriti* OR AB osteoarthriti* OR TI arthriti* OR AB arthriti* OR TI osteoarthrosis OR AB osteoarthrosis OR TI osteoarthroses OR AB osteoarthroses OR TI arthrosis OR AB arthrosis OR TI arthroses OR AB arthroses OR TI arthropathy OR AB arthropathy OR TI "degenerative joint disease*" OR AB "degenerative joint disease*")) OR TI gonarthrosis OR AB gonarthrosis)) AND (DE "ARTHROPLASTY" OR DE "TOTAL knee replacement" OR DE "ARTIFICIAL joints" OR DE "PROSTHETICS" OR DE "ARTIFICIAL knees" OR (TI replacement* OR AB replacement*

OR TI reconstruct* OR AB reconstruct* OR TI arthroplast* OR AB arthroplast* OR TI prosthes* OR AB prosthes* OR TI arthroprosthes* OR AB arthroprosthes* OR TI endoprosthes* OR AB endoprosthes* OR TI implant* OR AB implant* OR TI "artificial knee*" OR AB "artificial knee*" OR TI TKR OR AB TKR OR TI TKA OR AB TKA OR ((TI "minimally invasive" OR AB "minimally invasive" OR TI mini-invasive OR AB mini-invasive OR TI minimal OR AB minimal OR TI "minimal access" OR AB "minimal access") N3 (TI surgery OR AB surgery OR TI "surgical method*" OR AB "surgical method*" OR TI "surgical procedure*" OR AB "surgical procedure*" OR TI "surgical technique*" OR AB "surgical technique*" OR TI operation OR AB operation OR TI "operative treatment" OR AB "operative treatment" OR TI "operative intervention" OR AB "operative intervention" OR TI "operative repair" OR AB "operative repair" OR TI "operative restoration" OR AB "operative restoration")) OR TI "Active UKA" OR AB "Active UKA" OR TI "Advance Medial Pivot" OR AB "Advance Medial Pivot" OR TI Advantim OR AB Advantim OR TI "ALPINA PS" OR AB "ALPINA PS" OR TI "Anatomic Graduated Component" OR AB "Anatomic Graduated Component" OR TI Ascent OR AB Ascent OR TI ATTUNE OR AB ATTUNE OR TI Bi-Surface OR AB Bi-Surface OR TI Duracon OR AB Duracon OR TI EMPOWR OR AB EMPOWR OR TI "Genesis II" OR AB "Genesis II" OR TI "iBalance Unicondylar Knee" OR AB "iBalance Unicondylar Knee" OR TI "Insall-Burstein II" OR AB "Insall-Burstein II" OR TI "InterSpace Knee" OR AB "InterSpace Knee" OR TI KineMax OR AB KineMax OR TI KineSpring OR AB KineSpring OR TI Legion OR AB Legion OR TI Marmor OR AB Marmor OR TI Maxim OR AB Maxim OR TI "Maximum Congruent Knee system" OR AB "Maximum Congruent Knee system" OR TI Miller-Galante OR AB Miller-Galante OR TI "Natural Knee II" OR AB "Natural Knee II" OR TI "Natural-Knee Flex System" OR AB "Natural-Knee Flex System" OR TI NexGen OR AB NexGen OR TI Optetrak OR AB Optetrak OR TI OrthoGlide OR AB OrthoGlide OR TI Oxinium OR AB Oxinium OR TI "Persona Knee System" OR AB "Persona Knee System" OR TI "Press-Fit Condylar" OR AB "Press-Fit Condylar" OR TI Profix OR AB Profix OR TI Repicci OR AB Repicci OR TI Restoris OR AB Restoris OR TI Scorpio OR AB Scorpio OR TI "Search Evolution" OR AB "Search Evolution" OR TI "Segmental Knee System" OR AB "Segmental Knee System" OR TI Series OR AB Series OR TI Sigma OR AB Sigma OR TI Triathlon OR AB Triathlon OR TI "Tricon knee" OR AB "Tricon knee" OR TI UniCAP OR AB UniCAP OR TI Vanguard OR AB Vanguard OR TI "Advance Total Knee" OR AB "Advance Total Knee" OR TI Alegretto OR AB Alegretto OR TI EIUS OR AB EIUS OR TI "UC Plus Solution" OR AB "UC Plus Solution" OR TI Uni-Knee OR AB Uni-Knee OR TI Uniglide OR AB Uniglide OR TI DKnee OR AB DKnee OR TI "Advance Stature Knee" OR AB "Advance Stature Knee" OR TI HemiCAP OR AB HemiCAP OR TI "Dual Articular" OR AB "Dual Articular" OR TI Endo-Model OR AB Endo-Model OR TI Endo-Modell OR AB Endo-Modell OR TI Endomodel OR AB Endomodel OR TI EnduRo OR AB EnduRo OR TI "LCS Complete" OR AB "LCS Complete" OR TI Oxford OR AB Oxford OR TI "PFC Sigma" OR AB "PFC Sigma" OR TI Rotaflex OR AB Rotaflex OR TI "S-ROM Noiles" OR AB "S-ROM Noiles" OR TI Avon OR AB Avon OR TI Regenerex OR AB Regenerex))) OR ((DE "OSTEOARTHRITIS" OR DE "OSTEONECROSIS" OR DE "OSTEOCHONDROSIS" OR (TI osteoarthriti* OR AB osteoarthriti* OR TI arthriti* OR AB arthriti* OR TI osteoarthrosis OR AB osteoarthrosis OR TI osteoarthroses OR AB osteoarthroses OR TI arthrosis OR AB arthrosis OR TI arthroses OR AB arthroses OR TI arthropathy OR AB arthropathy OR TI "degenerative joint disease*" OR AB "degenerative joint disease*" OR TI gonarthrosis OR AB gonarthrosis OR ((TI avascular OR AB avascular OR TI bone OR AB bone) N3 (TI necrosis OR AB necrosis OR TI infarction OR AB infarction)) OR TI osteonecrosis OR AB osteonecrosis OR TI osteoradionecrosis OR AB osteoradionecrosis)) AND (DE "TOTAL knee replacement" OR DE "ARTIFICIAL knees" OR (((TI knee OR AB knee OR TI femorotibial OR AB femorotibial OR TI patella* OR AB patella* OR TI patellofemoral OR AB patellofemoral) N3 (TI replacement* OR AB replacement* OR TI reconstruct* OR AB reconstruct* OR TI arthroplast* OR AB arthroplast* OR TI prosthes* OR AB prosthes* OR TI arthroprosthes* OR AB arthroprosthes* OR TI endoprosthes* OR AB endoprosthes* OR TI implant* OR AB implant*)) OR TI "artificial knee*" OR AB "artificial knee*" OR TI TKR OR AB TKR OR TI TKA OR AB TKA OR TI "Active UKA" OR AB "Active UKA" OR TI "Advance Medial Pivot" OR AB "Advance Medial Pivot" OR TI Advantim OR AB Advantim OR TI "ALPINA PS" OR AB "ALPINA PS" OR TI

"Anatomic Graduated Component" OR AB "Anatomic Graduated Component" OR TI Ascent OR AB Ascent OR TI ATTUNE OR AB ATTUNE OR TI Bi-Surface OR AB Bi-Surface OR TI Duracon OR AB Duracon OR TI EMPOWR OR AB EMPOWR OR TI "Genesis II" OR AB "Genesis II" OR TI "iBalance Unicondylar Knee" OR AB "iBalance Unicondylar Knee" OR TI "Insall-Burstein II" OR AB "Insall-Burstein II" OR TI "InterSpace Knee" OR AB "InterSpace Knee" OR TI KineMax OR AB KineMax OR TI KineSpring OR AB KineSpring OR TI Legion OR AB Legion OR TI Marmor OR AB Marmor OR TI Maxim OR AB Maxim OR TI "Maximum Congruent Knee system" OR AB "Maximum Congruent Knee system" OR TI Miller-Galante OR AB Miller-Galante OR TI "Natural Knee II" OR AB "Natural Knee II" OR TI "Natural-Knee Flex System" OR AB "Natural-Knee Flex System" OR TI NexGen OR AB NexGen OR TI Optetrak OR AB Optetrak OR TI OrthoGlide OR AB OrthoGlide OR TI Oxinium OR AB Oxinium OR TI "Persona Knee System" OR AB "Persona Knee System" OR TI "Press-Fit Condylar" OR AB "Press-Fit Condylar" OR TI Profix OR AB Profix OR TI Repicci OR AB Repicci OR TI Restoris OR AB Restoris OR TI Scorpio OR AB Scorpio OR TI "Search Evolution" OR AB "Search Evolution" OR TI "Segmental Knee System" OR AB "Segmental Knee System" OR TI Series OR AB Series OR TI Sigma OR AB Sigma OR TI Triathlon OR AB Triathlon OR TI "Tricon knee" OR AB "Tricon knee" OR TI UniCAP OR AB UniCAP OR TI Vanguard OR AB Vanguard OR TI "Advance Total Knee" OR AB "Advance Total Knee" OR TI Alegretto OR AB Alegretto OR TI EIUS OR AB EIUS OR TI "UC Plus Solution" OR AB "UC Plus Solution" OR TI Uni-Knee OR AB Uni-Knee OR TI Uniglide OR AB Uniglide OR TI DKnee OR AB DKnee OR TI "Advance Stature Knee" OR AB "Advance Stature Knee" OR TI HemiCAP OR AB HemiCAP OR TI "Dual Articular" OR AB "Dual Articular" OR TI Endo-Model OR AB Endo-Model OR TI Endo-Modell OR AB Endo-Modell OR TI Endomodel OR AB Endomodel OR TI EnduRo OR AB EnduRo OR TI "LCS Complete" OR AB "LCS Complete" OR TI Oxford OR AB Oxford OR TI "PFC Sigma" OR AB "PFC Sigma" OR TI Rotaflex OR AB Rotaflex OR TI "S-ROM Noiles" OR AB "S-ROM Noiles" OR TI Avon OR AB Avon OR TI Regenerex OR AB Regenerex)))) AND (DE "MUSCLE strength" OR DE "MUSCLE weakness" OR DE "TORQUE" OR DE "GLUTEAL muscles" OR DE "GLUTEUS medius" OR DE "GLUTEUS minimus" OR DE "PIRIFORMIS muscle" OR (((TI muscle OR AB muscle OR TI muscular OR AB muscular) N3 (TI strength OR AB strength OR TI power OR AB power OR TI force OR AB force OR TI weakness OR AB weakness OR TI weakening OR AB weakening OR TI insufficiency OR AB insufficiency OR TI fatigue OR AB fatigue OR TI deficit* OR AB deficit*)) OR TI torque OR AB torque OR TI "torsional moment*" OR AB "torsional moment*" OR TI "turning force*" OR AB "turning force*" OR TI newton-meter* OR AB newton-meter* OR TI "hip abduct*" OR AB "hip abduct*" OR TI gluteus OR AB gluteus OR TI "gluteal muscle*" OR AB "gluteal muscle*" OR TI "abduction motion" OR AB "abduction motion" OR ((TI pelvic OR AB pelvic OR TI pelvis OR AB pelvis) N3 TI movement* OR AB movement*))))

Web of Science Core Collection

(20191219; 662 hits)

TS=((((((knee OR femorotibial OR patellofemoral) NEAR/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*")) OR "gonarthrosis") AND (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR "artificial knee*" OR TKR OR TKA OR (("minimally invasive" OR mini-invasive OR minimal OR "minimal access") NEAR/2 (surgery OR "surgical method*" OR "surgical procedure*" OR "surgical technique*" OR operation OR "operative treatment" OR "operative intervention" OR "operative repair" OR "operative restoration")) OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR

"Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex")) OR ((osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*" OR "gonarthrosis" OR ((avascular OR bone) NEAR/2 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis) AND (((knee OR femorotibial OR patella* OR patellofemoral) NEAR/2 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR "artificial knee*" OR TKR OR TKA OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex"))) AND (((muscle OR muscular) NEAR/2 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR "torsional moment*" OR "turning force*" OR newton-meter* OR "hip abduct*" OR gluteus OR "gluteal muscle*" OR "abduction motion" OR ((pelvic OR pelvis) NEAR/2 movement*)))

Scopus

(20191219; 993 hits)

TITLE-ABS-KEY((((((knee OR femorotibial OR patellofemoral) W/5 (osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*")) OR "gonarthrosis") AND (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant* OR "artificial knee*" OR TKR OR TKA OR (("minimally invasive" OR mini-invasive OR minimal OR "minimal access") W/2 (surgery OR "surgical method*" OR "surgical procedure*" OR "surgical technique*" OR operation OR "operative treatment" OR "operative intervention" OR "operative repair" OR "operative restoration")) OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total

Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex")) OR ((osteoarthriti* OR arthriti* OR osteoarthrosis OR osteoarthroses OR arthrosis OR arthroses OR arthropathy OR "degenerative joint disease*" OR "gonarthrosis" OR ((avascular OR bone) W/2 (necrosis OR infarction)) OR osteonecrosis OR osteoradionecrosis) AND (((knee OR femorotibial OR patella* OR patellofemoral) W/2 (replacement* OR reconstruct* OR arthroplast* OR prosthes* OR arthroprosthes* OR endoprosthes* OR implant*)) OR "artificial knee*" OR TKR OR TKA OR "Active UKA" OR "Advance Medial Pivot" OR "Advantim" OR "ALPINA PS" OR "Anatomic Graduated Component" OR "Ascent" OR "ATTUNE" OR "Bi-Surface" OR "Duracon" OR "EMPOWR" OR "Genesis II" OR "iBalance Unicondylar Knee" OR "Insall-Burstein II" OR "InterSpace Knee" OR "KineMax" OR "KineSpring" OR "Legion" OR "Marmor" OR "Maxim" OR "Maximum Congruent Knee system" OR "Miller-Galante" OR "Natural Knee II" OR "Natural-Knee Flex System" OR "NexGen" OR "Optetrak" OR "OrthoGlide" OR "Oxinium" OR "Persona Knee System" OR "Press-Fit Condylar" OR "Profix" OR "Repicci" OR "Restoris" OR "Scorpio" OR "Search Evolution" OR "Segmental Knee System" OR "Series 7000" OR "Sigma" OR "Triathlon" OR "Tricon knee" OR "UniCAP" OR "Vanguard" OR "Advance Total Knee" OR "Alegretto" OR "EIUS" OR "UC Plus Solution" OR "Uni-Knee" OR "Uniglide" OR "3DKnee" OR "Advance Stature Knee" OR "HemiCAP" OR "Dual Articular 2000" OR "Endo-Model" OR "Endo-Modell" OR "Endomodel" OR "EnduRo" OR "LCS Complete" OR "Oxford" OR "P.F.C. Sigma" OR "PFC Sigma" OR "Rotaflex" OR "S-ROM Noiles" OR "Avon" OR "Regenerex"))) AND (((muscle OR muscular) W/2 (strength OR power OR force OR weakness OR weakening OR insufficiency OR fatigue OR deficit*)) OR torque OR "torsional moment*" OR "turning force*" OR newton-meter* OR "hip abduct*" OR gluteus OR "gluteal muscle*" OR "abduction motion" OR ((pelvic OR pelvis) W/2 movement*)))

ADAPTED NEWCASTLE - OTTAWA QUALITY ASSESSMENT SCALE
COHORT STUDIES

Selection

1. Representativeness of the patient cohort *
   a) truly representative of the corresponding patient cohort in the general community (e.g. multi center trial with different types of hospitals) *
   b) somewhat representative of the corresponding patient cohort (e.g. single center study in only hospital of the catchment area) *
   c) selected group of patients
   d) no or unclear description of the derivation of the patient cohort
2. Selection of the healthy control cohort (if applicable)
   a) drawn from the same community as the patient cohort *
   b) drawn from a different source
   c) no description of the derivation of the healthy cohort
3. Ascertainment of exposure (not applicable)
4. Demonstration that outcome of interest was not present at start of study (not applicable)

Comparability

1. Comparability of cohorts on the basis of the design or analysis (if applicable)
   a) study controls for age differences between cohorts (e.g. by matching or statistical adjustment for potential confounding) *
   b) study does not control for age differences between cohorts

Outcome

1. Assessment of outcome

   a) independent assessment (e.g. by nurses or researchers not involved in the study) *
   b) assessment by member of the research team
   c) no information given
2. Was follow-up long enough for patients to recover?
   a) yes (follow up at least 12 months) *
   b) no (follow up less than 12 months)

3. Adequacy of follow up of cohorts

a) complete follow up - all subjects accounted for *
b) subjects lost to follow up unlikely to introduce bias (e.g. drop out because of medical complications) or at least 90% *
c) follow up rate < 90 % or no description of those lost or description suggests bias
d) no statement