Evidence report for Hip replacement for hip osteoarthritis

Part 1 - Scoping

Prepared by EBSCO Information Services

February 11, 2019

Prepared by EBSCO Health Innovations and EBM Development Department:

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Eric Manheimer, PhD, EBM Editor

Methods

Using an established, structured template that delineates key elements for scoping (i.e., the population, interventions, and key outcomes to consider), we collaboratively agreed with UKSH on the scope of the present evidence report. Preliminary scoping was completed on February 4, 2019 and revised based on mutual feedback on February 11, 2019.

Results – Criteria Selection for Critical Appraisal

Population:

Inclusion criteria

Patients with degenerative osteoarthritis of the hip (also called degenerative joint disease or cox-arthrosis)

Age range of greatest interest 60 to 80 years (but inclusion criteria not limited by age)

Intention or desire to consider surgical treatment

Exclusion criteria

Joint disease due to conditions other than degenerative osteoarthritis

Intervention and Comparator:

Total hip replacement (vs. continued nonsurgical management)

Intervention includes total hip arthroplasty (total endoprosthesis).

Comparative data are lacking, but the implied comparator is continuing with the patient's nonsurgical management regimen. In the absence of controlled studies with comparative data for most outcomes of interest, evidence review will use a prognostic framework with evidence from observational studies.

A note about the continued nonsurgical management option

This intervention includes the broad array of nonsurgical interventions for osteoarthritis of the hip (including injections), combined in any fashion or used in isolation. The intention of continuing with nonsurgical therapy is to avoid or delay surgical intervention. We will not consider specific combinations of or individual nonsurgical modalities. As this option is being presented as the "comparator option" for Total hip replacement, and as there is an absence of controlled studies or evidence providing estimates, outcomes may be reported descriptively or sometimes "Does not apply". In essence, the comparison may mainly amount to the benefit of having surgery (i.e., prospect of improvement in pain and function) compared to the benefits of not having surgery and continuing with nonsurgical management (e.g., avoiding the cost and risks of hip replacement surgery).

Outcomes:

FAQ 1: What does the treatment involve?

Include a description of the treatment or procedure. Include length of stay if relevant.

Descriptive responses are acceptable, and this does not involve systematic evidence searches, critical appraisal, or evidence synthesis.

FAQ 2: Will my symptoms get better?

Outcomes of interest are pain, function, and resolution of symptoms.

FAQ 3: Will I need surgery later?

Outcomes of interest are need for repeat surgery (especially for loss of efficacy in the longer term), and time to repeat surgery.

FAQ 4: When will I recover?

Outcomes of interest are time to return to usual activity and time to return to work.

FAQ 5: What are the side effects?

Side effects of interest – in addition to those in the literature – include surgery-related pain.

FAQ 6: What are the risks?

Risks of interest – in addition to those in the literature – include infections and repeat surgery for complications.

Evidence report for total hip arthroplasty for hip osteoarthritis

Part 2 - Search and Selection

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February 25, 2019

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Methods

First-round searching will consist of searching DynaMed Plus summaries pertinent to the topic. The search starts with DynaMed Plus because DynaMed Plus content is based on a thorough, systematic search and active literature surveillance system.

> Systematic literature surveillance (SLS) has been a cornerstone of creating DynaMed content since its inception. Currently, the SLS team works closely with members of McMaster University's Department of Health Research Methods, Evidence, and Impact to define and refine optimal search strategies, utilizing search terms for methodology and for clinical concepts (especially diagnosis and treatment) for each journal. These filters for PubMed searches are derived from PubMed Clinical Queries, McMaster University Hedges system, and DynaMed search filters and were found to capture >95% of relevant valid articles for use in DynaMed.[1]
>
> [1]Alper BS, Iorio A. Optimising search filters for active literature surveillance: a concordance study. Global Evidence Summit. Cape Town, South Africa; September 2017.
>
> The SLS team, in collaboration with McMaster University, continually evaluates and improves these filters to keep abreast of the ever-changing medical literature landscape. PubMed searches are performed daily. Each article is assessed by an external screener for clinical relevance, then reviewed by internal staff for both clinical relevance and validity. Any disagreements are settled by the Deputy Editor of the SLS team.
>
> In addition, the SLS team continually monitors the Journal source list against the list of journals catalogued in MEDLINE and existing DynaMed content to determine the set of journals that provide the highest yield for valid, clinically relevant content. As of November 2018, 507 Journals are systematically searched (see http://dynamed.com/home/content/content-sources). The journal selection threshold leads to routine adjustments to the number of journals selected.

Second-round searching will involve PubMed/MEDLINE® searches for intervention-specific systematic reviews that are more recent than those identified in first-round searching.

Third-round searching will involve original study tracing from systematic reviews, guidelines or other relevant sources. This may be done to identify additional evidence sources if the results from the first two rounds of searching are insufficient.

Fourth-round searching will involve searches for original evidence reports. Such searching will be limited to areas considered insufficiently addressed by earlier searches, such as focused concepts published after search dates in systematic reviews.

Additional selective searching, such as tracing citations from articles found or seeking related articles, may be done for additional concepts discovered.

FAQ Summary

Results

First-round searching – DynaMed Plus:

DynaMed Plus subsection	Relevant for FAQ(s)	Number of article citations	Number of unique references included
Elective total hip arthroplasty topic, preoperative decision-making and preparation subtopic, prognosis subtopic (February 25, 2019)	FAQ2, FAQ3, FAQ4, FAQ5, FAQ6	17	7 (Bayliss 2017, Berstock 2014, Kandala 2015, Lalmohamed 2012, Lu 2015, Singh 2013, Vissers 2011)
Elective total hip arthroplasty topic, thromboembolic prophylaxis subtopic, risk of venous thromboembolism subtopic (February 25, 2019)	FAQ6	3	1 (Pedersen 2012)

Second-round searching – searches for intervention-specific systematic reviews:

Database	Search string	Relevant for FAQ(s)	Number of search results	Number of references included
PubMed February 25, 2019	(total hip[ti] OR hip replacement[ti] OR hip arthroplasty[ti]) AND (pain[tiab] OR function[tiab]) AND systematic[sb] AND ("2011/01/01"[PDAT] : "3000/12/31"[PDAT])	FAQ2	84	2 (Beswick 2012, Shan 2014)
PubMed February 25, 2019	(total hip[ti] OR hip replacement[ti] OR hip arthroplasty[ti]) AND (duration[tiab] OR implant survival[tiab] OR revision surgery[tiab] OR repeat surgery[tiab] OR last[tiab]) AND systematic[sb] AND ("2017/01/01"[PDAT] : "3000/12/31"[PDAT])	FAQ3	14	1 (Evans 2019)
PubMed February 25, 2019	(total hip[ti] OR hip replacement[ti] OR hip arthroplasty[ti]) AND (pain after[tiab] OR pain following[tiab] OR resolution of pain[tiab] OR postoperative pain[tiab] OR postsurgical pain[tiab] OR recover*[tiab] OR return to[tiab] OR work[tiab] OR employment[tiab] OR driving[tiab] OR drive[tiab]) AND systematic[sb] AND ("2011/01/01"[PDAT] : "3000/12/31"[PDAT])	FAQ4, FAQ5	47	3 (Højer Karlsen 2015, Tilbury 2014, Vissers 2011*)
PubMed February 25, 2019	(total hip[ti] OR hip replacement[ti] OR hip arthroplasty[ti]) AND (risk[tiab] OR side effect[tiab] OR complication[tiab] OR adverse[tiab]) AND systematic[sb] AND ("2017/01/01"[PDAT] : "3000/12/31"[PDAT])	FAQ5, FAQ6	64	1 (Miller 2018)

* already captured in first-round searching

Third-round searching – original study tracing from systematic reviews:

Source	Tracing	Relevant for FAQ(s)	Number of search results	Number of references included
Not applicable				

Fourth-round searching – searches for original evidence reports:

Database	Search string	Relevant for FAQ(s)	Number of search results	Number of references included
Not applicable				

Evidence report for total hip arthroplasty for hip osteoarthritis

Part 3 - Critical Appraisal of Evidence Reports

Prepared by EBSCO Information Services

February 26, 2019

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Methods

For each study selected for critical appraisal, we assessed for criteria needed for Level 1 [likely reliable] evidence ratings in DynaMed's Levels of Evidence criteria in which evidence quality is labeled in 1 of 3 levels:

- **(level 1 [likely reliable] evidence)** for studies with clinical outcomes and minimal risk of bias;
- **(level 2 [mid-level] evidence)** for studies with clinical outcomes and significant methodological or statistical limitations; and
- **(level 3 [lacking direct] evidence)** for reports that do not include scientific analysis of clinical outcomes or for study types that do not include comparisons between groups.

The specific concepts we critically assessed are fully mapped to cover all the criteria used in GRADE. We summarized key concerns identified that reduce the certainty of evidence in categories used for GRADE methods (i.e., risks of bias, indirectness, imprecision, inconsistency, and other considerations if relevant). In the study-level summaries inconsistency assessment was applied to consistency of within-study results – this applies to consistency across related outcomes for both original studies and for systematic reviews, and also applies to consistency across studies when applied to systematic reviews.

FAQ Summary

Results

Characteristics and Results of Critically Appraised Studies/Sources

BAYLISS 2017
Bayliss LE, Culliford D, Monk AP, Glyn-Jones S, Prieto-Alhambra D, Judge A, Cooper C, Carr AJ, Arden NK, Beard DJ, Price AJ. The effect of patient age at intervention on risk of implant revision after total replacement of the hip or knee: a population-based cohort study. Lancet. 2017 Apr 8;389(10077):1424-1430. Epub 2017 Feb 14. PubMed

Relevant to FAQ3

- **Study design: observational study**
  - population-based data from Clinical Practice Research Datalink
    - comprised of primary care medical records of all patients attending selection of general practitioners in United Kingdom
    - representative of entire general practice population in wider UK population
  - data adjusted for all-cause mortality to generate lifetime risks of revision surgery based on age at time of primary surgery
- **Population:** patients who had undergone total hip replacement
  - This study also includes evidence for patients who had total knee replacement, but we do not consider these data further in this summary due to not being relevant for the scoped question
  - mean age 69.4 years old for hip patients
- **Intervention:** total hip replacement
- **Comparison:** not applicable

- **Study inclusion criteria:**
  - patients with joint replacement surgery from January 1, 1991 until August 10, 2011
  - aged ≥ 50 years at time of surgery

- **Number of studies:** Not applicable
- **Number of participants:** 63,158
- **Duration of follow-up:** mean 5.8 years; range 0 to 23.1 years; median 4.9 years

- **Certainty:** High (applies to both implant survival and lifetime risk of revision outcomes at all time points)
  - **Certainty by outcome:** Not applicable
  - **Risk of bias:** No serious concern
  - **Imprecision:** No serious concern
  - **Indirectness:** No serious concern
  - **Inconsistency:** No serious concern

- **Results:**

Implant survival at 5, 10, 15, and 20 years after total hip replacement

Years after total hip replacement	Cumulative implant survival rate (95% CI)
5	0.979 (0.9779 to 0.9804)
10	0.956 (0.9534 to 0.9585)
15	0.910 (0.9029 to 0.9157)
20	0.850 (0.8323 to 0.8663)

Lifetime risk of revision after total hip replacement by age at total hip replacement

Age at total hip replacement (years)*	Lifetime risk of revision (95% CI)**	
	Females	Males
50-54	17% (95% CI 15% to 18.5%)	29.6% (95% CI 26.6 to 32.6%)
55-59	19% (95% CI 17.5% to 20%)	23% (21% to 25%)
60-64	17% (95% CI 16% to 18%)	17% (95% CI 16% to 18%)
65-69	14% (95% CI 13% to 15%)	9% (95% CI 8% to 10%)
70-74	7% (95% CI 6.5% to 7.5%)	5% (95% CI 4.5% to 5.5%)

*For patients having total hip replacement at aged 75, lifetime risk of revision was about 5% with no difference between sexes. Older than 75, risk slightly reduced and was consistent between sexes.
**Values were estimated from Figure 2 graph and are not exact, with the exception of estimates for males aged 50-54 years old which were exactly reported in text

- mean time to revision surgery about 5 years after primary implantation in all age groups
    - 6.56 years (95% CI 6.05 to 7.08 years) for patients aged 50-59 years at initial surgery
    - 4.08 years (3.73 to 4.39 years) for patients in eighth decide at initial surgery
- consistently higher risks of revision for men and younger patients at all time points after initial surgery

BERSTOCK 2014
Berstock JR, Beswick AD, Lenguerrand E, Whitehouse MR, Blom AW. Mortality after total hip replacement surgery: A systematic review. Bone Joint Res. 2014 Jun;3(6):175-82. PubMed

Relevant to FAQ6

- **Study design:** systematic review of observational studies
- **Population:** patients with osteoarthritis who had total hip replacement
- **Intervention:** total hip replacement
- **Comparison:** not applicable
- **Study inclusion criteria:**
    - reported 30- or 90-day mortality following total hip replacement
    - published in English language
    - published since January 2003

- **Number of studies:** 32
- **Number of participants:** 1,129,330
    - due to concerns regarding the volume of historical (and possibly non-representative) data included in the 18-year longitudinal study of US patients receiving Medicare

benefits who had a total hip replacement between 1991 and 2008 (Cram 2011; total n = 1,453,493), the authors only included the most recent cohort from that study (n = 209,945)

- **Duration of follow-up:** 90 days after total hip replacement

- **Certainty: Moderate**
  - **Certainty by outcome:** Not applicable – inconsistency downgrade applies to both outcomes
  - **Risk of bias:** No serious concern
  - **Imprecision:** No serious concern
  - **Indirectness:** No serious concern
  - **Inconsistency:** Serious concern
    - estimates from individual studies were heterogeneous for both 30-day and 90-day mortality outcomes

Results:

- overall mortality following total hip replacement
  - 30-day mortality 0.30% (95% CI 0.22% to 0.38%) in analysis of 15 studies (number of participants not reported)
  - 90-day mortality 0.65% (95% CI 0.50% to 0.81%) in analysis of 17 studies (number of participants not reported)
- 8 out of 9 included studies reported cardiovascular causes as leading cause of mortality
- mortality rates appear to be decreasing with time
  - authors give examples of 90-day mortality rates from two large cohort studies included in their review
    - 0.56% in 2003 decreasing to 0.29% in 2011 in one large cohort (n = 409,096 patients in the National Joint Registry for England and Wales)
    - 1.2% in 1991 decreasing to 0.8% in 2008 in another large cohort (n = 1,453,493 patients in the US receiving Medicare)

BESWICK 2012

Beswick AD, Wylde V, Gooberman-Hill R, Blom A, Dieppe P. What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? A systematic review of prospective studies in unselected patients. BMJ Open. 2012 Feb 22;2(1):e000435. PubMed

Relevant to FAQ2

- **Study design:** systematic review of observational studies
- **Population:** patients who had total hip replacement for treatment of osteoarthritis
  - This study also includes evidence for patients who had total knee replacement for treatment of osteoarthritis, but we do not consider these data further in this summary due to not being relevant for the scoped question
- **Intervention:** total hip replacement
- **Comparison:** not applicable

- **Study inclusion criteria:**

    - patients were unselected and representative of primary total hip or knee replacement population
    - prospective collection of data from consecutive patients
    - complete reporting of losses to follow-up
    - results classifiable as proportion of patients with different extents of pain at follow-up were reported

- **Number of studies:** 6
- **Number of participants:** 13,031
- **Duration of follow-up:** 3 months to 5 years
    - duration of follow-up of 3 months to 5 years was used because the systematic review authors were "...concerned with outcomes when recovery can be considered maximal and not later issues of joint loosening and revision..."

- **Certainty overall: High**
    - **Certainty by outcome:** Not applicable – only 1 outcome
    - **Risk of bias:** No serious concern if using estimates from higher-quality studies (see table)
        - review authors considered following 2 markers of better representativeness as indicators of study quality:
            - studies conducted at multiple centers (compared to single center studies)
            - studies with lower losses to follow-up (< 10%)
        - as indicated in table below, 2 studies met both indicators of quality, 2 met only 1, and 2 met neither
    - **Imprecision:** No serious concern if using estimates from higher-quality studies
    - **Indirectness:** No serious concern
    - **Inconsistency:** No serious concern
    - **Other considerations:**
        - only 17 studies were included (6 for hip replacement, 11 for knee replacement) out of 115 studies that were otherwise eligible but did not report results classifiable as proportions of patients with different extents of pain at follow-up (typically due to 1 of following 2 reasons)
            - lack of pain outcome separate from overall outcome
            - presentation or pain results as mean only
        - small number of studies, different outcome measures reported, and different methods of analysis in studies with similar outcomes precluded meta-analysis
        - estimates varied across studies overall but were similar in the 2 studies judged highest quality

- **Results and certainty of individual studies:**

Author year; country; date of baseline	Sample size	Time point for outcome assess-ment	Number of patients with				Certainty (reasons for downgrade)
			favorable* outcome % (n/N)	uncertain† outcome % (n/N)	unfavorable‡ outcome % (n/N) without imputation§	unfavorable‡ outcome % (n/N) with imputation**	
Nikolajson 2006; Denmark; 2003	1,231	12-18 mos	61.3% (754/1,231)	28.4% (350/1,231)	10.3% (127/1,231)	13.2% (163/1,231) (95% CI, 11.5% to 15.2%)	High
Jones 2000; Canada; 1995-1997	242	6 mos	86.0% (208/242)	5.8% (14/242)	8.3% (20/242)	8.7% (21/242) (95% CI, 5.7% to 12.9%)	High
Quintana 2006; Spain; 1999-2000	784	6 mos	58.2% (456/784)	25.5% (200/784)	16.3% (128/784)	20.5% (161/784)	Moderate (downgrade due to high loss to follow-up)
Nilsdotter 2003; Sweden; 1995-1998	219	43 mos (mean)	69.9% (153/219)	9.6% (21/219)	20.5% (45/219)	22.4% (49/219)	Moderate (downgrade due to not multiple center study [single center])
Singh and Lewallen 2010; USA; 1993-2005	9,154	24 mos	57.6% (5,272/9,154)	37.7% (3,447/9,154)	4.8% (435/9,154)	6.5% (599/9,154)	Low (downgrade due to high loss to follow-up and not multiple center study [single center])
Wylde 2011; UK; 2004-2006	1,401 ††	41 mos (median)	58.4% (548/1,401) ††	52.7% (739/1,401) ††	8.1% (114/1,401)††	12.4% (174/1,401)	Low (downgrade due to high loss to follow-up and not multiple center study [single center])

N = Sample size of cohort, mos = months

* favorable outcome includes patients with no pain or mild pain at follow-up

† uncertain outcome includes "...all patients for whom we cannot be sure of their pain levels at follow-up. These include patients who died, had revision surgery, contralateral surgery or dislocation and were not followed up with questionnaires and those lost to follow-up. We also included as uncertain those patients with a degree of reported pain, which we could not classify as a favorable or unfavorable outcome"

‡ unfavorable outcome includes those with moderate-to-severe pain or for whom surgery had not relieved pain

§ proportion with unfavorable long-term pain outcome without imputing outcome information on patients lost to follow-up

** imputing proportion with known unfavorable long-term pain outcome to number with uncertain pain outcome

†† combined number of patients with "favorable" (n = 818), "uncertain" (n = 739), and "unfavorable" (n = 114) outcomes (total n = 1,671) reported in Table 1 of systematic review exceed the total size of the cohort (n = 1,401). Based on the actual report from Wylde 2011 and using Beswick 2012's definitions for "favorable" and "unfavorable" for this study, the number with "favorable" outcome was listed incorrectly in Table 1 of the systematic review and the table above includes the corrected value of 548.

EVANS 2019

Evans JT, Evans JP, Walker RW, Blom AW, Whitehouse MR, Sayers A. How long does a hip replacement last? A systematic review and meta-analysis of case series and national registry reports with more than 15 years of follow-up. Lancet. 2019 Feb 16;393(10172):647-654. Epub 2019 Feb 14. PubMed

Relevant to FAQ3

- **Study design:** systematic review of observational studies
    - systematic reviews/meta-analyses conducted separately for
        - case series and cohort studies
        - national joint replacement registries
- **Population:** patients who had total hip replacement
- **Intervention:** total hip replacement construct
- **Comparison:** Not applicable

- **Study inclusion criteria:**
    - systematic review of case series and cohort studies
        - predominantly unselected patients or patients having total hip replacement for osteoarthritis
        - required reporting of survival of specific implant, brand, or construct with mean/median follow-up > 15 years
        - published in English language
    - systematic review of national joint replacement registries assessed 6 registries with > 15 years of follow-up for total hip replacement at time of data collection (December 2017)

- **Number of studies:** 136
    - 44 case series
    - 92 series from joint replacement registries
- **Number of participants:** 228,888
    - 13,212 in case series articles
    - 215,676 in joint replacement registries (at 15 years follow-up time point)
- **Duration of follow-up:**
    - range from 15 to 40 years for case series and cohort studies
    - up to 25 years for registry series

- **Certainty for case series: Low**
    - **Certainty by outcome:** Not applicable – only 1 outcome
    - **Risk of bias:** serious concern
        - case series are susceptible to selection bias which may lead to study population not being representative of target population
        - none were multicenter
        - 54.5% of series were consecutive
        - 11.4% had < 20% follow-up, and variation in number of patients lost to follow-up across studies
    - **Imprecision:** No serious concern
    - **Indirectness:** No serious concern
        - changes over time in health service delivery, implant design, and patient characteristics may impact generalizability

        - however, changes over time are likely to improve implant survival, not reduce it, and per GRADE if plausible confounding would reduce a demonstrated effect we would not downgrade
    - **Inconsistency:** Serious concern
        - heterogeneity of survival estimates at 15, 20, and 25 years
    - **High risk of publication bias:** No serious concern

- **Certainty for national registry reports: Moderate**
    - **Certainty by outcome:** Not applicable – only 1 outcome
    - **Risk of bias:** No serious concern
    - **Imprecision:** No serious concern
    - **Indirectness:** No serious concern
        - changes over time in health service delivery, implant design, and patient characteristics may impact generalizability
            - however, changes over time are likely to improve implant survival, not reduce it, and per GRADE if plausible confounding would reduce a demonstrated effect we would not downgrade
        - estimates at 20 and 25 years from single country registry (Finland) and estimates at 15 years from registries from only 2 countries (Finland and Australia)
    - **Inconsistency:** Serious concern
        - heterogeneity of survival estimates at 15, 20, and 25 years
    - **High risk of publication bias:** No serious concern

- **Results:**

Pooled survival estimates from 44 case series reporting on 13,212 total hip replacements at 15, 20, and 25 years

Follow-up time (years)	Pooled survival of hip replacement
15	85.7% (95% CI 85.0% to 86.5%)
20	78.8% (95% CI 77.8% to 79.9%)
25	77.6% (95% 76.0% to 79.2%)

Pooled survival estimates from registry series at 15, 20, and 25 years

Follow-up time (years)	Number of construct series	Total number of hip replacements	Registry	Pooled survival
15	92	215,676	Finnish and Australian	89.4% (95% CI 89.2% to 89.6%)
20	43	73,057	Finnish	70.2% (95% CI 69.7% to 70.7%)
25	29	51,359	Finnish	57.9% (95% CI 57.1% to 58.7%)

HØJER KARLSEN 2015

Højer Karlsen AP, Geisler A, Petersen PL, Mathiesen O, Dahl JB. Postoperative pain treatment after total hip arthroplasty: a systematic review. Pain. 2015 Jan;156(1):8-30. PubMed

Relevant to FAQ5

- **Study design:** systematic review of randomized trials
- **Population:** adult patients having hip replacement surgery
- **Intervention:** analgesic intervention initiated in immediate perioperative period
- **Comparison:** placebo

- **Study inclusion criteria:** No relevant additional inclusion criteria

- **Number of studies:** 58
    - 58 studies evaluated 19 different interventions
    - most commonly evaluated interventions were nonsteroidal anti-inflammatory drugs (including COX2 inhibitors) (10 trials), local infiltration analgesia (11 trials), intrathecal administration of various opioids (7 trials), and lumbar plexus block (4 trials)
- **Number of participants:**
    - total number not reported, but calculated from values in Table 1 as 4,309
- **Duration of follow-up:** immediate postoperative period
- **Certainty: Moderate for mean postoperative pain scores in control groups**
    - **Certainty by outcome:** Not applicable
    - **Risk of bias:** No serious concern
    - **Imprecision:** No serious concern
    - **Indirectness:** No serious concern
    - **Inconsistency:** Serious concern
        - Although authors present pooled means for postoperative pain at rest 6 and 24 hours postoperatively, the spread of the mean pain values in the control groups in Figures 4 and 5 raises concern for inconsistency. Although forest plots are not available for postoperative pain during mobilization, the range reported by the authors leads us to have this concern for that outcome as well.

- **Results:**
    - This study was summarized to estimate postoperative pain in patients without pain control medications.
    - Mean pain levels in the control groups at rest at 6 and 24 hours after surgery were 31 out of 100 (42 trials, number of participants not reported) and 23 out of 100 (47 trials, number of participants not reported), respectively.
        - The ranges of postoperative pain scores at rest in the control groups (as provided in Figures 4 and 5) were 4 to 90 out of 100 at the 6-hour point and 0.5 to 59 out of 100 at the 24-hour point.
    - For pain levels during mobilization, only a range of values is reported in the results text: 3 to 74 out of 100 (it is not clear how many studies contribute to this range; 18 trials reported pain during movement at any time, with 12 and 16 trials reporting pain during movement at 6 hours and 24 hours, respectively, and 10 trials reporting pain during movement at both times).

- The 4 groups of most commonly evaluated interventions (anti-inflammatory medication, local infiltrative analgesia, intrathecal opioids, and lumbar plexus block) showed morphine-sparing effect, with 7.5 mg reduction in morphine consumption with local infiltration analgesia and ≥ 10 mg for the other 3 groups of interventions. The overall evidence was limited by high or unclear risk of bias in 48 of 58 trials, and small sample sizes in substantial number of trials. Authors concluded that the available evidence "...does not allow a designation of a "best proven intervention" for this surgical procedure."

KANDALA 2015
Kandala NB, Connock M, Pulikottil-Jacob R, Sutcliffe P, Crowther MJ, Grove A, Mistry H, Clarke A. Setting benchmark revision rates for total hip replacement: analysis of registry evidence. BMJ. 2015 Mar 9;350:h756. PubMed

Relevant to FAQ3

- **Study design:** observational study
  - retrospective cohort study
  - based on National Joint Registry for England and Wales
- **Population:** patients having total hip replacement for osteoarthritis
  - use sub-bullets for additional "notes" if needed
- **Intervention:** total hip replacement
- **Comparison:** not applicable

- **Study inclusion criteria:**
  - records of primary surgery from April 2003 to March 2012
  - revision or death notified up to September 2012
  - 5 total hip replacement prosthesis categories selected
    - 4 based of highest frequency of use of combinations of components
    - 5th that has recently gained in popularity

- **Number of studies:** not applicable
- **Number of participants:** 239,089
- **Duration of follow-up:** 10 years

- **Certainty and results:** High
  - **Certainty by outcome:** Not applicable – high for both 5-year and 10-year revision rates
  - **Risk of bias:** No serious concern
  - **Imprecision:** No serious concern
  - **Indirectness:** No serious concern
  - **Inconsistency:** No serious concern

Category of total hip replacement	**Number**	**5-year revision rates % (95% CI)***		**10-year revision rates % (95% CI)*†**		
		men	women	overall	men	women
Metal head (cemented stem) on cemented polyethylene cup	125,285	1.60 (1.48 to 1.74)	1.25 (1.17 to 1.34)	2.58 (2.41 to 2.77)	2.93 (2.62 to 3.28)	2.67 (2.44 to 2.92)

Metal head (cementless stem) on cementless hydroxyapatite coated metal cup (polyethylene liner)	37,874	2.64 (2.35 to 2.96)	2.10 (1.90 to 2.33)	3.71 (3.33 to 4.13)	4.31 (3.66 to 5.07)	3.37 (2.92 to 3.88)
Ceramic head (cementless stem) on cementless hydroxyapatite coated metal cup (ceramic liner)	34,754	2.72 (2.42 to 3.07)	2.32 (2.06 to 2.60)	4.33 (3.83 to 4.90)	4.39 (3.58 to 5.37)	3.76 (3.07 to 4.61)
Hybrid metal head (cemented stem) on cementless hydroxyapatite coated metal cup (polyethylene liner)	28,471	1.79 (1.52 to 2.12)	1.38 (1.20 to 1.59)	2.77 (2.39 to 3.22)	3.18 (2.54 to 3.98)	2.63 (2.17 to 3.18)
Ceramic head (cemented stem) on cemented polyethylene cup	12,705	1.18 (0.89 to 1.58)	1.01 (0.79 to 1.30)	1.96 (1.52 to 2.53)	2.10 (1.39 to 3.16)	1.68 (1.17 to 2.41)
All categories combined	239,089	1.94 (1.84 to 2.05)	1.48 (1.42 to 1.55)	2.92 (2.78 to 3.06)	3.25 (3.02 to 3.50)	2.79 (2.62 to 2.97)

*5-year and 10-year rates based on Kaplan-Meier flexible parametric model; similar results were found using alternative statistical model.
† 10-year revision rates stratified by sex were modeled for patients aged 70 years old

LALMOHAMED 2012
Lalmohamed A, Vestergaard P, Cooper C, de Boer A, Leufkens HG, van Staa TP, de Vries F. Timing of stroke in patients undergoing total hip replacement and matched controls: a nationwide cohort study. Stroke. 2012 Dec;43(12):3225-9. Epub 2012 Nov 6. PubMed

Relevant to FAQ6

- **Study design:** observational study
  - nationwide retrospective cohort study
- **Population:** adults following primary total hip replacement and comparison cohort matched by age, sex, and region to 3 referent adults without total hip replacement or total knee replacement using Danish national registries
- **Intervention:** primary total hip replacement
- **Comparison:** no total hip replacement or total knee replacement

- **Study inclusion criteria:**
  - patients in intervention cohort had primary total hip replacement between 1998 and 2007 inclusive

- **Number of studies:** Not applicable
- **Number of participants:** 266,578
  - 66,583 in intervention cohort
  - 199,995 in comparison cohort
- **Duration of follow-up:** about 4 years (mean)
  - 3.9 years mean for intervention cohort

- 4.1 years mean for comparison cohort

- **Certainty and results: Varies by outcome**
  - **Certainty by outcome:** See table below
  - **Risk of bias:** Very serious concern
    - double downgrade to Low for risk of bias due to observational design and risk of residual or unmeasured confounders
      - comparison at baseline indicated that patients who had total hip replacement had higher prevalence of prior cerebrovascular disease, had substantially greater use of pain relievers, and were more likely have used cardiovascular drugs
      - controls were not selected based on hospitalization or other surgery and may therefore the increased risk of stroke may not be specific to total hip replacement but may also apply to other surgeries/hospitalizations
    - risk of bias starts at low due to observational design; no additional downgrade to Very low because investigators adjusted in statistical analysis for potential confounding factors noted above
  - **Imprecision:** differs based on follow-up time (see table below)
  - **Indirectness:** No serious concern
  - **Inconsistency:** No serious concern
  - **Other considerations:**

Time since total hip replacement surgery*	**Ischemic stroke**			**Hemorrhagic stroke**			**Certainty (reason for downgrade)†**
	number of events per 1,000 person-years		**adjusted‡ hazard ratio (95% CI)**	**number of events per 1,000 person-years**		**adjusted‡ hazard ratio (95% CI)**	
	THR	**control**		**THR**	**control**		
< 2 weeks	26	5.6	4.69 (3.12 to 7.06)	6.7	1.6	4.40 (2.01 to 9.62)	Low (downgraded due to risk of bias)
2 to 6 weeks	14	6.2	2.12 (1.53 to 2.93)	3.8	1.7	2.16 (1.14 to 4.06)	Low (downgraded due to risk of bias)
6 to 12 weeks	7.0	5.7	1.12 (0.80 to 1.58)	4.3	1.7	2.17 (1.32 to 3.57)	*Ischemic stroke*: Very low (downgraded due to risk of bias and imprecision) *Hemorrhagic stroke*: Low (downgraded due to risk of bias)

THR, total hip replacement cohort; control is the comparison cohort as defined above

* Additional time points reported were 3 to 6 months, 6 to 12 months, and ≥ 1 year, but these are not applicable to the traditional definition of the perioperative period. The outcome at 3 to 6 months and 6 to 12 months were also of Very low

certainty (additional downgrade due to imprecision), and the outcome at ≥ 1 year actually favored total hip replacement (adjusted hazard ratio 0.81, 95% CI 0.70 to 0.94). These timepoints are not reported in this table.
† Downgrades listed in column are in addition to risk of bias downgrade, which starts certainty at Low; certainty same for ischemic and hemorrhagic stroke unless otherwise noted.
‡ Adjusted for disease history and drug use

LU 2015
Lu N, Misra D, Neogi T, Choi HK, Zhang Y. Total joint arthroplasty and the risk of myocardial infarction: a general population, propensity score-matched cohort study. Arthritis Rheumatol. 2015 Oct;67(10):2771 9. PubMed

Relevant to FAQ6

- **Study design:** observational study
  - propensity score–matched cohort study
  - matching within 1-year time blocks to account for changes in relative importance of confounding variables at different calendar times
  - based on large electronic medical record database representative of UK general population (database for UK National Health Service)
- **Population:** patients with hip osteoarthritis
  - This study also included evidence for patients with knee osteoarthritis, but we do not consider these data further in this summary due to not being relevant for the scoped question
- **Intervention:** (patients with) total hip replacement
- **Comparison:** (patients without) total hip replacement
  - propensity-score matched to (patients with) total hip replacement
  - baseline characteristics comparison cohort were well balanced with those of intervention cohort

- **Study inclusion criteria:**
  - aged > 50 years
  - diagnosed with hip osteoarthritis between January 2000 and December 2012

- **Number of studies:** Not applicable
- **Number of participants:** 12,126
  - 6,063 patients had total hip replacement
  - 6,063 patients had no total hip replacement
- **Duration of follow-up:** median 4.2 years

- **Results and Certainty:**
  - **Certainty by outcome:** Not applicable, but certainty differs by follow-up time as indicated in table below
  - **Risk of bias: Very serious concern**
    - applies to all outcomes
    - observational study design results in 2 downgrades for risk of bias (not further downgraded because propensity-score matching created comparison groups well balanced on baseline characteristics)
  - **Imprecision:** Serious concern

- **Indirectness:** Downgrade only for 'Total follow-up' which groups different time windows together
- **Inconsistency:** No serious concern

- **Results and Certainty:**

Follow-up*	Number of myocardial infarction cases		Hazard ratio (95% CI)	Certainty (reason for downgrade)**
	incident total hip replacement (n = 6,063)	no total hip replacement (n = 6,063)		
1 month of follow-up	13	3	4.33 (1.24 to 15.21)	Very low (downgraded due to imprecision)
3 months of follow-up	15	10	1.50 (0.74 to 3.34)	Very low (downgraded due to imprecision)

*Additional follow-up periods were 6 months, 1 year, 3 years, 5 years, and total follow-up, but these are not applicable to the traditional definition of the perioperative period. The HRs for each had wide confidence intervals, and all but the 6-month point had point estimates that either showed no difference or that favored the intervention (at 6 months, the point estimate was 1.20, but again, it had a confidence interval that spanned both benefit and harm). The data was Very low certainty from each of these additional time points and they are not included in this table.
**Downgrades listed in column are in addition to risk of bias due to risk of residual or unmeasured confounders, which starts certainty at Low.

- in analysis using venous thromboembolism as positive control outcome, total hip replacement associated with increased risk of myocardial infarction at 'total follow-up' and at all specific follow-up periods up to '5 years of follow-up'

MILLER 2018

Miller LE, Gondusky JS, Kamath AF, Boettner F, Wright J, Bhattacharyya S. Influence of surgical approach on complication risk in primary total hip arthroplasty. Acta Orthop. 2018 Jun;89(3):289-294. Epub 2018 Feb 16. PubMed

Relevant to FAQ6

- **Study design:** systematic review of randomized trials and observational studies
- **Population:** patients with predominant diagnosis of osteoarthritis who had total hip arthroplasty
- **Intervention:** anterior approach
- **Comparison:** posterior approach

- **Study inclusion criteria:**
  - minimum 1-year follow-up duration
  - extractable data on complications

- **Number of studies:** 19

    - 4 randomized trials, 1 prospective nonrandomized study, 10 retrospective studies, and 4 multicenter registries
- **Number of participants:** 164,307
    - 6,620 patients in 15 single-center comparative studies
    - 157,687 patients in 4 multiple center registries
- **Duration of follow-up:** about 17 months
    - median 16 months (range 12-64 months) with anterior approach
    - median 18 months (range 12-110 months) with posterior approach

- **Results and Certainty:**

Outcome	**Studies***	**Event rate per 100 person-years**		**Certainty, univariate estimates†**	**Rate ratio, anterior vs posterior (95% CI)**	**Certainty, anterior vs posterior (comparative estimates)‡**
		anterior	posterior			
infection	7	0.2	0.4	Moderate	0.55 (0.38 to 0.80)	Moderate (downgrade due to risk of bias)
thromboembolic event§	4	0.5	1.1	Moderate	0.59 (0.14 to 2.43)	Low (downgrade due to risk of bias and imprecision)
heterotopic ossification	4	1.5	2.3	Moderate	0.63 (0.35 to 1.13)	Low (downgrade due to risk of bias and imprecision)
dislocation	11	0.2	0.2	Moderate	0.65 (0.44 to 0.95)	Moderate (downgrade due to risk of bias)
reoperation	16	0.6	0.7	Moderate	0.84 (0.75 to 0.93)	Moderate (downgrade due to risk of bias)
fracture	10	0.3	0.1	Moderate	1.02 (0.75 to 1.38)	Low (downgrade due to risk of bias and imprecision)
patient-reported nerve injury‖	2	3.0	1.3	Moderate	2.31 (1.22 to 4.39)	Moderate (downgrade due to risk of bias)

wound complication#	5	1.7	1.9	Moderate	0.93 (0.54 to 1.63)	Low (downgrade due to risk of bias and imprecision)

* Number of participants not reported, only number of studies
† As there are insufficient data to assess imprecision and inconsistency of the univariate estimates, we downgraded all outcomes once to Moderate
‡ Risk of bias was a serious concern for all outcomes because only 4 randomized trials were included and pooled results restricting to the subgroup of randomized trials were not reported
§ Miller 2018 does not permit inference concerning this outcome in people who did not have total hip arthroplasty, and some people who do not have the surgery may have a thromboembolic event, even if a small number (see Pedersen 2012, below). Miller 2018 also did not specify whether thromboembolic events were symptomatic or not (whereas Pedersen 2012 did) and includes a follow-up period for this outcome that is well beyond the traditional definition of the perioperative period. Therefore, we do not consider this outcome from Miller 2018 in Parts 4 or beyond.
|| For this outcome, Miller 2018 provides rates on a per-patient level for the two studies that reported on this outcome. In one study, there was a 5.9% vs 3.3% rate in anterior vs posterior at 24 and 30 months of follow-up, respectively, and in another, there was a 3.8% vs 0% rate in anterior vs posterior at 14 months of follow-up.
In the largest study reporting on this outcome (Watts), the rate of wound complication was 1.7% vs. 1.9% for anterior vs posterior approach.

PEDERSEN 2012

Pedersen AB, Johnsen SP, Sørensen HT. Increased one-year risk of symptomatic venous thromboembolism following total hip replacement: a nationwide cohort study. J Bone Joint Surg Br. 2012 Dec;94(12):1598-603. PubMed

Relevant to FAQ6

- **Study design:** observational study
- **Population:** patients following primary total hip replacement and comparison cohort matched for gender and age at time of surgery to general population
    - patients following primary total hip replacement from Danish Hip Arthroplasty Registry, which includes all primary total hip replacement performed in Denmark from 1995 through 2010
    - persons from general population from Danish Civil Registration System, a national register of all Danish residents
    - 97% received anticoagulation during hospitalization, but no data were provided on whether anticoagulation was continued after discharge
- **Intervention:** total hip replacement
- **Comparison:** no total hip replacement

- **Study inclusion criteria:**

- **Number of studies:** not applicable
- **Number of participants:** 343,860
    - 85,965 patients following primary total hip replacement
    - 257,895 persons from general population
- **Duration of follow-up:** 1 year

- **Certainty:** Varies by outcome

- **Certainty by outcome:** Moderate for 0-90 days and Low for 91-365 days
- **Risk of bias:** Serious concern
  - risk of bias due to risk of residual or unmeasured confounders, which starts Certainty at Low
    - comparison at baseline indicated that patients who had total hip replacement had slightly more comorbid conditions than comparison cohort, based on Charlson comorbidity index scores
    - did not downgrade to Very low because these small between group differences in general comorbidities would be unlikely to explain the large increased risk of venous thromboembolism in hip replacement group
- **Imprecision:** No serious concern
- **Indirectness:** No serious concern
- **Inconsistency:** No serious concern
- **Other considerations:** upgrade outcome at 0 to 90 days based on large effect sizes

- **Results:**

Time since total hip replacement surgery	**Symptomatic venous thromboembolism, n (%)**		**Adjusted risk ratio (95% CI)***
	total hip replacement patients (n = 85,965)	comparison cohort (n = 257,895)	
0 to 90 days	678 (0.79%)	129 (0.05%)	15.84 (13.12 to 19.12)
91 to 365 days†	246 (0.29%)	308 (0.12%)	2.41 (2.04 to 2.85)

* Variables for which the authors adjusted not reported

† The traditional definition of the perioperative period is within 12 weeks/90 days of the surgery. We therefore do not consider the data for the period from 91 to 365 days beyond Part 3. We also reiterate that only the data from 0 to 90 days are considered Moderate certainty. The data from 91 to 365 days are of Low certainty.

SHAN 2014

Shan L, Shan B, Graham D, Saxena A. Total hip replacement: a systematic review and meta-analysis on mid-term quality of life. Osteoarthritis Cartilage. 2014 Mar;22(3):389-406. doi: 10.1016/j.joca.2013.12.006. Epub 2014 Jan 1. PubMed

Relevant to FAQ2

- **Study design:** systematic review of observational studies
- **Population:** adults who had total hip replacement for treatment of osteoarthritis
- **Intervention:** total hip replacement
- **Comparison:** pre-operative scores compared to post-operative scores at time of final follow-up

- **Study inclusion criteria:**
  - post-operative follow-up of > 3 years
  - disease-specific and/or generic health-related quality of life data recorded
  - published after January 2000

- **Number of studies:** 20
- **Number of participants:** 8,201

- **Duration of follow-up:** mean or median ranged from 3 to 12.8 years

- **Certainty: Varies by outcome**
  - **Certainty by outcome:** Moderate for range of proportions of patients reporting satisfaction with outcome; High for outcomes meta-analyzed with a standardized mean difference as the outcome measure
  - **Risk of bias:** Serious concern for range of proportion of patients reporting satisfaction with outcome; no serious concern for outcomes meta-analyzed with a standardized mean difference as the outcome measure (see below)
    - loss to follow-up was > 15% in 11 studies and retention rate of only 27% to 58% in 5 studies
      - none of the 6 studies included for meta-analysis with a standardized mean difference as the outcome measure were among the 11 studies that suffered from >15% loss to follow-up
      - 3 of the 5 studies contributing to the range of proportions of patients reporting satisfaction with outcome had >15% loss to follow-up, with 1 study having only 55% retention
  - **Imprecision:** No serious concern
  - **Indirectness:** No serious concern
  - **Inconsistency:** No serious concern
  - **Other considerations:**
    - of the 20 included studies, only 6 (totaling 1,990 participants) were pooled in meta-analysis
      - 9 studies were not included in meta-analysis because of incomplete or inconsistent reporting (eg, no pre-operative data, follow-up times not reported, use of different health-related quality of life scoring systems that could not be combined)
      - 5 other studies were not included in meta-analysis due to "poor study quality", reported to be determined based on "...sample size, response rates (RR) and overall level of evidence."
        - 4 of the 5 excluded studies were among those with retention rates between 27% to 58%. The other excluded study included 274 patients and had a generic HRQOL instrument (SF-36) but no disease-specific instrument, and it had a 65% retention rate.
    - notes about systematic review and meta-analysis methodology
      - Study quality was first assessed using "sample size, study design, use of both disease-specific and generic HRQOL measures, follow-up consistency and variability of results", and an "[o]verall level of evidence applicable to orthopaedic surgery" was also assigned to each study in Table 1, based on the *Levels of Evidence* used by *J Bone Joint Surg*.
      - 'Methods/Risk of bias' section reports that "Risk of bias across studies was analysed by Tau2 and I2 statistic"; however, these methods assess heterogeneity.

- **Results:**
  - generic health-related quality of life (HRQOL) data not reported here
  - for disease-specific HRQOL measures, compared to pre-operative scores, post-operative scores at time of final follow-up (range of 3.6 to 7 years) were significantly improved

        - including overall measure and pain- and function-specific measures
            - total Harris Hip Score (overall measure of disease-specific health-related quality of life) in analysis of 5 studies
                - standardized mean difference (SMD) 3.59 (95% CI, 2.27 to 4.91; I^2 = 0%)
            - combined Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Harris Hip Score pain score in analysis of 6 studies
                - SMD 2.33 (95% CI, 1.59 to 3.08; I^2 = 0%)
            - combined WOMAC and Harris Hip Score function score in analysis of 5 studies
                - SMD 2.31 (95% CI, 1.46 to 3.16; I^2 = 0%)
        - authors reported that post-operative health-related quality of life scores varied compared to those in reference populations, but were roughly comparable
    - authors report a range of 84% to 97% of patients were satisfied with outcome at up to 7 years following surgery in 4 studies (totaling 1,514 patients; they cite 5 studies with this statement, but 2 citations are from Nilsdotter and represent different follow-up periods for the same population, thus giving 4 unique studies); however, this estimate includes 3 studies that suffered from >15% loss to follow-up (1 of which had a retention rate of only 55%)

SINGH 2013

Singh JA, Lewallen DG. Patient-level clinically meaningful improvements in activities of daily living and pain after total hip arthroplasty: data from a large US institutional registry. Rheumatology (Oxford). 2013 Jun;52(6):1109-18. Epub 2013 Feb 4. PubMed

Relevant to FAQ2

- **Study design:** observational study
    - data analyzed from registry including all joint replacements performed at Mayo Clinic
- **Population:** patients who had primary total hip arthroplasty between 1993-2005
    - This study also includes pain and activities of daily living outcomes for patients who had revision total knee replacement, but we do not consider these data further in this summary due to not being relevant for the scoped question
- **Intervention:** primary total hip arthroplasty
- **Comparison:** comparison between preoperative outcomes and 2- and 5-year postoperative outcomes

- **Study inclusion criteria:**
    - primary total hip arthroplasty between 1993-2005
    - responded to pre- and/or post-surgery hip questionnaire

- **Number of studies:** Not applicable
- **Number of participants:** 6,168 preoperatively
    - 5,707 available at 2 years postoperatively
    - 3,289 available at 5 years postoperatively
- **Duration of follow-up:** 5 years postoperatively

- **Certainty: varies by outcome**
  - **Certainty by outcome:** High for 2-year follow-up and Moderate for 5-year follow-up
  - **Risk of bias:** Serious concern for 5-year outcome and no serious concern for 2-year outcome
    - high rate of nonresponse at 5 years, with almost twice as many responders preoperatively compared to 5 years postoperatively
  - **Imprecision:** No serious concern
  - **Indirectness:** No serious concern
  - **Inconsistency:** No serious concern

- **Results:**

Level of pain	Preoperatively (%)	2-year follow-up (%)	5-year follow-up (%)
Primary total hip replacement			
none	1%	70%	68%
mild	4%	22%	21%
moderate	51%	7%	9%
severe	44%	1%	2%

Outcome/time point	Proportion of patients with primary total hip replacement with none/mild at follow-up time	
	Preoperatively moderate	Preoperatively severe
pain		
• 2-year follow-up	94%	91%
• 5-year follow-up	91%	89%
limitations in activities of daily living (overall)		
• 2-year follow-up	82%	70%
• 5-year follow-up	75%	65%

TILBURY 2014

Tilbury C, Schaasberg W, Plevier JW, Fiocco M, Nelissen RG, Vliet Vlieland TP. Return to work after total hip and knee arthroplasty: a systematic review. Rheumatology (Oxford). 2014 Mar;53(3):512-25. doi: 10.1093/rheumatology/ket389. Epub 2013 Nov 23. PubMed

Relevant to FAQ4

- **Study design:** systematic review of observational studies
- **Population:** patients who had hip replacement
  - This study also includes evidence for patients who had total knee replacement, but we do not consider these data further in this summary due to not being relevant for the scoped question

    - in studies of patients who had hip replacement
        - mean age ranged from 47 to 70 years old
        - work status of patients prior to surgery was described in 10 studies
        - work status of patients after surgery was described in 11 studies
- **Intervention:** total hip or total knee replacement
- **Comparison:** before and after surgery

- **Study inclusion criteria:**
    - ≥ 10 patients having total hip replacement
    - reported quantitative information on patients' work status before and on ≥ 1 occasion after surgery

- **Number of studies:** 15
- **Number of participants:** 3,872
    -
- **Duration of follow-up:** ranged from 6-7 weeks to (median) 5 years

- **Certainty: varies by outcome**
    - **Certainty by outcome:** Very low for proportion of patients returning to work and Low for time to return to work
    - **Risk of bias:** Serious concern
        - methodological quality assessed by scoring likelihood of selection bias, information bias, and statistical analysis bias
        - overall methodological quality rated as high, moderate, or low
            - high if no evidence for selection, information, or analysis bias
            - moderate if evidence of bias in 1 of 2 categories in descriptive studies (statistical analysis of potential determinants of work status not applicable) or 2 of 3 categories in studies involving statistical analysis of association between various factors and work status
            - low if evidence of bias in 2 categories in descriptive studies and all 3 categories in other studies
        - for hip studies, methodological quality rated
            - high in 1 study
            - moderate in 8 studies
            - low in 5 studies
    - **Imprecision:** Very serious concern for proportion of patients returning to work; Serious concern for time to return to work
    - **Indirectness:** No serious concern
    - **Inconsistency:** Very serious concern for proportion of patients returning to work; Serious concern for time to return to work
        - The concepts of inconsistency and imprecision are clearly interrelated in this case; that is, the inconsistency in the results is what leads to our concern for imprecision. As a result, we do not downgrade in both domains. However, we note the proportion and time to return to work varied widely (worse for proportion returning to work than for time to return to work), and comparisons between studies were limited by variations in study design, patient selection and especially measurement of work status

- **Other considerations:** The variation in time to return to work, although considerable, seems more plausibly explainable (e.g., variations in types of employment, such as computer-based work versus manual labor) than the variation in the proportion returning to work.

- **Results:**
  - only the number of studies (not participants) was reported for the outcomes below
  - proportion of hip patients returning to work after hip surgery ranged from 25% to 96% at 1-12 months after surgery (in 7 studies that reported on this outcome)
  - time to return to work in patients who were working preoperatively ranged from 8 days to mean 10.5 weeks for hip patients (in 5 studies that reported on this outcome)
  - determinants of return to work based on multivariate analysis reported in 3 hip studies
    - factors associated with worse work outcomes included female gender, older age, pain in joints other than hips, failure of procedure, physical work, unskilled work, and being farmer
    - factors associated with better work outcomes included younger age, more education, working 1 month preoperatively, mental work, primary coxarthrosis, and better postoperative walking ability

VISSERS 2011
Vissers MM, Bussmann JB, Verhaar JA, Arends LR, Furlan AD, Reijman M. Recovery of physical functioning after total hip arthroplasty: systematic review and meta-analysis of the literature. Phys Ther. 2011 May;91(5):615-29. PubMed

Relevant to FAQ2, FAQ4

- **Study design:** systematic review of randomized trials and observational studies
- **Population:** patients who had primary total hip arthroplasty for osteoarthritis
- **Intervention:** primary total hip arthroplasty
- **Comparison:** pre-post comparison
  - the studies included and outcomes reported in this summary are based on pre-post comparisons, but the authors also compared results with a reference value derived from individuals who were healthy (noted in context below)

- **Study inclusion criteria:**
  - prospective study of patients receiving primary total hip arthroplasty for osteoarthritis
  - pre-post/before-after design with assessments at fixed time points (all patients must have been seen at the same follow-up time, with a small range in time)
  - minimum follow-up duration of 6 weeks
  - outcomes assessed had to include one of the following:
    - patient-reported outcome measures for functioning using validated questionnaires: Western Ontario and McMaster Universities Osteoarthritis Index physical functioning subscale (WOMAC-PF), the Medical Outcomes Study Short-Form Health Survey physical functioning subscale (SF-36-PF), the Oxford Hip Score, and the physical activity scale of the Arthritis Impact Measurement Scales (AIMS-PA).

        - functional capacity to perform activities in a lab setting or outpatient clinic
        - actual daily activity in the home using activity-monitoring devices (e.g., pedometer, accelerometer)
        - of the three outcome types listed above, we consider only patient-reported outcome measures for functioning to be immediately relevant to patients; we therefore do not report further on the other two outcome types

- **Number of studies:** 31
    - 7 randomized, controlled trials
        - None of the trials were directly assessing hip replacement vs no hip replacement (for instance, some assessed different types of arthroplasty), so Vissers' 2011 analyses of these trials were cohort analyses
    - 24 prospective cohort studies
- **Number of participants:** 9,890
    - number of participants in the included studies ranged from 11 to 7,151
- **Duration of follow-up:** range of 1.5 to 60 months overall
    - range of 3 to 60 months for patient-reported outcome measures of function (study with 1.5 months of follow-up only assessed gait analysis)
    - no overall follow-up period reported

- **Certainty: Varies by outcome**
    - **Certainty by outcome: Low for all outcomes other than SF-36-PF at 1-3 months postoperatively, which has Very low certainty**
    - **Risk of bias:** Very serious concerns
        - Very serious concerns stem from concerns about population representativeness and inadequate description of follow-up/loss to follow-up
        - Authors report only 3 studies described loss to follow-up, but in the tabulated results appraising study quality, only 30 of the 31 studies are included, and the study not included appears to be 1 of the 3 studies that described loss to follow-up so can only assess 2 of the reported 3 studies, and neither of these studies inform the WOMAC-PF or SF-36-PF outcomes
        - Authors report only 6 studies had representative populations, but due to issues noted above regarding tabulated quality ratings, can only assess 5 of the reported 6 studies, with only 3 and 2 of these studies contributing to the pooled WOMAC-PF and SF-36-PF estimates, respectively (and not at all time points)
    - **Imprecision:** Serious concern for SF-36-PF at 1-3 months postoperatively; No serious concern for other outcomes
    - **Indirectness:** No serious concerns
    - **Inconsistency:** No serious concerns

- **Results:**
    - Authors report sufficient data were available to pool the results for the WOMAC-PF and SF-36-PF outcomes
    - WOMAC-PF was reported by 11 studies
        - data pooled for only 7 of these studies due to authors judging that non-uniform approach to scoring precluded pooling all results (e.g., 5-point Likert scale in some studies, visual analog scale in other studies); results in table below
    - SF-36-PF was reported by 10 studies

        - data pooled for 8 of these studies due to 2 studies studying the same population studied in one of the other 8 publications; results in table below
    - Oxford Hip Score was reported in 3 studies. Results reported as "Preoperatively, the Oxford Hip Score ranged from 43.6 (SE=6.6) to 44.5 (SE=7.5); at 12 months postsurgery, the score had improved to 21.5 (SE=9.0)."
        - the authors did not describe the range or interpretation of the scale, but it was found to be 0 to 48 or 12 to 60 depending on whether one scores each item as 0 to 4 or 1 to 5, with higher scores being better if using the 0-to-48 scale and lower scores being better if using the 12-to-60 scale
    - AIMS-PA was reported by 1 study. Results reported as "the score ranges from 0 to 10, with a lower score representing better functioning. The mean preoperative score was 8.8 (SE=1.4), and the mean score at 6 months postsurgery was 5.6 (SE=2.8)."

Timepoint	WOMAC-PF*		SF-36-PF†	
	No. studies (no. participants)‡	**mean, SE (calculated 95% CI)**	**No. studies (no. participants)‡**	**mean, SE (calculated 95% CI)**
preoperative	7 (599)	35.75, 1.54 (32.73 to 38.77)	8 (1,022)	30.92, 3.69 (23.69 to 38.15)
1-3 months postoperative	5 (349)	18.00, 3.36 (11.41 to 24.59) p for comparison to preoperative score = 0.0003	4 (279)	49.3, 12.49 (24.82 to 73.78) p for comparison to preoperative score = 0.085
6-8 months postoperative	6 (569)	12.76, 1.98 (8.88 to 16.64) p for comparison to preoperative score = 0.0001	7 (949)	63.02§, 4.17 (54.85 to 71.19) p for comparison to preoperative score = 0.0001

CI, confidence interval; SE, standard error; SF-36-PF, Medical Outcomes Study Short-Form Health Survey physical functioning subscale; WOMAC-PF, Western Ontario and McMaster Universities Osteoarthritis Index physical functioning subscale
* range of scores is 0 to 68, with lower scores indicating better function
† range of scores is 0 to 100, with higher scores indicating better function
‡ total number of patients calculated based on studies in pooled analysis and number of patients reported in Table 1
§ results text reports mean of 63.04, tabulated results report mean of 63.02

    - Based on the cited reference values of 1.8 for WOMAC-PF and 76 for SF-36-PF among healthy controls, this would translate to the following
        - For WOMAC-PF, compared to being at about 46% to 49% (95% CI, 44% to 53%) of normal preoperatively, patients were at about:
            - 76% (95% CI, 66% to 85%) of normal at 1-3 months postoperatively
            - 81% to 83% (95% CI, 78% to 89%) at 6-8 months postoperatively
            - range for preoperative and 6-8 month point estimates is due to differences between authors' reported percentages (46%, 81%) and the calculated values (49%, 83%); CIs are all calculated based on the calculated CI for the mean shown in the above table

        - calculations require inversion of the scale due to lower scores indicating better outcomes
    - For SF-36-PF, compared to being at about 41% (95% CI, 31% to 50%) of normal preoperatively, patients were at about
        - 65% (95% CI 33% to 97%) of normal at 1-3 months postoperatively
        - 83% (95% CI 72% to 94%) of normal at 6-8 months postoperatively
        - CIs are all calculated based on the calculated CI for the mean shown in the above table

Evidence report for total hip arthroplasty for hip osteoarthritis

Part 4 - Evidence Review

Prepared by EBSCO Information Services

February 25, 2019

Prepared by EBSCO Health Innovations and EBM Development Department:

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Methods

For each FAQ, the key concepts (results and factors affecting certainty of the results) from the included studies that are most relevant to evidence synthesis will be summarized in Evidence Review Tables. Where evidence is very limited, or the FAQ is for descriptive summary, summary text will be provided.

Results

FAQ 1: What does the treatment involve?

Total hip arthroplasty (FAQ1a)

Descriptive Overview

A person's "hip joint" consists of one end of the femur and the acetabulum of the pelvis. The shaft of the femur is the long part of the bone that runs up and down a person's upper leg. Many people colloquially refer to as the "thigh bone". At the end of the femur that is near the hip joint, the femur has an angled part called the neck. Attached to the neck of the femur is the head of the femur. The head of the femur fits inside the acetabulum of the pelvis as a "ball-and-socket" joint. Osteoarthritis of the hip affects this "ball-and-socket" joint area and can lead to considerable pain and loss of function.

Total hip arthroplasty is often better known as total hip replacement. For people with osteoarthritis of the hip, total hip replacement is typically reserved for end-stage symptoms, where non-surgical management is not giving sufficient relief. In total hip replacement, the damaged hip joint is removed and replaced with an artificial hip joint. The two main parts of an artificial hip joint are designed to mimic the natural structure and function of a real hip joint. The two parts are often referred to as the "cup" and "stem". The "cup" is a socket that is anchored inside the acetabulum of the pelvis. The "stem" is an angled shaft. The straight part of the shaft is inserted into the femur. The angled part serves as a neck, and a ball on the end of this neck fits inside the socket of the "cup".

There are two options for anesthesia: general anesthesia (being put to sleep during the operation) and epidural anesthesia (an injection in the spine that numbs the lower half of the body). Epidural anesthesia is often combined with sedative medication.

To perform the surgery, the surgeon will make an incision along the hip joint area. The incision is about 6 to 12 inches long. Once the incision is made, the muscles will be moved out of the way. The damaged parts of the hip will be removed, and the artificial hip will be inserted. Cement is sometimes used to hold parts of the artificial hip in place, but this will depend on the specifics of the artificial hip that is used. The incision site will be closed with stitches or staples. Some hip replacements are now being done with minimally-invasive methods that use one or two smaller incisions (e.g., for the one-incision method, about 3 to 6 inches, and for the two-incision method, about 2 to 3 inches and 1 to 2 inches for the two incisions). However, minimally-invasive methods may not be offered by every facility or every surgeon.

The time for the actual surgery may be about 1 to 2 hours for the traditional approach to total hip replacement, and about 1 or more hours for minimally-invasive methods. The total time needed may

vary depending on the specifics of each patient. It is common to stay in the hospital for 3 to 4 days, but usually people can go home within 4 days. This may be shorter or longer depending on the specific patient. The length of stay may be shorter if receiving minimally-invasive surgery.

For a period of time after the surgery, patients are usually given medication to prevent blood clots, though recommendations are not strong or entirely consistent. After the surgery, patients will initially walk with an assistive device (e.g., walker, crutches) and progressively increase the amount of weight they put on the leg with the artificial hip. Dedication to attending/performing physical therapy and exercises as directed is very important for recovery, including after being discharged from the hospital. Some patients go to a rehabilitation facility for a short period to help ensure they stay on track with recovery. In general, assuming recovery is going well, people are often able to return to their normal activities by 6 to 12 weeks after the operation, with further recovery and improving strength occurring for 6 to 12 months. For resuming specific activities, the following are general timelines people might be able to expect, but these are overall approximations, and all timelines should be tailored to the specific patient:

- Within 3 to 8 weeks: Sexual activity
- Within 6 to 8 weeks: Driving a car (riding as a passenger may be feasible several weeks sooner)
- Within 6 to 12 weeks: Return to work (depending on the nature of the work)

(AAOS 2014, AAOS 2018, Cleveland Clinic nd, Cram 2011, DynaMed Plus 2018, EBSCO Health Library 2018, Mayo Clinic 2018, NIH 2016a, NHS 2016, Tilbury 2014)

Non-surgical treatment (FAQ1b)

Descriptive Overview

Non-surgical treatment for osteoarthritis of the hip may involve a number of different treatments, which should be tailored to the individual. According to the Management overview section of the DynaMed Plus topic Osteoarthritis (OA) of the hip (DynaMed Plus 2018):

- optimal management of osteoarthritis requires combination of nonpharmacologic and pharmacologic modalities (OARSI Level IV) (Osteoarthritis Cartilage 2008 Feb;16(2):137 full-text)

- patient education
  - all patients should be given information access and education about objectives of treatment and importance of changes in lifestyle, exercise, pacing of activities, weight reduction, and other measures to unload damaged joint(s) (OARSI Level 1a)
  - all patients with overweight and with symptomatic hip OA should be counseled regarding weight loss (ACR Strong recommendation)
  - all patients should receive advice concerning appropriate footwear (OARSI Level IV)
  - encourage patients with overweight to lose weight and maintain their weight at a lower level (OARSI Level Ia)
  - self-management education programs might reduce pain, but not function in short-term in patients with osteoarthritis (level 2 [mid-level] evidence)

- nonpharmacologic treatment
  - encourage patients with hip osteoarthritis to participate in an exercise program that matches their abilities (ACR Strong recommendation), including regular aerobic, muscle strengthening, and range-of-motion exercises (OARSI Level IV)
  - patients with symptomatic hip osteoarthritis may benefit from referral for physical therapy (OARSI Level IV; AAOS Strong recommendation), and aquatic exercises can be effective (OARSI Level Ib; ACR Strong recommendation)
  - walking aids can reduce pain (OARSI Level IV) and can be used as necessary (ACR Conditional recommendation)
    - give patients instruction in optimal use of cane or crutch in contralateral hand
    - frames or wheeled walkers often preferable for patients with bilateral disease
  - patients should be instructed in the use of thermal agents and receive manual therapy in combination with physical therapist-supervised exercise (ACR Conditional recommendation); thermal modalities and transcutaneous electrical nerve stimulation (TENS) may be effective for relieving symptoms (OARSI Level Ia, based on studies in patients with knee osteoarthritis)

- pharmacologic treatment
  - acetaminophen (up to 4 g/day) can be an effective initial oral analgesic for treatment of mild-to-moderate pain; consider alternative pharmacologic therapy if inadequate response to acetaminophen or in presence of severe pain and/or inflammation (OARSI Level IV; ACR Conditional recommendation)

- *DynaMed commentary* -- some clinicians suggest a maximum dose of acetaminophen 3.25 g/day to reduce risk for liver damage
- alternative pharmacologic therapy to consider for improving function and/or providing short-term pain relief
  - oral nonsteroidal anti-inflammatory drugs (NSAIDs) (AAOS Strong recommendation; ACR Conditional recommendation)
    - use NSAIDs at lowest effective dose and avoid long-term use if possible (OARSI Level Ia)
    - for pain of osteoarthritis, NSAIDs are better than acetaminophen and various NSAIDs and cyclooxygenase-2 (COX-2) inhibitors have similar efficacy (level 1 [likely reliable] evidence)
  - intra-articular corticosteroid injections may be considered as an option in the initial management (ACR Conditional recommendation), especially in patients with moderate-to-severe pain refractory to oral analgesic/anti-inflammatory agents (OARSI Level Ib; AAOS Strong recommendation)
- for treatment of refractory pain, where other pharmacologic agents have been ineffective, or are contraindicated, consider weak opioids and narcotic analgesics (OARSI Level Ia; ACR Strong recommendation), including tramadol (ACR Conditional recommendation)
  - clinical role of opioid therapy is for moderate or severe pain which impairs function or quality of life, for which potential benefits outweigh risks, and for which no alternative has better risk/benefit profile
  - nontramadol opioids might improve pain and function, but may increase adverse events in patients with knee or hip osteoarthritis (level 2 [mid-level] evidence)
  - tramadol may reduce pain in patients with knee and/or hip osteoarthritis (level 2 [mid-level] evidence)
- glucosamine sulfate is not effective for improving pain or function or reducing progression of joint space narrowing in hip osteoarthritis (level 1 [likely reliable] evidence), and is not recommended for use in patients with hip OA (AAOS Moderate recommendation; ACR Conditional recommendation)
- S-adenosylmethionine (SAMe) may not reduce pain or improve function in patients with hip osteoarthritis (level 2 [mid-level] evidence)

A 2014 systematic review of recommendations and guidelines for the management of osteoarthritis sought to harmonize recommendations across various guidelines (Nelson 2014). The following were recommended:

- non-pharmacologic modalities
  - self-management, exercise, and physical or occupational therapy
    - self-management and education
    - low-impact aerobic exercise (land- or water-based)
    - weight loss if overweight
    - *can consider* range-of-motion/flexibility exercises, supervised exercise with manual therapy, endurance/strengthening exercises, and physical therapy/occupational therapy referral
  - other non-pharmacologic modalities
    - walking aids or other assistive devices to maintain activities of daily living
    - heat/cold
- pharmacologic modalities
  - acetaminophen/paracetamol
  - oral non-steroidal anti-inflammatory drugs (NSAIDs; e.g., ibuprofen, naproxen)

- tramadol for symptoms refractory to acetaminophen/paracetamol and NSAIDs
- *can consider* opioids for symptoms refractory to acetaminophen/paracetamol and NSAIDs
- corticosteroid injections

Patients receiving an injection in the hip may be advised to rest the day of the procedure, but they should be able to resume most normal activities the next day. (NIH 2016b)

FAQ 2a: Will my symptoms get better?

Evidence Review Tables and Descriptive Evidence Review: Studies reporting results as proportions, including two systematic reviews of observational studies and an observational study

Beswick 2012 was a systematic review of observational studies in patients with primary total hip or knee replacement that reported results classifiable as proportion of patients with unfavorable pain outcome at follow-up from 3 months to 5 years. Among the 6 studies of total hip replacement included in this systematic review, 2 were judged to be the highest quality by the review authors, and both had consistent estimates for proportion of patients with unfavorable outcome. In accordance with the standard GRADE approach, we used the estimates from these 2 low risk of bias studies for evidence synthesis.

Author year	**Sample size**	**Time point for outcome assess-ment (months postopera tive)**	**Number of patients with**				**Certainty (reasons for downgrade)**
			favorable* outcome % (n/N)	uncertain† outcome % (n/N)	unfavorable‡ outcome % (n/N) without imputation§	unfavorable‡ outcome % (n/N) with imputation**	
Nikolajson 2006	1,231	12-18 mos	61.3% (754/1,231)	28.4% (350/1,231)	10.3% (127/1,231)	13.2% (163/1,231) (95% CI, 11.5% to 15.2%)	High
Jones 2000	242	6 mos	86.0% (208/242)	5.8% (14/242)	8.3% (20/242)	8.7% (21/242) (95% CI, 5.7% to 12.9%)	High

N, sample size of cohort; n, number with event; mos, months
* favorable outcome includes patients with no pain or mild pain at follow-up
† uncertain outcome includes "...all patients for whom we cannot be sure of their pain levels at follow-up. These include patients who died, had revision surgery, contralateral surgery or dislocation and were not followed up with questionnaires and those lost to follow-up. We also included as uncertain those patients with a degree of reported pain, which we could not classify as a favorable or unfavorable outcome"
‡ unfavorable outcome includes those with moderate-to-severe pain or for whom surgery had not relieved pain
§ proportion with unfavorable long-term pain outcome without imputing outcome information on patients lost to follow-up
** imputing proportion with known unfavorable long-term pain outcome to number with uncertain pain outcome

Shan 2014 was a systematic review of observational studies in patients with total hip replacement, and it reported a range of 84% to 97% for the proportion of patients reporting satisfaction with outcome at up to 7 years following surgery (4 studies, 1,514 patients; Moderate certainty due to downgrade for risk of bias due to loss to follow-up).

Singh 2013 was a registry-based observational study that compared preoperative outcomes and 2- and 5-year postoperative outcomes in patients who had hip replacement surgery. The table below indicates the proportion of patients with clinically meaningful improvements, which were defined by the authors (for both pain and activities of daily living limitations outcomes) as reduction from moderate or severe preoperatively to none or mild postoperatively.

Sample size*	**Outcome**	**Proportion of patients with no/mild pain or limitations in activities of daily living, based on preoperative symptom severity**		**Certainty**
6,168		**Preoperatively moderate**	**Preoperatively severe**	
5,707	pain at 2-year postoperative point	94%	91%	High
5,707	pain at 5-year postoperative point	91%	89%	Moderate (downgraded due to high rate of nonresponse at 5 years)
3,289	limitations in activities of daily living limitations at 2-year postoperative point	82%	70%	High
3,289	limitations in activities of daily living limitations at 5-year postoperative point	75%	65%	Moderate (downgraded due to high rate of nonresponse at 5 years)

*6,168 patients were available at baseline (preoperatively). 5,707 and 3,289 patients were available at 2 and 5 years postoperatively, respectively.

Evidence Review Tables: Systematic review of observational studies that reported results as standardized mean differences comparing preoperative to postoperative disease-specific health-related quality of life scores (Shan 2014).

No. studies (sample size)	Key findings	Certainty
6 (1,990)	compared to pre-operative scores, post-operative scores on disease-specific health-related quality of life measures significantly improved at time of final follow-up (range of 3.6 to 7 years): • total Harris Hip Score (overall measure of disease-specific health-related quality of life) in analysis of 5 studies (standardized mean difference 3.59, 95% CI 2.27 to 4.91) • combined Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Harris Hip Score pain score (pain-specific measure of disease-specific health-related quality of life) in analysis of 6 studies (SMD 2.33, 95% CI 1.59 to 3.08) • combined WOMAC and Harris Hip Score function score (function-specific measure of disease-specific health-related quality of life) in analysis of 5 studies (SMD 2.31, 95% CI 1.46 to 3.16)	High

Evidence Review Tables: Systematic review that reported results as means and standard errors preoperatively and at specified times postoperatively for physical function scores (Vissers 2011)

No. studies (sample size)	Key findings*,†	Certainty (reason for downgrade)
Preoperative: 7 (599) *6-8 months postoperative:* 6 (569)	For WOMAC-physical functioning, compared to being at about 46% to 49% (95% CI, 44% to 53%) of normal preoperatively, patients were at about 81% to 83% (95% CI, 78% to 89%) of normal at 6-8 months postoperatively.	Low (risk of bias [see Part 3])
Preoperative: 8 (1,022) 6-8 months postoperative: 7 (949)	For SF-36- physical functioning, compared to being at about 41% (95% CI, 31% to 50%) of normal preoperatively, patients were at about 83% (95% CI 72% to 94%) of normal at 6-8 months postoperatively.	Low (risk of bias [see Part 3])

SF-36-PF, Short-Form Health Survey physical functioning subscale; WOMAC-PF, Western Ontario and McMaster Universities Osteoarthritis Index physical functioning subscale

* Results were reported as means and standard errors at baseline and 6-8 month follow-up. The authors cited reference values for each of the above scales, which they used to calculate the percent of normal at baseline and at the specified periods of follow-up. However, they only did this for the point estimates. We calculated these values as well, including for the confidence interval.

† Outcomes were also assessed at 1-3 month time point, but we consider these data elsewhere (FAQ4). For FAQ2, we wanted to ensure we only included data for outcomes when recovery can be considered maximal (>3 months postoperatively; Beswick 2012) for FAQ2.

FAQ 3a: Will I need surgery later?

We found evidence for the following 3 related outcomes for the question of whether a person will need surgery later: (1) cumulative implant survival from 5 years postoperatively to up to 25 years postoperatively, (2) risk of revision surgery or reoperation, and (3) mean time to revision surgery among those requiring revision surgery.

Evidence Review Tables: Cumulative implant survival from 5 years postoperatively to up to 25 years postoperatively

Three articles we selected to summarize and critically appraise for FAQ3 used population-based data sources to estimate cumulative implant survival rates at 5-year interval time points following surgery up to 25 years (Bayliss 2017; Evans 2019; Kandala 2015). Evans 2019 was a systematic review/meta-analysis of cumulative implant survival rates at up to 25 years, with analyses reported separately for national joint replacement registries and case series/cohort studies. Bayliss 2011 was a population-based study that estimated implant survival rates at up to 20 years postoperatively. Kandala 2015 was a population-based study that estimated revision rates at 5-years and 10-years postoperatively, and which reported estimates for 5 different categories of total hip replacement.

Evans 2019

Cumulative implant survival at 15, 20, and 25 years
(based on systematic review of reports from registry series on patients who had total hip replacement)

Years after total hip replacement	Number of construct series	Total number of hip replacements*	Registry	Cumulative implant survival rate (95% CI)	Certainty
15	92	215,676	Finnish and Australian	89.4% (95% CI 89.2% to 89.6%)	Moderate (downgraded due to inconsistency)
20	43	73,057	Finnish	70.2% (95% CI 69.7% to 70.7%)	Moderate (downgraded due to inconsistency)
25	29	51,359	Finnish	57.9% (95% CI 57.1% to 58.7%)	Moderate (downgraded due to inconsistency)

* All 92 construct series reported survival analyses at 15 years (215 676 total hip replacements), 43 series at 20 years (73 057 total hip replacements), and 29 series at 25 years (51 359 total hip replacements)

Cumulative implant survival at 15, 20, and 25 years
(based on systematic review of 44 case series reporting on 13,212 patients who had total hip replacement)

Years after total hip replacement	Cumulative implant survival rate (95% CI)	Certainty
15	85.7% (95% CI 85.0% to 86.5%)	Low (downgraded due to risk of bias and inconsistency)
20	78.8% (95% CI 77.8% to 79.9%)	Low (downgraded due to risk of bias and inconsistency)
25	77.6% (95% 76.0% to 79.2%)	Low (downgraded due to risk of bias and inconsistency)

Bayliss 2017

Cumulative implant survival at 5, 10, 15, and 20 years
(based on UK population-based study reporting on 63,158 patients who had total hip replacement from 1991 through 2011)

Years after total hip replacement	Cumulative implant survival rate (95% CI)	Certainty
5	97.9% (97.79% to 98.04%)	High
10	95.6% (95.34% to 95.85%)	High
15	91.0% (90.29% to 91.57%)	High
20	85.0% (83.23% to 86.63%)	High

Kandala 2015

Revision rates at 5 and 10 years
(based on UK population-based study reporting on 239,089 patients who had hip replacement from April 2003 to March 2012)

Category of total hip replacement	Number	5-year revision rates % (95% CI)*		10-year revision rates % (95% CI)*†			Certainty
		Men	women	overall	men	women	
Metal head (cemented stem) on cemented polyethylene cup	125,285	1.60 (1.48 to 1.74)	1.25 (1.17 to 1.34)	2.58 (2.41 to 2.77)	2.93 (2.62 to 3.28)	2.67 (2.44 to 2.92)	High
Metal head (cementless stem) on cementless hydroxyapatite coated metal cup (polyethylene liner)	37,874	2.64 (2.35 to 2.96)	2.10 (1.90 to 2.33)	3.71 (3.33 to 4.13)	4.31 (3.66 to 5.07)	3.37 (2.92 to 3.88)	High

Ceramic head (cementless stem) on cementless hydroxyapatite coated metal cup (ceramic liner)	34,754	2.72 (2.42 to 3.07)	2.32 (2.06 to 2.60)	4.33 (3.83 to 4.90)	4.39 (3.58 to 5.37)	3.76 (3.07 to 4.61)	High
Hybrid metal head (cemented stem) on cementless hydroxyapatite coated metal cup (polyethylene liner)	28,471	1.79 (1.52 to 2.12)	1.38 (1.20 to 1.59)	2.77 (2.39 to 3.22)	3.18 (2.54 to 3.98)	2.63 (2.17 to 3.18)	High
Ceramic head (cemented stem) on cemented polyethylene cup	12,705	1.18 (0.89 to 1.58)	1.01 (0.79 to 1.30)	1.96 (1.52 to 2.53)	2.10 (1.39 to 3.16)	1.68 (1.17 to 2.41)	High
All categories combined	239,089	1.94 (1.84 to 2.05)	1.48 (1.42 to 1.55)	2.92 (2.78 to 3.06)	3.25 (3.02 to 3.50)	2.79 (2.62 to 2.97)	High

*5-year and 10-year rates based on Kaplan-Meier flexible parametric model; similar results were found using alternative statistical model.

† 10-year revision rates stratified by sex were modeled for patients aged 70 years old

Evidence Review Tables: Risk of revision surgery or reoperation

Miller 2018

Miller 2018 is a systematic review and meta-analysis of randomized, controlled trials and observational studies (19 studies totaling 164,307 participants) that compared risks associated with the anterior versus posterior approach to total hip arthroplasty. Over a median follow-up of about 17 months (16 months for anterior, 18 months for posterior), there were 0.6 versus 0.7 reoperation events per 100 person-years in the anterior and posterior groups, respectively (Moderate certainty for univariate estimates; 16 studies, number of participants not reported).

Bayliss 2017

Lifetime risk of revision surgery (a measure which allows patients to easily understand their risk in the context of their predicted life expectancy) for females and males, by age at total hip replacement
(based on UK population-based study reporting on 63,158 patients who had hip replacement from 1991 through 2011)

Age at total hip replacement (years)*	**Lifetime risk of revision (95% CI)****		**Certainty**
	Females	Males	
50-54	17% (95% CI 15% to 18.5%)	29.6% (95% CI 26.6 to 32.6%)	High
55-59	19% (95% CI 17.5% to 20%)	23% (21% to 25%)	High
60-64	17% (95% CI 16% to 18%)	17% (95% CI 16% to 18%)	High
65-69	14% (95% CI 13% to 15%)	9% (95% CI 8% to 10%)	High
70-74	7% (95% CI 6.5% to 7.5%)	5% (95% CI 4.5% to 5.5%)	High

*For patients having total hip replacement at aged 75, lifetime risk of revision was about 5% with no difference between sexes. Older than 75, risk slightly reduced and was consistent between sexes.

**Values were estimated from Figure 2 graph and are not exact, with the exception of estimates for males aged 50-54 years old which were exactly reported in text

Descriptive Evidence Review: Mean time to revision surgery among those requiring revision surgery

Bayliss 2017 also reported that the time to revision surgery is about 5 years and is not dependent on age at time of initial surgery.

- mean time to revision surgery among those requiring revision surgery about 5 years after primary implantation in all age groups
    - 6.56 years (95% CI 6.05 to 7.08 years) for patients aged 50-59 years at initial surgery
    - 4.08 years (3.73 to 4.39 years) for patients in eighth decide at initial surgery

FAQ 4a: When will I recover?

We found evidence for two outcomes informing recovery: return to work and early (within 1 to 3 months) improvement in function.

Evidence Review Description and Descriptive Summary: Return to work

Evidence Review Description

In the one identified systematic review of return to work after total hip arthroplasty, **Tilbury 2014** found the average time to return to work among those working before surgery ranged from 8 days to 10.5 weeks among the 5 studies that reported this outcome (number of participants not reported). (Low certainty, downgraded due to risk of bias [see Part 3] and inconsistency/imprecision).

Tilbury 2014 also reported on the proportion returning to work over 1 to 12 months, but this suffered from considerable additional limitations; this rendered it Very low certainty evidence, and we judged these estimates as neither useful nor appropriate for informing return to work after total hip arthroplasty (see Part 3).

Descriptive Summary

Results from the one systematic review identified that addressed return to work after total hip arthroplasty (Tilbury 2014) are essentially consistent with information provided for patients from reputable, non-indexed sources, which suggest a timeline for return to work ranging from 6 to 12 weeks (again depending on the particulars of the patient; see FAQ1).

Evidence Review Table: Early (within 1 to 3 months) improvement in function

Vissers 2011 (systematic review of randomized, controlled trials and observational studies)

No. studies (sample size)	Key findings*,†	Certainty (reason for downgrade)
Preoperative: 7 (599) *1-3 months postoperative:* 5 (349)	For WOMAC-physical functioning, compared to being at about 46% to 49% (95% CI, 44% to 53%) of normal preoperatively, patients were at about 76% (95% CI, 66% to 85%) of normal at 1-3 months postoperatively.	Low (risk of bias [see Part 3])
Preoperative: 8 (1,022) *1-3 months postoperative:* 4 (279)	For SF-36- physical functioning, compared to being at about 41% (95% CI, 31% to 50%) of normal preoperatively, patients were at about 65% (95% CI 33% to 97%) of normal at 1-3 months postoperatively.	Very low (risk of bias [see Part 3] and imprecision)

SF-36-PF, Short-Form Health Survey physical functioning subscale; WOMAC-PF, Western Ontario and McMaster Universities Osteoarthritis Index physical functioning subscale

* Results were reported as means and standard errors at baseline and 1-3 month follow-up. The authors cited reference values for each of the above scales, which they used to calculate the percent of normal at baseline and at the specified periods of follow-up. However, they only did this for the point estimates. We calculated these values as well, including for the confidence interval.

† Outcomes were also assessed at 6-8 month time point, but we consider these data more relevant for FAQ2.

FAQ 5a: What are the side effects?

Evidence Review Description and Descriptive Summary

Evidence Review Description

Højer Karlsen 2015 is a systematic review and meta-analysis of 58 randomized trials (4,309 patients) investigating different methods for analgesia following total hip arthroplasty. The mean pain level in the control groups at rest was 31 out of 100 at 6 hours after surgery (range, 4 to 90 out of 100; 42 trials, number of participants not reported) and 23 out of 100 at 24 hours after surgery (range 0.5 to 59 out of 100; 47 trials, number of participants not reported). For pain levels during mobilization, only a range of values is reported in the results text: 3 to 74 out of 100 (it is not clear how many studies contribute to this range; 18 trials reported pain during movement at any time, with 12 and 16 trials reporting pain during movement at 6 hours and 24 hours, respectively, and 10 trials reporting pain during movement at both times). (Moderate certainty, downgraded due to inconsistency)

For the 4 most commonly evaluated interventions (anti-inflammatory medication, local infiltrative analgesia, intrathecal opioids, and lumbar plexus block), Højer Karlsen 2015 also found the comparative evidence was limited overall by high or unclear risk of bias (48 of 58 trials), and many trials were small. The authors concluded their findings do "not allow designation of a 'best proven' [postoperative analgesic] intervention for this surgical procedure." (certainty not formally assessed, as this is beyond the scope of this work)

To further inform this outcome, we also considered descriptive summaries offered from reputable, non-indexed sources, as shown below.

Descriptive summary

Although you can expect to feel some pain from the surgery itself, this should not last for long, and you can be given medications to help keep postoperative pain to a minimum. (Cleveland Clinic nd, EBSCO Health Library 2018, NIH 2016a, NHS 2016)

FAQ 6a: What are the risks?

Evidence Review Table: Infection, heterotopic ossification, dislocation, wound complication, fracture, and patient-reported nerve injury

Miller 2018 was a systematic review of randomized trials and observational studies comparing the anterior to posterior approach to total hip arthroplasty. This comparison is outside the scope of this work, but in presenting estimates for the anterior and posterior approaches, Miller 2018 provides a source of univariate estimates for complications known to be associated with total hip replacement. The data in Miller 2018 have a median follow-up duration of about 17 months (median of 16 months for anterior approach and 18 months for posterior approach). This is well beyond what is typically considered the perioperative period.

Outcome*	Studies†	Event rate per 100 person-years		Certainty, univariate estimates‡
		anterior	posterior	
infection	7	0.2	0.4	Moderate
heterotopic ossification	4	1.5	2.3	Moderate
dislocation	11	0.2	0.2	Moderate
fracture	10	0.3	0.1	Moderate
patient-reported nerve injury§	2	3.0	1.3	Moderate
wound complication||	5	1.7	1.9	Moderate

* Miller 2018 also reports on rates of reoperation, which we include as part of FAQ3. Additionally, Miller 2018 reports on rates of thromboembolism, but for reasons stated in Part 3, these data are judged less relevant/appropriate than Pedersen 2012 (below), so we did not carry these results forward from Part 3.

† Number of participants not reported, only number of studies

‡ As there are insufficient data to assess imprecision and inconsistency of the univariate estimates, we downgraded all outcomes once to Moderate

§ For this outcome, Miller 2018 provides rates on a per-patient level for the two studies that reported on this outcome. In one study, there was a 5.9% vs 3.3% rate in anterior vs posterior at 24 and 30 months of follow-up, respectively, and in another, there was a 3.8% vs 0% rate in anterior vs posterior at 14 months of follow-up.

|| In the largest study reporting on this outcome (Watts), the rate of wound complication was 1.7% vs. 1.9% for anterior vs posterior approach.

Evidence Review Table: Symptomatic venous thromboembolism

Pedersen 2012 is a cohort study comparing patients who had primary total hip replacement to members of the general Danish population who did not have total hip replacement, with matching by gender and age at time of surgery. The primary outcome was symptomatic venous thromboembolism. Pedersen reports on the traditional perioperative period of 0-90 days, but also includes data for the rest of the year (91-365 days). We report here only on the period of 0-90 days.

Time since total hip replacement surgery	**Symptomatic venous thromboembolism, n (%)**		**Adjusted risk ratio (95% CI)***	**Certainty, comparative estimate (reason)**
	total hip replacement patients (n = 85,965)	comparison cohort (n = 257,895)		
0 to 90 days	678 (0.79%)	129 (0.05%)	15.84 (13.12 to 19.12)	Moderate (downgraded twice for risk of bias due to observational study, upgraded once due to large effect size)

* Variables for which the authors adjusted not reported

Evidence Review Table: Mortality

Berstock 2014 is a systematic review of observational studies of patients with osteoarthritis who had total hip replacement.

No. studies (sample size)	Time period for outcome assessment	Key findings	Certainty, univariate estimates (reason for downgrade)
32 (1,129,330)*	30 and 90 days	30-day mortality 0.30% (95% CI 0.22% to 0.38%) 90-day mortality 0.65% (95% CI 0.50% to 0.81%)	Moderate (downgrade for inconsistency)

* This is the overall number of studies and overall sample size. The analysis of 30-day mortality included 15 studies and the analysis of 90-day mortality included 17 studies, but the authors did not report the number of participants.

Evidence Review Table: Myocardial infarction

Lu 2015 is a propensity-score matched cohort study comparing patients with and without total hip replacement on the outcome of myocardial infarction. They report time periods beyond what would be typically considered the perioperative period, so we only report results up to 12 weeks/3 months here.

Time period for outcome assessment	Number of myocardial infarction cases		Hazard ratio (95% CI)	Certainty, comparative estimates (reason for downgrade)*
	incident total hip replacement (n = 6,063)	no total hip replacement (n = 6,063)		
1 month of follow-up	13	3	4.33 (1.24 to 15.21)	Very low (downgraded due to imprecision)
3 months of follow-up	15	10	1.50 (0.74 to 3.34)	Very low (downgraded due to imprecision)

*Downgrades listed in column are in addition to risk of bias due to risk of residual or unmeasured confounders, which starts certainty at Low.

Evidence Review Table: Stroke

Lalmohamed 2012 is a nationwide retrospective cohort study comparing a cohort of adults who had primary total hip replacement (n = 66,583) with a comparison cohort (n = 199,995) comprised of adults without total hip or total knee replacement matched in a 1:3 ratio, with matching by age, sex, and region (n = 199,995). The outcome of interest was stroke. They report time periods beyond what would be typically considered the perioperative period, so we only report results up to 12 weeks/3 months here.

Time since total hip replacement surgery	Ischemic stroke			Hemorrhagic stroke			Certainty, comparative estimates (reason for downgrade)*
	number of events per 1,000 person-years		adjusted** hazard ratio (95% CI), THR vs control	number of events per 1,000 person-years		adjusted** hazard ratio (95% CI), THR vs control	
	THR	control		THR	control		
<2 weeks	26	5.6	4.69 (3.12 to 7.06)	6.7	1.6	4.40 (2.01 to 9.62)	Low (downgraded due to risk of bias)
2 to 6 weeks	14	6.2	2.12 (1.53 to 2.93)	3.8	1.7	2.16 (1.14 to 4.06)	Low (downgraded due to risk of bias)
6 to 12 weeks	7.0	5.7	1.12 (0.80 to 1.58)	4.3	1.7	2.17 (1.32 to 3.57)	*Ischemic stroke*: Very low (downgraded due to risk of bias and imprecision) *Hemorrhagic stroke*: Low (downgraded due to risk of bias)

THR, total hip replacement cohort; control is the comparison cohort as defined above
*Downgrades listed in column are in addition to risk of bias downgrade, which starts certainty at Low
**Adjusted for disease history and drug use

Although total hip arthroplasty may be associated with a higher risk for ischemic stroke in the first 6 weeks after total hip arthroplasty, the data are of Low certainty, and in the 6-to-12-week period following total hip arthroplasty, there is no clear association between total hip arthroplasty and ischemic stroke. Additionally, the magnitude of the association appears to decrease from the immediate postoperative period (<2 weeks) to the 2-to-6-week period. Any associated increase in absolute risk is small.

Although total hip arthroplasty may be associated with a higher risk for hemorrhagic stroke in the first 12 weeks after total hip arthroplasty, the data are of Low certainty. Additionally, the magnitude of the association appears to decrease from the immediate postoperative period (<2 weeks) to the 2-to-12-week period, with no appreciable difference between the 2-to-6-week and 6-to-12-week periods. Any associated increase in absolute risk is small.

In support of the statement that any associated increase in absolute risk is small:

- Consider the scenario where (1) the observed associations are causal and (2) the adjusted hazard ratios (aHRs) for the periods with the highest apparent risk (<2 weeks since surgery) hold for the entire period of time where there may be an associated increase in risk. This would mean aHRs of:
  - 4.69 (95% CI 3.12 to 7.06) for the 6 weeks following surgery for ischemic stroke
  - 4.40 (95% CI 2.01 to 9.62) for the 12 weeks following surgery for hemorrhagic stroke
  - We note the above scenario favors showing harm at a magnitude greater than is likely true.
- Let us estimate the control group risks for ischemic stroke within 6 weeks of surgery and hemorrhagic stroke within 12 weeks of surgery based on the event rate in the control group at <2 weeks after surgery. For ischemic stroke, the estimate is 0.0644% or 0.0646% with a linear or exponential method of estimating, respectively; for hemorrhagic stroke, the estimate is 0.0368% with either method.
- Under the above conditions, total hip arthroplasty might have an absolute risk difference of 0.24% (95% CI 0.14% to 0.39%) for ischemic stroke and an absolute risk difference of 0.13% (95% CI 0.04% to 0.32%) for hemorrhagic stroke.
- Even if one estimates the absolute risk of any stroke within 6 weeks of surgery by combining the 6-week absolute risk of ischemic stroke in the surgery group (0.0646% + 0.24% = 0.3046%) and the 12-week absolute risk of hemorrhagic stroke in the surgery group (0.0368% + 0.13% = 0.1668%), this estimate is 0.3046% + 0.1668% = 0.4714%.

We note these findings are consistent with other studies cited by the authors in the introduction to their article regarding perioperative stroke, with the highest estimates reaching 0.6%.

Evidence report for total hip arthroplasty for hip osteoarthritis

Part 5 - Evidence Synthesis

Prepared by EBSCO Information Services

March 7, 2019

Prepared by EBSCO Health Innovations and EBM Development Department:

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Methods

Evidence synthesis process

Synthesis methods will be based on the most appropriate methods matching the available evidence. We will systematically consider synthesis methods with the following questions:

Is it useful and appropriate to present the synthesis of evidence results as a combined, single result as the best representation of the body of evidence?

State "Yes" or "No". Provide justification if "No".

If "Yes", what method is the best approach?

Pick one of the following and justify:

(1) meta-analysis already done

(2) meta-analysis created from the evidence results

(3) median of sufficiently-valid results, stating cutoff for validity

(4) median of all results

If "No", what method is best to represent the evidence synthesis?

Pick one of the following and justify:

(1) range of all results

(2) range of sufficiently valid results

(3) descriptive summary without quantitative representation (e.g., consistency in direction, but inconsistency in magnitude)

(4) statement of inconsistency too limiting for single synthesized conclusion

Where evidence is very limited, or the FAQ is for descriptive summary, such that summary text was provided instead of Evidence Review Tables, the Descriptive Evidence Summary will be noted.

Results

FAQ 1: What does the treatment involve?

Total hip arthroplasty (FAQ1a)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

Total hip arthroplasty (often called total hip replacement) for osteoarthritis is typically reserved for end-stage symptoms when non-surgical management is not giving enough relief. The damaged hip joint is removed and replaced with an artificial hip joint. The two main parts of an artificial hip joint are often referred to as the “cup” and “stem”, and these parts mimic the structure and function of a real hip joint.

One may either be put to sleep during the operation or have an injection in the spine that numbs the lower half of the body. If the injection in the spine is used, it is often combined with sedation.

To perform the surgery, the surgeon makes an incision along the hip joint area about 6 to 12 inches long. The muscles will be moved out of the way, the damaged parts of the hip will be removed, and the artificial hip will be inserted. Some hip replacements are now being done with minimally-invasive methods that use one or two smaller incisions (e.g., for the one-incision method, about 3 to 6 inches, and for the two-incision method, about 2 to 3 inches and 1 to 2 inches for the two incisions). However, minimally-invasive methods may not be offered by every facility or every surgeon.

The time for the actual surgery may be about 1 to 2 hours for the traditional approach to total hip replacement, and about 1 or more hours for minimally-invasive methods. It is common to stay in the hospital for 3 to 4 days, but usually people can go home within 4 days, and perhaps sooner if having minimally-invasive surgery. The total time needed for the surgery and total length of stay in the hospital may vary based on the specifics of the patient.

For a period of time after the surgery, patients are usually given medication to prevent blood clots, though recommendations are not strong or entirely consistent. After the surgery, patients will initially walk with an assistive device (e.g., walker, crutches), and they will progressively increase the amount of weight they put on the leg with the artificial hip. Attending / performing prescribed physical therapy and exercises is very important for recovery, including after being discharged from the hospital. Some patients go to a rehabilitation facility for a short period to help ensure they stay on track with recovery. In general, assuming recovery is going well, people are often able to return to their normal activities by 6 to 12 weeks after the operation, with further recovery and improving strength occurring for 6 to 12 months. For resuming specific activities, the following are general timelines people might be able to expect, but these are overall approximations, and all timelines should be tailored to the specific patient:

- Within 3 to 8 weeks: Sexual activity
- Within 6 to 8 weeks: Driving a car (riding as a passenger may be feasible several weeks sooner)
- Within 6 to 12 weeks: Return to work (depending on the nature of the work)

(AAOS 2014, AAOS 2018, Cleveland Clinic nd, Cram 2011, DynaMed Plus 2018, EBSCO Health Library 2018, Mayo Clinic 2018, NIH 2016a, NHS 2016, Tilbury 2014)

Your hip joint will be replaced with metal, plastic, or other material. You may be in the hospital for up to 4 days. You will do exercises or physical therapy after the surgery.

Non-surgical treatment (FAQ1b)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

Non-surgical treatment regimens should be individualized to each patient. Non-surgical treatment consists of non-pharmacologic and pharmacologic options.

Non-pharmacologic options: Patients should receive education and engage in self-management regimens, including activity modification as needed/appropriate. Patients should engage in ability-appropriate, low-impact aerobic exercise (land- or water-based) and lose weight if overweight. Walking aids or other assistive devices to maintain activities of daily living are also recommend. Topical application of heat or cold is recommended for pain. Patients can consider range-of-motion/flexibility exercises, supervised exercise with manual therapy, endurance/strengthening exercises, and referral to physical therapy or occupational therapy.

Pharmacologic options: Medications include acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs; e.g., ibuprofen, naproxen), tramadol, and non-tramadol opioids. Tramadol and non-tramadol opioids are reserved for more severe cases where other treatments are not sufficient. Patients can also receive corticosteroid injections in the hip.

(DynaMed Plus 2018, Nelson 2014)

Treatments not involving medication may include exercise, losing weight, modifying your activity, walking aids (such as a cane), putting heat or cold on the painful area, and going to physical therapy. Medications that may help include acetaminophen/paracetamol, NSAIDs (like ibuprofen or naproxen), tramadol, opioids, and shots in your hip.

FAQ 2: Will my symptoms get better?

Total hip arthroplasty (FAQ2a)

Pre-Synthesis Efforts:

Part 2 Search:

	Number of articles evaluated	Number of unique articles selected for evaluation
First-round (DynaMed Plus)	17	2 (Singh 2013, Vissers 2011)
Second-round (Systematic review searches)	84	2 (Beswick 2012, Shan 2014)
Third-round (Original study tracing)	Not applicable	
Fourth-round (Original article searches)	Not applicable	

Part 3 Critical Appraisal (evidence evaluated for symptom improvement for FAQ2a):

Certainty	**Systematic reviews**	**Randomized trials**	**Other article types**
High	Beswick 2012; systematic review of observational studies Shan 2014; systematic review of observational studies (outcomes assessed with standardized mean difference)		Singh 2013; observational study (certainty varies by time period of assessment)
Moderate	Shan 2014; systematic review of observational studies (proportion satisfied with treatment)		Singh 2013; observational study (certainty varies by time period of assessment)
Low	Vissers 2011; systematic review of mostly observational studies		
Very low			
Unusable			
Not applicable			

Evidence Synthesis Process and Part 4 Recap for FAQ2a

Is it useful and appropriate to present the synthesis of evidence results as a combined, single result as the best representation of the body of evidence?

Yes for pain (**median of sufficiently valid results**).

No for function (**range of sufficiently valid results**).

See rationale below.

For evaluating symptom improvement after hip replacement surgery, the following evidence sources reported outcomes in different ways and at different time points:

- **Beswick 2012** was a systematic review that included observational studies that reported proportion of patients with unfavorable pain outcome following hip replacement surgery; we restricted to the 2 included studies with High Certainty evidence which had time points for outcome assessment at 12-18 months and 6 months following surgery
- **Singh 2013** was an observational study that reported proportion of patients with clinically meaningful improvements in pain and activities of daily living limitations at 2 years and 5 years postoperatively
- **Shan 2014** was a systematic review of observational studies that reported results as standardized mean differences comparing preoperative to postoperative disease-specific health-related quality of life scores and as proportions satisfied with their treatment outcome

The findings of these reports are summarized separately below.

Beswick 2012

Author year	Sample size	Time point for outcome assess-ment (months postopera tive)	Number of patients with			Certainty
			unfavorable* outcome % (n/N)	uncertain† outcome % (n/N)	unfavorable outcome % (n/N) with imputation‡	
Nikolajson 2006	1,231	12-18 mos	10.3% (127/1,231)	28.4% (350/1,231)	13.2% (163/1,231) (95% CI, 11.5% to 15.2%)	High
Jones 2000	242	6 mos	8.3% (20/242)	5.8% (14/242)	8.7% (21/242) (95% CI, 5.7% to 12.9%)	High

N, sample size of cohort; n, number with event; mos, months
* a favorable outcome includes patients with no pain or mild pain at follow-up; an unfavorable outcome includes those with moderate-to-severe pain or for whom surgery had not relieved pain
† uncertain outcome includes "...all patients for whom we cannot be sure of their pain levels at follow-up. These include patients who died, had revision surgery, contralateral surgery or dislocation and were not followed up with questionnaires and those lost to follow-up. We also included as uncertain those patients with a degree of reported pain, which we could not classify as a favorable or unfavorable outcome"
‡ authors imputed proportion with a known unfavorable long-term pain outcome to the number with an uncertain outcome

Singh 2013

Sample size*	Outcome	Proportion of patients with no/mild pain or limitations in activities of daily living, based on preoperative symptom severity		Certainty
6,168		Preoperatively moderate	Preoperatively severe	
5,707	pain at 2-year postoperative point	94%	91%	High
5,707	pain at 5-year postoperative point	91%	89%	Moderate
3,289	limitations in activities of daily living limitations at 2-year postoperative point	82%	70%	High
3,289	limitations in activities of daily living limitations at 5-year postoperative point	75%	65%	Moderate

*6,168 patients were available at baseline (preoperatively). 5,707 and 3,289 patients were available at 2 and 5 years postoperatively, respectively.

Shan 2014 reported results as standardized mean differences (SMD) comparing preoperative to postoperative disease-specific health-related quality of life scores based on pooled analyses of 6 trials totaling 1,990 patients with follow-up ranging from 3.6 to 7 years. It found statistically significant, large (based on SMD magnitude) improvements on overall measure of disease-specific, health-related quality of life, as well as pain-specific and function-specific measure of disease-specific, health-related quality of life. However, although these results are of High certainty, because they are reported as SMDs, they do not provide easily-interpretable quantitative estimates for shared decision-making. Shan also reported a range of 84% to 97% for the proportion of patients satisfied with their treatment outcome at up to 7 years of follow-up based on 4 studies totaling 1,514 patients, but due to risk of bias due to loss to follow-up, these estimates are of Moderate certainty.

Synthesis

For the pain outcomes at various time points, both studies (Beswick 2012, Singh 2013) defined a favorable outcome/clinically-meaningful improvement in pain as having no pain or only mild pain. The proportion with a favorable outcome/clinically-meaningful improvement in pain all center around 90%. Taking the median of these values at the various time points (86.8% and 91.3% from Beswick 2012 based on subtracting unfavorable outcome rate from 100%; and 94%, 91%, 91%, and 89% from Singh 2013) gives 91%. Calculating the median for only High certainty estimates gives a median of 91.15%.

For the outcome pertaining to function, only Singh 2013 provides data (at 2- and 5-year follow-up points). We note all estimates center around 70% to 80% (82%, 70%, 75%, 65%), with a median of 72.5%. Calculating the median for only High certainty estimates would give a median of 76%. We therefore give a range for these values from 70% to 80%.

Shan 2014 measured a somewhat different construct (satisfaction with treatment outcome) that cannot really be directly applied to the outcomes of pain or function, but we note the results are broadly consistent with what we found for pain and function. If one were to calculate a median including Shan 2014's results (thereby necessarily including Moderate certainty estimates in calculation), the median for pain would be 91% and the median for function would be 78.5%. One could also potentially conclude separately on Shan 2014's outcome as the proportion of patients who may be satisfied with their treatment outcome, but we favor concluding on pain and function specifically.

Out of 100 people treated with total hip arthroplasty:

- **About 90 (90%) report no pain or only mild pain for years after surgery**
- **About 70 to 80 (70% to 80%) report no limitations or only mild limitations in their function for years after surgery**

Non-surgical treatment (FAQ2b)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

It is hard to say. With non-surgical treatment, symptoms may improve, stay the same, or get worse. It depends on what you have already tried and how bad your hip arthritis is. If you have not tried one of the treatments in 'What does the treatment involve?', you could consider trying that to help with your symptoms. As long as you are healthy enough to have surgery, you can reconsider hip replacement at any time if symptoms do not improve or get worse.

FAQ 3: Will I need surgery later?

Total hip arthroplasty (FAQ3a)

Pre-Synthesis Efforts:

Part 2 Search:

	Number of articles evaluated	Number of unique articles selected for evaluation
First-round (DynaMed Plus)	17	2 (Bayliss 2017, Kandala 2015)
Second-round (Systematic review searches)	78	2 (Evans 2019, Miller 2018)
Third-round (Original study tracing)	Not applicable	
Fourth-round (Original article searches)	Not applicable	

Part 3 Critical Appraisal (evidence evaluated for needing surgery later for FAQ3a):

Certainty	**Systematic reviews**	**Randomized trials**	**Other article types**
High			Bayliss 2017; observational study Kandala 2015; observational study
Moderate	Evans 2019; systematic review of national registries Miller 2018; systematic review of mostly observational studies		
Low	Evans 2019; systematic review of case series		
Very low			
Unusable			
Not applicable			

Part 4 Results for FAQ3a, cumulative implant survival from 5 years postoperatively to up to 25 years postoperatively

Three studies used population-based data sources to estimate cumulative implant survival rates at 5-year interval time points following surgery up to 25 years (Bayliss 2017; Evans 2019; Kandala 2015). The table below summaries the results and certainty ratings for these studies.

Years after total hip replacement	Country (author year of source)	Cumulative implant survival rate % (95% CI)	Certainty
5	UK (Kandala 2015*†)	men: 98.06% (97.95% to 98.16%) women: 98.52% (98.45% to 98.58%)‡	High
	UK (Bayliss 2017)	97.9% (97.79% to 98.04%)	High
10	UK (Kandala 2015*†)	men: 96.75% (96.5% to 96.98%) women: 97.21% (97.03% to 97.38%) overall: 97.08% (96.94% to 97.22%)	High
	UK (Bayliss 2017)	95.6% (95.34% to 95.85%)	High
15	Finland, Australia (Evans 2019§)	89.4% (95% CI 89.2% to 89.6%)	Moderate
	UK (Bayliss 2017)	91.0% (90.29% to 91.57%)	High
20	Finland (Evans 2019§)	70.2% (95% CI 69.7% to 70.7%)	Moderate
	UK (Bayliss 2017)	85.0% (83.23% to 86.63%)	High
25	Finland (Evans 2019§)	57.9% (95% CI 57.1% to 58.7%)	Moderate

* Kandala 2015 reported revision rates and these were converted to survival rates for reporting in this table.
† Kandala 2015 reported results separately for 5 different categories of hip replacement. For both men and women at both 5- and 10-year postoperative time points, cemented prostheses with ceramic-on-polyethylene bearing surfaces had the highest implant survival rates (at 10 years: 97.9% for men; 98.32% for women) and cementless prostheses with ceramic-on-ceramic bearing surfaces had the lowest implant survival rates (at 10 years: 95.61% for men; 96.24% for women).
‡ 5-year results in Kandala 2015 reported only stratified by gender.
§ In addition to the systematic review of registry results summarized in this table, Evans 2019 also reported results on cumulative implant survival at 15, 20, and 25 years based on a systematic review of 44 case series reporting on 13,212 patients who had total hip replacement. The systematic review of case series is summarized in Part 4 but it has not been carried over to this Part 5 table because the Certainty for this evidence was Low.

Miller 2018 also provides Moderate certainty evidence for reoperation rates for the anterior versus posterior approach to total hip replacement (16 studies, number of participants not reported). However, as these estimates are based on a median follow-up duration of 16 and 18 months and amount to 0.6 and 0.7 reoperations per 100 person-years, respectively, we did not feel these data were meaningful enough to inform our evidence synthesis process.

Evidence Synthesis Process for FAQ3a, cumulative implant survival from 5 years postoperatively to up to 25 years postoperatively

Is it useful and appropriate to present the synthesis of evidence results as a combined, single result as the best representation of the body of evidence?

Yes for the follow-up point of 25 years after total hip replacement (meta-analysis already done).

At 25 years of follow-up, only a single source (Evans 2019; Moderate Certainty) reported implant survival rates.

No for the follow-up points of 5, 10, 15, and 20 years after total hip replacement (range of sufficiently-valid results).

At the other follow-up periods, 2 studies each reported on implant survival rates. For 5 and 10 years, the evidence is of High certainty from two cohort studies (Kandala 2015 and Bayliss 2017). For 15 and 20 years, the evidence is of High and Moderate certainty from a cohort study (Bayliss 2017) and a systematic review of observational studies (Evans 2019), respectively. We note Evans 2019 was downgraded to Moderate certainty due to inconsistency, and this downgrade could not apply for the outcome of interest for Bayliss 2017.

Out of 100 people who have total hip replacement surgery:

- **1 to 2 (1% to 2%) may need to have another surgery 5 years after their first surgery**
- **3 to 4 (3% to 4%) may need to have another surgery 10 years after their first surgery**
- **9 to 11 (9% to 11%) may need to have another surgery 15 years after their first surgery**
- **15 to 30 (15% to 30%) may need to have another surgery 20 years after their first surgery**
- **42 (42%) may need to have another surgery 25 years after their first surgery**

Evidence Synthesis Process and Part 4 Recap for FAQ3a, lifetime risk of revision surgery

Is it useful and appropriate to present the synthesis of evidence results as a combined, single result as the best representation of the body of evidence?

No. Only 1 source (Bayliss 2017) reports lifetime risk of revision surgery, an outcome that allows patients to easily understand their risk in the context of their predicted life expectancy. Lifetime risk of revision surgery by age at total hip replacement are reported below. Estimates vary based on age at total hip replacement surgery and sex.

Age at total hip replacement (years)*	Lifetime risk of revision (95% CI)**		Certainty
	Females	Males	
50-54	17% (95% CI 15% to 18.5%)	29.6% (95% CI 26.6% to 32.6%)	High
55-59	19% (95% CI 17.5% to 20%)	23% (21% to 25%)	High
60-64	17% (95% CI 16% to 18%)	17% (95% CI 16% to 18%)	High
65-69	14% (95% CI 13% to 15%)	9% (95% CI 8% to 10%)	High
70-74	7% (95% CI 6.5% to 7.5%)	5% (95% CI 4.5% to 5.5%)	High

*For patients having total hip replacement at aged 75, lifetime risk of revision was about 5% with no difference between sexes. Older than 75, risk slightly reduced and was consistent between sexes.

**Values were estimated from Figure 2 graph and are not exact, with the exception of estimates for males aged 50-54 years old which were exactly reported in text

Providing a synthesis statement for the above findings beyond what is presented in the table was deemed inappropriate due to the difference in estimates, and providing such age- or sex-specific estimates is beyond the scope of this work. However, we provide these estimates in Part 5 as we consider them potentially informative for individualized estimates based on age at total hip replacement and sex.

Non-surgical treatment (FAQ3b)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

It is hard to say. With non-surgical treatment, symptoms may improve, stay the same, or get worse. It depends on what you have already tried and how bad your hip arthritis is. If you have not tried one of the treatments in 'What does the treatment involve?', you could consider trying that to help with your symptoms. Some people who originally decide not to have hip replacement surgery may eventually decide to have the surgery due to their symptoms, but this choice is specific to every person.

FAQ 4: When will I recover?

Total hip arthroplasty (FAQ4a)

Pre-Synthesis Efforts:

Part 2 Search:

	Number of articles evaluated	Number of unique articles selected for evaluation
First-round (DynaMed Plus)	17	1 (Vissers 2011)
Second-round (Systematic review searches)	47	1 (Tilbury 2014)
Third-round (Original study tracing)	Not applicable	
Fourth-round (Original article searches)	Not applicable	

Part 3 Critical Appraisal (evidence evaluated for recovery for FAQ4a):

Certainty	**Systematic reviews**	**Randomized trials**	**Other article types**
High			
Moderate			
Low	Vissers 2011; systematic review of mostly observational studies (WOMAC-PF) Tilbury 2014; systematic review of observational studies (time to return to work)		
Very low	Vissers 2011; systematic review of mostly observational studies (SF-36-PF) Tilbury 2014; systematic review of observational studies (proportion returning to work)		
Unusable			
Not applicable			

SF-36-PF, Medical Outcomes Study Short-Form Health Survey physical functioning subscale; WOMAC-PF, Western Ontario and McMaster Universities Osteoarthritis Index physical functioning subscale

Part 4 Results for FAQ4a:

- In the one identified systematic review of return to work after total hip arthroplasty, Tilbury 2014 found the average time to return to work among those working before surgery ranged from 8 days to 10.5 weeks (5 studies, number of participants not reported). (Low certainty)*
    - We note the results from Tilbury 2014 are not implausible, as return to work would conceivably vary based on the particulars of the patient, including his/her occupation.
    - We also note the results from Tilbury 2014 are consistent with the descriptive summaries from reputable, non-indexed sources that we consulted as part of responding to FAQ1, which generally reported an anticipated return-to-work timeframe of 6 to 12 weeks (but again, this must be individualized to the specifics of the patient, including his/her occupation).
- Vissers 2011 is a systematic review of mostly observational studies that assessed pre-post outcomes for patients undergoing total hip arthroplasty. One of the time periods of assessment was 1-3 months postoperatively, which is a timeframe when patients may still be in recovery (see FAQ1 and Beswick 2012)
    - Based on scores on the Western Ontario and McMaster Universities Osteoarthritis Index physical functioning subscale (WOMAC-PF), the Short-Form Health Survey physical functioning subscale (SF-36-PF), and reference values for the normal population:
        - Compared to being at about 46% to 49% (95% CI, 44% to 53%) of normal preoperatively, patients were at about 76% (95% CI, 66% to 85%) of normal at 1-3 months postoperatively (WOMAC-PF; Low certainty)
        - Compared to being at about 41% (95% CI, 31% to 50%) of normal preoperatively, patients were at about 65% (95% CI 33% to 97%) of normal at 1-3 months postoperatively (SF-36-PF; Very low certainty, additional downgrade from Low is due to imprecision)
        - We note a total of 279 patients contributed to the SF-36-PF results at 1-3 months, whereas a total of 599 patients contributed to the WOMAC-PF results at 1-3 months, and this may well have contributed to the SF-36-PF results suffering from imprecision at 1-3 months. We also note there is nothing about the SF-36-PF results that suggest inconsistency with the WOMAC-PF results.
        - We therefore conclude that patients may start noticing an improvement in function as early as 1 to 3 months following surgery. (Low certainty)
- We address the importance of postoperative physical therapy / prescribed exercises as a part of FAQ1. However, because this aspect of “What does the treatment involve?” also speaks to recovery, we specify the importance of physical therapy / exercise after surgery here.
- Other responses for FAQ4 shown below are also based on descriptive summaries addressed as part of responding to FAQ1.

* Tilbury 2014 also reports the proportion returning to work over 1 to 12 months, but this suffered from considerable additional limitations, rendering it Very low certainty evidence; we

therefore judged these estimates as neither useful nor appropriate for informing return to work after total hip arthroplasty.

Evidence Synthesis Process for FAQ4a

Is it useful and appropriate to present the synthesis of evidence results as a combined, single result as the best representation of the body of evidence?

No. The best-available evidence for return to work has too broad a range to support a combined, single result as the best representation of the evidence. For improvement in function, the results suggest a possible improvement in function as early as 1 to 3 months after surgery, but this evidence is of Low certainty.

If "No", what method is best to represent the evidence synthesis?

> *(3) descriptive summary without quantitative representation (e.g., consistency in direction, but inconsistency in magnitude)*

It will be important for you to do physical therapy / exercises after your surgery. You may notice an improvement in your function as early as 1 to 3 months after having the surgery.

You may be able to return to:

- **work within 6 to 12 weeks**
- **sexual activity within 3 to 8 weeks**
- **driving a car within 6 to 8 weeks (riding as a passenger may be possible earlier than this)**

These times may vary from patient to patient. You should talk with your health care professional about whether these times might be different for you.

Non-surgical treatment (FAQ4b)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

Non-surgical treatments will not usually interfere significantly with your work or usual activities.

You may be advised to rest for a day after receiving an injection in your hip, but you should be able to resume most normal activities the next day. (NIH 2016b)

FAQ 5: What are the side effects?

Total hip arthroplasty (FAQ5a)

Pre-Synthesis Efforts:

Part 2 Search:

	Number of articles evaluated	Number of unique articles selected for evaluation
First-round (DynaMed Plus)	17	0
Second-round (Systematic review searches)	111	1 (Højer Karlsen 2015)
Third-round (Original study tracing)	Not applicable	
Fourth-round (Original article searches)	Not applicable	

Part 3 Critical Appraisal (evidence evaluated for side effects for FAQ5a):

Certainty	**Systematic reviews**	**Randomized trials**	**Other article types**
High			
Moderate	Højer Karlsen 2015; systematic review of randomized trials		
Low			
Very low			
Unusable			
Not applicable			

Part 4 Results for FAQ5a:

- Højer Karlsen 2015 is a systematic review and meta-analysis of 58 randomized trials (4,309 patients) investigating different analgesic options following total hip arthroplasty. It provides Moderate certainty evidence for postoperative pain levels among those in the control groups.
    - At 6 hours after total hip arthroplasty, mean pain levels at rest were 31 out of 100 (range 4 to 90 out of 100; 42 trials, number of participants not reported)
    - At 24 hours after total hip arthroplasty, mean pain levels at rest were 23 out of 100 (range 0.5 to 59 out of 100; 47 trials, number of participants not reported)
    - For pain levels during mobilization, only a range of values is reported: 3 to 74 out of 100 (it is unclear how many studies contribute to this range; 18 trials reported pain during movement at any time, with 12 and 16 trials reporting pain during movement at 6 hours and 24 hours, respectively, and 10 trials reporting pain during movement at both times).
- For the 4 most commonly evaluated interventions (anti-inflammatory medication, local infiltrative analgesia, intrathecal opioids, and lumbar plexus block), Højer Karlsen 2015 also found the comparative evidence was limited overall by high or unclear risk of bias (48 of 58 trials), and many trials were small. The authors concluded their findings do "not allow designation of a 'best proven' [postoperative analgesic] intervention for this surgical procedure." (certainty not formally assessed, as this is beyond the scope of this work)
- We also considered descriptive summaries provided by reputable, non-indexed sources to supplement the above systematic review and meta-analysis. These sources suggested that patients can expect to experience some pain from the surgery itself, but this should not last for long, and patients can be given different analgesic options to help modulate postoperative pain (Cleveland Clinic nd, EBSCO Health Library 2018, NIH 2016a, NHS 2016)

Evidence Synthesis Process for FAQ5a

Is it useful and appropriate to present the synthesis of evidence results as a combined, single result as the best representation of the body of evidence?

No, because evidence is too limited to support a single, synthesized conclusion. The evidence from one systematic review and meta-analysis provides estimates for postoperative pain levels among those in the control groups of trials investigating different analgesic regimens to control postoperative pain following total hip arthroplasty. However, even these data are limited by inconsistency.

If "No", what method is best to represent the evidence synthesis?

(3) descriptive summary without quantitative representation (e.g., consistency in direction, but inconsistency in magnitude)

You can expect to experience some pain from the surgery. It seems people may have different levels of pain following the surgery if they do not take medication to help control the pain. However, the pain from the surgery should not last long, and there are several different options to help control pain people might have from the surgery.

Non-surgical treatment (FAQ5b)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

It depends on the specific treatments used.
Acetaminophen/paracetamol does not typically cause side effects.
NSAIDs can cause upset stomach and heart burn.
Tramadol and opioids can cause fatigue, dizziness, constipation, and upset stomach.
Injections are typically tolerated well, but may cause some people to have bruising, swelling, or skin irritation.
You can discuss side effects in more detail with your health care professional. (DynaMed Plus 2018, NIH 2016b)

FAQ 6: What are the risks?

Total hip arthroplasty (FAQ6a)

Pre-Synthesis Efforts:

Part 2 Search:

	Number of articles evaluated	Number of unique articles selected for evaluation
First-round (DynaMed Plus)	20	4 (Berstock 2014, Lalmohamed 2012, Lu 2015, Pedersen 2012)
Second-round (Systematic review searches)	64	1 (Miller 2018)
Third-round (Original study tracing)	Not applicable	
Fourth-round (Original article searches)	Not applicable	

Part 3 Critical Appraisal (evidence evaluated for risks for FAQ6a):

Certainty	**Systematic reviews**	**Randomized trials**	**Other article types**
High			
Moderate	Berstock 2014; systematic review of observational studies Miller 2018; systematic review of mostly observational studies		Pedersen 2012; observational study (certainty varies by time period of assessment)
Low			Lalmohamed 2012; observational study (certainty varies by time period of assessment) Pedersen 2012; observational study (certainty varies by time period of assessment)
Very low			Lalmohamed 2012; observational study (certainty varies by time period of assessment) Lu 2015; observational study
Unusable			
Not applicable			

Evidence Synthesis Process for FAQ6a, risks and Summarization of Part 4 Results

Outcome	Combined, single result best representation?	Reason for evidence synthesis answer and summarization of Part 4 evidence	Method for synthesis
Infection, dislocation, heterotopic ossification, wound complication, fracture, and patient-reported nerve injury	Yes	Moderate certainty univariate evidence for these outcomes comes from a systematic review of mostly observational studies (Miller 2018; 19 studies totaling 164,307 patients). This systematic review investigated various complications known to be associated with total hip arthroplasty, with the focus of the systematic review being to compare complication rates for the anterior (median follow-up of 16 months) versus posterior (median follow-up of 18 months) approach to total hip replacement. Although such a comparison is outside the scoping for this work, the systematic review provides a source for univariate estimates. Rate of infection per 100 person-years: 0.2 for anterior approach and 0.4 for posterior approach (7 studies, number of participants not reported) Rate of heterotopic ossification per 100 person-years: 1.5 for anterior approach and 2.3 for posterior approach (4 studies, number of participants not reported) Rate of dislocation per 100 person-years: 0.2 for anterior approach and 0.2 for posterior approach (11 studies, number of participants not reported) Rate of wound complication per 100 person-years: 1.7 for anterior approach and 1.9 for posterior approach (5 studies, number of participants not reported). Rates per 100 person-years may be less informative for risks mostly limited to the perioperative period. In the largest study reporting on this outcome (Watts), the rate of wound complication was 1.7% vs. 1.9% for anterior vs posterior approach. Rate of fracture per 100 person-years: 0.3 for anterior approach and 0.1 for posterior approach (10 studies, number of participants not reported) Rate of patient-reported nerve injury per 100 person-years: 3.0 for anterior approach and 1.3 for posterior approach (2 studies, number of participants not reported). For this outcome, Miller 2018 provides rates on a per-patient level for the two studies that reported on this outcome. In one study, there was a 5.9% vs 3.3% rate in anterior vs posterior and in another, there was a 3.8% vs 0% rate in anterior vs posterior.	Meta-analysis already done
Symptomatic venous thrombo-embolism	Yes	Moderate certainty comparative evidence for this outcome comes from a large cohort study (Pedersen 2012; 85,965 patients receiving total hip arthroplasty, compared to 257,895 patients who did not). Symptomatic venous thromboembolism within 90 days of surgery occurred in 0.79% of those who received total hip replacement and 0.05% of those who did not (adjusted hazard ratio, 15.8; 95% CI 13.1	Study already done

within 90 days of surgery		to 19.1). Based on the rate in the control group of 0.05% and the adjusted hazard ratio data, the estimated rate in the group receiving total hip arthroplasty (0.79%) is identical to the crude rate. The absolute risk difference is 0.74%.	
30- and 90-day mortality following total hip arthroplasty	Yes	Moderate certainty univariate evidence for these outcomes comes from a single systematic review and meta-analysis of observational studies (Berstock 2014; 32 studies totaling 1,129,330 people). 30-day mortality (15 studies) was 0.30% (95% CI 0.22% to 0.38%) 90-day mortality (17 studies) was 0.65% (95% CI 0.50% to 0.81%) (Number of participants overall was reported, but not for the two outcomes above.) However, we did not find comparative data, so we cannot comment on the rate of mortality among those who do not receive total hip arthroplasty.	Meta-analysis already done
Stroke within 90 days of surgery	No	Low to Very low certainty comparative evidence for this outcome comes from one cohort study (Lalmohamed 2012; 66,583 having total hip replacement compared to 199,995 not having hip replacement). This study considered ischemic and hemorrhagic stroke separately and stratified by various periods of time since surgery as shown below. All absolute rates were reported as number of events per 1,000 person-years. All estimates are considered Low certainty aside from ischemic stroke at the period of 6 to 12 weeks, which is Very low certainty due to an additional downgrade for imprecision. All estimates suggest that, if stroke is increased by having total hip arthroplasty, the absolute increase is small. <u><2 weeks since total hip replacement</u> ischemic: 26 vs 5.6 events per 1,000 person-years; adjusted hazard ratio 4.69 (95% CI 3.12 to 7.06) hemorrhagic: 6.7 vs 1.6 events per 1,000 person-years; adjusted hazard ratio 4.40 (95% CI 2.01 to 9.62) <u>2 to 6 weeks since total hip replacement</u> ischemic: 14 vs 6.2 events per 1,000 person-years; adjusted hazard ratio 2.12 (95% CI 1.53 to 2.93) hemorrhagic: 3.8 vs 1.7 events per 1,000 person-years; adjusted hazard ratio 2.16 (95% CI 1.14 to 4.06) <u>6 to 12 weeks since total hip replacement</u> ischemic: 7.0 vs 5.7 events per 1,000 person-years; adjusted hazard ratio 1.12 (95% CI 0.80 to 1.58) hemorrhagic: 4.3 vs 1.7 events per 1,000 person-years; adjusted hazard ratio 2.17 (95% CI 1.32 to 3.57) *<u>Even if one estimates the risk of any stroke within 6 weeks of surgery by combining the absolute risk of ischemic stroke within 6 weeks and the absolute risk of hemorrhagic stroke within 12 weeks, this estimate is 0.47%, and we note this is consistent with the highest estimate of absolute rate of perioperative stroke in the prior evidence cited in this study (0.6%).</u>*	Descriptive summary

Myocardial infarction within 90 days of surgery	No	There is only Very low certainty comparative evidence for this outcome from one cohort study (Lu 2015; 6,063 patients receiving total hip arthroplasty compared to 6,063 patients who did not, and only 25 myocardial infarctions at 3 months of follow-up, 15 among those receiving total hip arthroplasty and 10 among those not receiving total hip arthroplasty). If limiting to the 1-month follow-up period, the results suggest a possible increase in the rate of myocardial infarction, but with absolute risk difference estimates ranging from +0.01% to +0.70%. If considering the 3-month follow-up period, estimates range from -0.04% to +0.38%.	Descriptive summary

Evidence Synthesis Result for FAQ6a: risks

Some risks occur within a month or so of surgery. Out of 100 people who have their hip replaced:

- **up to 6 (6%) may have a nerve injured from the surgery**
- **up to 2 (2%) may have a wound complication**
- **fewer than 1 (< 1%) may have a blood clot in the leg or lung**
- **fewer than 1 (< 1%) may have a heart attack or die, but research is not clear how this compares to people who do not have surgery**

Some risks may occur months or years after the surgery. Within 2 years, out of 100 people who have their hip replaced:

- **up to 5 (5%) may have bone grow where it should not, and this may cause range of motion problems or pain**
- **fewer than 1 (<1%) may have an infection of the hip**
- **fewer than 1 (<1%) may have the hip come loose**
- **fewer than 1 (<1%) may have a fracture of part of the hip**

Non-surgical treatment (FAQ6b)

Pre-Synthesis Efforts: Not applicable

Descriptive Summary

It depends on the specific treatments used. Although serious risks may be uncommon, risks with medication may include the following:

- **NSAIDs can cause bleeding, which is sometimes serious**
- **tramadol and opioids can be addictive**
- **injections can lead to infection or bleeding in the hip**

Acetaminophen/paracetamol does not typically have serious risks when taken as directed.
You can discuss possible risks in more detail with your health care professional. (DynaMed Plus 2018, NIH 2016b)