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Total Hip Arthroplasty Versus Hemiarthroplasty for Displaced Femoral Neck Fractures: A Rapid Review

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Conflict of Interest Statement

All reports prepared by Health Quality Ontario (HQO) are impartial. There are no competing interests or conflicts of interest to declare.

Rapid Review Methodology

Clinical questions are developed by the Division of Evidence Development and Standards at HQO in consultation with experts, end-users, and/or applicants in the topic area. A systematic literature search is then conducted to identify relevant systematic reviews, health technology assessments (HTAs), and meta-analyses; if none are located, the search is expanded to include randomized controlled trials (RCTs), and guidelines. Systematic reviews are evaluated using a rating scale developed for this purpose. If the systematic review has evaluated the included primary studies using the GRADE Working Group criteria (http://www.gradeworkinggroup.org/index.htm), the results are reported and the rapid review process is complete. If the systematic review has not evaluated the primary studies using GRADE, the primary studies included in the systematic review are retrieved and a maximum of two outcomes are graded. If no well-conducted systematic reviews are available, RCTs and/or guidelines are evaluated. Because rapid reviews are completed in very short timeframes, other publication types are not included. All rapid reviews are developed and finalized in consultation with experts.

Disclaimer

This rapid review is the work of the Division of Evidence Development and Standards at HQO, and is developed from analysis, interpretation, and comparison of published scientific research. It also incorporates, when available, Ontario data and information provided by experts. As this is a rapid review, it may not reflect all the available scientific research and is not intended as an exhaustive analysis. Health Quality Ontario assumes no responsibility for omissions or incomplete analysis resulting from its rapid reviews. In addition, it is possible that other relevant scientific findings may have been reported since completion of the review. This report is current to the date of the literature search specified in the Research Methods section, as appropriate. This rapid review may be superseded by an updated publication on the same topic. Please check the HQO website for a list of all publications: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations.

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List of Abbreviations

AMSTAR	Assessment of Multiple Systematic Reviews
CI	Confidence interval(s)
HA	Hemiarthroplasty
HHS	Harris Hip Score
HQO	Health Quality Ontario
HTA	Health Technology Assessment
OHTAC	Ontario Health Technology Advisory Committee
RCT	Randomized controlled trial
RR	Relative risk
THA	Total hip arthroplasty
SD	Standard deviation

Background

As legislated in Ontario's *Excellent Care for All Act*, Health Quality Ontario's mandate includes the provision of objective, evidence-informed advice about health care funding mechanisms, incentives, and opportunities to improve quality and efficiency in the health care system. As part of its Quality-Based Funding (QBF) initiative, Health Quality Ontario works with multidisciplinary expert panels (composed of leading clinicians, scientists, and administrators) to develop evidence-based practice recommendations and define episodes of care for selected disease areas or procedures. Health Quality Ontario's recommendations are intended to inform the Ministry of Health and Long-Term Care's Health System Funding Strategy.

For more information on Health Quality Ontario's Quality-Based Funding initiative, visit www.hqontario.ca.

Objective of Analysis

This analysis aimed to evaluate the effectiveness of total hip arthroplasty (THA) in comparison to hemiarthroplasty (HA) for the treatment of displaced femoral neck fractures.

Clinical Need and Target Population

Displaced femoral neck fractures are defined as unstable fractures that can impair blood supply to the femoral head. (1) These fractures account for approximately half of all hip fractures and are associated with substantial fracture-related mortality and morbidity. (3) The optimal surgical management of displaced femoral neck fractures is unclear.

Technology/Technique

Hip arthroplasty refers to replacement of all or part of the hip joint with a prosthetic implant. (2) Arthroplasty that involves replacement of the femoral head can be divided into two groups: THA and HA. Total hip arthroplasty involves replacement of both the femoral head and the acetabular articular surface. In contrast to THA, HA replaces only the femoral head with an artificial implant, while retaining the patient's own acetabulum. Two groups of HA exist, unipolar and bipolar arthroplasty. With unipolar HA, hip movement occurs between the prosthesis and the acetabulum; whereas bipolar HA has an additional acetabular cup that is not attached to the pelvis and allows movement to occur between the acetabulum and the prosthesis and at the joint within the prosthesis itself. The objective of the smaller inside head is to reduce acetabular erosion. (1;2)

Rapid Review

Research Question

What is the effectiveness of THA versus HA among patients with displaced femoral neck fractures?

Research Methods

Literature Search

A literature search was performed on December 15, 2011, using Ovid MEDLINE, ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid Embase, the Wiley Cochrane Library, and the Centre for Reviews and Dissemination database, for studies published from January 1, 2008, until December 6, 2011. Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search.

Inclusion Criteria

- English-language full reports
- published between January 1, 2008, and December 6, 2012
- HTAs, systematic reviews, and meta-analyses
- adult population with displaced femoral neck fractures
- studies comparing THA to HA

Exclusion Criteria

- individual RCTs, observational studies, case reports, editorials
- studies where outcomes of interest cannot be abstracted

Outcomes of Interest

- revisions
- functional status (using a validated hip score)

Expert Panel

In December 2012, an Expert Advisory Panel on Episodes of Care for Hip Fractures was struck. Members of the panel included physicians, personnel from the Ministry of Health and Long-Term Care, and representation from the community.

The role of the Advisory Panel was to place the evidence produced by HQO in context and provide advice on the appropriate clinical pathway for a hip fracture in the Ontario health care setting. However, the statements, conclusions, and views expressed in this report do not necessarily represent the views of Advisory Panel members.

Quality of Evidence

The Assessment of Multiple Systematic Reviews (AMSTAR) measurement tool is used to assess the methodologic quality of systematic reviews. (4)

The quality of the body of evidence for each outcome is examined according to the GRADE Working Group criteria. (5) The overall quality is determined to be very low, low, moderate, or high using a step-wise, structural method.

Study design is the first consideration; the starting assumption is that RCTs are high quality, whereas observational studies are low quality. (5) Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—are then taken into account. Limitations or serious limitations in these areas result in downgrading the quality of evidence. Finally, 3 factors that can raise the quality of evidence were considered: large magnitude of effect, dose-response gradient, and accounting for all residual factors. For more detailed information, please refer to the latest series of GRADE articles.

As stated by the GRADE Working Group (5) , the final quality score can be interpreted using the following definitions:

High	Very confident that the true effect lies close to that of the estimate of the effect;
Moderate	Moderately confident in the effect estimate—the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different;
Low	Confidence in the effect estimate is limited—the true effect may be substantially different from the estimate of the effect;
Very Low	Very little confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of effect.

Results of Literature Search

The database search yielded 141 citations published between January 1, 2008, and December 28, 2012 (with duplicates removed). Articles were excluded on the basis of information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment.

Ten systematic reviews or HTAs were identified that evaluated the safety and effectiveness of THA in comparison to HA, with AMSTAR ratings ranging from 6 to 9. (1;2;6-12) Four of these reviews captured the largest and most recent RCT (6;7;11;12) and were inclusive of English RCTs captured by the earlier systematic reviews. Of these, 2 specifically reported on revision rates, rather than an aggregate outcome of reoperations. (6;7) These 2 reviews by Carroll et al and Burgers et al were thus selected for inclusion in the present analysis, both with an AMSTAR rating of 9 (Appendix 2, Table A1). (6;7)

A summary of the systematic reviews by Carroll et al and Burgers et al is provided in Table 1. Both reviews included the same 8 RCTs, of which 5 evaluated bipolar HA, 1 used either unipolar or bipolar HA (surgeon's choice), and 2 used unipolar HA. Among individual RCTs, sample sizes ranged from 40 to 252 patients, with mean age ranging from 69 to 82 years. Individual study follow-up ranged from 1 to 5 years, with one study publishing a 13-year follow-up in addition to their original 1-year data. Nearly all trials included required patients to be cognitively intact and independent or ambulatory at the time of hip fracture.

Table 1. Summary of Systematic Reviews Included

Author, Year	Review Type	Search Dates	Inclusion Criteria	No. of RCTs	AMSTAR Score
Burgers et al, 2012 (6)	MA	Up to March 2011	• RCTs • aged ≥ 50 years with displaced femoral neck fracture • any form of THA versus HA • reported revision surgery	8	9
Carroll et al, 2011 (7)	HTA, MA	Up to December 2010	• RCTs • Eligible for hip replacement as a result of intracapsular fracture • THA versus HA • able to give consent and independently mobile before fracture	8	9

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; HA, hemiarthroplasty; HTA, health technology assessment; MA, meta-analysis; No., number; RCT, randomized controlled trial; THA, total hip arthroplasty

Results for Outcomes of Interest

The review by Burgers et al (6) provided the GRADE level of evidence for revision rates and is reported as assessed by the authors. Carroll et al (7) did not assess the GRADE quality of evidence for revision rates, and neither study provided the GRADE for functional status outcomes. Where no GRADE was provided, the primary RCTs included in the review were pulled and the GRADE assessed.

Revision Surgery

The results from each meta-analysis of revision surgery are summarized in Table 2. Both reviews identified a reduction in the risk of revision rates with THA compared with HA. This decrease was found to be non-significant in the review by Burgers et al (relative risk [RR] 0.59, 95% confidence interval [CI] 0.32–1.09) based on very low GRADE quality of evidence. Carroll et al found a statistically significant reduction in revision rates (RR 0.31; 95% CI 0.17–0.59), which was assessed as low GRADE quality of evidence.

Table 2. Results from Meta-Analyses of Revision Surgery after Total Hip Arthroplasty Versus Hemiarthroplasty

Author, Year	No. of RCTs	THA		HA		RR (95% CI)[a]	P [a]	I^2 [a]	GRADE
		No. of Events	Total	No. of Events	Total				
Burgers et al, 2012 (6)	8	19	472	36	514	0.59 (0.32–1.09)	0.09	9%	Very low[b]
Carroll et al, 2011 (7)	7	12	399	42	440	0.31 (0.17–0.59)	0.003	0%	Low[c]

Abbreviations: CI, confidence interval; HA, hemiarthroplasty; No, Number; RCTs, randomized controlled trials; RR, relative risk; THA, total hip arthroplasty
[a] Both reviews used a Mantel-Haenzel statistical method with a random effects analysis
[b] GRADE assessed directly by Burgers et al (6); Authors downgraded for study quality, inconsistency, and imprecision
[c] GRADE not assessed by review authors and based on review of primary RCTs included in the meta-analysis (Appendix 1, Table 2, and Table 3)

The variations in the number of events and studies included in the meta-analyses of the two reviews appear to be subject to alternative interpretation of revision rates as well as length of study follow-up data. The review by Burgers et al (6) did not describe their definition of a revision surgery, but did include

nonrevision reoperations under a separate outcome of major complications. The review by Carroll et al (7) more stringently defined revision surgeries as a result of all causes, including dislocations, explicitly excluding studies reporting an aggregate outcome of "reoperations." As such, an RCT describing an outcome of "additional hip surgeries" was excluded from the meta-analysis by Carroll et al, yet was included in the Burgers et al analysis, largely weighting the meta-analysis towards a non-significant increase in surgeries for THA. Additionally, Burgers et al included 1-year follow-up data from the RCT by Skinner et al, whereas Carroll et al included updated 13-year follow-up data. This RCT had the greatest weight in both meta-analyses and likely attributed to the variation in final estimates. Other inconsistencies in number of events were minor, but appear to reflect differences in the interpretation of revision rate data. On the basis of the description provided by each review, greater confidence in the appropriate inclusion of revisions can be placed the review by Carroll et al review, and therefore conclusions were drawn from this assessment.

Carroll et al conducted subgroup analyses to identify possible differences in revision rates on the basis of study quality, cementing of the prosthesis, or type of HA prosthesis. Statistically significant reductions in revision rates were observed with lower-quality studies (RR 0.30, 95% CI 0.15 – 0.58; $P < 0.001$) and unipolar HA studies (RR 0.26, 95% CI 0.12–0.57; $P < 0.001$), with statistically non-significant reductions in higher quality (RR 0.66, 95% CI 0.03–13.98; $P = 0.79$) and bipolar HA (RR 0.41, 95% CI 0.11–1.48; P = 0.17) studies. There was no difference in direction of effect for cemented or uncemented prosthesis. Despite any observed differences, there were no statistically significant differences between subgroups on revision rates (P > 0.05 for ratio of RRs). The lack of difference could reflect small sample sizes in subgroups.

Functional Status

Both systematic reviews included functional status outcomes; however, only Burgers et al (6) conducted a meta-analysis for the primary measure reported, the Harris Hip Score (HHS); therefore, results from this meta-analysis were used to assess the GRADE quality of evidence.

Harris Hip Score

The Harris Hip Score (HHS) is a 10-item questionnaire that assesses the domains of pain, function, absence of deformity and range of motion. (13) The total score ranges from 0 to 100, with higher scores depicting better hip function. Total scores <70 are considered poor, 70 to 80 fair, 80 to 90 good, and 90 to 100 excellent. (13)

Burgers et al identified 4 RCTS that evaluated total HHS, with mean scores across RCTs ranging from 75.2 to 87.2 for THA and 71.9 to 81.1 for HA, with a weighted mean score of 81 (standard deviation [SD] 11) for THA and 77 for HA. Meta-analysis identified an increase in the mean total HHS score among patients receiving THA in comparison to HA (mean difference [MD] 5.12, 95% CI 2.81–7.42) (Table 3). The GRADE for this outcome was assessed as low (Appendix 1, Table A2, and Table A3)

Table 3. Total Harris Hip Score Meta-Analysis Results for Revision Surgery after Total Hip Arthroplasty Versus Hemiarthroplasty

Author, Year	No. of RCTs	Total Sample Size	MD in HHS (95% CI) [a]	*P* [a]	I^2 [a]
Burgers et al, 2012 (6)	4	300	5.12 (2.81–7.42)	<0.0001	0%

Abbreviations: CI, confidence interval; HA, hemiarthroplasty; HHS, Harris hip score; MD, mean difference; No., Number; RCTs, randomized controlled trials; THA, total hip arthroplasty

[a] Assessed using an inverse-variance random effects analysis

Other Hip Scores

Carroll et al (7) reported individual RCT data for 5 alternative hip rating scores, all observing a trend towards greater function and mobility and less pain among patients receiving THA in comparison to HA. This improvement was found to be significant at final follow-up (2 to 3 years) in 3 RCTs, with no statistical analysis reported in 2 RCTs. Results for individual studies at final follow-up, as reported by Carroll et al (7) are presented in Table 5.

Table 5. Summary of Functional Status Outcomes Using Hip Rating Scores for Total Hip Arthroplasty Versus Hemiarthroplasty

Measure[a]	No. of RCTs	Follow-up (years)	N	Mean Score (Range or SD)		P
				THA	HA	
Oxford Hip Score (lower = better)	1	3	69	18.8 (range 12–47)	22.3 (range 12–48)	0.033
Hip Rating Questionnaire	1	2	131	79.9 (SD 17)	73.8 (SD 16)	0.04
WOMAC (Function Subscale)	1	2	40	81.8 (SD 10.2)	65.1 (SD 18.1)	0.03
WOMAC (Pain Subscale)	1	2	40	94.4 (SD 6.8)	77.8 (SD 20.9)	0.05
Modified D'Aubigne/Postel Hip Score	1	2	Unclear	Pain = 5.5 Ambulation = 4.1	Pain = 5.1[b] / 3.0[c] Ambulation =4.0[b] / 3.0[c]	NR
Barthel Index	1	4	43	85.3 (SD 11.6)	79.6 (SD 6.3)	NR

Abbreviations: HA, hemiarthroplasty; No, number; NR, not reported; RCTs, randomized controlled trials; SD, standard deviation; THA, total hip arthroplasty; WOMAC, Western Ontario and McMaster Universities Arthritis Index

[a] Higher scores represent better outcome, unless otherwise specified

[b] Cemented HA

[c] Uncemented HA

Source: Carroll et al (7)

Conclusions

On the basis of 2 systematic reviews evaluating the effectiveness of THA in comparison with HA for the treatment of displaced femoral neck fractures, the following conclusions were reached:

- Based on low quality of evidence, there was a significant reduction in revision rates among patients receiving THA in comparison with HA;
- Based on low quality of evidence, the total HHS was significantly improved among patients receiving THA in comparison with HA;
- Alternative hip functional status measures appear to favour THA in comparison with HA for improvements in function, mobility, or pain.

Results primarily reflect cognitively intact adults with high pre-fracture mobility and independence and might not represent the effectiveness of THA in comparison with HA among less mobile adults.

Acknowledgements

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Expert Panel for Health Quality Ontario: Episode of Care for Hip Fracture

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Chair		
Dr. James Waddell	Orthopedic surgeon	St. Michael's Hospital, Toronto
Orthopedic Surgery		
Dr. John P. Harrington	Orthopedic surgeon	William Osler Health System, Toronto
Dr. Mark Harrison	Orthopedic surgeon	Queen's University, Kingston
Dr. Hans J. Kreder	Professor	Division of Orthopaedics, Department of Surgery, University of Toronto
Dr. Allan Liew	Orthopedic surgeon	Department of Surgery, University of Ottawa
Dr. Mark MacLeod	Orthopedic surgeon	London Health Sciences Centre
Dr. Aaron Nauth	Orthopedic surgeon	St. Michael's Hospital/University of Toronto
Dr. David Sanders	Orthopedic surgeon	London Health Sciences Centre
Dr. Andrew Van Houwelingen	Orthopedic surgeon	St. Thomas Elgin General Hospital
Anesthesiology		
Dr. Nick Lo	Staff anesthesiologist	St. Michael's Hospital, Toronto
Emergency Medicine		
Dr. Michael O'Connor	Emergency medicine	Kingston General Hospital
Dr. Lisa Shepherd	Emergency medicine	South West Local Health Integration Network (LHIN), London
Family Medicine		
Dr. Christopher Jyu	Physician lead, primary care	Central East LHIN, Ajax
Geriatrics		
Dr. Anna Byszewski	Geriatrician	The Ottawa Hospital
Dr. Maria Zorzitto	Chief of geriatric medicine	St. Michael's Hospital, Toronto
Physiotherapy		
Ruth Vallis	Physiotherapist	University Health Network, Toronto
Rehabilitation		
Charissa Levy	Executive director	GTA Rehab Network
Dr. Peter Nord	Vice president, chief medical officer and	Providence Healthcare, Toronto

Name	Role	Organization
	chief of staff	
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Dr. Valerie Palda	Associate professor	Department of Medicine and Institute of Health Policy, Management and Evaluation, University of Toronto
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Janet McMullan	Project director, consultant	Bone and Joint Canada
Professional Organizations		
Ravi Jain	Director, Ontario osteoporosis strategy	Osteoporosis Canada
Rhona McGlasson	Executive director	Bone and Joint Canada

Appendices

Appendix 1: Literature Search Strategies

Database: Ovid MEDLINE(R) <1946 to November Week 3 2012>, Ovid MEDLINE(R) In-Process and Other Non-Indexed Citations <December 6, 2012>, Embase <1980 to 2012 Week 49>
Search Strategy:

#	Searches	Results
1	exp Hip Fractures/ use mesz	16801
2	exp Hip Fracture/ use emez	26238
3	((hip* or femur* or femoral* or trochant* or petrochant* or intertrochant* or subtrochant* or intracapsular* or extracapsular*) adj4 fracture*).ti,ab.	56278
4	((hip* or ((femur* or femoral*) adj3 (head or neck or proximal))) adj4 fracture*).ti,ab.	38861
5	or/1-4	69802
6	exp Arthroplasty, Replacement, Hip/ use mesz	15469
7	exp arthroplasty/	101540
8	exp total hip prosthesis/ use emez	19181
9	exp hip arthroplasty/ use emez	35979
10	exp hip hemiarthroplasty/ use emez	152
11	(Arthroplasty* or Arthroplasty15sty* or hemi-arthroplast* or prosthes* or implant* or bipolar* or bi-polar*).ti,ab.	760520
12	(total hip adj2 (replace* or arthroplasty*)).ti,ab.	34545
13	((bipolar or bi-polar) adj2 arthroplast*).ti,ab.	242
14	or/6-13	796729
15	5 and 14	14229
16	Meta Analysis.pt.	37949
17	Meta Analysis/ use emez	67610
18	Systematic Review/ use emez	55424
19	exp Technology Assessment, Biomedical/ use mesz	8944
20	Biomedical Technology Assessment/ use emez	11419
21	(meta analy* or metaanaly* or pooled analysis or (systematic* adj2 review*) or published studies or published literature or medline or embase or data synthesis or data extraction or 15rthropl).ti,ab.	300528
22	((health technolog* or biomedical technolog*) adj2 assess*).ti,ab.	3997
23	or/16-22	361006
24	15 and 23	396
25	limit 24 to 15rthrop language	372
26	limit 25 to yr="2008 –Current"	194
27	remove duplicates from 26	122

Cochrane Library

ID	Search	Hits
#1	MeSH descriptor: [Hip Fractures] explode all trees	955
#2	((hip* or femur* or femoral* or trochant* or petrochant* or intertrochant* or subtrochant* or intracapsular* or extracapsular*) near/4 fracture*):ti (Word variations have been searched)	1407
#3	((hip* or ((femur* or femoral*) adj3 (head or neck or proximal))) near/4 fracture*):ti (Word variations have been searched)	792
#4	#1 or #2 or #3	1699
#5	MeSH descriptor: [Arthroplasty, Replacement, Hip] explode all trees	1297
#6	MeSH descriptor: [Arthroplasty] explode all trees	2627
#7	(arthroplasty* or arthroplasty15sty* or hemi-arthroplast* or prosthes* or implant* or bipolar* or bi-polar*):ti (Word variations have been searched)	8357

#8	(total hip near/2 (replace* or arthroplasty*)):ti (Word variations have been searched)	1255
#9	((bipolar or bi-polar) near/2 arthroplast*):ti (Word variations have been searched)	6
#10	#5 or #6 or #7 or #8 or #9	9959
#11	#4 and #10 from 2008 to 2012, in Cochrane Reviews (Reviews and Protocols), Other Reviews, Methods Studies, Technology Assessments, Economic Evaluations and Cochrane Groups	34

Centre for Reviews and Dissemination (CRD)

Line	Search	Hits
1	MeSH DESCRIPTOR hip fractures EXPLODE ALL TREES	161
2	((hip* or femur* or femoral* or trochant* or petrochant* or intertrochant* or subtrochant* or intracapsular* or extracapsular*) adj4 fracture*)):TI	117
3	((hip* or ((femur* or femoral*) adj3 (head or neck or proximal))) adj4 fracture*)):TI	97
4	#1 OR #2 OR #3	197
5	MeSH DESCRIPTOR Arthroplasty, Replacement, Hip EXPLODE ALL TREES	281
6	MeSH DESCRIPTOR Arthroplasty EXPLODE ALL TREES	508
7	((arthroplasty* or arthroplasty* or hemi-arthroplast* or prosthes* or implant* or bipolar* or bi-polar*)):TI	1033
8	((total hip adj2 (replace* or arthroplasty*))):TI	103
9	((bipolar or bi-polar) adj2 arthroplast*)	2
10	#5 OR #6 OR #7 OR #8 OR #9	1251
11	#4 AND #10	50
12	(#11) FROM 2008 TO 2012	31

Appendix 2: Quality Assessment Tables

Table A1: Assessment of Multiple Systematic Reviews (AMSTAR) Scores of Included Systematic Reviews

Author, Year	AMSTAR scorea	1) Provided Study Design	2) Duplicate Study Selection	3) Broad Literature Search	4) Considered Status of Publication	5) Listed Excluded Studies	6) Provided Characteristics of Studies	7) Assessed Scientific Quality	8) Considered Quality in Report	9) Methods to Combine Appropriate	10) Assessed Publication Bias	11) Stated Conflict of Interest
Burgers et al, 2012	9	✓	✓	✓	✓		✓	✓	✓	✓		✓
Carroll et al, 2011	9	✓	✓	✓	✓		✓	✓	✓	✓		✓

[a]Maximum possible score is 11. Details of AMSTAR score are described in Shea et al (4)

Table A2: Risk of Bias for All Individual Studies Included in Carroll et al Review of Total Hip Arthroplasty Versus Hemiarthroplasty

Author, Year	Allocation Concealment	Blinding	Complete Accounting of Patients and Outcome Events	Selective Reporting Bias	Other Limitations
van den Bekerom et al, 2010 (14)	No serious limitations	Serious limitations[b]	Serious limitations[c]	No serious limitations	Serious limitations[d]
Mouzopoulos et al, 2008 (15)	Very serious limitations[a]	Serious limitations [b]	Serious limitations [c]	No serious limitations	No serious limitations
Macaulay et al, 2008 (16)	No serious limitations	Serious limitations[b]	No serious limitations	No serious limitations	Serious limitations[d]
Blomfeldt et al, 2006 (17)	No serious limitations	Serious limitations[b]	No serious limitations	No serious limitations	No serious limitations
Keating et al, 2006 (18)	No serious limitations	Serious limitations[b]	No serious limitations	No serious limitations	Serious limitations[d]
Baker et al, 2006 (19)	No serious limitations	Serious limitations[b]	Serious limitations[c]	No serious limitations	No serious limitations
Ravikumar and Marsh, 2000 (20) and Skinner et al 1989 (21)	Very serious limitations[a]	Serious limitations[b]	Serious limitations [c]	No serious limitations	Serious limitations[d]
Dorr et al, 1986 (22)	Very serious limitations[a]	Serious limitations[b]	Serious limitations [c]	No serious limitations	Serious limitations[d]

[a] Quasi-randomized trials with unclear or inadequate allocation concealment; randomization by order of admission in Mouzopoulos et al, day of week in Ravikumar and Marsh, and hospital number in Dorr et al
[b] Patients and physicians not blinded; only the study by Mouzopoulos et al blinded data assessors
[c] van den Bekerom et al conducted a per protocol analysis, with secondary exclusions applied after randomization (10.3% not included); Mouzopolous et al excluded patients after randomization (23%-30% at 1 year and 46%-53% at 4 years); Ravikumar and Marsh excluded patients after randomization with intent to treat and loss to follow-up unspecified; intent to treat and loss to follow-up unclear in study by Dorr et al and Baker et al
[d] Poor description and comparison of intervention groups in study by Dorr et al; unclear whether comparable care provided to randomized groups in other studies

Table A3: GRADE Evidence Profile for Comparison of Total Hip Arthroplasty with Hemiarthroplasty

No. of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Quality
Revision Surgery (Analysis by Carroll et al)						
7 (RCTs)	Very serious limitations (-2)[a]	No serious limitations	No serious limitations	No serious limitations[b]	Undetected	⊕⊕ Low
Functional Status using Total HHS (Analysis by Burgers et al)						
4 (RCTs)	Very serious limitations (-2)[c]	No serious limitations	No serious limitations[d]	No serious limitations	Undetected	⊕⊕ Low

Abbreviations: HHS, Harris hip score; ITT, intent to treat; No., number; RCT, randomized controlled trial.

[a] Quasi-randomization or inadequate allocation concealment in 3 of 7 studies, which accounted for 71% of the weight of the meta-analysis; 5 of 7 studies failed to adhere to an ITT principle or had substantial loss to follow-up; 5 of 7 studies provided inadequate description of comparator groups or of additional care provided during or subsequent to surgery

[b] Study did not meet the optimal information size, but was not downgraded because confidence intervals were satisfactorily narrow and would not differ if the upper versus lower boundary represented the truth

[c] Inadequate allocation concealment in 1 of 4 studies; no studies blinded patients and 2 of 3 studies did not specify blinding assessors, which is likely to bias results for this subjective outcome; 2 of 3 studies failed to adhere to an ITT principle or to appropriately account for all patients; 2 of 3 studies provided inadequate description of comparator groups or of additional care provided subsequent to surgery

[d] Indirectness was not downgraded; however, it is noted that the HHS does not allow assessment of pre-fracture or pre-surgery status and has been validated only in reference to treatment of patients with degenerative disease of hip rather than femoral neck fractures

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