National Institute for Health and Care Excellence

Final

Joint replacement (primary): hip, knee and shoulder

[M] Evidence review for hip replacement approach

NICE guideline NG157

Intervention evidence review underpinning recommendation 1.8.1 and the research recommendation in the NICE guideline

March 2020

Final

This evidence review was developed by the National Guideline Centre, hosted by the Royal College of Physicians

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1 Hip replacement approach

1.1 Review question: In adults having primary elective hip replacement, what is the most clinical and cost-effective approach: posterior, direct anterior, anterolateral, direct superior or SuperPATH?

1.2 Introduction

There are a number of different surgical ways (approaches) to access the hip joint. Over the last decade total hip replacements have been performed using 2 main approaches: The posterior approach in which the hip joint is approached from the back by releasing and reflecting the short external rotators and dividing the capsule at the back of the hip; and the anterolateral (Hardinge) approach in which the hip joint is approached from the side by releasing a portion of the hip abductors and dividing the underlying hip capsule. Neither of these approaches follow a true internervous plane and both are thought to have advantages and disadvantages with respect to complications such as dislocation, nerve injury and post-operative limp.

There is increasing interest in alternatives to these two approaches such as the direct anterior, direct superior and super path (supercapsular percutaneously assisted). These approaches are attractive as they either use a true internervous plane or are reported to minimise soft tissue damage around the hip, both of which should theoretically improve recovery times and reduce length of hospital stay. This review aims to assess the clinical and cost effectiveness of all the approaches including the main approaches and newer approaches.

1.3 PICO table

For full details see the review protocol in Appendix A:

Table 1: PICO characteristics of review question

Population	Adults indicated for primary total hip replacement
Intervention(s)	• Primary total hip replacement utilising the posterior approach • Primary total hip replacement utilising the direct anterior approach • Primary total hip replacement utilising the anterolateral approach • Primary total hip replacement utilising the SuperPATH approach • Primary total hip replacement utilising the direct superior approach
Comparison	Comparison between interventions
Outcomes	**Critical** • Mortality: life expectancy • Mortality: 30 day • Quality of life at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years • Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years • Revision rate of joint replacement **Important** • Deep surgical site infection • Superficial surgical site infection • Length of stay

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	• Reoperation/dislocation rate • Intraoperative complications (for example nerve damage) • Surgery time To be extracted when not included within a PROM: • Function at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years • Pain at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years
Study design	Randomised controlled trials If no well conducted RCTs are available then observational studies with multivariate analysis will be investigated.

1.4 Clinical evidence

1.4.1 Included studies

A search was conducted for randomised controlled trials comparing the effectiveness of different surgical hip replacement approaches utilised for knee joint replacement surgery. Twenty six RCTs were included in the review;[2, 3, 9, 10, 12, 13, 15, 16, 41, 52, 56, 59, 64, 74, 81, 87, 88, 90, 95, 97, 108-110, 115, 118, 124, 128, 130] these are summarised in Table 2 below.

Studies covering four comparisons were found. These were:
Direct anterior approach compared to anterolateral approach – **10** RCTs
Direct anterior approach versus posterior approach – **8** RCTs
Posterior approach versus anterolateral approach – **7** RCTs
SuperPATH approach versus posterior approach – **1** RCT

Evidence from these studies is summarised in the clinical evidence summary below (Table 3).

See also the study selection flow chart in Appendix C: study evidence tables in Appendix D: forest plots in Appendix E: and GRADE tables in Appendix H:

1.4.2 Excluded studies

See the excluded studies list in Appendix I:

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1.4.3 Summary of clinical studies included in the evidence review

Table 2: Summary of studies included in the evidence review

Study	Intervention and comparison	Population	Outcomes	Comments
Direct anterior approach versus anterolateral approach				
Brismar 2018[9]	Direct anterior approach (n=50) Versus Anterolateral approach (n=50)	Adults with hip osteoarthritis indicated for primary total hip replacement Median (IQR) age: Anterior – 66 years (58 to 74) Anterolateral - 67 years (60 to 76)	Later than 6 weeks up to 1 year: • Pain After at least 2 years: • Dislocation • Revision • Intraoperative complications • Deep surgical site infection	Sweden
D'arrigo 2009[15]	Direct anterior (anterior tissue sparing) approach (n=20) Versus Anterolateral (modified Hardinge anterolateral) approach (n=20) Versus Anterolateral (anterolateral tissue sparing) approach (n=20)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 64 years (8) Anterolateral – 66.3 years (10.4) Anterolateral (TSS) – 66 years (7.5)	At 6 weeks or earlier: • PROMs - Harris hip score - WOMAC scale • Intraoperative complications • Length of stay • Surgery time	Italy
De anta-diaz 2016[16]	Anterolateral (direct lateral) approach (n=50) Versus Direct Anterior approach (n=49)	Adults with hip osteoarthritis indicated for primary total hip replacement	Later than 6 weeks up to 1 year: • PROMs - Harris hip score • Surgery time	Spain

Study	Intervention and comparison	Population	Outcomes	Comments
		Mean (SD) age: Lateral - 63.5 years (12.5) Anterior - 64.8 years (10.1)		
Mayr 2009[56]	Direct anterior approach (n=16) Versus Anterolateral approach (n=17)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (range) age: Lateral – 69 years (59 to 78) Anterior - 65 years (55 to 84)	No usable outcomes	Austria
Mjaaland 2015[64]	Direct anterior approach (n=84) Versus Anterolateral (direct lateral) approach (n=80)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 67.2 years (8.6) Lateral – 65.6 years (8.6)	At 6 weeks or earlier: • Surgery time	Norway
Nistor 2017[74]	Direct anterior approach (n=35) Versus Anterolateral (direct lateral) approach (n=35)	Adults with hip osteoarthritis indicated for primary total hip replacement Median (IQR) age: Anterior – 67 years (53.5 to 72.5) Lateral – 64 years (54.4 to 67.5)	At 6 weeks or earlier: • Deep surgical site infection • Intraoperative complications	Romania
Parvizi 2016[81]	Direct anterior approach (n=44) Versus Anterolateral (direct lateral)	Adults with hip osteoarthritis indicated for primary total hip replacement	No usable outcomes	USA

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Study	Intervention and comparison	Population	Outcomes	Comments
	approach (n=40)	No age details given		
Reichert 2018[87]	Direct anterior approach (n=77) Versus Anterolateral (direct transgluteal lateral) approach (n=71)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 63.2 years (8.2) Lateral – 61.9 years (7.8)	At 6 weeks or earlier and later than 6 weeks up to 1 year: • Quality of life - SF-36 scale • PROMs - Harris hip score • Dislocation	Germany
Restrepo 2010[90]	Direct anterior approach (n=63) Versus Direct lateral approach (n=59)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (range) age: Anterior – 62.02 years (35 to 84.5) Lateral – 59.91 years (40.1 to 76.1)	No usable outcomes	USA
Zomar 2018[130]	Direct lateral approach (n=42) Versus Direct anterior approach (n=36)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 59.54 years (8.40) Lateral – 60.78 years (9.26)	At 6 weeks or earlier and later than 6 weeks up to 1 year: • PROMs - WOMAC scale - Harris hip score • Quality of life - SF-12 scale • Length of stay	Canada
Direct anterior approach versus posterior approach				

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Study	Intervention and comparison	Population	Outcomes	Comments
Barrett 2013[2] Barrett 2019[3]	Direct anterior approach (n=43) Versus Posterior approach (n=44)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 61.4 years (9.2) Posterior – 63.2 years (7.7)	At 6 weeks or earlier and later than 6 weeks up to 1 year: • PROMs - Harris hip score - Hip disability and arthritis outcome score - UCLA score • Revisions • Dislocation • Length of stay • Surgery time	USA
Cheng 2017[12]	Direct anterior approach (n=37) Versus Posterior approach (n=38)	Adults with hip osteoarthritis indicated for primary total hip replacement Median (IQR) age: Anterior – 59 years (54 to 69) Posterior – 62.5 years (55 to 69)	At 6 weeks or earlier and later than 6 weeks up to 1 year: • Quality of life - EQ-5D • PROMs - WOMAC - Oxford hip score • Revisions • Dislocations • Intraoperative complications	Australia
Christensen 2015[13]	Direct anterior approach (n=32) Versus Posterior approach (n=24)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 64.3 years (9.1)	Length of stay	USA

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Study	Intervention and comparison	Population	Outcomes	Comments
		Posterior – 65.2 years (9.1)		
Reininga 2013[88]	Posterior (posterolateral) approach (n=40) Versus Direct anterior (minimally invasive anterior) approach (=35)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 60.3 years (7.7) Posterior – 60.5 years (9.5)	No usable outcomes	Netherlands
Rykov 2017[97]	Direct anterior approach (n=23) Versus Posterior (posterolateral) approach (n=23)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 62.8 years (6.1) Posterior – 60.2 years (8.1)	At 6 weeks or earlier: • Deep surgical site infection • Length of stay • Intraoperative complications • Surgery time	Netherlands
Taunton 2014[108]	Direct anterior approach (n=27) Versus Posterior (mini-posterior) approach (n=27)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean age: Anterior – 62.05 years Posterior – 66.4 years	Later than 6 weeks up to 1 year: Function	USA
Taunton 2018[109]	Direct anterior approach (n=56) Versus Posterior (mini-posterior) approach (n=60)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 65 years (10)	Later than 6 weeks up to 1 year: • Quality of life - SF-12 • PROMs - HOOS score - Harris Hip score	USA

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Study	Intervention and comparison	Population	Outcomes	Comments
		Mini-posterior – 64 years (11)	• Dislocation • Length of stay • Surgery time	
Zhao 2017[128]	Direct anterior approach (n=64) Versus Posterior (posterolateral) approach (n=64)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Anterior – 64.88 years (12.13) Posterior – 62.18 years (14.72)	Later than 6 weeks up to 1 year: • PROMs - Harris hip score - UCLA score • Length of stay • Intraoperative complications • Surgery time	China
Posterior approach versus anterolateral approach				
Catma 2017[10]	Posterior approach (n=34) Versus Anterolateral approach (n=34)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: 51.1 years (9.4)	Later than 6 weeks up to 1 year: • PROMs - Harris hip score • Dislocation • Reoperation • Surgery time	Turkey
Ji 2012[41]	Posterior approach (n=105) Versus Anterolateral (modified lateral) approach (n=100)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD) age: Posterior – 51 years (14.5) Lateral – 52 years (15.1)	After at least 2 years: • PROMs - Harris hip score • Revision • Dislocation • Surgery time	South Korea
Lorenzen 2013[52]	Posterior approach (n=18)	Adults with hip osteoarthritis	Later than 6 weeks up to 1	Denmark

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Study	Intervention and comparison	Population	Outcomes	Comments
	Versus Anterolateral approach (n=20)	indicated for primary total hip replacement Mean (range): Posterior – 45 years (36 to 60) Lateral – 53 years (35 to 61)	year: • Pain	This is the same RCT as Tjur, 2018 [110] People in this study meet the working age subgroup.
Meneghini 2008[59]	Posterior (mini posterior) approach (n=8) Versus Anterolateral (mini-anterolateral) approach (n=7)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (range) age: 54 years (38 to 74)	No usable outcomes	USA
Rosenlund 2016[95]	Posterior approach (n=23) Versus Anterolateral (direct lateral) approach (n=24)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD): Posterior – 61 years (6.7) Lateral – 60.5 years (6.6)	Later than 6 weeks up to 1 year: • Revision • Dislocation	Denmark
Witzleb 2009[115]	Posterior approach (n=30) Versus Anterolateral (direct lateral) approach (n=30)	Adults with hip osteoarthritis indicated for primary total hip replacement Median (range): Posterior – 55 years (47 to 64) Lateral – 58 years (46 to 64)	Later than 6 weeks up to 1 year: • Superficial surgical site infection • Dislocations	Germany People in this study meet the working age subgroup.

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Study	Intervention and comparison	Population	Outcomes	Comments
Yang 2010[124]	Anterolateral approach (n=55) Versus Posterior (postlateral) approach (n=55)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD): Posterior – 55.82 years (13.91) Lateral – 59.47 years (13.24)	After at least 2 years:: • Intraoperative complications • Surgery time	China
SuperPATH approach versus posterior approach				
Xie 2017[118]	Super path approach (n=46) Versus Posterior approach (n=46)	Adults with hip osteoarthritis indicated for primary total hip replacement Mean (SD): SuperPATH – 66.60 years (11.88) Posterior – 64.47 years (12.09)	Later than 6 weeks up to 1 year: • PROMs - Harris hip score - Barthel index score • Length of stay • Dislocation • Surgery time	China

See Appendix D: for full evidence tables.

1.4.4 Quality assessment of clinical studies included in the evidence review

Table 3: Clinical evidence summary: Direct anterior approach versus anterolateral approach

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Direct anterior (95% CI)
Mortality	Mortality				
Quality of life at 6 weeks or earlier	226 (2 studies)	LOW[1] due to risk of bias		The mean quality of life in the control groups was	The mean quality of life in the intervention groups was

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Direct anterior (95% CI)
SF-12, SF-36 - mental subscale	2 to 6 weeks			56.70	0.15 standard deviations lower (0.42 lower to 0.11 higher)
Quality of life at 6 weeks or earlier SF-12, SF-36 - physical subscale	226 (2 studies) 2 to 6 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean quality of life in the control groups was 32.59	The mean quality of life in the intervention groups was 2.67 higher (0.34 to 5.01 higher)
Quality of life later than 6 weeks up to 1 year SF-12, SF-36 - mental subscale	226 (2 studies) 3 to 12 months	LOW[1] due to risk of bias		The mean quality of life in the control groups was 56.01	The mean quality of life in the intervention groups was 1.01 lower (3.20 lower to 1.18 higher)
Quality of life later than 6 weeks up to 1 year SF-12, SF-36 - physical subscale	226 (2 studies) 3 to 12 months	VERY LOW[1,2,3] due to risk of bias, inconsistency, imprecision		The mean quality of life in the control groups was 44.79	The mean quality of life in the intervention groups was 1.96 higher (3.28 lower to 7.21 higher)
PROMs at 6 weeks or earlier WOMAC - total score	138 (3 studies) 6 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 28	The mean proms in the intervention groups was 3.75 lower (7.77 to 0.27 lower)
PROMs at 6 weeks or earlier Harris Hip Score. Scale from: 0 to 100.	208 (3 studies) 6 weeks	LOW[1] due to risk of bias		The mean proms in the control groups was 88.3	The mean proms in the intervention groups was 0.49 higher (2.35 lower to 3.33 higher)
PROMs later than 6 weeks up to 1 year WOMAC - total score	78 (1 study) 3 months	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 84.35	The mean proms in the intervention groups was 3.01 lower (8.34 lower to 2.32 higher)
PROMs later than 6 weeks up to 1 year Harris Hip Score. Scale from: 0 to 100.	325 (3 studies) 3 to 12 months	LOW[1] due to risk of bias		The mean proms in the control groups was 92.04	The mean proms in the intervention groups was 1.95 higher (0.07 to 3.84 higher)

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Direct anterior (95% CI)
Revision later than 2 years	87 (1 study) 5 years	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 6.91 (0.14 to 349.18)	0 per 1000	20 more per 1000 (from 40 fewer to 80 more)[5]
Dislocation later than 2 years	235 (2 studies) 1 to 5 years	VERY LOW[1,2,4] due to risk of bias, imprecision, indirectness	Peto OR 3.2 (0.54 to 18.95)	9 per 1000	20 more per 1000 (from 20 fewer to 70 more)
Deep Infection at 6 weeks or earlier	70 (1 study) 8 days	VERY LOW[1,2] due to risk of bias, imprecision	RR 0.50 (0.05 to 5.27)	57 per 1000	29 fewer per 1000 (from 54 fewer to 244 more)
Deep Infection later than 2 years	87 (1 study) 5 years	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 6.91 (0.14 to 349.18)	0 per 1000	20 more per 1000 (from 40 fewer to 80 more)
Intraoperative complications - lateral femoral cutaneous nerve injury, at 6 weeks or earlier	70 (1 study) 8 days	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 7.61 (0.47 to 124.15)	0 per 1000	60 more per 1000 (from 30 fewer to 150 more)
Intraoperative complications – hyperesthesia, later than 2 years	87 (1 study) 5 years	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 0.13 (0 to 6.37)	24 per 1000	20 fewer per 1000 (from 90 fewer to 40 more)
Intraoperative complications – blood loss (ml) at 6 weeks or earlier	60 (2 studies) 6 weeks	LOW[1,2] due to risk of bias, imprecision		The mean intraoperative complications - blood loss (ml) in the control groups was 1249	The mean intraoperative complications - blood loss (ml) in the intervention groups was 93.69 higher (292.87 lower to 480.26 higher)
Surgery time (minutes)	323 (4 studies)	VERY LOW[1,2,3] due to risk of bias,		The mean surgery time (minutes) in the control	The mean surgery time (minutes) in the intervention

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Direct anterior (95% CI)
		inconsistency, imprecision		groups was 92.1	groups was 9.57 higher (2.60 lower to 21.74 higher)
Length of stay (days)	138 (3 studies)	VERY LOW[1,2,3] due to risk of bias, inconsistency, imprecision		The mean length of stay (days) in the control groups was 7.07	The mean length of stay (days) in the intervention groups was 0.79 standard deviations lower (1.66 lower to 0.07 higher)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 or 2 increments because the point estimates varied widely across studies, unexplained by subgroup analysis. Random effects model utilised.
[4] Downgraded by 1 or 2 increments because the meta-analysed time points vary slightly from the protocol.
[5] Absolute values calculated using the risk difference.

Table 4: Clinical evidence summary: Direct anterior approach versus posterior approach

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with Direct anterior (95% CI)
Mortality	Not reported				
Quality of life at 6 weeks or earlier EQ-5D, HOOS (QOL subscale)	160 (2 studies) 2 to 6 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean quality of life in the control groups was 31.6	The mean quality of life in the intervention groups was 0.40 standard deviations lower (0.71 to 0.08 lower)
Quality of life later than 6 weeks	261	LOW[1]		The mean quality of life in the	The mean quality of life in the

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with Direct anterior (95% CI)
up to 1 year EQ-5D, HOOS (QOL subscale)	(3 studies) 3 to 12 months	due to risk of bias		control groups was 47.73	intervention groups was 0.03 standard deviations lower (0.28 lower to 0.21 higher)
Quality of life later than 6 weeks up to 1 year SF-12 scale mental subscale	101 (1 study) 1 years	LOW[1] due to risk of bias		The mean quality of life in the control groups was 54	The mean quality of life in the intervention groups was 0.00 higher (2.21 lower to 2.21 higher)
Quality of life later than 6 weeks up to 1 year SF-12 scale physical subscale	101 (1 study) 1 years	VERY LOW[1,2] due to risk of bias, imprecision		The mean quality of life in the control groups was 49	The mean quality of life in the intervention groups was 1.00 higher (2.35 lower to 4.35 higher)
PROMs at 6 weeks or earlier WOMAC scale. Scale from: 0 to 96.	73 (1 study) 2 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 40.3	The mean proms in the intervention groups was 4.2 higher (4.1 lower to 12.5 higher)
PROMs later than 6 weeks up to 1 year WOMAC scale. Scale from: 0 to 96.	73 (1 study) 12 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 9.1	The mean proms in the intervention groups was 3.7 higher (1.98 lower to 9.38 higher)
PROMs at 6 weeks or earlier Oxford Hip Score. Scale from: 0 to 48.	73 (1 study) 2 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 28.5	The mean proms in the intervention groups was 1.7 lower (6.01 lower to 2.61 higher)
PROMs later than 6 weeks up to 1 year Oxford Hip Score. Scale from: 0 to 48.	73 (1 study) 12 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 43.8	The mean proms in the intervention groups was 1 lower (3.4 lower to 1.4 higher)
PROMs at 6 weeks or earlier Harris Hip Total Score. Scale from: 0 to 100.	87 (1 study) 6 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 89.5	The mean proms in the intervention groups was 8.1 lower

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with Direct anterior (95% CI)
					(11.87 to 4.33 lower)
PROMs later than 6 weeks up to 1 year Harris Hip Score. Scale from: 0 to 100.	308 (3 studies) 6 to 12 months	LOW[1] due to risk of bias		The mean proms in the control groups was 95.57	The mean proms in the intervention groups was 1.28 lower (2.80 lower to 0.25 higher)
PROMs after at least 2 years Harris Hip Score. Scale from: 0 to 100	79 (1 study) 5 years	LOW[1] due to risk of bias		The mean proms in the control groups was 96.9	The mean proms in the intervention groups was 0.20 higher (3.87 lower to 4.27 higher)
PROMs - Symptoms subscale HOOS score, at 6 weeks or earlier	87 (1 study) 6 weeks	LOW[1] due to risk of bias		The mean proms - symptoms subscale in the control groups was 79.4	The mean proms - symptoms subscale in the intervention groups was 0.5 higher (4.53 lower to 5.53 higher)
PROMs - symptoms subscale HOOS score, later than 6 weeks up to 1 year	188 (2 studies) 12 months	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms - symptoms subscale in the control groups was 80.95	The mean proms - symptoms subscale in the intervention groups was 3.12 lower (6.27 lower to 0.03 higher)
PROMs later than 6 weeks up to 1 year HOOS score - pain subscale	101 (1 study) 1 years	LOW[1] due to risk of bias		The mean proms in the control groups was 69	The mean proms in the intervention groups was 2.00 lower (5.93 lower to 1.93 higher)
PROMs after at least 2 years HOOS Jr Total Score	78 (1 study) 6.2 years	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 95.7	The mean proms in the intervention groups was 2.80 lower (7.84 lower to 2.24 higher)
PROMs later than 6 weeks up to 1 year	120 (1 study)	VERY LOW[1,2] due to risk of bias,		The mean proms in the control groups was	The mean proms in the intervention groups was 0.08 lower

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with Direct anterior (95% CI)
UCLA score	6 months	imprecision		7.04	(0.5 lower to 0.34 higher)
PROMs after at least 2 years UCLA score	75 (1 study) 5 years	LOW[1] due to risk of bias		The mean proms in the control groups was 6.33	The mean proms in the intervention groups was 0.07 lower (0.87 lower to 0.73 higher)
Revision later than 6 weeks up to 1 year	160 (2 studies) 12 months	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 1.84 (0.19 to 17.91)	13 per 1000	10 more per 1000 (from 40 fewer to 60 more)
Dislocation later than 6 weeks up to 1 year	261 (3 studies) 12 months	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 1.48 (0.25 to 8.61)	15 per 1000	10 more per 1000 (from 30 fewer to 40 more)
Deep Infection at 6 weeks or earlier	46 (1 study) 6 weeks	LOW[2] due to imprecision	RR 0.5 (0.05 to 5.14)	87 per 1000	43 fewer per 1000 (from 83 fewer to 360 more)
Intraoperative complications - lateral cutaneous nerve of the thigh neuropraxia, later than 6 weeks up to 1 year	73 (1 study) 12 weeks	MODERATE[1] due to risk of bias	Peto OR 0.03 (0.01 to 0.08)	829 per 1000	830 fewer per 1000 (from 960 fewer to 700 fewer)
Intraoperative complications - blood loss (ml)	166 (2 studies)	LOW[1,2] due to risk of bias, imprecision		The mean intraoperative complications - blood loss (ml) in the control groups was 245.795	The mean intraoperative complications - blood loss (ml) in the intervention groups was 0.69 standard deviations lower (1.01 to 0.38 lower)
Length of stay (days)	405 (5 studies)	LOW[1] due to risk of bias		The mean length of stay (days) in the control groups was 2.28	The mean length of stay (days) in the intervention groups was 0.22 higher (0.03 to 0.41 higher)
Surgery time (minutes)	354	VERY LOW[1,2,3]		The mean surgery time (minutes)	The mean surgery time (minutes)

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with Direct anterior (95% CI)
	(4 studies)	due to risk of bias, inconsistency, imprecision		in the control groups was 77.13	in the intervention groups was 14.98 lower (21.77 to 8.20 lower)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 or 2 increments because the point estimates varied widely across studies, unexplained by subgroup analysis. Random effects model utilised.
[4] Absolute values calculated using the risk difference.

Table 5: Clinical evidence summary: Posterior approach versus anterolateral approach

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Posterior approach (95% CI)
Mortality	Not reported				
Quality of life	Not reported				
PROMs later than 6 weeks up to 1 year Harris Hip Score. Scale from: 0 to 100.	68 (1 study) 6 months	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 82.7	The mean proms in the intervention groups was 1.6 lower (4.82 lower to 1.62 higher)
PROMs later than 2 years Harris Hip Score. Scale from: 0 to 100.	196 (1 study) 37.9 months	LOW[1] due to risk of bias		The mean proms in the control groups was 91	The mean proms in the intervention groups was 1.3 higher (0.41 lower to 3.01 higher)
Revision later than 2 years	243 (2 studies) 37.9 months	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 0.36 (0.05 to	25 per 1000	20 fewer per 1000 (from 50 fewer to 20 more)

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Posterior approach (95% CI)
			2.58)		
Dislocation later than 2 years	371 (4 studies) 37.9 months	LOW[1,2] due to risk of bias, imprecision	Peto OR 1 (0.28 to 3.53)	27 per 1000	0 fewer per 1000 (from 40 fewer to 40 more)
Reoperation later than 6 weeks up to 1 year	68 (1 study) 6 months	VERY LOW[1,2] due to risk of bias, imprecision	Peto OR 0.14 (0 to 6.82)	29 per 1000	30 fewer per 1000 (from 110 fewer to 50 more)
Superficial surgical site infection later than 6 weeks up to 1 year	60 (1 study) 12 weeks	MODERATE[2] due to imprecision	Peto OR 7.65 (0.47 to 125.22)	0 per 1000	70 more per 1000 (from 40 fewer to 170 more)
Intraoperative complications - blood loss (ml)	110 (1 study)	MODERATE[2] due to imprecision		The mean intraoperative complications - blood loss (ml) in the control groups was 605	The mean intraoperative complications - blood loss (ml) in the intervention groups was 228.82 lower (303.1 to 154.54 lower)
Surgery time (minutes)	374 (3 studies)	VERY LOW[1,2,3] due to risk of bias, inconsistency, imprecision		The mean surgery time (minutes) in the control groups was 98.1	The mean surgery time (minutes) in the intervention groups was 9.34 higher (5.01 lower to 23.69 higher)
Pain (change score) VAS scale	22 (1 study) 12 months	LOW[1,2] due to risk of bias, imprecision		The mean pain (change score) in the control groups was -43.08	The mean pain (change score) in the intervention groups was 7.28 lower (24.1 lower to 9.54 higher)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 or 2 increments because the point estimates varied widely across studies, unexplained by subgroup analysis. Random effects model utilised.

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Anterolateral approach	Risk difference with Posterior approach (95% CI)
[4]Absolute values calculated using the risk difference.					

Table 6: Clinical evidence summary: SuperPATH approach versus posterior approach

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with SuperPATH approach (95% CI)
Mortality	Not reported				
Quality of life	Not reported				
PROMs at 6 weeks or earlier Barthel Index score	92 (1 study) 1 weeks	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 64.46	The mean proms in the intervention groups was 6.21 higher (2.68 to 9.74 higher)
PROMs at 6 weeks or earlier Harris Hip Score	92 (1 study) 1 weeks	LOW[1] due to risk of bias		The mean proms in the control groups was 69	The mean proms in the intervention groups was 4.8 higher (3.01 to 6.59 higher)
PROMs later than 6 weeks up to 1 year Barthel Index score	92 (1 study) 1 years	LOW[1] due to risk of bias		The mean proms in the control groups was 93.6	The mean proms in the intervention groups was 0.73 higher (2.49 lower to 3.95 higher)
PROMs later than 6 weeks up to 1 year Harris Hip Score	92 (1 study) 1 years	VERY LOW[1,2] due to risk of bias, imprecision		The mean proms in the control groups was 91.6	The mean proms in the intervention groups was 0.7 higher (0.14 lower to 1.54 higher)
Dislocation later than 6 weeks up	92 (1 study)	VERY LOW[1,2] due to risk of bias,	RR 0.5 (0.05 to	43 per 1000	22 fewer per 1000 (from 41 fewer to 188 more)

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Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Posterior approach	Risk difference with SuperPATH approach (95% CI)
to 1 year	12 months	imprecision	5.32)		
Length of stay (days)	92 (1 study)	MODERATE[1] due to risk of bias		The mean length of stay (days) in the control groups was 11.4	The mean length of stay (days) in the intervention groups was 3.1 lower (4.35 to 1.85 lower)
Surgery time (minutes)	92 (1 study)	LOW[1,2] due to risk of bias, imprecision		The mean surgery time (minutes) in the control groups was 106.5	The mean surgery time (minutes) in the intervention groups was 2.9 lower (8.76 lower to 2.96 higher)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.

See Appendix F: for full GRADE tables.

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1.5 Economic evidence

1.5.1 Included studies

Two health economic studies were identified with the relevant comparison and have been included in this review.[82] [102] The studies are summarised in the health economic evidence profile below (Table 7) and the health economic evidence table in Appendix H:

1.5.2 Excluded studies

Two studies relating to this review question were identified but were excluded due to limited applicability.[14, 18] Two studies relating to this review question were identified but were excluded due to very serious limitations.[28, 54] The studies are listed in Appendix I: with reasons for exclusion.

See also the health economic study selection flow chart in Appendix G:

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1.5.3 Summary of studies included in the economic evidence review

Table 7: Health economic evidence profile: Anterior THR versus posterior THR versus lateral THR

Study	Applicability	Limitations	Other comments	Incremental cost	Incremental effects	Cost effectiveness	Uncertainty
Petis 2016[82] Canada	Partially[(a)] applicable	Potentially serious limitations[(b)]	A prospective cohort study micro-costing 3 interventions; anterior posterior; and lateral THR, each carried out by a single surgeon. A 3-month time horizon was taken.	**Total cost of procedure (mean per patient):** Anterior: £4,155 Posterior: £4,716 Lateral: £4,469	**Inpatient LOS (mean days per patient):** Intervention 1: 1.42 Intervention 2: 2.74 Intervention 3: 2.68	The anterior THR approach is cost saving compared to the posterior and lateral approaches	No sensitivity analysis was conducted
Sharma 2019[102] Canada	Partially applicable[(c)]	Potentially serious limitations[(d)]	A retrospective matched cohort study that used two costing models to compare initial inpatient stay costs of 3 interventions: anterior posterior; and lateral THR. Time horizon was initial inpatient stay.	**Total cost of procedure (mean per patient):** Anterior: £5,234 Posterior: £6,156 Lateral: £6,361	**Inpatient LOS (mean days per patient):** Intervention 1: 0.25 Intervention 2: 3.54 Intervention 3: 3.12	The anterior THR approach is cost saving compared to the posterior and lateral approaches	No sensitivity analysis was conducted

Abbreviations: LOS: length of stay; THR: total hip replacement

(a) A cost comparison study with a Canadian perspective. No quality of life included.

(b) Quality of life is not included as an outcome; the follow-up may be too short to understand the long term complications of the interventions; no sensitivity analysis was conducted; no multivariate analysis conducted to adjust for confounders, although a 1-way ANOVA showed no significant difference in age, sex, BMI, side operated on, primary diagnosis and age adjust Charlson Comorbidity Index.

(c) A cost comparison study with a Canadian perspective. No quality of life included.

(d) Quality of life is not included as an outcome; the follow-up may be too short to understand the long term complications of the interventions; no sensitivity analysis was conducted; no multivariate analysis conducted to adjust for confounders although patients were retrospectively matched

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1.5.4 Unit costs

Relevant unit costs are provided below to aid consideration of cost effectiveness.

Table 8: Weighted average unit costs for HRG HN12 (Elective Very Major Hip Procedures for Non-Trauma) including excess bed days

Intervention/ Diagnosis	Reference cost HRG	National average unit cost	Average cost of excess bed day	Weighted national average	Weighted average length of stay	NOTES
Very Major Hip Procedures for Non-Trauma	Very Major Hip Procedures for Non-Trauma with CC Score 10+ (HN12A); as recorded for Elective Inpatients	£11,262	£446	£11,508	12.28	The number of data submissions for this code was 112, with 379 units of activity.
Very Major Hip Procedures for Non-Trauma	Very Major Hip Procedures for Non-Trauma with CC Score 8-9 (HN12B); as recorded for Elective Inpatients	£8,725	£360	£8,815	7.98	The number of data submissions for this code was 127, with 770 units of activity.
Very Major Hip Procedures for Non-Trauma	Very Major Hip Procedures for Non-Trauma with CC Score 6-7 (HN12C); as recorded for Elective Inpatients	£7,616	£357	£7,767	6.24	The number of data submissions for this code was 135, with 2259 units of activity.
Very Major Hip Procedures for Non-Trauma	Very Major Hip Procedures for Non-Trauma with CC Score 4-5 (HN12D); as recorded for Elective Inpatients	£7,008	£412	£7,140	4.98	The number of data submissions for this code was 137, with 5923 units of activity.
Very Major Hip Procedures for Non-Trauma	Very Major Hip Procedures for Non-Trauma with CC Score 2-3 (HN12E); as recorded for Elective Inpatients	£6,514	£411	£6,634	3.87	The number of data submissions for this code was 138, with 14705 units of activity.
Very Major Hip Procedures for Non-Trauma	Very Major Hip Procedures for Non-Trauma with CC Score 0-1 (HN12F); as recorded for Elective Inpatients	£6,061	£413	£6,119	3.21	The number of data submissions for this code was 139, with 23488 units of activity.
Very Major Hip Procedures for Non-Trauma	Weighted for complications and co morbidities for HRG codes: HN12A, HN12B, HN12C, HN12D, HN12E and HN12F; as recorded for Elective Inpatients			£6,571	3.93	

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Source: NHS Reference costs 2017/2018[21]

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1.6 Evidence statements

1.6.1 Clinical evidence statements

Direct anterior approach versus anterolateral approach

Evidence from 10 RCTs was found for this comparison.

A benefit was found for direct anterior approach in length of stay (n=247, very low quality), deep infection at 6 weeks or earlier (n=70, very low quality), and hyperesthesia at later than 2 years (n=87, very low quality).

A benefit was found for anterolateral approach in surgery time (n=432, very low quality), lateral femoral cutaneous nerve injury at 6 weeks or earlier (n=70, very low quality) and 3 outcomes at later than 2 years: dislocation (n=235, very low quality), revision (n=87, very low quality), and deep infection (n=87, very low quality).

No difference between approaches was found for blood loss during surgery (n=169, low quality), 4 quality of life or PROMs outcomes at 6 weeks or earlier (n=138 to226, low to very low quality) and 4 quality of life or PROMs outcomes at later than 6 weeks up to 1 year (n=78 or 325, low or very low quality).

Direct anterior approach versus posterior approach

Evidence from 8 RCTs was found for this comparison.

A benefit was found for direct anterior approach in Harris Hip Score at 6 weeks or earlier (n=87, very low quality), revision later than 6 weeks up to 1 year (n=160, very low quality), and dislocation later than 6 weeks up to 1 year (n=261, very low quality).

A benefit was found for posterior approach in surgery time (n=354, very low quality), lateral cutaneous nerve of the thigh neuropraxia (n=73, moderate quality), blood loss (n=166, low quality), and deep infection at 6 weeks or earlier (n=46, low quality).

No difference between approaches was found for length of stay (n=405, low quality) and 5 quality of life or PROMs outcomes at 6 weeks or earlier were (n=73 to160, low to very low quality), quality of life or 9 PROMs outcomes at later than 6 weeks to 1 year (n=73 to308, low to very low quality), and 3 PROMs outcomes at later than 2 years (n=75 to79, low to very low quality).

Direct anterior approach versus posterior approach

Evidence from 7 RCTs was found for this comparison.

A benefit was found for direct anterior approach for surgical blood loss (n=110, moderate quality), reoperation later than 6 weeks up to 1 year (n=68, very low quality), and revision later than 2 years (n=243, very low quality).

A benefit was found for posterior approach in superficial surgical site infection later than 6 weeks up to 1 year (n= 60, moderate quality).

No difference between approaches was found for surgery time (n=374, very low quality), Harris Hip Score (n=68, very low quality) or pain (n=22, low quality) later than 6 weeks up to 1 year, and Harris Hip Score (n=196, low quality) or dislocation (n=371, low quality) later than 2 years.

SuperPATH approach versus posterior approach

Evidence from 1 RCT was found for this comparison (n=92).

A clinically important benefit for the SuperPATH approach was found for length of stay (moderate quality) PROMS measured with the Barthel Index and Harris Hip Score at 6 weeks or earlier, dislocation later than 6 weeks up to 1 year and (low to very low quality).

No outcomes favoured posterior approach over SuperPATH approach.

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No difference between approaches was found for surgery time (low quality) and PROMs measured with the Barthel Index and HHS score at later than 6 weeks up to 1 year and (low to very low quality).

1.6.2 Health economic evidence statements

Two cost comparisons found that the anterior THR approach was cost saving compared to both the lateral and posterior approaches. Both studies were assessed as partially applicable with potentially serious limitations.

1.7 The committee's discussion of the evidence

1.7.1 Interpreting the evidence

1.7.1.1 The outcomes that matter most

The critical outcomes were mortality, quality of life, revision rate of joint replacement and Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier (short term) later than 6 weeks up to 1 year (moderate term) or after at least 2 years (long term). The benefits of knee joint replacement operations may not present themselves immediately after surgery; they may take months or years to become apparent. Therefore, multiple time points were necessary to capture this variation in outcomes as rehabilitation occurs.

The important outcomes were deep and superficial surgical site infection, length of stay, reoperation or dislocation rate, intraoperative complications such as nerve damage and surgery time.

1.7.1.2 The quality of the evidence

Twenty six RCTs were included in the review, showing outcomes ranging from very low to moderate quality due to risk of bias, imprecision or inconsistency. The majority of the evidence was very low quality mainly due to lack of allocation concealment and blinding, contributing to a higher risk of bias. There was often imprecision due to confidence intervals crossing default minimal important difference. Inconsistency was present several times due to heterogeneity unexplained by subgroup analysis or the number of zero events varying across arms.

1.7.1.3 Benefits and harms

There were four approach comparisons included in this review; direct anterior compared to anterolateral in 10 RCTs, direct anterior compared to posterior in 8 RCTs, posterior compared to anterolateral in 7 RCTs, and SuperPATH compared to posterior in 1 RCT.

The direct anterior versus anterolateral comparison indicated no clinically important difference in 8 for quality of life or PROMs outcomes across short and moderate time points, and blood loss. A clinically important benefit for anterolateral approach was found for revision at 5 years after surgery, dislocation, deep infection (later than 2 years from surgery), lateral femoral cutaneous nerve injury and surgery time. A clinically important benefit for direct anterior approach was found for deep infection at 6 weeks, hyperesthesia and length of stay.

The direct anterior versus posterior comparison indicated no clinically important difference for and length of stay, 5 quality of life or PROMs outcomes at short time points, 9 quality of life or PROMs outcomes moderate time points, and 3 PROMs outcomes at the long time point. However there was a clinically important benefit for direct anterior with 1 PROMs outcome (Harris hip score at 6 weeks) along with revision, and dislocation. There was a clinically important benefit for posterior for deep infection, lateral cutaneous nerve of the thigh neuropraxia, blood loss, and surgery time.

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The posterior versus anterolateral comparison showed no clinically important difference for 2 PROMs (Harris hip score) outcomes at moderate and long term time points, dislocation, surgery time and pain. There was a clinically important benefit of the anterolateral approach for revision at around 3 years, reoperation and blood loss. There was a clinically important benefit for the posterior approach for superficial surgical site infection.

SuperPATH versus posterior approach found no clinically important difference for 2 PROMs outcomes in the moderate term and also surgery time. The review found a clinically important benefit of the SuperPATH approach for 2 PROMs outcomes in the short term, and also dislocation and length of stay. No clinically important benefits were found for the posterior approach.

The committee related the evidence from the review to their own knowledge and experiences of the various approaches. The direct anterior appears better in the short term, with the committee noting the these are seen in the first 6 weeks after surgery, but these benefits tend to equalise after for the moderate to long term outcomes. Going home the day after surgery, feeling comfortable and getting back to work quickly are often important factors for patients.

Lateral cutaneous nerve of the thigh is a very painful adverse event and was found to be associated with the direct anterior approach in 2 comparisons. 1 outcome was nerve injury in the direct anterior versus anterolateral comparison and the other was neuropraxia in the direct anterior versus posterior comparison. The former showed a small increase in the direct anterior group while the latter affected over 80% in the direct anterior group and no people in the posterior group at 12 weeks. This was discussed by the committee and it was considered that such a high number of events may have been caused by the study's definition of the outcome which was the absence of normal sensation rather than pain or discomfort. The committee were cognisant that this outcome was not associated with lower PROMs in the study as it is conceivable that absence of normal sensation for a limited period of time does not have a significant negative affect on a person's experience of the post-surgery period.

There was some evidence at the long time point for 3 of the 4 comparisons. However the committee felt that much longer time horizons of at least 10 years would have given a better view of revision, quality of life, and PROMs outcomes.

The committee agreed the evidence did not indicate the superiority of any single approach.

In the NHS the great majority of people undergo hip replacement via the posterior or anterolateral approaches. In 2017 the National Joint Registry showed the breakdown of surgical approach for hip replacement as 72% for the posterior approach, 25% for the anterolateral approach, and 4% for other approaches. The committee agreed that most surgeons can use an anterolateral approach or posterior approach as initial training provides this. However the other approaches are less commonly used and would require training and experience to carry out effectively. tThe committee also agreed that the surgeon undertaking the approach should have experience and competence in that particular approach to get consistently good results.

The committee were aware that there was very limited RCT data investigating newer approaches. Therefore they agreed to make a consider recommendation for posterior or anterolateral surgical approaches, as they are established approaches and evidence did not show a benefit of one over the other. The also agreed to make a research recommendation to compare SuperPATH approach, direct superior approach, and direct anterior approach to either of the 'traditional' posterior or anterolateral approaches.

1.7.2 Cost effectiveness and resource use

The economic evidence showed that the anterior approach was cost saving compared to both the lateral and posterior approaches to total hip replacement, despite having the most expensive operating room costs. The net cost savings for the anterior approach were a result

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of reduced inpatient length of stay after the initial procedure. The quality of the evidence was very low; it was particularly notable that there was no multivariate adjustment, although there was no significant difference in key characteristics, such as BMI. The presented study also had a short follow-up (3 months) which is problematic as it may not have captured the benefits of the posterior and lateral approaches after this time.

The implant and closure costs between the different approaches will be roughly similar. The similarity in many of the costs and resource use between the approaches is shown through them all mapping to the same HRG code (HN12). However, additional resource use may be associated training surgeons to use the newer anterior approach. Most surgeons will be able to conduct lateral or posterior approaches as these make up the large majority of current practice. The anterior approach is likely to require a longer learning curve and there may be resource implications to this. The clinical review also suggested that the anterior approach may be associated with more neuropraxia at 12 weeks compared to the other approaches, there may be costs associated with treating this adverse event. Given this, the committee made a ‘consider’ recommendation for the lateral and posterior approaches.

No economic evidence was available for the SuperPath or direct superior approaches. Similarly to the anterior approach, SuperPath and direct superior are newer approaches which have not yet been fully explored in the literature. According the NJR, roughly 1/25 total hip replacements are done by anterior or SuperPath. The committee thought that there was some evidence for the short term benefits of these newer approaches, but evidence was lacking for the long term benefits and costs. Therefore a research recommendation was made addressing this.

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Appendices

Appendix A: Review protocols

Table 9: Review protocol: Hip replacement surgery

ID	Field	Content
0.	PROSPERO registration number	Not registered
1.	Review title	Surgical approaches for hip replacement surgery
2.	Review question	In adults having primary elective hip replacement, what is the most clinical and cost-effective approach: posterior, direct anterior, anterolateral, direct superior or SuperPATH?
3.	Objective	There are a number of surgical approaches for hip replacement that can be used. They vary in terms of how invasive the surgery is, the surgeon's access to and visibility of the joint, recovery period after the surgery and limitations in terms of movement and risks of adverse events during or after the surgery. Where multiple approaches are possible there is currently variation in practice and this review seeks to find the most clinically and cost effective approach where there are no contraindications.
4.	Searches	The following databases will be searched: Cochrane Central Register of Controlled Trials (CENTRAL) Cochrane Database of Systematic Reviews (CDSR) Embase MEDLINE Searches will be restricted by: English language Human studies Letters and comments are excluded. Other searches: Inclusion lists of relevant systematic reviews will be checked by the reviewer. The searches may be re-run 6 weeks before final committee meeting and further studies retrieved for inclusion if relevant.

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ID	Field	Content
		The full search strategies will be published in the final review.
5.	Condition or domain being studied	Hip replacement surgery
6.	Population	Inclusion: Adults indicated for primary total hip replacement Exclusion: Adults having joint replacement as immediate treatment following fracture. Adults having revision joint replacement. Adults having joint replacement as treatment for primary or secondary cancer affecting the bones.
7.	Intervention/Exposure/Test	Primary total hip replacement utilising the posterior approach Primary total hip replacement utilising the direct anterior approach Primary total hip replacement utilising the anterolateral approach Primary total hip replacement utilising the SuperPATH approach Primary total hip replacement utilising the direct superior approach
8.	Comparator/Reference standard/Confounding factors	Comparison between interventions
9.	Types of study to be included	Randomised controlled trials If no well conducted RCTs are available then observational studies with multivariate analysis will be investigated.
10.	Other exclusion criteria	Non-English language studies. Abstracts will be excluded as it is expected there will be sufficient full text published studies available.
11.	Context	N/A
12.	Primary outcomes (critical outcomes)	Mortality: life expectancy (dichotomous) Mortality: 30 day (dichotomous) Quality of life at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous) Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous)

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ID	Field	Content
		Revision rate of joint replacement (time to event)
13.	Secondary outcomes (important outcomes)	Deep surgical site infection (dichotomous) Superficial surgical site infection (dichotomous) Length of stay (continuous) Reoperation/dislocation rate (dichotomous) Intraoperative complications (for example nerve damage) Surgery time (continuous) To be extracted when not included within a PROM: Function at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous) Pain at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous)
14.	Data extraction (selection and coding)	EndNote will be used for reference management, sifting, citations and bibliographies. Titles and/or abstracts of studies retrieved using the search strategy and those from additional sources will be screened for inclusion. The full text of potentially eligible studies will be retrieved and will be assessed for eligibility in line with the criteria outlined above. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. An in-house developed database; EviBase, will be used for data extraction. A standardised form is followed to extract data from studies (see Developing NICE guidelines: the manual section 6.4) and for undertaking assessment of study quality. Summary evidence tables will be produced including information on: study setting; study population and participant demographics and baseline characteristics; details of the intervention and control interventions; study methodology' recruitment and missing data rates; outcomes and times of measurement; critical appraisal ratings. A second reviewer will quality assure the extracted data. Discrepancies will be identified and resolved through discussion (with a third reviewer where necessary).
15.	Risk of bias (quality) assessment	Risk of bias will be assessed using the appropriate checklist as described in Developing NICE guidelines: the manual. For Intervention reviews the following checklist will be used according to study design being assessed: Systematic reviews: Risk of Bias in Systematic Reviews (ROBIS) Randomised Controlled Trial: Cochrane RoB (2.0) Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.
16.	Strategy for data	Where possible, data will be meta-analysed. Pairwise meta-analyses will be performed using Cochrane Review Manager

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ID	Field	Content	
	synthesis	(RevMan5) to combine the data given in all studies for each of the outcomes stated above. A fixed effect meta-analysis, with weighted mean differences for continuous outcomes and risk ratios for binary outcomes will be used, and 95% confidence intervals will be calculated for each outcome. Heterogeneity between the studies in effect measures will be assessed using the I^2 statistic and visually inspected. We will consider an I^2 value greater than 50% indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented using random-effects. GRADE pro will be used to assess the quality of each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency and imprecision) will be appraised for each outcome. If the population included in an individual study includes children aged under 12, it will be included if the majority of the population is aged over 12, and downgraded for indirectness if the overlap into those aged less than 12 is greater than 20%. Publication bias is tested for when there are more than 5 studies for an outcome. Other bias will only be taken into consideration in the quality assessment if it is apparent. Where meta-analysis is not possible, data will be presented and quality assessed individually per outcome. If sufficient data is available to make a network of treatments, WinBUGS will be used for network meta-analysis.	
17.	Analysis of sub-groups	Age: Working age Non-working age	
18.	Type and method of review	☒	Intervention
		☐	Diagnostic
		☐	Prognostic
		☐	Qualitative
		☐	Epidemiologic
		☐	Service Delivery
		☐	Other (please specify)

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ID	Field	Content		
19.	Language	English		
20.	Country	England		
21.	Anticipated or actual start date	12/02/19		
22.	Anticipated completion date	31/07/19		
23.	Stage of review at time of this submission	Review stage	Started	Completed
		Preliminary searches	☐	☑
		Piloting of the study selection process	☐	☑
		Formal screening of search results against eligibility criteria	☐	☑
		Data extraction	☐	☑
		Risk of bias (quality) assessment	☐	☑
		Data analysis	☐	☑
24.	Named contact	5a. Named contact National Guideline Centre 5b Named contact e-mail 5e Organisational affiliation of the review National Institute for Health and Care Excellence (NICE) and the National Guideline Centre		
25.	Review team members	From the National Guideline Centre: Mr Carlos Sharpin [Guideline lead] Mr Alex Allen [Senior Systematic Reviewer] Ms Rafina Yarde [Systematic reviewer] Mr Robert King [Health economist] Ms Agnès Cuyàs [Information specialist]		

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ID	Field	Content	
		Ms Eleanor Priestnall [Project Manager]	
26.	Funding sources/sponsor	This systematic review is being completed by the National Guideline Centre which receives funding from NICE.	
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.	
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: [NICE guideline webpage].	
29.	Other registration details		
30.	Reference/URL for published protocol		
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: notifying registered stakeholders of publication publicising the guideline through NICE's newsletter and alerts issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.	
32.	Keywords	hip replacement surgery, approach, hip arthroplasty.	
33.	Details of existing review of same topic by same authors	N/A	
34.	Current review status	☐	Ongoing
		☒	Completed but not published
		☐	Completed and published
		☐	Completed, published and being updated

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ID	Field	Content	
		☐	Discontinued
35..	Additional information	N/A	
36.	Details of final publication	www.nice.org.uk	

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Table 10: Health economic review protocol

Review question	All questions – health economic evidence
Objectives	To identify health economic studies relevant to any of the review questions.
Search criteria	• Populations, interventions and comparators must be as specified in the clinical review protocol above. • Studies must be of a relevant health economic study design (cost–utility analysis, cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis). • Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.) • Unpublished reports will not be considered unless submitted as part of a call for evidence. • Studies must be in English.
Search strategy	A health economic study search will be undertaken using population-specific terms and a health economic study filter – see appendix B below.
Review strategy	Studies not meeting any of the search criteria above will be excluded. Studies published before 2003, abstract-only studies and studies from low or middle-income countries (e.g. most non-OECD countries) or the USA will also be excluded. Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual (2014).[72] **Inclusion and exclusion criteria** • If a study is rated as both 'Directly applicable' and with 'Minor limitations' then it will be included in the guideline. A health economic evidence table will be completed and it will be included in the health economic evidence profile. • If a study is rated as either 'Not applicable' or with 'Very serious limitations' then it will usually be excluded from the guideline. If it is excluded then a health economic evidence table will not be completed and it will not be included in the health economic evidence profile. • If a study is rated as 'Partially applicable', with 'Potentially serious limitations' or both then there is discretion over whether it should be included. **Where there is discretion** The health economist will make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to selectively exclude the remaining studies. All studies excluded on the basis of applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below. The health economist will be guided by the following hierarchies. *Setting:* • UK NHS (most applicable). • OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden). • OECD countries with predominantly private health insurance systems (for example,

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	Switzerland). • Studies set in non-OECD countries or in the USA will be excluded before being assessed for applicability and methodological limitations. *Health economic study type:* • Cost–utility analysis (most applicable). • Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis). • Comparative cost analysis. • Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations. *Year of analysis:* • The more recent the study, the more applicable it will be. • Studies published in 2003 or later but that depend on unit costs and resource data entirely or predominantly from before 2003 will be rated as 'Not applicable'. • Studies published before 2003 will be excluded before being assessed for applicability and methodological limitations. *Quality and relevance of effectiveness data used in the health economic analysis:* • The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review the more useful the analysis will be for decision-making in the guideline.

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Appendix B: Literature search strategies

The literature searches for this review are detailed below and complied with the methodology outlined in Developing NICE guidelines: the manual 2014.[72]

For more detailed information, please see the Methodology Review.

B.1 Clinical search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies for interventions as these concepts may not be well described in title, abstract or indexes and therefore difficult to retrieve. Search filters were applied to the searches where appropriate.

Table 11: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline (OVID)	1946 – 01 May 2019	Exclusions Randomised controlled trials Systematic review studies Observational studies
Embase (OVID)	1974 – 01 May 2019	Exclusions Randomised controlled trials Systematic review studies Observational studies
The Cochrane Library (Wiley)	Cochrane Reviews to 2019 Issue 5 of 12 CENTRAL to 2019 Issue 5 of 12	None

Medline (Ovid) search terms

1.	Arthroplasty, Replacement, Hip/
2.	Hip Prosthesis/
3.	((joint* or hip*) adj3 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)).ti,ab.
4.	1 or 3
5.	letter/
6.	editorial/
7.	news/
8.	exp historical article/
9.	Anecdotes as Topic/
10.	comment/
11.	case report/
12.	(letter or comment*).ti.
13.	or/5-12
14.	randomized controlled trial/ or random*.ti,ab.
15.	13 not 14
16.	animals/ not humans/
17.	exp Animals, Laboratory/

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18.	exp Animal Experimentation/
19.	exp Models, Animal/
20.	exp Rodentia/
21.	(rat or rats or mouse or mice).ti.
22.	or/15-21
23.	4 not 22
24.	limit 23 to English language
25.	((surgery or surgical or hip) adj4 approach*).ti,ab.
26.	(direct adj2 (anterior or superior)).ti,ab.
27.	(smithpeters?n or smith-peters?n).ti,ab.
28.	(anterolateral* or watson-jones).ti,ab.
29.	(posterior or moore or southern).ti,ab.
30.	(supercapsular or percutaneously or superpath or path).ti,ab.
31.	or/25-30
32.	24 and 31
33.	randomized controlled trial.pt.
34.	controlled clinical trial.pt.
35.	randomi#ed.ti,ab.
36.	placebo.ab.
37.	randomly.ti,ab.
38.	Clinical Trials as topic.sh.
39.	trial.ti.
40.	or/33-39
41.	Meta-Analysis/
42.	exp Meta-Analysis as Topic/
43.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
44.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
45.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
46.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
47.	(search* adj4 literature).ab.
48.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
49.	cochrane.jw.
50.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
51.	or/41-50
52.	Epidemiologic studies/
53.	Observational study/
54.	exp Cohort studies/
55.	(cohort adj (study or studies or analys* or data)).ti,ab.
56.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
57.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
58.	Controlled Before-After Studies/
59.	Historically Controlled Study/

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60.	Interrupted Time Series Analysis/
61.	(before adj2 after adj2 (study or studies or data)).ti,ab.
62.	or/53-62
63.	exp case control study/
64.	case control*.ti,ab.
65.	or/64-65
66.	63 or 66
67.	Cross-sectional studies/
68.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
69.	or/68-69
70.	63 or 70
71.	63 or 66 or 70
72.	32 and (40 or 51 or 71)

Embase (Ovid) search terms

1.	hip replacement/ or hip arthroplasty/
2.	Hip Prosthesis/
3.	((joint* or hip*) adj3 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)).ti,ab.
4.	or/1-3
5.	letter.pt. or letter/
6.	note.pt.
7.	editorial.pt.
8.	case report/ or case study/
9.	(letter or comment*).ti.
10.	or/5-9
11.	randomized controlled trial/ or random*.ti,ab.
12.	10 not 11
13.	animal/ not human/
14.	nonhuman/
15.	exp Animal Experiment/
16.	exp Experimental Animal/
17.	animal model/
18.	exp Rodent/
19.	(rat or rats or mouse or mice).ti.
20.	or/12-19
21.	4 not 20
22.	limit 21 to English language
23.	((surgery or surgical or hip) adj4 approach*).ti,ab.
24.	(direct adj2 (anterior or superior)).ti,ab.
25.	(smithpeters?n or smith-peters?n).ti,ab.
26.	(anterolateral* or watson-jones).ti,ab.
27.	(posterior or moore or southern).ti,ab.
28.	(supercapsular or percutaneously or superpath or path).ti,ab.
29.	or/23-28

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30.	22 and 29
31.	random*.ti,ab.
32.	factorial*.ti,ab.
33.	(crossover* or cross over*).ti,ab.
34.	((doubl* or singl*) adj blind*).ti,ab.
35.	(assign* or allocat* or volunteer* or placebo*).ti,ab.
36.	crossover procedure/
37.	single blind procedure/
38.	randomized controlled trial/
39.	double blind procedure/
40.	or/31-39
41.	systematic review/
42.	meta-analysis/
43.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
44.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
45.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
46.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
47.	(search* adj4 literature).ab.
48.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
49.	cochrane.jw.
50.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
51.	or/41-50
52.	Clinical study/
53.	Observational study/
54.	family study/
55.	longitudinal study/
56.	retrospective study/
57.	prospective study/
58.	cohort analysis/
59.	follow-up/
60.	cohort*.ti,ab.
61.	60 and 61
62.	(cohort adj (study or studies or analys* or data)).ti,ab.
63.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
64.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
65.	(before adj2 after adj2 (study or studies or data)).ti,ab.
66.	or/53-59,62-66
67.	exp case control study/
68.	case control*.ti,ab.
69.	or/68-69
70.	67 or 70
71.	cross-sectional study/

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72.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
73.	or/72-73
74.	67 or 74
75.	67 or 70 or 74
76.	30 and (40 or 51 or 75)

Cochrane Library (Wiley) search terms

#1.	MeSH descriptor: [Arthroplasty, Replacement, Hip] this term only
#2.	MeSH descriptor: [Hip Prosthesis] this term only
#3.	((joint* or hip*) near/3 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)):ti,ab
#4.	(OR #1-#3)
#5.	((surgery or surgical or hip) near/4 approach*):ti,ab
#6.	(direct near/2 (anterior or superior)):ti,ab
#7.	(smithpetersen or smithpeterson or smith-petersen or smith-peterson):ti,ab
#8.	(anterolateral* or watson-jones):ti,ab
#9.	(posterior or moore or southern):ti,ab
#10.	(supercapsular or percutaneously or superpath or path):ti,ab
#11.	(OR #5-#10)
#12.	#4 AND #11

B.2 Health Economics literature search strategy

Health economic evidence was identified by conducting a broad search relating to joint replacement population in NHS Economic Evaluation Database (NHS EED – this ceased to be updated after March 2015) and the Health Technology Assessment database (HTA) with no date restrictions. NHS EED and HTA databases are hosted by the Centre for Research and Dissemination (CRD). Additional health economics searches were run on Medline and Embase.

Table 12: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline	2014 – 01 May 2019	Exclusions Health economics studies
Embase	2014 – 01 May 2019	Exclusions Health economics studies
Centre for Research and Dissemination (CRD)	HTA - Inception – 01 May 2019 NHSEED - Inception to March 2015	None

Medline (Ovid) search terms

1.	arthroplasty/ or arthroplasty, replacement/ or arthroplasty, replacement, hip/ or arthroplasty, replacement, knee/ or arthroplasty, replacement, shoulder/ or hemiarthroplasty/
2.	joint prosthesis/ or hip prosthesis/ or knee prosthesis/ or shoulder prosthesis/
3.	((joint* or knee* or shoulder* or hip*) adj5 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)).ti,ab.
4.	or/1-3
5.	letter/

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6.	editorial/
7.	news/
8.	exp historical article/
9.	Anecdotes as Topic/
10.	comment/
11.	case report/
12.	(letter or comment*).ti.
13.	or/5-12
14.	randomized controlled trial/ or random*.ti,ab.
15.	13 not 14
16.	animals/ not humans/
17.	exp Animals, Laboratory/
18.	exp Animal Experimentation/
19.	exp Models, Animal/
20.	exp Rodentia/
21.	(rat or rats or mouse or mice).ti.
22.	or/15-21
23.	4 not 22
24.	limit 23 to English language
25.	Economics/
26.	Value of life/
27.	exp "Costs and Cost Analysis"/
28.	exp Economics, Hospital/
29.	exp Economics, Medical/
30.	Economics, Nursing/
31.	Economics, Pharmaceutical/
32.	exp "Fees and Charges"/
33.	exp Budgets/
34.	budget*.ti,ab.
35.	cost*.ti.
36.	(economic* or pharmaco?economic*).ti.
37.	(price* or pricing*).ti,ab.
38.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
39.	(financ* or fee or fees).ti,ab.
40.	(value adj2 (money or monetary)).ti,ab.
41.	or/25-40
42.	24 and 41

Embase (Ovid) search terms

1.	*arthroplasty/ or *replacement arthroplasty/ or *hip replacement/ or *knee replacement/ or *shoulder replacement/ or *hemiarthroplasty/
2.	*joint prosthesis/ or *hip prosthesis/ or *knee prosthesis/ or *shoulder prosthesis/
3.	((joint* or knee* or shoulder* or hip*) adj5 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)).ti,ab.

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4.	or/1-3
5.	letter.pt. or letter/
6.	note.pt.
7.	editorial.pt.
8.	case report/ or case study/
9.	(letter or comment*).ti.
10.	or/5-9
11.	randomized controlled trial/ or random*.ti,ab.
12.	10 not 11
13.	animal/ not human/
14.	nonhuman/
15.	exp Animal Experiment/
16.	exp Experimental Animal/
17.	animal model/
18.	exp Rodent/
19.	(rat or rats or mouse or mice).ti.
20.	or/12-19
21.	4 not 20
22.	limit 21 to English language
23.	health economics/
24.	exp economic evaluation/
25.	exp health care cost/
26.	exp fee/
27.	budget/
28.	funding/
29.	budget*.ti,ab.
30.	cost*.ti.
31.	(economic* or pharmaco?economic*).ti.
32.	(price* or pricing*).ti,ab.
33.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
34.	(financ* or fee or fees).ti,ab.
35.	(value adj2 (money or monetary)).ti,ab.
36.	or/23-35
37.	22 and 36

NHS EED and HTA (CRD) search terms

#1.	MeSH DESCRIPTOR arthroplasty
#2.	MeSH DESCRIPTOR arthroplasty, replacement
#3.	MeSH DESCRIPTOR arthroplasty, replacement, hip
#4.	MeSH DESCRIPTOR arthroplasty, replacement, knee
#5.	MeSH DESCRIPTOR arthroplasty, replacement, shoulder

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#6.	MeSH DESCRIPTOR hemiarthroplasty
#7.	MeSH DESCRIPTOR joint prosthesis
#8.	MeSH DESCRIPTOR hip prosthesis
#9.	MeSH DESCRIPTOR knee prosthesis
#10.	MeSH DESCRIPTOR shoulder prosthesis
#11.	(((joint* or knee* or shoulder* or hip*) adj5 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)))
#12.	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11) IN NHSEED
#13.	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11) IN HTA

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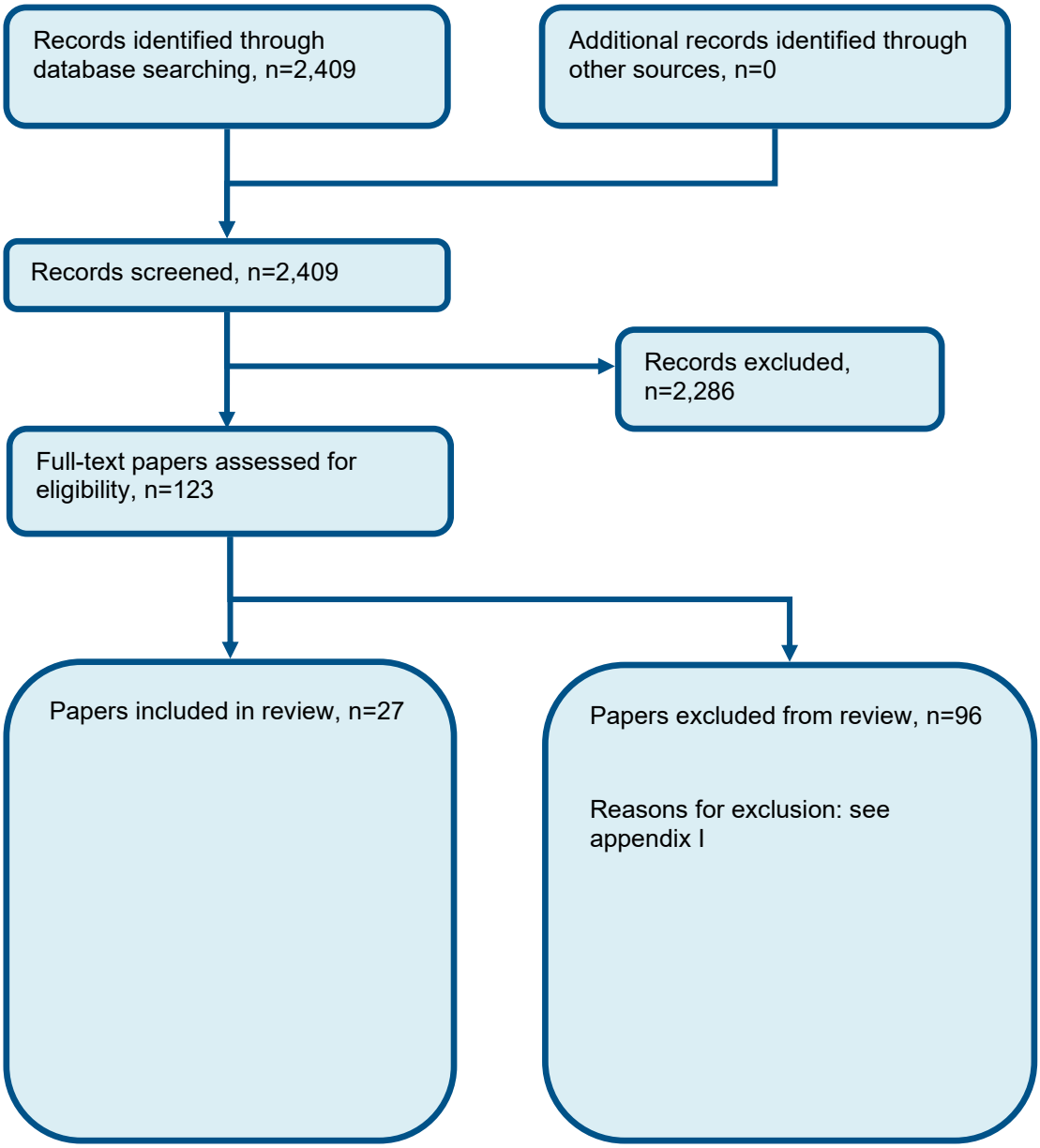
Appendix C: Clinical evidence selection

Figure 1: Flow chart of clinical study selection for the review of hip replacement



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Appendix D: Clinical evidence tables

Study (subsidiary papers)	Barrett 2013[2] (Barrett 2019[3])
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=87)
Countries and setting	Conducted in USA
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 month follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients were to require a non-cemented, primary (THA) total hip arthroplasty for non-inflammatory degenerative joint disease.
Exclusion criteria	N/A
Age, gender and ethnicity	Age - Mean (SD): DA - 61.4 (9.2), PA - 63.2 (7.7) . Gender (M:F): 48 male, 39 female . Ethnicity: N/A
Further population details	1. Age: Working age (study defined)
Indirectness of population	No indirectness
Interventions	(n=43) Intervention 1: Direct anterior approach. Direct anterior approach - Utilises a modern fracture table with the patient placed supine, both feet in boots for proper positioning. An anterior skin incision, 10 - 14cm long, is used. An inter-muscular plane is utilised to access the anterior hip capsule. The hip capsule is opened anteriorly, a femoral neck osteotomy is performed based on pre-operative templating, and the femoral head removed. Acetabular retractors are placed and reaming of the acetabulum commenced. This is done under direct visualisation with C-arm confirmation for positioning. The femoral side is then visualised with the aid of the fracture table. A hydraulic trochanteric hook elevates the proximal femur. Broaching of the femoral canal is started and proceeds up to the appropriate size. A trial reduction is performed and the length and offset are checked manually and with C-arm confirmation. The trial components are removed and the prostheses are placed with press-fit fixation. Routine closure is performed. . Duration N/A. Concurrent medication/care: Standard pre-operative and post operative treatment protocols, including multimodal pain and management and rapid rehabilitation, were utilised for all subjects. . Indirectness: No indirectness

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Study (subsidiary papers)	Barrett 2013[2] (Barrett 2019[3])
	(n=44) Intervention 2: Posterior approach. Posterolateral approach - Uses a standard OR table with the patient placed in the lateral decubitus position. A 10-14cm skin incision is utilised over the posterior-lateral corner of the hip. The gluteus maximus muscle is split in line with its fibers and the short external rotators and psoterior capsule are opened. The hip is dislocated posteriorly and a femoral neck osteotomy is performed. The acetabular and femoral components are inserted in the same manner as is done with the DAA with press fit fixation utilised. The PA is well described in all major texts on orthopedic surgery. . Duration N/A. Concurrent medication/care: Standard pre-operative and post operative treatment protocols, including multimodal pain and management and rapid rehabilitation, were utilised for all subjects. . Indirectness: No indirectness
Funding	Funding not stated

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH

Protocol outcome 1: Quality of life at later than 2 years
- Actual outcome: SF-36 scale at 3 years at 3 years ; Group 1: mean 10 (SD 7.5); n=40, Group 2: mean 11 (SD 6.5); n=44
Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 2: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: Harris Hip Score at 6 weeks at 6 weeks ; Group 1: mean 89.5 (SD 8.1); n=43, Group 2: mean 81.4 (SD 9.8); n=44
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0
- Actual outcome: Hip disability and arthritis outcome score (HOOS) - symptoms at 6 weeks at 6 weeks ; Group 1: mean 79.4 (SD 12.3); n=43, Group 2: mean 79.9 (SD 11.6); n=44
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0
- Actual outcome: Hip disability and arthritis outcome score (HOOS) - quality of life at 6 weeks at 6 weeks; Group 1: mean 62.6 (SD 19.8); n=43, Group 2: mean 54.7 (SD 20.5); n=44
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 3: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: Harris Hip Score at 12 months at 12 months; Group 1: mean 97.5 (SD 5.7); n=43, Group 2: mean 97.3 (SD 5.5); n=44
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low,

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Study (subsidiary papers)	Barrett 2013[2] (Barrett 2019[3])
Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Hip disability and arthritis outcome score (HOOS) - symptoms at 12 months at 12 months ; Group 1: mean 92.9 (SD 13.2); n=43, Group 2: mean 92.1 (SD 8.7); n=44 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Hip disability and arthritis outcome score (HOOS) - quality of life at 12 months at 12 months; Group 1: mean 81.3 (SD 21.8); n=43, Group 2: mean 85.3 (SD 17.5); n=44 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 4: Patient Reported Outcome Measures (PROMs) at later than 2 years - Actual outcome: Harris Hip Score at 5 years at 5 years ; Group 1: mean 96.9 (SD 8.44); n=39, Group 2: mean 97.1 (SD 9.95); n=40 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: DAA - 56.7 - 10.42 PA - 53.8 - 10.19 ; Group 1 Number missing: 3, Reason: death unrelated to procedure, lost after 1 year follow up ; Group 2 Number missing: 3, Reason: death unrelated to procedure, lost after 1 year follow up - Actual outcome: UCLA Activity Score at 5 years at 5 years ; Group 1: mean 6.33 (SD 1.639); n=36, Group 2: mean 6.26 (SD 1.888); n=39 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: death unrelated to procedure, lost after 1 year follow up ; Group 2 Number missing: 3, Reason: death unrelated to procedure, lost after 1 year follow up - Actual outcome: Hip disability and arthritis outcome score (HOOS) at 6.2 years at 6.2 years ; Group 1: mean 95.7 (SD 7.7); n=39, Group 2: mean 92.9 (SD 14.1); n=39 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: death unrelated to procedure, lost to follow up; Group 2 Number missing: 3, Reason: death unrelated to procedure, lost to follow up Protocol outcome 5: Revision rate of of joint replacement at time to event - Actual outcome: Revisions at 12 months; Group 1: 0/43, Group 2: 1/44 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 6: Length of stay at in hospital - Actual outcome: Length of stay (days) at N/A; MD; 0.74, Units: SE- 0.350027, Comments: Mean DA - 2.28 PA - 3.02; Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0	

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Study (subsidiary papers)	Barrett 2013[2] (Barrett 2019[3])
Protocol outcome 7: Reoperation/dislocation rate at N/A - Actual outcome: Dislocations at 12 months; Group 1: 0/43, Group 2: 1/44 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 8: Surgery time at N/A - Actual outcome: Surgery time (mins) at N/A; Group 1: mean 84.3 (SD 12.4); n=43, Group 2: mean 60.5 (SD 12.4); n=44 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Intraoperative complications (for example nerve damage) at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Brismar 2018[9]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=100)
Countries and setting	Conducted in Sweden; Setting: The study was conducted at the orthopaedic department, Karolinska University Hospital, Sweden.
Line of therapy	1st line
Duration of study	Follow up (post intervention): 5 years
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients with hip osteoarthritis referred for hip arthroplasty were, after consent, informed and asked for participation in the study.
Exclusion criteria	Exclusion criteria were dementia, neuromuscular disorders, alcohol/drug abuse, and previous hip surgery on the affected side.
Age, gender and ethnicity	Age - Median (IQR): DA - 66 (58 to 74), DL - 67 (60 to 76). Gender (M:F): 65 female, 35 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=50) Intervention 1: Direct anterior approach. Direct anterior approach - was carried out with the patient supine on a standard operating table allowing angulation at the level of the hip. The skin was incised at a point 2 finger breadths lateral to the anterior sciatic spine and extended 8–10 cm distally. The tensor fascia lata and gluteus medius muscles were retracted laterally and the sartorius and rectus muscles medially exposing the capsule. A special offset acetabular reamer and an offset broach handle were used.. Duration N/A. Concurrent medication/care: All patients had uncemented implants. 92 patients received spinal anaesthesia (47 DA and 45 DL) and 8 general anaesthesia (3 DA and 5 DL). 2 surgeons performed all procedures. All patients were treated postoperatively according to the same pain management protocol including a regular long-acting morphine analog the first day (oxycodone 10 mg 2 times daily), regular paracetamol (1 g 4 times daily) and short-duration morphine (oxycodone or morphine) on demand. The long-acting dose was adjusted with regard to the previous day's morphine consumption. The total sum of equipotent doses of oral morphine consumed 3 days postoperatively was estimated (10 mg oral oxycodone = 20 mg oral morphine, 10 mg iv morphine = 30 mg oral morphine). Patients were asked to keep track of how many days after discharge from hospital they continued to use morphine.. Indirectness: No indirectness

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	(n=50) Intervention 2: Anterolateral approach. Direct lateral approach - This was performed with the patient in a lateral decubitus position. Access to the joint was gained through a 10–20 cm long skin incision centered over the greater trochanter, splitting the fascia lata/gluteus maximus and detachment of the caudal 2/3 of the gluteus medius and the entire gluteus minimus tendon insertions. Finally, the capsule was excised anteriorly. The muscle tendons were reattached to the trochanter by osteosuture's following implantation.. Duration N/A. Concurrent medication/care: All patients had uncemented implants. 92 patients received spinal anaesthesia (47 DA and 45 DL) and 8 general anaesthesia (3 DA and 5 DL). 2 surgeons performed all procedures. All patients were treated postoperatively according to the same pain management protocol including a regular long-acting morphine analog the first day (oxycodone 10 mg 2 times daily), regular paracetamol (1 g 4 times daily) and short-duration morphine (oxycodone or morphine) on demand. The long-acting dose was adjusted with regard to the previous day's morphine consumption. The total sum of equipotent doses of oral morphine consumed 3 days postoperatively was estimated (10 mg oral oxycodone = 20 mg oral morphine, 10 mg iv morphine = 30 mg oral morphine). Patients were asked to keep track of how many days after discharge from hospital they continued to use morphine.. Indirectness: No indirectness
Funding	Study funded by industry (Stryker unconditionally sponsored the study.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus ANTEROLATERAL APPROACH

Protocol outcome 1: Revision rate of of joint replacement at time to event
- Actual outcome: Revision at 5 years; Group 1: 1/45, Group 2: 0/42; Comments: this patient also had a dislocation and so is included in that outcome too
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions

Protocol outcome 2: Deep surgical site Infection at before JR is revised
- Actual outcome: Deep infection at 5 years; Group 1: 1/45, Group 2: 0/42
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions

Protocol outcome 3: Reoperation/dislocation rate at N/A
- Actual outcome: Dislocation at 5 years; Group 1: 4/45, Group 2: 0/42
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions

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	Protocol outcome 4: Intraoperative complications (for example nerve damage) at before JR is revised - Actual outcome: DVT at 3 months; Group 1: 1/50, Group 2: 1/49 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions - Actual outcome: Hyperesthesia at 5 years; Group 1: 0/45, Group 2: 1/42; Comments: hyperesthesia from the femoral cutaneous nerve of the opposite, un operated leg, probably originating from pressure from the table support during surgery. Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions Protocol outcome 5: Pain at later than 6 weeks up to 1 year - Actual outcome: Pain >30 measured by VAS - at rest at 8 weeks; Group 1: 3/50, Group 2: 3/49; Comments: high is bad Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions - Actual outcome: Pain >30 measured by VAS - during activity at 8 weeks; Group 1: 3/50, Group 2: 6/49 Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions Protocol outcome 6: Pain at later than 2 years - Actual outcome: Pain >30 measured by VAS - at rest at 5 years; Group 1: 1/45, Group 2: 1/42 Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions - Actual outcome: Pain >30 measured by VAS - during activity at 5 years; Group 1: 2/45, Group 2: 2/42 Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died, revised, declined FU, unable to answer questions; Group 2 Number missing: 9, Reason: missed FU, died, declined FU, unable to answer questions
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6

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weeks or earlier

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Study	Catma 2017[10]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=68)
Countries and setting	Conducted in Turkey
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	All patients underwent THR surgery due to the Crowe type 4 developmental dysplasia of hip DDH.
Exclusion criteria	Not stated
Age, gender and ethnicity	Age - Mean (SD): 51.1 (9.4). Gender (M:F): 61 female, 7 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=34) Intervention 1: Posterior approach. Posterior approach - In group I, the posterior approach was familiar with modification of the Gibson–Moore approach. After a posterior curve skin incision, external rotator muscles and tendons were revealed and hanged with a suture. Elongated joint capsule was exposed and femoral head was revealed with external rotation of the femur.. Duration N/A. Concurrent medication/care: All the surgical procedures were done under general anaesthesia. Distal split and proximal HA-coated femoral stem were used for all patients. Based on their toleration level, all patients were allowed weight bearing the day after surgery with two crutches. Patients were discharged after tolerating mobilization within few days of surgery.. Indirectness: No indirectness (n=34) Intervention 2: Anterolateral approach. Anterolateral approach - after an anterolateral incision, the space between tensor fascia and gluteus medius muscles was used to reach joint capsule and femoral head. Femoral head was removed and femur was reamed in each group. Femur was rasped with proper size. A transverse osteotomy 1–2 cm distal to the minor trochanter was applied and proximal part of the femur was retracted, by following the prolonged joint capsule the real acetabulum was identified. Hydroxyapatite (HA)-coated cementless acetabular cup placed with 10–20 degrees of anteversion and 35–45 degrees of inclination after reaming the real acetabulum. Amount of shortening was determined by moving the proximal part of the femur distally and overlapping part of distal femur was osteotomied. The osteotomied part was used as a strut bone graft by splitting into two parts and fixing over the osteotomied

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	site with cables.. Duration N/A. Concurrent medication/care: All the surgical procedures were done under general anaesthesia. Distal split and proximal HA-coated femoral stem were used for all patients. Based on their toleration level, all patients were allowed weight bearing the day after surgery with two crutches. Patients were discharged after tolerating mobilization within few days of surgery.. Indirectness: No indirectness
Funding	No funding (The author(s) received no financial support for the research, authorship and/or publication of this article.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: POSTERIOR APPROACH versus ANTEROLATERAL APPROACH

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: PROMs (Harris hip score) - at 6 months at 6 months; Group 1: mean 82.7 (SD 7.7); n=34, Group 2: mean 81.1 (SD 5.7); n=34
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 2: Reoperation/dislocation rate at N/A
- Actual outcome: Dislocations at 6 months; Group 1: 2/34, Group 2: 3/34
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0
- Actual outcome: Reoperation at 6 months; Group 1: 1/34, Group 2: 0/34; Comments: also had a dislocation
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 3: Surgery time at N/A
- Actual outcome: Operation time (minutes) at N/A; Group 1: mean 98.1 (SD 13.1); n=34, Group 2: mean 96.4 (SD 15.1); n=34
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Intraoperative complications (for example nerve damage) at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Cheng 2017[12]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=73)
Countries and setting	Conducted in Australia; Setting:
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 weeks follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	The inclusion criteria for the study were unilateral symptomatic hip osteoarthritis, Dorr's femur classification A/B, American Society of Anesthesiologists (ASA) score 3 or less, a body mass index (BMI) less than 35 kg/m², and age between 40 to 75 years.
Exclusion criteria	Participants were excluded if they had Dorr's femur classification C, previous hip surgery (excluding arthroscopy), anticipated complex primary THA, previous joint arthroplasty, were unwilling to accept randomisation and blinding, or had severe pathology that would affect postoperative participation such as neurologic, psychiatric, or other confounding pre-existing musculoskeletal disorders.
Recruitment/selection of patients	Recruited from the health service's outpatient clinic and elective surgical waiting list.
Age, gender and ethnicity	Age - Median (IQR): Anterior group - 59 (54 to 69), posterior - 62.5 (55 to 69). Gender (M:F): 33 male, 40 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=37) Intervention 1: Direct anterior approach. Direct anterior approach - The anterior incision begins 3 cm posterior and distal to the anterior superior iliac spine, extending distally approximately 10cm over the tensor fascia lata. Heuter's interval was then identified and developed to gain access to the hip joint. A capsulotomy and femoral neck osteotomy was performed. This was followed by the retrieval of the femoral head and repositioning of retractors to expose the acetabulum. Sequential reaming and acetabular component implantation was conducted and verified under fluoroscopy. Femoral preparation was undertaken with the leg extended externally rotated, and adducted. A superior capsulotomy was performed to aid in femoral exposure. Femoral broaching and trials were performed with fluoroscopic assistance. Definitive implantation of the remaining prosthesis was undertaken with rotation capsular and wound closure. . Duration N/A. Concurrent medication/care: Similar intraoperative local infiltration anesthetic protocols were utilised in both DAA and PA groups based on a modification of Kerr's technique. A concoction of 0.2% ropivocaine with 30

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	mg ketorolac and 1% adrenaline was used. Ketorolac was not used in patients with evidence of renal impairment. Continuous infusion pumps were employed on the ward up to 24 hours postoperatively. All participants received prophylactic antibiotics in accordance with the health service's protocols. All patients were mobilized the day after surgery. Routine hip precautions (avoidance of combined hip flexion >90• and internal rotation past the neutral plane) were instituted for the PA group. The DAA group did not have restrictions to hip movement. The target day of discharge for home or transfer to rehabilitation was the third postoperative day. This was assessed daily by physiotherapists and physicians supporting the orthopedic team. Patients not meeting the discharge requirements were transferred to a rehabilitation facility. . Indirectness: No indirectness (n=38) Intervention 2: Posterior approach. Posterior approach - surgery was performed with the patient adopting a lateral position on a standard surgical table. The curvilinear incision 10 to 15 cm long centers over the posterior third of the greater trochanter. Dissection through the fascia in line with the fibers of the gluteus maximus was conducted to reach the short external rotators. With the piriformis muscle identified, the short external rotators and hip capsule were tagged and reflected. Subsequent hip joint dislocation was followed by a femoral neck osteotomy at the templated level. Acetabular and femoral preparations were then performed in a routine manner. Definitive implants were trialed and inserted under direct vision. An enhanced intraosseous short rotator and capsular repair was performed for all cases. . Duration N/A. Concurrent medication/care: Similar intraoperative local infiltration anesthetic protocols were utilised in both DAA and PA groups based on a modification of Kerr's technique. A concoction of 0.2% ropivocaine with 30 mg ketorolac and 1% adrenaline was used. Ketorolac was not used in patients with evidence of renal impairment. Continuous infusion pumps were employed on the ward up to 24 hours postoperatively. All participants received prophylactic antibiotics in accordance with the health service's protocols. All patients were mobilized the day after surgery. Routine hip precautions (avoidance of combined hip flexion >90• and internal rotation past the neutral plane) were instituted for the PA group. The DAA group did not have restrictions to hip movement. The target day of discharge for home or transfer to rehabilitation was the third postoperative day. This was assessed daily by physiotherapists and physicians supporting the orthopedic team. Patients not meeting the discharge requirements were transferred to a rehabilitation facility. . Indirectness: No indirectness
Funding	Other (The authors also acknowledge the generous donations from the Bulley Fellowship and Box Hill Golf Club for this research.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH

Protocol outcome 1: Quality of life at 6 weeks or earlier
- Actual outcome: EQ-5D - 2 weeks at 2 weeks; Group 1: mean 0.6 (SD 0.24); n=35, Group 2: mean 0.5 (SD 0.25); n=38
Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low,

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Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture

Protocol outcome 2: Quality of life at later than 6 weeks up to 1 year
- Actual outcome: EQ-5D - 12 weeks at 12 weeks; Group 1: mean 0.9 (SD 0.12); n=35, Group 2: mean 0.9 (SD 0.12); n=38
Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture

Protocol outcome 3: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: WOMAC total score - 2 weeks at 2 weeks; Group 1: mean 40.3 (SD 18.31); n=35, Group 2: mean 44.5 (SD 17.82); n=38
Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture
- Actual outcome: OHS score - 2 weeks at 2 weeks; Group 1: mean 28.5 (SD 9.49); n=35, Group 2: mean 26.8 (SD 9.25); n=38
Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture

Protocol outcome 4: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: WOMAC total score - 12 weeks at 12 weeks; Group 1: mean 9.1 (SD 12.47); n=35, Group 2: mean 12.8 (SD 12.27); n=38
Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture
- Actual outcome: OHS score - 12 weeks at 12 weeks; Group 1: mean 43.8 (SD 5.29); n=35, Group 2: mean 42.8 (SD 5.18); n=38
Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture

Protocol outcome 5: Revision rate of of joint replacement at time to event
- Actual outcome: Revisions at 12 weeks; Group 1: 1/35, Group 2: 1/38
Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture

Protocol outcome 6: Reoperation/dislocation rate at N/A
- Actual outcome: Dislocations at 12 weeks; Group 1: 1/35, Group 2: 1/38
Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low,

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Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture Protocol outcome 7: Intraoperative complications (for example nerve damage) at before JR is revised - Actual outcome: Lateral cutaneous nerve of the thigh neuropraxia at 12 weeks; Group 1: 29/35, Group 2: 0/38 Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: excluded due to emergency requiring cessation of surgery and equipment failure requiring conversion to PA; Group 2 Number missing: 1, Reason: required a revision due to fracture	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Christensen 2015[13]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=56)
Countries and setting	Conducted in USA
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 weeks follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	N/A
Exclusion criteria	Patients were excluded if they were <18 or >85 years of age, had been diagnosed with inflammatory or rheumatoid arthritis, had a BMI >40kg/m², or had previously undergone any prior ipsilateral hip surgery including arthroscopic procedures. Furthermore, patients were excluded if they demonstrated characteristics that led the surgeon to believe the patient would clearly benefit from one particular technique over the other.
Age, gender and ethnicity	Age - Mean (SD): DAA - 64.3 (9.1), PA - 65.2 (9.1). Gender (M:F): 24 male, 27 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=32) Intervention 1: Direct anterior approach. Direct anterior approach - No further details given. Patients were not given any postoperative restrictions. . Duration N/A. Concurrent medication/care: Regardless of approach, general anaesthesia was used in conjunction with a peri-articular injection. All procedures were performed with a short tapered wedge shaped femoral component. All patients received a porous-coated hemispherical titanium acetabular component. (n=24) Intervention 2: Posterior approach. Posterior approach - No further details given. Patients were given standard postoperative precautions to prevent dislocations. . Duration N/A. Concurrent medication/care: Regardless of approach, general anaesthesia was used in conjunction with a peri-articular injection. All procedures were performed with a short tapered wedge shaped femoral component. All patients received a porous-coated hemispherical titanium acetabular component. . Indirectness: No indirectness
Funding	Other author(s) funded by industry (One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either indirect or direct, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict

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	of interest with this work.)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH Protocol outcome 1: Length of stay at in hospital - Actual outcome: Length of stay (days) at N/A; Group 1: mean 1.4 (SD 0.6); n=28, Group 2: mean 2 (SD 1.1); n=23 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: removed due to complications, did not complete follow up ; Group 2 Number missing: 1, Reason: chose not to participate	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

Study	**D'arrigo 2009[15]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=169)
Countries and setting	Conducted in Italy
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 weeks
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable:
Inclusion criteria	Inclusion criteria to enter the study group (groups A–C) were: body mass index (BMI)≤30, diagnosis of primary osteoarthritis, age ≤75 years.

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Exclusion criteria	Exclusion criteria were: BMI≥30, fractures, tumours, severe deformities, rheumatoid arthritis, age ≥75 years.
Age, gender and ethnicity	Age - Mean (SD): Group A - 66.3 (10.4), B - 64 (8), C - 66 (7.5) . Gender (M:F): 37 male, 23 female. Ethnicity: N/A
Further population details	1. Age:
Extra comments	Group A - modified Hardinge approach, Group B - anterior, Group C - anterolateral, Group D - lateral direct Hardinge approach (control group)
Indirectness of population	No indirectness
Interventions	(n=20) Intervention 1: Direct anterior approach. Anterior tissue sparing surgery (TSS) approach - An anterior TSS approach utilising the interval between the tensor fasciae latae, gluteus medius and minimus muscle laterally and the sartorius and rectus femoris muscle medially, was used. . Duration N/A. Concurrent medication/care: All patients in groups A, B and C had a diagnosis of primary osteoarthritis. In group D the diagnosis was of primary osteoarthritis in 140 patients and of femoral head osteonecrosis in nine patients. In all cases a specialized dedicated surgical instrumentation was used. An epidural anaesthesia was used in all cases. All patients received the same standardised post-operative care. Mechanical foot pumps and pharmacological antithrombotic prophylaxis were used. Patients received antibiotics for 24 h post-operation. The drain was pulled on the first postoperative day by the resident on rounds the morning after surgery. No specific protocol was used to measure drain output. All patients received patient control epidural anaesthesia (PCEA) for initial pain control. Patients were switched to oral narcotics on the 2nd or 3rd post-operative day. The major goals of therapy were to enable patients to independently transfer, walk with a walker and negotiate stairs. The same physical therapist supervised the care of all patients. Physical therapy began the day after surgery. Patients were either discharged home or transferred to a rehabilitation facility based on their medical condition, progress in therapy, and home support system. Indirectness: No indirectness (n=20) Intervention 2: Anterolateral approach. Modified Hardinge approach - the anterior third of the gluteus medius and the underlying minimus is reflected anteriorly. The length of the skin incision to be made was measured and marked using a sterile ruler and marker pen after draping. The only difference from the modified Hardinge approach (control group) was the length of the skin incision (≤8 cm instead of 12–15 cm).. Duration N/A. Concurrent medication/care: All patients in groups A, B and C had a diagnosis of primary osteoarthritis. In group D the diagnosis was of primary osteoarthritis in 140 patients and of femoral head osteonecrosis in nine patients. In all cases a specialized dedicated surgical instrumentation was used. An epidural anaesthesia was used in all cases. All patients received the same standardised post-operative care. Mechanical foot pumps and pharmacological antithrombotic prophylaxis were used. Patients received antibiotics for 24 h post-operation. The drain was pulled on the first postoperative day by the resident on rounds the morning after surgery. No specific protocol was used to measure drain output. All patients received patient control epidural anaesthesia (PCEA) for initial

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	pain control. Patients were switched to oral narcotics on the 2nd or 3rd post-operative day. The major goals of therapy were to enable patients to independently transfer, walk with a walker and negotiate stairs. The same physical therapist supervised the care of all patients. Physical therapy began the day after surgery. Patients were either discharged home or transferred to a rehabilitation facility based on their medical condition, progress in therapy, and home support system. Indirectness: No indirectness (n=20) Intervention 3: Anterolateral approach. An antero-lateral TSS approach utilising the intermuscular plane between gluteus medius and tensor fascia latae was used. . Duration N/A. Concurrent medication/care: All patients in groups A, B and C had a diagnosis of primary osteoarthritis. In group D the diagnosis was of primary osteoarthritis in 140 patients and of femoral head osteonecrosis in nine patients. In all cases a specialized dedicated surgical instrumentation was used. An epidural anaesthesia was used in all cases. All patients received the same standardised post-operative care. Mechanical foot pumps and pharmacological antithrombotic prophylaxis were used. Patients received antibiotics for 24 h post-operation. The drain was pulled on the first postoperative day by the resident on rounds the morning after surgery. No specific protocol was used to measure drain output. All patients received patient control epidural anaesthesia (PCEA) for initial pain control. Patients were switched to oral narcotics on the 2nd or 3rd post-operative day. The major goals of therapy were to enable patients to independently transfer, walk with a walker and negotiate stairs. The same physical therapist supervised the care of all patients. Physical therapy began the day after surgery. Patients were either discharged home or transferred to a rehabilitation facility based on their medical condition, progress in therapy, and home support system. Indirectness: No indirectness
Funding	Funding not stated

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus ANTEROLATERAL APPROACH - A

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: HHS at 6 weeks at 6 weeks; Group 1: mean 93.1 (SD 7.8); n=10, Group 2: mean 88.3 (SD 8); n=20
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0
- Actual outcome: WOMAC at 6 weeks at 6 weeks; Group 1: mean 23.3 (SD 9.9); n=10, Group 2: mean 27.7 (SD 13.6); n=20
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 2: Length of stay in hospital
- Actual outcome: Length of hospital stay (days) at N/A; Group 1: mean 8 (SD 3.7); n=10, Group 2: mean 10 (SD 4.6); n=20
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low,

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Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 3: Intraoperative complications (for example nerve damage) at before JR is revised
- Actual outcome: Blood loss (ml) at N/A; Group 1: mean 1344 (SD 710); n=10, Group 2: mean 1219 (SD 786.5); n=20
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 4: Surgery time at N/A
- Actual outcome: Surgical time (minutes) at N/A; Group 1: mean 121 (SD 23.6); n=10, Group 2: mean 102 (SD 10.6); n=20
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus ANTEROLATERAL APPROACH - C

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: HHS at 6 weeks at 6 weeks; Group 1: mean 93.1 (SD 7.8); n=10, Group 2: mean 93.8 (SD 7.4); n=20
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0
- Actual outcome: WOMAC at 6 weeks at 6 weeks; Group 1: mean 23.3 (SD 9.9); n=10, Group 2: mean 28 (SD 8.5); n=20
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 2: Length of stay in hospital
- Actual outcome: Length of hospital stay (days) at N/A; Group 1: mean 8 (SD 3.7); n=10, Group 2: mean 9 (SD 3.6); n=20
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 3: Intraoperative complications (for example nerve damage) at before JR is revised
- Actual outcome: Blood loss (ml) at N/A; Group 1: mean 1344 (SD 710); n=10, Group 2: mean 1279 (SD 694.9); n=20
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 4: Surgery time at N/A
- Actual outcome: Surgical time (minutes) at N/A; Group 1: mean 121 (SD 23.6); n=10, Group 2: mean 110 (SD 6.3); n=20
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0

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Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Reoperation/dislocation rate at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	De anta-diaz 2016[16]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=99)
Countries and setting	Conducted in Spain
Line of therapy	1st line
Duration of study	Intervention + follow up:
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	The inclusion criteria were aged 55 or older, diagnosis of primary osteoarthritis, and asymptomatic opposite hip.
Exclusion criteria	The exclusion criteria included prior hip surgery, arthroplasty to treat a facture, inflammatory arthropathies, autoimmune disease, immunosuppressive treatment, or cancer.
Age, gender and ethnicity	Age - Mean (SD): lateral - 63.5 (12.5), anterior - 64.8 (10.1) . Gender (M:F): 52 male, 47 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=50) Intervention 1: Anterolateral approach. Direct lateral approach - approach as described by Hardinge was used. Briefly, the gluteus medius and minimus were incised and detached ventrally from the greater trochanter. The incision was not extended more than 3 cm above greater trochanter to prevent injury to superior gluteal nerve. After implantation, the tendons were reattached with transperiosteal sutures. . Duration N/A. Concurrent medication/care: According to standard protocol, all patients had antibiotic prophylaxis with cefazoline for 24 hours (started 30 mins prior to skin incision), and thromboembolic prophylaxis with low-molecular-weight heparin fro 30 days. All patients were allowed to stand on the second post-operative day, and were instructed to weight bearing as tolerated with the use of a walker. . Indirectness: No indirectness (n=49) Intervention 2: Direct anterior approach. Direct Anterior approach - Arthrotomy was performed by retracting the muscles rectus femoris and iliopsoas medially and gluteus medius laterally. . Duration N/A. Concurrent medication/care: According to standard protocol, all patients had antibiotic prophylaxis with cefazoline for 24 hours (started 30 mins prior to skin incision), and thromboembolic prophylaxis with low-molecular-weight heparin fro 30 days. All patients were allowed to stand on the second post-operative day,

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	and were instructed to weight bearing as tolerated with the use of a walker. . Indirectness: No indirectness
Funding	Funding not stated
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ANTEROLATERAL APPROACH versus DIRECT ANTERIOR APPROACH Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year - Actual outcome: Harris score at 1 year at 1 year ; Group 1: mean 94.5 (SD 9.7); n=50, Group 2: mean 96.2 (SD 10.1); n=49 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 1, Reason: excluded from analysis due to intra-operative trochanteric fracture; Group 2 Number missing: 2, Reason: excluded from analysis due to early wound infection Protocol outcome 2: Surgery time at N/A - Actual outcome: Surgery time (minutes) at N/A; Group 1: mean 82.2 (SD 15.2); n=50, Group 2: mean 78.2 (SD 16.2); n=49 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 1, Reason: excluded from analysis due to intra-operative trochanteric fracture; Group 2 Number missing: 2, Reason: excluded from analysis due to early wound infection	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Ji 2012[41]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=205)
Countries and setting	Conducted in South Korea
Line of therapy	1st line
Duration of study	Intervention + follow up: mean 37.9 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Primary total hip arthroplasties.
Exclusion criteria	Fused hips and hips with a unilateral Crowe type IV developmental dislocation were excluded because they necessitated extensile approaches and/or other prostheses.
Age, gender and ethnicity	Age - Mean (SD): posterior - 51 (14.5), lateral - 52 (15.1) . Gender (M:F): 112 male, 84 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=105) Intervention 1: Posterior approach. Posterior approach - Patient was transferred to the lateral decubitus position and the hip was flexed by 30 degrees. A straight skin incision was made over the center of the greater trochanter, equidistant cephalad and caudad to the centre of the trochanter. The length of skin incision ranged from 16 to 22 cm. After implantation of the prosthesis, we repaired the capsule and short external rotators. 2 to 3 drill holes 1.5cm to 2 cm apart were made in the trochanteric crest of the greater trochanter from the anterior to the posterior direction . . Duration N/A. Concurrent medication/care: Patients were instructed to walk with partial weight bearing with the aid of 2 crutches for 4 weeks after surgery. . Indirectness: No indirectness (n=100) Intervention 2: Anterolateral approach. Modified lateral approach - the patient was transferred to the lateral decubitus position and the hip was flexed by 30 degrees. A straight lateral skin incision was made over the center of the greater trochanter midway between the anterior and posterior dimensions of the greater trochanter. The length of the skin incision was similar to that of the posterior approach. . Duration N/A. Concurrent medication/care: Patients were instructed to walk with partial weight bearing with the aid of 2 crutches for 4 weeks after surgery. . Indirectness: No indirectness
Funding	Funding not stated

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RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: POSTERIOR APPROACH versus ANTEROLATERAL APPROACH

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at later than 2 years
- Actual outcome: Harris Hip score at 37.9 months at 37.9 months; Group 1: mean 91 (SD 6.7); n=99, Group 2: mean 92.3 (SD 5.5); n=97
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died or lost to follow up; Group 2 Number missing: 3, Reason: died or lost to follow up

Protocol outcome 2: Revision rate of of joint replacement at time to event
- Actual outcome: Revisions at 37.9 months; Group 1: 1/99, Group 2: 1/97
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died or lost to follow up; Group 2 Number missing: 3, Reason: died or lost to follow up

Protocol outcome 3: Reoperation/dislocation rate at N/A
- Actual outcome: Dislocations at 37.9 months; Group 1: 0/99, Group 2: 3/97
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died or lost to follow up; Group 2 Number missing: 3, Reason: died or lost to follow up

Protocol outcome 4: Surgery time at N/A
- Actual outcome: Operation time (minutes) at N/A; Group 1: mean 105 (SD 25.7); n=99, Group 2: mean 132 (SD 37.5); n=97
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 6, Reason: died or lost to follow up; Group 2 Number missing: 3, Reason: died or lost to follow up

Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Intraoperative complications (for example nerve damage) at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study (subsidiary papers)	Lorenzen 2013[52] (Tjur 2018[110])
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=38)
Countries and setting	Conducted in Denmark
Line of therapy	1st line
Duration of study	Intervention + follow up: up to 72 hours after surgery
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Primary osteoarthritis or secondary osteoarthritis due to mild or moderate acetabular dysplasia. Acceptable bone mineral density on a pre-operative DXA scan, age 30-60 years at the time of inclusion, no vascular or neuromuscular disease in the operated leg, no fracture sequelae, no avascular necrosis of the femoral head, no wish to become pregnant, no alcohol abuse, no daily intake of non-steroid anti-inflammatory drugs, no daily intake of K-vitamin antagonists or loop diuretics.
Exclusion criteria	N/A
Age, gender and ethnicity	Age - Mean (range): posterior - 45 (36-60), lateral - 53 (35-61). Gender (M:F): 13 female, 11 male . Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=18) Intervention 1: Posterior approach. Posterior approach - No further details given. . Duration N/A. Concurrent medication/care: In all cases, the ReCap Total Hip System was used. The implant is made of a chrome-cobalt alloy and consists of a cementless acetabular cup coated with a Titanium Porous Plasma Spray Coating and a cemented femoral resurfacing component fixed to the bone with Simplex bone cement by Stryker. All surgical procedures were performed by one of the two senior surgeon, and standard equipment supplied by the manufacturer was used. The patients stayed in the hospital 2-3 days after surgery, and they all received similar post-operative rehabilitation. All patients were mobilised within 6 hours after surgery and were allowed to put full weight on the affected hip. . Indirectness: No indirectness (n=20) Intervention 2: Anterolateral approach. Antero-lateral approach - No further details given. . Duration N/A. Concurrent medication/care: In all cases, the ReCap Total Hip System was used. The implant is made of a chrome-cobalt alloy and consists of a cementless acetabular cup coated with a Titanium Porous Plasma Spray Coating and a cemented femoral resurfacing component fixed to the bone with Simplex bone cement

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	by Stryker. All surgical procedures were performed by one of the two senior surgeon, and standard equipment supplied by the manufacturer was used. The patients stayed in the hospital 2-3 days after surgery, and they all received similar post-operative rehabilitation. All patients were mobilised within 6 hours after surgery and were allowed to put full weight on the affected hip. . Indirectness: No indirectness
Funding	Academic or government funding (The Danish Rheumatism Association supported the study.)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: POSTERIOR APPROACH versus ANTEROLATERAL APPROACH Protocol outcome 1: Pain at later than 6 weeks up to 1 year - Actual outcome: Pain using VAS scale at 12 months at 12 months; Group 1: mean -43.08 (SD 19.75); n=12, Group 2: mean -50.36 (SD 20.29); n=10; Comments: change score baseline to 12 months Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: 2 unable to participate at 12 months; Group 2 Number missing: 1, Reason: 1 unable to participate at 12 months	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 2 years

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Study	Mayr 2009[56]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=33)
Countries and setting	Conducted in Austria
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 weeks follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	All patients had unilateral hip disease.
Exclusion criteria	Co-morbidities of the lower extremity, such as osteoarthritis or misalignment at other joints which might affect gait, were the exclusion criteria.
Age, gender and ethnicity	Age - Mean (range): DA - 65 (55 -84), AL - 69 (59 -78). Gender (M:F): 20 female, 14 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=16) Intervention 1: Direct anterior approach. Direct anterior - with the patient in supine position, a 7cm skin incision was made distally and laterally to the anterior superior iliac spine. The anterior aspect of the capsule of the hip was bluntly exposed by holding apart the rectus femoris muscle medially and the gluteus minimus muscle laterally. . Duration N/A. Concurrent medication/care: The same standard rehabilitation protocol was recommended to the patients in both groups. Patients were instructed to walk with two crutches during the first 6 weeks after surgery. For the following 6 weeks, patients were instructed to use one crutch on the contralateral side. . Indirectness: No indirectness (n=17) Intervention 2: Anterolateral approach. Anterolateral approach - The patient was placed in the supine position. After skin incision over the greater trochanter, the iliotibial band was split. The ventral third of vastus lateralis muscle and the gluteal muscle was detached from the bone in one coherent layer using diathermy. The exposed capsule was then opened, and the femoral head was dislocated. . Duration N/A. Concurrent medication/care: The same standard rehabilitation protocol was recommended to the patients in both groups. Patients were instructed to walk with two crutches during the first 6 weeks after surgery. For the following 6 weeks, patients were instructed to use one crutch on the contralateral side. . Indirectness: No indirectness

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Funding	Funding not stated
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Meneghini 2008[59]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=23)
Countries and setting	Conducted in USA
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 weeks postoperatively
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Primary diagnosis of degenerative rheumatoid, or posttraumatic arthritis or arthritis secondary to developmental dysplasia classified as Crowe II or less, age greater than 18 and less than 75 years, body mass index of 30 or less, no previous hip surgery, implants, arthrodesis or infection, and no neurological, musculoskeletal or medial conditions that would prevent the ability to comply with early weight-bearing and early functional recovery in the postoperative period. Patients with contralateral hip disease were not excluded, provided the contralateral hip did not preclude the ability to comply with the rapid rehabilitation protocol.
Exclusion criteria	N/A
Age, gender and ethnicity	Age - Mean (range): 54 (38 to 74). Gender (M:F): N/A. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=8) Intervention 1: Posterior approach. Mini posterior approach - was performed similar to that described by Dorr et al. . Duration N/A. Concurrent medication/care: All patients received one preoperative physical therapy session to orient patients to the postoperative PT protocol and expectations. All patients were full weight bearing and received an identical postoperative rehabilitation protocol, including inpatient PT the afternoon of surgery. (n=7) Intervention 2: Anterolateral approach. Mini-anterolateral approach - performed as described by Berger and is a modification of the Hardinge approach with evaluation and subsequent repair of the anterior one third of the gluteus medius and minimus tendons. . Duration N/A. Concurrent medication/care: All patients received one preoperative physical therapy session to orient patients to the postoperative PT protocol and expectations. All patients were full weight bearing and received an identical postoperative rehabilitation protocol, including inpatient PT the afternoon of surgery. . Indirectness: No indirectness

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Funding	Academic or government funding (Benefits or funds were received in partial or total support of the research material described in this article. Theses benefits or support were received from the following sources: Orthopaedic Research and Education Foundation.)
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

Study	**Mjaaland 2015[64]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=164)
Countries and setting	Conducted in Norway
Line of therapy	1st line
Duration of study	Intervention + follow up: 4 days
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall:
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients with end-stage clinical osteoarthritis of the hip, verified on plain radiograms, were considered candidates. Further inclusion criteria were age between 20 and 80 years and willingness to offer written consent to participate in the study.
Exclusion criteria	Exclusion criteria was previous surgery of the hip, BMI>35 kg/m2, and dementia/psychiatric illness preventing follow-up, as was an explicit request regarding approach.

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Age, gender and ethnicity	Age - Mean (SD): anterior - 67.2 (8.6), lateral - 65.6 (8.6). Gender (M:F): 55 male, 109 female. Ethnicity: Not stated
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=83) Intervention 1: Direct anterior approach. Minimally invasive anterior approach - Direct anterior approach was performed with the patient supine. No traction was used. . Duration N/A. Concurrent medication/care: Surgery was performed using spinal anaesthesiaanaesthesia and local infiltration analgesia (LIA) with Ropivacain (NaropinTM) 300mg, Ketorolac (ToradolTM) 30mg, Triamcinolon (LederspanTM) 40mg, and adrenaline 0.5mg in saline solution to a volume of 150ml. All patients were given Cefalotin 2 g i.v. prior to surgery and further three doses after surgery. Tranexamic acid of 500mg were given intravenously at the onset of surgery and 500mg at the time of closure. In all patients, a cemented cup (Marathon, DePuy, Warsaw, IN), uncemented stem (Corail, DePuy), and ceramic head with a diameter of 32mm (Biolox forte, Ceramtec, Plochingen Germany) were used. Patients started physiotherapy on the first postoperative day allowing full weight bearing. Postoperative pain-regime included for all patients a daily dose of paracetamol of 4 g for the duration of admission and a total dose of ibuprofen of 4g with a daily dose of 1200mg. Tramadol was used from the first postoperative day in range of 200–400mg daily. If needed, patients were given oxycodone or ketobemidone. All analgesic use was recorded and converted to morphine equivalents (ME).. Indirectness: No indirectness (n=80) Intervention 2: Anterolateral approach. Direct lateral approach - Direct lateral approach was performed with the patient in lateral decubitus. . Duration N/A. Concurrent medication/care: Surgery was performed using spinal anaesthesiaanaesthesia and local infiltration analgesia (LIA) with Ropivacain (NaropinTM) 300mg, Ketorolac (ToradolTM) 30mg, Triamcinolon (LederspanTM) 40mg, and adrenaline 0.5mg in saline solution to a volume of 150ml. All patients were given Cefalotin 2 g i.v. prior to surgery and further three doses after surgery. Tranexamic acid of 500mg were given intravenously at the onset of surgery and 500mg at the time of closure. In all patients, a cemented cup (Marathon, DePuy, Warsaw, IN), uncemented stem (Corail, DePuy), and ceramic head with a diameter of 32mm (Biolox forte, Ceramtec, Plochingen Germany) were used. Patients started physiotherapy on the first postoperative day allowing full weight bearing. Postoperative pain-regime included for all patients a daily dose of paracetamol of 4 g for the duration of admission and a total dose of ibuprofen of 4g with a daily dose of 1200mg. Tramadol was used from the first postoperative day in range of 200–400mg daily. If needed, patients were given oxycodone or ketobemidone. All analgesic use was recorded and converted to morphine equivalents (ME).. Indirectness: No indirectness
Funding	No funding (No financial support or grant was received for the study.)

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RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus ANTEROLATERAL APPROACH Protocol outcome 1: Surgery time at N/A - Actual outcome: Average surgery time (minutes) at N/A; MD; 15 (95%CI 11 to 19, Comments: mean (range) anterior - 77 (52 to 136) lateral - 62 (47 to 90)); Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 1, Reason: 1 withdrew due to cancer diagnosis ; Group 2 Number missing: 0 - Actual outcome: Average surgery time (minutes) at N/A; Group 1: mean 77 (SD 13.064); n=83, Group 2: mean 62 (SD 13.064); n=80 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 1, Reason: 1 withdrew due to cancer diagnosis ; Group 2 Number missing: 0 Protocol outcome 2: Pain at 6 weeks or earlier - Actual outcome: Pain at 4 days at 4 days; Group 1: mean 1.8 (SD 1.8); n=83, Group 2: mean 2.9 (SD 1.9); n=80 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 1, Reason: 1 withdrew due to cancer diagnosis ; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Nistor 2017[74]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=70)
Countries and setting	Conducted in Romania; Setting:
Line of therapy	1st line
Duration of study	Intervention + follow up: 8 days follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients aged between 35 and 85 that were diagnosed with end stage primary degenerative hip arthritis verified on plain radiographs, and elected to undergo a primary total cementless hip arthroplasty.
Exclusion criteria	Diagnosis of secondary arthritis, femur fractures, previous hip operations, presence of a contralateral joint implant, any muscle diseases, recent heart attacks or rhabdomyolysis and any type of mental or physical disability.
Age, gender and ethnicity	Age - Median (IQR): DA - 67 (53.5 to 72.5), LA - 64 (54.4 to 67.5). Gender (M: F): 42 female, 28 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=35) Intervention 1: Direct anterior approach. Direct anterior approach - a modified Smith-Peterson approach. Patients in a supine position, on a standard operating table that could be flexed so that hip hyperextension could be achieved. Both legs were completely draped separately to facilitate proximal femoral exposure. An 8 cm skin incision was made over the body of the tensor fascia lata muscle and then lengthened as needed for a proper exposure. . Duration N/A. Concurrent medication/care: All patients received the same implant. All participants received only spinal anaesthesia, with an intravenous analgesia during the intervention at the anaesthesiologists' discretion. Antibiotic prophylaxis was administered for 48 hours. . Indirectness: No indirectness (n=35) Intervention 2: Anterolateral approach. Direct lateral approach - Hardinge approach. With the patient on a standard operating table, in a supine position, skin incision was initiated 3cm proximal to the tip of the greater trochanter and was continued 5 cm distally. The 8cm incision that resulted was then lengthened if needed for better exposure. Fascia lata was then split and the gluteus medius and vastus lateralis were divided. . Duration N/A. Concurrent medication/care: All patients received the same implant. All participants

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	received only spinal anaesthesia, with an intravenous analgesia during the intervention at the anaesthesiologists' discretion. Antibiotic prophylaxis was administered for 48 hours. . Indirectness: No indirectness
Funding	No funding (There are no funding sources in support of this research.)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus ANTEROLATERAL APPROACH Protocol outcome 1: Deep surgical site Infection at before JR is revised - Actual outcome: Superficial haematoma at 8 days ; Group 1: 1/35, Group 2: 2/35 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 2: Intraoperative complications (for example nerve damage) at before JR is revised - Actual outcome: Lateral femoral cutaneous nerve injury at 8 days ; Group 1: 2/35, Group 2: 0/35 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of joint replacement at time to event; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Parvizi 2016[81]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=84)
Countries and setting	Conducted in USA
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	All patients with end-stage arthritis of the hip needing THA were approached and consented. Patients needed to be between the ages of 18 and 75 years, have the underlying diagnosis of osteoarthritis, able to read and comprehend English, and to sign the consent form to participate.
Exclusion criteria	Patients with cognitive impairment or severe psychiatric illness that would preclude participation in the protocol mandated procedures were excluded.
Age, gender and ethnicity	Age - --: . Gender (M:F): 32 male, 52 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=44) Intervention 1: Direct anterior approach. Direct anterior approach - performed in the supine position on a regular operating table that could be flexed at the hip for the DA patients. The initial incision length was 5cm, and the incision was lengthened as dictated by the need for surgical exposure. Involved exposure of tensor fascia lata and division of its perimysium. A double osteotomy of the neck was performed and a wedge of bone from the femoral neck was removed to allow easy extraction of the remaining head. . Duration N/A. Concurrent medication/care: All patients received a social service consultant, who was also blinded to the surgical approach. The only difference between the two groups was the location of the incision, which was placed laterally over the greater trochanter for the DL patients, and more anteriorly for the DA patients. . Indirectness: No indirectness (n=40) Intervention 2: Anterolateral approach. Direct lateral - performed by placement of the incision over the greater trochanter and division of the underlying fascia lata. The abductor mechanism was divided and the anterior one half retracted anteriorly. Following capsulotomy, the hip was dislocated and the femoral neck was cut. Acetabular and femoral preparation was conducted in a conventional manner. . Duration N/A. Concurrent medication/care: All patients received a social service consultant, who was also blinded to the

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	surgical approach. The only difference between the two groups was the location of the incision, which was placed laterally over the greater trochanter for the DL patients, and more anteriorly for the DA patients. . Indirectness: No indirectness
Funding	Study funded by industry (Zimmer provided financial support for this study.)
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Reichert 2018[87]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=148)
Countries and setting	Conducted in Germany
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 months Follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients with primary osteoarthritis scheduled for cemented or non-cemented THA were enrolled following defined inclusion and exclusion criteria.
Exclusion criteria	Exclusion criteria were an age < 40 or > 80 years, a Body-Mass-Index (BMI) > 35 kg/m2; hip dysplasia or a congenital disorder of the hip, former osteotomies of hip, knee or pelvis; an impairment of the contralateral side or osteoarthritis of the ipsilateral knee, osteoporosis, degenerative spine disease, or a severe systemic disease (ASA-Score ≥ 4, malignant or cardiovascular disease).
Age, gender and ethnicity	Age - Mean (SD): anterior - 63.2 (8.2), lateral - 61.9 (7.8) . Gender (M:F): 64 female, 84 male. Ethnicity: Not stated
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=71) Intervention 1: Anterolateral approach. Posterior - direct transgluteal lateral approach. . Duration N/A. Concurrent medication/care: For all patients participating in the trial we applied established standardized treatment protocols, which included a multimodal pain management and rapid rehabilitation. . Indirectness: No indirectness (n=77) Intervention 2: Direct anterior approach. Anterior - minimally invasive single-incision direct anterior (DAA). Duration N/A. Concurrent medication/care: For all patients participating in the trial we applied established standardized treatment protocols, which included a multimodal pain management and rapid rehabilitation. . Indirectness: No indirectness
Funding	Academic or government funding (The study was financially supported by the Deutsche Arthrose-Hilfe (Grant P178-A49-Eulert-EP2nöth3-hüfte-opII-156 k-2008-12 and P235-A284-Rudert-EP2-nöth1-hüfte-op-II-67 k-2001-12). The funding body was not involved in collection, analysis, and interpretation of data and in

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	writing the manuscript.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus ANTEROLATERAL APPROACH

Protocol outcome 1: Quality of life at 6 weeks or earlier
- Actual outcome: SF-36 scale - physical sub scale at 6 weeks at 6 weeks; Group 1: mean 39.1 (SD 9.7); n=77, Group 2: mean 34.8 (SD 9.8); n=71
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria
- Actual outcome: SF-36 scale - mental sub scale at 6 weeks at 6 weeks; Group 1: mean 58.1 (SD 8.7); n=77, Group 2: mean 59.3 (SD 6.6); n=71
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria

Protocol outcome 2: Quality of life at later than 6 weeks up to 1 year
- Actual outcome: SF-36 scale - physical sub scale at 12 months at 12 months; Group 1: mean 47.5 (SD 9.9); n=77, Group 2: mean 42.9 (SD 11.9); n=71
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria
- Actual outcome: SF-36 scale - mental sub scale at 12 months at 12 months; Group 1: mean 55 (SD 9.8); n=77, Group 2: mean 56.2 (SD 6.9); n=71
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria

Protocol outcome 3: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: Harris Hip score - 6 weeks at 6 weeks; Group 1: mean 81.6 (SD 12.1); n=77, Group 2: mean 82.4 (SD 12); n=71
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria

Protocol outcome 4: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: Harris Hip score - 12 months at 12 months; Group 1: mean 92.4 (SD 8.6); n=77, Group 2: mean 91.4 (SD 9.1); n=71
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria

Protocol outcome 5: Reoperation/dislocation rate at N/A

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- Actual outcome: Dislocation at 12 months; Group 1: 0/77, Group 2: 1/71 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: lost to follow up, diagnosed with malignant disease; Group 2 Number missing: 21, Reason: moved away, lack of time, not meeting criteria	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Reininga 2013[88]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=75)
Countries and setting	Conducted in Netherlands
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients between the ages of 18 and 75 who were admitted for primary cementless unilateral THA due to primary or secondary osteoarthritis (OA) were selected.
Exclusion criteria	Exclusion criteria were a history of previous surgery to the affected hip, inflammatory polyarthritis where the severity of multiple joint disease was likely to compromise postoperative mobility, and a BMI > 32 kg/m2. This latter criteria was applied because in obese patients an extensive procedure is needed to gain access to the hip due to the surrounding adipose tissue.
Age, gender and ethnicity	Age - Mean (SD): anterior - 60.3 (7.7), posterolateral - 60.5 (9.5). Gender (M:F): 56 female, 19 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=40) Intervention 1: Posterior approach. Posterolateral approach - For the conventional technique, a standard posterolateral approach was used. The same acetabular cup (Trident1 Cup with X3 or Ceramic inlay; Stryker Corp.) and femoral component (ABG II; Stryker Corp.) were used in the MISCAS and CON groups.. Duration N/A. Concurrent medication/care: The anesthetic, analgesic, and postoperative physical therapy protocols were identical in both groups. Discharge criteria were also identical. No physical therapy following discharge was prescribed, in accordance with the guidelines of the Dutch Orthopaedic Association.. Indirectness: No indirectness (n=35) Intervention 2: Direct anterior approach. Minimally invasive anterior approach - Patients in the MISCAS group had surgery using the MIS single-incision anterior approach. Advantage of the anterior approach is the possibility of using the intermuscular plane between the m. tensor fascia latae and the m. sartorius, avoiding muscle damage by cutting or detaching muscles. To optimize placement of the acetabular and femoral components, a computer navigation system (Stryker1 Navigation System iNstride Hip; Stryker

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	Corp., Kalamazoo, MI) was used. . Duration N/A. Concurrent medication/care: The anesthetic, analgesic, and postoperative physical therapy protocols were identical in both groups. Discharge criteria were also identical. No physical therapy following discharge was prescribed, in accordance with the guidelines of the Dutch Orthopaedic Association.. Indirectness: No indirectness
Funding	Academic or government funding (Grant sponsors: ZonMw; The Netherlands Organization for Health Research and Development; Grant number: 94527001)
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Restrepo 2010[90]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=122)
Countries and setting	Conducted in USA
Line of therapy	1st line
Duration of study	Intervention + follow up: 2 years follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	The inclusion criteria were as follows: patients between 18 and 75 years, any sex or race, an underlying diagnosis of osteoarthritis, and agreement to provide the consent to participate in the study.
Exclusion criteria	Patients with a body mass index greater than 30kg/m² or those with cognitive impairment or severe psychiatric illness that would preclude participation in the protocol-mandated procedures were excluded.
Age, gender and ethnicity	Age - Other: Anterior - 62.02 (35 to 84.5), lateral - 59.91 (40.1 to 76.1). Gender (M:F): 39 male, 60 female. Ethnicity:
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=63) Intervention 1: Direct anterior approach. Direct anterior - surgery performed in the supine position on regular operating table that could be flexed at the hip. The initial incision length was 8cm, but, in every case the incision was lengthened, as dictated by the need for proper surgical exposure. The only difference between the 2 groups was the location of the incision. Involved exposure of tensor fascia lata and division of its perimysium. . Duration N/A. Concurrent medication/care: All patients received a social service consultation to discuss social circumstances and confirm the preoperatively determined disposition plan based on the degree of home support, the layout of their home and the physical ability of the patient. Appropriate prophylaxis for infection and thromboembolism was administered to all the patients according to protocol. All patients received spinal anaesthesia. . Indirectness: No indirectness (n=59) Intervention 2: Anterolateral approach. Direct lateral approach - performed using a modified Hardinge technique, with patient in supine position, which included placement of the incision over the greater trochanter and division of the underlying fascia lata. The abductor mechanism was divided approximately in the anterior two thirds of the gluteus medius, the approach was extended into the anterior aspect of the vastus lateralis, and the anterior portion retracted anteriorly. . Duration N/A. Concurrent medication/care: All

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	patients received a social service consultation to discuss social circumstances and confirm the preoperatively determined disposition plan based on the degree of home support, the layout of their home and the physical ability of the patient. Appropriate prophylaxis for infection and thromboembolism was administered to all the patients according to protocol. All patients received spinal anaesthesia. . Indirectness: No indirectness
Funding	Study funded by industry (Benefits or funds were received in partial or total support of the research material described in this article. These benefits or support were received from the following sources: J P consultant for Stryker Orthopaedics.)
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Rosenlund 2016[95]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=47)
Countries and setting	Conducted in Denmark
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Aged 45 to 70 years, diagnosed with unilateral primary hip osteoarthritis or secondary osteoarthritis due to mild hip dysplasia, scheduled for primary cementless total hip arthroplasty.
Exclusion criteria	Symptoms in several joints (hip, knee or ankle) with expected total joint arthroplasty within one year, prior total joint arthroplasty in any joint or major lower limb surgery still causing symptoms, BMI > 35 kg/m², any physical disability preventing the patient from walking freely without walking aids, any neurological disease compromising walking ability, any severe medical condition compromising physical function, severe dementia, inability to read and understand Danish written and oral instructions.
Age, gender and ethnicity	Age - Mean (SD): lateral - 60.5 (6.6), posterior - 61 (6.7). Gender (M:F): 34 male, 13 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=23) Intervention 1: Posterior approach. Posterior approach - performed through an incision over the posterior part of the greater trochanter through the fascia, followed by blunt dissection of the gluteus maximus. Then detachment of the external rotators and incision of the hip capsule were performed. The hip was dislocated by internal rotation and flexion. During closure of the wound, capsular repair and re-insertion of the external rotators were performed if possible. . Duration N/A. Concurrent medication/care: Both groups received an identical post-operative rehabilitation programme. Patients were mobilised immediately with full weight-bearing and no movement restrictions. . Indirectness: No indirectness (n=24) Intervention 2: Anterolateral approach. Direct lateral approach - modified direct lateral approach used. Performed through a mid-line incision over the greater trochanter and involved detachment of the anterior one-third of the gluteus medius insertion and gluteus minimus insertion at the tip of the greater trochanter. Excision of the hip capsule was performed on the anterior side of the joint, from the basis of the collum femoris on the acetabular rim. The hip was dislocated by external rotation, adduction and flexion. During

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	closure of the wound, re-insertion of the detached parts of the gluteus medius and minimus was performed using a heavy absorbable suture to reapproximate the divided gluteus minimus and the anterior flap of gluteus medius. No capsular repair was performed. . Duration N/A. Concurrent medication/care: Both groups received an identical post-operative rehabilitation programme. Patients were mobilised immediately with full weight-bearing and no movement restrictions. . Indirectness: No indirectness
Funding	Academic or government funding (This trial was supported by the Danish Rheumatism Association, University of Southern Denmark, Region of Zealand, Region of Southern Denmark, Bevica)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: POSTERIOR APPROACH versus ANTEROLATERAL APPROACH Protocol outcome 1: Revision rate of of joint replacement at time to event - Actual outcome: Revision at 12 months; Group 1: 2/23, Group 2: 0/24 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 5, Reason: Peri-prosthetic fracture, dislocation, cemented cup, pelvic fracture ; Group 2 Number missing: 1, Reason: Parkinson disease Protocol outcome 2: Reoperation/dislocation rate at N/A - Actual outcome: Dislocation at 12 months; Group 1: 1/23, Group 2: 0/24 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 5, Reason: Peri-prosthetic fracture, dislocation, cemented cup, pelvic fracture ; Group 2 Number missing: 1, Reason: Parkinson disease	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Rykov 2017[97]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=46)
Countries and setting	Conducted in Netherlands
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 weeks follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients with primary or secondary symptomatic osteoarthritis of the hip aged 18-70 were included in the study.
Exclusion criteria	A history of previous surgery of the ipsilateral hip, peripheral neuropathy, (inflammatory) arthritis, a history of cerebrovascular disease or cognitive impairments.
Age, gender and ethnicity	Age - Mean (SD): DAA - 62.8 (6.1), PLA - 60.2 (8.1) . Gender (M:F): 19 male, 27 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=23) Intervention 1: Direct anterior approach. Direct anterior approach - patient placed in supine decubitus position. The skin incision is made over and in the direction of the lateral part of the femoral head and neck. After division of skin and subcutis, the interval between the tensor fasciae latae muscle and the sartorius muscle is identified and the overlying fascia is opened. . Duration N/A. Concurrent medication/care: All patients were treated according to the hospitals' standardised fast-track protocol. . Indirectness: No indirectness (n=23) Intervention 2: Posterior approach. Posterolateral approach - patient placed in lateral decubitus position. The skin incision is made over the greater trochanter to cranial, with a slight curve to posterior. After transection of the subcutis the fasciae latae and the gluteus maximus muscles are split. Next, the short external rotators - namely, the piriformis, the inferior and superior gemellus and the obturator internus muscles- are cut at the level of their insertion at the greater trochanter, making this approach not minimally invasive. . Duration N/A. Concurrent medication/care: All patients were treated according to the hospitals' standardised fast-track protocol. . Indirectness: No indirectness

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Funding	No funding
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH Protocol outcome 1: Deep surgical site Infection at before JR is revised - Actual outcome: Deep infection at N/A; Group 1: 2/23, Group 2: 1/23 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: deep infection, forgotten lab visit ; Group 2 Number missing: 5, Reason: deep infection, another surgical procedure, forgotten lab visit Protocol outcome 2: Length of stay at in hospital - Actual outcome: Length of stay (days) at N/A; Group 1: mean 1.5 (SD 0.7); n=23, Group 2: mean 1.5 (SD 0.7); n=23 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: deep infection, forgotten lab visit ; Group 2 Number missing: 5, Reason: deep infection, another surgical procedure, forgotten lab visit Protocol outcome 3: Intraoperative complications (for example nerve damage) at before JR is revised - Actual outcome: Blood loss (mL) at N/A; Group 1: mean 325.7 (SD 99.74); n=23, Group 2: mean 273.7 (SD 181); n=23 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: deep infection, forgotten lab visit ; Group 2 Number missing: 5, Reason: deep infection, another surgical procedure, forgotten lab visit Protocol outcome 4: Surgery time at N/A - Actual outcome: Operative time (minutes) at N/A; Group 1: mean 71 (SD 7); n=23, Group 2: mean 62 (SD 7); n=23 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 3, Reason: deep infection, forgotten lab visit ; Group 2 Number missing: 5, Reason: deep infection, another surgical procedure, forgotten lab visit	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Superficial surgical site infection at before JR is revised; Reoperation/dislocation rate at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Taunton 2014[108]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=54)
Countries and setting	Conducted in USA
Line of therapy	1st line
Duration of study	Intervention + follow up: 12 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Aged between 25 to 80 years and elected to undergo primary total hip arthroplasty for primary degenerative arthritis of the hip. Also, the patient was able to comply with the requirements of the study including pre-operative and post-operative evaluations and questionnaires.
Exclusion criteria	An inability or unwillingness to comply with the postoperative rehabilitation or follow-up protocols, previous THA, inflammatory arthritis, osteomyelitis or a previous intra-articular infection, severe developmental dysplasia of the hip, known metal allergy, offset greater than 50mm, acetabular deformity requiring advanced reconstructive techniques, Charcot arthropathy, Pagets disease or chronic narcotic dependence.
Age, gender and ethnicity	Age - Mean (SD): DA - 62.05, MPA - 66.4. Gender (M:F): 25 men, 29 women. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=27) Intervention 1: Direct anterior approach. Direct anterior approach - patient in a supine position on an orthopedic table. An oblique incision is made over the anterior margin of the tensor muscle at a point approximately 2cm lateral from the anterior superior iliac spine and extending 10cm. The interval of the tensor fascia lata and sartorius is developed. A measured resection of the femoral neck is performed. Acetabular reaming is performed and the acetabular component is inserted. . Duration N/A. Concurrent medication/care: All patients were encouraged to move from bed to chair on the day of surgery and being walking with weight-bearing as tolerated on the morning after surgery. Two sessions of supervised physical therapy were planned on each hospital day. THe same femoral component design and the same acetabular component design were used in every case. . Indirectness: No indirectness (n=27) Intervention 2: Posterior approach. Mini-posterior approach - Patient positioned in the lateral decubitus position. A 10cm incision is placed over the greater trochanter, slightly curved posteriorly. An incision is placed just superior to the piriformis tendon through the hip capsule. The hip capsule is retracted

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	posteriorly and is detached with the short external rotators from the psoterior aspect of the greater trochanter extending down to and often including the quadratus muscle. . Duration N/A. Concurrent medication/care: All patients were encouraged to move from bed to chair on the day of surgery and being walking with weight-bearing as tolerated on the morning after surgery. Two sessions of supervised physical therapy were planned on each hospital day. THe same femoral component design and the same acetabular component design were used in every case. . Indirectness: No indirectness
Funding	Funding not stated
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH Protocol outcome 1: Function at 6 weeks or earlier - Actual outcome: Mean time to ambulation with no assistive device (days) at N/A; Group 1: mean 22.8 (SD 11.5); n=27, Group 2: mean 35.1 (SD 24.6); n=27 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

Study	**Taunton 2018[109]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	1 (n=170)
Countries and setting	Conducted in USA
Line of therapy	Part of comparison
Duration of study	Intervention + follow up: 1 year

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Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Male or female patients between the ages of 20 and 100 years with unilateral OA who were surgical Candidates for THA. The study participants were required to be able to give informed consent.
Exclusion criteria	•Significant proximal femoral deformity (post-SCFE, Perthes, DDH), acetabular dysplasia (any Crowe), inflammatory arthritis, septic arthritis, osteomyelitis, prior infection of the hip, significant leg length discrepancy (> 4 cm), osteoporosis, arthrodesis of the affected hip The presence of infections, highly communicable diseases, eg, AIDS,active tuberculosis, venereal disease, hepatitis Significant neurologic or musculoskeletal disorders or disease that may adversely affect normal gait or weightbearing Presence of previous prosthetic hip replacement device (any type)• Active metastatic disease• Active major psychiatric illnessActive drug or alcohol abuse• BMI > 40 kg/m2 • Patients who are known to be pregnant • Actively failing contralateral hip replacement
Recruitment/selection of patients	Patients having a consultation appointment for unilateral hip osteoarthritis (OA) were identified as potential study recruits by study coordinators. The 101 patients randomized and included in this study were recruited from the practices of the four participating surgeons.
Age, gender and ethnicity	Age - Mean (SD): direct anterior approach; 65 (10) miniposterior approach; 64 (11). Gender (M:F): 49 female, 52 male. Ethnicity: N/A
Further population details	1. Age: Non-working age (study defined) (65 (10) for DAA 64 (11) for MPA).
Indirectness of population	No indirectness
Interventions	(n=56) Intervention 1: Direct anterior approach. For the DAA technique, a specialized table with fluoroscopy was utilized. with capsulotomy and repair. Before initiation of this study, the surgeon in the DAA arm of the trial had performed > 500 THAs with the DAA technique. . Duration 1 year . Concurrent medication/care: All patients received 1 g tranexamic acid at incision and at closure. Every patient received the same formal preoperative class educating them on perioperative expectations. Patients received the same comprehensive multimodal pain management approach, including an indwelling psoas

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	nerve catheter for 36 hours postoperatively, and an oral pain regimen, including scheduled acetaminophen with tramadol and short-acting opioid medication on an as-needed basis. Both treatment groups had identical postoperative care. Patients were treated on the same ward and seen by the Same physical therapy (PT) team; no specific hip precautions were given to either group. Structured PT began the day after surgery and continued during the hospitalization. Patients were encouraged to sit up at the bedside The evening of their surgery. On postoperative Day 1, the patients began ambulation with the assistance of PT With a walker or crutches as well as active ROM. Weight bearing was progressed as tolerated. A home therapy program was given to the patient although formal PT did not continue on an outpatient basis. The patients were instructed to progress ambulation from a walker when they were able to walk stable without pain and then to continue with a crutch or cane until they were able to walk without a limp. The patients were encouraged to maximize independent ambulation and increase daily distance ambulated.All patients received a phone call at2 weeks to discuss progression of activities,m pain control, and any postoperative issues or complications. At that time, the patients were also mailed the activity monitors for 3 days. The first postoperative visit was at 8 weeks and the second was at 1 year. . Indirectness: No indirectness (n=60) Intervention 2: Posterior approach. For the MPA technique, the hip capsule and external rotators were incised as one layer and repaired formally at conclusion of THA Before initiation of this study, all of the surgeons in the MPA arm of the trial had performed > 500 THAs with the MPA technique. . Duration 1 year. Concurrent medication/care: All patients received 1 g tranexamic acid at incision and at closure. Every patient received the same formal preoperative class educating them on perioperative expectations. Patients received the same comprehensive multimodal pain management approach, including an indwelling psoas nerve catheter for 36 hours postoperatively, and an oral pain regimen, including scheduled acetaminophen with tramadol and short-acting opioid medication on an as-needed basis. Both treatment groups had identical postoperative care. Patients were treated on the same ward and seen by the Same physical therapy (PT) team; no specific hip precautions were given to either group. Structured PT began the day after surgery and continued during the hospitalization. Patients were encouraged to sit up at the bedside The evening of their surgery. On postoperative Day 1, the patients began ambulation with the assistance of PT With a walker or crutches as well as active ROM. Weight bearing was progressed as tolerated. A home therapy program was given to the patient although formal PT did not continue on an outpatient basis. The patients were instructed to progress ambulation from a walker when they were able to walk stable without pain and then to continue with a crutch or cane until they were able to walk without a limp. The patients were encouraged to maximize independent ambulation and increase daily distance ambulated.All patients received a phone call at2 weeks to discuss progression of activities,m pain control, and any postoperative issues or complications. At that time, the patients were also mailed the activity monitors for 3 days. The first postoperative visit was at 8 weeks and the second was at 1 year. . Indirectness: No indirectness

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Funding	Other (One of the authors (MJT) is a consultant and has received royalties from DJO Global (Austin, TX, USA). One of the authors (RTT), or a member of his immediate family, has or may receive payments or benefits, in any 1 year, an amount in excess of USD 10,000 from DePuy Orthopaedics (Warsaw, IN, USA). One of the authors (RJS), or a member of his immediate family, has or may receive payments or benefits, in any 1 year, an amount in excess of USD 10,000 from Zimmer Biomet (Warsaw, IN, USA). One of the authors (MWP), ora member of his immediate family, has or may receive payments or benefits, in any 1 year, an amount in excess of USD 10,000 from DePuy Orthopaedics and Stryker Orthopaedics (Mahwah, NJ, USA)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH

Protocol outcome 1: Quality of life at later than 6 weeks up to 1 year
- Actual outcome: SF-12 scores at 1 year - Physical
at 1 year ; Group 1: mean 49 (SD 10); n=52, Group 2: mean 50 (SD 7); n=49
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: DAA - 30 (7) MPA 31 (7); Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study
- Actual outcome: SF-12 scores at 1 year - Mental
at 1 year ; Group 1: mean 54 (SD 7); n=52, Group 2: mean 54 (SD 4); n=49
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: DAA 54 (10) MPA 53 (8); Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study

Protocol outcome 2: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: Harris hip scores at 1 year at 1 year ; Group 1: mean 97 (SD 4); n=52, Group 2: mean 95 (SD 7); n=49; Comments: The Harris hip score (HHS) is a clinician-based outcome tool that is frequently used for the evaluation of patients after THA. The indication for THA is particularly pain and impaired physical function, which are the two dominating domains in the HHs However, there are ceiling effects that severely limit its validity.

Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study
- Actual outcome: HOOS - Pain at 1 year at 1 year ; Group 1: mean 69 (SD 9); n=52, Group 2: mean 67 (SD 11); n=49

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Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: DAA -16 (17) MPA 16 (12)
; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study
- Actual outcome: HOOS - symptoms at 1 year
at 1 year ; Group 1: mean 69 (SD 8); n=52, Group 2: mean 64 (SD 13); n=49
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: DAA 20 (18) (-20 to 65) MPA 16 (16) (-15 to 65)
; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study
- Actual outcome: HOOS - Quality of life at 1 year at 1 year ; Group 1: mean 61 (SD 18); n=52, Group 2: mean 56 (SD 20); n=49
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: DAA -5 (16) MPA -1 (16); Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study

Protocol outcome 3: Length of stay at in hospital
- Actual outcome: Length of stay
at 1 year ; Group 1: mean 57 hours (SD 15); n=52, Group 2: mean 59 hours (SD 19); n=49
Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study

Protocol outcome 4: Reoperation/dislocation rate at N/A
- Actual outcome: Dislocation at 1 year
at 1 year; Group 1: 1/52, Group 2: 1/49
Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study

Protocol outcome 5: Intraoperative complications (for example nerve damage) at before JR is revised
- Actual outcome: Intraoperative Complications - calcar fractures at 1 year
at 1 year ; Group 1: 0/52, Group 2: 2/49
Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study

Protocol outcome 6: Surgery time at N/A
- Actual outcome: Surgery time (mins)
at N/A; Group 1: mean 70 (SD 16); n=52, Group 2: mean 61 (SD 18); n=49; Comments: MINUTES (SECONDS)
Risk of bias: All domain - Very high, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low,

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Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: withdrew from study ; Group 2 Number missing: 11, Reason: withdrew from study	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Witzleb 2009[115]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=60)
Countries and setting	Conducted in Germany; Setting:
Line of therapy	1st line
Duration of study	Intervention + follow up:
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	All patients between 45 and 65 years of age, who suffered from unilateral osteoarthritis of the hip and were admitted to our department for a primary cementless THR between October 2003 and February 2006, were screened for study inclusion.
Exclusion criteria	Exclusion criteria were age (older than 65 or younger than 45 years), known or suspected osteopenia or osteoporosis, deep infection or tumor illness of the hip, rheumatoid arthritis or higher grade developmental dysplasia of the hip (DDH Crowe stage II or higher), Charnley class B and C patients, previous operation or fracture of the joint, body mass index (BMI) over 40 kg/m2, psychiatric illness and drug or alcohol abuse. In addition, all patients who underwent Arthroplasty with other implants than stemmed THR (i.e. surface replacement) were excluded.
Age, gender and ethnicity	Age - Median (range): posterior - 55 (47 to 64), lateral - 58 (46 to 64). Gender (M:F): 31 female, 29 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=30) Intervention 1: Posterior approach. Posterior - posterior approach entailed a curved incision centered on the greater trochanter in lateral decubitus position of the patient. The fascia lata was incised in line of the skin incision and the fibres of the gluteus maximus were split by blunt dissection. The short external rotators were then detached close to their femoral insertion leaving one centimetre of muscle tissue of the quadratus femoris at the dorsal aspect of the greater trochanter for re-attachment. The posterior hip capsule was incised and preserved. After implantation, the posterior capsule was re-attached on the greater trochanter together with the short external rotators and the wound was closed in layers. . Duration N/A. Concurrent medication/care: Preoperatively, all patients received one dose of an intravenous cephalosporin. All patients were implanted with a cementless press-fit cup, cementless straight stem and a 28mm metal-on-metal (in cases of metal allergy ceramic-on-ceramic) articulation. Low molecular heparin (0.2-0.6 ml fraxiparine per

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	day, weight-adapted, GlaxoSmithKline GmbH, Germany) was used for thrombo prophylaxis until re-mobilization, at least for three weeks. 150mg diclophenac per day was used for two weeks in order to prevent the formation of heterotopic bone. Walking training was started on the first postoperative day, with full weight-bearing allowed. All patients underwent a standardized physiotherapy program until hospital discharge at the seventh postoperative day. Following discharge, all patients trained walking under full weight-bearing with two crutches and received physiotherapy at an individual basis. During the first four weeks, hip flexion was limited to 90° and forced internal as well as external rotation was not allowed. Four weeks after surgery all patients were admitted to a cooperative rehabilitation department, where they underwent a standardized rehabilitation program for three weeks. . Indirectness: No indirectness (n=30) Intervention 2: Anterolateral approach. Direct lateral - entailed a longitudinal skin incision centered over the greater trochanter in supine position. The tractus iliotibialis and the gluteal fascia were divided in the line of the skin incision. The anterior part of the gluteus medius and minimus insertion was incised down to the bone, prolonged distally through the vastus lateralis in a curved line to spare some tendinous tissue at the greater trochanter for reattachment. The anterior hip capsule was excised. After implantation, the tendinous tissue was re-attached at the greater trochanter and the wound was closed in layers. . Duration N/A. Concurrent medication/care: Preoperatively, all patients received one dose of an intravenous cephalosporin. All patients were implanted with a cementless press-fit cup, cementless straight stem and a 28mm metal-on-metal (in cases of metal allergy ceramic-on-ceramic) articulation. Low molecular heparin (0.2-0.6 ml fraxiparine per day, weight-adapted, GlaxoSmithKline GmbH, Germany) was used for thrombo prophylaxis until re-mobilization, at least for three weeks. 150mg diclophenac per day was used for two weeks in order to prevent the formation of heterotopic bone. Walking training was started on the first postoperative day, with full weight-bearing allowed. All patients underwent a standardized physiotherapy program until hospital discharge at the seventh postoperative day. Following discharge, all patients trained walking under full weight-bearing with two crutches and received physiotherapy at an individual basis. During the first four weeks, hip flexion was limited to 90° and forced internal as well as external rotation was not allowed. Four weeks after surgery all patients were admitted to a cooperative rehabilitation department, where they underwent a standardized rehabilitation program for three weeks. . Indirectness: No indirectness
Funding	No funding (The investigation was not granted.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: POSTERIOR APPROACH versus ANTEROLATERAL APPROACH

Protocol outcome 1: Superficial surgical site infection at before JR is revised
- Actual outcome: Superficial wound infection at 12 weeks; Group 1: 0/30, Group 2: 2/30
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0, Reason: N/A; Group 2 Number missing: 0, Reason: N/A

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Protocol outcome 2: Reoperation/dislocation rate at N/A - Actual outcome: Dislocations at 12 weeks; Group 1: 1/30, Group 2: 0/30 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0, Reason: N/A; Group 2 Number missing: 0, Reason: N/A	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Length of stay at in hospital; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Xie 2017[118]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=92)
Countries and setting	Conducted in China
Line of therapy	1st line
Duration of study	Intervention + follow up: 1 year follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Patients, who suffered from unilateral primary hip osteoarthritis, were recruited.
Exclusion criteria	Our exclusion criteria were femoral neck fracture, severe acetabular defect, metastatic disease, and overweight patients with a body mass index over 40.
Age, gender and ethnicity	Age - Mean (SD): SP - 66.60 (11.88), control - 64.47 (12.09). Gender (M:F): 31 female, 61 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=46) Intervention 1: SuperPATH approach. SuperPATH approach - (lateral position) The hip was in a 45° of flexion and 10–15° of internal rotation. A 6–8-cm incision superior to the greater trochanter was made. The gluteal fascia was incised, and the gluteus maximus was separated in line with fibers. The interval between the gluteus minimus and piriformis was exposed by using a Zelpi retractor. One blunt Hohmann retractor was placed anteriorly under the gluteus medius to protect the muscle, and the leg was elevated to reduce the tension on the external rotators making it easier to place another Hohmann retractor beneath the piriformis to protect the sciatic nerve. A Cobb elevator was used to push the posterior part of the gluteus minimus muscle anteriorly and expose the hip joint capsule. The hip joint capsule was then cut according to the incision from the base of the greater trochanter to 1 cm proximal to the acetabular rim. The capsule was elevated as a flap anterior and posterior to improve visualization, and the blunt Hohmann retractor was then moved to the intracapsular position. Starting in the anterior portion of the piriformis fossa, the femur was reamed and broached without dislocation. Occasionally, in osteoarthritis patients, huge osteophytes need to be removed by osteotome to expose the starting point. An entry reamer was used to open the canal, and a canal feeler was used to confirm the position in the canal. A calcar punch was used to knock out the femoral neck and head in order to insert the broaches. Consecutive broaches were used until the appropriate broach was placed, and depth relative to the greater trochanter was compared to the preoperative plan. The femoral

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	neck osteotomy was made using the superior aspect of the broach as a guide and two Schanz pins were inserted into the femoral head in order to rotate and remove the head. The femur was then displaced anteriorly by the assistant using a bone hook. The implant trial cup was placed into the acetabulum. A portal placement guide was used to allow for the placement of a reaming cannula just posterior to the trochanter in line with the planned acetabular placement. The cannula was left in place, and extraction was made using a portal placement guide. The cannula was kept close to the femur to ensure that it was well away from the sciatic nerve. The acetabulum was prepared by resecting calcified labrum and ensuring that the transverse acetabular ligament remained visible. An appropriately sized acetabular basket reamer was inserted in the acetabulum through the main incision and connected to the reamer drive shaft through the cannula, allowing reaming with preservation of the external rotators. The definitive cup and polyethylene liner were placed in a similar procedure (using a portal placement guide) with the option for alignment guides. A trial head and neck were placed, and a blunt trocar was used to push the femur with an assistant adducting the leg and rotating the femur to reduce the neck into the femoral head. C-arm fluoroscopy was used in order to ensure that the trial component position and angulation were correct. Components were then separated and removed. The definitive femoral head was inserted, and a femoral prosthesis was implanted and reduced again. The hip joint capsule was perfectly preserved and closed with a suture. Then, the gluteal fascia and skin were closed with sutures. . Duration N/A. Concurrent medication/care: All patients were followed up in the same rehabilitation unit in our hospital.. Indirectness: No indirectness (n=46) Intervention 2: Posterior approach. Posterior - (Moore approach) The patient was placed in a lateral position; the incision was started 10 cm distal to the posterior superior iliac spine and extended to the posterior margin of the greater trochanter. The length of the incision was 12–13 cm; exposure and division of the deep fascia was made in line with the skin incision. The fibers of the gluteus maximus were dissected bluntly and separated, and exposed the greater trochanter. Divisions of the distal fibers were exposed, and the external rotators were released. The muscles were retracted medially, and the capsule was exposed and split distally to the proximal along the line of the femoral neck in order to detach the distal part of the capsule from the femur the rim of the acetabulum. The standard posterior technique was followed in order to perform the femoral neck osteotomy, the hip was dislocated posteriorly, and the prosthesis was implanted. . Duration N/A. Concurrent medication/care: All patients were followed up in the same rehabilitation unit in our hospital. . Indirectness: No indirectness
Funding	Academic or government funding (This study was supported by the Health Science and Technology Special Projects Foundation of Zhenjiang, Jiangsu Province (SHW2016005).)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: SuperPATH APPROACH versus POSTERIOR APPROACH

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: Harris Hip Score at 1 week at 1 week; Group 1: mean 73.8 (SD 3.89); n=46, Group 2: mean 69 (SD 4.81); n=46

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	Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Barthel Index at 1 week at 1 week; Group 1: mean 70.67 (SD 9.47); n=46, Group 2: mean 64.46 (SD 7.7); n=46 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 2: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year - Actual outcome: Harris Hip Score at 1 year at 1 year; Group 1: mean 92.3 (SD 1.62); n=46, Group 2: mean 91.6 (SD 2.41); n=46 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Barthel Index at 1 year at 1 year; Group 1: mean 94.33 (SD 6.9); n=46, Group 2: mean 93.6 (SD 8.74); n=46 Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 3: Length of stay at in hospital - Actual outcome: Length of stay at 1 year; Group 1: mean 8.3 (SD 3.6); n=46, Group 2: mean 11.4 (SD 2.4); n=46 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 4: Reoperation/dislocation rate at N/A - Actual outcome: Dislocation at 1 year; Group 1: 1/46, Group 2: 2/46 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 5: Surgery time at N/A - Actual outcome: Operation time at 1 year; Group 1: mean 103.6 (SD 11.8); n=46, Group 2: mean 106.5 (SD 16.5); n=46 Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Intraoperative complications (for example nerve damage) at before JR is revised; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Yang 2010[124]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=110)
Countries and setting	Conducted in China
Line of therapy	1st line
Duration of study	Intervention + follow up: 3 year follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	N/A
Exclusion criteria	Included a history of previous surgery on the affected hip, inflammatory polyarthritis with severity to compromise postoperative mobility, pulmonary and heart insufficiency intolerant of surgery, cerebrovascular diseases accompanied by physical sequelae, BMI > 30, and Crowe III-IV of DDH.
Age, gender and ethnicity	Age - Mean (SD): PL - 55.82 (13.91), AL - 59.47 (13.24). Gender (M:F): 56 men, 54 women. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=55) Intervention 1: Anterolateral approach. Anterolateral approach - OCM approach. Each patient was positioned on the operating table in the lateral position with the affected side up. The patient's pelvis and torso were firmly secured to the operating table with a rigid stabilisation system. Skin incision was made on a line beginning at the anterior tubercle of the greater trochanter and extending along the femoral axis approximately 7cm in length. . Duration N/A. Concurrent medication/care: All surgical incisions were covered with the same size dressing. All patients were given patient-controlled analgesia with a sustained release analgesic pump. All patients were boosted with analgesic drug two times per hour at the first 3hr after surgery, four times per hour at the 4-16th hr and two times per hour at the 17-24th hr. Following surgery all patients had a standard length wound dressing, ensuring that the patients and all staff, except those directly attending to wound care, were blind to the technique used. . Indirectness: No indirectness (n=55) Intervention 2: Posterior approach. Postlateral approach - No further details given. . Duration N/A. Concurrent medication/care: All surgical incisions were covered with the same size dressing. All patients were given patient-controlled analgesia with a sustained release analgesic pump. All patients were boosted with analgesic drug two times per hour at the first 3hr after surgery, four times per hour at the 4-16th hr and two times per hour at the 17-24th hr. Following surgery all patients had a standard length wound dressing,

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	ensuring that the patients and all staff, except those directly attending to wound care, were blind to the technique used. . Indirectness: No indirectness
Funding	Funding not stated
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ANTEROLATERAL APPROACH versus POSTERIOR APPROACH Protocol outcome 1: Intraoperative complications (for example nerve damage) at before JR is revised - Actual outcome: Blood loss (ml) at N/A; Group 1: mean 376.18 (SD 168.3); n=55, Group 2: mean 605 (SD 225.12); n=55 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0 Protocol outcome 2: Surgery time at N/A - Actual outcome: Operation time (minutes) at N/A; Group 1: mean 77.55 (SD 13.39); n=55, Group 2: mean 73.67 (SD 14.51); n=55 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Length of stay at in hospital; Reoperation/dislocation rate at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Zhao 2017[128]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=128)
Countries and setting	Conducted in China
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	All patients undergoing primary THA diagnosed with osteoarthritis of the hip, femoral head necrosis. or Crowe type 1 or 2 dysplasia were eligible.
Exclusion criteria	BMI >30kg/m², Crowe type 3 or 4 dysplasia, previous hardware, prior hip surgery, an inability to tolerate general anaesthesia, the first 100 patients performed with the DAA or an unwillingness to participate in the trial.
Age, gender and ethnicity	Age - Mean (SD): DA - 64.88 (12.13), PL - 62.18 (14.72) . Gender (M:F): 70 female, 58 male. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=64) Intervention 1: Direct anterior approach. Direct anterior approach - performed using the interval between the tensor fascia latae and the sartorius muscle. Patients treated using the DAA were positioned supine on a standard operating table with the pubic symphysis at the table break to allow anterior access during surgery. For preoperative planning, an acetabular template was placed in the anatomical hip center, and then a femoral template was placed with the prosthetic femoral head center at the height of the tip of the greater trochanter. . Duration N/A. Concurrent medication/care: Before surgery, all patients received the same multimodal anaesthesia. For 24 hours before surgery, all patients received cefazolin. During surgery, ropivacaine was infiltrated into the surgical site and delivered as a periarticular cocktail injection. Both groups adopted the same postoperative rehabilitation protocol. (n=64) Intervention 2: Posterior approach. Posterolateral approach - performed with the patient in a lateral decubitus position on a standard operating table. After skin incision through the fascia over the greater trochanter, the gluteus maximus was split, the external rotators were detached, and an incision was made in the hip capsule. The hip was dislocated by internal rotation and flexion. . Duration N/A. Concurrent medication/care: Before surgery, all patients received the same multimodal anaesthesia. For 24 hours before

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	surgery, all patients received cefazolin. During surgery, ropivacaine was infiltrated into the surgical site and delivered as a periarticular cocktail injection. Both groups adopted the same postoperative rehabilitation protocol. . Indirectness: No indirectness
Funding	No funding (This research did not receive financial support from funding agencies in the public, commercial or not-for-profit sectors.)

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RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT ANTERIOR APPROACH versus POSTERIOR APPROACH

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: Harris Hip Score at 6 months at 6 months; Group 1: mean 92.2 (SD 13.25); n=60, Group 2: mean 89.9 (SD 11.74); n=60
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: dropped out; Group 2 Number missing: 4, Reason: dropped out
- Actual outcome: University of California at Los Angeles at 6 months at 6 months; Group 1: mean 7.04 (SD 1.13); n=60, Group 2: mean 6.96 (SD 1.21); n=60
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: dropped out; Group 2 Number missing: 4, Reason: dropped out

Protocol outcome 2: Length of stay at in hospital
- Actual outcome: Length of hospital stay (days) at N/A; Group 1: mean 2.8 (SD 0.16); n=60, Group 2: mean 3.3 (SD 0.37); n=60
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: dropped out; Group 2 Number missing: 4, Reason: dropped out

Protocol outcome 3: Intraoperative complications (for example nerve damage) at before JR is revised
- Actual outcome: Intraoperative blood loss (ml) at N/A; Group 1: mean 165.89 (SD 42.6); n=60, Group 2: mean 123.84 (SD 56.83); n=60
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: dropped out; Group 2 Number missing: 4, Reason: dropped out

Protocol outcome 4: Surgery time at N/A
- Actual outcome: Operating time (minutes) at N/A; Group 1: mean 83.26 (SD 6.69); n=60, Group 2: mean 65.48 (SD 13.32); n=60
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 4, Reason: dropped out; Group 2 Number missing: 4, Reason: dropped out

Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Reoperation/dislocation rate at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ;

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Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Study	Zomar 2018[130]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=78)
Countries and setting	Conducted in Canada; Setting:
Line of therapy	1st line
Duration of study	Intervention + follow up: 3 months follow up
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Participants were included if they were undergoing a primary, unilateral THA for osteoarthritis and were between the ages of 18 and 75 years old.
Exclusion criteria	Exclusion criteria included those with a body mass index (BMI) >40, inability to ambulate a minimum of 10 m pre-surgery, ipsilateral total knee arthroplasty or comorbidities of the lower extremities that would affect gait.
Age, gender and ethnicity	Age - Mean (SD): lateral - 59.54 (8.40), anterior - 60.78 (9.26). Gender (M:F): 41 male, 37 female. Ethnicity: N/A
Further population details	1. Age:
Indirectness of population	No indirectness
Interventions	(n=42) Intervention 1: Anterolateral approach. Direct lateral - No further details given. . Duration N/A. Concurrent medication/care: No further details given. . Indirectness: No indirectness (n=36) Intervention 2: Direct anterior approach. Direct anterior - No further details given. . Duration N/A. Concurrent medication/care: No further details given. . Indirectness: No indirectness
Funding	No funding (The author(s) received no financial support for the research, authorship, and/or publication of this article.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: ANTEROLATERAL APPROACH versus DIRECT ANTERIOR APPROACH

Protocol outcome 1: Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier
- Actual outcome: WOMAC scale - total score at 6 weeks at 6 weeks; Group 1: mean 74.3 (SD 13.22); n=42, Group 2: mean 71.5 (SD 13.26); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low,

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Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn
- Actual outcome: SF-12 scale - physical sub scale at 2 weeks at 2 weeks; Group 1: mean 30.37 (SD 7.84); n=42, Group 2: mean 31.05 (SD 7.8); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn
- Actual outcome: SF-12 scale - mental sub scale at 2 weeks at 2 weeks; Group 1: mean 54.09 (SD 10.11); n=42, Group 2: mean 52.52 (SD 10.14); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn

Protocol outcome 2: Patient Reported Outcome Measures (PROMs) at later than 6 weeks up to 1 year
- Actual outcome: WOMAC scale - total score at 3 months at 3 months; Group 1: mean 84.35 (SD 11.79); n=42, Group 2: mean 81.34 (SD 12.12); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn
- Actual outcome: SF-12 scale - physical sub scale at 3 months at 3 months ; Group 1: mean 46.67 (SD 8.3); n=42, Group 2: mean 45.92 (SD 8.58); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn
- Actual outcome: SF-12 scale - mental sub scale at 3 months at 3 months; Group 1: mean 55.81 (SD 8.17); n=42, Group 2: mean 55.16 (SD 8.46); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn
- Actual outcome: Harris Hip Score at 3 months at 3 months; Group 1: mean 92.04 (SD 7.26); n=42, Group 2: mean 95.44 (SD 7.5); n=36
Risk of bias: All domain - Very high, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn

Protocol outcome 3: Length of stay at in hospital
- Actual outcome: Length of stay at N/A; MD; -1.4 (95%CI -1.8 to -1, Comments: Mean score
anterior - 0.8, lateral - 2.2);
Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Group 1 Number missing: 2, Reason: missed; Group 2 Number missing: 3, Reason: missed, withdrawn

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Protocol outcomes not reported by the study	Mortality: life expectancy at time to event; Mortality at within 30 days; Quality of life at 6 weeks or earlier; Quality of life at later than 6 weeks up to 1 year; Quality of life at later than 2 years ; Patient Reported Outcome Measures (PROMs) at later than 2 years ; Revision rate of of joint replacement at time to event; Deep surgical site Infection at before JR is revised; Superficial surgical site infection at before JR is revised; Reoperation/dislocation rate at N/A; Intraoperative complications (for example nerve damage) at before JR is revised; Surgery time at N/A; Function at 6 weeks or earlier; Function at later than 6 weeks up to 1 year; Function at later than 2 years ; Pain at 6 weeks or earlier; Pain at later than 6 weeks up to 1 year; Pain at later than 2 years

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Appendix E: Forest plots

E.1 Direct anterior vs anterolateral

Figure 2: Quality of life, SF-12 and SF-36 scale, mental subscales, high is good outcome, 6 weeks or earlier

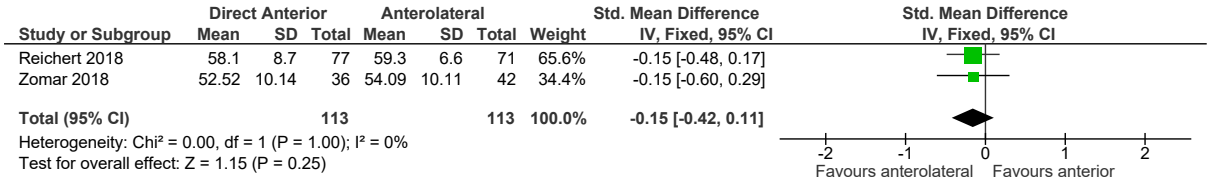

Figure 3: Quality of life, SF-12 and SF-36 scale, physical subscales, high is good outcome, 6 weeks or earlier

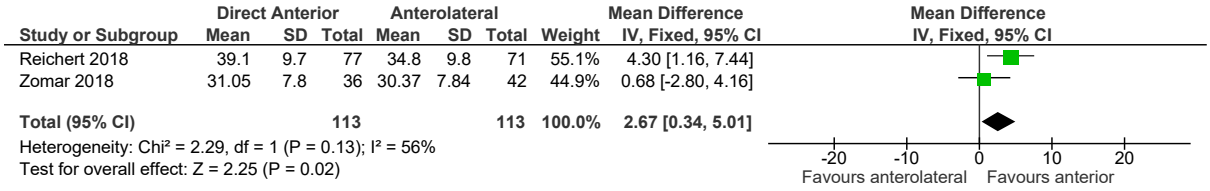

Figure 4: Quality of life, SF-12 and SF-36 scale, mental subscales, high is good outcome, later than 6 weeks up to 1 year

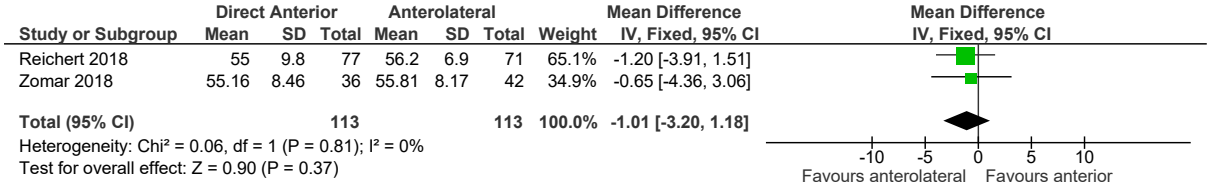

Figure 5: Quality of life, SF-12 and SF-36 scale, physical subscales, high is good outcome, later than 6 weeks up to 1 year

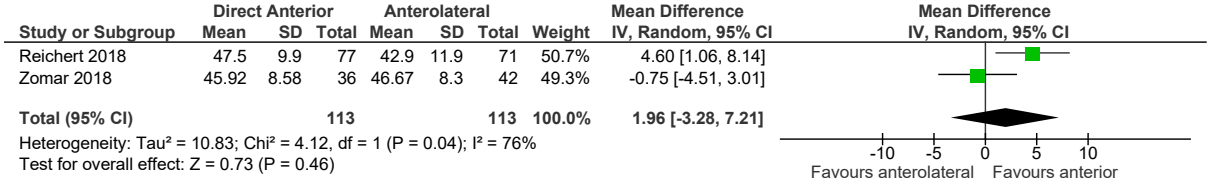

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Figure 6: PROMs, WOMAC, total score, high is good, 6 weeks or earlier

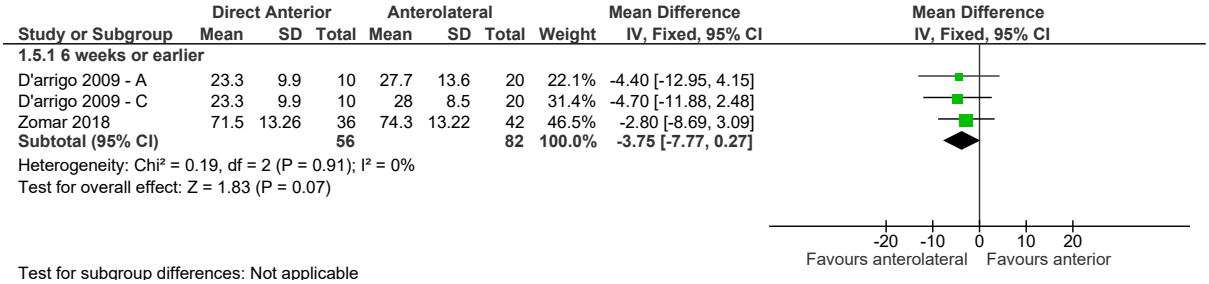

Figure 7: PROMs, Harris Hip Score, 0-100, high is good, 6 weeks or earlier

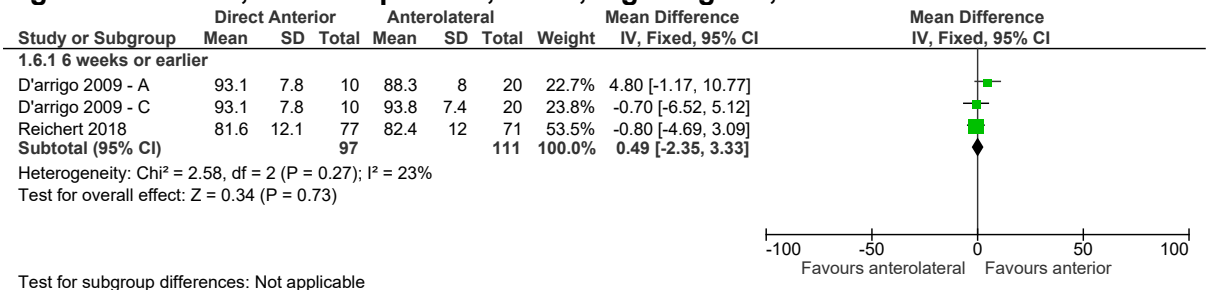

Figure 8: PROMs, WOMAC, total score, high is good, later than 6 weeks up to 1 year

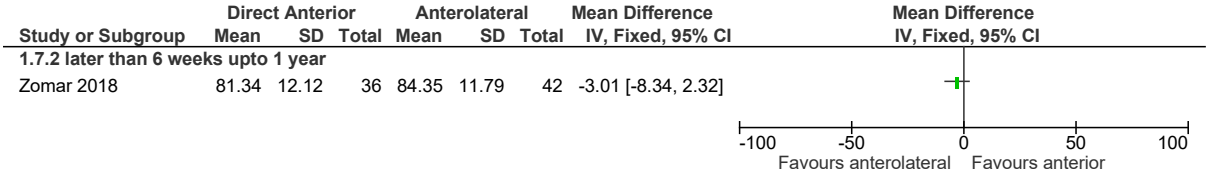

Figure 9: PROMs, Harris Hip Score, 0-100, high is good, later than 6 weeks up to 1 year

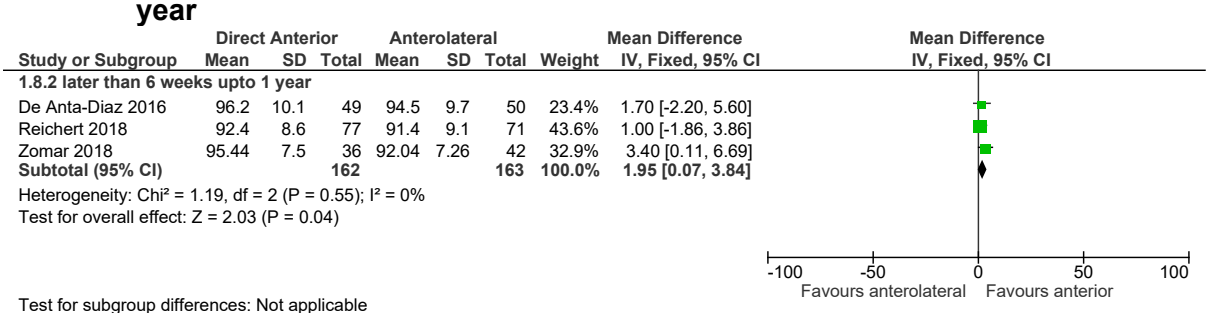

Figure 10: Revision, 5 years

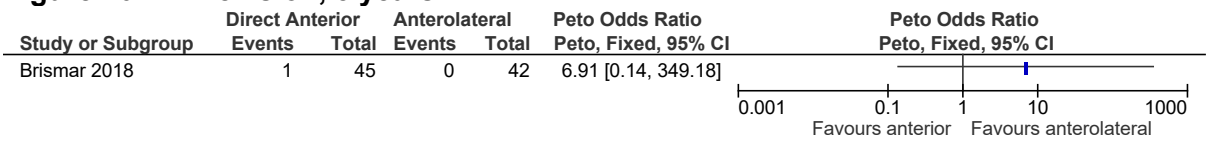

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Figure 11: Dislocation, 5 years

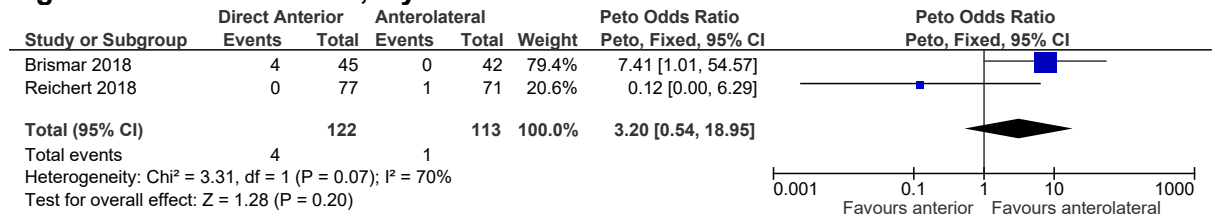

Figure 12: Deep Infection

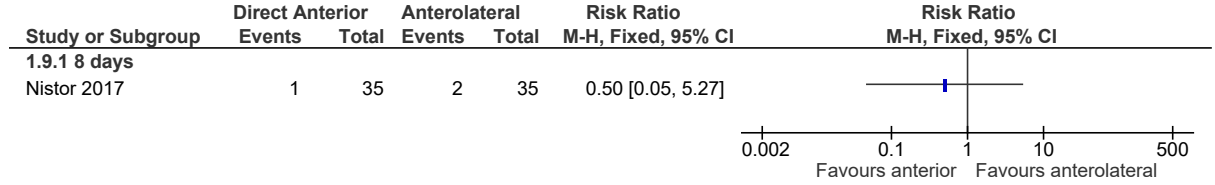

Figure 13: Deep Infection

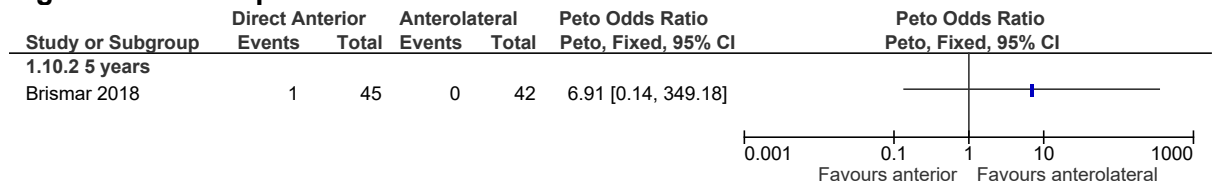

Figure 14: Intraoperative complications - lateral femoral cutaneous nerve injury, 8 days

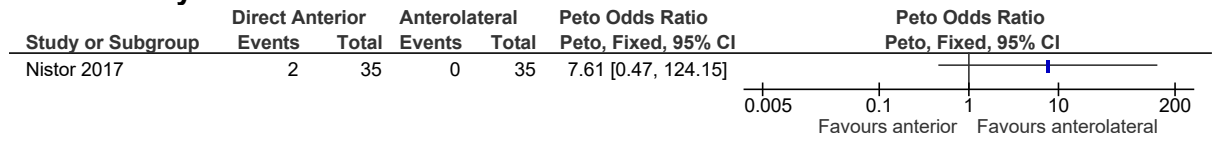

Figure 15: Intraoperative complications - hyperesthesia

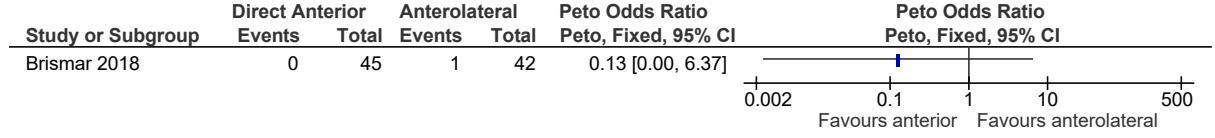

Figure 16: Intraoperative complications - blood loss (ml)

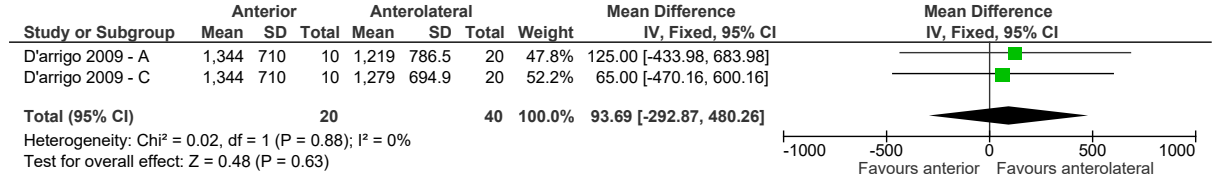

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Figure 17: Surgery time (minutes)

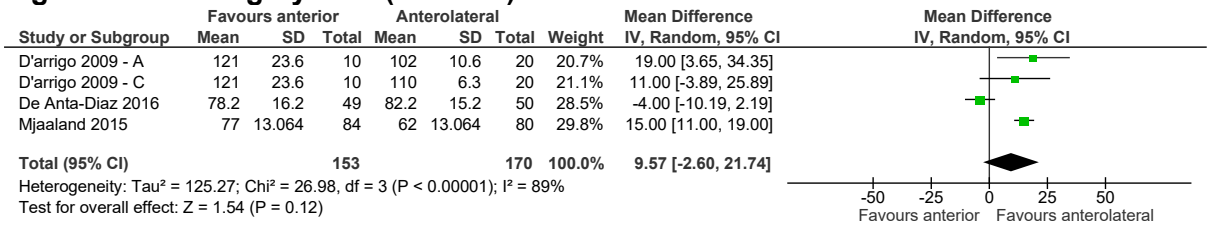
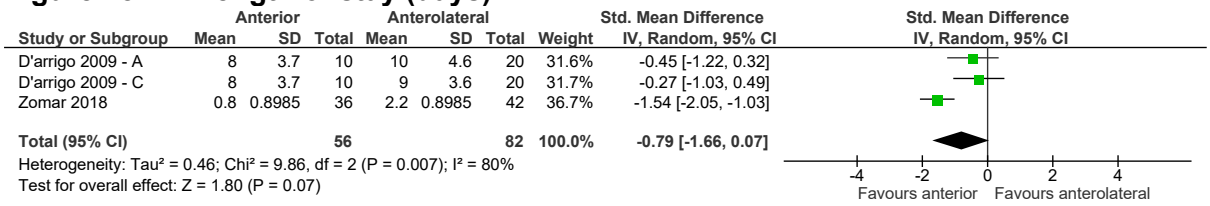


Figure 18: Length of stay (days)



E.2 Direct anterior vs posterior

Figure 19: Quality of life, EQ-5D, HOOS (QOL subscale) high is good outcome, 6 weeks or earlier

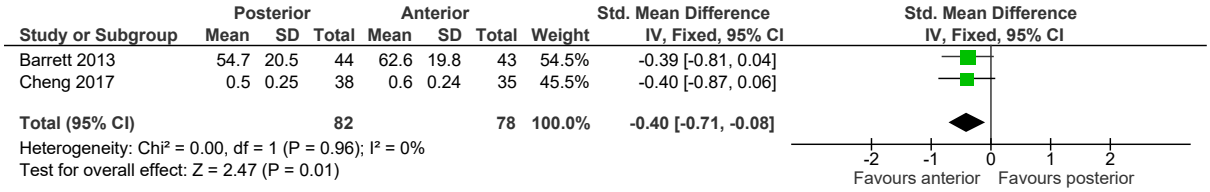


Figure 20: Quality of life, EQ-5D, HOOS (QOL subscale) high is good outcome, later than 6 weeks up to 1 year

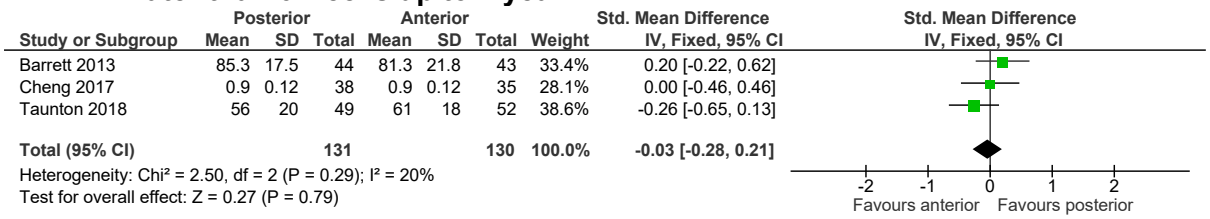


Figure 21: Quality of life, SF-12 scale, mental subscales, high is good outcome, later than 6 weeks or up to 1 year

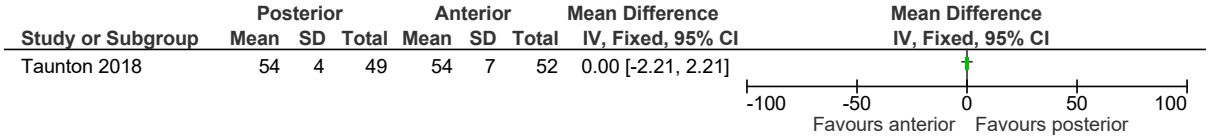


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Figure 22: Quality of life, SF-12 scale, physical subscales, high is good outcome, later than 6 weeks or up to 1 year

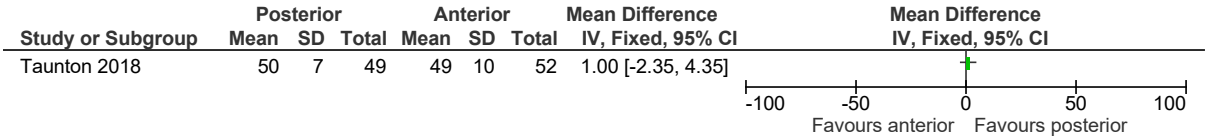


Figure 23: PROMs, WOMAC, 0-96, high is poor

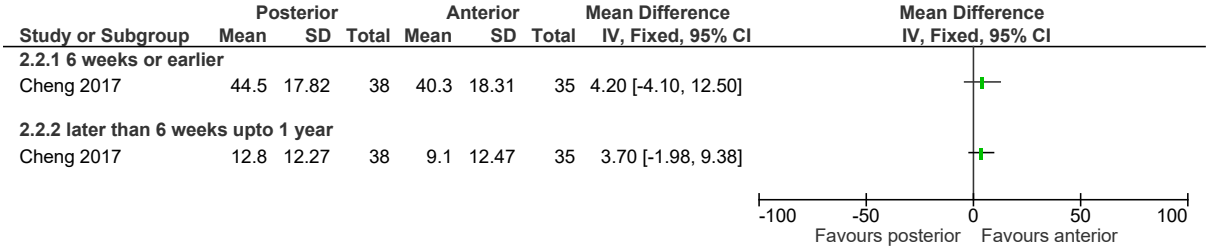


Figure 24: PROMs, Oxford Hip Score, 0-48, high is good

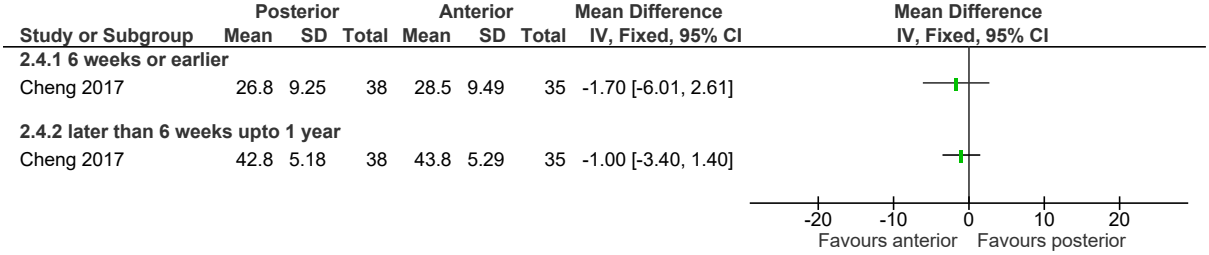
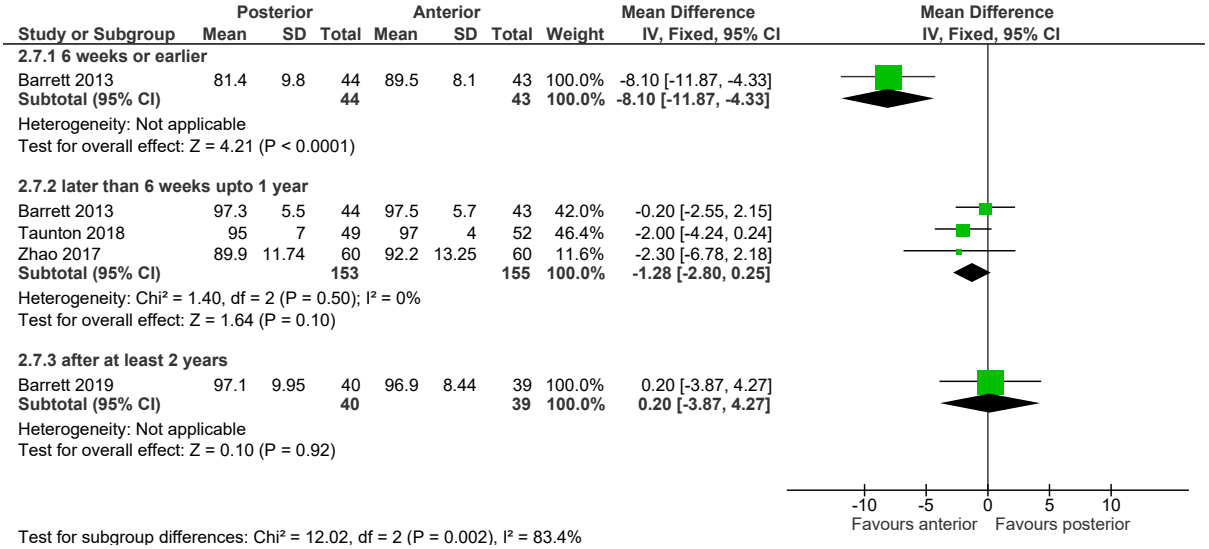


Figure 25: PROMs, Harris Hip Score, 0-100, high is good



Test for subgroup differences: Chi² = 12.02, df = 2 (P = 0.002), I² = 83.4%

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Figure 26: PROMs, HOOS score - symptoms subscale, high is good, 6 weeks or earlier

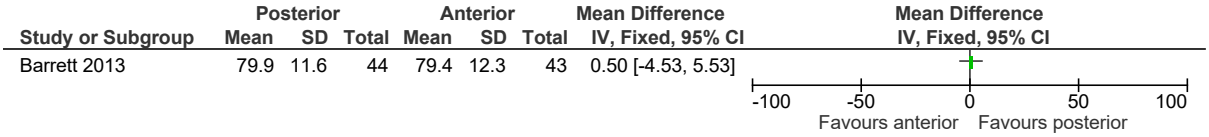

Figure 27: PROMs, HOOS score - symptoms subscale, high is good, later than 6 weeks or up to 1 year

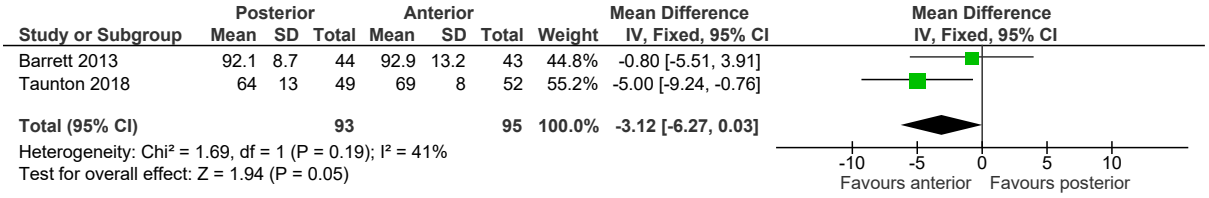

Figure 28: PROMs, HOOS score - pain subscale, high is good, later than 6 weeks or up to 1 year

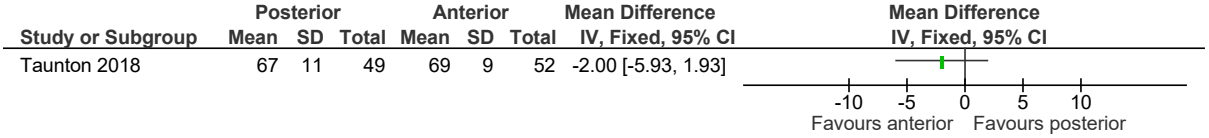

Figure 29: PROMs, HOOS Jr score, high is good, after at least 2 years

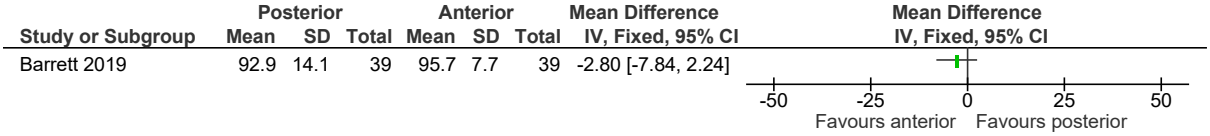

Figure 30: PROMs, UCLA score, 6 months, high is poor

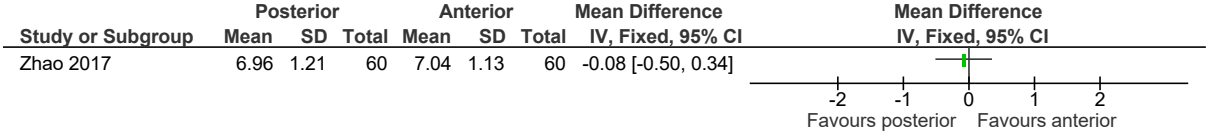

Figure 31: PROMs, UCLA score, after at least 2 years, high is good

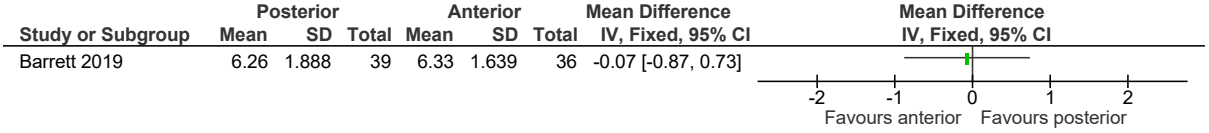

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Figure 32: Revision, 12 months

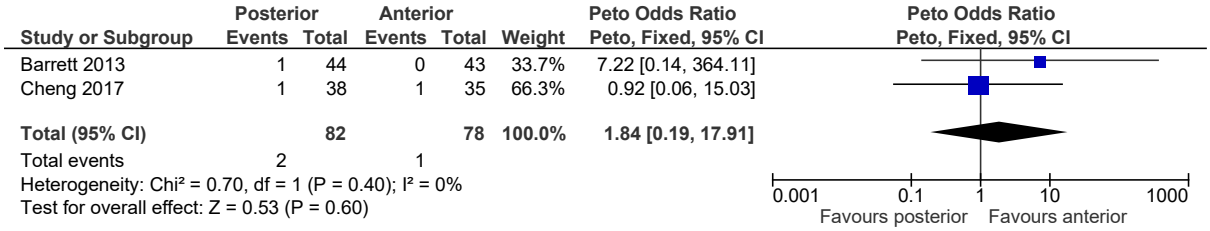

Figure 33: Dislocation, 12 months

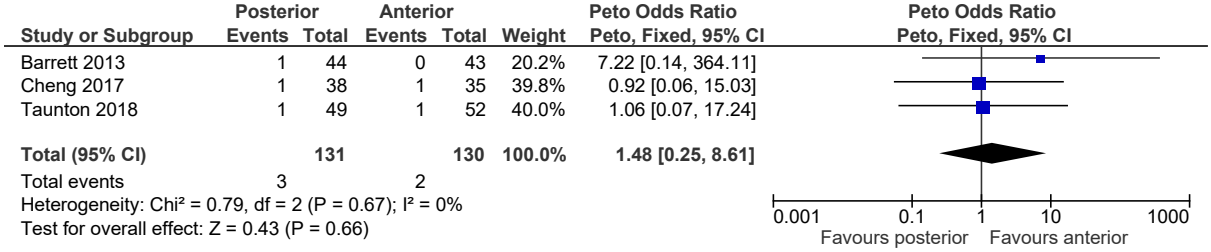

Figure 34: Deep Infection, 6 weeks

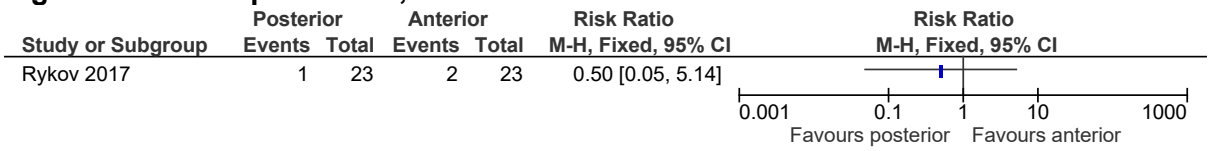

Figure 35: Intraoperative complications - lateral cutaneous nerve of the thigh neuropraxia, 12 weeks

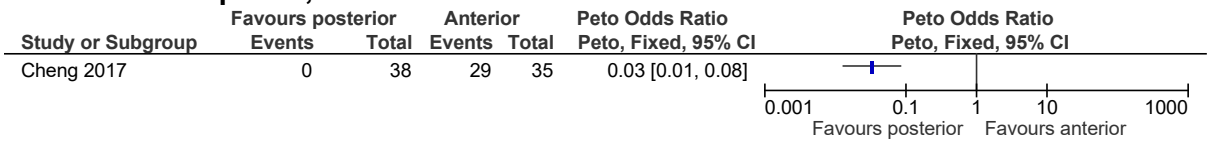

Figure 36: Intraoperative complications - blood loss (ml)

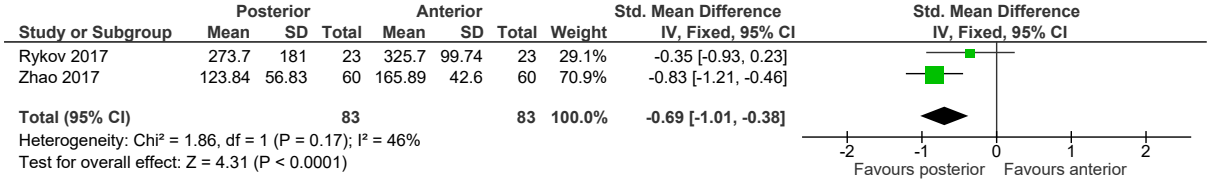

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Figure 37: Length of stay (days)

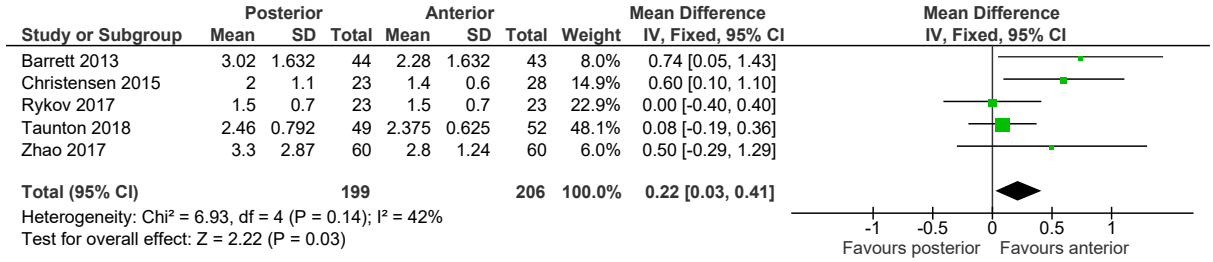
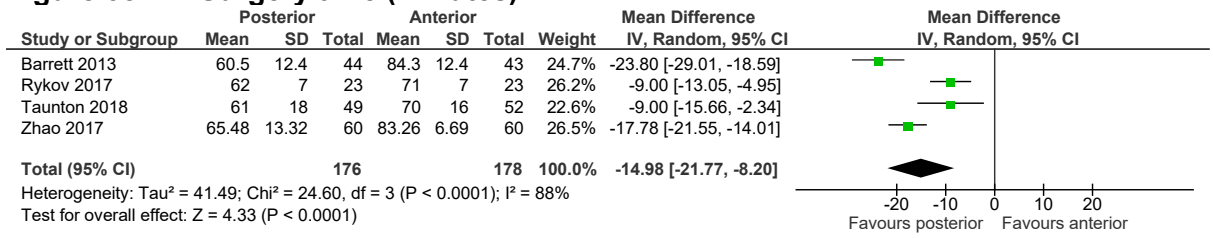


Figure 38: Surgery time (minutes)



E.3 Posterior vs anterolateral

Figure 39: PROMs, Harris Hip Score, 0-100, high is good

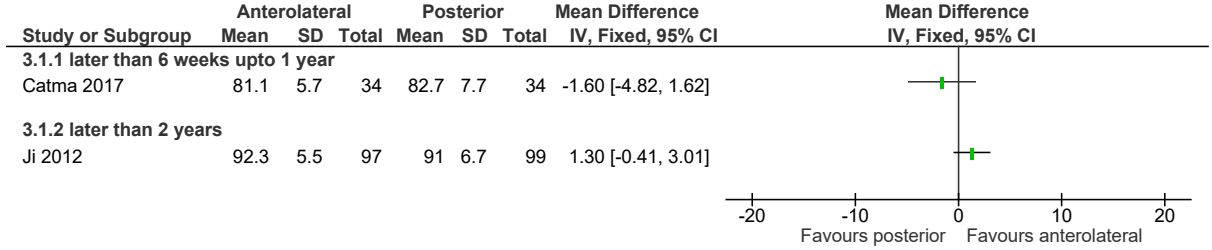


Figure 40: Revision, 37.9 months

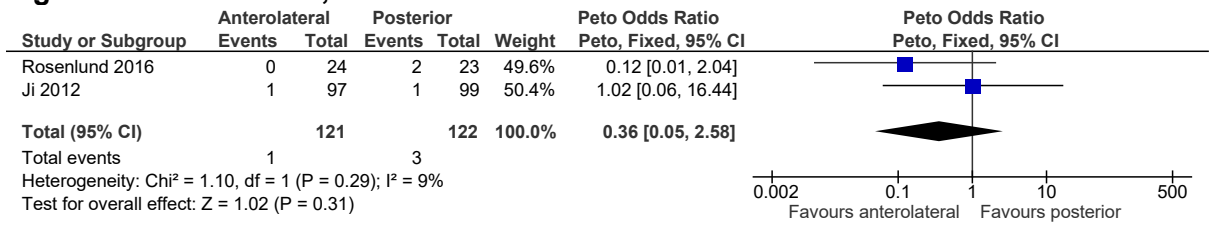


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Figure 41: Dislocation, 37.9 months

Study or Subgroup	Anterolateral Events	Anterolateral Total	Posterior Events	Posterior Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Catma 2017	2	34	3	34	48.6%	0.65 [0.11, 3.98]
Ji 2012	3	97	0	99	30.7%	7.70 [0.79, 74.93]
Rosenlund 2016	0	24	1	23	10.3%	0.13 [0.00, 6.54]
Witzleb 2009	0	30	1	30	10.3%	0.14 [0.00, 6.82]
Total (95% CI)		**185**		**186**	**100.0%**	**1.00 [0.28, 3.53]**
Total events	5		5			

Heterogeneity: Chi² = 5.35, df = 3 (P = 0.15); I² = 44%
Test for overall effect: Z = 0.00 (P = 1.00)

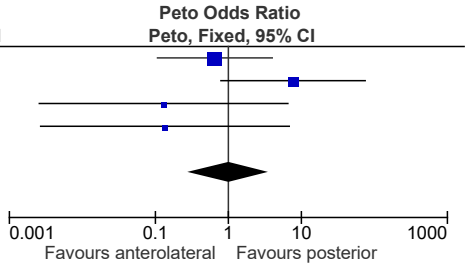


Figure 42: Reoperation, 6 months

Study or Subgroup	Anterolateral Events	Anterolateral Total	Posterior Events	Posterior Total	Peto Odds Ratio Peto, Fixed, 95% CI
Catma 2017	0	34	1	34	0.14 [0.00, 6.82]

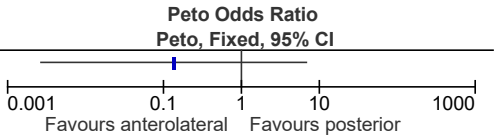


Figure 43: Superficial surgical site infection, 12 weeks

Study or Subgroup	Anterolateral Events	Anterolateral Total	Posterior Events	Posterior Total	Peto Odds Ratio Peto, Fixed, 95% CI
Witzleb 2009	2	30	0	30	7.65 [0.47, 125.22]

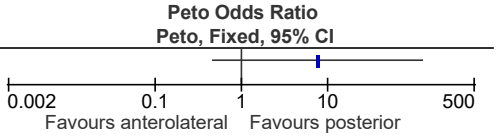


Figure 44: Intraoperative complications - blood loss (ml)

Study or Subgroup	Anterolateral Mean	Anterolateral SD	Anterolateral Total	Posterior Mean	Posterior SD	Posterior Total	Mean Difference IV, Fixed, 95% CI
Yang 2010	376.18	168.3	55	605	225.12	55	-228.82 [-303.10, -154.54]

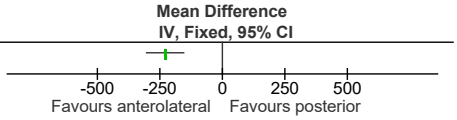


Figure 45: Surgery time (minutes)

Study or Subgroup	Anterolateral Mean	Anterolateral SD	Anterolateral Total	Posterior Mean	Posterior SD	Posterior Total	Weight	Mean Difference IV, Random, 95% CI
Catma 2017	96.4	15.1	34	98.1	13.1	34	33.6%	-1.70 [-8.42, 5.02]
Ji 2012	132	37.5	97	105	25.7	99	31.7%	27.00 [17.98, 36.02]
Yang 2010	77.55	13.39	55	73.67	14.51	55	34.6%	3.88 [-1.34, 9.10]
Total (95% CI)			**186**			**188**	**100.0%**	**9.34 [-5.01, 23.69]**

Heterogeneity: Tau² = 147.66; Chi² = 26.51, df = 2 (P < 0.00001); I² = 92%
Test for overall effect: Z = 1.28 (P = 0.20)

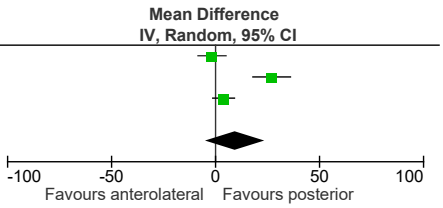
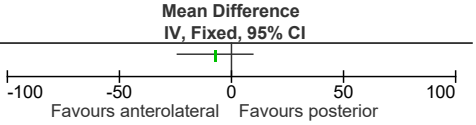


Figure 46: Pain later than 6 weeks up to 1 year, VAS scale, high is poor outcome (change score)

Study or Subgroup	Anterolateral Mean	Anterolateral SD	Anterolateral Total	Posterior Mean	Posterior SD	Posterior Total	Mean Difference IV, Fixed, 95% CI
Lorenzen 2013	-50.36	20.29	10	-43.08	19.75	12	-7.28 [-24.10, 9.54]



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E.4 SuperPATH vs posterior

Figure 47: PROMs, Barthel Index score, high is good

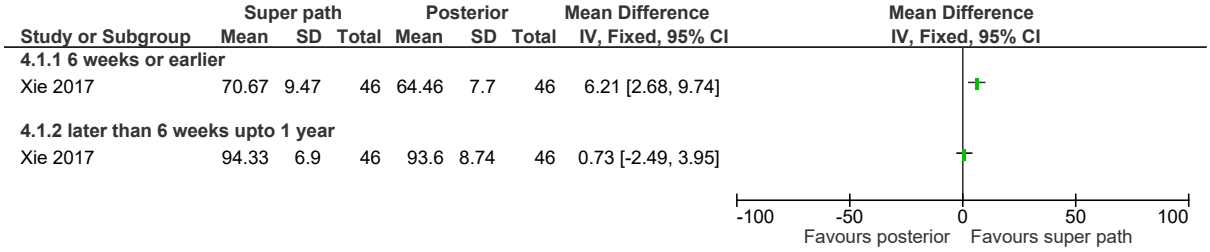


Figure 48: PROMs, Harris Hip Score, high is good

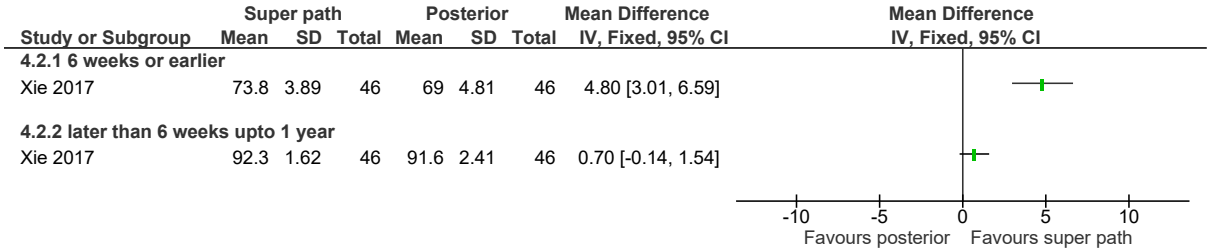


Figure 49: Dislocation, 12 months

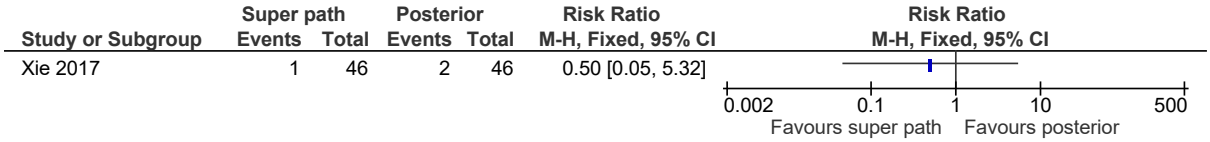


Figure 50: Length of stay (days)

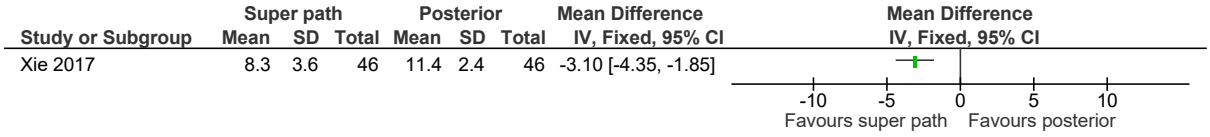
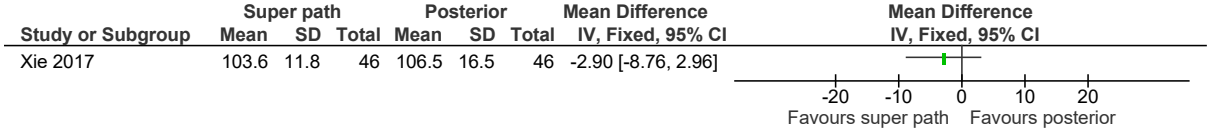


Figure 51: Surgery time (minutes)



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Appendix F: GRADE tables

Table 13: Clinical evidence profile: Direct anterior approach versus Anterolateral approach

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Direct anterior	Anterolateral approach	Relative (95% CI)	Absolute		
Quality of life (follow-up 2 to 6 weeks; measured with: SF-12, SF-36 - mental subscale; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	113	113	-	SMD 0.15 lower (0.42 lower to 0.11 higher)	⊕⊕OO LOW	CRITICAL
Quality of life (follow-up 2 to 6 weeks; measured with: SF-12, SF-36 - physical subscale; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	113	113	-	MD 2.67 higher (0.34 to 5.01 higher)	⊕OOO VERY LOW	CRITICAL
Quality of life (follow-up 3 to 12 months; measured with: SF-12, SF-36 - mental subscale; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	113	113	-	MD 1.01 lower (3.2 lower to 1.18 higher)	⊕⊕OO LOW	CRITICAL
Quality of life (follow-up 3 to 12 months; measured with: SF-12, SF-36 - physical subscale; Better indicated by higher values)												
2	randomised trials	very serious[1]	serious[3]	no serious indirectness	serious[2]	none	113	113	-	MD 1.96 higher (3.28 lower to 7.21 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 6 weeks; measured with: WOMAC - total score; Better indicated by higher values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	56	82	-	MD 3.75 lower (7.77 lower to 0.27 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 6 weeks; measured with: Harris Hip Score; range of scores: 0-100; Better indicated by higher values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	97	111	-	MD 0.49 higher (2.35 lower to 3.33 higher)	⊕⊕OO LOW	CRITICAL
PROMs (follow-up 3 months; measured with: WOMAC - total score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	36	42	-	MD 3.01 lower (8.34 lower to 2.32 higher)	⊕OOO VERY	CRITICAL

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											LOW	
PROMs (follow-up 3 to 12 months; measured with: Harris Hip Score; range of scores: 0-100; Better indicated by higher values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	162	163	-	MD 1.95 higher (0.07 to 3.84 higher)	⊕⊕OO LOW	CRITICAL
Revision (follow-up 5 years)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	1/45 (2.2%)	0/42 (0%)	Peto OR 6.91 (0.14 to 349.18)	20 more per 1000 (from 40 fewer to 80 more)	⊕OOO VERY LOW	CRITICAL
Dislocation (follow-up 1 to 5 years)												
2	randomised trials	serious[1]	no serious inconsistency	serious indirectness[4]	very serious[2]	none	4/122 (3.3%)	1/113 (0.88%)	Peto OR 3.2 (0.54 to 18.95)	20 more per 1000 (from 20 fewer to 70 more)	⊕OOO VERY LOW	IMPORTANT
Deep Infection (follow-up 8 days)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	1/35 (2.9%)	2/35 (5.7%)	RR 0.50 (0.05 to 5.27)	29 fewer per 1000 (from 54 fewer to 244 more)	⊕OOO VERY LOW	IMPORTANT
Deep Infection (follow-up 5 years)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	1/45 (2.2%)	0/42 (0%)	Peto OR 6.91 (0.14 to 349.18)	20 more per 1000 (from 40 fewer to 80 more)	⊕OOO VERY LOW	IMPORTANT
Intraoperative complications - lateral femoral cutaneous nerve injury (follow-up 8 days)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	2/35 (5.7%)	0/35 (0%)	Peto OR 7.61 (0.47 to 124.15)	60 more per 1000 (from 30 fewer to 150 more)	⊕OOO VERY LOW	IMPORTANT
Intraoperative complications - hyperesthesia (follow-up 5 years)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	0/45 (0%)	1/42 (2.4%)	Peto OR 0.13 (0 to 6.37)	20 fewer per 1000 (from 90 fewer to 40 more)	⊕OOO VERY LOW	IMPORTANT
Intraoperative complications - blood loss (ml) (follow-up 6 weeks; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	20	40	-	MD 93.69 higher (292.87 lower to 480.26 higher)	⊕⊕OO LOW	IMPORTANT
Surgery time (minutes) (Better indicated by lower values)												
4	randomised trials	very serious[1]	serious[3]	no serious indirectness	serious[2]	none	153	170	-	MD 9.57 higher (2.60 lower to 21.74 higher)	⊕OOO VERY LOW	IMPORTANT

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Length of stay (days) (Better indicated by lower values)												
3	randomised trials	very serious[1]	serious[3]	no serious indirectness	serious[2]	none	56	82	-	SMD 0.79 lower (1.66 lower to 0.07 higher)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 or 2 increments because the point estimates varied widely across studies, unexplained by subgroup analysis
[4] Downgraded by 1 or 2 increments because the meta-analysed time points vary slightly from the protocol.

Table 14: Clinical evidence profile: Direct anterior approach versus Posterior approach

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Direct anterior**	**Posterior approach**	**Relative (95% CI)**	**Absolute**		
Quality of life (follow-up 2 to 6 weeks; measured with: EQ-5D, HOOS (QOL subscale); Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	82	78	-	SMD 0.40 lower (0.71 to 0.08 lower)	⊕OOO VERY LOW	CRITICAL
Quality of life (follow-up 3 to 12 months; measured with: EQ-5D, HOOS (QOL subscale); Better indicated by higher values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	131	130	-	SMD 0.03 lower (0.28 lower to 0.21 higher)	⊕⊕OO LOW	CRITICAL
Quality of life (follow-up 1 years; measured with: SF-12 scale mental subscale; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	49	52	-	MD 0.00 higher (2.21 lower to 2.21 higher)	⊕⊕OO LOW	CRITICAL
Quality of life (follow-up 1 years; measured with: SF-12 scale physical subscale; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	49	52	-	MD 1.00 higher (2.35 lower to 4.35 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 2 weeks; measured with: WOMAC scale; range of scores: 0-96; Better indicated by lower values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	38	35	-	MD 4.2 higher (4.1 lower to 12.5 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 12 weeks; measured with: WOMAC scale; range of scores: 0-96; Better indicated by lower values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	38	35	-	MD 3.7 higher (1.98 lower to 9.38 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 2 weeks; measured with: Oxford Hip Score; range of scores: 0-48; Better indicated by higher values)												

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1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	38	35	-	MD 1.7 lower (6.01 lower to 2.61 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 12 weeks; measured with: Oxford Hip Score; range of scores: 0-48; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	38	35	-	MD 1 lower (3.4 lower to 1.4 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 6 weeks; measured with: Harris Hip Total Score; range of scores: 0-100; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	44	43	-	MD 8.1 lower (11.87 to 4.33 lower)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 6 to 12 months; measured with: Harris Hip Score; range of scores: 0-100; Better indicated by higher values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	153	155	-	MD 1.28 lower (2.80 lower to 0.25 higher)	⊕⊕OO LOW	CRITICAL
PROMs (follow-up 5 years; measured with: Harris Hip Score; range of scores: 0-100; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	40	39	-	MD 0.20 higher (3.87 lower to 4.27 higher)	⊕⊕OO LOW	CRITICAL
PROMs - Symptoms subscale (follow-up 6 weeks; measured with: HOOS score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	44	43	-	MD 0.5 higher (4.53 lower to 5.53 higher)	⊕⊕OO LOW	CRITICAL
PROMs - symptoms subscale (follow-up 12 months; measured with: HOOS score; Better indicated by higher values)												
2	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	93	95	-	MD 3.12 lower (6.27 lower to 0.03 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up mean 1 years; measured with: HOOS score - pain subscale; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	49	52	-	MD 2.00 lower (5.93 lower to 1.93 higher)	⊕⊕OO LOW	CRITICAL
PROMs (follow-up mean 6.2 years; measured with: HOOS Jr Total Score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	39	39	-	MD 2.80 lower (7.84 lower to 2.24 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 6 months; measured with: UCLA score; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	60	60	-	MD 0.08 lower (0.5 lower to 0.34 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 5 years; measured with: UCLA score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	39	36	-	MD 0.07 lower (0.87 lower to 0.73 higher)	⊕⊕OO LOW	CRITICAL
Revision (follow-up 12 months)												
2	randomised	very	no serious	no serious	very serious[2]	none	2/82	1/78	Peto OR 1.84	10 more per 1000	⊕OOO	CRITICAL

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	trials	serious[1]	inconsistency	indirectness			(2.4%)	(1.3%)	(0.19 to 17.91)	(from 40 fewer to 60 more)	VERY LOW	
Dislocation (follow-up 12 months)												
2	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	3/131 (2.3%)	2/130 (1.5%)	Peto OR 1.48 (0.25 to 8.61)	10 more per 1000 (from 30 fewer to 40 more)	⊕OOO VERY LOW	IMPORTANT
Deep Infection (follow-up 6 weeks)												
1	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[2]	none	1/23 (4.3%)	2/23 (8.7%)	RR 0.5 (0.05 to 5.14)	43 fewer per 1000 (from 83 fewer to 360 more)	⊕⊕OO LOW	IMPORTANT
Function, mean time to ambulation with no assistive device (days) (follow-up mean 12 months; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	27	27	-	MD 12.30 higher (2.06 to 22.54 higher)	⊕⊕OO LOW	IMPORTANT
Intraoperative complications - lateral cutaneous nerve of the thigh neuropraxia (follow-up 12 weeks)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	0/38 (0%)	29/35 (82.9%)	Peto OR 0.03 (0.01 to 0.08)	830 fewer per 1000 (from 960 fewer to 700 fewer)	⊕⊕⊕O MODERATE	IMPORTANT
Intraoperative complications - blood loss (ml) (Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	83	83	-	SMD 0.69 lower (1.01 to 0.38 lower)	⊕⊕OO LOW	IMPORTANT
Length of stay (days) (Better indicated by lower values)												
5	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	199	206	-	MD 0.22 higher (0.03 to 0.41 higher)	⊕⊕OO LOW	IMPORTANT
Surgery time (minutes) (Better indicated by lower values)												
4	randomised trials	very serious[1]	very serious[3]	no serious indirectness	very serious[2]	none	176	178	-	MD 14.98 lower (21.77 to 8.20 lower)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 or 2 increments because the point estimates varied widely across studies, unexplained by subgroup analysis

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Table 15: Clinical evidence profile: Anterolateral approach versus Posterior approach

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Posterior approach	Anterolateral approach	Relative (95% CI)	Absolute		
PROMs (follow-up 6 months; measured with: Harris Hip Score; range of scores: 0-100; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	34	34	-	MD 1.6 lower (4.82 lower to 1.62 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up mean 37.9 months; measured with: Harris Hip Score ; range of scores: 0-100; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	97	99	-	MD 1.3 higher (0.41 lower to 3.01 higher)	⊕⊕OO LOW	CRITICAL
Revision (follow-up 37.9 months)												
2	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	1/121 (0.83%)	3/122 (2.5%)	Peto OR 0.36 (0.05 to 2.58)	20 fewer per 1000 (from 50 fewer to 20 more)	⊕OOO VERY LOW	CRITICAL
Dislocation (follow-up 37.9 months)												
4	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	5/185 (2.7%)	5/186 (2.7%)	Peto OR 1 (0.28 to 3.53)	0 fewer per 1000 (from 40 fewer to 40 more)	⊕⊕OO LOW	IMPORTANT
Reoperation (follow-up 6 months)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	0/34 (0%)	1/34 (2.9%)	Peto OR 0.14 (0 to 6.82)	30 fewer per 1000 (from 110 fewer to 50 more)	⊕OOO VERY LOW	IMPORTANT
Superficial surgical site infection (follow-up 12 weeks)												
1	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	2/30 (6.7%)	0/30 (0%)	Peto OR 7.65 (0.47 to 125.22)	70 more per 1000 (from 40 fewer to 170 more)	⊕⊕⊕O MODERATE	IMPORTANT
Intraoperative complications - blood loss (ml) (Better indicated by lower values)												
1	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	55	55	-	MD 228.82 lower (303.1 to 154.54 lower)	⊕⊕⊕O MODERATE	IMPORTANT

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Surgery time (minutes) (Better indicated by lower values)												
3	randomised trials	serious[1]	very serious[3]	no serious indirectness	serious[2]	none	186	188	-	MD 9.34 higher (5.01 lower to 23.69 higher)	⊕OOO VERY LOW	IMPORTANT
Pain (change score) (follow-up 12 months; measured with: VAS scale; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	10	12	-	MD 7.28 lower (24.1 lower to 9.54 higher)	⊕⊕OO LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 or 2 increments because the point estimates varied widely across studies, unexplained by subgroup analysis

Table 16: Clinical evidence profile: SuperPATH approach versus Posterior approach

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**SuperPATH approach**	**Posterior approach**	**Relative (95% CI)**	**Absolute**		
PROMs (follow-up 1 weeks; measured with: Barthel Index score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	46	46	-	MD 6.21 higher (2.68 to 9.74 higher)	⊕OOO VERY LOW	CRITICAL
PROMs (follow-up 1 weeks; measured with: Harris Hip Score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	46	46	-	MD 4.8 higher (3.01 to 6.59 higher)	⊕⊕OO LOW	CRITICAL
PROMs (follow-up 1 years; measured with: Barthel Index score,; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	46	46	-	MD 0.73 higher (2.49 lower to 3.95 higher)	⊕⊕OO LOW	CRITICAL
PROMs (follow-up 1 years; measured with: Harris Hip Score; Better indicated by higher values)												
1	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	46	46	-	MD 0.7 higher (0.14 lower to 1.54 higher)	⊕OOO VERY LOW	CRITICAL
Dislocation (follow-up 12 months)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	1/46 (2.2%)	2/46 (4.3%)	RR 0.5 (0.05 to 5.32)	22 fewer per 1000 (from 41 fewer to 188 more)	⊕OOO VERY LOW	IMPORTANT

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Length of stay (days) (Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	46	46	-	MD 3.1 lower (4.35 to 1.85 lower)	⊕⊕⊕O MODERATE	IMPORTANT
Surgery time (minutes) (Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	46	46	-	MD 2.9 lower (8.76 lower to 2.96 higher)	⊕⊕OO LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.

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Appendix G: Health economic evidence selection

Figure 52: Flow chart of health economic study selection for the guideline

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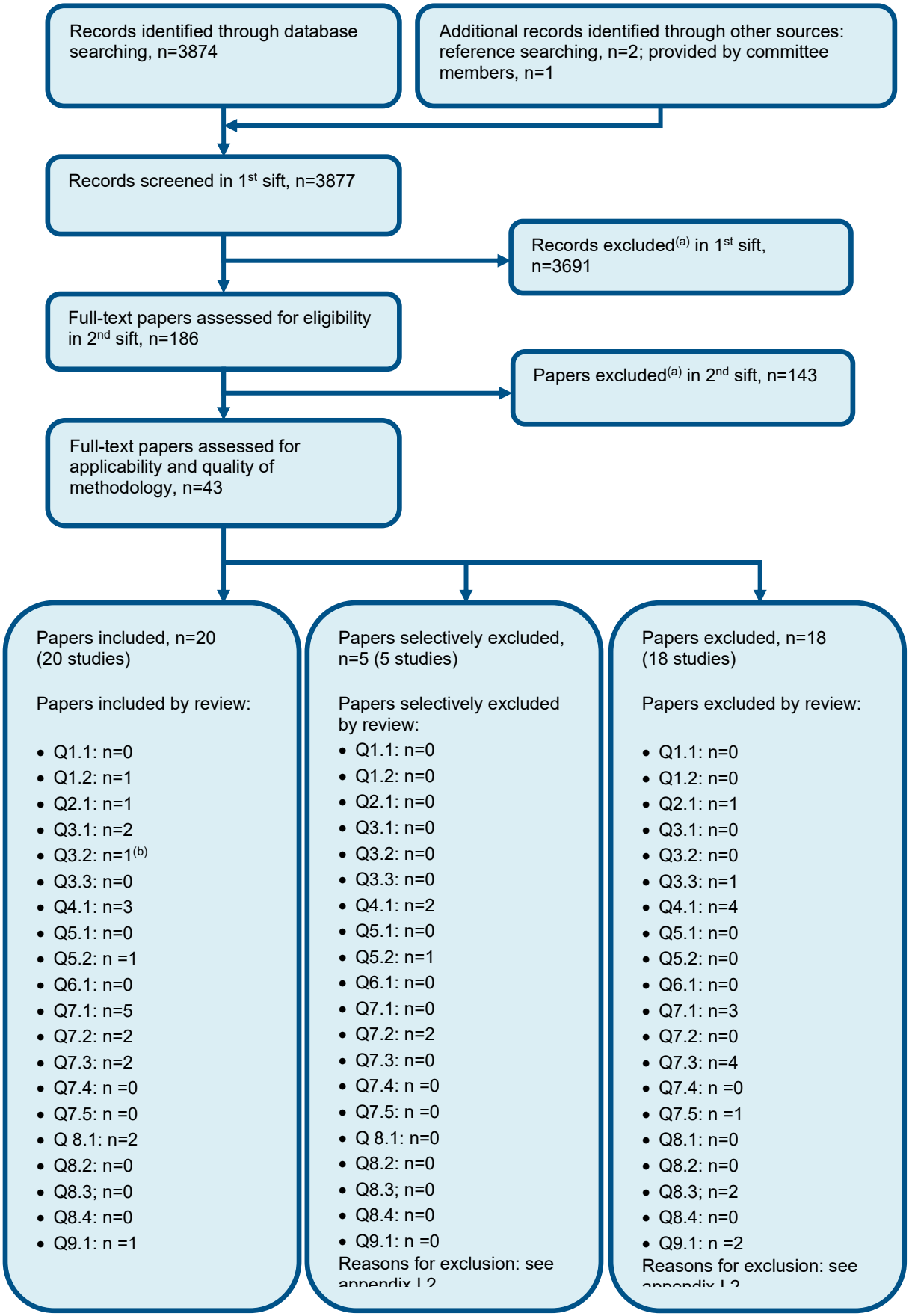

a) Non-relevant population, intervention, comparison, design or setting; non-English language
b) One study was applicable to both Q3.1 and Q3.2

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Appendix H: Health economic evidence tables

Study	Petis 2016[82]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: Cost comparison **Study design:** Prospective cohort study **Approach to analysis:** Micro-costing of 3 interventions, each carried out by a single surgeon **Perspective:** Canadian public payer (Ontario Ministry of Health) **Follow-up**: 3 months **Discounting:** Costs: N/A ; Outcomes: N/A	**Population:** People over 19 years old indicated for THR **Cohort characteristics:** Interventions 1, 2 and 3 Population (n) = 40, 38 and 40 Mean age: 66.9, 66.7 and 65.5 Male: 37.5%, 58.3% and 53.8% **Intervention 1:** Anterior approach **Intervention 2:** Posterior approach **Intervention 3:** Lateral approach	**Total cost of procedure (mean per patient):** Intervention 1: £4,154.51 Intervention 2: £4,716.34 Intervention 3: £4,469.15 **Currency & cost year:** 2013 Canadian dollars, presented here as 2013 British pounds[(a)] **Cost components incorporated:** Direct and indirect operating room costs and PACU costs were calculated from cost per minute value. Complications occurring in hospital and after discharge were recorded. However paper also states readmissions and care occurring after discharge were not included.	**Inpatient LOS (mean days per patient):** Intervention 1: 1.42 Intervention 2: 2.74 Intervention 3: 2.68	The anterior THR approach is cost saving compared to the posterior and lateral approaches **Analysis of uncertainty:** No sensitivity analysis was conducted
Data sources				
Health outcomes: N/A **Quality-of-life weights:** N/A **Cost sources:** Costs applicable to the billing surgeon and anaesthetist were obtained from the Ontario Ministry of Health Schedule of Benefits. LOS was recorded for each patient in the cohort and included as a cost. The inventory control clerk provided the cost of implants and operating room supplies. Equipment specifically required for the anterior approach was amortised by a longevity estimate and per case basis.				
Comments				
Source of funding: NR **Limitations:** Quality of life is not included as an outcome; the follow-up may be too short to understand the long term complications of the interventions; no sensitivity analysis was conducted; no multivariate analysis conducted to adjust for confounders, although a 1-way ANOVA showed no significant difference in age, sex, BMI, side operated on, primary diagnosis and age adjust Charlson Comorbidity Index.				

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Overall applicability:[(b)] Partially applicable **Overall quality:**[(c)] Potentially serious limitations

Abbreviations: ANOVA: analysis of variance; LOS: length of stay; NR: not reported; PACU: post-anaesthesia care unit; THR: total hip replacement
(a) Converted using 2013 purchasing power parities[77]
(b) Directly applicable / Partially applicable / Not applicable
(c) Minor limitations / Potentially serious limitations / Very serious limitations

Study	**Sharma 2019[102]**			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: Cost comparison **Study design:** Retrospective matched cohort study **Approach to analysis:** Two cost models were used: a micro-costing analysis and a Resource Intensity Weights analysis[(a)] **Perspective:** Canadian healthcare **Follow-up**: Initial inpatient stay **Discounting:** Costs: N/A; Outcomes: N/A	**Population:** Hip arthroplasty patients **Cohort characteristics:** Interventions 1, 2 and 3 Population (n): 69, 69 and 69 Mean age: 66, 66 and 66 Male: 53%, 53% and 53% **Intervention 1** Anterior approach **Intervention 2** Lateral approach **Intervention 3** Posterior approach	**Total cost of procedure (mean per patient):** Intervention 1: £5,234 Intervention 2: £6,361 Intervention 3: £6,156 **Currency & cost year:** 2018 Canadian dollars, presented here as 2018 British pounds[(b)] **Cost components incorporated:** Direct costs, drugs, indirect costs and administration costs	**Inpatient LOS (mean days per patient):** Intervention 1: 0.25 Intervention 2: 3.54 Intervention 3: 3.12	The anterior THR approach is cost saving compared to the posterior and lateral approaches **Analysis of uncertainty:** No sensitivity analysis was conducted
Data sources				
Health outcomes: Initial inpatient length of stay. **Quality-of-life weights:** N/A **Cost sources:** Alberta Health Services Analytics databases				
Comments				
Source of funding: the authors received no financial support for the research however some of the authors are paid consultants for Depuy, Stryker, Mizuho OSI and Zimmer Biomet **Limitations:** Quality of life is not included as an outcome; the follow-up may be too short to understand the long term complications of the interventions; no sensitivity analysis was conducted; no multivariate analysis conducted to adjust for confounders although patients were retrospectively matched.				

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Overall applicability:[c] Partially applicable **Overall quality:**[d] Potentially serious limitations

Abbreviations: LOS: length of stay; N/A: not applicable; THR: total hip replacement

(a) One the micro-costing cost model is presented here as both models showed the same results.

(b) Converted using 2018 purchasing power parities[77]

(c) Directly applicable / Partially applicable / Not applicable

(d) Minor limitations / Potentially serious limitations / Very serious limitations

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Appendix I: Excluded studies

I.1 Excluded clinical studies

Table 17: Studies excluded from the clinical review

Study	Exclusion reason
Anonymous 2018[1]	Not in English
Berstock 2014[4]	Systematic review - references individually checked
Berstock 2015[5]	Systematic review - references individually checked
Bon 2019[6]	Systematic review - references individually checked
Bostrom 2005[7]	Incorrect study design
Botha 1996[8]	Incorrect study design
Cheng 2009[11]	Systematic review - references individually checked
De geest 2015[17]	Systematic review - references individually checked
De verteuil 2008[18]	Systematic review - references individually checked
Della valle 2010[19]	Inappropriate comparison
Den hartog 2016[20]	Systematic review - references individually checked
Dienstknecht 2013[22]	Inappropriate comparison
Dienstknecht 2014[23]	Inappropriate comparison
Dorr 2007[24]	Inappropriate comparison
Dutka 2007[25]	Inappropriate comparison
Eto 2017[26]	Incorrect study design
Fink 2012[27]	Not in English
Goosen 2011[29]	Incorrect interventions. Inappropriate comparison
Graves 2016[30]	Incorrect study design
Greidanus 2013[31]	Inappropriate comparison
Gunther 2001[32]	Incorrect study design
Ha 2013[33]	Incorrect study design
Hendrickx 2014[34]	Protocol
Higgins 2015[35]	Systematic review - references individually checked
Hjorth 2017[36]	Not review population
Horwitz 1993[37]	Incorrect interventions. Inappropriate comparison
Hozack 2015[38]	Abstract
Hu 2012[39]	Incorrect study design
Inaba 2011[40]	Inappropriate comparison
Jia 2018[42]	Systematic review - references individually checked
Jolles 2004[43]	Systematic review - references individually checked
Jolles 2006[44]	Systematic review - references individually checked
Khan 2012[45]	Incorrect interventions
Kucukdurmaz 2018[46]	Systematic review - references individually checked
Kwon 2006[47]	Systematic review - references individually checked
Landgraeber 2013[48]	Inappropriate comparison
Lee 2015[49]	Systematic review - references individually checked
Leuchte 2007[50]	Not in English
Lin 2017[51]	Inappropriate comparison

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Study	Exclusion reason
Luo 2016[53]	Not in English
Martin 2011[54]	Incorrect interventions. Inappropriate comparison
Matziolis 2011[55]	Inappropriate comparison
Meermans 2017[57]	Systematic review - references individually checked
Meneghini 2009[58]	Incorrect interventions
Migliorini 2019[60]	Systematic review - references individually checked
Miller 2018[61]	Systematic review - references individually checked
Miller 2018[62]	Systematic review - references individually checked
Miller 2018[63]	Systematic review - references individually checked
Mouilhade 2011[65]	Incorrect study design
Mukka 2014[66]	Systematic review - references individually checked
Muller 2011[68]	Incorrect interventions. Inappropriate comparison
Muller 2012[67]	Inappropriate comparison
Murphy 2006[69]	Not in English
Musil 2008[71]	Not in English
Musil 2013[70]	Not in English
O'brien 2005[75]	Incorrect interventions. Inappropriate comparison
Ogonda 2005[76]	Incorrect interventions. Inappropriate comparison
Ouyang 2018[78]	Not in English
Pai 1997[79]	Incorrect interventions. Inappropriate comparison
Parker 2002[80]	Not review population
Pospischill 2010[83]	Inappropriate comparison
Putananon 2018[84]	NMA- references individually checked
Queen 2014[85]	Incorrect study design
Radoicic 2018[86]	Incorrect study design
Repantis 2015[89]	Inappropriate comparison. Incorrect interventions
Rittmeister 2006[91]	Not in English
Rodriguez 2014[92]	Incorrect study design
Rosenlund 2014[94]	Protocol
Rosenlund 2017[93]	Protocol
Rykov 2016[96]	Protocol
Salineros 2007[98]	Conference abstract
Sander 2011[99]	Not in English
Schwarze 2018[100]	Incorrect interventions. Inappropriate comparison
Sendtner 2011[101]	Inappropriate comparison. Incorrect interventions
Sharma 2006[103]	Conference abstract
Speranza 2007[104]	Inappropriate comparison. Incorrect interventions
Takada 2018[105]	Not review population
Talia 2018[106]	Protocol
Tanavalee 2006[107]	Incorrect study design
Varela-Egocheaga 2010[111]	Not in English
Varela-Egocheaga 2013[112]	Incorrect interventions. Inappropriate comparison
Wang 2018[113]	Systematic review - references individually checked
Whatling 2008[114]	Incorrect study design
Wohlrab 2004[117]	Not in English

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Study	Exclusion reason
Wohlrab 2008[116]	Not in English
Xu 2013[119]	Systematic review - references individually checked
Xu 2017[120]	Not in English
Yamamoto 2017[121]	Not review population
Yan 2005[122]	Not in English
Yang 2009[125]	Not in English
Yang 2012[123]	Systematic review - references individually checked
Yue 2015[126]	Systematic review - references individually checked
Zhang 2006[127]	Not in English
Zheng 2018[129]	Not in English

I.2 Excluded health economic studies

Studies that meet the review protocol population and interventions, and the economic study inclusion criteria but have not been included in the review based on applicability and/or methodological quality are summarised below with reasons for exclusion.

Table 18: Studies excluded from the health economic review

Reference	Reason for exclusion
Coyle 2008[14]	This study was excluded as it compared the length of incision with all surgery approaches meta-analysed together
de Verteuil 2008[18]	This study was excluded as it compared the length of incision with all surgery approaches meta-analysed together
Gofton 2016[28]	This study was assessed as partially applicable with very serious limitations as it may have been a US study (unclear) and it only reported costs in percentages.
Martin 2011[54]	This study was assessed as having very serious limitations as a cost figure was presented without any described methodology of calculations

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Appendix J: Research recommendations

J.1 Surgical approaches in primary elective hip replacement

Research question: Do the direct anterior, direct superior and supercapsular percutaneously assisted(SuperPATH) approaches to hip replacement improve patient-recorded outcome measures and reduce length of hospital stays, revision rates, neurological complications and surgical site infections compared with the posterior and anterolateral approaches?

Why this is important:

The posterior and anterolateral approaches to the hip and the most commonly used approaches for hip replacement surgery. In 2017 NJR data reported that 93,161 of 96,717 (96.3%) of primary hip replacements were performed through one of these two approaches.[73] Hip replacements undertaken through these two approaches have excellent results with low 10 year failure rates, significant improvement in functional outcome scores and low rates of complications. In recent years there has been increased uptake and interest in alternative hip approaches (direct anterior, direct superior, superPATH). These approaches have theoretical advantages but often require additional specialist equipment and surgery can take longer to perform, both of which may have cost implications. Furthermore the NICE evidence review raised concerns about the rates of specific complications with some of these newer approaches. There is currently no evidence to support the wider adoption of these approaches and this research recommendation had therefore been developed to support specific research in this area.

PICO question	Population: Patients receiving an elective primary total hip replacement Intervention(s): Direct anterior, direct superior or superPATH surgical approaches to the hip Comparison: Posterior or anterolateral approaches to the hip Outcome(s): Patient reported outcome measures including health related quality of life, Surgical time, Length of stay, rates of complications including the risk of nerve injury and/or neuropraxia, infection, dislocation and problems relating to wound healing
Study design	Multicentre Randomised controlled trial comparing one or more interventions to one of the current standard practices (comparators)
Other details	NICE evidence review raised concerns over the high rates of nerve injury and/or neuropraxia reported in previous studies examining outcomes after the direct anterior approach. The committee also had concerns about infected and wound healing problems related to some of the newer approaches. The committee felt it essential that these outcomes be measured as secondary endpoints in any trial but that a PROM / Health related quality of life measure should be the primary outcome.

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