Supplementary data

Table 4. Risk of bias of included trials (study-level) and justifications for judgements

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Park, 2007	**Unclear** No information provided on how the sequence was generated.	**Unclear** Allocation concealment method not provided	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Unclear** Although radiological outcome assessors were blinded, it was unknown whether assessors of patient-reported outcomes and other functional outcomes were blinded.	**Low**	**Unclear** No protocol or study registration available although all outcomes stated in the methods section were reported.	**Unclear** No information on how the sample size was arrived at, age was the only baseline characteristics reported.
Song, 2011	**Low**	**Low** Concealment should not be an issue when 2 knees of the same patient were randomized into two interventions	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Low**	**Low**	**Unclear** No protocol or study registration available although all outcomes stated in the methods section were reported.	**Low**
Song, 2013	**Low**	**Low**	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Low**	**High** High rate of loss to follow-up for clinical outcomes	**Unclear** No protocol or study registration available although all outcomes stated in the methods section were reported	**Unclear** Potential financial conflict of interest
Liow, 2014	**Low**	**High** The randomization sequence was not concealed	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Unclear** Although radiological outcome assessors were blinded, it was unknown whether assessors of patient-reported outcomes and other functional outcomes were blinded.	**Low**	**Unclear** No protocol or study registration available although all outcomes stated in the methods section were reported.	**Low**
Liow, 2017	**Low**	**High** The randomization sequence was not concealed	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Unclear** Although radiological outcome assessors were blinded, it was unknown whether assessors of patient-reported outcomes and other functional outcomes were blinded.	**Low**	**Unclear** No protocol or study registration available although all outcomes stated in the methods section were reported.	**Low**
Kim, 2020	**Low**	**Low**	**High** Reported that patients were not blinded, and the intervention cannot be blinded to the surgeon(s).	**Unclear** Although outcome assessors were blinded but patients were not blinded which may pose risk of bias for patient-reported outcomes	**Low**	**Low**	**Low**
Kayani, 2021	**Low**	**Unclear** Allocation concealment method not provided.	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Low**	**Low**	**High** The trial registration did not include the outcomes reported which may have been subject to multiple analyses and selective reporting.	**Low**
Thiengwittayaporn, 2021	**Low**	**Unclear** Allocation concealment method not provided	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Low**	**Low**	**Low**	**Low**
Vaidya, 2022	**Low**	**Unclear** Allocation concealment method not provided	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Unclear** No information whether outcome assessors other than the patients were blinded	**Low**	**Unclear** No protocol or study registration available although all outcomes stated in the methods section were reported	**Low**
Xu, 2022	**Low**	**Unclear** Allocation concealment method not provided	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Unclear** Although radiological outcome assessors were blinded but patients were not blinded which may pose risk of bias for patient-reported outcomes.	**Low**	**Low**	**Unclear** No information on how the sample size was arrived at.
Li, 2022	**Unclear** No information provided on how the sequence was generated.	**Unclear** Allocation concealment method not provided	**High** The intervention cannot be blinded to the surgeon(s) performing the intervention.	**Unclear** Although radiological outcome assessors were blinded, it was unknown whether assessors of patient-reported outcomes and other functional outcomes were blinded.	**Low**	**Unclear** No protocol or study registration available although all important outcomes stated in the methods section were reported	**Unclear** No information on how the sample size was arrived at.
Lychagin, 2022	**Low**	**Low**	**High** Patients were blinded although the surgeons performing the intervention cannot be blinded.	**Unclear** No information whether outcome assessors other than the patients were blinded	**Low**	**High** Not all secondary outcomes in the trial registration were reported, thereby being at risk for selective reporting	**Unclear** The sample size in the present study was much lower than that stated in the registration.

Table 5. Details on the GRADE assessments of quality of evidence

Outcomes (importance)	**Domain 1** Risk of bias	**Domain 2** Inconsistency	**Domain 3** Indirectness	**Domain 4** Imprecision	**Domain 5** Publication bias	**Overall quality of evidence**
WOMAC (critical)	**Serious limitations, downgrade 1 level** Reasons: 2/6 studies had high risk of bias, one of which had the highest weight for the synthesized result	**No serious limitations not downgraded** Reasons: most point estimates in the same direction, Confidence Intervals (CIs) overlap, I^2=3% with insignificant Chi-squared test	**No serious limitations not downgraded** Reasons: patients, interventions, outcomes, and methodology of included studies were similar to those of this review.	**No serious limitations not downgraded** Reasons: optimal information size (OIS) met based on rule of thumb (n=400), CI includes no effect and excludes possible important difference	**No serious limitations not downgraded** Reasons: Included studies were from a comprehensive search. Although many trial protocols were registered and not yet published, they were undergoing patient recruitment and follow-up data collection.	**Moderate**
KSS (critical)	**Serious limitations, downgraded 0.5 level** Reasons: 1/5 study with high risk (allocation concealment) which was important, but it only contributed to 0.7% weight of the result.	**Serious limitations, downgraded 0.5 level** Reasons: most point estimates in the same direction, CIs overlap, I^2=25% with insignificant Chi-squared test but it was quite large due to the study with high risk of bias.		**No serious limitations not downgraded** Reasons: adequate sample size, CI includes no effect and excludes possible important difference		**Moderate**
HSS (critical)	**Serious limitations, downgraded 0.5 level** Reasons: 1/3 study had high risk of bias (large missing outcome proportion) with relatively high contribution (29.7%) but its result was similar to the other studies.	**No serious limitations, not downgraded** Reasons: all point estimates in the same direction, CIs overlap, I^2=0% with non-statistically significant Chi-squared test.		**Serious limitations, downgraded 0.5 level** Reasons: CI covers no effect and excludes possible important benefit but OIS not met by the rule of thumb (400 participants)		**Moderate**
ROM (critical)	**Serious limitations, downgraded 1 level** Reasons: 2/8 studies had high risk of bias, one of which had relatively high weight (37.3%).	**Serious limitations, downgraded 1 level** Reasons: most point estimates in a different direction with non-overlapping CI and I^2=99%. One study contributed largely to this inconsistency explained by its risk of bias and robot type used.		**No serious limitations not downgraded** Reasons: adequate sample size, CI includes no effect and excludes possible important difference.		**Low**
Deviation from mechanical axis (critical)	**Serious limitations, down-grade d0.5 level** Reasons: 1/6 study with high risk (allocation conceal-ment) which was important and contributed to 14.8 % weight of the result but excluding it did not change the pooled result.	**No serious limitations not downgraded** Reasons: most point estimates in the same direction, CIs overlap, I^2=0% with insignificant Chi-squared test .		**Serious limitations, downgraded 0.5 level** Reasons: adequate sample size, CI excludes no effect but did not include important difference.		**Moderate**
MA outliers (critical)	**Serious limitations, downgraded 0.25 level** Reasons: 1/8 study with high risk (allocation concealment) which was important, but it only contributed to 0.097% weight of the synthesized result.	**Serious limitations, downgraded 0.25 level** Reasons: Point estimates in the same direction, CIs mostly overlap. Downgrade 0.25 point for high I^2 (31%) that could be explained by studies with scarce events.		**Serious limitations, downgraded 0.5 level** Reasons: CI excludes no effect and a large benefit but OIS not met by the rule of thumb (300 events).		**Moderate**
Implant survivorship (critical)	**No serious limitations not downgraded** Reasons: only one study with generally low risk of bias analyzed	**No serious limitations not downgraded** Reasons: only one study analyzed.		**Serious limitations, downgraded 2 levels** Reasons: CI includes no effect and large benefit and harm, OIS not met.		**Low**

Search strategies

Ovid MEDLINE: Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE® Daily and Ovid MEDLINE® <1946-August 2022>
Date of search: 23 August 2022

#	Search
1	Osteoarthritis, Knee/
2	(Osteoarthritis Knee or OA knee or Knee arthrosis patient or osteoarthritic knee or Gonarthrosis or Primary gonarthrosis).tw,kf.
3	1 or 2
4	Robotic Surgical Procedures/
5	Robotics/
6	(Robo or Robot* or RATKA or RATKR or Robotic arm* or assisted Robotic device* or Robotic surgical device* or Robotic-aided surger*).tw,kf.
7	4 or 5 or 6
8	Arthroplasty, Replacement, Knee/
9	((conventional or traditional or primary or total) adj3 (knee replacement or knee arthroplasty or knee surgery or knee resurfac*)).tw,kf.
10	8 or 9
11	3 and 7 and 10

EMBASE: Embase Classic+Embase <1947 to 2022 August 22>
Date of search: 23 August 2022

#	Search
1	exp knee osteoarthritis/
2	(Osteoarthritis knee or OA knee or Knee arthrosis patient or osteoarthritic knee or Gonarthrosis or Primary gonarthrosis).tw,kf.
3	1 or 2
4	robot assisted surgery/
5	exp robotics/
6	exp robot/
7	(Robo or Robot* or Robotic or Robotic surgery or RATKA or RATKR or Robotic arm* or assisted Robotic device* or Robotic surgical device* or Robotic-aided surger*).tw,kf.
8	4 or 5 or 6 or 7
9	total knee arthroplasty/ or total knee prosthesis/
10	exp knee replacement/
11	((conventional or traditional or total or primary) adj3 (knee replacement or knee arthroplasty or knee surgery or knee resurfac*)).tw,kf.
12	9 or 10 or 11
13	3 and 8 and 12

SCOPUS <1966 to 2022 August 22>
Date of search: 23 August 2022

#	Search
1	TITLE-ABS-KEY (knee AND osteoarthritis)
2	(TITLE-ABS-KEY (knee AND osteoarthritis)) OR (SUBJAREA (medi OR nurs OR vete OR dent OR heal OR mult) TITLE-ABS-KEY ((knee AND osteoarthritis))) OR (TITLE-ABS-KEY ((knee AND osteoarthritis))) AND (LIMIT-TO (SRCTYPE , "j"))
3	TITLE-ABS-KEY ((knee AND osteoarthritis)) AND (LIMIT-TO (SRCTYPE , "j"))
4	(TITLE-ABS-KEY ((knee AND osteoarthritis))) OR (TITLE-ABS-KEY ((knee AND osteoarthritis))) OR ((TITLE-ABS-KEY (knee AND osteoarthritis)) OR (SUBJAREA (medi OR nurs OR vete OR dent OR heal OR mult) TITLE-ABS-KEY ((knee AND osteoarthritis))) OR (TITLE-ABS-KEY ((knee AND osteoarthritis)))) AND (LIMIT-TO (SRCTYPE , "j"))
5	TITLE-ABS-KEY (robot AND assisted AND surgery)
6	TITLE-ABS-KEY (robotics)
7	TITLE-ABS-KEY (robot)
8	(TITLE-ABS-KEY (robot AND assisted AND surgery)) OR (TITLE-ABS-KEY (robotics)) OR (TITLE-ABS-KEY (robot)) OR (TITLE-ABS-KEY (robo OR robot* OR robotic OR robotic AND surgery OR ratka OR ratkr OR robotic AND arm* OR assisted AND robotic AND device* OR robotic AND surgical AND device* OR robotic-aided AND surger* OR robo* AND resurfac*))
9	TITLE-ABS-KEY (total AND knee AND arthroplasty/ OR total AND knee AND prosthesis/)
10	TITLE-ABS-KEY (knee AND replacement)
11	TITLE-ABS-KEY (conventional OR traditional OR total OR primary AND knee AND replacement OR knee AND arthroplasty)
12	(TITLE-ABS-KEY (conventional OR traditional OR total OR primary AND knee AND replacement OR knee AND arthroplasty)) OR ((TITLE-ABS-KEY (total AND knee AND arthroplasty/ OR total AND knee AND prosthesis/)) OR (TITLE-ABS-KEY (knee AND replacement)) OR (TITLE-ABS-KEY (conventional OR traditional OR total OR primary AND knee AND replacement OR knee AND arthroplasty OR resufac*)))
13	((TITLE-ABS-KEY (conventional OR traditional OR total OR primary AND knee AND replacement OR knee AND arthroplasty)) OR ((TITLE-ABS-KEY (total AND knee AND arthroplasty/ OR total AND knee AND prosthesis/)) OR (TITLE-ABS-KEY (knee AND replacement)) OR (TITLE-ABS-KEY (conventional OR traditional OR total OR primary AND knee AND replacement OR knee AND arthroplasty OR resufac*)))) AND ((TITLE-ABS-KEY (robot AND assisted AND surgery)) OR (TITLE-ABS-KEY (robotics)) OR (TITLE-ABS-KEY (robot)) OR (TITLE-ABS-KEY (robo OR robot* OR robotic OR robotic AND surgery OR ratka OR ratkr OR robotic AND arm* OR assisted AND robotic AND device* OR robotic AND surgical AND device* OR robotic-aided AND surger* OR robo* AND resurfac*))) AND ((TITLE-ABS-KEY (knee AND osteoarthritis)) OR (SUBJAREA (medi OR nurs OR vete OR dent OR heal OR mult) TITLE-ABS-KEY ((knee AND osteoarthritis))) OR (TITLE-ABS-KEY ((knee AND osteoarthritis)))) AND (LIMIT-TO (SRCTYPE , "j"))

Cochrane Library <1908 to 2022 August 22>
Date of search: 23 August 2022

#	Search
#1	[mh "knee osteoarthritis"]
#2	(Osteoarthritis knee or OA knee or Knee arthrosis patient or osteoarthritic knee or Gonarthrosis or Primary gonarthrosis):ti,ab,kw
#3	#1 OR #2
#4	[mh ^"robot assisted surgery"]
#5	[mh "robotics"]
#6	[mh "robot"]
#7	(Robo or Robot* or Robotic or Robotic surgery or RATKA or RATKR or Robotic arm* or assisted Robotic device* or Robotic surgical device* or Robotic-aided surger*):ti,ab,kw
8	#4 or #5 or #6 or #7
9	[mh "Arthroplasty"]
10	((conventional or traditional or primary or total) NEAR/3 (knee replacement or knee arthroplasty or knee replacement or knee arthroplasty or knee surgery or knee resurfac*)):ti,ab,kw
11	#9 OR #10
12	#3 AND #8 AND #11

PRISMA Checklist

	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 4
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 4, 6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 5
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 5, 6
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 5, 6
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	n/a
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 5, 6
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 5, 6
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 5, 6
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 5, 6
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	n/a
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 6
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 7, Fig.1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	n/a
Study characteristics	17	Cite each included study and present its characteristics.	Page 7
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 8, Fig.2
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval),	Fig.3

Section and Topic	Item #	Checklist item	Location where item is reported
		ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 8-10
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 8-10
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 8-10
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 8-10
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Fig.A.1
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Sum table, Table A.2
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 10
	23b	Discuss any limitations of the evidence included in the review.	Page 12-13
	23c	Discuss any limitations of the review processes used.	Page 12-13
	23d	Discuss implications of the results for practice, policy, and future research.	Page 12-13
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	n/a
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	n/a
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	n/a
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 13
Competing interests	26	Declare any competing interests of review authors.	Page 13
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 13