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Medial pivot design does not yield superior results compared to posterior-stabilised total knee arthroplasty: a systematic review and meta-analysis of randomised control trials

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Abstract

Purpose The aim of this meta-analysis was a comparison between medial pivot (MP) and posterior-stabilised (PS) knee designs regarding functional and radiological outcomes as well as gait parameters.

Methods A systematic literature search was conducted in PubMed, Cochrane Library, Science Direct and Clinical Trials.gov from conception up to April 2022, to identify eligible randomised control trials (RCTs). The extracted data were analysed according to the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) statement.

Results Fifteen studies met inclusion criteria, enrolling 1101 patients who underwent 1242 total knee arthroplasties (TKAs). A total of 1158 TKAs (581 MP/577 PS) were included in the quantitative analysis. Mean follow-up ranged from 6 months up to 6.6 years. MP knees showed comparable range of motion (ROM) with PS design 1, 2 and 4 years postoperatively ($p=0.2$, $p=0.25$, $p=0.34$, respectively). No statistical difference was found in patient-related outcome measures (PROMs) ($p>0.05$). Mean walking speed (MWS), length of stay (LOS), radiographic alignment and complications rates were also similar between the two groups ($p>0.05$).

Discussion The present meta-analysis demonstrated that the theoretical biomechanical advantage of MP implants does not have a better impact on patient satisfaction compared to the traditional PS knees.

Level of evidence I.

Keywords Medial pivot · Medial stabilised · Posterior stabilised · Total knee replacement · Total knee arthroplasty

Abbreviations

TKA	Total knee arthroplasty
PS	Posterior stabilised
RCT	Randomised control trial
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PICO	Population, intervention, comparison, outcome
ROM	Range of motion
PROMs	Patient-related outcome measures
MeSH	Medical subject headings
KSS	Knee Society Score
KFS	Knee Society Function Score
WOMAC	Western Ontario and McMaster Universities Arthritis Index
OKS	Oxford Knee Score
FJS	Forgotten Joint Score
TUG	Timed up and go test
VR-12	Veterans RAND 12 Item Health Survey
LOS	Length of stay
MWS	Mean walking speed test
RoB2	Cochrane risk-of-bias tool for randomised trials version 2

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SD	Standard deviation
RR	Relative risk
MD	Mean difference
CI	Confidence interval
DVT	Deep-vein thrombosis
MCID	Minimum clinically important difference

Introduction

Since the introduction of the very first total knee arthroplasty (TKA) models, the orthopaedic community has witnessed a substantial progress and improvement in implant design [4, 39]. This arguably led to increased prosthesis survival rates and better patient-related clinical outcomes [4, 39].

Among the plethora of different bearing surfaces, the posterior-stabilised (PS) variant is one of the most well studied. This implant is considered to induce posterior translation of the femur during flexion relying on a post cam mechanism [5]. Contrary to that belief, during the early stages of flexion, the body pushes the femur so that the femoral component slides anteriorly producing a 'paradoxical motion' [19]. The alterations in normal knee kinematics have raised concerns about its ability to meet the steadily increasing patients' expectations [40].

Normal knee kinematics suggest a firmly attached medial meniscus to the tibia providing greater knee stability to the medial compartment [11]. The lateral side with the more mobile lateral meniscus is more flexible [11]. It provides greater posterior translation of the lateral condyle over the medial, with increasing flexion and illustrates higher ranges of active and passive flexion than conventional knee implants [6, 12, 20]. Thus, the use of a knee apparatus which achieves normal kinematics may exhibit a potential advantage over the traditional one. This philosophy led eventually to the evolution of the medial pivot (MP) design.

The MP prosthesis is designed to reproduce the rotational and translational kinematics of the normal knee by replicating the native structure of the knee [33]. This ball and socket articulation provides a highly conforming surface on the medial side [33]. It is developed with a robust anterior lip which prevents paradoxical anterior movement and enhances stability throughout the range of motion [3]. This theoretical advantage though is yet to be proven [22].

The aim of the study was to compare MP and PS knee prostheses in terms of (i) postoperative functional scores, (ii) radiographic alignment, (iii) gait parameters and (iv) complications, by performing a systematic literature review and meta-analysis of randomised control trials (RCTs) only.

Methods

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [23]. The review protocol was registered in the International Prospective Register of Systematic Reviews PROSPERO under the registration number CRD42022346241.

Search strategy

The PICO (Population, Intervention, Comparison, Outcome) framework used for this systematic review was:

P: patients with knee osteoarthritis.

I: surgical management with MP knee prosthesis.

C: surgical management with PS knee prosthesis.

O: range of motion (ROM) as primary outcome, patient-related outcome measures (PROMs), radiographic alignment and other complications as secondary outcomes.

A systematic comprehensive search was conducted in the following search engines: PubMed, Cochrane Library and Science Direct from the first included and published RCT up to 7th April 2022. For currently registered but yet to be published trials, a search was performed on ClinicalTrials.gov. The reference lists of the relevant studies retrieved were also hand-screened for additional missing records.

The search terms used were "medial pivot", "medial stabilized", "posterior stabilized", "knee", "kinematic", "articulation", "knee arthroplasty'', and "medial ball and socket". Free text searching was combined with Medical Subject Headings (MeSH) terms. The detailed search strategy used can be found in the Supplementary Table 1.

Inclusion and exclusion criteria

Inclusion and exclusion criteria of this meta-analysis are summarised in detail in the Supplementary Table 2.

Study selection and data extraction

Two authors (PK and SP) conducted independent searches in electronic databases to identify potentially relevant articles. Upon removing the duplicate studies, the authors screened the titles and abstracts of the remaining records for eligibility. Studies with overlapping series of patients were excluded except for the one with the best evidence. Any discrepancy about the selected studies was resolved by a third investigator (CT) who evaluated the papers independently. Eligibility was defined by agreement with all the authors and the study selection process was completed upon discussion. Kappa coefficient was utilised to estimate the agreement between the reviewers.

Data were extracted, where present, from each eligible study by two investigators (PK and SP) independently and are presented thoroughly in Supplementary Table 3. Any disagreement was resolved by discussion between the two reviewers (PK and SP). A third author (CT) was recruited to extract data independently, where necessary, in order to reach consensus.

Quality assessment

We examined the methodological quality and risk of bias of the included studies utilising the Cochrane risk-of-bias tool for randomised trials version 2 (RoB2) [36]. The RoB2 tool is comprised of a series of 'signalling questions' about randomisation process, deviations from intended interventions, missing outcome data, measurement of the outcome and selection of the reported result. An algorithm assessing the risk of bias is generated by the given answers. The judgement was defined as "high risk'', "low risk'' or expressing "some concerns'' by three independent reviewers (PK, SP, CT).

Statistical analysis

The analysis of the extracted data was performed using the Review Manager version 5.4.1 software (Cochrane Collaboration, London, UK, 2020) [32]. Heterogeneity was estimated with Chi-Square test. A value of I^2 less than 30% was considered as low, 30–60% as moderate and above 60% as high heterogeneity, respectively. Random effects model was used for moderate and high heterogeneity and fixed effects model in case of low statistical heterogeneity. A *p* value < 0.05 was considered as statistically significant for each outcome. The confidence interval was set to 95% (95% CI). Mean differences and standard deviations (SDs) were used for continuous variables. Dichotomous variables were examined using risk ratio (RR).

Missing SDs from the included studies were calculated from *p* values according to the methods reported in Cochrane Handbook (Chapter 7.7.3.3) [15]. Final values and change from baseline values of outcomes were combined in the meta-analysis following the guidelines described in Cochrane Handbook (Chapter 9.4.5.2) [15]. The pooled results are presented using forest plots. Publication bias was estimated using funnel plot.

Results

Search results

The electronic literature search returned 3021 hits. The detailed study selection including an accounting of the ineligible studies and the reasons for their ineligibility is shown in the PRISMA flowchart of Fig. 1. Thus, a total of 15 randomised control trials (RCTs) [2–4, 7, 8, 13, 14, 16, 17, 21, 22, 27, 31, 34, 42] were available for qualitative analysis. One study [31] presented incomplete data and was not qualified for quantitative analysis leaving 14 [2–4, 7, 8, 13, 14, 16, 17, 21, 22, 27, 34, 42] eligible studies as well.

The value of Cohen's Kappa coefficient was estimated 0.91, indicating 96.3% agreement between the reviewers.

Characteristics of the included studies

The 15 RCTs included in this review were published between 2011 and 2022. They included 1101 patients who underwent 1242 TKAs (623 MP/619 PS) with a mean follow-up from 6 months up to 6.6 years. Mean reported patient age ranged from 61.7 to 74.4 years. Quantitative analysis was performed in 1158 TKAs (581 MP/577 PS). The descriptive characteristics and main findings of the studies are demonstrated comprehensively in Table 1.

Methodology quality and risk-of-bias assessment

A total of three studies [2, 8, 16] found to be at 'low' risk, four trials [3, 13, 14, 31] at 'high' risk of bias and eight studies [4, 7, 17, 21, 22, 27, 34, 42] were considered to have 'some concerns' (Fig. 2). Figure 3 shows the review authors' judgements about each domain presented as percentages across all included studies.

Meta-analysis outcomes

A brief summary of the meta-analysis results is demonstrated in Table 2.

Primary outcome (ROM)

There was no statistically significant difference between MP and PS group regarding ROM at 1, 2 and 4 years postoperatively (Fig. 4).

There was one study [31] to examine ROM at midterm follow-up (6.1 years for MP/6.6 years for PS). Once again there was no significant difference in ROM between the two groups.

Sensitivity analysis for ROM outcome.

One study [13] was characterised as 'high risk' of bias. After excluding this study from the analysis, the mean difference at second-year follow-up remained statistically insignificant (MD 2.09, 95% CI [− 6.68, 10.87], $p = 0.64$, $I^2 = 90\%$).

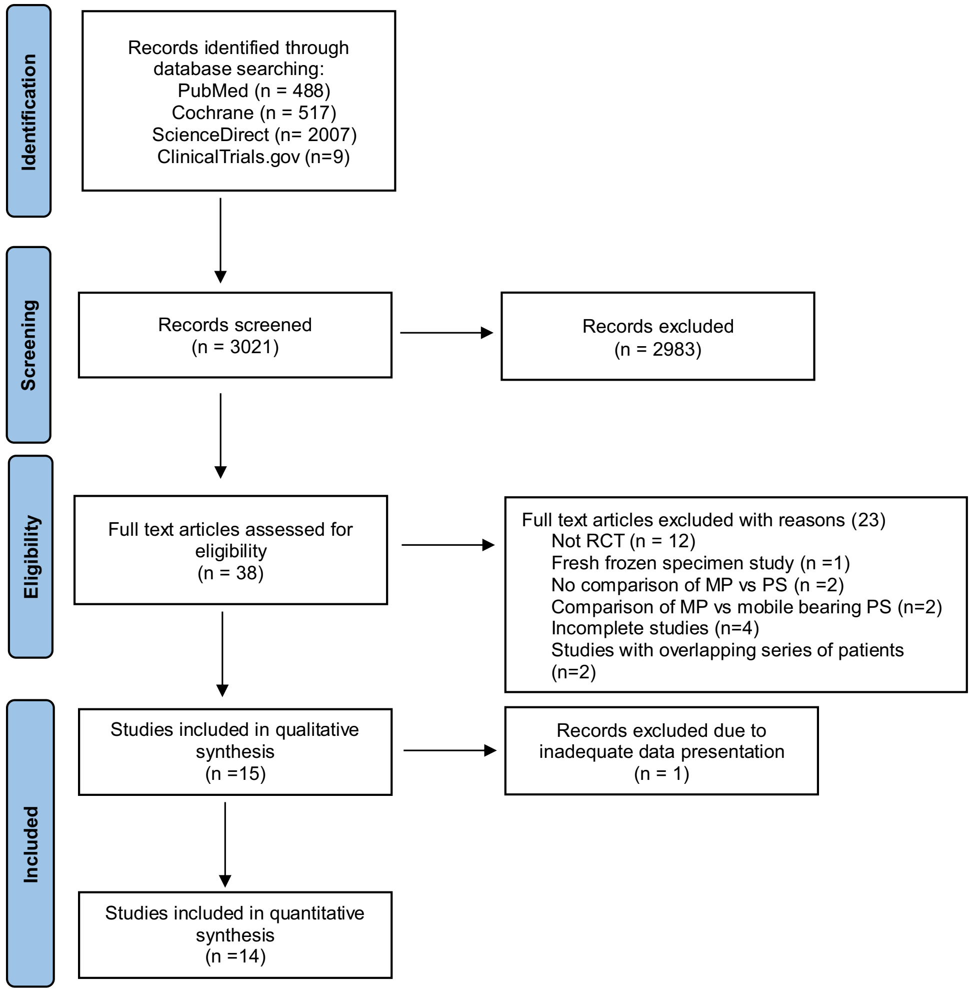


Fig. 1 PRISMA flowchart illustrating the search strategy

Secondary outcomes assessment at short-term follow-up

Quantitative analysis revealed no statistical difference in each clinical score (Knee Society Score (KSS), Knee Function Score (KFS), Western Ontario and McMaster Universities Arthritis Index (WOMAC), Oxford Knee Score (OKS), Forgotten Joint Score (FJS), Veterans RAND 12 Item Health Survey (VR-12), and timed up and go (TUG)) for the groups examined at 1 or 2 years postoperatively (Figs. 5, 6, 7, 8, 9, 10, 11 and 12).

Sensitivity analysis

After excluding two studies [3, 13] which scored poorly in RoB2 tool, the results for KSS and OKS remained statistically insignificant at 1 year postoperatively (MD 1.54, 95% CI [− 2.77, 5.84], $p=0.48$, $I^2=73\%$ and MD − 0.45, 95% CI [− 3.41, 2.52], $p=0.77$, $I^2=37\%$, respectively). Two years postoperatively, the mean difference for KSS and FJS also remained statistically insignificant upon excluding these studies (MD 3.61, 95% CI [− 1.90, 9.12], $p=0.20$, $I^2=68\%$ and MD 3.36, 95% CI [− 9.27, 15.98], $p=0.60$, $I^2=82\%$, respectively).

Secondary outcomes' assessment at midterm follow-up

Two RCTs [17, 31] reported KSS and KFS outcome at midterm follow-up. Due to the inadequate data of one trial, we were unable to perform quantitative analysis. Once again, none of these papers reported statistically significant difference between MP and PS groups.

There was only one study [2] to examine OKS at midterm follow-up (4 years). The authors found no statistical difference between MP and PS knees (mean 44.3, SD 2.17 vs. mean 44, SD 2.31, $p=$n.s.).

There was only one study [42] that compared WOMAC score between MP and PS knees at midterm follow-up (5 years). It revealed no significant differences in any category of WOMAC score between the two groups (change from baseline total WOMAC − 74.29, SD 12.05 MP/− 72.15, SD 10.74 PS, $p=0.35$).

Table 1 Characteristics of the included studies

Author	Year	Study design	n (MP/PS)	Age (MP/PS)	Follow-up (years)	Comparison	Outcomes assessed	Main findings
Scott et al. [34]	2022	RCT	101/99	66.2/64.9	2	Medacta GMK Sphere vs. Medacta PS International, Castel San Pietro, SW	KSS, FJS, ROM, radiographic data, complications	PS: longer tourniquet time MP: better ROM, KSS, FJS No difference in other outcomes
Chang et al. [4]	2021	RCT	43/45	68.4/ 69.1	2	SAIPH Knee System, Matortho, Surrey, UK vs. Triathlon ps Knee System, Stryker Limited, Kalamazoo, MI	OKS, KSS, WOMAC, ROM, SF-36, radiographic data, complications	No difference in preop characteristics No difference between MP and PS groups
Kulshrestha et al. [21]	2020	RCT	36/37	63.8/66	2	ADVANCE MP Knee System, Wright Medical Technology, Arlington, TN, USA vs. Nexgen Legacy PS System, Zimmer, Warsaw, IN, USA	ROM, new KSS, DOPS, TUG, SCT, SPW, CTS, LHT, FJS-12, EQ-5D, complications	No difference in preop characteristics PS: better ROM, KSS (objective) MP: better TUG, SPW No difference in other outcomes
Dowsey et al. [7]	2020	RCT	29/26	66/ 65.7	1	GMK Sphere Prosthesis, Medacta, Castel San Pietro Switzerland vs. GMK PS Prosthesis	New KSS, 6MWT, OKS, VR-12, TUG, WOMAC, LOS, complications	Preop: higher BMI and more comorbidities in MS group MS: better KSS satisfaction at 6 m No difference in other outcomes
Gray et al. [14]	2020	RCT	26/23	67.3/66.8	0.5	GMK Sphere Prosthesis, Medacta, Castel San Pietro Switzerland vs. GMK PS Prosthesis	Knee joint kinematics	Knee kinematic profiles observed for MS resemble those of the healthy joint more closely than PS
Batra et al. [2]	2020	RCT	53/53	61.7	4	ADVANCE® Medial Pivot, Micro Port Orthopedics, Arlington, TN, USA vs. PS Genesis II, Smith and Nephew, Memphis, USA	OKS, KSS, ROM, radiographic data, knee joint kinematics, complications	No difference in preop characteristics MP: better KSS (satisfaction, expectation) and kinematics No difference in other outcomes
Lee et al. [22]	2020	RCT	46/46	70	1	NA	FJS, KSS, ROM, WOMAC, LOS, pain score, patient preference and satisfaction	No difference in preop characteristics No difference in outcomes
Yuan et al. [42]	2019	RCT	49/51	69.4/69.6	5	Advance Medial-Pivot Knee System, Wright Medical Group vs. NexGen LPS-Flex, Zimmer, Warsaw, IN	HSS, WOMAC, radiographic data, complications	No difference in outcomes
Gill et al. [13]	2019	RCT	35/35	68.85/68.6	2	ADVANCE Medial-Pivot System (microport orthopedics) vs. Zimmer or Johnson and Johnson PS-TKA Prosthesis	ROM, KSS, FJS-12	MP: better knee flexion, FJS-12 No difference in other outcomes

Table 1 (continued)

Author	Year	Study design	*n* (MP/PS)	Age (MP/PS)	Follow-up (years)	Comparison	Outcomes assessed	Main findings
Edelstein et al. [8]	2019	RCT	25/25	67/64	2	GMK Sphere Prosthesis, Medacta, Castel San Pietro Switzerland vs. GMK PS Prosthesis	KT-1000, OKS, VR-12, IKDC, PROMIS, KSS, FJS, WBiF, ROM, GUAG	No difference in preop characteristics MP: better sagittal stability at 30 degrees PS: worse satisfaction for WBif vs non-WBif activities No difference in other outcomes
Benjamin et al. [3]	2018	RCT	45/45	62.4/64.8	1	MCBS (SAIPH Knee System, Matortho, Leatherhead, United Kingdom) vs. Press Fit Triathlon Knee System, Stryker, Kalamazoo, Michigan	KSS, OKS, gait analysis	No difference in outcomes
Nishitani et al. [27]	2018	RCT	33/32	73.8/74.4	2	Bi-Surface Total Knee Prosthesis (Kyocera, Kyoto, Japan) Asymmetrical vs. Symmetrical	ROM, KSS, radiographic data, complications	No difference in outcomes
Ishida et al. [17]	2012	RCT	20/20	71/72	4.8	ADVANCE Medial-Pivot (wright medical technology, Arlington, TN) vs. DH PS Insert	KSS, ROM, UCLA, pain score, complications, stability, radiographic data	No difference in outcomes
Hossain et al. [16]	2011	RCT	40/40	72.5/68.9	2	Medial Rotation Kneetm (MRK, Finsbury Orthopaedics, Leatherhead, Surrey, UK) vs. Press Fit Condylar SigmaTM PS (PFC, DePuy, Warsaw, IN)	ROM, KSS, OKS, WOMAC, SF-36, TKFQ, radiographic data, complications	No difference in preop functional measures MP: better ROM, WOMAC pain, SF-36 (physical) and TKFQ No difference in other outcomes
Pritchett et al. [31]	2011	RCT	42	NA	6.1/6.6	Medial Pivot (MP) Prosthesis (wright medical technology) vs. Posterior-Substituting (PS) Prosthesis (Biomet, Depuy, Stryker, Wright Medical Technology, and Zimmer	ROM, pain score radiographic data, KSS, patient preference, stability	Higher patient preference for MP vs. PS No differences in other outcomes

n number of total knee arthroplasties, *MP* medial pivot, *PS* posterior stabilised, *RCT* randomised control trial, *OKS* Oxford Knee Score, *KSS* Knee Society Score, *WOMAC* Western Ontario and McMaster Universities Arthritis Index, *ROM* range of motion, *SF-36* 36-item short form survey, *DOPS* Delaware Osteoarthritis Profile Score, *TUG* timed up and go, *SCT* stair climb test, *SPW* self-paced walk test, *CTS* chair to stand test, *LHT* leg holding test, *FJS-12* Forgotten Joint Score, *EQ-5D* European quality of life index five-dimensional on visual analog scale, *6MWT* 6 min walk test, *VR-12* Veterans RAND 12 Item Health Survey, *LOS* length of stay, *BMI* body mass index, *m* months, *MS* medial stabilised, *HSS* Hospital for Special Surgery Scoring System, *KT-1000* KT-1000 test, *IKDC* International Knee Documentation Committee, *PROMIS* Patient-Reported Outcomes Measurement Information System, *WBiF* weight-bearing in flexion, *GUAG* go up and go test, *UCLA* University of California, Los Angeles Activity Score, *TKFQ* total knee function questionnaire, *NA* non-available

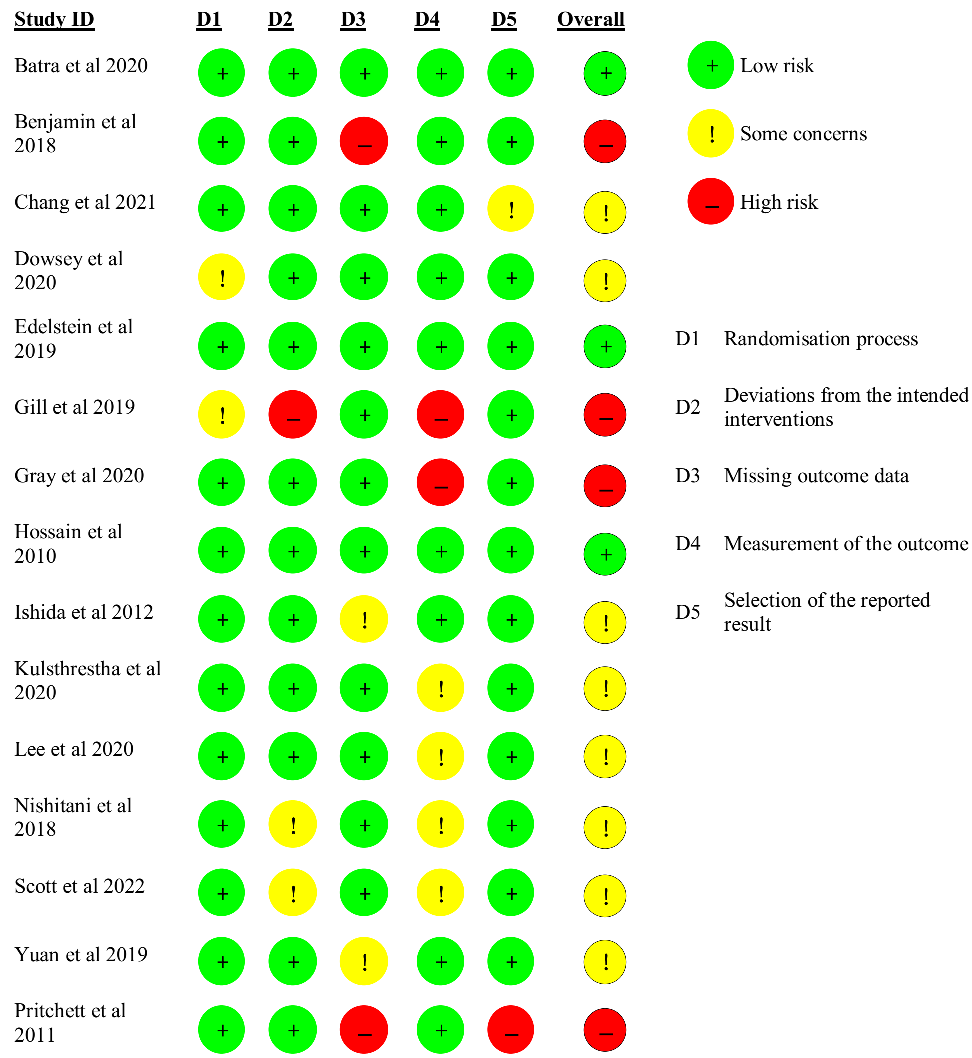


Fig. 2 Risk of bias summary: review authors' judgements about each risk-of-bias item for each included study

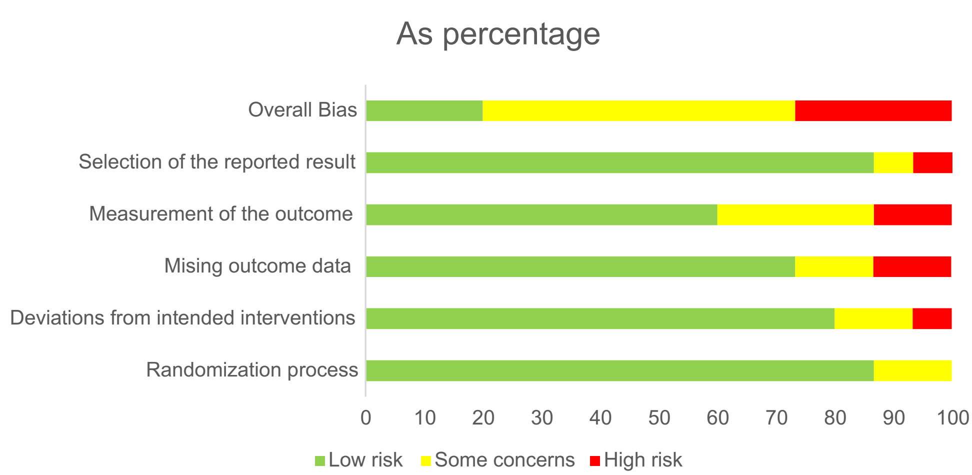


Fig. 3 Risk of bias graph: review authors' judgements about each risk-of-bias item presented as percentages across all included studies

Mean walking speed (MWS) and length of stay (LOS)

The mean difference in MWS and days of hospitalisation was found to be statistically insignificant for the two groups (Figs. 13, 14).

Table 2 Summary of meta-analysis results

	n					
	MP	PS	MD	95% CI	p	I^2 (%)
ROM[a]						
1 year	248	253	4.4	(– 2.38, 11.18)	0.20	88
2 years	271	267	3.15	(– 2.23, 8.52)	0.25	88
4 years	73	73	1.61	(– 1.71, 4.92)	0.34	0
KSS[a]						
1 year	282	284	1.10	(– 2.80, 5.00)	0.58	69
2 years	195	190	2.56	(– 1.62, 6.74)	0.23	78
KFS[a]						
1 year	143	142	– 0.14	(– 4.12, 3.84)	0.94	0
2 years	72	72	1.93	(– 3.41, 7.27)	0.48	0
WOMAC[b]						
1 year	158	157	– 2.39	(– 7.44, 2.65)	0.35	44
2 years	79	80	– 0.31	(– 10.69, 10.08)	0.95	72
OKS[a]						
1 year	182	181	– 0.58	(– 2.73, 1.57)	0.59	17
2 years	104	105	– 0.54	(– 3.27, 2.19)	0.70	30
FJS[a]						
1 year	165	166	1.65	(– 10.74, 14.04)	0.79	73
2 years	159	155	6.23	(– 3.62, 16.08)	0.21	78
VR-12[a]						
Physical	54	51	0.78	(– 4.43, 6.00)	0.77	30
Mental	54	51	– 3.26	(– 7.64, 1.13)	0.15	18
TUG[b]	54	51	0.91	(– 0.88, 2.70)	0.32	42
MWS[a]	36	33	– 0.03	(– 0.08, 0.03)	0.33	24
LOS[b]	75	72	– 0.44	(– 1.05, 0.17)	0.16	0
Radiographic alignment						
Tibiofemoral angle	146	147	0.13	(– 0.28, 0.55)	0.53	39
Coronal femoral angle	126	125	– 0.11	(– 0.23, 0.02)	0.09	0
Coronal tibial angle	126	125	– 0.20	(– 0.60, 0.20)	0.32	0
Sagittal femoral angle	126	125	– 0.11	(– 0.37, 0.15)	0.40	0
Sagittal tibial angle	126	125	0.36	(– 0.37, 1.09)	0.34	40
Tibial slope	138	140	0.41	(– 0.74, 1.56)	0.48	94
Posterior condylar offset	93	93	– 0.02	(– 0.10, 0.07)	0.71	11
Mechanical hip–knee–angle	126	127	0.11	(– 0.57, 0.79)	0.76	0
Complications	402	400	0.96[c]	(0.63, 1.47)	0.86	0

n number of total knee arthroplasties, *MD* mean difference, *CI* confidence intervals, I^2 heterogeneity, *MP* medial pivot, *PS* posterior stabilised, *OKS* Oxford Knee Score, *KSS* Knee Society Score, *KFS* Knee Function Score, *WOMAC* Western Ontario and McMaster Universities Arthritis Index, *ROM* range of motion, *TUG* timed up and go, *FJS-12* Forgotten Joint Score, *VR-12* Veterans RAND 12 Item Health Survey, *LOS* length of stay, *MWS* mean walking speed

[a]Positive value of MD favours MP

[b]Negative value of MD favours MP

[c]The value is expressed as risk ratio of MP compared to PS

Radiographic analysis

There was no significant difference in tibiofemoral angle, coronal femoral angle, coronal tibial angle, sagittal femoral angle, sagittal tibial angle and mechanical hip–knee–ankle angle between MP and PS groups (Fig. 15).

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Random, 95% CI
4.1.1 ROM 1 year								
Chang 2021	114.6	16.3	43	111.3	17.8	45	18.4%	3.30 [-3.83, 10.43]
Edelstein 2019	111.2	10.4	25	114.7	10.7	25	19.7%	-3.50 [-9.35, 2.35]
Hossain 2010	115.5	11.6	40	98.2	14.2	40	19.9%	17.30 [11.62, 22.98]
Lee 2020	108	12	46	110	14	46	20.2%	-2.00 [-7.33, 3.33]
Scott 2022	129.85	11.54	94	123.21	11.54	97	21.9%	6.64 [3.37, 9.91]
Subtotal (95% CI)			**248**			**253**	**100.0%**	**4.40 [-2.38, 11.18]**
Heterogeneity: Tau² = 51.88; Chi² = 33.92, df = 4 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 1.27 (P = 0.20)								
4.1.2 ROM or ROM change 2 years								
Chang 2021	114.9	15.5	39	114.9	16.4	40	15.4%	0.00 [-7.04, 7.04]
Gill 2019	119.4	3.16	35	113.43	2.48	35	20.6%	5.97 [4.64, 7.30]
Hossain 2010	114.9	12.8	40	100.1	15.9	40	16.2%	14.80 [8.47, 21.13]
Kulshrestha 2020	-6.1	19.7	36	9.3	14.3	37	14.4%	-15.40 [-23.31, -7.49]
Nishitani 2018	108.7	15.8	33	106.9	15.6	32	14.7%	1.80 [-5.83, 9.43]
Scott 2022	132.14	12.81	88	124.33	12.81	83	18.8%	7.81 [3.97, 11.65]
Subtotal (95% CI)			**271**			**267**	**100.0%**	**3.15 [-2.23, 8.52]**
Heterogeneity: Tau² = 36.04; Chi² = 40.09, df = 5 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 1.15 (P = 0.25)								
4.1.3 ROM 4 years								
Batra 2020	118	8.6	53	116	9.3	53	94.4%	2.00 [-1.41, 5.41]
Ishida 2012	110	22	20	115	23	20	5.6%	-5.00 [-18.95, 8.95]
Subtotal (95% CI)			**73**			**73**	**100.0%**	**1.61 [-1.71, 4.92]**
Heterogeneity: Tau² = 0.00; Chi² = 0.91, df = 1 (P = 0.34); I² = 0%								
Test for overall effect: Z = 0.95 (P = 0.34)								

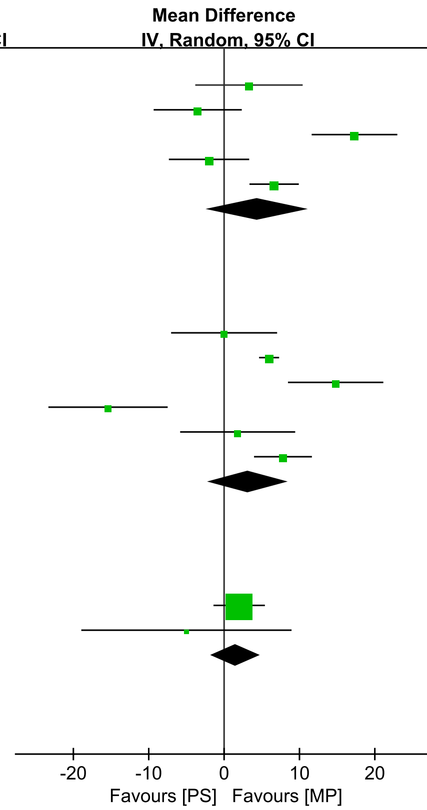


Fig. 4 Forest plot for ROM

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Random, 95% CI
5.1.1 KSS 1 year								
Benjamin 2018	85.1	19.25	45	87.2	19.25	45	12.4%	-2.10 [-10.05, 5.85]
Chang 2021	83	17	43	81.1	10.7	45	15.9%	1.90 [-4.07, 7.87]
Dowsey 2020	88.8	11	29	93.2	5.9	26	18.8%	-4.40 [-9.00, 0.20]
Edelstein 2019	88.1	9.5	25	86	12.6	25	15.5%	2.10 [-4.09, 8.29]
Lee 2020	91	11	46	90	18	46	15.7%	1.00 [-5.10, 7.10]
Scott 2022	95.41	11.18	94	88.98	11.18	97	21.8%	6.43 [3.26, 9.60]
Subtotal (95% CI)			**282**			**284**	**100.0%**	**1.10 [-2.80, 5.00]**
Heterogeneity: Tau² = 15.61; Chi² = 16.02, df = 5 (P = 0.007); I² = 69%								
Test for overall effect: Z = 0.55 (P = 0.58)								
5.1.2 KSS 2 years								
Chang 2021	82.9	16.96	39	81.42	10.45	40	19.6%	1.48 [-4.75, 7.71]
Gill 2019	89.2	1.73	35	88.8	2.6	35	34.1%	0.40 [-0.63, 1.43]
Nishitani 2018	85.1	10	33	85.2	14.7	32	19.9%	-0.10 [-6.23, 6.03]
Scott 2022	96.16	13.38	88	88	13.38	83	26.4%	8.16 [4.15, 12.17]
Subtotal (95% CI)			**195**			**190**	**100.0%**	**2.56 [-1.62, 6.74]**
Heterogeneity: Tau² = 13.05; Chi² = 13.61, df = 3 (P = 0.003); I² = 78%								
Test for overall effect: Z = 1.20 (P = 0.23)								

Test for subgroup differences: Chi² = 0.25, df = 1 (P = 0.62), I² = 0%

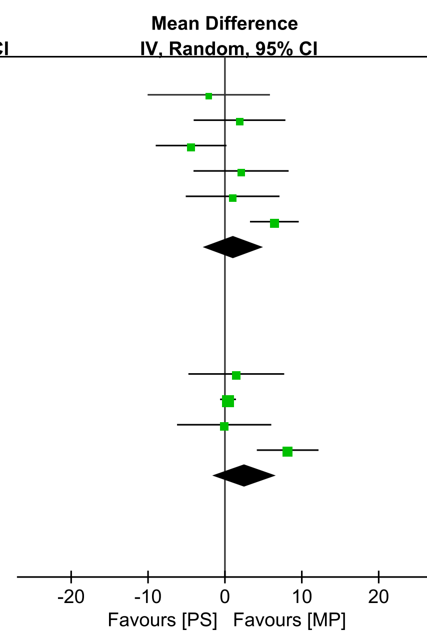


Fig. 5 Forest plot for KSS

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Fixed, 95% CI
6.1.1 KFS 1 year								
Chang 2021	77.6	15.8	43	76.5	10.4	45	50.3%	1.10 [-4.52, 6.72]
Dowsey 2020	65.7	17.3	29	70.4	19.4	26	16.7%	-4.70 [-14.46, 5.06]
Edelstein 2019	81.4	17.9	25	77.4	22.5	25	12.5%	4.00 [-7.27, 15.27]
Lee 2020	58	21	46	60	22	46	20.5%	-2.00 [-10.79, 6.79]
Subtotal (95% CI)			**143**			**142**	**100.0%**	**-0.14 [-4.12, 3.84]**
Heterogeneity: Chi² = 1.72, df = 3 (P = 0.63); I² = 0%								
Test for overall effect: Z = 0.07 (P = 0.94)								
6.1.2 KFS 2 years								
Chang 2021	76.2	18.81	39	73.93	8.53	40	68.1%	2.27 [-4.20, 8.74]
Nishitani 2018	74.3	19.4	33	73.1	19.5	32	31.9%	1.20 [-8.26, 10.66]
Subtotal (95% CI)			**72**			**72**	**100.0%**	**1.93 [-3.41, 7.27]**
Heterogeneity: Chi² = 0.03, df = 1 (P = 0.85); I² = 0%								
Test for overall effect: Z = 0.71 (P = 0.48)								
Test for subgroup differences: Chi² = 0.37, df = 1 (P = 0.54), I² = 0%								

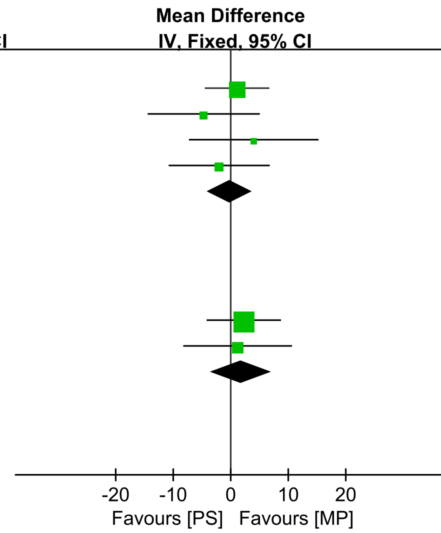


Fig. 6 Forest plot for KFS

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Random, 95% CI
7.1.1 WOMAC total 1 year								
Chang 2021	27.3	23.7	43	32.3	16.8	45	21.5%	-5.00 [-13.62, 3.62]
Dowsey 2020	19.2	14.8	29	23	18.1	26	20.9%	-3.80 [-12.60, 5.00]
Hossain 2010	25.9	14.9	40	32.9	22.3	40	22.5%	-7.00 [-15.31, 1.31]
Lee 2020	19	14	46	16	12	46	35.1%	3.00 [-2.33, 8.33]
Subtotal (95% CI)			**158**			**157**	**100.0%**	**-2.39 [-7.44, 2.65]**
Heterogeneity: Tau² = 11.51; Chi² = 5.32, df = 3 (P = 0.15); I² = 44%								
Test for overall effect: Z = 0.93 (P = 0.35)								
7.1.3 WOMAC pain 1 year								
Chang 2021	6.3	6.8	43	6.9	4.3	45	41.9%	-0.60 [-2.99, 1.79]
Dowsey 2020	16.7	15.9	29	22.8	18.8	26	5.9%	-6.10 [-15.36, 3.16]
Hossain 2010	2.6	1.8	40	5.9	5.4	40	52.3%	-3.30 [-5.06, -1.54]
Subtotal (95% CI)			**112**			**111**	**100.0%**	**-2.33 [-4.67, 0.00]**
Heterogeneity: Tau² = 1.91; Chi² = 3.79, df = 2 (P = 0.15); I² = 47%								
Test for overall effect: Z = 1.96 (P = 0.05)								
7.1.4 WOMAC stiffness 1 year								
Chang 2021	1.9	2.8	43	2.4	1.9	45	45.5%	-0.50 [-1.50, 0.50]
Dowsey 2020	20.7	19.3	29	26	22.2	26	0.4%	-5.30 [-16.35, 5.75]
Hossain 2010	2.2	2.1	40	2.8	2.1	40	54.1%	-0.60 [-1.52, 0.32]
Subtotal (95% CI)			**112**			**111**	**100.0%**	**-0.57 [-1.25, 0.11]**
Heterogeneity: Tau² = 0.00; Chi² = 0.73, df = 2 (P = 0.70); I² = 0%								
Test for overall effect: Z = 1.66 (P = 0.10)								
7.1.5 WOMAC function 1 year								
Chang 2021	19.3	16.2	43	23	13.4	45	42.6%	-3.70 [-9.93, 2.53]
Dowsey 2020	19.7	15.3	29	22.7	19.2	26	19.3%	-3.00 [-12.25, 6.25]
Hossain 2010	21.1	12.5	40	24.1	17.2	40	38.1%	-3.00 [-9.59, 3.59]
Subtotal (95% CI)			**112**			**111**	**100.0%**	**-3.30 [-7.36, 0.77]**
Heterogeneity: Tau² = 0.00; Chi² = 0.03, df = 2 (P = 0.99); I² = 0%								
Test for overall effect: Z = 1.59 (P = 0.11)								
Test for subgroup differences: Chi² = 3.92, df = 3 (P = 0.27), I² = 23.5%								

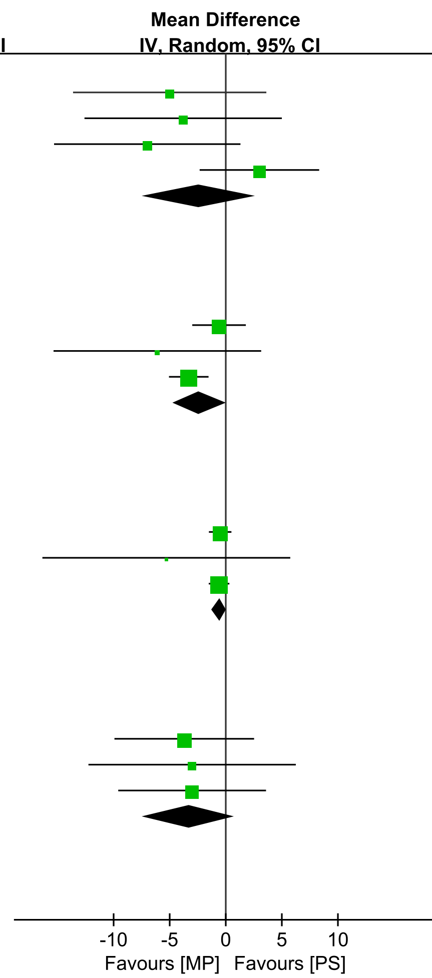


Fig. 7 Forest plot for WOMAC at 1-year follow-up

	MP			PS				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
8.1.1 OKS 1 year								
Benjamin 2018	39.6	9.32	45	40.4	9.32	45	24.6%	-0.80 [-4.65, 3.05]
Chang 2021	41.9	8.7	43	41.1	7.5	45	29.8%	0.80 [-2.60, 4.20]
Dowsey 2020	32.4	13.2	29	33.8	13.4	26	8.6%	-1.40 [-8.44, 5.64]
Edelstein 2019	39.16	9.97	25	35.81	11.33	25	11.9%	3.35 [-2.57, 9.27]
Hossain 2010	25.9	10.1	40	29.5	7	40	25.1%	-3.60 [-7.41, 0.21]
Subtotal (95% CI)			**182**			**181**	**100.0%**	**-0.58 [-2.73, 1.57]**
Heterogeneity: Tau² = 1.02; Chi² = 4.81, df = 4 (P = 0.31); I² = 17%								
Test for overall effect: Z = 0.53 (P = 0.59)								
8.1.2 OKS 2 years								
Chang 2021	42.7	8.1	39	42.3	6.7	40	42.6%	0.40 [-2.88, 3.68]
Edelstein 2019	40.41	8.56	25	38.28	11.8	25	18.9%	2.13 [-3.58, 7.84]
Hossain 2010	26.2	9.1	40	29.1	7	40	38.5%	-2.90 [-6.46, 0.66]
Subtotal (95% CI)			**104**			**105**	**100.0%**	**-0.54 [-3.27, 2.19]**
Heterogeneity: Tau² = 1.75; Chi² = 2.84, df = 2 (P = 0.24); I² = 30%								
Test for overall effect: Z = 0.39 (P = 0.70)								
Test for subgroup differences: Chi² = 0.00, df = 1 (P = 0.98), I² = 0%								

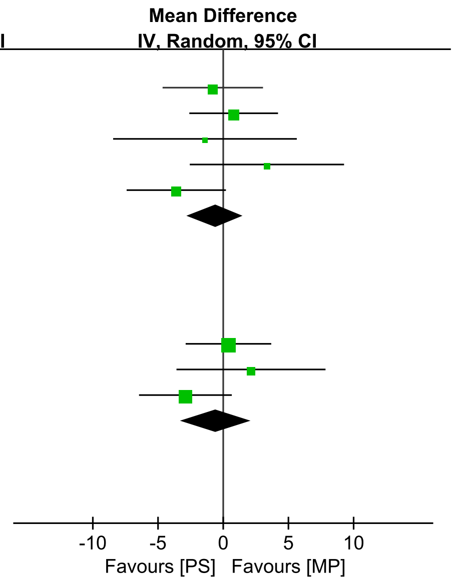


Fig. 8 Forest plot for OKS

	MP			PS				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
9.1.1 FJS 1 year								
Edelstein 2019	57.1	37.6	25	54.6	41.6	25	19.3%	2.50 [-19.48, 24.48]
Lee 2020	75	24	46	82	20	46	39.0%	-7.00 [-16.03, 2.03]
Scott 2022	64	26.12	94	54.67	26.12	95	41.7%	9.33 [1.88, 16.78]
Subtotal (95% CI)			**165**			**166**	**100.0%**	**1.65 [-10.74, 14.04]**
Heterogeneity: Tau² = 81.31; Chi² = 7.48, df = 2 (P = 0.02); I² = 73%								
Test for overall effect: Z = 0.26 (P = 0.79)								
9.1.2 FJS or FJS change 2 years								
Gill 2019	60.09	16.73	35	47.6	20.96	35	31.7%	12.49 [3.61, 21.37]
Kulshrestha 2020	52.7	14.6	36	55.6	15.38	37	35.3%	-2.90 [-9.78, 3.98]
Scott 2022	68.29	27.08	88	58.3	27.08	83	33.1%	9.99 [1.87, 18.11]
Subtotal (95% CI)			**159**			**155**	**100.0%**	**6.23 [-3.62, 16.08]**
Heterogeneity: Tau² = 59.19; Chi² = 9.25, df = 2 (P = 0.010); I² = 78%								
Test for overall effect: Z = 1.24 (P = 0.21)								
Test for subgroup differences: Chi² = 0.32, df = 1 (P = 0.57), I² = 0%								

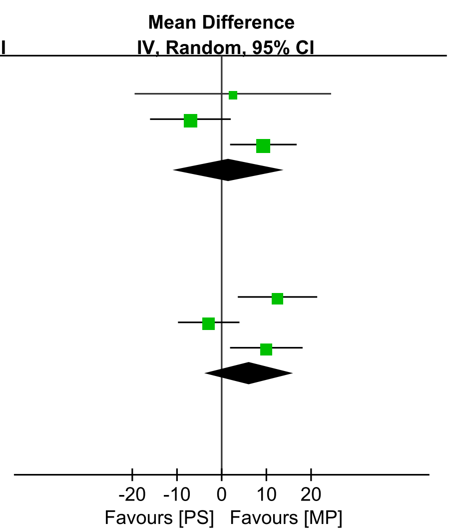


Fig. 9 Forest plot for FJS

Complications

Among the most common reported complications were knee stiffness requiring manipulation under anaesthesia and deep-vein thrombosis (DVT). Other failures comprised of minor pain symptoms, infection, myocardial infarction, hematoma, wound dehiscence, and pulmonary embolism. Quantitative analysis showed no significant difference between the two groups in overall complication rates (Fig. 16).

Publication bias

The visual inspection of the funnel plot for the primary outcome (ROM) showed that the distribution was symmetric indicating no obvious publication bias (Fig. 17).

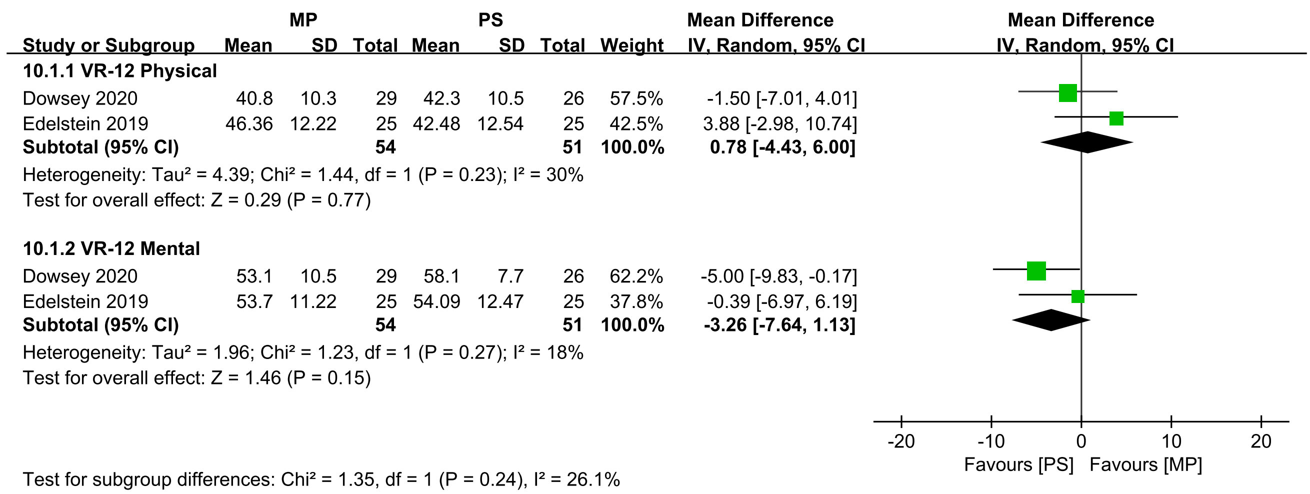


Fig. 10 Forest plot for VR-12

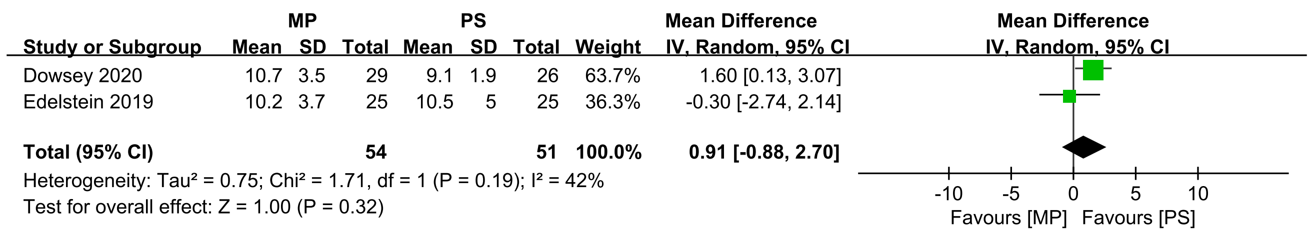


Fig. 11 Forest plot for TUG

Discussion

The primary outcome of this study was the similar short- and midterm satisfactory functional results between MP and PS knee designs. Our analysis concluded also that radiographic alignment, gait parameters, and overall complications did not differ statistically significantly. The clinical satisfaction scores conformed with these results subsequently. At this point, we have to mention also that the included studies are quite contemporary with a publication gap spanning approximately a decade (2011–2022) and utilising modern bearing implants.

While all TKAs are arguably performed to primarily alleviate pain, the restoration of normal knee function, although strived for, is not always achieved [28]. It is believed that an implant closely mimicking the native knee movement could potentially have a positive impact on patient satisfaction [2]. In MP design, the paradoxical motion of the femoral component seen in PS knees is limited and the asymmetrical tibial insert results in a more smooth knee motion [21]. However, comparative trials reported contradictory findings for ROM [2, 4, 7, 14, 21, 34]. Sufficient evidence in the literature does not support any superiority of MP prosthesis [1]. Nisar et al. in a previously published meta-analysis noted comparable ROM between the two implants [26]. Similarly, three other meta-analyses failed to prove any advantage of MP for ROM [9, 24, 38]. Our study found better ROM for MP knees at the first 2 years postoperatively but the results did not support any statistical superiority, which is in line with the aforementioned studies. Midterm results were also similar between the two groups.

Among the most common PROMs examined in TKA are WOMAC score, OKS and KSS. Our observations showed no clear advantage for any of the groups regarding all these functional scoring algorithms. This finding corroborates with all four previous meta-analyses but only for KSS [9, 24, 26, 38]. Contrary to our findings, two reviews reported significantly better WOMAC score for the MP knees [9, 24]. However, the mean difference value was less than the minimum clinically important difference (MCID) of 15 points [10]. The results for OKS are even more ambiguous. Liu et al. in the most recent meta-analysis, demonstrated a significantly better OKS in favour of PS design [24]. Nisar et al. on the other hand, showed a clear advantage of OKS for MP knees [26]. Once again, the mean difference in both studies was less than MCID of 4.7–10 points [25]. Moreover, all previous meta-analyses

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Random, 95% CI
12.1.1 WOMAC total 2 years								
Chang 2021	26.8	19.84	39	22	12.03	40	51.8%	4.80 [-2.46, 12.06]
Hossain 2010	27.1	13.4	40	32.9	23.1	40	48.2%	-5.80 [-14.08, 2.48]
Subtotal (95% CI)			**79**			**80**	**100.0%**	**-0.31 [-10.69, 10.08]**
Heterogeneity: Tau² = 40.41; Chi² = 3.56, df = 1 (P = 0.06); I² = 72%								
Test for overall effect: Z = 0.06 (P = 0.95)								
12.1.2 WOMAC pain 2 years								
Chang 2021	6.14	6.37	39	6.77	4.32	40	41.2%	-0.63 [-3.04, 1.78]
Hossain 2010	2.7	1.8	40	5.4	5.2	40	58.8%	-2.70 [-4.41, -0.99]
Subtotal (95% CI)			**79**			**80**	**100.0%**	**-1.85 [-3.84, 0.15]**
Heterogeneity: Tau² = 1.01; Chi² = 1.89, df = 1 (P = 0.17); I² = 47%								
Test for overall effect: Z = 1.81 (P = 0.07)								
12.1.3 WOMAC stiffness 2 years								
Chang 2021	2.11	1.53	39	2.16	2.75	40	44.5%	-0.05 [-1.03, 0.93]
Hossain 2010	2.1	2	40	2.6	2	40	55.5%	-0.50 [-1.38, 0.38]
Subtotal (95% CI)			**79**			**80**	**100.0%**	**-0.30 [-0.95, 0.35]**
Heterogeneity: Tau² = 0.00; Chi² = 0.45, df = 1 (P = 0.50); I² = 0%								
Test for overall effect: Z = 0.90 (P = 0.37)								
12.1.4 WOMAC function 2 years								
Chang 2021	18.56	12.23	39	19.02	8.84	40	65.9%	-0.46 [-5.18, 4.26]
Hossain 2010	22.2	11.6	40	24.9	17.7	40	34.1%	-2.70 [-9.26, 3.86]
Subtotal (95% CI)			**79**			**80**	**100.0%**	**-1.22 [-5.05, 2.61]**
Heterogeneity: Tau² = 0.00; Chi² = 0.30, df = 1 (P = 0.59); I² = 0%								
Test for overall effect: Z = 0.63 (P = 0.53)								

Test for subgroup differences: Chi² = 2.24, df = 3 (P = 0.53), I² = 0%

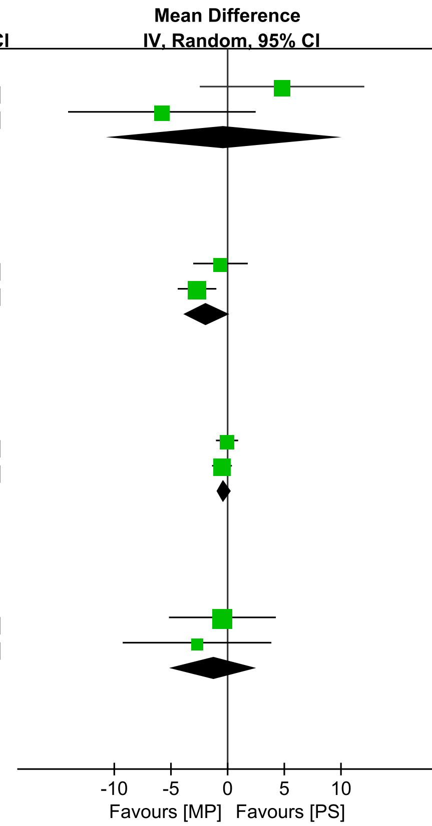


Fig. 12 Forest plot for WOMAC at 2-year follow-up

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Fixed, 95% CI
Benjamin 2018	1.16	0.075	10	1.21	0.075	10	58.8%	-0.05 [-0.12, 0.02]
Gray 2020	0.87	0.14	26	0.86	0.14	23	41.2%	0.01 [-0.07, 0.09]
Total (95% CI)			**36**			**33**	**100.0%**	**-0.03 [-0.08, 0.03]**
Heterogeneity: Chi² = 1.32, df = 1 (P = 0.25); I² = 24%								
Test for overall effect: Z = 0.98 (P = 0.33)								

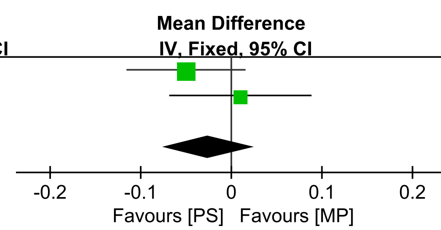


Fig. 13 Forest plot for MWS

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Fixed, 95% CI
Dowsey 2020	4.5	1.5	29	5.4	3	26	22.9%	-0.90 [-2.18, 0.38]
Lee 2020	5.5	1.8	46	5.8	1.6	46	77.1%	-0.30 [-1.00, 0.40]
Total (95% CI)			**75**			**72**	**100.0%**	**-0.44 [-1.05, 0.17]**
Heterogeneity: Chi² = 0.65, df = 1 (P = 0.42); I² = 0%								
Test for overall effect: Z = 1.40 (P = 0.16)								

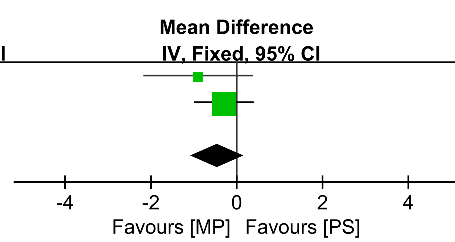
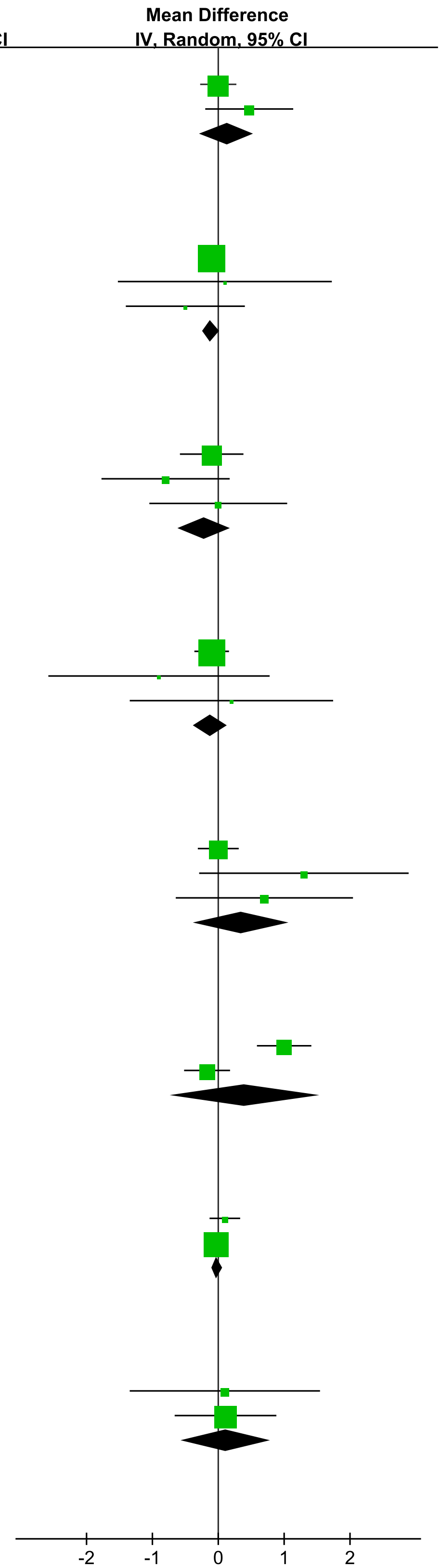


Fig. 14 Forest plot for LOS

Study or Subgroup	MP Mean	MP SD	MP Total	PS Mean	PS SD	PS Total	Weight	Mean Difference IV, Random, 95% CI
15.1.1 TIBIOFEMORAL ANGLE								
Batra 2020	-4.1	0.77	53	-4.1	0.67	53	71.8%	0.00 [-0.27, 0.27]
Scott 2022	6.11	2.33	93	5.64	2.33	94	28.2%	0.47 [-0.20, 1.14]
Subtotal (95% CI)			**146**			**147**	**100.0%**	**0.13 [-0.28, 0.55]**
Heterogeneity: Tau² = 0.04; Chi² = 1.63, df = 1 (P = 0.20); I² = 39%								
Test for overall effect: Z = 0.63 (P = 0.53)								
15.1.2 CORONAL FEMORAL ANGLE								
Batra 2020	94.9	0.46	53	95	0.04	53	97.6%	-0.10 [-0.22, 0.02]
Hossain 2010	95.6	3.9	40	95.5	3.5	40	0.6%	0.10 [-1.52, 1.72]
Nishitani 2018	89.4	1.7	33	89.9	2	32	1.8%	-0.50 [-1.40, 0.40]
Subtotal (95% CI)			**126**			**125**	**100.0%**	**-0.11 [-0.23, 0.02]**
Heterogeneity: Tau² = 0.00; Chi² = 0.80, df = 2 (P = 0.67); I² = 0%								
Test for overall effect: Z = 1.70 (P = 0.09)								
15.1.3 CORONAL TIBIAL ANGLE								
Batra 2020	90.2	1.32	53	90.3	1.21	53	68.6%	-0.10 [-0.58, 0.38]
Hossain 2010	88.4	1.9	40	89.2	2.5	40	16.8%	-0.80 [-1.77, 0.17]
Nishitani 2018	89.1	2.1	33	89.1	2.2	32	14.6%	0.00 [-1.05, 1.05]
Subtotal (95% CI)			**126**			**125**	**100.0%**	**-0.20 [-0.60, 0.20]**
Heterogeneity: Tau² = 0.00; Chi² = 1.77, df = 2 (P = 0.41); I² = 0%								
Test for overall effect: Z = 1.00 (P = 0.32)								
15.1.4 SAGGITAL FEMORAL ANGLE								
Batra 2020	2.5	0.7	53	2.6	0.68	53	94.9%	-0.10 [-0.36, 0.16]
Hossain 2010	2.4	2.7	40	3.3	4.7	40	2.3%	-0.90 [-2.58, 0.78]
Nishitani 2018	4.6	2.8	33	4.4	3.5	32	2.7%	0.20 [-1.34, 1.74]
Subtotal (95% CI)			**126**			**125**	**100.0%**	**-0.11 [-0.37, 0.15]**
Heterogeneity: Tau² = 0.00; Chi² = 1.01, df = 2 (P = 0.60); I² = 0%								
Test for overall effect: Z = 0.84 (P = 0.40)								
15.1.5 SAGGITAL TIBIAL ANGLE								
Batra 2020	86	0.83	53	86	0.8	53	62.9%	0.00 [-0.31, 0.31]
Hossain 2010	88.7	4.3	40	87.4	2.8	40	16.2%	1.30 [-0.29, 2.89]
Nishitani 2018	86.3	3.1	33	85.6	2.4	32	20.8%	0.70 [-0.65, 2.05]
Subtotal (95% CI)			**126**			**125**	**100.0%**	**0.36 [-0.37, 1.09]**
Heterogeneity: Tau² = 0.20; Chi² = 3.33, df = 2 (P = 0.19); I² = 40%								
Test for overall effect: Z = 0.96 (P = 0.34)								
15.1.6 TIBIAL SLOPE								
Chang 2021	2	1	45	1	1	45	49.5%	1.00 [0.59, 1.41]
Scott 2022	6.01	1.22	93	6.18	1.22	95	50.5%	-0.17 [-0.52, 0.18]
Subtotal (95% CI)			**138**			**140**	**100.0%**	**0.41 [-0.74, 1.56]**
Heterogeneity: Tau² = 0.65; Chi² = 17.98, df = 1 (P < 0.0001); I² = 94%								
Test for overall effect: Z = 0.70 (P = 0.48)								
15.1.7 POSTERIOR CONDYLAR OFFSET								
Batra 2020	17.9	0.62	53	17.8	0.6	53	11.3%	0.10 [-0.13, 0.33]
Hossain 2010	0.96	0.14	40	0.99	0.14	40	88.7%	-0.03 [-0.09, 0.03]
Subtotal (95% CI)			**93**			**93**	**100.0%**	**-0.02 [-0.10, 0.07]**
Heterogeneity: Tau² = 0.00; Chi² = 1.12, df = 1 (P = 0.29); I² = 11%								
Test for overall effect: Z = 0.37 (P = 0.71)								
15.1.8 MECHANICAL HIP KNEE ANKLE ANGLE								
Nishitani 2018	181.3	2.3	33	181.2	3.5	32	22.2%	0.10 [-1.34, 1.54]
Scott 2022	180	2.7	93	179.89	2.7	95	77.8%	0.11 [-0.66, 0.88]
Subtotal (95% CI)			**126**			**127**	**100.0%**	**0.11 [-0.57, 0.79]**
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 0.99); I² = 0%								
Test for overall effect: Z = 0.31 (P = 0.76)								



Test for subgroup differences: Chi² = 4.98, df = 7 (P = 0.66), I² = 0%

Fig. 15 Forest plot for radiographic analysis

Study or Subgroup	MP Events	MP Total	PS Events	PS Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Batra 2020	2	53	0	53	1.5%	5.00 [0.25, 101.73]
Chang 2021	4	43	5	45	14.3%	0.84 [0.24, 2.91]
Dowsey 2020	6	27	7	23	22.1%	0.73 [0.29, 1.87]
Hossain 2010	2	40	1	40	2.9%	2.00 [0.19, 21.18]
Ishida 2012	0	20	0	20		Not estimable
Kulshrestha 2020	1	36	3	37	8.7%	0.34 [0.04, 3.14]
Nishitani 2018	13	33	12	32	35.7%	1.05 [0.57, 1.94]
Scott 2022	5	101	5	99	14.8%	0.98 [0.29, 3.28]
Yuan 2019	0	49	0	51		Not estimable
Total (95% CI)		**402**		**400**	**100.0%**	**0.96 [0.63, 1.47]**
Total events	33		33			

Heterogeneity: Chi² = 2.81, df = 6 (P = 0.83); I² = 0%
Test for overall effect: Z = 0.18 (P = 0.86)

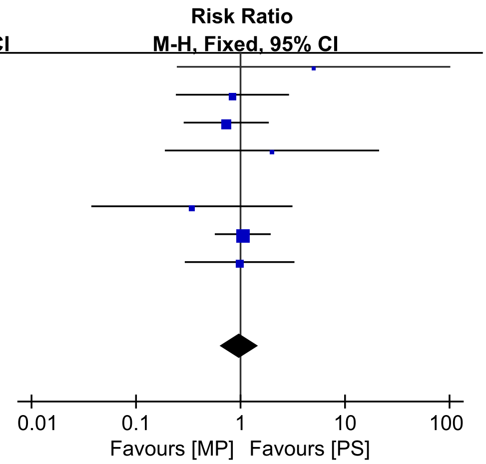
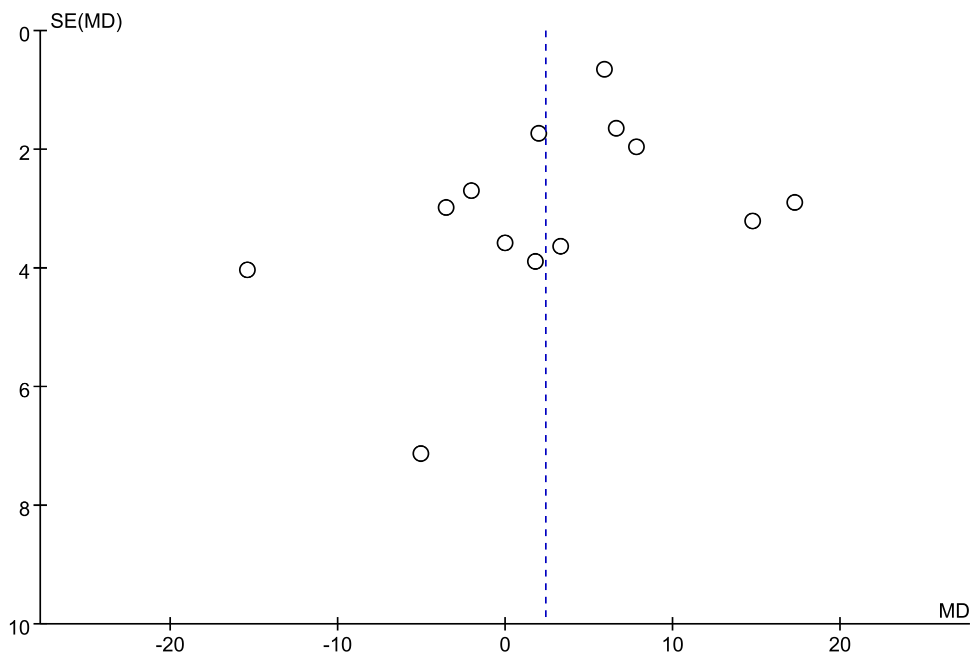


Fig. 16 Forest plot for complications

Fig. 17 Funnel plot for ROM



suffered from selection bias as they comprised of a mixture of retrospective studies along with RCTs.

One interesting finding is that despite the similar outcomes reported between the two knee designs, patients with bilateral TKA seem to prefer one implant over another [31]. This has been underlined by the study of Pritchett et al. who demonstrated that 77% of patients preferred MP knee over PS and could mainly be attributed to the noise related problems that are associated to PS knees [29, 30]. By contrast, the MP design produces more native patellofemoral activity and thus, it triggers less audible symptoms [41].

Radiographic markers are paramount for assessing a TKA. Any deviation from the correct implant alignment can change the knee kinematics and impact patient satisfaction and overall material survivorship [35]. The implant positioning basically depends on the preoperative plan and the surgeons' surgical skills [18, 35]. In our study, all radiology signs examined were similar across the groups, which means that the implant positioning was not a confounding factor for the reported clinical outcomes.

Lower limb kinematics and ROM are affected by spatial–temporal parameters of gait [37]. Ground reaction forces and peak values of knee moments in the sagittal and frontal planes increase with high walking speed [37]. In our analysis, we found comparable MWS between MP and PS groups. However, both studies included in the quantitative analysis have a high value of bias which lessens the importance of this finding.

The main limitation of our study was the high heterogeneity found in many outcomes, which could possibly be attributed to the different types of prostheses used. However, we believe that the different product makes cannot have a major impact on functional outcomes as prostheses of the same type, whether MP or PS, share the same basic design principles. The short follow-up period found in most of the studies is also a drawback of this meta-analysis. Another weakness is that we included studies that compared outcomes in the same patient (bilateral TKA) and trials that compared outcomes among different patients. With regards to the risk of bias, we found a low percentage of 'high risk' for each domain with an overall bias of 26.7% (Fig. 3). That said, we acknowledge that such a bias might influence the interpretation and accuracy of the findings.

However, the data we presented are extracted from RCTs only, and this is actually the major strength of our study. Another advantage of our meta-analysis is that we performed quantitative analysis for gait parameters apart from PROMs for the two groups.

Conclusions

In light of our analysis, the superiority of MP knee implants remains uncorroborated. Our review and meta-analysis showed comparable outcomes between MP and PS prostheses at short-term follow-up. Long-term data and even more high-quality RCTs are essential to establish a potential advantage of MP TKAs in patient satisfaction.

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Author contributions PK was the major contributor in writing the manuscript, making substantial contributions to conception, design, acquisition of data, analysis and interpretation of data. SP was a contributor in writing the manuscript, involved in drafting the article, acquisition of data, analysis and interpretation of data. GP was a contributor in writing the manuscript, involved in drafting the article, acquisition of data, analysis and interpretation of data. KP was a contributor in writing the manuscript, involved in drafting the article and revising it critically for important intellectual content. ET was a contributor in writing the manuscript, involved in drafting the article and revising it critically for important intellectual content. CT was a contributor in writing the manuscript, involved in drafting the article and revising it critically for important intellectual content and gave the final approval of the version to be published.

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Declarations

Conflict of interest The authors declare that they have no competing interests.

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Informed consent Informed consent was not required for this study.

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