To resurface or not to resurface: the patellar dilemma in total knee arthroplasty

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Received: 09-Mar-2024
Revised: 27-Jul-2024
Accepted: 29-Jul-2024
Published: 08-Mar-2025

The Egyptian Orthopaedic Journal 2024, 59:330–345

Introduction
Total knee arthroplasty (TKA) is a highly successful clinical procedure, but there is no consensus regarding optimal patellar management. Options include patellar resurfacing and nonresurfacing, with the latter sometimes involving de-afferentation. Anterior knee pain post-TKA affects 5–20% of patients with patellar retention, prompting varied surgical approaches. Over 80% of surgeons prefer patellar resurfacing due to its cost-effectiveness, fewer re-operations, and reduced anterior knee pain. However, resurfacing has risks like patellar fracture, dislocation, implant failure, and patellar tendon damage. Proponents of patellar retention argue against its additional complexities and lack of clear benefits. Nonresurfacing correlates with higher anterior knee pain rates, necessitating more interventions and re-operations. Despite randomized trials, the superiority of either option remains unclear.

Patients and methods
Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, we conducted a meta-analysis of comparative studies on patellar resurfacing versus nonresurfacing in TKA, focusing on revision and complication rates. A comprehensive search of MEDLINE, EMBASE, Cochrane, and PubMed databases was performed using keywords such as 'Knee,' 'Arthroplasty,' 'Patella,' 'Resurfacing,' 'Prosthesis,' and 'Replacement.' Two independent reviewers assessed articles for relevance and extracted data. Inclusion criteria included detailed surgical procedure descriptions, sufficient follow-up duration, and at least one validated outcome score. Studies lacking these parameters were excluded. The risk of bias was assessed using the ROBIS tool.

Results
Out of 1885 citations, 35 studies met the inclusion criteria, comprising 5304 TKAs (2345 nonresurfaced, 2359 resurfaced). The average follow-up duration was 58.1±37.1 months. The meta-analysis revealed a significantly lower re-operation rate in the resurfaced group (1%) compared with the nonresurfaced group (6.9%) [Odd's ratio (OR) 0.18, 95% Confidence interval (CI) 0.11–0.29, $P<0.00001$]. Anterior knee pain was also significantly lower in the resurfaced group (2%) compared with the nonresurfaced group (10%) [OR 0.17, 95% CI 0.12–0.25, $P<0.00001$]. Additionally, the resurfaced group showed higher postoperative Knee Society Score pain scores (Mean difference 1.52, 95% CI 0.68–2.35, $P=0.0004$) and Hospital for Special Surgery scores (Mean difference 4.35, 95% CI 3.21–5.49, $P<0.00001$). The results were shown on a forest and funnel plot diagram.

Conclusion
Patellar resurfacing in TKA demonstrated superior outcomes compared with nonresurfacing, with lower re-operation rates, reduced anterior knee pain, and better Knee Society Score pain and Hospital for Special Surgery scores. These findings suggest the potential benefits of patellar resurfacing in TKA. However, standardized reporting of follow-up durations and outcomes in larger randomized controlled trials is essential to enhance understanding and guide clinical decisions on patellar management in TKA patients.

Keywords:
anterior knee pain, nonresurfacing, patella resurfacing, re-operation, total knee arthroplasty

Egypt Orthop J 2024, 59:330–345

1110-1148

Introduction

Total knee arthroplasty (TKA) is generally very successful, but there is still debate in the literature about the best way to manage the patella during the procedure [1]. The current options include resurfacing the patella,

not resurfacing it, and using de-afferentation (electro-cautery treatment) with or without resurfacing [2].

Knee pain anteriorly affects 5–20% of patients postprimary TKA with patellar retention, leading to varied surgical approaches [3]. Resurfacing the patella is preferred by over 80% of surgeons, citing cost-effectiveness, fewer re-operations, and reduced knee pain anteriorly [4].

Despite there being a number of benefits of patellar resurfacing, there are associated risks including dislocation, patellar fracture, patellar tendon damage, implant failure, and clunk syndrome [5–7]. Proponents of patellar retention argue against its additional complexities and lack of clear benefits in terms of healthcare costs, functional outcomes, or re-operation rates [8,9].

Nonresurfacing seems to correlate with higher rates of anterior knee pain, necessitating additional interventions, and re-operations [6,10]. Yet, the reasons behind the significant proportion of TKA performed without resurfacing remain unclear [11]. Although randomized trials have been conducted, they have not definitively established the superiority of either option [12–19].

Our present study aimed to comprehensively compare and evaluate the outcomes of patellar nonresurfacing versus resurfacing in TKA by conducting a meta-analysis. The focus was on key parameters such as anterior knee pain, revision and reoperation rates, and functional knee scores [specifically Knee Society Score (KSS) pain, function, and overall score], to determine the optimal management strategy for the patella in TKA patients.

Patients and methods

Search strategy for the identification of studies

According to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we performed an analysis of all comparative studies to compare two technical approaches to patellar management: patellar resurfacing and patellar nonresurfacing in terms of revision and complications rates [20,21]. A thorough search of the MEDLINE, EMBASE, Cochrane, and PubMed databases was conducted using the following keyword combinations: 'Knee,' 'Arthroplasty,' 'Patella,' 'Resurfacing,' 'Prosthesis,' and 'Replacement.'

Study selection and inclusion criteria

Full-length English-language articles reporting clinical outcomes were screened for inclusion in the study. The inclusion criteria required a detailed description of the surgical procedure, a sufficient follow-up duration, and the inclusion of at least one validated outcome score. Specific outcome parameters of interest included clinical outcomes, anterior knee pain, and revision rates. Literature that lacked data on these parameters was excluded from the systematic review. Additionally, literature reviews, case studies, editorials, instructional courses, and studies conducted on cadavers, animals, or *in vitro* models were excluded. Articles that did not provide adequate information regarding the surgical procedure, follow-up duration, patient demographics, clinical scores, outcomes, or statistical analyses were also excluded. Two independent reviewers performed individual searches, reviewed all journals, and assessed relevance based on titles and abstracts. Articles without abstracts or those where the abstract did not provide sufficient information were excluded. Full texts were retrieved for further evaluation. A cross-reference search of the selected articles was conducted to locate additional relevant publications. The final search was completed in December 2023.

Data extraction and analysis

Data extraction was performed independently by two investigators. Information collected included demographics, anterior knee pain, revision rates, and clinical outcomes. The data was systematically reviewed to ensure accuracy and reduce selection bias. For statistical assessment, categorical variable data frequencies and percentages were reported, and continuous variable data was presented with mean values and ranges between the lowest and highest values. Differences between the two reviewers were settled through consensus and, if needed, by involving a third reviewer. Data analysis was carried out using Review Manager 5.3. A P value of less than 0.05 was considered statistically significant, and heterogeneity was quantified using I^2, with significance defined as I^2 greater than 50%. Random effects models were applied if the Q test or I^2 indicated significant heterogeneity, or if only a few studies were included. The analysis involved evaluating the impact of patellar resurfacing versus nonresurfacing on the defined outcome parameters. The extracted data were used to conduct a meta-analysis, comparing re-operation rates, anterior knee pain, and functional scores, such as the Knee Society Score (KSS) and Hospital for Special Surgery (HSS) scores.

Assessment of risk of bias

The quality of evidence in the included studies was evaluated using the ROBIS tool.

Results

1885 citations were found in the search for research. 1750 articles were eliminated from the review when

exclusion and inclusion criteria were applied to abstracts. Following the application of exclusion and inclusion criteria to 135 full-length manuscripts, 35 articles were left for review. Figure 1 depicts the search algorithm developed in accordance with the PRISMA guidelines. The relevant findings from these 35 publications can be seen in Table 1.

Using the ROBIS tool, the risk of bias was assessed, and the findings showed that the methods and outcomes of the literature search qualified for a low risk of bias (Table 2).

Demographic details

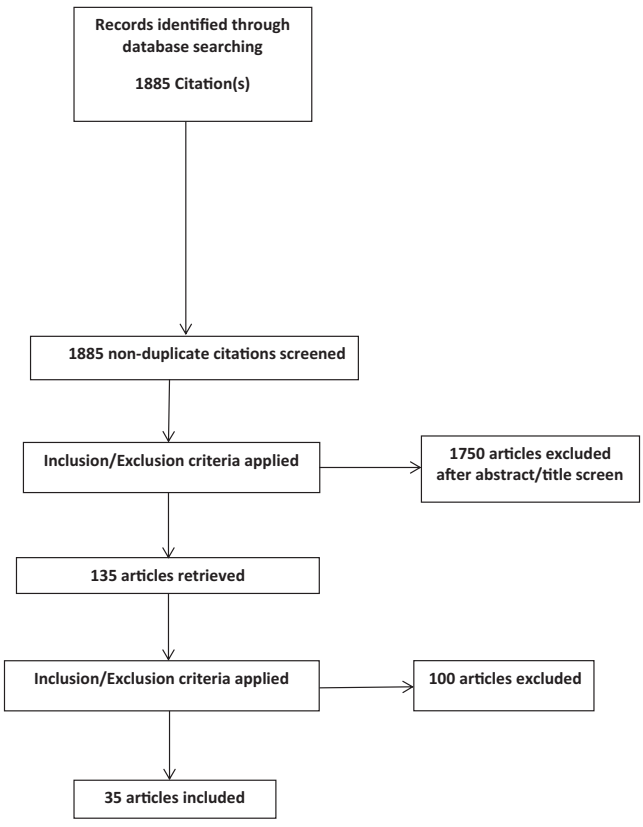
This meta-analysis included 35 studies that reported on 5304 TKA. In total, 2345 surgeries without resurfacing of the patella and 2359 with resurfacing of the patellar were performed. Each study group included an average of 74.1 knees. The average length of follow-up was 58.1 +/– 37.1 months (Table 1).

Outcome assessment

Meta-Analysis of Re-operation rates

In the 22 studies that reported revisions due to patellar complications, there was a 4% re-operation rate. The resurfaced TKA group had a 1% re-operation rate, while the non-resurfaced patella group had a 6.9% re-operation rate. This analysis focused solely on re-operations related to the patellar-femoral joint, excluding those due to infection or other unrelated reasons. Reasons for revising the patella prosthesis included: 35% for patellar component loosening, 41% for patellar fracture, and 12% each for patellar subluxation or mal-tracking. The findings indicated that the re-operation rate was significantly higher in the non-resurfaced group compared with the resurfaced group, with an odds ratio (OR) of 0.18, a 95% confidence interval (CI) of 0.11–0.29, and a *P* value of less than 0.00001. The results were shown on a forest and funnel plot diagram (Fig. 2).

Figure 1



Preferred Reporting Items for Systematic Reviews and Meta-Analyses Flowchart.

Meta-analysis of anterior knee pain

Eighteen studies reported on the occurrence of anterior knee pain during follow-up, covering a total of 3313 operated knees. Out of these, 212 (6.4%) knees experienced anterior knee pain. In the resurfaced group, 2% of patients reported anterior knee pain, whereas the nonresurfaced group had a rate of 10%. The analysis showed a statistically significant difference in the incidence of anterior knee pain between the two groups, with the nonresurfaced group having a significantly higher rate [OR 0.17, 95% CI 0.12–0.25, *P*<0.00001]. The results were shown on a forest and funnel plot diagram (Fig. 3).

Meta-analysis of functional scores

Sixteen studies provided data on the standard deviation and mean of postoperative KSS for pain outcomes, encompassing 1132 patients in the nonresurfacing group and 1173 patients in the patellar resurfacing group. Comparison revealed a significantly higher KSS pain score in the patellar resurfacing group compared with the nonresurfacing group (Mean difference [MD] 1.52, 95% CI 0.68–2.35, *P*=0.0004). The results were shown on a forest and funnel plot diagram (Fig. 4).

Fourteen studies with available SD and mean for postoperative KSS function scores included 1082 patients in the nonresurfacing group and 1112 patients in the patellar resurfacing group. However, there was no significant difference observed in KSS function score between the patellar resurfacing and nonresurfacing groups (MD 0.38, 95% CI 1.48–2.24, *P*=0.69) (Fig. 5).

Data from five studies, with 193 patients in the nonresurfacing group and 362 patients in the patellar resurfacing group, reported standard deviation and mean for postoperative HSS scores. Notably, the patellar resurfacing group exhibited significantly higher postoperative HSS scores compared with the nonresurfacing group (MD 4.35, 95% CI 3.21–5.49, *P*<0.00001) (Fig. 6).

Table 1 Demographics, reoperation, anterior knee pain, and clinical outcome scores

Sr. No	Study	Type of study	Number of Knees Enrolled	Knees reviewed	Lost at Final Follow-up (Patients)	Mean follow-up (Months)	Evaluation of Outcome	Type	Number of Knee (Final follow-up)	Anterior Knee pain	Re-operation	KSS Mean Score +/–SD					HSS	
												Preoperative		Postoperative				
												Pain	Function	Pain	Function	Total	Preoperative	Postoperative
1	Abraham *et al.* [22]	Prospective randomized study	111	100	11	60	Subjective symptoms, function, physical examination, radiographs	Resurfaced	47	NA	1	NA	NA	NA	NA	NA	NA	NA
								Non-Resurfaced	53	NA	1	NA	NA	NA	NA	NA	NA	NA
2	Aunan *et al.* [9]	Prospective randomized study	130	129	1	36	KOOS, Knee Society Clinical Rating System, Oxford Knee Score, visual analog scale (VAS)	Resurfaced	63	1	1	34 ± 18	65 ± 19	92 ± 9	83 ± 21	NA	NA	NA
								Nonresurfaced	66	NA	NA	35 ± 15	69 ± 20	90 ± 14	83 ± 21	NA	NA	NA
3	Barrack *et al.* [23]	Prospective randomized study	121	118	3	30	Knee Society Clinical Scoring System, patient satisfaction questionnaire, radiographs	Resurfaced	58	4	0	45.8	NA	91.2	83.1	174.5	NA	NA
								Non-Resurfaced	60	8	6	47.4	NA	89.3	81.3	170.9	NA	NA
4	Barrack *et al.* [12]	Prospective randomized study	121	93	28	70.5	Knee Society Clinical Score, patient satisfaction questionnaire, radiographs	Resurfaced	47	9	0	45.3	NA	88.3	73.5	161.6	NA	NA
								Nonresurfaced	46	8	7	43.6	NA	88.5	80.7	169.1	NA	NA
5	Bourne *et al.* [24]	Retrospective randomized study	100	100	0	24	Knee Society Clinical Rating, 30-s stair climbing, hamstring torques	Resurfaced	50	NA	0	37 ± 15	41 ± 13	81 ± 15	**67±26**	NA	NA	NA
								Non-Resurfaced	50	NA	2	41 ± 14	44 ± 13	87 ± 8	76 ± 19	NA	NA	NA
6	Boyd *et al.* [25]	Prospective randomized study	1197	945	252	78	Interview, examination, AKP	Resurfaced	396	1	NA	NA	NA	NA	NA	NA	NA	NA
								Non-Resurfaced	495	51	51	NA	NA	NA	NA	NA	NA	NA

Table 1. Continued

Sr. No	Study	Type of study	Number of Knees Enrolled	Knees reviewed	Lost at Final Follow-up (Patients)	Mean follow-up (Months)	Evaluation of Outcome	Type	Number of Knee (Final follow-up)	Anterior Knee pain	Re-operation	KSS Mean Score +/–SD					HSS	
												Preoperative		Postoperative				
												Pain	Function	Pain	Function	Total	Preoperative	Postoperative
7	Burnett *et al.* [26]	Prospective randomized study	100	90	10	129.6	KSS, VAS for AKP, functional tests	Resurfaced	42	13	1	44.7 ± 19	40.8 ± 13.8	86.9 ± 12.8	58.7 ± 24.7	NA	NA	NA
								Non-Resurfaced	48	11	3	43.4 ± 16.7	42.4 ± 14.4	85 ± 13.5	59.5 ± 25.3	NA	NA	NA
8	Burnett *et al.* [13]	Prospective randomized study	64	56	8	110	Knee Society Clinical Rating Score, questionnaire (nonvalidated)	Resurfaced	28	4	1	48	38	83	63	146	NA	NA
								Non-Resurfaced	28	5	2	50	40	83	65	148	NA	NA
9	Cameron *et al.* [27]	Retrospective randomized study	77	77	0	12	British rating system, radiographs	Resurfaced	14	NA	1	NA	NA	NA	NA	NA	NA	NA
								Non-Resurfaced	63	11	1	NA	NA	NA	NA	NA	NA	NA
10	Campbell *et al.* [14]	Prospective randomized study	100	100	0	120	KSS, WOMAC	Resurfaced	30	14	1	36.0 ± 14.9	NA	71.8 ± 14.2	NA	137.6 ± 37.7	NA	NA
								Non-Resurfaced	28	12	2	39.9 ± 17.4	NA	74.9 ± 14.0	NA	135.5 ± 31.8	NA	NA
11	Enis *et al.* [28]	Retrospective randomized study	50	50	0	40	Radiographs, examination, phone interviews	Resurfaced	20	NA	NA	NA	NA	NA	NA	NA	NA	NA
								Nonresurfaced	20	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	Garneti *et al.* [5]	Retrospective randomized study	142	142	0	33	AKP, patellar apprehension, knee instability, ability to kneel, return to preop function level, KSS, Eurocol score	Resurfaced	76	5	0	NA	NA	89 ± 10.62	72 ± 25.01	161 ± 33.07	NA	NA
								Nonresurfaced	66	18	9	NA	NA	81 ± 26.30	75 ± 28.55	156 ± 52.70	NA	NA
13	Gildone *et al.* [29]	Prospective randomized study	56	56	0	25.4	KSS, patella-related activities	Resurfaced	28	0	NA	NA	NA	NA	86.7	178.3	NA	NA
								Nonresurfaced	28	6	NA	NA	NA	NA	85.5	178	NA	NA
14	Joo *et al.* [30]	Prospective randomized study	49	49	0	28.8	KSS, WOMAC, Anterior Knee Pain Scale	Resurfaced	23	NA	NA	43.07 ± 13.08	34.81 ± 10.05	66.12 ± 14.16	54.58 ± 13.78	NA	NA	NA
								Nonresurfaced	26	NA	NA	45.25 ± 9.46	38.75 ± 7.20	69.4 ± 13.29	61 ± 11.77	NA	NA	NA

Table 1. Continued

Sr. No	Study	Type of study	Number of Knees Enrolled	Knees reviewed	Lost at Final Follow-up (Patients)	Mean follow-up (Months)	Evaluation of Outcome	Type	Number of Knee (Final follow-up)	Anterior Knee pain	Re-operation	KSS Mean Score +/–SD					HSS	
												Preoperative		Postoperative				
												Pain	Function	Pain	Function	Total	Preoperative	Postoperative
15	Kim *et al.* [31]	Retrospective randomized study	373	92	281	104.4	ROM, Kellgren and Lawrence scale, WOMAC, KSS, HSS	Resurfaced	69	NA	NA	36.6±17.5	46.0±21.6	98.3±8.8	88.6±10.2	NA	41.6±11	93.3±7.8
								Nonresurfaced	23	NA	NA	37.6±21.1	42.9±14.9	91.5±7.6	86.5±13.6	NA	44.5±10.3	89.1±9.2
16	Levai et.al [32]	Retrospective randomized study	73	71	2	60	Clinical information sheet, radiographs	Resurfaced	39	2	NA	NA	NA	NA	NA	NA	NA	NA
								Nonresurfaced	32	9	2	NA	NA	NA	NA	NA	NA	NA
17	Li *et al.* [33]	Retrospective randomized study	130	130	0	112.8	AKP, KSS, patient satisfaction, revision rate and radiographic findings	Resurfaced	59	3	NA	22.1±6.5	NA	47.6±8.2	83.4±16.7	91.6±10.1	NA	NA
								Nonresurfaced	71	10	NA	22.1±6.5	NA	46.9±7.5	82.2±17.5	92.1±11.4	NA	NA
18	Mayman *et al.* [16]	Prospective randomized study	100	100	0	120	Knee Society Scores, Patient-Determined Subjective Questionnaires	Resurfaced	50	NA	1	NA	NA	NA	NA	146.8	NA	NA
								Nonresurfaced	50	NA	5	NA	NA	NA	NA	156.5	NA	NA
19	Myles *et al.* [34]	Prospective randomized study	50	50	8	24	American Knee Society Clinical Rating System, WOMAC, motion analysis	Resurfaced	18	NA	0	40.7±11.4	53.8±13.5	83.2±14.8	63.6±17.6	146.8	NA	NA
								Nonresurfaced	24	NA	0	41.9±10.8	62.2±12.1	83.4±16.1	79.2±18.3	162.2	NA	NA
20	Ogon *et al.* [35]	Retrospective randomized study	65	65	0	139.2	KSS, Knee Society Roentgenographic Evaluation System	Resurfaced	44	NA	NA	NA	NA	85.3±12.9	70.3±23.4	NA	NA	NA
								Nonresurfaced	21	NA	NA	NA	NA	82.7±16.2	71.7±22.4	NA	NA	NA
21	Park *et al.* [36]	Retrospective randomized study	71	71	10	149	AKSS, HSS score, Bristol patellar score, Lonnerpat.-fem. score, radiographs	Resurfaced	36	1	0	50.5±16.2	39.8±17.5	93.5	77.5	NA	61.1	87
								Nonresurfaced	25	0	0	53.7±15.9	46.3±15.3	95	60	NA	65.3	83
22	Patel *et al.* [37]	Prospective randomized study	130	130	10	90	American Knee Society Clinical Rating System, radiographs	Resurfaced	60	2	0	44	40	88	80	168	NA	NA

Table 1. Continued

Sr. No	Study	Type of study	Number of Knees Enrolled	Knees reviewed	Lost at Final Follow-up (Patients)	Mean follow-up (Months)	Evaluation of Outcome	Type	Number of Knee (Final follow-up)	Anterior Knee pain	Re-operation	KSS Mean Score +/–SD					HSS	
												Preoperative		Postoperative				
												Pain	Function	Pain	Function	Total	Preoperative	Postoperative
								Nonresurfaced	60	6	4	46	42	76	68	144	NA	NA
23	Roberts *et al.* [38]	Prospective randomized study	350	350	23	93.6	KS score, KS function score, KS stair subscore, active passive ROM	Resurfaced	164	10	0	NA	NA	88.0 ± 9.0	65.6 ± 28.0	NA	NA	NA
								Nonresurfaced	163	9	9	NA	NA	86.6 ± 11.9	59.8 ± 26.3	NA	NA	NA
24	Schroeder *et al.* [18]	Prospective randomized study	40	40	NA	24	Knee Society Score, radiographs	Resurfaced	20	NA	NA	NA	NA	82.6	80	NA	NA	NA
								Nonresurfaced	20	NA	NA	NA	NA	65.7	69.5	NA	NA	NA
25	Van Hemert *et al.* [39]	Retrospective randomized study	53	53	0	16.7	KSS, DynaPort Knee Test, Minimod Gait test	Resurfaced	31	NA	NA	42.7 ± 12.5	NA	83.1 ± 13.5	NA	NA	NA	NA
								Nonresurfaced	22	NA	NA	50.5 ± 13.8	NA	85.0 ± 14.0	NA	NA	NA	NA
26	Waters *et al.* [19]	Prospective randomized study	514	474	40	63.6	Knee Society Rating System, Brit. Orthopaedic Association patientsatisfaction score	Resurfaced	243	13	NA	44.1 ± 13.1	NA	91.4 ± 5.93	75.8 ± 20.94	NA	NA	NA
								Nonresurfaced	231	58	NA	43.1 ± 13.0	NA	88.5 ± 10.23	73.2 ± 23.21	NA	NA	NA
27	Wood *et al.* [40]	Prospective randomized study	240	240	20	48	Knee Society Clinical Rating System, AKP, stair climbing test, radiographics	Resurfaced	92	15	9	57.4	51.3	87	70	NA	NA	NA
								Nonresurfaced	128	39	11	55.7	51.6	86.5	65	NA	NA	NA
28	Badhe *et al.* [41]	Retrospective randomized study	170	170	NA	36	HSS score, patellar score, radiographs	Resurfaced	99	NA	2	NA	NA	NA	NA	NA	61.8 ± 10.3	87.6 ± 5.8
								Nonresurfaced	71	NA	10	NA	NA	NA	NA	NA	63.7 ± 9.8	76.8 ± 5.6
29	Feller *et al.* [42]	Prospective randomized study	40	38	2	36	HSS score, patellar score, radiographs	Resurfaced	19	NA	0	NA	NA	NA	NA	NA	63.8 ± 10.1	85.7 ± 7.0
								Non-Resurfaced	19	NA	0	NA	NA	NA	NA	NA	61.6 ± 10.5	88.6 ± 5.2
30	Ikejiani *et al.* [43]	Prospective randomized study	185	185	0	24	ROM, pain assessment, HSS score	Resurfaced	140	NA	0	NA	NA	NA	NA	NA	54.8 ± 12.7	89.1 ± 9.5
								Nonresurfaced	45	NA	0	NA	NA	NA	NA	NA	56.0 ± 13.4	91 ± 7.4

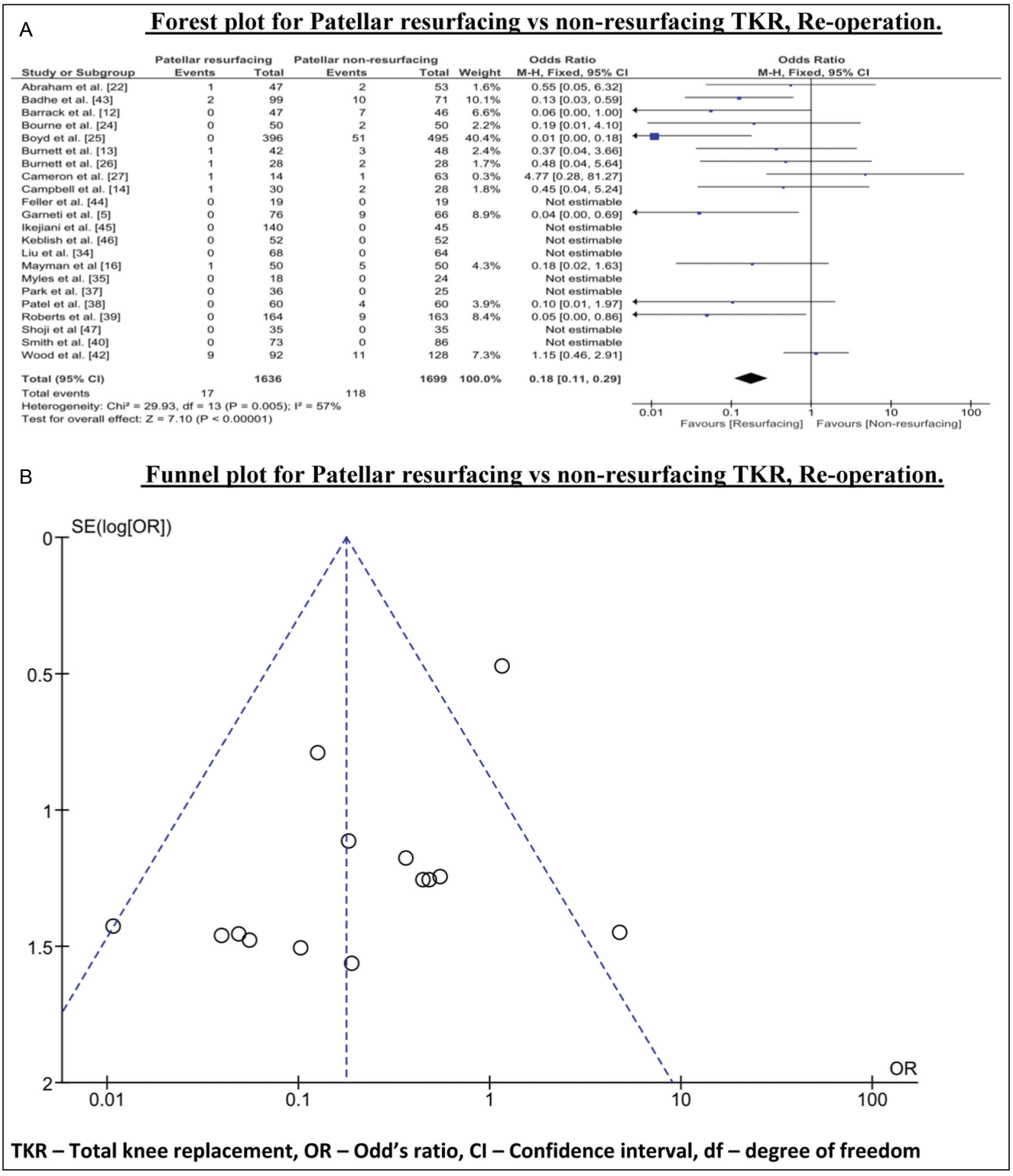
Table 1. Continued

Sr. No	Study	Type of study	Number of Knees Enrolled	Knees reviewed	Lost at Final Follow-up (Patients)	Mean follow-up (Months)	Evaluation of Outcome	Type	Number of Knee (Final follow-up)	Anterior Knee pain	Re-operation	KSS Mean Score +/–SD					HSS	
												Preoperative		Postoperative				
												Pain	Function	Pain	Function	Total	Preoperative	Postoperative
31	Kajino *et al.* [15]	Prospective randomized study	70	52	9	79.2	HSS knee score, radiographs	Resurfaced	26	NA	NA	NA	NA	NA	NA	NA	48	81
								Nonresurfaced	26	NA	1	NA	NA	NA	NA	NA	47	80
32	Keblish *et al.* [44]	Prospective randomized study	118	104	4	62.9	Modified HSS knee score, Knee Society Radiological Evaluation System	Resurfaced	52	3	0	NA	NA	NA	NA	NA	NA	90.1
								Nonresurfaced	52	3	0	NA	NA	NA	NA	NA	NA	89.2
33	Smith *et al.* [45]	Prospective randomized study	181	181	22	52.4	Knee Society Clinical Rating System, knee pain scale, knee diagram	Resurfaced	73	22	0	39.7	51.9	92	60	152	NA	NA
								Nonresurfaced	86	18	0	39	51.7	93	70	163	NA	NA
34	Liu *et al.* [46]	Prospective randomized study	144	144	12	84	KSS, anterior knee pain rate, radiographs	Resurfaced	68	10	0	23.5	NA	46.7	83.8	91.4	NA	NA
								Nonresurfaced	64	8	0	21.1	NA	46	80	91.5	NA	NA
35	Shoji *et al.* [47]	Prospective randomized study	70	70	0	32.4	HSS knee score	Resurfaced	35	NA	0	NA	NA	NA	NA	NA	49.9	85.5
								Nonresurfaced	35	NA	0	NA	NA	NA	NA	NA	48.6	85.6
		Total	5304				Total	Resurfaced	2359		18							
								Nonresurfaced	2345		127							
		Mean	151.5															

Table 2 ROBIS Tool for assessing risk of bias

	Study eligibility criteria	Identification and selection of studies	Data collection and study appraisal	Synthesis findings	Risk of bias in the review
Meta-analysis	Yes	Yes	Yes	Yes	A. Yes B. Yes C. No Overall: Low

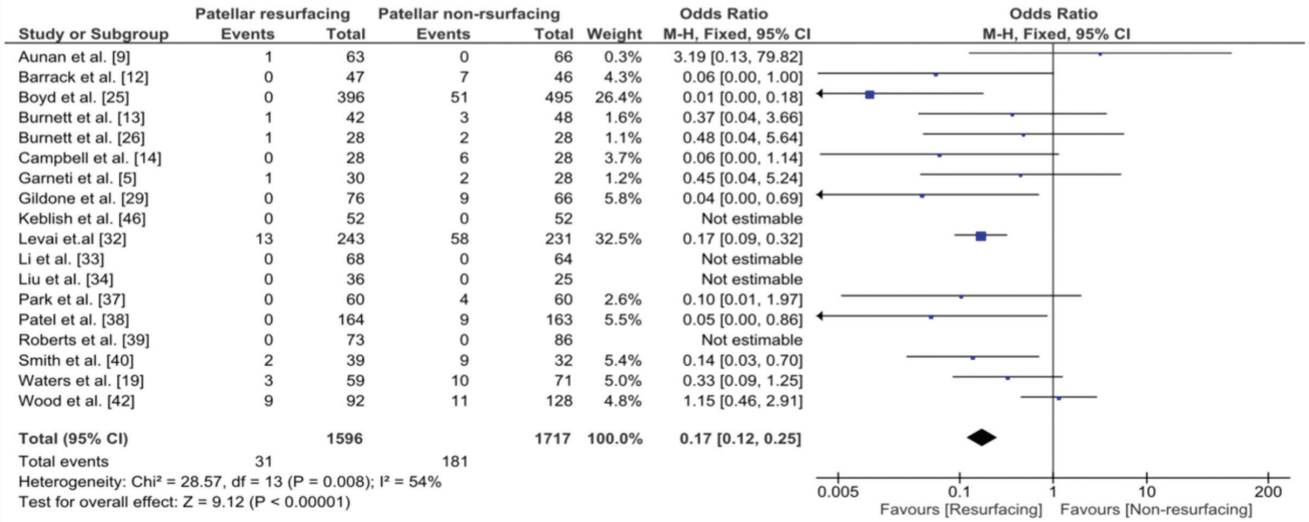
Figure 2



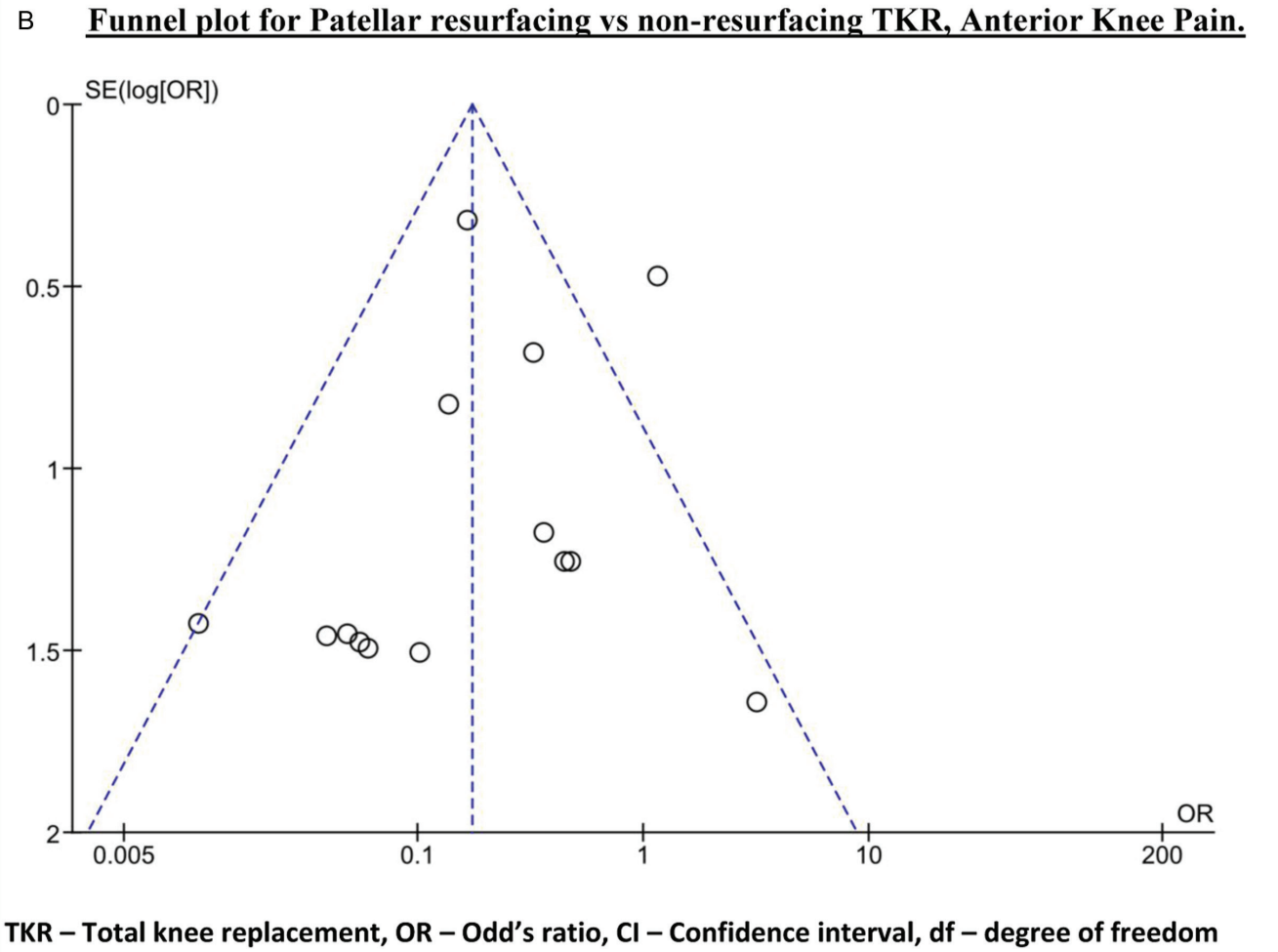
(a): Forest plot for Patellar resurfacing versus nonresurfacing TKR, Re-operation. (b): Funnel plot for Patellar resurfacing versus nonresurfacing TKR, Re-operation. TKR, Total knee replacement; OR, Odd's ratio; CI, confidence interval; df, degree of freedom.

Figure 3

A



B



(a): Forest plot for Patellar resurfacing versus nonresurfacing TKR, Anterior Knee Pain. (b): Funnel plot for Patellar resurfacing versus nonresurfacing TKR, Anterior Knee Pain. TKR, Total knee replacement; OR, Odd's ratio; CI, Confidence interval; df, degree of freedom.

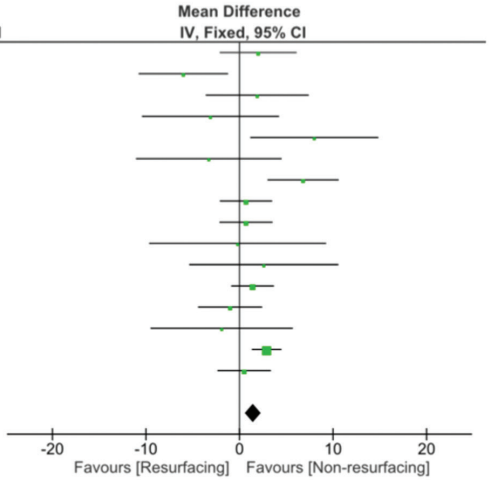
Figure 4

A

Forest plot for Patellar resurfacing vs non-resurfacing TKR, Post-operative KSS pain.

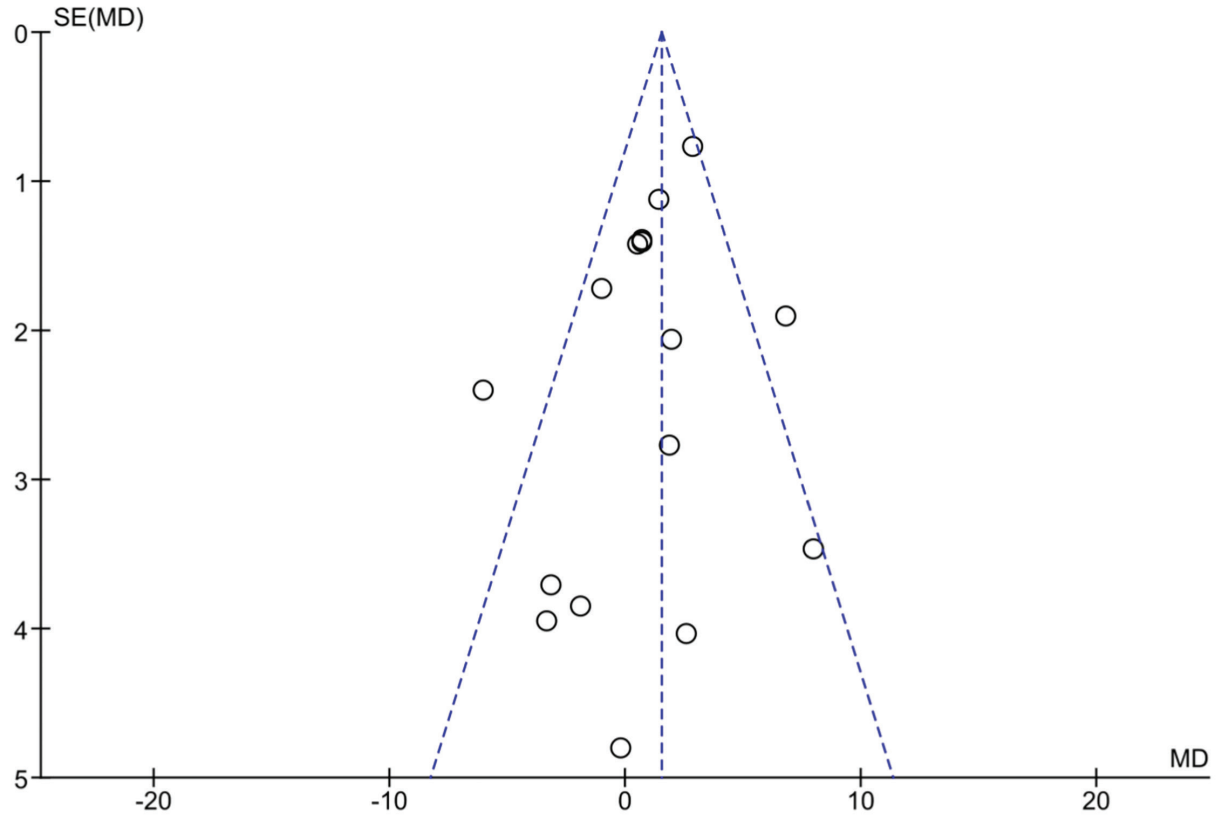
Study or Subgroup	Patellar resurfacing Mean	SD	Total	Patellar non-resurfacing Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Aunan et al. [9]	92	9	63	90	14	66	4.3%	2.00 [-2.04, 6.04]
Bourne et al. [24]	81	15	50	87	8	50	3.1%	-6.00 [-10.71, -1.29]
Burnett et al. [26]	86.9	12.8	42	85	13.5	48	2.4%	1.90 [-3.54, 7.34]
Campbell et al. [14]	71.8	14.2	30	74.9	14	28	1.3%	-3.10 [-10.36, 4.16]
Garneti et al. [5]	89	10.62	76	81	26.3	66	1.5%	8.00 [1.22, 14.78]
Joo et al. [30]	66.12	14.16	23	69.4	13.29	26	1.2%	-3.28 [-11.00, 4.44]
Kim et al. [31]	98.3	8.8	69	91.5	7.6	23	5.0%	6.80 [3.06, 10.54]
Li et al. [33]	47.6	8.2	59	46.9	7.5	71	9.4%	0.70 [-2.02, 3.42]
Liu et al. [34]	46.7	7.4	68	46	8.6	62	9.1%	0.70 [-2.07, 3.47]
Myles et al. [35]	83.2	14.8	18	83.4	16.1	24	0.8%	-0.20 [-9.59, 9.19]
Ogon et al. [36]	85.3	12.9	44	82.7	16.2	21	1.1%	2.60 [-5.31, 10.51]
Roberts et al. [39]	88	9	178	86.6	11.9	172	14.2%	1.40 [-0.82, 3.62]
Smith et al. [40]	92	12	87	93	11	94	6.2%	-1.00 [-4.36, 2.36]
Van Hemert et al. [41]	83.1	13.5	31	85	14	22	1.2%	-1.90 [-9.44, 5.64]
Waters et al. [19]	91.4	5.93	243	88.5	10.23	231	30.4%	2.90 [1.38, 4.42]
Wood et al. [42]	87	10	92	86.5	11	128	8.9%	0.50 [-2.29, 3.29]
Total (95% CI)			**1173**			**1132**	**100.0%**	**1.52 [0.68, 2.35]**

Heterogeneity: Chi² = 31.62, df = 15 (P = 0.007); I² = 53%
Test for overall effect: Z = 3.56 (P = 0.0004)



B

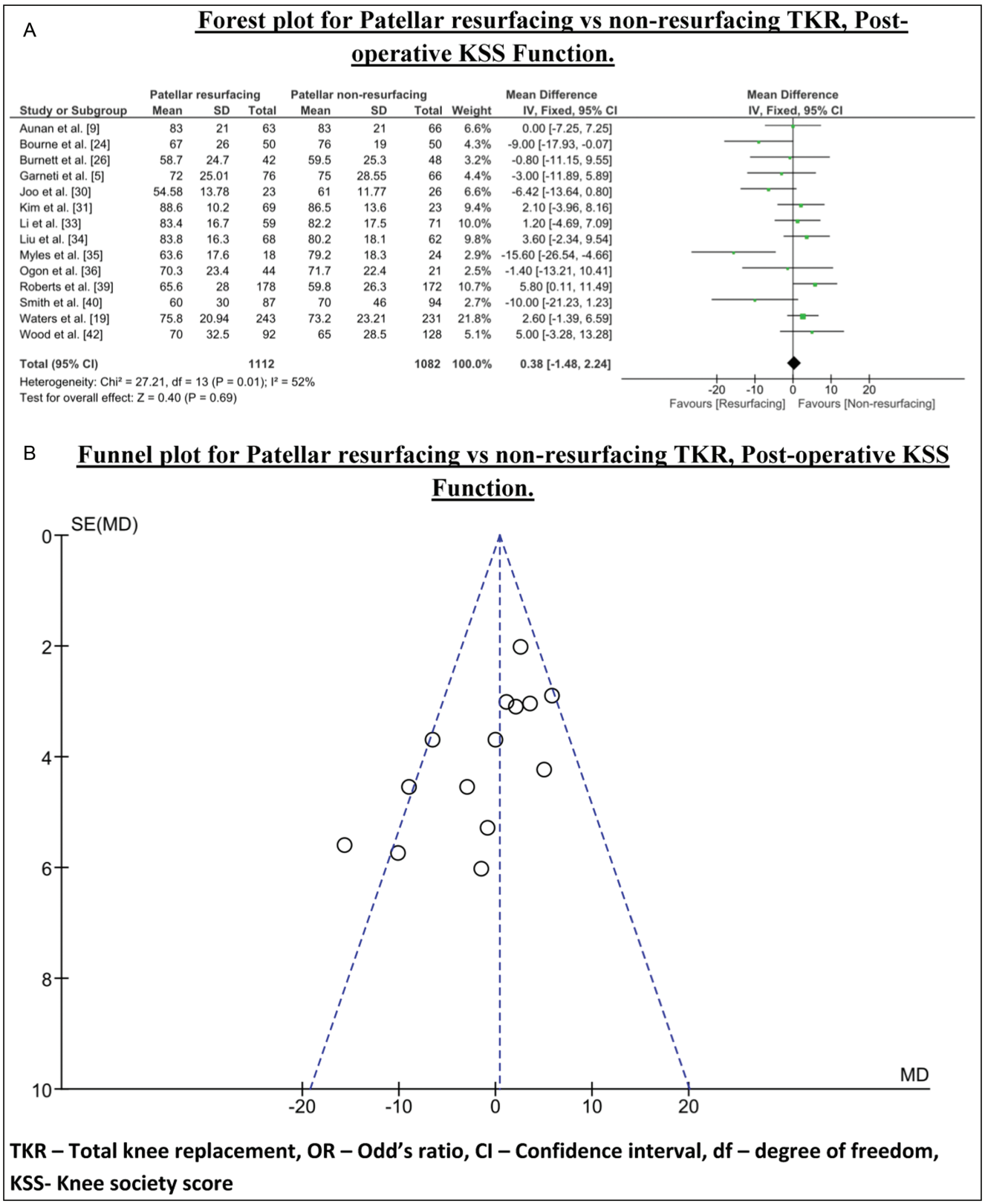
Funnel plot for Patellar resurfacing vs non-resurfacing TKR, Post-operative KSS pain.



TKR – Total knee replacement, OR – Odd's ratio, CI – Confidence interval, df – degree of freedom, KSS- Knee society score

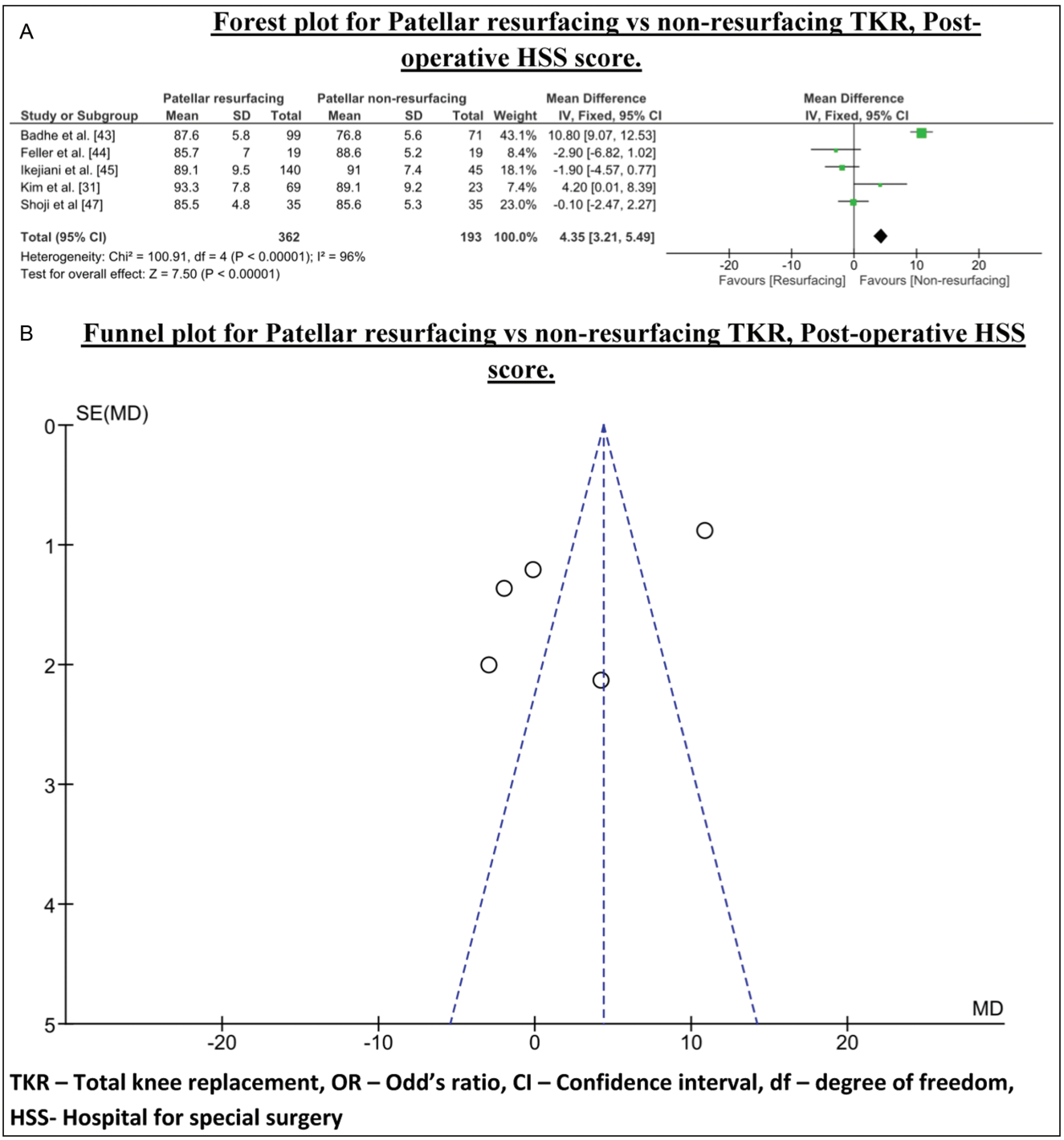
(a): Forest plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative KSS pain. (b): Funnel plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative KSS pain. TKR, Total knee replacement; OR, Odd's ratio; CI, Confidence interval; df, degree of freedom; KSS, Knee society score.

Figure 5



(a): Forest plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative KSS Function. (b): Funnel plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative KSS Function. TKR, Total knee replacement; OR, Odd's ratio; CI, Confidence interval; df, degree of freedom; KSS, Knee society score.

Figure 6



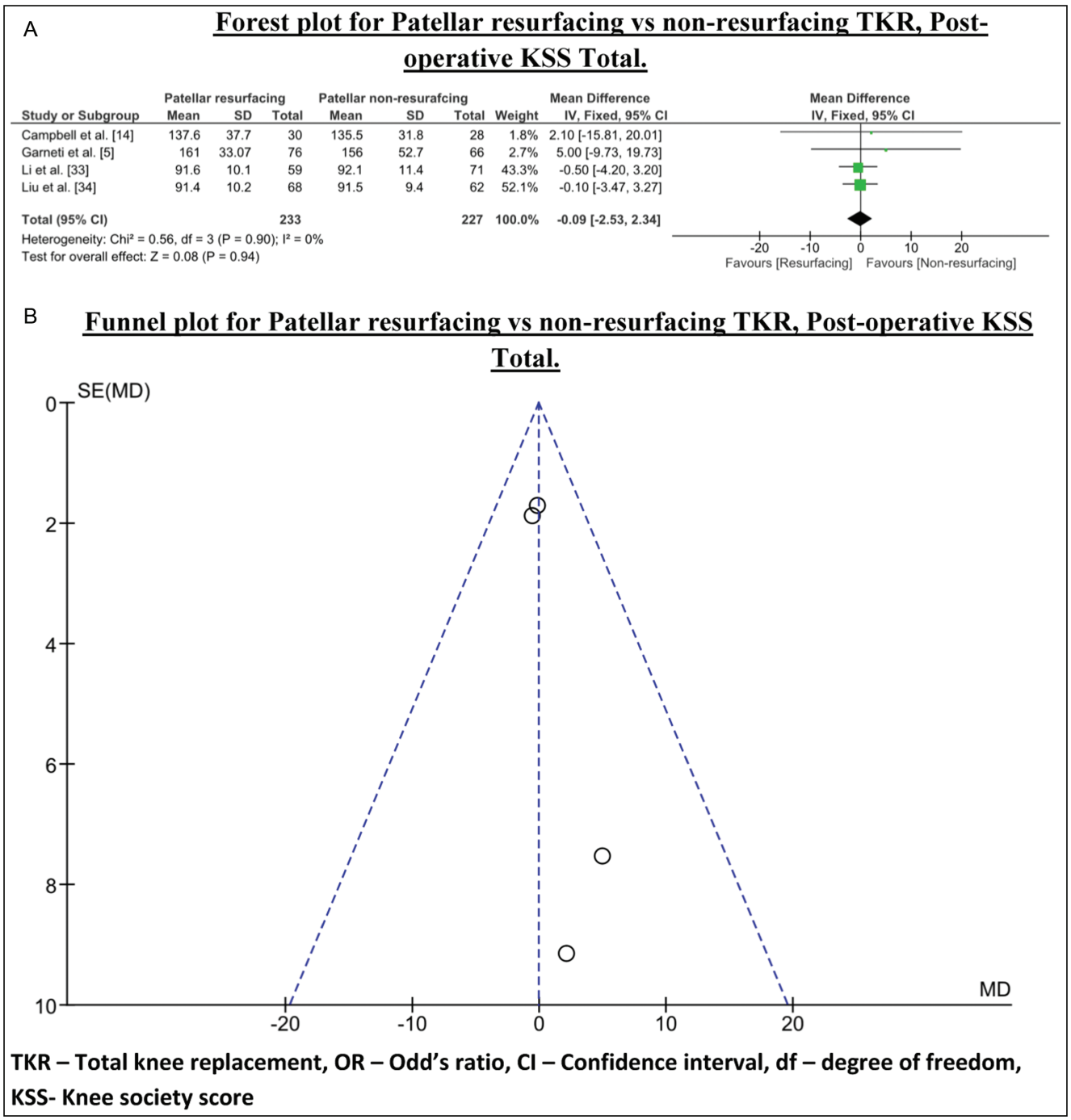
(a): Forest plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative HSS score. (b): Funnel plot for Patellar resurfacing vs non-resurfacing TKR, Postoperative HSS score. TKR, Total knee replacement; OR, Odd's ratio; CI, Confidence interval; df, degree of freedom; HSS, Hospital for special surgery.

Additionally, four studies provided standard deviation and mean for total postoperative KSS scores, comprising 227 patients in the nonresurfacing group and 233 patients in the patellar resurfacing group. However, there was no significant difference observed in total postoperative KSS scores between the two groups (MD 0.09, 95% CI 2.53–2.34, *P*=0.94) (Fig. 7).

Discussion

The most notable finding of our study was that the patellar resurfacing group exhibited significantly lower KSS pain scores (*P*=0.0004) and postoperative HSS scores (*P*<0.00001) compared with the nonresurfacing group. Additionally, the patellar resurfacing group had a lower re-operation rate (*P*<0.00001) and less postoperative anterior knee pain (*P*<0.00001)

Figure 7



(a): Forest plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative KSS Total. (b): Funnel plot for Patellar resurfacing versus nonresurfacing TKR, Postoperative KSS Total. TKR, Total knee replacement; OR, Odd's ratio; CI, Confidence interval; df, degree of freedom; KSS, Knee society score.

compared to the nonresurfaced TKA group. Based on these endpoints, TKA with patellar resurfacing demonstrated better overall performance. Our meta-analysis included 35 studies and a total of 5304 knees, showing that the rate of revision surgery was lower in TKAs with patellar resurfacing than in those without.

Contrary to our findings, Pakos *et al.* [6] and Calvisi *et al.* [48] reported higher rates of anterior knee pain and re-operation in TKAs where the patella was resurfaced. Due to insufficient data on standard deviation and mean, these studies were not included in our meta-analysis, complicating the interpretation of results. Nonetheless, our study supports that the patellar resurfacing group had lower overall KSS pain scores (MD 1.52, 95% CI 0.68–2.35, *P*=0.0004) compared with the nonresurfacing group.

While the available data in the current literature is constrained, it is essential to establish limitations

on the inclusion criteria for analyses to ensure valid comparisons. It is important to note that outcomes are not the sole determinant of whether to proceed with patellar resurfacing [49]. Additionally, the incidence of patellar resurfacing during TKA varies geographically in current practice. For instance, the majority of TKAs in Asia are done without patellar resurfacing whereas TKAs in the United States are tri compartmental.

These variations arise because, currently, the decision to perform patellar resurfacing primarily hinges on the surgeon's preference. Selective indications for patellar resurfacing vary based on various factors such as patellar alignment, patient age, and patellar-femoral cartilage condition. However, there is a lack of data supporting this approach [50,51].

Limitations

Our systematic review has some limitations that should be acknowledged. First, all available studies were analyzed using broad inclusion criteria based on the Coleman Methodology Score. Only excellent studies where the Coleman Methodology score was more than 85 points were considered for further detailed analysis. Second, anterior knee pain prevalence, re-operation rate, and knee scores were either not reported at all or incompletely reported in some trials.

There was variation in the included studies' follow-up times. The current literature has evidence that most complications arise after 3–4 years of long-term follow-up [25], but of the reviewed studies 12 have a follow-up period of only 3 years or less. In either technique, this tends to decrease the rate of actual complications.

Remarkably, none of these studies discuss the proficiency or experience of the surgeons involved. Given that patellar resurfacing demands greater attention and operative time, the surgeon's expertise could significantly influence the decision to opt for patellar resurfacing or not. Future studies should consider these surgeon-related factors to ensure a more uniform cohort.

There is an important role of other confounding factors when one considers the resurfacing of the patella; for example, after patella resurfacing crepitus was less in only those patients who had preoperative pain, while those without pain seem to have more crepitus [8]. This aspect has the potential to add complexity to the matter, as it is important to comprehend not only the general performance of the technique of patellar resurfacing but also its effectiveness when tailored to specific patient groups.

Conclusion

We can conclude that patellar resurfacing TKA performed better than nonresurfaced TKA in terms of HSS and KSS (pain) postoperatively. Lower re-operation rates and anterior knee pain for TKA with resurfaced patella also suggest the superiority of this technique. It is essential to advocate for standardized reporting of follow-up durations and outcomes in larger randomized controlled trials. This approach is crucial for enhancing our understanding of patellar management in TKA patients.

Author's contribution

All authors have contributed equally to the preparation of the manuscript.

Availability of data and materials

This published article contains all the data generated or analyzed during this study.

PRISMA 2020 Checklist statement

The authors have read the PRISMA 20020 Checklist, and the manuscript was prepared and revised according to the PRISMA 20020 Checklist.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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