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UP-TO DATE REVIEW AND CASE REPORT • KNEE - ARTHROPLASTY

Posterior-stabilized versus cruciate-retained implants for total knee arthroplasty: a meta-analysis of clinical trials

Filippo Migliorini[1] · Jörg Eschweiler[1] · Markus Tingart[1] · Björn Rath[1]

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Abstract

Aim A meta-analysis comparing the outcomes of patients undergoing cruciate retaining (CR) versus posterior stabilized (PS) in primary total knee arthroplasty was performed. The outcomes of interest were the Knee Society Rating System, clinical (KSCS) and functional (KSFS) subscales, joint range of motion (ROM), surgical duration and further complications (anterior knee pain, instability and revision rate).

Materials and methods The search was conducted in July 2018, accessing the following databases: Cochrane Systematic Reviews, Scopus, PubMed, EMBASE, CINAHL, AMED and Google Scholar. We included only clinical trials level of evidence I and II. During the statistical analysis, we excluded all the studies that affect negatively the I^2 test, in order to achieve more reliable results. For the methodological quality assessment we referred to the PEDro score. The risk of publication's bias was evaluated by the funnel plots across all the comparisons.

Results The PEDro score reported a good methodological quality assessment. The funnel plot detected a very low risk of publication's bias. We included in this study 36 articles, counting a total of 4052 patients and 4884 procedures. The mean follow-up term for both groups was 3.39 years. The ROM resulted in an overall estimate effect of 2.18° in favor of the PS group. The overall WOMAC showed a result in favor of the PS group. The overall estimate effect of the KSCS was 0.02% higher in the CR group. The KSFS showed an overall estimate effect of 2.09% in favor of the PS group. Concerning the surgical duration, the estimate effect resulted in 6.87 min shorter in the CR group. No differences were reported across the two groups regarding anterior knee pain, knee joint instability or revision rate.

Conclusion Both the prosthetic implants provided to be a safety and feasible solution to treat end-stage knee joint degeneration. The PS implants reported improvements in the knee range of motion and a prolongation of the surgical time. No clinically relevant dissimilarities concerning the analyzed scores were evidenced. No statistically significant relevant differences in complications were detected.

Keywords Total knee arthroplasty · Posterior stabilized · Cruciate retain · Posterior cruciate ligament

Introduction

Total knee arthroplasty (TKA) is one of the most performed surgical procedures worldwide [1]. This procedure represents a feasible solution for patients with advanced knee joint degeneration, being both clinically and cost-effective [2]. The aim of TKA is to restore the physiological joint biomechanics, improving patient quality of life [3]. Currently, there are still debates concerning the best implant, whether posterior stabilized (PS) or cruciate retaining (CR) [4]. In the last years, a lot of reviews and meta-analysis [5–11] tried to clarify the role of the two implants, but contrasting results with no significant differences were found, concluding that further high-quality studies were required. The purpose of this work is to improve current evidences providing a meta-analysis of the clinical trials, comparing posterior stabilized versus cruciate retaining implants. We focused on knee scores, range of motion, surgical duration and further complications.

✉ Filippo Migliorini
migliorini.md@hotmail.it

1 Department of Orthopaedics, RWTH Aachen University Clinic, Pauwelsstraße 30, 52074 Aachen, Germany

Materials and methods

Search strategy and data extraction

This meta-analysis was performed according to the standard methodology of the Cochrane Handbook [12]. To guide the search, a preliminary protocol was carried out:

- Type of study: clinical trial (level of evidence I to II);
- Population: primary total knee arthroplasty;
- Intervention: posterior stabilize prosthesis;
- Comparison: cruciate retain prosthesis;
- Outcomes: clinical scores, range of motion, surgical duration and further complications.

Two authors (FM and JE) independently conducted the search in August 2018. The following databases were accessed: Cochrane Systematic Reviews, Scopus, PubMed, EMBASE and Google Scholar. The following keywords were used in combination: *total knee arthroplasty, prosthesis, posterior stabilized, cruciate ligament, versus, cruciate retain, removing, sacrificing, KSFS, KSCS, range of motions, WOMAC, surgical duration, posterior cruciate ligament*. The authors initially reviewed all the articles resulting from the literature search, afterward initiated the screening of the abstracts for the inclusion. If the abstract matched the topic, the full-text version was accessed. The bibliography of the articles was also screened.

Eligibility criteria

All the randomized (RCT) and non-randomized (n-RCT) clinical trials comparing cruciate retain versus posterior stabilized in TKA were considered for inclusion. According to the Oxford Center of Evidence-based Medicine [13], only studies of level of evidence I to II were included. According to the authors capabilities, articles in English, German, Italian, French and Spanish were considered. Articles published in a timeframe ranging from 2000 to 2018 were included. Studies providing unicondylar, cementless and/or bi-cruciate retaining prosthesis were excluded. Studies reporting patient baseline demographic generalities with incomparable and heterogeneous data were also excluded. Only studies performing a minimum 6-months follow-up were considered. We included only clinical trials focused on the topic and reporting quantitative data under the outcomes of interest. Disagreements between the authors were debated and mutually solved.

Outcomes of interest

Two independent authors (FM and JE) exported the data of interest from the enrolled articles. The following demographic data were collected: author and year of the study; type of study; number of patients and procedures; surgical indication; mean follow-up duration. For both CR and PS groups, the following data were collected: number of enrolled patients and procedures; mean age; mean body mass index (BMI); mean Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and related subscales (pain, stiffness, function) [14], mean Knee Society Clinical Rating System (KSCS) [15]; mean Knee Society Functional Rating System (KSFS) [16]; mean range of motion (ROM) [17]; mean surgical duration. The following complications were collected: anterior knee pain, knee joint instability, further revision surgery. Lack of quantitative data under the outcomes of interest warranted the exclusion from this meta-analysis.

Methodological quality assessment

Regarding the methodological quality assessment, we referred to the PEDro score [18]. Two authors (FM and JE) independently performed the score. This score evaluates the included studies under 11 items of interest: eligibility criteria, allocation, baseline comparability, blinding methods, duration of the follow-up, intention of the analysis, analysis between the groups, point estimates and variability. The result of the PEDro score ranks from 0 (low quality) to 10 (high quality). Values ≥ 6 points are considered satisfactory. To achieve a better quality assessment, studies resulting in < 5 points were excluded.

Statistical analysis

The statistical analysis was performed using the Cochrane Collaboration Software Review Manager 5.3 (The Nordic Cochrane Centre, Copenhagen). An analysis model for continuous variables was performed using the inverse variance statistical method. The arithmetic mean evaluated the effect measure of the samples, with a confidence interval set at 95%. An analysis model for dichotomous variables was performed using the Mantel–Haenszel statistical method. For this analysis, the risk ratio effect measure was used with a confidence interval set at 95%. A fixed effect model was used to carry out the analysis in case of low level of heterogeneity. The forest plots were performed for each comparison. To evaluate the heterogeneity, both χ^2 and I^2 tests were performed. The I^2 test value indicates that the percentage of variations across the studies can be due to heterogeneity rather than chance. Values of I^2 equal to 25%, 50% and 75% represent, respectively, low, moderate and high grade of heterogeneity. Values of $P < 0.05$ were considered statistically significant. The risk of publication's bias was evaluated by the funnel plots across all the comparisons. To assess the overall publication's bias, we referred to the funnel plot of the most reported outcome.

Results

Search result

The database search and the cross-references of the bibliography resulted in 984 articles. A total of 261 articles were removed because of duplication. Another 556 articles were rejected, because they did not match with the eligibility criteria. Another 111 articles were rejected, because missing of quantitative data under the outcomes of interest. Another 15 articles were additionally excluded because poor level of evidence. Further four articles were excluded because of low quality according to the PEDro score. This left 37 articles for the present study, 22 RCTs and 15 n-RCTs. The flow-chart of the literature search is shown in Fig. 1.

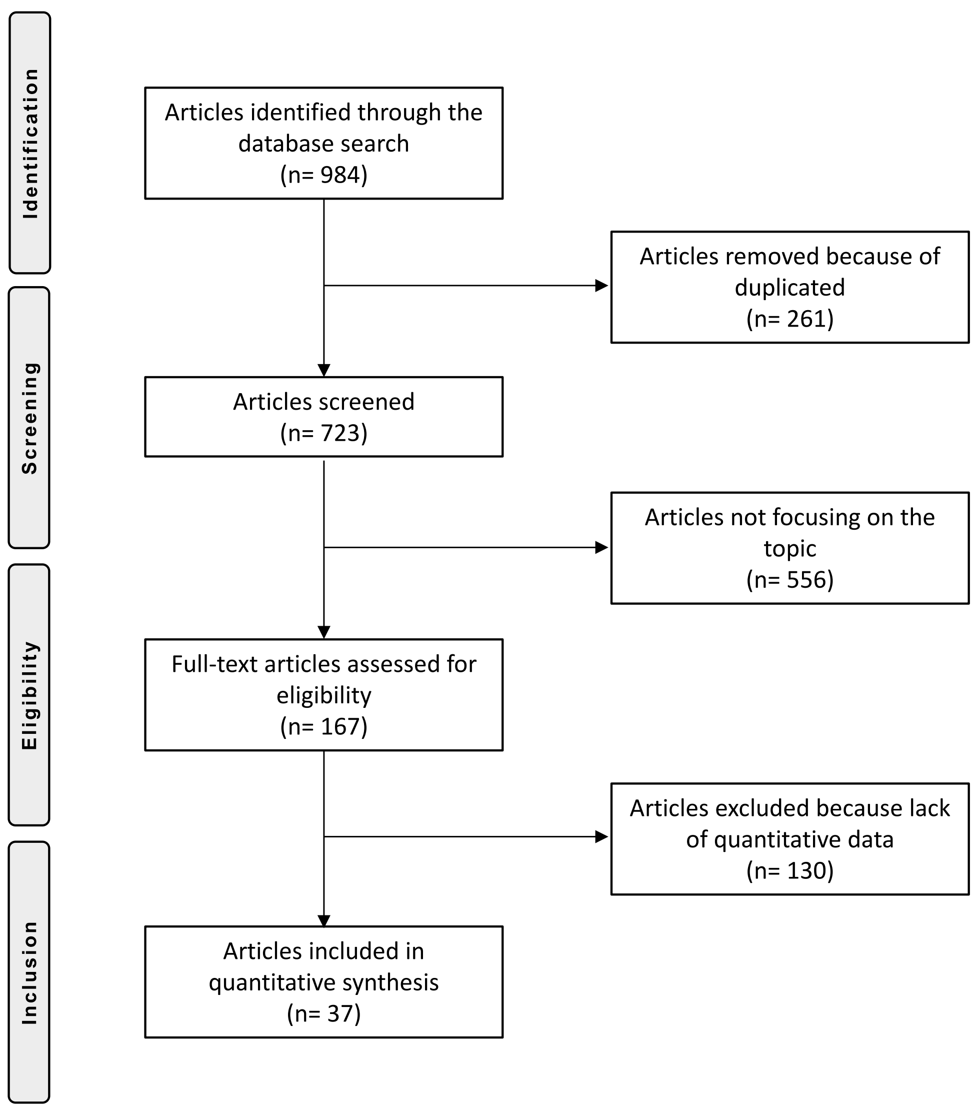
Analysis of publication bias

To assess the publication bias, we performed the funnel plot of the outcome involving a larger number of samples: the Knee Society Clinical Rating System. Most of the referral points are close to the median line with a very symmetrical distribution. No studies are located out of the range of acceptability. We stated that this study is affected by a very low risk of publication's bias. The funnel plot is shown in Fig. 2.

Methodological quality assessment

The PEDro appraisal score evidenced some limitations: first, the small number (4/37) of studies performing blinding methods. Second, the low number (22/37) of studies performing a randomization of the samples. Despite the limits, the overall result was 7.7, rating this work a very good

Fig. 1 Flow-chart diagram of the literature search



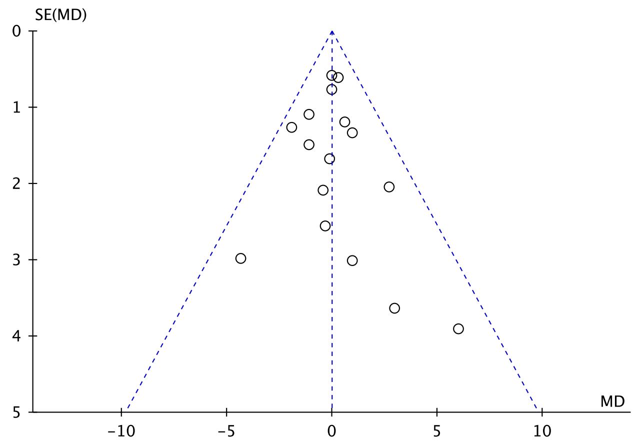


Fig. 2 Funnel plot of the outcome involving the largest number of samples (Knee Society Clinical Rating System). *SE* standard error; *MD* mean difference

methodological quality assessment. The results of PEDro score across the studies are shown in Table 1.

Patient's demographic

A total of 4052 patients were enrolled, undergoing 4884 TKAs. Osteoarthritis is the most reported surgical indication for both techniques. Other secondary surgical indications are represented by rheumatoid arthritis, avascular necrosis and osteonecrosis. We included in the present study 22 level of evidence I and 15 level of evidence II studies. The mean follow-up time for both cohorts was 3.39 ± 3.18 years. In the CR group, a total of 2403 procedures were enrolled. The mean age of the patients was 69.33 ± 3.9 years, with a mean BMI of 31.79 ± 11.31 kg/m^2. In the PS group, a total of 2481 procedures were registered. The mean age of the samples was 69.15 ± 3.79 years, with a mean BMI of 31.57 ± 11.31 kg/m^2. The demographic generalities of the included studies are shown in Table 1.

Outcomes

The overall WOMAC score and related subscales resulted statistically significantly more improved in the PS group: pain (EE 3.43 CI 95% 1.07–5.79; $P=0.004$; $I^2=59\%$), subscale function (EE 2.92 CI 95% 0.39–5.44; $P=0.02$; $I^2=68\%$,), stiffness (EE 1.08 CI 95% −0.04 2.20; $P=0.06$; $I^2=0\%$), overall (EE 2.51 CI 95% 0.05–4.96; $P=0.05$; $I^2=46\%$). The ROM resulted in an overall estimate effect of 4.05° in favor of the PS group (CI 95% 0.69 3.67; $P=0.004$; $I^2=0\%$; Fig. 3).

The KSCS resulted in favor of the CR group (EE 0.01 CI 95% −0.59–0.57; $P=0.98$; $I^2=0\%$). Surgical duration was shorter in the CR group (CI 95% 1.30–9.81; $P=0.001$; $I^2=63\%$). The KSFS resulted in favor of the PS group (EE 2.94 CI 95% 1.20–4.67; $P=0.0009$; $I^2=48\%$; Fig. 4).

A total of 19 studies reported complications over 2527 patients. In the PS group, all the complications of interest resulted decreased: anterior knee pain (OR 1.26; 95% CI 0.31–5.16; $P=0.75$; $I^2=0\%$), knee joint instability (OR 1.12; 95% CI 0.39–3.18; $P=0.84$; $I^2=0\%$) and further revision surgeries (OR 1.15; 95% CI 0.32–4.17; $P=0.84$; $I^2=51\%$). Table 2 summarizes the overall results of these analyses.

Discussion

The main findings of this meta-analysis were that both the prosthetic implants provided to be a safety and feasible solution to treat end-stage degenerative knee pathologies. The PS implants reported improvements in the knee range of motion and a prolongation of the surgical time. No clinically relevant dissimilarities concerning the analyzed scores were evidenced. No statistically significant relevant differences in complications were detected. During the process-making decision, we remained the role of the posterior cruciate ligament (PCL). During the movement of flexion and extension, the PCL dynamically stabilizes the articulation [19]. Furthermore, giving his mechanoreceptors [20], it is supposed to detect the body kinanesthesia and proprioception [21]. These are some of the reasons behind the CR prosthesis. Since the TKA is reserved for patients with end-stage articular disease, the PCL often result unstable, degenerate, frayed, partially or totally broken [22]. This is the rationale behind the PS implant that provides the removal of the posterior cruciate ligament.

Concerning the ROM, the estimated effect showed an improvement in the PS group of ca. four degrees. The explanation has a biomechanical foundation: CR implants produce a paradoxical tendency of the femur to slip anteriorly during flexion, reducing the ROM [23]. In contrast, PS implants, by removing the PCL and presenting the central prominence, create a posterior translation of the femur on the tibial plateau during flexion, increasing the rollback movement and consequently increasing the ROM [24, 25]. The comparison surgical duration evidenced a statistically significant reduction of ca. 6 min in favour of the CR group. The time prolonging is explained by the additional installation steps required by the PS implants. Regarding the overall WOMAC score and related subscales, an improvement in the PS group was observed. These results are statistically significant, affected by acceptable heterogeneity level. Even the KSFS score resulted statistically significant in favor of the PS implants. On the clinical practice, these data must be interpreted with caution, since these differences between are small. The comparison KSCS evidenced not noteworthy differences across the two cohorts.

Table 1 Demographic data of included patients and results of the PEDro appraisal score

References	Generalities						Cruciate retain			Posterior stabilized		
	Type of study	Patients (*n*)	Knees (*n*)	Surgical indications	Mean follow-up (year)	PEDro score	Knees (*n*)	Mean age (years)	Mean BMI	Knees (*n*)	Mean age (years)	Mean BMI
Aglietti et al. [26]	RCT	210	210	OA	3	10	103	71	27.5	107	69.5	27.5
Arabori et al. [27]	nRCT	20	40	OA	2.6	8	20	74.3		20	74.3	
Baier et al. [28]	RCT	60	60	OA	0.5	8	37	70.5		23	69.8	
Beaupre et al. [29]	RCT	56	56	OA	10	10	30	68.8		26	68.8	
Cancaya et al. [30]	RCT	100	100	OA		8	50	66	30.2	50	67	30.4
Carvalho et al. [31]	nRCT	31	38	OA	2.55	6	14	73		24	73	
Catani et al. [32]	RCT	40	40	OA	2	9	20	70		20	71	
Cates et al. [33]	nRCT	30	30	OA, RA, AVN	0.5	5	15	67.8	27.4	15	66.9	28.6
Chaudhary et al. [34]	RCT	78	78	OA	2	6	40	69.2	32.4	38	70.2	30.9
Cho et al. [35]	nRCT	102	102	OA	0.5	5	51	65.8	28.1	51	68	28.1
Clark et al. [36]	RCT	128	128	OA, PTA	2.5	9	69	71.8	23.3	59	71.2	22.1
Delport et al. [37]	nRCT	943	1152	OA	15	6	561	70.5	27	591	70.5	27
Fantozzi et al. [38]	nRCT	23	23	OA	2.87	7	10	73.9	29.3	13	67.7	28.1
Harato et al. [39]	RCT	189	192	OA	5.5	9	99	68.3	29.8	93	66	31.4
Kim et al. [40]	RCT	68	136	OA	3.1	8	68	65		68	65	
Kim et al. [41]	RCT	250	500	OA	2.3	8	250	71.6	26.8	250	71.6	26.8
Kolisek et al. [42]	nRCT	91	91	OA, ON, RA	5	6	46	64	32	45	66	32
Liu et al. [43]	nRCT	32	64	OA, RA	2	6	32	65.6		32	65.6	
Lützner et al. [44]	nRCT	39	78	OA	1	5	39	68.9	32.8	39	68.9	32.8
Maruyama et al. [45]	nRCT	20	40	OA	2.6	7	20	74.3		20		
Matsumoto et al. [46]	RCT	41	41	OA	5	10	19	73.5		22	74.4	
Misra et al. [47]	RCT	103	105	OA, RA	4.75	9	51	66.8		54	67.2	
Roh et al. [48]	RCT	86	86	OA	1.35	8	42	69.8	26.5	44	71	26.4
Sando et al. [49]	nRCT	360	414	OA	12.3	6	143	68.4	33	271	69.3	31.8
Seon et al. [50]	nRCT	95	95	OA	2.25	6	48	68.2	25.8	47	69.2	23.7
Snider et al. [51]	RCT	200	200	OA	2	8	100			100		
Straw et al. [52]	RCT	108	108	OA	3.5	9	66	72.6		42	74.1	
Tanzer et al. [53]	RCT	37	40	OA, RA, AN	2	9	20	68	30.7	20	66	30
Thomsen et al. [54]	RCT	33	66	OA	1	10	33	67.2	29.4	33	67.3	29.4
Tsuneizumi et al. [55]	nRCT	40	44	OA	2	6	22	72.5	26.9	22	72.5	27.3
van De Groes et al. [56]	RCT	47	47	OA	1.31	10	23	65.2	30.8	24	66.5	32.1
van den Boom et al. [57]	nRCT	21	21	OA	0.75	9	9	72		12	75	
Vermesan et al. [58]	RCT	50	50	OA, RA	0.5	7	25	68.8	32.6	25	68.4	33.4
Victor et al. [59]	RCT	44	44	OA	5	8	22	70	34.4	22	70	32.8

Table 1 (continued)

References	Generalities						Cruciate retain			Posterior stabilized		
	Type of study	Patients (*n*)	Knees (*n*)	Surgical indications	Mean follow-up (year)	PEDro score	Knees (*n*)	Mean age (years)	Mean BMI	Knees (*n*)	Mean age (years)	Mean BMI
Wang et al. [60]	nRCT	228	267	OA, RA, ON	3.5	7	157	54.5	28.1	110	55	27.2
Yagishita et al. [61]	RCT	29	58	OA	5	8	29	74.3	26.3	29	74.3	26.3
Yoshiya et al. [62]	RCT	20	40	OA	4.4	9	20	73.8		20		

LE level of evidence; *OA* osteoarthritis; *RA* rheumatoid arthritis; *AN* avascular necrosis; *ON* osteonecrosis; *PTA* post-traumatic necrosis

Moreover, despite the low level of heterogeneity, no statistical significance was observed.

An important limitation of this study is the relatively short-term follow-up. It would be interesting to clarify the rate of complications and reoperations in the long-term follow-up, analyzing the implant survovirship. Concerning the implant choice, based on the current evidences and on the main results of this study, we found any relevant difference. The decision-making process should depend on the degree of degeneration of the PCL. Further studies should evaluate or elaborate other scores to analyze the outcomes of the implants under other point of views. The strength points of this study are made by the comprehensive nature of the search, the rigorous methodological quality assessment and baseline comparability, the purpose of reducing the bias by excluding high-risk studies and the heterogeneity according to both χ^2 and I^2 tests. All these attentions provided a high-quality meta-analysis with very reliable and safe results.

Conclusion

The main findings of this meta-analysis were that both the prosthetic implants provided to be a safety and feasible solution to treat end-stage degenerative knee pathologies. The PS implants reported improvements in the knee range of motion and a prolongation of the surgical time. No clinically relevant dissimilarities concerning the analyzed scores were evidenced. No statistically significant relevant differences in complications were detected.

	Posterior Stabilized			Cruciate Retain				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Aglietti et al. 2005	112	0	107	108	0	103		Not estimable
Arabori et al. 2008	131	13	20	123	15	20	1.2%	8.00 [−0.70, 16.70]
Baier et al. 2013	125	0	23	130	0	37		Not estimable
Carvalho et al. 2014	105.43	11.7	24	106.43	9	14	2.1%	−1.00 [−7.64, 5.64]
Catani et al. 2004	114	21	20	97	15	20	0.7%	17.00 [5.69, 28.31]
Cates et al. 2008	125	10.4	15	125.8	8.8	15	1.9%	−0.80 [−7.69, 6.09]
Chaudhary et al. 2008	108	0	38	107.5	0	40		Not estimable
Cho et al. 2016	135	7	51	133	9	51	9.4%	2.00 [−1.13, 5.13]
Clark et al. 2001	113.6	0	59	108.5	0	69		Not estimable
Fantozzi et al. 2006	124.1	0	13	103	0	10		Not estimable
Harato et al. 2008	115.4	0	93	112.9	0	99		Not estimable
Kim et al. 2008	129	0	68	126	0	68		Not estimable
Kim et al. 2009	129	5.2	250	124.3	9.2	250	53.5%	4.70 [3.39, 6.01]
Kolisek et al. 2009	118	0	45	125	0	46		Not estimable
Liu et al. 2015	115.9	0	32	109.3	0	32		Not estimable
Lützner et al. 2015	135.4	7.3	39	134.2	7.2	39	8.9%	1.20 [−2.02, 4.42]
Maruyama et al. 2004	129.6	13.9	20	122.2	14.8	20	1.2%	7.40 [−1.50, 16.30]
Matsumoto et al. 2012	121.6	0	22	125.3	0	19		Not estimable
Misra et al. 2003	105.2	0	54	107.5	0	51		Not estimable
Roh et al. 2012	124	11.9	44	124.3	9.1	42	4.6%	−0.30 [−4.77, 4.17]
Sando et al. 2015	116.2	0	271	113	0	143		Not estimable
Seon et al. 2011	127.3	14.1	47	115	15.1	48	2.7%	12.30 [6.43, 18.17]
Straw et al. 2003	110	0	42	100	0	66		Not estimable
Tanzer et al. 2002	111	17	20	112	13	20	1.0%	−1.00 [−10.38, 8.38]
Thomsen et al. 2013	127	0	33	120	0	33		Not estimable
Tsuneizumi et al. 2008	118.9	11.2	22	116.3	11	22	2.1%	2.60 [−3.96, 9.16]
Van den Boom et al. 2014	120	7	12	113	11	9	1.4%	7.00 [−1.21, 15.21]
Vermesan et al. 2015	110	15	25	100	10	25	1.8%	10.00 [2.93, 17.07]
Victor et al. 2005	117	7	22	114	10	22	3.5%	3.00 [−2.10, 8.10]
Wang et al. 2004	114.8	0	110	111	0	157		Not estimable
Yagishita et al. 2012	129.3	11.7	29	125.4	10.9	29	2.7%	3.90 [−1.92, 9.72]
Yoshiya et al. 2005	131	12	20	121	16	20	1.2%	10.00 [1.23, 18.77]
Total (95% CI)			**1690**			**1639**	**100.0%**	**4.05 [3.09, 5.01]**

Heterogeneity: $Chi^2 = 33.78$, df = 16 ($P = 0.006$); $I^2 = 53\%$
Test for overall effect: $Z = 8.28$ ($P < 0.00001$)

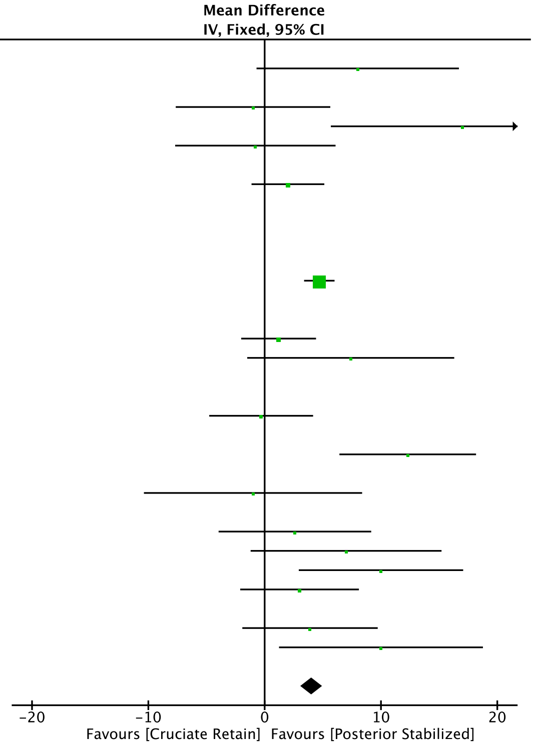


Fig. 3 Forest plot of the comparison ROM. *SD* standard deviation, *IV* inverse variance, *CI* confidence interval

	Posterior Stabilized			Cruciate Retain				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Aglietti et al. 2005	79	0	107	80	0	103		Not estimable
Baier et al. 2013	74	0	23	76	0	37		Not estimable
Catani et al. 2004	76	19	20	81	17	20	2.4%	−5.00 [−16.17, 6.17]
Cates et al. 2008	92	10.5	15	81	24	15	1.7%	11.00 [−2.26, 24.26]
Chaudhary et al. 2008	77.8	17.4	38	76.5	20.9	40	4.1%	1.30 [−7.22, 9.82]
Cho et al. 2016	87	10	51	86	11	51	18.0%	1.00 [−3.08, 5.08]
Delport et al. 2013	97	0	591	94	0	561		Not estimable
Fantozzi et al. 2006	84.6	0	13	84	0	10		Not estimable
Harato et al. 2008	74.9	18.7	93	69.6	19.7	99	10.2%	5.30 [−0.13, 10.73]
Kim et al. 2008	85	0	68	83	0	68		Not estimable
Kim et al. 2009	83.7	19.6	250	80.2	19.7	250	25.3%	3.50 [0.06, 6.94]
Kolisek et al. 2009	73.7	0	45	71.9	0	46		Not estimable
Liu et al. 2015	67	0	32	65.6	0	32		Not estimable
Matsumoto et al. 2012	84.8	0	22	88.6	0	19		Not estimable
Roh et al. 2012	84.6	13.6	44	83.8	16.6	42	7.3%	0.80 [−5.63, 7.23]
Sando et al. 2015	69.5	25	271	56.5	32.5	143	8.1%	13.00 [6.90, 19.10]
Tanzer et al. 2002	76	28	20	73	24	20	1.2%	3.00 [−13.16, 19.16]
Tsuneizumi et al. 2008	80	8.1	22	81.8	12.8	22	7.5%	−1.80 [−8.13, 4.53]
Victor et al. 2005	74.8	27.9	22	83.6	15.3	22	1.7%	−8.80 [−22.10, 4.50]
Wang et al. 2004	87	19.6	110	84.2	20.8	157	12.5%	2.80 [−2.10, 7.70]
Total (95% CI)			**1857**			**1757**	**100.0%**	**2.94 [1.20, 4.67]**

Heterogeneity: $Chi^2 = 21.22$, df = 11 ($P = 0.03$); $I^2 = 48\%$
Test for overall effect: $Z = 3.32$ ($P = 0.0009$)

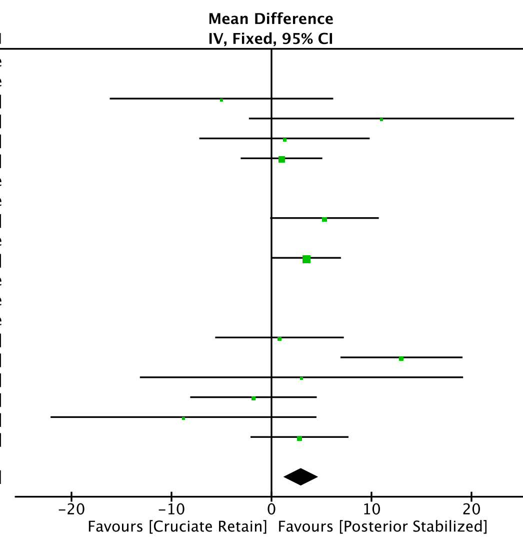


Fig. 4 Forrest plot of the comparison KSFS. *SD* standard deviation, *IV* inverse variance, *CI* confidence interval

Table 2 Meta-analysis results of the comparison

Comparison	Overall effect		
	Effect estimate [95% CL]	I^2 (%)	*P*
WOMAC			
Pain	3.43 [1.07, 5.79]	59	0.004
Function	2.92 [0.39, 5.44]	68	0.02
Stiffness	1.08 [−0.04, 2.20]	0	0.06
Overall	2.51 [0.05, 4.96]	46	0.05
KSS			
Clinical	−0.01 [−0.59, 0.57]	0	0.98
Functional	2.94 [1.20, 4.67]	48	0.0009
ROM	4.05 [3.09, 5.01]	53	< 0.0001
Surgical duration	5.55 [1.30, 9.81]	63	0.01
Complication			
Anterior knee pain	1.26 [0.31, 5.16]	0	0.75
Instability	1.12 [0.39, 3.18]	0	0.84
Revision	1.15 [0.32, 4.17]	51	0.84

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, informed consent is not required.

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