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REVIEW

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# Effects of previous arthroscopic knee surgery on the outcomes of primary total knee arthroplasty: a systematic review and PRISMA-compliant meta-analysis

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## Abstract

**Objective** The aim of this study was to evaluate the potential adverse effects of prior arthroscopic knee surgery on the prognosis of primary total knee arthroplasty (TKA).

**Methods** This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive literature search was performed in the PubMed, Embase, Cochrane Library, and other relevant databases up to October 2024. Cohort studies comparing the outcomes of patients with and without previous arthroscopic knee surgery were retrieved. Meta-analysis was performed to assess the differences in postoperative function, complications, and revision rates between the arthroscopy and primary TKA groups.

**Results** The analysis included 11 cohort studies comprising a total of 194,367 patients; 13,086 of these patients had a history of knee arthroscopy. The meta-analysis results revealed no significant differences in postoperative range of motion, functional improvement, stiffness, periprosthetic fracture, venous thromboembolism (VTE), and other complications between the groups. However, the arthroscopic group showed a higher risk of postoperative prosthetic joint infection (PJI) and manipulation under anaesthesia (MUA). The revision rate was also higher in the arthroscopic group (Relative Risk (RR) 1.423, 95% Confidence Interval (CI) 1.280 to 1.583). Subgroup analysis revealed an increased PJI risk within one year of arthroscopic TKA (RR 1.314, 95% CI 1.156 to 1.493). Sensitivity analysis confirmed the stability of the results, and Egger's test showed no publication bias.

**Conclusion** Prior arthroscopic surgery was not found to have significant impacts on the functional outcomes of TKA but was found to increase the risks of postoperative infection and revision.

**Keywords** Knee osteoarthritis, Knee arthroscopy, Total knee arthroplasty, Systematic review, Meta-analysis

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## Introduction

Knee osteoarthritis (OA) is a prevalent and disabling condition affecting a substantial portion of the aging population, with projections indicating an increase in its prevalence aligned with global aging trends [1, 2]. Initially, the condition is managed through conservative interventions, such as physical therapy, pharmacologic treatments, and lifestyle modifications [3, 4]. However, as OA progresses, conservative measures are often rendered ineffective, necessitating surgical intervention for many patients [5]. Total knee arthroplasty (TKA) is the gold standard for managing end-stage knee OA, providing significant pain relief and functional restoration with favourable long-term outcomes [6].

The influence of prior arthroscopic knee surgery on TKA outcomes remains a subject of scientific debate. Knee arthroscopy (KA), commonly performed to address meniscal tears, loose bodies, or other intra-articular issues, is hypothesised to impact the outcomes of subsequent TKA due to its potential effects on knee joint structures [7–10]. Although numerous studies, including several meta-analyses, have explored this relationship, a clear consensus on whether prior KA adversely impacts TKA outcomes has not been reached. Several studies have indicated that patients with a history of KA have higher rates of postoperative complications, including infections, stiffness, and revision procedures, alongside inferior functional recovery [11–16]. The proposed mechanisms underlying these findings include intra-articular adhesions, altered joint biomechanics, or iatrogenic cartilage and bone damage resulting from arthroscopic procedures [7–10].

In contrast, other studies have reported no significant associations between prior KA and TKA outcomes, suggesting that previous arthroscopic intervention does not influence postoperative recovery or implant longevity [17–21]. The authors of these studies have hypothesised that the minimally invasive nature of KA likely minimises disruption to bone structures essential for TKA, resulting in comparable postoperative outcomes to those seen in patients without prior KA [19]. Of note, several studies have suggested that the interval between KA and TKA could play a moderating role in TKA outcomes, with shorter intervals potentially linked to less favourable results, as incomplete recovery from the prior procedure may influence subsequent surgical outcomes [13].

This lack of consensus highlights the critical need for further investigation into the relationship between prior KA and TKA outcomes. Based on existing hypotheses, it was anticipated that patients with a history of KA would exhibit distinct postoperative outcomes relative to those without. Specifically, it was hypothesised that prior KA would be associated with an increased risk of postoperative complications, reduced functional outcomes, and a higher revision rate following TKA. The present systematic review and meta-analysis was conducted to deliver a comprehensive and updated synthesis of the available literature in order to gain evidence-based insights for clinical decision-making in the management of patients with advanced knee OA.

**Table 1** Keywords used for the search strategy

| PICO Element | Keywords / MeSH Terms |
|---|---|
| Population (P) | "Arthroplasty, Replacement, Knee" [Mesh]<br>"total knee arthroplasty"<br>"total knee replacement"<br>TKA<br>"primary total knee arthroplasty" |
| Intervention (I) | "Arthroscopy" [Mesh]<br>"knee arthroscopy"<br>"arthroscopic knee surgery"<br>"previous knee arthroscopy"<br>"prior arthroscopic knee surgery"<br>"arthroscopic surgery" |
| Comparison (C) | Not specified (most studies naturally include a control group) |
| Outcome (O) | "Treatment Outcome" [Mesh]<br>"outcome"<br>"outcomes"<br>"complications"<br>"surgical complications"<br>"revision"<br>"reoperation"<br>"infection"<br>"periprosthetic joint infection"<br>"functional recovery"<br>"function scores" |

**PICO**: Population Intervention Comparison Outcome

## Method

A systematic review of the scientific literature was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist [22]. This review was registered in PROSPERO under the registration number CRD42024562998. The PICO (Population, Intervention, Comparison, Outcome) strategy was employed to formulate a precise search approach. The target population comprised patients diagnosed with advanced knee OA, with older age groups being predominant as knee OA is most common in these age groups. The intervention under investigation was prior arthroscopic knee surgery performed before TKA. The comparison group included patients who underwent TKA without any history of prior arthroscopic surgery. The primary outcomes included postoperative complications, functional recovery, pain relief, joint stability, and the rate of revision surgery. The keywords used to conduct the search are presented in Table 1.

The computerized search strategy utilized several databases, including PubMed, Embase, Cochrane Library, Wanfang Database, and China National Knowledge

Infrastructure (CNKI). The most recent search was conducted on October 20, 2024. Tailored modification of the search strategy was required for each database, and no language restrictions were applied. Additionally, the reference lists of the studies identified in the database searches, as well as those of pertinent reviews, were manually examined to identify further studies for potential inclusion. Details of the search strategies and results can be found in Supplementary Table 1.

#### Inclusion and exclusion criteria

The inclusion criteria included: randomized controlled trials and retrospective studies of the effects of KA on the prognosis of TKA from both domestic and international sources; the study comprised knee OA patients undergoing TKA surgery; the study comprised a KA group (those with a history of KA prior to TKA) and a non-KA group (those without a history of KA before TKA); the outcome measures included the TKA revision rate, reoperation rate, stiffness rate, prosthetic joint infection (PJI) rate, venous thromboembolism (VTE) incidence, postoperative range of motion (ROM), and Knee Society Score (KSS), among others. The exclusion criteria included: patients with a history of open knee surgery or fractures; studies that did not evaluate postoperative indicators or did not compare the two groups; incomplete data or literature for which the full text was unavailable; reviews, editorials, letters, conference abstracts, or case reports.

#### Data extraction

Two researchers conducted independent screening of the identified studies and extracted the relevant data from the included studies, resolving any disagreements through discussion or by consulting a third party. The screening process strictly adhered to the above criteria. Priority was given to recent or high-impact factor publications in cases of duplicate authorship or research centre publications. The collected data encompassed the study details, patient characteristics, interval between previous arthroscopy and joint arthroplasty, follow-up time, effect size, and adjustment variables. If there were any uncertainties in the data, the authors were contacted for clarification.

#### Quality evaluation

Quality assessment of the cohort studies was conducted using the Newcastle-Ottawa Scale (NOS) [23], which assigns scores ranging from 0 (highest bias risk) to 9 (lowest bias risk). Disagreements were resolved through consensus. The risk of bias was then categorized as high (0–3), medium (4–6), or low (7–9) [24].

#### Data synthesis and statistical analysis

The mean difference and standard deviation were used in the assessment of continuous functional outcomes. For skewed data, the median and interquartile range were employed, according to Wan et al.'s method [25]. The results are reported as 95% confidence intervals (CIs) using either the weighted mean difference (WMD) or standardized mean difference (SMD). For binary outcomes, the relative risk (RR) was extracted or calculated. Heterogeneity among effect sizes was evaluated using chi-square tests. A fixed effects model was used when homogeneity was observed ($p > 0.1$ and $I^2 < 50\%$), while a random effects model was employed when significant heterogeneity was present ($p < 0.1$ and $I^2 \geq 50\%$). Subgroup analyses were conducted in cases of substantial heterogeneity. Sensitivity analysis was performed to assess the stability of the results, and publication bias was evaluated using Egger's test when data were available from more than five studies. The statistical analyses were conducted using Stata 12.0, with a significance level of $p < 0.05$.

## Results

#### Selection of studies

A comprehensive search was performed across the PubMed, Embase, Cochrane Library, Wanfang Data, and CNKI databases. The search identified a total of 1770 records. After removing 243 duplicate records, 1527 unique articles remained for initial screening. The titles and abstracts of these articles were reviewed, resulting in the exclusion of 1501 articles that did not meet the inclusion criteria, primarily due to irrelevance to the study's scope. This preliminary screening yielded 26 articles deemed potentially eligible for full-text review. Of these, two articles were excluded due to unavailability of the full text. The remaining 24 articles were thoroughly evaluated against the detailed eligibility criteria. During this review, 12 articles were excluded for the following reasons: three were review articles, two were conference abstracts, one lacked the specific data required for analysis, three did not investigate outcomes related to TKA, two did not focus on arthroscopic surgery (e.g., in Watters's study [26], it was unclear whether open surgery or arthroscopic surgery was used for anterior cruciate ligament repair), and two contained duplicate or insufficient data [27, 28]. Ultimately, 11 studies met the inclusion criteria and were included in the quantitative synthesis for meta-analysis. The entire selection process, including each stage of screening and exclusion, is illustrated in Fig. 1, according to the PRISMA guidelines. This systematic approach ensured the inclusion of relevant studies to enhance the validity and reliability of the meta-analysis findings.

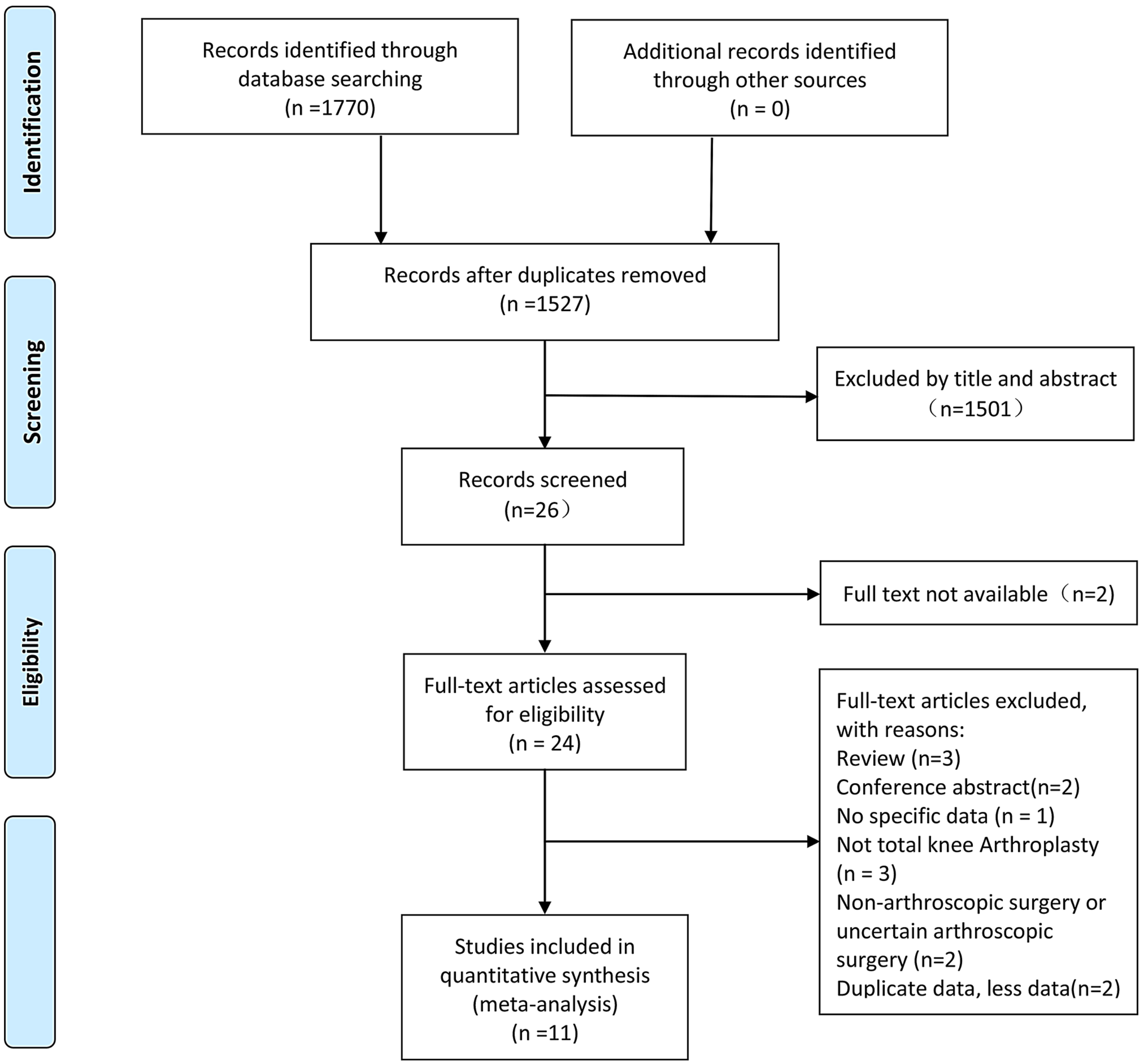


**Fig. 1** Flow diagram of the study selection for the present meta-analysis

### Study and patient characteristics

The 11 included studies [11–13, 15, 16, 18–21, 29, 30], detailed in Table 2, were published between 2009 and 2024, and predominantly originated from the United States ($n = 6$), with contributions from China, Brazil, England, and France. Ten studies were retrospective cohort analyses, utilizing registry or institutional databases, while one was a prospective study. Together, the studies comprised 194,367 patients undergoing primary TKA, with 13,086 (6.7%) having prior knee KA. The patients ranged in age from 18 to 95 years, with mean ages between 56 and 72 years. Overall, over 55% of patients were female, reaching up to 91.7% in some control groups [17]. The body mass index (BMI) values averaged between 27 and 33 kg/m², indicating that most patients were overweight or obese. This is common among knee OA cases. The interval between KA and subsequent TKA varied significantly, from less than three months to four years, as reported in eight studies. The follow-up period post-TKA ranged from 90 days to 8 years, allowing for the assessment of both immediate and long-term outcomes. The postoperative complications that were evaluated included infection, stiffness, VTE, and the need for manipulation under anaesthesia (MUA). The findings were mixed: studies such as those by Piedade et al. [11] and Gu et al. [29] reported increased postoperative complications and reduced TKA survival with prior

**Table 2** Characteristics of the included studies

| Author | Year | Country | Matched pair | Study | Level of evidence | Study groups | Patients (Knees) | Age (years) | Female (%) | BMI | Interval between arthroplasty and arthroscopy | Mean Follow-up | Finding | NOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Piedade SR [11] | 2009 | Brazil | Non | Retro cohort | Level III | Arthroscopy | 60 (60) | 69(34–81) | 75 | | 53 months | 46.6 months | Prior knee arthroscope increase postoperative complications, failures, and worse survival in primary TKA outcomes. | 8 |
| | | | | | | Control | 1,035(1,119) | 72(20–95) | 76 | | NA | 43.2 months | | |
| Issa K [17] | 2012 | USA | Non | Retro cohort | Level III | Arthroscopy | 60 (61) | 56(18–86) | 70 | | NA | 39(26–68) months | Earlier arthroscopic procedures did not negatively affected the outcome of TKA. | 9 |
| | | | | | | Control | 438(563) | 62(18–92) | 91.7 | | NA | 38(24–65) months | | |

**Table 2** (continued)

| Author | Year | Country | Matched pair | Study | Level of evidence | Study groups | Patients (Knees) | Age (years) | Female (%) | BMI | Interval between arthroplasty and arthroscopy | Mean Follow-up | Finding | NOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Werner BC [12] | 2015 | USA | Matched | Retro cohort | Level III | Arthroscopy | 3051 | NA | 69.2 | | 681 within 6 months; 1301 TKA within 6 months to 1 year; 1069TKA within 1–2 years | 90days | TKA performed within six months following ipsilateral knee arthroscopy appears to be associated with increased rates of postoperative infection, stiffness and venous thromboembolism. | 7 |
| | | | | | | Control | 37,235 | NA | 65.6 | | | 90 days | | |
| Rothermich MA [18] | 2017 | USA | matched | Retro cohort | Level III | Arthroscopy | 469 | 57.8 ± 7.22 | 53.9 | 33.3 ± 6.70 | | NA | Previous ipsilateral knee surgery is not associated with worse functional outcomes following primary TKA. | 7 |
| | | | | | | Control | 469 | 58.0 ± 7.10 | 53.9 | 33.2 ± 6.42 | | NA | | |

**Table 2** (continued)

| Author | Year | Country | Matched pair | Study | Level of evidence | Study groups | Patients (Knees) | Age (years) | Female (%) | BMI | Interval between arthroplasty and arthroscopy | Mean Follow-up | Finding | NOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Barton SB [13] | 2017 | England | Non | Retro cohort | Level III | Arthroscopy | 186 | 65 ± 8.5 | 60.2 | 31.4 ± 4.6 | 193(87) days | 40.9 ± 16.4months | TKA should not routinely be performed within six months of arthroscopy. | 7 |
| | | | | | | Control | 1708 | 68 ± 10 | 57.0 | 30.3 ± 6.3 | | 20 ± 17.0months | | |
| Viste A [19] | 2017 | USA | Matched | Retro cohort | Level III | Arthroscopy | 153(160) | 66 ± 8.8 (41–85) | 58 | 32 ± 5.5 | 25 TKA less than 1 year;135 TKA ≥ 1 year | 8.7 ± 2.5 (2–12) | Clinical outcomes, survivorship, and complications were similar in TKAs patients that had a previous non-ACL arthroscopic procedure. | 9 |
| | | | | | | Control | 320(320) | 66 ± 8.4 (41–85) | 58 | 32 ± 6.6 | | 8.5 ± 2.6 (2–12) | | |

**Table 2** (continued)

| Author | Year | Country | Matched pair | Study | Level of evidence | Study groups | Patients (Knees) | Age (years) | Female (%) | BMI | Interval between arthroplasty and arthroscopy | Mean Follow-up | Finding | NOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gu A [29] | 2019 | USA | Non | Retro cohort | Level III | Arthroscopy | 3357 | NA | 65.6 | NA | 0.93 ± 0.75(0.01-2.00)years | within 2 years | Arthroscopy before TKA substantially increases the rates of revision, PJI, aseptic loosening, and stiffness. | 8 |
| | | | | | | | 134,662 | NA | 63 | NA | | | | |
| Ma JN [15] | 2020 | China | Matched | Retro cohort | Level III | Arthroscopy | 87TKAs | 63.1 ± 7.9 | 57.5 | 27.9 ± 4.6 | (2.3 ± 1.7)years | 4.3 ± 1.9 years | Prior knee arthroscopy linked to worse TKA outcomes, especially in males and those with prior ACL-related KA. Increased complication risk within nine months of KA. | 8 |
| | | | | | | Control | 174TKAs | 63.0 ± 7.6 | 56.9 | 27.7 ± 4.9 | | | | |

**Table 2** (continued)

| Author | Year | Country | Matched pair | Study | Level of evidence | Study groups | Patients (Knees) | Age (years) | Female (%) | BMI | Interval between arthroplasty and arthroscopy | Mean Follow-up | Finding | NOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xu K [20] | 2021 | China | Matched | Pros cohort | Level II | Arthroscopy | 56TKA | 62.89 ± 6.30 | 87.5 | 27.96 ± 2.97 | NA | 43mos | No significant differences in recovery or complications were found in patients who had knee arthroscopy before total knee replacement surgery. | 9 |
| | | | | | | Control | 56TKA | 63.06 ± 6.27 | 87.5 | 27.79 ± 3.01 | NA | 41mos | | |
| Sax OC [16] | 2022 | USA | Non | Retro cohort | Level III | Arthroscopy | 5,523 | NA | NA | NA | 0-12weeks($n = 1,023$);12-16weeks($n = 816$);16–20 weeks($n = 1,957$)and20-24 weeks ($n = 1,727$). | 90days to 2years | Knee arthroscopy within 24 weeks of primary TKA was linked to a higher risk of 90-day post-TKA MUA, both in unadjusted and adjusted analyses. | 7 |
| | | | | | | Control | 5,000 | 66 ± 8.68 | 63.3 | NA | | | | |

**Table 2** (continued)

| Author | Year | Country | Matched pair | Study | Level of evidence | Study groups | Patients (Knees) | Age (years) | Female (%) | BMI | Interval between arthroplasty and arthroscopy | Mean Follow-up | Finding | NOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Giovanoulis [21] | 2024 | France | Matched | Retro cohort | Level III | Arthroscopy | 84 | 68.9 ± 7.4 | 59.5 | 29.6 ± 5.3 | 3.6 ± 2.4 years | 8.4 ± 2.1 years | Previous KA of the medial meniscus does not negatively affect a subsequent TKA | 9 |
| | | | | | | Control | 84 | 69.1 ± 9.1 | 61.9 | 29.3 ± 4.8 | | | | |

Retr: Retrospective; Pros: Prospective; TKA: Total Knee Arthroplasty; NA: Not Applicable; ACL: Anterior Cruciate Ligament; MUA: Manipulation Under Anesthesia

arthroscopy, while studies such as those by Issa et al. [17] and Xu et al. [20] found no significant negative impacts.

The methodological quality of the included studies was assessed using the NOS and is presented in Table 2. The scores on this scale ranged from 7 to 9, indicating an overall low risk of bias. However, the area with the greatest risk of bias was the comparability between groups, as most studies did not adequately adjust for important confounders that could have influenced the results (see Supplementary Table 2).

## Meta-analysis

### *Postoperative functional improvement*

Four studies [11, 15, 19, 20] compared preoperative and postoperative ROM, while six others [11, 13, 17–20] evaluated functional improvement scores. The meta-analysis showed no significant difference in ROM between patients with and without prior arthroscopy (mean difference −0.61, 95% CI -3.48 to 2.26; $I^2 = 62.4\%$; random effects model; 4 studies; $n = 362$ in the arthroscopic group, $n = 1542$ in the control group; Supplementary Fig. 1A). Sensitivity analysis upheld these findings (Supplementary Fig. 2A) and there was no evidence of publication bias (Table 3). Functional improvement, measured mainly through the KSS, was marginally lower in the arthroscopic group, albeit not significantly (SMD −0.075, 95% CI -0.186 to -0.037; $p = 0.081$; $I^2 = 46.7\%$; random effects model; 7 studies; $n = 1067$ in the arthroscopic group, $n = 4067$ in the control group; Supplementary Fig. 1B). Subgroup analysis based on the interval between arthroscopy and TKA indicated poorer outcomes for intervals less than one year, though this was based on a single study. The stability of the results was confirmed through sensitivity analysis (Supplementary Fig. 2B), and no publication bias was detected (Table 3).

### *Postoperative complications*

**Joint stiffness** The analysis included six articles [11, 12, 14, 15, 17, 21] and seven data sets, with a total of 6,699 cases in the experimental group and 173,748 cases in the control group. A meta-analysis of the data revealed significant interstudy heterogeneity ($p = 0.001$; $I^2 = 73.1\%$), and a random effects model was employed. The results revealed no statistically significant difference between the two groups (RR 1.354, 95% CI 0.881 to 0.081; $p = 0.167$), indicating that knee arthroscopy did not increase the risk of stiffness after subsequent TKA. Subgroup analysis also indicated that the incidence of postoperative stiffness was not increased when a TKA was performed within one year or one year after receiving an arthroscopy (Supplementary Fig. 1C). Sensitivity analysis confirmed the sta-

**Table 3** Overall and subgroup meta-analysis of the impact of knee arthroscopy on subsequent total knee replacement and publication bias

| Subjects | *n* | | Pool | | | Heterogeneity | | | Egger | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | RR/SMD/WMD | 95%CI | *P* | I2 | *P* | model | t | *P* |
| Range of motion | 4 | WMD | -0.61 | -3.479,2.259 | 0.677 | 62.40% | 0.047 | Random | NA | NA |
| | 2 | WMD | 1.71 | -0.672,4.092 | 0.159 | 0.00% | 0.709 | Fixed | NA | NA |
| | 2 | WMD | -2.938 | -5.160,-0.716 | 0.01 | 0.00% | 0.904 | Fixed | NA | NA |
| Functional outcome | 7 | SMD | -0.075 | -0.186 0.037 | 0.19 | 46.70% | 1067 | Random | 1.27 | 0.259 |
| | 1 | SMD | -0.288 | -0.439,-0.136 | <0.01 | NA | NA | NA | NA | NA |
| | 2 | SMD | -0.024 | -0.222 0.174 | 0.813 | 0.00% | 0.447 | NA | NA | NA |
| | 4 | SMD | -0.039 | -0.135 0.056 | 0.42 | 0.00% | 0.439 | Fixed | NA | NA |
| Stiffness | 7 | RR | 1.354 | 0.881 2.081 | 0.167 | 73.10% | 0.001 | Random | 0.06 | 0.955 |
| | 2 | RR | 1.313 | 0.902,1.912 | 0.155 | 81.00% | 0.022 | Random | NA | NA |
| | 4 | RR | 1.765 | 0.525 5.931 | 0.358 | 74.80% | 0.008 | Random | NA | NA |
| | 1 | RR | 9.23 | 0.585,145.706 | 0.114 | NA | NA | NA | NA | NA |
| Periprosthetic fracture | 4 | RR | 0.863 | 0.134,5.540 | 0.876 | 81.20% | 0.001 | Random | NA | NA |
| | 1 | RR | 0.434 | 0.180,1.047 | 0.063 | NA | NA | NA | NA | NA |
| | 2 | RR | 3.4 | 1.271,9.098 | 0.015 | 40.20% | 0.196 | Fixed | NA | NA |
| | 1 | RR | 0.163 | 0.008,3.360 | 0.24 | NA | NA | NA | NA | NA |
| venous thromboembolism | 3 | RR | 1.055 | 0.829,1.342 | 0.662 | 0.00% | 0.388 | Fixed | NA | NA |
| | 1 | RR | 1.183 | 0.887,1.577 | 0.252 | NA | NA | NA | NA | NA |
| | 2 | RR | 0.839 | 0.540,1.304 | 0.435 | 0.00% | 0.599 | Fixed | NA | NA |
| Aseptic loosening | 9 | RR | 1.542 | 0.876,2.716 | 0.134 | 75.90% | <0.01 | Random | 1.16 | 0.289 |
| | 4 | RR | 1.327 | 0.669,2.632 | 0.418 | 86.60% | <0.01 | Random | NA | NA |
| | 3 | RR | 2.283 | 0.551,9.453 | 0.083 | 59.90% | 0.107 | Random | NA | NA |
| | 1 | RR | 1.439 | 0.070,29.628 | 0.813 | NA | NA | NA | NA | NA |
| PJI | 10 | RR | 1.317 | 1.165 1.488 | <0.01 | 0.00% | 0.622 | Fixed | 1.18 | 0.272 |
| | 4 | RR | 1.314 | 1.156,1.493 | <0.01 | 0.00% | 0.722 | Fixed | NA | NA |
| | 5 | RR | 1.395 | 0.911 2.137 | 0.143 | 23.80% | 0.262 | Fixed | NA | NA |
| | 1 | RR | 0.5 | 0.047,5.358 | 0.567 | NA | NA | NA | NA | NA |
| Manipulation Under Anesthesia | 3 | RR | 1.87 | 1.134,3.086 | 0.014 | 93.20% | <0.01 | Random | NA | NA |
| Revision | 10 | RR | 1.423 | 1.280 1.583 | <0.01 | 30.40% | 0.166 | Fixed | 0.91 | 0.387 |
| | 4 | RR | 1.346 | 1.182 1.533 | <0.01 | 0.00% | 0.396 | Fixed | NA | NA |
| | 4 | RR | 2.369 | 1.365 4.110 | 0.002 | 39.60% | 0.174 | Fixed | NA | NA |
| | 2 | RR | 0.645 | 0.140,2.983 | 0.575 | 0.00% | 0.786 | Fixed | NA | NA |

NA: Not Applicable; WMD: weighted mean difference; SMD: Standardized Mean Difference; RR: Relative Risk; PJI: Prosthetic Joint Infection; MUA: Manipulation Under Anesthesia

bility of these results (Supplementary Fig. 2C), and Egger's test indicated no publication bias (Table 3).

**Periprosthetic fractures** A total of four studies [11, 14, 15, 19] were included in this analysis, with 3,664 patients in the experimental group and 136,085 patients in the control group. The meta-analysis revealed significant heterogeneity among the four studies ($p < 0.001$; $I^2 = 81.2\%$), leading to the use of a random effects model. The analysis showed no significant difference between the two groups (RR -0.86, 95%CI 0.13 to 5.54; $p = 0.876$). These findings suggest that knee arthroscopy did not increase the risk of periprosthetic fracture after TKA. Subgroup analysis supported this finding, indicating that arthroscopy performed within one year after TKA and after one year did not increase the incidence of postoperative fracture around the prosthesis (Supplementary Fig. 1D). Sensitivity analysis further confirmed the stability of these results (Fig. 2D).

**VTE** Two articles were included in this analysis [12, 15], with a total of three groups of data. Given that the heterogeneity between the study results was not large ($p = 0.662$; $I^2 = 0.00\%$), a fixed effects model was used for the meta-analysis. The results showed that the incidence of VTE between the two groups was not significantly different (RR 1.06, 95% CI 0.83 to 1.35; $p = 0.662$). Likewise, the subgroup analysis showed that arthroscopy within one year and one year after KA did not increase the incidence of postoperative VTE (Supplementary Fig. 1E). Sensitivity analysis confirmed that this finding was relatively stable, verifying the reliability of the results (Fig. 2E).

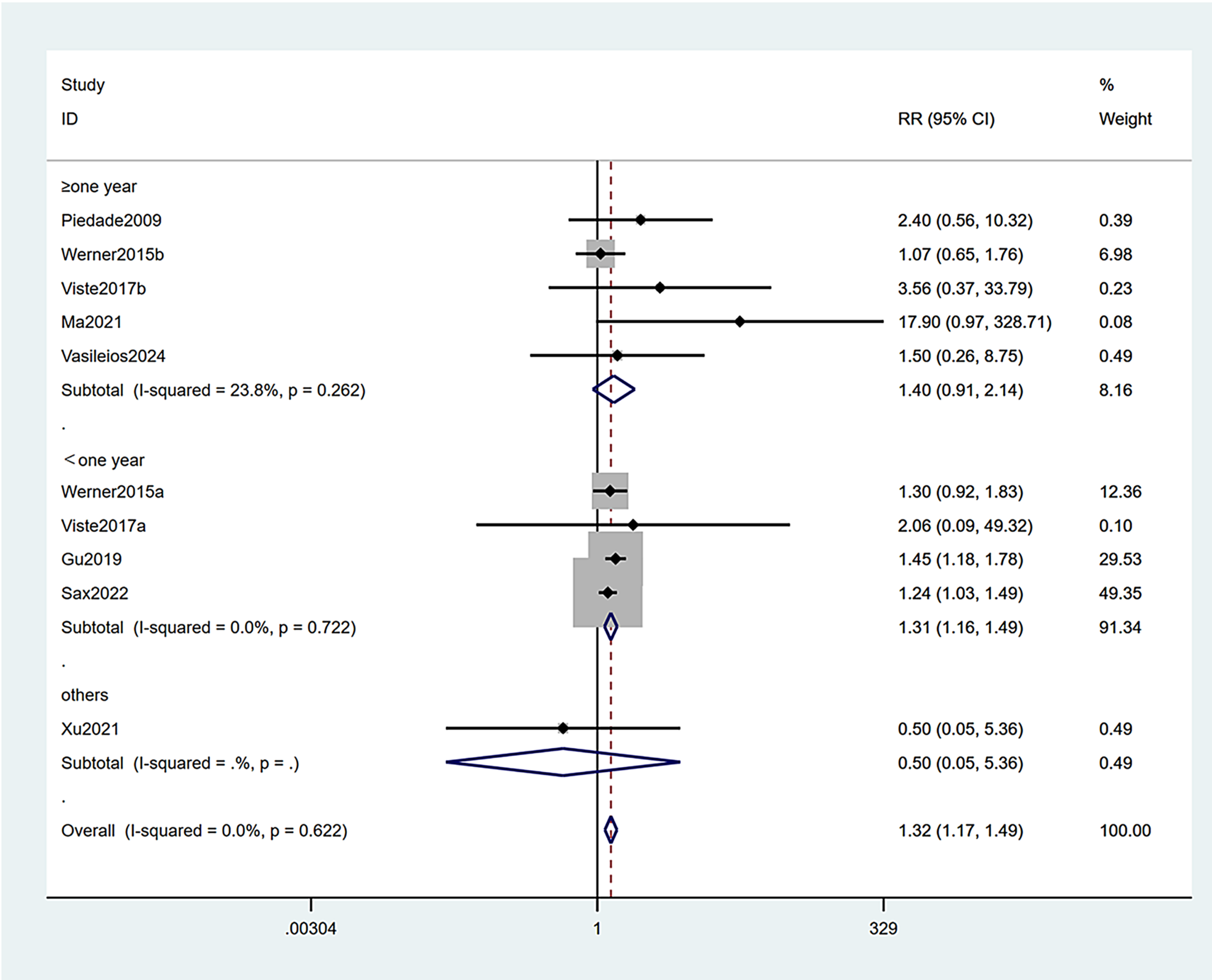


**Fig. 2** Forest plot showing the difference in prosthetic joint infection between TKA patients with (left) and without (right) prior arthroscopy. Studies are grouped by the time interval between arthroscopy and TKA. "Others" refers to studies that did not provide the time interval between arthroscopy and TKA

**Aseptic loosening** Eight studies [11, 13–17, 19], encompassing eight sets of data, were incorporated into the meta-analysis of aseptic loosening; there were 9,433 cases in the experimental group and 143,420 cases in the control group. The meta-analysis of the included data revealed considerable heterogeneity among the studies ($p < 0.001$; $I^2 = 75.9\%$); thus, a random effects model was employed. The comparison between the two groups yielded no statistically significant difference (RR 1.542, 95% CI 0.876 to 2.716; $p = 0.134$), suggesting that arthroscopic surgery of the knee did not increase the risk of aseptic loosening following TKA (Supplementary Fig. 1F). Sensitivity analysis indicated that the results were relatively stable (Supplementary Fig. 2F), and Egger's test suggested the absence of publication bias (Table 4).

**PJI** A total of eight articles were included [11–16, 19, 20] in this analysis, comprising 10 groups of data. The experimental group consisted of 12,377 cases, while the control group consisted of 178,523 cases. The meta-analysis revealed a lack of heterogeneity ($p = 0.622$; $I^2 = 0.0\%$), and a fixed effects model was used. The difference between the two groups was statistically significant (RR 1.317, 95%CI 1.165 to 1.488; $p < 0.01$). The results indicated that KA increased the risk of artificial joint infection after TKA (Fig. 2). Subgroup analysis indicated that within one year of TKA, arthroscopy increased the risk of PJI (RR 1.314, 95% CI 1.156 to 1.493; $p < 0.01$). Sensitivity analysis confirmed the stability of the results (Supplementary Fig. 2G), and an Egger's test suggested no publication bias (Table 3).

**MUA** A total of three articles [13, 14, 16] were included in this analysis, with 9,066 cases in the experimental group and 141,370 cases in the control group. The results of the meta-analysis showed heterogeneity among the studies ($p < 0.001$; $I2 = 89.8\%$), and a random effects model

**Table 4** Functional outcome, complications and revision rate of included studies

| Author | Year | Country | Study groups | Patients (Knees) | Functional outcome | Complications | Revision rate |
|---|---|---|---|---|---|---|---|
| Piedade SR [11] | 2009 | Brazil | Arthroscopy | 60 (60) | IKS | Patella baja, patella fracture, anterior tibial tubercle fracture, TKA loosening, stiffness | 30% re-operated, 8.3% revision |
| | | | Control | 1,035(1,119) | IKS | | 4% re-operated, 1.4% revision |
| Issa K [17] | 2012 | USA | Arthroscopy | 60 (61) | KSS | 1 for persistent knee pain and stiffness | Revision1 |
| | | | Control | 438(563) | KSS | 5 for pain, 4 for instability, 2 for tibial component loosening, and 1 for arthrofibrosis | Revision12 |
| Werner BC [12] | 2015 | USA | Arthroscopy | 3051 | NA | Infection, stiffness, and venous thromboembolism | NA |
| | | | Control | 37,235 | NA | NA | NA |
| Rothermich MA [18] | 2017 | USA | Arthroscopy | 469 | SF-12,KS, WOMAC | NA | NA |
| | | | Control | 469 | | NA | NA |
| Barton SB [13] | 2017 | England | Arthroscopy | 186 | OKS | NA | Revision7 |
| | | | Control | 1708 | | | NA |
| Viste A [19] | 2017 | USA | Arthroscopy | 153(160) | KSS, ROM | Intraoperative (Patellar tendon avulsion, Tibial Fracture); Postoperative (Contracture, Patellar clunk or crepitus, Periprosthetic Joint Infection, Periprosthetic fracture, Skin, and soft-tissue issues) | Revision 8; Re-operation 16 |
| | | | Control | 320(320) | | | Revision12; Re-operation 27 |
| Gu A [29] | 2020 | USA | Arthroscopy | 3357 | NA | PJI, Aseptic loosening, Manipulation under anesthesia, stiffness | Revision93 |
| | | | | 134,662 | | | Revision2406 |
| Ma JN [15] | 2021 | China | Arthroscopy | 87TKAs | HSS, ROM | Stiffness, PJI | Re-operation 8, revision 5 |
| | | | Control | 174TKAs | | | Re-operation 2, revision 1 |
| Xu K [20] | 2021 | China | Arthroscopy | 56TKA | ROM, KSS | Infection1, Poor healing of the incisn1, aseptic loosening0 pathological dislocation0, periprosthetic fracture0,Stiffness0 | Revision |
| | | | Control | 56TKA | | Infection2, Poor healing of the incisn1, aseptic loosening0 pathological dislocation0, periprosthetic fracture0,Stiffness1 | Revision |
| Sax OC [16] | 2022 | USA | Arthroscopy | 5,523 | NA | MUA, Aseptic revision, PJI, SSI | Septic and aseptic Revisions |
| | | | Control | 5,000 | | MUA, Aseptic revision, PJI, SSI | Septic and aseptic Revisions |
| Giovanoulis [21] | 2024 | France | Arthroscopy | 84 | IKS | PJI3, stiffness3 | Revision1 |
| | | | Control | 84 | | Stiffness4, PJI2, 1of patellar tendon rupture and 1 of patella baja | Revision0 |

TKA: total knee arthroplasty; KSS: Knee Society Score; NA: Not Available; IKS: Interational Knee Society; SF-12:Short Form-12; KS: Knee Society; WOMAC: Western Ontario and McMaster Universities Arthritis Index; OKS: Oxford Knee Score; ROM: Range Of Motion; HSS: Hospital for Special Surgery; MUA: manipulation under anesthesia; PJI: Prosthetic joint infection; SSI, surgical site infection

was used. A statistically significant difference was found between the two groups (RR 1.761, 95%CI 1.140 to 2.719; $p = 0.011$). The results suggested that manipulation under anaesthesia in experimental group was increased after TKA (Fig. 3). Sensitivity analysis indicated that the results were relatively stable (when excluding Sax 2022 [16], the combined results no longer remained statistically significant (RR 15.514, 95% CI 0.075 to 3196.22)) (Supplementary Fig. 2H).

#### Meta-analysis of the revision rate

A total of eight studies [11, 13–17, 19, 20] were included in this analysis, with a total of nine sets of data. The follow-up period ranged from 2 to 8.7 ± 2.5 years. The

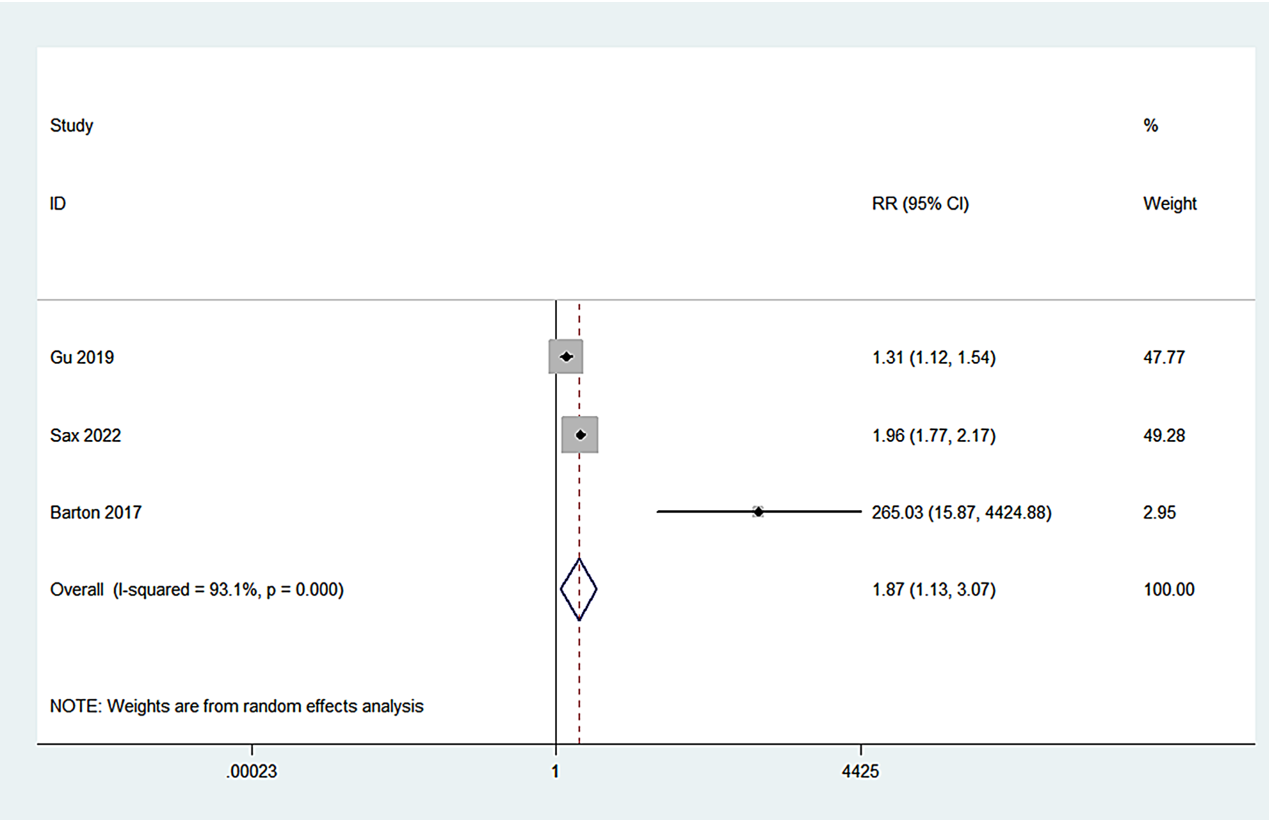


**Fig. 3** Forest plot showing the difference in manipulation under anaesthesia between TKA patients with (left) and without (right) prior arthroscopy

results revealed heterogeneity between the studies ($p = 0.166$; $I^2 = 30.40\%$), and a fixed effects model was employed. The analysis revealed a statistically significant difference between the two groups (RR 1.423, 95%CI 1.280 to 1.583; $p < 0.01$). Specifically, KA was associated with an increased revision rate after TKA. Subgroup analyses indicated that knee arthroplasty performed within one year after arthroscopy was associated with a higher rate of revision after surgery, particularly at one year (Fig. 4). Sensitivity analysis showed that the combined effect size changed significantly when Sax 2022 [16] was removed, but the results remained statistically significant (RR 1.623, 95%CI 1.351 to 1.950; $p < 0.001$) (Supplementary Fig. 2I). This suggests that these meta-analysis results are relatively robust and not overly influenced by the number of studies. Additionally, Egger's test suggested no publication bias (Table 3).

## Discussion

This systematic review and meta-analysis revealed the impact of prior KA on the outcomes of TKA. Although functional outcomes, as measured by the KSS and ROM, were comparable between patients with and without a history of arthroscopy, an increased risk of postoperative infection and a higher need for revision surgery were observed in the arthroscopy group.

Several meta-analyses have previously examined the influence of prior KA on subsequent TKA outcomes [31–33]. A recent study by Liu et al. [31] found that performing arthroscopy before TKA significantly increased the risk of postoperative revision, reoperation, infection, and aseptic loosening. However, it is worth noting that the analysis mistakenly included a duplicate study [14], which could affect the accuracy and credibility of the results. Furthermore, a large-scale study was recently published [16], which may change the results of the aforementioned meta-analysis. The current study addresses these limitations and provides a more comprehensive and up-to-date analysis of the literature.

The current meta-analysis revealed comparable postoperative ROM and functional improvement between patients with and without prior arthroscopy before TKA. The 95% CIs for these outcomes provide insight into both the statistical significance and clinical relevance of the findings. For these primary functional outcomes, the CIs were narrow and centred near zero, overlapping with the null effect (i.e., RR = 1). This not only indicates statistical non-significance but also a lack of clinically meaningful difference [34, 35]. It has been suggested that arthroscopic surgery may impact future TKA outcomes, with the potential mechanisms including intraarticular scarring, adhesions, cartilage damage, ligament rupture,

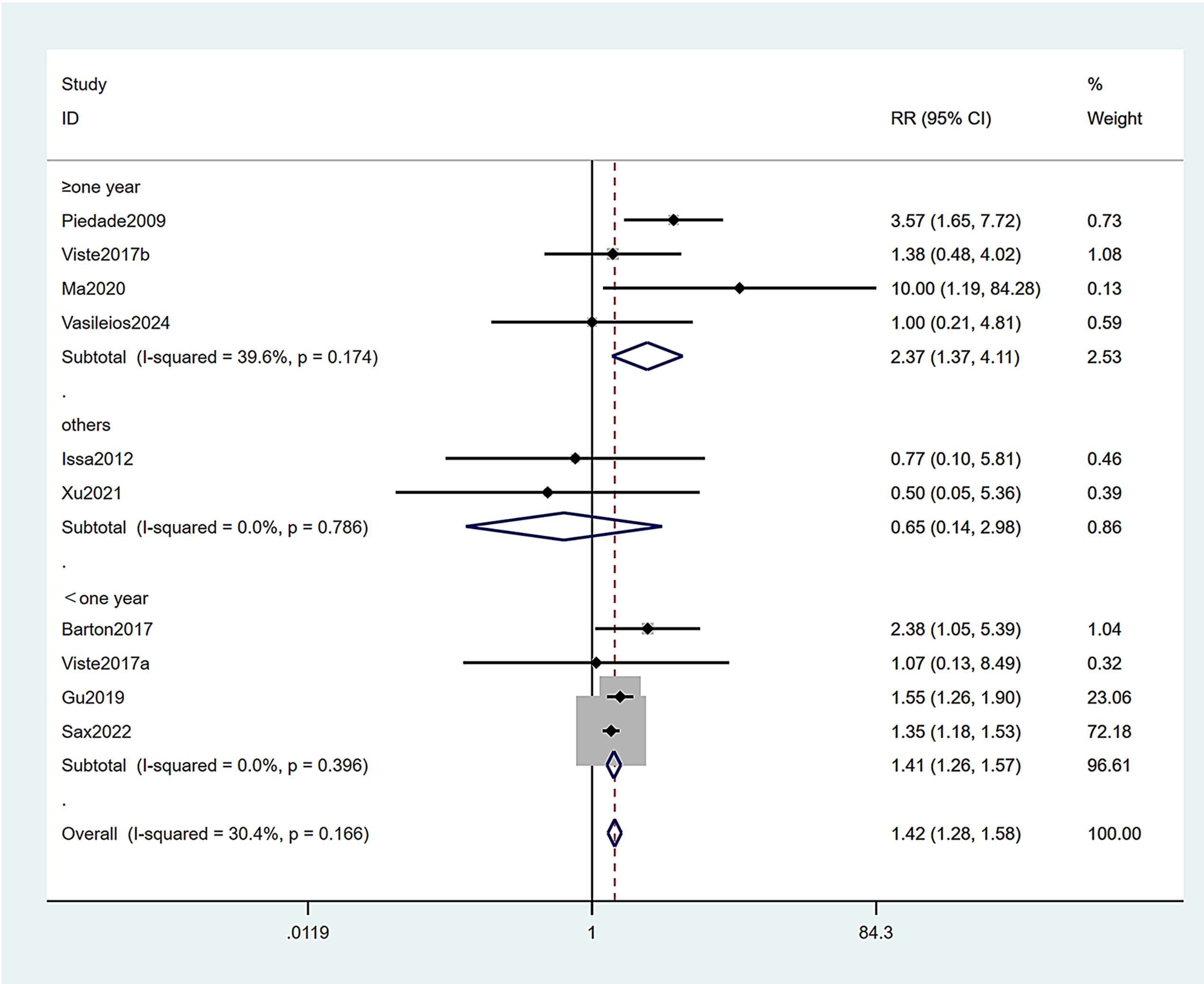


**Fig. 4** Forest plot showing the difference in revision rate between TKA patients with (left) and without (right) prior arthroscopy. Studies are grouped by the time interval between arthroscopy and TKA. "Others" refers to studies that did not provide the time interval between arthroscopy and TKA

and changes in the patellar trajectory [11]. However, the current study did not find any clinical impact on functional performance, possibly because arthroscopy is mainly used to address localized knee lesions such as meniscal tears and loose bodies, whereas TKA is indicated for conditions such as end-stage OA.

The findings of the current study suggest that, except for a marginally increased risk of joint infection, severe complications post-TKA are similar between those who have undergone prior arthroscopy and those who have not, consistent with the findings of Issa et al. [17] and Viste et al. [19]. No significant difference in postoperative complications was noted between those undergoing TKA within one year of arthroscopy and those who underwent it more than one year later, suggesting minimal impact of preoperative arthroscopy on post-TKA complications such as stiffness, fractures, and VTE. However, the need for postoperative general anaesthesia and traction (MUA) was almost double in the previous KA group, likely due to intra-articular adhesions from arthroscopy. Nonetheless, no significant disadvantage in postoperative motion scores was observed, potentially due to limitations in the sample size and the absence of clinically significant differences in activity levels between the groups.

The current findings revealed a higher TKA revision rate in patients who had previously undergone arthroscopy. This may be attributed to arthroscopy-induced cartilage and bone damage, which can affect implant stability. The osmotic pressure of arthroscopic perfusate affects the metabolism of the knee tissues, disrupting cartilage structures and exposing subchondral bone. This, in turn, stimulates autoimmune responses, leading to osteolysis [36]. It is important to note that the average follow-up period of the included studies ranged from 90 days to 8 years, and since TKA revisions tend to peak at 8–10 years post-surgery [37], the actual revision risk in the arthroscopy group could be higher. TKA revisions are more risky, traumatic, and costly compared to primary surgeries [38]. Therefore, reducing the revision rate after TKA is crucial for optimizing the quality of joint arthroplasty. This finding has important implications for determining the necessity of arthroscopic surgery prior to TKA.

Infection after joint arthroplasty is a significant complication. This meta-analysis revealed that patients who had previously undergone arthroscopy had a 32% higher risk of infection after TKA. This increased risk may be attributed to the destruction of the joint barrier and the formation of hematoma caused by arthroscopy [12]. Additionally, the presence of scar tissue following arthroscopy can potentially weaken local immunity and elevate the risk of infection during subsequent prosthesis placement [36]. However, it is important to interpret this relatively small increase in infection risk cautiously. The baseline incidence of peri-implant infection after primary TKA is low, at approximately 1–2% [39]. Therefore, a 32% relative risk increase translates to a minimal absolute risk difference of only approximately 0.3–0.6%.

Recent work by Werner et al. [12] has highlighted the temporal criticality of the adverse effects of arthroscopy on subsequent joint replacement. Their large study, based on national databases, showed that the risk of complications increased only when TKA was performed within six months of an arthroscopy. However, TKA within one year after arthroscopy is currently used as a surrogate marker of departmental compliance with guidelines for the management of degenerative knees [13]. According to Johanson's research, the goal of a one-year conversion rate of less than 10% has been set as the benchmark for optimal care [38]. In the current study, subgroup analysis showed that the repair rates of patients who received TKA within one year of arthroscopy and those who received TKA more than one year later were significantly higher than that of TKA patients who did not receive arthroscopy. However, the postoperative joint infection rate was significantly higher in patients who underwent TKA within one year of arthroscopy as compared to patients who did not undergo arthroscopy. Therefore, we recommend caution when performing TKA within one year of arthroscopy, and surgeons should inform patients of the possibility of an increased risk of postoperative complications. Further studies with longer follow-ups are required to verify these findings and explore the optimal time interval between arthroscopy and TKA.

The meta-analysis conducted in this study has several notable strengths. Firstly, a systematic synthesis of evidence from over 100,000 knee arthroplasty surgeries was performed. This provided enhanced precision of estimates regarding the relationship between prior arthroscopy and outcomes. This approach also allowed for the examination of potential complications that are often underreported in individual cohorts. Additionally, the study employed detailed subgroup and sensitivity analyses to investigate the impact of the interval length between arthroscopy and TKA on the results, thereby enhancing the robustness of the findings. Furthermore, the assessment of publication bias using Egger's test indicated no significant bias. Finally, this study incorporated several recent relevant studies.

Despite its strengths, this study has several limitations that should be noted. First, all included studies were retrospective, which may introduce selection bias, confounding variables, and group differences. Most studies did not adequately control for factors such as age, obesity, and systemic diseases. To address this, original data were collected for this study, where possible, and adjusted effect sizes were used in the meta-analysis. Second, while no significant differences were found in KSS and ROM, variability in follow-up times, patient demographics, and scoring methods may limit the generalizability of the current findings. Additionally, due to insufficient data, the effects of different arthroscopic surgeries (e.g., meniscectomy, debridement, microfracture) on TKA outcomes could not be distinguished. Heterogeneity in outcomes such as postoperative stiffness and periprosthetic fractures may relate to differences in surgical techniques, comorbidities, and implant types. Moreover, despite the independent literature search and data extraction conducted by both authors, potential discrepancies in interpretation could impact the data synthesis. While consensus resolution may mitigate this effect, the current study did not employ a formal assessment method to evaluate inter-rater agreement, which is a limitation of the methodology. Lastly, short follow-up periods and limited assessment of long-term complications reduce the robustness of the current conclusions. Future prospective studies are needed to provide more reliable evidence.

## Conclusion

This study investigated the impact of prior KA on the outcomes of subsequent TKA. The findings indicate that although functional outcomes are similar between these two groups, those with prior arthroscopy have higher risks of deep infection and revision.

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13018-024-05348-w.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

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**Author contributions**
Z.P., J.L., Z.L., and G.W. contributed to the study design, data collection, analysis, and interpretation of the results. Z.P. also served as the corresponding author, handling the correspondence and communication with the journal. All authors were involved in drafting the manuscript and gave final approval for publication.

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**Data availability**
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. This study utilized data extracted from published articles, all of which are publicly accessible. No new data were generated or collected specifically for this study.

## Declarations

**Informed consent**
Written informed consent was not required for this study because it was a meta-analysis based on studies that have already been published.

**Competing interests**
The authors declare no competing interests.

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