European Review for Medical and Pharmacological Sciences 2021; 25: 4459-4469

Does prior arthroscopic procedure impact outcomes of knee arthroplasty? A systematic review and meta-analysis

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Abstract. – OBJECTIVE: Despite generally favorable outcomes following knee arthroscopy, a certain subset of patients inevitably develops progression of knee disease, necessitating subsequent total knee arthroplasty (TKA). Therefore, the evaluation of TKA outcomes following arthroscopy has emerged as a major area of research. The aim of the current review is to measure the impact of prior arthroscopy on functional and adverse outcomes following TKA.

MATERIALS AND METHODS: Literature search was conducted in the databases including Medline, EMBASE, PubMed Central, ScienceDirect, Google Scholar and Cochrane library from inception until April 2021. Meta-analysis with random-effects model was conducted to calculate pooled odds ratio (OR) or standardized mean difference (SMD) with 95% confidence interval (CI) depending on the type of outcome.

RESULTS: In total, 9 studies with 185,013 participants were included in the review. The majority of the studies were conducted in the USA and China. Almost all the studies had low quality as per Newcastle Ottawa (NO) scale. The pooled SMD for functional outcome was -0.19 [95%CI: -0.30 to -0.09], while the pooled OR for revision rate was 1.53 (95% CI: 1.21 to 1.92). In terms of postoperative complications, the pooled OR for stiffness was 1.55 (95% CI: 0.92-2.61), infection was 1.39 (95%CI: 1.17-1.67), aseptic loosening was 1.93 (95% CI: 1.19-3.11), VTE was 1.06 (95% CI: 0.83-1.35), and MUA was 1.33 (95% CI: 1.13-1.57) respectively.

CONCLUSIONS: Prior arthroscopy has significant impact on the functional and adverse clinical outcomes following TKA. Surgeons need to develop a comprehensive intervention plan to manage these high-risk patients and reduce the rate of postoperative complications.

Key Words:
Arthroscopy, Meta-analysis, Total knee arthroplasty.

Introduction

The benefits of performing knee arthroscopy in managing patients with degenerate knee still remain a major contentious issue[1]. It is a well-established fact that the arthroscopic lavage or debridement is not much better than the sham surgery or physiotherapy for patients with osteoarthritis (OA)[2]. Recent evidence, including a systematic review, has demonstrated that any short-term benefits provided by the arthroscopy do not persist for more than a year irrespective of the presence of mechanical meniscal symptom[3]. These observations are in conflict with previous reports that demonstrated the effect of arthroscopy on delaying the total knee arthroplasty (TKA). The benefits of arthroscopy cannot be quantified, therefore, by the current metrics[4].

Over the recent years, there has been a growing body of evidence[5-9] describing the impact of previous knee arthroscopy on the subsequent TKA. Early research evaluating the risk of prior arthroscopic procedure has reported some contradicting outcomes. There was higher risk of postoperative complication and revision rates reported in some studies, while other showed no differences in the implant survival, knee society scores or radiological outcomes[5-9]. Ma et al[10] based on data from the national database[6] showed an increased risk of stiffness, venous thromboembolism (VTE) and infection when TKA was

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performed within six months of the arthroscopy. However, the current state of evidence does not allow to determine whether there is any impact of the prior knee arthroscopy on the outcomes of subsequent TKA. Since nursing personnel is closely involved in post-operative management and assessment of complications, it is important to assess such relationship between arthroscopy and TKA. The main goal of the current systematic review is to analyze and compare the outcomes of TKA between patients with prior history of arthroscopy and those undergoing TKA without prior arthroscopy.

Materials and Methods

Eligibility Criteria

Study design

We have included the studies with any of the following study designs: prospective or retrospective observational study or cross-sectional studies. Only published full-text studies or abstracts were included, while unpublished data or grey literature were excluded.

Participants

Studies conducted among the patients undergoing TKA with or without prior history of arthroscopy were included to form two groups.

Exposure

Studies reporting the outcomes among TKA patients with prior arthroscopy and those who did not undergo prior arthroscopy were eligible for inclusion in our analysis.

Type of outcome

Functional score, revision rate, complications such as aseptic loosening, infection, stiffness, VTE, manipulation under anaesthesia (MUA) are considered as outcomes.

Search Strategy

A comprehensive, systematic and extensive search was conducted in electronic databases such as Medline, EMBASE, PubMed Central, ScienceDirect, Google Scholar and Cochrane library. We selected the terms required for the search during the protocol stage itself. We used both the medical subject headings (MeSH) and free-text words while performing the search, and a set of keywords and their synonyms was used for search using appropriate truncations, wildcards and proximity searching. Search was also conducted for key concepts using corresponding subject headings in each database. The final search was carried out by combining the individual search results using appropriate Boolean operators ("OR" and "AND"). The search was narrowed down using the available filters on type of studies. The following MeSH and free-text search terms were used in our review: "Total Knee Arthroplasty", "Knee Arthroscopy", "Impact", "Arthroscopy", "Postoperative Complications", "Periprosthetic Joint Infection", "Stiffness", "Aseptic Loosening", "Venous Thromboembolism", "Manipulation Under Anaesthesia". We restricted the search to papers published from inception of the databases to April 2021 in the English language only. Bibliography sections of the retrieved articles were also hand-searched to identify any relevant articles missed during the database search.

Study selection process

This process has involved three stages.

Step 1: Two independent investigators have performed primary screening of title, abstract and keywords by executing the literature search. Full-text articles were retrieved for the studies that were shortlisted based on the eligibility criteria.

Step 2: Full-text of the studies, retrieved in Step 1, was screened by the same two investigators and assessed using eligibility criteria of the review. Studies that satisfy all the eligibility criteria with respect to design, participants, exposure and outcome were included.

Step 3: Any disagreements between the investigators during the screening process were resolved by discussion with the third investigator. PRISMA flow chart was used to clearly represent the screening and selection process (Figure 1).

Data Collection Process and Management

Data were extracted manually from the included studies using a structured data extraction form, developed and pilot tested during the protocol stage itself. Data extracted using the form were as follows: general information about the article such as author, year of publication, information related to methods section such as study design, setting, sample size, sampling strategy, study participants, inclusion and exclusion criteria, timing of prior arthroscopy, outcome assessment method, quality related information, and information related to outcome. Data were entered by the investigator and the entry was double-checked by the secondary investigators to ensure correct entry.

Risk of Bias Assessment

Risk of bias was assessed by two independent investigators using the Newcastle Ottawa (NO) Quality Assessment Form for observational studies under the following three domains: Selection, Comparability and Outcome[11]. For each of the above-mentioned domains, risk of bias was graded as low (if adequate information is provided), high (if the information is inadequate or not performed) and unclear (if the information is missing). Studies, having a score of four or more on the NO scale, were considered as high quality.

Statistical Analysis

Meta-analysis was executed using the software STATA version 14.2 (StataCorp, CollegeStation, TX, USA). Functional outcome was continuous in nature, and therefore, mean, standard deviation (SD) and total sample size were obtained for both groups. The pooled effect was calculated as standardized mean difference (SMD) with 95% confidence interval (CI), as different scales were used by each of the studies for reporting functional outcome. Since all the other outcomes were dichotomous, number of events and participants in each group were entered to obtain the pooled effect estimate as odds ratio (OR) with 95% CI. We used the random effects model with inverse variance method to calculate the weight of individual studies[12]. Evidence of between-study variance due to heterogeneity was assessed through chi square test of heterogeneity and I^2 statistics to quantify the inconsistencies, where I^2 less than 25% is considered mild, 25-75% - moderate and more than 75% is considered as substantial heterogeneity[12]. Subgroup analysis was performed to explore the source of heterogeneity. Study specific and pooled estimates were graphically represented through forest plot. Sensitivity analysis to assess the robustness of results was performed by removing the studies one by one to check for any significant variation in the results. Meta-regression *or* publication bias could not be assessed due to limitations in the number of studies reporting the outcomes (less than 10 studies).

Results

Selection of Studies

A total of 954 records were identified through the systematic literature search. Of them, 45 were deemed relevant for full-text retrieval. Full-texts of three additional articles were identified by manually searching bibliography sections in the retrieved studies. During the second screening stage, 9 studies with 185,013 participants met the eligibility criteria and were included in the analysis (Figure 1)[5-10,13-15].

Characteristics of Studies Included

Characteristics of the studies are described in Table I. All the studies were retrospective in nature. Most of the studies were conducted in USA (5 studies) followed by China (2 studies). Studies included 185,013 participants, with sample size ranging from 112 to 138,019. The mean age of the participants in arthroscopy group ranged from 56 to 69 years, while those in the non-arthroscopy group had mean age ranged from 63 to 72 years. Time interval between prior arthroscopy and TKA ranged from 6 months to 2 years in the reported studies, while four studies did not report on the time interval between the arthroscopy and TKA. Majority (7 out of 9 studies) of the included studies were low quality based on the NO assessment checklist.

Impact of prior arthroscopy on the TKA outcomes

Functional outcome

Four studies[7,8,10,15] have reported on the impact of prior arthroscopy on functional outcome following TKA, with a pooled SMD of -0.19 [95% CI: -0.30 to -0.09]. The difference between the two groups was statistically significant ($p<0.001$) (Figure 2). There was no heterogeneity found among the included studies reporting functional outcome ($I^2=0\%$, $p=0.57$).

Revision rate

Seven studies[7-10,13-15] have reported on the revision rate among the TKA patients with and without prior arthroplasty. The pooled OR was 1.53 (95% CI: 1.21 to 1.92) (Figure 3), indicating that the TKA patients with prior arthroplasty exposure have 1.53 times higher odds of having revision when compared to those without prior arthroplasty exposure. This association was statistically significant as the confidence interval of OR did not cross the null value (1). We found no heterogeneity between the studies reporting the revision rate ($I^2=8.6\%$, $p=0.36$). Sensitivity analysis did not show significant variability in the magnitude or direction of outcome, indicating a lack of influence of a single study on the overall pooled estimate.

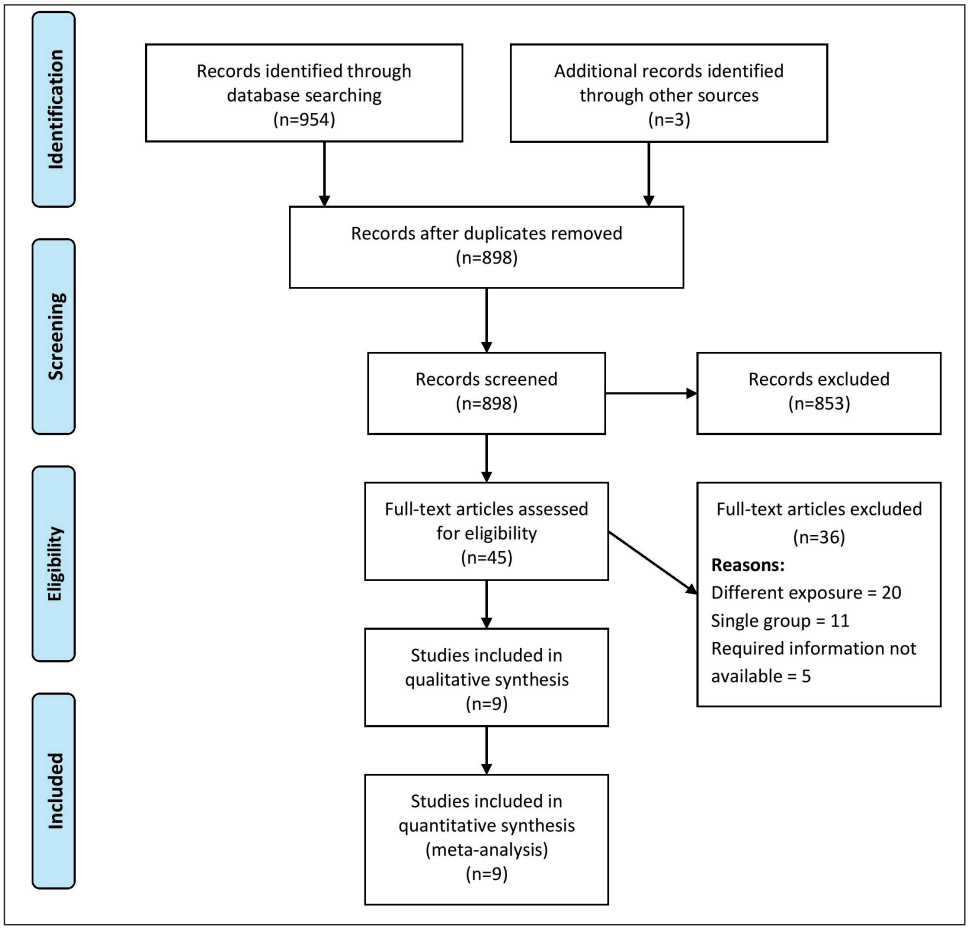

Figure 1. PRISMA search strategy.

Complications

We have analysed the impact of prior arthroscopy on the following complications in TKA patients: stiffness, infection, aseptic loosening, VTE and MUA. Pooled OR for stiffness was 1.55 (95% CI: 0.92-2.61) indicating that there was no statistically significant association between stiffness and prior arthroscopy exposure among TKA patients (Figure 4). Pooled OR for infection was 1.39 (95% CI: 1.17-1.67) indicating that the TKA patients with prior arthroscopy had 1.39 times higher odds of having postoperative infection compared to those without prior arthroscopy and this association was statistically significant (Figure 5). Pooled OR for aseptic loosening was 1.93 (95% CI: 1.19-3.11) indicating that there was a statistically significant association between aseptic loosening and prior arthroscopy exposure among TKA patients (Figure 6). Pooled OR for VTE was 1.06 (95% CI: 0.83-1.35) indicating that there was no statistically significant association between VTE and prior arthroscopy exposure among TKA patients (Figure 7). Pooled OR for MUA was 1.33 (95% CI: 1.13-1.57) indicating that there was a statistically significant association between MUA and prior arthroscopy exposure among TKA patients (Figure 8). Sensitivity analysis has showed that there was no significant variation in the magnitude or direction of outcome, indicating lack of influence of a single study on the overall pooled estimate of any of these complication outcomes.

Discussion

The use of knee arthroscopy has increased significantly in the last several years. Despite generally favourable outcomes following knee arthroscopy, certain subset of these patients inevitably develops progression of knee disease, necessitating subsequent arthroplasty. Numerous studies focus, therefore, on evaluating knee ar-

Table I. Characteristics of the included studies (N=9). USA.

Study No	First author and year	Country	Study design	Sample size	Study participants	Timing of prior arthroscopy	Outcomes reported	Quality of study
1	Barton et al 2017[7]	United Kingdom	Retrospective	1894	**Group 1**: TKA patients with prior arthroscopy within 12 months **Group 2:** TKA patients without prior arthroscopy	Within 12 months of TKA	Revision rate, Oxford knee score for function and pain	Low
2	Fassihi et al 2020[13]	USA	Retrospective	2158	**Group 1**: TKA patients with prior arthroscopy within 2 years **Group 2:** TKA patients without prior arthroscopy	Within 2 years of TKA	Revision rate, infection, manipulation under anesthesia, aseptic loosening	Low
3	Gu et al 2019[14]	USA	Retrospective	138019	**Group 1**: TKA patients with prior arthroscopy within 2 years **Group 2:** TKA patients without prior arthroscopy	Within 2 years of TKA	Revision rate, infection, manipulation under anesthesia, stiffness, aseptic loosening	Low
4	Issa et al 2012[9]	USA	Retrospective	624	**Group 1**: TKA patients with prior arthroscopy **Group 2:** TKA patients without prior arthroscopy	Not reported	Revision rate	High
5	Ma et al 2021[10]	China	Retrospective	261	**Group 1**: TKA patients with prior arthroscopy **Group 2:** TKA patients without prior arthroscopy	Not reported	Revision rate, venous thromboembolism, stiffness, infection, hospital for special surgery score for functional outcome	High
6	Piedade et al 2009[5]	Brazil	Retrospective	1179	**Group 1**: TKA patients with prior arthroscopy **Group 2:** TKA patients without prior arthroscopy	Not reported	Infection, aseptic loosening, stiffness	Low
7	Viste et al 2017[8]	USA	Retrospective	480	**Group 1**: TKA patients with prior arthroscopy **Group 2:** TKA patients without prior arthroscopy	Mean delay of 5.3 years	Infection, aseptic loosening, stiffness, Knee society score for functional outcome and revision rate	Low
8	Werner et al 2015[5]	USA	Retrospective	40286	**Group 1**: TKA patients with prior arthroscopy within 6 months **Group 2:** TKA patients without prior arthroscopy	Within 6 months of TKA	Stiffness, infection, venous thromboembolism	Low
9	Xu et al 2021[15]	China	Retrospective	112	**Group 1**: TKA patients with prior arthroscopy **Group 2:** TKA patients without prior arthroscopy	Not reported	Revision rate, infection, aseptic loosening, stiffness, Knee society function score	Low

United States of America; TKA – Total Knee Arthroplasty.

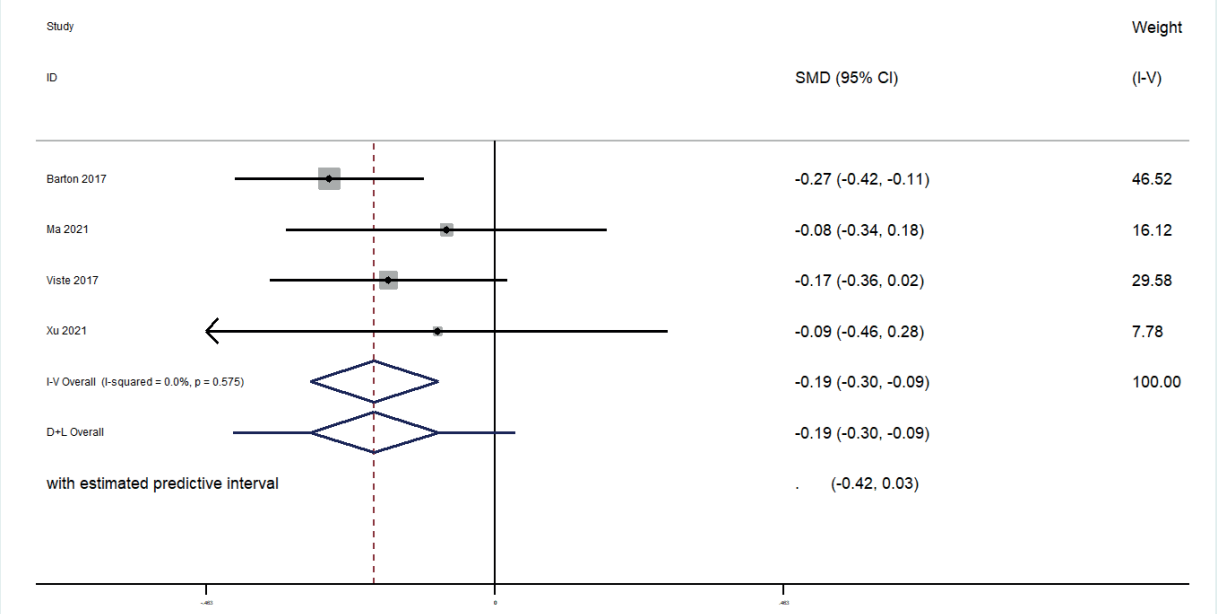

Figure 2. Forest plot showing the difference in functional outcome between TKA patients with and without prior arthroscopy.

throplasty outcomes following arthroscopic knee surgery. Our systematic review and meta-analysis assessed the impact of prior arthroscopy on functional and adverse outcomes following TKA. We have identified 9 eligible studies, conducted mostly in USA. All the studies were retrospective

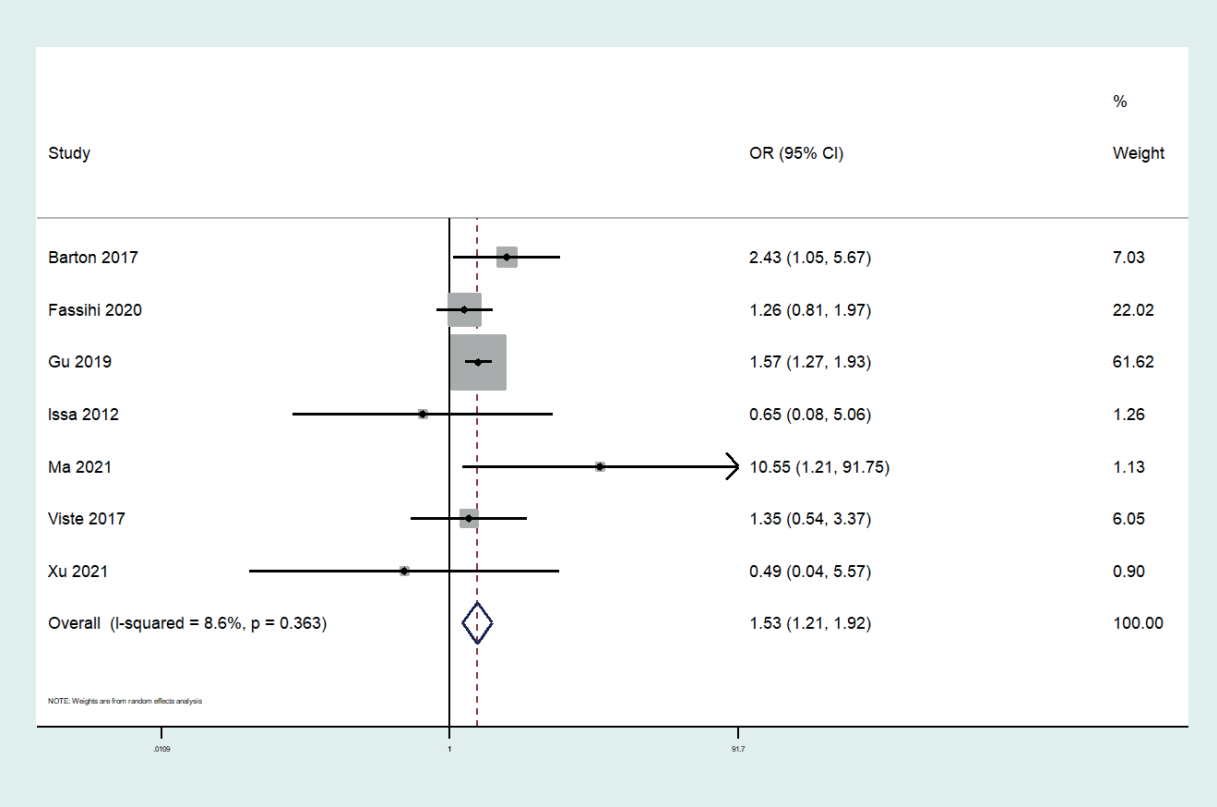

Figure 3. Forest plot showing the difference in revision rate between TKA patients with and without prior arthroscopy.

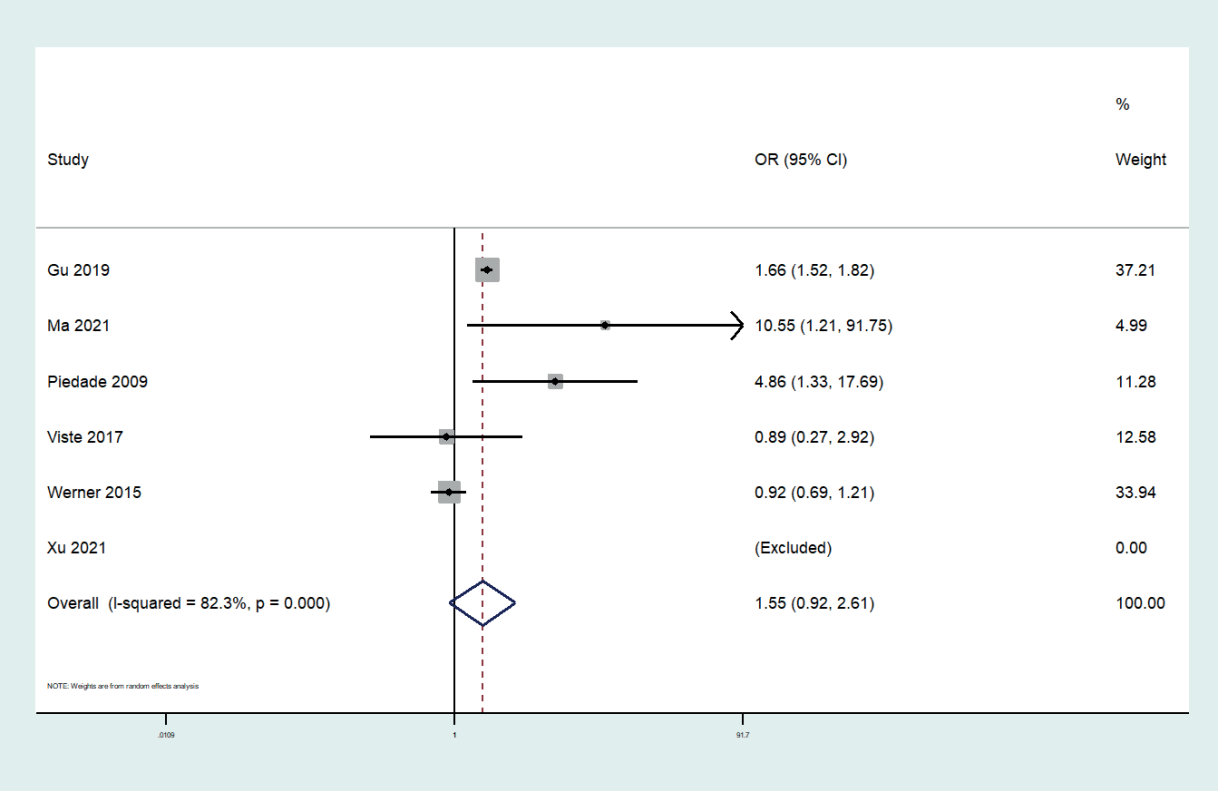

Figure 4. Forest plot showing the difference in postoperative stiffness between TKA patients with and without prior arthroscopy.

in nature and most of them were of low quality as per the NO scale.

We found a statistically significant association between the prior arthroscopic procedure and poor functional outcome following TKA. Prior arthroscopy was also associated with higher revision rates and complications such as stiffness, infection, aseptic loosening, MUA and VTE, as compared to those without exposure to arthroscopy prior to TKA. Although, there were no previous studies comparing the rate of complications in TKA patients with/without prior arthroscopy, arthroscopy was associated with higher revision rate and complications in patients undergoing similar surgeries in other sites, such as hip[16]. Our findings may have certain implications for the patients undergoing arthroplasty, orthopedic surgeons, and the overall healthcare system, since the observed complications, such as stiffness, infection, aseptic loosening, MUA and VTE might make the subsequent knee arthroplasty much more difficult[5-10]. A possible reason for the observed higher complication rate amongst this group in our review is the effect arthroscopic knee surgery may have on wound healing process[16]. As with any invasive knee surgery, arthroscopic knee surgery can traumatize the connective tissue envelope around the knee joint, leading to tissue plane derangement, formation of scars, and heterotopic ossification, thus increasing the risk of complications[16]. More high-quality studies are required to explore the reasons for higher complication rates to allow surgeons to better customize surgical corrections for the patients.

The major strength of our review was the rigorous literature search and methodology used to provide reliable estimates. To our knowledge, this is the first review providing evidence on the impact of prior arthroscopy exposure of TKA patients on functional outcomes and complications. We also did not find any substantial heterogeneity between the included studies for any of the outcomes.

Our study has several limitations, and the results should be interpreted with caution and inferred accordingly, considering the difference in methodology and quality across the included studies. All the studies included in the analysis were retrospective, which might introduce a number of potential biases. Only 9 studies were in-

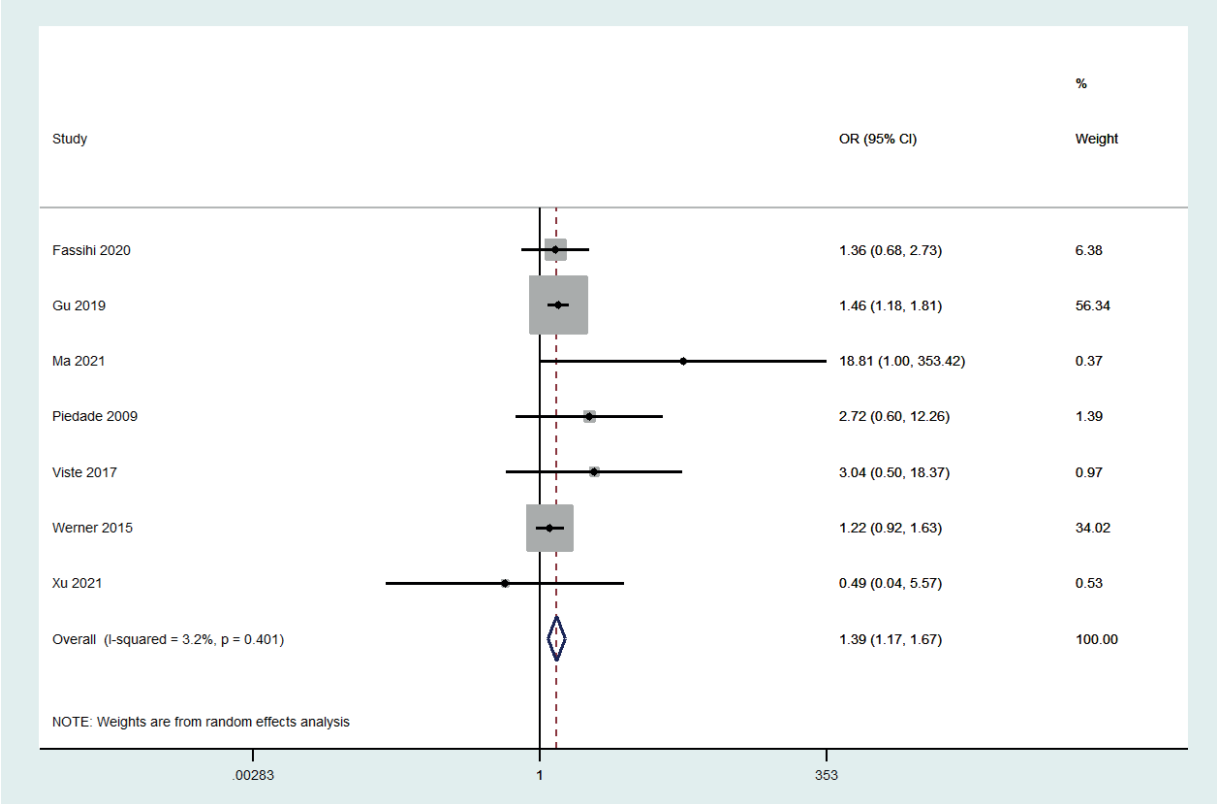

Figure 5. Forest plot showing the difference in postoperative infections between TKA patients with and without prior arthroscopy.

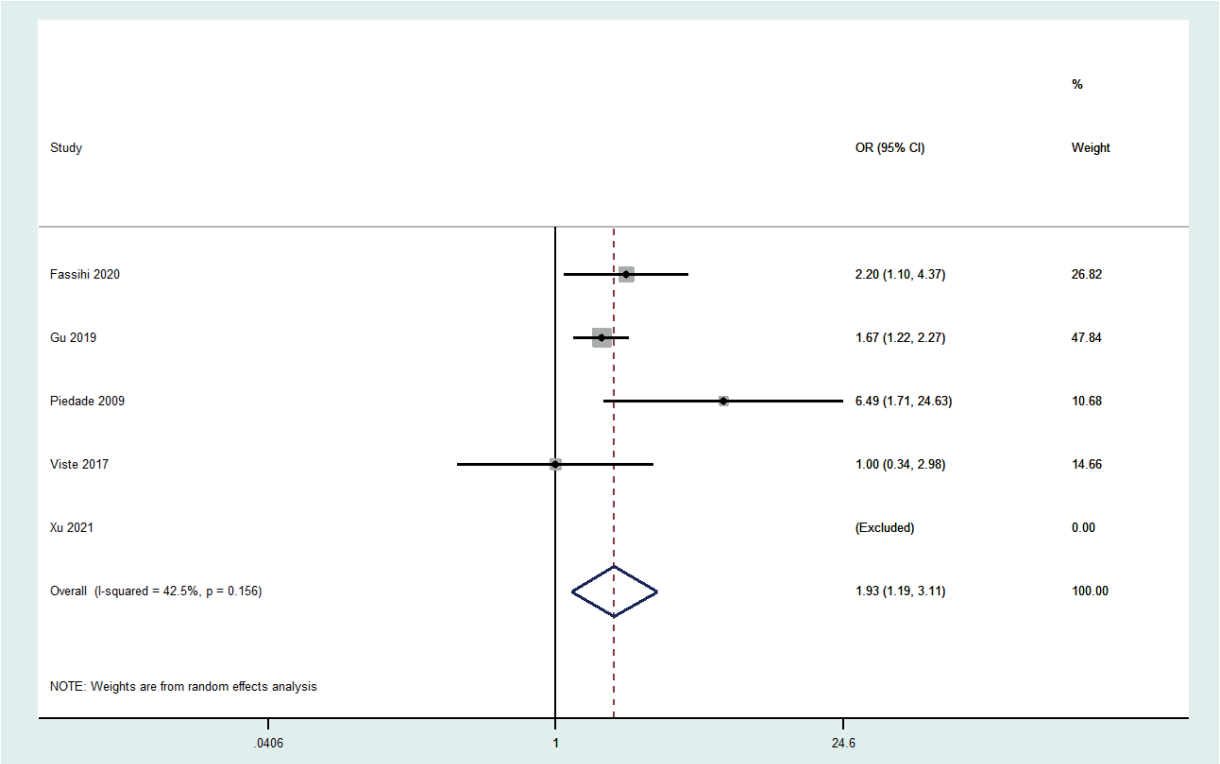

Figure 6. Forest plot showing the difference in postoperative aseptic loosening between TKA patients with and without prior arthroscopy.

cluded in our analysis. Therefore, more studies, especially high-quality longitudinal ones, are required to improve the statistical efficacy of the evidence. There was no sufficient data to perform subgroup analysis by type of arthroplasty or insufficient information regarding the timing of arthroscopy. This makes it difficult to determine the impact of these factors on the clinical outcomes of the patients. Moreover, only the English language publications were included in our analysis, which makes for an unavoidable publication bias in our review. However, we could not assess the potential publication bias due to limitation in the number of studies. Finally, certain factors such as differences in the technique, assessment method, the time interval between knee arthroscopy and subsequent TKA might also affect the quality of the pooled results.

Our review findings have some important implications for clinical practice. While patients undergoing TKA are at risk of developing some adverse outcomes, the risk of complications almost doubles in cases of prior arthroscopy. The results of the current meta-analysis may be used by the surgeons to provide such patients with a customized line of management earlier to avoid any unforeseen adverse clinical outcomes.

Though our results provide some crucial information for better understanding the association between prior arthroscopy and TKA outcomes, there is still a need for additional longitudinal studies to establish the temporality of association and causal link between these two events. Understanding this causal link will break a crucial barrier in the management of these patients and help prevent serious morbidity.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

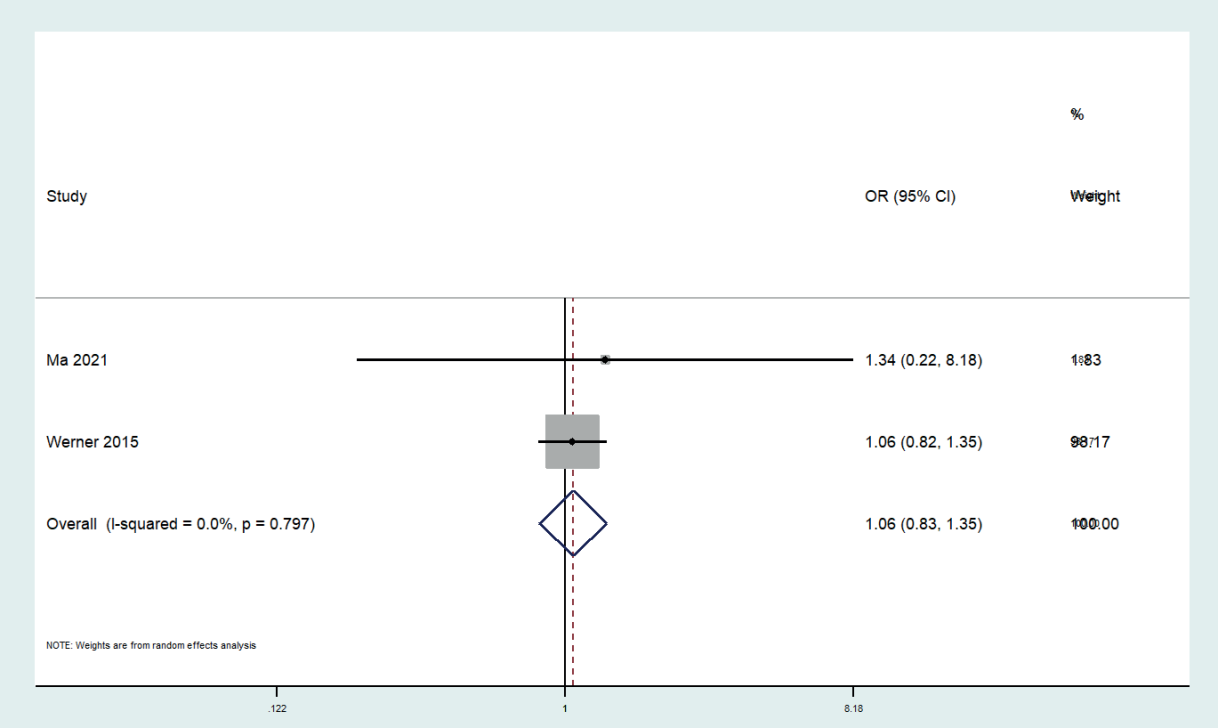

Figure 7. Forest plot showing the difference in venous thromboembolism between TKA patients with and without prior arthroscopy.

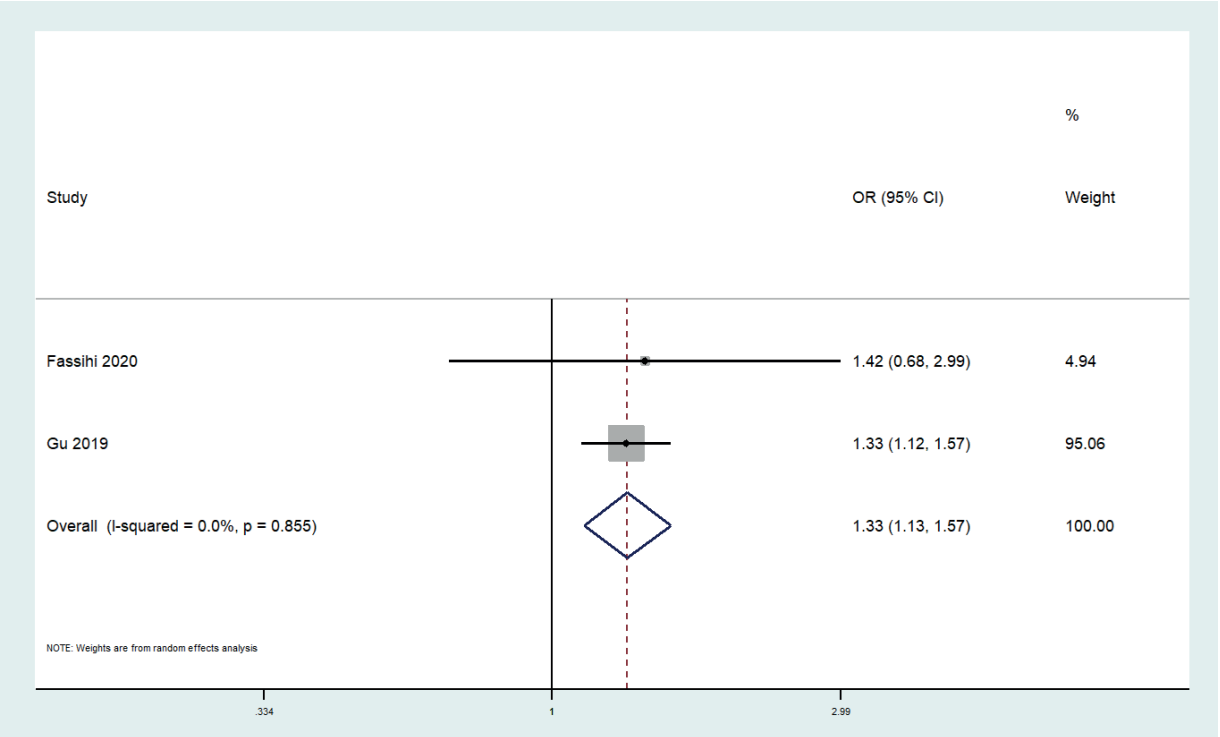

Figure 8. Forest plot showing the difference in manipulation under anaesthesia between TKA patients with and without prior arthroscopy.

Competing interests

The authors declare that they have no competing interests.

Funding

None.

Authors' contributions

LZ and CC designed the project; JM and YC were involved in data collection and data analysis; LZ and CC prepared the manuscript; JC edited the manuscript; all authors read and approved the final manuscript.

Acknowledgments

Not applicable.

References

1) Katz JN, Brownlee SA, Jones MH. The role of arthroscopy in the management of knee osteoarthritis. Best Pract Res Clin Rheumatol 2014; 28: 143-156.
2) Medical Advisory Secretariat. Arthroscopic lavage and debridement for osteoarthritis of the knee: an evidence-based analysis. Ont Health Technol Assess Ser 2005; 5: 1-37.
3) Doral MN, Bilge O, Huri G, Turhan E, Verdonk R. Modern treatment of meniscal tears. EFORT Open Rev 2018; 3: 260-268.
4) Feng JE, Novikov D, Anoushiravani AA, Schwarzkopf R. Total knee arthroplasty: improving outcomes with a multidisciplinary approach. J Multidiscip Healthc 2018; 11: 63-73.
5) Piedade SR, Pinaroli A, Servien E, Neyret P. Is previous knee arthroscopy related to worse results in primary total knee arthroplasty? Knee Surg Sports Traumatol Arthrosc 2009; 17: 328-333
6) Poland S, Everhart JS, Kim W, Axcell K, Magnussen RA, Flanigan DC. Total knee arthroplasty within six months after knee arthroscopy is associated with increased post-operative complications. J Arthroplasty 2015; 30: 1313-1316.
7) Barton SB, McLauchlan GJ, Canty SJ. The incidence and impact of arthroscopy in the year prior to total knee arthroplasty. Knee 2017; 24: 396-401.
8) Viste A, Abdel MP, Ollivier M, Mara KC, Krych AJ, Berry DJ. Prior knee arthroscopy does not influence long-term total knee arthroplasty outcomes and survivorship. J Arthroplasty 2017; 32: 3626-3631.
9) Issa K, Naziri Q, Johnson AJ, Pivec R, Bonutti PM, Mont MA. TKA results are not compromised by previous arthroscopic procedures. J Knee Surg 2012; 25: 161-164.
10) Ma JN, Li XL, Liang P, Yu SL. When can total knee arthroplasty be safely performed following

prior arthroscopy?. BMC Musculoskeletal Disord 2021; 22: 1-6.
11) Wells G, Shea B, O'Connell D, Peterson J, Welch V, Losos M, et al. Newcastle-Ottawa quality assessment scale cohort studies. University of Ottawa. 2014.
12) Higgins JP and Green S: Cochrane Handbook for Systematic Reviews of Interventions. John Wiley & Sons, Ltd, Chichester, UK, 2008.
13) Fassihi SC, Gu A, Wessel LE, Thakkar SC, Sculco PK, Ast MP. Prior Knee arthroscopy increases the failure rate of subsequent unicompartmental knee arthroplasty. J Arthroplasty 2021; 36: 1556-1561.
14) Gu A, Malahias MA, Cohen JS, Richardson SS, Stake S, Blevins JL, Sculco PK. Prior knee arthroscopy is associated with increased risk of revision after total knee arthroplasty. J Arthroplasty 2020; 35: 100-104.
15) Xu K, Zhang L, Shen R, Wang C, Li T, Zhao X, Yu T. The influence of previous arthroscopic treatment on subsequent primary total knee arthroplasty: the comparison between bilateral knees of the same patient. BMC Musculoskeletal Disord 2021; 22: 1-6.
16) Guo J, Dou D. Influence of prior hip arthroscopy on outcomes after hip arthroplasty: a meta-analysis of matched control studies. Medicine (Baltimore) 2020; 99: e21246.