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A Meta-Analysis of the Therapeutic Effect of Total Knee Replacement after Knee Arthroscopic Surgery

Abstract

Purpose: To appraise the influence of knee arthroscopic surgery on subsequent Total Knee Arthroplasty (TKA) through meta-analysis.

Methods: A computer search was implemented from the establishment of the database to August 2023 for literature on the influence of knee arthroscopic surgery on the efficacy of subsequent TKA in Web of Science, PubMed, CNKI, Embase, Cochrane Library, Wanfang and other databases. Quality assessment, literature screening and data extraction were enforced according to the exclusion and inclusion criteria and the methodological quality of the involved literature was assessed using the risk-of-bias assessment method recommended by the cochrane assistance network. RevMan 5.4 software was used to conduct a meta-analysis on the postoperative revision rate, periprosthetic infection rate, postoperative stiffness rate, postoperative Venous Thromboembolism (VTE) incidence rate, reoperation rate and postoperative knee flexion range of motion after TKA.

Results: Seven documents were finally involved, with a total of 42,642 cases, including 3,405 cases in the knee arthroscopy group and 39,237 cases in the non-knee arthroscopy group. Meta-analysis results show that the revision rate (95% CI (0.97, 44.82)) and reoperation rate (95% CI (1.66, 4.23)) after TKA between the knee arthroscopy surgery group and the non-knee arthroscopy surgery group, there were statistically significant differences in postoperative stiffness rate (95% CI (0.86, 10.84)) and periprosthetic infection rate (95% CI (0.86, 2.07)); while in postoperative VTE incidence (95% CI (0.83, 1.35)) and there was no statistically significant difference in postoperative knee flexion range of motion (95% CI (-0.35, 0.10)).

Conclusion: Knee arthroscopic surgery hurts subsequent TKA surgery. Previous arthroscopic surgery will increase the risk of postoperative stiffness, revision, periprosthetic infection and reoperation after TKA, but there was no significant difference in the incidence of VTE and knee flexion range of motion after surgery.

Keywords: Arthroscopy; Replacement; Knee; Arthroplasty; Meta-analysis

Introduction

Osteoarthritis (OA) is an illness caused by diverse factors that affect all joint tissues, such as synovium, cartilage and ligaments. The cause is not yet clear. The main pathological characteristics include cystic degeneration or subchondral bone sclerosis, synovial lesions, articular cartilage degeneration and destruction, joint capsule contracture, joint edge bone hyperplasia, intra-articular ligament relaxation or contracture and muscle atrophy and weakness. Studies believe that the occurrence and development of osteoarthritis are related to age, obesity, trauma, inflammation and genetic factors [1,2]. Osteoarthritis mostly occurs in middle-aged and elderly people and is more common in joints such as knees, hips and hands. Knee Osteoarthritis (KOA) is more common [3]. Studies have shown that middle-aged and elderly people are a high-risk group for the onset of KOA and about one-third of people aged 65 and above suffer from KOA [4]. The most common clinical manifestations of patients with osteoarthritis are joint pain and limited joint mobility [5]. The incidence of pain as the first symptom in patients is 36.8% to 60.7%. Osteoarthritis can occur in various joints, with the knee joint having the highest incidence rate, followed by the hip joint and interphalangeal

The knee joint is composed of the patella and lateral condyle in the front, the inner femur at the upper end and the inner tibia at the lower end. The joint is surrounded by a joint capsule. In front of the joint capsule is the patellar ligament, which is the extension of the quadriceps tendon that surrounds the patella. On both sides of the patellar ligament are the medial and lateral retinaculum of the patella, the fibular collateral ligament on the outside of the knee joint, the tibial collateral ligament on the medial side and the fibrocartilage connecting the lower end of the femur. The upper end of the tibia in the knee joint is called the meniscus. The knee joint is the most complex in the human body, so injuries are common in daily life. At present, the treatment of knee osteoarthritis still adopts a stepped treatment concept. The first is basic treatment suitable for all

patients with knee osteoarthritis, including self-behavioral therapy, exercise therapy, physical therapy, *etc*. When the disease progresses, drug treatment is required, such as the single use of the most common non-steroidal anti-inflammatory drugs and invasive treatment in the joint cavity that requires strict control of the frequency, intervals and standardized operations to reduce the risk of infection, even the combined use of some antidepressants and Chinese patent medicines, as osteoarthritis continues to worsen, surgical treatment is required when the above treatments are ineffective, which are divided into two categories. One is restorative treatment, including arthroscopy, cartilage repair, alignment correction, *etc*. and the other is reconstructive treatment, which is joint replacement [8].

In the environment of continuous development of medical and health services, people are paying more and more attention to how to reduce pain, so knee arthroscopy surgery has also received more attention. It can not only improve and restore the patient's joint function but also improve the patient's quality of life. Knee arthroscopy is a type of minimally invasive surgery [9]. Compared with other arthroscopic surgeries, it was carried out earlier, more widely and more maturely. Clinically, if a patient's joint has meniscal, synovial or cartilage lesions, this technology can be used to diagnose it and it is even called the gold standard. Knee arthroscopy can effectively remove the broken meniscus present in the patient's joint cavity; it can also effectively deal with uneven parts, remove the diseased and damaged synovial membrane and reduce the inflammatory reaction in the joint cavity. Knee arthroscopic surgery is a treatment method that is often used in clinical practice today [10]. It can allow patients to recover as early as possible without affecting their daily lives, so it has a relatively wide recognition in clinical practice.

Total Knee Arthroplasty (TKA), as the main treatment for end-stage knee osteoarthritis, is usually used for patients with advanced knee degenerative osteoarthritis or rheumatic osteoarthritis who have failed conservative treatment. It has significant mid-term and long-term benefits in relieving pain and rebuilding knee joint function and greatly increases patient satisfaction [11]. As predicted, the use of TKA therapy for arthritis continues to increase. In the UK, more than 100,000 knee replacement surgeries are implemented each year and the total number of surgeries in the US has now surpassed 700,000 cases per year and will continue to increase [12]. It is reported that the incidence rate of rheumatoid arthritis eventually involving knee arthritis is 90% [13]. For end-stage rheumatoid knee arthritis, TKA is still the best solution at present. With the continuous heightened of surgical technology and the excellent advancement of prosthetic biomechanics, the range of clinical contraindications for total knee arthroplasty has gradually decreased and total knee arthroplasty has become more and more common in the treatment of end-stage rheumatoid arthritis.

However, studies on the influence of knee arthroscopy on the efficacy of TKA are sparse and controversial. Many studies believe that it will increase the cost of treatment and its effectiveness is questionable [14,15]. 10.2% of patients who underwent knee arthroscopy required TKA within one year and 32.5% of patients still required TKA after 9 years [16]. The purpose of this article is to understand the efficacy of knee arthroscopy on subsequent TKA through a meta-analysis of existing domestic and foreign literature.

Methods and Materials

Literature inclusion criteria

Research type: Randomized controlled trials and retrospective studies at home and abroad on the influence of knee arthroscopic operation on the prognosis of TKA.

Research subjects: All KOA patients who underwent TKA surgery.

Intervention measures: Knee Arthroscopy group (KA group), there is a history of knee arthroscopy surgery before TKA; non Knee Arthroscopy group (non-KA group), there is no history of knee arthroscopy surgery before TKA.

Outcome indicators: TKA postoperative revision rate, postoperative stiffness rate, postoperative reoperation rate, postoperative Venous Thromboembolism (VTE) incidence rate, postoperative periprosthetic infection rate, postoperative knee flexion activity degree and American Knee Society score (AKS) [17].

Literature exclusion criteria

- Patients with a history of knee surgery, fracture, posterior cruciate ligament reconstruction surgery anterior cruciate ligament and high tibial osteotomy surgery.
- There was no evaluation of postoperative indicators or no study comparing the two groups.
- The data is incomplete or the full-text literature cannot be obtained.
- Reviews, Editorials, Letters, Meeting minutes, Case reports or Personal communications.

Literature search methods

Search PubMed, CNKI, Embase, Wanfang, Cochrane Library and other databases from the establishment of the database to October 2023. The Chinese search keywords were “knee joint”, “arthroscopy” and “total knee replacement”. The english search terms were "arthroscopy", "arthroplasty", "replacement" and "knee". To ensure the recall rate, the search strategy used an association of topic words and free words. Additionally, the references of involved documents were manually searched and unpublished academic documents and monograph chapters were searched to include and exclude documents.

Literature screening and data extraction

Two researchers respectively reviewed each eligible article according to the literature exclusion and inclusion criteria for literature screening and acquired and quality evaluated the data, cross-checked and listed the following relevant characteristics: Title, first author, year of publication, research design, each

group intervention, research quality, diagnostic criteria, number of subjects, age range of subjects and other relevant data, were screened by two reviewers using the inclusion criteria and disagreement was resolved by discussion between the two reviewers, to seek the opinion of a third author when necessary. A unified form was used for data extraction and the extracted literature information included author, publication year, research subject profile (gender, age), intervention measures and outcome indicators.

Literature quality assessment

We adopted the cochrane collaboration. A systematic review is a review of a well-articulated issue that uses a systematic and categoric approach to verify, pick and critically evaluate relevant studies and collect and analyze data from the literatures involved in the review. Cochrane Collaboration applied six criteria: A: Random sequence generation; B: Blinding of participants and personnel; C: Allocation concealment; D: Incomplete outcome data; E: Blinding of outcome assessments; F: Selective reporting.

Additionally, assessments were expressed as low risk, high risk or unclear risk, according to the methodological description within each study. Meta-analysis may or may not be used to summarize and analyze the results of involved literatures and to statistically integrate the results of all involved studies into a series of systematic reviews.

Statistical method

RevMan5.4 software was used for statistical analysis and the evaluation indicators were presented by Weighted Mean Differences (WMD) and 95% Confidence Interval (95% CI) and the heterogeneity of the included research data was analyzed by χ^2 test and corresponding P value, P<0.05 means the difference is statistically significant, otherwise, there is no statistical significance. I2 was used to represent heterogeneity, when I2>50%, it means that there is statistical heterogeneity among the studies and the random effect model is used for analysis; when I2<50%, it means that there is no statistical heterogeneity among the studies. If heterogeneity exists, sensitivity analysis is used to explore the source of heterogeneity.

Results

Literature search results

A total of 626 literatures were retrieved and 7 relevant studies were screened out based on the exclusion and inclusion criteria, with a total sample size of 42642 cases, including 3405 cases in the KA group and 39237 cases in the non-KA group, KA group [18-24]. The literature screening process is shown in **Figure 1** and the basic characteristics of the included literature are shown in **Table 1**.

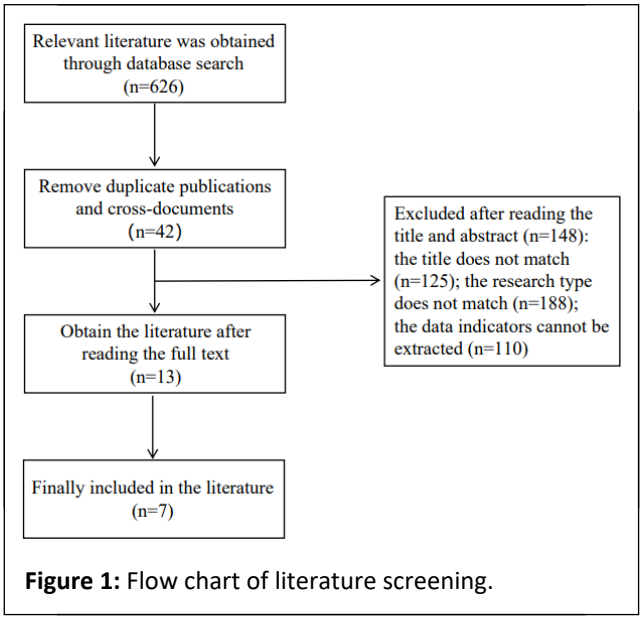

Figure 1: Flow chart of literature screening.

Table 1: Inclusion of basic information in literature.

Literature	Group	Cases	Age	Male/Female	Body mass index	Outcome indicators
[22]	KA	60	69	15/45	28	A, B, C, D, F
	non-KA	1119	72	248/787	29	
[23]	KA	3051	-	938/2113	-	C, D, E
	non-KA	37235	-	12818/24417	-	
[18]	KA	40	-	Mar-37	-	A, B
	non-KA	40	-	Apr-36	-	

[20]	KA	61	56	18/42	32	A, B, C
	non-KA	563	62	136/302	33	
[24]	KA	36	62	Mar-33	-	A, B, D, F
	non-KA	36	63	Mar-33	-	
[19]	KA	70	-	28/42	32	A, B
	non-KA	70	-	25/45	32	
[21]	KA	87	63	37/50	-	A, B, C, D, E, F
	non-KA	174	63	75/99	-	

Note: KA: Arthroscopic surgery before TKA; Non-KA: No arthroscopic surgery before TKA; A: Postoperative revision; B: Reoperation; C: Postoperative stiffness; D: Periprosthetic infection; E: Venous thromboembolism; F: Postoperative knee flexion range of motion.

Quality assessment of literature included in the studies

Assess the risk of bias assessment method recommended by the cochrane network, which mentions 5 randomization groups, 4 concealment groups, 4 blinding methods and 4 double-blinding methods. Results were well documented and selection bias is unknown **(Table 2)**. There were no dropouts or losses to follow up in all studies. The quality level of all research documents is level B **(Figures 2 and 3)**.

Table 2: Quality assessment of 13 included literature.

Literature	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
[22]	Correct	Not described	Not described	Correct	Incorrect	Not described
[23]	Correct	Correct	Not described	Correct	Incorrect	Not described
[18]	Not described	Correct	Correct	Not described	Incorrect	Not described
[20]	Correct	Not described	Correct	Correct	Incorrect	Not described
[24]	Correct	Correct	Not described	Not described	Incorrect	Not described
[19]	Correct	Not described	Correct	Not described	Incorrect	Not described
[21]	Not described	Correct	Correct	Correct	Incorrect	Not described

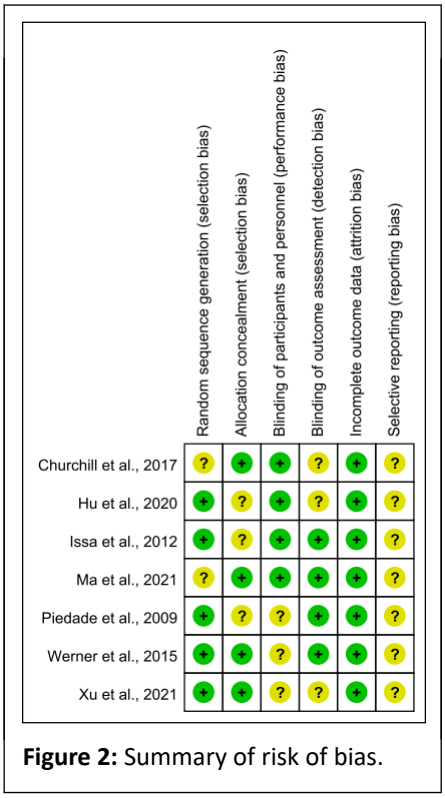

Figure 2: Summary of risk of bias.

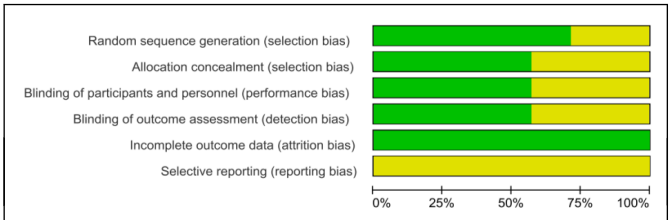

Figure 3: Risk of bias ratio.
Note: ( ): Low risk of bias; ( ): Unclear risk of bias; ( ): High risk of bias.

Postoperative revision rate

A total of 6 documents compared the revision rate after TKA and there was no statistical heterogeneity between studies (P=0.27, I2=22%). Therefore, a stable effects model was employed for meta-analysis. The results reflected that there was statistical significance in the postoperative revision rates between the two groups (95% CI (0.97; 44.82)) **(Figure 4)**.

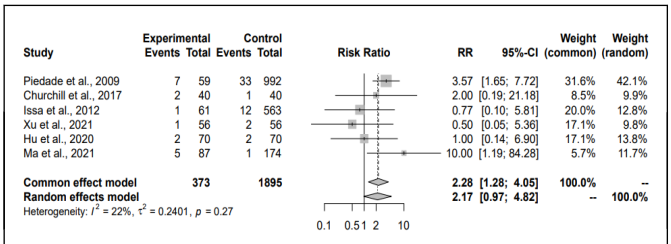

Figure 4: Forest plot on meta-analysis of revision rate after TKA with or without a history of knee arthroscopy.

Postoperative reoperation rate

Six articles compared reoperation rates after TKA. The heterogeneity between each study group was large (P=0.15, I2=38%). A random effects model was employed for meta-analysis. And the results reflected that there was a statistically significant difference in the postoperative reoperation rate between the two groups (95% CI (1.66, 4.23)) **(Figure 5)**.

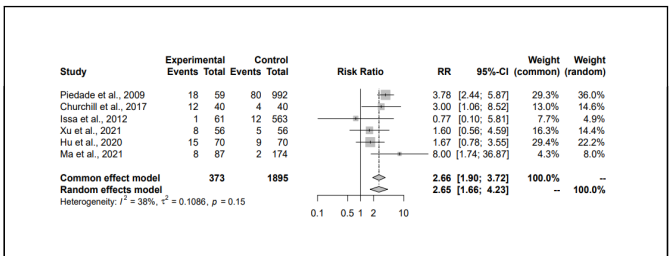

Figure 5: Forest plot on meta-analysis of re-operation rate after TKA with or without a history of knee arthroscopy.

Incidence of postoperative stiffness

A total of 4 articles compared postoperative stiffness rates. Because there is heterogeneity in the results of each study (P<0.01, I2=76%), a random effects model was employed for meta-analysis. The results reflected that the postoperative stiffness rate between the two groups was statistically significant (95% CI (0.86,10.84)) **(Figure 6)**.

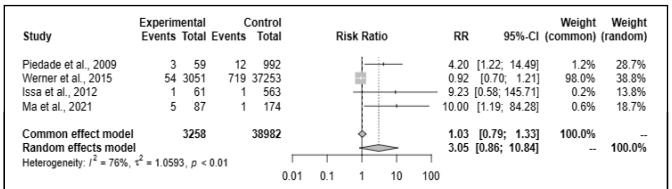

Figure 6: Forest plot on meta-analysis of incidence of stiffness after TKA with or without a history of knee arthroscopy.

Postoperative periprosthetic infection rate

Four articles compared postoperative periprosthetic infection rates. There was no statistical heterogeneity among the studies (P=0.20, I2=35%), so the stable effect model was employed for Meta-analysis. The results reflected that there was a statistically significant difference in the postoperative periprosthetic infection rate between the two groups (95% CI (0.86,2.07)) **(Figure 7)**.

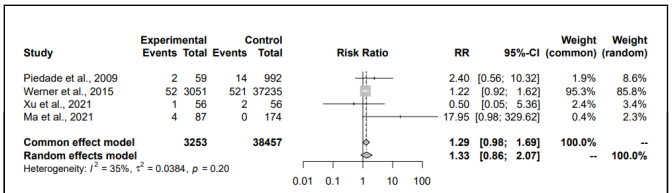

Figure 7: Forest plot on meta-analysis of incidence of infection around the prosthesis after TKA with or without a history of knee arthroscopy.

Incidence of postoperative VTE

Two articles compared the incidence of postoperative VTE. There was no statistical heterogeneity among the studies (P=0.80, I2=0%), so the stable effects model was selected for meta-analysis. The results reflected that there was no statistically significant difference in the incidence of VTE between the two groups (95% CI (0.83,1.35)) **(Figure 8)**.

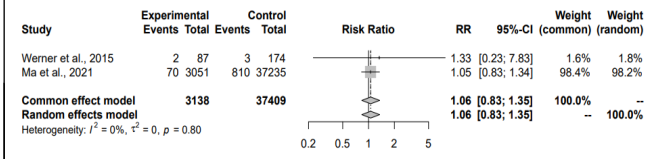

Figure 8: Forest plot on meta-analysis of the incidence of venous thromboembolism after TKA with or without a history of knee arthroscopy.

Postoperative knee flexion range of motion

Three articles compared postoperative knee flexion range of motion. There was no statistical heterogeneity among the studies (P=0.80, I2=0%), so the stable effects model was selected for meta-analysis. The results reflected that there was no statistically significant difference in postoperative knee flexion range of motion between the two groups (95% CI (-0.35,0.10)) **(Figure 9)**.

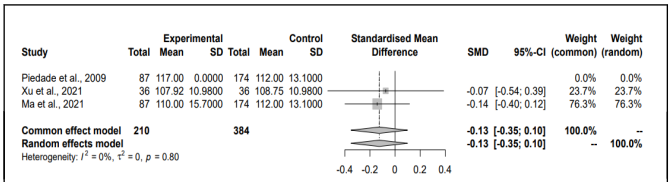

Figure 9: Forest plot on meta-analysis of knee arthroscopy in patients with or without a history of knee flexion range of motion after TKA.

Discussion

Osteoarthritis is a chronic musculoskeletal disease that often occurs in people's daily lives. The knee joint is one of the main areas where osteoarthritis occurs. It is generally caused by knee joint degeneration, trauma, strain and other factors and the degradation of knee joint cartilage tissue. Clinically, its main pathological features include narrowing of the knee joint space, osteophytes and sclerosis. The prevalence increases sharply with age. It is most common in middle-aged and elderly people who are obese or exercise a lot. They will experience joint pain and obvious swelling when walking and daily life. If not treated in time, it may even cause deformity and even disability. Currently, TKA is clinically the main treatment for end-stage knee osteoarthritis and most patients who undergo knee arthroscopy require TKA later.

This meta-analysis commented on the influence of knee arthroscopy on the efficacy of subsequent TKA. The results reflected that previous knee arthroscopy increased the knee stiffness rate, periprosthetic infection rate, revision rate and reoperation rate after TKA. There was no statistically significant difference in postoperative knee flexion range of motion and VTE incidence between the two groups. Periprosthetic infection is a common complication after TKA. This meta-analysis found that arthroscopic surgery can increase the rate of periprosthetic infection after TKA. The possible reason is that joint effusion and hematoma after arthroscopy will increase the risk of incision infection; joint capsule injury, the uncertainty of operation time and postoperative injection of drugs into the joint cavity all increase the risk of potentially pathogenic bacteria entering the joint cavity, thereby increasing the infection rate after TKA [16]. Postoperative joint stiffness is another common complication after TKA. This meta-analysis found that knee arthroscopy increases the rate of postoperative stiffness after TKA. The possible reasons are that the perfusion fluid replaces joint synovial fluid during arthroscopic surgery and that postoperative bleeding, hematoma, effusion and synovial inflammatory reaction increase the level of fibrous tissue in the joint cavity, synovial thickening and tissue adhesion [18,25]. In addition, patients who are afraid of activities due to pain after surgery do not pay attention to rehabilitation and do not cooperate may limit the range of activities before surgery and increase the risk of joint stiffness after TKA.

Based on the comparative results of periprosthetic infection rates, we compared the reoperation rate revision rate and revision rate after TKA and found that knee arthroscopy increased the reoperation rate revision rate and revision rate after TKA. The possible reason is that the osmotic pressure of arthroscopy perfusion fluid will affect the metabolism of knee joint tissue, destroy the cartilage structure and expose the subchondral bone, thereby stimulating an autoimmune response and causing osteolysis. In addition, arthroscopic surgery affects bone cement penetration during TKA, causing an increase in fibrous tissue and thickening of the synovial membrane at the postoperative bone-cement interface [26,27]. This leads to a reduction in the structural holding force between bone cement and trabecular bone, thereby affecting the stability of the prosthesis, thus increasing the revision rate and reoperation rate after TKA [28].

This study found that there was no statistically significant difference in postoperative knee flexion range of motion and VTE incidence between the two groups. Postoperative knee flexion range of motion is closely related to the patient's postoperative rehabilitation. Patients should pay attention to and actively cooperate with postoperative rehabilitation to restore knee joint range of motion. To obtain a good view, the routine use of tourniquets during arthroscopy will increase the time of venous stasis and increase the risk of VTE. As a major orthopedic surgery, TKA causes blood flow stasis, vessel wall damage and blood hypercoagulability, which are also important risk factors for VTE [29]. Therefore orthopedic surgeons should standardize the use of tourniquets during surgery, operate them gently and carefully to avoid venous damage and provide appropriate fluid replenishment during and after surgery to reduce blood viscosity and prevent the occurrence of postoperative VTE.

This study used established search strategies and strictly screened literature according to exclusion and inclusion criteria to compare the influence of knee arthroscopy on subsequent TKA. Arthroscopic surgery and TKA are relatively mature in clinical operations and the outcome indicators involved in this article are of high clinical concern. Therefore, the conclusions drawn in this study through meta-analysis have practical clinical significance. However, the variety of knee arthroscopy surgery methods, knee prostheses and differences in the interval between two surgeries may affect the authenticity of this study to a certain extent.

At present, the concepts of stepped treatment and personalized treatment of KOA are popular in clinical practice. As a treatment for end-stage KOA, the prognosis of TKA is tightly related to the patient's quality of life and knee joint function. Therefore, it is crucial to study the influence of knee arthroscopy on the efficacy of TKA. This meta-analysis found that arthroscopic surgery can increase the revision rate, reoperation rate, periprosthetic infection rate and postoperative stiffness rate after subsequent TKA. Before patients undergo TKA, non-surgical treatment of KOA may be more effective. However, the diagnostic value of arthroscopy should not be ignored in patients who fail conservative treatment and whose imaging cannot provide sufficient evidence of TKA [30].

Conclusion

In summary, knee arthroscopic has a negative influence on consecutive TKA. Knee arthroscopic operation will increase the risk of revision, reoperation, postoperative stiffness and periprosthetic infection after TKA, but there was no important difference in postoperative knee flexion range of motion and postoperative VTE rate. Further research with higher and more rigorous evidence levels is needed to demonstrate this in the future.

Acknowledgements

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

Data and Materials Availability

The datasets in the current study are available from the corresponding author on reasonable request.

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