Systematic Review and Meta-Analysis

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Modified Robert Jones Bandage in reducing blood loss in total knee arthroplasty

A meta-analysis of randomized controlled trials

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Abstract

Background: The purpose of this meta-analysis was to assess the effects of Modified Robert Jones Bandage (MRJB) in primary total knee arthroplasty (TKA).

Methods: PubMed, EMBASE, the Cochrane Library, Web of Science, and Google Scholar were systematically searched for randomized controlled trials (RCTs). All RCTs were compared to receive either MRJB (study group) or conventional wound dressing (control group) in TKA. Statistical analysis was assessed using RevMan 5.3 software.

Results: A total of 5 RCTs involving 362 patients were included in the meta-analysis. No significant difference between the 2 groups was found in terms of total blood loss (Mean difference [MD], –25.41; 95% confidence interval [CI], –90.52 to 39.70; $P = .44$), intra-operative blood loss (MD, –13.77; 95% CI, –31.84 to 4.29; $P = .14$), drain blood loss (MD, 0.83; 95% CI, –30.07 to 31.72; $P = .96$), and transfusion rate (risk ratio, 0.95; 95% CI, 0.55–1.64; $P = .86$); There was also no significant difference in terms of range of motion (MD, –0.93; 95% CI, –3.64 to 1.79; $P = .50$), visual analog scale pain sores (MD, –0.02; 95% CI, –0.34 to 0.30; $P = .90$), and operative time (MD, –3.12; 95% CI, –13.42 to 7.18; $P = .55$), without increasing the risk of wound-related complications (risk ratio, 0.75; 95% CI, 0.27–2.08; $P = .58$) in both groups. No deep venous thrombosis occurred in all studies.

Conclusions: The current meta-analysis of the available evidence indicates patients with MRJB had not required the additional advantage compared to the conventional wound dressing for TKA. However, more high-quality studies are needed to confirm the above conclusions.

Level of Evidence: Level I, therapeutic study.

Abbreviations: CI = confidence interval, DVT = deep venous thrombosis, MD = Mean difference, MRJB = Modified Robert Jones Bandage, RCTs = randomized controlled trials, ROM = range of motion, TKA = total knee arthroplasty, VAS = visual analog scale.

Keywords: blood loss, Modified Robert Jones Bandage, swelling, total knee arthroplasty

1. Introduction

Total knee arthroplasty (TKA) is a successful method for the treatment of end-stage knee osteoarthritis.[1,2] However, TKA is associated with extensive perioperative bleeding caused by surgical trauma and the use of pneumatic tourniquet leading to fibrinolysis,[3,4] which is still associated with knee swelling and decreased extension strength, as well as an important factor in delaying the recovery of patients.[5,6] Various materials and application techniques, including cold compress,[7] elastic bandage,[8] and compression dressing,[9] have been widely established to reduce bleeding and swelling of the knee joints.

In recent years, as a bulky compression dressing, the Modified Robert Jones Bandage (MRJB) is often used to reduce blood loss, visual analog scale (VAS) pain and swelling during TKA.[7,10,11] Theoretically, the MRJB can reduce intra-articular bleeding by providing knee joint tamponade, and reduce soft tissue edema by increasing intra-cellular pressure, thereby helping lower limb venous reflux.[12,13] However, some authors reported the opposite view that it is not associated with reducing blood loss and that it can potentially increase complications[7,14] including peroneal paralysis, pressure ulcers, bruise, and blisters, which may limit its use.

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

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Although most studies[7,10,11,15,16] have been investigated for MRJB efficacy in TKA, however, to our knowledge, it is not clear that the potential advantages of MRJB outweigh its disadvantages. Therefore, the current authors performed an meta-analysis to assess the highest evidence-based (level I) studies to investigate the effectiveness of MRJB in TKA in terms of blood loss, including total blood loss, intra-operative blood loss, drain blood loss, and transfusion rate; range of motion (ROM), VAS pain scores, and operative time; wound-related complications and deep venous thrombosis (DVT).

2. Materials and methods

The meta-analysis was reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) checklist,[17] and ethical approval for this study was unnecessary because the data are extracted from previously published studies.

2.1. Search strategy

The following electronic databases were carefully searched, including PubMed (1996 to October 2018), Embase (1980 to October 2018), and the Cochrane Library (CENTRAL, October 2018). To search more potentially eligible studies, the Google Scholar was also searched ending up to October 2018. The following keywords were used (Modified Robert Jones bandage or Robert Jones bandage or bandage or compressing) AND (total knee arthroplasty OR total knee replacement OR TKA OR TKR). Only randomized controlled trials (RCTs) were included in the current meta-analysis.

2.2. Inclusion criteria

Eligible studies were considered if they met the following criteria: PICOS (population, intervention, comparator, outcome, study design). Population: patients were performed for primary TKA; Intervention: the intervention was the application of MRJB for blood loss and pain management (study group); Comparison: the comparator was placebo or conventional wound dressing for TKA (control group); Outcomes: total blood loss, intra-operative blood loss, drain blood loss, transfusion rate, ROM, VAS sores operative time, wound-related complications, and thrombosis; Study design: RCTs. All included studies were entered into Endnote X7. Next, 2 reviewers independently excluded the study based on the title and summary. The disagreement was resolved through discussions with the third reviewer.

2.3. Data extraction

Two reviewers independently collected available data and clinical outcomes from the eligible studies in pre-defined data fields, and any disagreement between the 2 reviewers is judged by a third reviewer. The information from RCT studies included first authors, publication data, age, sex, number of patients, intervention method, tourniquet, and drain. The blood loss and transfusion rate were primary outcomes in our meta-analysis. Secondary outcomes consisted of VAS pain scores, ROM, operative time, wound-related complications, and thrombosis.

2.4. Assessment of methodological quality

Two reviewers assessed independently the methodological quality of the included studies which were performed by the Cochrane Collaboration for Systematic Reviews,[17] including assessment of random sequence generation, allocation sequence concealment, blinding of participants and personnel, blinding of outcomes assessment, incomplete outcome data, selective reporting, and other bias. The overall methodological quality of each included study was characterized as "Yes" (low risk of bias), "No" (high risk of bias), or "Unclear" (unclear risk of bias). Differences will be resolved by consensus after discussion and, if necessary, a third reviewer will be consulted.

2.5. Data synthesis

Statistical analyses of the meta-analysis were used the RevMan 5 software (Version 5.3, the Cochrane Collaboration). For continuous data, the mean difference (MD) and 95% confidence interval (CI) were calculated. For discontinuous data, the risk ratio and 95% CI were calculated. The chi-squared test and I^2 statistic were performed to assess the statistical heterogeneity. On the basis of statistical heterogeneity, the fixed-effects model was chosen if the chi-squared test >0.1 or the $I^2 <50\%$; otherwise, the random-effects model was chosen. P value $<.05$ was considered to be statistically significant. Transfusion rates and wound-related complications were also used to assess publication bias. If the funnel graph is symmetrical, the publication bias is low, and vice versa.

3. Results

3.1. Search results

The PRISMA flow diagram is indicated in Figure 1. A total of 294 studies were screened out by the initial search, and 216 studies were removed according to the title and abstract, the remaining 78 were read in full-text. After reading the full text, 73 was excluded because it did not meet the inclusion criteria. Consequently, 5 independent RCTs[7,10,11,15,16] finally met the pre-defined inclusion criteria in this meta-analysis.

3.2. Study characteristics

The total sample size was 362 patients in primary TKA, comprising 179 patients in the study group and 183 patients in the control group. The sample size of the included studies ranged from 30 to 44, and the average age of participants ranged from 69.11 to 72.1 years. The bandage time in all studies ranged from 24 hours to 48 hours. All but 1 study[16] involved the tourniquet, of which 274 patients used tourniquets, accounting for 75.69% of the total. The drainage tube was used in 4 studies,[7,10,11,15] of which 274 patients involved drainage tube, accounting for 75.69% of the total. Table 1 summarizes the basic characteristics of all studies.

3.3. Risk of bias assessment

Risk of bias assessments is presented in Table 2. Among the 5 RCTs, all studies reported random sequence generation. Three studies[10,15,16] described allocation concealment and blinded. All of the RCTs described the incomplete outcome data, selective reporting, and other biases. The meta-analysis independently used funnel plots of transfusion rates and wound-related complications to assess publication bias; the results were symmetrical and the publication bias was low (Fig. 2A, B).

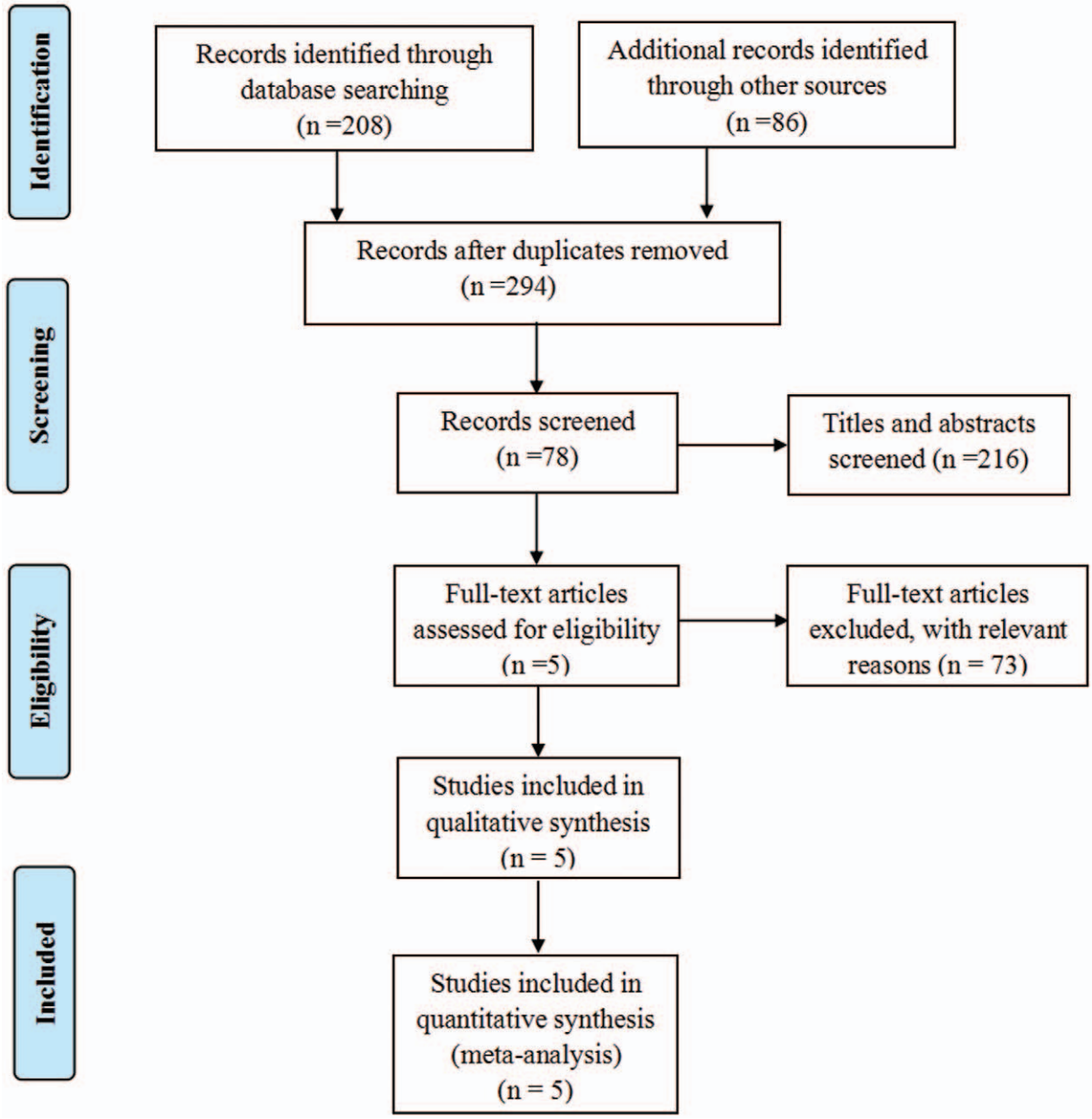

Figure 1. Preferred reporting items for systemic reviews and meta-analyses (PRISMA) flow diagram of literature selection.

Table 1

Characteristics of included studies.

First authors (date)	Diseases	Age		No. of patients		Sex (M/F)		Intervention method		Tourniquet	Drain
		CC	SC	CC	SC	CC	SC	CC	SC		
Gibbons et al 2001[7]	OA; RA	70	71	30	30	11/19	14/16	The cold therapy for 1 h	MRJB for 48 h	Yes	Yes
Pinsornsak and Chumchuen 2013[10]	OA	70.23	69.20	30	30	5/25	5/25	The conventional dressing	MRJB for 24 h	Yes	Yes
Smith et al 2002[11]	OA	72.1	72	44	40	21/23	21/19	The cold therapy for 24 h	MRJB for 24 h	Yes	Yes
Pornrattanamaneewong et al 2018[15]	OA	71.0	69.3	35	35	2/33	7/28	Non-compressive dressing placed the gauze pads	MRJB for 24 h	Yes	Yes
Yu et al 2018[16]	OA	69.11	69.32	44	44	10/34	10/34	The conventional dressing	MRJB for 24 h	No	no

CC = control group, F = female, h = hours, M = male, MRJB = Modified Robert Jones Bandage, No = number, OA = osteoarthritis, RA = rheumatoid arthritis, SC = study group.

Table 2

Quality assessment of included studies.

Studies (years)	Random sequence generation	Allocation sequence concealment	Blinding of participants and personnel	Blinding of outcomes assessment	Incomplete outcome data	Selective reporting	Other bias
Gibbons et al 2001[7]	Yes	Unclear	Unclear	Unclear	Yes	Yes	Yes
Pinsornsak and Chumchuen 2013[10]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Smith et al 2002[11]	Yes	Unclear	Unclear	Unclear	Yes	Yes	Yes
Pornrattanamaneewong et al 2018[15]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yu et al 2018[16]	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Yes (low risk of bias), No (high risk of bias), Unclear (unclear risk of bias).

3.4. Meta-analysis result

3.4.1. Total blood loss. A total of 2 studies[15,16] including 158 patients reported the total blood loss (79 patients in the control group and 79 patients in the study group). Pooled results showed that there was no significant difference between the 2 groups in total blood loss (MD, –25.41; 95% CI, –90.52 to 39.70; $P = .44$). A fixed effects model was used in this study because there was no significant statistical heterogeneity ($P = .17$, $I^2 = 48\%$) (Fig. 3).

3.4.2. Intra-operative blood loss. A total of 3 studies[10,15,16] including 218 patients reported the intra-operative blood loss (109 patients in the control group and 109 patients in the study group). Pooled results showed that there was no significant difference between the 2 groups in intra-operative blood loss (MD, –13.77; 95% CI, –31.84 to 4.29; $P = .14$). A fixed effects model was used in this study because there was no significant statistical heterogeneity ($P = .61$, $I^2 = 0\%$) (Fig. 4).

3.4.3. Drain blood loss. A total of 2 studies[10,15] including 130 patients reported the drain blood loss (65 patients in the control group and 65 patients in the study group). Pooled results showed that there was no significant difference between the 2 groups in drain blood loss (MD, 0.83; 95% CI, –30.07 to 31.72; $P = .96$). A fixed effects model was used in this study because there was no significant statistical heterogeneity ($P = .96$, $I^2 = 0\%$) (Fig. 5).

3.4.4. Transfusion rate. A total of 4 studies[7,10,15,16] including 278 patients reported the drain blood loss. Transfusions were reported in 20 of 139 patients (14.39%) in the control group, compared with 21 of 139 patients (15.11%) in the study group. Pooling the data demonstrated patients in the study group had similar benefits for transfusion requirements compared with the patients in the control group (risk ratio, 0.95; 95% CI, 0.55–1.64; $P = .86$). A fixed effects model was used in this study because there was no significant statistical heterogeneity ($P = .97$, $I^2 = 0\%$) (Fig. 6).

3.4.5. VAS pain scores. A total of 4 studies[10,11,15,16] including 302 patients reported the VAS pain scores (153 patients in the control group and 149 patients in the study group). Pooled results showed that there was no significant difference between the 2 groups in VAS pain scores (MD, –0.02; 95% CI, –0.34 to 0.30; $P = .90$). A fixed effects model was used in this study because there was no significant statistical heterogeneity ($P = .20$, $I^2 = 36\%$) (Fig. 7).

3.4.6. Operative time. A total of 2 studies[10,15] including 130 patients reported the operative time (65 patients in the control group and 65 patients in the study group). Pooled results showed that there was no significant difference between the 2 groups in operative time (MD, –3.12; 95% CI, –13.42 to 7.18; $P = .55$). A random- effects model was used in this study because there was no significant statistical heterogeneity ($P = .10$, $I^2 = 64\%$) (Fig. 8).

3.4.7. Range of motion. A total of 3 studies[10,15,16] including 242 patients reported the ROM (123 patients in the control group and 119 patients in the study group). Pooled results showed that there was no significant difference between the 2

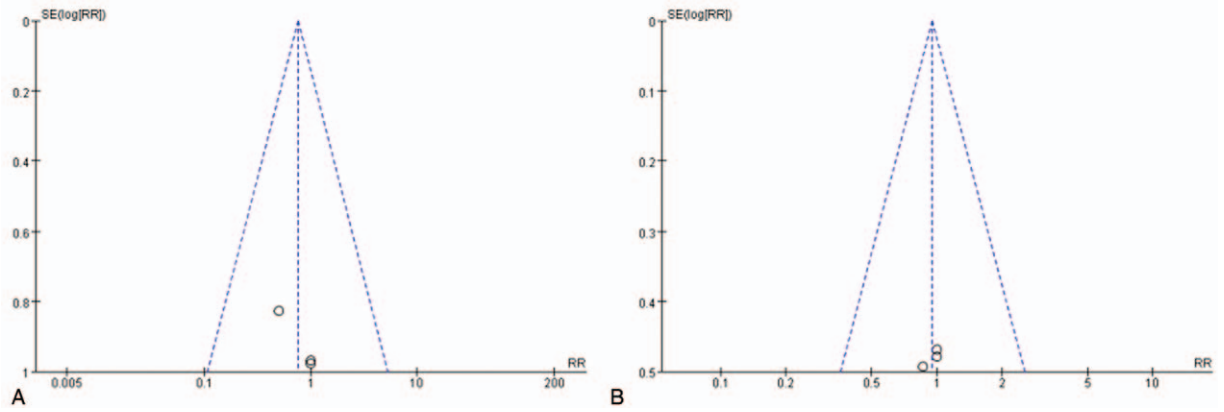

Figure 2. Publication bias: (A) Transfusion rate; (B) Wound-related complications.

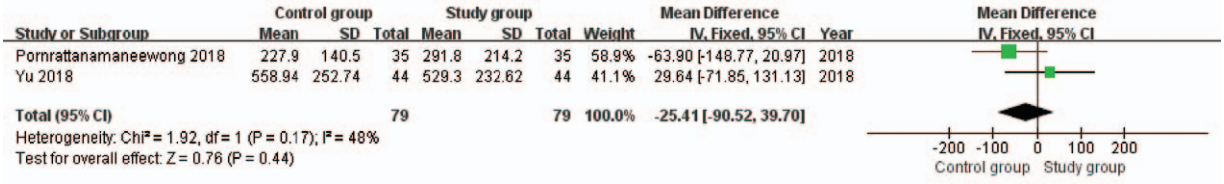

Figure 3. Total blood loss forest plot analysis.

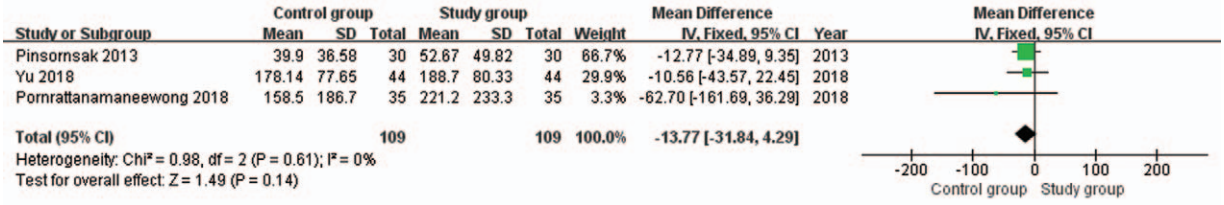

Figure 4. Intra-operative blood loss forest plot analysis.

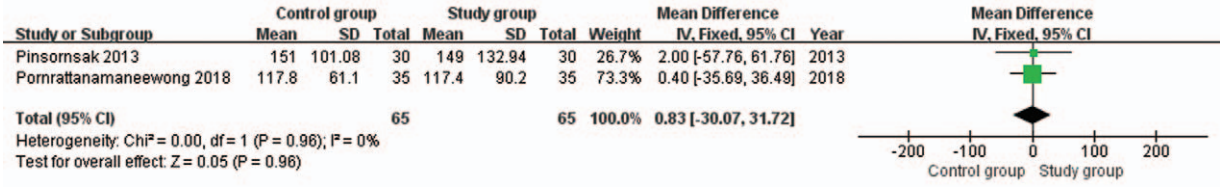

Figure 5. Drain blood lossforest plot analysis.

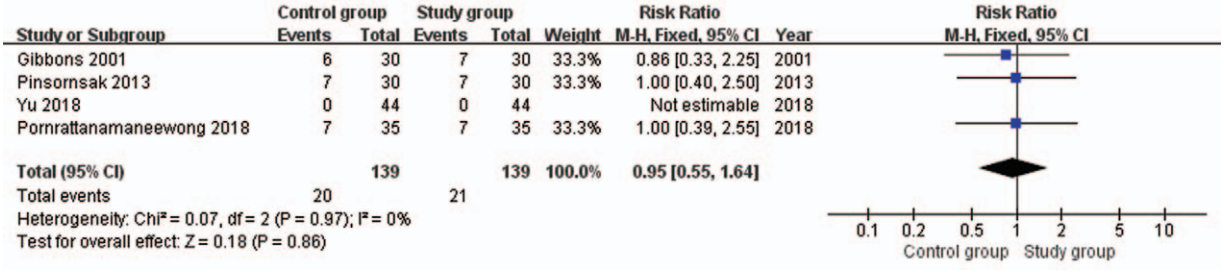

Figure 6. Transfusion rate forest plot analysis.

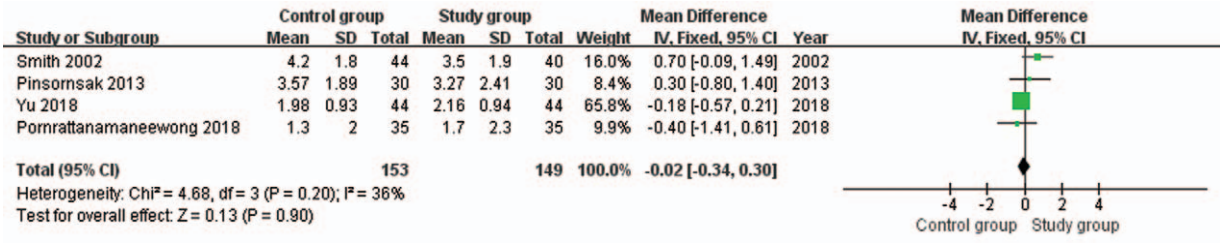

Figure 7. VAS pain scores forest plot analysis. VAS = visual analog scale

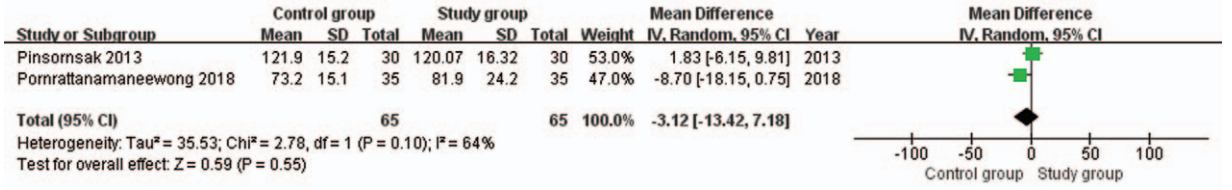

Figure 8. Operative time forest plot analysis.

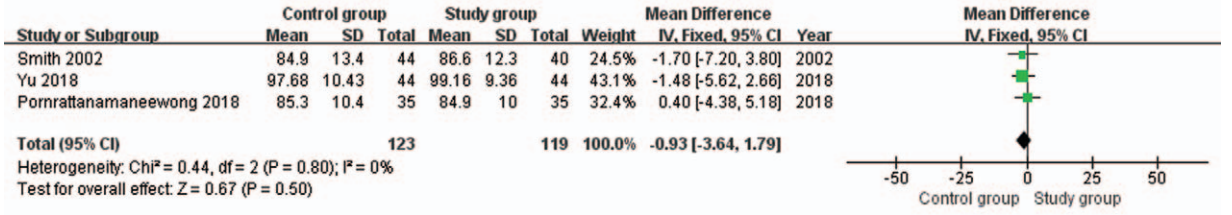

Figure 9. ROM forest plot analysis. ROM = range of motion.

groups in ROM (MD, –0.93; 95% CI, –3.64 to 1.79; $P = .50$). A fixed effects model was used in this study because there was no significant statistical heterogeneity ($P = .80$, $I^2 = 0\%$) (Fig. 9).

3.4.8. Wound-related complications and DVT. A total of 4 studies[7,10,15,16] including 278 patients reported relevant data regarding wound-related complications (139 patients in the control group and 139 patients in the study group). Six (4.32%) wound-related complications occurred in the control group compared with 8 (5.76%) in the study group, no significant difference was found between the 2 groups (risk ratio, 0.75; 95% CI, 0.27–2.08; $P = .58$) (Fig. 10). No DVT occurred in all studies.

4. Discussion

This is the first systematic review and meta-analysis of the effect of MRJB in TKA. Knee swelling is caused by intra-articular bleeding and periarticular inflammation and is an important factor hindering the accelerated recovery of patients.[18,19,20] As previously reported,[7,11,15] TKA patients are usually treated with MRJB compression to reduce intra-articular bleeding and swelling of the soft tissue. However, it is not clear whether MRJB has an advantage over traditional dressing in TKA. Therefore, the authors performed this meta-analysis.

The most important finding of this study is no significant difference in total blood loss, intra-operative blood loss, drain blood loss, and transfusion rate between the control and study groups. The similar results are found in ROM, VAS pain scores, operative time, and knee swelling. In terms of safety evaluation, there was no significant difference in complications between the 2 groups. Based on the current results, we believe that the pressure from MRJB may not be sufficient to fill the knee to reduce bleeding and swelling.

The blood loss and transfusion rate were the primary outcome in our meta-analysis. As previously reported, some published RCTs[10,15,16] suggested that MRJB has a similar effect compared with the traditional wound dressing. An RCT performed by Pinsornsak and Chumchuen[10] involving 60 patients who had TKA by 2010 to 2011. In their study, MRJB were placed for 24 hours after TKA in the compression group, while the control group did not receive compression, but a conventional wound dressing. These results demonstrated that there was no significant difference in blood loss and blood transfusion rate in patients treated with MRJB compared with conventional dressing. Similarly, another RCT performed by Yu et al,[16] 90 patients were randomly divided into receiving compression therapy with MRJB from toes to thigh for 24 hours and the control group received no compression therapy. The results indicated that there

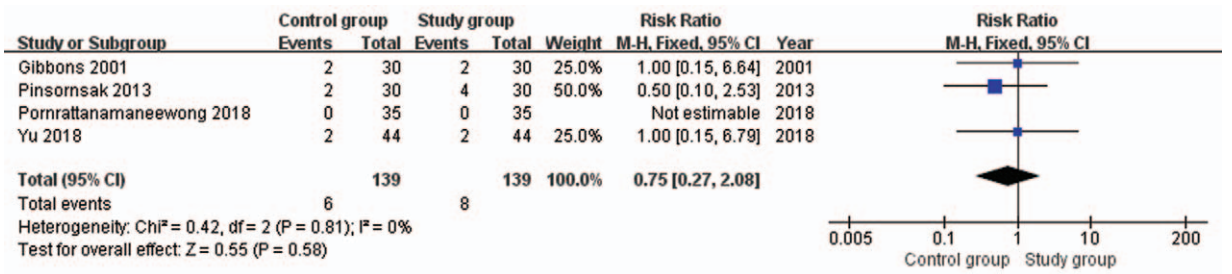

Figure 10. Wound-related complications forest plot analysis.

was no significant difference in blood loss and transfusion rate in both groups. However, an RCT of Gibbons et al[7] revealed that MRJB had more blood loss than cold compressive dressing, but it did not result in a significant difference in transfusion requirements. In our meta-analysis, we found that the application of MRJB was similar for reducing blood loss and knee swelling after TKA as the conventional wound dressing, and there also was no difference in the amounts of transfusion requirements in each group. On this basis, we cannot get the advantages of reducing the amount of blood loss and transfusion rate in clinical practice.

Data for knee swelling and ROM were used to assess the early knee-function recovery postoperatively.[21,22] Performing early ROM exercises has benefits on functional recovery, lower medical costs, and complications.[23,24] In theory, the compressing bandages can be used to reduce intra-articular bleeding by providing knee joint tamponade and reducing soft tissue edema by increasing intra-cellular pressure.[9] Charalambides et al[12] also reported that the administration of compression bandage was effective in controlling bleeding in the knee joints and that very few patients with compression bandages developed lower limb swelling after surgery. However, a high- quality RCT conducted by Smith et al[11] reported that the study group and the control group acquired similar ROM after surgery ($86.6 \pm 12.3°$ and $84.9 \pm 13.4°$, respectively) between the 2 groups. Yu et al[16] also reported that no significant differences were found in the 2 groups regarding knee flexion ($99.16 \pm 9.36°$ and $97.68 \pm 10.43°$). In the current meta-analysis, this result was also consistent with previously published studies, that show no difference in whether bandages were used for reducing knee swelling and improving ROM. In addition, we found no differences in VAS scores and operative time between the 2 groups.

Another problem with MRJB in TKA was the possible complications, including wound-related complications and DVT. In the current study, there was no significant difference between the 2 groups ($P = .58$), although there were 6 cases of wound-related complications in the control group and 8 cases in the study group. More importantly, none of the studies produced DVT. However, the occurrence of these complications events does not indicate that there is no risk. Previous power analysis showed that more than 3500 patients needed to meaningfully assess the increase in surgical infections.[25] Therefore, the meta-analysis must acknowledge that due to the relatively small sample size, it lacks the ability to adequately assess low incidence events. The incidence of complication outcomes may be much higher than the results of the study. Therefore, large-scale prospective studies are needed to provide insights into the safety of MRJB.

This meta-analysis has several advantages. First, this is the first meta-analysis to compare the application of MRJB in TKA. Second, the meta-analysis only included RCTs with strict inclusion criteria, and the quality of the included studies was relatively high. Third, total blood loss, transfusion rate, and knee swelling were the primary outcome in the current meta-analysis, for both of these results were a response to the main effects of the MRJB. It seems that there was no difference between the 2 groups. Based on the above conclusions, therefore, we can draw hypotheses that MRJB after primary TKA may not be routinely indicated in common clinical use, and it can potentially avoid the related complications.

The meta-analysis still has some limitations, including, Only 5 RCTs were included, the amount of sample is relatively small; As important parameters of TKA postoperative recovery criteria, tourniquet-induced ischemia increases fibrinolytic activity and induces local reactive hyperemia, resulting in more blood loss and knee swelling. However, due to the limitation of the sample size, we cannot perform a subgroup analysis to compare results; Most studies lack long-term follow-up and should be performed in the future; The application time of MRJB ranges from 24 hours to 48 hours, which may also impact the results of our study. Despite these limitations, this is a meta-analysis using RCT to assess the first efficiency and safety of MRJB in TKA.

5. Conclusion

The current meta-analysis of the available evidence indicates patients with MRJB had similar blood loss, knee swelling, ROM, pain relief, and complications when compared to the conventional wound dressing for TKA. The application of MRJB does not require the additional advantage. However, the results of the meta-analysis should be interpreted with caution due to the small sample size, and more high-quality studies are needed to confirm the above conclusions.

Author contributions

Conceptualization: Mingying Shuai.
Formal analysis: Mingying Shuai.
Methodology: Yueping Li, Mingying Shuai.
Resources: Mingying Shuai.
Supervision: Mingying Shuai.
Writing – original draft: Yueping Li.
Writing – review & editing: Yueping Li.

References

[1] Zeni JA, Snyder-Mackler L. Early postoperative measures predict 1- and 2-year outcomes after unilateral total knee arthroplasty: importance of contralateral limb strength. Phys Ther 2010;90:43–54.
[2] Nouta KA, Pijls BG, Nelissen RGHH. All-polyethylene tibial components in TKA in rheumatoid arthritis: a 25-year follow-up study. Int Orthop 2012;36:565–70.
[3] Sun Q, Yu X, Wu JZ, Ge W, Cai M, Li SH. Efficacy of a single dose and an additional dose of tranexamic acid in reduction of blood loss in total knee arthroplasty. J Arthroplasty 2017;32:2108–12.
[4] Hasanain MS, Apostu D, Alrefaee A, Tarabichi S. Comparing the effect of tourniquet vs tourniquet-less in simultaneous bilateral total knee arthroplasties. J Arthroplasty 2018;33:2119–24.
[5] Wang C, Zhou CH, Qu H, Yan SG, Pan ZJ. Comparison of tourniquet application only during cementation and long-duration tourniquet application in total knee arthroplasty: a meta-analysis. J Orthop Surg Res 2018;13:216.
[6] Harper RA, Sucher MG, Giordardani M, Nedopil AJ. Topically applied epsilon-aminocaproic acid reduces blood loss and length of hospital stay after total knee arthroplasty. Orthopedics 2017;40: E1044–9.
[7] Gibbons CER, Solan MC, Ricketts DM, Patterson M. Cryotherapy compared with Robert Jones bandage after total knee replacement: a prospective randomized trial. Int Orthop 2001;25:250–2.
[8] Chiu FY, Hung SH, Chuang TY, Chiang SC. The impact of exsanguination by Esmarch bandage on venous hemodynamic changes in total knee arthroplasty - a prospective randomized study of 38 knees. Knee 2012;19:213–7.
[9] Brodell JD, Axon DL, Evarts CM. The Robert Jones Bandage. J Bone Joint Surg Br 1986;68:776–9.
[10] Pinsornsak P, Chumchuen S. Can a modified Robert Jones Bandage after knee arthroplasty reduce blood loss? A prospective randomized controlled trial. Clin Orthop Relat Res 2013;471:1677–81.
[11] Smith J, Stevens J, Taylor M, Tibbey J. A randomized, controlled trial comparing compression bandaging and cold therapy in postoperative total knee replacement surgery. Orthop Nurs 2002;21:61–6.

[12] Charalambides C, Beer M, Melhuish J, Williams RJ, Cobb AG. Bandaging technique after knee replacement. Acta Orthop 2005;76: 89–94.
[13] Ramelet AA. Compression therapy. Dermatol Surg 2002;28:6–10.
[14] Webb JM, Williams D, Ivory JP, Day S, Williamson DM. The use of cold compression dressings after total knee replacement: a randomized controlled trial. Orthopedics 1998;21:59–61.
[15] Pornrattanamaneewong C, Ruangsomboon P, Chareancholvanich K, Wilairatana V, Narkbunnam R. Modified Robert Jones bandage cannot reduce invisible blood loss after total knee arthroplasty: a randomized-controlled trial. Arch Orthop Trauma Surg 2018;138: 1151–7.
[16] Yu H, Wang H, Zhou K, et al. Modified Robert Jones bandage cannot reduce postoperative swelling in enhanced-recovery after primary total knee arthroplasty without intraoperative tourniquet: a randomized controlled trial. BMC Musculoskelet Disord 2018;19:357.
[17] Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Rev Esp Nutr Hum Die 2016;20:148–60.
[18] Xie JW, Ma J, Yao H, Yue C, Pei FX. Multiple boluses of intravenous tranexamic acid to reduce hidden blood loss after primary total knee arthroplasty without tourniquet: a randomized clinical trial. J Arthroplasty 2016;31:2458–64.
[19] Prakash J, Seon JK, Song EK, Lee DH, Yang HY, Jin C. Is combined administration of tranexamic acid better than both intravenous and topical regimes for total loss, hidden loss and post-operative swelling? A randomized control trial. J Orthop 2018;52:117–23.
[20] Huang ZY, Pei FX, Ma J, et al. Comparison of three different tourniquet application strategies for minimally invasive total knee arthroplasty: a prospective non-randomized clinical trial. Arch Orthop Trauma Surg 2014;134:561–70.
[21] Li B, Wang GB, Wang YF, Bai LH. Effect of two limb positions on venous hemodynamics and hidden blood loss following total knee arthroplasty. J Knee Surg 2017;30:70–4.
[22] Mikashima Y, Takagi T, Tomatsu T, Horikoshi M, Ikari K, Momohara S. Efficacy of acupuncture during post-acute phase of rehabilitation after total knee arthroplasty. J Tradit Chin Med 2012;32:545–8.
[23] Ebert JR, Joss B, Jardine B, Wood DJ. Randomized trial investigating the efficacy of manual lymphatic drainage to improve early outcome after total knee arthroplasty. Arch Phys Med Rehab 2013;94:2103–11.
[24] Wang R, Gong L, Geng L, Yu Y, Li HJ, Wang ZH. Effects of ethyl chloride spray on early recovery after total knee arthroplasty: a prospective study. J Orthop Sci 2017;22:89–93.
[25] Lunn TH, Kehlet H. Perioperative glucocorticoids in hip and knee surgery - benefit vs. harm? A review of randomized clinical trials. Acta Anaesthesiol Scand 2013;57:823–34.