International Journal of Surgery 37 (2017) 15–23

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Review

Effect of different postoperative limb positions on blood loss and range of motion in total knee arthroplasty: An updated meta-analysis of randomized controlled trials

Yuangang Wu, M.D. [a, 1, 2], Timin Yang, M.D. [b, 1, 3], Yi Zeng, M.D. [a, 4], Haibo Si, M.D. [a, 5], Canfeng Li, M.D. [a, 6], Bin Shen, M.D. [a, *]

[a] Department of Orthopaedic Surgery, West China Hospital, West China Medical School, Sichuan University, Chengdu, Sichuan Province, 610041, China
[b] Department of Orthopaedic Surgery, People's Hospital of Tibet Autonomous Region, Lasa, 850000, China

HIGHLIGHTS

- We compared the efficacy of the two different limb position in primary TKA.
- Subgroup analysis was performed based mild-flexion and high-flexion position.
- High-flexion has a similar efficacy to mild-flexion position in reducing blood loss.
- High-flexion position is more advantageous in improving range of motion.

ARTICLE INFO

Article history:
Received 25 August 2016
Received in revised form
16 October 2016
Accepted 27 November 2016
Available online 30 November 2016

Keywords:
Total knee arthroplasty
Mild-flexion
High-flexion
Blood loss

ABSTRACT

Background: Postoperative limb positioning has been reported to be an efficient and simple way to reduce blood loss and improve range of motion following total knee arthroplasty (TKA). This meta-analysis was designed to compare the effectiveness of two different limb positions in primary TKA.
Materials and methods: A meta-analysis of the PubMed, CENTRAL, Web of Science, EMBASE and Google Search Engine electronic databases was performed. In this meta-analysis, two postoperative limb positions were considered: mild-flexion (flexion less than 60°) and high-flexion (flexion at 60° or more). The subgroups were analysed using RevMan 5.3.
Results: Nine RCTs were included with a total sample size of 913 patients. The mild- and high-flexion positions significantly reduced postoperative total blood loss ($P = 0.04$ and $P = 0.01$; respectively). Subgroup analysis indicated that knee flexion significantly reduced hidden blood loss when the knee was fixed in mild-flexion ($P = 0.0004$) and significantly reduced transfusion requirements ($P = 0.03$) and improved range of motion (ROM) ($P < 0.00001$) when the knee was fixed in high-flexion. However, the rates of wound-related infection, deep venous thrombosis (DVT) and pulmonary embolism (PE) did not significantly differ between the two flexion groups.
Conclusion: This meta-analysis suggests that mild- and high-flexion positions have similar efficacy in reducing total blood loss. In addition, subgroup analysis indicates that the mild-flexion position is superior in decreasing hidden blood loss compared with high-flexion; the high-flexion position is superior to mild−flexion in reducing transfusion requirements and improving postoperative ROM. Thus, the use of

* Corresponding author. Department of Orthopaedics, West China Hospital, Sichuan University, 37# Guoxue Road, Chengdu, 610041, China. Tel.: +86 13881878767; fax: +86 028 85423438.
E-mail addresses: wuyuangang23@163.com (Y. Wu), ytm313@sohu.com (T. Yang), zengyigd@126.com (Y. Zeng), hb.si@163.com (H. Si), licanfeng87@163.com (C. Li), shenbin71@hotmail.com (B. Shen).
[1] Yuangang Wu and Timin Yang contributed equally to this work and should be considered as equal first authors.
[2] Tel.: +86 18328318171.
[3] Tel.: +86 13709029906.
[4] Tel.: +86 13688069779.
[5] Tel.: +86 13408682290.
[6] Tel.: +86 18280087198.

http://dx.doi.org/10.1016/j.ijsu.2016.11.135

the high-flexion position is a viable option to reduce blood loss in patients following primary TKA without increasing the risk of wound-related infection, DVT or PE.

1. Introduction

Total knee arthroplasty (TKA) is considered to be the most successful surgical procedure for severe knee arthritis [1,2]. However, TKA can result in significant postoperative anaemia and transfusion requirements [3,4]. Transfusion-associated risks include immunological reactions, transfusion-associated circulatory overload, transfusion-related acute renal failure, and even death [5–7]. The ultimate goal of blood management in TKA is to reduce blood loss and postoperative transfusion requirements by using strategies such as tourniquets and tranexamic acid (TXA) [4,6,8]. Furthermore, early restoration and improvement of range of motion (ROM) play an important role after TKA [9–11]. Good ROM is vital for an optimal result, and small changes in maximum flexion can have profound effects on functional capability [12]. Clinically, the effect of blood loss on functional ROM is an important factor in evaluating the success of TKA [13]. Controversy exists regarding the effects of the knee flexion position on blood loss and ROM associated with TKA. Some studies reported reduced blood loss with postoperative knee flexion [14,15], while other studies found no differences in the transfusion rates [10,16] between the two groups. One systematic review by Faldini [17] and one meta-analysis by Fu [18] found that postoperative leg flexion in TKA was safe and effective in significantly decreasing total blood loss, hidden blood loss and blood transfusion requirements as well as in improving ROM. However, these studies had several limitations. First, they did not simultaneously compare patients who were placed in knee flexion or extension or create subgroups based on the degree or position of knee flexion to assess the overall volume of total blood loss, hidden blood loss, transfusion requirements and complications. We deemed it important to assess these factors because they may substantially affect clinical and complication outcomes in patients after primary TKA. Second, they did not establish funnel plots to determine publication bias. Third, one recent RCT reported in 2016 [19] drew a positive conclusion as the knee is in the mild-flexion position. This meta-analysis was therefore designed to compare the effectiveness and safety of two different limb positions in patients following primary TKA by evaluating: (1) blood loss, including total blood loss and hidden blood loss; (2) transfusion requirements and ROM; and (3) wound-related infection and thromboembolic complications, including deep venous thrombosis (DVT) and pulmonary embolism (PE). We hypothesized that different knee flexion positions would result in different degrees of effectiveness and safety.

2. Materials and methods

The methods used for this meta-analysis were based on the recommended PRISMA checklist guidelines [20].

2.1. Search strategy

We searched electronic databases, including PubMed (1966 to July 2016), EMBASE (1974 to July 2016), the Cochrane Library (July 2016), and Web of Science (1990 to July 2016). To identify additional potential studies, we also used the Google Search Engine through July 2016. The following keywords were used to search the databases: (flexion OR position OR splinting) AND (total knee arthroplasty OR total knee replacement OR TKA OR TKR).

2.2. Inclusion criteria

Studies were included based on the following criteria: (1) randomized controlled trials (RCTs); (2) participants underwent primary TKA; (3) interventions including knee flexion and extension positions; (4) sufficient sample size in each RCT; and (5) reported outcomes including blood loss, hidden blood loss, transfusion requirements, ROM, wound-related infection and incidence of DVT and PE. The exclusion criteria were as follows: (1) studies with cadaver and artificial models; (2) studies of revision knee arthroplasty; and (3) studies published in a language other than English. If any of the studies did not conform to the aforementioned inclusion criteria, they were excluded. Two of the reviewers (XXX, XXX) independently reviewed the titles and abstracts to identify potential studies; eligible studies were then considered for inclusion based on review of the full text. Discrepancies were resolved by consensus after discussion; a third reviewer (XXX) was consulted if necessary.

2.3. Assessment of methodological quality

The methodological quality of the included trials was assessed independently by the two reviewers (XXX, XXX). For randomized controlled trials, the reviewers used a specific tool to assess the methodological quality and risk of bias of the clinical trials as described by the Cochrane Collaboration for Systematic Reviews [21]. The six items of sequence generation, allocation sequence concealment, blinding, incomplete outcome data, selective outcome reporting, and other potential risks contained in the specific tool were considered to be a meaningful evaluation index. 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).

2.4. Outcome measures

The primary outcomes in this meta-analysis were total blood loss, hidden blood loss, and ROM in the mild-flexion and high-flexion groups following primary TKA. Furthermore, we also considered transfusion requirements and complications (including wound-related infection, DVT and PE) as the secondary outcomes in the two groups.

2.5. Data extraction

Two reviewers (XXX, XXX) independently extracted outcomes from the eligible studies in predefined data fields. The databases of the two reviewers were then compared, and disagreements were resolved by discussion. Information and data extracted from eligible studies included baseline characteristics, author(s), patients, ages, disease, intervention method, blood transfusion, DVT prophylaxis and DVT screening method. If the studies reported different follow-up periods in the same patient, we chose the longer duration of follow-up to avoid duplication of data. If