

# Efficacy of postoperative drainage in total knee arthroplasty: Review of the literature

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## Abstract

Postoperative drainage after total knee arthroplasty (TKA) is an established routine procedure for orthopedic surgeries, and is considered a useful practice in postoperative, but the use of drainage is controversial. Our study aims to clarify this aspect of knee prosthetic surgery. A systematic review of the literature was performed in the electronic databases to investigate the risks and the benefits of wound drainage in total knee arthroplasty: 30 articles were included in our review for eligibility. After the analysis of the literature performed, we found no significant advantages related with the use of wound drain following total knee replacement (TKR) in terms of pain, transfusion rate, blood loss, swelling, postoperative range of motion, wound complications, deep infection and hospital stay, while no drainage means a significant cost saving compared to drainage use. Thus, the use of drainage after TKA cannot be justified on the basis of the results of this study.

## Introduction

Knee osteoarthritis is an increasingly diffuse pathology, according to recent studies 1 in 10 US adult is affected by this disease.<sup>1</sup>

It could become a disabling disease, limiting walking and daily activities. This is the reason why total knee arthroplasty (TKA) has been on the increase over the years. The debate on total knee replacement (TKR) is therefore always more intense in order to perfect the technique.<sup>2-4</sup> The focus is on many variables that can affect the outcomes of TKA, including preoperative clinical plan, implantation technique, selection of implant materials and intra- and postoperative strategies.<sup>5-6</sup>

In the following discussion, our review is located and focused on the application of postoperative intraarticular wound drainage in total knee prosthetics. Wound drainage is an established routine procedure for orthopedic surgeries and is considered a useful practice in postoperative to decrease hematoma, surgical wound infection and wound dehiscence.<sup>7</sup>

However, the real benefit of drainage in TKA is not clear, and several authors are questioning its efficacy.<sup>8-10</sup> On the one hand some studies seem to demonstrate the association between drainage and increased postoperative blood loss, transfusion rate and average hospital stay, while on the other hand other papers seem not to confirm this evidence.<sup>11-12</sup>

Moreover, the drainage represents a 'communication' between the articular cavity and the outside and it could be considered as a source of retrograde infection. As mentioned, the use of drainage is controversial. Our study aims to clarify this aspect of knee prosthetic surgery, systematically analyzing the literature on this topic. Moreover, the socio-economic aspect related to the use of drainage should be considered, in a society where this aspect becomes increasingly relevant.<sup>13</sup>

## Materials and Methods

A systematic review of the literature was performed in the electronic databases Pubmed, MEDLINE, EMBASE, the Cochrane Library. The Mesh terms search were "(Drainage[Title] or Drain [Title]) AND (knee replacement[Title] OR knee arthroplasty[Title])" and was updated on February 2020.

### Study selection

Two reviewers collected the data obtained after systematic research and cataloged them independently of each other.

Articles that met the following eligibility criteria were chosen: randomized, prospective and retrospective observational controlled clinical trials and meta-analysis that compare clinical outcomes related with use or not use of drainage following TKA. There was no restriction about the date or place of publication.

A third reviewer had the task of checking the registry and eliminating duplicates and non-eligible articles: works that did not analyze the comparison between drainage and no drainage in TKR were excluded. Non-English studies were also discarded.

The total number of studies identified through database searching were 138. Following the previous criteria, 30 articles

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were included in our review (Figure 1).

### Data extraction

An adapted data extraction form was used, which included the following variables: pain, transfusion rate, blood loss, swelling, postoperative range of motion, wound complications, deep infection, hospital stay (Table 1).

Each parameter in each study was related, with the use or non-use of wound drainage (Tables 2 and 3).

## Results

Electronic databases were systematically searched for trials that investigated the risks

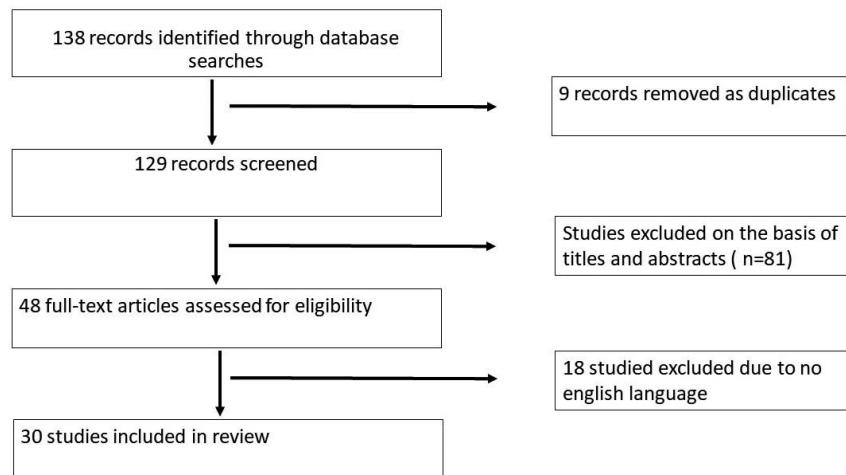
and the benefits of wound drainage in TKA. The studies identified through database searching were 138. From this first search, 9 were excluded because they were duplicates and 81 were excluded after the analysis of the title and the abstract because they were not focused on compare between drainage and no drainage in TKR, for a total of 48 articles. Moreover 18 articles were excluded because they were not available in English.

Thus, in all, 30 articles were included in our review.

## Discussion

### Swelling and hematoma

One of the advantages classically related to the postoperative drainage is the reduction



**Figure 1. Flowchart summarizing the selection process of randomized controlled trial.**

**Table 1. Parameters considered in each study.**

	Blood loss	Rom	Pain	Length of stay	Wound complication/ infection	Swelling/ knee circumference
Concina C <i>et al.</i>	✓	✓	✓	✓	✓	✗
Erne F <i>et al.</i>	✓	✓	✓	✗	✓	✓
Zhou K <i>et al.</i>	✓	✓	✓	✓	✓	✓
Mortazavi SMJ <i>et al.</i>	✓	✓	✓	✓	✓	✓
Raja A <i>et al.</i>	✓	✗	✗	✓	✗	✗
Wang D <i>et al.</i>	✓	✓	✓	✓	✓	✓
Si HB <i>et al.</i>	✓	✓	✓	✗	✓	✗
Watanabe T <i>et al.</i>	✓	✓	✗	✗	✓	✓
Zhang Q <i>et al.</i>	✓	✓	✓	✓	✓	✓
Li N <i>et al.</i>	✗	✗	✗	✗	✓	✓
Märdian S <i>et al.</i>	✓	✓	✗	✗	✓	✓
Quinn M <i>et al.</i>	✓	✓	✗	✗	✗	✓
Liu XH <i>et al.</i>	✓	✓	✓	✗	✓	✓
Zhang QD <i>et al.</i>	✓	✓	✗	✗	✓	✗
de Andrade MA <i>et al.</i>	✓	✓	✗	✗	✓	✓
Tai TW <i>et al.</i>	✓	✓	✓	✓	✗	✗
Parker MJ <i>et al.</i>	✓	✓	✓	✓	✓	✓
Corpe RS <i>et al.</i>	✗	✗	✗	✗	✓	✗
Ashraf T <i>et al.</i>	✗	✗	✗	✗	✗	✓
Niskanen RO <i>et al.</i>	✓	✓	✗	✗	✓	✗
Adalberth G <i>et al.</i>	✓	✓	✗	✓	✗	✓
Holt BT <i>et al.</i>	✓	✗	✗	✗	✗	✗
Ritter MA <i>et al.</i>	✓	✓	✗	✗	✗	✗
Sharma GM <i>et al.</i>	✓	✗	✗	✓	✓	✓
Jhurani A <i>et al.</i>	✓	✗	✗	✗	✗	✗
Abolghasemian M <i>et al.</i>	✓	✗	✗	✗	✓	✗
Lee QJ <i>et al.</i>	✓	✓	✓	✗	✗	✗
Keška Ret <i>et al.</i>	✓	✗	✓	✗	✗	✗
Confalonieri N <i>et al.</i>	✗	✓	✓	✓	✗	✓
Reilly TJ <i>et al.</i>	✓	✓	✗	✗	✓	✗

of hematoma and swelling at the surgical site, and consequently a faster recovery of the range of motion (ROM): the rationale is that no drainage could increase arthrocele and ecchymosis.<sup>14</sup>

Märdian *et al* measured the knee circumference at the upper patellar pole for intra-articular hematoma in TKA performed without tourniquet, and showed no significant difference preoperatively, but lower measurements for the drain group at day four and day six after the operation.<sup>15</sup>

In reality, our analysis of the literature does not reveal this reported hematoma and swelling reduction indeed according with it, Confalonieri *et al.* noted that knee circumference seems to be smaller already in the early postoperative days in the no-drain group compared with drain group.<sup>16-18</sup>

In support of this, the study performed by Varley *et al.* using ultrasound to assess postoperative drained and non-drained wounds after hip fractures demonstrated that

drains can prevent haematoma formation only whilst they remain in situ, once the drain is removed the haematoma reforms as without drainage.<sup>19</sup>

### Postoperative range of motion

As already mentioned, we investigated the influence of the use of drainage after TKR in the recovery of range of motion: drainage should favor faster recovery

reducing swelling. In this regard, we can cite the work written by De Andrade *et al.*, in which the authors have shown that there was no statistically significant difference between the groups with and without drains preoperatively, during the first postoperative day, on the fifth to seventh postoperative day or at the six-month follow-up, but the range of movement at the end of the first month was greater in the patients that received

**Table 2. It is reported the number of studies that showed better outcome with or without drainage for each parameter considered.**

	Drainage	Without drainage	No differences
Blood loss	0	9	17
Rom	3	2	16
Pain	1	3	9
Length of stay	0	5	6
Wound complication/ infection	0	3	16
Swelling/knee circumference	2	1	13

**Table 3. For each parameter considered in each study, the group that showed better outcome is reported (D: drainage or WD: without drainage). n.d. means no differences between two groups.**

	Blood loss	Rom	Pain	Length of stay	Wound complication/ infection	Swelling/ knee circumference
Concina C <i>et al.</i>	WD	WD	WD	nd	WD	
Erne F <i>et al.</i>	WD	nd	D		nd	nd
Zhou K <i>et al.</i>	nd	nd	nd	WD	WD	nd
Mortazavi SMJ <i>et al.</i>	WD	nd	nd	nd	nd	nd
Raja A <i>et al.</i>	WD			WD		
Wang D <i>et al.</i>	nd	WD	WD	WD	nd	nd
Si HB <i>et al.</i>	nd	nd	nd		nd	
Watanabe T <i>et al.</i>	WD	nd			nd	nd
Zhang Q <i>et al.</i>	nd	nd	nd	nd	nd	nd
Li N <i>et al.</i>					nd	nd
Märdian S <i>et al.</i>	nd	nd			WD	D
Quinn M <i>et al.</i>	nd	nd				nd
Liu XH <i>et al.</i>	nd	D	nd		nd	D
Zhang QD <i>et al.</i>	WD	nd			nd	
de Andrade MA <i>et al.</i>	nd	D			nd	nd
Tai TW <i>et al.</i>	WD	nd	nd	WD		
Parker MJ <i>et al.</i>	WD	nd	nd	nd	nd	nd
Corpe RS <i>et al.</i>					nd	
Ashraf T <i>et al.</i>						nd
Niskanen RO <i>et al.</i>	nd	nd			nd	
Adalberth G <i>et al.</i>	nd	nd		nd		nd
Holt BT <i>et al.</i>	nd					
Ritter MA <i>et al.</i>	nd	nd				
Sharma GM <i>et al.</i>	nd			WD	nd	nd
Jhurani A <i>et al.</i>	nd					
Abolghasemian M <i>et al.</i>	nd				nd	
Lee QJ <i>et al.</i>	nd	D	nd			
Keška Ret <i>et al.</i>	nd		WD			
Confalonieri N <i>et al.</i>		nd	nd	nd		WD
Reilly TJ <i>et al.</i>	WD	nd			nd	

suction drainage.<sup>20</sup> Furthermore, according with Lee *et al.*, the use of a short duration, low suction pressure drain following TKR seems associated with an earlier return of quadriceps power.<sup>21</sup>

However, most of the studies analyzed do not seem to demonstrate significant difference in ROM in patients undergoing TKA with or without drainage.<sup>22-25</sup>

### Blood loss

Many studies examined in this review focus on postoperative blood loss and subsequent transfusion rate and hospital stay. Blood loss is measured in pre and postoperative hemoglobin levels.

Regarding blood loss, there is no significant difference between the use and non-use of drainage, but in general closed suction drain placement is associated with low hemoglobin levels, an increased rate of allogeneic blood transfusion, and a longer hospital stay.<sup>26-29</sup>

This may be explained by inevitably increase bleeding because the tamponade effect of a closed and undrained wound is eliminated.

The study of Watanabe *et al.*, is appropriate, in which 63 patients (126 knees) who underwent simultaneous bilateral TKA were classified into 3 groups: closed suction drain on both sides (bilateral group), closed suction drain on one side and no drain on the other side (unilateral group), and no drain (no-drainage group). The mean hemoglobin drop on the day after surgery was significantly greater in the bilateral and unilateral group compared with the no-drainage group.<sup>30</sup>

### Pain

Pain is a fundamental aspect in postoperative course, both because it is directly linked to the patient's welfare but also because, according with Peters *et al.*, adequate pain relief accelerates rehabilitation.<sup>31</sup> In fact, pain evaluation was performed in almost all the studies examined, as it is a low cost but indicative measurement for the patient's well-being and compliance. Several authors have noted lower drug use and therefore less perceived postoperative pain in patients without the use of drainage or non-significant differences between the use and non-use of drainage.<sup>14, 32</sup>

Interestingly, Erne F. *et al.* have reported that patients without drainage related higher pain levels during the entire postoperative period and also at the 6-week follow-up but these differences could not be observed in longer follow-up.<sup>37</sup>

The study conducted by Mortazavi SMJ and al. in 2017 is peculiar. Evaluating the mean visual analogue scale (VAS) value in 106 hemophilic patients undergoing TKA

(half in which the suction drain was not inserted and half in which drain was inserted at the end of the surgery) they observed no differences between both groups.<sup>38</sup>

### Wound complication and deep infection

Another belief traditionally associated with the use of wound drainage is its prevention of wound complication.

Wound complications include ecchymosis, cellulitis, swelling, skin blistering, prolonged discharge, deep infection, and wound dehiscence. On this topic, Kim *et al.* analyzed wound complications in patients undergoing simultaneous bilateral knee arthroplasties and, reported a higher incidence of discharge from the wound, and more ecchymosis and erythema around the wound in no-drainage knees but wound complications were not significantly different.<sup>39</sup>

Parker *et al.* demonstrated in their study that the occurrence of wound infection and deep infection were not significantly different between the drainage group and no-drainage group.<sup>36</sup>

Equally, the studies performed by Abolghasemian M *et al.* in 2016 and Corpe *et al.* in 2000, led to the same result as the aforementioned studies regarding wound complication.<sup>40,41</sup>

### Hospital stay

The length of hospital stay and therefore the speed of recovery of the patient depends on all the variables examined previously and on several factors that can influence the postoperative course. For this reason it is difficult to clearly associate hospital stay and the use of drainage, as it is just one of the mentioned factors.

Examining 120 patients (135 knees) with primary total knee arthroplasty divided in a study group (no drain) and a control group (drain used), Sharma *et al.*, have observed that duration of hospital stay was more in the control group.<sup>42</sup>

Likewise, a similar study conducted by Raja *et al.* in Pakistan, (100 patients examined) showed that closed suction group also had an extra one-day stay in the hospital, while Concina *et al.* demonstrated no significant difference between the use or non use of drainage in terms of duration of hospitalization.<sup>32-33</sup>

### Conclusions

The use of drainage is common in clinical practice, but it is still unclear whether drainage is necessary after total knee arthroplasty.

This uncertainty has remained

unchanged over the years, as early in 2003, Canty *et al.* demonstrated that the majority of British Orthopedic surgeons interviewed did not practice evidence-based medicine with regard to the use of drains in knee arthroplasty.<sup>43</sup>

Furthermore, in economic terms, as early as 1998, Adalberth G *et al.* calculated a saving of SEK 400 (USD 55) per patient undergoing TKR without drainage and more recent studies have confirmed the increased costs associated with post-operative closed-suction drainage.<sup>13,35,44</sup> After the analysis of the literature performed, we can affirm that there seem to be no significant advantages related with the use of postoperative drainage following TKR in terms of pain, transfusion rate, blood loss, swelling, postoperative range of motion, wound complications, deep infection, hospital stay and its use cannot be justified on the basis of the results of this study. Future researches are needed to achieve the objective set forth in this article. Prospective cohort studies with numerous sample sizes should be performed in order to eliminate interpersonal variables and obtain reliable data.

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