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KNEE REVISION SURGERY

Suction drain usage has no benefit following revision total hip and knee arthroplasty

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Abstract

Introduction The use of drains after primary total joint arthroplasty (TJA) has shown little benefit. Few studies have investigated drain usage after revision TJA. The purpose of this study was to determine whether utilizing suction drains is beneficial for patients undergoing revision arthroplasty.

Materials and methods We performed a comprehensive literature review utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines from the PubMed, Embase, Web of Science, and Cochrane Library. Inclusion criteria of this review were all original articles written in English investigating the efficacy and safety of closed suction drainage in revision TKA or THA, reporting at least one of the following outcome measures: (1) estimated blood loss (EBL), (2) perioperative hemoglobin change, (3) needs for transfusion, (4) postoperative infection, and (5) wound complications. Articles were excluded if they are not available in English or they included case reports, systematic reviews, comments, editorials, surveys, or animal studies prior to July 22, 2023. A total of six studies met inclusion criteria. In total, 655 patients had a drain while 1765 patients did not have a drain after revision total hip or knee arthroplasty. Primary outcomes included for meta-analysis included estimated blood loss (EBL), postoperative hemoglobin, need for transfusion. Other data extracted includes postoperative infections, and wound complications.

Results Six studies met the inclusion criteria. In total, 655 patients had drains, while 1765 patients did not after revision total hip or knee arthroplasty. The average age of the patients was 66.1+/- 3.4 years, and the average BMI was 30.3 +/-0.8. There was no difference in postoperative infections ($p=0.14$), wound complications ($p=0.621$) or need for transfusion ($p=0.521$) between the two groups. There was also no difference in EBL (Hedges' g CI[-3.52, 2.77]) or postoperative Hb (Hedges' g CI[-1.65, 2.41]) between patients with and without drains.

Conclusions Our results do not show any benefit from drain placement after revision total hip or knee arthroplasty. With the increased cost, time and need for drain removal, this is likely an unnecessary intervention.

Level of evidence Level III, systematic review and meta-analysis.

Keywords Arthroplasty · Revision · Total hip · Total knee · Drain

Introduction

The use of drains after total hip and knee arthroplasty has been a topic of debate [1, 2]. Earlier literature identified the utility of closed suction drains in total joint arthroplasty to prevent the formation of hematomas and improve healing in primary joint arthroplasty. Closed suction drains are associated with increased blood loss [1, 3–6], shorter hospital stays [7–9], and hindered mobility [10] in patients undergoing total hip and knee arthroplasty, suggesting that the utility of these drains outweigh the issues associated with closed suction drains during the postoperative period. The increased utilization of tranexamic acid makes closed suction drainage less advantageous for primary total joint arthroplasty, with studies showing no difference in postoperative blood loss or transfusion rates between patients treated with tranexamic acid with or without closed suction drainage. [11] Earlier studies that supported closed suction

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drainage in primary joint arthroplasty [12] were completed prior to the mainstream use of tranexamic acid in total joint arthroplasty. The use of tranexamic acid, a common intraoperative practice for preventing blood loss and hematoma formation, questions the utility of suction drainage in primary total joint arthroplasty. Based on the current literature, closed suction drainage in primary total hip and total knee arthroplasty is no longer the best practice, given the alternatives available for preventing postoperative blood loss and hematoma formation [1, 2].

The use of closed suction drainage in revision joint arthroplasty is much more common than that in primary arthroplasty. Revision arthroplasty is more complex, has more extensive wounds, and has higher rates of wound complications than primary joint arthroplasty. [9, 13, 14] Closed suction drainage is used to prevent these complications associated with revision arthroplasty, but the evidence supporting this decision is limited.

The purpose of this study was to evaluate the utility of closed suction drainage for revision total hip and knee arthroplasty. We conducted a systematic review to evaluate the impact of drains on blood loss, transfusion, infection and wound complications in patients undergoing revision TJA. Based on the available literature [1, 2], we anticipate that there will be no significant difference in clinical or functional outcomes between patients with and those without postoperative drain utilization in revision hip and knee arthroplasty.

Methods

Literature search strategy and screening

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were utilized in this study. A comprehensive and systematic search was performed using the PubMed, Embase, Web of Science and Cochrane Library databases. The search was performed on July 22,2023 on all papers published prior to this date. The combination search strategy employed the following keywords: ("Arthroplasty, Replacement, Knee" OR Knee Replacement* OR Knee Arthroplasty* OR "TKA" OR "TKR") OR ("Arthroplasty, Replacement, Hip" OR Hip Replacement* OR Hip Prosthesis Implantation* OR Hip Arthroplasty* OR "THA" OR "THR") AND (("Suction" AND "closed") OR closed Suction* OR Drain* OR Mechanical Aspiration*) AND revision*. The search strategy was refined in collaboration with a professional librarian. Additionally, reference lists of the included studies were scrutinized for any additional publications not captured in our original search.

The inclusion criteria of this review were all original articles written in English investigating the efficacy and safety of closed suction drainage in revision TKA or THA that reported at least one of the following outcome measures: (1) estimated blood loss (EBL), (2) perioperative hemoglobin change, (3) need for transfusion, (4) postoperative infection, and (5) wound complications. Articles were excluded if they were unavailable in English or if they included case reports, systematic reviews, comments, editorials, surveys, or animal studies.

Two coauthors independently reviewed the titles and abstracts of all the resulting articles (O.S., J.M.), with disagreements resolved by consulting a third author (A.L.). Following the initial title and abstract screening, the remaining studies were meticulously reviewed. Six eligible studies meeting the criteria were selected (Fig. 1).

Data collection and outcome measures

The data retrieved from each study were extracted. The following study data were extracted: study data (authors, publication year, level of evidence, study design), number of patients, patient demographics (sex, age, ASA, BMI, TKA vs. THA), and patient inclusion criteria (Table 1). The outcome measures included EBL, preoperative and postoperative hemoglobin levels, changes in hemoglobin levels, need for transfusion, postoperative infection, and wound complications (Tables 2, 3 and 4). Patient-reported outcome measures were collected for each study (Table 5).

Data synthesis and analysis

An independent statistician conducted the data synthesis and analysis. The two treatment categories in the studies analyzed were closed suction drain use and no drain use. Postoperative hemoglobin and EBL were treated as continuous variables, with effect size as the standardized mean difference (Hedge's g). Binary outcomes (wound complications, postoperative infection, and need for transfusion) were analyzed with Fisher's exact test. All calculations were performed in SPSS version 23. The largest number of studies available for any one outcome was six. The outcomes that were not available for meta-analysis were reported in a descriptive fashion.

Study quality assessment and risk of bias assessment

Two coauthors (A.L.,J.M.) independently assessed the quality of each study. Nonrandomized studies were reviewed according to the Newcastle Ottawa Scale (NOS).The revised Cochrane risk-of-bias tool (Rob2) was used for randomized

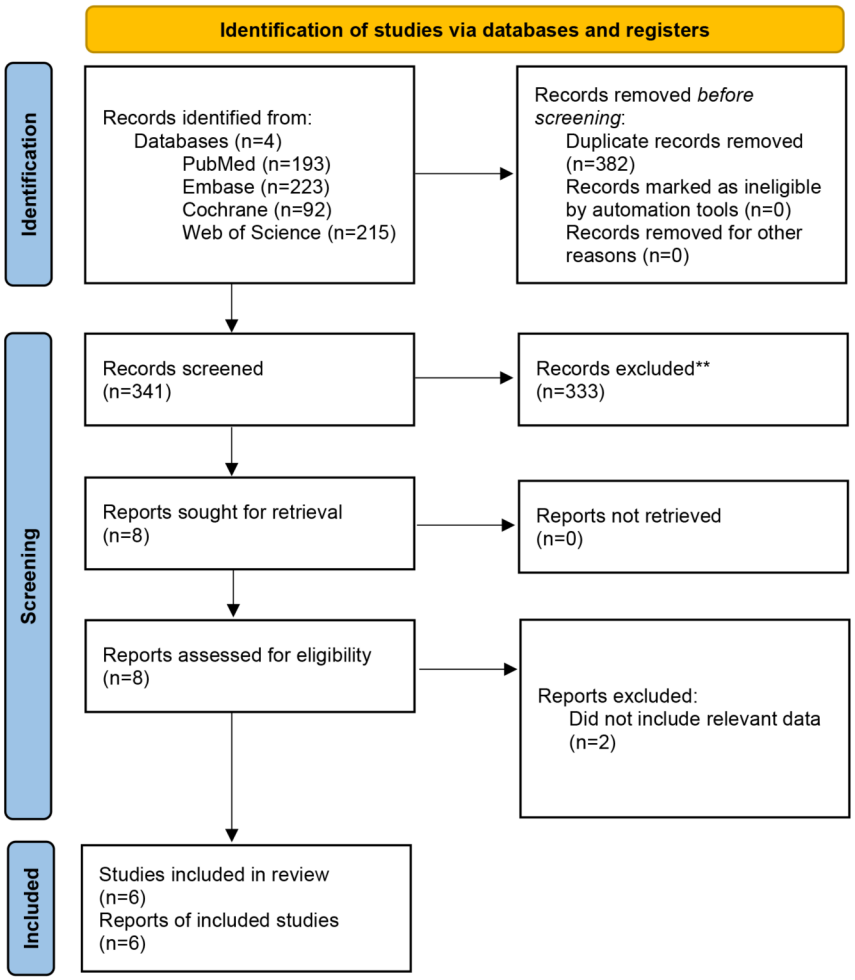

Fig. 1 Flow diagram displaying the systematic review of search strategy

trials. Discrepancies were resolved through group consensus. The assessment of each study can be found in Supplemental 1 and 2.

Results

Our initial search yielded 727 studies that were potentially relevant to this study (Fig. 1). Duplicates of studies found in multiple databases were excluded, leaving 341 unique entries. The title and abstract of the remaining studies were reviewed, and 8 studies were left for further review. After filtering out studies not about drain usage after revision arthroplasty, 6 studies were included in the final analysis. The data were screened in accordance with the PRISMA system. Study characteristics were described with four studies with level 2 evidence and two with level 3 evidence (Table 1).

In total, 655 patients had drains, while 1765 patients did not have drains after revision total hip or knee arthroplasty. The average age of these patients was 66.1 ± 3.4 years, and the average BMI was 30.3 ± 0.8, with 73% of patients being female (Table 1) [4, 15–19]. There were 299 reported revision THAs [4, 16–18], 91 reported TKAs [15, 17] and 2030 patients for whom the authors did not specify revision THA versus TKA [19]. 6.1% of patients with drains had postoperative infections versus 7.5% in patients with no drain. ($p = 0.14$) (Tables 2 and 3). Wound complications were found in 11.1% of patients with drains versus 10.5% without drains ($p = 0.621$). 20.5% of patients with drain were transfused postoperatively, compared to 21.5% without a drain. ($p = 0.521$). The drain group had an average EBL of 1244 versus1180 in the group without drains (Hedges' g CI[-3.52, 2.77]). Postoperative Hb levels were 11.4 for patients with drains versus 11.8 for patients without drains (Hedges' g CI[-1.65, 2.41]) (Tables 2 and 4).

No significant differences in postoperative infection, wound complications, postoperative EBL, postoperative Hb, and need for transfusion between the group with drains and the group without drains. The p values and Hedges' g numbers are shown for each corresponding variable in Tables 3 and 4.

Table 1 Study characteristics and demographic information

Article	Level of Evidence	Study Design	Number of Patients	Age (years) (Drain, No Drain)	Sex (Drain, No Drain)	ASA (Drain, No Drain)	BMI (Drain, No Drain)	Diabetes (Drain, No Drain)	Smoking (Drain, No Drain)	THA (Drain, No Drain)	TKA (Drain, No Drain)
Abolghasemian 2016	2	RCT	81	67.33, 69.85	20 M 21 F, 18 M 21 F	n/a	33.51, 33.56	n/a	n/a	0, 0	41, 40
Fichman 2016	2	RCT	88	71, 65	18 M 26 F, 22 M 22 F	2.5 (1–4), 2.5 (1–4)	31, 32	n/a	n/a	44, 44	0, 0
Bartosz 2022	2	RCT	40	56.6, 62.1	9 M 11 F, 8 M 12 F	n/a	27.7, 26.9	n/a	n/a	20, 20	0, 0
Ashraf 2001	2	RCT	74	79, 80	12 M 10 F, 20 M 32 F	n/a	n/a	n/a	n/a	22,42	0, 10
Okuzu 2023	3	Retrospective Cohort	107	74.4, 71.4	3 M 52 F, 5 M 46 F	n/a	23.8, 24.5	n/a	n/a	56, 51	0, 0
Najafi 2023	3	Retrospective Cohort	2030	65.1, 65.3	254 M 214 F, 683 M 875 F	n/a	30.5, 31.1	n/a	n/a	n/a	n/a
Total			**2420**		**316 M 756 F, 334 M 1008 F**					**142, 157**	**41, 50**
Average				**66.1 +/- 3.4, 66.1 +/- 2.9**		**2.5, 2.5**	**30.3 +/- 0.8**				

Among the studies reporting patient-reported outcomes, there was no difference between the studies at several time points (Table 5). Abolghasemian [15] found no difference in knee society (KSS) scores at 6 and 12 weeks between groups. Fichman [16] reported no difference in visual analog scale (VAS) or postoperative HHS between patients with and without drains. Bartosz [4] reported no difference in short-term VAS score at 3 days or postoperative HHS at 6 weeks. The HHS, Oxford Hip Score (OHS) and UCLA Activity Scale (UCLA) were also not different at 3 and 6 months, as reported by Okuzu [18].

Discussion

Our findings, similar to those demonstrated in primary arthroplasty, do not support the utilization of postoperative closed suction drainage in patients undergoing revision THA or TKA. No difference in the need for transfusion, postoperative hemoglobin concentration, or EBL between patients who did or did not have drains postoperatively. Across 26 studies, Basilco [2] reported no difference in blood loss between groups in 17 studies, with 9 studies finding less blood loss in patients without drains. Pempe [20] reported that drains were predictive of RBC transfusion alongside preoperative anemia in primary TKA and THA patients. Although not statistically significant, Okuzu [18] reported estimated blood loss to be 150 mL greater in the drain group after revision THA. Abolghasemian [15] found that blood loss and transfusion needs were greater in the drain group after revision TKA. Decreasing the need for transfusion is essential, as transfusion is associated with higher costs and complications. Decreased transfusion without drains is thought to be due to the tamponade effect of a closed wound. Revision cases are generally more extensive dissections resulting in more intraoperative bleeding, emphasizing the importance of identifying techniques to minimize transfusion needs. Increased utilization of TXA and the transition to aspirin for DVT prophylaxis may aid in decreased postoperative blood loss. [21]

No difference in wound complications or infections were found between the two groups in this review, challenging the theory that drains decrease postoperative wound complications. Postoperative hematomas are thought to act as a medium that facilitates bacteria proliferation, leading to increased infection risk. With more extensive dissections needed in THA and TKA revision arthroplasty coupled with increased dead space associated with postoperative hematoma formation, postoperative infection is a worthy concern in revision arthroplasty. Hematomas also increase pressure on the skin, decreasing skin perfusion and increasing the risk for wound dehiscence. [15] Willeman [22] reported

Table 2 Clinical outcomes data

Article		Total Patients in Each Group	Postoperative infection	Wound complications	Need for transfusion	EBL	Postoperative Hb
Abolghasemian 2016	Drain	41	3	3	.37 units/pt	1856	n/a
	No drain	40	4	4	0.15 units/pt	1533	n/a
Fichman 2016	Drain	44	4	4	20	n/a	8.6
	No drain	44	4	4	11	n/a	9.5
Bartosz 2022	Drain	20	1	18	13	1641	13.9
	No drain	20	0	12	8	1089.3	14.1
Ashraf 2001	Drain	22	2	13	n/a	n/a	n/a
	No drain	52	2	9	N/A	n/a	n/a
Okuzu 2023	Drain	56	0	2	8	1283	12.8
	No drain	51	0	5	3	1164	12.9
Najafi 2023	Drain	472	30	33	93	1170	n/a
	No drain	1558	122	152	357	1173	n/a
Total	Drain	655	40 (6.1%)	73 (11.1%)	134 (20.5%)	1244+/- 190	11.4+/- 2.2
	No drain	1765	132 (7.5%)	186 (10.5%)	379 (21.5%)	1180+/- 56	11.8+/- 1.9

Table 3 Variable analysis

Outcome Measure	*p*-value for Fisher's exact test
Postoperative infection	0.140
Wound complication	0.621
Need for transfusion	0.521

Table 4 Continuous variable analysis

Outcome Measure	Hedges' g	Hedges' g CI
EBL	-0.37	[-3.52, 2.77]
Postoperative Hb	0.38	[-1.65, 2.41]

that closed suction drains may increase infection risk, as the drain provides a route for retrograde infection. Willeman's study correlated the increased risk of infection directly to longer durations of indwelling closed suction drain. Infections after revision THA and TKA can be detrimental causing pain, instability and return to the operating room [13, 14]. With increased infection risk after revision arthroplasty, minimizing infection risk is important to prevent need for washout of explanation of revision components [13, 14]. The results from our study do not suggest that the presence

Table 5 Patient reported outcome measures

Article	Drain vs. No drain	KSS scores (6w, 12w)	VAS	p value	HHS (preop, 6 weeks)		OHS (pre-op; 3 mo; 6 mo)	P value	UCLA (pre-op; 3 mo; 6 m	P value
Abolghasemian, 2016	Drain	22.25, 33.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	No Drain	21.25, 31.98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fichman, 2016	Drain	N/A	pain VAS at 6 weeks: 2.64 (range 0-9) satisfaction at 6 weeks: 1.93 (range1-4)	.53, .53	43.3 (range 11.1-87.5), 63.1 (range 37.7-89.4)	.25, .82	N/A	N/A	N/A	N/A
	No Drain	N/A	pain VAS at 6 weeks: 2.33 (range 0-7), satisf	N/A	49 (range 10.5-98), 63.9 (range 40.5-89)	N/A	N/A	N/A	N/A	N/A
Bartosz 2022	Drain	N/A	pre-op: 3.8 (+-1.7) 3 day post-op: 3.6 (+-1.6)	.17, .61	45.4 (+-21.8), 65 (+-19.1)	0.81, .56	N/A	N/A	N/A	N/A
	No Drain	N/A	pre-op:3.2 (+-1.3), 3 day post-op: 3.9 (+-1.5)	N/A	46.8 (+-14.8), 61.9 (+-14.2)	N/A	N/A	N/A	N/A	N/A
Ashraf, 2001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Okuzu, 2023	Drain	N/A	N/A	N/A	(pre-op; 3 mo; 6 mo): 61.2 (+-21.8); 80.3 (75.2-88.2); 84.7 (76.4-89.4)	.57; .52; .35	33.2 (+-10.5); 42 (36-44); 43 (40-47)	.44; .25; .45	3 (3-5); 4 (3-5); 4 (3-5)	.49; .55; .86
	No drain	N/A	N/A	N/A	(pre-op; 3 mo; 6 mo): 58.9 (+-19.1); 83.2 (76.9-87.4); 86.1 (77.1-93.9)	N/A	34.8 (+-9.7); 43 (35-46); 45 (41-47)	N/A	3 (3-5); 4 (3-5); 4 (3-5)	N/A
Najafi 2023	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

of a postoperative drain increases infection rates, contrary to those studies mentioned previously.

Postoperative function and range of motion optimization are essential considerations after revision arthroplasty. Drains are hypothesized to improve the range of motion through decreased postoperative swelling. Evidence does not support this theoretical benefit associated with postoperative drain utilization. Range of motion was similar at postoperative days 1, 5–7, and 6 months between patients with and without drain placement post-primary arthroplasty. [23] Drains may actually limit early ROM for patients. In primary TJA, drains are associated with one additional day to regain active straight-leg raises. [1] KSS, VAS, and HSS scores were not different between groups at 6–12 months, similar to previous studies that evaluated the impact of postoperative drain utilization on patient-reported outcome measures.

Utilizing drains in the operating room is an unnecessary additional step that consumes operating room time, increases cost, and may delay patients from being eligible for same-day discharge. Several studies have shown that patients who undergo drain placement have longer hospital stays after TJA. [24, 25]. Yin [26] estimated postoperative drain utilization cost at $31.87, an expense that, based on our findings, provides no clinical benefit to the patient.

Limitations

Our study has several limitations. The literature evaluating the efficacy of closed suction drains in revision arthroplasty is limited compared to that in primary arthroplasty. The studies also lacked uniformity in the specific variables each study measures, which is expected with data from RCTs compared to retrospectively collected data. Due to the paucity of relevant evidence, we combined the results of revision THA and TKA. Differences in surgical technique exist between revision THA and TKA, such as the threshold for transfusion and the duration of drain implantation. In addition, the degree of complexity related to revision surgery may differ. Finally, postoperative complications after revision arthroplasty are rare. If a distinction genuinely exists, statistical significance for these rare events necessitates using larger sample sizes.

Conclusion

The findings of this systematic review do not support the use of postoperative closed drain suction in revision hip and knee arthroplasty. Our findings are similar to the current recommendations for closed suction drain utilization in primary arthroplasty. Based on these findings, the authors of this study do not recommend closed suction drain utilization in patients undergoing revision THA and TKA. Additional large, prospective studies investigating this topic are needed to adequately power individual analyses of revision THA and TKA populations.

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Declarations

Ethical approval All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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