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The Use of a Closed-Suction Drain in Revision Knee Arthroplasty May Not Be Necessary
A Prospective Randomized Study

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A B S T R A C T

Background: The benefit of suction drains (SD) for the first 24-48 hours following joint replacement surgery is controversial. We aimed to determine if there is any difference in the early outcome of revision TKA when performed with, or without SD.
Methods: 83 cases indicated for revision knee arthroplasty were randomized to receive (42) or not receive (41) a deep intra-articlular drain. First-stage revisions for treating periprosthetic infection were excluded. Patients were statistically compared for demographic parameters, early complications and early knee functional outcome. The assessed outcomes included total blood loss, number of transfusions, fever and wound complication rate at 24 months follow-up. In addition, the change in knee society score at 12 weeks postoperatively was compared between the groups.
Results: There were no significant difference in demographic factors, wound complications, knee scores at 12 weeks and infection rate 24 months after surgery in either group. Average blood loss was 1856ml and 1533ml for the drain and no drain groups, respectively (P value=0.0470). The need for transfusion was significantly less in the no-drain group with an average of 0.15 unit/patient as compared to an average 0.37 unit/patient for the drain group (P value=0.0432).
Conclusion: We were unable to find a point of superiority for using a drain for revision knee arthroplasty. Future studies with longer follow-up and larger population of patients are needed to make a valid conclusion.

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The advantage of a suction drain (SD) for revision total knee arthroplasty (TKA) has traditionally believed to be prevention of hematoma formation and subsequent wound complications. However, drains may complicate nursing and mobilization and early rehabilitation maneuvers of the patient, potentially affecting length of inpatient stay postsurgery [1].

The use of suction drainage after primary hip and knee arthroplasty has been thoroughly evaluated. Little benefit has been found with the usage of suction drainage [2-4]. Reduced amounts of blood loss and change in hemoglobin have been proposed when no drain is used [3-5]. Some primary arthroplasty studies have shown that blood soaking of dressing is more likely if SD is not used, however, with no significant consequences [6]. However, there are differences between primary arthroplasty and revision TKA. Revision surgery is often more complex, associated with longer incision, more bleeding, and potential for hematoma formation [7]. As a result, it is accepted that there is increased susceptibility to wound complications after a revision surgery when compared to primary TKA [8,9]. The same reasons are considered justifications for the use of SD in a revision surgery; however, there is a paucity of actual verifying data.

The purpose of this study is to investigate if using an SD is associated with any benefit after a revision knee arthroplasty when compared to the same surgery performed without use of SD. Primary outcomes were the amount of blood loss, the need for transfusion, rates of hemarthrosis, skin necrosis, wound dehiscence, and deep infection. Secondary outcomes included rates of superficial infection, soaked dressing, swelling, ecchymosis, blister formation, prolonged discharge, fever, reoperation, general complications, and the magnitude of postoperative pain and knee scores.

Materials and Methods

This is an REB-approved prospective, randomized trial on a series of revision knee arthroplasties performed in a single center by a single surgeon (DB). Only patients scheduled for revision of all components of a previous knee arthroplasty were included. Exclusion criteria included

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patients already on anticoagulation medications, those not willing to be included in the study, first-stage revisions for periprosthetic infection, cases with unsuspected infection that had positive intraoperative cultures, and patients with severe soft tissue compromise in need of soft tissue procedures such as rotational muscle flap with skin graft.

Patients were assessed in preadmission clinic 2 weeks before surgery to calculate the Knee Society Score (KSS) [10], measure the quadriceps force (Medical Research Council scale) [11], measure knee range of motion, and obtain an informed consent. All patients were admitted on the day of surgery and received routine urinary catheterization and prophylactic intravenous antibiotics (cephazolin [2 g] and gentamicin [80 mg] or ciprofloxacin [400 mg]). Pneumatic tourniquet was used for all patients and was deflated after the cement was cured. Intravenous tranexamic acid was administered immediately after tourniquet deflation whenever not contraindicated at a dose of 20 mg/kg. Contraindications to tranexamic acid included history of venous or arterial thromboembolism, ischemic cardiac or brain events, arterial or venous insufficiency of the lower limbs, and current malignancy. Standard medial parapatellar approach was used for all cases. All cases received Nexgen revision implants (Zimmer Orthopaedics, Warsaw, IN). Stemmed tibial and femoral prostheses were used with hybrid cementing technique (cementation of articular implants without cementation of stems). After hemostasis was obtained and before closure of the retinaculum started, randomization was performed by selecting a sealed envelope. Those randomized to receive a SD had a single Hemovac drain (Zimmer Orthopaedics) (approved by the Food and Drug Administration) placed inside the knee joint and attached to a vacuum reservoir after closure of the skin was performed, using staples. A bulky compression bandage was routinely applied to the limb up to the upper thigh for the first 2 days.

Enoxaparin 40 mg daily was used for all patients for thromboprophylaxis. Patients were ambulated, and knee active and passive motion was started the day after surgery with assistance of a trained physiotherapist. Suction drains were routinely removed on the second day after surgery regardless of drainage condition. The dressing was changed at the same time. Uncomplicated patients were discharged on the fifth day postoperatively.

The decision to proceed with transfusion was made by the senior author (DB). In patients with a history of cardiovascular disease, a hemoglobin level of less than 8 g/dL was the trigger point for transfusion. For all other patients, a hemoglobin level of less than 7 g/dL and hemodynamic instability were primary indications. A resting heart rate of greater than or equal to 90 per minute necessary for maintaining the blood pressure greater than 110/70 mm Hg in a well-hydrated patient was considered the trigger point for transfusion with hemoglobin levels between 7 and 10 g/dL.

In addition to demographic and surgery information, the following data were obtained and recorded for all patients: comorbidities as indicated by American Society of Anesthesiologists score, anesthesia type; use of tranexamic acid, preoperative and 72-hour postoperative hemoglobin; soaking of the wound dressing (defined as visible blood at the outer surface of the dressing, determined by the senior author [DB]) and the need to premature dressing change; amount of blood lost to SD reservoir; pain severity based on visual analog score (VAS) for the first 3 postoperative day; fever episodes defined as temperature greater than 38°C; wound complications including ecchymosis, cellulitis, swelling, skin blistering, hematoma formation needing evacuation, prolonged discharge (>3 days), suture abscess, deep infection, and wound dehiscence; and duration of hospital stay. Total amount of perioperative blood loss was calculated using a validated formula described by Rosencher et al [12] in which RBC is the acronym for red blood cells and Hct is the abbreviation for hematocrit:

$$\text{Total RBC loss (mL)} = [\text{Uncompensated RBC loss (mL)}] + [\text{Compensated RBC loss (mL)}]$$

$$\text{Uncompensated RBC loss (mL)} = [\text{Initial RBC (mL)}] - [\text{Final RBC (mL)}]$$

$$\text{Compensated RBC loss (mL)} = [\text{Sum of RBCs received from the various sources of transfusion}]$$

$$\text{Initial RBC (mL)} = [\text{Estimated blood volume (mL)}] \times [\text{Initial Hct level (\%)}] \text{ at Day} - 1$$

$$\text{Final RBC (mL)} = [\text{Estimated blood volume (mL)}] \times [\text{Final Hct level (\%)}] \text{ at Day} + 3$$

$$\text{Women}: \text{ Estimated blood volume (mL)} = \left[\text{Body surface area } \left(\text{m}^2\right)\right] \times 2430$$

$$\text{Men}: \text{ Estimated blood volume (mL)} = \left[\text{Body surface area } \left(\text{m}^2\right)\right] \times 2530$$

$$\text{Body surface area } \left(\text{m}^2\right) = 0.0235 \times [\text{Height (cm)}]^{0.42246} \times [\text{Weight (kg)}]^{0.51456}$$

$$\text{Total blood loss at Hct level of 35\% (mL)} = [\text{Total blood loss (mL)}] / 0.35$$

Diagnosis of deep infection was based on generally accepted criteria. The joint was considered to have a deep infection if (1) the patient presented with a sinus communicating with the joint; (2) purulence was found intraoperatively; (3) at least 2 preoperative or intraoperative positive cultures with the same organism were obtained; or (4) high inflammatory serum markers and associated abnormal intraoperative polymorphonuclear cell count [13]. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were the routine markers measured when infection was suspected. Cutoff points for abnormal erythrocyte sedimentation rate and CRP in our institution are 30 mm/h and 10 mg/L, respectively [14]. More than 10 PMNs per high-power field was considered elevated [15]. For diagnosing early postoperative deep infection, CRP level and PMN counts greater than 100 mg/L and 9000/μL, respectively, were considered abnormal [16].

Diagnosis of superficial infection was based on the clinical judgment of the surgeon (DB) as recorded in the chart. Prolonged discharge was diagnosed when the wound drainage persisted beyond the fifth postoperative day. *Swelling* was defined as the lack of skin wrinkles extending more than 2 cm from the incision when the wound was inspected 2 days after surgery. Only hematoma that resulted in wound complications or required evacuation was considered clinically important. In addition, distinguishing hematoma from soft tissue swelling was not possible in some cases without appropriate imaging which was not performed routinely for all swollen knees.

Force of quadriceps muscle, ability to straight leg raise, and range of motion were measured preoperatively and each day postoperatively during the patients' stay in the hospital. After discharge, basic and functional KSS were measured at 6 and 12 weeks by an advanced practice physiotherapist, blinded to whether an SD was used.

For a minimum of 24 months postoperatively, all patients were reviewed for emergence of any complications including infection, thromboembolism, and need for reoperation.

Statistical Analysis

The Student *t* test and Fisher exact test were used to compare the demographical and categorical features of the 2 groups with a *P* value less than .05 as the critical level of significance. Multivariate analysis (linear regression) was performed to assess the potential confounding factors affecting blood loss. Post hoc test was used to calculate the study power for parameters where significant difference was not detected