External Suction Drainage in Primary Total Joint Arthroplasties

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Abstract

We compared a novel external suction drainage (ESD) system with a conventional internal suction drainage (ISD) system in patients undergoing primary total hip or knee arthroplasties. Forty-two consecutive patients were studied: 22 who received an ISD system and 20 who received the ESD system. Drainage volume was measured, standardized questionnaires were used to assess patient comfort and response to drain removal, and number of complications were recorded. Significantly less drainage, less pain, and fewer complications occurred in patients treated with the ESD system ($P<.05$ for each endpoint). Results showed that ESD has advantages over ISD in primary total hip and knee arthroplasties.

Use of drainage systems for surgical wounds was first described in antiquity.[1] During the past century, various kinds of drains have been used clinically, including drains that functioned by gravity, wicking, or suction. Internal suction drainage (ISD) was first recommended for orthopedic applications in 1961, based on the theory that elimination of dead space promotes healing.[2] Results from subsequent studies did not show any benefit in using ISD in total joint arthroplasties.[3-6] Nevertheless, orthopedic surgeons have widely adopted the principle of ISD, and it is now a standard part of postoperative management after total joint procedures.

ISD can lead to complications such as infection,[7] increased blood loss,[8] need for blood transfusions,[4] and breakage of the drain tube.[9,10] In addition, patients may experience pain during removal of the drain tube.[11]

A possible alternative to ISD is a suction drainage system in which the drain tube remains external to the skin, to which it is sealed by means of an occlusive film to facilitate suction[12] ("external suction drainage," ESD). The purpose of the study reported here was to compare ISD with ESD in the postoperative management of total joint arthroplasties.

Materials and Methods

Our study involved 42 patients undergoing either primary total hip replacement (n=27) or primary total knee replacement (n=15). The hip procedures were performed with the patient under hypotensive anesthesia, using a cementless prosthesis (Intermedics, Austin, Tex, or Wright Medical, Arlington, Tenn), and the knee procedures were performed with a tourniquet and a cemented prosthesis (Zimmer, Warsaw, Ind, or Wright Medical, Arlington, Tenn).

Patients were randomly assigned to 1 of 2 surgical teams, each using only a single kind of drainage. One surgical team used a commercial ISD system (Snyder Hemovac; Zimmer, Warsaw, Ind) in a conventional manner. The system consisted of a polyvinyl chloride (PVC) tube (external diameter, 3 mm) containing perforations (diameter, 1 mm) spaced 6.5 mm apart in the portion of the tube ("drain tube") intended for placement in the wound; a fluid collection device; and a PVC tube (diameter, 6 mm) connecting the device to a suction apparatus. Before wound closure, the drain tube was passed from the subcutaneous tissues through a stab wound in the skin near the incision site and was connected to the fluid collection device, which was maintained at 120 to 300 mm Hg during the period the drain tube remained in the tissue.

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A second surgical team modified the ISD system to eliminate placement of the drain tube inside the wound (Figure 1). After the operative incision was closed, the region of the wound was covered with an absorbent sterile dressing, and the perforated portion of the drain tube was formed into a loop using a Y connector and was placed on top of the dressing. Another absorbent sterile dressing was placed on top of the drain tube, and an occlusive adhesive film (Ioban, 3M) was cut to extend 3 to 5 cm beyond the wound in all directions. The film was first attached to the skin at the opposite end of the wound from which the unperforated portion of the drain tube emerged from the Y connector. Moderate tension was maintained on the opposite end of the film as it was progressively sealed to the skin. The drain tube was lifted off the skin where it exited the film, which was pinched around the tube and sealed to the skin to form an airtight seal. Suction was maintained at 300 to 450 mm Hg.

Twenty patients were treated with ISD: 8 who underwent total hip replacement and 12 who underwent total knee replacement. Mean age was 54.8 years (SD, 2.4 years). Another 22 patients were treated with ESD: 7 who underwent total hip replacement and 15 who underwent total knee replacement. Mean age was 57.6 years (SD, 3.4 years). Patients were effectively randomized to the 2 types of suction drainage systems because any patient treated by a particular surgical team received the type of drainage system used by that team. The study was approved by the Institutional Review Board.

Drainage was measured at 8-hour intervals, and the drain tube was removed when the drainage became negligible (<20 mL). Total amount of fluid removed was recorded. A binary (yes–no) scale was used to evaluate pain caused by drain removal. Within 24 hours after drain removal, a series of questions was asked to determine patient comfort: Was the suction drain comfortable? Was it easy to take care of hygiene needs with the drain in place? Was the drain effective in keeping the operative site dry? Each patient answered these questions on a discrete scale ranging from 1 (best) to 3 (worst). Nursing notes were reviewed for information regarding nursing care occasioned by drainage system use. Postoperative complications were recorded up to 1 month postoperatively.

Data for the 2 groups (hip replacement, knee replacement) did not differ and therefore were combined. The *t* test was used to evaluate drainage data and patient comfort data, and the Fisher exact test was used to evaluate pain data and complications data.

Results

ESD immediately constricted the wound area when suction was first applied. Nothing similar occurred with ISD. Drainage and pain on drain removal were less with ESD than with ISD ($P<.05$ for each comparison) (Figures 2, 3).

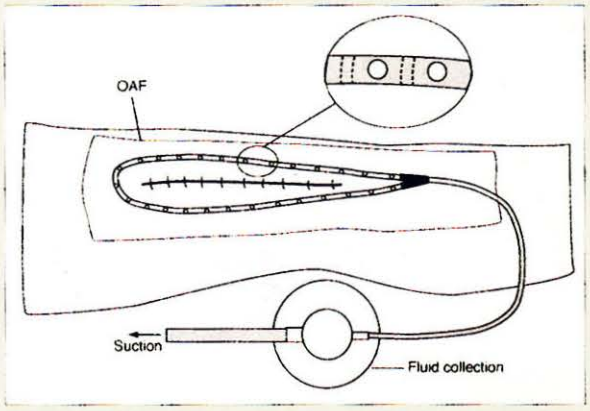

Figure 1. In this external suction drainage system, the drain tube (Snyder Hemovac; Zimmer, Warsaw, Ind) was modified to form a loop and was placed over the site of the incision. An occlusive adhesive film (Ioban, 3M) was attached to the skin and sealed around the drain tube, thereby forming a region of low pressure over the incision.

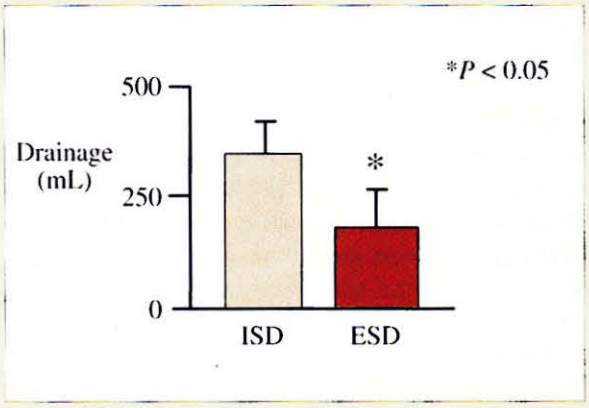

Figure 2. Effect of type of suction drainage on volume of serosanguineous fluid drained postoperatively from patients who underwent total joint arthroplasty. ISD, internal suction drainage (n=20); ESD, external suction drainage (n=22).

Mean patient comfort scores—3.05 and 3.45 for the ESD and ISD groups, respectively—did not differ significantly. There were no nursing notes regarding problems associated with ESD.

Postoperative fever over 100.8° F occurred in 82% of patients in the ISD group and in 35% of patients in the ESD group ($P<.05$). The ISD group had 26 complications, and the ESD group had 12 (Figure 4). In both groups, there were no infections.

Discussion

The term suction drainage used in connection with postoperative treatment of surgical wounds has come to mean use of some form of catheter placed deep in the soft tissue to facilitate vacuum-enhanced with-

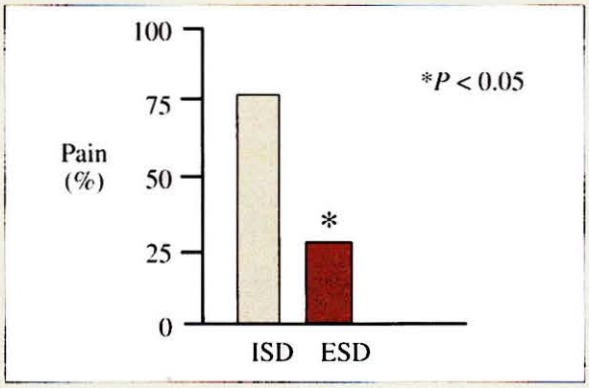

Figure 3. Association between type of suction drainage and incidence of pain on drain removal. ISD, internal suction drainage (n=20); ESD, external suction drainage (n=22).

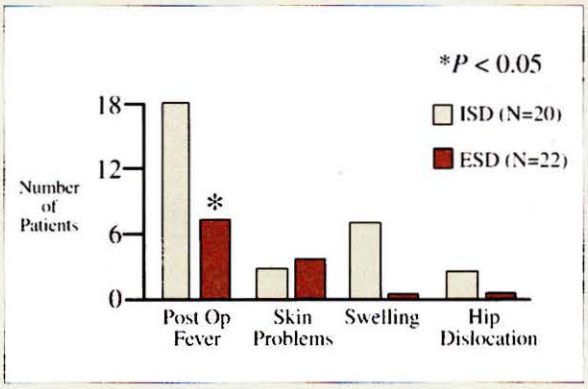

Figure 4. Complications in patients treated with internal and external suction drainage (ISD and ESD, respectively).

drawal of tissue fluids to promote wound healing. Despite repeated efforts in many studies to demonstrate the clinical efficacy of using suction drainage with an internal catheter,[1-6] no such evidence has been forthcoming. Nevertheless, use of ISD after orthopedic procedures has become standard practice. One difficulty with this custom is that ISD is associated with several kinds of side effects.[7-11] The incidence of these side effects is undoubtedly small compared with the extent of clinical use of ISD. Even so, a suction drainage system that at least matches ISD in performance but is associated with fewer complications would be a useful adjunct to postoperative wound care.

Results from this study showed that an ESD system (Figure 1) had several advantages over an ISD system in primary total joint arthroplasties. With ESD, there was less fluid loss (Figure 2). It could be argued that this result suggests that ESD is less efficient than ISD, but, as there was no fluid accumulation with ESD, we think a better argument is that ISD is less compatible with the wound-healing process because ISD extracts more fluid from the wound than is necessary for proper healing. ESD also resulted in fewer cases of postoperative fever (Figure 4), which is consistent with the view that ISD is physiologically suboptimal compared with ESD.

The ESD system did not violate the operative site and consequently resulted in less pain on removal (Figure 3). ESD kept the wound dry and sterile, maintained appropriate tissue apposition, and eliminated tissue dead space. ESD performance equaled ISD performance with respect to the endpoints of patient comfort and ease of nursing care. We would be surprised if any of the differences between the 2 groups were due to differences in level of surgical skill, because both teams were comparable on the basis of training, experience, and general performance. Nevertheless, as there was little crossover of surgeons between the 2 teams, we cannot exclude the possibility that surgical skill was at least partially responsible for the observed differences.

Conclusion

We conclude that ESD has advantages over ISD with respect to the endpoints of fluid loss, patient comfort, and development of postoperative fever. ESD should therefore be considered an alternative in uncomplicated total joint replacement in which the decision has been made to use suction drainage.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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