CHAPTER 51

# USE OF DRAINS IN FOOT AND ANKLE SURGERY

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Today's foot and ankle surgeon has a number of ancillary tools in his armamentarium. When used properly, they provide an invaluable mechanism for successful surgical intervention and enhancement of the postoperative course. Among these tools are surgical wound drainage systems.

## HISTORICAL REVIEW

The use of drains in medicine dates back to the third century BC when Hippocrates utilized hollow tubes to treat empyema (1-3). Other individuals of that era used various materials ranging from lead pipes to linen to hollowed-out bones with limited success. Several hundred years later during the sixteenth century, Ambroise Pare would be given credit for being the first individual to question the frequent use of drains. He noticed a very common problem where the healing tissue grew around and into the holes of the drain obstructing flow and complicating removal (2). This complication raises the question of how long the drains were actually left in place. Even today, almost twenty five hundred years later, the use of drains in orthopedic surgery is still questioned. In 1890, Charles Penrose proposed an improvement on the rubber tubing by surrounding gauze with an ordinary condom, the end of which had been cut open (3). The Penrose drain became the drain universally used to avoid tissue damage in situ and upon removal until suction drainage was introduced at the close of the nineteenth century; a development that was considered a major advancement. In the early 1950s, the use of negative pressure drains to hold skin flaps against the thoracic wall in mastectomies was described. Wound healing with practically no serum formation and minimal marginal skin necrosis was noted (4). The first portable enclosed wound suction unit was unveiled in Paris in 1954 and twenty years later, Dr. Stanley Kalish developed the TLS drain (5). In 1980, Miller and Kalish first described the use of this closed suction wound drainage system in 35 cases (6,7) and today, it is the drain most commonly used in our institution.

## TYPES OF DRAINS

Drains can be classified based on various factors or characteristics; a practical and useful description is based on the mechanism of action (8). The mechanism of action of drains is either passive or active. Passive drains work in the absence of any electrical or mechanical means (2,9). They depend on the higher pressure inside the wound, gravity, and capillary action to evacuate fluid from a wound (8) into the surrounding dressing. The classic example of a passive drain is a Penrose drain. Since the drained material collects in the dressing, the wound may become macerated and serve as a portal for infection. Active drains are attached to a vacuum device that works through negative pressure to draw the fluid from the wound while atmospheric pressure provides compression (10, 11).

A drain should be firm enough to remain in its intended place while resisting twisting or kinking. It should also be wide enough to prevent easy blockage of effluents and smooth to prevent fibrin adhesions to it and facilitate easy removal (7). The drain should not cause a reaction in the patient and should be nonelectrolytic and noncarcinogenic. Finally, something that is not as important today as it was during the early years of drain evolution is the fact that a drain needs to resist decomposition or disintegration to keep from leaving any foreign materials behind in the body.

## ADVANTAGES OF DRAINS

Closed suction drainage, as reported in the literature (1, 6, 11-20), withdraws pools of blood and air pockets from a wound, obliterating dead space from surgical sites. As a result, this minimizes the inflammatory process by providing conditions conducive to optimal wound healing. Disruption of blood vessels, lymphatics, and tissue excision lead to fluid collection in tissue spaces and potentially to increased pain due to added pressure against skin, nerves, and blood vessels resulting in ischemia. This decreased perfusion will also slow healing by prolonging the inflammatory phase, and skin necrosis can occur from lack of skin coaptation in extremity cases. The use of postoperative drains minimizes the occurrence of ecchymosis, need for frequent dressing changes (10), scar formation, adhesions, and tissue contraction. All this is possible by removing the void that the granulation process will need to fill in (1, 12).

## PRINCIPLES AND INDICATIONS OF CLOSED SUCTION DRAINS

Any procedure that has the potential for accumulating transudative or exudative fluid will benefit from a surgical drain. These potential fluid collections can result from procedures that require extensive dissection, result in dead space, or expose a substantial amount of medullary bone (13). The deliberate controlled egress of fluids will allow a gradual collapse and apposition of tissue. Procedures where we have used closed drainage systems include but are not limited to rearfoot and midfoot fusions, neuroma removal, trauma, excision of plantar fibromatosis, amputations, and heel spur resection.

In 1981, Miller (11) described four principles of closed suction drainage: hemostasis, external drainage, negative pressure, and an airtight wound. The first principle of hemostasis refers to the notion that drains do not replace anatomic dissection but are instead designed to remove the unavoidable, natural fluid accumulation after certain procedures. The second principle refers to the external reservoir that the drainage tube attaches to and its characteristics as described above. Negative pressure allows the drain to be placed in any position and yet still be effective. An airtight wound is necessary for optimal function of the drain. Exiting of the drainage catheter through a different hole is one of the ways this is attained.

A 2007 Cochrane review by Parker et al (10) reviewed and compared the use of drains in orthopedic procedures involving hip and knee replacement, shoulder surgery, hip fracture surgery, spinal surgery, cruciate ligament reconstruction, open meniscectomy, and fracture fixation surgery. The review included all randomized to quasi-randomized trials comparing the use of closed suction drainage systems with no drainage systems for all types of elective and emergency orthopedic surgery. Pooling of results from 36 studies and 5,697 surgical wounds indicated the need for reinforcement of wound dressings, skin edge necrosis, bruising/ecchymosis and possible trend to more wound hematoma in the undrained group. A statistically significant difference in wound infection was not found between the two groups.

## TECHNICAL PEARLS

- The tubing of the drainage system should be placed in the appropriate layer. It should reach the deepest most dependent part of the wound. For example, in a triple arthrodesis, the tubing should be placed underneath the deep fascial layer where a significant amount of bone bleeding is expected.
- Drain tubing should exit through a separate stab incision at least 2 cm away and not through the surgical incision.
- Poorly placed drains may dislodge and kinking and knotting of tubing may cause blockage, which can increase pain and pressure.
- Prolonged use of drainage systems offers no additional advantage just as premature removal of a drain before it has completed its function increases morbidity and is a waste of resources. On average, the majority of wound drainage occurs within the first 24-48 postoperative hours (21).
- Negative pressure inside the tube slowly declines as it fills up and for this reason, tubes should be replaced when 1/2 to 2/3 full.
- Finally and most importantly, a drain should never be used as a substitute for meticulous hemostasis and anatomic dissection.

## CONCLUSION

When indicated and appropriately implemented, closed suction drainage systems maintain optimal conditions in the management of surgical patients by removing body fluid that accumulates in the wound bed and eliminating dead space after surgical procedures.

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