

**A Cost Analysis of Irrigation Methods for Open Fractures:  
Are High-Pressure and Very Low-Pressure Delivery Devices Equivalent?**

*Jesse Chlebeck, MD; Michael Blankstein, MD; Thomas Kristiansen, MD;  
Craig Bartlett III, MD; Patrick Schottel, MD*

*University of Vermont Medical Center, Burlington, Vermont, USA*

**Background/Purpose:** Timely irrigation and debridement of open fractures is currently considered the standard of care. While no definitive guidelines exist, irrigation with multiple liters of fluid using either very low-pressure gravity flow tubing or higher-pressure pulsatile lavage devices is commonplace. Recently, a multicenter, randomized controlled trial of open extremity fractures found that the delivery pressure of the irrigation solution had no effect on reoperation rate at 12 months for infection, wound-healing, or bone-healing problems. With neither delivery device showing clinical superiority, we performed a cost analysis of two commonly used irrigation devices. We hypothesized that gravity flow tubing would overall be costlier due to longer irrigation time.

**Methods:** Two irrigation delivery devices were used in our study. For very low-pressure gravity flow irrigation we used transurethral resection flexible irrigation tubing (Hospira) and for high-pressure irrigation the InterPulse pulsatile lavage device (Stryker). Both delivery methods are commonly used by our orthopaedic trauma service for the irrigation of open fractures. Three different irrigation quantities were tested: 3 L, 6 L, and 9 L. Each 3-L bag of fluid was placed on an IV pole extended to a height of 8 feet. All irrigation was performed at a height of 4 feet with a Y-connector when more than one bag of irrigation was tested. Each of the two devices were used to irrigate with the three different quantities of irrigation fluid. The total time for all of the irrigation fluid to completely run through the irrigation device was recorded. Five separate trials were performed. Our institution's cost for each irrigation device as well as current operating room and anesthesia charges were obtained from our operating room administration and recorded.

**Results:** The very low-pressure gravity flow irrigation was significantly faster on average than the high-pressure delivery device for all fluid quantities tested: 9 L - 373 versus 530.2 seconds; 6 L - 229.6 versus 364 seconds; and 3 L - 134.4 versus 171.4 seconds. The gravity flow tubing was more than 2 minutes faster than the pulsatile device for irrigation of both 6-L and 9-L quantities. At our institution, gravity flow tubing costs \$9.94 and the pulsatile device is \$41.67. Typical operating room charges were found to be \$63.00 per minute and average anesthesia costs are \$122.00 per 15-minute block. Therefore, the cost of irrigating an open fracture was less expensive with gravity flow tubing resulting in a cost savings of \$157.73 per 6-L and 9-L case and \$31.73 for 3-L cases. Over an 8-year period at our institution we treated an average of 50 open fracture cases per year requiring 6 L or 9 L of irrigation and 50 cases requiring 3-L irrigation. Therefore, exclusively using very low-pressure gravity flow tubing instead of a pulsatile lavage device would save our institution approximately \$9473 per year.

**Conclusion:** Very low-pressure gravity flow irrigation was found to not only cost less but irrigate faster than a pulsatile device. Using our institution's current operating room, anesthesia, and irrigation device costs, we estimated that converting exclusively to use of gravi-

ty flow irrigation would save our trauma center a modest \$9473 per year. Our findings may not be applicable to other institutions depending on the structure of operating room and anesthesia charges as well as negotiated device costs. Ultimately, based on our findings of only nominal cost savings, we believe that the choice of irrigation device should be at the discretion of the surgeon depending on the particular circumstances of each open fracture case.

The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.