Do arthroscopic fluid pumps display true surgical site pressure during hip arthroscopy?

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Top Level Summary:

The purpose of this study was to report on the accuracy of five commercially available arthroscopic fluid pumps to measure fluid pressure at the surgical site during hip arthroscopy. **Results demonstrate that joint-calibrated pumps reflect surgical site pressure more accurately than gravity-equivalent pumps.**

Methods:

This prospective block-randomized study included 25 patients (Five patients per pump group; Table 1) undergoing hip arthroscopy for femoroacetabular impingement (FAI).

Table 1. Joint-calibrated (JC) vs. Gravity-equivalent (GE) pumps.

	Pump type	Method to estimate surgical site pressure
JC Pumps	Stryker CrossFlow (SC)	• Direct measurement in the arthroscope cannula • Computer algorithm that integrates frictional losses and flow rates into the calculation of the displayed pressure
	ConMed Linvatec 24K (LC)	
	Arthrex Continuous Wave III (ACW)	
GE Pumps	Medical Vision Double Pump RF (MVDP)	• Gravity tubing setup; pressure (mmHg) is equivalent to the hydrostatic pressure produced by an irrigation fluid bag placed at a variable height above the surgical site
	DePuy Mitek FMS/DUO+ (DM)	

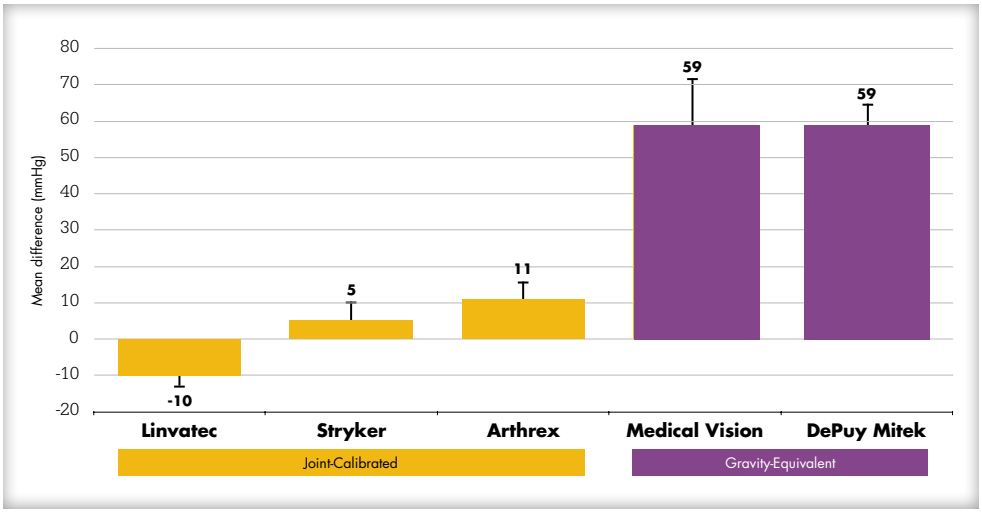
A 21-guage cannulated needle placed at the location of the traditional anterior portal needle was connected to an arterial line pressure-monitoring system (Edward Lifesciences), and the pressure was measured by an anesthesia machine (GE Healthcare Aisys CS). The surgical site pressure as measured by the arterial line and the displayed fluid pump pressure were manually and simultaneously recorded at 30-second intervals. The collection period began after introduction of the needle into the surgical site and continued for the duration of the case.

The irrigation fluid bag was placed at a standard height of 60 inches above the surgical site. Pressures were set at 40 to 50 mmHg for the joint-calibrated pumps and 110 mmHg for the gravity-equivalent pumps. Intermittent pressure increases of 20 mmHg for two minutes were used to improve visualization.

Results:

A statistically significant difference in mean pressure was found between joint-calibrated and gravity-equivalent pumps, as **joint-calibrated pumps were found to reflect surgical site pressure more accurately than gravity-equivalent pumps** ($p < 0.001$; Fig. 1). Of the five pumps studied, the three joint-calibrated pumps reflected the operative field fluid pressure within 11 mmHg of the pressure readout. In contrast, the two gravity-equivalent pumps showed a difference of greater than 59 mmHg between the operative field fluid pressure and the pressure readout. Despite these pressure differences, both pump designs were used to safely and effectively accomplish hip arthroscopy.

Figure 1. Mean differences per pump group between pump set pressure and surgical site pressure. Data are presented as mean (standard deviation) in millimeters of mercury. A positive value reflects that the displayed pump pressure was greater than the surgical site pressure.



Clinical Relevance:

The entire discussion regarding whether pump pressure is a risk factor for fluid extravasation hinges on what type of pump is used and the surgeon's awareness of how the pump calculates the displayed pressure.

In general, gravity-equivalent pumps require a higher pump setting to obtain appropriate surgical site pressure for visualization. This is based solely on their design and is not a judgement of their effectiveness or safety. However, surgeon knowledge of pump design is very important, especially if changing from one design to another. Consider a surgeon changing from a joint-calibrated pump to a gravity-equivalent pump, as might occur as a surgeon travels from one hospital to another. This circumstance would result in the need to increase the pressure set point to achieve the same surgical site pressure and avoid the perception of pump underperformance. On the other hand, a surgeon changing from a gravity-equivalent pump to a joint-calibrated pump would need a lower pressure set point or would risk an unrecognized, and potentially dangerous, increase in surgical site pressure.

From the current literature, it is difficult to truly decipher what the optimal pump pressure may be to avoid excessive fluid extravasation because the type of pump used was not defined. However, with a basic understanding of pump design, either type of pump can be used safely and efficiently.

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