SUTURING WITH Senhance® Surgical System: AN ANALYSIS SHOWING THE BENEFIT OF ARTICULATING INSTRUMENTS

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Objective

The study evaluates the Senhance® Surgical System's articulating needle driver, a robotic-assisted laparoscopic instrument with additional degrees of freedom compared to the Senhance® straight needle driver.

Background

The Senhance® Surgical System is digitizing laparoscopy by integrating advanced technology—robotic precision, haptic sensing, eye-tracking camera control, and improved ergonomics. The open-platform architecture allows for compatibility with 3DHD and fluorescence vision along with other existing laparoscopy systems .

The Senhance articulating needle driver Instrument is Robotic assisted digital laparoscopy instrument with 5 mm diameter, 360° tip rotation, 63 ° tip deflection in combination with 360° shaft rotation needle driver.

As a robotization of hand-guided r2 DRIVE-instruments and successor of Senhance articulated Radia instruments, Senhance articulating needle driver with deflectable tip to parallel to the suture line and rotatable tip enter and emerge from the tissue with the ideal angle may perform a fast-learning curve in laparoscopic suturing tasks than Senhance straight needle driver.



Image . Senhance force feedback handles on Laparoscopic Teleoperation Masters

Methodology

An experienced general surgeon with prior knowledge of Senhance® straight needle driver (STR) and Senhance® articulating needle driver (ART) received 20 hours of intensive training on both instruments. Training involved knot-tying, running suturing, needle control, and quadrant suturing. Time and accuracy were measured for knot-tying and suturing tasks. Needle control involved suturing at different angle planes (30°, 60°, 90°), with actions and time recorded. A quadrant suture task was performed using a circular pad with ten quadrants.



Image 1 . Suture and tying with articulating needle holder in horizontal direction



Image 2. Quadrant suturing with articulating needle driver

Results

In knot-tying, there were no significant differences between groups. In horizontal running suturing, the ART was significantly faster. In needle control, the ART need less time and less actions on 30° angle plane. In the quadrant suture task, the STR faced difficulties at the fifth and tenth quadrant, while the ART allowed successful completion in six attempts.

Table 1. Results of running suturing task

		Straight needle driver(n=12)	Articulating needle driver(n=8)	p Value
Running suturing Vertical	Times (s)	313.6±72.1	302.0±77.2	ns
	Accuracy (%)	100±0.0	100±0.0	ns
Running suturing Horizontal	Times (s)	409.4±102.7	292.3±76.1	**0.0124**
	Accuracy (%)	100±0.0	100±0.0	ns

Table 2. Results of needle control task

		Straight needle driver(n=3)	Articulating needle driver(n=3)	p Value
Needle control Vertical 30°	Times (s)	43.2±21.2	72.3±29.8	ns
	Actions (n)	1.2±0.4	1.3±0.6	ns
Needle control Horizontal 30°	Times (s)	95.2±50.1	51.4±7.3	**0.0357**
	Actions (n)	2.0±0.0	1.0±0.0	**0.0179**

Conclusion

The ART excels in horizontal running suturing and 30° plane horizontal needle control, offering advantages in challenging suturing angles. Its design reduces the need for needle repositioning, improving efficiency. With two extra degrees of freedom, it enhances needle handling and positioning, particularly beneficial for reconstructive techniques.



Image 3 . Setup of suture task of Senhance® manipulator arms and cockpit

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