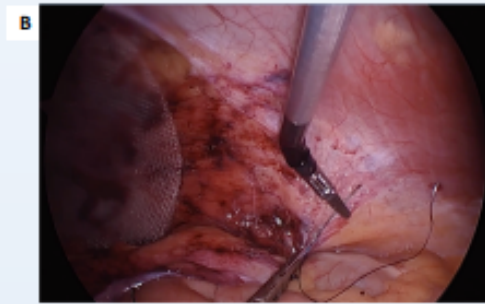
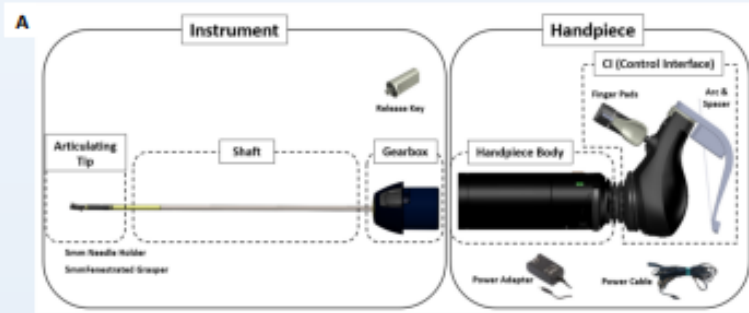


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## BACKGROUND

- The laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair is a widely-used minimally invasive operation, but can present considerable ergonomic challenges for the surgeon.
- Our objective was to determine if a novel handheld software-driven laparoscopic articulating needle driver can mitigate these difficulties.



A. HandX™ device by Human Xtensions. B. Utilization of the articulating elbow of the HandX™ device to facilitate laparoscopic suturing at the anterior abdominal wall.

## METHODS

- The video recordings of a consecutive series of TAPP cases by a single surgeon using the articulating device were compared with a series of cases using traditional straight-stick laparoscopy.
- Two major steps of the procedure were analyzed: mesh fixation and peritoneal suture closure.
- A learning curve analysis for the novel device was performed by comparing these metrics before and after 10 initial consecutive cases.
- A cost analysis was also performed between the two techniques.

## RESULTS

- The surgeon averaged 227 seconds to fixate the mesh using tacker devices, compared with 462.4 seconds for suture fixation using the novel laparoscopic device ( $p=0.06$ ).
- The surgeon improved the time per suture pass during peritoneal closure from 60.61s during the first 10 cases to 38.84s after a 10 case learning curve ( $p=0.0004$ ), which was comparable to the time per stitch for standard laparoscopy (34.8s vs 34.84s,  $p=0.997$ ).
- Left-sided inguinal hernia repairs using the articulating device demonstrated a significantly longer time per stitch compared to the right side after the 10 case learning curve (left: 40.62s; right: 27.91,  $p=0.005$ ).
- Our direct cost analysis demonstrated that suture-closure of the peritoneum using the articulating device was more-cost effective than tack fixation.

	Standard Laparoscopy	Hand X Device	p
<b>MESH FIXATION</b>			
Mesh Fixation (t)	227	462.39	0.059
Mesh Fixation After 10 Case HandX™ Learning Curve (t)	227	403.27	0.106
<b>PERITONEAL CLOSURE</b>			
Time of closure all cases (t)	594.63	720.26	0.084
Time of closure during first 10 HandX™ cases (t)	594.63	779.88	0.063
Time of closure after first 10 HandX™ cases (t)	594.63	676.91	0.281
Number of stitches all cases	17.25	16.74	0.788
Number of stitches during first 10 HandX™ cases	17.25	13.00	0.047
Number of stitches after 10 HandX™ cases	17.25	19.45	0.230
Time per stitch all cases (t)	34.83	45.69	0.016
Time per stitch during first 10 HandX™ cases (t)	34.83	60.61	0.0005
Time per stitch after first 10 HandX™ cases (t)	34.83	34.84	0.997

	First 10 HandX™ Cases	After 10 HandX™ Cases	p
<b>PERITONEAL CLOSURE</b>			
Time of closure (t)	779.88	676.91	0.273
Number of stitches	13.00	19.45	0.0002
Time per stitch (t)	60.61	38.84	0.0004
<b>Right Sided</b>			
Time of closure (t)	676.00	535.60	0.151
Number of stitches	12.00	19.20	0.005
Time per stitch (t)	57.13	27.91	0.004
<b>Left Sided</b>			
Time of closure (t)	953.00	794.67	0.174
Number of stitches	14.67	19.67	0.030
Time per stitch (t)	66.40	40.62	0.117

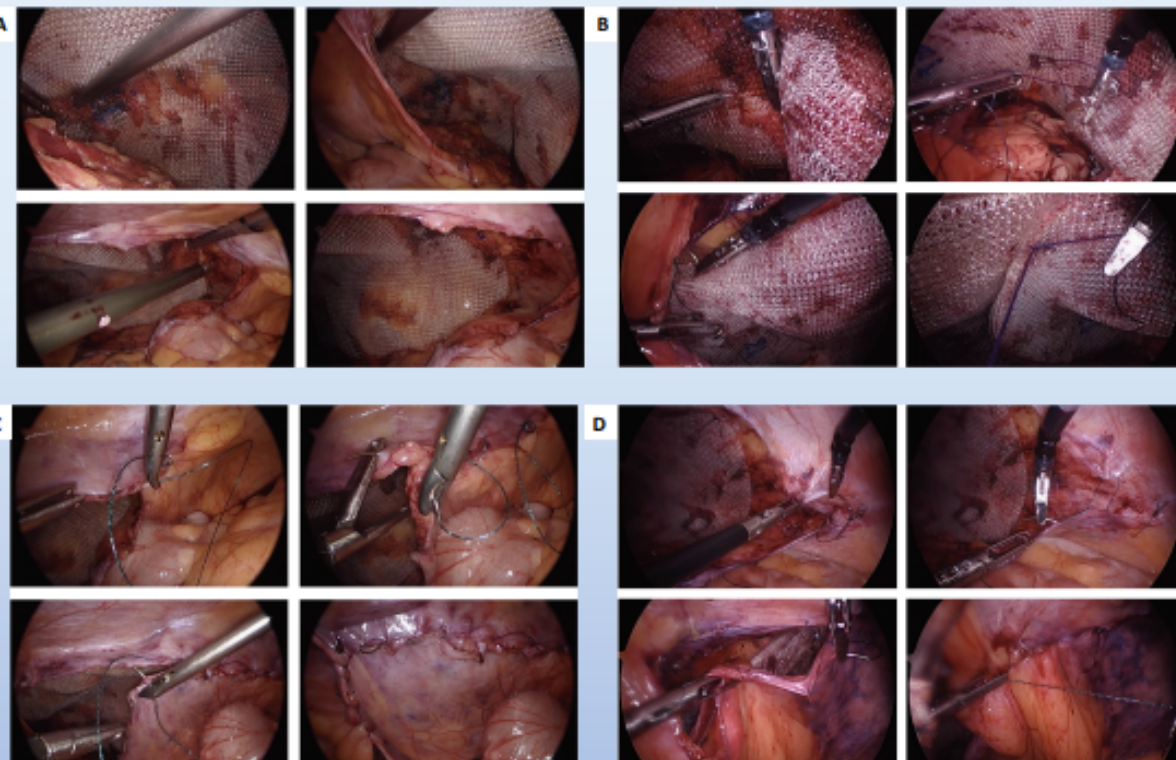
	Right	Left	p
<b>PERITONEAL CLOSURE</b>			
Standard laparoscopy (t)	578.50	610.75	0.791
Standard laparoscopy number of stitches	16.75	17.75	0.793
Standard laparoscopy time per stitch (t)	34.81	34.85	0.991
HandX™ all cases (t)	605.80	847.44	0.002
Number of stitches all cases	15.60	18.00	0.192
Time per stitch all cases (t)	42.52	49.21	0.392
First 10 HandX™ cases (t)	676.00	953.00	0.055
After 10 HandX™ cases (t)	535.60	794.57	0.004
Number of stitches first 10 HandX™ cases (t)	12.00	14.67	0.195
Number of stitches after 10 HandX™ cases (t)	19.20	19.67	0.679
Time per stitch first 10 HandX™ cases (t)	57.13	66.40	0.441
Time per stitch after 10 HandX™ cases (t)	27.91	40.62	0.005

TAPP, STANDARD LAPAROSCOPIC TECHNIQUE – TACKER FIXATION OF MESH				
				Average Cost per Operation (USD)
Disposable Laparoscopic Stapler <sup>1</sup>				\$488.27
TAPP, HANDX™-ASSISTED LAPAROSCOPIC TECHNIQUE – SUTURE FIXATION OF MESH				
# Annual Procedures	Capital Expense*	Service Expense*	Instrument Expense*	Total Cost per Operation (USD)*
200	50.00	10.00	310.00	\$370.00
300	33.33	6.67	310.00	\$350.00
LIGHTWEIGHT POLYPROPYLENE MESH (SUTURE OR TACK FIXATION)				
Mesh				Average Cost per Operation (USD)
Laparoscopic Hernia Mesh <sup>2</sup>				\$190.53
COMBINED COST				
Fixation and Peritoneal Closure Technique				Price Range
Laparoscopic Hernia Mesh + Tacking Device (Standard Laparoscopic Technique)				\$620.94 – \$730.00
Laparoscopic Hernia Mesh + Suture Fixation (HandX™ Assisted Technique)				\$520-\$580

<sup>1</sup>Cost variation of maximum \$50 per procedure at our institution regardless of brand. <sup>2</sup>Cost variation of maximum \$40 per procedure at our institution regardless of brand/size. \*cost of HandX™ per number of annual procedures

## CONCLUSIONS

- After only a 10 case learning curve, a laparoscopic hand-held articulating needle driver is comparable to standard laparoscopy to complete suture mesh fixation and peritoneal closure for TAPP inguinal hernia repair.
- The feasibility of suture mesh fixation eliminates the need for costly tacker devices.
- This instrument appears to be a promising tool in this largely minimally invasive era of hernia repair.



A. Mesh fixation during TAPP repair using laparoscopic tacking device.  
B. Suture mesh fixation during TAPP repair using the HandX™ device.  
C. Peritoneal closure during TAPP repair with running baseball suture using standard laparoscopic technique.  
D. Peritoneal closure during TAPP repair with horizontal mattress suture using HandX™ device.