

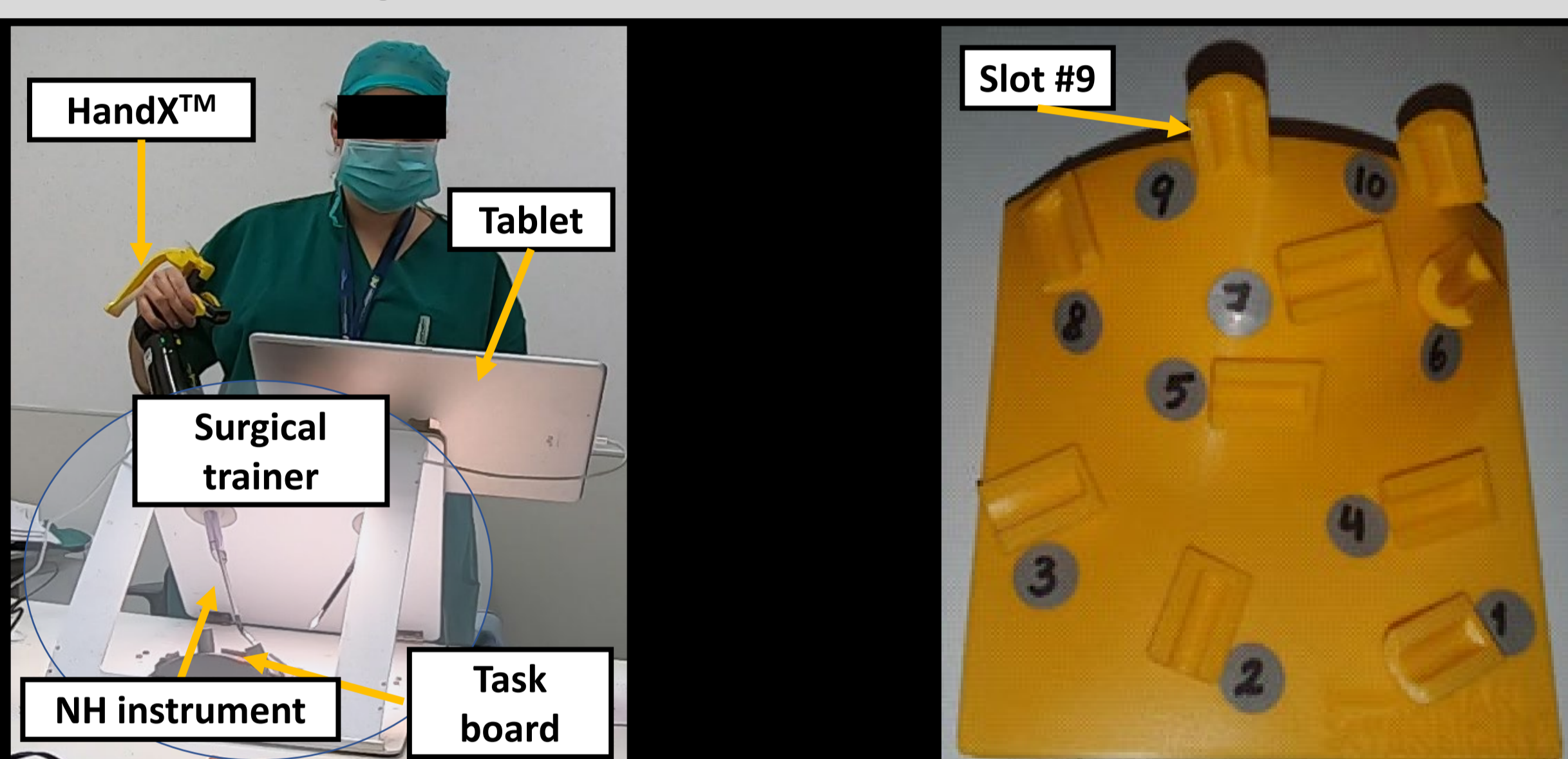
I. Meshorer¹, T. Brown¹, A. Milstein, PhD¹, B. Rattner¹, M. Sudak, DVM¹, A. Szold, MD.FACS^{1,2}
¹Human Xtensions™ LTD, Israel, ²Assia Medical Group, Israel

Introduction

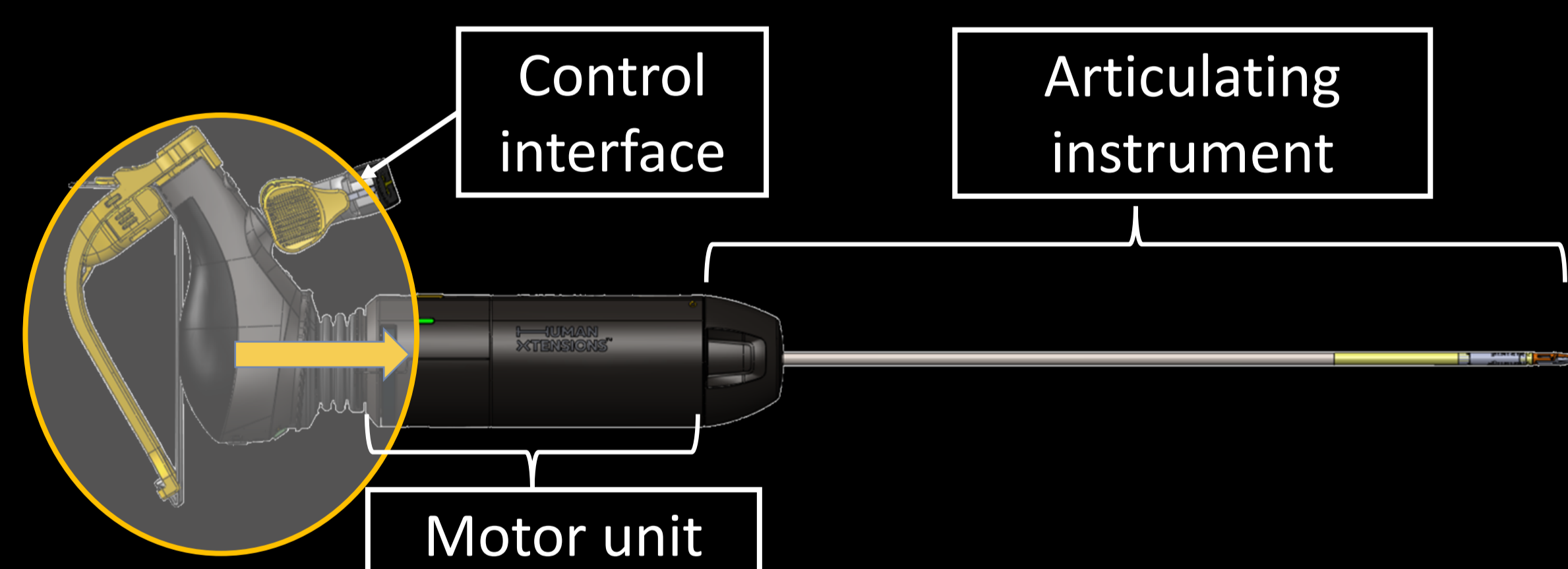
- The **HandX™** is an electromechanical, handheld, laparoscopic device which operates fully articulating (90° in all directions) set of 5mm instruments; e.g., needle-holder, grasper, and mono-polar hook.
- The **HandX™** has a small footprint in the OR, and offers the possibility to improve surgeon's dexterity, precision and ergonomics in a more cost-effective manner than other platforms.
- Laparoscopic minimally invasive surgery, presents control difficulties to the surgeon due the "fulcrum effect".
- As a part of an ongoing research and development process, we implemented an inverse, fulcrum-like, control design to the **HandX™** control interface (CI).

Methods

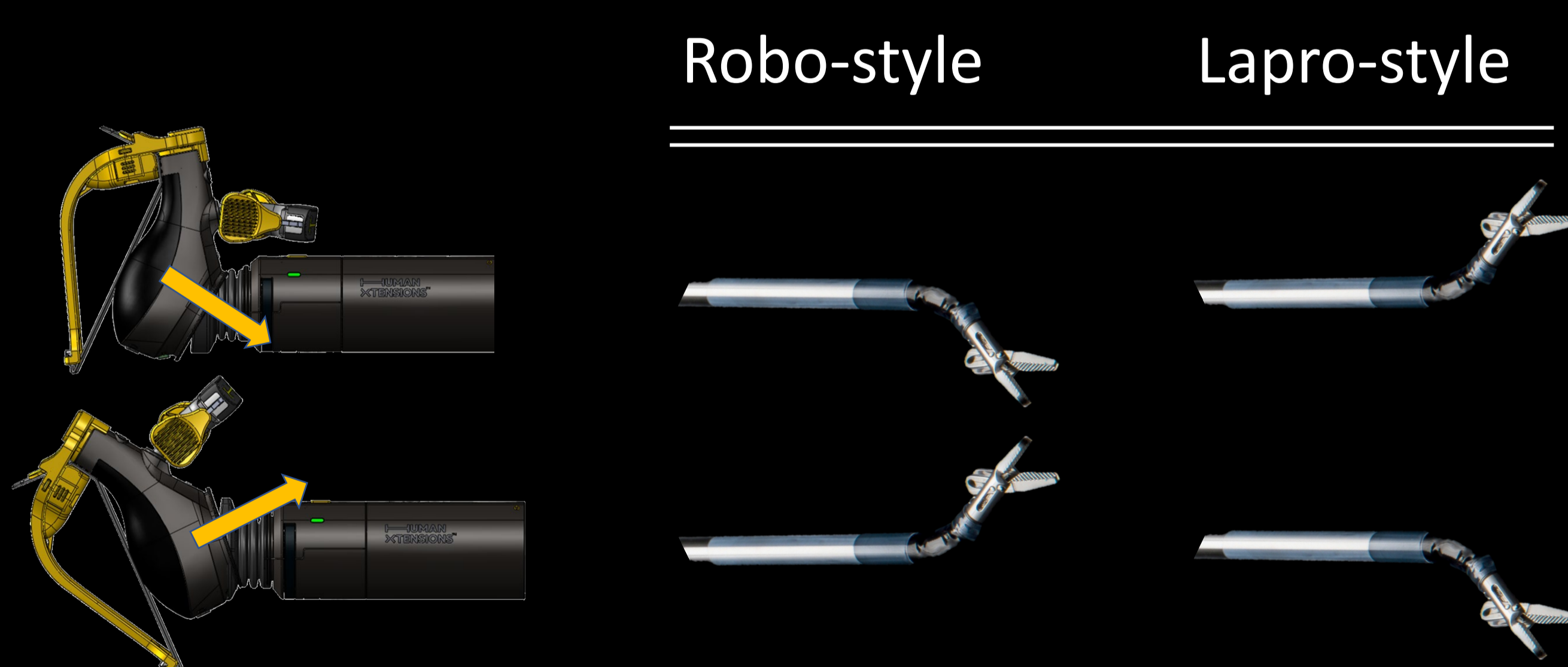
Experiment Setup



The HandX™ Device



The HandX™ Control



Participants

17 participants were included in this study and were divided into four user groups:

- I. **HX naïve** (N=6) – no experience with the device.
- II. **HX intermediate** (N=4) – some experience with the device.
- III. **HX skilled** (N=3) – a significant experience with the device.
- IV. **Laparoscopic Surgeons** (N=4) – no experience with the device.

Protocol & Data Analysis

- Participants performed the **Tip positioning skills task** (depicted on the left) using the HandX™, once in each of the control configuration in succession, and were given a questionnaire to fill out about their experience with each control configuration
- The goal was to position the end effector of the instrument in each of the slots, going from 1 to 10 as fast as possible.
- Task completion time was measured, and a performance metric (slot rate [1/minute]) was calculated.

Results

Group	Robo-style	Lapro-style	Difference	Significance
HX naïve	1.7 ± 1.70	9.52 ± 1.23	7.82 ± 0.65	t=5.202, p<0.001
HX intermediate	7.52 ± 4.10	10.04 ± 4.61	2.52 ± 247	t=1.368, p=0.78
HX skilled	17.5 ± 3.77	9.29 ± 4.32	-8.21 ± 7.44	t=3.859, p<0.01
Surgeons	3.95 ± 2.08	19.58 ± 5.26	15.63 ± 3.88	t=8.49, p<0.001

- In the **HX naïve** and **surgeon** groups, the step rate was significantly higher in the inverted control (**Lapro-style**) than in the direct control (**Robo-style**).
- For the **HX intermediate** group inverted control step rate was also higher but not significantly.
- For the **HX skilled** group the Lapro-style control step rate was significantly lower.
- The reactions to the Lapro-style, as well as the experience with it, were very positive towards that control style, and most participants (excluding the HX skilled group) had favored it over the Robo-style control.

Discussion

- The HandX™, being a digital electromechanical device, allows rapid performance improvements to be made by simply applying software updates.
- We implemented a control design change in the form of the Lapro-style, which significantly improved intuitiveness and performance in **naïve** HandX™ users, both surgeons and non-surgeons.
- Our results suggests that operating an articulating instrument in a fulcrum-effected environment, may require the control interface to be consistent with the fulcrum effect as well.
- This is an example of how the HandX digital platform can empower the minimal invasive surgical landscape by allowing rapid improvements with personalized digital platforms that combine the power of robotics with the ease and affordability of hand-held solutions.

Contact

amikisz@gmail.com
<https://human-x.com>

