Overcoming the Learning Curve: Achieving Surgical Expertise Through Robotic Simulation

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Background

- Implementation of robotic surgery has increased over recent years, leading to surgical training programs implementing robotic simulation curricula.
- Robotic simulation curriculum is not standardized across programs, and the question of how to train surgical residents on the robot and measure their progress and proficiency remains difficult to answer.
- **Aim**: Evaluate the degree of the learning curve on robotic simulation modules between junior and senior operators to determine which modules have a true impact on training.

Methods

- A retrospective analysis (June 2020 – December 2022) of general surgery residents and attendings at a single institution completed nine DaVinci® skills simulator modules until mastery was reached.
- 2 cohorts consisted of Junior (Clinical PGY-1/2/3 plus research residents; n=35) versus Senior (Clinical PGY-4/5 plus attendings/fellows; n=24) operators.
- Nine modules consisted of Camera 0, Sea Spike 1, Sea Spike 2, Ring Rollercoaster 1, Big Dipper Needle, Wrist Articulation, 30-Degree Scope Swap, and Combo Exercise.
- **Definitions:** Mastery was defined as obtaining an aggregate score (i.e., total score – penalties) of ≥90.
- Operators were allowed a maximum of 10 attempts to reach mastery. If unable to attain mastery, an attempt value of 11 was assigned.
- The ability and number of attempts to reach mastery was compared between the two cohorts.

References:
[1] Thornblade LW, Fong Y. Simulation-Based Training in Robotic Surgery: Contemporary and Future Methods. J Laparoendosc Adv Surg Tech A. 2021 May;31(5):556-560. doi: 10.1089/lap.2021.0082. Epub 2021 Apr 8. PMID: 33835885.
[2] Radi I, Tellez JC, Alterio RE, Scott DJ, Sankaranarayanan G, Nagaraj MB, Hogg ME, Zeh HJ, Polanco PM. Feasibility, effectiveness and transferability of a novel mastery-based virtual reality robotic training platform for general surgery residents. Surg Endosc. 2022 Oct;36(10):7279-7287. doi: 10.1007/s00464-022-09106-z. Epub 2022 Feb 22. PMID: 35194662; PMCID: PMC8863393.

Results

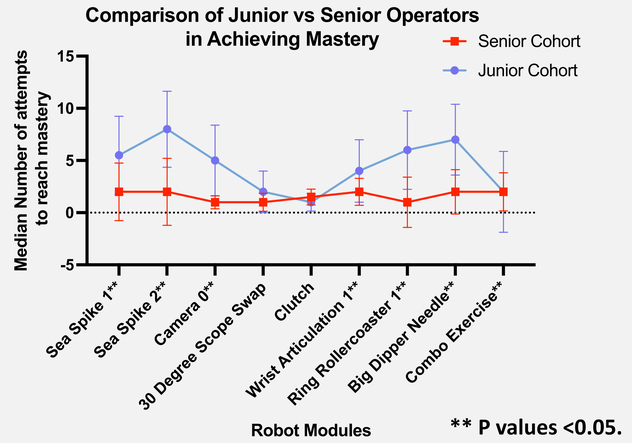
Table 1. Number of junior & senior operators achieving mastery

Module	*Junior Cohort*	*Senior Cohort*	*P value*
Sea Spike 1	26/32 (81.3)	20/21 (95.2)	0.223
Sea Spike 2	18/27 (66.7)	18/20 (90.0)	0.086
Camera 0	25/30 (83.3)	18/18 (100.0)	0.142
30 Degree Scope Swap	24/24 (100.0)	19/19 (100.0)	>0.999
Clutch	31/31 (100.0)	18/18 (100.0)	>0.999
Wrist Articulation 1	27/29 (93.1)	21/21 (100.0)	0.503
Ring Rollercoaster 1	20/27 (74.1)	21/22 (100.0)	0.059
Big Dipper Needle	18/24 (75.0)	21/21 (100.0)	**0.023***
Combo Exercise	16/19 (84.2)	17/17 (100.0)	0.231

Note: Table 1's P values were calculated using Fisher's exact test

Results

Figure 1. Median number of attempts required to achieve mastery



** P values <0.05.

Conclusions

- There was no difference in the achievement of mastery between junior and senior operators in 8 out of 9 modules (Table 1).
- Exercises requiring a combination of fundamental skills such as spatial awareness, camera control, and needle control had steeper learning curves for junior operators compared to modules focusing on a single task (Figure 1).
- This suggests the need for a standardized, dedicated robotic simulation training curriculum focusing on advanced modules at an earlier stage in a resident's training to ultimately prepare trainees for real-time robotic surgery.