Robotic Skills Acquisition in General Surgery Residency: a Retrospective Analysis of Performance Data on an Inanimate Deliberate Practice Model of an Intestinal Anastomosis

Benjamin Rail, BS; Andres A Abreu, MD; Emile Farah, MD; Rodrigo E Alterio, MD; Ganesh Sankaranarayanan, PhD; Herbert J III Zeh; Daniel J Scott, MD; Patricio M Polanco, MD

UT Southwestern Medical Center

Introduction

- The integration of robotic surgical training in a time-scarce residency program is a new challenge for institutions.
- Simulation-based training is a validated tool allowing residents to efficiently acquire the necessary robotic skills without compromising patient safety.
- There is lack of data describing the learning curve of task-specific robotic surgical skills for general surgery residents. The purpose of this study is to assess the learning curve of a robotic inanimate intestinal anastomosis drill across various performance metrics.

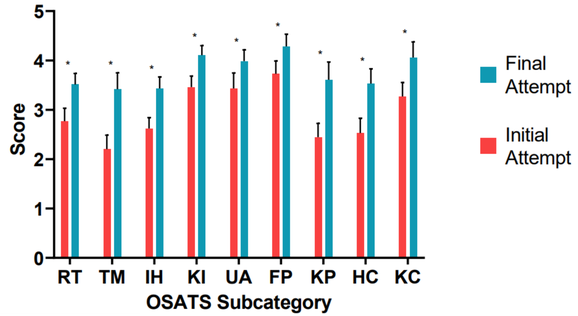
Methods

After completing a validated proficiency-based virtual reality and inanimate robotic curriculum, residents advance to bio-tissue drills, each meant to simulate a technically demanding component of an operation. One of these bio-tissue drills is a side-to-side intestinal anastomosis: a relevant skill for most gastrointestinal surgeries. Video-based assessment of each attempt was performed independently by two trained graders using the validated Objective Structured Assessment of Technical Skill (OSATS) scale. Residents must have had at least two consecutive attempts and achieved proficiency for inclusion. Performance data was gathered over a four-year period and analyzed using independent t-test, one-way ANOVA, and binary logistic regression.





OSATS Subcategory Scores Initial vs Final Attempt



* indicates $p < 0.05$
RT = Respect for Tissue
TM = Time and Motion
IH = Instrument Handling
KI = Knowledge of Instruments
UA = Use of Assistance
FP = Flow and Forward Progress
KP = Knowledge of Procedure
HC = Handling Composite
KC = Knowledge Composite

General Surgery Resident Information

Total Passing Residents	33.0
Average Post-Graduate Year	4.0 (2-5)
Total Attempts	139.0
Total Completed Attempts	130.0
Average Total Attempts Per Resident	4.2 (2-6)
Average Attempts to Pass	3.3 (1-6)

Results

33 residents performed a total of 139 attempts with a mean of 4.2 attempts per resident and a range of 2 to 6. On average, residents required 3.3 attempts to achieve proficiency. Across the first 4 attempts, average OSATS score increased from 21.7 on initial attempt to 27.2 on 4th attempt ($p < 0.001$). Of the OSATS subcategories, time and motion showed the greatest average score improvement of 1.5 on a 5-point Likert scale, 95% CI [0.82, 2.18] ($p < 0.001$). Despite varying baseline levels on initial assessment, residents had no clear variations or deficiencies when comparing final attempts. A worse performance on the initial attempt, especially failing to finish, was associated with greater odds of requiring 5 or more attempts to pass the drill.

First Attempt Risk Factors for >4 Attempts to Pass

	Odds Ratio	95% CI	p-value
Post-Graduate Year	0.72	[0.33-1.58]	0.42
Average Days Between Attempts	1.01	[0.99-1.03]	0.34
OSATS Score	0.73	[0.54-0.99]	0.04*
Failure to Finish	28.75	[2.62-315.41]	0.01*
Completion Time	1.08	[0.98-1.20]	0.13
Errors	1.18	[0.77-1.80]	0.45
Respect for Tissue	0.82	[0.32-2.20]	0.69
Time and Motion	0.14	[0.03-0.69]	0.02*
Instrument Handling	0.21	[0.04-0.99]	0.05*
Knowledge of Instruments	0.53	[0.17-1.63]	0.27
Use of Assistance	0.34	[0.13-0.88]	0.03*
Flow and Forward Progress	0.74	[0.31-1.79]	0.51
Knowledge of Procedure	0.57	[0.23-1.42]	0.23
Handling-Based Subcategories	0.15	[0.03-0.90]	0.04*
Knowledge-Based Subcategories	0.12	[0.02-0.99]	0.05*

* = $p < 0.05$

Discussion

- All performance metrics improved over multiple attempts of our simulated, deliberate-practice model of an intestinal anastomosis.
- All residents who achieved proficiency did so within six attempts.
- Initial performance could predict who would require more attempts to pass.
- After achieving proficiency, residents showed no clear differences in graded performance.