A COMPARISON OF PROFICIENCY SCORES AND WORKLOAD OF ADVANCED TRAINING IN LAPAROSCOPIC SUTURING (ATLAS) TRAINING CURRICULUM TO ROBOTIC-ATLAS (R-ATLAS) TRAINING CURRICULUM

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Abstract

INTRODUCTION: In an effort to standardize skill acquisition between laparoscopic and robotic surgery, we modified the Advanced Training in Laparoscopic Suturing (ATLAS) curriculum for the robotic platform. The purpose of this study was to compare proficiency scores from ATLAS to newly defined proficiency scores for the Robotic-ATLAS (R-ATLAS) curriculum.

METHODS AND PROCEDURES: The proficiency levels for R-ATLAS were determined using the same methodology as the previously published laparoscopic cohort. Four experts in robotic surgery performed each of the six tasks five times. The NASA Task Load Index (NASA-TLX) assessment tool was used to measure workload. The results were compared using linear mixed effects models with random intercepts accounting for within-surgeon correlation fitted to log-transformed time and score to evaluate the relative (%) difference between approaches (R-ATLAS vs. ATLAS).

RESULTS: The robotic surgeons had less years in practice than laparoscopic surgeons. Robotic surgeons performed better on Task 3. All other tasks were not significantly different,. NASA-TLX scores were lower for Tasks 1, 4, 5 and 6.

Table 1. Summary of score by task and approach

	ATLAS		R-ATLAS		p-value
	Mean	SD	Mean	SD	
Task 1	217.85	24.12	212.6	49.62	0.72
Task 2	479.95	20.82	510.75	32.81	0.07
Task 3	474.8	30.69	519.85	17.86	0.02
Task 4	474.75	55.19	501.15	48.69	0.34
Task 5	185.9	18.77	201.4	20.83	0.29
Task 6	642.6	68.56	699.85	21.64	0.15

Table 2. Summary of NASA-TLX total scores by task

	ATLAS		R-ATLAS		p-value
	Mean	SD	Mean	SD	
Task 1	66.25	12.58	26.75	10.63	0.004
Task 2	69.5	3.79	30.5	28.52	0.052
Task 3	76.25	11.24	34.75	38.52	0.052
Task 4	73	6.78	22.75	20.76	0.015
Task 5	46.75	20.93	19.5	6.24	0.016
Task 6	66.75	22.5	23.5	12.4	0.008

Task1: Needle handling, Task 2: Off-set camera forehand suturing, Task 3: Off-set camera backhand suturing, Task 4: Confined space suturing, Task 5: Suturing under tension, Task6: Continuous suturing

CONCLUSION: This study found that expert robotic and laparoscopic surgeons can perform advanced suturing skills on the ATLAS curriculum similarly. However, robotic suturing appears to be less mentally demanding, suggesting it might have an easier learning curve. The robotic platform provides an opportunity for less experienced surgeons to perform advanced suturing tasks. Future study should include larger sample size to examine the validity of this study. ATLAS provides a reproducible and reliable model to assess expert laparoscopic suturing across different platforms.

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Results

Table 1: Summary of time by task and approach

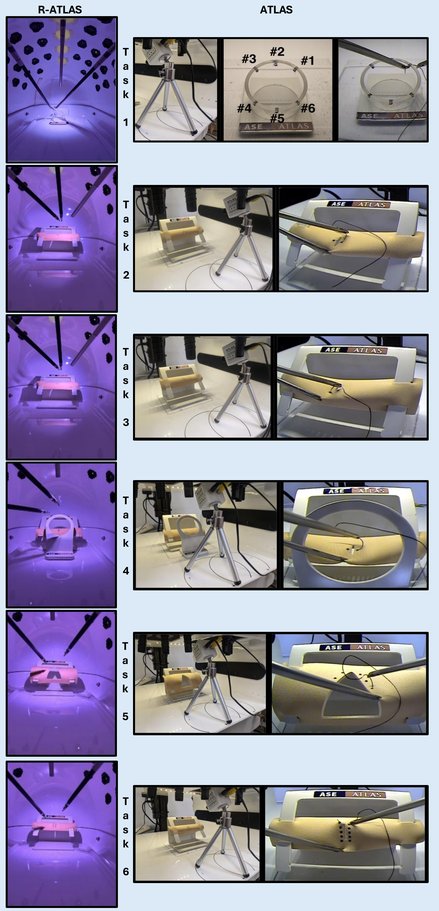
	ATLAS				R-ATLAS				% difference (95% CI)	p-value
	# of surgeons	# of Obs	Mean Time (s)	SD	# of surgeons	# of Obs	Mean Time (s)	SD		
Task 1	4	20	82.15	24.12	4	20	82.4	42.52	-7.36 (-52.21, 79.50)	0.79
Task 2	4	20	119.05	20.64	4	20	84.25	25.34	-30.97 (-50.8, -3.15)	0.04
Task 3	4	20	125.2	30.69	4	20	80.15	17.86	-35.68 (-54.07, -10.74)	0.02
Task 4	4	20	108.75	20.77	4	20	93.85	29.64	-16.55 (-45.87, 17.67)	0.25
Task 5	4	20	113.6	18.28	4	20	98.6	20.83	-13.7 (-35.07, 14.7)	0.25
Task 6	4	20	245.4	43.72	4	20	200.15	21.64	-17.76 (-33.85, 2.25)	0.07

Table 2: Summary of score by task and approach

	ATLAS				R-ATLAS				% difference (95% CI)	p-value
	# of surgeons	# of Obs	Mean Score	SD	# of surgeons	# of Obs	Mean Score	SD		
Task 1	4	20	217.85	24.12	4	20	212.6	49.62	-4.78 (-30.69, 90.83)	0.72
Task 2	4	20	479.95	20.82	4	20	510.75	32.81	6.28 (-0.66, 13.76)	0.07
Task 3	4	20	474.8	30.69	4	20	519.85	17.86	9.65 (2.45, 17.36)	0.02
Task 4	4	20	474.75	55.19	4	20	501.15	48.69	5.82 (-7.44, 21.98)	0.34
Task 5	4	20	185.9	18.77	4	20	201.4	20.83	8.26 (-6.53, 28.11)	0.29
Task 6	4	20	642.6	68.56	4	20	699.85	21.64	9.36 (-4.23, 25.31)	0.15

Table 3: Summary of NASA-TLX by task and approach

	ATLAS			R-ATLAS			R-ATLAS vs. ATLAS	
	# of surgeons	# of Obs	Median (Q1, Q3)	# of surgeons	# of Obs	Median (Q1, Q3)	% difference (95% CI)	p-value
Item	Mental Demand							
Task 1	4	4	13.5 (10.5, 15.75)	4	4	3 (3, 3.25)	-72.7 (-83.31, -55.35)	0.002
Task 2	4	4	11.5 (11, 12.75)	4	4	4 (2.5, 6)	-71.94 (-88.88, -29.22)	0.036
Task 3	4	4	13.5 (12, 15.75)	4	4	2.5 (2, 6)	-73.92 (-90.01, -31.92)	0.033
Task 4	4	4	13 (10.5, 13)	4	4	2.5 (1.75, 4.5)	-77.81 (-91.28, -43.53)	0.02
Task 5	4	4	6 (6, 9.75)	4	4	3 (2.75, 3.5)	-62.47 (-81.65, -23.23)	0.036
Task 6	4	4	12.5 (6.75, 18)	4	4	3 (2.75, 4)	-68.98 (-85.75, -32.49)	0.026
Item	Physical Demand							
Task 1	4	4	9.5 (8.25, 11.25)	4	4	3.5 (3, 4.75)	-58 (-75.48, -28.09)	0.02
Task 2	4	4	13 (11, 15)	4	4	4 (3.25, 6.5)	-69.88 (-89.66, -12.11)	0.07
Task 3	4	4	13.5 (10.5, 15.75)	4	4	3 (2, 7)	-66.12 (-88.38, -1.24)	0.095
Task 4	4	4	13 (11.25, 14.25)	4	4	2.5 (2, 5.25)	-71.77 (-88.08, -33.15)	0.028
Task 5	4	4	6 (6, 6.25)	4	4	3.5 (2.75, 4.25)	-46.92 (-64.24, -21.22)	0.02
Task 6	4	4	7.5 (6, 11.25)	4	4	2.5 (2, 3)	-71.97 (-83.95, -51.06)	0.004
Item	Temporal Demand							
Task 1	4	4	15 (10.75, 18)	4	4	3.5 (3, 4.5)	-70.15 (-82.67, -48.59)	0.005
Task 2	4	4	11 (10, 12.75)	4	4	3 (2.5, 4.5)	-74.1 (-89.46, -36.35)	0.026
Task 3	4	4	13.5 (11.25, 15.75)	4	4	2.5 (2, 5)	-74.06 (-88.85, -39.67)	0.02
Task 4	4	4	13 (10.5, 15.75)	4	4	2.5 (1.75, 3.75)	-80.84 (-91.35, -57.56)	0.007
Task 5	4	4	9 (8.5, 11.25)	4	4	3 (2.75, 3)	-73.03 (-82.71, -57.92)	0.001
Task 6	4	4	16 (13.5, 18)	4	4	3 (3, 6.25)	-70.15 (-87.16, -30.63)	0.031
Item	Performance							
Task 1	4	4	6 (6, 7)	4	4	4.5 (3.75, 6.5)	-25.65 (-59.23, 35.57)	0.371
Task 2	4	4	10 (8.25, 11)	4	4	3.5 (2, 7)	-56.34 (-82.2, 12.08)	0.137
Task 3	4	4	9 (8.25, 9.75)	4	4	3.5 (2, 7.75)	-51.6 (-82.31, 32.4)	0.207
Task 4	4	4	7.5 (6, 9.75)	4	4	3 (1.75, 4.75)	-65.36 (-85.79, -15.54)	0.059
Task 5	4	4	5.5 (4.5, 6)	4	4	3.5 (2.75, 4.25)	-31.34 (-58.5, 13.98)	0.194
Task 6	4	4	6.5 (6, 7.5)	4	4	3.5 (3, 4)	-49.8 (-80.84, -35.65)	0.002
Item	Effort							
Task 1	4	4	11.5 (10.5, 12.75)	4	4	3.5 (3, 5.75)	-61.39 (-79.62, -26.85)	0.027
Task 2	4	4	12 (12, 12.75)	4	4	3.5 (2.5, 6.25)	-72.15 (-90.14, -21.3)	0.062
Task 3	4	4	14 (12.75, 15.75)	4	4	3 (2, 7.25)	-77.65 (-89.61, -22.64)	0.049
Task 4	4	4	14.5 (13.5, 15)	4	4	2.5 (1.75, 5.5)	-82.07 (-90.67, -38.07)	0.03
Task 5	4	4	6 (5.75, 8.25)	4	4	3.5 (3.75, 4.25)	-54.09 (-75.34, -14.5)	0.05
Task 6	4	4	11 (9, 13.5)	4	4	3 (3, 4.5)	-63 (-81.61, -25.53)	0.032
Item	Frustration							
Task 1	4	4	10 (9, 12)	4	4	4 (2.75, 5.5)	-64.6 (-80.39, -36.07)	0.014
Task 2	4	4	10.5 (9, 12)	4	4	3.5 (2.5, 6.5)	-65.36 (-88.18, 1.54)	0.102
Task 3	4	4	12.5 (11.25, 13.5)	4	4	3 (2, 7.25)	-66.29 (-87.73, -7.36)	0.08
Task 4	4	4	12 (12, 12.5)	4	4	2.5 (1.75, 3.75)	-80.36 (-90.62, -58.68)	0.005
Task 5	4	4	6 (5.5, 7.5)	4	4	3 (2.75, 3.25)	-54.82 (-73.33, -23.46)	0.025
Task 6	4	4	10.5 (8.5, 12.75)	4	4	3 (2.75, 3.25)	-71.77 (-81.62, -56.64)	0.001
Item	Total							
Task 1	4	4	68 (58.5, 75.75)	4	4	23 (19.75, 30)	-61.14 (-74.07, -41.76)	0.004
Task 2	4	4	68 (67, 70.5)	4	4	21.5 (16.75, 35.25)	-68.39 (-87.6, -19.41)	0.052
Task 3	4	4	77.5 (70.5, 77.25)	4	4	17.5 (12, 40.25)	-68.96 (-86, 19.66)	0.052
Task 4	4	4	75.5 (72, 76.5)	4	4	15.5 (10.75, 27.5)	-76.56 (-89.95, -45.3)	0.015
Task 5	4	4	37.5 (35.5, 48.75)	4	4	19.5 (16.5, 22.5)	-57.41 (-74.29, -29.46)	0.016
Task 6	4	4	63 (51.75, 78)	4	4	18 (16.75, 24.75)	-66.28 (-80.5, -41.69)	0.008



Background

- ATLAS has been in development since 2014 with the curriculum finalized in 2022 with the official launch of the industry developed training kit.
- Updated proficiency scores were published for ATLAS in 2024.
- R-ATLAS was developed in 2024 and designed to be as close as ATLAS as possible for expert suturing comparison

Conclusions

- Expert laparoscopic surgeons are comparable in speed and precision of suturing to that of expert robotic surgeons, at least in the setting of a consistently repeatedly exam.
- Workload of laparoscopic suturing is exceedingly higher than robotic suturing that may mean a quicker learning curve to perform at the level of an expert at robotic suturing over laparoscopic suturing.

Disclosures

The authors report no conflicts of interest

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