

Pilot Evaluation of a Novel, Low-cost, Simulation Model for Training and Assessment of Laparoscopic, Intracorporeal, Running Suture

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Introduction

Minimally invasive surgery has become standard of practice for many general surgical procedures, from emergency perforated ulcer repair to elective colectomy cases. In addition, with increasing laparoscopic experience, advanced techniques such as continuous suturing are being employed more frequently by surgeons. Intracorporeal anastomosis is a technically complex but vital skill necessary for success in many laparoscopic surgeries.

At the moment standard laparoscopic trainer box simulation tasks allow for performance of basic interrupted suturing and knot tying techniques only, leading to a deficit in simulation training for more complex tasks. Therefore we propose the creation of a low-cost laparoscopic bench model which could be used to gain proficiency in laparoscopic continuous suturing.

Objectives

In order to address the gap in easily accessible training with regards to the advanced, complex task of laparoscopic continuous suturing, we designed a novel model using low-cost, tubular, elastic, dressing retainer material and standard laparoscopic trainer boxes.

Primary objective:

To assess whether a novel, low-cost, laparoscopic, bench model can be used to differentiate between surgeons and trainees with differing levels of expertise for laparoscopic intracorporeal continuous suturing.

Specific Aims:

- To assess both novice and expert performance on this novel bench model to distinguish between varying levels of suturing proficiency.
- To create an aggregate performance score measure from collected performance data.
- To correlate proposed accuracy metrics and aggregate performance scores with metrics of time and established GOALS score.
- To use the performance data collected from experts to set a performance level for proficiency.

Participants

Participants were stratified into two groups (n=16):

- Laparoscopic Experts (LE): General surgeons with greater than 50 prior laparoscopic suturing cases or surgeons with fellowship training in minimally invasive surgery (n=7).
- Laparoscopic Novices (LN): All others who did not meet above criteria (n=9).

Task

A custom laparoscopic trainer box with a centrally mounted webcam and two 10mm trocar sites was built at the CSTAR lab. Enterotomy was simulated using Size 2, 1-inch wide, Surgilast™ Tubular Elastic Dressing Retainer, fashioned into two side by side pieces and mounted under tension with a 1cm gap between pieces.

Participants were required to place an interrupted stay suture at at the proximal pre-marked spot using a 2-0 Vicryl™ suture. Next a second suture of 2-0 Vicryl™ suture cut to a length 20 cm was used to place a second knot at the distal pre-marked spot. This suture was then used to close the defect in a continuous fashion and tied to the stay suture to complete defect closure. Maximal 20 minutes was be allowed for completion of the task.

Outcomes

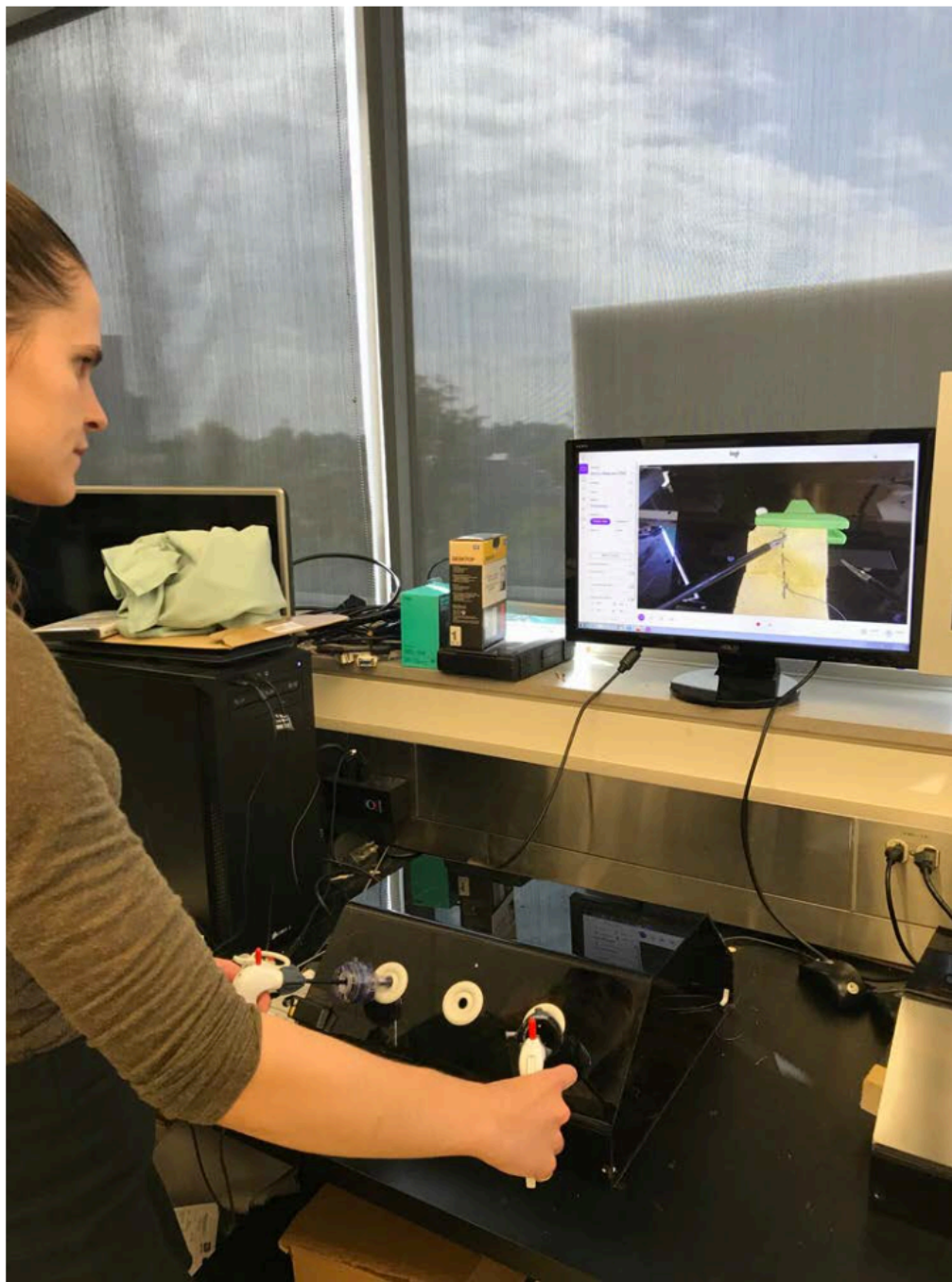
◆ Time measured in seconds

◆ Accuracy penalties:

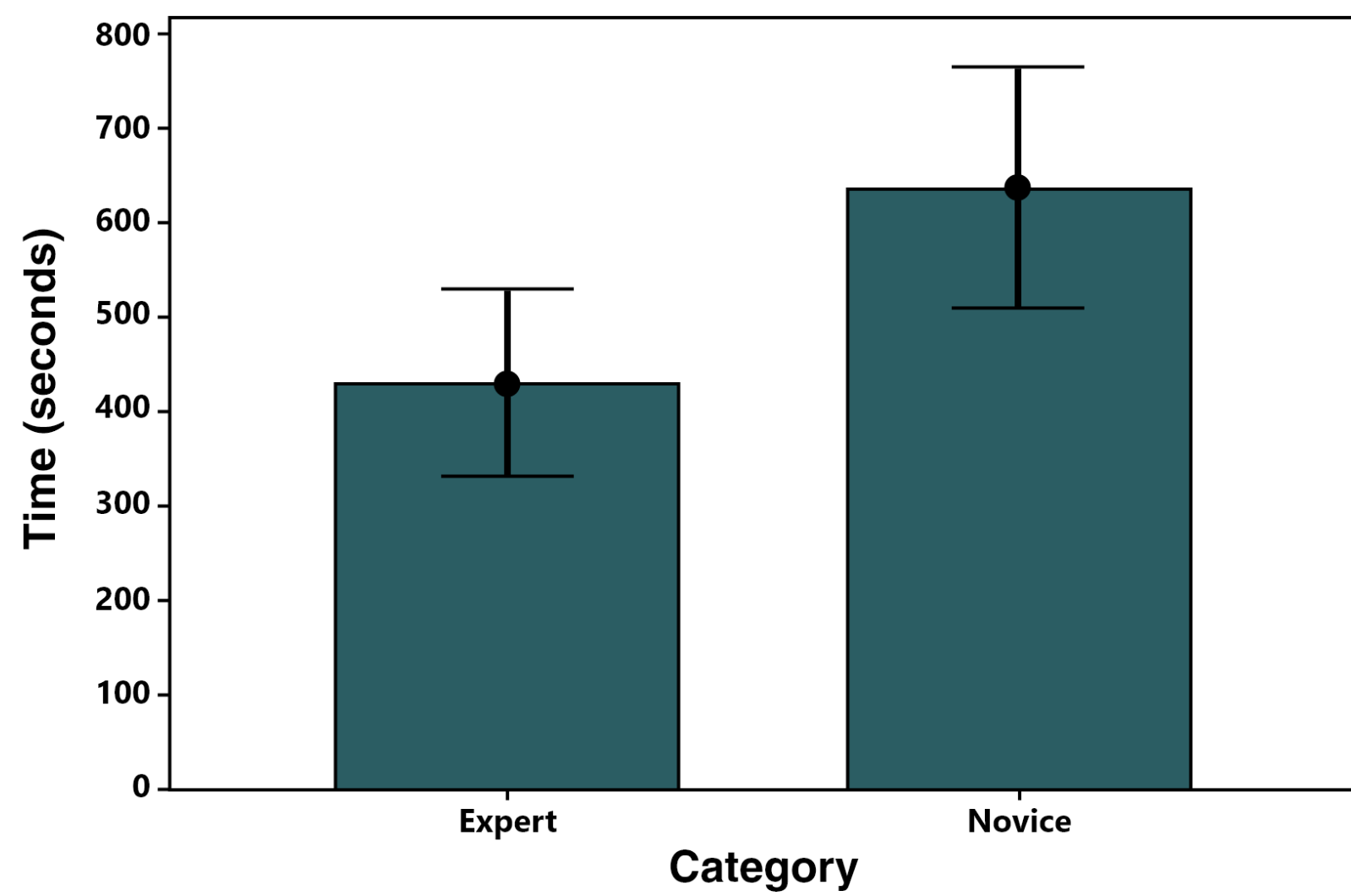
Five metrics determined by study authors to be of importance for the quality of the task

- ✓ Security of Knot
- ✓ Adequate defect closure
- ✓ Equal distance between bites
- ✓ Equal depth of bites
- ✓ Suture on mark

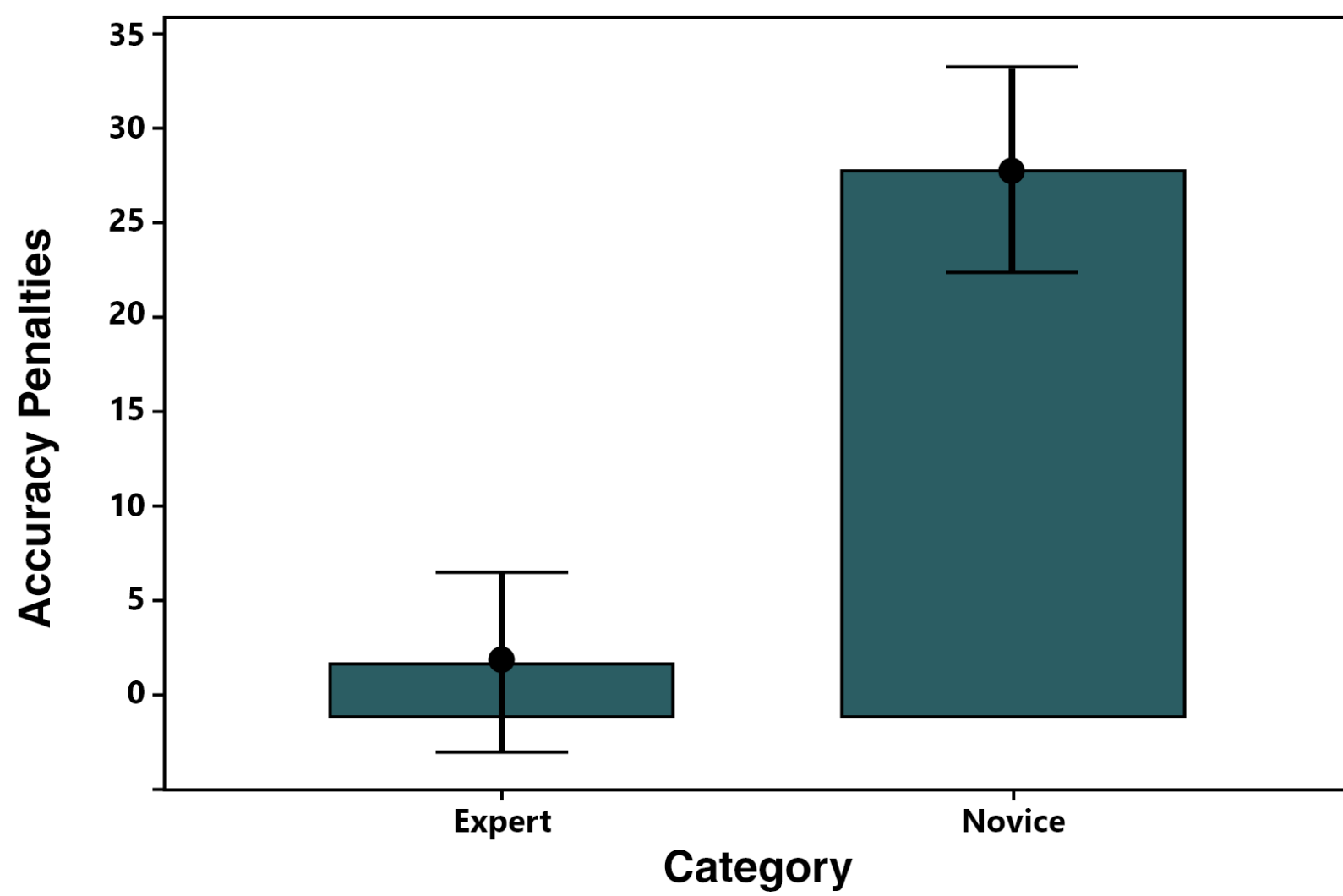
◆ Global Operative Assessment of Laparoscopic Skills (GOALS) standard scores:
Each video was reviewed by 2 independent raters from a group of 4 minimally invasive surgeons



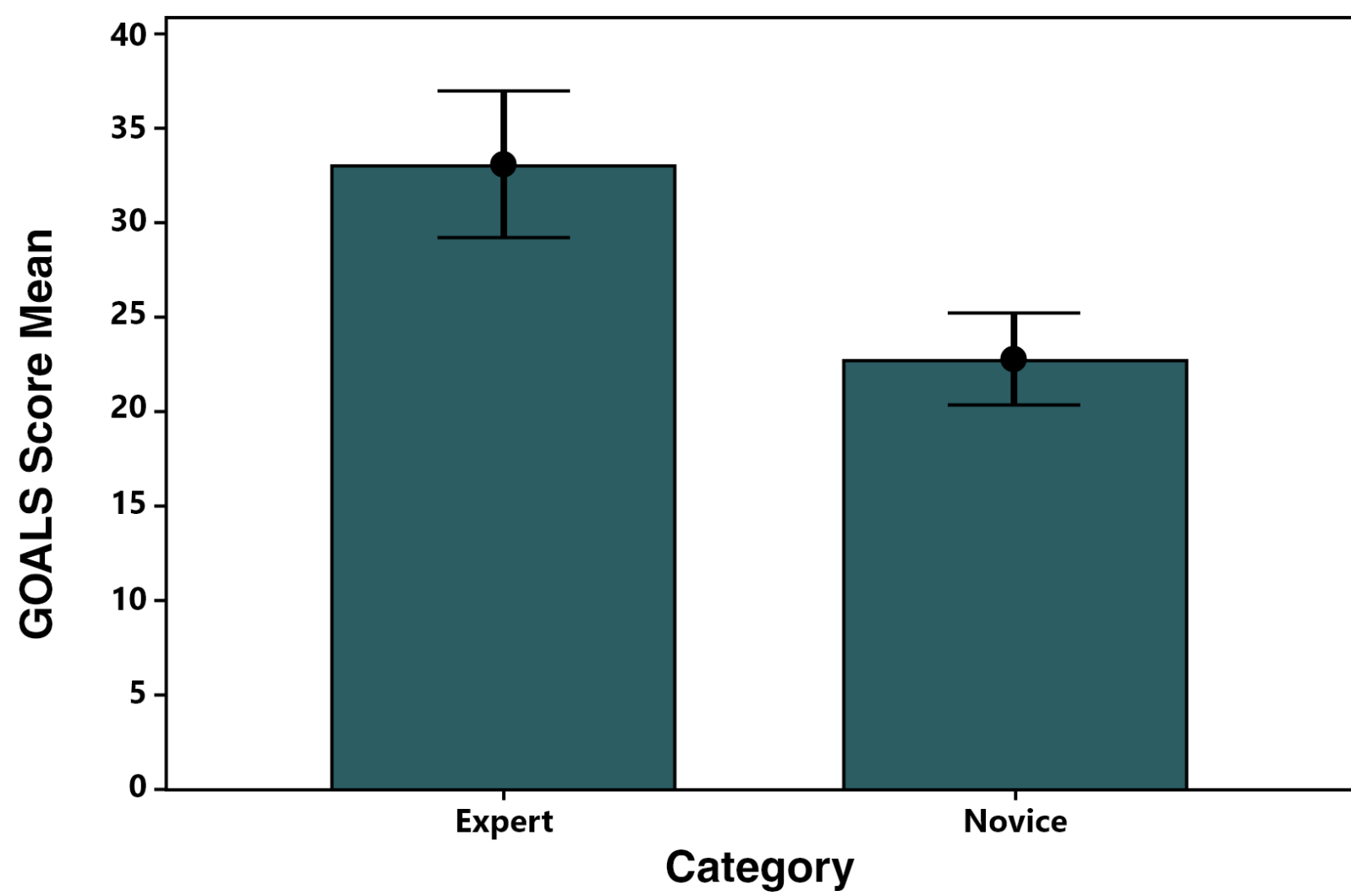
Results



Mean time for task completion:
Expert **430.43±107.252** seconds vs.
Novice **636.78±163.882** seconds
(p≤0.05)



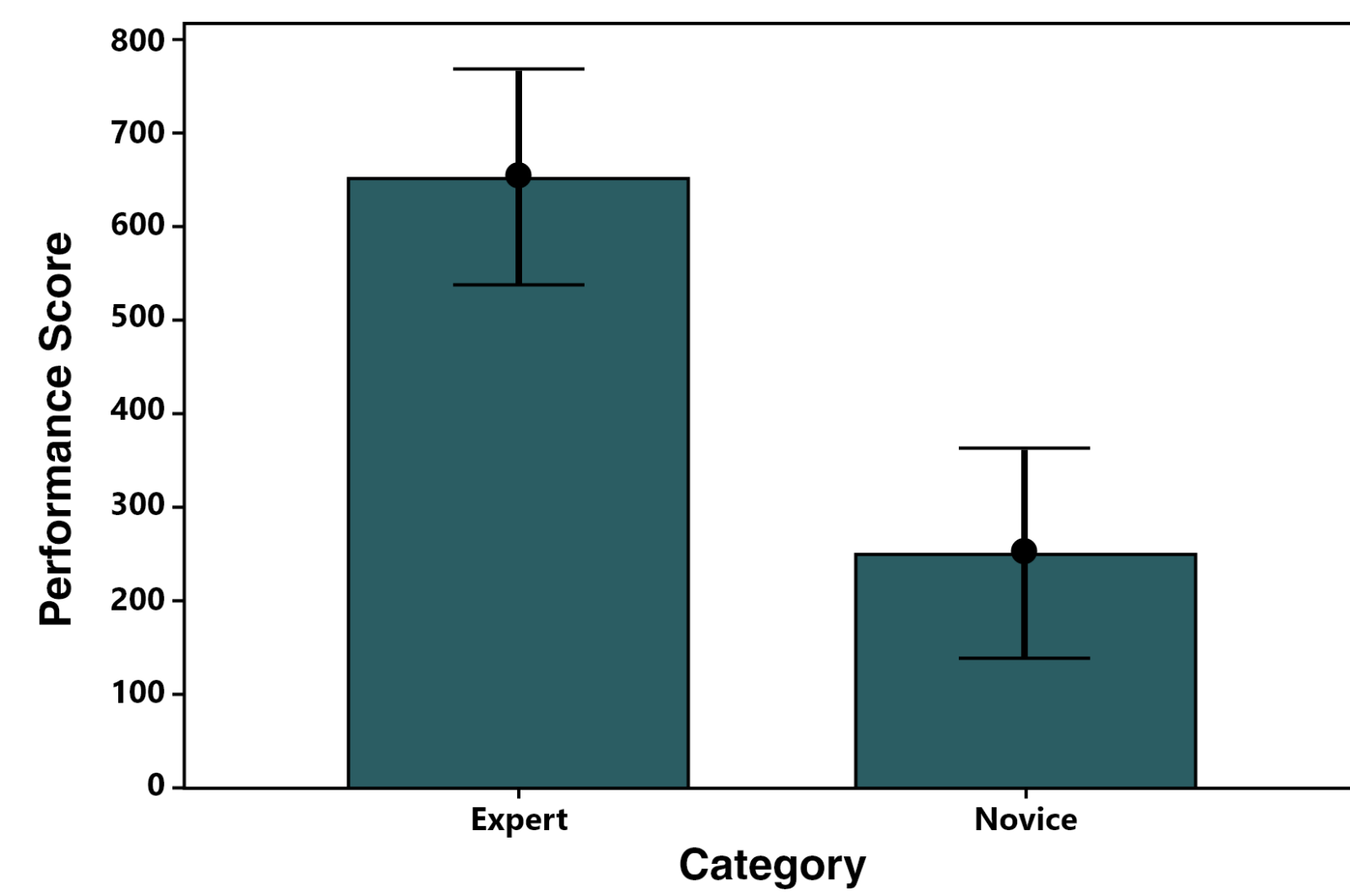
Mean Accuracy Penalty Scores:
Expert **2.86±4.88** vs. Novice **27.78±6.67**
Median accuracy penalty scores:
Expert **0** vs. Novice **30** (p≤0.05)



Mean GOALS scores:
Expert **20.64±2.64** vs. Novice
14.28±1.94 (p<0.001)

Performance Score Creation

Composite Performance Score:
1200 (max. time allowed) - time (secs) - (accuracy penalties x 10)



Mean Performance Scores:
Expert **741±141** vs.
Novice **285±167**
(p<0.001)

Correlation with GOALS Scores

	GOALS Correlation <i>r</i>	95% Confidence Interval	P-value
Performance Score	0.91	(0.754, 0.969)	p<0.001
Time (seconds)	-0.79	(-0.924, -0.484)	p<0.001
Accuracy Penalty Score	-0.826	(-0.938, -0.560)	p<0.001

Conclusions

This novel low-cost laparoscopic bench model was able to distinguish accurately between laparoscopic experts and laparoscopic novices with significant differences in performance metrics of time, accuracy and GOALS scores.

Using the study data a performance aggregate measure was created for proficiency in the task of continuous suturing. In addition using a score of ≥512 was determined to be the cutoff score to distinguish between experts and novices.

With further study this low-cost novel bench model may be useful for both assessment and training of laparoscopic continuous suturing.