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THE LEARNING CURVE OF A NOVEL ROBOTIC SYSTEM IN COLECTOMY PROCEDURES: OUTCOMES FROM A SINGLE SURGEON

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INTRODUCTION

Published data report learning curves (LC) in the range of 25-45 cases for robotic colectomies. Various factors, such as experience, technical skills, frequency of repetition, and procedure complexity, can impact the surgical LC. Quantitative parameters used to evaluate a LC include case volume and operating time. Performance metrics, captured as computer data may help to track improvement in robotic technical skills as well as measure a surgeon's LC.

We previously reported on the safety and efficacy of a novel miniaturized Robotic Assisted Surgery (miniRAS) device (MIRA Surgical System, Virtual Incision, Lincoln, NE) in colectomy procedures in a multicenter, investigational device exemption (IDE) study.[1] (See Figure 1). In the IDE study, performance data was recorded for each case.

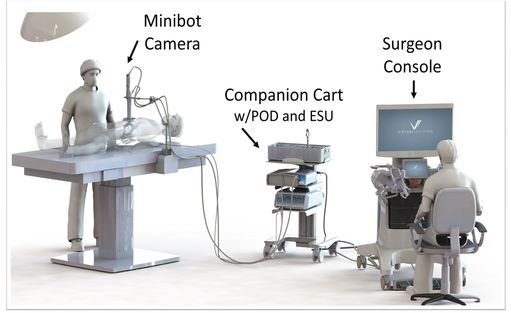


FIGURE 1. MiniRAS Surgical System Setup

OBJECTIVES

To analyze system performance metric data to explore the LC of a single surgeon's experience with miniRAS.

METHODS

We reviewed consecutive cases by the senior author (M.J.) from August 2021 to November 2022 from the IDE Study.

Performance metrics included:

- Instrument in view
- Instrument Cycle (frequency of open/closing of instruments)
- Console time
- Robotic workspace position
- Clutch Reminder
- Average instrument movement speed

Linear regressions were performed, p-value < 0.05 using SPSS (IBM SPSS Statistics for Windows, Version 29.0.1 Armonk, NY, USA).

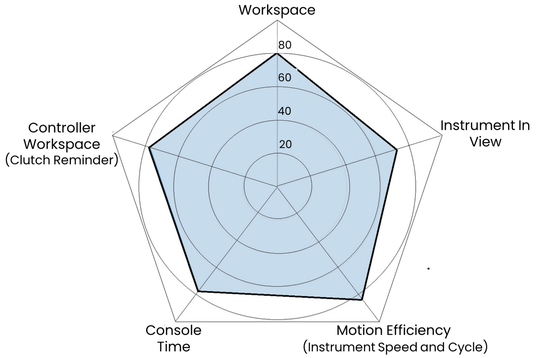


FIGURE 2. Spider chart of percentile scores (from 0 to 100) for different metrics. Higher scores indicate more ideal performance.

RESULTS

For 15 consecutive cases, a linear relationship was observed for several performance metrics.

Table 1. Patient Characteristics and Operative Details

	N = 15
Age, mean (SD), years	60.3 (14.1)
Gender, Female : Male	5 : 10
ASA classification, No. (%)	
II, Patient with mild systemic disease	9 (60%)
III, Patient with severe systemic disease	6 (40%)
BMI classification, No. (%), kg/m^2	
Underweight or normal, 0-24.9	5 (33.3%)
Overweight, 25.0-29.9	5 (33.3%)
Obese, ≥ 30.0	5 (33.3%)
Indications for Surgery	
Malignant Disease	6 (40%)
Benign Disease	9 (60%)
Operation Performed, No. (%)	
Left Colectomy	7 (47%)
Right Colectomy	8 (53%)
Operating Time, Mean (SD), minutes	
Overall	133.9 (35.9)
Left Colectomy	141.0 (28.4)
Right Colectomy	127.8 (42.3)
30-day Morbidity (CD grade ≥ 2), No. (%)	2 (13.3)

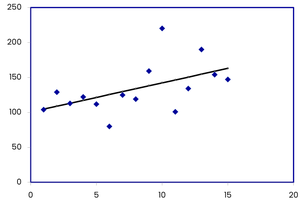


FIGURE 3. Operating Time, minutes (r=0.52, p=0.048)

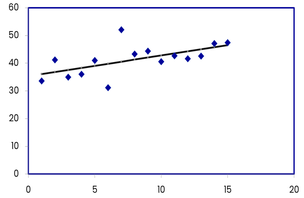
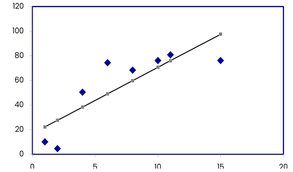


FIGURE 4. Controller Workspace Position, mm (r=0.59, p=0.02)

FIGURE 5. Instrument in View for Right Colectomies (r=0.83, p=0.010)



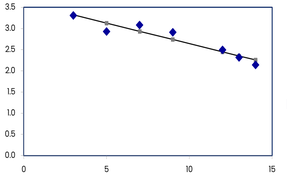


FIGURE 6. Average Instrument Cycle per minute for Left Colectomies (r=0.95, p=0.001)

CONCLUSIONS

In this small series, we confirmed relevant metrics that may assess robotic skills and surgeon performance. However, a typical LC, exhibiting improvements in metrics followed by a plateau over time, could not be observed. As expected, a greater number of cases is likely required over multiple surgeons to evolve our understanding of the learning curve and to discriminate the relative importance of specific performance parameters. The positive slope observed for operating time was affected by the growth of more complicated procedures later in the case series than at the beginning. Such factors can confound a LC based only on operating time.

REFERENCES

1. Marks, JH et al (in Press 2024) Safety and Efficacy of a Novel Miniaturized Robotic Assisted Surgery System in Colectomy: A Prospective, Investigational Device Exemption Clinical Study Using the IDEAL Framework. Diseases of the Colon and Rectum.

ACKNOWLEDGEMENTS

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DISCLAIMER

1. Michael Jobst, MD is a consultant for Virtual Incision
2. Piet Hinoul; Celeste Williams; Sheng Lu are employees of Virtual Incision