Robotic Vs. Open Component Separation: A Retrospective Cohort and Propensity Score Analysis of Complication Rates and Clinical Outcomes

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Background

- Complex ventral hernias are defined as fascial defects >10 cm or a rectus width-to-defect ratio <2:1
- Global prevalence ~5%, with ~600,000 repairs annually in the United States
- Annual healthcare costs have risen to **$9.7 billion**
- Component separation is the standard technique, performed via **open or minimally invasive (robotic/laparoscopic) approaches**

Objectives

- Compare outcomes of **robotic vs open component separation** for complex ventral hernia repair
- Address limitations of prior studies, which are largely **small, retrospective, and heterogeneous**
- Provide **large-scale, risk-adjusted** analysis to better define clinical outcomes

Methods

- **Study design:** Retrospective cohort study using ACS-NSQIP database
- **Case identification:**
 - ICD-10: K43.2, K43.9 (ventral hernias)
 - CPT: 15734, 49659 (component separation)
 - Robotic cases confirmed using NSQIP robotic variable
- **Cohort definition:**
 - Open component separation
 - Robotic component separation
- **Outcomes:**
 - 30-day morbidity and complication rates
- **Analysis:**
 - Multivariate logistic regression to identify risk factors for complications

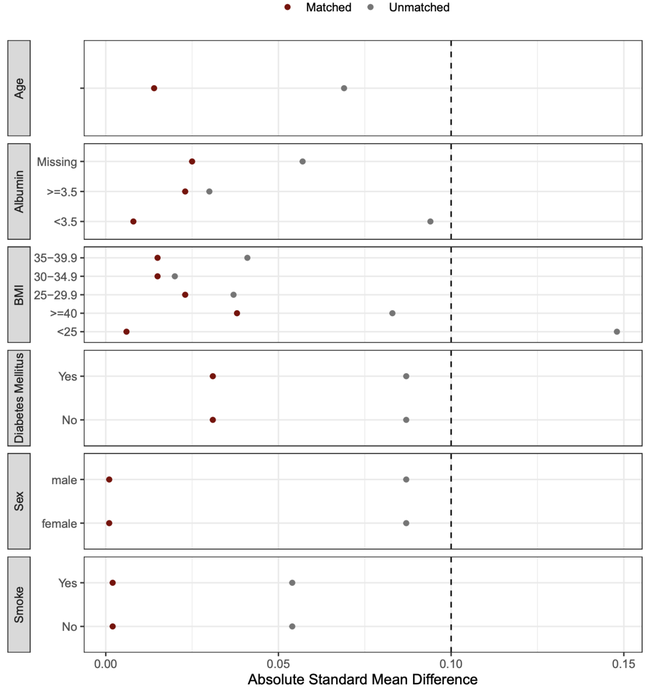
Results

Table 1. ***Clinicopathological and surgical characteristics of patients who underwent component abdominal separation from 2022 to 2023 according to the surgical approach***

Characteristics	After propensity matching			
	Surgical approach		Total N=5259	P value
	Open N=3506	Robotic N=1753		
Age – years ± SD	58.77±12.69	58.59±12.96	58.71±12.78	0.629 [a]
Age >65 years	1297 (37.0)	631 (64.0)	1928 (36.7)	0.479 [b]
Sex				
Female	1772 (50.5)	887 (50.6)	2659 (50.6)	0.969 [b]
Male	1734 (49.5)	866 (49.4)	2600 (49.4)	
Race				
White	2721 (84.0)	1320 (82.8)	4041 (83.6)	0.730 [b]
African-American	373 (11.5)	200 (12.5)	573 (11.9)	
Asian	40 (1.2)	19 (1.2)	59 (1.2)	
Other	105 (3.2)	55 (3.5)	160 (3.3)	
Hispanic ethnicity	391 (11.2)	231 (13.2)	622 (11.8)	<0.001 [b]
Specialty				
General Surgery	1411 (89.7)	1753 (100.0)	3164 (60.2)	<0.001 [b]
Plastic Surgery	361 (10.3)	0 (0.0)	361 (39.8)	
BMI – kg/m2	32.77±6.19	33.16±6.26	32.91±6.22	0.289 [a]
BMI classification				
Normal	259 (7.4)	127 (7.2)	389 (7.3)	0.656 [b]
Overweight	954 (27.2)	459 (26.2)	1413 (26.9)	
Obesity type 1	1167 (33.3)	571 (32.6)	1738 (33.0)	
Obesity type 2	709 (20.2)	365 (20.8)	1074 (20.4)	
Obesity type 3	417 (11.9)	231 (13.2)	648 (12.3)	
Smoking	386 (11.0)	194 (11.1)	580 (11.0)	0.950 [b]
Diabetes Mellitus	621 (17.7)	332 (18.9)	953 (18.1)	0.276 [b]
COPD	155 (4.4)	74 (4.2)	229 (4.4)	0.738 [b]
CHF	128 (3.7)	39 (2.2)	167 (3.2)	0.005 [b]
Hypertension	1894 (54.0)	915 (52.2)	2809 (53.4)	0.211 [b]
Metastatic cancer	40 (1.1)	14 (0.8)	54 (1.0)	0.246 [b]
Immunosuppression	347 (9.9)	111 (6.3)	458 (8.7)	<0.001 [b]
Bleeding disorder	107 (3.1)	43 (2.5)	150 (2.9)	0.219 [b]
ASA – ASA classification ± SD	2.64±0.55	2.53±0.57	2.60±0.56	<0.001 [a]

Well balanced groups: Age, sex, race, BMI → *no significant differences* (all p>0.05)
Key differences that persisted: Hispanic ethnicity ↑ in robotic
Robotic = 100% general surgery
CHF ↑ in open
Immunosuppression ↓ in robotic
ASA classification differed

Figure 1. ***Covariate balance after propensity score matching for key preoperative variables***



A total of **6,207** patients were included **(open: 71.6%, robotic: 28.4%).**
Propensity matching (n=5,259).
Robotic repair associated with **significantly lower overall complications** compared to open surgery (4.8% vs. 19.6%, aOR 0.19, p<0.001).
Wound (2.2% vs. 10.2%), surgical (2.9% vs. 10.0%), and medical complications (2.0% vs. 7.0%) (all p<0.001).
Robotic repair demonstrated **shorter LOS** (1.34 vs. 3.86 days, p<0.001) and **lower readmission** rates (4.4% vs. 9.1%, p<0.001)

Discussion

- **Robotic approach consistently demonstrated lower complication rates** Surgical: 2.9% vs 10.0%
 Wound: 2.2% vs 10.2%
- **Findings remained significant after risk adjustment**
- Independent association between **open approach and higher complications**
 Robotic approach was independently associated with significantly lower odds of complications (OR ~0.20–0.27), corresponding to a ~70–80% reduction in risk
- **Benefits likely driven by minimally invasive technique**
 Avoids large incisions and extensive subcutaneous dissection.
 Preserves abdominal wall perfusion and reduces dead space.
 Associated with lower wound morbidity.
- **Technical advantages of robotic platform**
 Enhanced 3D visualization
 Improved dexterity and precision
 Less tissue trauma and blood loss
- **Clinical impact**
 Lower 30-day complications despite matched cohorts
 Shorter length of stay (1.3 vs 3.9 days)
 Reduced readmissions (4.4% vs 9.1%)

Conclusion

- Robotic component separation was associated with significantly lower rates of overall, surgical, wound, and medical complications compared to the open approach
- Robotic surgery was associated with shorter length of stay and lower readmission rates
- Robotic approach is a favorable strategy for complex ventral hernia repair when feasible

References

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