P176 SAGES 2026 Annual Meeting | ePoster Presentation

Artificial Intelligence for Real-Time Recognition of TME Dissection Lines in Robotic Colorectal Surgery

ChangHyun Kim, MD, PhD; Young Kyu Park, MD, PhD
Department of Surgery, Chonnam National University Hwasun Hospital, South Korea | March 25-28, 2026 | Tampa, FL

Scan for Abstract

BACKGROUND

Total Mesorectal Excision (TME) relies on precise dissection along the "Holy Plane" (avascular plane between parietal pelvic fascia and mesorectal fascia). While robotic systems (da Vinci Xi, SP) offer superior 3D vision, identification of this plane remains operator-dependent.

Challenge: Training AI for surgical navigation requires massive annotated datasets. Manual labeling is costly, and single-center models often suffer from **Domain Shift** (failure to generalize to external data/different robotic platforms).

OBJECTIVE

To develop a robust AI model for real-time incision line recognition using a Trajectory-based Auto-Labeling Pipeline and validate its performance across different robotic systems (Xi vs. SP) and external institutions.

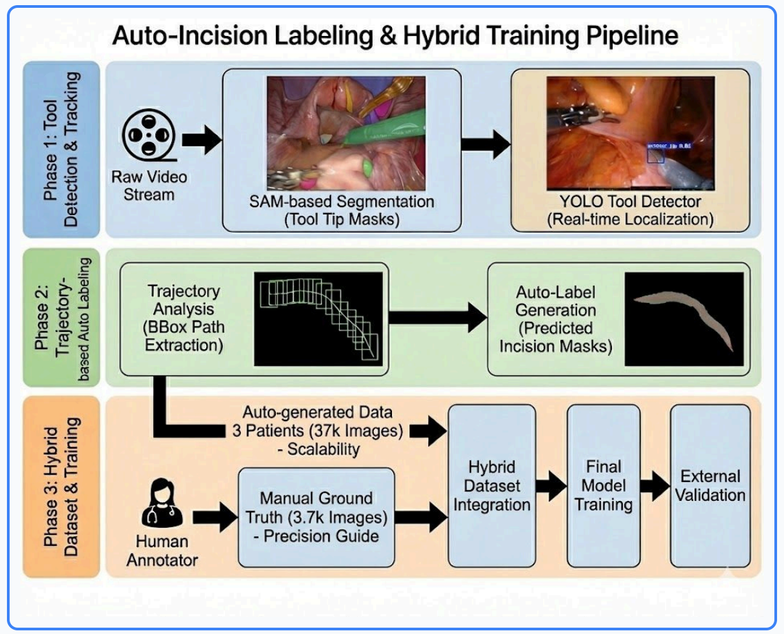
STUDY POPULATION

Table 1. Clinicopathological Characteristics (N=36)

Age (Mean)	59.1 years
BMI (Mean)	23.78 kg/m²

METHODS: AUTO-LABELING PIPELINE

We propose a **3-Phase Pipeline** to minimize manual annotation cost while maximizing model robustness.



Phase 1: Tool Detection & Tracking

Utilized SAM (Segment Anything Model) for initial ground truth and trained a lightweight YOLO model for real-time scissor tip tracking.

Phase 2: Trajectory-based Auto Labeling

Generated incision line labels by tracking tool motion history ($T = \{C_1, ..., C_n\}$) with Kalman filter smoothing. Created **~90,000 auto-labeled images**.

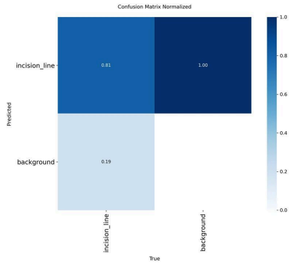
RESULTS

Table 2 & 3. Manual-Only vs. Hybrid Model Performance

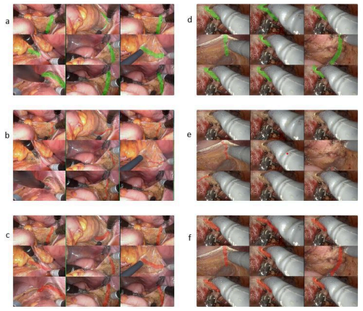
Model Strategy	Internal Validation		External Validation (Test)	
	mAP50	mAP50-95	mAP50	mAP50-95
Manual-Only	0.374	0.089	0.000	0.000
Hybrid (Ours)	0.873	0.414	0.675	0.416

* Manual-only model failed completely on external data (Generalization Error). Hybrid model maintained high precision (mAP50-95: 0.416) on external datasets.

Confusion Matrix (Normalized)



Qualitative Results



CONCLUSION

- **Trajectory-based Auto-labeling** successfully scaled training data without manual effort.
- The **Hybrid Strategy** overcame the domain shift problem, achieving robust performance on external datasets where manual-only models failed.

Contact: cksantiago8@gmail.com | +82-10-3655-5138

References: 1. Heald RJ et al. Br J Surg 1982 2. Kolbinger FR et al. Eur J Surg Oncol 2023 3. Suzuki Y et al. Ann Gastroenterol Surg 2025