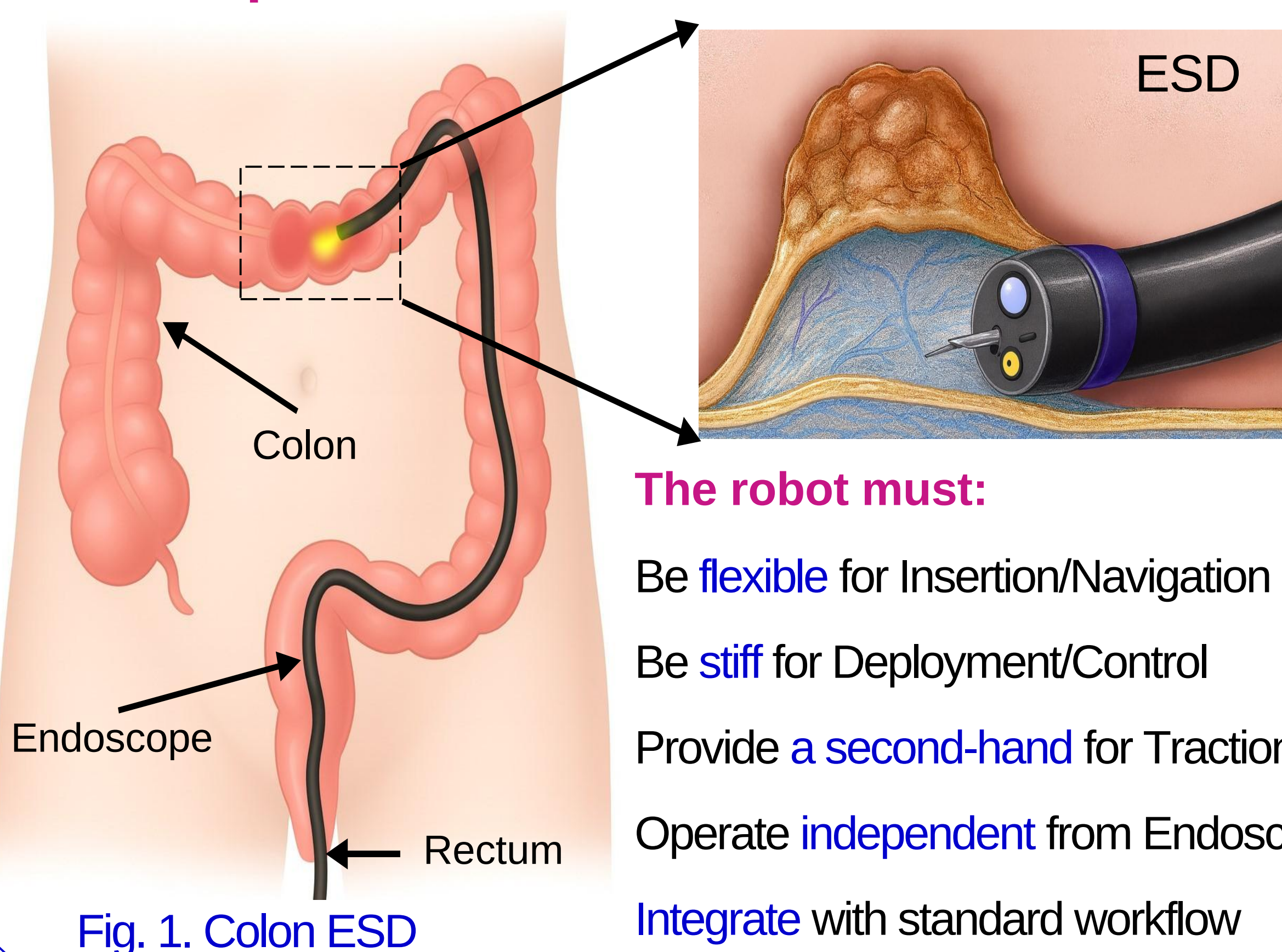


Submucosal Dissection (ESD): An Ex vivo Feasibility Study

Background

- ESD is technically demanding, with limited adoption in Western practice
- Conventional endoscopes lack dexterity for ESD → poor submucosal exposure and a steep learning curve
- Existing traction techniques are mostly passive and lack stable, adjustable tissue manipulation
- Robotic endoscopic systems may overcome these limitations by enabling active countertraction

Design
Requirements



System Description

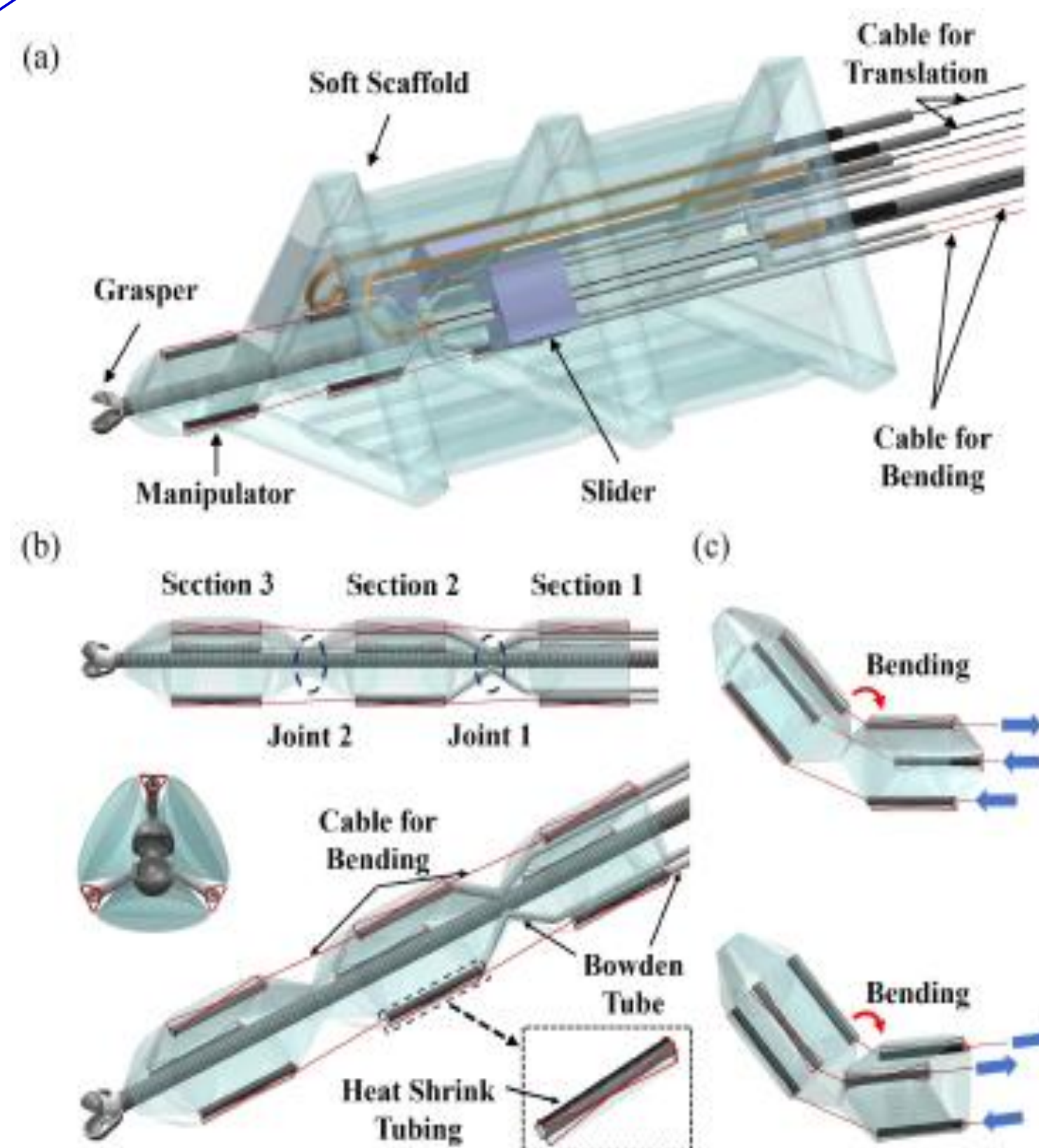


Fig. 2. Schematic of robot structure

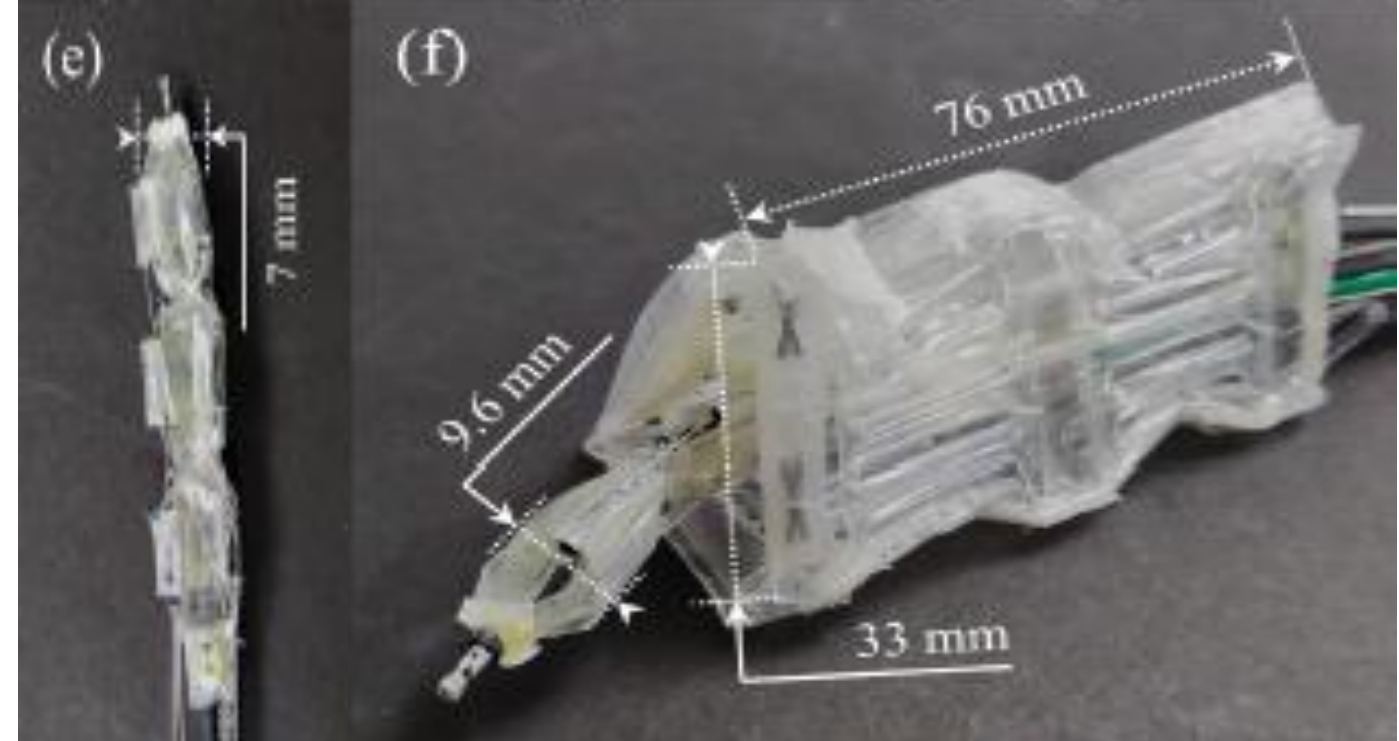


Fig. 3. Manipulator - Support Frame – Control Device

Key Features

- Inflatable triangular-prism support frame
- Cable-driven manipulator with grasper for traction
- 5 DoFs (4 articulation + 1 linear translation)
- Pneumatic deployment with structural stiffening
- Haptic control with endoscopic visual feedback

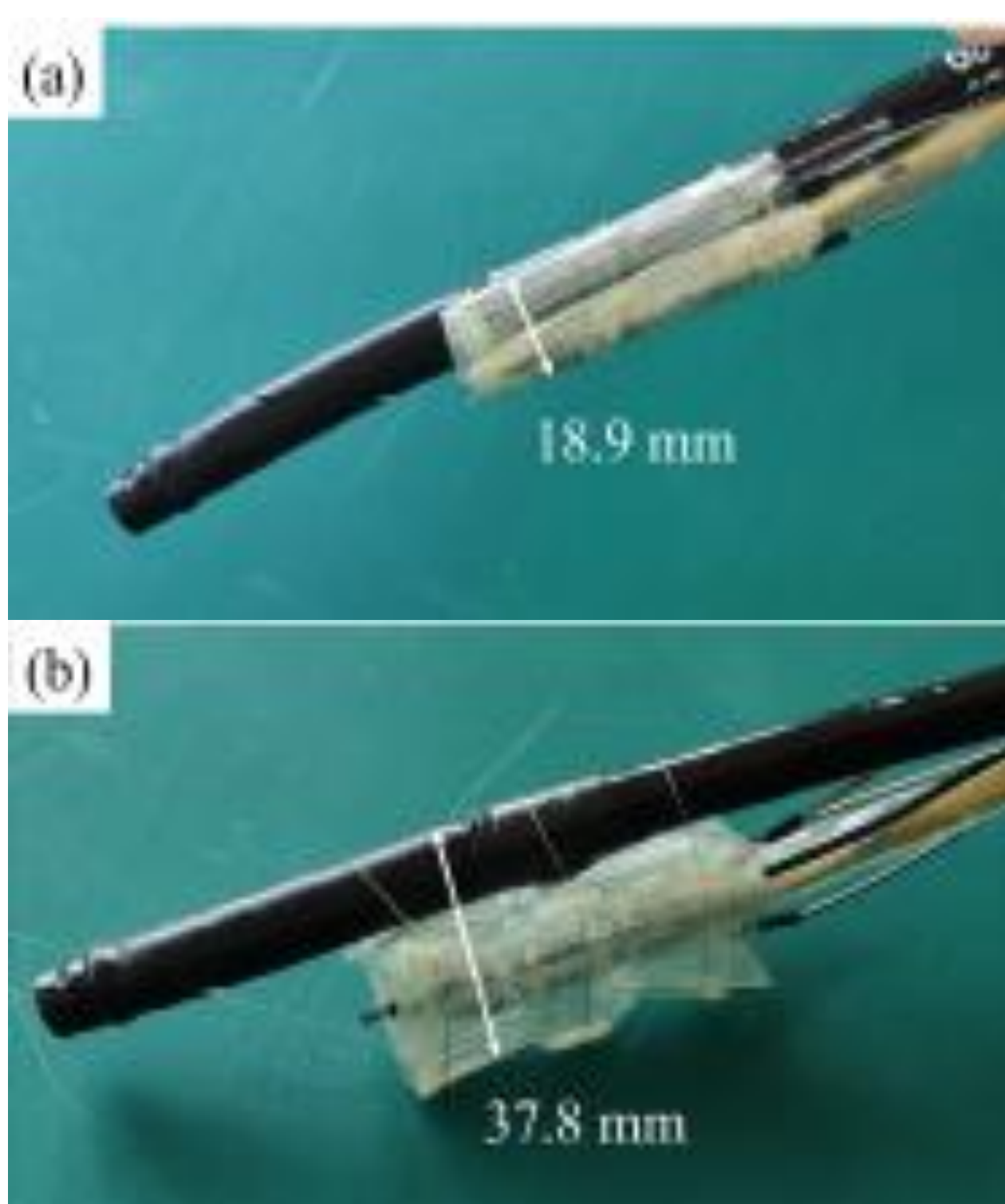


Fig 4. Snare-assisted insertion (Top) and deployment (Bottom)

Setup

Ex Vivo Trial - Colon

Procedure

Robot Configuration

Specimen: Defrosted porcine colon segment

Mounting: Using the BradfordSimTech tray model

Insufflation: Endoscope + Airmate compressor

Pseudolesion: 20–25 mm lesion marked circumferentially on the luminal roof

Submucosal lift: Volplex® injected to create a submucosal cushion

Initial incision: Anal-side mucosal incision performed using a DualKnife

Insertion: Robot introduced alongside the endoscope

Deployment: Robot deployed, manipulator activated

Traction: Distal grasper engaged the mucosal flap

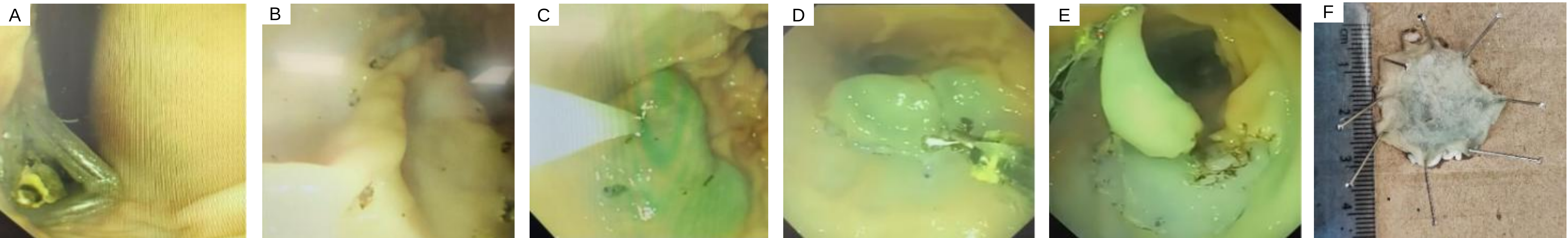


Fig. 5. (A) Retroflexed view (B) Marking (C) Submucosal Injection (D) Robotic Arm Engaging Mucosal Flap (E) Dynamic Traction and Dissection (F) Resected Specimen (26 x 24 mm)

Future Work

System Improvements

- Switch to joystick-based interface for easier and more intuitive control
- Improve manipulator–frame stability and explore operation without the external frame
- Enhance grasper mechanism (dexterity and potential instrument exchange)

Future Work

- Conduct comparative ex vivo studies vs conventional ESD to quantify performance metrics
- Progress to in vivo feasibility studies and workflow integration

