

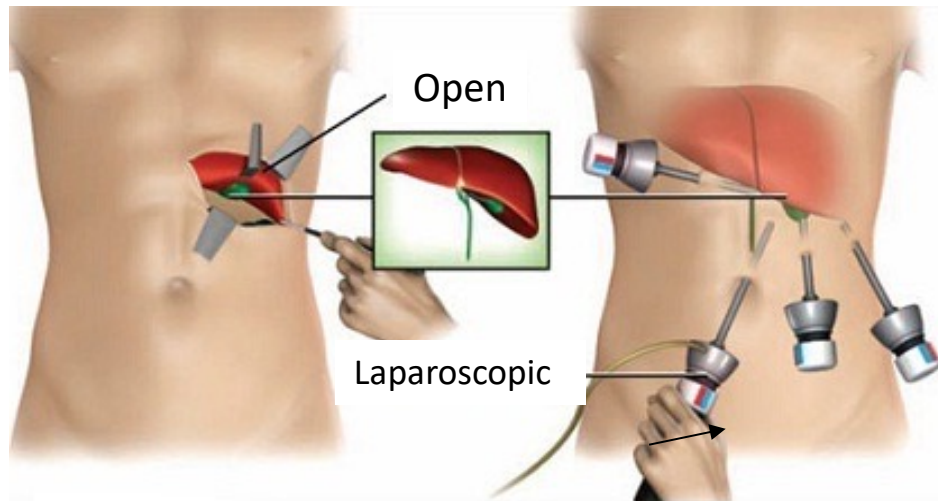


Surgical Robotics

(Features, advantages and current problems)



Robot-Assisted Laparoscopic Surgery



Conventional open surgery

- Blood loss
- Post-operative pain
- Prolonged hospital stay
- Risk of infection

Advantage:

- Full visualization of target site
- Natural ergonomics

Laparoscopic surgery (Manual)

- Small Incision (up to – 1.5 cm)
- Reduce risk of bleeding and pain
- Significantly shorter hospital stay
- Less exposure of internal organs to external contaminants

Disadvantages:

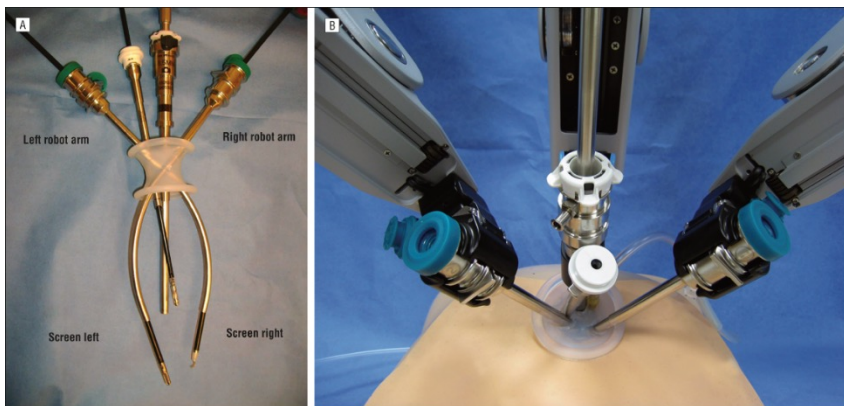
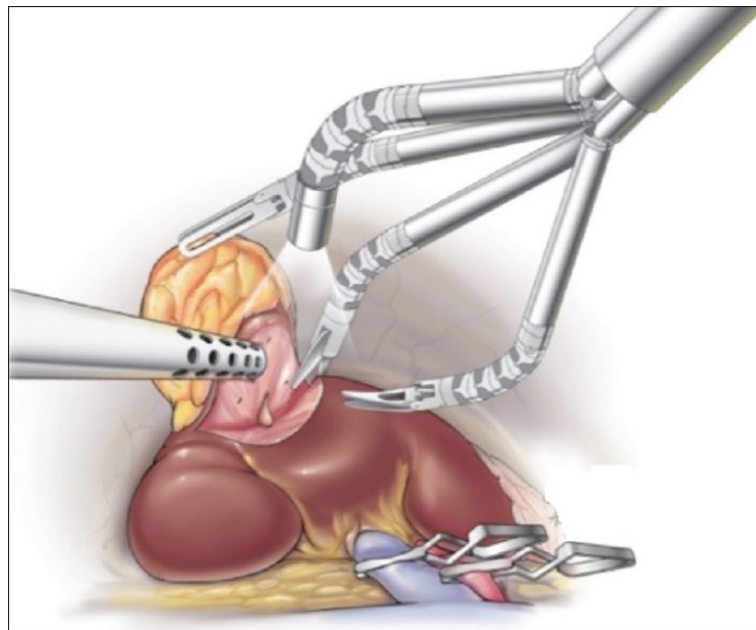
- Limited range of motion at the surgical site resulting in a loss of dexterity.
- Poor depth perception.



Robot-Assisted Laparoscopic Surgery

Single port robot-assisted surgery

- Minimize trauma
- Reduce various complications associated with external incisions such as skin scars, postoperative pain and wound infections.



[Cite: intuitive surgicals](#)

Singh, S., et al IcRoM-2017



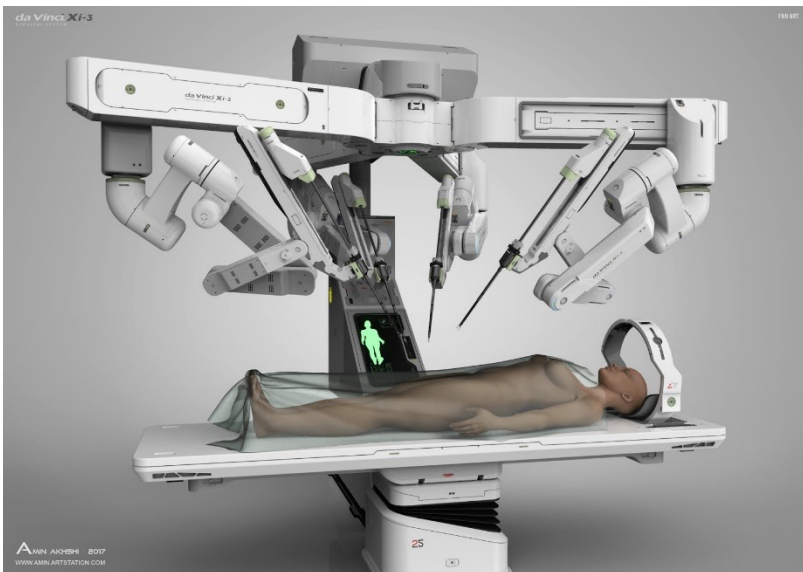
Classification of surgical procedures

- Open Surgery
- Manual Laparoscopic Surgery
- Robot-assisted Laparoscopic Surgery (Multi-port)
- Robot-assisted Single port Laparoscopic Surgery
- Natural Orifice Transluminal Endoscopic Surgery (NOTES)



Classification

- Robot-assisted Laparoscopic Surgery (Multi-port)



Examples

Da Vinci Si
Da Vinci Xi
RAVEN II
RAVEN IV

Disadvantages:

- More number of incision, more blood loss and hence more time for recovery
- Difficult access patient (in case of emergency)



Classification

- Robot-assisted Single port Laparoscopic Surgery



Features:

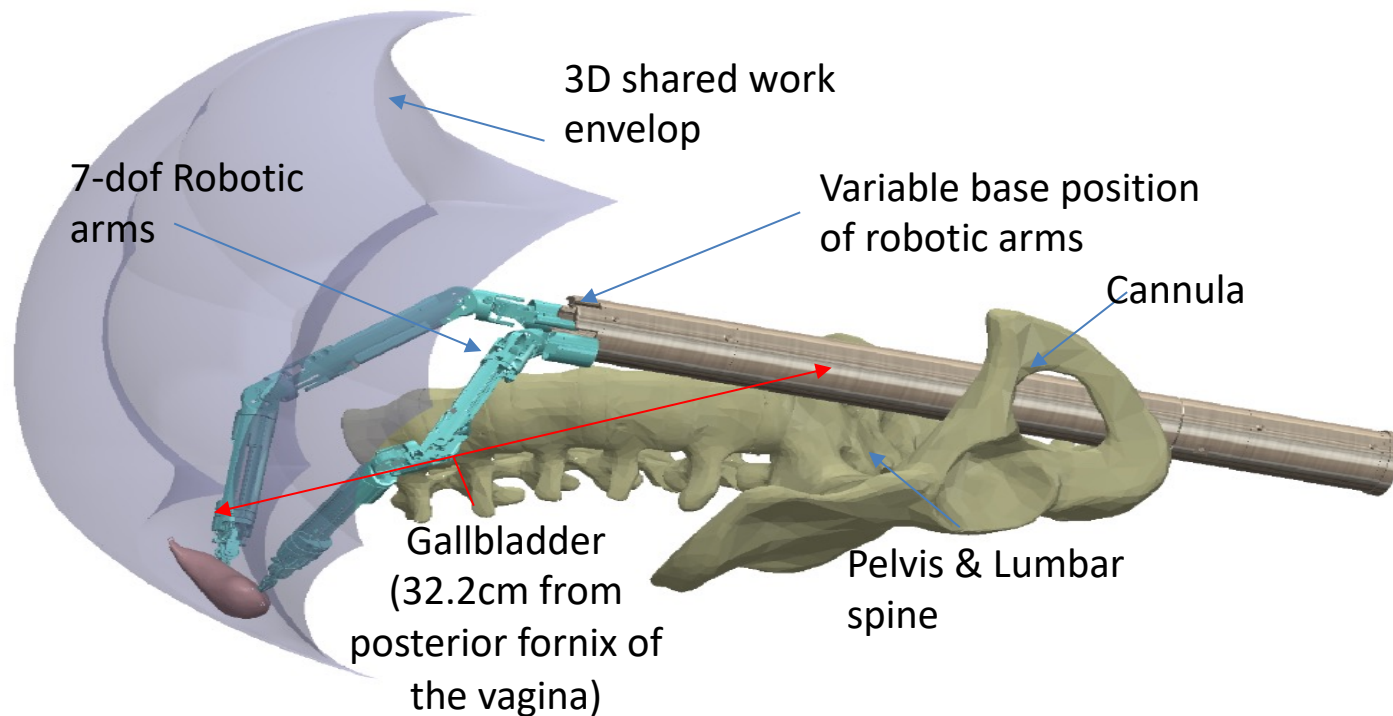
- One big incision to insert 3 tools
- Recovery time (not proven yet)
- Advancement towards Natural orifice entry

Examples :
da Vinci SP
Micro IGES
SAIT- Korea

Other names:
SPL (Single port laparoscopy)
SILS (Single-incision laparoscopic surgery)
LESS (Laparo-endoscopic single-site surgery)



Robot-Assisted Laparoscopic Surgery (NOTES)



NOTES Possibilities:

Trans-oral

Trans-nasal

Trans-Vaginal

Trans-rectal

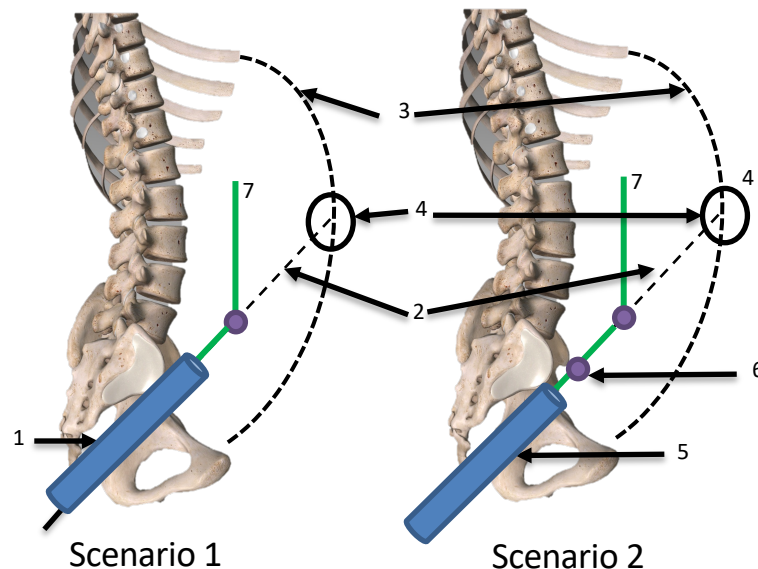
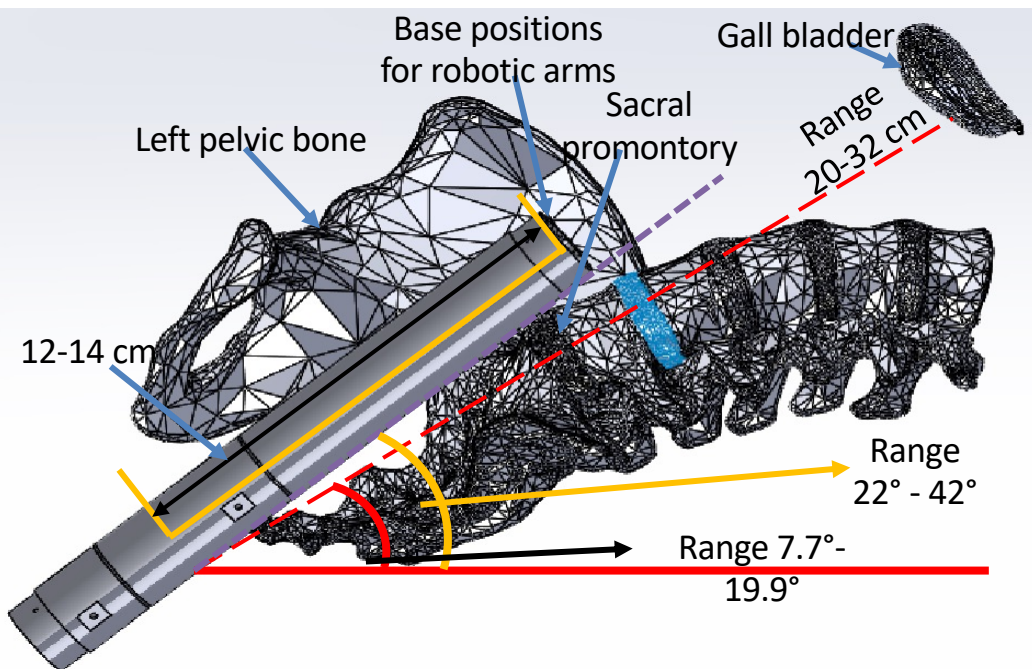
Example:

MICRO-IGES (ICL-Hamlyn centre)

Research Project for Trans rectal NOTES



Robot-Assisted Laparoscopic Surgery (NOTES)

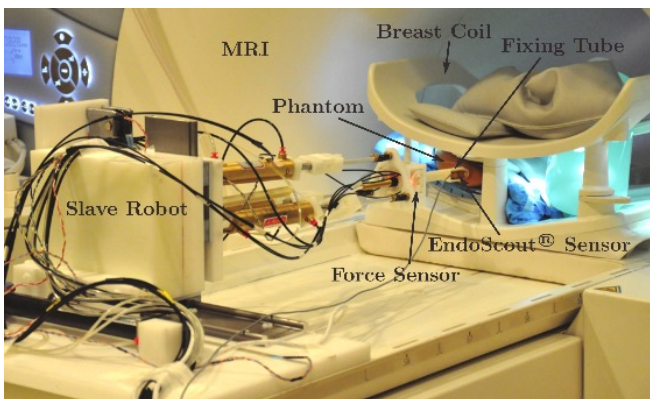


- To study the potential of NOTES (trans-vaginal) applicability for the procedures in abdominal cavity
- design a surgical robotic arm intended to perform surgeries inside the abdominal cavity while avoiding all the environmental obstacles posed by other organs and bones

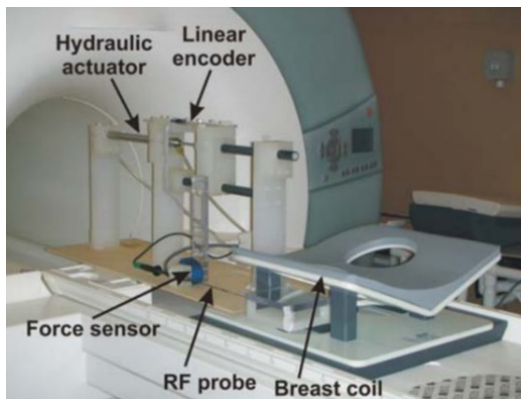


Challenges – Biopsy Mechanisms

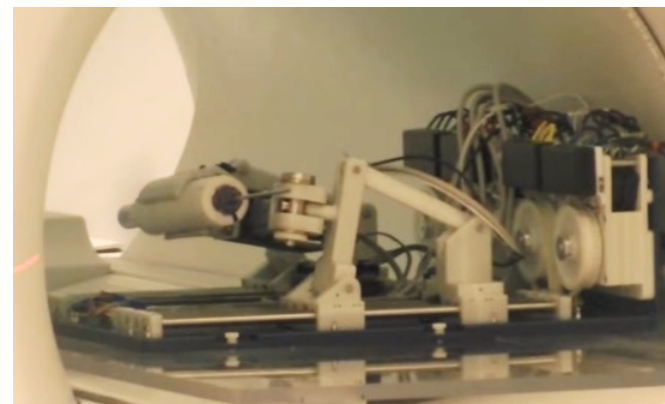
- Existing biopsy robots are **too large** to perform lateral needle insertions



Yang B et al (2014)

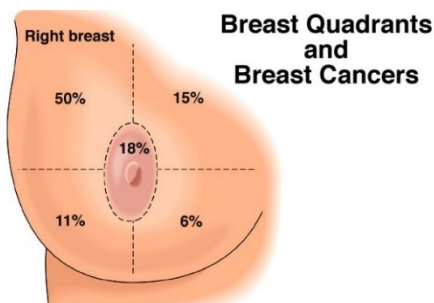


Kokes R et al. (2009)



Chan K et al. (2016)

Most lesions are located in the outer-upper quadrant



Lee A et al. "Why is carcinoma of the breast more frequent in the upper outer quadrant" The Breast, 2005

Current (manual) practice

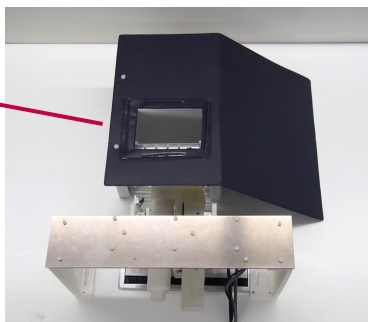




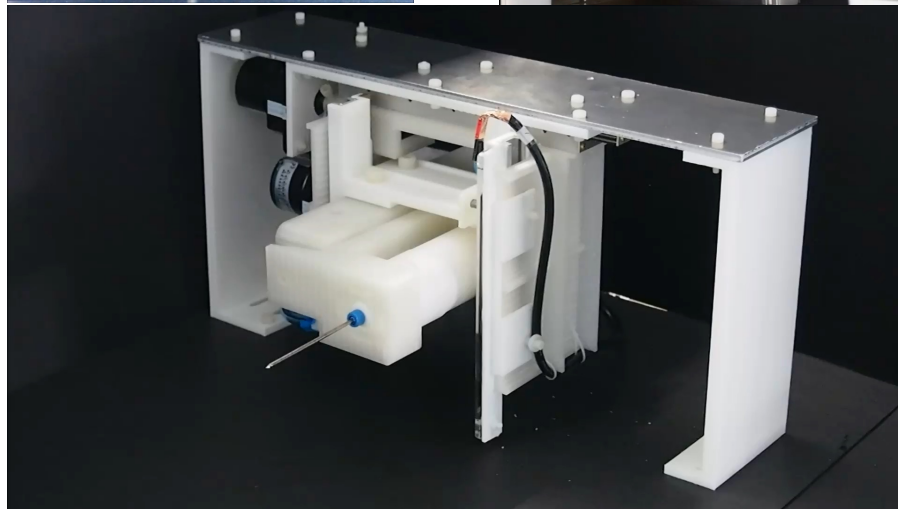
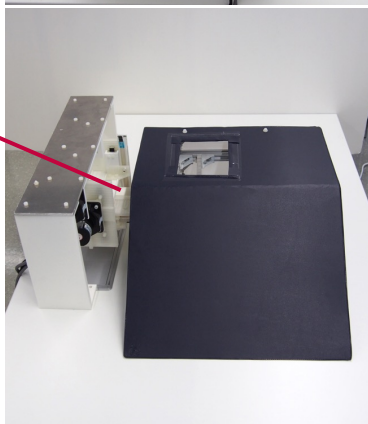
Exemplary Prototype

- **Compact mechanism** (250 mm width including biopsy gun)

Breast coil model



Lateral insertion

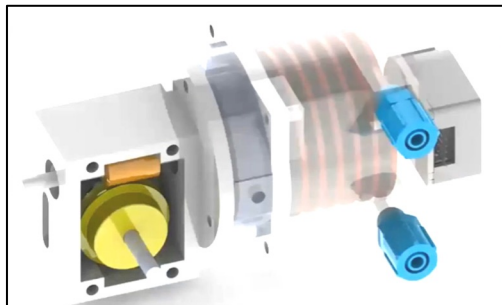


Navarro-Alarcon, D., Singh, S., et al. IEEE Robotics and Automation Letters, 2(3), 1648-1655 and ICRA-2017

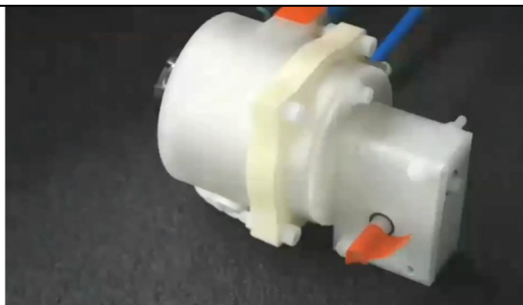


Requirements for MRI compatibility

Pneumatic actuator

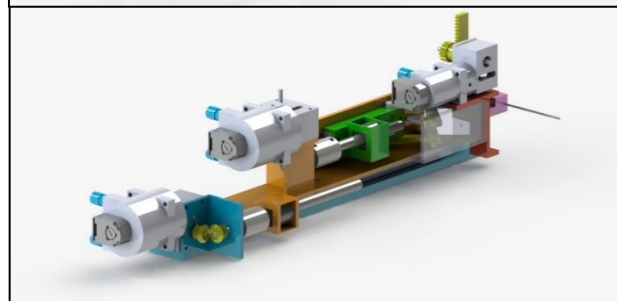
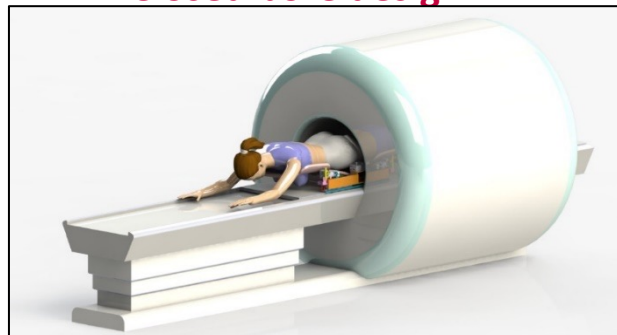


Tesla turbine inspired motor
(Concept drawing)

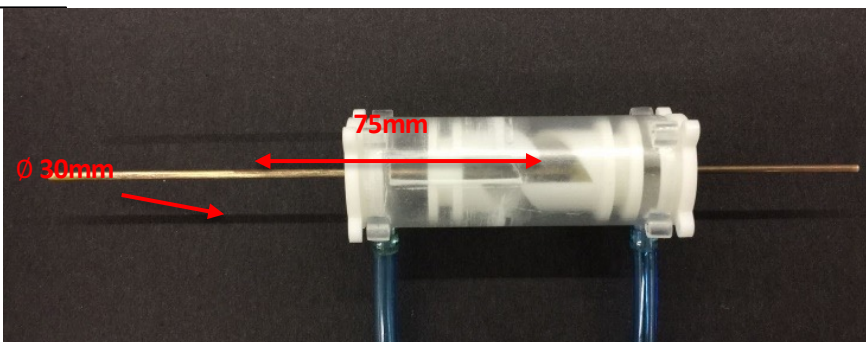
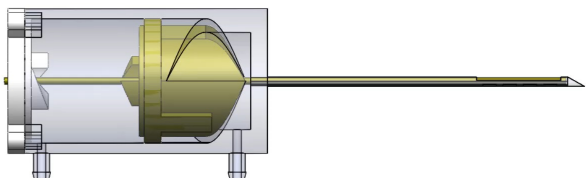


Tesla turbine inspired motor
(Prototype), Speed x2

Closed bore design



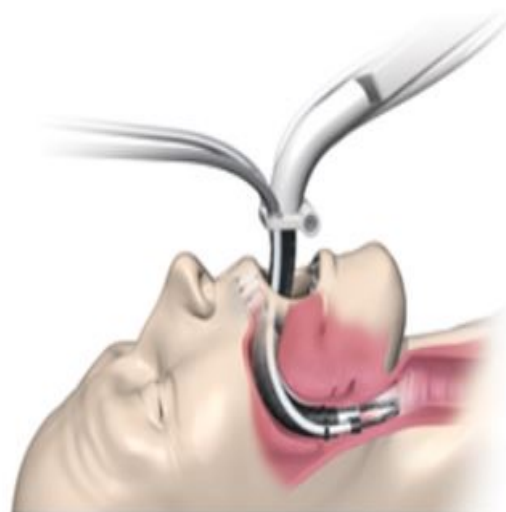
Non-electric biopsy gun





Soft Robotics Colonoscopy and Endoscopy

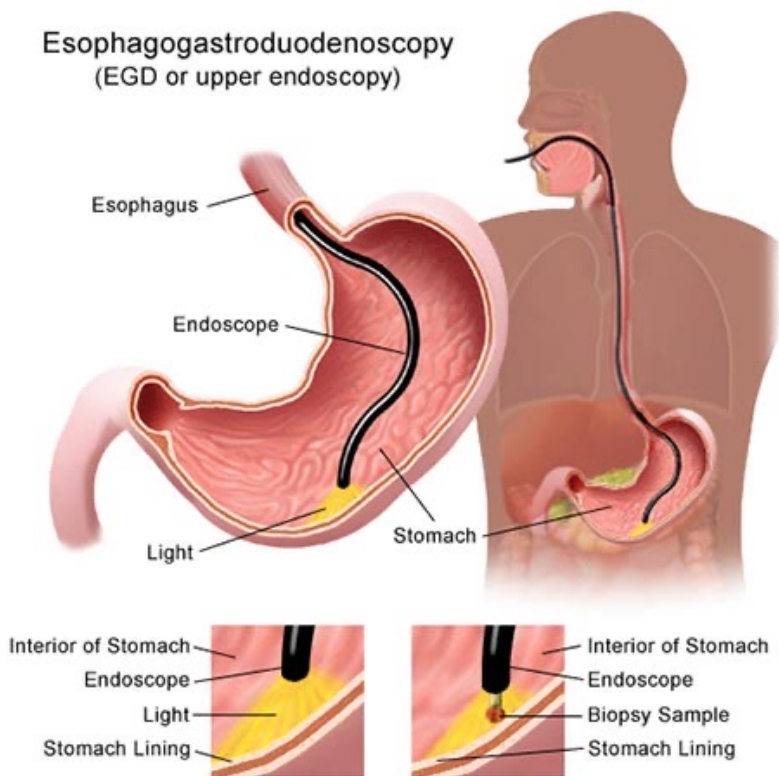
During colonoscopy/endoscopy, the doctor controls different functions of the colonoscope by two hands.





Challenges in Colonoscopy

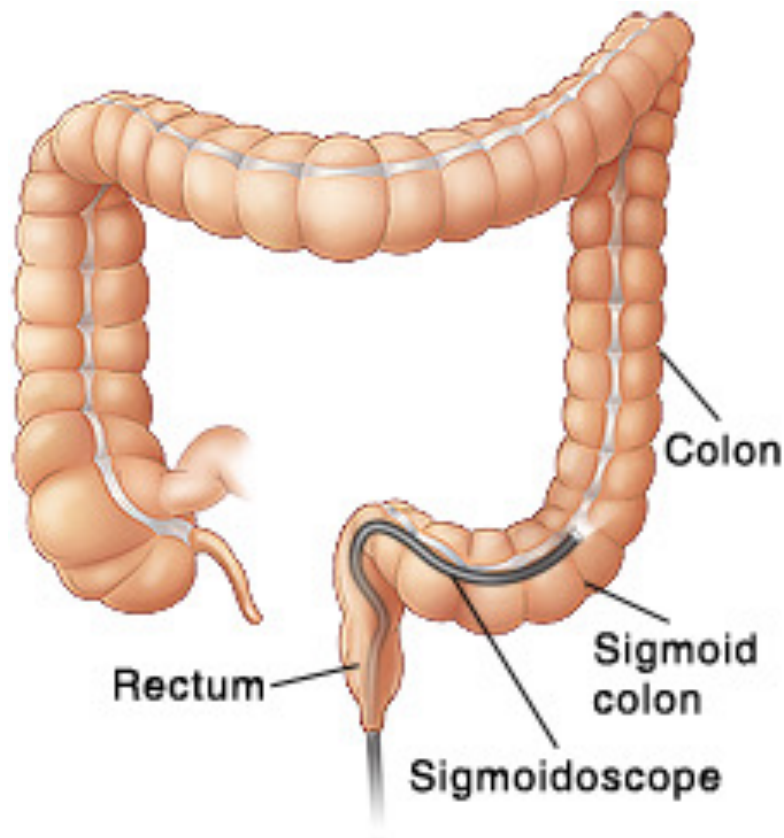
Esophagogastroduodenoscopy
(EGD or upper endoscopy)



Relatively easier than
colonoscopy



(2) What happens during and after a colonoscopy - YouTube.webm



- Sigmoid colon bend – deciding factor for bending angle while design
- Hardness of colonoscope
- Sedation
- Pain



Colonoscopy/Endoscopy Video Demonstrations



© Mechanisms in Medicine Inc.

www.YouAndColonoscopy.com

STORM LAB, Vanderbilt
and Leeds

Colonoscopes:

Olympus (Most Widely Used)

Aeroscope

Invendoscope





Any Questions/Suggestions