Computer Navigation, Planning, and Robots in Otolaryngology

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Division of Head and Neck Surgery
Head and Neck Oncology
Microvascular Reconstruction
Robotic Surgery

JOHNS HOPKINS
MEDICINE

Disclosures

- Intuitive Surgical, Inc – previous consultant

Otolaryngology – Head and Neck Surgery

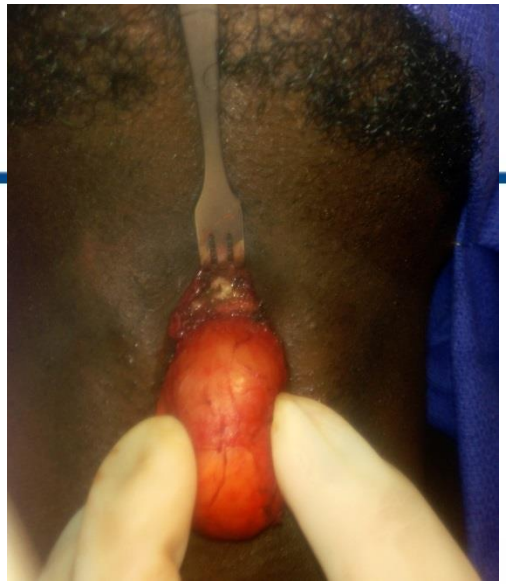
- Deals with the medical and surgical treatment of ailments of the head and neck, including:
  - Nose, Sinus, anterior skull base
  - Larynx (speech/swallowing)
  - Head and neck cancer
  - Otology/neurotology (ear, lateral skull base)
  - Allergy
  - Facial Plastic Surgery
  - Thyroid/Parathyroid
  - Pediatric Oto

Head and Neck Surgeon

- Lumps and bumps in head and neck
  - Neoplastic
  - Congenital
  - Infectious
  - Vascular
  - Traumatic
- Airway and swallowing problems
- Reconstruction

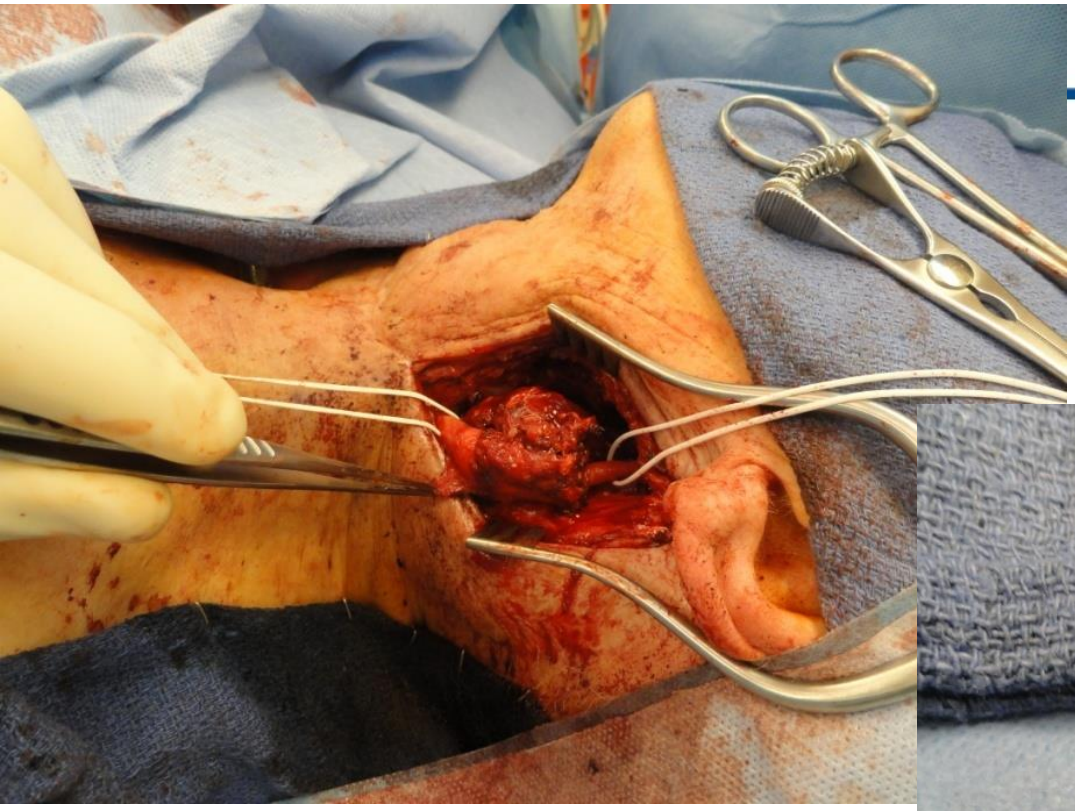
Head and Neck Surgery

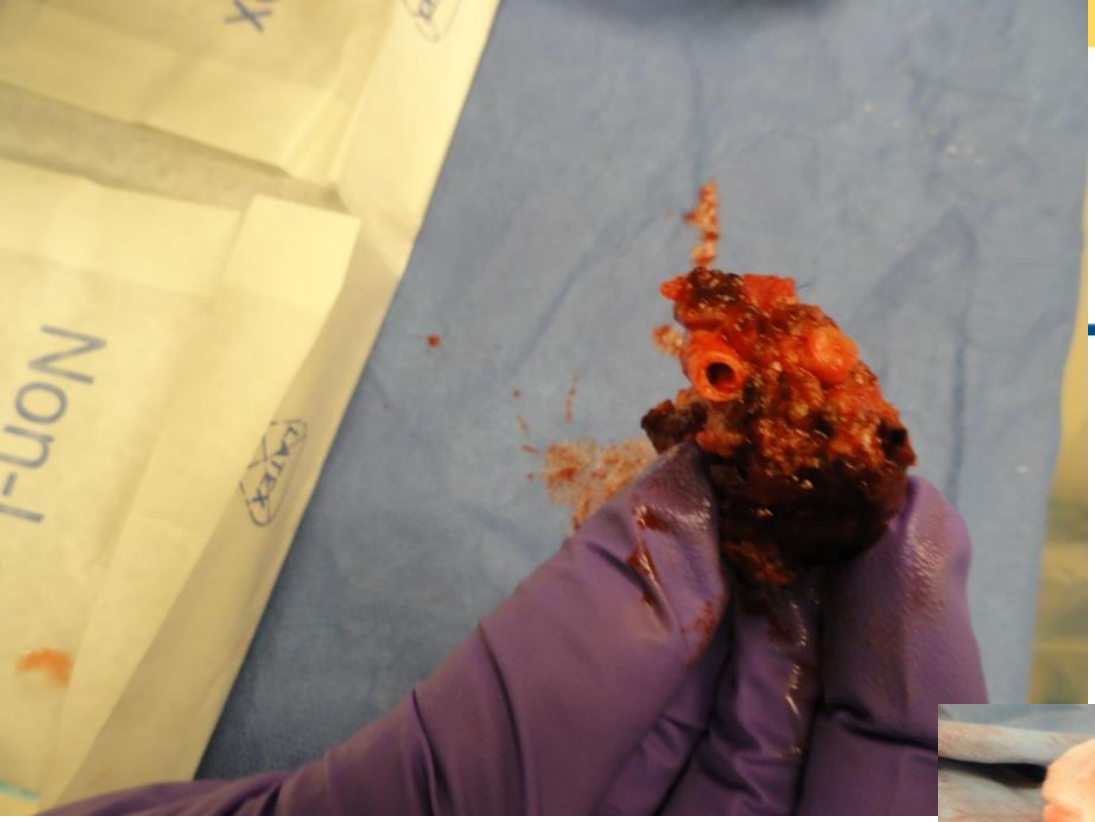
Congenital

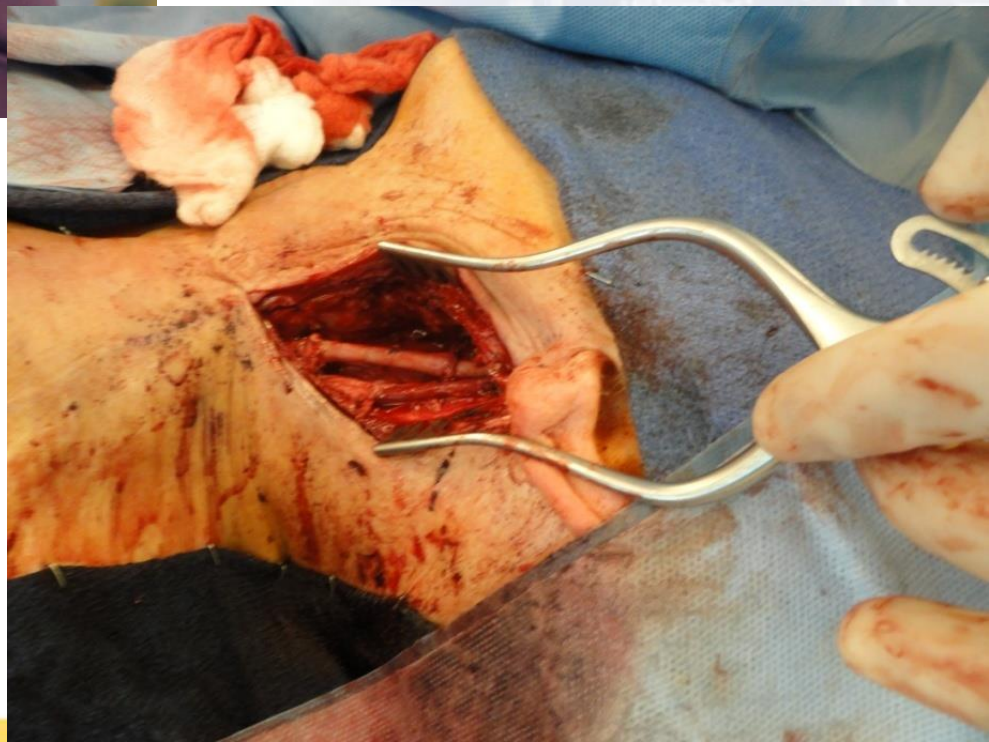


Infectious

Vascular







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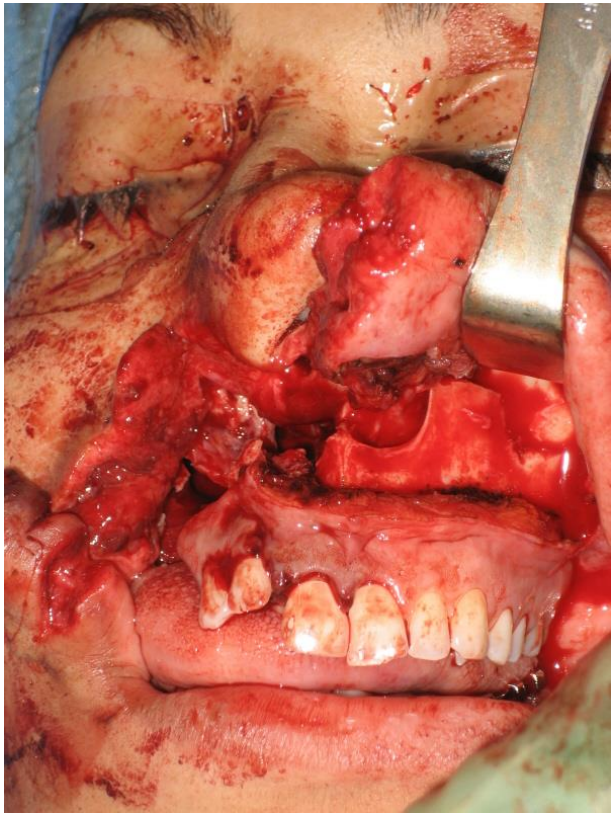
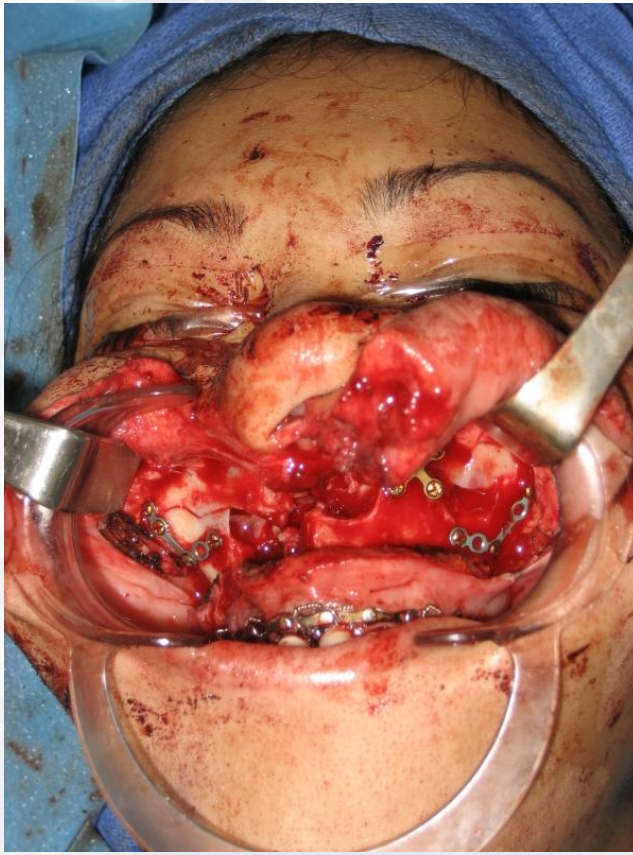
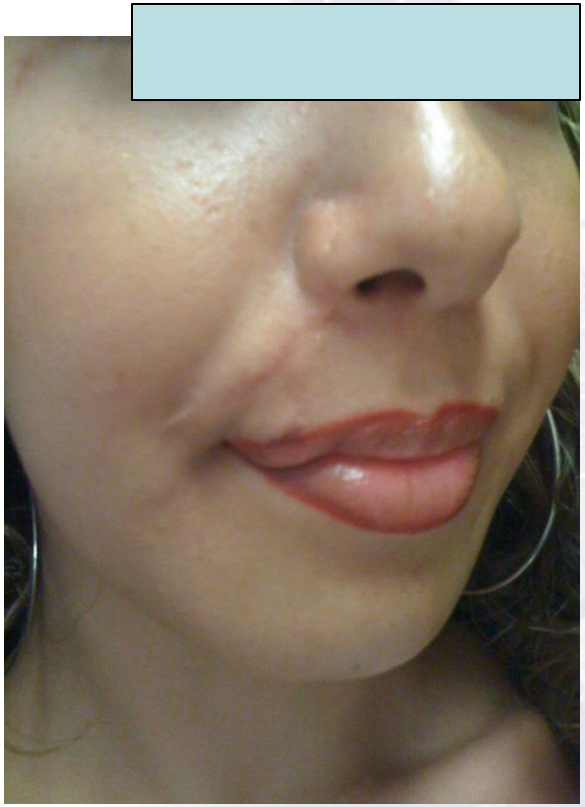
Traumatic







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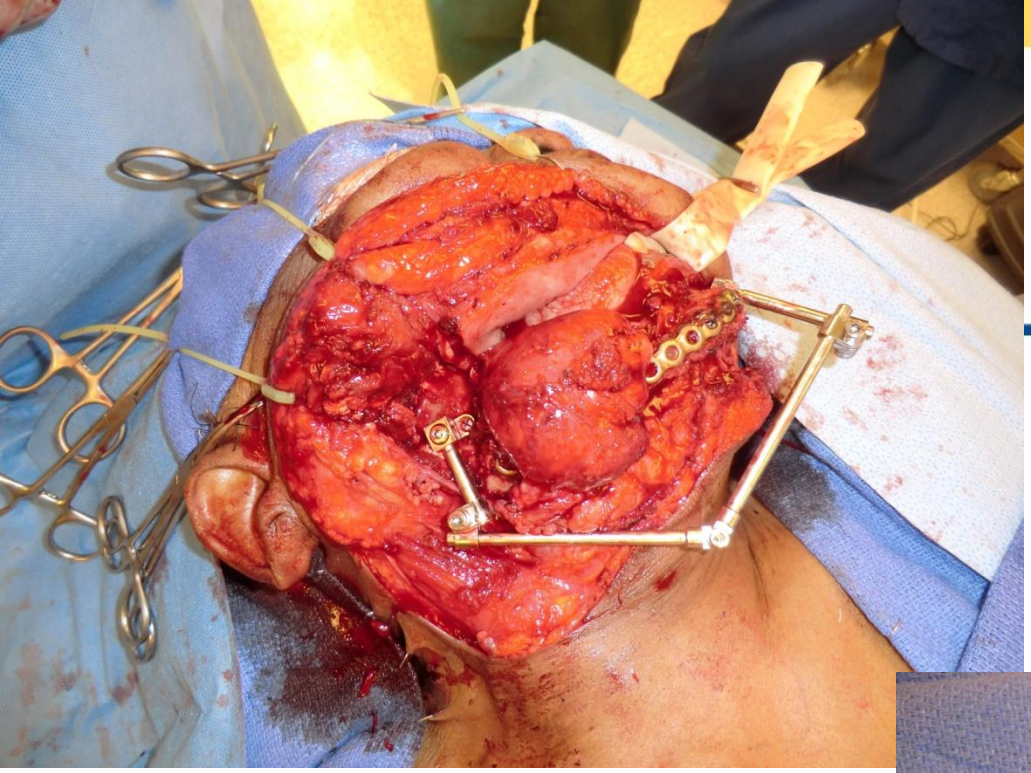

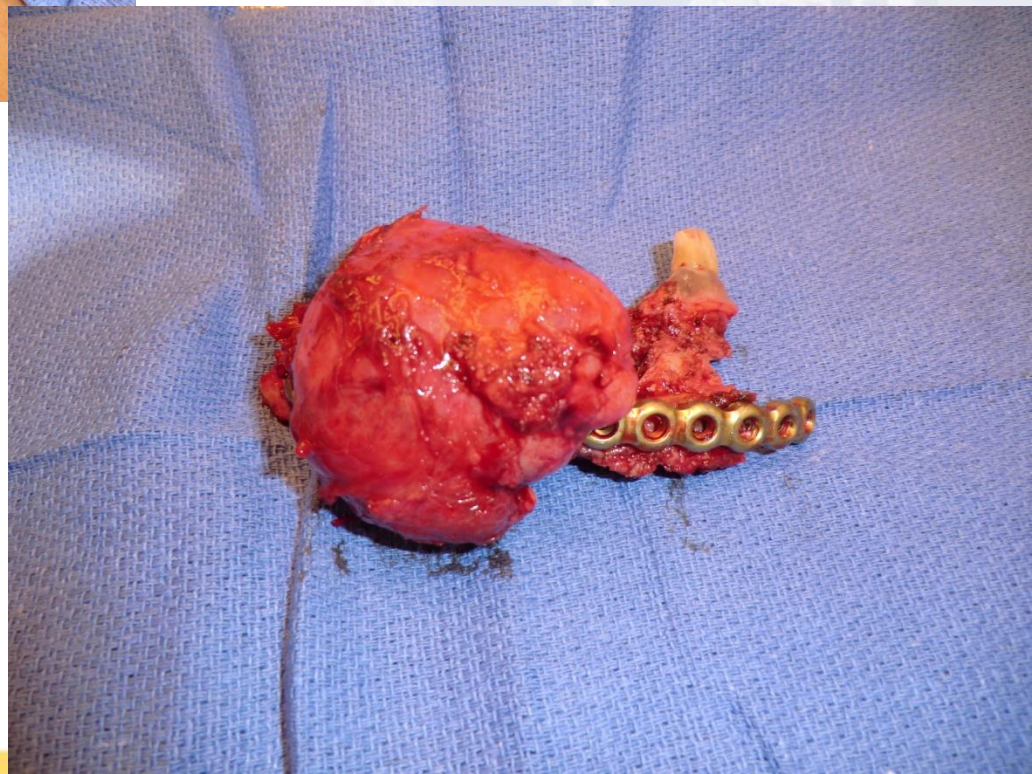

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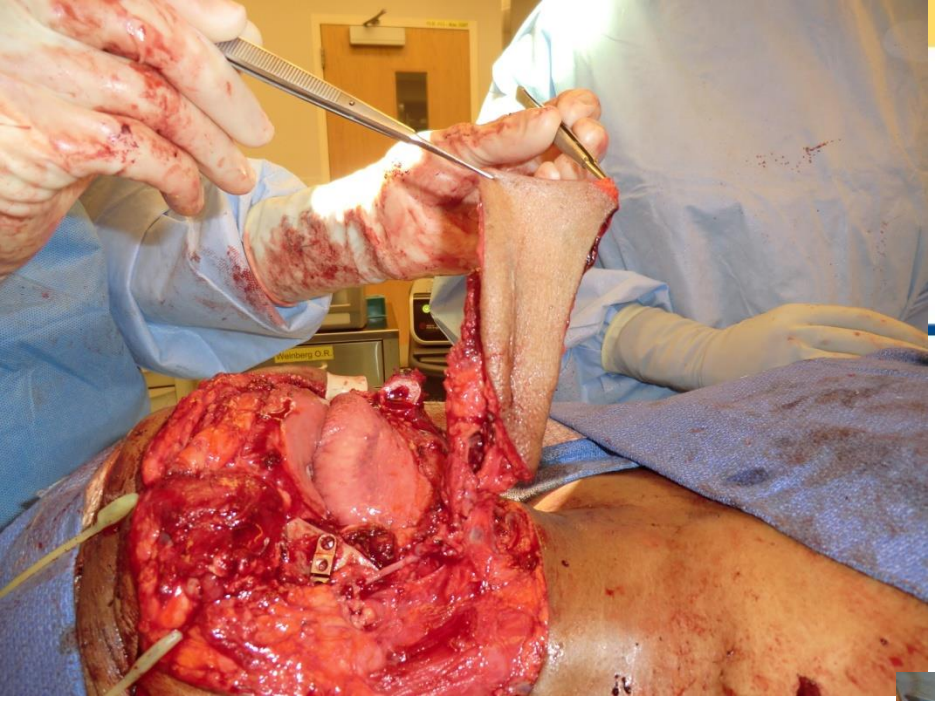

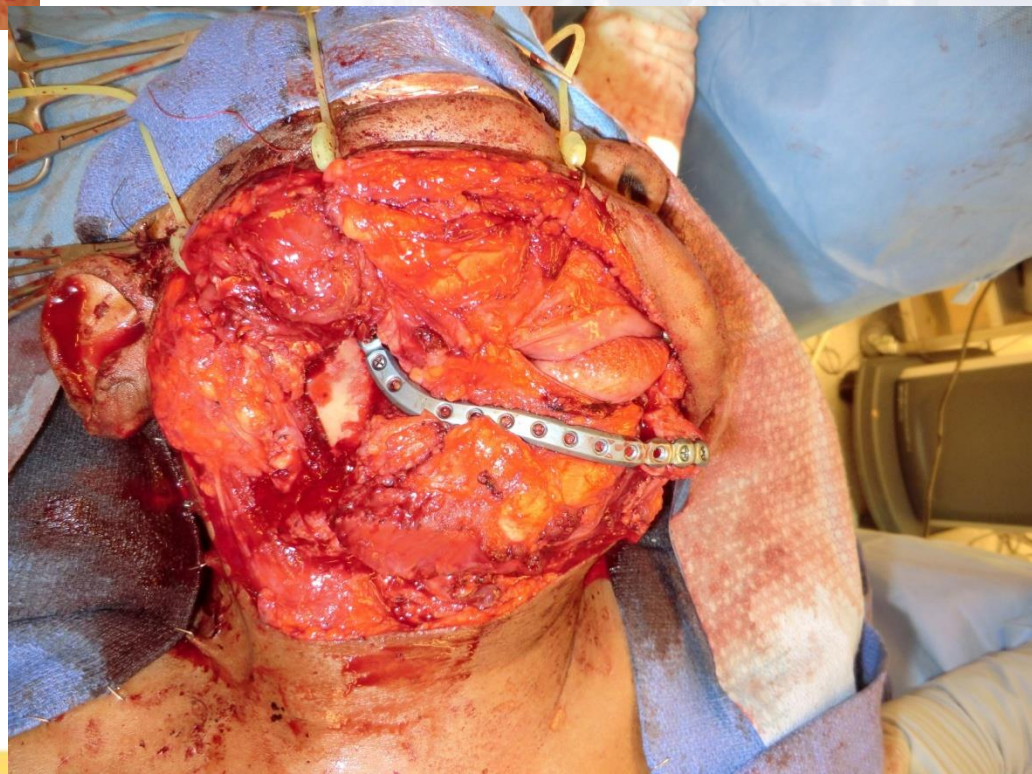

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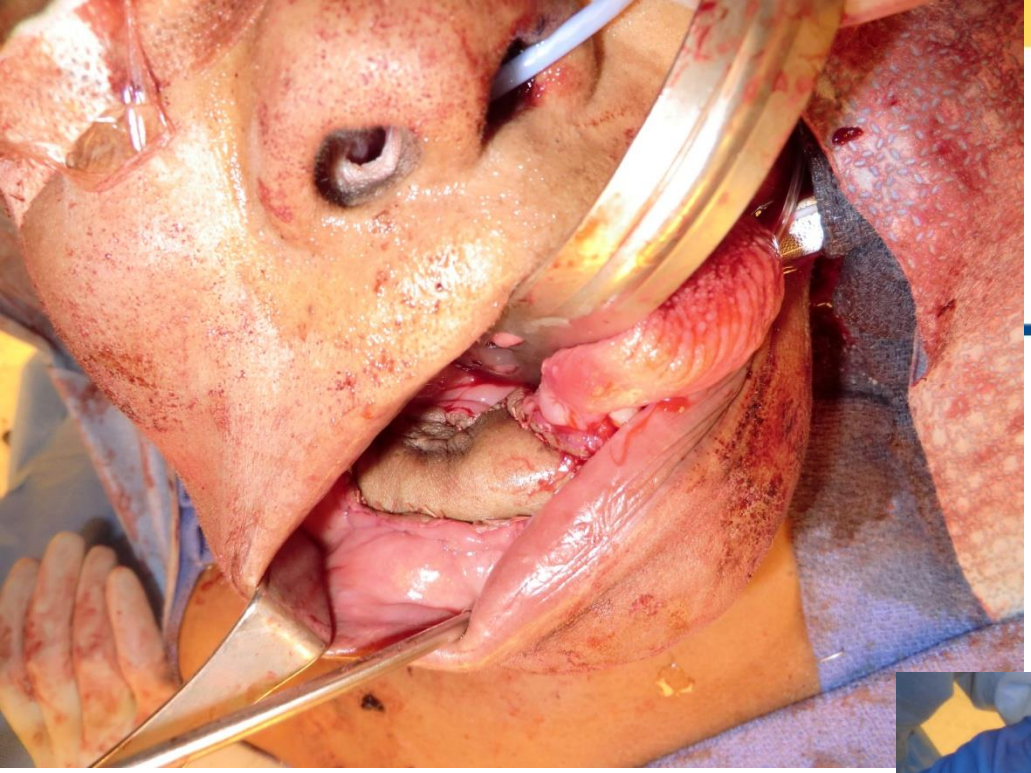

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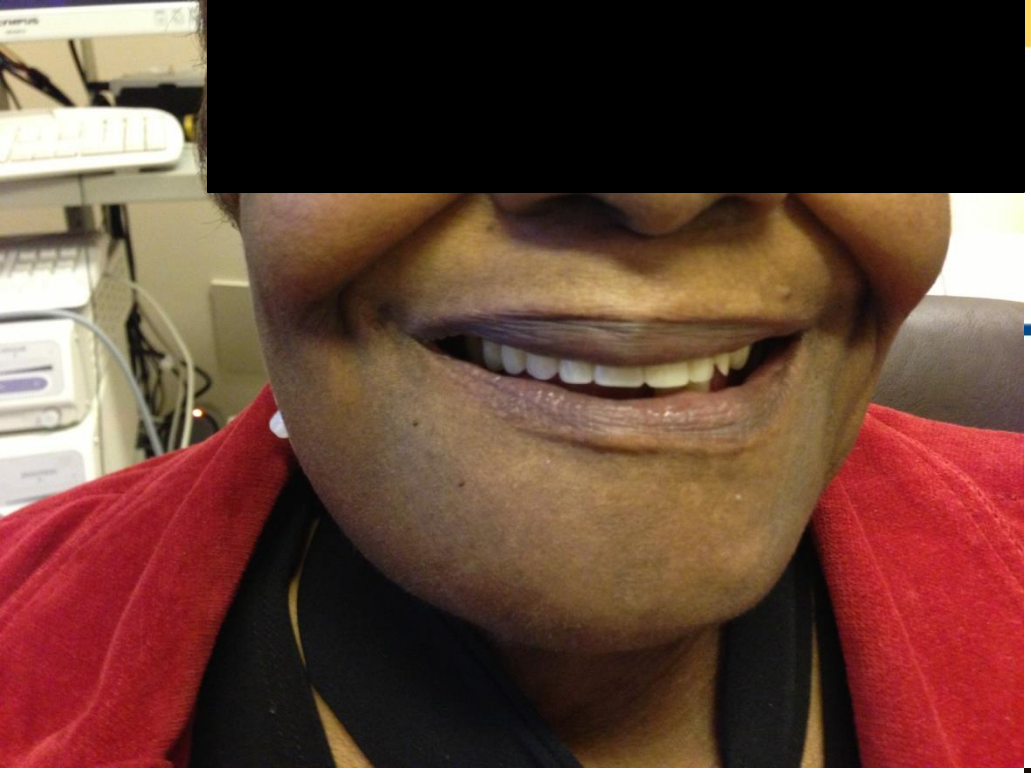

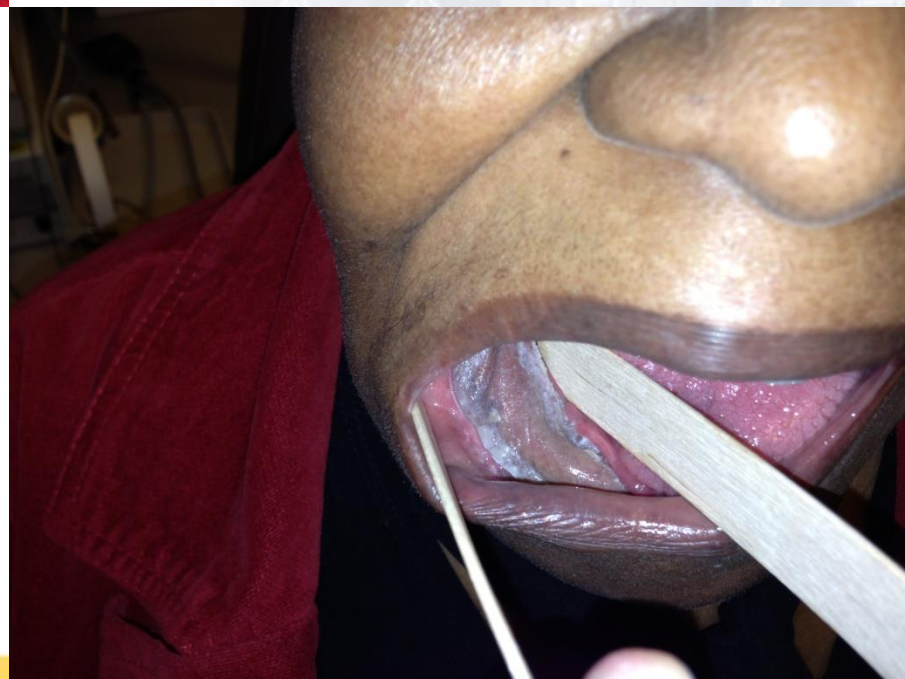

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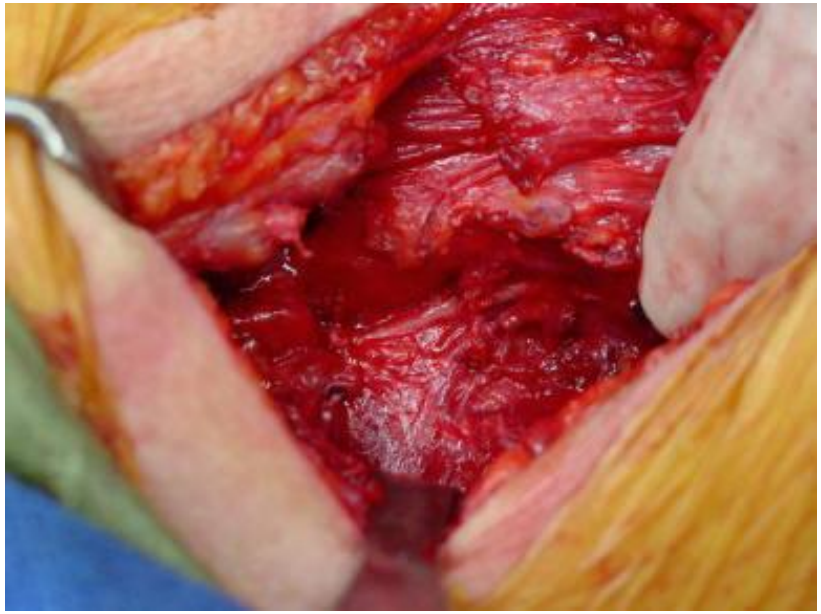
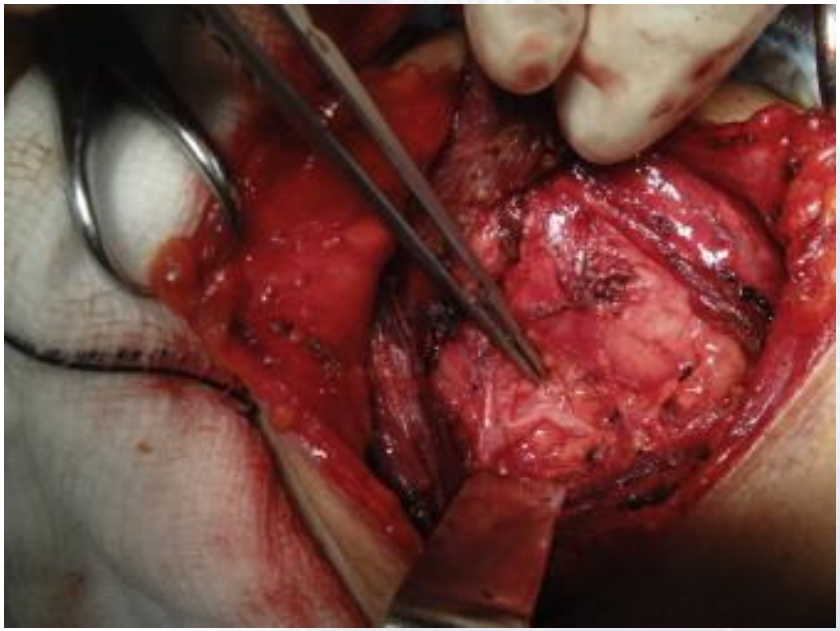
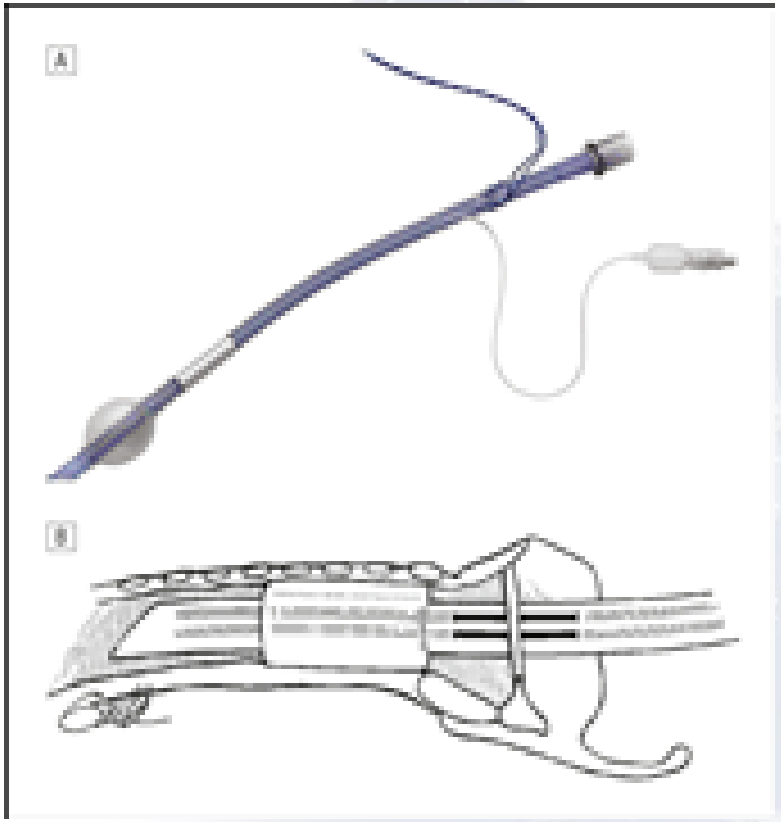
OHNS Technology Driven Field

- Over past 30 years
  - Endoscopy
  - image-guidance
  - Fiberoptic lasers
  - Radiofrequency
  - Microscopic instrumentation
  - Plates/screws
  - Imaging techniques (CT, MR, PET)

Thyroid Surgery







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Parotid Surgery

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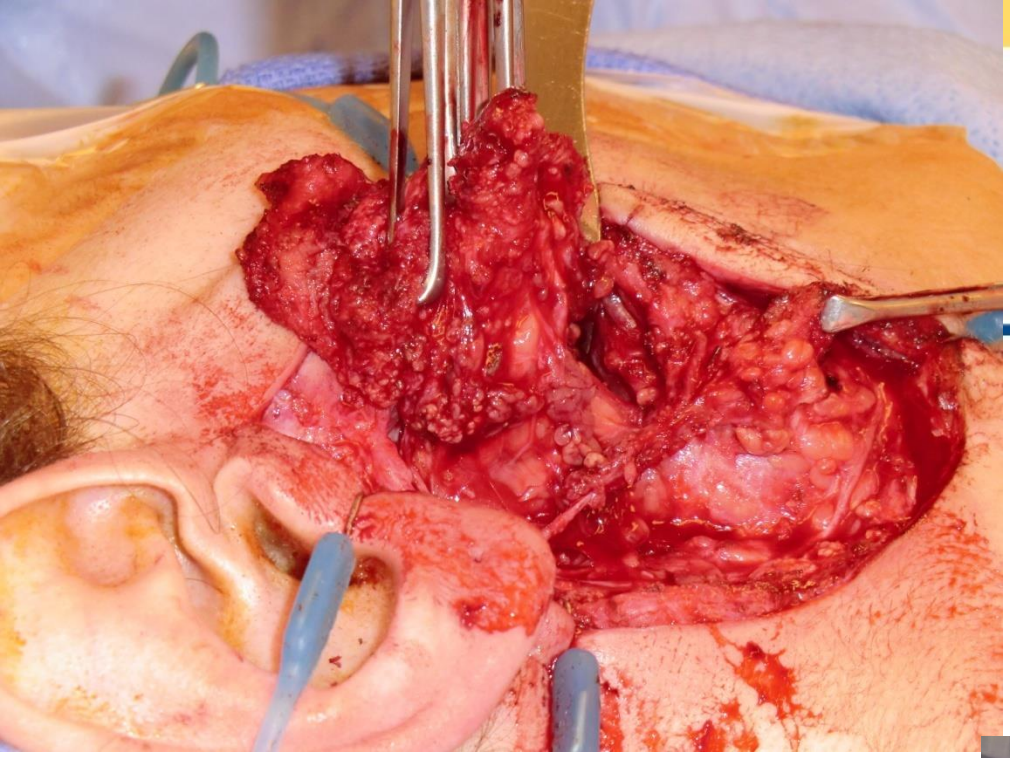

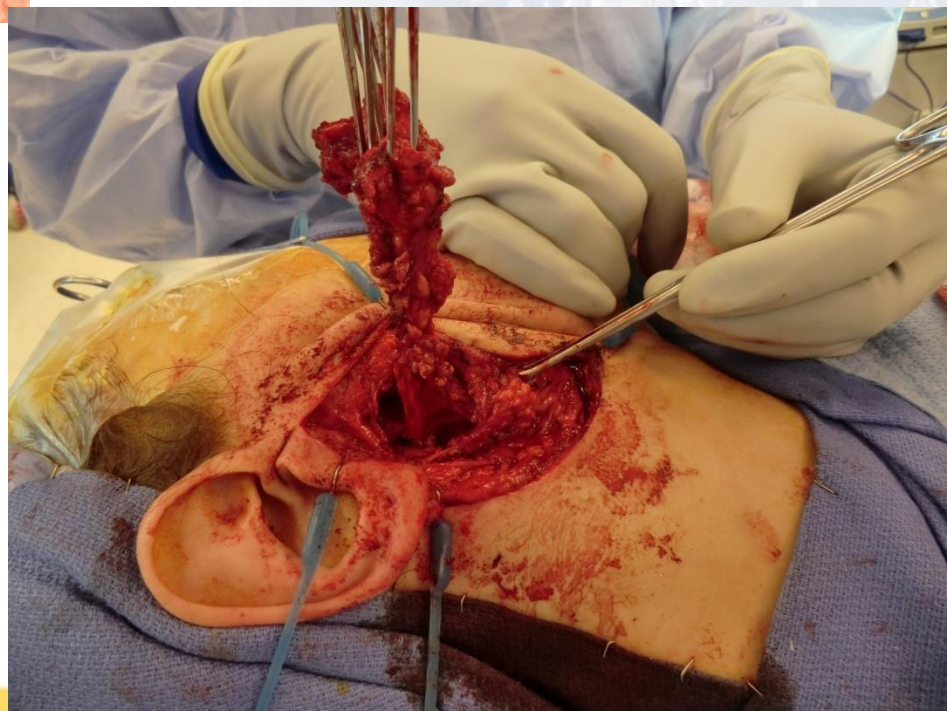

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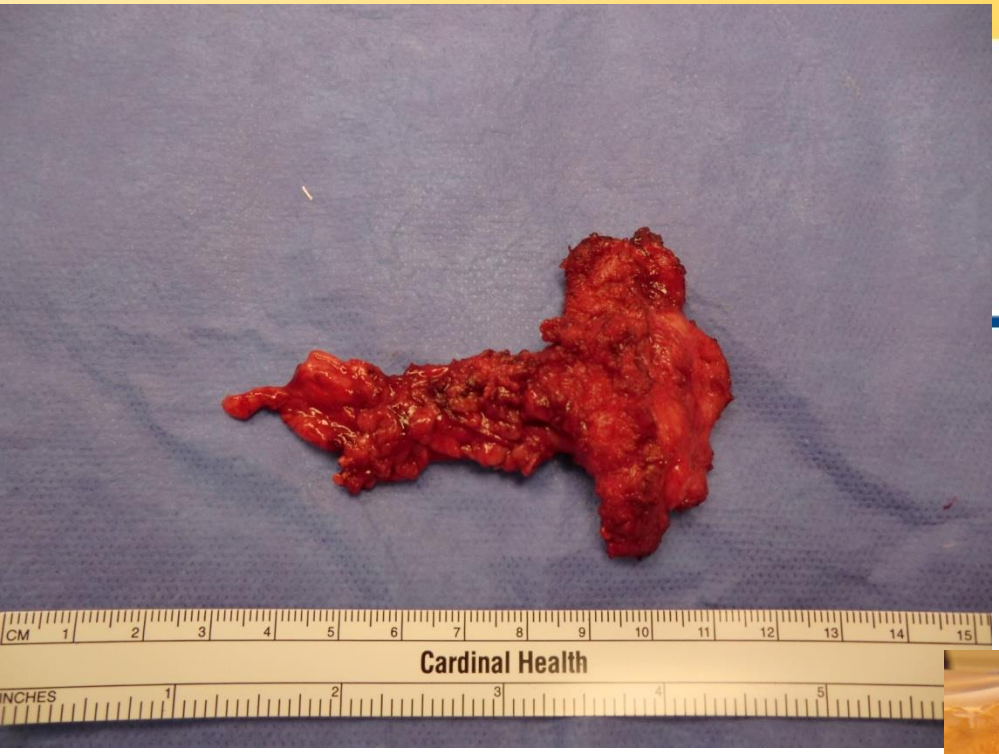

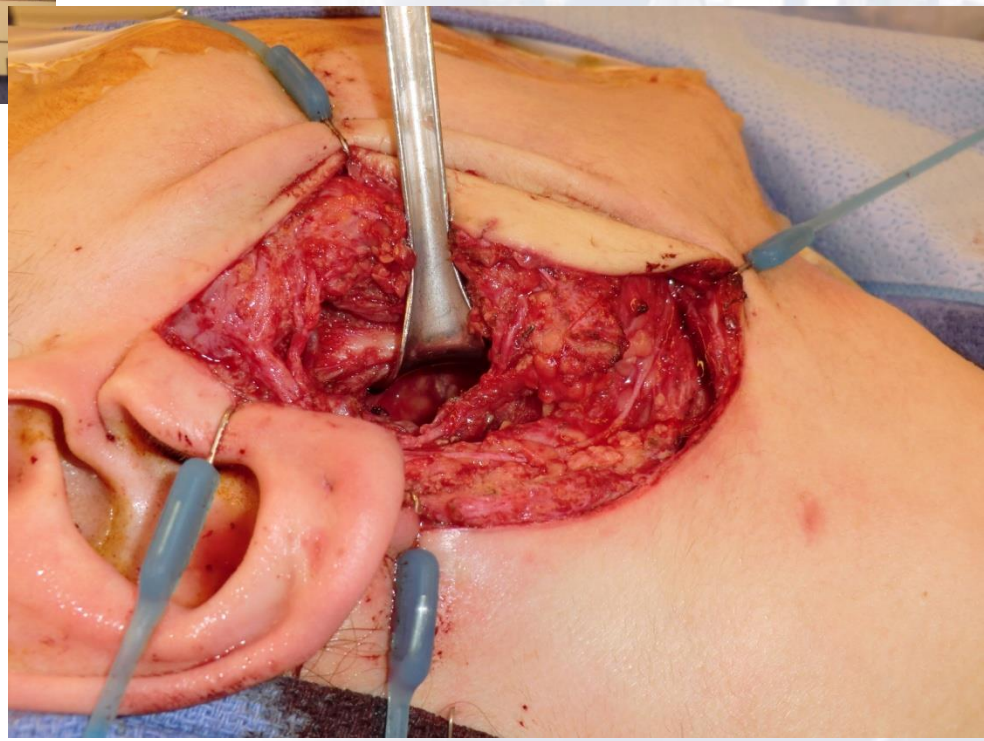

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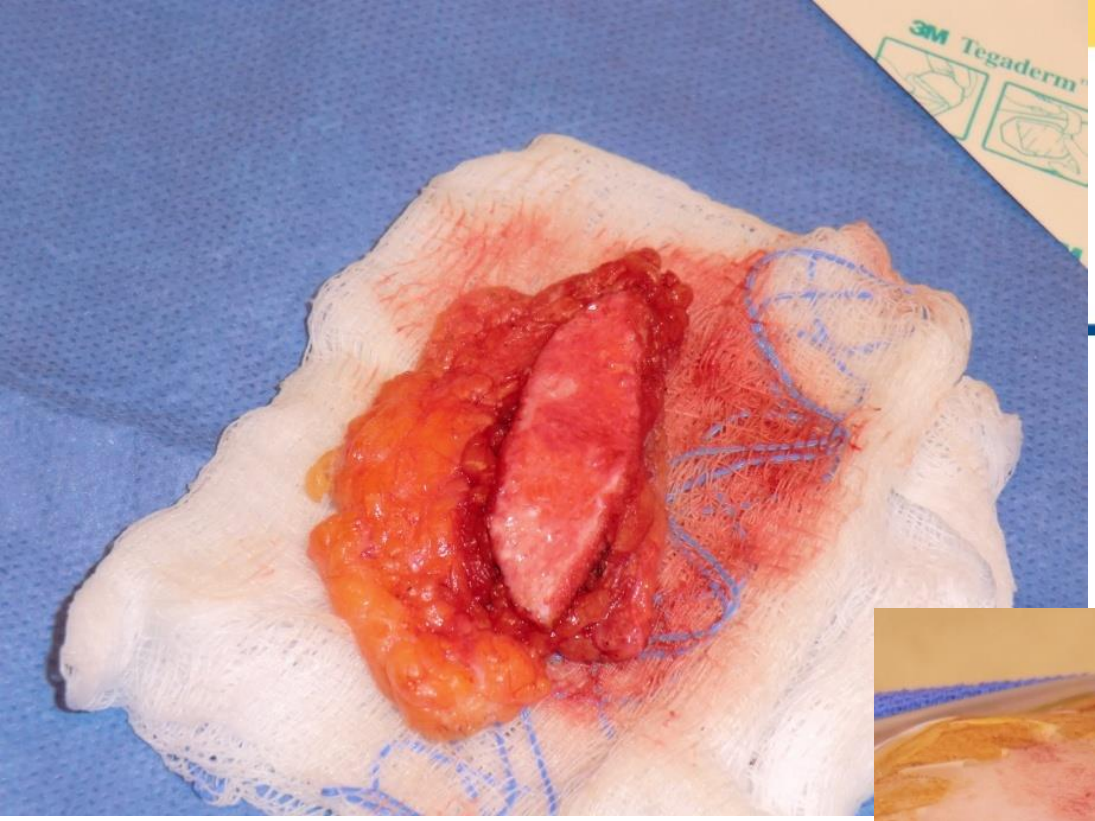

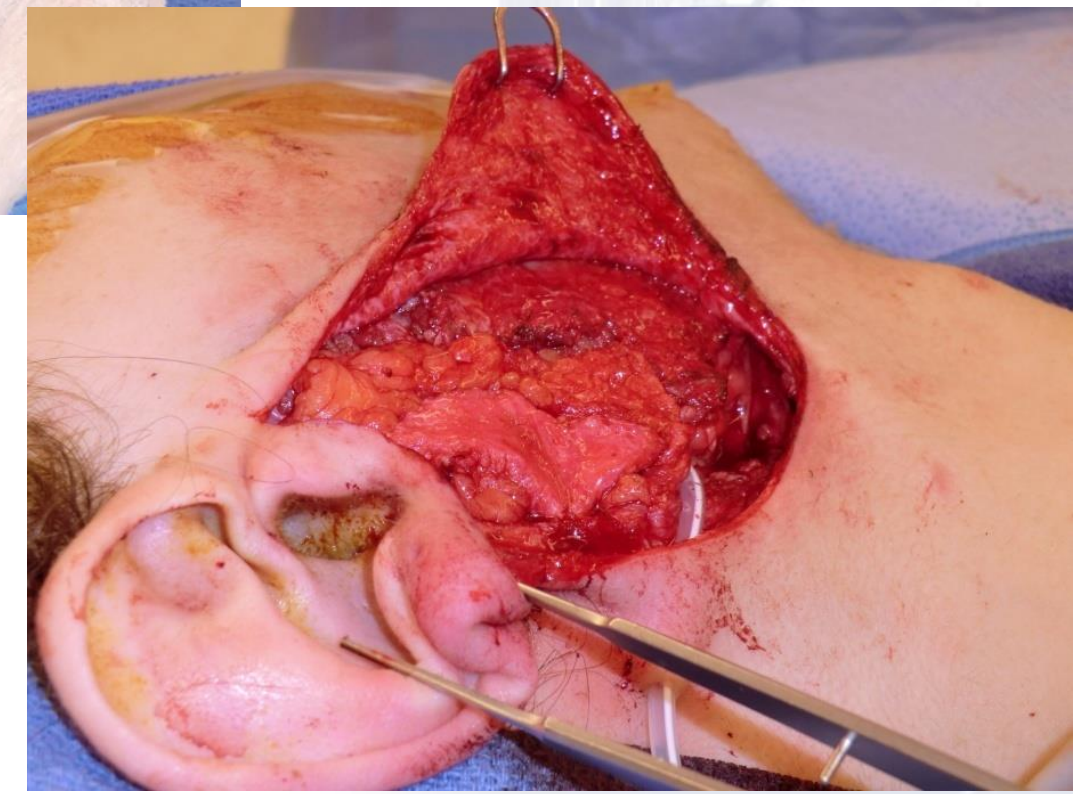

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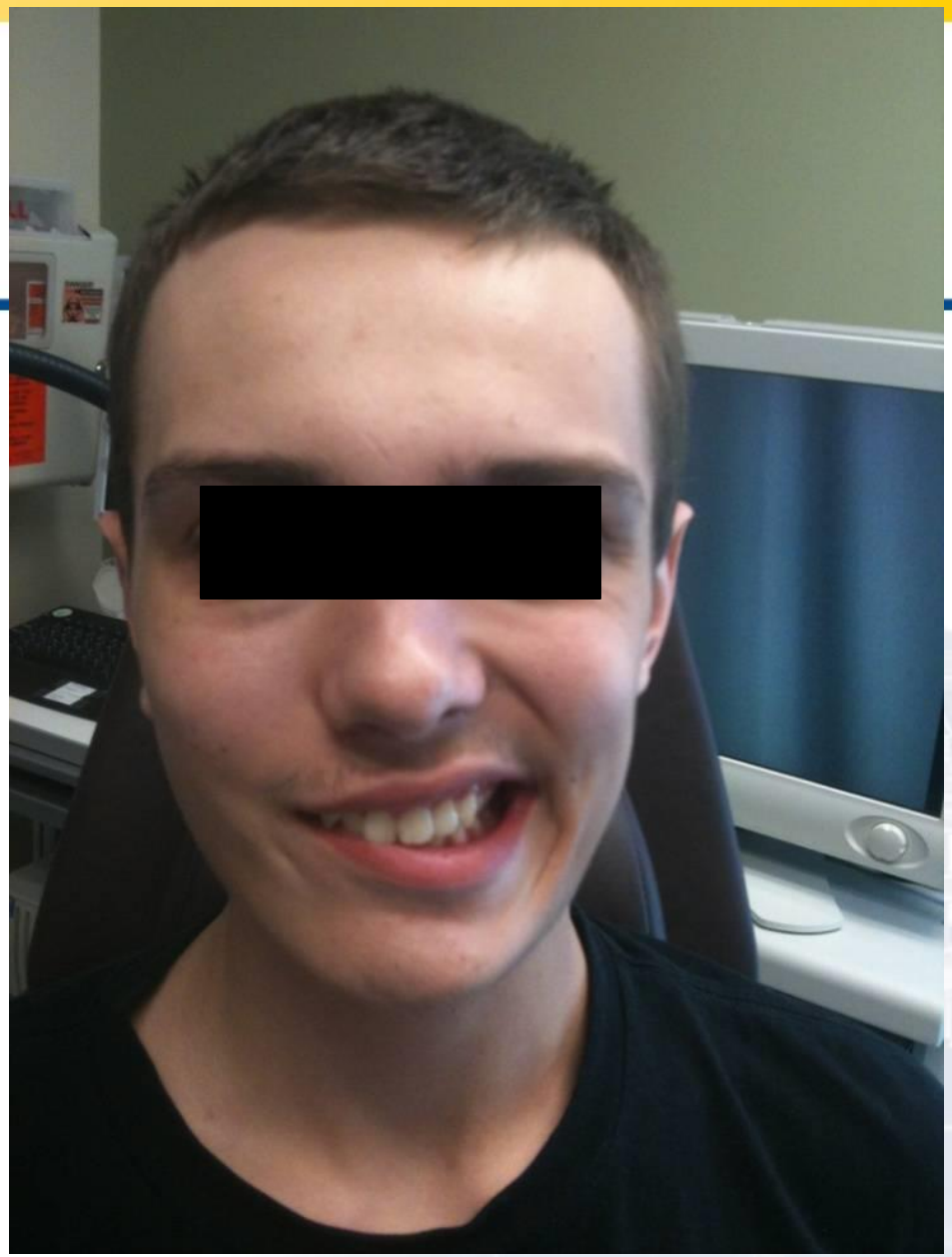
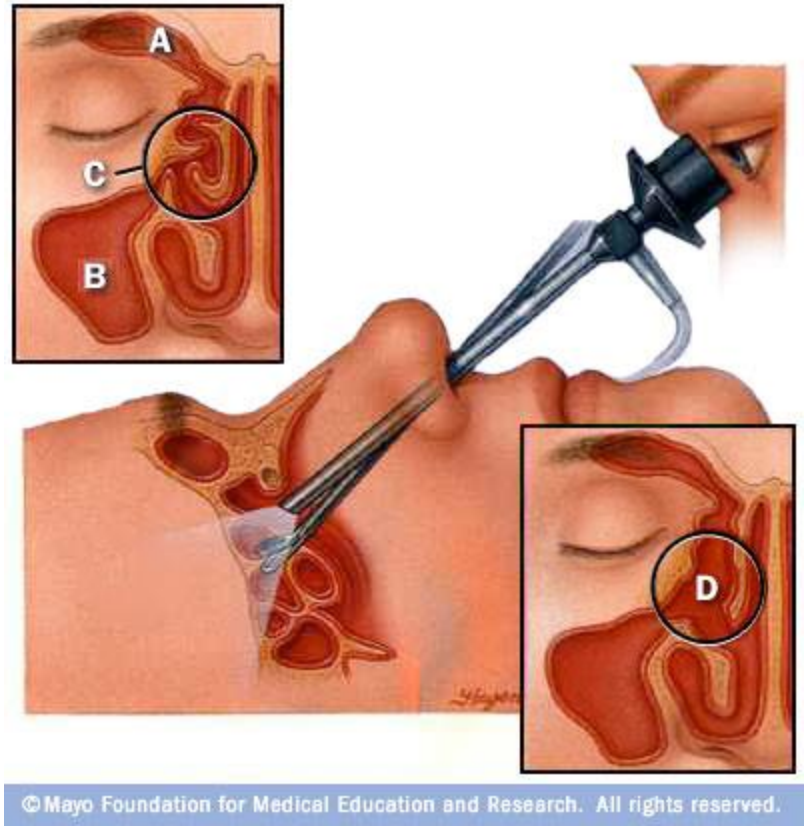
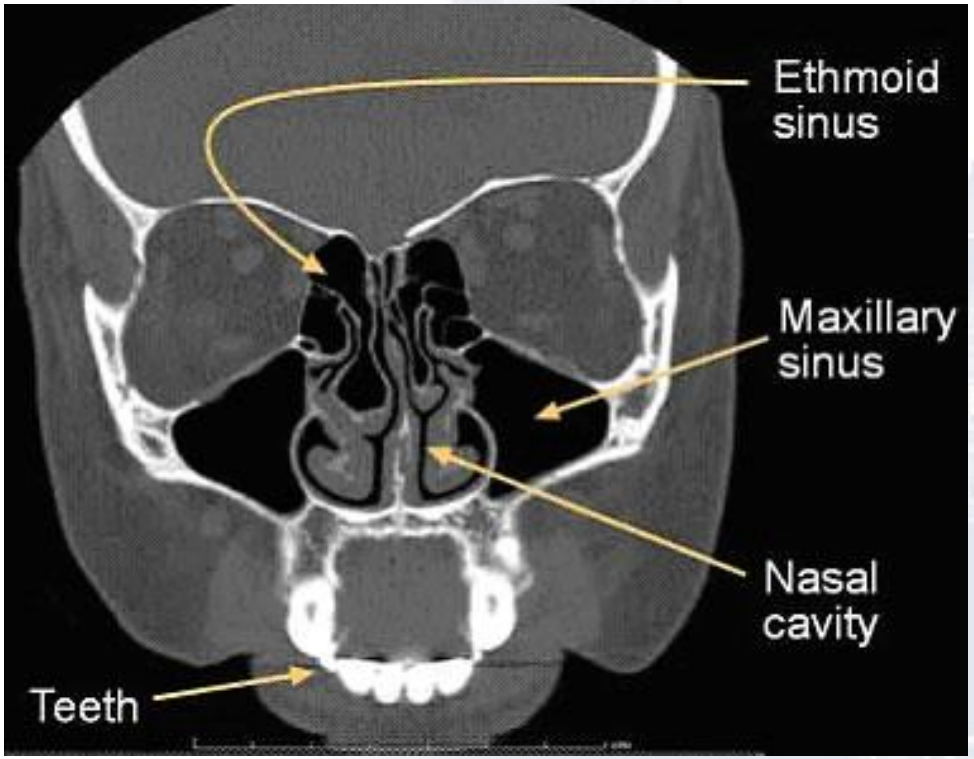
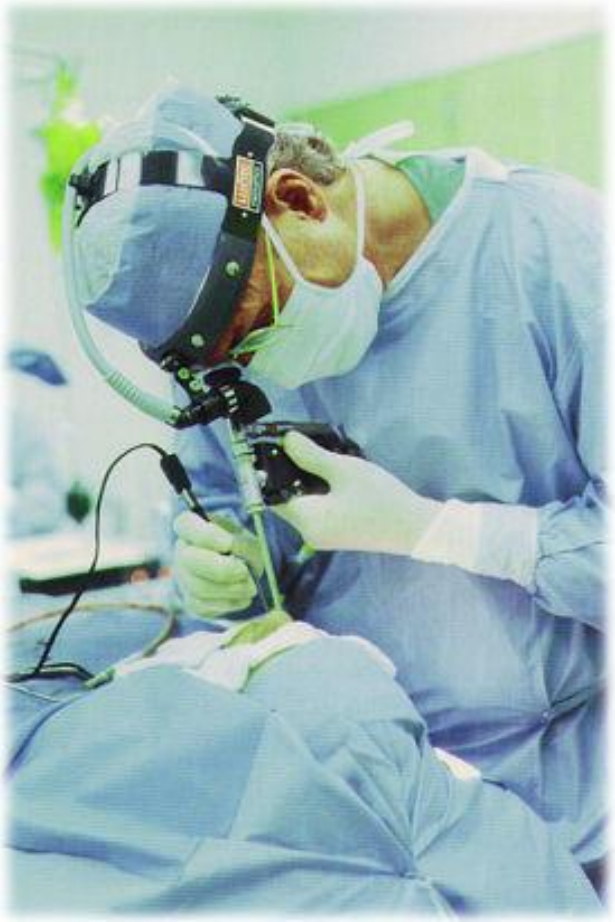


Sinus/skull base surgery







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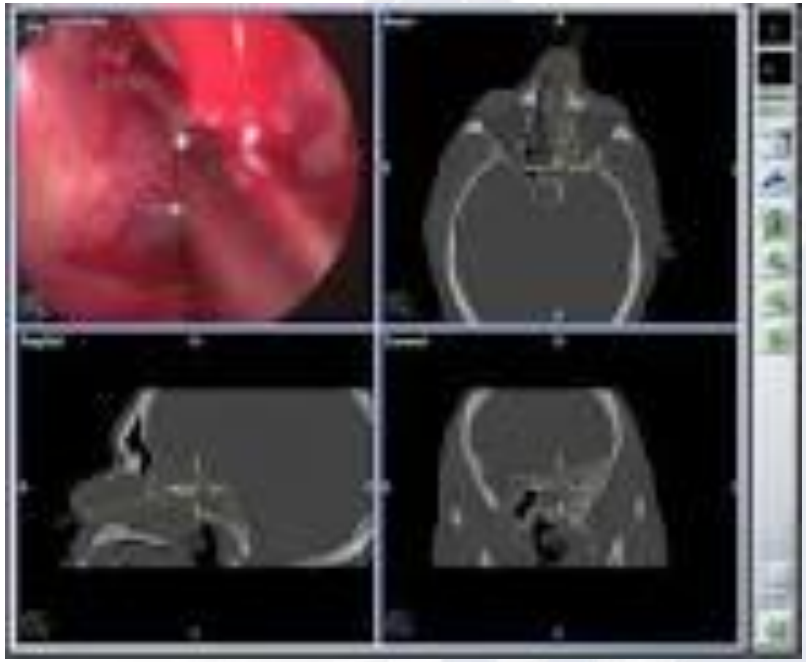

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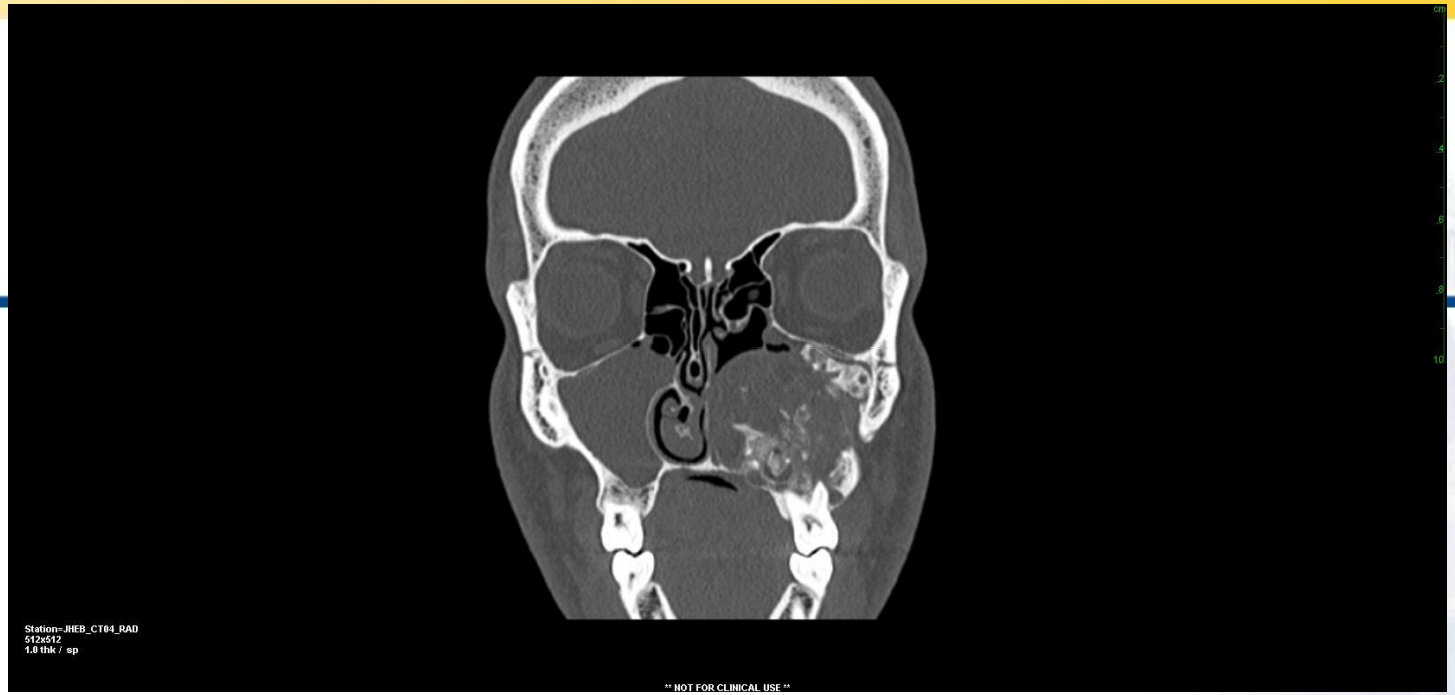

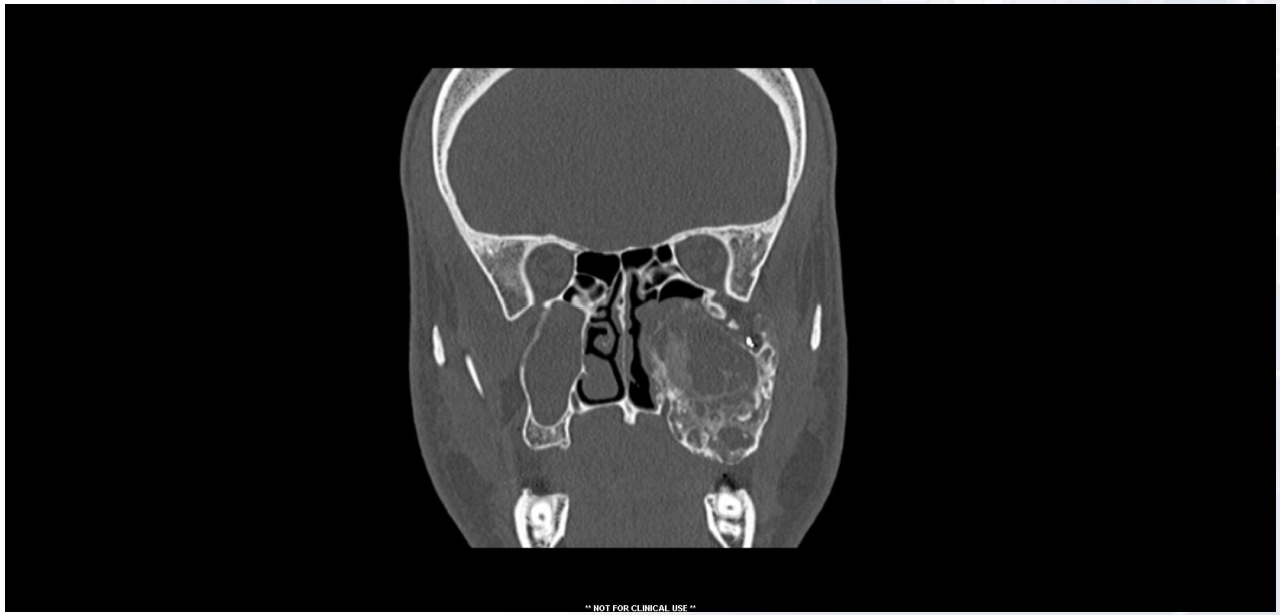

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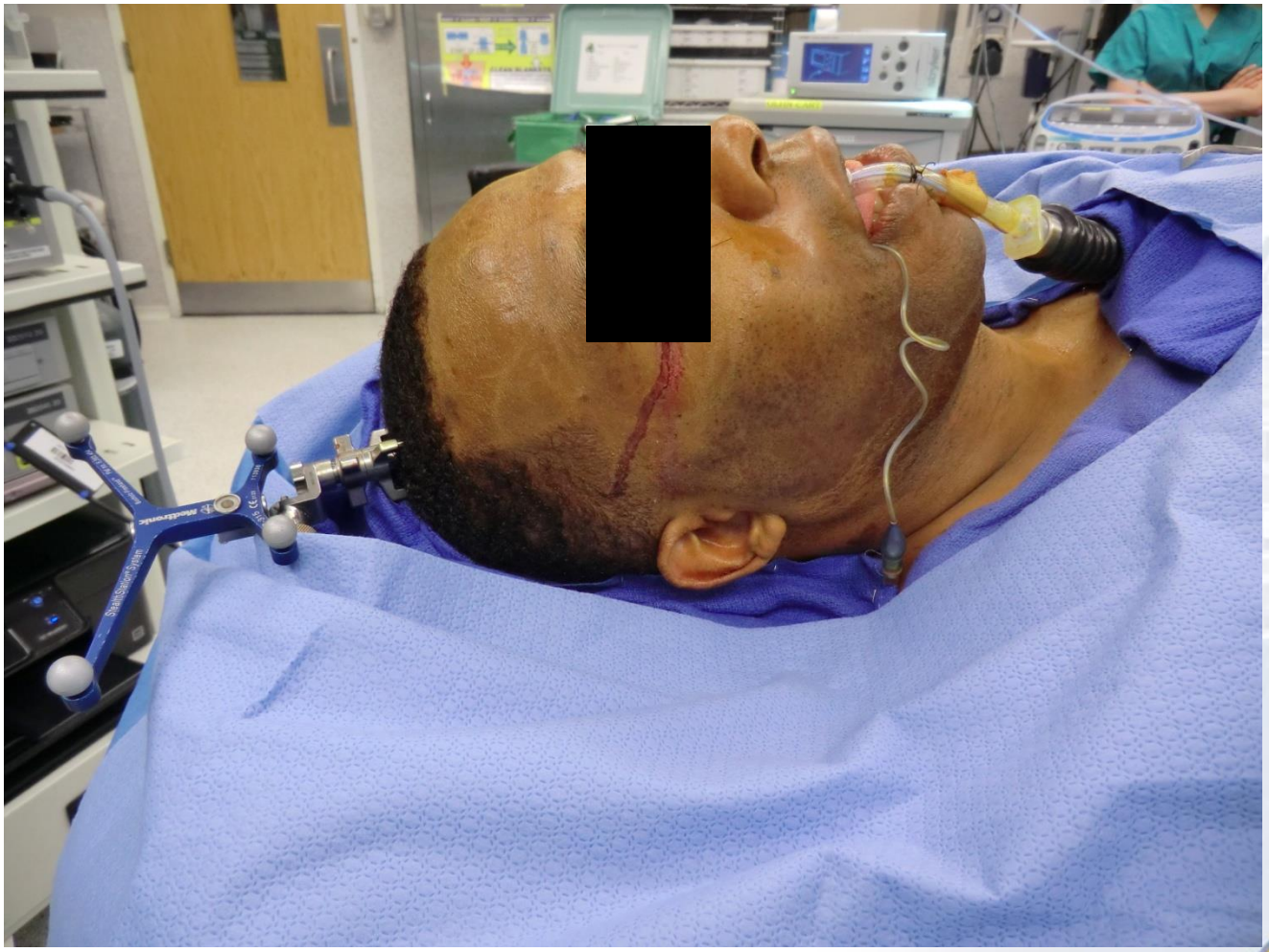

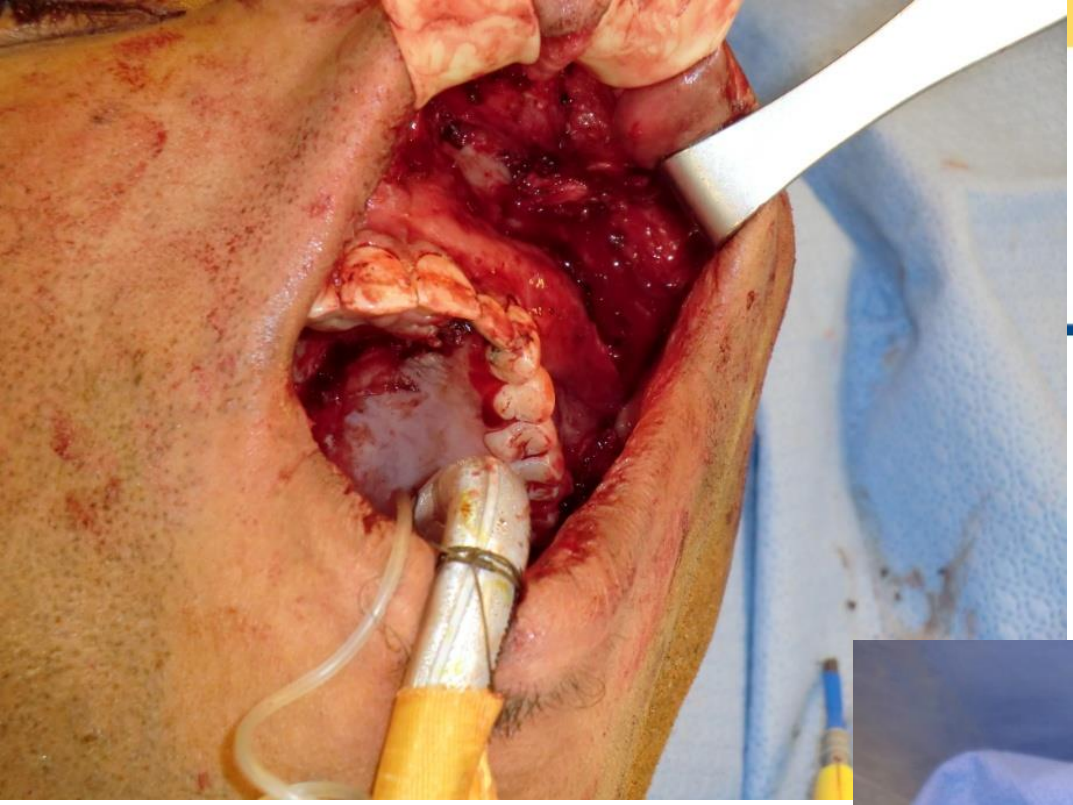

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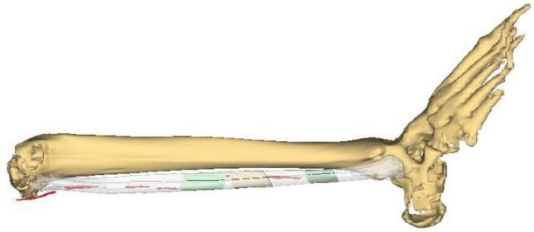
Synthes ProPlan CMF

Case ID: MU12-DIT-TAZ
Case Report Version: 1.0
7 of 10

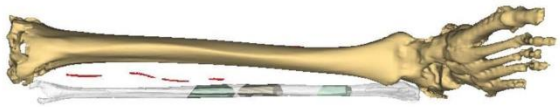
Surgical Plan – Planned Reconstruction (Plan A)

Patient specific right leg. Graft positioned 6cm from distal end of the fibula.

Lateral



Anterior



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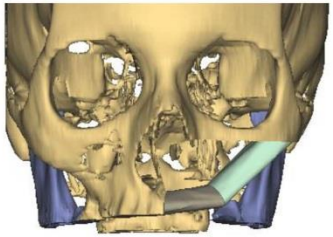
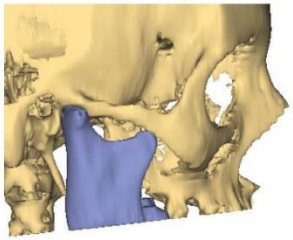
Mate
driving

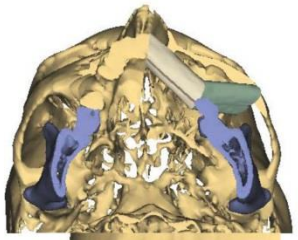
Synthes ProPlan CMF

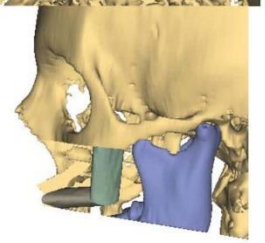
Case ID: MU12-DIT-TAZ
Case Report Version: 1.0
8 of 10

Surgical Plan – Planned Reconstruction (Plan B)









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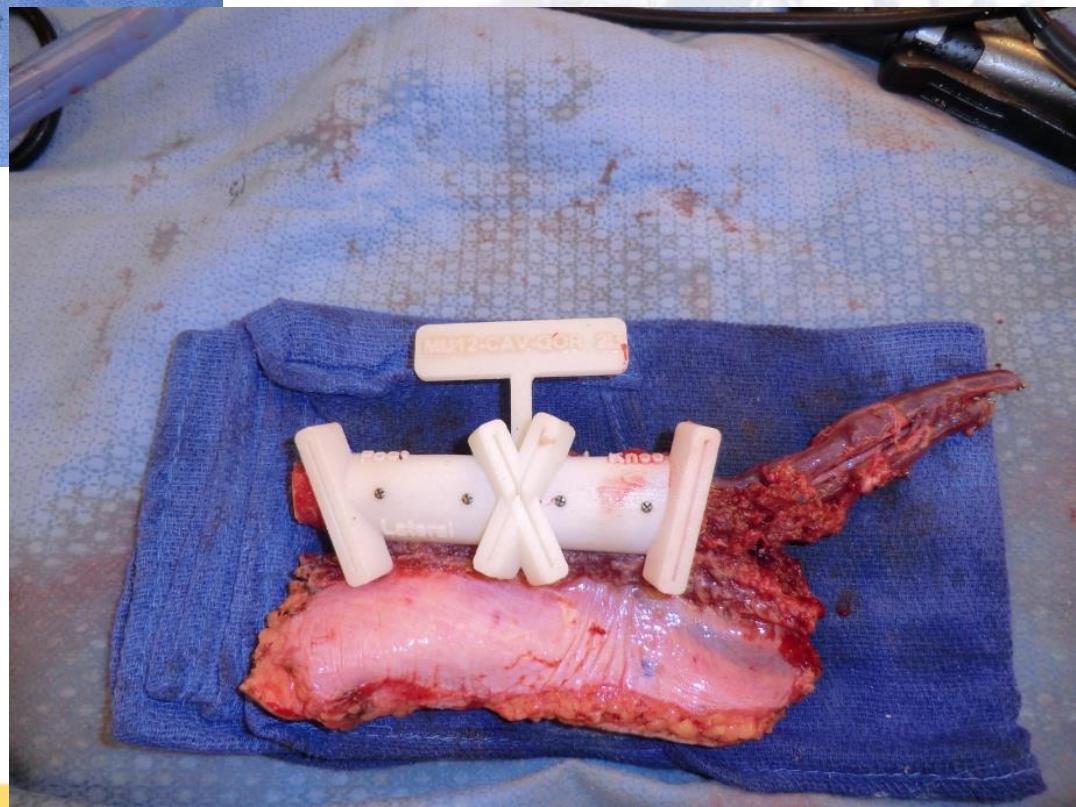
F-MPROD-105-03

Materialise
driving your innovations



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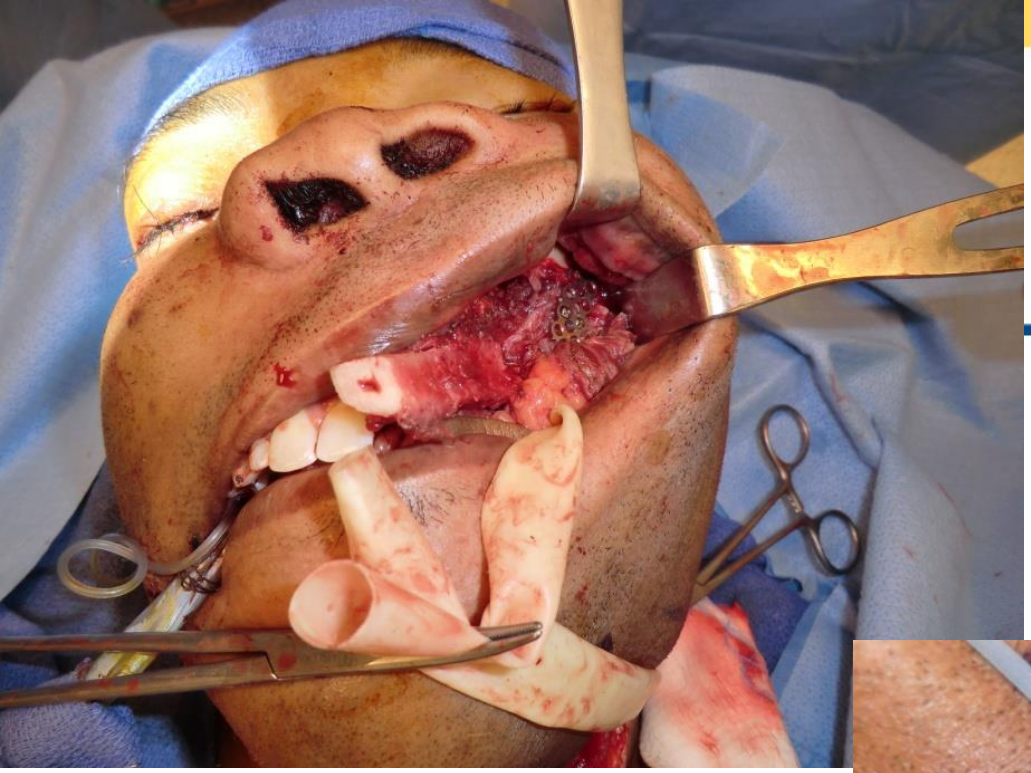

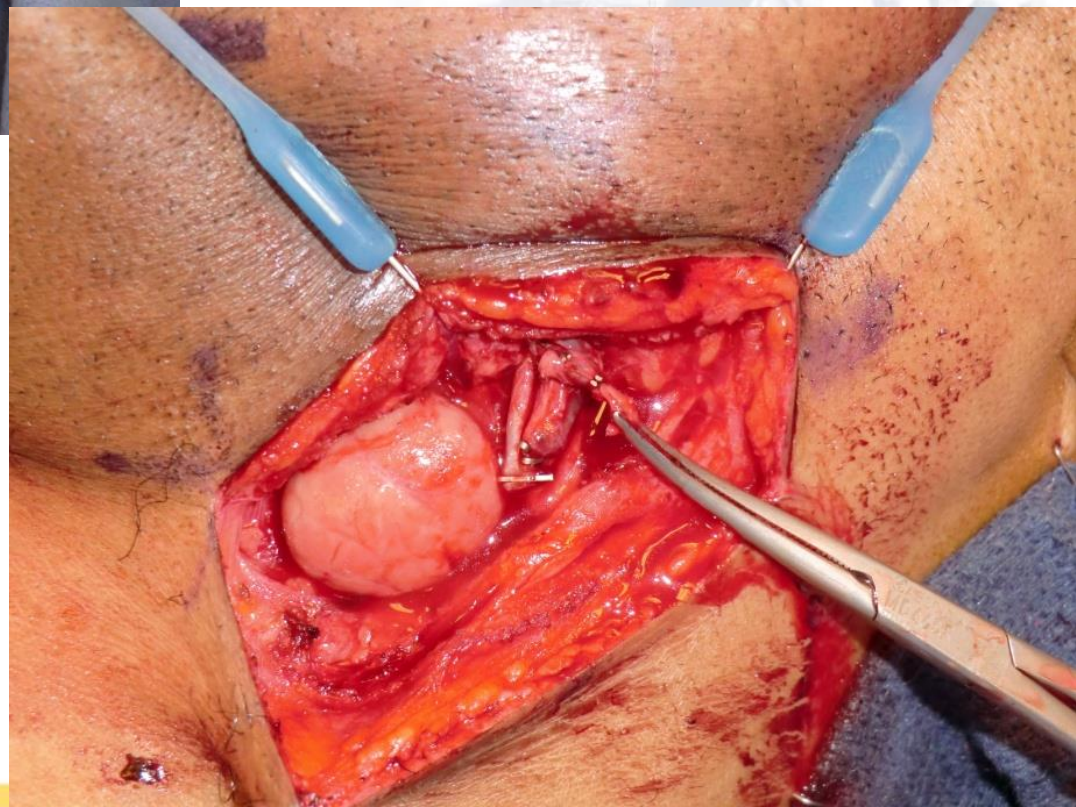

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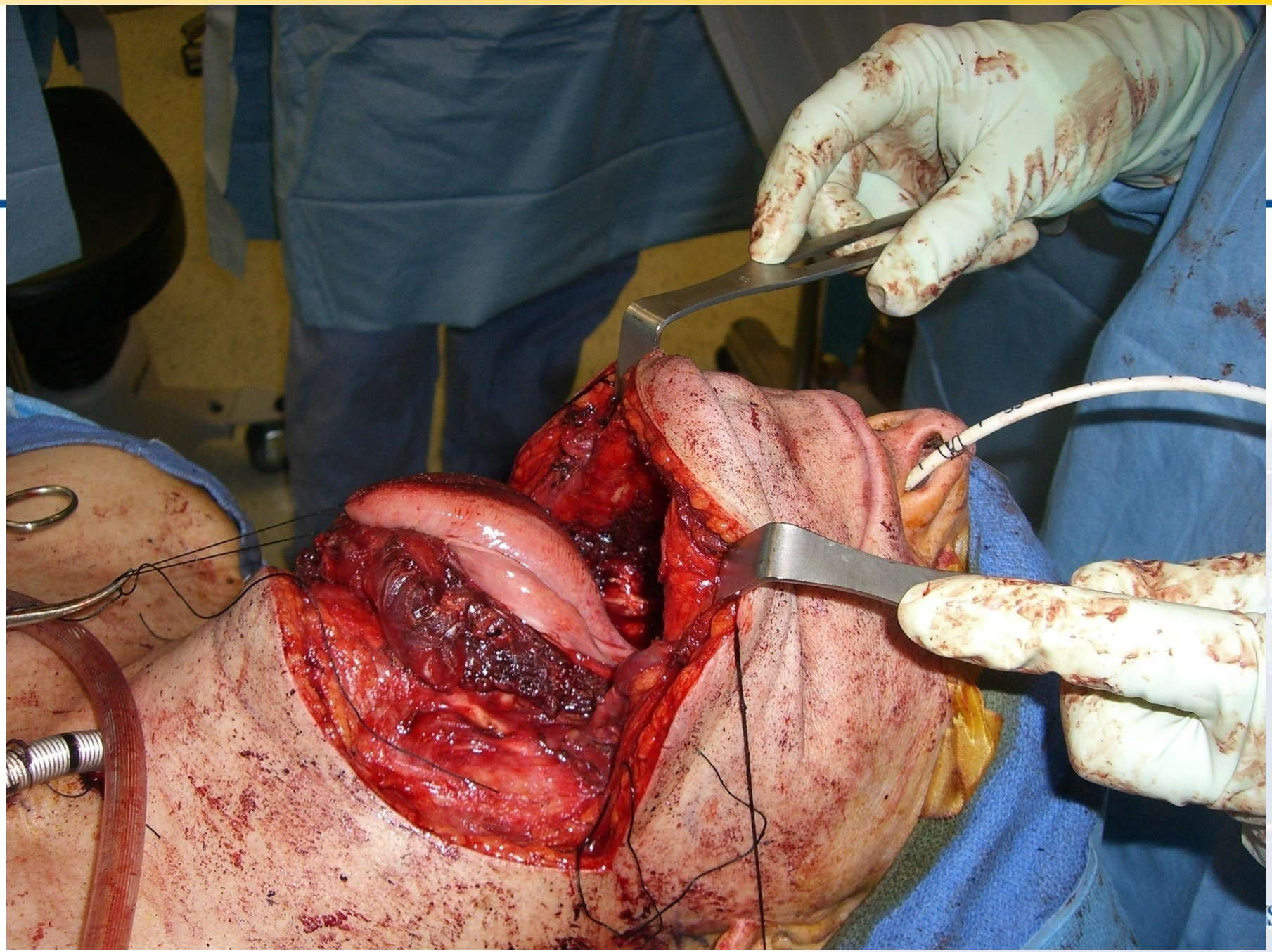
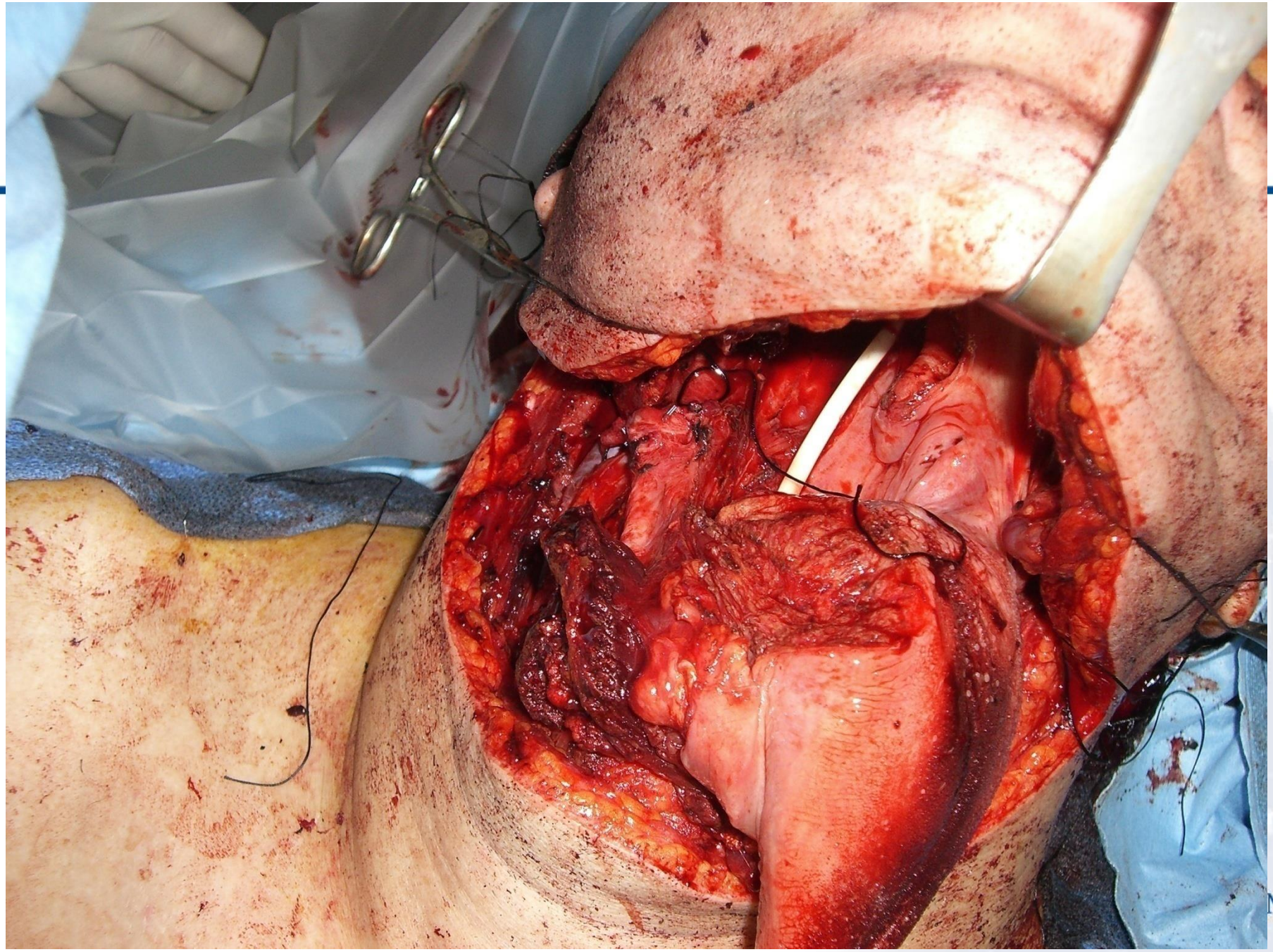




History

- In 1985 a robot, the PUMA 560 (Programmable Universal Machine for Assembly), was used to place a needle for a brain biopsy using CT guidance.
- In 1988, the PROBOT, developed at Imperial College London, was used to perform prostate surgery.
- The ROBODOC from Integrated Surgical Systems was introduced in 1992 to mill out precise fittings in the femur for hip replacement.

Robot vs Surgeon

- Limit to human perception and dexterity
- Technology with a higher degree of accuracy than humans allows for continued progress and surgical success.

AESOP

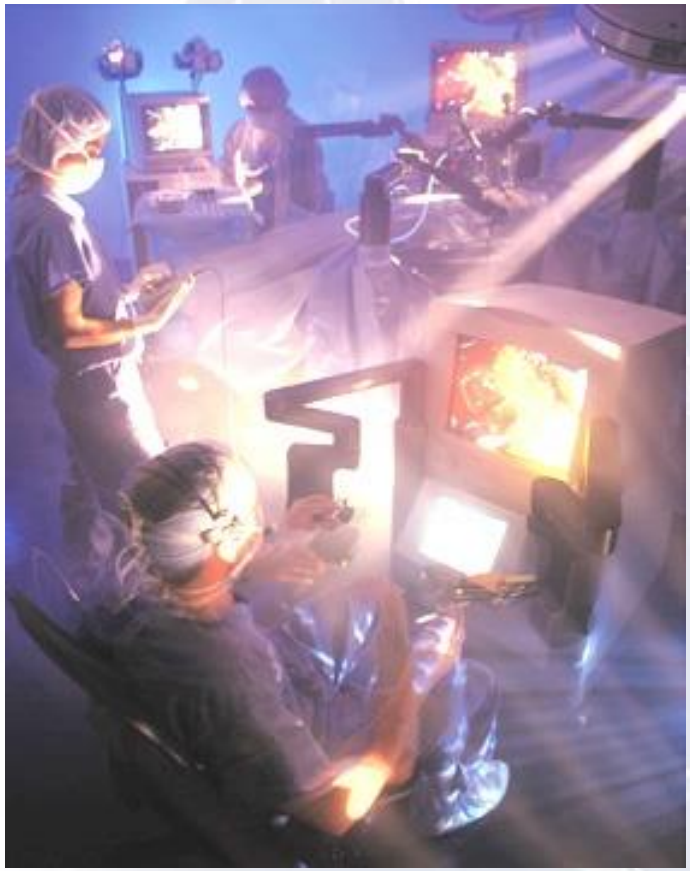
- The first robotic applications to gain clinical acceptance was Automated Endoscopic System for Optimal Positioning (AESOP), a robotic arm for endoscopic camera control.
- AESOP was coupled with the Hermes voice-activation system to allow endoscope control by voice command.
- Food and Drug Administration (FDA) approval in 1993.

Zeus

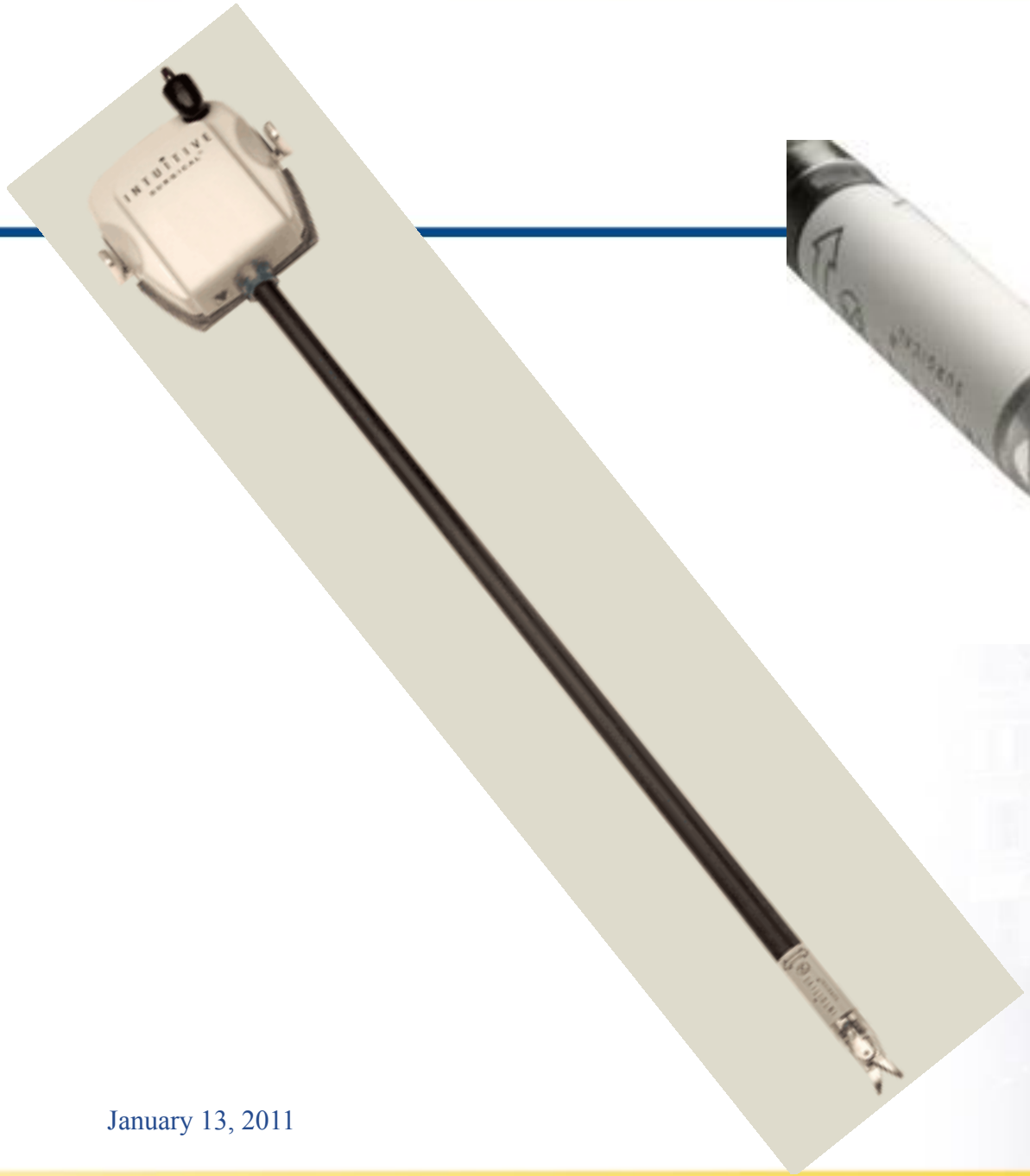
Used 3 modified AESOP arms

Initial testing at JHU 1996

Master-slave robot
versus
Active robot



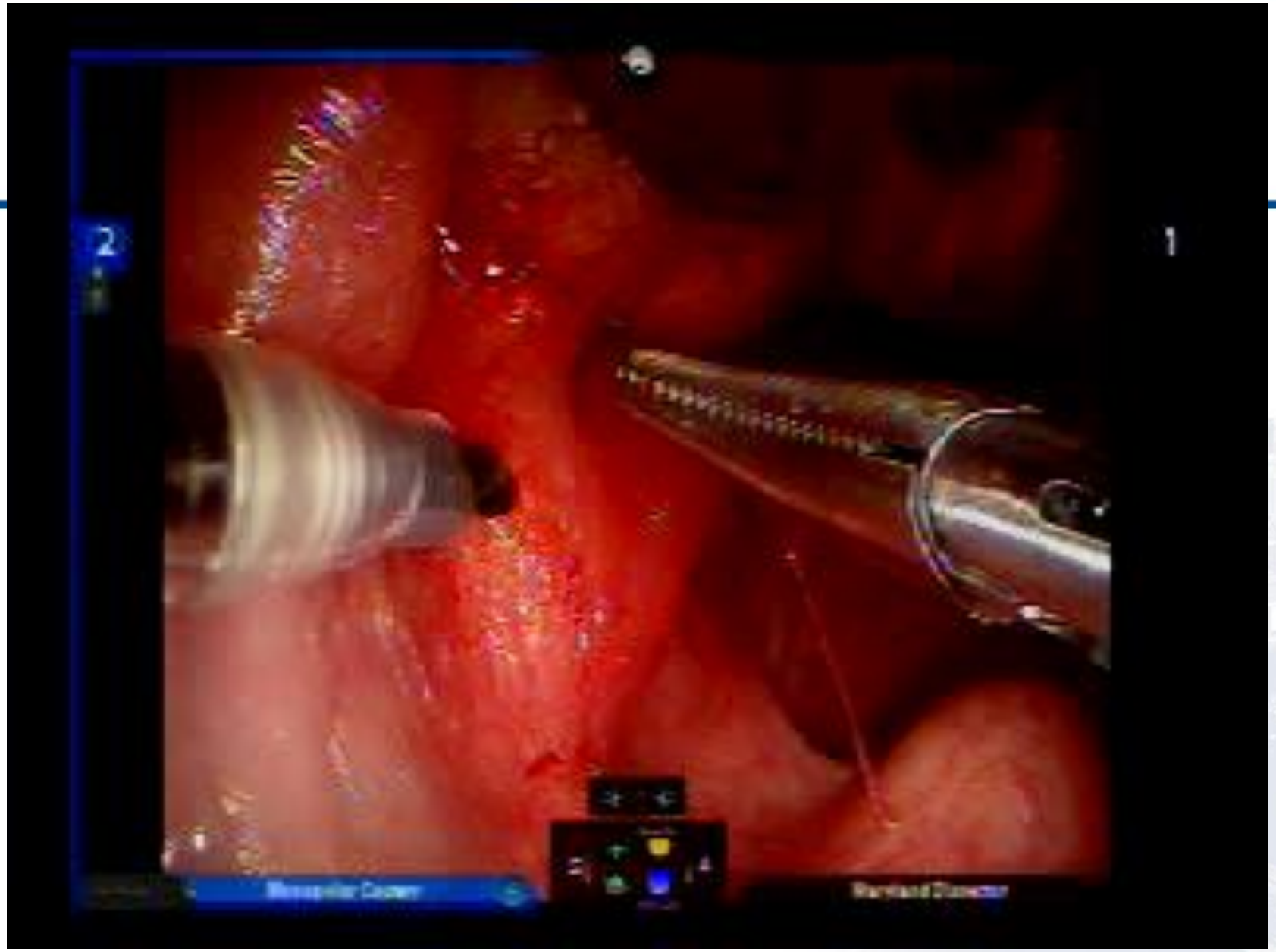
- NASA, Stanford, Military, Civilian licence -> Intuitive, Inc.
- In 1997 a prototype of the DaVinci was used to perform a lap chole
- In 2000 the DaVinci was FDA approved for laparoscopic abd surgery



DaVinci

- FDA approved for use in urological surgical procedures, general laparoscopic surgical procedures, gynecologic laparoscopic surgical procedures, *transoral otolaryngology surgical procedures restricted to benign and malignant tumors classified as T1 and T2*, general thoracoscopic surgical procedures, and thoracoscopically assisted cardiotomy procedures.


da Vinci S HD
SURGICAL SYSTEM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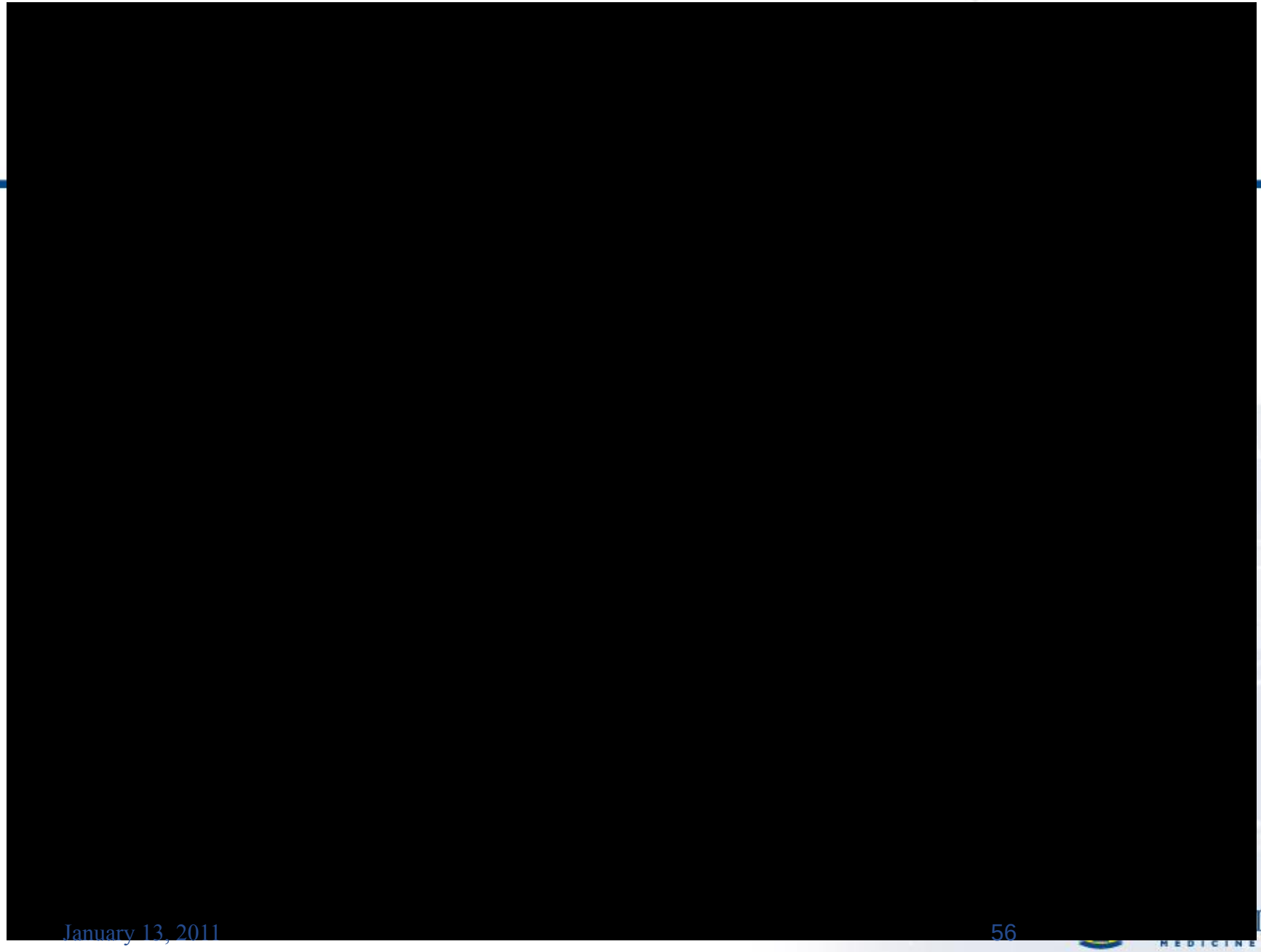

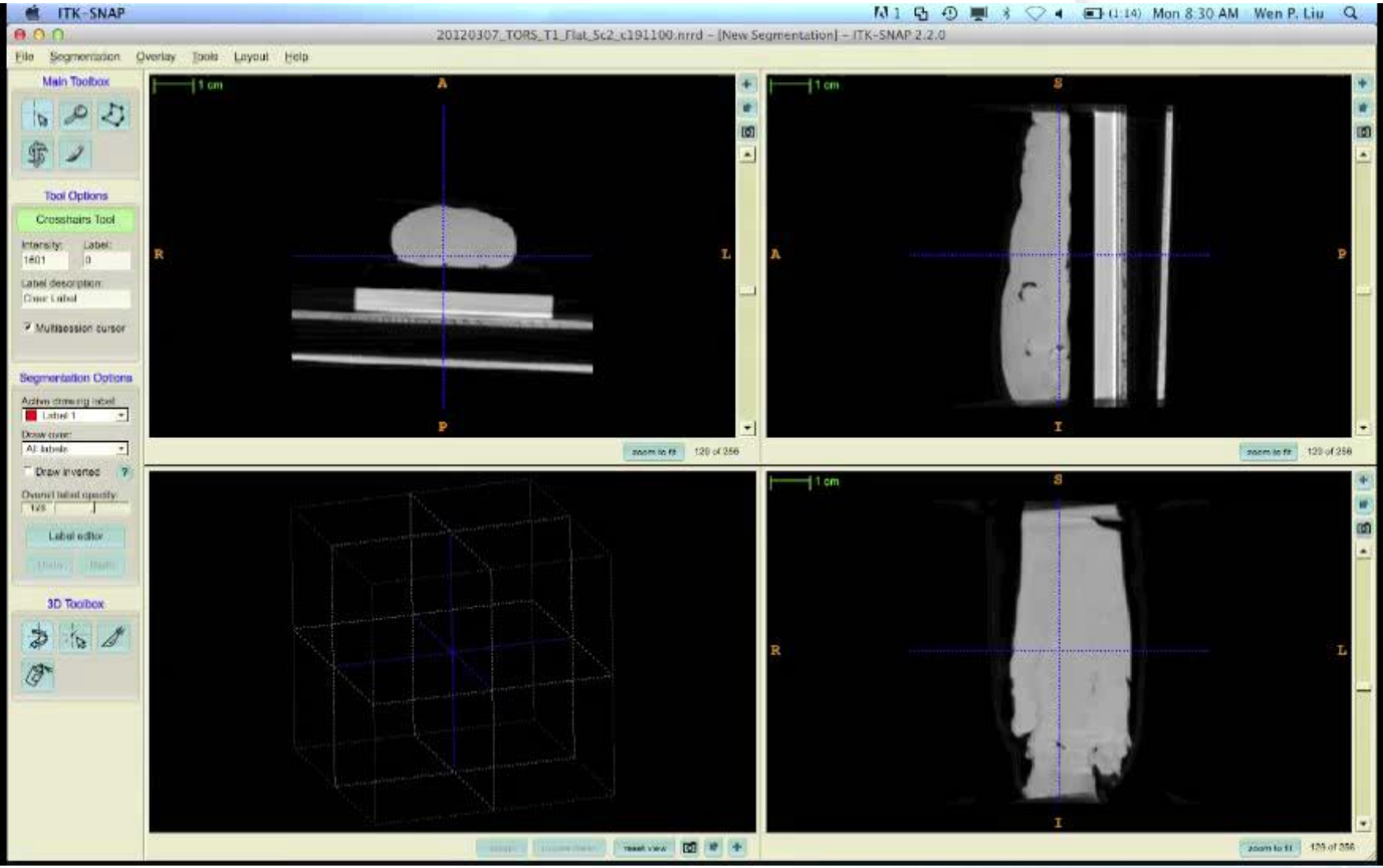

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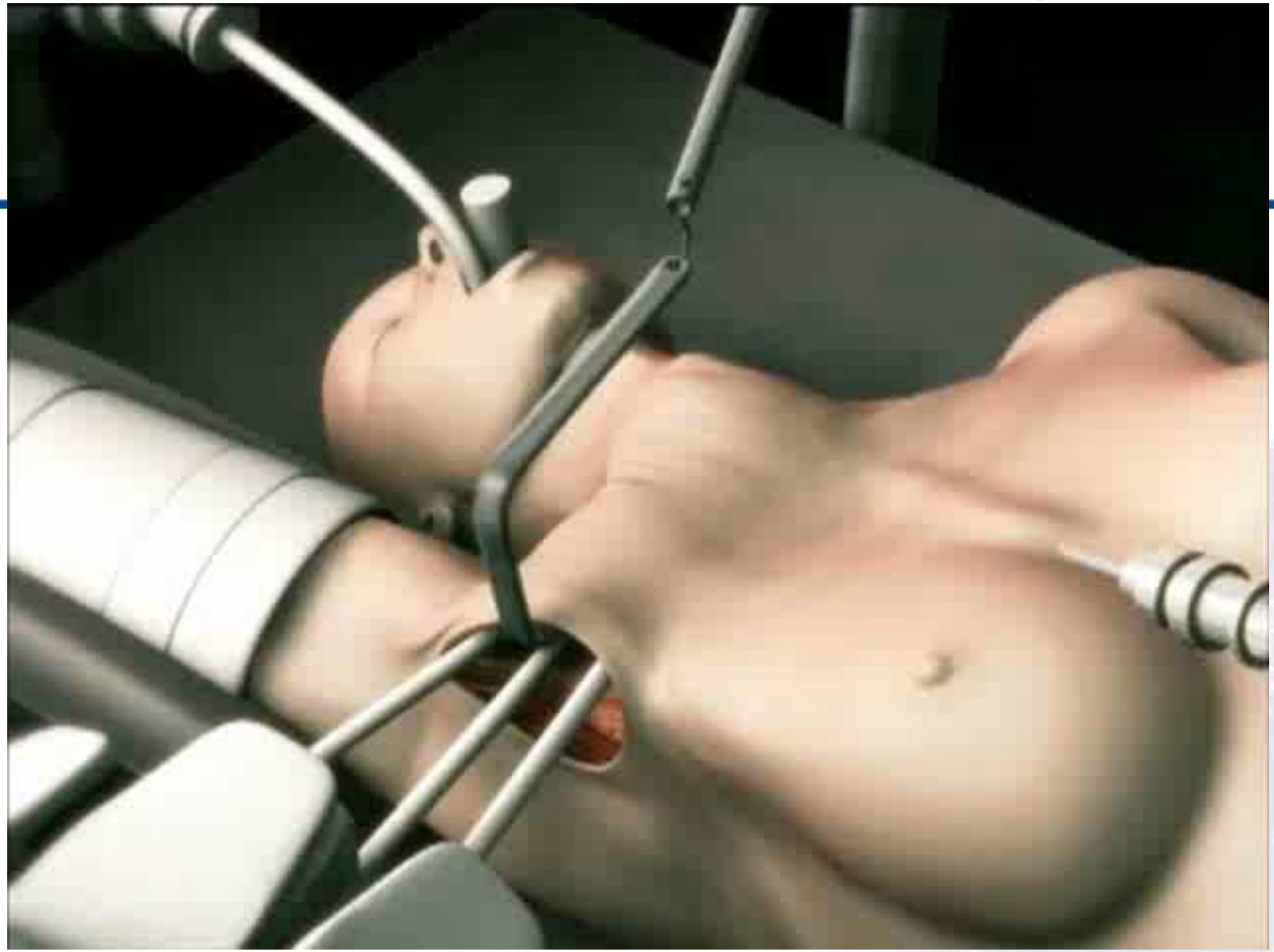
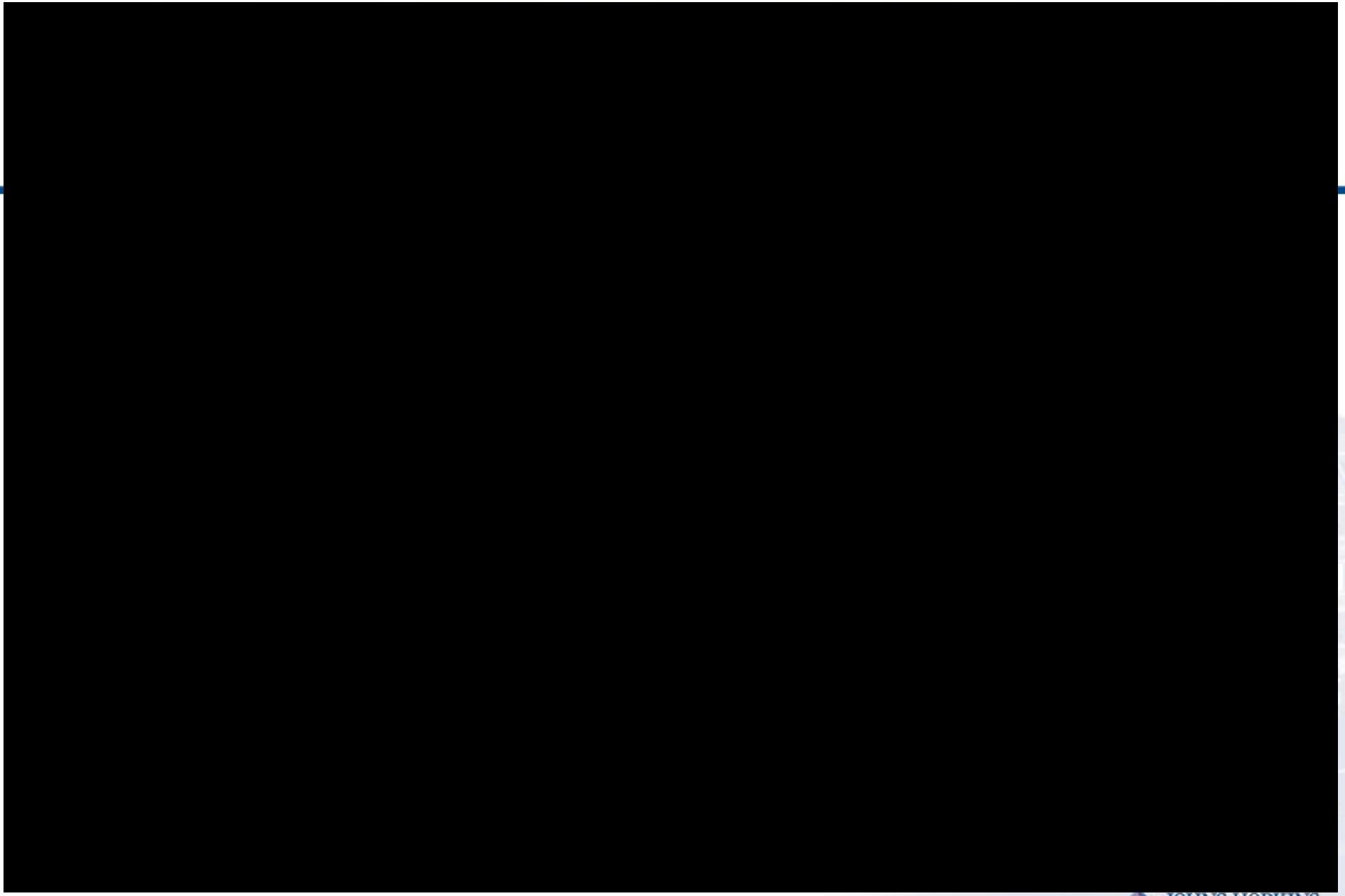
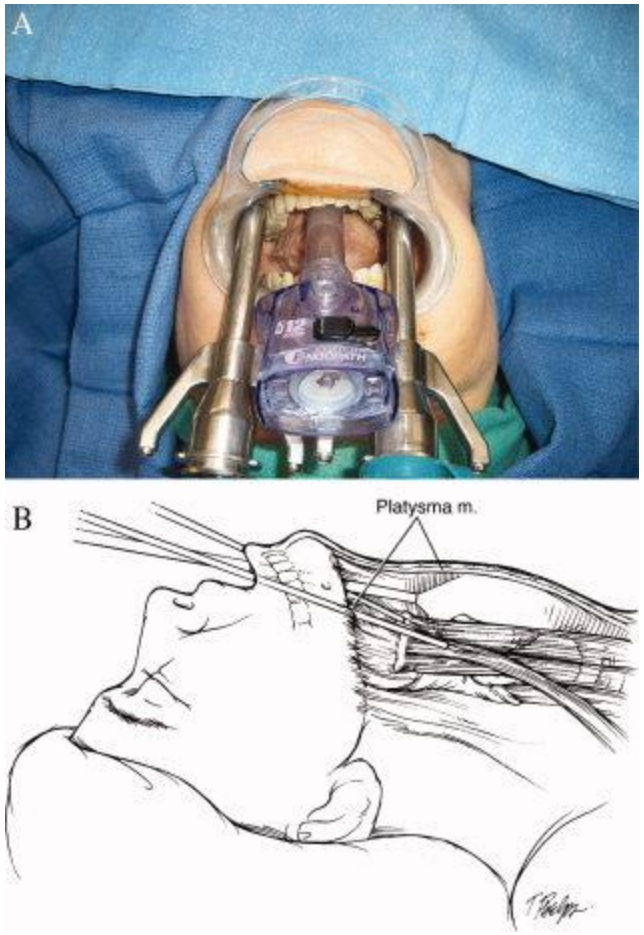
Transaxillary Robotic Thyroidectomy

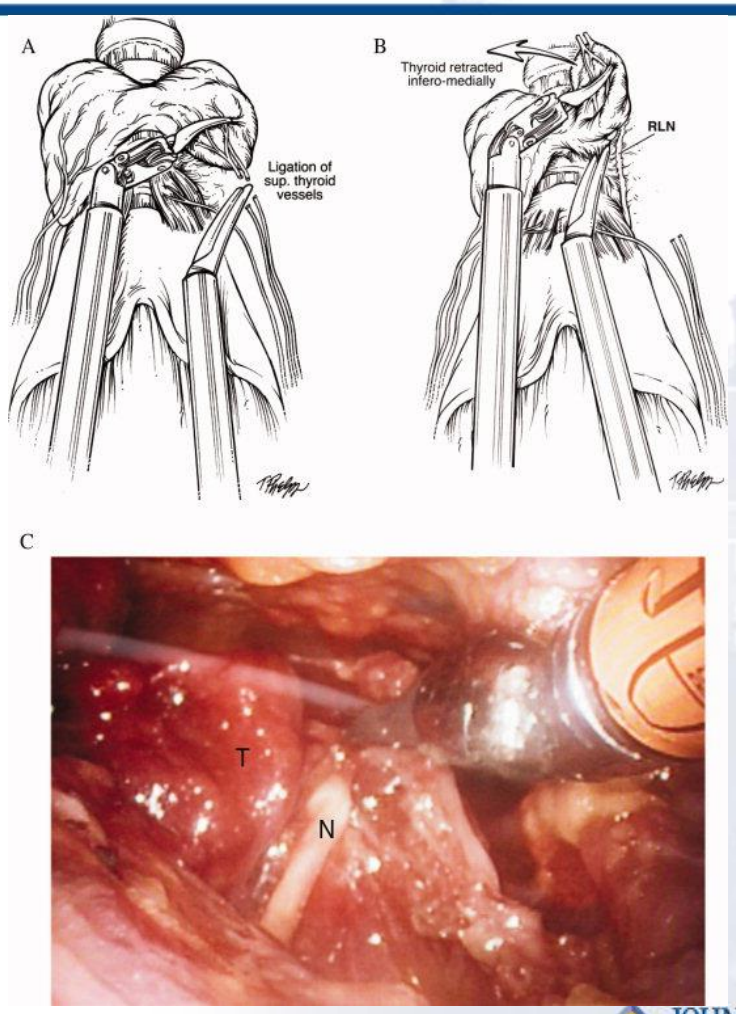




Transoral robotic-assisted thyroidectomy: A preclinical feasibility study in 2 cadavers.

Richmon JD, Pattani KM, Benhidjeb T, Tufano RP. Head Neck. 2010 Jul 13.





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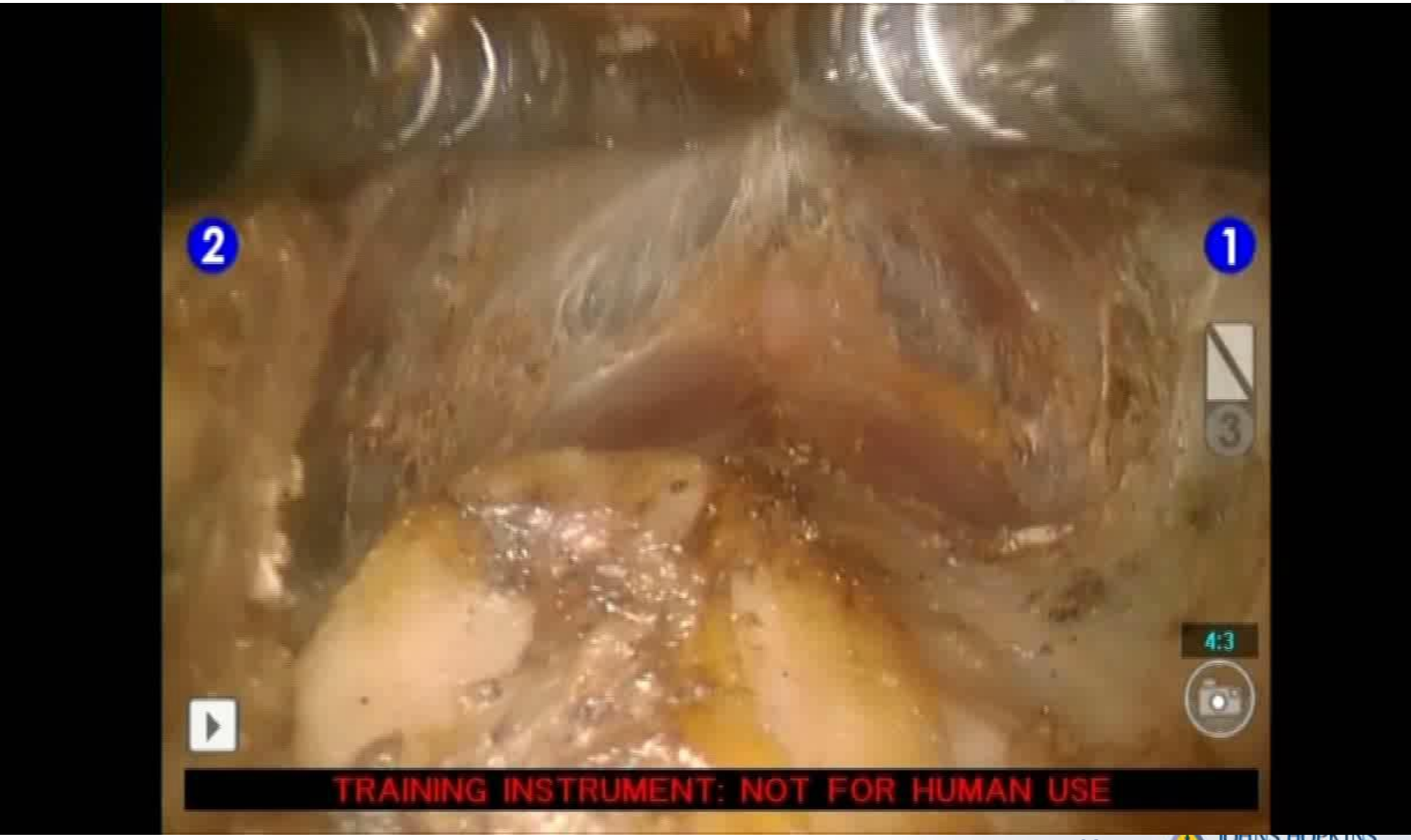
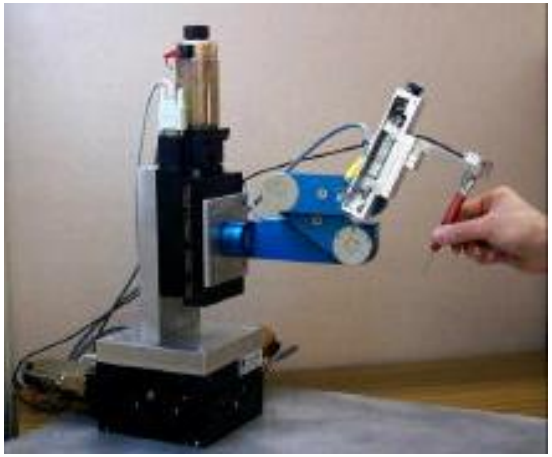

2
1
3
4:3
TRAINING INSTRUMENT: NOT FOR HUMAN USE

Drawbacks

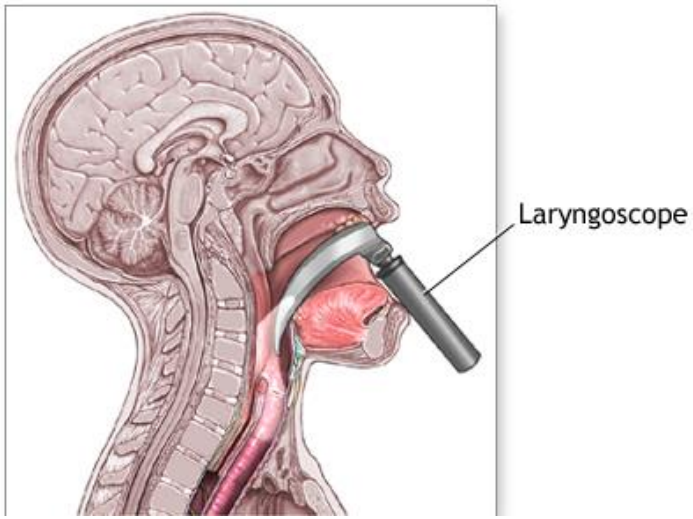
- Cost
- Equipment/Space
- Learning curve
- Training and credentialing
- Lack of access (patients and anatomy)
- No tactile feedback (yet)

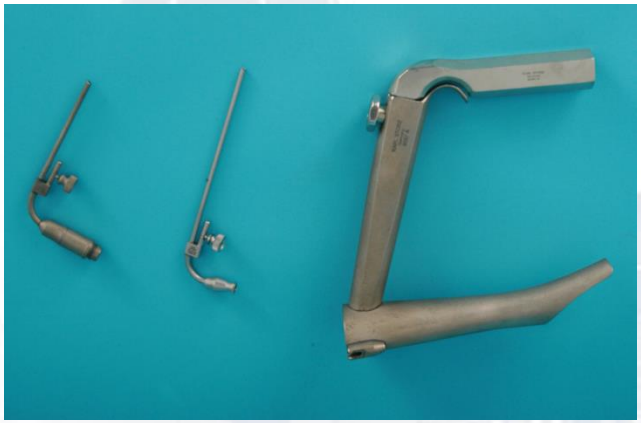
Larynx – Ear - Micro

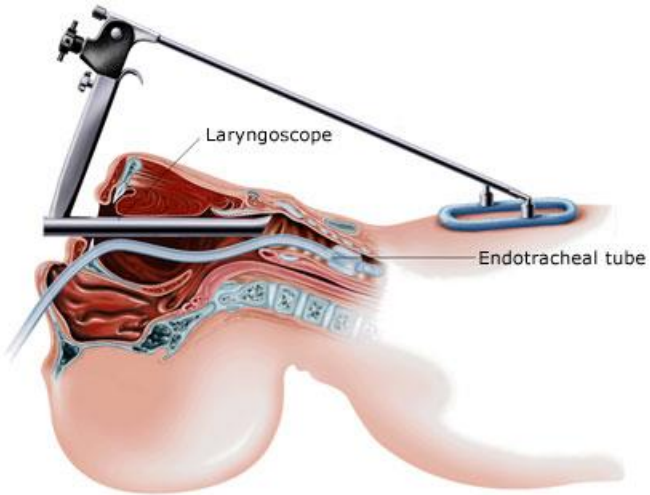
- Steady Hand
  - Tremor-free
  - Scaled movements
  - Force sensor
  - Movement limits

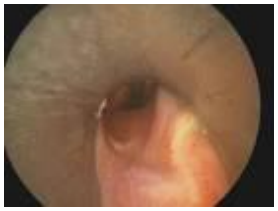


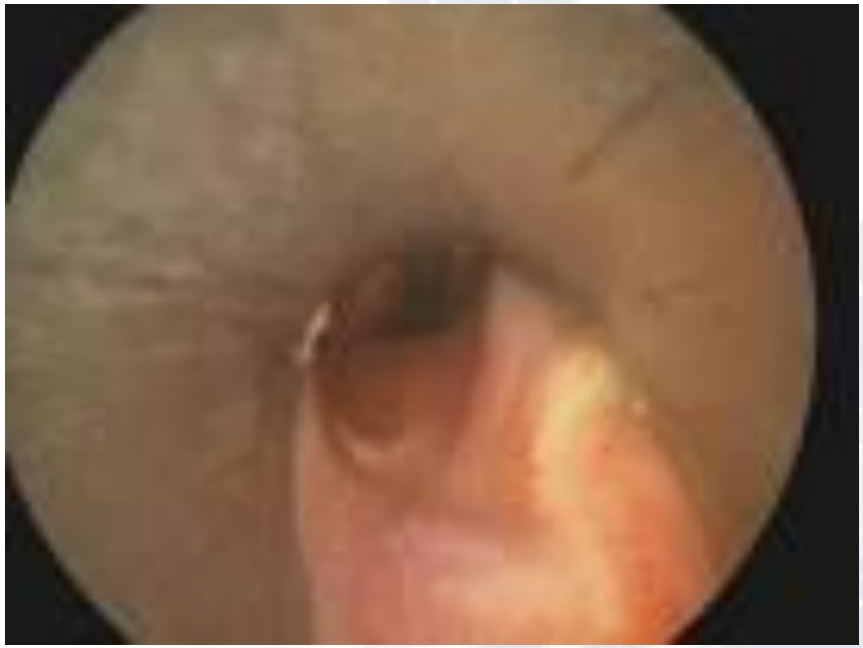
Challenge












OTO-ENDO 2

Limitations

- One-handed surgery
- Line-of-site limitations
- Rigid scope not paired with vision
- Cumbersome
- Narrow field of view

Robo-ELF scope