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
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
Traumatic
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
Parotid Surgery

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Sinus/skull base surgery
Synthes ProPlan CMF

Surgical Plan – Planned Reconstruction (Plan A)
Patient specific right leg. Graft positioned 6cm from distal end of the fibula.

Surgical Plan – Planned Reconstruction (Plan B)
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® HD Surgical System
Transaxillary Robotic Thyroidectomy
Transoral robotic-assisted thyroidectomy: A preclinical feasibility study in 2 cadavers.
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
Limitations

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