

Robotic Upper Airway Surgery Challenges and Opportunities

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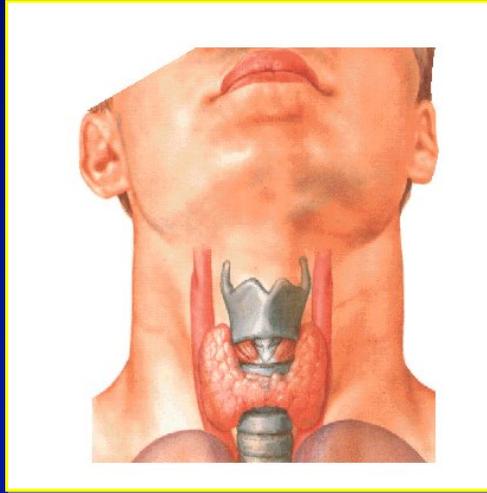
Robota

- Czech playwright Karel Capek introduced the notion and coined the term robot in his play Rossum's Universal Robots (1921)
- Robot, taken from the Czech **robota**, meaning forced labor, has evolved in meaning from dumb machines that perform menial, repetitive tasks to the highly intelligent robots of popular culture



Anatomy

(For Orientation)



Conflicts

- None



Airway Surgery

- Surgery for Obstructive Sleep apnea (OSA) and benign laryngeal and pharyngeal conditions is commonly performed by Otolaryngologist Head and Neck (ENT) surgeons



Limitations of Endoscopic Surgery

- Angle of access
- Visualization 2-dimensional at best
- Limited degree of motion of instrumentation
- Amplification of physiologic tremors
- Compromised dexterity
- Challenging in pts with limited neck mobility



How can Robot help

- Enhanced visualization
- Multi-articulated instruments
- Elimination of physiologic tremor



Robotics in Airway Surgery Sleep Apnea

- Access to the tissue difficult because of anatomical reasons (excessive soft tissue) or obesity
- Surgeon factors (tremors, fatigue of the small muscles of the hand and wrist)



Robotics in Airway Surgery Laryngeal and Hypopharyngeal

- Throat
- Surgical procedures for benign laryngeal conditions pose similar challenges and
- May benefit tremendously from similar technological advances in minimally invasive surgery



My Plan

- Describe current techniques
- Discuss novel possibilities afforded by the Robotic Systems
- Seek your input on feasibility for available systems and Improvements needed
- I will be especially interested in your input comparing the DaVinci System to the Flex^R primarily for Upper Airway procedures



TORS

- TransOral Robotic Surgery
- Reliably perform state-of-the-art resection of the primary disease process through a minimally invasive transoral approach



How

- Surgery is assisted by remote-controlled miniaturized surgical instruments and magnified visualization with a high-definition three-dimensional camera.



Robotics in Surgery Urology and OB/Gyn

- Robotic surgery using the da Vinci Surgical System has been increasingly performed in the last decade, especially in urology and gynecology.



Robotics in Airway Surgery

- The da Vinci Surgical System has not become standard in surgery of the upper gastrointestinal tract.
- A lack of clear benefits in comparison with conventional minimally invasive surgery.



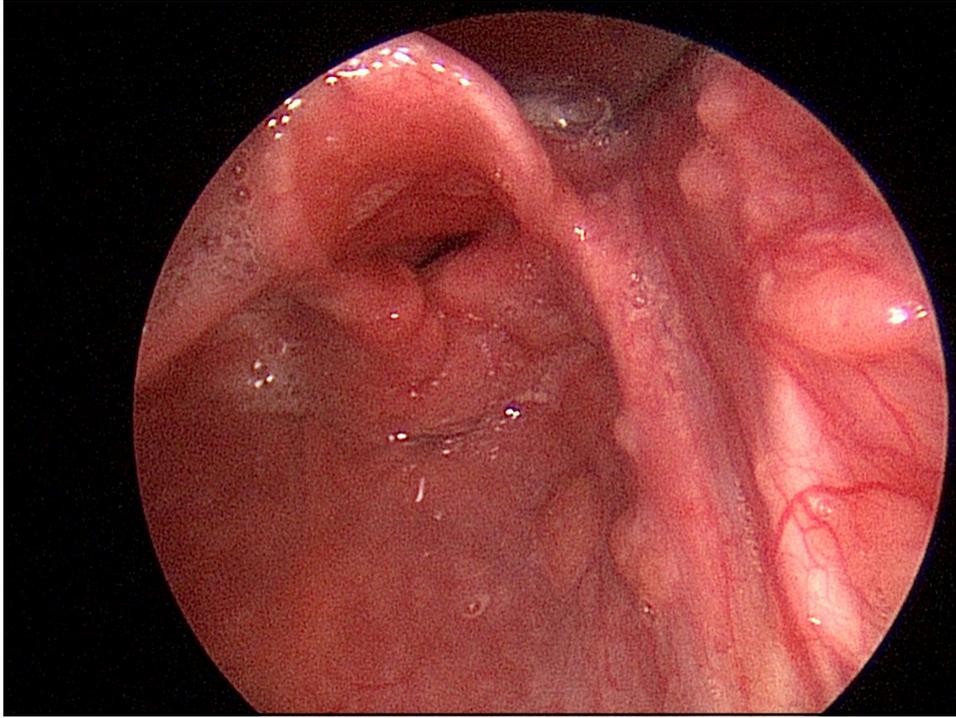
Robotics in Airway Surgery Sleep Apnea

- Access to the tissue difficult because of anatomical reasons (excessive soft tissue) or obesity
- Surgeon factors (tremors, fatigue of the small muscles of hand and wrist)
- Need for use of robotic systems

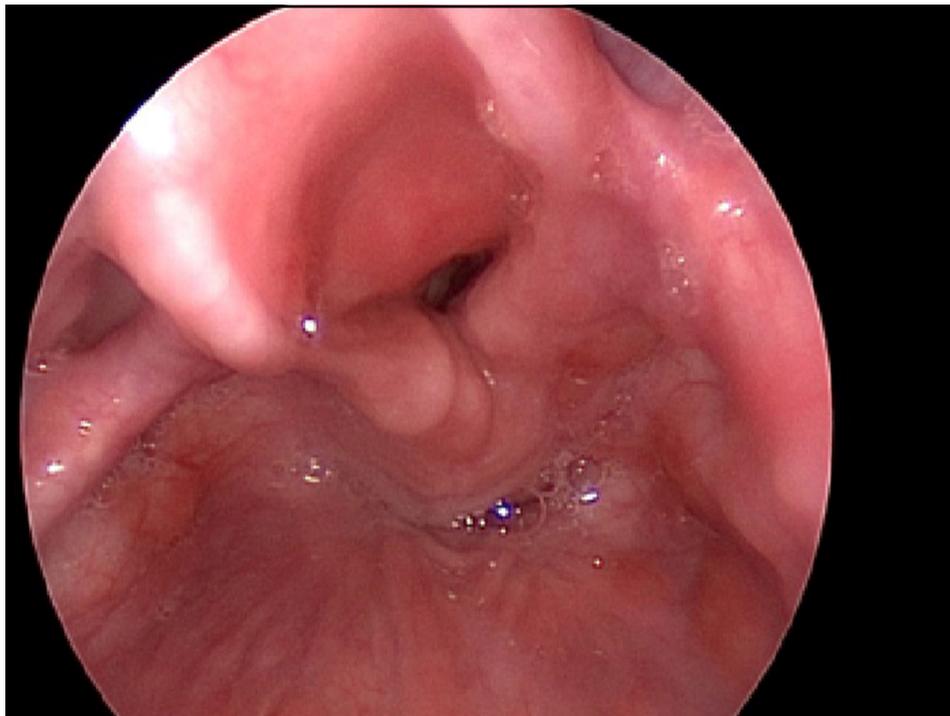
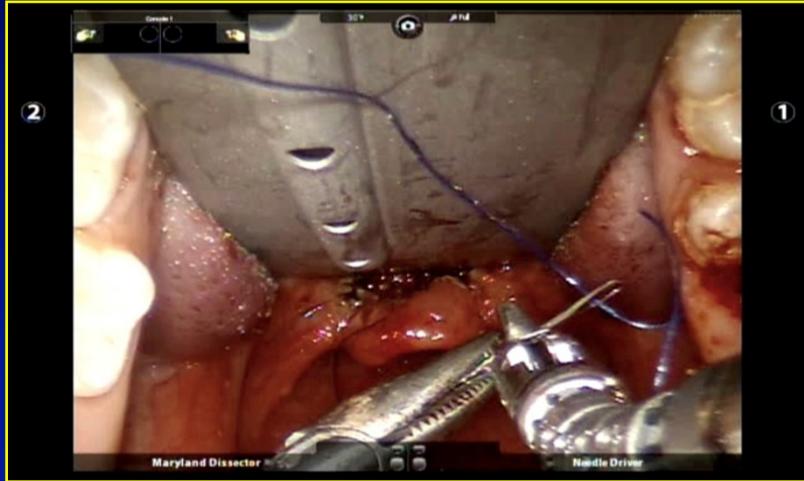


Surgery to Relieve Airway Obstruction Da Vinci System





Intra-operative



Play Video from Epiglot



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RRP

- Recurrent respiratory papillomatosis (RRP) is a benign disease
- Patients develop multiple papillomas in the larynx, upper aerodigestive tract as well as the lower tracheobronchial tree
- Majority of cases are juvenile onset
- Diagnosis typically occurs at ages 2–3 years.
- RRP is caused by Human Papilloma Virus (HPV), acquired from the mother's birth canal



Presentation of RRP

- Patients present with hoarseness, stridor and
- Airway obstruction. Endoscopic examination reveals multiple polypoid growths overlying vocal folds and supraglottis
- Management is surgical with aim of debulking papillomas to restore voice and airway. In severe cases, multiple surgeries as well as tracheostomy may be required



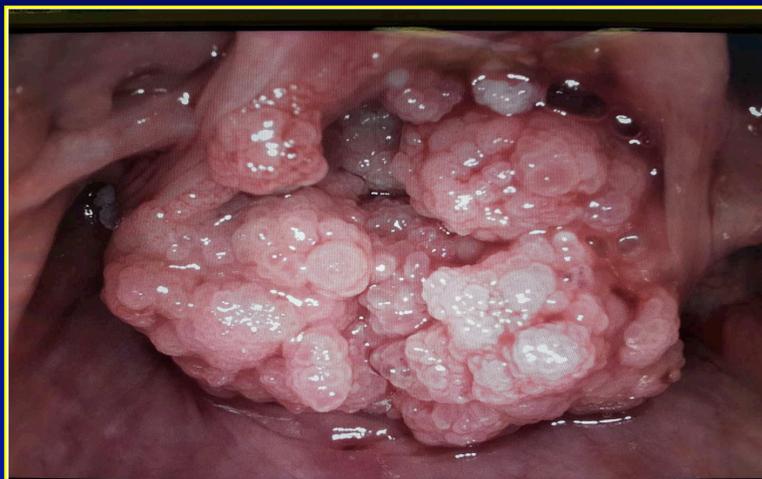
RRP

Current Treatment Modalities

- Established surgical modalities include microdebrider and CO2/KTP laser
- Numerous adjuvant therapies have been described, including interferon, acyclovir, cidofovir, bevacizumab and HPV vaccination
- Transoral robotic surgery has been successfully utilised for the excision of oropharyngeal and laryngeal tumours as well as for pediatric airway surgery.



Laryngeal Papillomas



Operative Set-up for Flex Robot



Robot-Assisted Surgery



- <https://www.youtube.com/watch?v=MFTJpnDeuKM>



- <https://www.youtube.com/watch?v=IGMWHXSZa4c>



Flex Robot System Non-Linear Access



Flex systems Advantages

- Less cumbersome setup
- Suitable for pts with reduced neck mobility
- Obviating need for “straight line of sight ” for curvilinear anatomy
- Enhanced visualization (HD camera)
- Better haptic feedback



Flex systems Disadvantages

- Use of flexible instrumentation is manual and there are no robotic enhancements in surgical precision, tremor reduction and scaling of motion
- Current robotic technology inhibited by size of the instruments to perform such delicate laryngeal work. Also, automatic suture and stapling devices used endoscopically are not available yet in TORS



Flex System Room for Improvements

- Improve array of instruments
- Miniaturization which will enhance exposure as well as visualization (3D is now available)
- Further refinements such as tremor negation may help provide the surgeon with improved precision in this small and delicate area



Robot-Assisted Surgery Challenges

- Requires a significant upfront investment of time and resources to assemble
- Necessary individuals (training) and
- Technologies(cost and extra time) to coordinate a case
- Learning curve (especially hard to train residents)
- Setup time is “long”
- Haptic feedback not optimal (Da Vinci system)



References:

1. Tan Wen Shen B, Wong P, Teo E Hoon. Transoral Robotic excision of Laryngeal Papillomas with Flex Robotic System-A novel approach. Am J Otolaryngol 2018 May;39(3):355-358
2. Chao JR et al: Hypopharyngeal Application of a new flexible robotic system in otolaryngology. J Robot Surg. 2018 Sep;12(3):571-574

