Transnasal Endoscopic Training Model

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Abstract

To train clinicians to perform transnasal endoscopy, a model with realistic and anatomically correct structures of the nasal passages and larynx has a market to be developed. Currently, training is conducted on human volunteers and/or patients. The current prototype incorporates a feedback system to increase the competency of clinicians. Preliminary survey results from medical personnel expressed enthusiasm towards implementing the TomPetty model in training methods. After more feedback from clinicians, we will have a better concept of improvements for fabrication and material selection.

Background

- Transnasal endoscopy
  - Procedure to view nasal and larynx structures
  - Uses flexible endoscope

Fig. 1 Flexible Endoscope [1]

Fig. 2 Endoscopic view of vocal cords and throat structures [2]

- Motivation
  - Current technique is to train on volunteers
    - Amplifies clinician's anxiety while learning
    - Touching sensitive regions causes discomfort
  - Desire less stressful, more flexible alternative
- Existing anatomic models
  - Constructed of hard plastic (poor compliance)
  - Limited tactile feedback

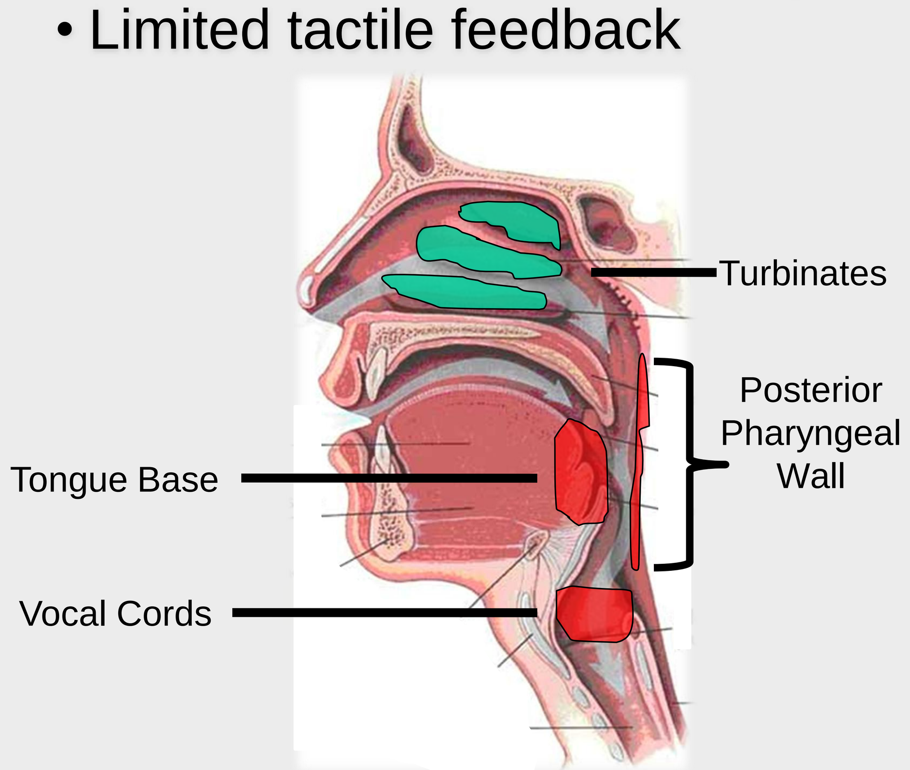

Fig. 3 Sagittal cross=section of the human head, with the turbinates highlighted in turquoise, and the no-touch regions (tongue base, posterior pharyngeal wall, and vocal structures) highlighted in red [3]

Design Specifications

- Accurately model nasal passages and larynx
- Provide user immediate feedback when mistakes occur
- Materials mimic natural tissue structures
- Should cost less than $3000

Current Design: "TomPetty"

- Feedback system
  - Piezoelectric force film
    - Flexible
    - Variable voltage output
    - Low maintenance
    - Single calibration
  - Visual - LED
  - Auditory – buzzer

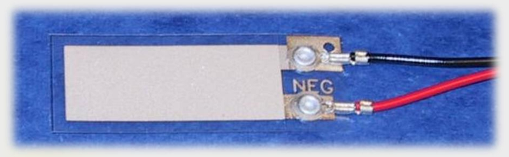

Fig. 4 Piezoelectric film with rivets [4]

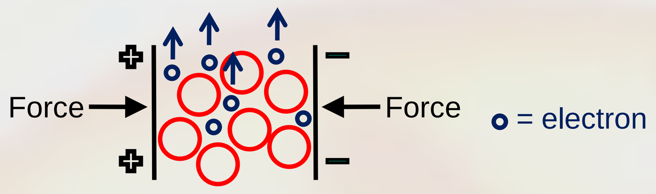

Fig. 5 When force is applied, electrons, represented by blue circles, are displaced creating a temporary change in voltage across the film

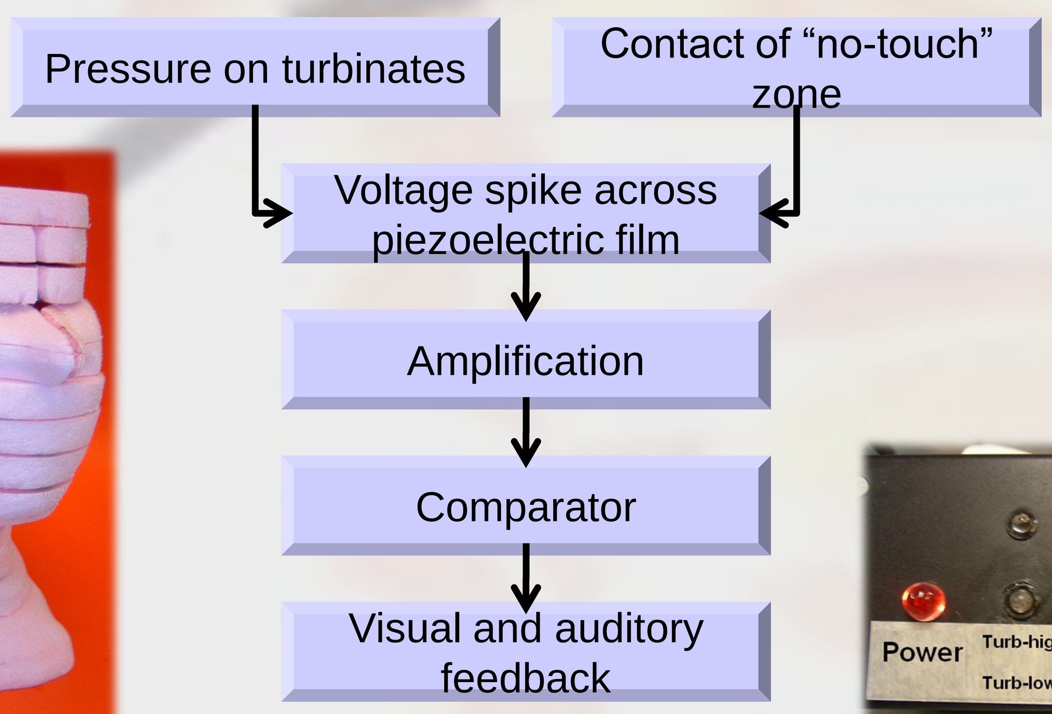

Fig. 6 Stacked foam cross-sections of the completed head that are housed inside a solid mannequin shell for protection and stability

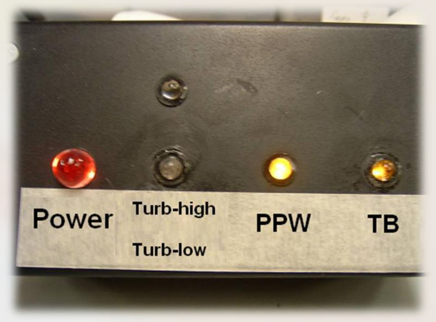

Fig. 7 LED light box. which provides specific visual feedback for the clinician on whether they are applying low or high pressure to the turbinates or contacting a no-touch region

Fig. 8 Cross-section view of last semester's prototype, when pigmentation was significantly darker and less life-like

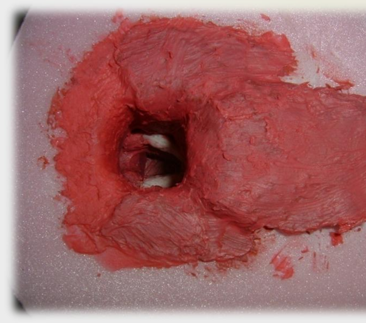

Fig. 9 Cross-section of current prototype, showing the tongue base and vocal structures

Educational Efficacy

- Preliminary Survey
  - 3 medical professionals and a medical student
  - Minimal anxiety
  - Easy set-up and use
  - "Very interesting! Great learning experience."

Marketability

- Transnasal endoscopy performed in:
  - Otolaryngology
  - Speech Pathology
  - Gastrointestinal
  - Asthma and Allergy
  - Emergency Room

  } ~ 1000 procedures at UW-Madison Hospital
- TomPetty Advantages
  - Low cost training
  - More flexible hours for training
  - Convenient and easy set-up

Future Work

- Circuitry
  - Research custom-formed piezoelectric film
  - Design more user-friendly calibration system
- Physical Model
  - Pursue rapid-prototyping approach for better accuracy
  - Utilize alternative materials to mimic tissue compliance

References

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