Tracheoesophageal Prosthesis Insufflator

Computer Integrated Surgery II, Project 13

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ERC | CISST

Overview

-- Background

-- Goals

-- Approach

-- Deliverables

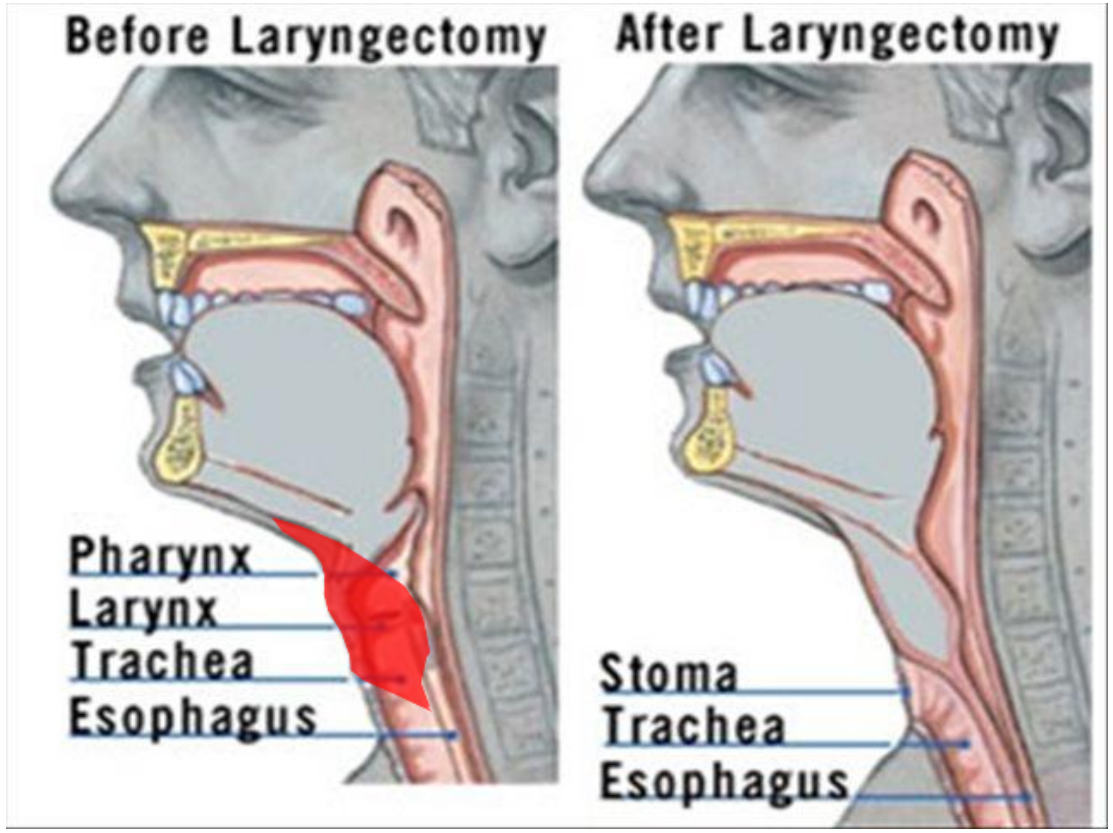
-- Schedule

-- Milestones

-- Dependencies

-- Bibliography

Background: Laryngectomy



- Removal of larynx
- No vocal chords
- Mouth, Nose replaced by stoma for breathing functions

Background: Restoring speech with TEP

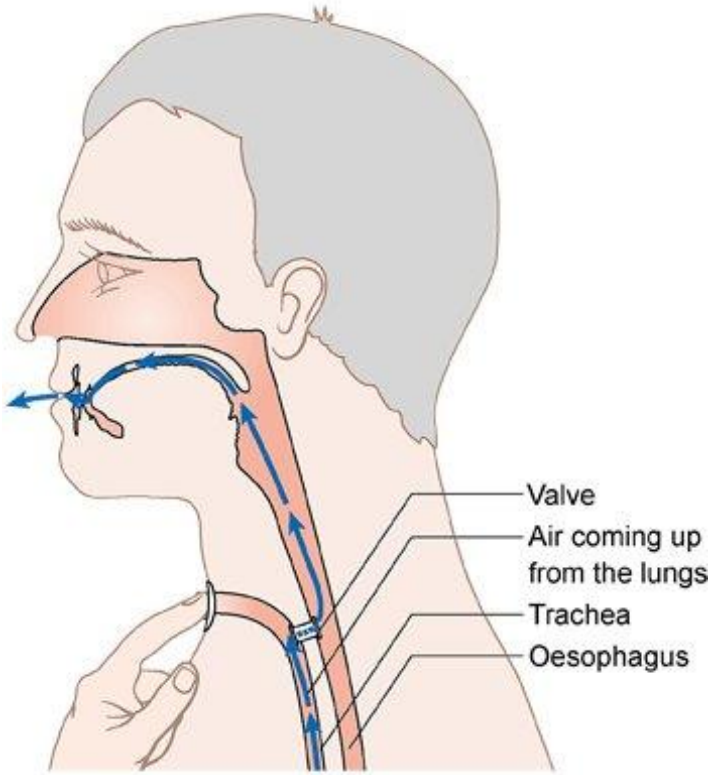


Diagram showing a voice valve
© CancerHelp UK

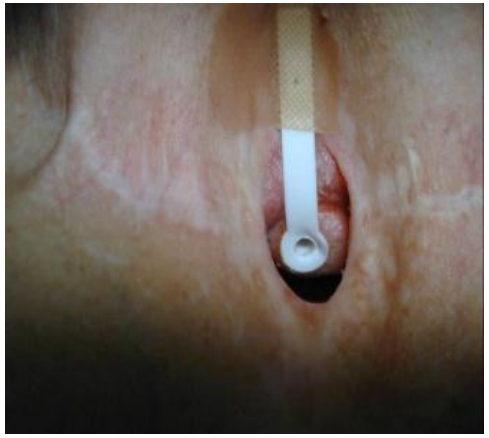


Figure 4: Blom-Singer Voice Prosthesis—On the left, the 8-mm prosthetic device is shown with the one-way flap valve positioned within its proximal tip. The device on the right illustrates application of the gelatin capsule for atraumatic insertion into a tracheoesophageal puncture. Reprinted, with permission, from Myers and Suen.[29] © 1995, W.B. Saunders.

- TEP is one-way valve between esophagus and trachea

- Speak by vibrating esophagus

Background: Current problems

- Difficulties blocking stoma

- Inconvenient

- Physical demands

Goals

-- Construct an insufflator that will connect to TEP

- Portable
- Easy to use
- Reliable on a daily basis

Approach: Pressure Source

-- Air canisters

- Compact
- Easy to replace
- Inexpensive
- Potentially dangerous
- Long-term costs

-- Air compressors

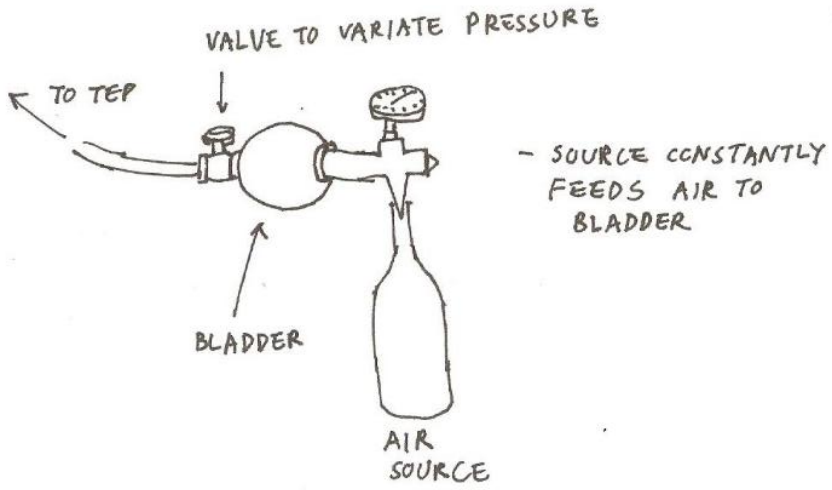
- Rechargeable
- One-time cost (ideally)
- Could be heavy/bulky/noisy
- May have to design one

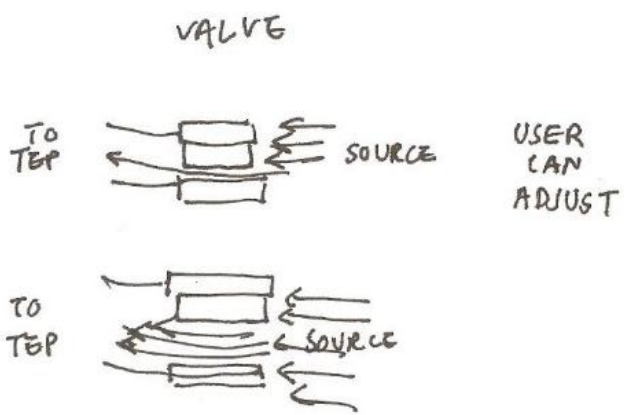
Approach: Delivery

-- Must control output pressure

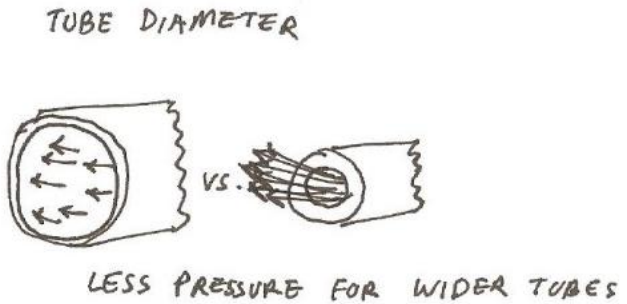
- Canister/Compressor pressure likely too high
- Output pressure should be user-adjustable

- Initial design: Bladder, valve, and pipe radius





USER CAN ADJUST



Approach: Other Considerations

-- Does it have to be air?

- Helium increases voice pitch, ideal for women

-- Emergency/quick-detach

- In case of malfunction
- Prevent user injury

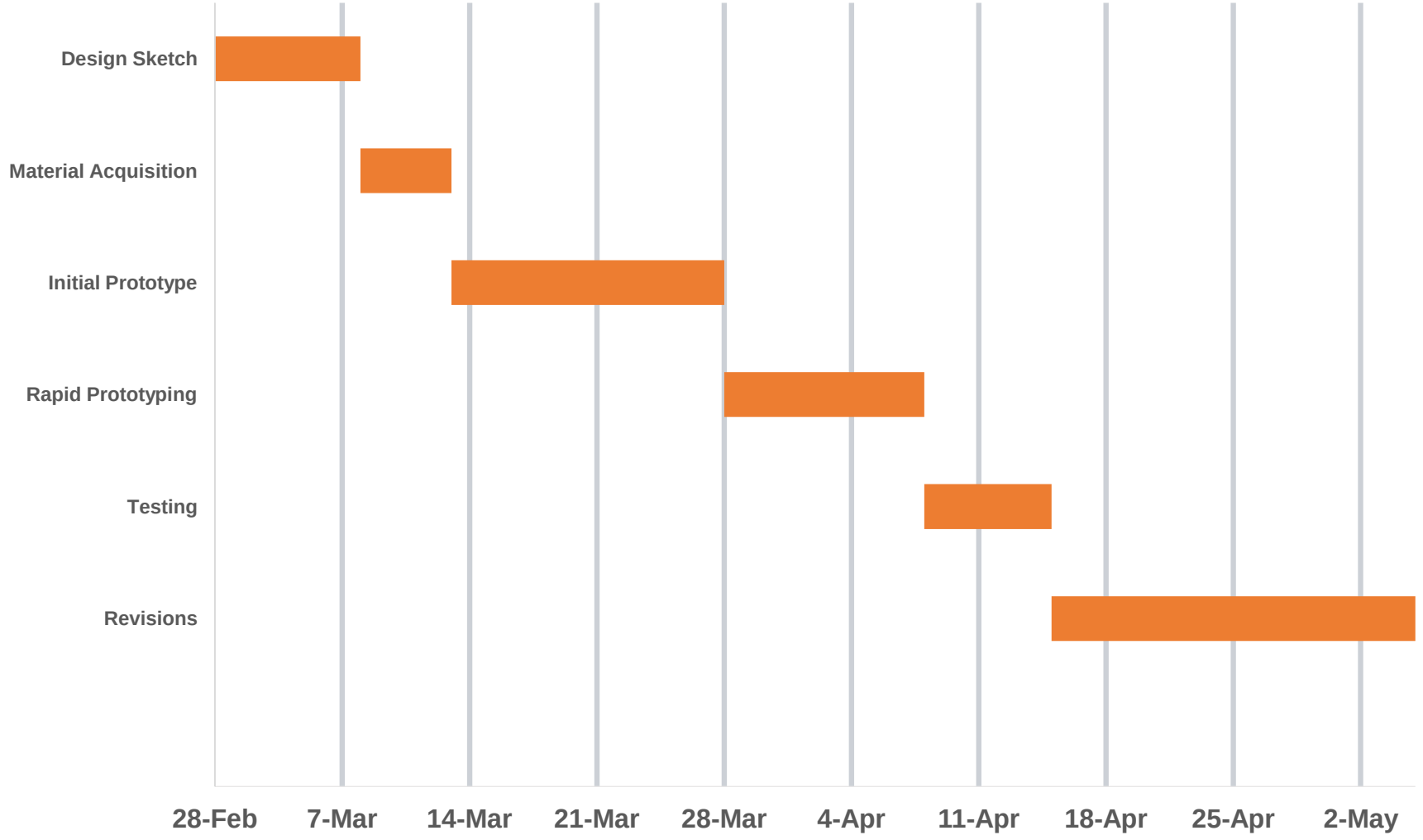
-- Better than a normal person?

- No need to exert air from lungs

Deliverables

CAD/Pad sketch of components Rough prototype of insufflator	Minimum
Improved prototype with custom-built parts Tested on voluntary patients Portable, belt-worn	Expected
Polish into sell-able condition World domination	Maximum

Schedule


Design Sketch
Material Acquisition
Initial Prototype
Rapid Prototyping
Testing
Revisions
28-Feb
7-Mar
14-Mar
21-Mar
28-Mar
4-Apr
11-Apr
18-Apr
25-Apr
2-May

Milestones

-- March 8: Completion of design sketch and CAD

-- March 13: Acquisition of materials

-- March 28: Initial prototype of insufflator

-- April 8: Proceed to develop RP parts

-- April 15: Begin testing on voluntary patients, revise based on feedback

Dependencies

Dependency	Reason for dependency	Impact	Resolution	Alternative
TEP device	Output tubing interface	No interface	Will acquire	N/A
Rapid Prototyping	Costs, qualifications	Less streamlined design	Contacts in MechE Dept.	Do without
Voluntary Patient testing	Ethics	Cannot test device	Will acquire, according to Dr. Richmon	Perform on realistic model

Bibliography/Readings

Blom, E. D., & Singer, M. I. (1979). Surgical-prosthetic approaches for postlaryngectomy voice restoration. In R. L. Keith & F. L Darley (Eds.), *Laryngectomee Rehabilitation*. Houston: College-Hill Press. - See more at: http://www.asha.org/policy/TR2004-00138.htm#r8

Blom, E. D., & Hamaker, R. C. (1996). Tracheoesophageal voice restoration following total laryngectomy. In E. N. Meyers & J. Suen (Eds.), *Cancer of the Head and Neck* (pp. 839–852). Philadelphia: W. B. Saunders. - See more at: http://www.asha.org/policy/TR2004-00138.htm#r8

Blom, E. D. (1995). Tracheoesophagel speech. In S. C. McFarlane & T. L. Watterson (Eds.), *Seminars in Speech and Language* (Vol. 16). New York: Thieme Medical. - See more at: http://www.asha.org/policy/TR2004-00138.htm#r8

Panje, W. R. (1981). Prosthetic vocal rehabilitation following laryngectomy: The voice button. *Annals of Otology, Rhinology, and Laryngology, 90*, 116–120. - See more at: http://www.asha.org/policy/TR2004-00138.htm#r34

Questions?

Be gentle.