Adjustable wave tube stand for Acoustic Reflection Technique

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Problem Statement:

The Vocal Tract Development lab (VT Lab) plans to compare anatomic measurements secured from Acoustic reflection technology (ART)- also known as acoustic pharyngometry with measurements secured from imaging studies (MRI & CT). The data collection for ART is done by means of a wave tube. The wave tube has a mouth piece that keeps the subject's tongue in position not blocking the airway - and ensures that all exhaled air passes through it. Sounds waves are emitted and the system's microphone captures the acoustic reflections of the airway. Currently, researchers in the VT Lab need to hold the wave tube in their hands which is presenting variability in the data. It is difficult to hold the wave tube at the same angle during each trial within subjects and across subjects. Hood Laboratories, the company who makes AR technology, reports that they will not be offering an adjustable stand at this time or in the near future to keep the wave tube stable while testing in the upright and supine position. We are requesting for the BME team to design and build a steady stand for the ART wave tube. The stand should be adjustable so that it may be used by individuals of different ages -- young children to adult. Also, the stand must allow the patient's head to remain in a standardized position in the upright and supine position. Another important criterion is that the stand/unit should be easy to clean and disinfect.

Client Requirements:

- The unit should be adjustable so that it may be used by individuals of different ages – young children to adult.
- The unit must allow the patient's head to remain in a standardized position in the upright and supine position
- The unit should be easy to clean and disinfect.
- The unit should be non-invasive to the patients.
- The unit should be portable.

Design Requirements:

- The unit should be able to fit on a relatively small table.
- The interface between the unit and the wave tube should put little to no pressure on the wave tube.
- The unit should be fully adjustable to accommodate the upright and supine position
- The cost should be relatively low.

1. **Physical and Operational Characteristics**
    a. *Performance Requirement:* The unit will need to reduce variability in results by holding a constant angle between the wave tube and the subject.
    b. *Safety:* The unit will be stable on any surface it is placed. There will be no sharp appendages that have the ability of harming the subject or operator.
    c. Reliability: Once put in a position, the unit will hold that position throughout the duration of the experiments.
    d. Shelf Life: Shelf life will not be an issue with the unit.
    e. Operating Environment: The unit will be in use in a mid-size lab where the wave tube is located. It will be placed on a table where the subject will be sitting and on the ground while the subject is lying down.
    f. *Ergonomics:* The unit will have a simple interface to adjust the height. There will be position markers on the side of the unit for a reference for the operator.
    g. Size and Shape: The unit will accommodate for the height of the subject. It will provide a lateral distance between the patient and base. This allows for the subject to be seated comfortably at a table throughout the experiment. The unit will also allow for the subject to be lying in a supine position.
    h. Weight: The base of the unit will be heavy enough to keep it stable. However, the unit will be light enough to be portable and safe if dropped from a small distance.
    i. Aesthetics, Appearance, and Finish: The unit will be non-intimidating for all subjects.

2. **Product Characteristics:**
    a. Quantity: One unit that performs two tasks is required.
    b. Price: The budget for the project is $500.00. Our goal is to make it for well under this price.

3. **Miscellaneous:**
    a. Human Subject Protocol: The unit should meet requirements set by the IRB in regards to testing human subjects.
    b. Customer: The unit should allow our client to obtain more accurate data using ART.
    c. Patient-related concerns: The unit should not present any danger to harming the patient.
    d. Competition: There is currently no unit available that adheres to the requirements set forth by the client.