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Improving the reproducibility of acoustic rhinometry: a customized stand giving control of height and angle

EDWARD W. FISHER, M.A., F.R.C.S., F.R.C.S.ED.*, ADRIAN B. BOREHAM, I.ENG., M.I.MECH.I.E., M.I.S.M.†

Abstract
Control and recording of the position of the acoustic rhinometer in relation to the nostrils is important for serial measurements. Several technical factors must be controlled, including the angle of the incident acoustic wave. We describe a simple, newly-designed, rhinometer stand which allows control of height and angle, and hence improves the reliability of serial measurements in clinical and physiological work.

Key words: Acoustic rhinometry

Introduction

Acoustic rhinometry is gaining popularity as a versatile alternative to rhinomanometry in objective nasal airway assessment (Hilberg *et al.*, 1989; Fisher *et al.*, 1994). Although it was initially hailed as highly reproducible, it has become clear that many theoretical and technical factors can lead to errors (Fisher *et al.*, 1995). Control of respiratory pattern, palate position, angle of incidence of the acoustic wave and nosepiece seal quality has been shown to be important if unacceptable errors are to be avoided (Lenders *et al.*, 1992; O'Flynn, 1992).

Maintaining constancy of these technical factors is of particular importance in situations where serial measurements are taken in the same subject. The follow-up readings in such cases may be minutes (nasal provocation and pharmacology studies), hours (nasal cycle studies), days (pathophysiology studies) or weeks (post-operative studies) or even longer after the first study. If test–retest variability is to be within an acceptable range then investigators must record the appropriate test conditions for each subject or patient, and be confident of reproducing these conditions on a second or subsequent occasion.

Commercial and *ad hoc* rhinometer stands have left something to be desired, particularly with respect to recording the angle of the wave tube to the horizontal. We describe a robust adjustable stand which we have designed and developed to meet these needs.

Material and methods

Our initial studies using acoustic rhinometry used a simple chemistry laboratory-style burette stand, and commercial rhinometer stands have been modified from photographic tripods. The former, and to a lesser extent the latter, were found to be unstable and unsatisfactory, hence we replaced them with a specially designed stand (Figures 1 and 2). The stand is made from an aluminium column of 25 mm diameter on a trespar base. An acetol carriage slides up and down the column in a keyway (groove) and supports a 125 mm diameter × 12 mm thick PVC rotating disc and PVC clamping block. A protractor and thumbscrew is incorporated into the PVC rotating disc, and a pointer allows measurement of the angle of the sound tube from the horizontal. Both angle and height from the ground are adjustable to account for individual subjects' anatomy.

The materials used in the construction of the stand are inexpensive, most of the expense being in labour. We have found that the improved stability and manoeuvrability of the rhinometer has facilitated studies in children in particular, since the rhinometer can adjust to the subject more easily, rather than the subject having to move into an awkward position.

Discussion

We recommend that investigators should make careful records of several factors when using acoustic rhinometers:

(1) Angle of approach of the sound tube in the axial plane (parasagittal, mid-position or lateral). This is with reference to the head in a neutral and comfortable position.
(2) Angle of approach of the sound tube in the sagittal plane (20–75°).
(3) Nosepiece size.
(4) Type of seal used (good fit without sealant; vaseline; silicone-based sealant).
(5) Height of the stand (if a fixed chair is used).
(6) Identity of the observer (to avoid inter-observer curve selection bias).
(7) Mode of respiration used (cessation of nasal respiration is ideal).

This will facilitate more valid repeat measurements on subsequent occasions (Fisher *et al.*, 1995).

Passali and coworkers have suggested that variation due to involuntary head movements can be reduced by using a head-rest of a similar design to that used in slit lamp examination in the ophthalmic clinic (Passali *et al.*, 1994). This device has merit in adults, but has a forbidding

From the Department of Otolaryngology*, Addenbrooke's Hospital, Hills Road, Cambridge, and the Clinical School Workshops†, University of Cambridge, Cambridge, UK.
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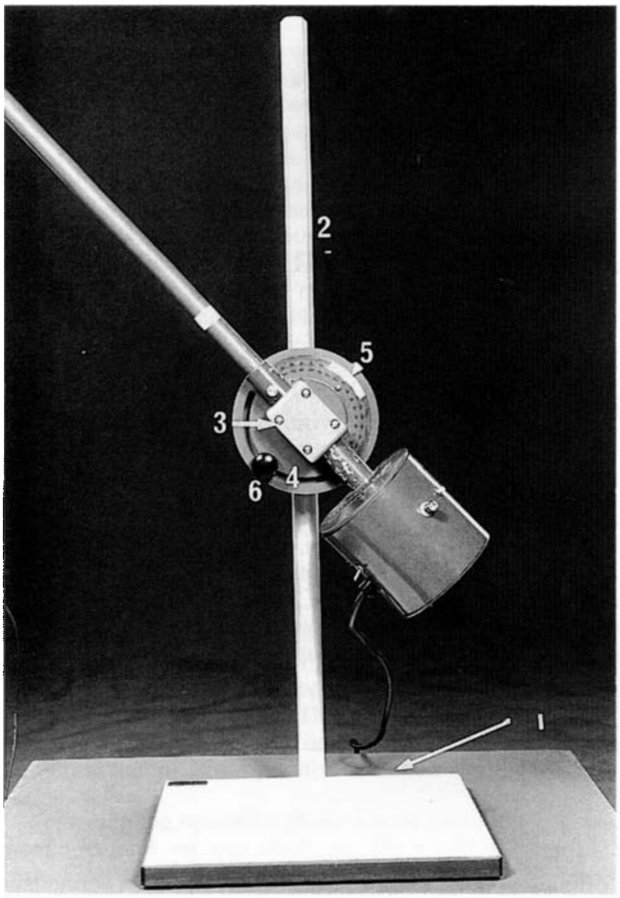

FIG. 1
Rhinometer stand with acoustic rhinometer attached. 1 – Trespar base; 2 – aluminium column; 3 – PVC clamping block; 4 – PVC rotating disc; 5 – protractor and pointer; 6 – thumbscrew.

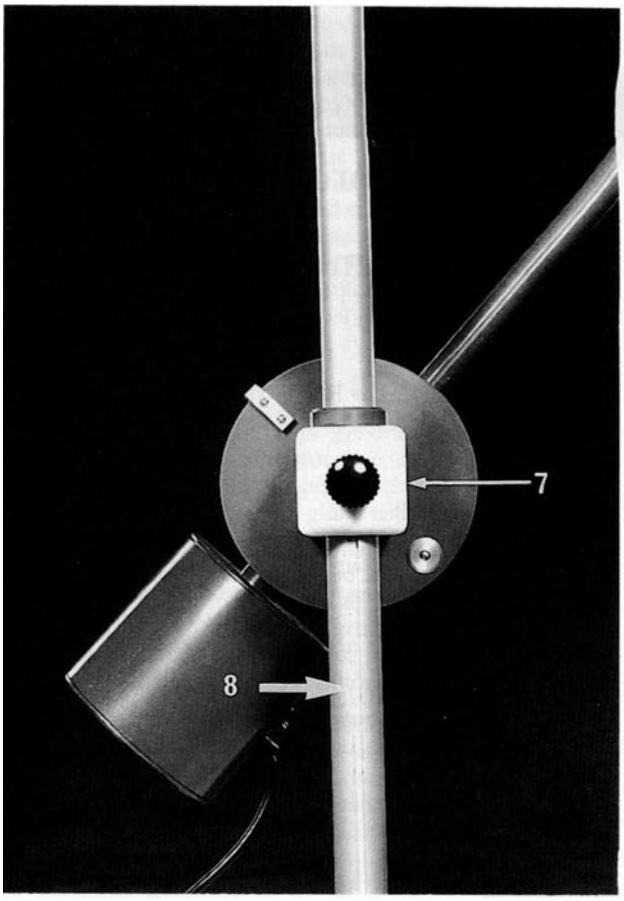

FIG. 2
View of the stand at 180° to Figure 1. 7 – Acetol carriage and securing screw; 8 – keyway in aluminium column.

appearance, and we consider it to be unsuitable for our paediatric subjects and patients.

We suggest that the use of a rhinometer base of a design similar to our own is advisable if maximum reproducibility and reliability is to be obtained from acoustic rhinometry data.

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Address for correspondence:
Mr Edward W. Fisher, M.A., F.R.C.S.,
Consultant Otorhinolaryngologist,
ENT Department,
Birmingham Heartlands Hospital,
Bordesley Green East,
Birmingham B9 5SS.

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