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Title: Detection of air leaks and their effects on forced oscillometry measurements

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Body: Introduction: Forced oscillation technique (FOT) is a method to estimate respiratory resistance (Rrs) and reactance (Xrs). However, some common artefacts may affect the accuracy of FOT readings. In particular, air leaks from lips not sealed around the mouthpiece, or those from the equipment. We studied the significance of this artefact and identified possible markers to detect it. Methods: 11 healthy subjects (33±7 years) underwent FOT measurements (Jaeger, Wurzburg, Germany) which generated 0.4 kPa peak-to-peak input signals. The Rrs and Xrs values at 5 and 20 Hz (R5, R20, X5) were registered in parallel with breathing volumes. To simulate air leaks, we applied artificial holes of increasing sizes (3.5 mm, 6 mm, and 8.5 mm diameters) on the breathing filter at 1 cm from the circumference. FOT data were compared to normal values obtained with no air leaks. Results: With increasingly bigger filter holes and resulting air leaks, we identified corresponding larger indentations in the descending limb of the breathing volume (ΔV (2.2±0.6 mL, 5.3±1.7 mL, 8.7±3.1 mL and 14.4±2.9 mL; respectively, p<0.001), indicating that ΔV may be a marker for air leak. This was confirmed by a significant correlation between ΔV and R5 (p<0.001, r=-0.74), R20 (p<0.001, r=-0.71), X5 (p<0.001, r=0.79) and R5-R20 (p=0.001, r=-0.50). In line with this, a 1.1 mL increase in ΔV was associated with a 10% decrease in R5 values. Conclusion: Indentations on the descending limb of the breathing volume may be used to detect the presence and magnitude of air leaks. Visual inspection of the data is required to exclude records where indentations are found. The first author is receiving an ERS Long Term Fellowship.