



Resmon™ Pro

Clinical Applications for COPD



THE CLINICAL APPLICATIONS OF THE UNIQUE FOT SYSTEM, RESMON PRO, FEATURING AN EXCLUSIVE “WITHIN-BREATH” FORCED OSCILLATION TECHNIQUE

THE CLINICAL ISSUES

- Pre-Post bronchodilator testing with forced flow-volume loops maneuvers and body plethysmography are very difficult to perform by most patients especially in Acute Exacerbations COPD (AECOPD).

“The presence of airflow obstruction is a defining feature of several lung diseases and its persistence over time and despite bronchodilator treatment is typical in chronic obstructive pulmonary disease (COPD).”

REFERENCE: Celli BR and committee members. Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. Eur Respir J 2004.

- DEEP INHALATION EFFECT: It has been demonstrated and referenced over the last years that the Deep Inhalation has bronchostrictor or bronchodilator EFFECT in COPD and Asthma patients, both adults and pediatrics.

“The deep inspiration that precedes forced expiration may modify airway smooth muscle tone, and, therefore, may influence the result of the BHR test. FOT has the considerable advantage that it measures airway properties during quiet breathing.”

REFERENCE: Oostveen et al. The forced oscillation technique in clinical practice: methodology, recommendations and future developments. Eur Respir J 2013, 22(6), 1026–1041.

- EFL (EXPIRATORY FLOW LIMITATION): *“EFL promotes dynamic pulmonary hyperinflation and intrinsic positive end-expiratory pressure (PEEPi) with concurrent dyspnea.”*

REFERENCE: N G Koulouris et al ‘Physiological Techniques for Detecting Expiratory Flow Limitation during Tidal Breathing.’, European respiratory review : an official journal of the European Respiratory Society, and exercise limitation” 20 (2011), 147–55.

“The presence of airway closure and EFL in the tidal volume range may promote peripheral airway injury and accelerate the abnormalities of lung function. This enhances inflammation due to smoke per se, leading to severe functional and structural abnormalities within the lung.”

REFERENCE: P. M. A. Calverley, ‘Flow Limitation and Dynamic Hyperinflation: Key Concepts in Modern Respiratory Physiology’, European Respiratory Journal, 25 (2005), 186–199.



FOT CLINICAL SOLUTIONS:

- *“In contrast to standard PFT requiring maximal coordinated efforts, FOT requires only normal quiet breathing with the lips tightly closed to avoid airflow leak, and the wearing of a nose-clip. For this reason, children can be easily studied, often as early as 3 yrs. Similarly, elderly subjects, those with severe airflow obstruction or those with neuromuscular disease who find maximal forced respiratory efforts difficult to perform are able to breathe normally for FOT testing. Portability of commercial FOT instruments permits lung function testing at the bedside or, for occupational lung disease studies, at the place of work.”*
- *“.. as a matter of practical convenience, FOT is more readily utilised in the clinical pulmonary function laboratory than body plethysmography.”*
- *“Spirometry does not provide a clear indication of peripheral airway obstruction, despite the general information contained within the shape of the flow–volume curve, and values of mid-flow rates (forced expiratory flow between 25 and 75% of the forced vital capacity). Thus, the most striking characteristic of FOT in relation to spirometry is the relatively greater sensitivity of FOT to peripheral airway disease.”*

REFERENCE: Goldman et al - Forced oscillation technique and impulse oscillometry - Eur Respir Mon 2005;31:72– 105.

- *“More recently, the within-breath analysis of Rrs and Xrs has been shown to help differentiate between asthma and COPD and also offer more useful information about the pathophysiology of asthma and COPD, which the spirometer does not.”*

REFERENCE: Brashier et al., Measuring lung function using sound waves: role of the forced oscillation technique and impulse oscillometry system, Breathe (Sheff). 2015 Mar; 11(1): 57–65.

- *“FOT has been reported to show greater sensitivity to inhaled corticosteroid or beta-agonist inhalation than spirometry. Both inhaled corticosteroids and b-agonists improve small airways function, and FOT responses manifest prominent changes in indices of peripheral airway obstruction. In contrast, spirometric sensitivity to small airways function is less prominent. “*
- *“Such use of FOT provides a clinically valuable monitoring tool to follow therapeutic changes in small airways function over time. This use of FOT for therapeutic monitoring is not dependent on the use of FOT as an initial diagnostic evaluation.”*

REFERENCE: Goldman et al - Forced oscillation technique and impulse oscillometry - Eur Respir Mon 2005;31:72– 105.

- *“After the use of the short-acting B₂-agonist, Rrs decreased in all of the COPD patient subgroups. A reduction in the negative dependence of the Rrs curve with frequency was also evident. Previous studies investigating adults with asthma and COPD have reported similar results. After the use of the bronchodilator in the control group, Xrs exhibited small changes at the investigated frequency range, confirming previous findings [ref]. In agreement with a study by Dellacá et al., the reactance values decreased following bronchodilator use in the COPD patients; the reduction of Xrs was proportional to the increase in bronchial obstruction (fig. 1 e–h). Such changes occur mainly at the lower frequencies.”*

REFERENCE: Gerasa Maritimo da Costa et al, 'Respiratory Impedance and Response to Salbutamol in Healthy Individuals and Patients with COPD', Respiration, 88 (2014), 101–111.

- *“Rinsp is the most sensitive functional parameter of airway caliber and is unaffected by lung volume history”*

REFERENCE : Pellegrino R. et al - Assessing the effect of deep inhalation on airway calibre: a novel approach to lung function in bronchial asthma and COPD - Eur Respir J 1998;12:1219–1227.

- “Grs index can be considered as sensitive as FEV1 for detecting bronchodilation and for separating asthmatics and patients with COPD... This study demonstrates that the FOT is useful for detecting acute bronchodilator induced changes in airway caliber. We found that the increase in Grs was equivalent to the increase in FEV1 for detecting bronchodilation in patients with obstructive conditions.”

REFERENCE: F Zerah et al 'Forced Oscillation Technique vs Spirometry to Assess Bronchodilatation in Patients with Asthma and COPD.', Chest, 108 (1995), 41–7. Research 2014, 15:86.

- “Increase in Grs was the best and sole predictor of reduction in exertional dyspnoea, explaining 41% of the variance. There was no additional contribution to the model from the increase in FEV1 or IC. Conclusion: Bronchodilator induced improvements in exertional dyspnoea in moderate to severe COPD are predicted by improvements in Grs, measured by FOT, independent of improvements in spirometry or hyperinflation.”

REFERENCE: Chantale Diba et al 'Improved Respiratory System Conductance Following Bronchodilator Predicts Reduced Exertional Dyspnoea.', Respiratory medicine, 105 (2011), 1345–51.

- “As forced oscillation technique is automatic and can measure multiple breaths over long periods, it is suitable for monitoring expiratory flow limitation continuously and identifying patients breathing close to the onset of expiratory flow limitation, where intermittent sampling may be unrepresentative.”
- “The within-breath change in reactance (ΔXrs) measured by forced oscillation technique (FOT) at 5 Hz reliably detects expiratory flow limitation in chronic obstructive pulmonary disease (COPD).”

REFERENCE: Calverley et al - Expiratory flow limitation detected by forced oscillation and negative expiratory pressure - Eur Respir J 2007; 29: 363–374.

- “Multiple-breath ΔXrs was similar to FEV1 in its ability to identify breathlessness, defined as having an mMRC score ≥ 2 , using ROC curve analysis. However, these data are, to a degree, complementary, as we found that COPD patients with high ΔXrs reported significantly higher mMRC scores across all GOLD grades. Consequently, we suggest that ΔXrs can be used as a marker for the subjective feeling of dyspnoea, adding information beyond spirometry on its own.”

REFERENCE: Bernt B Aarli and others, 'Variability of within-breath Reactance in COPD Patients and Its Association with Dyspnoea.', The Eur Respir J, 2014, 1–10.

- “Forced oscillometry may be particularly appropriate for the objective physiological assessment of patients with an exacerbation of COPD. It is a passive manoeuvre that requires only tidal breathing, and is easily performed by breathless subjects.”
- “Changes in Xrs_{insp} and Xrs_{exp} were easily detected during an exacerbation in subjects with COPD, were widely associated with changes in symptom and HRQOL scores and could represent useful objective measurements for documenting recovery.”

REFERENCE: MK Johnson et al 'Measurement of Physiological Recovery from Exacerbation of Chronic Obstructive Pulmonary Disease Using within-Breath Forced Oscillometry.', Thorax, 62 (2007), 299–306.

- “This study indicates that reactance and flow limitation improve early in the recovery phase of a COPD exacerbation in those who have flow-limited breathing, whereas resistance and spirometry do not change.”
- “...patients with flow-limited breathing on admission (EFL index values greater than 2.8 cmH₂O s L⁻¹), improvement in EFL index values was a significant determinant of improved dyspnea during recovery in hospital!”

REFERENCE: Farah CS. et al 'Expiratory Flow Limitation Relates to Symptoms during COPD Exacerbations Requiring Hospital Admission.', Int J Chron Obstruct Pulmon Dis, 10 (2015), 939–945.



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The Resmon Pro FOT system is not approved for clinical or diagnostic use in the U.S.A.