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Carlo Gulotta

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ATS 2014 Poster Presentation: **DETECTION OF EXPIRATORY FLOW LIMITATION IN OBESE PATIENTS WITH CHRONIC RESPIRATORY FAILURE.** Pompilio, P., Suh, E. S., Dellaca, R., Hart, N., & Mandal, S. American Journal of Respiratory and Critical Care Medicine, Vol. 189, Meeting Abstracts, 2014 EFFECTS OF OBESITY ON LUNG FUNCTION, 2014, pp. A3514

ATS 2014 Poster Presentation: **ABOLITION OF EXPIRATORY FLOW LIMITATION IN SEVERE CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) USING AUTO-TITRATING CONTINUOUS POSITIVE AIRWAY PRESSURE BASED ON THE MEASUREMENT OF WITHIN-BREATH AIRWAY REACTANCE DETERMINED BY THE FORCED OSCILLATION TECHNIQUE.** Suh, E.S., Pompilio, P., Mandal, S., Hill, P., Romano, R., Dellaca, R., Hart, N. American Journal of Respiratory and Critical Care Medicine, Vol. 189, Meeting Abstracts, 2014, NOVEL AND TRADITIONAL LUNG FUNCTION ASSESSMENT. May 1, 2014, A3555-A3555

ATS 2014 Poster Presentation: **CLINICAL TRIALS FOR ELDERLY PATIENTS WITH MULTIPLE DISEASES (CHROMED): A PILOT STUDY.** *: Chromed is a clinical research study performed with the home measuring version “Diary” of the Resmon Pro Pasquale Pompilio, Valentina Isetta, Andrei Malinovschi, Jo Middlemass, Giulia Munaro, Mireia Dalmases, Christer Janson, Aloysius Nirosian Siriwardena, Roberta Macis, Paolo Zanaboni, Peter M Calverley, Raffaele Dellaca, Roberto Rosso- on behalf of CHROMED consortium Eur Respir J 2014; 44: Suppl. 58, P971.

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ATS 2014 Poster Discussion: **DETECTION OF FLOW LIMITATION IN COPD PATIENTS USING TWO DIFFERENT FORCED OSCILLATION DEVICES.**
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E. Oostveen, K. De Soomer, J. A. Otte, A. M. Vints, W. De Backer.
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ATS 2014 Poster Presentation: **DAY-BY-DAY VARIABILITY OF INSPIRATORY RESISTANCE: A NOVEL TEST FOR THE DIAGNOSIS OF ASTHMA.**
Gobbi A, Gulotta C, Mellano E, Suki B, Dellacà R.
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COPD 9th Conference 2014 Poster Presentation: **ACCEPTABILITY OF A NOVEL TELEMONITORING SYSTEM FOR ELDERLY PEOPLE WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE AND COMORBIDITIES: THE CHROMED CLINICAL TRIAL, PRELIMINARY RESULTS.**
* : Chromed is a clinical research study performed with the home measuring version “Diary” of the Resmon Pro
Pasquale Pompilio, Valentina Isetta, Andrei Malinovschi, Jo Middlemass, Giulia Munaro, Mireia Dalmases, Christer Janson, Aloysius Niroshan Siriwardena, Roberta Macis, Paolo Zanaboni, Peter M Calverley, Raffaele Dellaca, Roberto Rosso- on behalf of CHROMED consortium.

National SAPC Congress 2014: **CLINICAL TRIALS FOR ELDERLY PATIENTS WITH MULTIPLE DISEASES (CHROMED) PILOT STUDY.**
* : Chromed is a clinical research study performed with the home measuring version “Diary” of the Resmon Pro
Pasquale Pompilio, Valentina Isetta, Andrei Malinovschi, Jo Middlemass, Giulia Munaro, Mireia Dalmases, Christer Janson, Aloysius Niroshan Siriwardena, Roberta Macis, Paolo Zanaboni, Peter M Calverley, Raffaele Dellaca, Roberto Rosso- on behalf of CHROMED consortium

SIMG Congress 2014: **SCREENING DI PATOLOGIE OSTRUTTIVE RESPIRATORIE PRESSO GLI STUDI DI MEDICINA GENERALE: IL POSSIBILE RUOLO DELLA TECNICA DELLE OSCILLAZIONI FORZATE (FOT)./ SCREENING OF OBSTRUCTIVE RESPIRATORY DISEASES IN GENERAL PRACTITIONERS OFFICES: POSSIBLE ROLE OF FORCED OSCILLATION TECHNIQUE (FOT).**
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The European Respiratory Journal, 29(2),363–74.

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European Respiratory Journal, 23(2), 187–188.
REFERENCE EQUATIONS USED IN THE RESMON PRO FULL:

NEW in version 6.1.2:

PRESCHOOL and 2-13 years of age: Claudia Calogero, MD, Shannon J. Simpson, PhD, Enrico Lombardi, MD, Niccolò Parri, MD, Barbara Cuomo, MD, Massimo Palumbo, MD, Maurizio de Martino, MD, Claire Shackleton, BSc (Hons), Maureen Verheggen, MMEdSc, Tania Gavidia, MIH, Peter J. Franklin, PhD, Merci M.H. Kusel, MBBS, PhD, Judy Park, MBiostat, Peter D. Sly, DSc, and Graham L Hall, PhD

Respiratory Impedance and Bronchodilator Responsiveness in Healthy Children Aged 2–13 Years. Pediatric Pulmonology 48:707–715(2013)

And, option:

PRESCHOOL(2-7 years of age): Calogero, C., Parri, N., Baccini, a, Cuomo, B., Palumbo, M., Novembre, E., … Lombardi, E. (2010). Respiratory impedance and bronchodilator response in healthy Italian preschool children. Pediatric Pulmonology, 45(11), 1086–94.

7-17 YEARS OLD: Ducharme, F. M., Davis, G. M., & Ducharme, G. R. (1998). Pediatric reference values for respiratory resistance measured by forced oscillation. Chest, 113(5), 1322–8.

ADULTS: Oostveen, E., Boda, K., van der Grinten, C. P. M., James, A. L., Young, S., Nieland, H., & Hantos, Z. (2013). Respiratory impedance in healthy subjects: baseline values and bronchodilator response. The European Respiratory Journal : Official Journal of the European Society for Clinical Respiratory Physiology

FOT CONCEPTS, GUIDELINES AND SUGGESTED READING

ADULTS:

Oostveen, E., MacLeod, D., Lorino, H., Farre, R., Hantos, Z., Desager, K., & Marchal, F. (2003). The forced oscillation technique in clinical practice: methodology, recommendations and future developments. European Respiratory Journal, 22(6), 1026–1041.

“As a tool for the investigation of respiratory mechanics in clinical practice, the forced oscillation technique (FOT) is well supported theoretically.”

“The most attractive feature of FOT is that the forced oscillations are superimposed on the normal breathing, avoiding the need for any special breathing manoeuvre or any noticeable interference with respiration.”

“WESSELING and WOUTERS [61] found abnormal Zrs data in 70% of the subjects with chronic bronchitis in the
presence of normal spirometry.”

“FOT has proven to be at least as sensitive as spirometry to detect impairment of lung function due to exposure to cigarette smoke or occupational hazards. The sensitivity to detect mild airway disease and the minimal requirements for subjects cooperation make FOT a very suitable lung function test for epidemiological and field studies.”

“A significant correlation between the changes in Rrs and FEV1 following bronchoconstriction has been reported by several investigators. “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. This may be the reason why FOT has proved more sensitive than FEV1 to detect changes in BHR in asthmatics after corticosteroid treatment.”

“There is evidence that FOT and plethysmography provide comparable information on bronchial sensitivity and responsiveness and may be superior to spirometry.”

Navajas, D., & Farré, R. (2001). Forced oscillation technique: from theory to clinical applications. Monaldi Archives for Chest Disease - Archivio Monaldi per Le Malattie Del Torace / Fondazione Clinica Del Lavoro, IRCCS [and] Istituto Di Clinica Tisiologica E Malattie Apparato Respiratorio, Università Di Napoli, Secondo Ateneo, 56(6), 555–62. 555–562.

“It has been suggested that FOT is adequate for assessing the increase in airway obstruction induced by bronchial challenge... Similarly, FOT has been used to assess the decrease in airway resistance induced by bronchodilation agents... Another interesting feature of FOT is that its time resolution allows the easy measurement of the dose-response effect.”

“According to the currently available data, FOT has a sensitivity and specificity similar to that of conventional spirometric indices [65, 69].”

“In recent years, FOT has been employed to assess upper airway obstruction in patients with the sleep apnea/hypopnea syndrome (SAHS).” “The technique has enough time resolution to track the obstructive events undergone by the upper airway during the different phases of the breathing cycles.”

Bates, J. H. T., Irvin, C. G., Farré, R., & Hantos, Z. (2011). Oscillation mechanics of the respiratory system. Comprehensive Physiology, 1(3), 1233–72.

“The reproducibility of Zrs in healthy humans is similar to that observed in other parameters of respiratory mechanics such as those provided by body plethysmography or the flow interrupter technique;”

“The FOT has been shown to reveal differences in baseline lung mechanics in patient both with asthma and COPD who had abnormal spirometry (52). Also, the frequency dependence of Rrs has been shown to change in patients with asthma or other obstructive diseases (37, 52, 112, 192, 212), likely due to the presence of ventilation inhomogeneities (37, 212). Furthermore, patients with different types of obstructive lung disease (emphysema, chronic bronchitis and asthma) have been reported to show different patterns of abnormality by the FOT with similar abnormalities in spirometry (282).”

“The FOT has also been shown to provide indices related to the severity of asthma (50), and can be used to detect central airway obstruction due to either tracheal stenosis or vocal cord dysfunction (137), which can be
confused with asthma."

“Several recent studies have used the FOT to follow the temporal variations in lung function associated with asthma (72, 110, 233). Indeed, home monitoring via the FOT may become an important means of following asthmatic patients in the future (66).”

“Another characteristic feature of COPD is that Zrs is often very different between inspiration and expiration in contrast to the situation in normal subjects (65). In particular, the magnitude of Zrs is abnormally elevated in expiration due to the presence of expiratory flow limitation (68), which prevents the FOT from being able to probe the lung beyond the choke point where flow limitation occurs. Accordingly, bronchodilation produces a particularly marked reduction in the magnitude of Xrs when flow limitation is relieved (67).”

“The FOT has been used in patients with sarcoidosis, providing parameters that correlate significantly with those of spirometry. In particular, the magnitude of Zrs at 4Hz appears to be clinically useful in this disease (78).”

“Routinely measured lung volumes (total lung capacity and vital capacity) have been shown to correlate well with aver-age Xrs and with the slopes of Xrs and Rrs versus frequency in patients that have ILDs but no sign of airway obstruction (281).”

FOT has been applied in occupational respiratory diseases such as silicosis in which the pattern of Rrs is similar to that seen in COPD; Rrs is elevated and has an increased negative dependence on frequency (59).

“The FOT can also be useful in assessing possible side effects of therapies in nonpulmonary diseases, such as the treatment of spinal cord injury with neostigmine and glycopyrrolate which have been implicated in increased airway secretions and bronchospasm (235).”

“Recent preliminary data suggest that the FOT could be useful for assessing the evolution of respiratory function soon after lung transplantation when spirometry is not feasible (119).”

“In a study of patients with extra-thoracic upper airway obstruction, mostly due to carcinoma, Rrs and Xrs were correlated with airway resistance measured by body plethysmography. Moreover, Rrs tended to be higher in patients with upper airway obstruction compared to patients with COPD (284).”

Tracheal stenosis is another extrapulmonary disease where the FOT has been employed to characterize respiratory resistance, and a strong correlation between indices derived from Rrs and the diameter of tracheostenosis has been reported (137). Patients with tracheal stenosis also tend to have a marked flow dependence of Rrs measured by FOT which has been found to be correlated with conventional upper airway obstruction indices derived from spirometry (288).”

**PEDIATRICS**

Beydon, N., Davis, S. D., Lombardi, E., Allen, J. L., Arets, H. G. M., Aurora, P., … Wilson, N. M. (2007). An official American Thoracic Society/European Respiratory Society statement: pulmonary function testing in preschool children. American Journal of Respiratory and Critical Care Medicine, 175(12), 1304–45

“Lack of cooperation and noninvasiveness are key features of the FOT, which is therefore increasingly used in young children.”

“The feasibility of the FOT in the acutely ill, untrained preschool children measured in the emergency room ranged from 20% in 3 years old to more than 80% in 5 years old. In laboratory or field settings, higher values of 80 to 100% have been obtained in healthy preschool children or stable preschool patients.”
"The single frequency sinusoid has optimal signal-to-noise ratio; allows the descriptions of Zrs variations with time, within- and between-breath and in relation to flow and volume; “

“FOT assessment of response to bronchodilator was found to be in agreement with FEV1 and airway resistance with plethysmography”

“The FOT was probably one of the first techniques applied to preschool children to estimate the airway response to metacholine and histamine. … In wheezy preschool children, changes in FOT paralleled those observed with plethysmography, interrupter resistance, or spirometry.

Frey, U. (2005). Forced oscillation technique in infants and young children. Paediatric Respiratory Reviews, 6(4), 246–54.

“In stable ASTHMA, higher respiratory resistance at various frequencies were found in the mid range in comparison with healthy subjects. These changes in Rrs were consistent with decreased FEV1 values in asthmatic group”

“Reversible airway obstruction and bronchial hyperresponsiveness (BHR) are significant components contributing to the diagnosis of bronchial asthma in infants and young children. Changes in mid-frequency Zin were related to changes in FEV1 or clinical signs after a challenge with bronchodilators. Similarly, BHR showed changes from baseline comparable or better than other lung function tests. The increased Rrs was accompanied by a decrease in Xrs in most studies after challenge.”

“One study assessed the feasibility of FOT in the emergency department in the untrained child with respiratory distress. …. These success rates were higher than those for spirometry”

### Resmon™ PRO FULL
Forced Oscillation Technique