# Hvad er IMT (Inspirationsmuskeltræning)

## Temadag
## Dansk Selskab for Neurologisk Fysioterapi

*Barbara C. Brocki*
*Fysioterapeut, ph.d.*
*Aalborg Universitetshospital*
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# Indhold

- Baggrund for IMT/evidens
- Kort om måling af respirationsmuskelstyrke
- Udstyr
- Min erfaring med IMT

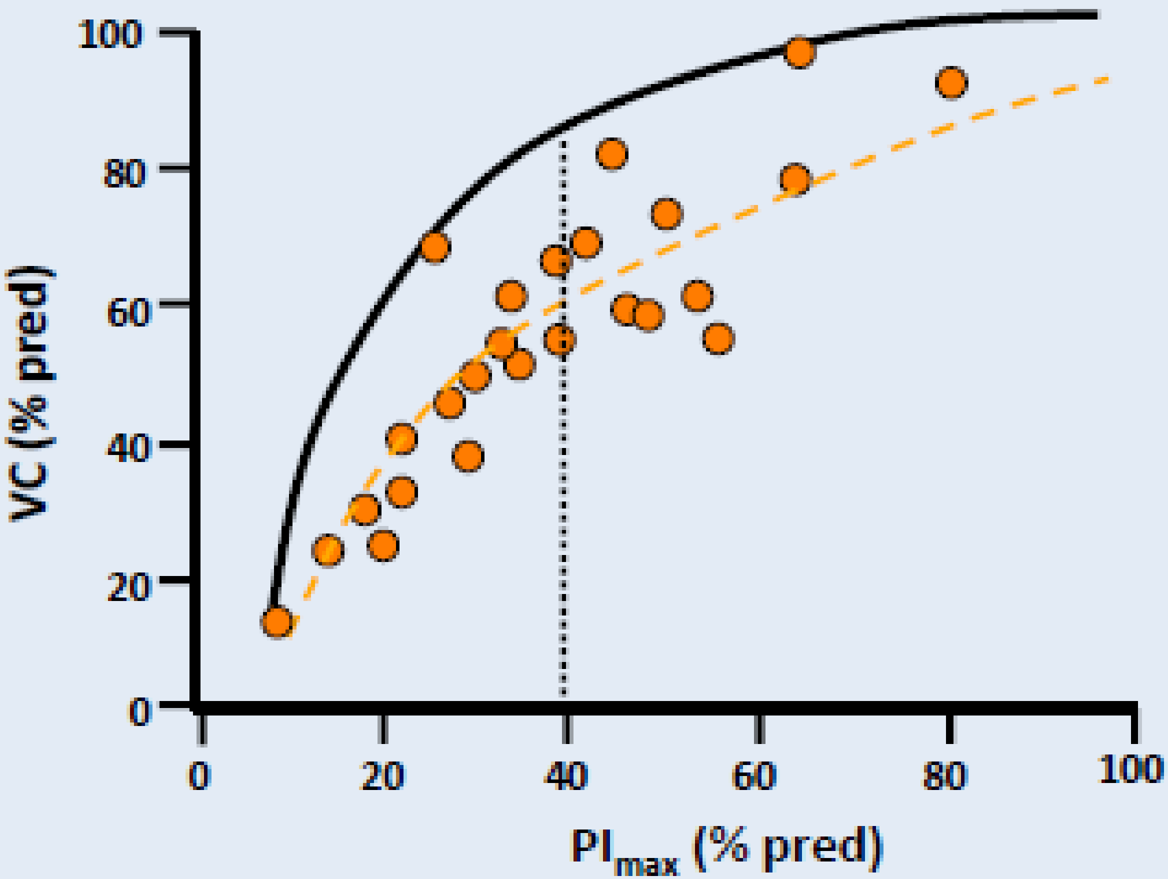
# ACT OF RESPIRATORY MUSCLES

- RESPIRATION
- COUGH
- SPEECH
- TRUNK MOVEMENT/STABILISATION
- DEFEACATION

# RESPIRATORY MUSCLE WEAKNESS CONTRIBUTES TO

- RESPIRATORY FAILURE (HYPERCAPNIA, HYPOXEMIA)
- WEANING FAILURE
- NOCTURNAL DESATURATION
- IMPAIRED COUGH EFFICIENCY
- DYSPNEA
- EXERCISE LIMITATION

# Lung function and respiratory muscles




De Troyer et al. Thorax 1980, 35: 603- 610.

# EVIDENCE FOR IMT (RMT)

- COPD
- PREOPERATIVE INTERVENTION
- HEART FAILURE
- INTENSIVE UNIT
- NEUROMUSCULAR DISEASES

# Global Initiative for Chronic Obstructive Lung Disease

**GLOBAL STRATEGY FOR THE DIAGNOSIS,
MANAGEMENT, AND PREVENTION OF
CHRONIC OBSTRUCTIVE PULMONARY DISEASE**

**UPDATED 2016**

# COPD: IMT vs. upper limb exercises

Some programs also include upper limb exercises, usually involving an upper limb ergometer or resistive training with weights. There are no randomized clinical trial data to support the routine inclusion of these exercises, but they may be helpful in patients with comorbidities that restrict other forms of exercise and those with evidence of respiratory muscle weakness[335]. In contrast, inspiratory muscle training appears to provide additional benefits when included in a comprehensive pulmonary rehabilitation program[336-338]. The addition of upper limb exercises or other strength training to aerobic training is effective in improving strength, but does not improve quality of life or exercise tolerance[339].

Journal of Physiotherapy 61 (2015) 125–134

Journal of
PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Research

# Inspiratory muscle training facilitates weaning from mechanical ventilation among patients in the intensive care unit: a systematic review

Mark Elkins [a], Ruth Dentice [b]

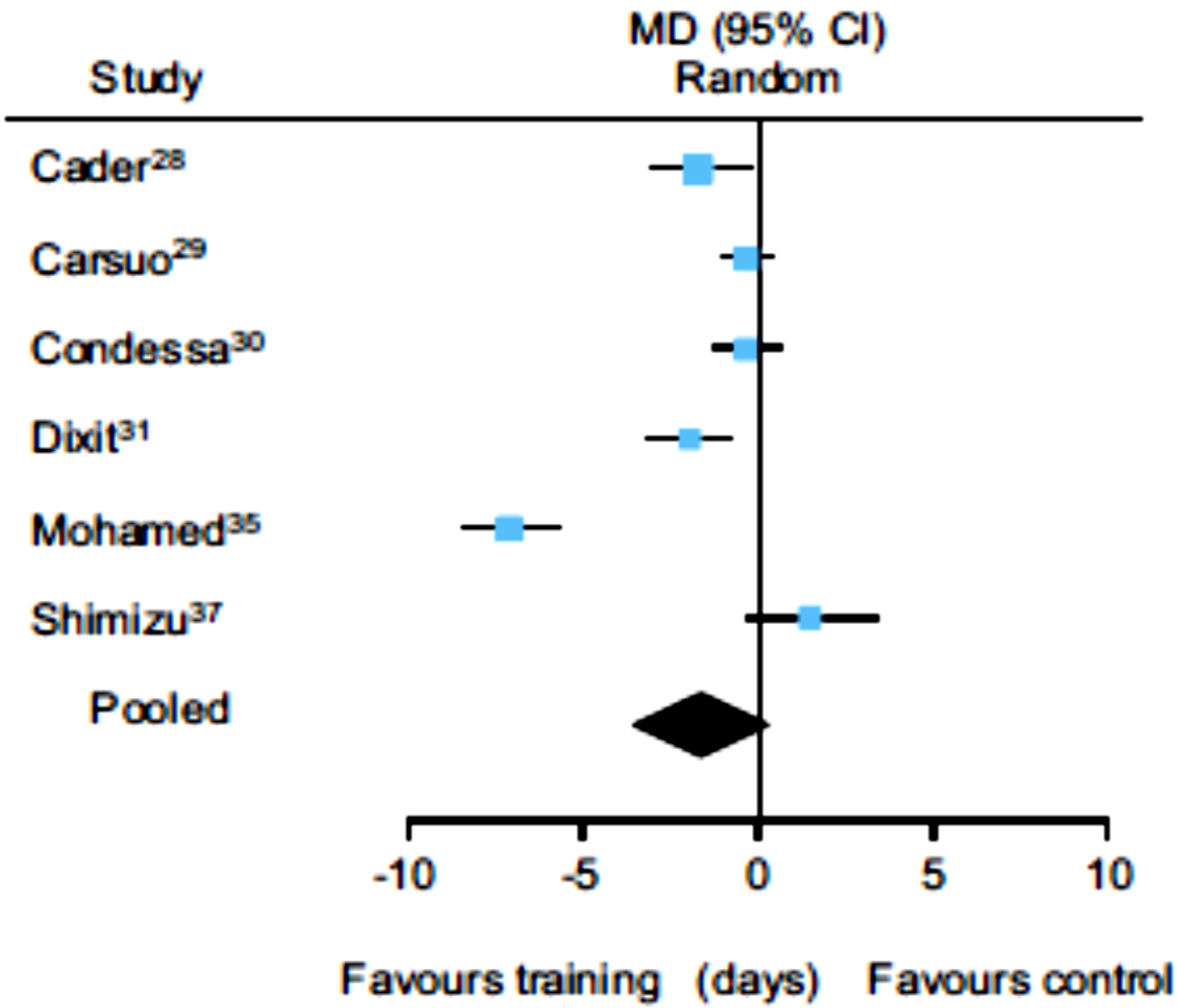



**Figure 6.** Mean difference (95% CI) in weaning duration (in days) due to inspiratory muscle training, estimated by pooling data from six studies (n = 212).

Most of the studies using a threshold trainer positioned the patient in supine with elevation of the backrest to 45 deg, whereas in the studies using ventilator adjustment, no positioning of the patient was specified. Training sessions were prescribed to last 5 to 30 minutes or to consist of three to six sets of 6 to 10 breaths. The frequency of sessions varied from twice daily to 5 days per week. The training period lasted 3 to 7 days in half of the studies and was continued until the patient had weaned in the other studies. Monitoring the patient for adverse cardiorespiratory changes during the training was common. Most studies nominated a list of physiological criteria that would mandate the cessation of a training session during the study (Appendix 4, see eAddenda).

TRAINING LOAD: 20 TO 40 % AF $P_{imax}$, INCREMENTALLY INCREASING DAILY BY 10% OR 2 CM $H_2O$

ELSEVIER

Physiotherapy

Physiotherapy 102 (2016) 221–228

Systematic review

# Respiratory training improved ventilatory function and respiratory muscle strength in patients with multiple sclerosis and lateral amyotrophic sclerosis: systematic review and meta-analysis☆

CrossMark

Gustavo D. Ferreira[a,b], Ana Cecília C. Costa[b], Rodrigo D.M. Plentz[b,c], Christian C. Coronel[b], Graciele Sbruzzi[b,d,*]

training as Litchke 2010 (B). Eight studies used resistive muscle training devices targeting either inspiratory ($n = 5$)[6,13,14,18,20] or expiratory ($n = 3$)[13,16,17] muscle resistance. Five studies simultaneously targeted both inspiratory and expiratory muscle function.[6–8,15,19] The different interventions ranged in intensity from 10 to 60 min per day, 3 to 7 days per week, and total length of training ranged from 4 to 12 weeks (mean 8 weeks).

Spinal Cord (2014) 52, 175–180
© 2014 International Spinal Cord Society All rights reserved 1362-4393/14
www.nature.com/sc

REVIEW

# A systematic review and meta-analysis of the effects of respiratory muscle training on pulmonary function in tetraplegia

J Tamplin[1] and DJ Berlowitz[1,2]

**Results:** Eleven studies (212 participants) were included. A significant benefit of RMT was revealed for five outcomes: vital capacity (mean difference (95% confidence interval)) = 0.41(0.17–0.64) l, maximal inspiratory pressure = 10.66(3.59, 17.72) $cmH_2O$, maximal expiratory pressure = 10.31(2.80–17.82) $cmH_2O$, maximum voluntary ventilation = 17.51(5.20, 29.81) l $min^{-1}$ and inspiratory capacity = 0.35(0.05, 0.65) l. No effect was found for total lung capacity, peak expiratory flow rate, functional residual capacity, residual volume, expiratory reserve volume or forced expiratory volume in 1 second.

# MEASUREMENT
# RESPIRATORY MUSCLE FUNCTION

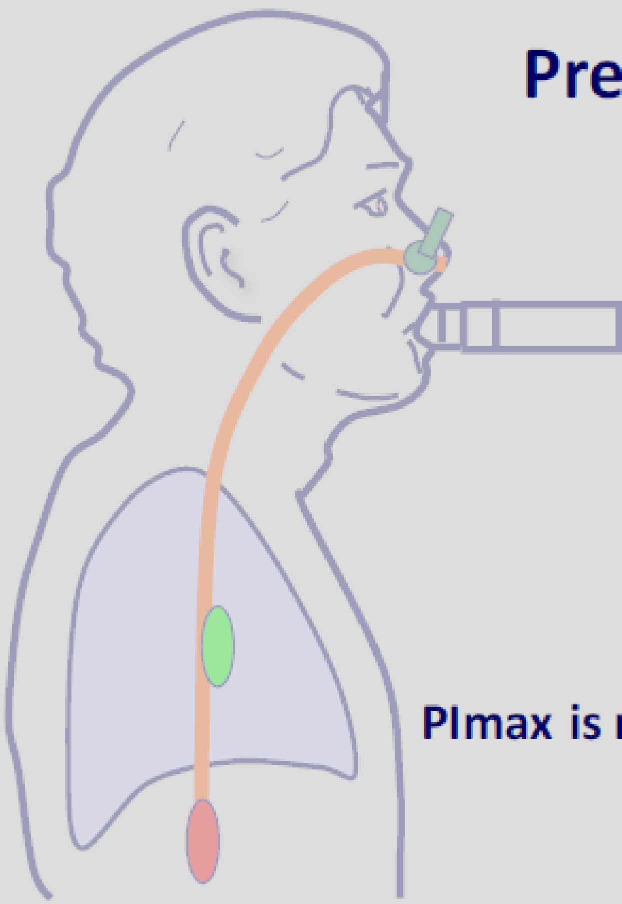
- STRENGTH

1. Mouth pressure ($P_{imax}$; $P_{e\ max}$)
2. Sniff pressure ($P_{sniff}$)
3. Transdiaphragmatic pressure ($T_{DI}max$)
4. Phrenic nerve stimulation
5. Cervical magtnetic stimulation

- ENDURANCE

1. Sustained normocapnic hyperpnea
2. Incremental threshold loading
3. Repeated (sub)maximal inspiratory manouvres

# Measurement of respiratory muscle strength

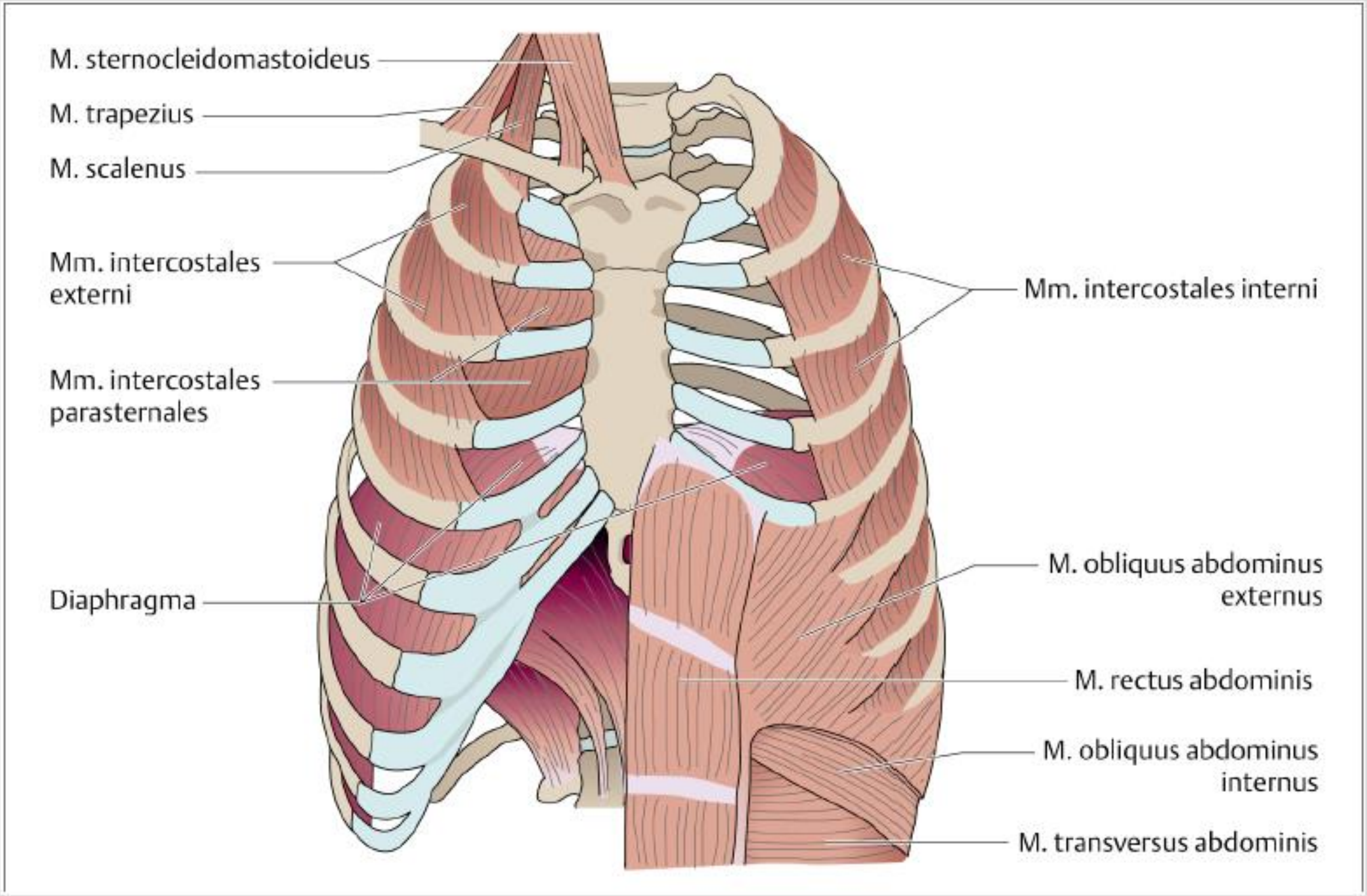


**Pressure** → **Force**

**Geometry of the thorax**
**Mechanical properties (stiffness)**

**PImax is not a measure of muscle contractile properties but rather a measure of *pressure***

# *ALL* RESPIRATORY MUSCLES ARE INCLUDED



# Standardisation of the measurement

STANDARDISED
LUNG VOLUME
IS ESSENTIAL

MUSCLE LENGTH
ELASTIC PROPERTIES OF LUNGS
AND CHEST WALL
(FRC: IDEAL ELASTIC PROPERTIES INCLUDED)

$P_{imax}$ from RV
$P_{emax}$ from TLC

# THE EQUIPMENT



MicroRPM - MicroMedical

PowerBreathe KH2

# $P_{emax}$ MEASUREMENT

- Check for contra-indications (e.g. stress incontinence)
- Patient seated straight
- Explain the maneuver: emphasis on FORCE, not VOLUME

- Full inspiration (TLC)
- Apply measuring device to the mouth
- Forcefull expiration with stiff cheeks
- Check quality and performance
- Repeat until reproducible (< 5% between best 3 tries)

# $P_{imax}$ measurement

- Patient seated straight
- Explain the maneuver: emphasis on FORCE, not VOLUME, explain the sensation of not getting air in
- Full expiration (RV)
- Apply measuring device to the mouth
- Forcefull inspiration with stiff cheeks (creating a vacuum)
- Check quality and performance
- Repeat until reproducible (< 5% between best 3 tries)

# Normative data

| Age | | 9 - 18 | 19 - 49 | 50 - 69 | > 70 |
|---|---|---|---|---|---|
| Man | $PI_{max}$ ($cmH_2O$) | -96 ±35 | -127 ±28 | -112 ±20 | -76 ±27 |
| | $PE_{max}$ ($cmH_2O$) | 170 ±32 | 216 ±45 | 196 ±45 | 133 ±42 |
| Women | $PI_{max}$ ($cmH_2O$) | 90 ±25 | -91 ±25 | -77 ±18 | -66 ±18 |
| | $PE_{max}$ ($cmH_2O$) | 136 ±34 | 138 ±39 | 124 ±32 | 108 ±28 |

Rochester & Arora 1983

# NORMATIVE DATA

Table 2. Prediction of Maximal Mouth Pressures in Adults With a Flanged Mouthpiece

| | |
|---|---|
| Male MIP reference = 120 – (0.41 × age) | Male MIP LLN = 62 – (0.15 × age) |
| Male MEP reference = 174 – (0.83 × age) | Male MEP LLN = 117 – (0.83 × age) |
| Female MIP reference = 108 – (0.61 × age) | Female MIP LLN = 62 – (0.50 × age) |
| Female MEP reference = 131 – (0.86 × age) | Female MEP LLN = 95 – (0.57 × age) |

MIP = maximal inspiratory pressure
LLN = lower limit of normal
MEP = maximal expiratory pressure

(Evans JA, Resp Care 2009)

# RESPIRATORY MUSCLE WEAKNESS

- ATS/ERS statement: $P_{imax}$ values > 80 cm H2O usually exclude RMW
- Low $P_{imax}$ + normal $P_{emax}$ = obs RMW
- Gosselink R, 2011: $P_{imax}$ < 60 cm H2O RMW in COPD
- In general < 70 % of expected values = RMW

American Thoracic Society/European Respiratory Society

# ATS/ERS Statement on Respiratory Muscle Testing

This Joint Statement of the American Thoracic Society (ATS), and the European Respiratory Society (ERS) was adopted by the ATS Board of Directors, March 2001 and by the ERS Executive Committee, June 2001

Am J Respir Crit Care Med Vol 166. pp 518–624, 2002
DOI: 10.1164/rccm.166.4.518
Internet address: www.atsjournals.org

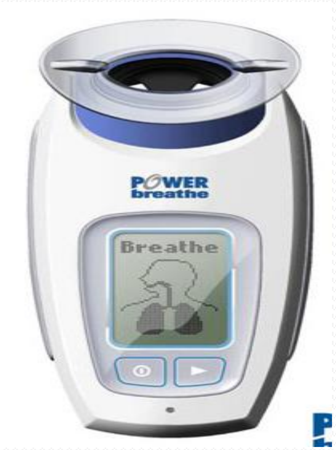
# IMT DEVICES

## PowerBreathe

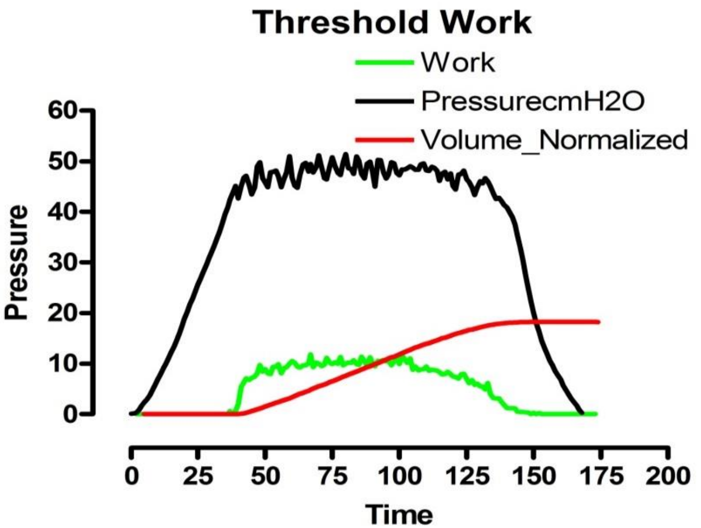
+ Resistance flow-independent (elastic load)
- Not validated
+ Monitor unsupervised training sessions

## Threshold

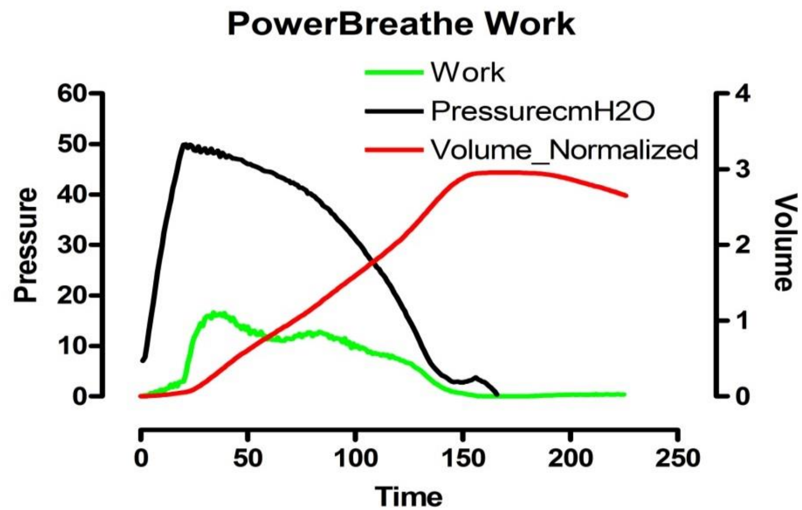
+ Resistance flow-independent (threshold load)
+ Frequently used / validated
- No monitoring unsupervised training sessions




# Comparison Devices




| | Work | Power |
|---|---|---|
| Baseline | 0.0 | 0.0 |
| Total Area | 57.97 | 5537 |




| | Work | Power |
|---|---|---|
| Baseline | 0.0 | 0.0 |
| Total Area | 88.49 | 8557 |

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ORIGINAL ARTICLE

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# Postoperative inspiratory muscle training in addition to breathing exercises and early mobilization improves oxygenation in high-risk patients after lung cancer surgery: a randomized controlled trial

Barbara Cristina Brocki[a,b,*], Jan Jesper Andreasen[c,d], Daniel Langer[e,f], Domingos Savio R. Souza[b] and Elisabeth Westerdahl[b]

ÖREBRO UNIVERSITY

Kræftens Bekæmpelse

AALBORG UNIVERSITY HOSPITAL

NORTH DENMARK REGION

# Intervention

- All subjects received usual PT at the hospital ward
- (breathing exercises with PEP device; early mobilisation)
- For IG: before surgery: instruction on IMT one working day prior to the surgery: 2 x 30 respirations per session, twice daily, intensity 30% of MIP
- After surgery: IMT 2 weeks, twice daily, start with 15 % MIP, 2 cm $H_2O$ increase per day; supervised during hospital stay
- Use of Powerbreathe  K3 – compliance registeret in the device

## Results

Table 3: Baseline values and postoperative change from baseline to 2 weeks for Intervention and Control groups. Analyses within groups and between groups regarding change from baseline.

| Variable | Intervention group n= 34 | | Control group n=34 | | Mean difference of changes between groups [95% CI] 2 weeks | *P*-value |
|---|---|---|---|---|---|---|
| | | Change from baseline | | Change from baseline | | |
| | Baseline | 2 weeks | Baseline | 2 weeks | | |
| MIP (cm $H_2O$) | 82.8 ± 26.8<br>90 [34;143] | 0.21 ± 17.9<br>3 [-42;28] | 78.5 ± 29.5<br>81.5 [23;137] | -4.29 ± 15.1<br>1 [-37;24] | 4.50 [-3.85;12.85] | 0.22 |
| MEP (cm $H_2O$) | 100 ± 30.7<br>100 [37;185] | -4.7 ± 16.3<br>-5 [-47;36] | 93.7 ± 27.6<br>98 [38;158] | -0.5 ± 16.2<br>3 [-34;44] | -4.12 [-12.27;4.04] | 0.26 |
| 6MWT (meter) | 495.3 ± 112.5<br>508 [254;706] | -48.1 ± 71.9***<br>-34 [-210;116] | 450.4 ± 110.2<br>487 [120;612] | -31.7 ± 79.1<br>-19 [-304;69] | -16.4 [-54.2;21.3] | 0.21 |

Values are presented as means ± SD * *P*-value < 0.05; ** *P*-value <0.01 and *** *P*-value <0.001 for comparison of change from baseline within group.

# Results – Periferal oxygen saturation

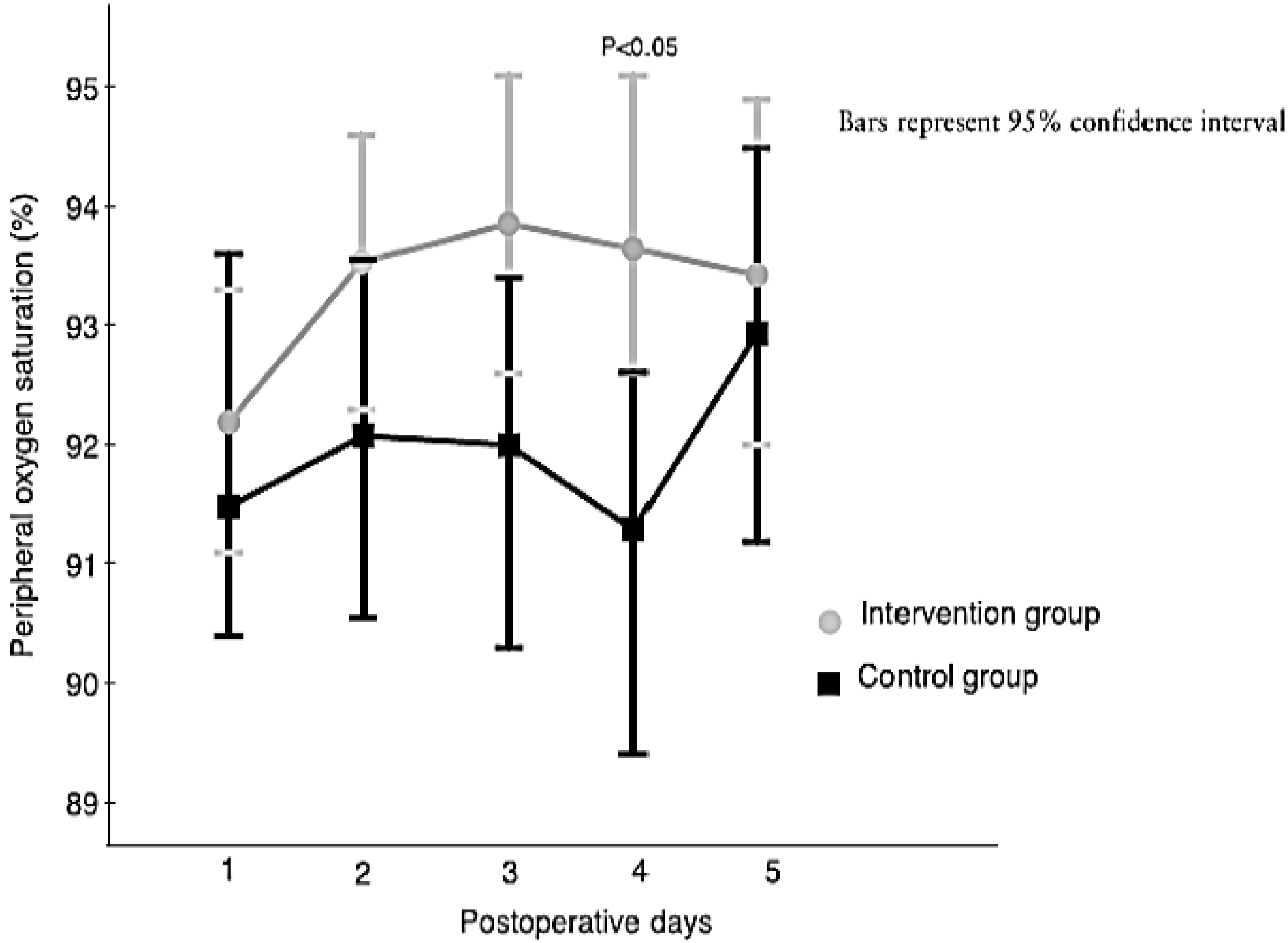


Figure 8: Peripheral oxygen saturation postoperative days 1 - 5 in both groups.
Daily number of cases for each group: Day 1 (IG n=34;CG n=33); day 2 (IG n=34; CG n=33); day 3 (IG n=31;CG n=30); day 4 (IG n=25;CG n=24); day 5 (IG n=19; CG n=20).

# TAKE HOME - MESSAGES

- The addition of IMT to general exercise training, *in patients with respiratory muscle weakness*, results in larger improvements in inspiratory muscle strength and tend to improve exercise performance
- IMT in neuromuscular disease can slow the decline in respiratory function

# Tak for i dag !