Muscle strength training in SLP, how does it work and what effects can we expect?

EMST and IOPI

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Functional Area Speech and Language Pathology
Karolinska University Hospital
1. Clinical position
   • In- and outpatients – swallowing and speech
   • Mainly patients with neurological disorders

2. Teaching and supervising at the Speech and Language Pathology Program at Karolinska Institutet

3. Research
   • Multiple sclerosis, MS (Lena Hartelius, Kerstin Johansson, Ellika Schalling, Fredrik Sand)
     • Speech-10, screening instrument to capture patients who may need SLP contact
     • EMST
   • Cervical spinal cord injury (Anita McAllister, Stina Flodin, Kerstin Johansson)
     • Identifying voice problems
     • In-depth analysis of breathing and voice, speech and communication
   • Evidence-based protocol for clinical assessment of swallowing – KIS2018 (Huotari & Larsson, 2017; Kjellholm & Starfeldt, 2018)
   • Elderly and swallowing (Anita McAllister, Per Östberg, Kerstin Johansson)
     • Identifying (Deery, 2017; Amanuel & Åbonde, 2018; ongoing Colman & Johansson)
     • Intervention
     • Prevention
Initial contact with EMST?

• LSVT (Lee Silverman Voice Treatment) for patients with Parkinson’s disease (PD)
  • Difficulty taking a deep breath!

• "Frog breathing" (glossofaryngeal breathing) project with physiotherapist Malin Bonnier-Nygren
  • Any effects of frog breathing on speech?
  • ... shouldn’t patients with neurological diagnosis also practise their breathing in order to gain a better speech breathing?

• Study by Chiara et al. (2007)
  • Voice and speech in MS following EMST

• Breathing – voice – speech in neurological conditions
  • One study with EMST in my doctoral project
  • Visit to Chris Sapienza at University of Florida autumn 2011
Thesis

- 2004...
- Accepted as a doctoral student 2009
  - Supervisors: Ellika Schalling, Lena Hartelius, Sten Fredrikson
- Dissertation in 2013 (November 29)
- Studies included in my thesis
  - Effects of glossopharyngeal breathing on voice in individuals with cervical spinal cord injury (2011)
  - Effects of glossopharyngeal breathing in a case of MS (2012)
  - "I can walk briskly and talk at the same time": effects of expiratory muscle strength training on respiration and speech in multiple sclerosis (2013)
  - Assessment of respiration and speech in CSCI (2018)
Doctoral project: Conclusions

• Cervical spinal cord injury > changed voice > limitations
  • Above all affected maximum speech performance (calling out loud, speaking in long phrases, speaking for a long time)
  • Participants with a vital capacity (VC) <50% significantly worse than those with a VC >50%

• Exempel på kompensatoriska strategier vid CSCI är anpassad talandning, extra ansträngning, vara tyst eller undvika talsituationer
  • Vissa strategier ökar risken för rösttrötthet

• Grodandningsträning kan ha positiva kort- och långsiktiga effekter på andning, röst och tal hos personer med CSCI och MS

• EMST can have an effect on voice and speech in individuals with MS
  • Possibly larger effects in individuals with mild MS
  • Participants answers to questions about the treatment suggestive of a general effects of EMST (Ventilation? Wellbeing?)

• Speech tasks needs to be identified to capture individuals with voice and speech difficulties following CSCI
  • Identify those who need SLP intervention
And then?

• Tried EMST in our clinic, above all for individuals with MS or Parkinson’s disease
  • Subjective:
    • Increased endurance
    • Improved speech
    • Louder voice
  • Clinical guidelines?

• Anecdotal evidence:
  • Improved speech, articulates more precisely....
  • Improved swallowing, less coughing....
  • One person who wants to train every morning...

• Evaluate (the use of) the method in the clinic
  • Protocol for evaluation?
  • Often, Stockholm patients express that it is tough travelling to the hospital for follow ups...

• Where to get the apparatus, the EMST?!?
  • Bought it straight from the US, but need for a approval from the Medical Technical dep.t/Karolinska after a looong process och assessment of risk before
  • EMST150 now is CE-approved of and is being sold in the Nordic countries!
Muscle strength training
Basic principles for intervention

1. Assessment as basis (ICF)
2. Factors influencing tx decision (ICF, personal factors, environmental factors, next of kin), available evidence (level of evidence etc)
3. Evaluate what you do – outcome measures related to goals, (single-case methodology)
4. Frequency, intensity and dose – related to outcome
5. Type of tx: improve function, facilitation, cuing, compensate, participation restriction, partner communication training, information and recommendations (to pt and carer)
6. Principles of Motor Learning
7. Principles to drive plasticity
8. Principle to improve strength
9. Biofeedback (fonetogram, Voxlog, S-EMG, IOPI)
10. Tx programs, vs individually tailored goals (examples: LVST, ....) muscle training programs
   1. Muscle strength training
Intervention at different levels

- Body functions and structures
- Activities
- Participation

EMST works here

Effects even on these levels?
<table>
<thead>
<tr>
<th>Etiology</th>
<th>Body function/structure (impairment of)</th>
<th>Activity (limitation)</th>
<th>Participation (restriction)</th>
</tr>
</thead>
</table>
| Stroke, neurological disease, traumatic brain injury, tumour, other...  | Structure: e.g. palatal lift  
Function: e.g. training of respiration, voice etc                                                              | E.g. rate control                                                                     | E.g. speaker and listener instruction, change of behaviour in communicative situations...    |
| **Dysphagia**                                                          |                                                                                                         |                                                                                      |                                                                                             |
| Structure: e.g. surgically removed part of anterior tongue  
Function: e.g. training of tongue base strength, training of suprahyoid muscles etc | E.g. supraglottal swallow, training of swallowing sequence, use of adapted utensils                  |                                                                                      | E.g. strategies for preparation of food when eating out                                   |
Strength training for improved motor function

• Overload and adaptation

• The muscle **adapts**
  - Slow, resistant: Typ I-fibers
  - Fast, easily fatigued: Typ IIa, IIb-fibers change into Typ I
  - Hypertrophy

• To see a result, the **load** needs to be **large enough**, that is, the muscle is forced to adapt to the increased demands

• Increased strength because of:
  - *Initially: neuromuscular adaptation*
  - *Later: structural changes in the muscle and in the nervous system*

• ”**Detraining**” – different circumstances, e.g
  - Bedridden patients
  - Inactivity
  - Age

*(Sapienza & Wheeler, 2006; Burkhead et al., 2007)*
Tre central concepts in strength training

• Stimulus intensity
  • The load (here expiratory resistance)
  • Number of repetitions
  • Duration of practise (minutes per day x days per week x total number of weeks)

• Specificity – to get better at running, one needs to practise running

• Transference
  • dvs via komplexa biokemiska system som aktiveras vid en specifik träningsuppgift, sprids effekterna till relaterade eller parallella system
  • Non-specific training, e.g. EMST, results in improvement in a closely located function (here: expiration – cough, expiration – swallowing)

For example, improved swallowing after LSVT or EMST

(Sapienza & Wheeler, 2006; Burkhead et al., 2007)
Respiratory training

Some function in the respiratory muscles is necessary

EMST: Forceful exhalations against a resistance
IMST: Forceful inspirations inandningar

Increased pressure/flow at ex- and inhalations

Increased lung volumes, capacities (VC, FVC)
Reduced dyspnea
More forceful cough
Safer swallowing
Louder voice, improved speech

For example Smeltzer m fl, 2000; Gosselink m fl, 1999; Chiara m fl, 2006
Training of respiratory muscles (RMT)

**GOAL**

- Increased strength in resp muscles >
- Improved lung capacity >
- Reduced dyspnea >
- Increased strength

For the expiratory musculature:
- Expiratory muscle strength training (EMST)
  - Increased pressure/flow at exhalations

For the inspiratory musculature:
- Inspiratory muscle strength training (IMST)
  - Increased inspiratory volume for increased relaxation pressure
EMST – what is it?

• Focus on increased strength in the expiratory musculature
• Goal: primary expiratory muscles, since these generate the largest changes in power and pressure
  • Internal oblique abdominis
  • External oblique abdominis
  • Rectus abdominis
  • Internal intercostalis

(Sapienza & Troche, 2012)

• For increased endurance: other training programs with different resistance and number of repetitions, for example,
  • Large number of repetitions at a low level of resistance

• Effects on the breathing
  • Increased max utandningstryck (MEP, i cm H2O)
  • But so with MIP (max inhalation pressure)
  • VC (vital capacity, in liters)
  • FVC (forced vital capacity, i liter/sekund)
  • Coughing (ökad kraft/flöde)
Muscle strength devices

• IOPI (Iowa Oral Performance Instrument)
  • Measures muscle strength
    • Anterior tongue
    • Posterior tongue
    • Lips/Cheeks
  • Offers biofeedback

• RMT (Respiratory Muscle Strength Training)
  • EMST (Expiratory...)
    • Abdominal muscles
    • Internal intercostal muscles
  • IMST (Inspiratory...)
    • Diaphragm
    • External intercostal muscles
  • Offers individualized resistance
Forceful expirations against a resistance
A valve opens at a certain expiratory pressure
Training at 75-80% of the individuals maximum expiratory pressure (MEP)
Weekly follow-ups to measure MEP and adjust the resistance

Intensive training
• 25 exhalations/session (appr 15 min)
• 4-7 days/week
• 4-12 weeks

(Chiara et al., 2006
Gosselink et al, 1999, 2000
Smeltzer, 1996)
• Forceful exhalations against a resistance
  • *Increased strength in muscles of floor of the mouth*
  • *Increased hyoid elevation*  
    (Wheeler et al., 2006)
• Rationale for dysphagia rehabilitation
  • *Patients with PD:*
    • *Reduced PAS scores*
    • *Prolonged opening of PES > less retention post swallow?*  
    (Troche et al., 2010)

  – Videodemo:  
How does EMST impact on swallowing?

- **EMG**: Increased activity seen in musculature of the floor of the mouth at forceful exhalations (*Wheeler et al.* 2006)

- Ascent of hyoid bone
  - Increased range of the laryngeal excursion

- Increased duration for several swallowing parameters
  - For example, increased duration of opening of the upper esophageal sphincter > decreased amount of hypopharyngeal residual and decreased risk for aspiration post-swallow

- Penetration-Aspiration Scale: score decreased, indicating a safer swallow

- Improved SwalQoL (*Troche et al.* 2010)

- **Anecdotal evidence**: Patient with MS who spontaneously recalled that he did not have as many incidents of misdirected swallows compared to earlier (*Johansson* 2013)
So...

• The training seems to have effect also on other muscle groups than the ones that are the primary target, here, respiratory musculature.

  There is evidence that suggest that EMST can for example have a positive impact on swallowing function.

• The training has a value, because it has a potential to improve vital functions.
Evidence for effects of EMST?
Figure 2. Standardised mean differences and 95% confidence intervals for swallowing outcome measures respiratory outcomes measures and communication outcomes measures for expiratory muscles strength training. *RCT, †pre/post, ‡pre-/post-data from single group within a RCT

Preliminary data:
- suggests improved airway safety during swallowing in people with dysphagia
- increased strength of the expiratory muscles in all patient groups
- Little evidence to suggest changes in communication outcomes after expiratory muscle strength training.
- Conclusion: Speech–language pathologists might consider using expiratory muscle strength training to improve airway safety in adults with swallowing disorders.


• Purpose: To investigate the effects of expiratory muscle strength training on communication and swallowing outcomes in adults with acquired motor based communication and/or swallowing difficulties of any aetiology. Method: A systematic review was conducted. Six databases (CINAHL, MEDLINE, EMBASE, SPEECHBYTE, AMED and PUBMED) were searched from inception until end of May 2016. Randomised and non-randomised controlled studies and pre-test/post-test studies published in English that investigated the effects of expiratory muscle strength training were included. Study quality was assessed using the PEDro scale. Data were analysed descriptively and effect sizes and associated 95% confidence intervals were calculated. Result: Seven articles reporting data from five studies were included. Preliminary data suggests expiratory muscle strength training improved airway safety during swallowing in people with dysphagia and increased the strength of the expiratory muscles in all patient groups. There was little evidence to suggest changes in communication outcomes after expiratory muscle strength training. Conclusion: Speech–language pathologists might consider using expiratory muscle strength training to improve airway safety in adults with swallowing disorders.

• The purpose of this study was to determine the impact of an in home expiratory muscle strength training (EMST) program on
  • pulmonary, swallow and cough function in individuals with amyotrophic lateral sclerosis (ALS).

• EMST was tested in a prospective, single center, double-blind, randomized, controlled trial in 48 ALS individuals who completed eight weeks of either active-EMST (n=24) or sham-EMST (n=24).

• The primary outcome to assess treatment efficacy was change in maximum expiratory pressure (MEP).

• Secondary outcomes included: cough spirometry, swallowing, forced vital capacity, and the ALS functional rating scale revised. Treatment was well tolerated with 96% of patients completing the protocol.

• Significant differences in group change scores were noted for MEP and Dynamic Imaging Grade of Swallowing Toxicity scores (p<0.02). No differences were noted for other secondary measures. This respiratory training program was well-tolerated and led to improvements in respiratory and bulbar function in ALS. This article is protected by copyright. All rights reserved.

• **Purpose:** The purpose of this study was to examine the impact of expiratory muscle strength training on speech breathing and functional speech outcomes in individuals with Parkinson's disease (PD).

• **Method:** Twelve individuals with PD were seen once a week for 8 weeks: 4 pretraining (baseline) sessions followed by a 4-week training period. Posttraining data were collected at the end of the 4th week of training. Maximum expiratory pressure, an indicator of expiratory muscle strength, and lung volume at speech initiation were the primary outcome measures. Secondary outcomes included lung volume at speech termination, lung volume excursion, utterance length, and vocal intensity. Data were collected during a spontaneous speech sample. Individual effect sizes > 1 were considered significant.

• **Results:** Maximum expiratory pressure increased in a majority of participants after training. Training resulted in 2 main respiratory patterns: increasing or decreasing lung volume initiation. Lung volume termination and excursion, utterance length, and vocal loudness were not consistently altered by training.

• **Conclusions:** Preliminary evidence suggests that the direct physiologic intervention of the respiratory system via expiratory muscle strength training improves speech breathing in individuals with PD, with participants using more typical lung volumes for speech following treatment.
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☆

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• Abstract
• Background
• Among neurodegenerative diseases, multiple sclerosis (MS) and amyotrophic lateral sclerosis (ALS) have a high rate of respiratory disability.
• Objectives
• To analyze the effects of respiratory muscle training (RMT) on ventilatory function, muscle strength and functional capacity in patients with MS or ALS.
• Data sources
• A systematic review and meta-analysis of randomized controlled trials (RCTs) was performed. The sources were MEDLINE, PEDro, Cochrane CENTRAL, EMBASE, and LILACS, from inception to January 2015.
• Study selection/eligibility criteria
• The following were included: RCTs of patients with neurodegenerative diseases (MS or lateral ALS) who used the intervention as RMT (inspiratory/expiratory), comparison with controls who had not received RMT full time or were receiving training without load, and evaluations of ventilatory function (forced vital capacity – FVC, forced expiratory volume in one second – FEV1, maximum voluntary ventilation – MVV), respiratory muscle strength (maximal expiratory pressure/maximum inspiratory pressure – MEP/MIP) and functional capacity (6-minute walk test – 6MWT).
• Results
• The review included nine papers, and a total of 194 patients. It was observed that RMT significantly increased at MIP (23.50 cmH2O; 95% CI: 7.82 to 39.19), MEP (12.03 cmH2O; 95% CI: 5.50 to 18.57) and FEV1 (0.27 L; 95% CI: 0.12 to 0.42) compared to the control group, but did not differ in FVC (0.48 L; 95% CI: −0.15 to 1.10) and distance in 6MWT (17.95 m; 95% CI: −4.54 to 40.44).
• Conclusion
• RMT can be an adjunctive therapy in the rehabilitation of neurodegenerative diseases improving ventilatory function and respiratory strength.
Results of EMST?

• 32 healthy adults trained for 4 or 8 weeks:
  • ↑ MEP 50%
  • The effect remained after 4 weeks and decreased 12% after 8 weeks

• 18 older persons 68-89 years:
  • ↑ MEP 44%, improved cough

(Baker et al., 2003)

(Kim et al., 2009)
EMST in PD and MS

• PD (fallstudie):
  • ↑ MEP 50% after 4 w EMST
  • ↑ MEP 158% after 20 w EMST
  
  *(Saleem et al, 2005)*

• PD (RCT): 4 w EMST resulted in improved airway protection and a more forceful, efficient cough

  *(Pitts et al., 2009)*

  *(Troche et al, 2010)*

• MS (28 persons with severe MS): 18 EMST, 9 controls
  • ↑ MEP 35% (30% after 3 months, 9% after 6 months)

  *(Gosselink et al, 2000)*

• MS (17 persons with MS and 14 healthy controls):
  • ↑ MEP 40%, improved cough
When considering EMST...

- Possibility to co-operate with physical therapist?
  - Sitting position
  - Coordinate with other respiratory intervention?

- Baseline measurements!

- Contraindications (Sapienza et al., 2012):
  - Acute stroke
  - Untreated high blood pressure
  - Untreated GERD
  - Restrictive respiratory disorders (e.g. asthma)
  - Fatigue?
  - Oral motor function?
  - Cognitive function?

- Hypernasalility – forceful exhalations can be uncomfortable
- Correct training protocol!!

(Sapienza & Troche, 2012; Burkhead et al., 2007)

**Aims**

- To evaluate the effects of 6-weeks EMST intervention on voice, speech and communication in individuals with MS
Method

“Single subject” design

• Duplicated over 5 persons with MS
• Mild – moderate dysarthria

• Participant 1-5: A – B – A
• Participants 4 och 5: A – B – A – C – A

• Kontroll parameter: snabb repetition av ”pa”
• Tre frågor om erfarenheter av behandlingen
Some results

4/5 ↑ voice intensity (sustained vowel)

3/5 ↑ maximum phonation time (MPT)

3/5 ↓ coefficient of variation for F0

3/5 ↑ voice intensity (reading)

More pronounced improvement for P4 and P5 (milder MS) who trained against a higher resistance
QASD (Questionnaire for Aquired Speech Disorders)

Max score = 90 p, Maximum Mean score = 3 p

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pre EMST</th>
<th>Post EMST 1</th>
<th>Post EMST 2</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1,0</td>
<td>0,8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0,9</td>
<td>0,9</td>
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<tr>
<td>3</td>
<td>1,3</td>
<td>1,3</td>
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<tr>
<td>4</td>
<td>0,7</td>
<td>0,9</td>
<td>0,3</td>
</tr>
<tr>
<td>5</td>
<td>1,0</td>
<td>0,1</td>
<td>0,4</td>
</tr>
</tbody>
</table>
Social validity

4/5 participants described improvement in respiration, speech and communication

• "The treatment has made me more confident in larger groups. Also, I dare to speech on the phone with people I don’t know" (P3)

• "Positive, can walk briskly and talk at the same time" (P4)

• "It is very positive... I felt that my voice has become much louder. Before the intervention, my voice fatigued, but now I can go on speaking and I really enjoy speaking with my colleagues again!" (P5)
Cont.

• Still many questions around effects of EMST
  
  • Large variation between study designs, for example
    • Length of training period
    • Intensity level
    • Experimental groups – often smaller Ns

(Saleem et al, 2005)
Clinical experiences
Experiences 😊

• Easy to learn, easy to perform, easy to assist.

• Needs to be done WITH EFFORT! 💪

• Patients may need training in
  • Exhaling correctly in the mouthpiece
  • timing inhalation and exhalation
  • Taking rests between the forceful exhalations

• Some oral motor function is needed to be able to close lips around the mouthpiece
  • Some individuals need help from assistant
  • Close lips with fingers

• Close lips around mouthpiece – may work if first practised!
Future studies and clinic

• We need to study and learn more about what patient groups benefit from the treatment
  • Diagnoses?
  • Degree of illness?

• Ongoing: important to use similar study protocol and to use the same outcome measures
  • Evaluate each individual patient – use a good study design!

• Trials in combination with traditional swallowing treatment
  • Better effect of regular swallowing therapy after EMST?
  • Increased strength ork att genomföra annan träning efter EMST?

• Training early in the illness progress: hinder decline of functions?
Case 1
CS (F, 39 y): mild MS, no dysarthria, subtle dysphagia, somewhat weak, creaky voice quality

- **Symptoms** (defined by the patient and rated by herself on a 100 mm Visual Analogue Scale, VAS: 0 mm = no problem, 100 mm = severe problems)
  - Feeling of food getting stuck in her throat (VAS 55 mm)
  - Voice fades off, fatigue (VAS 12 mm)
  - Embarrassing that somebody would happen to see her, that she should start coughing + “MS-stress” (VAS 50 mm)
  - AND also... Feeling of the tongue being weak in some way

- **Test with IOPI (before start of EMST):**
  - Maximum tongue strength:
    - Anterior tongue: 64 kPa (51, 55, 54, 64, 59, 51, 56) (ref values, middle aged women: 40-80 kPa)
    - Posterior tongue: 45 kPa (31, 43, 36, 45, 39)
Case 1, cont.

- **Test with MicroRPM (Respiratory Pressure Meter)**
  - **BL 1:** MEP = 119 cm H2O (16, 57, 51, 59, 44, 60, 102, 112, **119**, 115), i.e 79% of the expected for gender and age, $M = 152$, $sd = 27$, $Z = -1.2$ (Black & Hyatt, 1969)
  - **BL 2:** MEP 121 (100, 93, **121**, 113, 120, 11), i.e 80% of the expected for gender and age
    - MIP 79 (72, **79**, 74), i.e 87% of the expected for gender and age
  - Trains at home, increases resistance ¼ every week. Reports that each time she increases the level of resistance, it is very hard to exhale in the EMST150, but after some time she adapts and find a way to exhale more forcefully
- **After 5-weeks EMST**
  - **Test with MicroRPM:**
    - MEP indicates 80% of expected
  - **Self-reported changes:**
    - Able to do several forceful exhalations in a row: increased endurance
    - Noticed that she did not need to take broncodilators for her asthma when having a cold
    - Improved strength/breathing when jogging
  - However, has still not reached an adequate resistance level
  - Continues practising and increasing level of resistance
Case 2
BR, F 63 y, Mild-moderate PD, dysarthrophia, no swallowing problems

• Wants to do everything she can in order to slow down the progression of her PD

• Mild dysarthrophia (no articulation difficulties, but typical Parkinsonian voice symptoms, that is, hoarse, weak, monotonous voice loudness and intonation)
  • Has engaged in LSVT (Lee Silverman Voice Treatment: 1 hour/d x 4 d/w x 4 weeks + home training every day)

• RMT or IOPI? RMT within refernce values, so practises IOPI

• Patient’s experiences:
  • Heavy, exhausting
  • Easier over time, feels that her tongue is much stronger
    • However, in this case, no significant improvement at end of treatment
Case 3
JF (M, 72 y), severe Multiple Systemic Atrophy – Parkinsonistic

- dysarthria, dysphagia + other medical issues, complicated condition
- Coughs less during meals
- Feels stronger
- Competetive - numbers
Case 4
AH (M, 52 y) Muscular Dystrophy, dysphagia, weak resp musculature, mild dysarthria

• Describes several improvements following 5-weeks training
  • Has enough strength to cough with his CPAP-mask on (needed to take mask off before)
  • Stronger cough
  • ”Better condition”

• MEP markedly better, but still very low compared to reference values

• Very motivated

• New FEES tomorrow
  • Residual?
Case 5
BOJ (M, 74 y), Mild-moderate PD, mild dysphagia, weak, hoarse, slightly monotonous voice

Amateur musician – french horn

Started with practise with a garden tube

Went from MEP 123 cm H2O Pre EMST to 176 cm H2O EMST, that is 99% of the expected
Contraindications?

• Training has similar physiological effects on heart and blood as. For example, a valsalvamanöver

  Laciuga m fl. (2012)

• Careful with patients who have
  • Untreated high blood pressure
  • Gastroesophageal surgery or severe reflux
  • Kidney problems
  • Balance problems (need to sit down when practising!)

• If patient with any risk factors: check with patient-responsible doctor; collaborate more with the doctor and collaborate with the physiotherapist?
EMST – for which patient groups?

• ALS  
  Plowman m fl (2016, 2018), Pinto m fl (2012)

• Cystisk fibros  
  Cerny m fl (1992)

• Lätt-måttlig MS  
  Johansson m fl (2013), Chiara m fl (2007), Chiara m fl (2006), Sapienza m fl (2001)

• Måttlig - grav MS  
  Smeltzer m fl (1996)

• Grav MS  
  Gosselink m fl (2000)

• Parkinsons sjukdom  
  Troche m fl (2010), Pitts m fl (2009), Saleem m fl (2005)

• Ryggmärgsskada  
  Roth m fl (2010)

• Stroke  
  Wheeler Hegland m fl (2016), Kulnik m fl (2015)

• Röst  
  Tsai m fl (2015), Roy m fl (2003)

• Äldre  
  Kim m fl (2009)
Maximum ex-/inspiratory pressure (MEP/MIP)

• Indirect measure of an individuals respiratory muscle strength
  • Measurement of MEP (Maximal expiratory pressure)
    • Healthy adults: > 80 cm H₂O
  • MIP (Maximal inspiratory pressure)
    • Healthy adults: < -60 cm H₂O
• MEP < 30 cm H₂O – risk for inefficient cough

*Sapienza & Troche (2012)*
Expected maximum expiratory pressures

Values for individuals 55-80 years according to Black & Hyatt (1969):

Women:
- Expected MEP = 158-(0,18* age in years)
- Expected MIP = 100-(0,39* age in years)

Men:
- Expected MEP = 353-(2,33* age in years)
- Expected MIP = 120-(0,25* age in years)

Other reference values exist

How do we best measure ex- and inspiratory pressures?

• Using the EMST150 – inexact

• MicroRPM (Micro Respiratory Pressure Meter)
  • Nose clip to reduce nasal leakage
  • Sometimes necessary to close corners of the mouth with fingers (at high pressures or weak lip musculature)
  • Different motor patterns when exhaling in the MicroRPM and in the EMST?
    • Check patient!
    • Sometimes necessary to practise before taking measures
Suitable outcome measures?

- Measurements of mouth pressure: MIP/MEP

- FEES/Videofluoroscopy: Penetration-Aspiration Scale (PAS), residual scale

- Clinical assessment ("bedside")
  - Lip-to-Lift (in seconds)
  - Number of swallows per bolus

- Borg CR10 – self reported exertion

- In single subject design: Control task that is not expected to change as a result of the intervention (here EMST)

- Self reported swallowing disorders and impact on the dysphagia on the individual’s life situation – for example SSQ (Sydney Swallowing Questionnaire), EAT-10, SwalQoL

- The individuals experience of the training’s effect on life
Referenser


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