The role of the scapula in shoulder rehabilitation

Schouderenwerk Vlaanderen 09-05-2017

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Role of the scapula in **normal** shoulder function
Normal scapular movement and muscle recruitment patterns
Scapulothoracic muscle recruitment:

Prime Movers

Dynamic Stabilizers

Postural muscles
Normal scapular *movement* and *muscle recruitment* patterns: examples

upward rotation
Scapular *dyskinesia* in relation to shoulder pain \(\text{(Ludewig et al. JOSPT 2009)}\)

### TABLE 2

**Summary of Scapular Kinematics During Arm Elevation in Healthy and Pathologic States**

<table>
<thead>
<tr>
<th>Group</th>
<th>Healthy</th>
<th>Impingement or Rotator Cuff Disease</th>
<th>Glenohumeral Joint Instability</th>
<th>Adhesive Capsulitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary scapular motion</td>
<td>Upward rotation</td>
<td>Lesser upward rotation</td>
<td>Lesser upward rotation</td>
<td>Greater upward rotation</td>
</tr>
<tr>
<td>Secondary scapular motion</td>
<td>Posterior tilting</td>
<td>Lesser posterior tilting</td>
<td>No consistent evidence for alteration</td>
<td>No consistent evidence for alteration</td>
</tr>
<tr>
<td>Accessory scapular motion</td>
<td>Variable internal/external rotation</td>
<td>Greater internal rotation</td>
<td>Greater internal rotation</td>
<td>No consistent evidence for alteration</td>
</tr>
<tr>
<td>Presumed implications</td>
<td>Maximize shoulder range of motion and available subacromial space</td>
<td>Presumed contributory to subacromial or internal impingement</td>
<td>Presumed contributory to lesser inferior and anterior joint stability</td>
<td>Presumed compensatory to minimize functional shoulder range-of-motion loss</td>
</tr>
</tbody>
</table>
Abnormal muscle recruitment patterns in patients with shoulder pain in superficial muscles (Struyf et al. 2014)

**Conclusion:** Patients with SIS and glenohumeral instability display numerous variations in scapulothoracic muscle activity compared to healthy controls. In the SIS-group, the LT and SA muscle activity is decreased. In addition, the UT muscle activity is increased among the SIS patients, whereas no clear change is seen among patients with glenohumeral instability. Although the scapulothoracic muscle activity changed, no conclusions can be made regarding muscle recruitment timing.
Need for a science based rehabilitation program (Cools et al. BJSM 2014)

Rehabilitation of scapular dyskinesis: from the office worker to the elite overhead athlete
Br J Sports Med published online May 18, 2013
doi: 10.1136/bjsports-2013-092148
Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)

Lack of Soft-tissue flexibility
- Scapular muscles
  - Pm↑, LS↑, RH↑, UT↑
- GH muscles/capsule
  - Posterior shoulder
  - Anterior shoulder

Lack of Muscle performance
- Muscle Control
  - co-contraction force couples
- Muscle Strength
  - LT↓, MT↓, UT↓, RH↓, SA↓

STRETCHING & MOBILISATION
- Manual soft tissue techniques
- Manual stretching and MWM
- Home stretching

NEUROMUSCULAR COORDINATION
- Conscious muscle control
- Advanced control During basic activities
  - Advanced control During sports

STRENGTH TRAINING
- Conscious muscle control
- Balance -ratio
- Endurance/strength
Scapular Rehabilitation: which exercises to prescribe?

1. Focus on **neuromuscular coordination**: the role of conscious correction of scapular position
2. Focus on scapular **muscle balance** rather than muscle strength
3. Role of **kinetic chain** and **functional (sport specific) tasks** in scapular exercises
Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
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1. Focus on neuromuscular coordination: conscious correction of scapular position

(De Mey et al. JOSPT 2013)
Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
2. Focus on scapular muscle balance rather than muscle strength
3. Role of kinetic chain and functional (sport specific) tasks in scapular exercises
2. Focus on **scapular muscle balance** in scapular rehabilitation

- Shoulder/neck patients
  - LT & MT ↓
  - SA ↓
  - UT ↑ or ↓
  - PMin ↑
  - Lev Scap ↑
  - RH ↑ or ↓

(Ludewig et al. JOSPT 2009, Struyf et al. JEK 2014, Castelein JEK 2015, Castelein et al. Man Ther 2016)
Focus on **muscle balance** rather than muscle strength

**UT/SA**  **UT/LT**  **LS/UT**  **Pm/LT**  **Pm/SA**

(less/more activity)
Focus on muscle balance rather than muscle strength: UT/LT & UT/SA
(Ludewig et al. AJSM 2004; Cools et al. AJSM 2007)

Rehabilitation of Scapular Muscle Balance
Which Exercises to Prescribe?
Ann M. Cools,† PT, PhD, Vincent Dewitte,† PT, Frederick Lanszewert,† PT,
Dries Notebaert,‡ PT, Arne Roela,† MPSS, Barbara Scetens,† PhD,
Barbara Cagnie,† PT, PhD, and Erik E. Witvrouw,† PT, PhD
From the †Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and
Health Sciences, University Hospital, Ghent, Belgium, and the ‡Department of Developmental,
Personality and Social Psychology, Faculty of Psychology and Educational Sciences, Ghent
University, Ghent, Belgium

Relative Balance of Serratus Anterior
and Upper Trapezius Muscle Activity
During Push-Up Exercises
Paula M. Ludewig,* PhD, PT, Molly S. Hoff, MS, PT, Erin E. Oowski, MS, PT,
Shane A. Meschke, MS, MA, PT, ATC, and Peter J. Rundquist, PhD, PT
From the Program in Physical Therapy, The University of Minnesota,
Minneapolis, Minnesota
2. Focus on muscle balance rather than muscle strength (Castelein et al. JOSPT 2015)

UT ↓
SA =
Lev Scap ↓

UT ↓
SA =
MT & LT ↑ RH ↑
Pect Min ↓
2. Focus on muscle balance rather than muscle strength: UT/LS
(Castelein et al. Man Ther 2015)
2. Focus on muscle balance rather than muscle strength: UT/LS
(Castelein et al. Man Ther 2015)

Original article

Modifying the shoulder joint position during shrugging and retraction exercises alters the activation of the medial scapular muscles

Birgit Castelein a,*, Ann Cools a, Thierry Parlevliet b, Barbara Cagnie a

a Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University Hospital, Ghent, Belgium
b Department of Physical Medicine and Orthopedic Surgery, University Hospital, Ghent, Belgium

<table>
<thead>
<tr>
<th></th>
<th>No additional weight</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Shrug</td>
</tr>
<tr>
<td>Upper Trapezius</td>
<td>33.8 ± 12.9</td>
</tr>
<tr>
<td>Middle Trapezius</td>
<td>8.1 ± 5.3</td>
</tr>
<tr>
<td>Lower Trapezius</td>
<td>3.4 ± 1.9</td>
</tr>
<tr>
<td>Levator Scapulae</td>
<td>44.0 ± 25.8</td>
</tr>
<tr>
<td>Rhomboid Major</td>
<td>18.8 ± 15.0</td>
</tr>
</tbody>
</table>
2. Focus on muscle balance rather than muscle strength: SA/Pm
(Castelein et al. Man Ther 2015)
Focus on Muscle Balance: scientific rationale

<table>
<thead>
<tr>
<th>hyper-active muscles</th>
<th>hypo-active muscles</th>
<th>clinically relevant balance ratios</th>
<th>proposed exercises</th>
<th>reference</th>
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<tbody>
<tr>
<td>Pm</td>
<td>SA</td>
<td>Pm/SA</td>
<td>serratus punch standing</td>
<td>Castelein et al. Man Ther1 2016</td>
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<td>MT</td>
<td>Pm/MT</td>
<td>elevation with ER</td>
<td>Castelein et al. JOSPT 2016</td>
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<td>LT</td>
<td>Pm/LT</td>
<td>elevation with ER</td>
<td>Castelein et al. JOSPT 2016</td>
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<tr>
<td>Rh</td>
<td>Pm/Rh</td>
<td>elevation with ER</td>
<td>Castelein et al. JOSPT 2016</td>
<td></td>
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<tr>
<td>UT</td>
<td>SA</td>
<td>UT/SA</td>
<td>elbow push up</td>
<td>Ludewig et al. AJSM 2004</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>serratus punch supine</td>
<td>Uhl 2010</td>
</tr>
<tr>
<td>MT or LT</td>
<td>UT/MT or UT/LT</td>
<td>elevation with ER</td>
<td>Castelein et al. JOSPT 2016</td>
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</tr>
<tr>
<td></td>
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<td>side-lying forward flexion</td>
<td>Cools et al. AJSM 2007</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>side-lying external rotation</td>
<td>Cools et al. AJSM 2007</td>
<td></td>
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<td>prone Hor Abd with ER</td>
<td>Cools et al. AJSM 2007</td>
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<td>prone extension</td>
<td>Cools et al. AJSM 2007</td>
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<td></td>
<td></td>
<td>prone ER in 90° abd</td>
<td>Ekstrom et al. 2003</td>
<td></td>
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<tr>
<td>RH</td>
<td>UT/RH</td>
<td>elevation with ER</td>
<td>Castelein et al. JOSPT 2016</td>
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</tr>
<tr>
<td>LS</td>
<td>SA</td>
<td>LS/SA</td>
<td>wall slide</td>
<td>Castelein et al. JOSPT 2016</td>
</tr>
<tr>
<td>UT</td>
<td>LS/UT</td>
<td>overhead shrugged</td>
<td>Castelein et al. Man Ther2 2016</td>
<td></td>
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<tr>
<td>MT or LT or RH</td>
<td>LS/MT or LS/LT or LS/RH</td>
<td>overhead retraction</td>
<td>Castelein et al. Man Ther2 2016</td>
<td></td>
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<tr>
<td>RH</td>
<td>SA</td>
<td>RH/SA</td>
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Scapular Rehabilitation: which exercises to prescribe?

1. Focus on neuromuscular coordination: the role of conscious correction of scapular position
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3. Role of kinetic chain and functional (sport specific) tasks in scapular exercises
3. Role of Kinetic Chain in exercises in OPEN chain exercises
(De Mey et al. JSMS 2012)

Kinetic chain influences on upper and lower trapezius muscle activation during eight variations of a scapular retraction exercise in overhead athletes

Kristof De Mey, Lieven Danneels, Barbara Cagnie, Van den Bosch Lotte, Flier Johan, Ann M. Cools

Graph showing the average (% MVC) of Zit, Stand, Squat, Lunge, Squat dynamisch, Lunge dynamisch, Unipodale Squat, and Squat dynamisch.

Contents lists available at SciVerse ScienceDirect
Journal of Science and Medicine in Sport
journal homepage: www.elsevier.com/locate/jsms
3. Role of Kinetic Chain CLOSED chain exercises (Maenhout et al. BJSM 2009)

Original article

Electromyographic analysis of knee push up plus variations: what is the influence of the kinetic chain on scapular muscle activity?

A Maenhout, K Van Praet, L Pizzi, M Van Herzeele, A Cools
3. Role of SPORT SPECIFIC PLYOMETRIC tasks on scapular muscle recruitment (Maenhout et al. JEK 2015)
Goal of the exercise:
1. UT ↓
2. MT & LT ↑
3. SA ↑
4. Overall scap muscles ↑
Take home message:
choose the right exercise for your patient

1. Focus on **conscious** muscle recruitment in early stages of rehab

2. Choose exercises to restore **muscle balance** around the scapula, including the deep muscles

3. **Diagonals** are in favor of optimal scapular recruitment

4. **Plyometrics** highly challenge scapular muscle activity
THANK YOU