SHOULDER REHABILITATION – PART II

Shoulder rehab course level I

Shoulder pathology and clinical examination
- RC tendinopathy
- Instability
- SLAP lesions
- GIRD
- Scap dyskinesis

Shoulder examination protocol

Shoulder rehabilitation principles and techniques
- Eccentric training RC
- Muscle control training in instability
- Thrower’s program & sportspecific exercises
- Stretching GIRD
- Scapular rehab: PM stretching and examples of exercises for control and strength
Level II Advanced Course

**Day 1: Scapular rehabilitation**

1. Scapular biomechanics & kinesiology
2. Advanced evaluation of scapular dyskinesis: measuring scapular position and strength
3. Scapular rehabilitation exercises: from early to advanced sport-specific rehabilitation
4. Scapular taping techniques

Level II Advanced Course

**Day 2: Capita selecta**

1. Rehabilitation of the patient with SLAP lesions and biceps related pathology: conservative and post-operative approach
2. Return to sports after shoulder injury: high level performance training and return-to-play criteria
3. Conservative Treatment of (partial and full thickness) rotator cuff tears
4. Rehabilitation of the patient with MDI – Multidirectional Instability of the shoulder
Part III Clinical Workshop

8 cases refreshing clinical reasoning and practical skills

1. Rotator cuff tendinopathy
2. Rotator cuff tear
3. SLAP & tenosynovitis LHB
4. Internal impingement based on instability
5. Multidirectional instability
6. Impingement - Scapular dyskinesis type I
7. Impingement - Scapular dyskinesis type II
8. Impingement - Scapular dyskinesis type III

Scapular biomechanics and kinesiology

Coupled movements scapula and clavicula

(Ludewig 2009)
Coupled movements scapula and clavicula (saddle joint)

- Elevation
- Retraction
- Posterior axial rotation


Coupled movements **scapula** and clavicula

- Upward rotation
- Posterior tilting
- Internal/external rotation:
  - No consensus, however:
    - Early internal rotation
    - Late external rotation

Coupled movements scapula and clavicle

- Elevation + upward rotation
- Retraction + external rotation
- Posterior axial rotation* + posterior tilting

Scapular upward rotation

<table>
<thead>
<tr>
<th>Axis of Rotation</th>
<th>Sagittal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane of Motion</td>
<td>Frontal</td>
</tr>
<tr>
<td>Resting Position</td>
<td>$2^\circ \pm 5^\circ$</td>
</tr>
<tr>
<td>Normal Range</td>
<td>$50^\circ \pm 5^\circ$</td>
</tr>
</tbody>
</table>

Scapular upward rotation


Scapular posterior tilting

Scapular posterior tilting


Scapular internal/external rotation

<table>
<thead>
<tr>
<th>Axis of Rotation</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane of Motion</td>
<td>Transverse</td>
</tr>
<tr>
<td>Resting Position</td>
<td>$-30^\circ \pm 15^\circ$</td>
</tr>
<tr>
<td>Normal Range</td>
<td>$25^\circ \pm 10^\circ$</td>
</tr>
</tbody>
</table>

Scapular internal/external rotation


Role of the axial rotation of the clavicle

Clavicular Elevation = 40°
Scapular Upward Rotation = 60°

P2-P3: upward rotation scapula + axial rotation clavicle (20°)
Role of lig. Conoideum during this movement

Axial rotation clavicula is the result of tension of this ligament

Scapular Muscle Function

<table>
<thead>
<tr>
<th>Serratus Anterior</th>
<th>Trapezius</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Serratus Anterior Image]</td>
<td>![Trapezius Image]</td>
</tr>
</tbody>
</table>

A Cools 2016
-Elevation + retraction + Downward rotation
-Probably “postural” muscles
-Have to work eccentrically or relax during elevation....
m. pectoralis minor

- special scapular muscle: origin and insertion both anterior side thoracic wall
- Performing anterior tilt during isolated contraction
- Also active performing scapular elevation through level arm

Abnormal muscle recruitment patterns in patients with shoulder pain in deeper muscles (Castelein et al Accepted Man Ther 2016)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Population</th>
<th>Shoulder</th>
<th>Thorax wall</th>
<th>Scapular with ER</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT</td>
<td>Healthy controls</td>
<td>17.2 ± 6.6</td>
<td>12.9 ± 4.4</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>17.1 ± 5.8</td>
<td>12.4 ± 3.7</td>
<td>15.5 ± 7.4</td>
<td>Group NS</td>
</tr>
<tr>
<td>SF</td>
<td>Healthy controls</td>
<td>11.1 ± 6.5</td>
<td>7.5 ± 4.0</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>13.9 ± 5.9</td>
<td>7.9 ± 4.8</td>
<td>12.8 ± 11.0</td>
<td>Group NS</td>
</tr>
<tr>
<td>LT</td>
<td>Healthy controls</td>
<td>12.1 ± 3.2</td>
<td>9.5 ± 4.8</td>
<td>9.9 ± 5.0</td>
<td>Group NS</td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>18.6 ± 1.2</td>
<td>9.4 ± 4.5</td>
<td>17.9 ± 4.3</td>
<td>Group NS</td>
</tr>
<tr>
<td>SA</td>
<td>Healthy controls</td>
<td>28.7 ± 11.9</td>
<td>25.6 ± 11.0</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>25.7 ± 9.0</td>
<td>28.0 ± 11.0</td>
<td>21.2 ± 3.2</td>
<td>Group NS</td>
</tr>
<tr>
<td>PSa</td>
<td>Healthy controls</td>
<td>13.9 ± 7.6</td>
<td>12.3 ± 6.4</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>15.8 ± 7.8</td>
<td>11.8 ± 9.0</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td>LA</td>
<td>Healthy controls</td>
<td>17.1 ± 11.0</td>
<td>11.8 ± 8.7</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>19.1 ± 10.0</td>
<td>13.8 ± 7.0</td>
<td>16.7 ± 11.0</td>
<td>Group NS</td>
</tr>
<tr>
<td>RM</td>
<td>Healthy controls</td>
<td>26.5 ± 17.0</td>
<td>16.9 ± 11.0</td>
<td>SIS vs Group NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIS patients</td>
<td>20.5 ± 13.4</td>
<td>17.0 ± 9.2</td>
<td>21.2 ± 18.4</td>
<td>Group NS</td>
</tr>
</tbody>
</table>
Type I scapular dyskinesis

Lack of Soft-tissue flexibility
Lack of Muscle performance

Scapular muscles
GH muscles/capsule
Muscle Control
Muscle Strength

Pectoralis minor
GIRD
Dysfunction lower trap/serr ant

A Cools 2016
Type II scapular dyskinesis

A Cools 2016
Type III scapular dyskinesis

<table>
<thead>
<tr>
<th>Lack of Soft-tissue flexibility</th>
<th>Lack of Muscle performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scapular muscles</td>
<td>GH muscles/capsule</td>
</tr>
<tr>
<td>Muscle Control</td>
<td>Muscle Strength</td>
</tr>
</tbody>
</table>

Dysfunction
Upper trap/serr ant
Upper trap/ lower trap

Tightness levator scapulae

Levator Scapulae
Some examples & practice

• Classify scapular movement as “normal” or “abnormal” (McClure 2009, Uhl 2009)
  • Compared to best-knowledge “ideal” (smooth movement)?
  • Asymmetry? Relevant to shoulder pain?
  • Inconsistency?

• Identify predominant type of dyskinesis based on observation (Kibler 2002)

• “observe” muscle performance: muscle volume, fatigue…(Tsai 2003, McQuade 1998)

• Observe kinetic chain variables: forward head posture, thoracic kyphosis, rounded shoulders, lumbar spine movement during arm elevation (Lewis 2007, Thygen 2010)
Some examples & practice

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Advanced assessment of scapular dyskinesis

1. Scapular involvement in shoulder pain: the shoulder symptom modification model (Lewis BJSM 2008)

2. Additional clinical testing/observation and Objective measurements (Cools BJSM 2012, JAT 2013, JSES 2014)
1. Scapular involvement in shoulder pain

- Active correction of scapular position
- SAT and SRT – modified based on type of dyskinesis
- Thoracic extension
- correction head position
- Sitting versus standing
- ...
2. Additional clinical testing/observation and Objective measurements

1. Scapular upward rotation
2. Scapular muscle strength
3. Pectoralis Minor Length

Practice:

- Inclinometry upward rotation
- Clinical test SA vs TRAP
- HHD scapular muscles
- PM length
1. SCAPULAR UPWARD ROTATION

First publications on scapular measurements used Pro 3600 inclinometer (Johnson 2001, Borsa 2003, Su 2004, Laudner 2007....)
Acumar/similar inclinometer

Easier to use, and high reliability (Watson 2005, Struyff 2011)

Reliability and reference data on a normal population of this procedure

Table 2 Descriptive statistics, standard error of measurement (SEM), and intraclass correlation coefficient (ICC) of the scapula measurements at each position over two trials

<table>
<thead>
<tr>
<th>TSA position</th>
<th>Trial</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>SEM</th>
<th>ICC (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All neutral</td>
<td>1</td>
<td>3.58 (7.23)</td>
<td>-15 to 20</td>
<td>1.7</td>
<td>0.94 (0.90 to 0.99)</td>
</tr>
<tr>
<td>(average 10.2°)</td>
<td>2</td>
<td>3.93 (7.06)</td>
<td>-12 to 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 45°</td>
<td>1</td>
<td>13.19 (11.09)</td>
<td>-10 to 36</td>
<td>4.0</td>
<td>0.88 (0.79 to 0.97)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12.65 (11.42)</td>
<td>-6 to 39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 90°</td>
<td>1</td>
<td>28.35 (13.01)</td>
<td>0 to 56</td>
<td>3.8</td>
<td>0.90 (0.82 to 0.97)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>28.12 (10.46)</td>
<td>3 to 55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 135°</td>
<td>1</td>
<td>41.46 (13.13)</td>
<td>13 to 65</td>
<td>5.2</td>
<td>0.81 (0.67 to 0.94)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>41.27 (12.59)</td>
<td>17 to 62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At end of range</td>
<td>1</td>
<td>56.58 (12.64)</td>
<td>27 to 75</td>
<td>2.9</td>
<td>0.94 (0.89 to 0.98)</td>
</tr>
<tr>
<td>(average 174.6°)</td>
<td>2</td>
<td>55.19 (11.33)</td>
<td>25 to 75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.88 (0.73 to 1.00)*</td>
</tr>
</tbody>
</table>

*The 95% confidence interval calculated is the one sided, lower limit confidence interval.
TSA, Total shoulder abduction.

(Watson BJSM 2005)
Results of this procedure on healthy overhead athletes
(Cools et al. JAT 2014)

Table 2: Means (±SD) for Scapular Upward Rotation (in degrees) on the Non-Dominant (ND) and Dominant (D) side for the Tennis Players in Three Age Categories <14y (N=24), 14-16y (N=22), and >16y (N=13) in Three Arm Elevation Positions in the Scapular Plane: 0°, 90°, and 180°

<table>
<thead>
<tr>
<th></th>
<th>0°</th>
<th>ND</th>
<th>90°</th>
<th>D</th>
<th>180°</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;14y</td>
<td>4.3 ±3.6</td>
<td>5.6 ±4.0</td>
<td>22.8 ±6.7</td>
<td>27.5 ±7.5</td>
<td>48.8 ±6.9</td>
<td>54.7 ±6.9</td>
</tr>
<tr>
<td>14-16y</td>
<td>3.9 ±2.8</td>
<td>5.7 ±4.0</td>
<td>22.2 ±7.0</td>
<td>27.5 ±7.2</td>
<td>51.4 ±8.5</td>
<td>56.4 ±8.6</td>
</tr>
</tbody>
</table>
| >16y   | 4.6 ±4.0 | 5.2 ±4.1 | 19.8 ±5.6 | 19.6 ±7.5 | 45.2 ±6.9 | 46.6 ±9.7 |  * significant group difference (p<0.05)  

2. SCAPULAR MUSCLE STRENGTH

Clinical test: serr ant versus trapezius

Selected muscles:
1. Upper trapezius
2. Middle trapezius
3. Lower trapezius
4. Serratus anterior
Clinical test: SA vs TRAP

(Martin Kelley, scapula meeting 2003)

HDD Measurements: General
MANY DIFFERENT PROCEDURES

(Michener 2005, Cools 2010, Williams 2009)
(HandHeld dynamometer CompuFET, Biometrics)

- Upper Trapezius (UT)
- Serratus Anterior (SA)
- Middle Trapezius (MT)
- Lower Trapezius (LT)


Results from this procedure for overhead athletes (Cools 2010)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Absolute muscle strength (N)</th>
<th>Normalised muscle strength (N/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MD (SD)</td>
<td>D (MD)</td>
</tr>
<tr>
<td>UT Male</td>
<td>140.4 (±45.0)</td>
<td>2.73 (±0.67)</td>
</tr>
<tr>
<td>Female</td>
<td>156.0 (±47.7)</td>
<td>3.0 (±0.7)</td>
</tr>
<tr>
<td>MT Male</td>
<td>112.0 (±33)</td>
<td>7.46 (±0.58)</td>
</tr>
<tr>
<td>Female</td>
<td>123.5 (±36.1)</td>
<td>6.68 (±0.64)</td>
</tr>
<tr>
<td>SA Male</td>
<td>30.8 (±15)</td>
<td>0.71 (±0.14)</td>
</tr>
<tr>
<td>Female</td>
<td>32.7 (±18.8)</td>
<td>0.88 (±0.19)</td>
</tr>
<tr>
<td>LT Male</td>
<td>7.0 (±13.9)</td>
<td>0.45 (±0.37)</td>
</tr>
<tr>
<td>Female</td>
<td>2.9 (±6.1)</td>
<td>0.60 (±0.21)</td>
</tr>
<tr>
<td>SA</td>
<td>154.0 (±61.5)</td>
<td>2.94 (±1.12)</td>
</tr>
</tbody>
</table>

(Cools 2016)
Clinical relevance of the scapular strength measurements

Scapular muscle strength should be symmetric in non-athletic subjects

Scapular muscles should be stronger in one-handed overhead athlete on the dominant side

There should be a balance in the force couples around the scapula
3. PECT MINOR LENGTH

Short PM induces changes similar to impingement related dyskinesis

(Borstad JOSPT 2005)

PMI - PECTORALIS MINOR INDEX

\[
PMI = \left( \frac{PML}{\text{length}} \right) \times 100
\]

CUT-OFF POINTS

- PMI < 7.65: SHORT
- PMI > 8.61: LONG
Cools & Johansson BJSM 2010: significant decrease PML length in elite junior (11-17yr) tennis players dominant versus non-dominant side

Table 4  Means (±SD) for PML (cm) and the PMI (PML/body length × 100) on the non-dominant and dominant side for male (n=19) and female (n=16) tennis players

<table>
<thead>
<tr>
<th></th>
<th>Male players</th>
<th>Female players</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ND</td>
<td>D</td>
</tr>
<tr>
<td>PML (cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.9 ±1.3</td>
<td>11.7 ±1.2</td>
</tr>
<tr>
<td>PMI</td>
<td>7.9 ±0.4</td>
<td>7.1 ±0.4</td>
</tr>
</tbody>
</table>

Scapular rehabilitation exercises: practical workshop

- Scapular rehab algorithm: update
- From early rehab exercises to sport-specific approach
- General guidelines scapular correction exercises
- Taping techniques
- Exercises based on type of scapular dyskinesis
Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)

Lack of Soft-tissue flexibility
- Scapular muscles
  - Pm↑, LS↑, RH↑, UT↑

Lack of Muscle performance
- GH muscles/capsule
  - Posterior shoulder
  - Anterior shoulder
- Muscle Control
  - co-contraction force couples
- Muscle Strength
  - LT↓, MT↓, UT↓, RH↓, SA↓

STRETCHING & MOBILISATION
- Manual soft tissue techniques
- Manual stretching and MWM
- A Cools 2016
  - Home stretching

NEUROMUSCULAR COORDINATION
- Conscious muscle control
- Advanced control
  - During basic activities
- Balance -ratio
- Endurance/Strength

STRENGTH TRAINING
- Advanced control
  - During sports
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

STRETCHING & MOBILISATION
- Manual soft tissue techniques
- Manual stretching and MWM
  - A Cools 2016
  - Home stretching

Lack of Muscle performance
- Muscle Control
  - co-contraction force couples
  - LT↓, MT↓, UT↓,
  - RH↓, SA↓
- Muscle Strength
  - NEUROMUSCULAR COORDINATION
  - STRENGTH TRAINING
    - Conscious muscle control
    - Balance -ratio
    - Endurance/strength

Advanced control
- During basic activities
- During sports

Conscious muscle control
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  - Manual stretching and MWM
  - Home stretching

A Cools 2016

Manual stretching and MWM
- A Cools 2016
  - Home stretching

Scapular orientation exercise

Advanced control
- During basic activities
- During sports

Balance -ratio
- Endurance/strength

Endurance/strength
Scapular orientation exercise
(Mottram 2009)

- Palpate base of the spine + acromion
- Add tactile feedback to “upward rotation and posterior tilting”
- Adjust body position (gravity) to correct performance
Type I scapular dyskinesis

- Lack of soft-tissue flexibility
- GH muscles/capsule
- Muscle Control
- Muscle Strength

Scapular muscles

Pectoralis minor

GIRD

Dysfunction lower trap/serrant

Stretching pectoralis minor
Type I scapular dyskinesia

Lack of Soft-tissue flexibility
Lack of Muscle performance

Scapular muscles  GH muscles/capsule  Muscle Control

Muscle Strength

Pectoralis minor  GIRD

Dysfunction lower trap/serr ant

Pectoralis Minor

Electromyographic Analysis of Specific Exercises for Scapular Control in Early Phases of Shoulder Rehabilitation

Average Amplitude EMG Activity All Subjects (N = 39): by Exercises

<table>
<thead>
<tr>
<th></th>
<th>Inferior Glide</th>
<th>Low Bow</th>
<th>Lawnmower</th>
<th>Robbery</th>
<th>Differences Between Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper trapezius</td>
<td>8.1 (5.9)</td>
<td>10.4 (8.1)</td>
<td>21.8 (15.7)</td>
<td>31.6 (16.7)</td>
<td>BB &gt; all others</td>
</tr>
<tr>
<td>Lower trapezius</td>
<td>19.4 (26.6)</td>
<td>15.4 (11.6)</td>
<td>30.5 (19.2)</td>
<td>27.0 (20.8)</td>
<td>LM &gt; IG, LR</td>
</tr>
<tr>
<td>Serratus anterior</td>
<td>23.4 (19.6)</td>
<td>28.2 (20.8)</td>
<td>25.5 (21.4)</td>
<td>20.9 (16.8)</td>
<td>None</td>
</tr>
<tr>
<td>Anterior deltoid</td>
<td>4.6 (2.0)</td>
<td>16.6 (13.3)</td>
<td>5.5 (3.6)</td>
<td>7.4 (5.5)</td>
<td>LM &gt; BB &gt; LR</td>
</tr>
<tr>
<td>Posterior deltoid</td>
<td>8.6 (6.0)</td>
<td>42.4 (33.2)</td>
<td>36.2 (10.6)</td>
<td>14.0 (9.2)</td>
<td>LR &gt; all others</td>
</tr>
<tr>
<td>Differences</td>
<td>SA &gt; UT, AD, PD</td>
<td>PD &gt; UT, LT, AD</td>
<td>UT &gt; LT &gt; SA</td>
<td>UT &gt; LT &gt; SA &gt; AD</td>
<td></td>
</tr>
<tr>
<td>between muscles</td>
<td>LF = all others</td>
<td>PD &gt; SA</td>
<td>LT &gt; AD, PD</td>
<td>UT &gt; LT &gt; PD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA &gt; UT, LT'</td>
<td>PD &gt; AD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Practice and progression

Add thoracic extension and ER component to “inferior glide”

A Cools 2016

Practice and progression

Add KC components, weights and higher elevation angles to “lawnmower”

A Cools 2015
Practice and progression

Add KC components, weights and higher elevation angles to “robbery”

Practice and progression

Other exercises with “external rotation component”
Practice and progression

Other exercises with “external rotation component”

Scapular elevation exercises: influence of closed chain performance and external rotation component on the muscle activity of the deep and superficial scapular muscles

Birgit Castelein, Msc, Pt1, Barbara Cagnie, Phd, Pt1, Thierry Parlevliet, Md2, Ann Cools, Phd, Pt1
1. Elevation scap plane

2. Wall slide

3. Elevation + ER

Scapular elevation exercises: influence of closed chain performance and external rotation component on the muscle activity of the deep and superficial scapular muscles

Birgit Castelein, Msc, Pt\(^1\), Barbara Cagnie, Phd, Pt\(^1\), Thierry Parlevliet, Md\(^2\), Ann Cools, Phd, Pt\(^1\)

Focus on muscle balance rather than muscle strength: UT/SA, Pm/LT, UT/LT, LS/SA... (Castelein et al. JOSPT 2015)
### Type I scapular dyskinesis

<table>
<thead>
<tr>
<th>Lack of Soft-tissue flexibility</th>
<th>Lack of Muscle performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scapular muscles</td>
<td>Muscle Control</td>
</tr>
<tr>
<td>GIRD</td>
<td>Muscle Strength</td>
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- **Pectoralis minor**
- **Dysfunction lower trap/serrant**

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Focus on muscle balance rather than muscle strength: Pm/SA  
(Castelein et al. Man Ther 2015)

- **A Cools 2016**
Exercises with low ratio UT/SA:
- Elbow push-up / prone bridging
- Serratus punch supine
- Serratus punch in CKC (bench slide)

Exercises with low ratio UT/LT
- Side-lying forward flexion
- Side-lying external rotation
- Prone hor abd with ext rot
- Prone extension


(level I shoulder rehab course)

Type I scapular dyskinesis

Proprioceptive Taping Techniques

- Scapular muscles
- GH muscles/capsule
- Muscle Control
- Muscle Strength

- Pectoralis minor
- GIRD
- Dysfunction lower trap/serrant
GIRD: relaxation of the infraspinatus

Taping improves scapular *posterior tilt* in all elevation angles, but has no influence on muscle activity or subacromial space width in elite handball players.

Type II scapular dyskinesis

- Lack of soft-tissue flexibility
  - Scapular muscles
  - Gh muscles/capsule

- Lack of muscle performance
  - Muscle control
  - Muscle strength

General forward shoulder posture

Dysfunction 3 trap parts/serrant

A Cools 2015
Thoracic and cervical position and ROM exercises

Type II scapular dyskinesis

<table>
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</table>

General forward shoulder posture

Exercises increasing strength in SA and/or trap
Exercises for type II scapular dyskinesis

General guideline: focus on retraction /protraction in horizontal plane (90° elevation)

A Cools 2016
Exercises for type II
### Type III scapular dyskinesis

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<td>Muscle Control</td>
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</tbody>
</table>

#### Tightness
- Levator scapulae

#### Dysfunction
- Upper trap/serr ant
- Upper trap/ lower trap

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**Exercises: focus on UPWARD ROTATION**

*(level I shoulder rehab course)*

- Serr punch >90°
- W-V exercise
- Wall slide

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*Image: [A Cools 2016]*
Scapular elevation exercises: influence of closed chain performance and external rotation component on the muscle activity of the deep and superficial scapular muscles

Birgit Castelein, Msc, Pt¹, Barbara Cagnie, Phd, Pt¹, Thierry Parlevliet, Md², Ann Cools, Phd, Pt¹

Comparison muscle activity UT, MT, LT, LS, rhomboid

<table>
<thead>
<tr>
<th>Muscle</th>
<th>No additional weight</th>
<th>Shrugging 100</th>
<th>Shrugging 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Trapezius</td>
<td>31.8 ± 12.9</td>
<td>25.3 ± 11.9</td>
<td>28.4 ± 12.5</td>
</tr>
<tr>
<td>Middle Trapezius</td>
<td>8.1 ± 5.3</td>
<td>6.9 ± 4.6</td>
<td>10.1 ± 11.0</td>
</tr>
<tr>
<td>Lower Trapezius</td>
<td>3.4 ± 1.9</td>
<td>7.2 ± 4.5</td>
<td>22.4 ± 8.2</td>
</tr>
<tr>
<td>Levator Scapula</td>
<td>44.0 ± 25.8</td>
<td>16.1 ± 11.1</td>
<td>25.0 ± 22.7</td>
</tr>
<tr>
<td>Rhomboid Major</td>
<td>15.8 ± 15.0</td>
<td>10.3 ± 7.3</td>
<td>29.9 ± 15.7</td>
</tr>
</tbody>
</table>

A Cools 2016
Exercises: focus on UPWARD ROTATION

[Images of people performing exercises]

Exercises: focus on UPWARD ROTATION

[Images of people performing exercises]
Exercises: focus on UPWARD ROTATION

Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)

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

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

STRETCHING & MOBILISATION
- Manual soft tissue techniques
- Manual stretching and MWM
- A Cools 2016
  - Home stretching

NEUROMUSCULAR COORDINATION
- Conscious muscle control
  - Advanced control
    - During basic activities
  - Advanced control
    - During sports
- Conscious muscle control
  - Balance -ratio
  - Endurance/strength

STRENGTH TRAINING
- Advanced control
  - During sports