



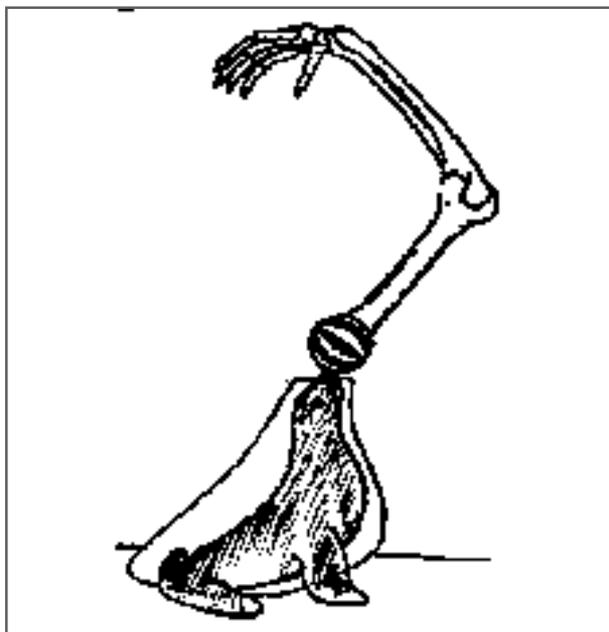
The role of the scapula in shoulder rehabilitation

Schoudernetwerk Vlaanderen 09-05-2017

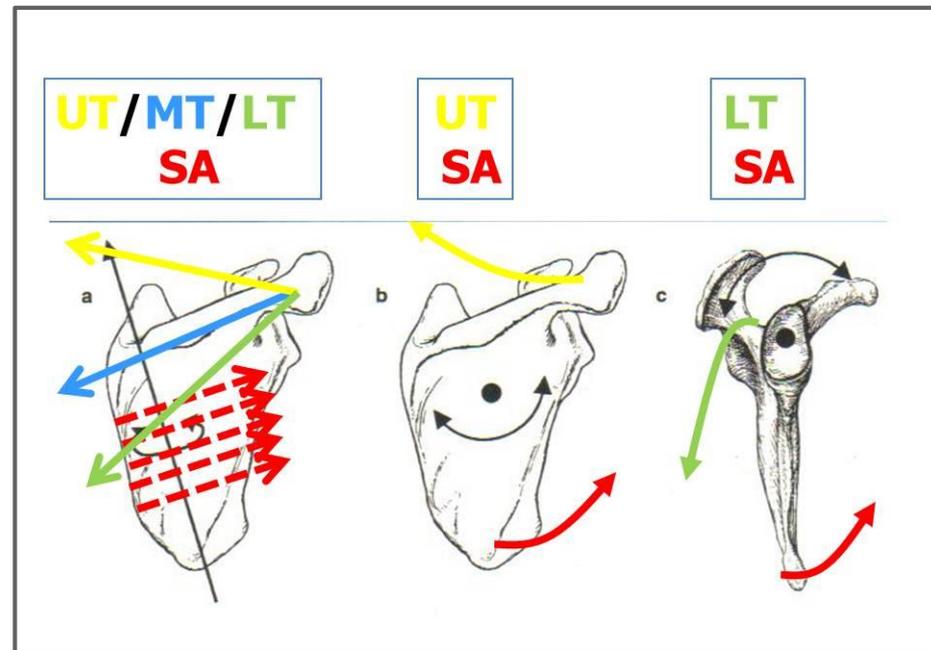


Ann Cools, PT, PhD
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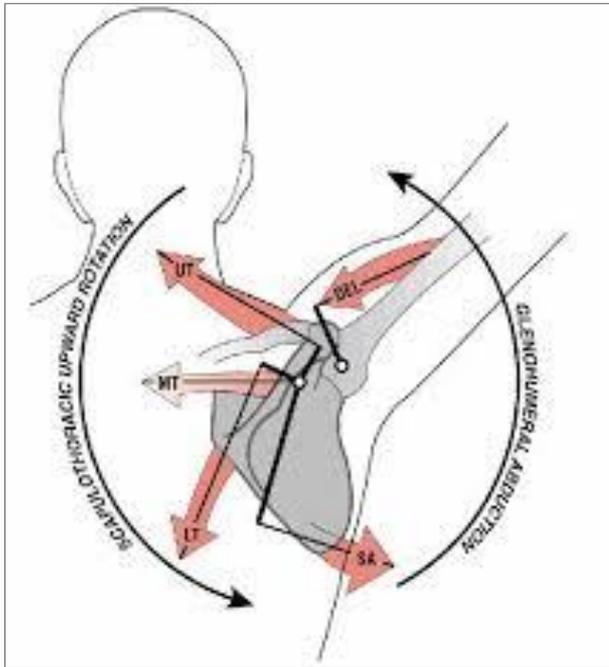
Role of the scapula in **normal** shoulder function



Normal scapular movement and muscle recruitment patterns



Scapulothoracic muscle recruitment:



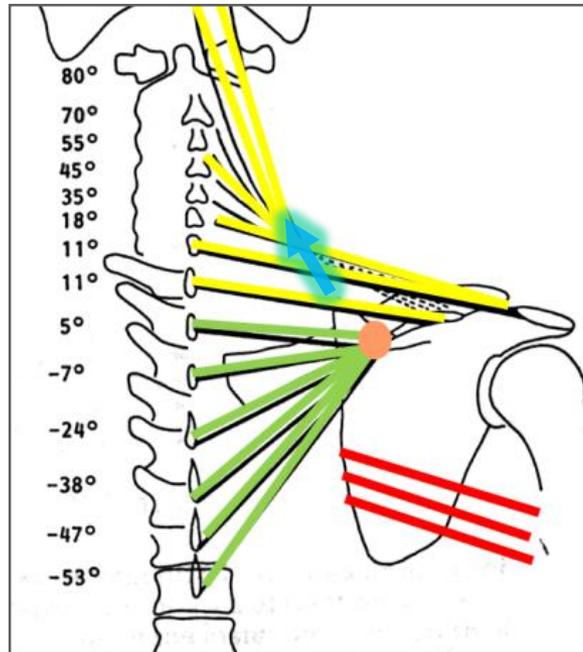
Prime Movers

Dynamic Stabilizers

Postural muscles

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

upward rotation



Scapular dyskinesis in relation to shoulder pain

(Ludewig et al. JOSPT 2009)

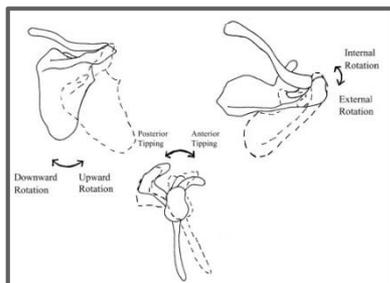
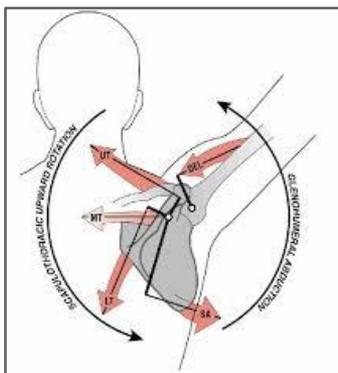


TABLE 2

SUMMARY OF SCAPULAR KINEMATICS DURING ARM ELEVATION IN HEALTHY AND PATHOLOGIC STATES

Group	Healthy	Impingement or Rotator Cuff Disease	Glenohumeral Joint Instability	Adhesive Capsulitis
Primary scapular motion	Upward rotation	Lesser upward rotation	Lesser upward rotation	Greater upward rotation
Secondary scapular motion	Posterior tilting	Lesser posterior tilting	No consistent evidence for alteration	No consistent evidence for alteration
Accessory scapular motion	Variable internal/external rotation	Greater internal rotation	Greater internal rotation	No consistent evidence for alteration
Presumed implications	Maximize shoulder range of motion and available sub-acromial space	Presumed contributory to subacromial or internal impingement	Presumed contributory to lesser inferior and anterior joint stability	Presumed compensatory to minimize functional shoulder range-of-motion loss

Abnormal muscle recruitment patterns in patients with shoulder pain in **superficial** muscles (Struyf et al. 2014)



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Journal of Electromyography and Kinesiology

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



Review

Scapulothoracic muscle activity and recruitment timing in patients with shoulder impingement symptoms and glenohumeral instability



Filip Struyf^{a,b,*}, Barbara Cagnie^c, Ann Cools^c, Isabel Baert^{a,b}, Jolien Van Brempt^a, Pieter Struyf^d, Mira Meeus^{a,b,c}

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 clear change in recruitment timing could be made regarding muscle recruitment timing.

Need for a science based rehabilitation program (Cools et al. BJSM 2014)

BJSM

Rehabilitation of scapular dyskinesis: from the office worker to the elite overhead athlete

Ann M J Cools, Filip Struyf, Kristof De Mey, et al.

Br J Sports Med published online May 18, 2013
doi: 10.1136/bjsports-2013-092148

Scapular Rehabilitation Algorithm

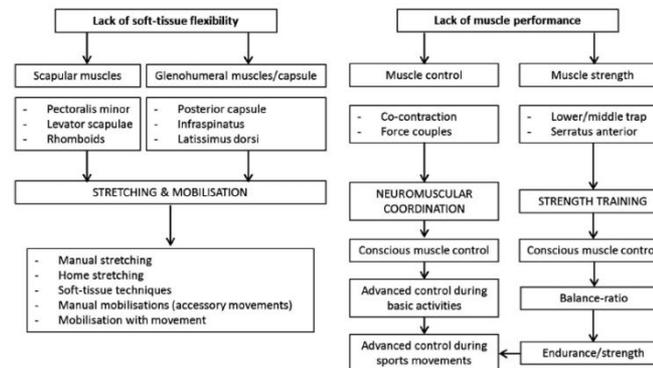
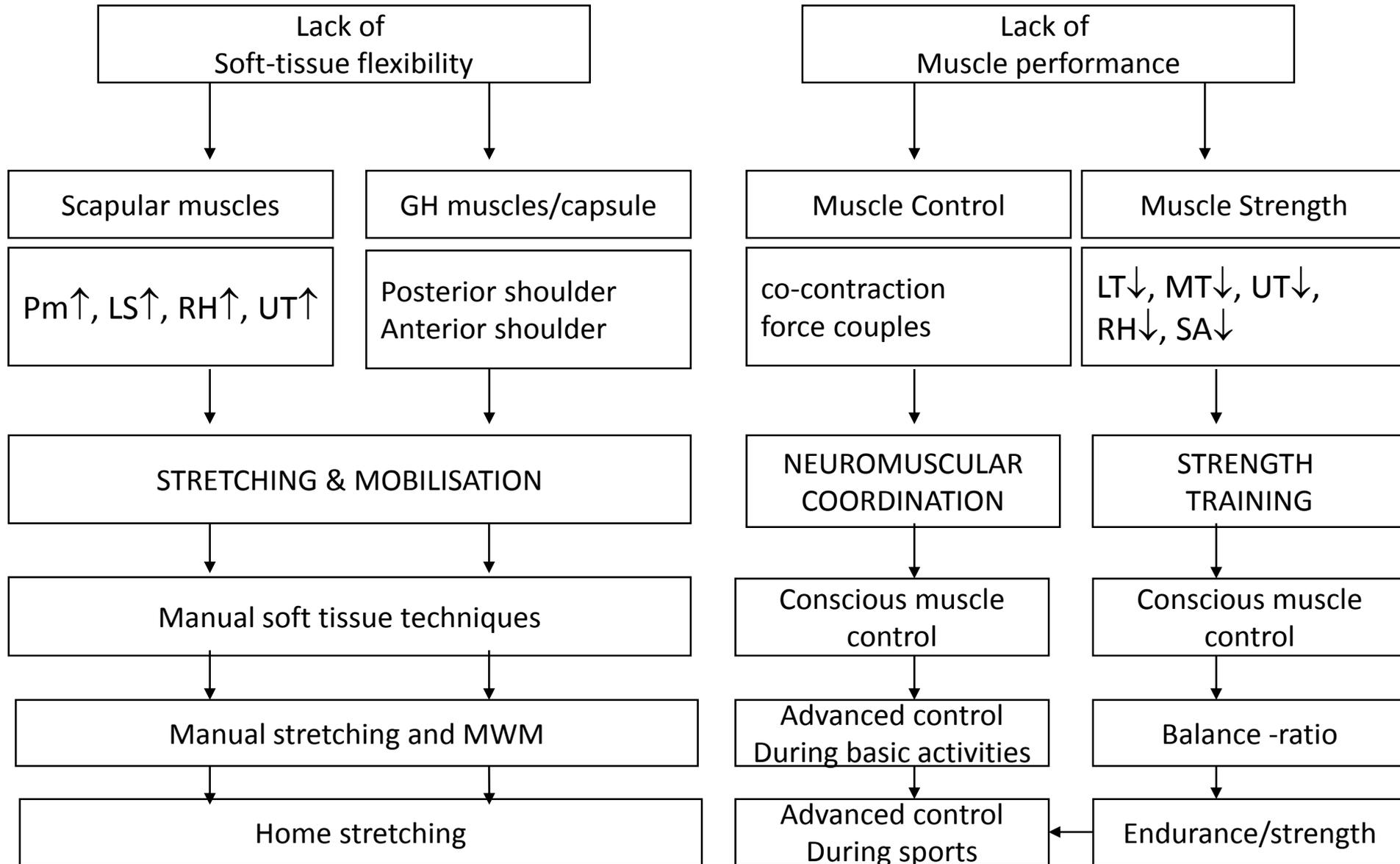


Figure 1 Scapular rehabilitation algorithm.

Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)



Scapular Rehabilitation: which exercises to prescribe?

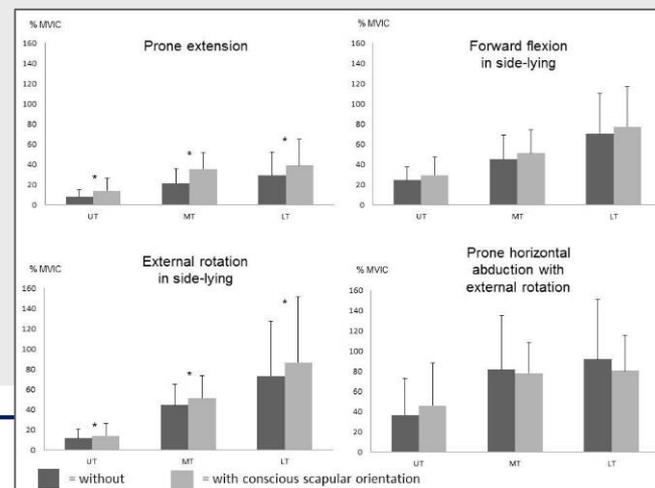
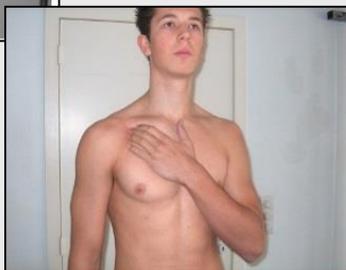
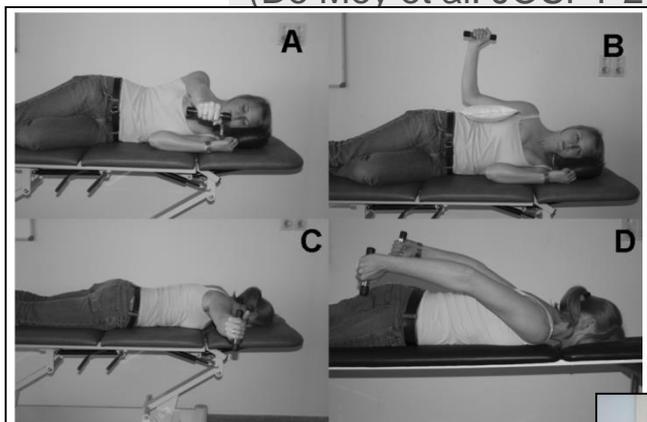
1. Focus on **neuromuscular coordination**: the role of conscious correction of scapular position
2. Focus on scapular **muscle balance** rather than muscle strength
3. Role of **kinetic chain** and **functional (sport specific) tasks** in scapular exercises

Scapular Rehabilitation: which exercises to prescribe?

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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
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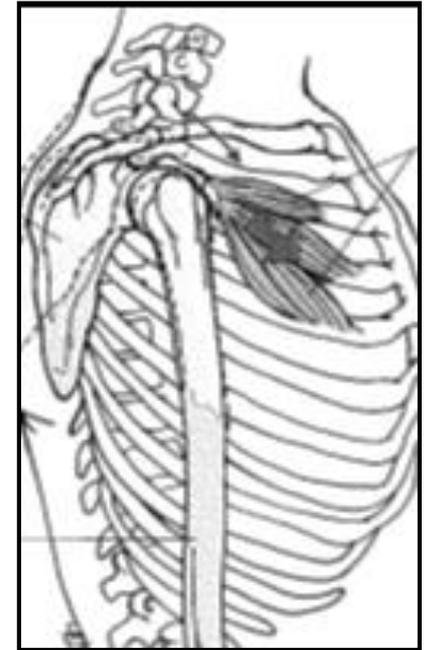
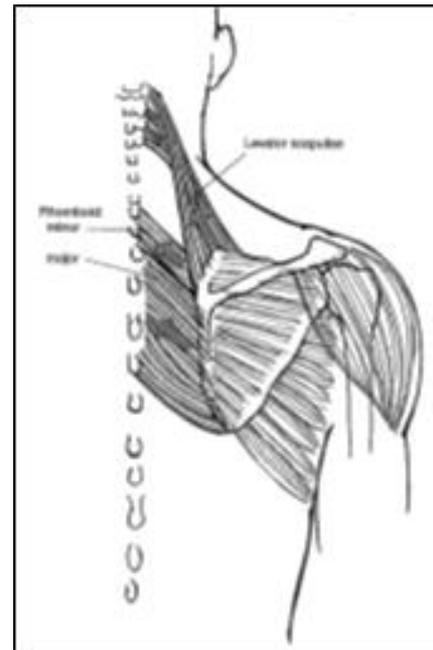
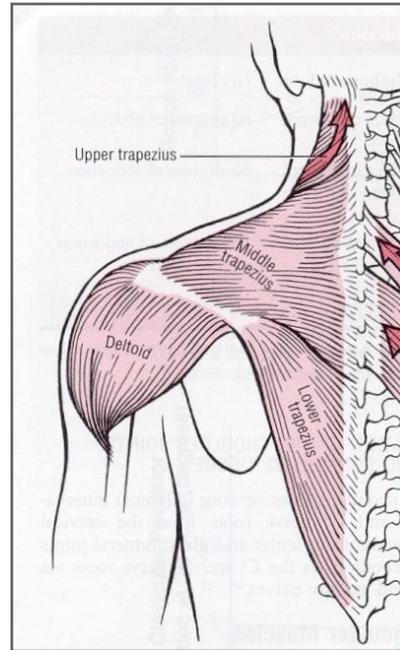
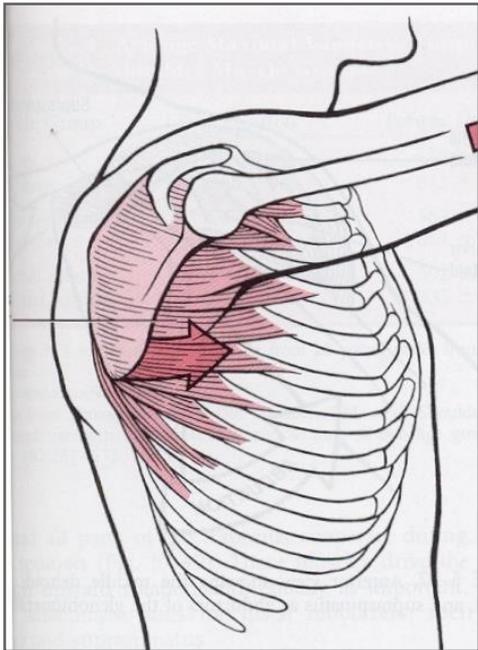
2. Focus on **scapular muscle balance** in scapular rehabilitation



- 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 Lanszweert,[†] PT, Dries Notebaert,[†] PT, Arne Roets,[‡] MPSS, Barbara Soetens,[‡] 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. Osowski, 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



[RESEARCH REPORT]

BIRGIT CASTELEIN, PT, MSc¹ • BARBARA CAGNIE, PT, PhD²
THIERRY PARLEVLIET, MD² • ANN COOLS, PT, PhD³

Superficial and Deep Scapulothoracic
Muscle Electromyographic
Activity During Elevation Exercises
in the Scapular Plane

Journal of Orthopaedic & Sports Physical Therapy

JOSPT

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)

Manual Therapy xxx (2015) 1–6

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Manual Therapy

journal homepage: www.elsevier.com/math

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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



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Manual Therapy xxx (2015) 1–6

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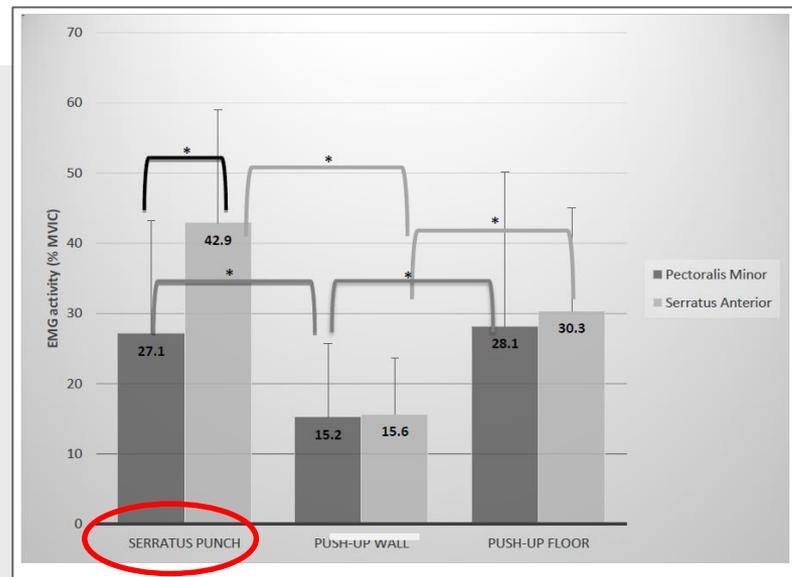
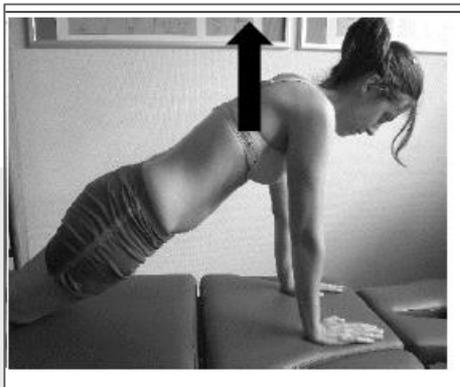
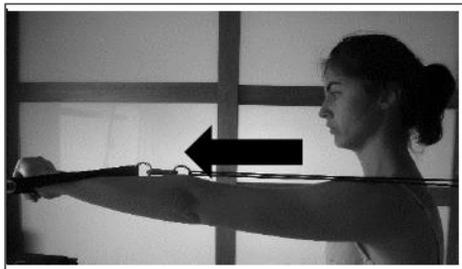
Birgit Castelein ^{a,*}, Ann Cools ^a, Thierry Parlevliet ^b, Barbara Cagnie ^a

^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



	No additional weight		
	Shrug	Shrug 180°	Retraction 180°
Upper Trapezius	33,8 ± 12,9	25,8 ± 11,9	28,4 ± 12,5
Middle Trapezius	8,1 ± 5,3	6,9 ± 4,6	16,1 ± 11,6
Lower Trapezius	3,4 ± 1,9	7,2 ± 4,5	22,4 ± 8,2
Levator Scapulae	44,0 ± 25,8	19,1 ± 14,1	25,9 ± 22,7
Rhomboid Major	18,8 ± 15,0	10,3 ± 7,3	29,9 ± 15,7

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



Focus on Muscle Balance: scientific rationale



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

(Cools, Michener & Ellenbecker in: The Scapula, Kibler WB ed. Elsevier 2017 in press)

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 in exercises in OPEN chain exercises

(De Mey et al. JSMS 2012)



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Journal of Science and Medicine in Sport

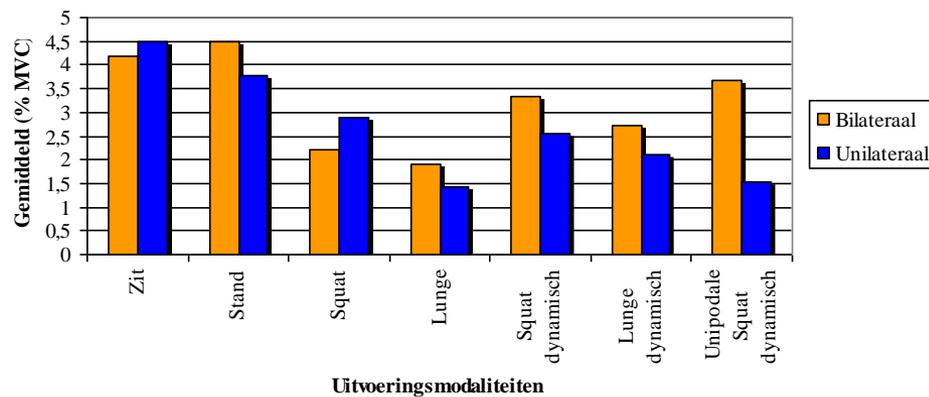
journal homepage: www.elsevier.com/locate/jsams



Original research

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

Kristof De Mey^{a,*}, Lieven Danneels^a, Barbara Cagnie^a, Van den Bosch Lotte^b, Flier Johan^b, Ann M. Cools^a



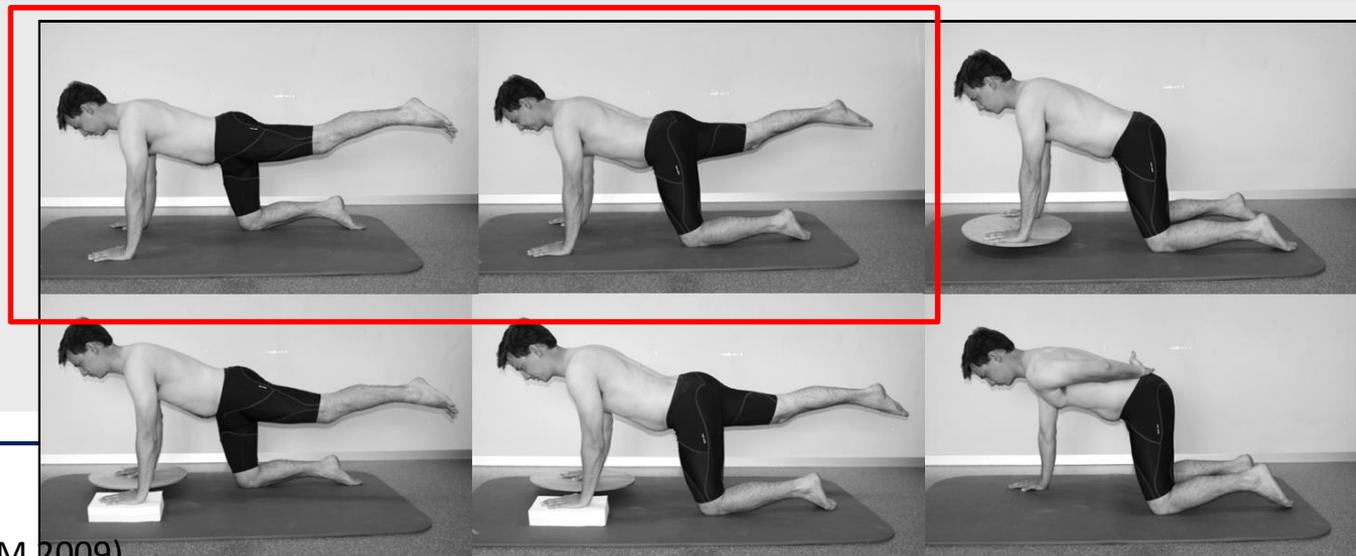
3. Role of Kinetic Chain CLOSED chain exercises (Maenhout et al. BJSM 2009)

Original article

BJSM
The Journal of Sport
& Exercise Medicine

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

A Maenhout,¹ K Van Praet,² L Pizzi,³ M Van Herzele,¹ A Cools¹



(Maenhout et al. BJSM 2009)

3. Role of SPORT SPECIFIC PLYOMETRIC tasks on scapular muscle recruitment (Maenhout et al. JEK 2015)

Journal of Electromyography and Kinesiology 27 (2016) 39–45



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Journal of Electromyography and Kinesiology

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Scapular muscle activity in a variety of plyometric exercises

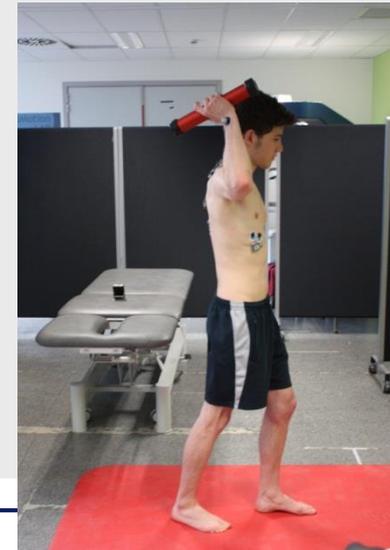


Maenhout Annelies^{a,*}, Benzoor Maya^{b,c}, Werin Maria^a, Cools Ann^a

^aGhent University, Department of Rehabilitation Medicine and Physiotherapy, Campus Heymans, De Pintelaan 185, 9000 Ghent, Belgium

^bRibstein Center for Sports Medicine and Research at the Wingate Institute, Netanya 42902, Israel

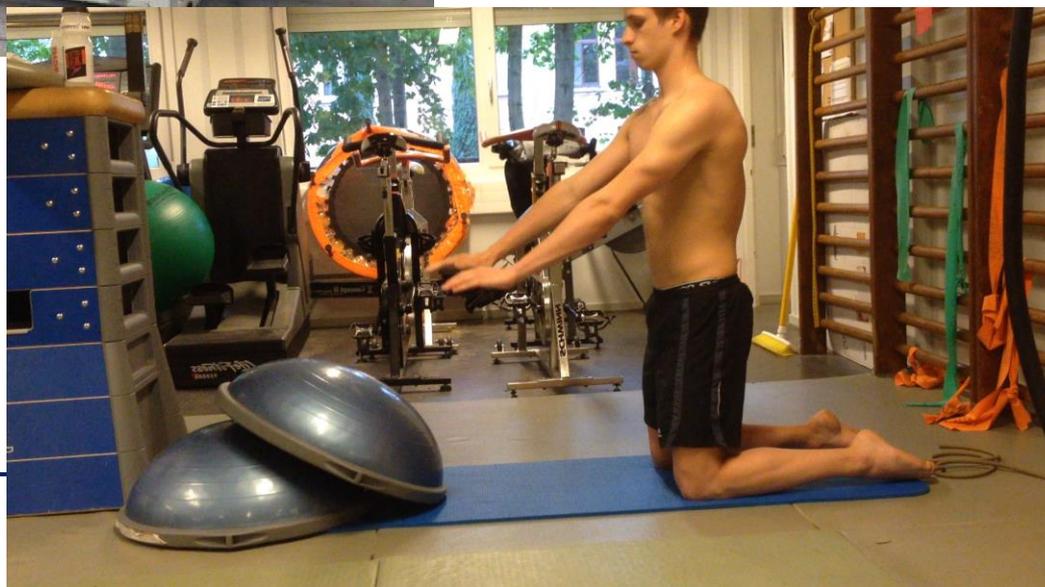
^cDepartment of Physical Therapy, University of Haifa, Sderot Abba Hushi 199, Mount Carmel, Haifa 3498838, Israel

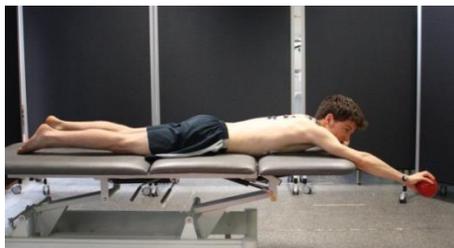
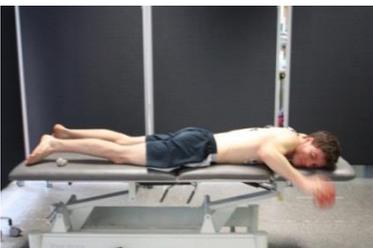
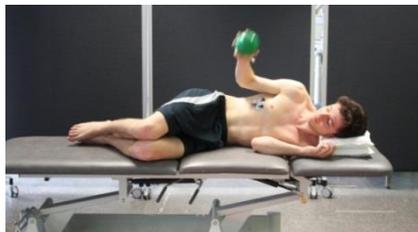


(Ellenbecker BJSM 2010)



(Maenhout JAT 2014)





Goal of the exercise:

1. UT ↓

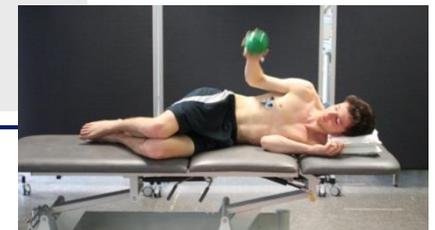
2. MT & LT ↑

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

