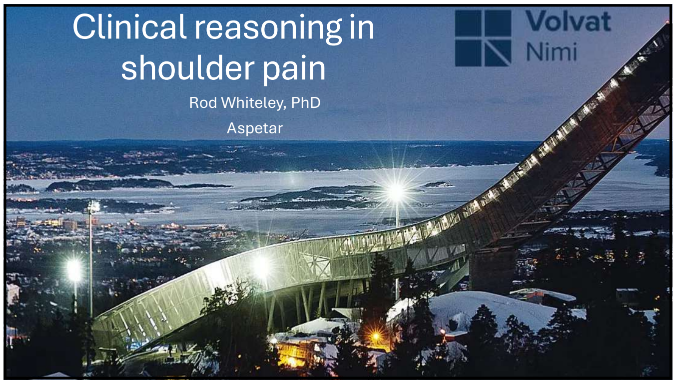
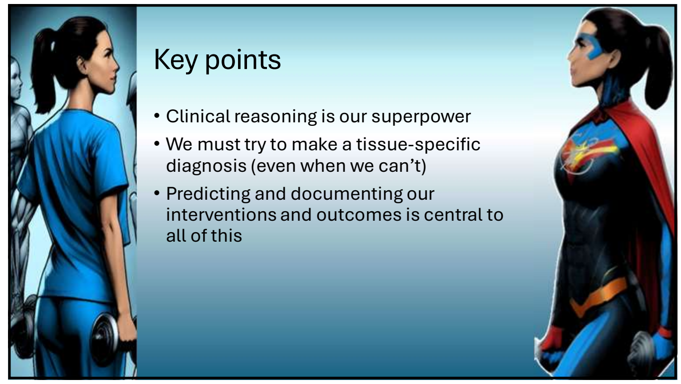
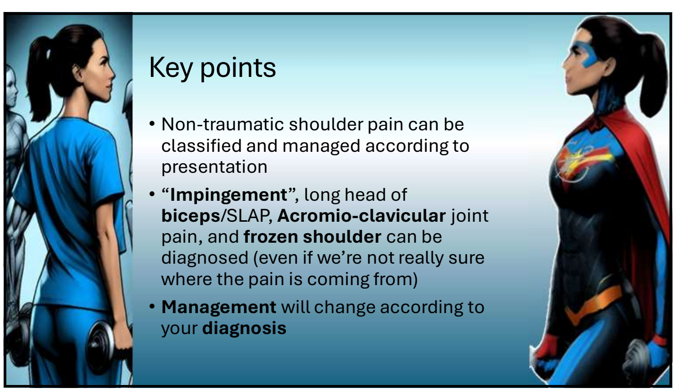

Clinical reasoning in shoulder pain
Volvat Nimi
Rod Whiteley, PhD
Aspetar

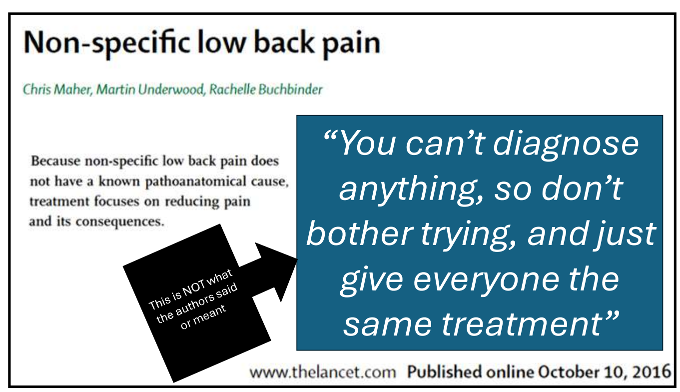
1


Key points
• Clinical reasoning is our superpower
• We must try to make a tissue-specific diagnosis (even when we can't)
• Predicting and documenting our interventions and outcomes is central to all of this

2


Key points
• Non-traumatic shoulder pain can be classified and managed according to presentation
• "**Impingement**", long head of **biceps**/SLAP, **Acromio-clavicular** joint pain, and **frozen shoulder** can be diagnosed (even if we're not really sure where the pain is coming from)
• **Management** will change according to your **diagnosis**

3


Non-specific low back pain
Chris Maher, Martin Underwood, Rachelle Buchbinder
Because non-specific low back pain does not have a known pathoanatomical cause, treatment focuses on reducing pain and its consequences.
This is NOT what the authors said or meant
"You can't diagnose anything, so don't bother trying, and just give everyone the same treatment"
www.thelancet.com Published online October 10, 2016

4

What Do Patients with Chronic Spinal Pain Expect from Their Physiotherapist?

Steven J. Kamper, PhD;† Tsjitske M. Haanstra, PhD;† Kathy Simmons, PT;‡ Mike Kay, MSc;‡ Tony G.J. Ingram, MSc;‡§ Jeannette Byrne, PhD;§ Jenna M. Roddick, MSc;§ Alissa Setliff, PhD;¶ Amanda M. Hall, PhD§¶***

Physiotherapy Canada 2018; 70(1);36–41; doi:10.3138/ptc.2016-58

in St. John's, Newfoundland and Labrador, were included. They filled out a questionnaire detailing their expectations of treatment. ***Results:*** Before treatment, more than 90% of patients expected a physical examination, tests or investigations, a diagnosis, reassurance and advice, and clear explanations of causation, symptom management, and benefits and risks of treatment. Approximately half hoped for a prescription or referral to a specialist, and about 60% hoped to discuss problems in their life. ***Conclusions:*** The findings of this study indicate that patients attend physiotherapy with clear expectations about what information should be provided. Most expected tests or investigations leading to diagnosis and an explanation of causation; this presents a challenge for clinicians, given the current understanding of LBP reflected in international practice guidelines. The fact that more than half of the patients wanted to discuss problems in their life points to the need for physiotherapists to consider LBP from a bio-psychosocial perspective.

5

Whiteley R. "The only certainties in life are … wait, I pay no taxes, and I'm not dead, yet." A letter from Qatar. *IJSPT*. 2022;17(5):738-741.

On day one, mostly your patients want to know:

> *"What's wrong with me?"*
> *"What's going to happen?" and*
> *"What can I/you do about it?"*

Make a diagnosis

Measure your outcomes

Make an outcome prediction

6

Importance of assessment

Make a tissue-specific diagnosis or prove that you can't

7

Higher order thinking about differential diagnosis

Chad E. Cook[a,*], Simon Décary[b] Brazilian Journal of Physical Therapy 2020;24(1):1–7

How a diagnostic label may overcomplicate care

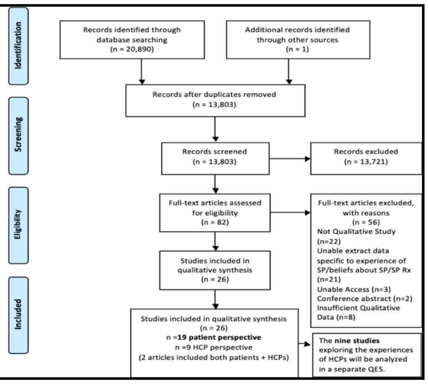
The creation of diagnostic codes from a patho-anatomical viewpoint has led to focus on tissue based musculoskeletal disorders. Here we argue that identifying and classifying patients based on this model can lead to overcomplicated or asymptomatic diagnostic labeling that may not translate into better patient outcomes.

8

Understanding Shoulder Pain: A Qualitative Evidence Synthesis Exploring the Patient Experience

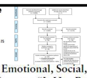
Christina Maxwell , BSc, MSc[1,*], Katie Robinson , BSc, MSc, PhD[2], Karen McCreesh , BSc, MSc, PhD[2]

PTJ: Physical Therapy & Rehabilitation Journal | Physical Therapy, 2021;101:1–15
DOI: 10.1093/ptj/pzaa229



9

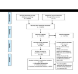
Understanding Shoulder Pain: A Qualitative Evidence Synthesis Exploring the Patient Experience



Citation	Negative Emotional, Social, and Activity Impact: "It Has Been a Big Upheaval."	Developing an Understanding: "Why Is It Hurting So Much?"	Exercise: "What If I Really Hurt This Shoulder?"
Barrett et al,[39] (2018)		X	X
Bele et al,[50] (2015)	X	X	X
Carr et al,[55] (2014)	X		X
Carter,[43] (2002)	X	X	X
Cuff and Littlewood,[44] (2018)	X	X	
Eriksson et al,[51] (2011)	X	X	X
Franz and Uhazie,[56] (2018)			X
Gilbert et al,[45] (2018)		X	X
Gillespie et al,[20] (2017)	X	X	X
Jones et al,[22] (2013)	X	X	
Littlewood et al,[47] (2014)		X	X
Lowe et al,[21] (2014)	X	X	X
Lowe et al,[48] (2018)	X	X	X
Nyman et al,[54] (2012)	X	X	X
Palenius and Nyman,[53] (2018)		X	X
Payne,[49] (2010)	X	X	X
Sandford et al,[46] (2017)	X	X	X
Sole et al,[52] (2019)	X	X	X
Stamp et al,[57] (2018)		X	X

10

Understanding Shoulder Pain: A Qualitative Evidence Synthesis Exploring the Patient Experience



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Payne,[49] (2010)	X	X	X
Sandford et al,[46] (2017)	X	X	X
Sole et al,[52] (2019)	X	X	X
Stamp et al,[57] (2018)		X	X

11

"I wanted to know what was hurting so much": a qualitative study exploring patients' expectations and experiences with primary care management

Véronique Lowry[1,2*], François Desmeules[1,2], Diana Zidarov[1,3,4], Patrick Lavigne[2,5], Jean-Sébastien Roy[6,7], Audrey-Anne Cormier[2], Yannick Tousignant-Laflamme[8,9], Kadija Perreault[6,7], Marie-Claude Lefèbvre[10], Simon Décary[8,9] and Anne Hudon[1,3,11]

Lowry *et al. BMC Musculoskeletal Disorders* (2023) 24:755
https://doi.org/10.1186/s12891-023-06885-x

12

Diagnosed pathology with clear management implications

No clear pathology but pain ± disability

Clear pathology not related to pain ± disability

13

Diagnosed pathology with clear management implications

No clear pathology but pain ± disability

Clear pathology not related to pain ± disability

14

Diagnosed pathology with clear management implications

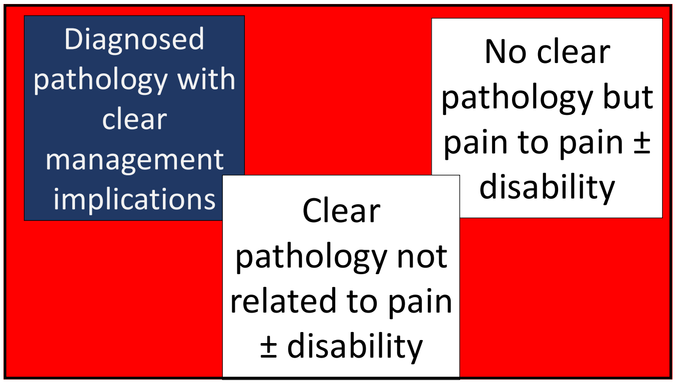
No clear pathology but pain ± disability

Clear pathology not related to pain ± disability

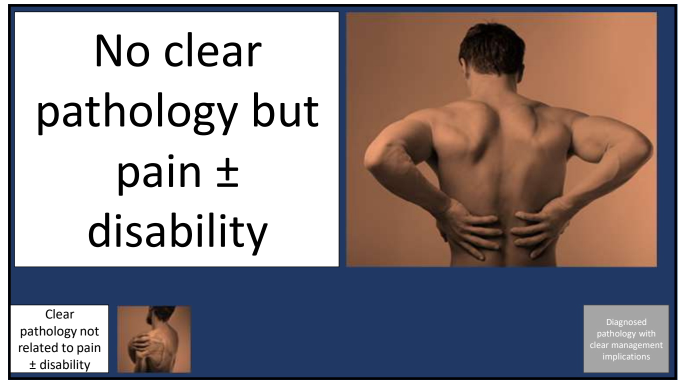
15

Clear pathology, short time-frame

16


Diagnosed pathology with clear management implications
No clear pathology but pain to pain ± disability
Clear pathology not related to pain ± disability

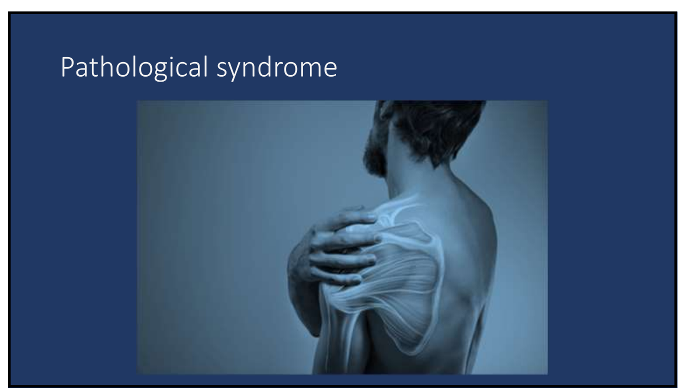
17


No clear pathology but pain ± disability
Clear pathology not related to pain ± disability
Diagnosed pathology with clear management implications

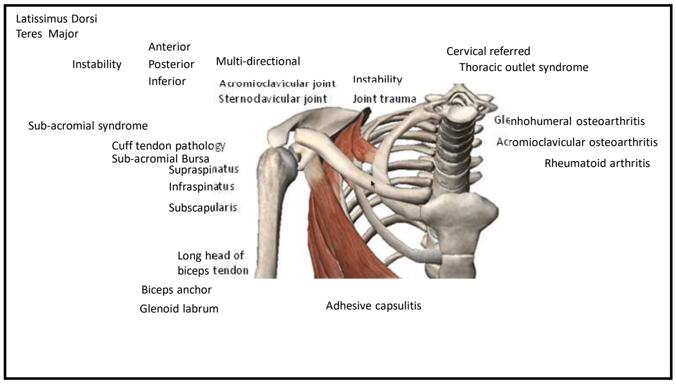
18


Clear pathology not related to pain ± disability
No clear pathology but pain to pain ± disability
Diagnosed pathology with clear management implications

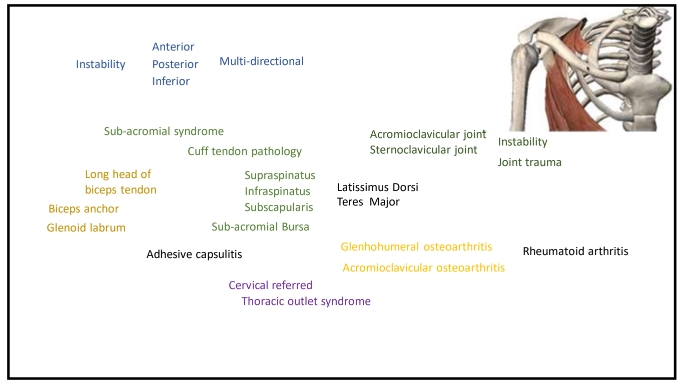
19


Pathological syndrome

20


Latissimus Dorsi
Teres Major
Instability
Anterior
Posterior
Inferior
Multi-directional
Acromioclavicular joint
Sternoclavicular joint
Instability
Joint trauma
Cervical referred
Thoracic outlet syndrome
Sub-acromial syndrome
Cuff tendon pathology
Sub-acromial Bursa
Supraspinatus
Infraspinatus
Subscapularis
Glenhohumeral osteoarthritis
Acromioclavicular osteoarthritis
Rheumatoid arthritis
Long head of
biceps tendon
Biceps anchor
Glenoid labrum
Adhesive capsulitis

21


Instability
Anterior
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Inferior
Multi-directional
Sub-acromial syndrome
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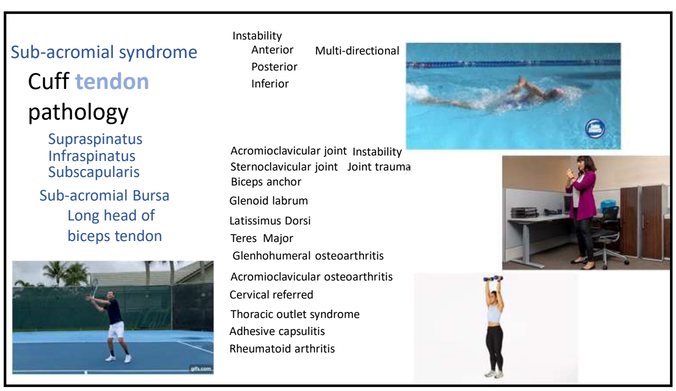
Rheumatoid arthritis
Adhesive capsulitis
Cervical referred
Thoracic outlet syndrome

22


Sub-acromial syndrome
Cuff tendon
pathology
Supraspinatus
Infraspinatus
Subscapularis
Sub-acromial Bursa
Long head of
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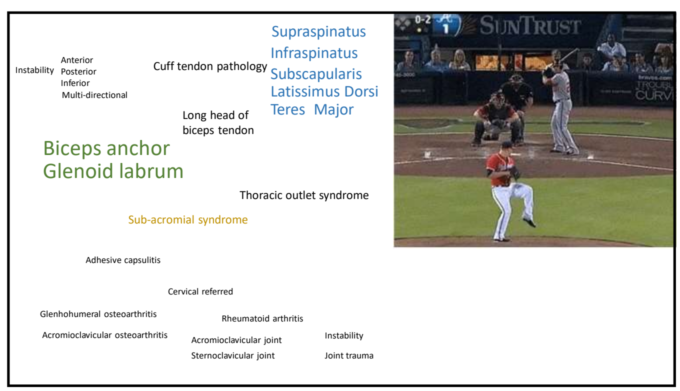
Cervical referred
Thoracic outlet syndrome
Adhesive capsulitis
Rheumatoid arthritis

23


Supraspinatus
Infraspinatus
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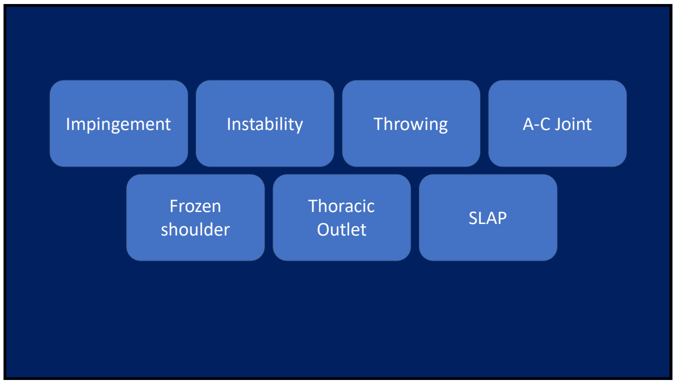
Sub-acromial syndrome
Adhesive capsulitis
Cervical referred
Glenhohumeral osteoarthritis
Acromioclavicular osteoarthritis
Rheumatoid arthritis
Acromioclavicular joint
Sternoclavicular joint
Instability
Joint trauma
SUNTRUST

24



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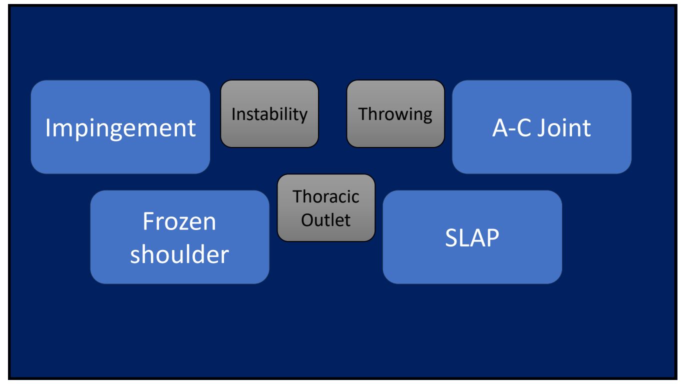

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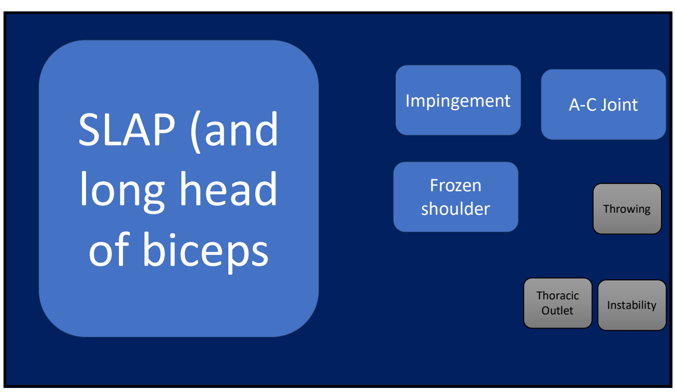

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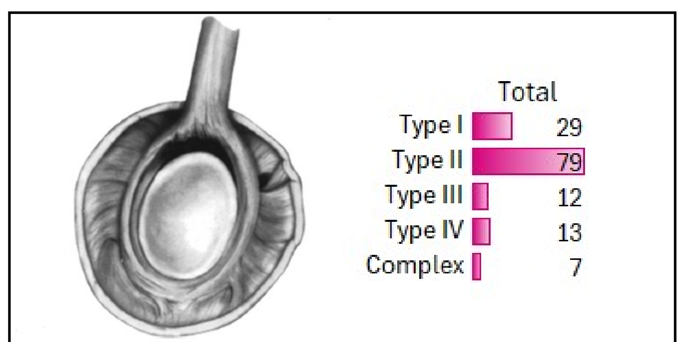

Figure 2 Type II SLAP lesion with detachment of superior labrum and biceps tendon from glenoid rim.

28

Innervation

- *Free nerve endings were noted in the surrounding connective tissue.*
- *Occasional free nerve endings were noted in the fibro-cartilage tissue of the labrum and these appeared only in the peripheral half.*

Neural Anatomy of the Glenohumeral Ligaments, Labrum, and Subacromial Bursa

C. Thomas Vangsness, Jr., M.D., Michael Ennis, M.D., Jeremy G. Taylor, B.S., and Roscoe Atkinson, M.D.

Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 11, No 2 (April), 1995: pp 180-184

29

Sensory innervation of the human shoulder joints in healthy and in chronic pain shoulder syndromes

Abel Martínez-Gago [a,b,1], Yolanda García-Mesa [a], Patricia Cuendias [a], José Martín-Cruces [a], Juan F. Abellán [c,d], Olivia García-Suárez [a], José A. Vega [a,e,*]

Annals of Anatomy 252 (2024) 152206

Methods: Joints shoulder from healthy subjects (n = 20) and with chronic pain shoulder syndromes (n = 17) were analyzed using immunohistochemistry for S100 protein to identify nerve structures (nerve fibers and sensory corpuscles), coupled with a quantification of the sensory formations. Sensory nerve formations were quantified in 13 distinct areas in healthy joint shoulder and in the available equivalent areas in the pathological joints. Statistical analyses were conducted to assess differences between healthy shoulder and pathological shoulder joint ($p < 0.05$).

30

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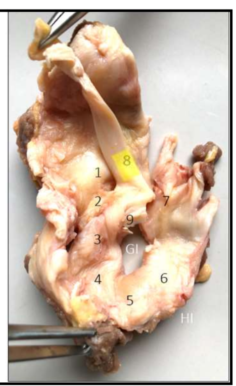

31

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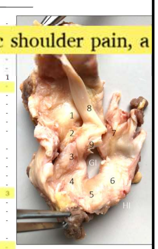
Annals of Anatomy 252 (2024) 152206

DENSITY PER CM^2	Free nerve endings	Simple lamellar corpuscles	Pacini corpuscles	Golgi-Mazzoni corpuscles	Ruffini-like corpuscles	Others
HEALTHY SHOULDER						
Zone 1	4.9	2.2	-	-	4.1	-
Zone 5	3.2	[illegible]	[illegible]	[illegible]	3.6	-
Zone 6	1.6	[illegible]	[illegible]	[illegible]	1	-
Zone 7	4.4	5.1	-	1	5.9	1
Zone 8	6.3	3.8	-	-	4.3	-
Zone 9	4.6	3.9	-	-	3.2	-
Zone 10	-	-	-	-	-	-
Zone 11	5.8	5.2	1	-	4.4	-
Zone 12	7.6	4.1	-	-	6.8	-
Zone 13	4.2	3.8	2	1	5.4	-
OMARTHROSIS						
Zone 1	-	-	-	-	-	-
Zone 2	1.6	-	-	-	-	-
Zone 3	1.3	1	-	-	-	-
Zone 5	-	-	-	-	-	-
Zone 7	-	-	-	-	1	-
Zone 8	2.4	0.8	-	-	3.1	3
Zone 9	2.7	3.2	-	-	1	-
Zone 10	-	-	-	-	-	-
Zone 11	5.2	2	-	-	2	-
SUBACROMIAL SYNDROME						
Zone 1	-	-	-	-	-	-
Zone 8	3.4	-	-	3.2	1.3	-
Zone 9	5.2	4.1	1.9	-	-	-
Zone 11	3.1	-	-	-	-	-

On the other hand, in joints from subjects suffering chronic shoulder pain, a reduced innervation was found.



32

MRI Findings in Throwing Shoulders

Abnormalities in Professional Handball Players

Bernhard Jost, MD; Matthias Zumstein, MD*; Christian W. A. Pfirrmann, MD†; Marco Zanetti, MD†; and Christian Gerber, MD**

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 434, pp. 130–137

Although 93% of the throwing shoulders had abnormal magnetic resonance imaging findings, only 37% were symptomatic.

Magnetic Resonance Imaging of the Shoulder in Asymptomatic Professional Baseball Pitchers

Anthony Miniaci,*† MD, FRCSC, Anthony T. Mascia,‡ MD, FRCPC, David C. Salonen,‡ MD, FRCPC, and Edna J. Becker,‡ MD, FRCPC

THE AMERICAN JOURNAL OF SPORTS MEDICINE, Vol. 30, No. 1

The labrum was abnormal in 79% of the 28 shoulders.

33

SLAP (and long head of biceps)

Impingement

A-C Joint

Frozen shoulder

Throwing

Thoracic Outlet

Instability

34

Impingement

A-C Joint

Frozen shoulder

Throwing

SLAP (and long head of biceps

Thoracic Outlet

Instability

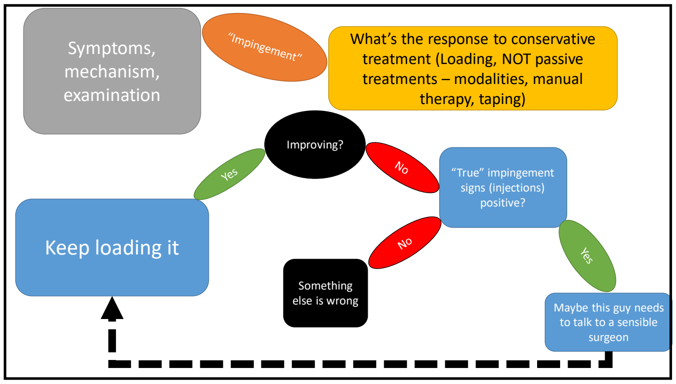
35

"Impingement"

(Mostly) it's **not** impingement of the acromion, it's a tendinopathy

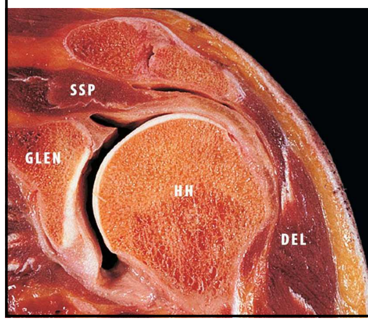
Tendinopathy is best managed with graded exercise, but it takes time

36



37

"Subacromial impingement"

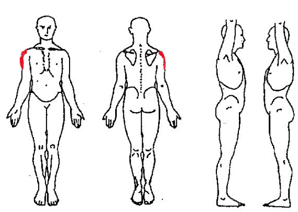


- Jaravay JF. Sur la luxation du tendon de la longue portion du muscle biceps humeral: sur la luxation de tendons des muscles peroniers latercux. Gaz Hebd Med Chir **1867**;21:325.
- Neer CS II. Anterior acromioplasty for the chronic impingement syndrome of the shoulder. A preliminary report. J Bone Joint Surg **1972**; 54A: 41.

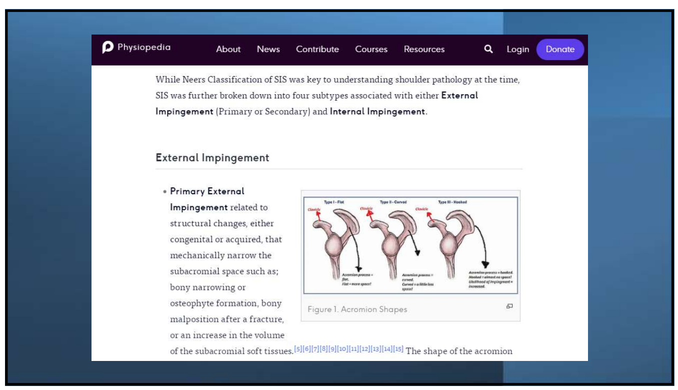
38

"Sub-acromial syndrome" (~~Impingement~~)

- *"It hurts here – deep in the top of my shoulder, and can run down my arm"*
- *"It hurts to sleep on it"*
- *"Sometimes it catches and gives me a really sharp pain"*



39



While Neers Classification of SIS was key to understanding shoulder pathology at the time, SIS was further broken down into four subtypes associated with either **External Impingement** (Primary or Secondary) and **Internal Impingement**.

External Impingement

- **Primary External Impingement** related to structural changes, either congenital or acquired, that mechanically narrow the subacromial space such as; bony narrowing or osteophyte formation, bony malposition after a fracture, or an increase in the volume of the subacromial soft tissues.[5][6][7][8][9][10][11][12][13][14][15] The shape of the acromion

Figure 1. Acromion Shapes

40

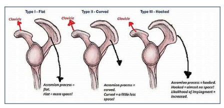
THE 'HOOKED' ACROMION REVISITED

J. G. EDELSON

From Poriya Hospital, Tiberias, Israel

Examination was made of 750 scapular dry bone specimens from museum collections and 80 cadaver shoulders. Hooking of the acromion was not found in subjects under the age of 30 years. The hooked configuration developed at later ages in an increasing proportion of subjects as a result of calcification of the acromial attachment of the coracoacromial ligament.

J Bone Joint Surg [Br] 1995;77-B:284-7.
Received 23 February 1994; Accepted after revision 17 May 1994



41

SAI: reactive acromial changes

- Neer 1972: 8 of 19
- (Budoff et al 1998: 20 of 79)
- Recommendation:
  Acromioplasty:

100%

42

Cuff Tears and SAI

- Ozaki et al 1988 200 cadaveric shoulders:

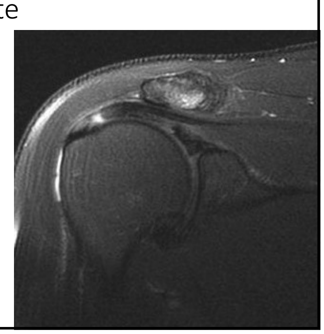
Lesion on undersurface of anterior 1/3 of acromion always associated with a RCT

- ***Reverse is not true***

43

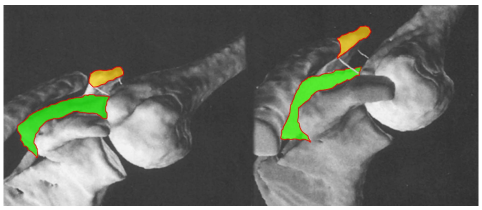
Pathophysiology: tear site

- Uthoff et al 1998 Ozaki et al 1988: Cadaveric study: vast majority undersurface tears
- Loehr & Uthoff 306 degenerative cuffs 1987: articular side, near the insertion
- Payne et al: 91% of 43 athletes with partial thickness tears: undersurface



44

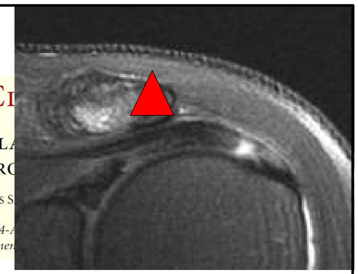
Graichen 1999



- Beyond 120° of abduction the entire supraspinatus footprint is medial to the acromion

45

How has the information in the article withstood the "test of time"?
Neer believed that impingement causes rotator cuff tears. This hypothesis does not appear to have withstood the test of time. It is more likely that rotator cuff dysfunction results in upward displacement of the humeral head and causes impingement of the humeral head against the acromion with shoulder use rather than the reverse. Arthroscopy and magnetic resonance imaging arthrography have elucidated many conditions that cause shoulder pain and that previously have been misdiagnosed as impingement. The liberal use of acromioplasty to treat "impingement" is being replaced by a trend toward making an anatomic diagnosis, such as a partial or a complete tear of the rotator cuff, and performing corrective surgery, such as repair of the torn rotator cuff.



46

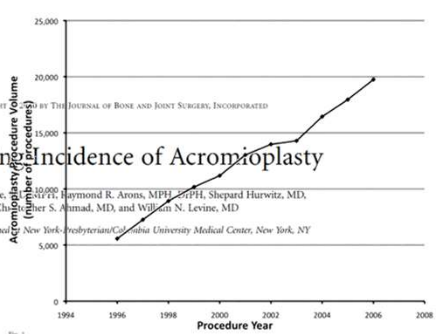
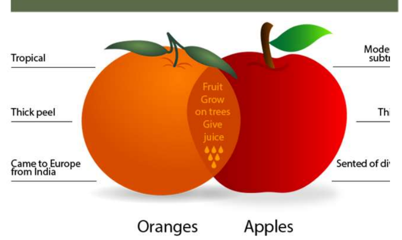


Fig. 1
Line graph showing the volume of acromioplasty procedures by year in New York State.

47

Shoulders are different, but are they?

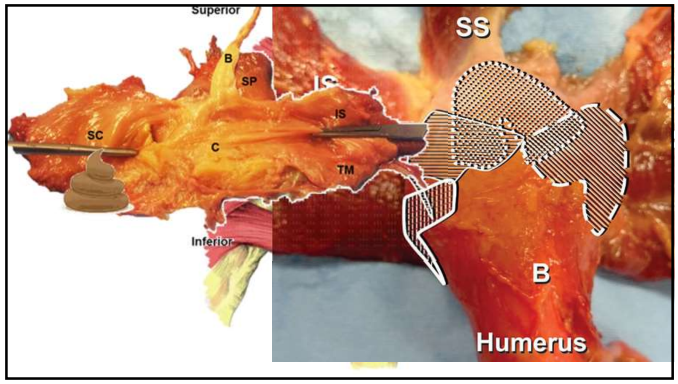


- It's just tendonopathy (mostly)
- Tendons don't know they're in the shoulder or leg

48

The anatomy is the same, only different

49



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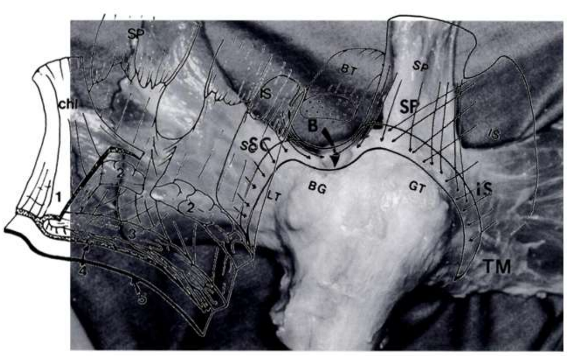

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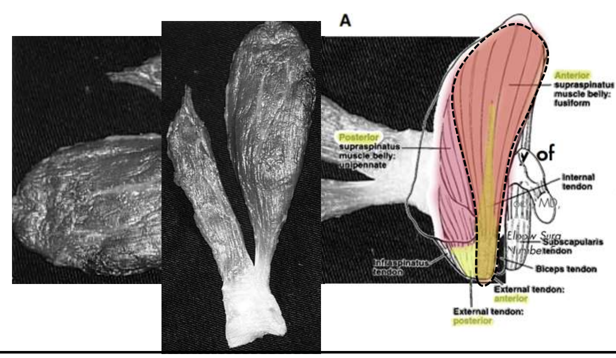

52

The histology of tendon attachments to bone in man

M. BENJAMIN, E. J. EVANS AND L. COPP

J. Anat. (1986), **149**, pp. 89–100

Why don't we see many tendon tears of the deltoid?

53

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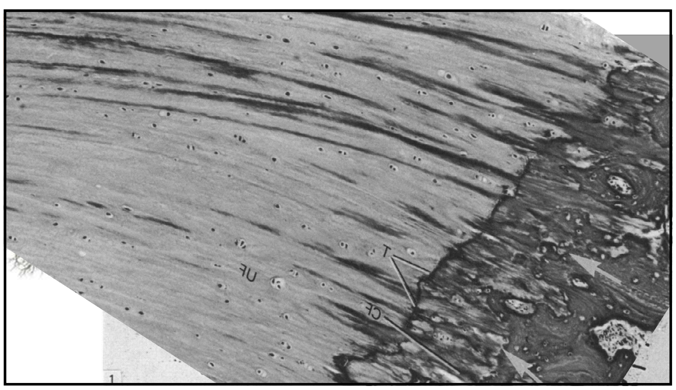

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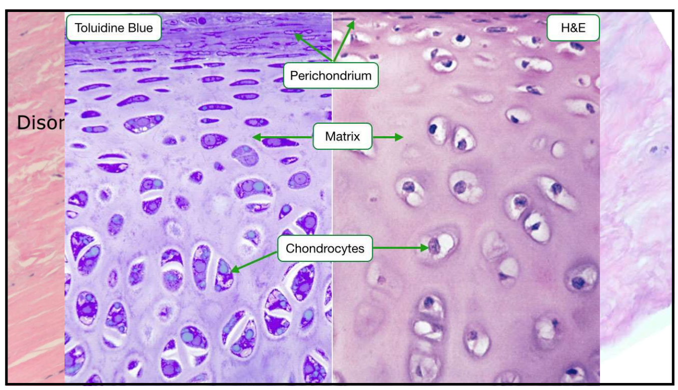


56

New regimen for eccentric calf-muscle training in patients with chronic insertional Achilles tendinopathy: results of a pilot study

P Jonsson,[1] H Alfredson,[1] K Sunding,[2] M Fahlström,[3] J Cook[4]

	Good	Poor	Good	Poor
	(n=90)	(n=11)	(n=10)	(n=

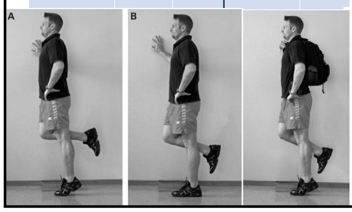
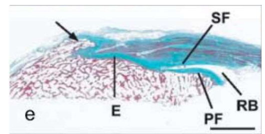


Table 2 Characteristics of 34 tendons in 27 subjects with chronic insertional Achilles tendinopathy: comparison between subjects who were satisfied and not satisfied with treatment

Variable	Satisfied (n = 23)	Not satisfied (n = 11)	p Value
Female	15/23	3/11	
Age	54.9 (14.7)	50.3 (7.8)	0.336
Height (cm)	171.1 (9.3)	176.1 (7.1)	0.130
Weight (kg)	86.7 (19.8)	83.0 (14.0)	0.584
BMI	29.7 (7.0)	26.7 (3.9)	0.206
Duration of symptoms (months)	23.3 (22.6)	33.4 (16.3)	0.196
Haglund's deformity	18/23	9/11	0.813
Bursitis	17/23	5/11	0.110
Bone spurs	20/23	5/11	0.373
Baseline VAS	69.9 (18.9)	77.5 (8.6)	0.115
Follow-up VAS	21.0 (20.6)	58.1 (14.8)	<0.001*

57

Insertional tendinopathy



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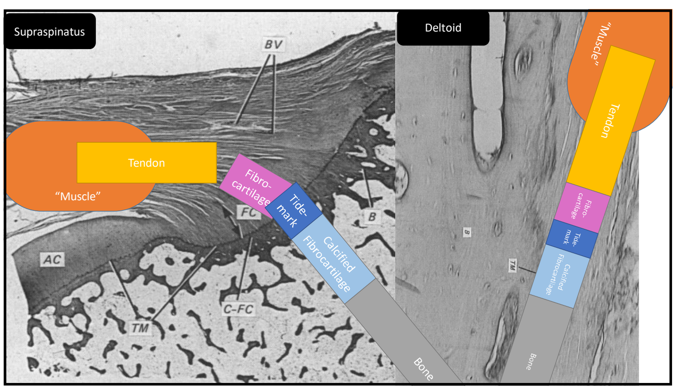
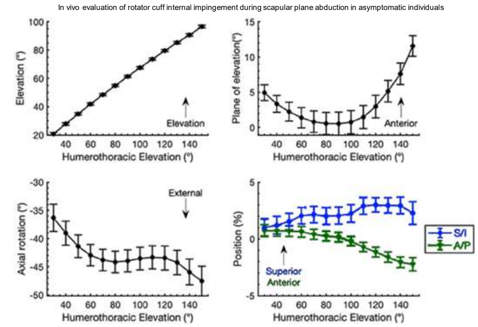


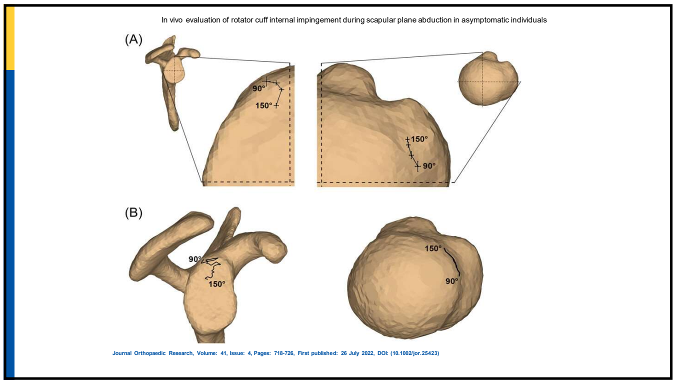
59

In vivo evaluation of rotator cuff internal impingement during scapular plane abduction in asymptomatic individuals



Journal Orthopaedic Research, Volume: 41, Issue: 4, Pages: 718-726, First published: 26 July 2022, DOI: (10.1002/jor.25423)

60



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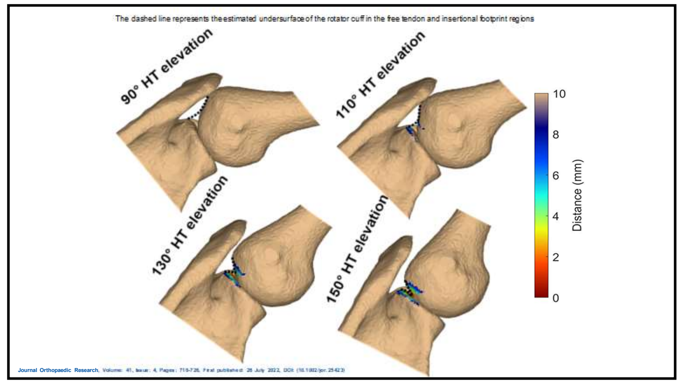
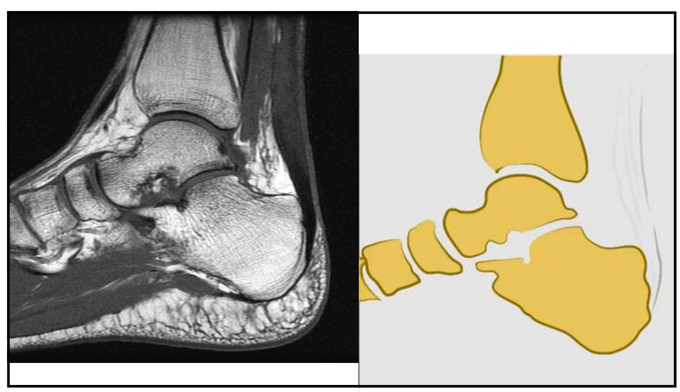


62

Another interesting finding of this study was the high prevalence of glenoid-to-footprint contact (100%) compared to acromion-to-footprint contact (51.4%), without a significant difference between supraspinatus pathology groups. This finding is consistent with growing evidence that subacromial contact occurs in only about 50% of individuals during humeral elevation.

63



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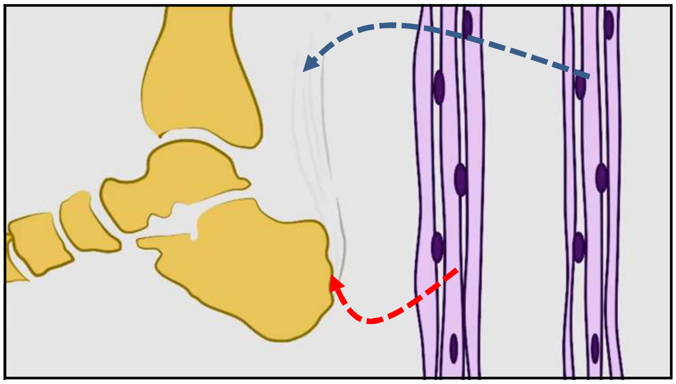

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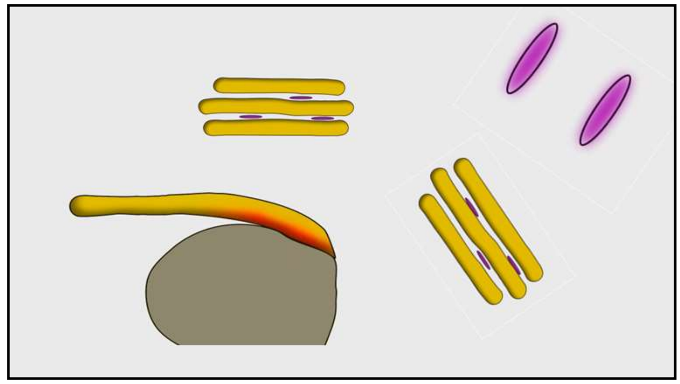

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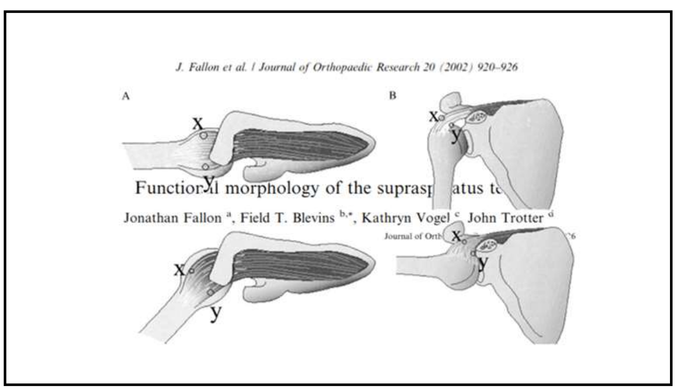
J. Fallon et al. / Journal of Orthopaedic Research 20 (2002) 920–926
A
B
x
y
Jonathan Fallon a, Field T. Blevins b,*, Kathryn Vogel c, John Trotter d

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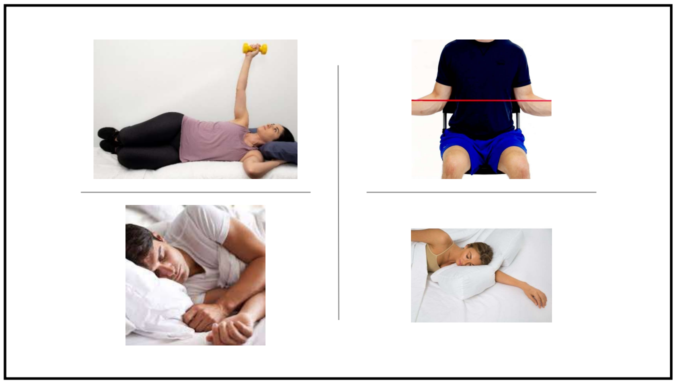
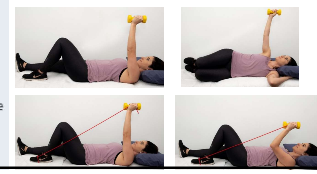
68



69

"Neutral" cuff, long lever

- Supine, Sidelying
- Weights
- Weights + elastic ("artificial gravity")



70

Masci *et al. BMC Musculoskeletal Disorders* (2016) 17:97
DOI 10.1186/s12891-016-0955-5

BMC Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

How to diagnose plantaris tendon involvement in midportion Achilles tendinopathy - clinical and imaging findings

Lorenzo Masci[1], Christoph Spang[2*], Hans T. M. van Schie[3,5] and Håkan Alfredson[1,4,5]

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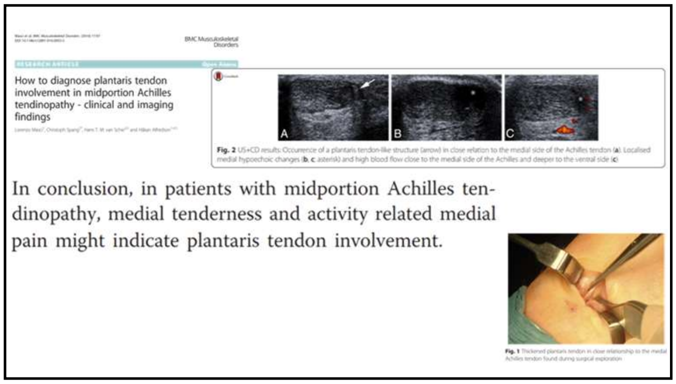
Fig. 1 Thickened plantaris tendon in close relationship to the medial Achilles tendon found during surgical exploration

72


BMC Musculoskeletal Disorders
How to diagnose plantaris tendon involvement in midportion Achilles tendinopathy - clinical and imaging findings
A
B
C
Fig. 2 US+CD results: Occurrence of a plantaris tendon-like structure (arrow) in close relation to the medial side of the Achilles tendon (a). Localised medial hypoechoic changes (b, c asterisk) and high blood flow close to the medial side of the Achilles and deeper to the ventral side (c)
In conclusion, in patients with midportion Achilles tendinopathy, medial tenderness and activity related medial pain might indicate plantaris tendon involvement.
Fig. 1 Thickened plantaris tendon in close relationship to the medial Achilles tendon found during surgical exploration

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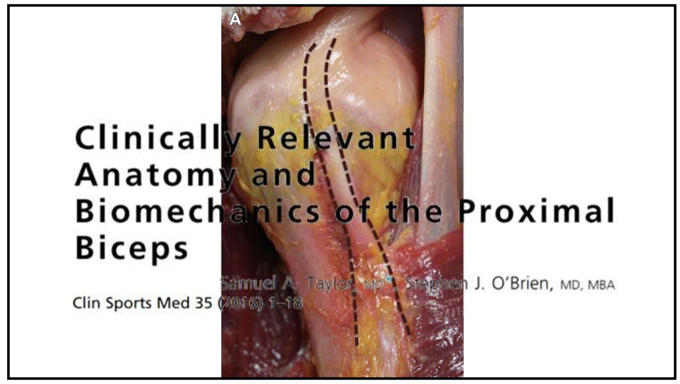
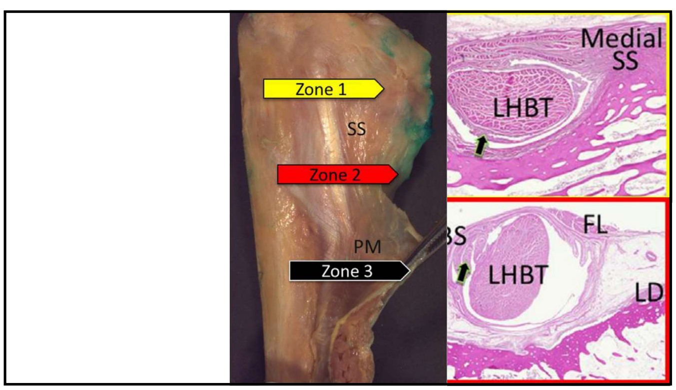
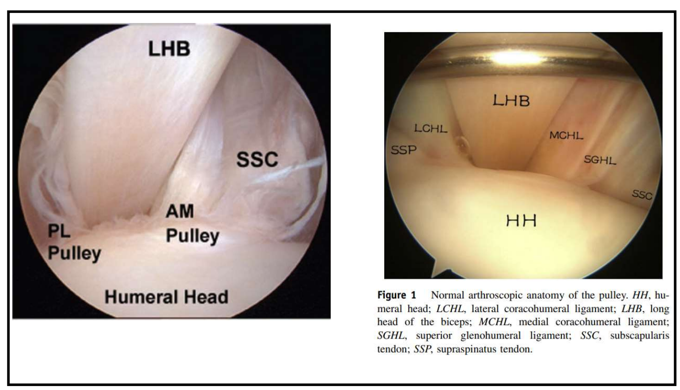

A
Clinically Relevant Anatomy and Biomechanics of the Proximal Biceps
Samuel A. Taylor, Stephen J. O'Brien, MD, MBA
Clin Sports Med 35 (2016) 1–18

74


Zone 1
SS
Zone 2
PM
Zone 3
Medial SS
LHBT
FL
LD
LHBT

75


LHB
SSC
AM Pulley
PL Pulley
Humeral Head
LHB
LCHL
SSP
MCHL
SGHL
SSC
HH
Figure 1 Normal arthroscopic anatomy of the pulley. HH, humeral head; LCHL, lateral coracohumeral ligament; LHB, long head of the biceps; MCHL, medial coracohumeral ligament; SGHL, superior glenohumeral ligament; SSC, subscapularis tendon; SSP, supraspinatus tendon.

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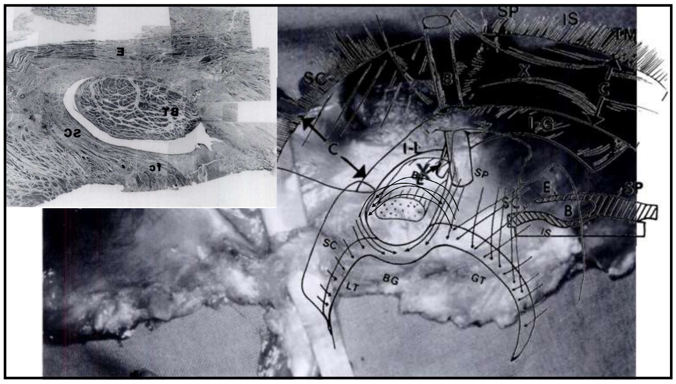
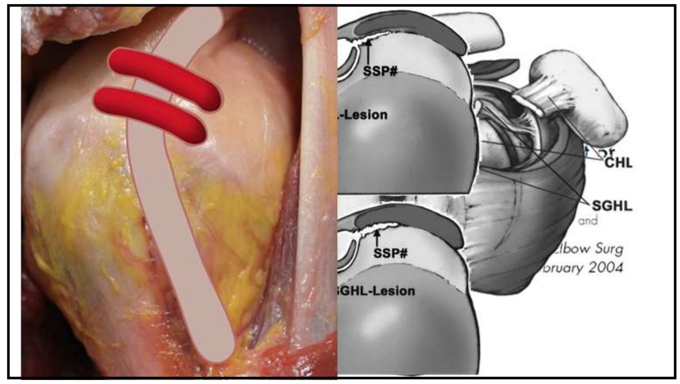


77



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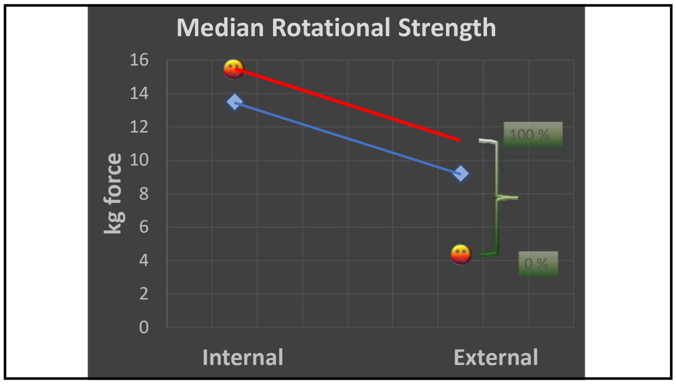
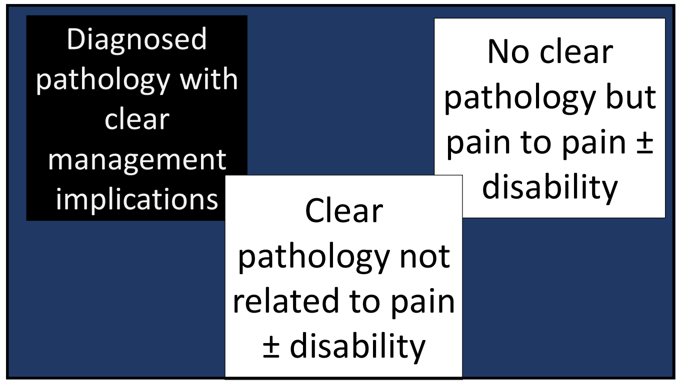
Rotational strength testing: Break test

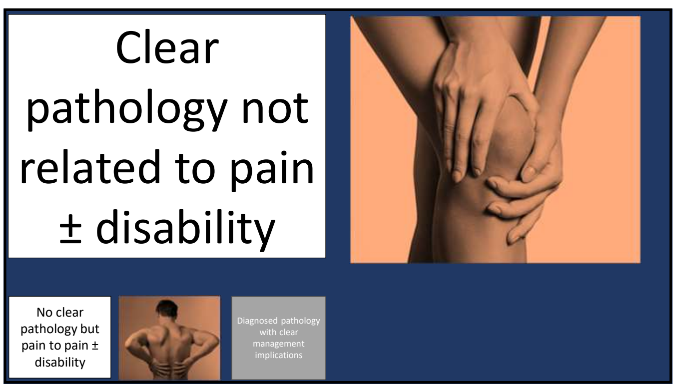
80


Median Rotational Strength
kg force
16
14
12
10
8
6
4
2
0
100 %
0 %
Internal
External

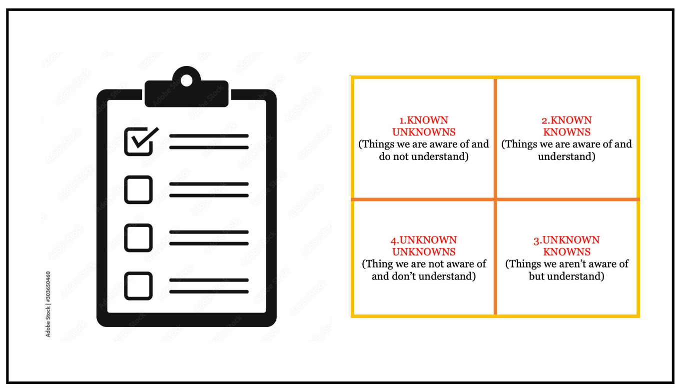
81


Diagnosed pathology with clear management implications
No clear pathology but pain to pain ± disability
Clear pathology not related to pain ± disability

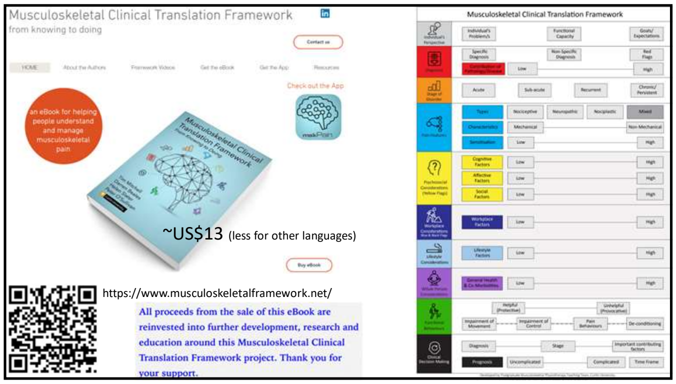
82


Clear pathology not related to pain ± disability
No clear pathology but pain to pain ± disability
Diagnosed pathology with clear management implications

83


1.KNOWN UNKNOWNS
(Things we are aware of and do not understand)
2.KNOWN KNOWNS
(Things we are aware of and understand)
4.UNKNOWN UNKNOWNS
(Thing we are not aware of and don't understand)
3.UNKNOWN KNOWNS
(Things we aren't aware of but understand)

84



Musculoskeletal Clinical Translation Framework
from knowing to doing
an eBook for helping people understand and manage musculoskeletal pain
~US$13 (less for other languages)
https://www.musculoskeletalframework.net/
All proceeds from the sale of this eBook are reinvested into further development, research and education around this Musculoskeletal Clinical Translation Framework project. Thank you for your support.
Musculoskeletal Clinical Translation Framework

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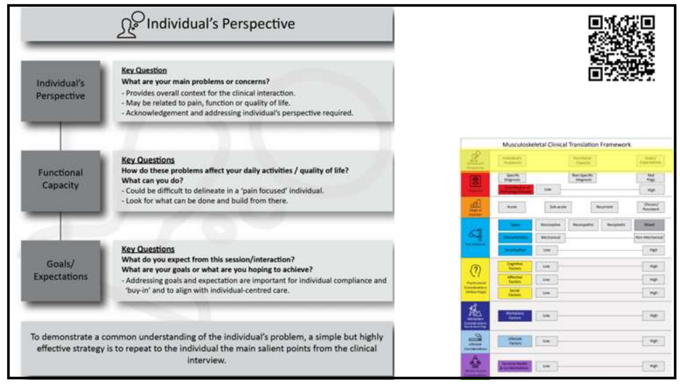

Individual's Perspective
Individual's Perspective
Key Question
What are your main problems or concerns?
- Provides overall context for the clinical interaction.
- May be related to pain, function or quality of life.
- Acknowledgement and addressing individual's perspective required.
Functional Capacity
Key Questions
How do these problems affect your daily activities / quality of life?
What can you do?
- Could be difficult to delineate in a 'pain focused' individual.
- Look for what can be done and build from there.
Goals/ Expectations
Key Questions
What do you expect from this session/interaction?
What are your goals or what are you hoping to achieve?
- Addressing goals and expectation are important for individual compliance and 'buy-in' and to align with individual-centred care.
To demonstrate a common understanding of the individual's problem, a simple but highly effective strategy is to repeat to the individual the main salient points from the clinical interview.
Musculoskeletal Clinical Translation Framework

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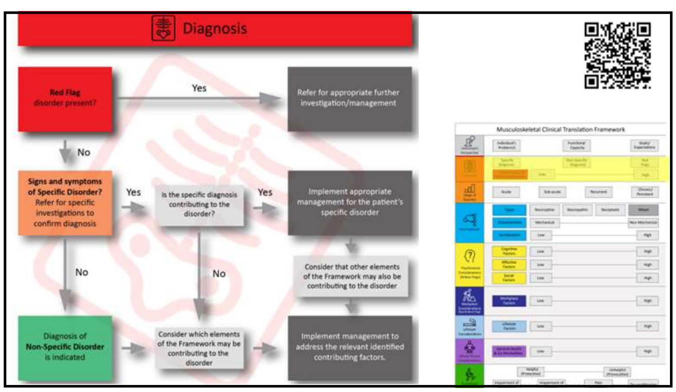

Diagnosis
Red Flag disorder present?
Yes
Refer for appropriate further investigation/management
No
Signs and symptoms of Specific Disorder? Refer for specific investigations to confirm diagnosis
Yes
Is the specific diagnosis contributing to the disorder?
Yes
Implement appropriate management for the patient's specific disorder
Consider that other elements of the Framework may also be contributing to the disorder
No
No
Diagnosis of Non-Specific Disorder is indicated
Consider which elements of the Framework may be contributing to the disorder
Implement management to address the relevant identified contributing factors.
Musculoskeletal Clinical Translation Framework

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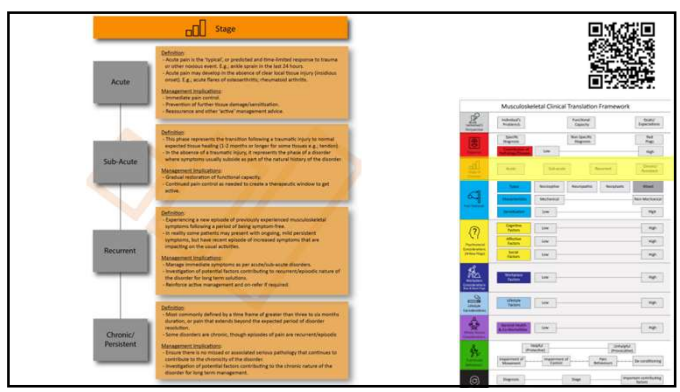

Stage
Acute
Definition:
- Acute pain is the 'typical', or predicted and time-limited response to trauma or other noxious event. E.g., ankle sprain in the last 24 hours.
- Acute pain may develop in the absence of clear local tissue injury (insidious onset). E.g., acute flares of osteoarthritis, rheumatoid arthritis.
Management Implications:
- Immediate pain control.
- Prevention of further tissue damage/sensitisation.
- Reassurance and other 'active' management advice.
Sub-Acute
Definition:
- This phase represents the transition following a traumatic injury to normal expected tissue healing (1-2 months or longer for some tissues e.g., tendon).
- In the absence of a traumatic injury, it represents the phase of a disorder where symptoms usually subside as part of the natural history of the disorder.
Management Implications:
- Gradual restoration of functional capacity.
- Continued pain control as needed to create a therapeutic window to get active.
Recurrent
Definition:
- Experiencing a new episode of previously experienced musculoskeletal symptoms following a period of being symptom-free.
- In reality some patients may present with ongoing, mild persistent symptoms, but have recent episode of increased symptoms that are impacting on the usual activities.
Management Implications:
- Manage immediate symptoms as per acute/sub-acute disorders.
- Investigation of potential factors contributing to recurrent/episodic nature of the disorder for long term solutions.
- Reinforce active management and on-refer if required.
Chronic/ Persistent
Definition:
- Most commonly defined by a time frame of greater than three to six months duration, or pain that extends beyond the expected period of disorder resolution.
- Some disorders are chronic, though episodes of pain are recurrent/episodic.
Management Implications:
- Ensure there is no missed or associated serious pathology that continues to contribute to the chronicity of the disorder.
- Investigation of potential factors contributing to the chronic nature of the disorder for long term management.
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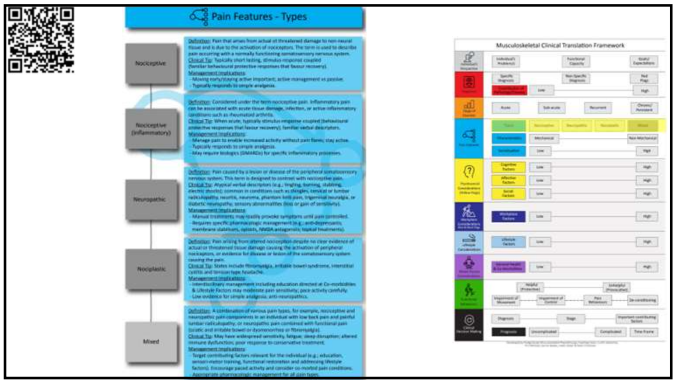
Pain Features - Types
Nociceptive
Nociceptive (Inflammatory)
Neuropathic
Nociplastic
Mixed
Musculoskeletal Clinical Translation Framework

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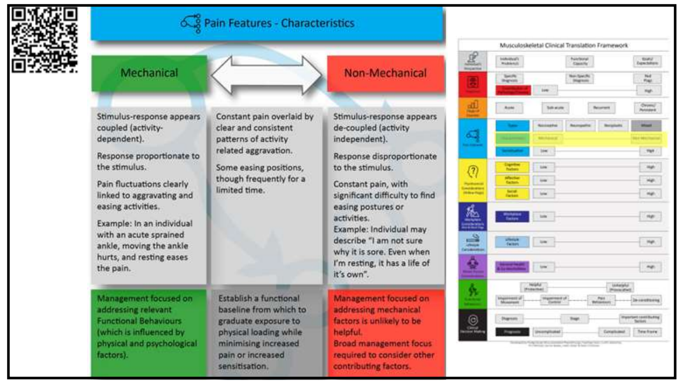
Pain Features - Characteristics
Mechanical
Non-Mechanical
Stimulus-response appears coupled (activity-dependent).
Response proportionate to the stimulus.
Pain fluctuations clearly linked to aggravating and easing activities.
Example: In an individual with an acute sprained ankle, moving the ankle hurts, and resting eases the pain.
Constant pain overlaid by clear and consistent patterns of activity related aggravation.
Some easing positions, though frequently for a limited time.
Stimulus-response appears de-coupled (activity independent).
Response disproportionate to the stimulus.
Constant pain, with significant difficulty to find easing postures or activities.
Example: Individual may describe "I am not sure why it is sore. Even when I'm resting, it has a life of it's own".
Management focused on addressing relevant Functional Behaviours (which is influenced by physical and psychological factors).
Establish a functional baseline from which to graduate exposure to physical loading while minimising increased pain or increased sensitisation.
Management focused on addressing mechanical factors is unlikely to be helpful.
Broad management focus required to consider other contributing factors.
Musculoskeletal Clinical Translation Framework

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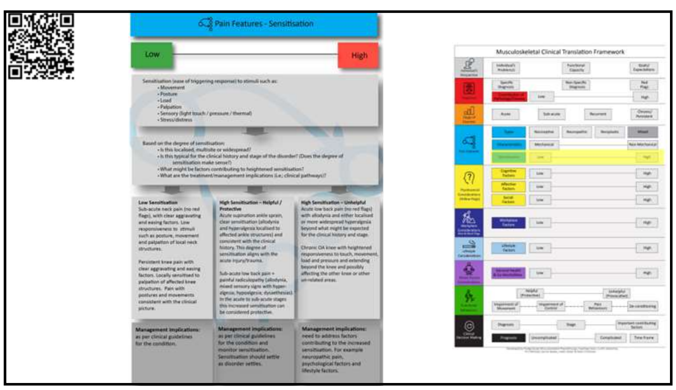
Pain Features - Sensitisation
Low
High
Sensitisation (ease of triggering response) to stimuli such as:
• Movement
• Posture
• Load
• Palpation
• Sensory (light touch / pressure / thermal)
• Stress/distress
Based on the degree of sensitisation:
• Is this localised, multisite or widespread?
• Is this typical for the clinical history and stage of the disorder? (Does the degree of sensitisation make sense?)
• What might be factors contributing to heightened sensitisation?
• What are the treatment/management implications (i.e.; clinical pathways)?
Low Sensitisation
Sub-acute neck pain (no red flags), with clear aggravating and easing factors. Low responsiveness to stimuli such as posture, movement and palpation of local neck structures.
Persistent knee pain with clear aggravating and easing factors. Locally sensitised to palpation of affected knee structures. Pain with postures and movements consistent with the clinical picture.
High Sensitisation – Helpful / Protective
Acute supination ankle sprain, clear sensitisation (allodynia and hyperalgesia localised to affected ankle structures) and consistent with the clinical history. This degree of sensitisation aligns with the acute injury/trauma.
Sub-acute low back pain + painful radiculopathy (allodynia, mixed sensory signs with hyper-algesia, hypoalgesia, dysaethesias). In the acute to sub-acute stages this increased sensitisation can be considered protective.
High Sensitisation – Unhelpful
Acute low back pain (no red flags) with allodynia and either localised or more widespread hyperalgesia beyond what might be expected for the clinical history and stage.
Chronic OA knee with heightened responsiveness to touch, movement, load and pressure and extending beyond the knee and possibly affecting the other knee or other un-related areas.
Management implications: as per clinical guidelines for the condition.
Management implications: as per clinical guidelines for the condition and monitor sensitisation. Sensitisation should settle as disorder settles.
Management implications: need to address factors contributing to the increased sensitisation. For example neuropathic pain, psychological factors and lifestyle factors.
Musculoskeletal Clinical Translation Framework

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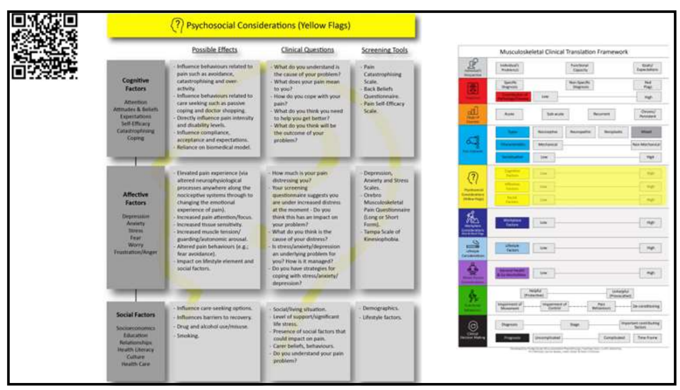
Psychosocial Considerations (Yellow Flags)
Possible Effects
Clinical Questions
Screening Tools
Cognitive Factors
Attention
Attitudes & Beliefs
Expectations
Self-Efficacy
Catastrophising
Coping
- Influence behaviours related to pain such as avoidance, catastrophising and over-activity.
- Influence behaviours related to care seeking such as passive coping and doctor shopping.
- Directly influence pain intensity and disability levels.
- Influence compliance, acceptance and expectations.
- Reliance on biomedical model.
- What do you understand is the cause of your problem?
- What does your pain mean to you?
- How do you cope with your pain?
- What do you think you need to help you get better?
- What do you think will be the outcome of your problem?
- Pain Catastrophising Scale.
- Back Beliefs Questionnaire.
- Pain Self-Efficacy Scale.
Affective Factors
Depression
Anxiety
Stress
Fear
Worry
Frustration/Anger
- Elevated pain experience (via altered neurophysiological processes anywhere along the nociceptive systems through to changing the emotional experience of pain).
- Increased pain attention/focus.
- Increased tissue sensitivity.
- Increased muscle tension/guarding/autonomic arousal.
- Altered pain behaviours (e.g.; fear avoidance).
- Impact on lifestyle element and social factors.
- How much is your pain distressing you?
- Your screening questionnaire suggests you are under increased distress at the moment - Do you think this has an impact on your problem?
- What do you think is the cause of your distress?
- Is stress/anxiety/depression an underlying problem for you? How is it managed?
- Do you have strategies for coping with stress/anxiety/depression?
- Depression, Anxiety and Stress Scales.
- Orebro Musculoskeletal Pain Questionnaire (Long or Short Form).
- Tampa Scale of Kinesiophobia.
Social Factors
Socioeconomics
Education
Relationships
Health Literacy
Culture
Health Care
- Influence care-seeking options.
- Influences barriers to recovery.
- Drug and alcohol use/misuse.
- Smoking.
- Social/living situation.
- Level of support/significant life stress.
- Presence of social factors that could impact on pain.
- Carer beliefs, behaviours.
- Do you understand your pain problem?
- Demographics.
- Lifestyle factors.
Musculoskeletal Clinical Translation Framework

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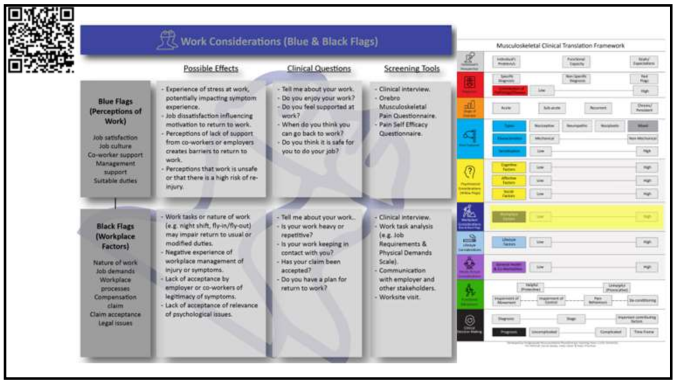

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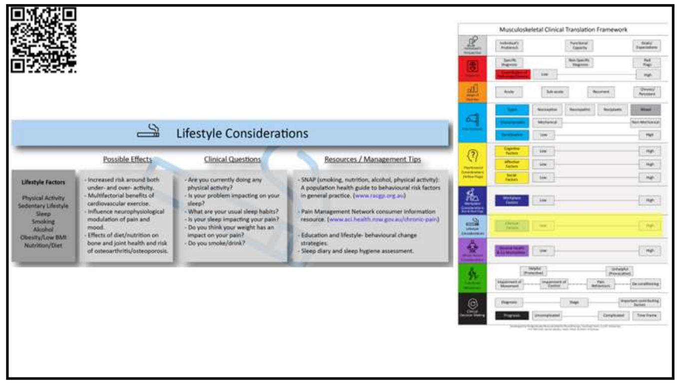

94

Chronic hyperglycemia, hypercholesterolemia, and metabolic syndrome are associated with risk of tendon injury

Dorthe Skovgaard[1] | Volkert D. Siersma[2] | Soren Bering Klausen[3,4] | Håvard Visnes[5,6,7] | Inger Haukenes[3] | Christine W. Bang[2] | Peter Bager[8] | Karin Grävare Silbernagel[9] | Jamie Gaida[10] | Stig Peter Magnusson[1,4] | Michael Kjaer[1] | Christian Couppé[1,4]

In conclusion, for the first time, it was demonstrated that individuals with elevated HbA1c (glycated hemoglobin, proxy for elevated blood glucose) have a 3 times higher risk of tendon injury in lower extremities compared to individuals with normal HbA1C within a 3-year period. These novel data based on a large cohort with different physical activity levels indicate that increased HbA1c also within the non-diabetic range probably affects tendon structure and makes tendinous tissue more prone to damage and injury. Likewise, adding to the existing knowledge, we found that hypercholesterolemia and metabolic syndrome exert detrimental effects in tendon connective tissue and increase the risk of tendon injury. These data imply that it could be beneficial to use a more comprehensive perspective and address metabolic status when working with patients during tendon rehabilitation and injury prevention.

95

Chronic hyperglycemia, hypercholesterolemia, and metabolic syndrome are associated with risk of tendon injury

In conclusion, for the first time, it was demonstrated that individuals with elevated HbA1c (glycated hemoglobin, proxy for elevated blood glucose) have a **3 times higher risk** of tendon injury in lower extremities compared to individuals with **normal HbA1C** within a 3-year period. These novel data based on a large cohort with different physical activity levels indicate that increased HbA1c also within the non-diabetic range probably affects tendon structure and makes tendinous tissue more prone to damage and injury. Likewise, adding to the existing knowledge, we found that hypercholesterolemia and metabolic syndrome exert detrimental effects in tendon connective tissue and increase the risk of tendon injury. These data imply that it could be beneficial to use a more comprehensive perspective and **address metabolic status** when working with patients during tendon rehabilitation and injury prevention.

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Clinical Impact of Metabolic Syndrome on Eccentric Exercises for Chronic Insertional Achilles Tendinopathy

Young Hwan Park, MD[1], Woon Kim, MD[1], Jae Young Kim, MD[1], Gi Won Choi, MD[2], Hak Jun Kim, MD, PhD[1]

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[2] *Department of Orthopedic Surgery, Korea University Ansan Hospital, Ansan, Korea*

The Journal of Foot & Ankle Surgery 61 (2022) 726–729

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At Least 3 of the Following 5 Criteria:
(1) Clinical diagnosis of diabetes treated with oral hypoglycemic medication or insulin or a fasting serum glucose level of 110 mg/dL or higher
(2) Arterial blood pressure of 130/85 mm Hg or higher or current use of antihypertensive medication
(3) Plasma triglyceride level of 150 mg/dL or higher
(4) High-density lipoprotein cholesterol level less than 50 mg/dL for females or less than 40 mg/dL for males
(5) Waist circumference greater than 88 cm for women or 102 cm for men*

98

Eccentric Calf-Muscle Exercise Regimen

The patients were taught to perform eccentric calf-muscle training, which is known to be effective for chronic insertional Achilles tendinopathy (19). The senior author demonstrated how to perform the eccentric exercises to each patient on an individual basis, and all patients were given handwritten instructions of the exercises for future use. The eccentric calf-muscle training exercises were performed by the patient in an upright standing position with straight legs. The patients raised the heel of uninjured leg, moved all their weight to the injured side, and slowly lowered the heel to floor level. The procedure was performed without ankle dorsiflexion. Patients performed 3 sets of 15 repetitions with 1 minute of rest between the sets twice a day on 7 days per week for 12 weeks. If the patient reported no pain during exercise, the load was increased to reach a new level of painful training using a progressively weighted backpack. When the pain was tolerable, the patients were permitted to slowly return to their previous sports/recreational activity after 6 weeks of training. Prescriptions for paracetamol or naproxen were given as needed.

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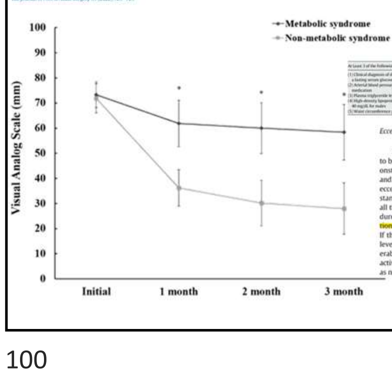

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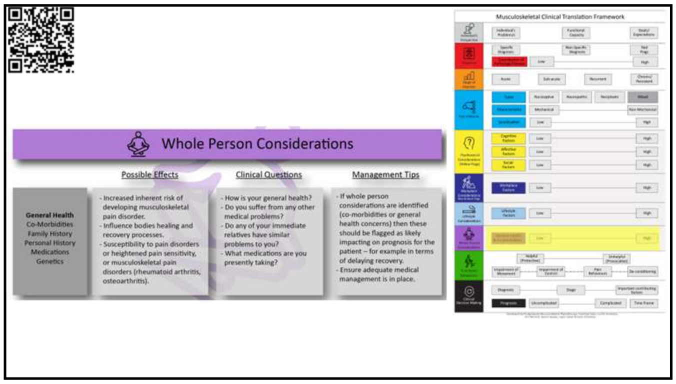

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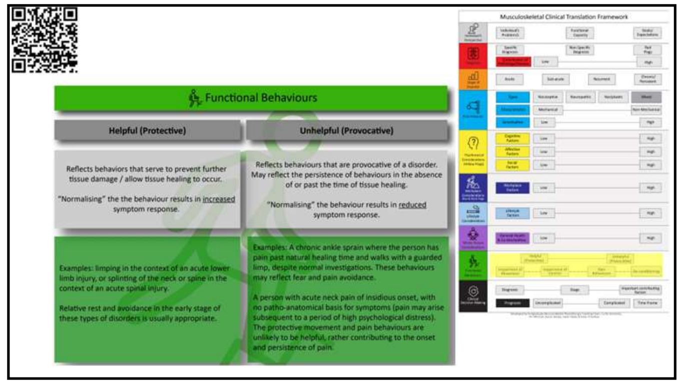

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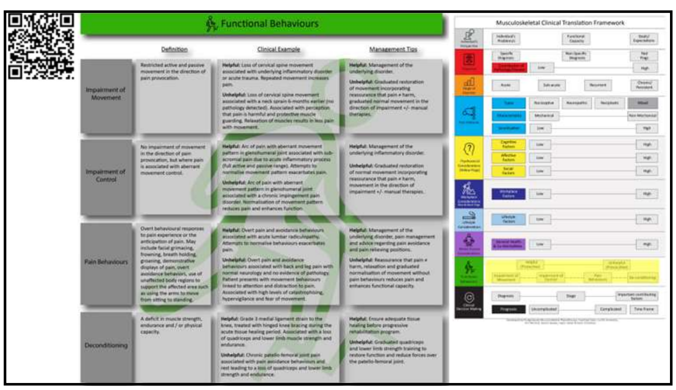

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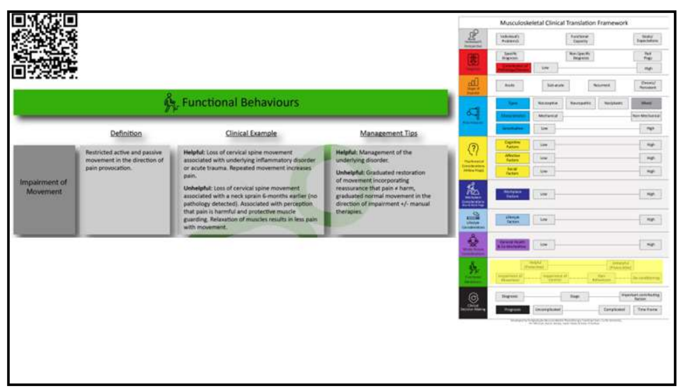

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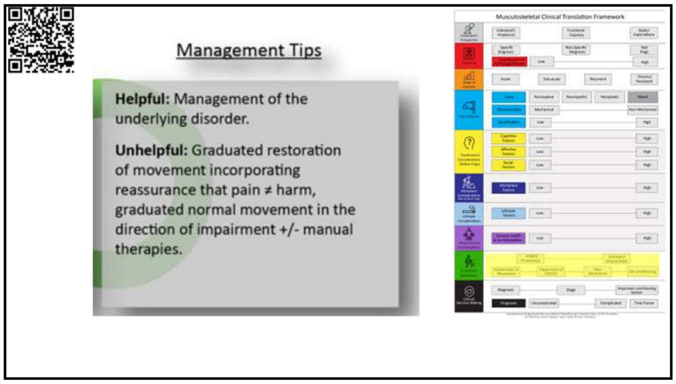

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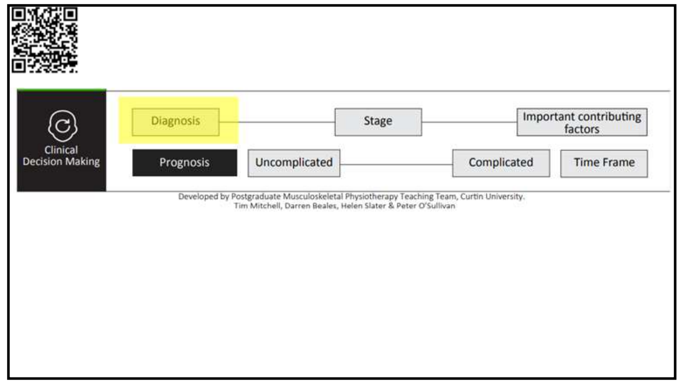

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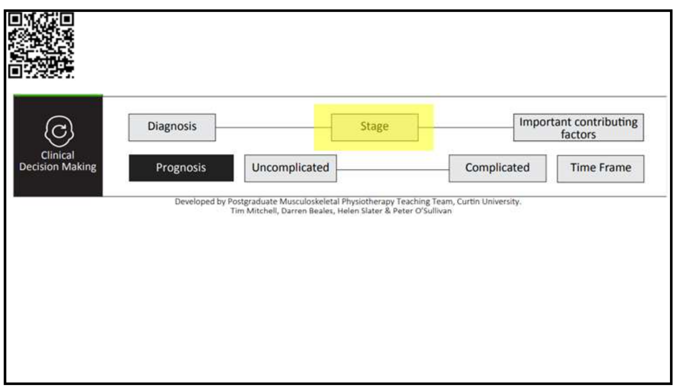

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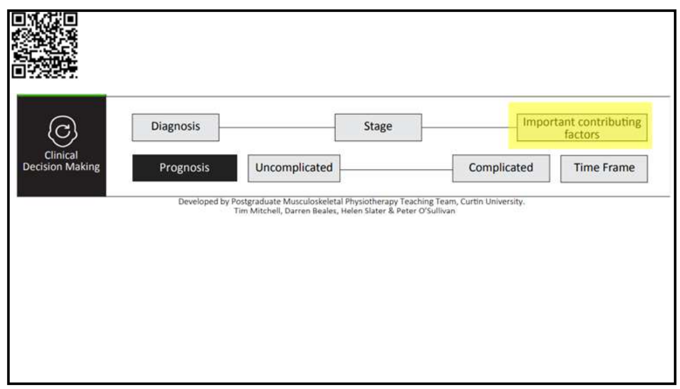

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Whiteley R. "The only certainties in life are … wait, I pay no taxes, and I'm not dead, yet." A letter from Qatar. *IJSPT*. 2022;17(5):738-741.

On day one, mostly your patients want to know:

> *"What's wrong with me?"*
> *"What's going to happen?" and*
> *"What can I/you do about it?"*

110

Each subject participated in a one-hour education session, once per week for four weeks. The education session was in a one-to-one seminar format, was conducted by an independent therapist, and focused on the neurophysiology of pain with no particular reference to the lumbar spine. In addition, the subjects completed a short workbook which consisted of one page of revision material and three comprehension exercises per day for 10 days.

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Moseley: Combined physiotherapy and education is efficacious for chronic low back pain

Combined physiotherapy and education is efficacious for chronic low back pain

Lorimer Moseley
The University of Queensland and Royal Brisbane Hospital

Manual therapy, exercise and education target distinct aspects of chronic low back pain and probably have distinct effects. This study aimed to determine the efficacy of a combined physiotherapy treatment that comprised all of these strategies. By concealed randomisation, 57 chronic low back pain patients were allocated to either the four-week physiotherapy program or management as directed by their general practitioners. The dependent variables of interest were pain and disability. Assessors were blind to treatment group. Outcome data from 49 subjects (86%) showed a significant treatment effect. The physiotherapy program reduced pain and disability by a mean of 1.5/10 points on a numerical rating scale (95% CI 0.7 to 2.3) and 3.9 points on the 18-point Roland Morris Disability Questionnaire (95% CI 2 to 5.8) , respectively. The number needed to treat in order to gain a clinically meaningful change was 3 (95% CI 3 to 8) for pain, and 2 (95% CI 2 to 5) for disability. A treatment effect was maintained at one-year follow-up. The findings support the efficacy of combined physiotherapy treatment in producing symptomatic and functional change in moderately disabled chronic low back pain patients. **[Moseley L (2002): Combined physiotherapy and education is efficacious for chronic low back pain. *Australian Journal of Physiotherapy* 48: 297-302]**

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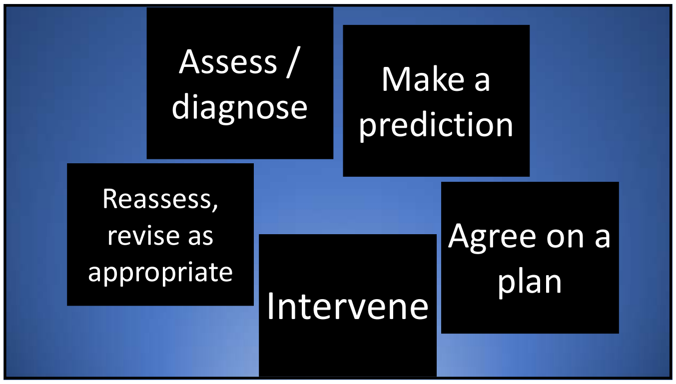

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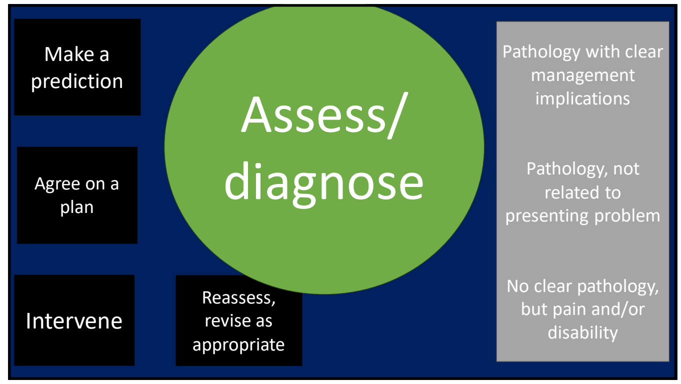

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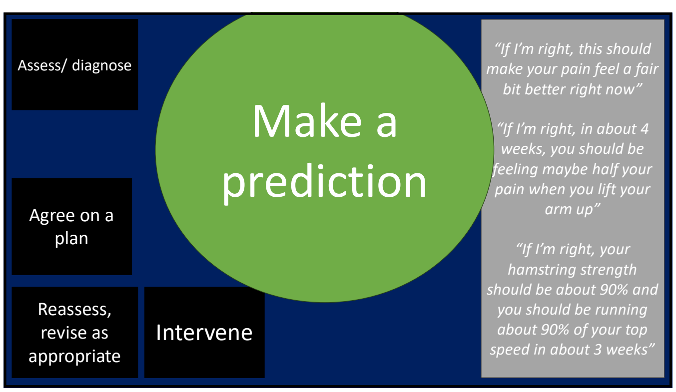

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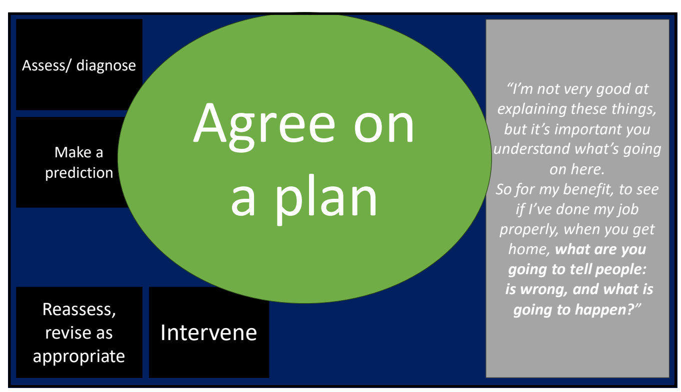

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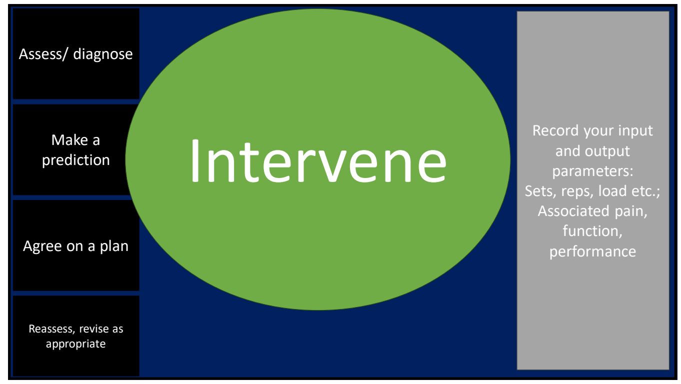
Assess/ diagnose
Make a prediction
Agree on a plan
Intervene
Reassess, revise as appropriate
"This really should be better by now. I'd like to go through all those tests we did again, and ask a few more questions to be sure we aren't missing anything here"

117


Assess/ diagnose
Make a prediction
Agree on a plan
Reassess, revise as appropriate
Intervene
Record your input and output parameters:
Sets, reps, load etc.;
Associated pain, function, performance

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Atraumatic shoulder pain assessment

Rod Whiteley, PhD
Aspetar Sports Medicine Hospital

1

Author	Journal	Year	Test	Pathology tested for	Reference St	n	n (patholog	Accuracy	TP	FP	TN	FN	PPV	NPV	Sn	Sp	+LR	-LR
Holtby	A	2007	Yergason's	Bicipital tendonitis, subluxed, dislocated, partial tear, or complete rupture of the biceps tendon, or SLAP lesions type II or IV	Arthroscopy	49	21	63.3%	9	6	22	12	0.60	0.65	0.43	0.79	2.00	0.50
Holtby	A	2007	Speed's	Bicipital tendonitis, subluxed, dislocated, partial tear, or complete rupture of the biceps tendon, or SLAP lesions type II or IV	Arthroscopy	50	22	56.0%	7	7	21	15	0.50	0.58	0.32	0.75	1.27	0.79
Jain	AJPMR	2017	Bicipital groove tende	Biceps tendinopathy	MRI	185	16	58.4%	11	72	97	5	0.13	0.95	0.69	0.57	1.61	0.62
Jain	AJPMR	2017	Speed's	Biceps tendinopathy	MRI	173	16	47.4%	12	87	70	4	0.12	0.95	0.75	0.45	1.35	0.74
Kibler	AJSM	2009	Belly Press	Long head of biceps	Arthroscopy	101	33	67.3%	10	10	58	23	0.50	0.72	0.30	0.85	2.06	0.49
Kibler	AJSM	2009	Upper Cut	Long head of biceps	Arthroscopy	101	34	76.2%	25	15	52	9	0.63	0.85	0.74	0.78	3.28	0.30
Kibler	AJSM	2009	Bear Hug	Long head of biceps	Arthroscopy	101	32	65.3%	25	28	41	7	0.47	0.85	0.78	0.59	1.93	0.52
Kibler	AJSM	2009	Yergason's	Long head of biceps	Arthroscopy	101	32	67.3%	13	14	55	19	0.48	0.74	0.41	0.80	2.00	0.50
Kibler	AJSM	2009	Speed's	Long head of biceps	Arthroscopy	101	32	72.3%	17	13	56	15	0.57	0.79	0.53	0.81	2.82	0.35
Kibler	AJSM	2009	DLS	Long head of biceps	Arthroscopy	101	32	42.6%	6	32	37	26	0.16	0.59	0.19	0.54	0.40	2.47
Kibler	AJSM	2009	Anterior Slide	Long head of biceps	Arthroscopy	101	33	49.5%	8	26	42	25	0.24	0.63	0.24	0.62	0.63	1.58
Kibler	AJSM	2009	O'Brien's	Long head of biceps	Arthroscopy	101	32	53.5%	12	27	42	20	0.31	0.68	0.38	0.61	0.96	1.04
Kim	M	2022	Flexion-extension-supination test	Long head of biceps	Arthroscopy	162	125	82.9%	102	12	24	14	0.89	0.63	0.88	0.67	2.64	0.38
Lasbleiz	APRM	2014	Palm-up Pain	Complete tear long head of biceps	Ultrasound	39	1	30.8%	0	26	12	1	0.00	0.92	0.00	0.32	0.00	
Lasbleiz	APRM	2014	Yergason Pain	Complete tear long head of biceps	Ultrasound	38.99	1	71.8%	0	10	28	1	0.00	0.97	0.00	0.74	0.00	
Lasbleiz	APRM	2014	Palm-up Pain	Biceps tendinopathy	Ultrasound	39	6	43.6%	5	21	12	1	0.19	0.92	0.83	0.36	1.31	0.76
Lasbleiz	APRM	2014	Yergason Pain	Biceps tendinopathy	Ultrasound	39	6	79.5%	4	6	27	2	0.40	0.93	0.67	0.82	3.67	0.27

2

Subacromial impingement syndrome/cuff pathology

3

"DIME"

The new dynamic isotonic manipulation examination (DIME) is a highly sensitive secondary screening tool for supraspinatus full-thickness tears

Paul F. Abraham, BS[a,*], Mark R. Nazal, MD, MPH[a], Nathan H. Varady, SB[a], Stephen M. Gillinov, AB[a], Noah J. Quinlan, MD[b], Kyle Alpaugh, MD[c], Scott D. Martin, MD[a]
J Shoulder Elbow Surg (2020) 29, 2213–2220

- *(ie, shoulder pain worsened with overhead activities; nighttime pain), negative traditional rotator cuff examination (no pain or weakness on full can or empty can tests, no weakness or inability to lift hand from the sacrum on the lift-off test, and no pain or weakness on external or internal rotation strength tests)*

DIME strength ≤86.0 N?	Supraspinatus FTT on MRA? Yes	No	Total
Coronal plane			
Yes	27	127	154
No	0	16	16
Total	27	143	170*

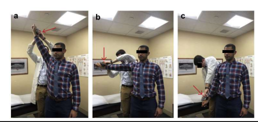
PPV: 18%
NPV: 100%

	Supraspinatus pathology on MRA? Yes	No	Total
Angle of pain on unopposed ROM in the coronal plane			
≤90°	24	0	24
>90°	66	13	79
Total	90	13	103

PPV: 100%
NPV: 16%

Pain during DIME examination?	Supraspinatus FTT on MRA? Yes	No	Total
Coronal plane			
Yes	26	119	145
No	1	25	26
Total	27	144	171

PPV: 20%
NPV: 96%



4

Whipple

Comparison of efficacy of supraspinatus tendon tears diagnostic tests: a prospective study on the "full-can," the "empty-can," and the "Whipple" tests

T. Ackmann · K. N. Schneider · D. Schorn · C. Rickert · G. Gosheger · D. Liem
MUSCULOSKELETAL SURGERY (2021) 105:149–15
https://doi.org/10.1007/s12306-019-00631-0

	F and P	F	P
PPV			
WT	76.5	62.7	15.7
EC	84.8	69.6	15.2
FC	78.6	62.8	14.0
NPV			
WT	50.0	50.0	100
EC	66.7	66.7	100
FC	42.1	44.4	72.2

F and P: full- and partial-thickness supraspinatus tendon tears

All the tests were classified as positive if they produced pain in the shoulder and/or they were weaker against the downward force than the contralateral arm

Whipple test (WT), empty-can test (EC), and full-can test (FC) for patients with full- and partial-thickness supraspinatus tendon tears. Results presented as percentages

5

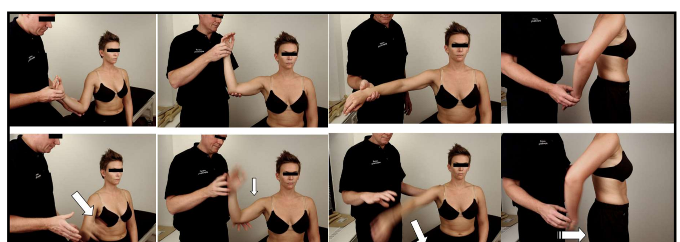


FIGURE 2. The external rotation lag sign (ERL

FIGURE 3. The infraspinatus drop sign (IDS).

FIGURE 4. The drop arm test (DAT).

FIGURE 5. The internal rotation lag sign (IRLS).

Clinical Test	Sensitivity	Specificity	PPV	NPV	Accuracy	LR+	LR−
Hawkins	0.77 (0.66-0.88)	0.26 (0.14-0.38)	0.58 (0.45-0.71)	0.50 (0.36-0.64)	0.56 (0.43-0.69)	1.04 (1.00-1.08)	0.88 (0.84-0.92)
Neer	0.60 (0.47-0.73)	0.35 (0.22-0.48)	0.52 (0.38-0.66)	0.38 (0.25-0.51)	0.46 (0.32-0.60)	0.92 (0.88-0.96)	1.14 (1.10-1.18)
Jobe	0.76 (0.64-0.88)	0.39 (0.26-0.52)	0.61 (0.48-0.74)	0.56 (0.43-0.69)	0.60 (0.47-0.73)	1.25 (1.21-1.29)	0.62 (0.59-0.65)
Painful arc	0.96 (0.90-1.00)	0.04 (0.01-0.09)	0.56 (0.43-0.69)	0.50 (0.36-0.64)	0.56 (0.43-0.69)	1.00 (0.96-1.04)	1.00 (0.96-1.04)
DAT	0.41 (0.28-0.54)	0.83 (0.73-0.93)	0.75 (0.63-0.87)	0.53 (0.39-0.67)	0.60 (0.47-0.73)	2.41 (2.21-2.61)	0.71 (0.68-0.74)
ERLS	0.45 (0.31-0.59)	0.91 (0.83-0.99)	0.87 (0.78-0.96)	0.57 (0.44-0.70)	0.65 (0.52-0.78)	5.00 (4.92-5.08)	0.60 (0.58-0.62)
IDS	0.45 (0.31-0.59)	0.70 (0.58-0.82)	0.65 (0.52-0.78)	0.50 (0.36-0.64)	0.56 (0.43-0.69)	1.50 (1.45-1.55)	0.79 (0.76-0.82)
IRLS	0.31 (0.18-0.44)	0.87 (0.78-0.96)	0.75 (0.63-0.87)	0.50 (0.36-0.64)	0.56 (0.43-0.69)	2.38 (2.32-2.44)	0.79 (0.76-0.82)

The Value of Clinical Tests in Acute Full-Thickness Tears of the Supraspinatus Tendon: Does a Subacromial Lidocaine Injection Help in the Clinical Diagnosis? A Prospective Study

Klaus Bak, M.D., Anne Kathrine Belling Sørensen, M.D., Uffe Jørgensen, M.D., Ph.D., Marianne Nygaard, M.D., Ph.D., Annabel Lee Krarup, M.D., Charlotte Thune, M.D., Carsten Sloth, M.D., and Søren Torp Pedersen, M.D.
Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 26, No 6 (June), 2010: pp 734-742

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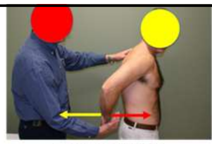

Figure 1 Gerber Lift-Off test.

Figure 2 Gerber Belly-Press test.

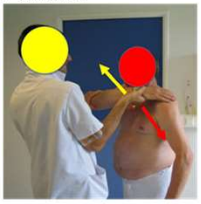

Figure 3 Bear-Hug test.

Diagnosis of subscapularis tendon tears: Are available diagnostic tests pertinent for a positive diagnosis?

J. Barth[a,*], S. Audebert[b], B. Toussaint[c], C. Charousset[d], A. Godeneche[e], N. Graveleau[f], T. Joudet[g], Y. Lefebvre[h], L. Nove-Josserand[e], E. Petroff[i], N. Solignac[j], C. Scymanski[k], M. Pitermann[m], C.-E. Thelu[l], French Arthroscopy Society[1]

This prospective multicenter study confirms that the LOT, BPT and BHT tests are valid and are strongly correlated to the severity of subscapularis tendon tears (both their level and anatomical type). The BHT is a more effective and should be performed at 90° of flexion to test the inferior subscapularis and at 45° (in association with the BPT) to test the superior subscapularis. The two other tests should be associated (LOT and BPT) to minimize the risk of underestimating the presence of small subscapularis tears, because one quarter of subscapularis tears are discovered during surgery.

A negative LOT, a positive BPT and a negative BHT (90°) suggest a limited partial thickness tear. If the BHT at 90° is also positive, this suggests that the tear involves the superior subscapularis. Positive results in the three tests and a significant loss of strength suggest a severe lesion (full thickness tendon tear with retraction or type 4) and requires rapid, surgical management.

Orthopaedics & Traumatology: Surgery & Research (2012) 98S, S178–S185

7

Diagnostic values of clinical tests for subscapularis lesions

Martin Bartsch · Stefan Greiner · Norbert P. Haas · Markus Scheibel

Knee Surg Sports Traumatol Arthrosc (2010) 18:1712–1717
DOI 10.1007/s00167-010-1109-1

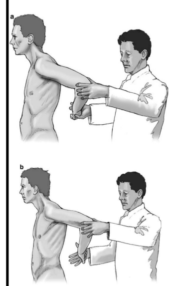

Fig. 2 a, b Internal rotation lag sign (IRLS) [23]

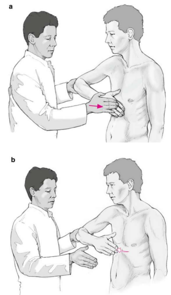

Fig. 4 a, b Belly-off sign (BOS) [23]

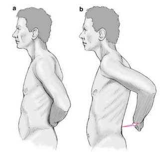

Fig. 1 a, b Lift-off test (LOT) [23]

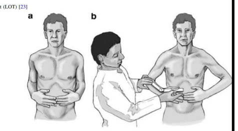

Fig. 3 a, b Modified belly-press test (Mod. BPT) [23]

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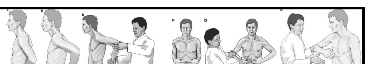
Diagnostic values of clinical tests for subscapularis lesions



	LOT	IRLS	Mod. BPT	BOS
True-positive results	6	10	14	13
True-negative results	23	18	23	32
False-positive results	6	12	11	3
False-negative results	9	4	2	2
Sensitivity (%)	40	71	80	86
Specificity (%)	79	60	88	91
PPV (%)	50	45	75	81
NPV (%)	71	81	91	94
Accuracy (%)	66	63	86	90

9

Internal rotation resistance test at abduction and external rotation: a new clinical test for diagnosing subscapularis lesions

Lin Lin · Hui Yan · Jian Xiao · Yingfang Ao ·

Knee Surg Sports Traumatol Arthrosc (2015) 23:1247–1252
DOI 10.1007/s00167-013-2808-1

	Lift-off	Belly-press	Bear-hug	IRLS		
True-positive results	47	56	59	25	54	62
True-negative results	85	118	115	123	113	115
False-positive results	39	30	29	10	35	28
False-negative results	31	31	25	54	34	19
Sensitivity (%)	59.8	64.4	70.2	31.6	62.7	76.5
Specificity (%)	68.5	79.7	79.9	92.5	76.3	80.4
PPV (%)	54.7	65.1	67	71.4	60.1	68.9
NPV (%)	73.3	79.2	82.1	69.5	76.9	85.8
Accuracy (%)	65.3	74.0	76.3	69.8	71.1	79.0

10

The scissors sign: a provocative test for detecting the leading-edge tear of subscapularis tendon: a diagnostic study

Sung-Min Rhee[1†], Seung-Min Youn[2†], Joon Hong Park[1], Geun Wu Chang[3] and Yong Girl Rhee[3*]

Rhee *et al. BMC Musculoskeletal Disorders* (2022) 23:679
https://doi.org/10.1186/s12891-022-05621-1

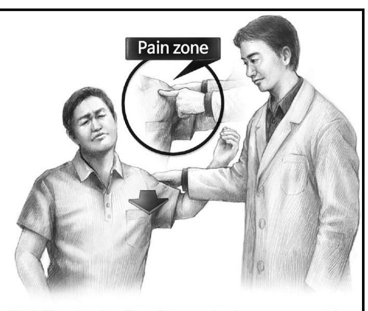
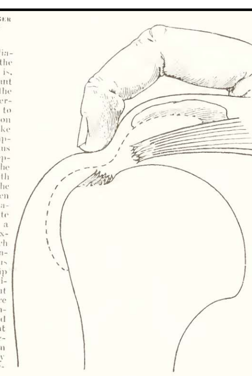


Fig. 2 The scissoring effect of the examiner's arm creates anterior translational force (arrow) onto the humeral head at around 60° of shoulder abduction, which may provoke the injured or pathological part of the subscapularis

11

FIGURE 42. TIP OF FINGER PRESSING ON EMINENCE AND ON SULCUS

The plane of this diagram is halfway between the coronal and sagittal. It is, perhaps, the most important diagram in the book for the reader entirely to understand, for it is the ability to put the finger in this position which enables one to make the clinical diagnosis of rupture of the supraspinatus tendon. The dotted line represents the contour of the bursa. Compare this with Figure 11, which shows the contour of the bursa when filled with the calcified material, and also with Plate II, Fig. 3, which shows a large calcified deposit in exactly the situation in which the rupture lies in this diagram. In this one the sulcus is immediately under the tip of the finger and the eminence just external to it, but in Figure 3 the eminence would be just under the finger. Therefore, as explained on page 118, the tender point in a case of rupture is represented by a depression, but in cases of calcified deposit, by an eminence at the corresponding position.



12

Palpation tests versus impingement tests in Neer stage I and II subacromial impingement syndrome

Knee Surg Sports Traumatol Arthrosc (2013) 21:424–429
DOI 10.1007/s00167-012-1969-7

Ugur Toprak · Evren Ustuner · Derya Ozer ·
Sadık Uyanık · Gul Baltacı · Secil Sezgin Sakızlıoglu ·
Mehmet Alp Karademir · Ahmet Ozgur Atay

Table 2 Statistical results of the impingement and palpation tests

Variable	Sensitivity (95 % confidence interval)	Specificity (95 % confidence interval)	Accuracy
Neer test	80 (67–89)	52 (30–73)	74
Hawkins test	67 (53–78)	47 (26–69)	62
Supraspinatus palpation test	92 (78–95)	41 (18–64)	79
Infraspinatus palpation test	33 (6–79)	66 (54–76)	65
Subscapularis palpation test	60 (23–88)	0 (0–13)	10
Biceps palpation test	85 (67–94)	48 (33–62)	62

validity of our study. For manual palpation tests to be valid, a standardized finger pressure needs to be applied. Using a scale and a pinch grip dynamometer, the physiotherapist practiced a finger pressure (thumb, index finger, and middle finger, respectively) of 2 kg. Then, after frequent practice, the physiotherapist was able to apply a finger pressure ranging from 1.8 to 2.2 kg without checking the scale or dynamometer. The examiner determined tenderness by the deep palpation of four anatomical shoulder locations on the left and right side, as follows: supraspinatus, infraspinatus, subscapularis, and biceps' long head tendons at the shoulder. The examiner used a score of 0–3, corresponding to "no tenderness," "mild tenderness," "moderate," or "severe tenderness," respectively, for each anatomical location based on the participants response and feedback during the palpation [14, 20, 21, 26].

13

Palpation tests versus impingement tests in Neer stage I and II subacromial impingement syndrome

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Ugur Toprak · Evren Ustuner · Derya Ozer ·
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Biceps palpation test	85 (67–94)	48 (33–62)	62

Test	Pathology tested for	Reference Sta	n	ogy)	Accuracy	TP	FP	TN	FN	PPV	NPV
Palpation 2kg	Subacromial impingement syn	US	138	69	0.6594203	63	41	28	6	0.61	0.82
Neer	Subacromial impingement syn	US	138	69	0.6594203	55	33	36	14	0.63	0.72
Hawkins	Subacromial impingement syn	US	138	69	0.5652174	46	37	32	23	0.55	0.58

14

FIGURE 1. The Speed's test: a downward pressure is applied to the upper extremity with 90° of shoulder elevation, full supination of the forearm, and with the elbow completely extended. Pain experienced in the anterior shoulder of the patient when pressure is applied indicates a positive Speed's test result.

Specificity of the Speed's Test: Arthroscopic Technique for Evaluating the Biceps Tendon at the Level of the Bicipital Groove

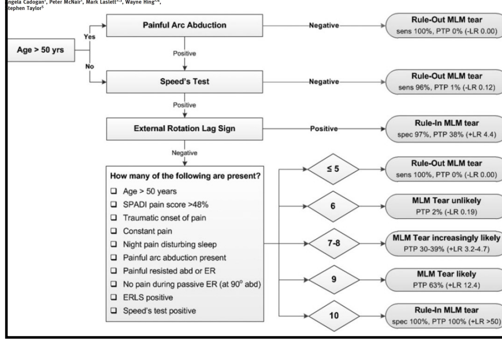
Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 14, No 8 (November-December), 1998: pp 789–796

15

Diagnostic accuracy of clinical examination features for identifying large rotator cuff tears in primary health care

Angela Cadogan[1], Peter McNair[1], Mark Laslett[2,3], Wayne Hing[1,4], Stephen Taylor[5]

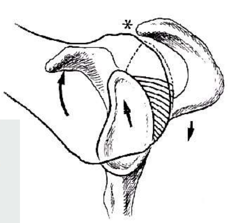
medium, large or multitendon (MLM) rotator cuff tear in a primary care cohort.

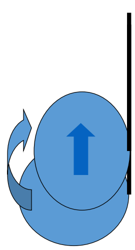


Pathology identified on ultrasound	MLM tear (n=24) % with pathology	No MLM tear (n=179) % with pathology
SAB pathology	63	27***
Dynamic bursal bunching	74	58
Rotator cuff tendinosis	17	15
supraspinatus	13	14
infraspinatus	0	1
subscapularis	4	2
Calcific tendinopathy	21	25
supraspinatus	4	18
infraspinatus	4	5
subscapularis	21	8
LHB pathology	17	1**
Biceps tendon sheath effusion	33	10**
GHJ effusion	17	2
ACJ pathology	26	26

16

Posterior Capsule





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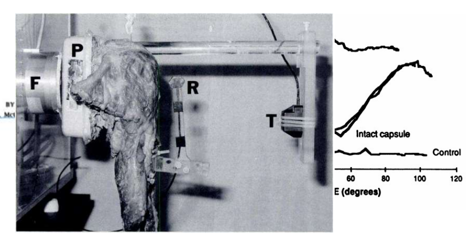
BY
KEVIN J. Mc

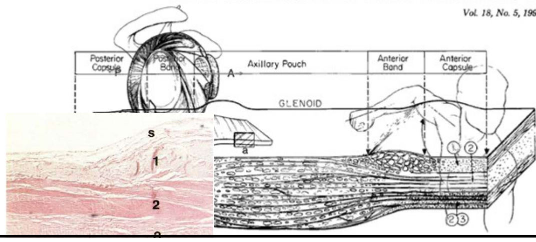


18

The anatomy and histology of the inferior glenohumeral ligament complex of the shoulder*

STEPHEN J. O'BRIEN,†‡ MD, MANUEL C. NEVES,† MD, STEVEN P. ARNOCZKY,§ DVM, S. ROBERT ROZBRUCK,† EDWARD F. DICARLO,† MD, RUSSELL F. WARREN,† MD, ROBERT SCHWARTZ,† MD, AND THOMAS L. WICKIEWICZ,† MD

Vol. 18, No. 5, 1990



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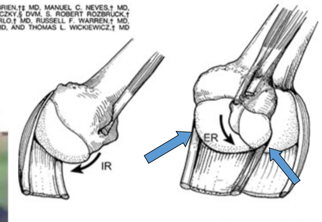
O'Brien's Capsular 'sling'/hammock

The anatomy and histology of the inferior glenohumeral ligament complex of the shoulder*

STEPHEN J. O'BRIEN,†‡ MD, MANUEL C. NEVES,† MD, STEVEN P. ARNOCZKY,§ DVM, S. ROBERT ROZBRUCK,† EDWARD F. DICARLO,† MD, RUSSELL F. WARREN,† MD, ROBERT SCHWARTZ,† MD, AND THOMAS L. WICKIEWICZ,† MD



Vol. 18, No. 5, 1990

20

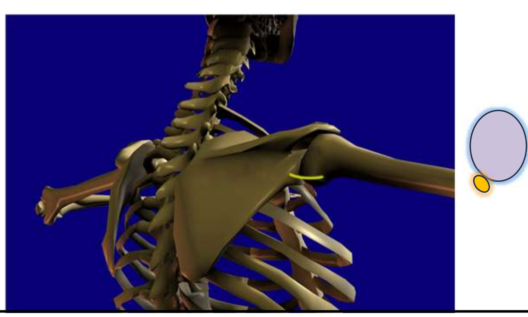
Capsule and rotation

- Abd 90° + [illegible] capsule
- Abd 90° + [illegible] capsule

21

22

Capsular sling



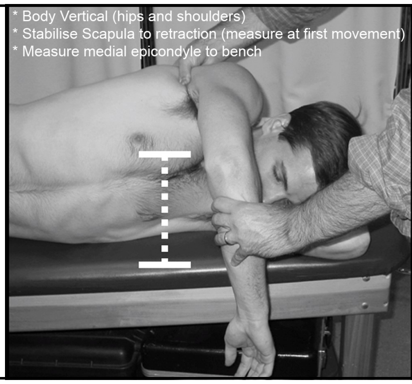
23

Posterior Capsular Tightness

- Lin Man Ther (2006)

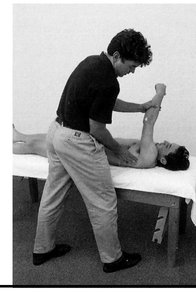
Cross-chest adduction measurement with inclinometer

24



25

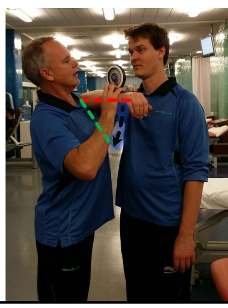
Posterior capsule



- Standard arm position (shoulder rotation and elbow flexion)
- Palpate scapula for first movement
- 5° - 30° past vertical (bubble inclinometer)

26

Hawkins-Kennedy as ROM



- 90° flexion
- “Quiet” shoulder
- Passive ROM
  - Note limiting factor (Pain or stiff)

27

Practice

- IR & ER with HHD (“DIME” – resisted ecc abd through ROM)
- Resisted flexion (Whipple)
- ROM:
  - Posterior Capsule ROM assessment
  - Hawkins position
  - Hadd ROM
  - Rotational ROM at 90, ER by side
- Upper Cut, Bear Hug, Belly press, (Scissors)

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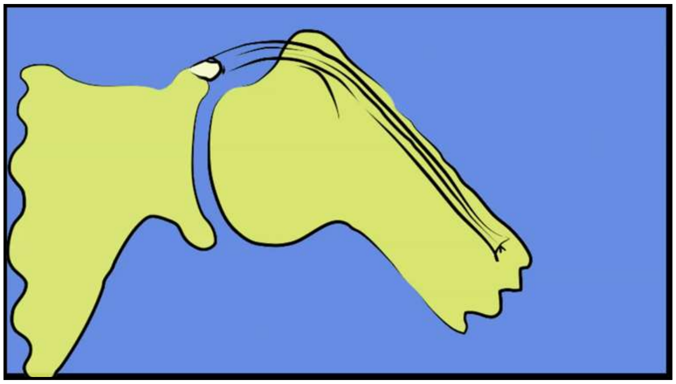
SLAP/long head of biceps

29

30



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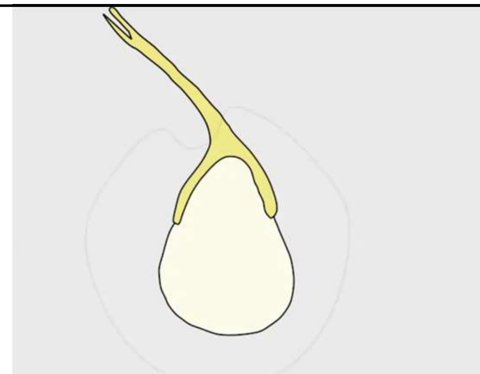


32

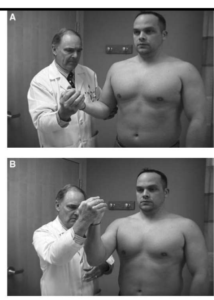


Figure 1. A, the upper cut maneuver is performed with the involved shoulder in a neutral position, the elbow flexed to 90°, the forearm supinated, and the patient making a fist. B, the patient is instructed to perform a boxing "upper cut" punch while the examiner places his hand over the patient's fist and resists the upward motion. A positive test is pain or a painful pop over the anterior portion of the involved shoulder during the resisted movement.

	Upper Cut
Sensitivity	0.73
Specificity	0.78
Accuracy	0.77
+PV	0.63
–PV	0.85
+LR	3.38
–LR	0.34

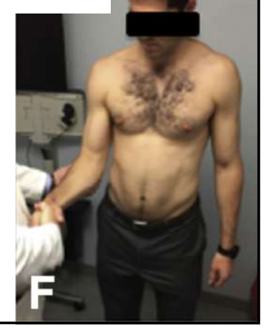
33

Gilecreest EL, Albi P. Unusual lesions of muscles and tendons of the shoulder girdle and upper arm. *Surg Gynecol Obstet* 1939;68:903-917.

Pathology tested for: Any Labral injury; Biceps tendinopathy; Bicipital tendonitis, subluxed, dislocated, partial tear, or complete rupture of the biceps t...; Complete tear long head of biceps; Long head of biceps; SLAP; SLAP and any other pathology; SLAP Type I; SLAP Type II

Test: Single and Double Arm Jobe Pain; Single and Double Arm Jobe Weakness; Single and Double Arm Weakness and Pain; Single Arm Jobe Pain; Single Arm Jobe Weakness; Unable to sleep on affected side; Upper Cut; Weakness; Weakness history; Whipple; Whipple Pain; Whipple Pain and Weakness; Whipple Weakness; Yergason; Yergason Pain; Yergason's

Sum of TP	Sum of FP	Sum of TN	Sum of FN
29	44	235.985	51
Sensitivity	36.3%		
Specificity	84.3%		
PPV	39.7%		
NPV	82.2%		
+LR	2.31		
-LR	0.76		
Accuracy	73.6%		



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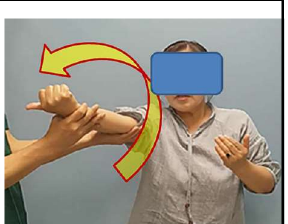
Flexion-extension-supination test compared to arthroscopic findings of biceps long head pathology

A physical examination that reflect anatomical evolution of human shoulder girdle

Byung-Kook Kim, MD, Ho-Jae Lee, MD, Suk-Han Jung, MD, Jinmyoung Dan, MD

Medicine (2022) 101:28

Figure 1. FES test is used as a provocative test to determine the presence of pain around bicipital groove caused by passive shoulder movement. To perform the FES test, the involved shoulder was flexed at 90-degrees and neutrally rotated with an extended elbow. The patient was then asked to supinate their forearms or be passively supinated by the examiner. If the patient felt pain in the bicipital groove or could not supinate fully, the test was considered as positive. The FES test result was negative if pain was not elicited in a passive forearm supination position.



Author	Journal	Year	Test	Pathology tested for	Reference St	n	n (patholog	Accuracy	TP	FP	TN	FN	PPV	NPV	Sn	Sp	+LR	-LR
Kim	M	2022	Flexion-extension-supination test	Long head of biceps	Arthroscopy	162	125	82.9%	102	12	24	14	0.89	0.63	0.88	0.67	2.64	0.38

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Labral Signs

- Crank
- O'Brien's Active Compression Sign
- Kibler's Anterior Slide
- Biceps Load II
- Resisted External Rotation Supination

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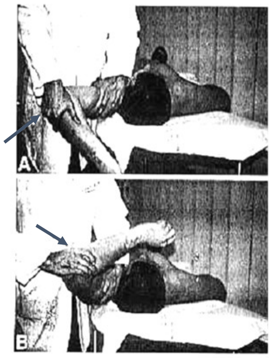
Crank

Liu et al 1996
+LR: 13
-LR: 0.097



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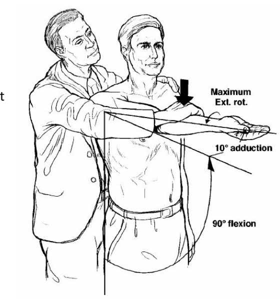
O'Brien's

'The patient was asked to forward flex the affected arm 90º with the elbow in full extension. The patient then adducted the arm 10º-15º medial to the sagittal plane of the body. The arm was internally rotated so that the thumb pointed downward. The examiner then applied a uniform downward force to the arm. *With the arm in the same position*, the palm was then fully supinated and the maneuver was repeated.'

O'Brien et al 1998



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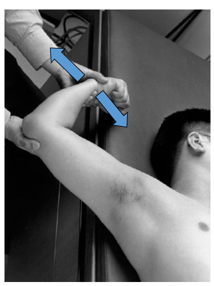
Biceps Load II

- The arm to be examined is elevated to 120° and externally rotated to its maximal point
- Elbow in 90° flexion and the forearm in the supinated position.
- Patient is asked to flex the elbow while resisting the elbow flexion by the examiner
- **+ive:** Pain in elbow F or ↑'d P in elbow F
- **-ive:** Pain ↓'d Elbow F or ºP Elbow F

127 Consecutive, double blind (A/S)
+L.R.: 26.3
-L.R.: 0.11



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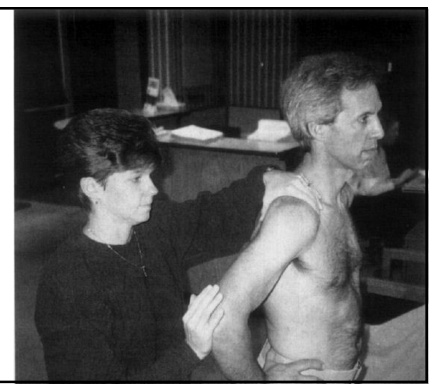
Anterior Slide

- Kibler, Arthroscopy, 1995, 11 **3** 296-300
  - +LR: 9.2
  - -LR: 0.24



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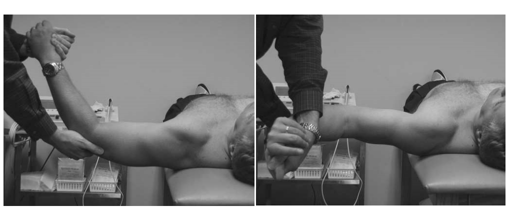
Resisted Supination External Rotation (Myers et al, AJSM 2005)

+LR: 4.55
-LR: 0.21



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Practice

1. Crank
2. O'Brien's Active Compression Sign
3. Kibler's Anterior Slide
4. Biceps Load II
5. Resisted External Rotation Supination
6. Upper Cut (long head of biceps)
7. F/E/Supination (long head of biceps)

42

Acromioclavicular joint

43

Acromioclavicular joint

- Traumatic v gradual onset
- 14% Prevalence (primary care, local anaesthetic)

Shoulder pain in primary care: diagnostic accuracy of clinical examination tests for non-traumatic acromioclavicular joint pain

Angela Cadogan[1*], Peter McNair[1], Mark Laslett[1] and Wayne Hing[2]

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A-C diagnosis – History & presentation

- Repeated, overhead, high load, "push"
- Pain location

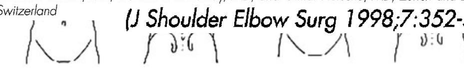
45

A-C versus SAI

The pattern of pain produced by irritation of the acromioclavicular joint and the subacromial space

Christian Gerber, MD, Richard V. Galantay, MD, and Otmar Hersche, MD, *Zurich and Bern, Switzerland*

(J Shoulder Elbow Surg 1998;7:352-5.)



46

Grade I and II acromioclavicular dislocations: Results of conservative treatment

Elyazid Mouhsine, MD, Raffaele Garofalo, MD, Xavier Crevoisier, MD, and Alain Farron, MD, *Lausanne, Switzerland*

- JSES 2003, 12, 599 – 602
- 37 consecutive Tossy I & II, 6.3 Yr Follow-up
- 4 lost to follow-up
- 27% required surgery (mean 26 months)
- 48% residual symptoms

47

Detection of acromioclavicular joint pathology in asymptomatic shoulders with magnetic resonance imaging

Beth E. Shubin Stein, MD, J. Michael Wiater, MD, H. Charles Pfaff, MD, Louis U. Bigliani, MD, and William N. Levine, MD, *New York, NY*

MRI findings consistent with ACJ arthritis were present in 41 (82%) of 50 shoulders. Of those with evidence of ACJ arthritis, 33 (80%) shoulders were graded mild, 6 (15%) shoulders moderate, and 2 (5%) shoulders severe. There was no significant difference in either the prevalence or the severity of the ACJ abnormalities when comparing men with women. However, there was a significant difference in the severity of the abnormalities with respect to age. In the over-30 age group there were more advanced degenerative changes than in the 30-and-under group (*P* < .05).

The prevalence of abnormal findings varied according to the age of the subject. In the 30-and-under age group, 68% of the asymptomatic population had abnormalities on MRI. In the over-30 age group, the prevalence of abnormal findings was 93%. The overall prevalence of ACJ abnormalities on MRI in asymptomatic shoulders was 82%.

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A comparison of magnetic resonance imaging findings of the acromioclavicular joint in symptomatic versus asymptomatic patients

Beth E. Shubin Stein, MD, Christopher S. Ahmad, MD, Charles H. Pfaff, MD, Louis U. Bigliani, MD, and William N. Levine, MD, New York, NY

J Shoulder Elbow Surg January/February 2006

The MRI scans of 25 patients with symptomatic AC joints were compared with 50 asymptomatic

Group	None (Grade I)	Mild (Grade II)	Moderate (Grade III)	Severe (Grade IV)	Bone edema
Asymptomatic	18%	66%	12%	4%	0%
Symptomatic	0%	20%	52%	28%	80%

Predictive findings on magnetic resonance imaging in patients with symptomatic acromioclavicular osteoarthritis

J Shoulder Elbow Surg (2018) 27, e252–e258

Methods: The MRI scans of 70 patients with symptomatic AC osteoarthritis were compared with those of 70 patients with subacromial pain syndrome and no clinical signs of symptomatic AC osteoarthritis.

The presence of bone marrow edema predicted a 100% probability for clinical symptomatic AC

49

Predictive findings on magnetic resonance imaging in patients with symptomatic acromioclavicular osteoarthritis

Egbert J.D. Veen, MD[a,b,*], Cornelia M. Donders, MD[a], Robin E. Westerbeek, MD[c], Rosalie P.H. Derks, MD[c], Ellie B.M. Landman, PhD[a], Cornelis T. Koorevaar, MD, PhD[a]

J Shoulder Elbow Surg (2018) 27, e252–e258

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50

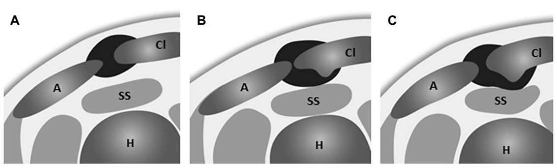

Figure 2 Compression of supraspinatus on sagittal images from magnetic resonance imaging scans: no contact (**A**), adjacent (**B**), and impression (**C**). *A*, acromion; *Cl*, clavicle; *SS*, supraspinatus; *H*, humerus.

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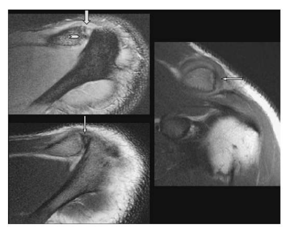


Figure 3 Early MRI changes in DCO. Axial T2 (top left), axial T1 (bottom left), coronal proton density (right) demonstrating subtle erosions (arrows) and mild adjacent subchondral marrow edema (chevron).

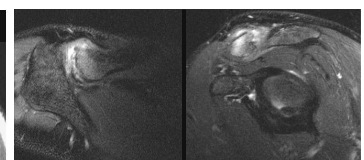
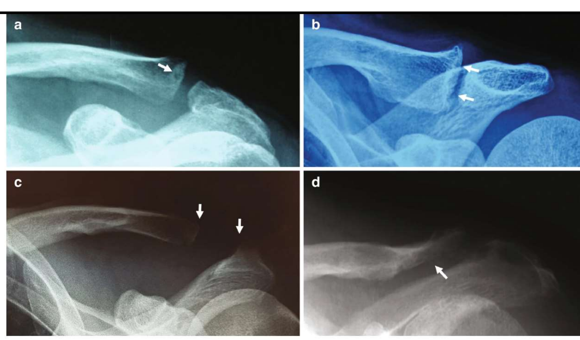


Figure 4 Axial (left) and sagittal (right) fluid-weighted, fat-suppressed images, demonstrating more advanced DCO with a greater degree of marrow edema and more pronounced distal clavicular erosions. Note the prominence of musculature and relative paucity of fat in this avid weightlifter.

52



(**a**–**d**) Radiographic findings in DCO. (**a**) Subchondral cysts (arrow), (**b**) fragmentation and erosions limited to the clavicular articular surface (arrow), (**c**) widening of the acromioclavicular joint space (arrows), and (**d**) erosions and tapering of the distal clavicle in long-standing DCO (arrow)

53

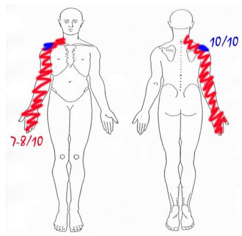
A-C joint and painful weak Int Rot

- Traumatic origin
- Often footballers (differentiate)
- Atraumatic origin in weight training - commonly "chest" exercises

54

Case History

- Abrupt onset
- Intolerable, worrying pain
- No history of trauma
- Changed work practice



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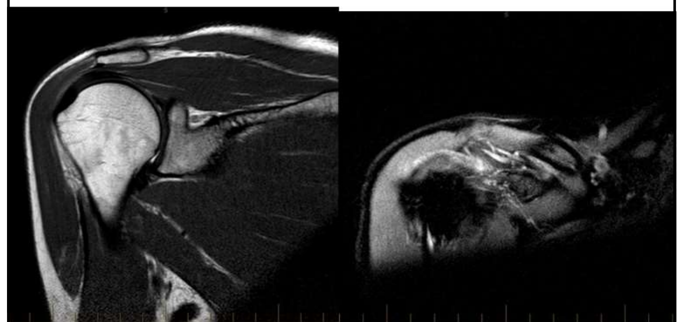

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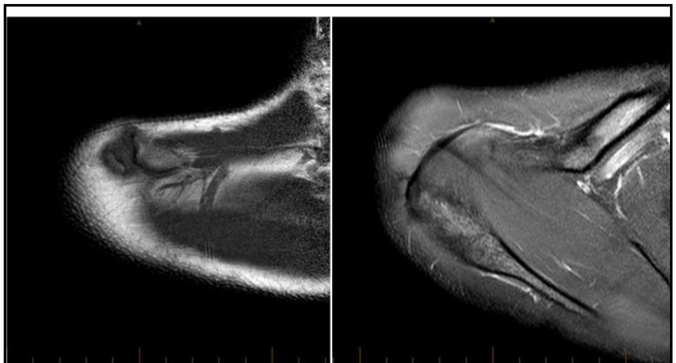

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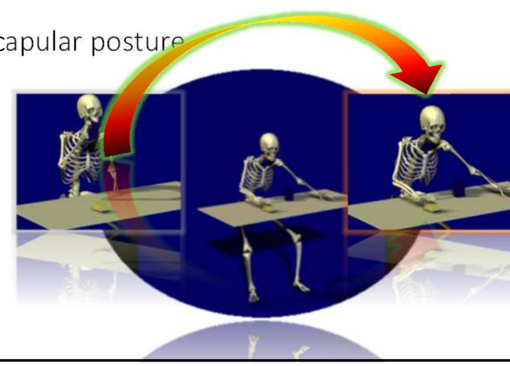
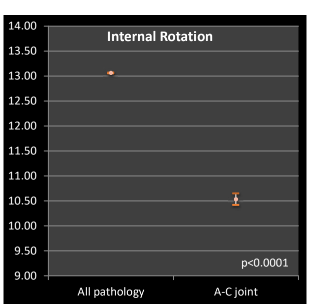
Scapular posture



58

A-C joint

- A-C Vs All pathology
  - 13.1kg Vs 10.5kg
- $IR_{INJ} < ER_{INJ}$
  - 3 X incidence



59

A-C joint

- Resisted internal rotation (not external) painful and weak
- worsens

60

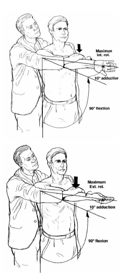
61

AC joint summary

- "Chest" exercises
- Pain pattern
- Physical exam, imaging might be required
- Can be significantly disabling
- Think about scapular positioning (and changing loads) in your management

62

A-C joint examination



Chronopolous et al *Diagnostic value of Physical Tests for Isolated Chronic Acromioclavicular Lesions* AJSM 32, (3) 2004 655-61

- O'Brien's
- Cross-Body Adduction
- Resisted Extension

63

Chronopolos et al 2004

Diagnostic Value of Combined Examination					
	Sensit.	Specif.	P.P.V.	N.P.V.	Acc'cy
Test	% (n/N)	% (n/N)	% (n/N)	% (n/N)	% (n/N)
All 3	25 (4/16)	97 (4/13)	31 (4/13)	[illegible] (290/302)	93 (294/315)
≥ 2	81 (13/16)	89 (266/299)	28 (13/46)	99 (266/269)	89 (279/315)
≥ 1	0 (16/16)	74 (221/299)	17 (16/94)	100 ([illegible])	75 (237/315)

All 3: +L.R.: 8.33
-L.R.: 0.77
≥2: +L.R.: 7.3
-L.R.: 0.21

64

Diagnosis & Examination

- History
- Pain pattern

- Imaging
  - MR
  - XR

- O'Briens position 1 ("on top")
- Cross-Body
- Resisted Extension
- Palpation

65

Practice

- (O'Brien's Active Compression, part 1)
- Cross-Body Adduction
- Resisted Extension
- Palpate A-C joint – mark this first

66

Inducing cell changes requires loading

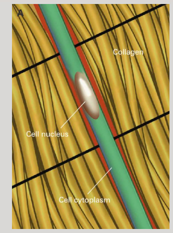
Injection therapies haven't worked…and nor will they until they can target Piezo-1

1

Mechanotherapy: how physical therapists' prescription of exercise promotes tissue repair

K M Khan, A Scott

Br J Sports Med 2009;**43**:247–251. doi:10.1136/bjsm.2008.054239



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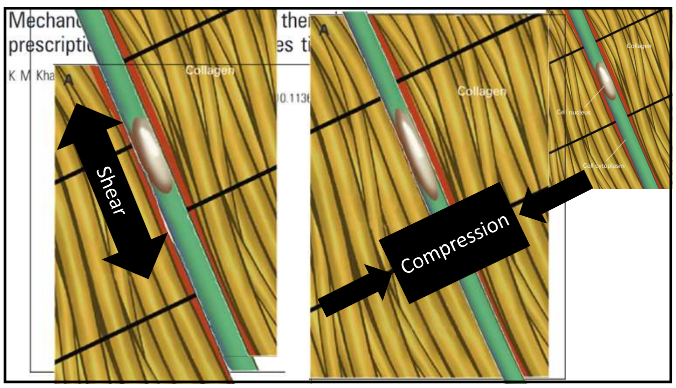

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Mechanotherapy: how physical therapists' prescription of exercise promotes tissue repair

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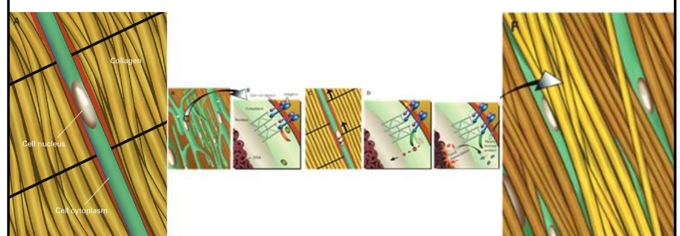

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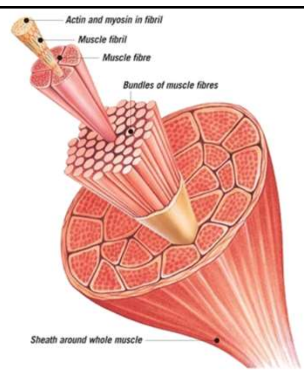


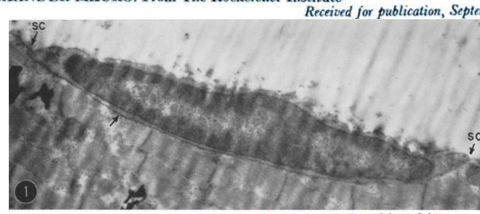
5

SATELLITE CELL OF SKELETAL MUSCLE FIBERS

ALEXANDER MAURO. From The Rockefeller Institute

Journal of Cell Biology

Received for publication, September 1, 1961.



A typical longitudinal view of the satellite cell as it appears in the periphery of the skeletal muscle fiber of the tiabialis anticus of the frog. The extreme poles of the cell are indicated (*sc*). Note that even at the magnification of 10,000 the cell could be dismissed, upon cursory examination, as a peripheral muscle nucleus. The apposing plasma membranes of the satellite cell and the muscle cell can be seen at the inner border of the cell as indicated, by the unmarked arrow. Epon embedding. Unstained. × 10,000.

6

Fission impossible: Mitochondrial dynamics direct muscle stem cell fates

Ji-Hyung Lee[1] and Foteini Mourkioti[1,2,3,*]

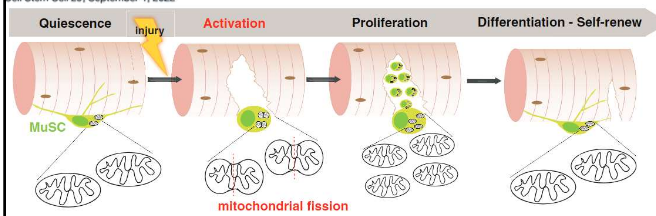
Cell Stem Cell *29*, September 1, 2022

7

Fission impossible: Mitochondrial dynamics direct muscle stem cell fates

Ji-Hyung Lee and Foteini Mourkioti

Cell Stem Cell *29*, September 1, 2022



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Fission impossible: Mitochondrial dynamics direct muscle stem cell fates

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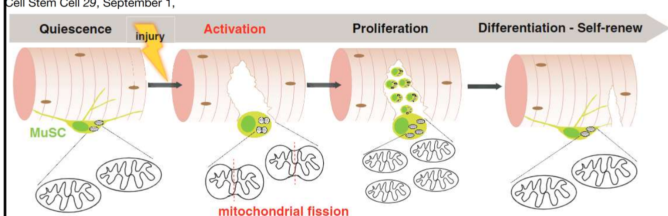
Cell Stem Cell *29*, September 1,



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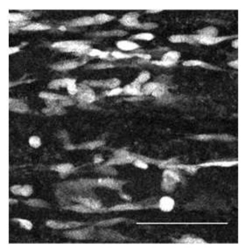
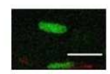
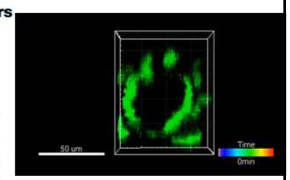
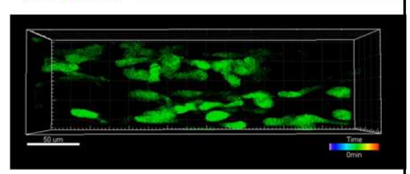
Intravital Imaging Reveals Ghost Fibers as Architectural Units Guiding Myogenic Progenitors during Regeneration

Webster et al., 2016, Cell Stem Cell *18*, 243–252







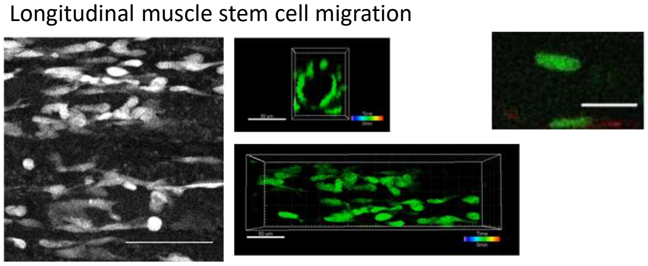


10

Intravital Imaging Reveals Ghost Fibers as Architectural Units Guiding Myogenic Progenitors during Regeneration

Webster et al., 2016, Cell Stem Cell *18*, 243–252

Longitudinal muscle stem cell migration



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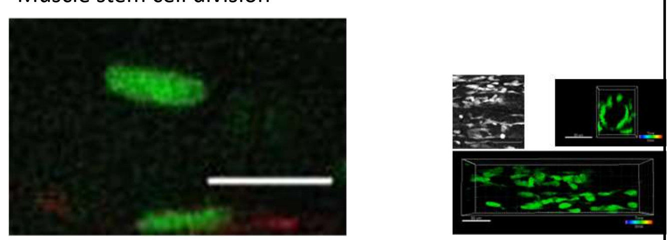
Intravital Imaging Reveals Ghost Fibers as Architectural Units Guiding Myogenic Progenitors during Regeneration

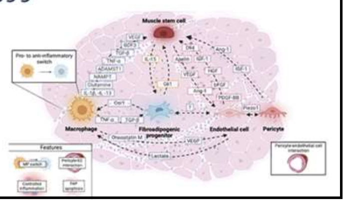
Webster et al., 2016, Cell Stem Cell *18*, 243–252

Muscle stem cell division



12

Rodríguez C, Timóteo-Ferreira F, Minchiotti G, Brunelli S and Guardiola O (2024), Cellular interactions and microenvironment dynamics in skeletal muscle regeneration and disease. *Front. Cell Dev. Biol.* 12:1385399. doi: 10.3389/fcell.2024.1385399



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Rodríguez C, Timóteo-Ferreira F, Minchiotti G, Brunelli S and Guardiola O (2024). Cellular interactions and microenvironment dynamics in skeletal muscle regeneration and disease. Front. Cell Dev. Biol. 12:1385399. doi: 10.3389/fcell.2024.1385399

Piezo is derived from the Greek πιέζω, which means to squeeze or press.

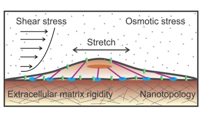
14

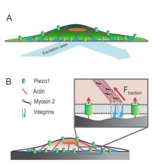
How cells channel their stress: Interplay between Piezo1 and the cytoskeleton

Jamison L. Nourse, Medha M. Pathak*

Seminars in Cell & Developmental Biology 71 (2017) 3–12

Loading → Piezo1, satellite cells → New muscle, more muscle





- Ion channels are unique transducers of mechanical force.
- The Piezo1 channel converts mechanical cues into electrical and biochemical signals.
- Piezo1 transduces outside-in as well as inside-out mechanical forces.
- The cytoskeleton modulates Piezo1 activation in complex ways.
- Piezo1 activity affects cytoskeletal organization and dynamics.

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Loading & tendinopathy, *"Training in the presence of an injury"*

- Desired/required load
- Current load

16

Synthesis has an upper limit (degradation doesn't)

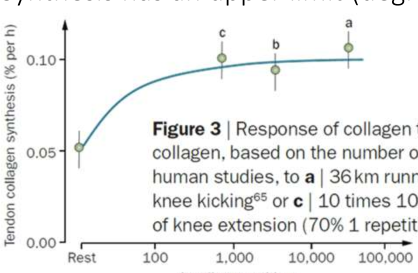
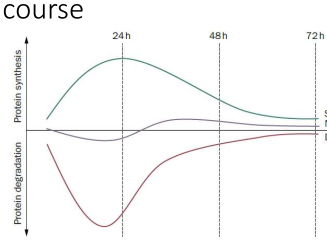


Figure 3 | Response of collagen to loading. The synthesis of collagen, based on the number of loading repetitions from human studies, to **a** | 36 km running,[111] **b** | 1 h of maximal knee kicking[65] or **c** | 10 times 10 repetitions of knee extension (70% 1 repetition maximum). The graph

17

Time course



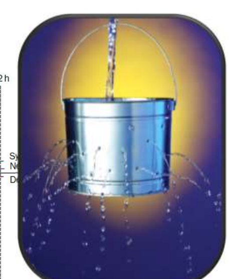


Figure 2 | Schematic representation of collagen synthesis and degradation. Acute exercise in humans is followed by an increase in both the synthesis and degradation of collagen. Over the first 24–36 h, this response results in a net loss of collagen, but is followed by a net synthesis 36–72 h after exercise. Repeated training with rest periods that are too short can result in a net degradation of the matrix and lead to overuse injury.[65,66,111]

18

Tendon response depends on load

- **Sustained** (iso) load (30-60s) uncrimping – 3-6 reps
- **Stretch-shortening** – 6-10 mins every 8-10 hours

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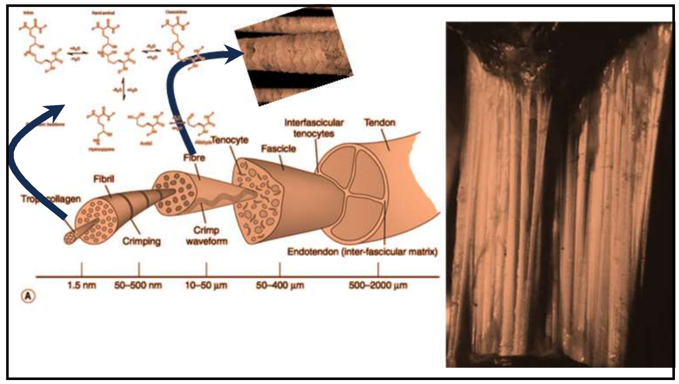

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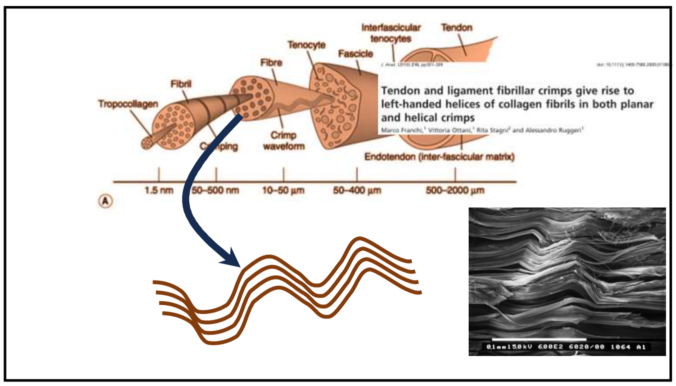

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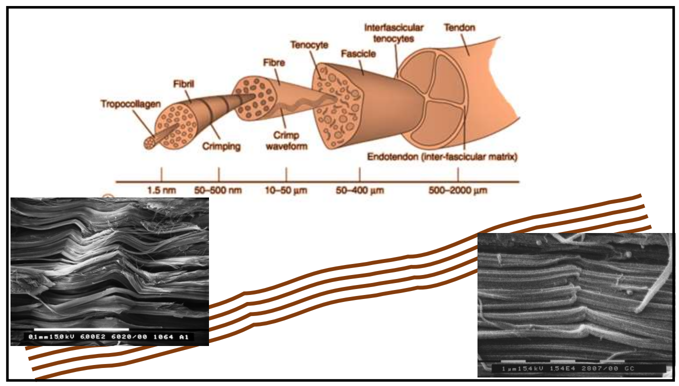

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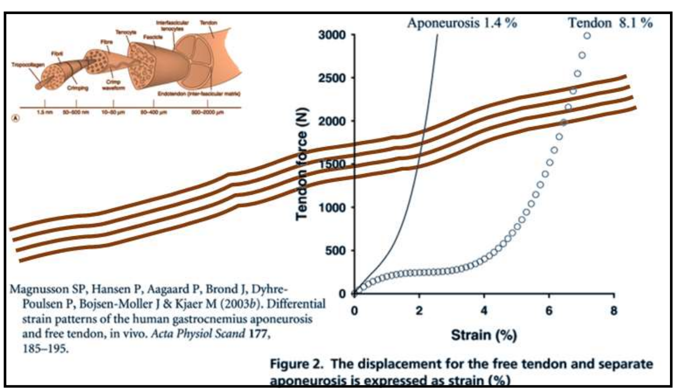

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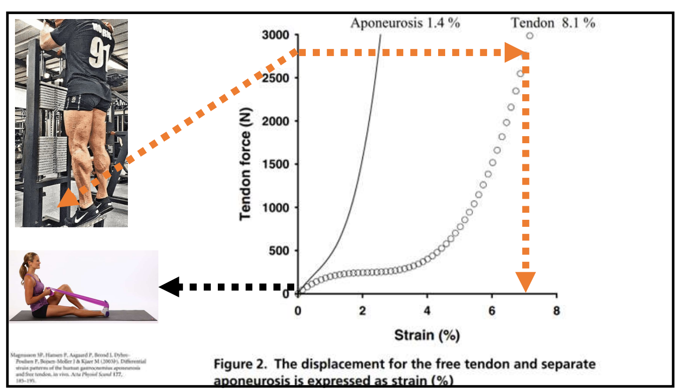

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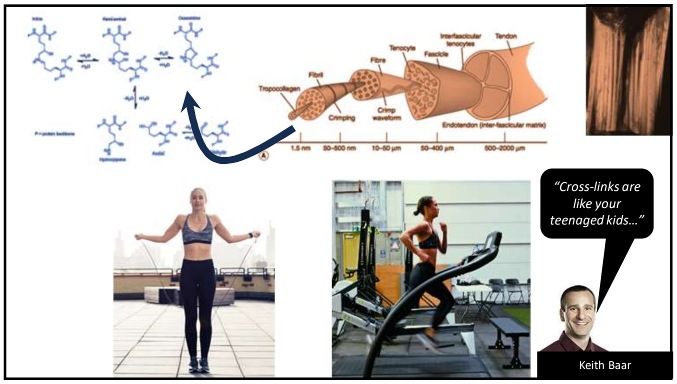

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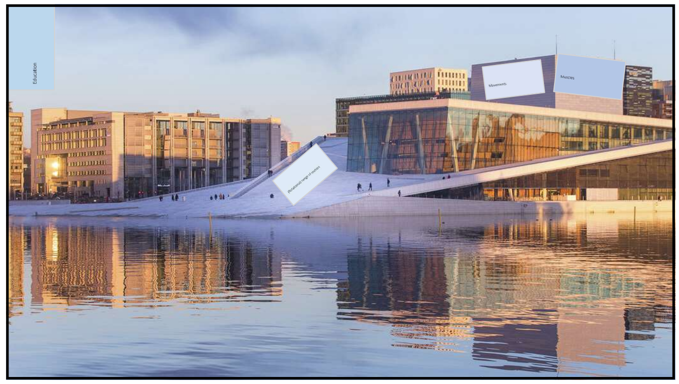

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Education

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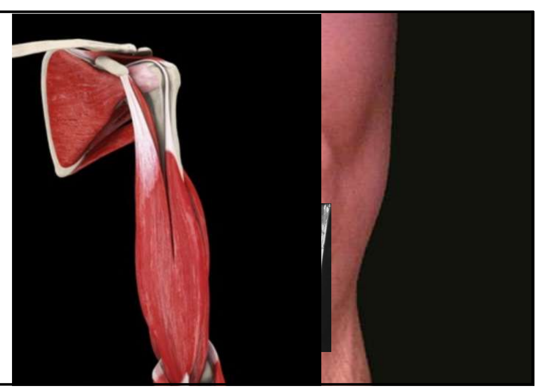
Citation	Exercise: "What If I Really Hurt This Shoulder?"
Barrett et al,[39] (2018)	X
Bele et al,[50] (2015)	X
Carr et al,[55] (2014)	X
Carter,[43] (2002)	X
Cuff and Littlewood,[44] (2018)	
Eriksson et al,[51] (2011)	X
Franz and Uhazie,[56] (2018)	X
Gilbert et al,[45] (2018)	X
Gillespie et al,[20] (2017)	X
Jones et al,[22] (2013)	
Littlewood et al,[47] (2014)	X
Lowe et al,[21] (2014)	X
Lowe et al,[48] (2018)	X
Nyman et al,[54] (2012)	X
Palenius and Nyman,[53] (2018)	X
Payne,[49] (2010)	X
Sandford et al,[46] (2017)	X
Sole et al,[52] (2019)	X
Stamp et al,[57] (2018)	X

28

Tendon explanation to patients

- These blue background slides are for information only – don't use these in the patient explanation, just notes for myself

29



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Tendon

- Connect a muscle to a bone
- Muscle: "makes the force"
- Tendon: cable attached to the engine
- Muscles grow:
- Tendons grow:

- Muscles "burn" and get tired
- Tendons get stretched "steel cables"
- 4 weeks
- 12 weeks

31

"healthy" v "damaged" tendons

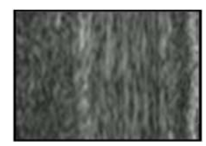
- Mostly grow your tendons up until ~20
- After then, harder to change tendons – maybe ~10% remodeling
- Slow to regrow (like bones)
- "Damage" to tendons probably like wrinkles on skin

32

Tendons change through your life

- Mostly active until about 20
- After then change depending on exercise, but slowly
- One day on, at least one day off
- "Trigger" for loading

33

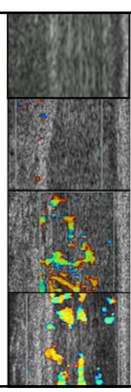


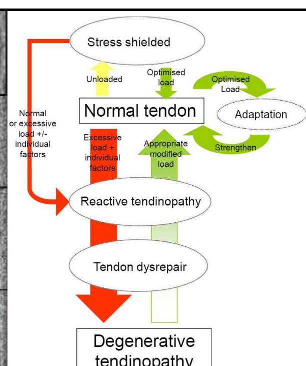
"Ultrasound" tendon

"Simple" tendon – straight cable

34

Cook, J. & Purdam, C. BJSM 2009 *Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load induced tendinopathy*





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Tendons change with loading

Loading
- Fast increase (too much)
- Slow increase
- Slow or fast decrease

Tendon change
- Swollen & painful
- More, and stronger tendon
- Less (and weaker) tendon

36

“Reactive” versus “Degenerative”

“Reactive”
- Big increase in tendon load (compared to what you’re used to)
- Quickly swells up
- Quite painful
- Needs some rest
- Fairly quick to recover
- Why did this overload?

“Degenerative”
- Maybe a small injury
- Maybe natural ageing
- “Warms up”
- Need to grow more tendon
- (Probably won’t ‘fix’ the damaged part – this doesn’t matter)

37

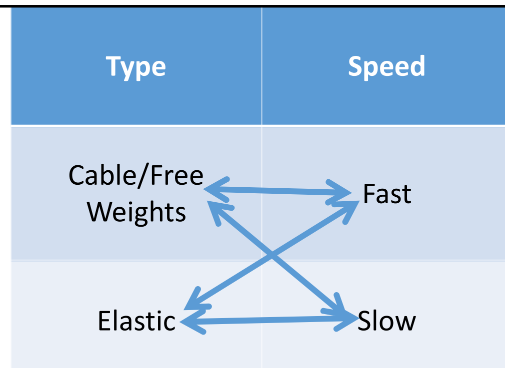
Degenerative

- Where are you now?
- Where do you need to get to? (Worst case scenario)
- Small steps

38

Muscles

39



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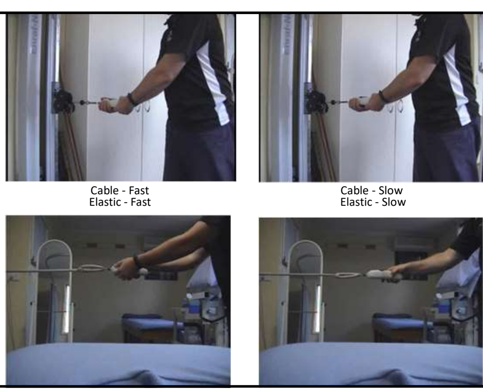

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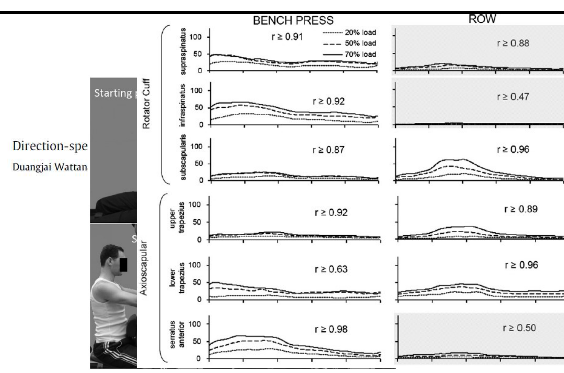

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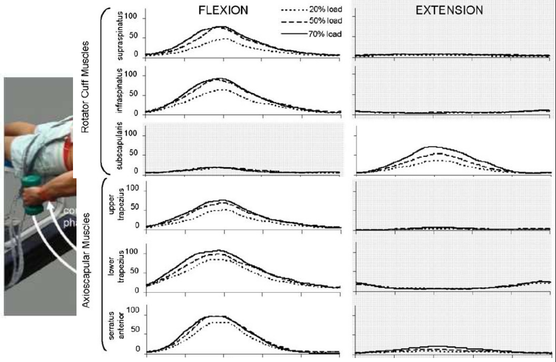

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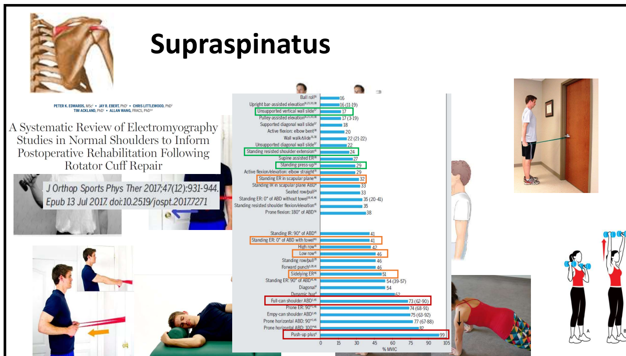
4 simple options cover cuff & scapula

- Push
- Pull
- Flex
- Extend

44

45

Supraspinatus



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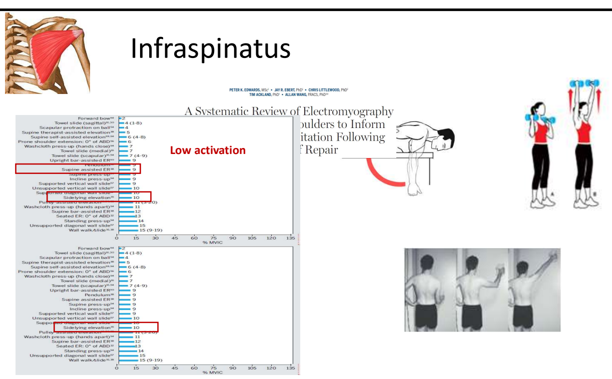
Infraspinatus



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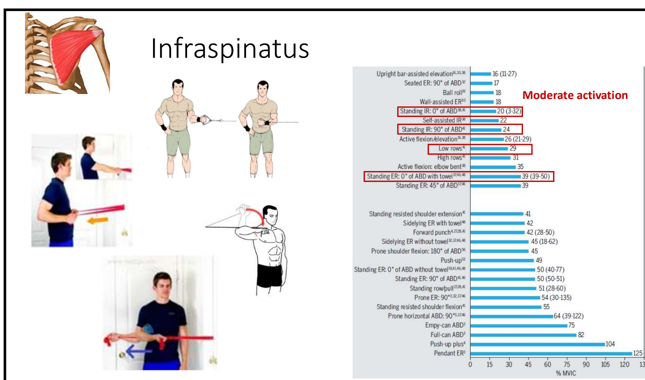
Infraspinatus



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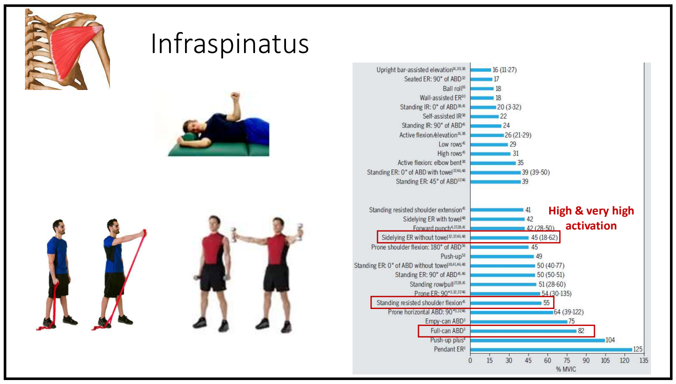

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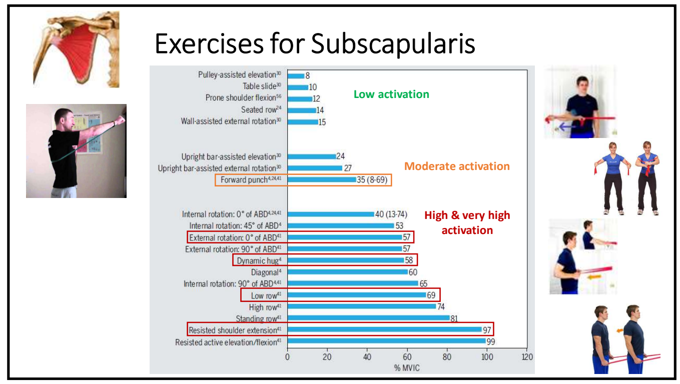

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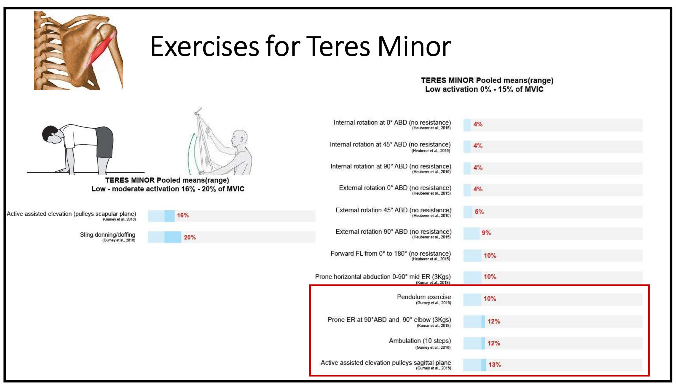

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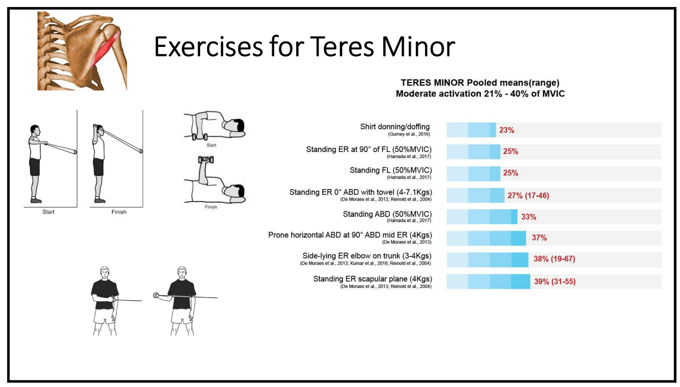

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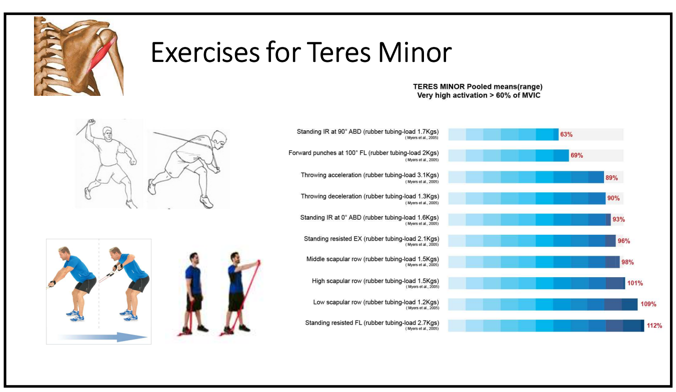

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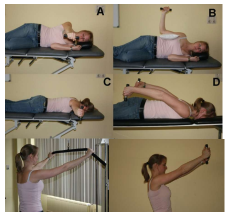
Scapular stabilizers rehabilitation
Trapezius (upper-mid-lower)

TABLE 1
Exercises Commonly Used for Trapezius Training[a]

Exercise Movement	UT	MT	LT	Reference(s)
Abduction	x	x	x	22,35
Forward flexion		x	x	22,34,35,39
Dynamic hug	x			7,12,39
External rotation			x	2
Extension		x	x	7,22,35
Horizontal abduction (neutral or external rotation)	x	x	x	7,22,35
Military press	x			17,35
Rowing (low or high)	x	x	x	17,20,35
Scaption (neutral or external rotation)	x	x	x	2,12,22,35
Scapular retraction		x	x	7,22
Shoulder shrug	x			12,22

[a]UT, upper trapezius; MT, middle trapezius; LT, lower trapezius.



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Movements

57

Push	Pull	Flex	Proprio
Abduct	Adduct	Extend	Impact
Internal Rot’n	External Rot’n	ROM	

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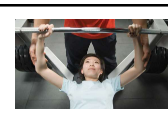
Inner range	Mid range	Outer range
Isometric	Concentric	Eccentric
Controlled		Maximum intent
Low load		High load

59

Push

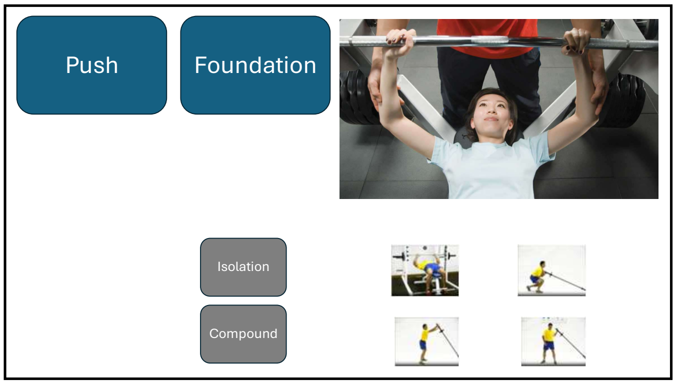
Foundation



Isolation

Compound

60



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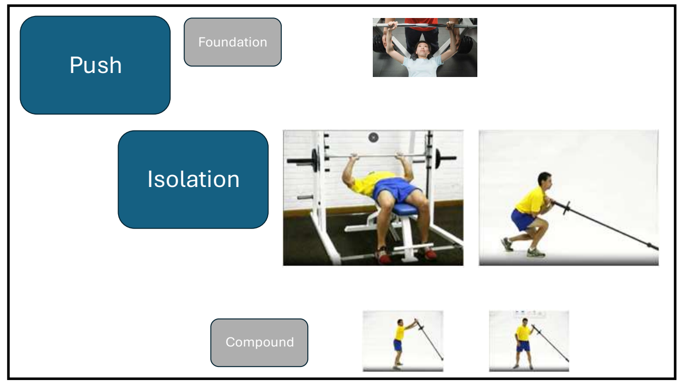

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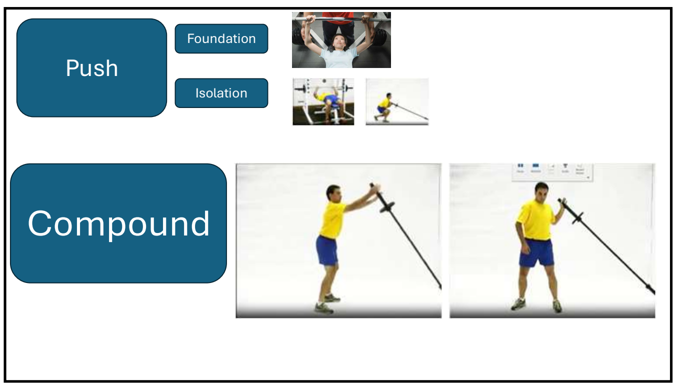

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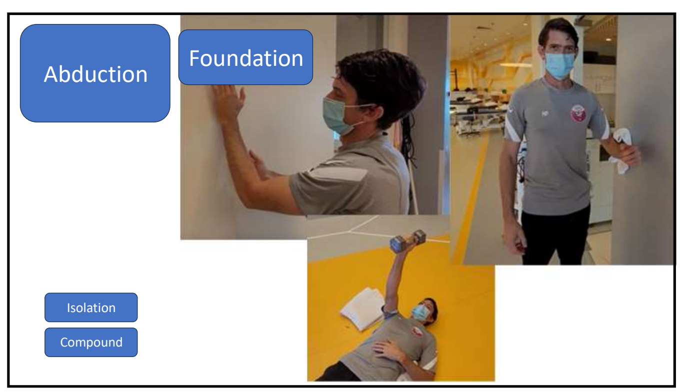
Push
Pull
Flex
Proprio
Abduct
Adduct
Extend
Impact
Internal Rot’n
External Rot’n
ROM

64

Inner range
Mid range
Outer range
Isometric
Concentric
Eccentric
Controlled
Maximum intent
Low load
High load

65



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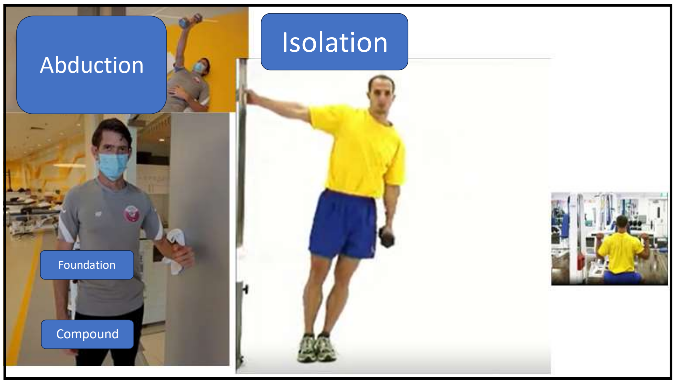

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(Rotational) range of motion

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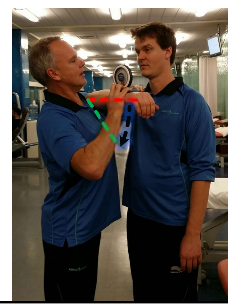
Hawkins-Kennedy as ROM



- 90° flexion
- “Quiet” shoulder
- Passive ROM
  - Note limiting factor (Pain or stiff)

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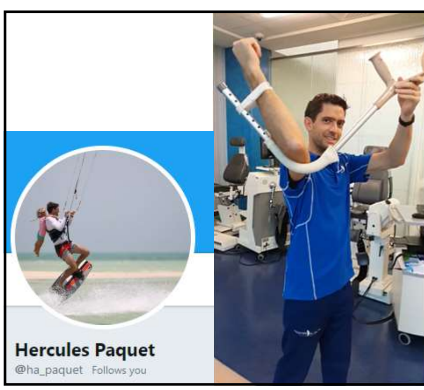

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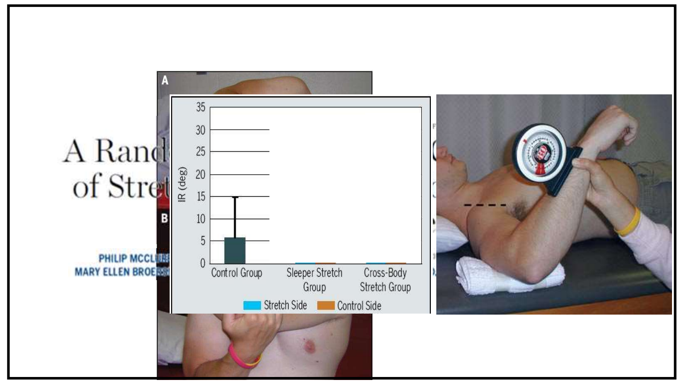
IR (deg)
0
5
10
15
20
25
30
35
Control Group
Sleeper Stretch Group
Cross-Body Stretch Group
Stretch Side
Control Side

74

75