



**Evidence-Based
Rotator Cuff Exam
for the Practicing
Clinician**

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Faculty Disclosure

In compliance with ACCME Guidelines, I hereby declare:

I do not have financial or other relationships with the manufacturer(s) of any commercial services(s) discussed in this educational activity.

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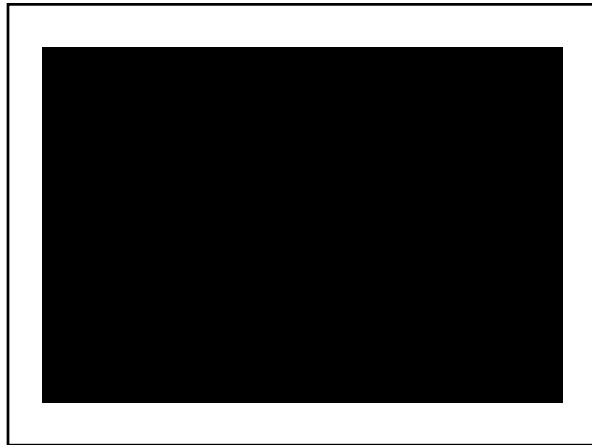


Let's Discuss

- Is this normal?
- Would you say he is impaired?




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Context is Key


- Was your initial opinion relative to your definition of "normal"?
- Did the additional information change your opinion?
- How you approach a patient is no different
 - Many pieces of information is required to provide an accurate diagnosis
 - You will always be biased



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Why the Rotator Cuff?


- 20-30% of population with rotator cuff disease have symptoms
 - Yamamoto et al JSES 2010
 - Yamamoto et al JSES 2011
- Asymptomatic tears exist
 - Prevalence varies based on age
 - 10% ≤20 y/o to 60+%; ≥80 y/o
 - Prevalence high enough that injury versus degeneration hard to distinguish
 - Teunis et al JSES 2014
- Over 50 y/o, up to 50% prevalence of any type of RC tear
 - Sorensen et al JSES 2007



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Question

- In patients with shoulder pain (P), is there evidence supporting making a diagnosis of a rotator cuff injury (O) from the patient history (I)?



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Subjective Information



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Why is the patient in your office?

- **Does the patient have:**
 - Anatomic injury
 - Dysfunction
- **Case Example**
 - 52 y/o assembly line worker
 - C/O inability to repetitively hold arms in front of body when performing job




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Why is this important?


- Current methods of making the diagnosis are not resulting in optimal outcomes
 - Using imaging as primary means for diagnosis
 - Thinking the injury is always directly related to the complaint
- In other words: the context you approach your evaluation greatly affects your treatment plan
 - Anatomical lesion versus functional limitation



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The Evidence


- Symptom duration does not correlate well with RC tear size or impairments (weakness, ROM, PROs)
 - Unruh et al JSES 2014
- History items alone have low diagnostic value
 - Cadogan et al J Man Manip Ther 2013
- A cluster of symptoms plus age has more clinical value than symptoms alone
 - Litaker J Am Geriatr Soc 2000
 - Cadogan et al J Man Manip Ther 2013



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The Evidence


- Pain does not correlate with rotator cuff tear severity
 - 393 subjects with full-thickness atraumatic tears
 - Dunn et al (MOON Shoulder Group) JBJS (Am) 2014
- But what does?
 - Race
 - Co-morbidities
 - Education Level



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The Evidence

- Risk factors for sustaining a tear: Age, history of trauma, dominant arm
 - Under 49 y/o: history of trauma, dominant arm
 - Over 49 y/o: age, history of trauma, dominant arm
 - Yamamoto et al JSES 2010
- Risk factors for having a rotator cuff tear when symptoms are present
 - + impingement sign (OR:10), weakness in ER (OR:3), dominant arm (OR:2)
 - Yamamoto et al JSES 2011



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Value of History

Cadogan et al J Man Manip Ther 2013


Clinical variables	+LR (95% CI)	-LR (95% CI)
Age >50 years	1.79 (1.07, 2.70)	0.69 (0.45, 0.97)
SPADI (pain >48%)	1.30 (0.91, 1.66)	0.64 (0.32, 1.12)
Traumatic onset	1.96 (1.31, 2.67)	0.51 (0.27, 0.82)
Night pain	1.59 (1.15, 2.00)	0.43 (0.19, 0.84)

Van Kampen et al J Orthop Surg Res 2014

	LR (+)	LR (-)
Weakness	0.75	1.2
Night pain	1.1	0.58

Measuring Patient Perception


- Disease-specific instrument ideal for assessing outcomes specific to rotator cuff
 - WORC index
 - RCQOL measure
 - Longo et al KSSTA 2012
- Patient-Specific Functional Scale (PSFS)
 - Allows patient to write down the tasks that he or she struggles with
 - Stratford et al Physiother Can 1995



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Recommendation


- Start exam with proper context
- History alone is limited in diagnosing a rotator cuff injury



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Recommendation


- Items to consider
 - Age (especially ≥ 50 y/o)
 - Arm dominance
 - History of trauma
 - C/O weakness (especially ER)
 - Night pain
- Combine history with other exam components for best answer



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Question

- In patients with shoulder pain (P), is there evidence supporting making a diagnosis of a rotator cuff injury (O) from range of motion and manual muscle testing results (I)?



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Range of Motion Assessments




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Why Do We Assess ROM?

- Motion is basic component of physical function
 - Observation of limitation
 - Try to decide what is “normal”

- Pain versus restriction
 - Pain with active motion loss
 - Contractile tissue involvement?
 - Pain with passive motion loss
 - Soft tissue involvement (contractile or non-contractile)?
 - Restricted movement
 - Chronic condition?




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Why Do We Assess ROM?

- If pain is the issue
 - When and where does it hurt?
 - Does movement affect pain (quality and quantity)?

- If restriction is the issue
 - Where does the restriction begin?
 - Is there a compensatory pattern?
 - Is it tissue pliability or muscle activation?



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What Does the Literature Tell Us?

- Movement analysis by itself not helpful in determining which shoulder is symptomatic
 - Hickey et al Man Ther 2007
- Instrumentation improves reliability of measurement
 - Van de Pol et al J Physio Ther 2010
- Patients over-estimate the amount of their own motion
 - Rudiger et al JSES 2008



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What Else Does the Literature Tell Us?

- Specific to Rotator Cuff Diagnosis
 - Pain during motion not indicative of a rotator cuff injury
 - Itoi et al AJSM 2006
 - Tear size does not affect loss of motion
 - McCabe et al JOSPT 2005
 - Good agreement between clinicians when combination of complete history and selective tissue tension is used
 - Active arm movements
 - Hanchard et al JOSPT 2005




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Combining the Literature with Experience


- ROM by itself not diagnostic
 - Should you continue to measure it?
 - YES!!! But why?
- Aids treatment decision making
- In most cases, postural anatomy is deficient which we know leads to.....




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Decreased Arm Motion and Strength

- Shoulder abduction ROM
 - Erect: 157.5° (± 10.8)
 - **Slouched: 133.9° (± 13.7)**
- Abduction strength @ 90°
 - Erect: 10.4kg (± 4.5)
 - **Slouched: 8.7kg (± 3.5)**
- Scapular upward rotation:
 - Erect: 43.1° (±7.5)
 - **Slouched: 37.9° (±6.5)**
- Scapular posterior tilt
 - Erect: 44.7° (±6.8)
 - **Slouched: 40.6° (±6.9)**



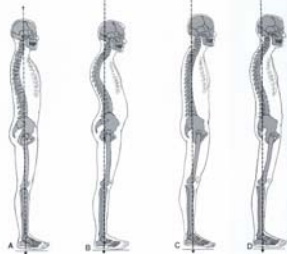
– Kebaetse et al. Arch Phy Med Rehab 1999




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Abnormal Posture

- Rotator cuff prevalence based on posture, age, and past pain
 - Ideal posture: 3%
 - Kyphotic-lordotic: 66%
 - Flat-back: 54%
 - Sway-back: 49%
 - Yamamoto et al JSES 2015



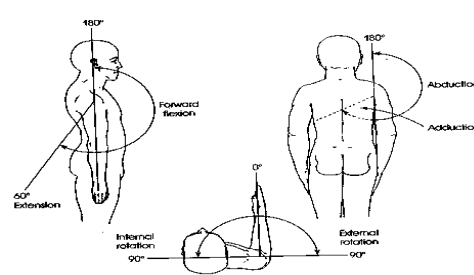
Kendall, McCreary, Provanice. Muscles: Testing and Function 4th ed Lippincott Williams and Wilkins 1993



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Active Range of Motion

"Normal" assumes proper alignment exists



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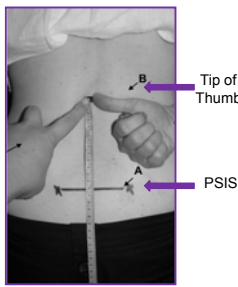
What Should You Evaluate?

- Arm Motion
 - Forward Elevation
 - Abduction
 - ER/IR @ 0°
 - ER/IR @ 90°
 - Other motions as dictated by patient needs and presentation
- Scapular motion
 - Difficult to measure
 - Only upward rotation can be performed clinically at this time

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Functional IR?

- Behind the back ROM
 - ADL specific motion
- Poor to good reliability
- Modified method excellent reliability
 - ICC=.95_{intra}, .96_{inter}
 - SEM=4.3mm_{intra}, 2.6mm_{inter}
 - Van der Dolder et al Man Ther 2014

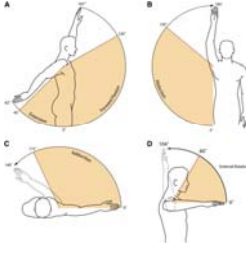


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How Much is Enough?

Functional ranges

- For ADLs
 - 120° forward elevation
 - 45° extension
 - 130° abduction
 - 115° cross body adduction
 - 60° ER (at 90°)
 - 100° IR (at side)



Namdari et al JSES 2012

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Instrumentation

- Eyes
 - Shown to have variable reliability (.26-.96)
 - Van de Poi et al J Physio Ther 2010
- Goniometer/Inclinometer
 - Individual SEM 2-5°, can vary up to 20°


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Recommendations

- Do not perform ROM by itself – not diagnostic or predictive of injury
- Devices improve measurement reliability but practice is key for consistency
- ROM assessment is helpful in rotator cuff exam when combined with other exam findings

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Manual Muscle Testing



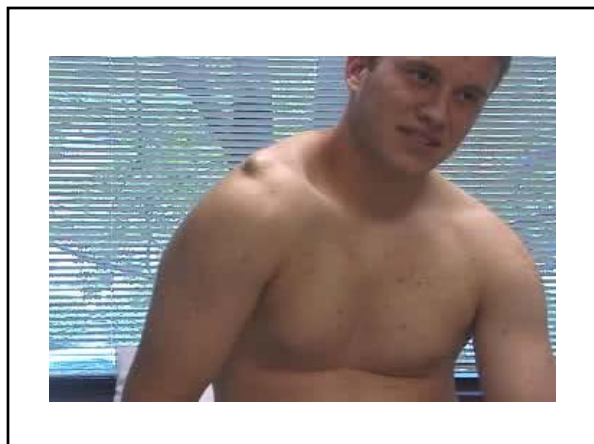
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Why Do We Perform MMT?

- Designed for patients with paralytic conditions
 - Lovett and Martin JAMA 1916
 - Decided assessment could be useful in all populations
- Injury versus malalignment
 - Injury: inhibition from pain or derangement
 - Malalignment: altered position modifies load and stress creating pain, injury, or altered output



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Number System Doesn't Equal Objective

Grade	Value	Description
5	Normal	Complete ROM against gravity, max resistance
4	Good	Complete ROM against gravity, mod resistance
3+	Fair+	Complete ROM against gravity, min resistance
3	Fair	Complete ROM against gravity
3-	Fair-	Some ROM against gravity
2+	Poor+	Initiates motion against gravity
2	Poor	Complete ROM w/ gravity eliminated
2-	Poor-	Initiates motion w/ gravity eliminated
1	Trace	Evidence of contraction w/ no joint motion
0	Zero	No contraction



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What Grade Would You Give?



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What We Know About MMT

- Grade 3 (fair) is least subjective
 - Sapega JBJS 1990
- Grade 4 cannot accurately determine impairment
 - Dvir Clin Rehab 1997
- MMT with hands lower reliability compared to instrumentation
 - Hayes et al JSES 2002




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MMT Reliability

- Measurement device
 - MMT (grades 1-4, 4.5, 5)
 - Hand Held Dynamometer
 - Spring Scale
- Motion
 - Elevation
 - External Rotation
 - Internal Rotation
 - Lift off

– Hayes K et al., JSES 2002


	Intraclass correlation coefficient (ρ)	95% CI
Manual muscle test		
Elevation	0.72	0.38-0.93
External rotation	0.55	0.17-0.88
Internal rotation	0.61	0.26-0.89
Lift-off	0.38	0.02-0.81
Dynamometry		
Elevation	0.92	0.75-0.99
External rotation	0.82	0.55-0.96
Internal rotation	0.85	0.62-0.97
Lift-off	0.79	0.50-0.95
Spring scale dynamometer		
Elevation	0.96	0.84-1.00
External rotation	0.75	0.40-0.95
Internal rotation	0.88	0.68-0.98
Adduction	0.90	0.72-0.98



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Additional Thought


- If devices improve reliability of the measure, do you need to purchase a device?
 - You still must become proficient at using a device
 - Your clinical skills do not automatically improve because you now own expensive equipment
 - Unknown if devices improve diagnostic capability



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Manual Muscle Testing

- Force production at a specific muscle in isolation is not realistic
- EMG analysis of rotator cuff muscle function identified optimal positions
 - Maximal activation of target muscle with minimal activation of synergistic muscles
 - Best reliability and minimal pain during test



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Rotator Cuff Manual Muscle Tests

Full Can ER at Side Lift-Off

Kelly et al AJSM 1996

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What Do These Tests Tell Us?

- Weakness during tests help determine muscle injury
 - Full can <grade 5 = supraspinatus
 - ER at side <grade 4+ = infraspinatus
 - Lift-off <grade 3 = subscapularis
 - Pain not a reliable predictor of injury
 - Itoi et al AJSM 2006

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What Do These Tests Tell Us?


- Tear size and strength
 - Weakness >50% of non-involved arm in 10° shoulder abduction indicative of large or massive rotator cuff tear
 - Full thickness tears 20% larger strength loss compared to partial thickness tears
 - McCabe et al JOSPT 2005

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Clinical Experience Tip

The “non-shoulder” shoulder examination



Looking for potential causes of shoulder pain



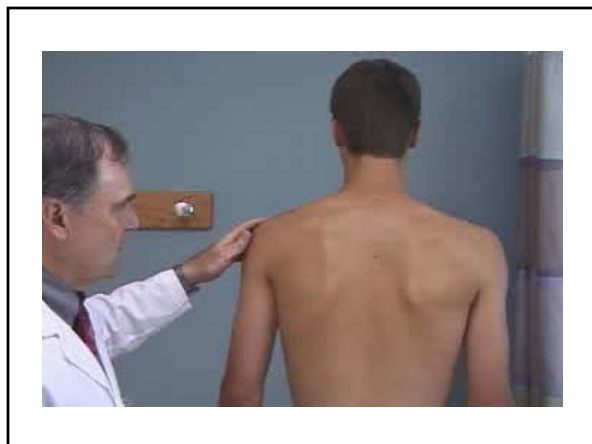
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Scapular Assessment

- Static position
- Dynamic motion – 3-5 reps
 - “Yes/No”
 - Uhl et al Arthroscopy 25(11): 1240-1248, 2009
- Modifications
 - Up to 10 reps
 - Add light 2-5 lb weight
 - McClure et al Journal of Athletic Training 44(2): 160-164, 2009




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Corrective Maneuvers

- Use maneuvers to show a component of dysfunction to help guide treatment (quality assessment)

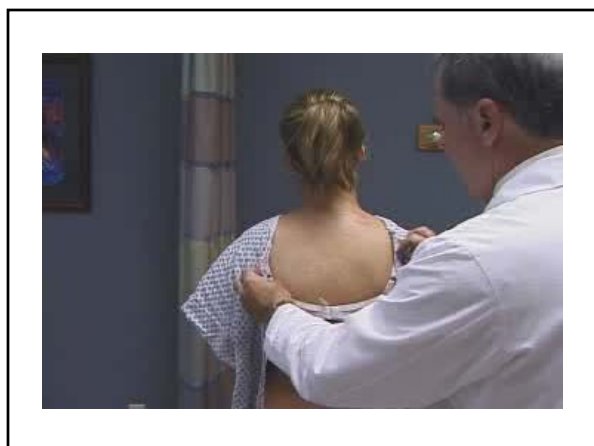


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Controversy


- Tests cannot differentially diagnose patients with and without shoulder pain
 - Wright et al BJSM 2013
- Scapular issues are “impairments” not pathology
 - Dyskinesis is not an injury or a diagnosis
 - Kibler et al BJSM 2013
- Scapular dyskinesis is a physical finding so there should be no value for making a diagnosis

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Recommendations


- MMT grading system is not truly objective
- Rotator cuff strength testing can help diagnose rotator cuff injury using weakness as the outcome with larger tears having more weakness
- Scapular examination not diagnostic of rotator cuff injury but can assist in impairment detection
- Deficits found in MMT guide treatment options for impairment resolution



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Question

- In patients with shoulder pain (P), is there evidence supporting making a diagnosis of a rotator cuff injury (O) from special testing results (I)?



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Confirming Suspicions



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What We Know


- Over 120 clinical shoulder tests
- Current opinion: Lack of quality evidence to advocate using any one clinical shoulder test exclusively
 - There is no Lachman's for the shoulder



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Different Approaches


- Only use the literature
 - Excellent work exists identifying clinical utility of most tests
 - If it's in print in must be true
- Only use your preferences
 - Part of being a clinician is science but also art
 - Enters bias into the equation
- Complementary approach



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Complementary Approach


- Patient values
 - What are the complaints: anatomical, functional, both?
- Clinician experience
 - What have you seen and what have you used in the past?
- Best available evidence
 - What does the literature tell you and how good is it (quality)?
- **Haven't we heard this before?**
 - Components of evidence-based medicine



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Quick Definitions


- Sensitivity: proportion of patients with disorder who have a positive test
 - SnNout: high **sensitivity**, test **negative** = rule out
- Specificity: proportion of patients without disorder who have a negative test
 - SpPin: high **specificity**, test **positive** = rule in



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Quick Definitions

- + Likelihood Ratio: how much a positive test increases the probability of a disease being present
 - Sensitivity/1 – Specificity
- - Likelihood Ratio: how much a negative test decreases the probability of a disease being present
 - 1 – Sensitivity/Specificity



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Likelihood Ratio		Interpretation
“+”	“-”	
>10	<0.1	Large & often conclusive changes from pre-test to post-test probability
5 – 10	0.1 – 0.2	Moderate shifts in pre-test to post-test probability
2 – 5	0.5 – 0.2	Small but sometimes important changes in probability
1 – 2	0.5 – 1	Small and rarely important changes in probability

Jaeschke et al JAMA 1994

Rule of thumb

- For LR+ of 2
 - pretest probability is increased by about 15%
- For LR+ of 5
 - pretest probability is increased by about 30%
- For LR+ of 10
 - pretest probability is increased by about 45%
- For LR- of 0.5
 - pretest probability is decreased by about 15%
- For LR- of 0.2
 - pretest probability is decreased by about 30%
- For LR- of 0.1
 - pretest probability is decreased by about 45%

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What are Diagnostic Values?

- 50% prevalence of rotator cuff injury in 50 y/o patient and a special test with a +LR=7
- A positive ER lag sign increases post-test probability to approximately 85%

From the CEBM


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Category	Number of Tests
Labral Injury	18
Anterior Instability	19
Posterior Instability	13
Multidirectional Instability	11
Scapular Dysfunction	7
AC Joint Injury	11
Biceps Injury	14
Impingement	12
Rotator Cuff Injury	18
Total	122

Sciascia et al JAT 2012

Rotator Cuff Injury


- What we know
 - At least 2 tests exist per muscle
 - Multiple muscles = various injuries
 - Combination of resistance tests and lag signs
 - Most common shoulder injury



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Controversies


- A variety of conditions: impingement, tendinopathy, PT-RCT, FT-RCT, massive RCT
- Do positive tests indicate tear or “involvement”?
- Should you use a dynamic task, break test, or lag sign?
 - Dynamic task: impeded by pain not allowing accurate measurement
 - Break test: other larger muscles can override smaller cuff muscles
 - Lag signs: inability to hold arm in position




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Tests for Tears

- External Rotation Lag Sign
 - +LR: 7.2
- Internal Rotation Lag Sign
 - +LR: 5.6
- Dropping Sign
 - +LR: 3.2



Hermans et al JAMA 2013




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Tests for Disease

Resistance Tests

- External Rotation Resistance
- Patte
- Full Can
- Empty Can (Jobe)
- Resisted Abduction
 - +LR 0.72-2.6
 - Translation = not the tests you should be using exclusively

Patte Test







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Single Test Suggestions


ERLS




Lateral Jobe



Belly Press



Belly Off Sign




Myer et al BJSM 2013, Hermans et al JAMA 2013, Hegedus et al BJSM 2012, Sciascia et al JAT 2012

Combination Suggestions

- Supraspinatus Tendinopathy
 - >39y/o, painful arc, patient reported pop or click
 - 2 positive tests (+LR: 3.8)
 - 3 positive tests (+LR: 32.2)
 - Chew et al Physiother Sing 2010
- Rotator Cuff Tear
 - ≥65 y/o, external rotation weakness, night pain (+LR: 9.8)
 - Litaker et al J Am Geriatr Soc 2000
- Subscapularis Injury
 - Lift-off and/or resisted internal rotation (+LR: 3.13)
 - Naredo et al Ann Rheum Dis 2002


From Hegedus BJSM 2012



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Possible Approach

- Special testing is another tool in the toolbox
 - Special testing is often confirmatory of your clinical suspicion derived from the patient history
- Requirements for gaining useful information from special testing
 - Appreciation of anatomy and function
 - Familiarity with test and how to execute it
 - Matching up patient history with test results



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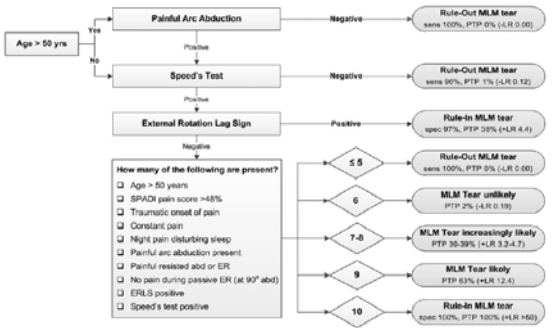
Recommendation

- Evidence and experience supports using resistance and lag signs to confirm suspicion of muscle tear. A cluster of symptoms and maneuvers appear to be most useful
 - Hegedus et al BJSM 2012
 - Myer et al BJSM 2013
 - Cadogan et al J Man Manip Ther 2013
 - Hermans et al JAMA 2013




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Putting it all together




The flowchart starts with 'Age > 50 yrs'. If 'Yes', it leads to 'Painful Arc Abduction'. If 'No', it leads to 'Speed's Test'. Both 'Painful Arc Abduction' and 'Speed's Test' have 'Positive' and 'Negative' outcomes. 'Painful Arc Abduction' (Positive) leads to 'External Rotation Lag Sign'. 'Speed's Test' (Positive) also leads to 'External Rotation Lag Sign'. 'External Rotation Lag Sign' (Positive) leads to 'Rule-in MLM tear' (spec: 97%, PTP: 30%, +LR: 4.4). 'External Rotation Lag Sign' (Negative) leads to a decision diamond 'How many of the following are present?'. The decision diamond has five paths based on the number of symptoms present (5, 6, 7-8, 9, 10). The symptom list includes: Age > 50 years, SPADI pain score >= 6/8, Traumatic onset of pain, Constant pain, Night pain disturbing sleep, Painful arc abduction present, Painful resisted abd or ER, No pain during passive ER (at 90° abd), ERLS positive, and Speed's test positive.

Cadogan et al J Man Manip Ther 2013

Wrap-Up

- History
 - Age
 - Arm involved
 - History of trauma
 - Self-reported weakness
- Manual Muscle Testing
 - Full can
 - ER at side
 - Lift-off
- Range of Motion
 - AROM/PROM to assist in tissue involvement
- Special Testing
 - Lag Signs
 - Selected Resistance Tests

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THANK YOU