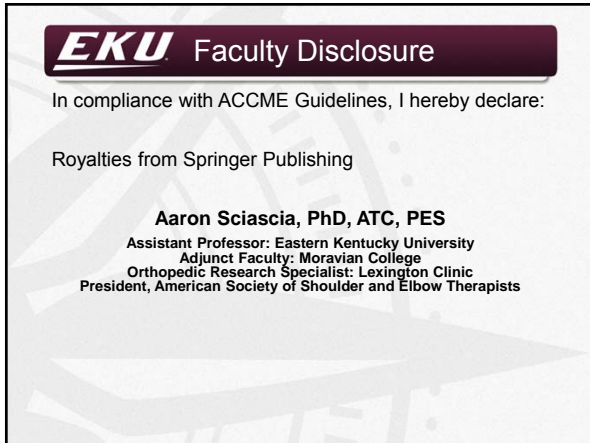


E Evidence-Based Rotator Cuff Exam for the Practicing Clinician

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EKU Faculty Disclosure

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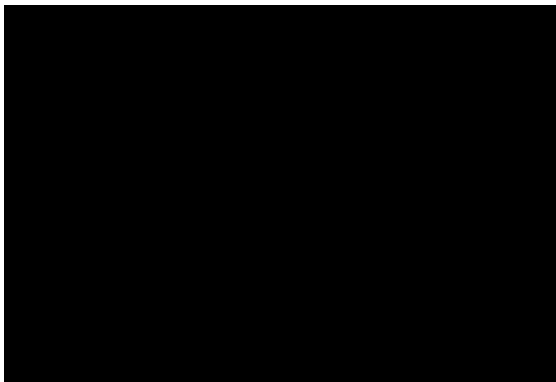
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Let's Discuss

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





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

EKU Context

- The context you approach your evaluation greatly affects your treatment plan
 - Anatomical lesion versus functional limitation
 - 83% of complaints relate to inability to perform a task
 - o Smith-Forbes et al J Sport Rehabil 2015
- 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

EKU Why is the patient in your office?

- **Case Example**
 - 52 y/o assembly line worker
 - C/O inability to repetitively hold arms in front of body when performing job

EKU





EKU 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)?

EKU

Subjective Information

EKU 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
 - o 10% ≤20 y/o to 60+% ≥80 y/o
 - Prevalence high enough that injury versus degeneration hard to distinguish
 - o Teunis et al JSES 2014
- Over 50 y/o, up to 50% prevalence of any type of RC tear
 - o Sorensen et al JSES 2007

EKU 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

EKU The Evidence

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

EKU Risk Factors

- 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
 - o 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)
 - o Yamamoto et al JSES 2011

EKU Risk Factors

- Risk factors for diagnosing a tear:
 - Hypercholesterolemia (LR=2.3)
 - Relative with RC disease (LR=1.2-2.6)
 - Heavy lifting/Manual labor (LR=1.7-2.6)
 - Above shoulder work (LR=2.1-3.1)
 - Hand-held vibration work (LR=2.2-4.5)
 - Age >60 years (LR=2.1-3.3)
 - o Raynor and Kuhn JSES 2016
- **INTERPRETATION: If any of these factors are present, chance of rotator cuff tear existing increases by 15-30%**

EKU Value of History?

Cadogan et al J Man Manip Ther 2013

Characteristic	LR (+)	LR (-)
Rotator cuff tear	1.75 (1.07, 2.79)	0.68 (0.45, 0.97)
Rotator cuff disease	1.83 (1.07, 3.09)	0.64 (0.42, 0.97)
Rotator cuff tear and disease	1.83 (1.07, 3.09)	0.64 (0.42, 0.97)
Rotator cuff tear only	1.83 (1.07, 3.09)	0.64 (0.42, 0.97)

Van Kampen et al J Orthop Surg Res 2014

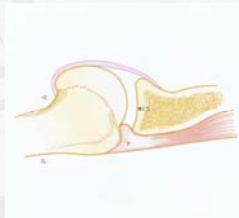
	LR (+)	LR (-)
Weakness	0.75	1.2
Night pain	1.1	0.58

EKU Measuring Patient Perception

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

EKU What About Throwers?

- Anecdotally
 - Superior/Posterior Pain
 - o Between cocking – late cocking: SLAP
 - o Between acceleration – deceleration: RC
 - Burkhart et al Arthroscopy 2003
 - Dugas and Mathis Op Tech Sports Med 2016



EKU Recommendation

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

EKU Recommendation

- Items to consider
 - Age (especially ≥ 50 y/o)
 - Arm dominance
 - History of trauma
 - Occupation
 - Co-morbidities
- Combine demographics/history with other exam components for best answer

EKU 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)?

EKU

Range of Motion Assessments

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

EKU Why Do We Assess ROM?

- If pain is the issue
 - o When and where does it hurt?
 - o Does movement affect pain (quality and quantity)?
- If restriction is the issue
 - o Where does the restriction begin?
 - o Is there a compensatory pattern?
 - Is it tissue pliability or muscle activation?

EKU 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

EKU What Else Does the Literature Tell Us?

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




EKU 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.....

EKU Decreased Arm Motion and Strength

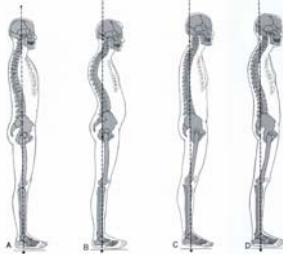
- Shoulder abduction ROM
 - Erect: 157.5° (± 10.8)
 - **Slouched: 133.9° (± 13.7)**
- Abduction strength @ 90°
 - Erect: 10.4kg (± 4.5)
 - **Slouched: 8.7kg (± 3.5)**
- Scapular upward rotation:
 - Erect: 43.1° (±7.5)
 - **Slouched: 37.9° (±6.5)**
- Scapular posterior tilt
 - Erect: 44.7° (±6.8)
 - **Slouched: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



• Kebaetse et al. Arch Phy Med Rehab 1999

EKU Abnormal Posture

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



o Yamamoto et al JSES 2015

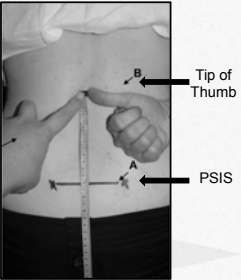
Kendall, McCreary, Provanco. Muscles: Testing and Function 4th ed Lippincott Williams and Wilkins 1993

EKU 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

EKU Functional IR?

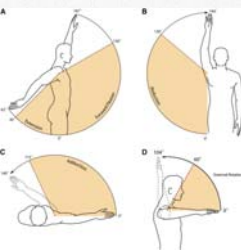
- Behind the back ROM
 - ADL specific motion
- Poor to good reliability
- Modified method excellent reliability
 - ICC = .95_{intr} - .96_{inter}
 - SEM = 4.3mm_{intr} 2.6mm_{inter}
 - o Van der Dolder et al Man Ther 2014



EKU How Much is Enough?

Functional ranges

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



Namdari et al JSES 2012

EKU 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

EKU

Manual Muscle Testing

EKU 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

EKU 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

EKU What Grade Would You Give?



EKU 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

EKU 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 (i)	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

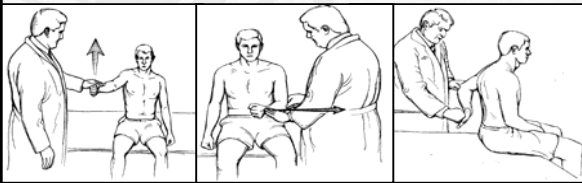
EKU Additional Thought

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

EKU 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

EKU Rotator Cuff Manual Muscle Tests



Full Can ER at Side Lift-Off

Kelly et al AJSM 1996

EKU 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
 - o Pain not a reliable predictor of injury
 - o Itoi et al AJSM 2006

EKU What Do These Tests Tell Us?

- Weakness in pre-season associated with in-season injury requiring surgery
 - Prone ER
 - Seated ER
 - Full can
 - o Byram et al AJSM 2010

EKU 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
 - o McCabe et al JOSPT 2005

EKU This Might Confuse You

- Infraspinatus atrophy not a concern in professional tennis players
 - 58% ranked in top 100 had atrophy
 - 40% ranked outside top 100 had atrophy
 - Atrophy not associated with any other clinical finding
- Young et al Am J Sports Med 2015

EKU Clinical Experience Tip

The “non-shoulder” shoulder examination

Looking for potential causes of shoulder pain

EKU Scapular Assessment

- Static position
- Dynamic motion – 3-5 reps

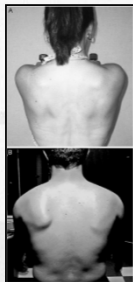
- “Yes/No”

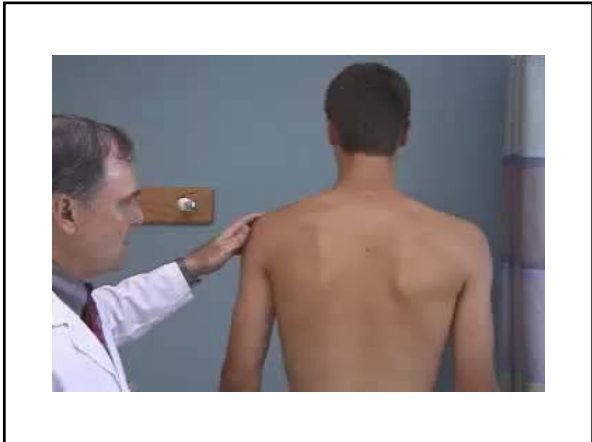
• Uhl et al Arthroscopy 25(11): 1240-1248, 2009

- Modifications

- Up to 10 reps
- Add light 2-5 lb weight

• McClure et al Journal of Athletic Training 44(2): 160-164, 2009





EKU Corrective Maneuvers

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

EKU Scapular Assistance Test

Kibler Am J Sports Med 1998
Rabin et al J Orthop Sports Phys Ther 2006

EKU Scapular Retraction Test



Kibler et al Am J Sports Med 2006

EKU Why Use the Corrective Maneuvers?

- SAT
 - Shows patient and clinician that scapular dysfunction is limiting ROM and contributing to pain
 - o Kibler and Sciascia AAOS ICL 57 2008
- SRT
 - Strength increase with scapular stabilization
 - o Rehab needs to address scapular muscles, not RC muscles
 - o Strength increase can be as high as 24% with stabilized scapula
 - Kibler, Sciascia, Dome Am J Sports Med 2006
 - Tate et al J Orthop Sports Phys Ther 2008

EKU Recommendations

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



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)?



Confirming Suspicions



What We Know

- Over 126 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

EKU 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

EKU Complementary Approach

- Patient values
 - o What are the complaints: anatomical, functional, both?
- Clinician experience
 - o What have you seen and what have you used in the past?
- Best available evidence
 - o What does the literature tell you and how good is it (quality)?
- **Components of evidence-based medicine**

EKU 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

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

EKU General Guidelines

- 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%

EKU What are Diagnostic Values?

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

From the CEBM

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

EKU Rotator Cuff Injury


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

EKU Controversies

- o A variety of conditions: impingement, tendinopathy, PT-RCT, FT-RCT, massive RCT
- o Do positive tests indicate tear or "involvement"?
- o 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

EKU Rotator Cuff Injury

- ER Lag Sign (+LR: 3-70)
 - Hertel et al JSES 1996
 - Miller et al APMR 2008
- Useful for detecting various full thickness tears
 - SSp: +LR=28
 - IF: +LR=14
 - TM: +LR=14
 - Castoldi et al JSES 2009
- IR Lag Sign (+LR: 5.6)
 - Hertel et al JSES 1996
 - Miller et al APMR 2008



EKU Rotator Cuff Injury

- Belly Off Sign
 - First reported by
 - o Scheibel et al Arthroscopy 2005
 - Evidence
 - o +LR=10 Bartsch et al Arthroscopy 2010



EKU Example



EKU Rotator Cuff Injury

- Lateral Jobe Test
 - First reported by
 - o Gillooly et al Int J Shoulder Surg 2010
 - Evidence
 - o +LR=10 Gillooly et al Int J Shoulder Surg 2010




EKU 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



EKU Combination Suggestions

- Supraspinatus Tendinopathy
 - >39y/o, painful arc, patient reported pop or click
 - o 2 positive tests (+LR: 4)
 - o 3 positive tests (+LR: 32)
 - Chew et al Physiother Sing 2010
- Rotator Cuff Tear
 - ≥65 y/o, external rotation weakness, night pain (+LR: 10)
 - o Litaker et al J Am Geriatr Soc 2000
- Subscapularis Injury
 - Lift-off and/or resisted internal rotation (+LR: 3)
 - o Naredo et al Ann Rheum Dis 2002

From Hegedus BJSM 2012

EKU 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

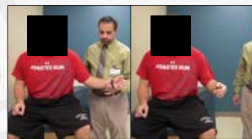
EKU Putting it all together

The flowchart starts with 'Age > 50 yrs'. If 'Yes', it leads to 'Painful Arc Abduction'. If 'No', it leads to 'Speed's Test'. From 'Painful Arc Abduction', a 'Positive' result leads to 'Rule-Out MLM tear' (sensitivity 100%, PTP 0%, L/R 0.00) and a 'Negative' result leads to 'Speed's Test'. From 'Speed's Test', a 'Positive' result leads to 'Rule-In MLM tear' (specificity 97%, PTP 32%, L/R 4.4) and a 'Negative' result leads to 'Rule-Out MLM tear' (sensitivity 96%, PTP 1%, L/R 0.12). From 'Speed's Test', a 'Positive' result also leads to 'External Rotation Lag Sign'. From 'External Rotation Lag Sign', a 'Positive' result leads to 'Rule-In MLM tear' (specificity 97%, PTP 32%, L/R 4.4) and a 'Negative' result leads to 'How many of the following are present?'. The 'How many of the following are present?' section lists 10 criteria: Age > 50 years, SPADI pain score >=48%, 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. The number of criteria present (0-10) leads to different outcomes: 0-5: Rule-Out MLM tear (sensitivity 100%, PTP 0%, L/R 0.00); 6: MLM Tear unlikely (PTP 2%, L/R 0.19); 7-8: MLM Tear increasingly likely (PTP 30-39%, L/R 3.2-4.7); 9: MLM Tear likely (PTP 63%, L/R 12.4); 10: Rule-In MLM tear (specificity 100%, PTP 100%, L/R 150).

Cadogan et al J Man Manip Ther 2013

EKU Recommendation

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



EKU Wrap-Up

- History
 - Age
 - Dominant arm involved
 - History of trauma
 - Occupation
 - Co-morbidities
- Range of Motion
 - AROM/PROM to assist in tissue involvement but not for diagnosis
- Manual Muscle Testing
 - Full can
 - ER at side
 - Lift-off
- Special Testing
 - Lag Signs
 - Selected Resistance Tests

EKU THANK YOU