




**Differential Diagnosis and Special Tests:
 Diagnosing Shoulder Pain**
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Diagnosis: What is it?

- Process and end-result of evaluating information obtained from the examination, which the clinician then organizes into defined:
 - clusters, syndromes, or categories to help determine the most appropriate intervention strategies.

Guide to Physical Therapist Practice, APTA

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What's in a study to determine the diagnostic utility of a test?

- Dx test: adequately defined & reproducible
- Patients that you would apply the test to
 - Ex: Shoulder tests → pts with shoulder pain
 - NOT: Shoulder tests → pts with knee pain
- A blind comparison to a gold standard
 - Capsular laxity – MRA, surgery for Ant Instability tests
 - ACL tear – surgery, MRI for Lachman's test
- Other key features
 - <http://www.stard-statement.org/>

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Key Metrics for Dx Accuracy

- Diagnostic Accuracy values: **BLUF**
 - **Sensitivity**
 - **Specificity**
 - PPV: Predictive value of a positive test
 - NPV: Predictive value of a negative test
 - **LR+ : Positive likelihood ratio**
 - **LR- Negative likelihood ratio**

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	Subjects with disease Gold standard is "+"	Subjects w/o disease Gold standard is "-"	
Test applied is "+"	True positive a	False positive b	a + b
Test applied is "-"	False negative c	True negative d	c + d
	a + c	b + d	

Sensitivity = with condition & test + / all pts with condition
 True positive / true positive + false negative
 $a / a + c$

Specificity = w/o condition & test - / all pts w/o condition
 True negative / true negative + false positive
 $d / b + d$

Sensitivity and Specificity

- Sensitivity
 - SnNOut = When Sn is high, a Negative test rules Out the disease
- Specificity (SpPIn)
 - SpPIn = When Sp is high, a Positive test rules In the disease.
- Interpretation:
 - Indicates if a test ↓s or ↑s disease probability
 - **BUT: No set cut-off to quantify shift in probability**

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	Subjects with disease Gold standard is "+"	Subjects w/o disease Gold standard is "-"	
Test applied is "+"	True positive a	False positive b	a + b
Test applied is "-"	False negative c	True negative d	c + d
	a + c	b + d	

PPV = proportion of pts with a + test, who have the disease
 NPV = proportion of patients with - test, who do not have the disease
PREVALENCE dependent!! Can be a more unstable estimate

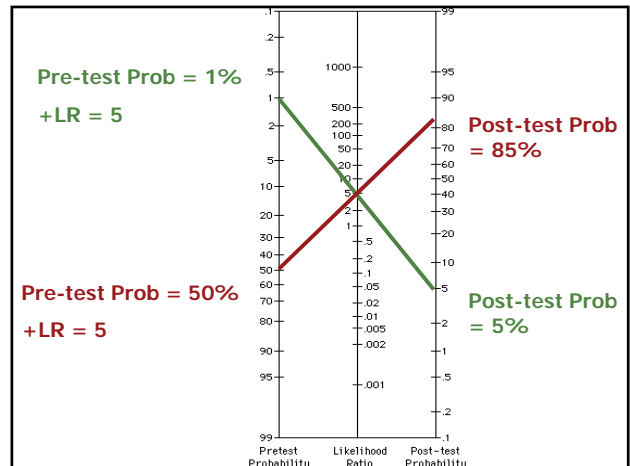
	Subjects with disease Gold standard is "+"	Subjects w/o disease Gold standard is "-"	
Test applied is "+"	True positive a	False positive b	a + b
Test applied is "-"	False negative c	True negative d	c + d
	a + c	b + d	

+LR = Sensitivity / 1 - Specificity
 $(a / a+c) / [1 - (d / b+d)]$
 -LR = 1 - Sensitivity / Specificity
 $[1 - (a / a+c)] / (d / b+d)$

Likelihood Ratios

- More helpful for Dx
- Indicate *by how much* a given diagnostic test result will ↓ or ↑ the probability of the disease.
- Quantify shifts in probability of the diagnosis/disorder for an individual patient
 - Ex: +LR= 5: a patient with a + test is 5x more likely in a patient with the disease as compared to a patient without the disease
- Minimal affect of prevalence

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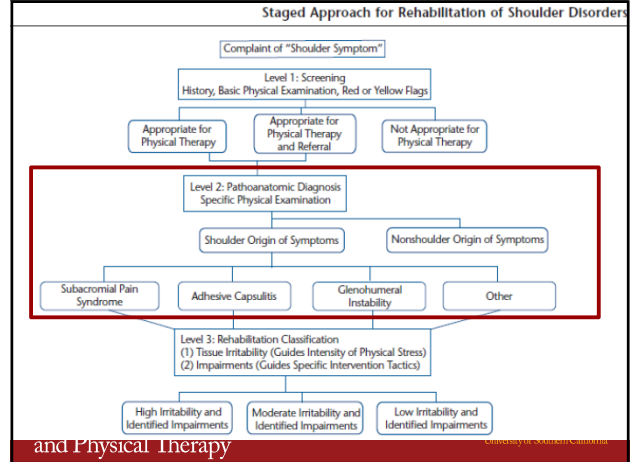
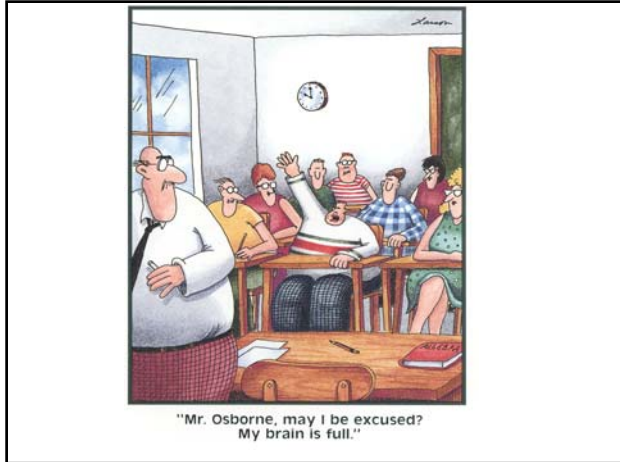


<u>Likelihood Ratio</u>		<u>Interpretation</u>
"+"	"-"	
>10	<0.1	Large & often conclusive changes from pre-test to post-test probability
5 - 10	0.1 - 0.2	Moderate shifts in pre-test to post-test probability
2 - 5	0.5 - 0.2	Small but sometimes important changes in probability
1 - 2	0.5 - 1	Small and rarely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

Recommendation: Dx Interpretation

<p>Screen (Rule/ Out)</p> <ul style="list-style-type: none"> - Sensitivity: SnNOut * Sn ≥ 80% - Likelihood ratio (- LR) * - LR ≤ 0.5 	<p>Confirm (Rule/ IN)</p> <ul style="list-style-type: none"> - Specificity: SpPIn * Sp ≥ 80% - Likelihood ratio (+LR) * +LR ≥ 2.0
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Rotator Cuff Disease Heterogeneous pathology

- Subacromial Pain Syndrome (SPS)
- RCD - includes SPS, PT-RCT, FT-RCT

How do we diagnosis or classify for treatment?

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Diagnosis of Rotator Cuff Disease

Rotator cuff disease

- Full-thickness RC tear
- Partial thickness RC tear
- Bursitis
- Tendinitis
- Tendinopathy
- Subacromial impingement

Single clinical Dx category:

- Subacromial pain syndrome**
- FT- RC tear**

Same general approach, but impairments and irritability considered for staged approach for rehabilitation

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Dx SA pain - Systematic Reviews

1. Hermans J, JAMA, 2013; 2. Hanchard NCA, Cochrane, 2013; 3. Hegedus EJ, BMJ, 2012; 4. Alqunaei M, APMR, 2012

<p>Confirm SA pain (R/In) – single tests</p> <ol style="list-style-type: none"> Painful arc Resisted ER (ERRT) – pain or weakness Full Can Drop Arm 	<p>Screen Out SA pain (R/Out) – single tests</p> <ol style="list-style-type: none"> Painful arc Resisted ER (ERRT) – pain or weakness Hawkins Neer Full Can Empty/ Jobe Can
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Painful Arc

- During elevation of arm
- Pain / sx: 60° to 120°
 - Associated with SAIS & RCT
- Pain / sx: 160/170° - 180°
 - Associated with AC joint, and/or SAIS / RC tears (RC tears and SAIS: more common is pain in the mid ROM)

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Hawkin's Test


- Stabilize scapula, place arm in 90° flexion & then max IR (passive end ROM)
- Criteria: pain / Sx at end ROM of test
- Single test:
 - only good to R/Out
 - NOT R/In



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Neer's Test

- Stabilize scapula, elevate passively as far as possible
- Criteria: pain / Sx at end ROM of test
- Single test:
 - only good to R/Out
 - NOT R/In




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Empty Can/Jobe



- Scapular plane elevation
 - Empty can: humeral IR
 - Full can: humeral ER

Full Can




- Resist humeral elevation
- +: pain or /& weakness

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External rotation resistance test (ERRT)

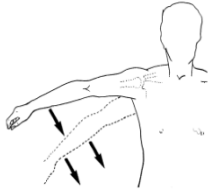
- Shoulder neutral, elbow flexed 90°
- Apply isometric resistance to distal forearm, while pt attempts to ER shoulder
- “+”: pain OR weak
- Markedly weak:* FT-RCT



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Drop Arm Test

- Ask pt to abduct to 90°, ask pt to lower arm slowly
- “+” test: pain & difficulty lowering arm slowly




Calis M, et al. Ann Rheum Dis., 2000; Hertel, R et al, JSES, 1996.
 Park HB, et al; JBJS, 2005.

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Speed's Test

- Biceps pathology / labrum / SAIS
- Resist sh. flex w/ elbow ext & forearm supinated
- +: ant/ sup shoulder pain
- NOT useful to RIn or ROut any pathology

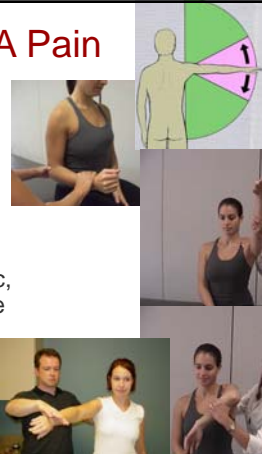


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Combo of Tests: SA Pain

3/3 tests: (Park HB, JBJS, 2005)
Hawkins, Painful arc, ER resistance (Pain/Weak)
- All 3+: **+LR of 10.56**
- All 3-: **-LR of 0.17**

3/5 tests: (Michener LA, APMR, 2009)
- Hawkins, Neer, Painful arc, Empty can, ER resistance
- If $\geq 3+ / 5$: **+LR of 2.93**
- If $< 3+ / 5$: **-LR of 0.34**



Posterior Impingement

- Posterior / Internal impingement
 - Compression of the tendons between the posterior glenoid rim and the humeral head
 - Overhead athletes
 - Is this a potential in non-athletes??

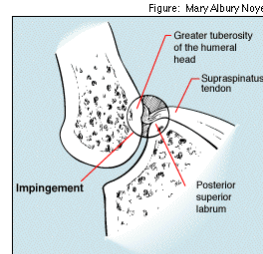



Figure 3. Posterior superior glenoid impingement occurs when the arm is abducted 90° and maximally externally rotated, and the posterior inferior aspect of the supraspinatus tendon is impinged between the greater tuberosity of the humeral head and the posterior superior labrum.

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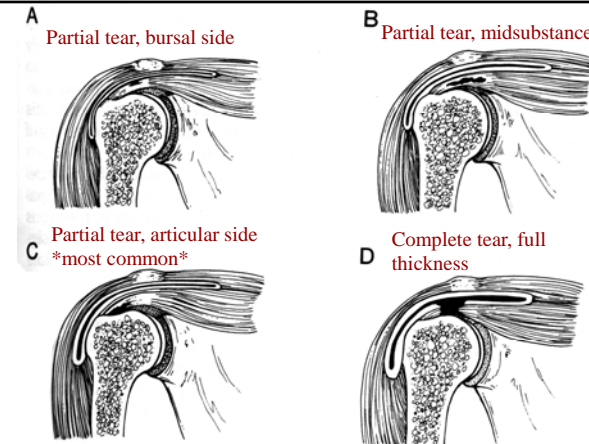
Posterior Internal Impingement

- Impingement of the internal/deep aspect of RC tendons on posterior superior edge of the glenoid
- May be associated with anterior instability
- Relocation test positive for reduction in POSTERIOR pain



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A Partial tear, bursal side

B Partial tear, midsubstance

C Partial tear, articular side
most common

D Complete tear, full thickness

Rotator Cuff Tears

- Partial Thickness Tears
 - Impingement syndrome category
- Full Thickness Tears
 - Tears classified as (DeOrio & Cofield, 1984)
 - Small: < 1cm
 - Medium: 1 – 3 cm
 - Large: 3 – 5 cm
 - Massive: > 5 cm

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Dx FT-RCT - Syst Reviews

1. Hermans J, JAMA, 2013; 2. Hanchard NCA, Cochrane, 2013; 3. Hegedus EJ, BMJ, 2012; 4. Alquanaee M, APMR, 2012


<p>Confirm FT-RCT (R/In) – single tests</p> <ol style="list-style-type: none"> 1- Painful arc 2- Resisted ER – pain or weak 3- ER lag test – supraspinatus infraspinatus 4- IR lag & Lift off subscapularis 5- Drop arm 6- Atrophy of infraspinatus 7- Belly off – Subscapularis 	<p>Screen Out FT-RCT (R/Out) – single tests</p> <ol style="list-style-type: none"> 1- Resisted ER (ERRT) – pain or weakness 2- IR lag & Lift-off subscapularis 3- Empty Can 4- Full Can <p>History: Age $\geq 60/ 65$yo and c/o night pain</p>
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Lift Off and Lag Test

- Subscapularis tear
- Hand at sacrum/LB;
- - Lift-off: ask pt to lift hand away from the back
- - Lag: examiner positions hand off the back and asks to hold
- “+”: inability to “lift off” or “lags” back




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Empty Can



Full Can




- Empty can: humeral IR
- Full can: humeral ER
- Resist humeral elevation
- Positive: p! or /& weakness

External Rotation Lag Sign

Hertel, R et al, JSES, 1996

- At 0 deg abd, 90 deg elbow flex; passive ER & ask patient to hold
- “+”: “lags” back to less than full ER



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Combination of Tests: FT-RCT


- Test Combo (Litaker D, et al; J Am Geriatr Soc, 2000)
 $\geq 65yo$, ER weak (ERRT), night pain
 All 3 +: R/In +LR: 9.84
 All 3 -: R/Out -LR: 0.54
- Test Combo (Park HB, et al; JBJS, 2005)
 3 Tests: Drop arm, Painful arc, ERRT
 All 3 tests + R/In +LR: 15.57
 All 3 tests - R/Out -LR: 0.16

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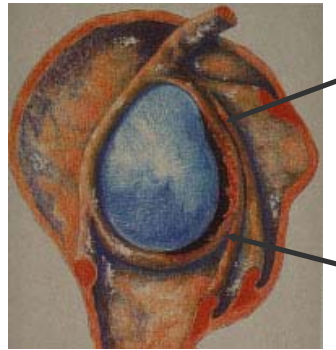
Glenohumeral Instability

- Degree of Instability:
 - Subluxation
 - Dislocation
- Other pathology?



Labral Tear

- Bankart: Ant-inf labral tear
- More types – more about that later



Hill-Sach's Lesion




- Humeral head defect of the post-lateral HH
- Reverse Hill-sach's: ant-medial defect with posterior dis/instability

GH Instability: Special Tests

- Anterior instability
 - Apprehension (anterior)
 - Anterior release
 - Relocation
 - Load and shift
- Posterior instability:
 - Load and shift
 - Posterior apprehension
- Inferior / multidirectional instability: Sulcus
- R/Out or In additional Dx: labral tears, SAIS
- Lift-off test with ant/inf instability

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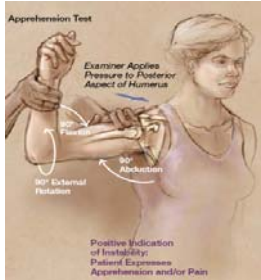
Sulcus Test



- Multidirectional instability
- Sitting: traction on humerus at elbow
- "+": space btw acromion & HH as compared bilaterally
- Graded: 1+ - 3+ (Hawkins et al, Orthop Trans 12:727-8, 1988)

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Apprehension Test

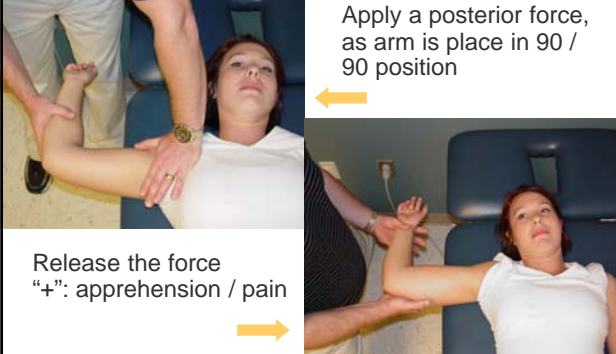


- Ant instability
- Supine or standing: first abduct to 90°, then gradually ER shoulder
- "+": test:
 - Apprehension (visual expression or by pulling arm out of that position)
 - Sx reproduction

T'Jonk L et al, 2001

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Anterior Release



Apply a posterior force, as arm is place in 90 / 90 position

Release the force
"+": apprehension / pain


Shoulder Relocation



Arm in 90 / 90 position, apply an ant force to HH

Apply post. force (relocation)
"+": ↑ed apprehension with ant force & ↓ with post force


Load and Shift



- Anterior / posterior instability *and* glenoid labral tears
- “Load” the humerus into the glenoid, then ant/post translate
- “+”: amount of translation (3 grade system, Magee); click for labral tear

Posterior Apprehension Test

- Posterior GH instability
- Supine: stabilize the scapula; flex to 90°, horizontal add & IR, then axially load humerus post.
- “+”: apprehension or pain/ Sx



No Dx Accuracy evidence

Dx GH instability- Systematic Review

Hegedus EJ, BMJ, 2012

<p>Confirm GH Instability (R/In) – single tests</p> <ul style="list-style-type: none"> 1- Apprehension +LR: 17.21 2- Relocation +LR: 5.48 3- Surprise/ Ant Release +LR: 5.42 <p>NOTE: All 3 had high +LR in Meta-analysis</p>	<p>Screen GH Instability (R/Out) – single tests</p> <ul style="list-style-type: none"> 1- Apprehension - LR: 0.39 2- Relocation - LR: 0.55 3- Surprise/ Ant. Release - LR: 0.25 <p>NOTE: All 3 had low -LR in Meta-analysis</p>
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Combo of Tests: Anterior Instability

- **Test Combo** (Farber AJ, JBJS Am, 2006)
Apprehension AND Relocation
Both+: R/In +LR: 39.68
Both -: R/Out - LR: 0.19

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GH Instability: Special Tests

- Posterior instability:
 - Load and shift
 - Posterior apprehension
- Inferior / multidirectional instability
 - Sulcus
- No Dx accuracy evidence

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Glenoid Labral Tears

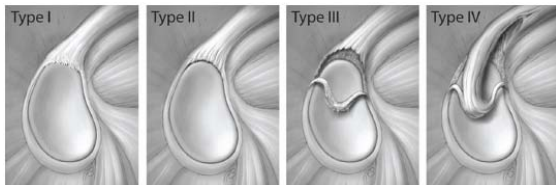
- Tear of glenoid labrum
- Various lesion types
 - **Bankart:** ant / inf glenoid labrum
 - **SLAP:** sup. glenoid labral ant. to post.
 - **Other:** any other location
- May be associated with GH instability, SAIS, biceps tendinitis



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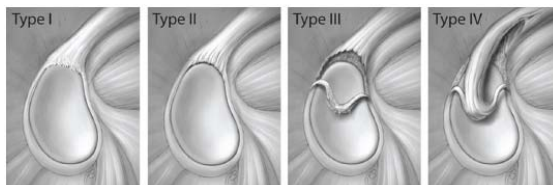
SLAP lesions - Types

- 4 Types defined (Snyder SJ et al, Arthroscopy, 1990)
 - **Type I** – fraying & degeneration, no biceps involvement. Not considered a source of shoulder symptoms



SLAP lesions - Types

- **Type II** – degeneration & fraying with detachment of the superior biceps- labral complex
- **Type III** – bucket-handle tear of superior labrum with displacement of labrum, intact biceps tendon
- **Type IV** – bucket-handle tear that involves the biceps tendon



Dx SLAP: Special Tests

- Last count: 26 tests
- Anterior Slide
 - Active compression
 - Yeargason's
 - Crank
 - Clunk
 - Compression-Rot.
 - Biceps load I & II
 - Whipple
 - Pain provocation
 - Dynamic Labral Shear Test (DLST)
 - MODIFIED DLST
 - Apprehension(huh?)
 - Relocation (huh?)
 - Passive distraction
 - Passive compression
 - And MORE.....

Dx SLAP: History

History of popping, clicking or catching as a stand-alone finding – NOT diagnostic of a SLAP lesion

(Walsworth MK, 2008; Michener LA, 2011; McFarland EJ, 2002)

Dx SLAP: Physical Exam

1- Bicipital groove tenderness – NOT diagnostic of a SLAP lesion

(Meta-analysis: Hegedus EJ, 2012)



Active Compression (O'Brien's)


- Horiz add to ~ 10°, max IR resist elevation; then repeat in max ER
- “+”: ↑ed pain w/ hum IR & ↓ed w/ ER for labral & AC jt; pain location indicates Dx

(O'Brien SJ, et al. AJSM, 1998)



Active Compression

O'Brien SJ, et al. AJSM. 26:610-3,1998




O'Brien results

- n = 318, orthopedic surgeons
- Labral tear Dx accuracy:

Sensitivity: 100%	Specificity: 98%
- LR: 0.01	+ LR: 21
- These numbers look great, BUT:
[Pt. Selection: controls were knee patients !?](#)

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However, when O'Brien's Test was examined by others and Meta-Analysis....



- NOT diagnostic – NOT good to R/in or R/Out as an individual test (Hegedus E, 2012)

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SLAP Diagnosis




CONFIRM (R/In)

1- Anterior Slide
 (Meta-analysis: Hegedus EJ, 2012)



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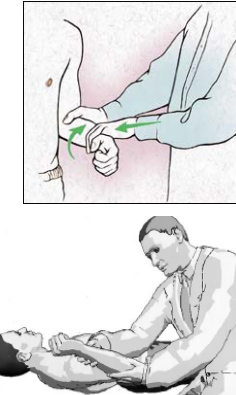
SLAP Diagnosis



CONFIRM (R/In)

2- Yergason's test
 (Meta-analysis: Hegedus EJ, 2012)

3- Compression-rotation:
 (Meta-analysis: Hegedus EJ, 2012)




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SLAP Diagnosis

Confirm (R/In)


4- Pain Provocation (Mimori K, 1999; Parentis MA, 2006)



+ test: more painful / painful with pronation vs. supination


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SLAP Diagnosis



CONFIRM (R/In)

5- Anterior Apprehension
 (Oh JH, 2008; Nakagawa S, 2005; Guancho CA, 2003; Fowler, 2010)



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SLAP Diagnosis




CONFIRM (R/In)

6- Biceps Load II
 (Oh JH, 2008; Cook C, 2012; Kim SH, 2001)




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SLAP Diagnosis



Screen (RuleOut)


1- Pain Provocation (Mimori K, 1999; Parentis MA, 2006)



+ test: more painful / painful with pronation vs. supination

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Dx: SLAP Tears



<p>Confirm (R/In)</p> <p>Meta-Analysis Anterior Slide Yergason's Compression - Rotation</p> <p>Multiple single studies Pain provocation Anterior Apprehension Biceps Load II</p>	<p>Screen (R/Out)</p> <p>Meta-Analysis NONE</p> <p>Multiple single studies Pain provocation</p>
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SLAP – Combo of Hx and Tests




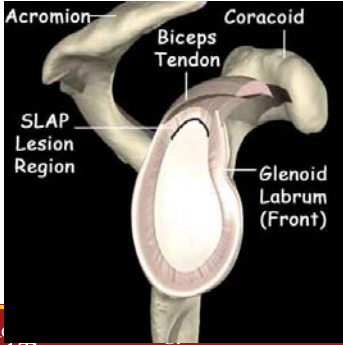
**** ONLY single studies – use caution ****

- Hx of Pop Click & Catch + Anterior Slide
 - Useful to RIn (Sp=93%, +LR=6.0) (Michener LA, 2011)
- NO Hx Pop, Click, Catch + neg Ant. Slide
 - ROut (Sn=82%, -LR=0.33) (Walsworth MK, 2008)
- Passive Distraction + Active Compression
 - Useful to ROut (Sn=70%, -LR=0.11)
 - Useful to RIn (Sp=90%, +LR=7.0) (Schlechter JA, 2009)
- Compression-rot. + Speed + Apprehension
 - Useful to RIn (Sp=92%, +LR=3.13) (Oh JH, 2008)

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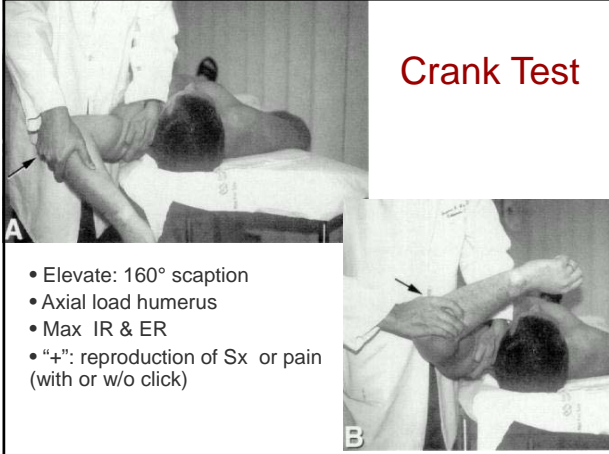
Labral Tear of any type





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Crank Test



- Elevate: 160° scaption
- Axial load humerus
- Max IR & ER
- "+": reproduction of Sx or pain (with or w/o click)

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Dx: Labral Tears

- Crank Test (Meta-analysis: Hegedus EJ, 2012)
 - R/In: Sp=73%, +LR = 2.44 Likely useful
 - R/Out: Sn=57%, -LR = 0.51 Likely/ Maybe

Combinations:

- Relocation + Apprehension
 - R/In (Sp=93%, +LR=5.43) (Guanche CA, 2003)
- Anterior Slide + Crank
 - R/In (Sp=91%, +LR=3.75) (Walsworth MK, 2008)
- NO Hx Pop, Click, Catch + neg Ant. Slide
 - R/Out (Sn=82%, -LR=0.33) (Walsworth MK, 2008)

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Shoulder Pain and Mobility Deficits: Adhesive Capsulitis

CLINICAL PRACTICE GUIDELINES

MARTIN J. KELLEY, DPT • MICHAEL A. SHAFFER, MSPT • JONNE KUHN, MD • LORI A. MICHENER, PT PhD
AMEE L. SEITZ, PE PhD • TIMOTHY L. UHLE, PT PhD • JOSEPH J. GOODIES, DPT, MA • PHILIP W. MCCLOURE, PT PhD *J Orthop Sports Phys Ther* 2013;43(5):A1A3

- Pain may be local and/or referred (C5,6)
- Normal radiographs
- Spontaneous loss of motion
- Passive ROM loss: "global" limitation
 - 2 or more planes of > 25%; ER ≥ 50% loss
 - ▶ Comorbidities...IDDM?
 - ▶ S/P surgery, immobilization, or self-immob?
 - ▶ Underlying cause?
 - ▶ Rotator cuff tear/SAIS, Idiopathic, Thoracic kyphosis -- change in scapula position

Questions?



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