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

Key Metrics for Dx Accuracy

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

BLUF

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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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

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

Recommendation: Dx
Screen (Rule/ Out)
– Sensitivity: SnNOut
  * Sn ≥ 80%
– Likelihood ratio (→ LR)
  * → LR ≤ 0.5

Confirm (Rule/ IN)
– Specificity: SpPIn
  * Sp ≥ 80%
– +Likelihood ratio (+LR)
  * +LR ≥ 2.0

Likelihood Ratio

<table>
<thead>
<tr>
<th>“+”</th>
<th>“—”</th>
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<tr>
<td>&gt;10</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>5 - 10</td>
<td>0.1 - 0.2</td>
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<td>2 - 5</td>
<td>0.5 - 0.2</td>
</tr>
<tr>
<td>1 - 2</td>
<td>0.5 - 1</td>
</tr>
</tbody>
</table>

Interpretation

Large & often conclusive changes from pre-test to post-test probability
Moderate shifts in pre-test to post-test probability
Small but sometimes important changes in probability
Small and rarely important changes in probability
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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?*

**Diagnosis of Rotator Cuff Disease**

Rotator cuff disease
- Full-thickness RC tear
- Partial thickness RC tear
- Bursitis
- Tendinitis
- Tendinopathy
- Subacromial impingement

**FT- RC tear**

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

**Subacromial pain syndrome**

**Dx SA pain - Systematic Reviews**


**Confirm** SA pain (R/In) – single tests
1- Painful arc
2- Resisted ER (ERRT) – pain or weakness
3- Full Can
4- Drop Arm

**Screen Out** SA pain (R/Out) – single tests
1- Painful arc
2- Resisted ER (ERRT) – pain or weakness
3- Hawkins
4- Neer
5- Full Can
6- Empty/ Jobe Can

**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)
**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

**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

**Empty Can/Jobe**
- Scapular plane elevation  
- Resist humeral elevation  
- +: pain or /& weakness

**Full Can**
- Empty can: humeral IR  
- Full can: humeral ER

**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

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

**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

Park RB, et al: JGG, 2005._
**Diagnosis of Shoulder Pain**

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**Diagnosis**

**Shoulder Pain**

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**4/18/2017**

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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 ≥ 3+ / 5: +LR of 2.93
  - If < 3+/ 5: −LR of 0.34

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**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??

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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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**Rotator Cuff Tears**

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

---

**Dx FT-RCT - Syst Reviews**


**Confirm FT-RCT**

(R/In) – single tests
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

**Screen Out FT-RCT**

(R/Out) – single tests
1- Resisted ER (ERRT) – pain or weakness
2- IR lag & Lift-off subscapularis
3- Empty Can
4- Full Can

**History:** Age ≥ 60/65yo and c/o night pain

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**Diagnosis of Shoulder Pain**

**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

**Empty Can**
- Empty can: humeral IR
- Full can: humeral ER
- Resist humeral elevation
- Positive: pl or /& weakness

**Full Can**

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

**Combination of Tests: FT- RCT**
  - >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

**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

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)

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)

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

Confirm GH Instability (R/in) – single tests
1- Apprehension +LR: 17.21
2- Relocation +LR: 5.48
3- Surprise/ Ant Release +LR: 5.42

NOTE: All 3 had high +LR in Meta-analysis

Screen GH Instability (R/out) – single tests
1- Apprehension - LR: 0.39
2- Relocation - LR: 0.55
3- Surprise/ Ant Release - LR: 0.25

NOTE: All 3 had low -LR in Meta-analysis

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

GH Instability: Special Tests

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

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
**Diagnosis of Shoulder Pain**

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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
  - **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.....

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### 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)

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### 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

Active Compression

**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 ?

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 (Hedegus E, 2012)

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### SLAP Diagnosis

**CONFIRM (R/In)**

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

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

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

4. Pain Provocation  
   (Mimori K, 1999; Parentis MA, 2006)
   + test: more painful / painful with pronation vs. supination

5. Anterior Apprehension
   (Oh JH, 2008; Nakagawa S, 2005; Guanche 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)

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

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

Dx: SLAP Tears

Confirm (R/In)
Meta-Analysis
Anterior Slide
Yergason’s
Compression - Rotation
Multiple single studies
Pain provocation
Anterior Apprehension
Biceps Load II

Screen (R/Out)
Meta-Analysis
NONE
Multiple single studies
Pain provocation

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=92%, +LR=7.0) (Schlechter JA, 2009)
• Compression-rot. + Speed + Apprehension
  • Useful to RIn (Sp=92%, +LR=3.13) (Oh JH, 2008)

Labral Tear of any type

Crank Test

• Elevate: 160° scaption
• Axial load humerus
• Max IR & ER
• “+”: reproduction of Sx or pain
  (with or w/o click)
Diagnosis of Shoulder Pain

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

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?