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Glenohumeral Impingement Syndrome: Individualizing Treatment Approaches Based on Examination and Evidence

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Northern Arizona University
Flagstaff Mountain Campus

Learning Objectives

The participant will be able to:

- Describe an overview and summary of shoulder impingement tests and measures described in the literature.
- Identify evidence which evaluates the accuracy of shoulder impingement tests and measures.
- List at least three key, impaired body structures which guide treatment plan design.
- Outline at least three evidence-supported interventions which are individualized to and effective for reducing the patients problems and deficits.
Background

Course Outline

- Objectives
- Review of Impingement Anatomy
- Types / Stages of Impingement
- Tests and Measures Overview
- Evidence for Tests and Measures
- Key Impairments
- Interventions to Address Key Impairments
- Evidence for Management of Impingement
- Summary
Considering how you manage patients with suspected impingement syndrome …

What are your preconceived notions?

Common findings from the patient history?

Key components of your physical exam?

Considerations for interpreting your exam findings?

Question #1

Is it really impingement syndrome?

Common Differential Diagnoses?
Shoulder Impingement Anatomy

- What is impingement syndrome?
  - **What does the impinging (imping-ers)?**
    - Mechanical compromise between humeral head and coraco-acromial arch or glenoid labrum
    - “Pinching” of soft tissues in this area

- What structures can be impinged (“imping-ees”)?
  1. Supraspinatus tendon
  2. Infraspinatus tendon
  3. Biceps tendon
  4. Sub-acromial bursa
  5. More rarely
    - Teres minor & subscapularis

Shoulder Impingement – Additional causes

- **Acromioclavicular Morphology**
  - Acromion Typing
    - **Type I**: 90%
    - **Type II**: 60-70%
    - **Type III**: 50-60%
  - Sub-acromial Spurring or Osteophyte Formation

- Acute Inflammatory Condition
  - Bursitis, RC tendonitis

- Degenerative tear of RC
Types of Impingement

Test your prior knowledge

21 year old college volleyball player with complaints of pain in posterior shoulder when performing “volleyball spike”. This individual presents more consistent with:

A. Internal Impingement
B. External Impingement

47 year old male has pain across anterior-lateral shoulder with overhead reaching and reaching behind his back. This individual presents more consistent with:

A. Internal Impingement
B. External Impingement

Internal vs. External Impingement
Internal Impingement Syndrome

- Mechanical compression of RC insertion point *between humeral head and posterior-superior labrum*

- Subjective: Pain posteriorly - Especially in ABD-ER position

- Other impingement tests may be (+)

- Common in overhead athletes

- (+) *Internal rotation resisted strength test*

Shoulder Impingement Stages

I
- Type I – Bursitis/Tendonitis; Reactive Tissue with Edema / Hemorrhage

II
- Type II – Partial Rotator Cuff Tears and/or Tissue Fibrosis

III
- Type III – FullThickness Rotator Cuff Tears
  - Small → Medium → Large → Massive
Examination Considerations

Subjective Presentation

Tests and Measures Overview

Shoulder Impingement (External)

Subjective Findings

- Pain in lateral upper arm (deltoid insertion common) & anterior / proximal humerus
- Pain during ROM and movements
- Which planes / movements most symptomatic
  1. End & overhead ranges
  2. IR positions
  3. Which functional activities will mimic these?
Which of the following functional activities do you perceive as MOST commonly painful in Patients with **External Impingement Syndrome**?
(Select all that apply !!!)

A. Cocking phase of throwing  
B. Reaching into back pocket  
C. Donning belt  
D. Donning bra  
E. Buttoning a shirt  
F. Pulling open a door  
G. Tucking in a shirt  
H. Lifting a heavy carton of milk

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**Shoulder Impingement (External)**

**Common Objective Findings**

- **Stage 1**
  - Tender to palpation @ involved tendon insertion
  - Painful arc
  - RC &/or Scapular weakness
  - (+) Special tests
  - Other impaired body structures based on primary vs. secondary

- **Stage 2**
  - Crepitus & catching
  - Limited range of motion into lower ranges

- **Stage 3**
  - Atrophy of supra/infra spinatus
  - More limited ROM & weakness
Common Tests for Patients with Suspected Impingement

**Symptom Provocation Tests**

- Neer’s
- Kennedy-Hawkins
- Painful Arc Assessment
- Yocums’ Test
- Internal Rotation Resisted Strength Test

**Symptom Relief Tests**

Impingement Relief Test
Scapular Assistance Test
Scapular Retraction / Reposition Test

**Tests for RC Pathology**

- Infraspinatus Test
- Empty Can Test
How familiar are you with these tests?

How useful/accurate do you feel these tests are?

Other thoughts on use of these tests?

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**Sensitivity / Specificity / Likelihood Ratios**

- Tests with high sensitivity effective for “ruling out” diagnosis
- Tests with high specificity effective for “ruling in” diagnosis
- Sensitivity / Specificity Range: 0 – 1.0

<table>
<thead>
<tr>
<th>Diagnostic Accuracy</th>
<th>Positive Likelihood Ratio</th>
<th>Negative Likelihood Ratio</th>
<th>Interpretation Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 10</td>
<td>Less than 0.1</td>
<td></td>
<td>Generate large and often conclusive shifts in probability</td>
</tr>
<tr>
<td>5–10</td>
<td>0.1–0.2</td>
<td></td>
<td>Generate moderate shifts in probability</td>
</tr>
<tr>
<td>2–5</td>
<td>0.2–0.5</td>
<td></td>
<td>Generate small but sometimes important shifts in probability</td>
</tr>
<tr>
<td>1–2</td>
<td>0.5–1</td>
<td></td>
<td>Alter probability to a small and possibly important degree</td>
</tr>
</tbody>
</table>

*Table 1-5: Interpretation of Likelihood Ratios*
### Published Accuracy of Impingement Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>(+) Likelihood Ratio</th>
<th>(-) Likelihood Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neer’s</td>
<td>0.72</td>
<td>0.60</td>
<td>1.79</td>
<td>0.47</td>
</tr>
<tr>
<td>Hawkins-Kennedy</td>
<td>0.80</td>
<td>0.56</td>
<td>1.84</td>
<td>0.35</td>
</tr>
<tr>
<td>Painful Arc</td>
<td>0.53</td>
<td>0.76</td>
<td>2.25</td>
<td>0.62</td>
</tr>
<tr>
<td>Yocum’s</td>
<td>0.70 - 0.79</td>
<td>0.40 – 0.92</td>
<td>1.32 – 8.80</td>
<td>0.33 – 0.53</td>
</tr>
<tr>
<td>IRRST</td>
<td>0.88</td>
<td>0.96</td>
<td>8.2</td>
<td>0.13</td>
</tr>
<tr>
<td>Impingement Relief</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Scapular Assistance</td>
<td>Established to increase sub-acromial space; Acceptable reliability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scapular Repositioning</td>
<td>Provided ↓ in pain and/or ↑ strength in high % of patients with (+) impingement signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infraspinatus Test</td>
<td>0.56</td>
<td>0.87</td>
<td>4.39</td>
<td>0.50</td>
</tr>
<tr>
<td>Empty Can Test</td>
<td>0.50</td>
<td>0.87</td>
<td>3.9</td>
<td>0.57</td>
</tr>
</tbody>
</table>

### Practical Considerations for Performing these Tests

**Stages of impingement**

I – Bursitis / Tendonitis (Reactive tissue)

II – Partial RCT and/or tissue fibrosis

III – Full Thickness RCT

Which can tests present the most logistic difficulties during later stages of impingement?

*With patients with higher levels of severity & irritability?*

A. Neer’s Test  
B. Painful Arc  
C. Symptom relief tests  
D. Hawkins-Kennedy  
E. Infraspinatus Test
Test Clustering

**Michener et al., 2009**
- 3/5 of the following tests positive increases diagnostic accuracy for identifying impingement
  - Painful Arc
  - Empty Can
  - Infraspinatus (resisted ER)
  - Neer's
  - Hawkins-Kennedy

**Park et al., 2005**
- Combination of 3 positive tests significantly increases diagnostic accuracy
  - (+ LR 10.6)
  - Hawkins-Kennedy
  - Painful Arc Sign
  - Infraspinatus

**Best cluster of 3?**
- Painful arc Sign
- Empty can
- Infraspinatus

Question #2

What might be causing the impingement?

Identification of Key Impaired Body Structures and Limitations

![Impingement Syndrome Diagram](image)
What might be causing the impingement?

- Why is this important?

- How do we determine this?

- What exam findings are helpful for this purpose?

When providing treatment for a patient with impingement syndrome, how often do you think in terms of ...

<table>
<thead>
<tr>
<th>Primary vs. Secondary Impingement</th>
<th>Internal vs. External Impingement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Very often</td>
<td>A. Very often</td>
</tr>
<tr>
<td>B. Sometimes</td>
<td>B. Sometimes</td>
</tr>
<tr>
<td>C. Rarely</td>
<td>C. Rarely</td>
</tr>
</tbody>
</table>

Most of my patients with impingement syndrome tend to present with:

A. Primary External Impingement
B. Secondary External Impingement
C. Internal Impingement
D. Not sure
Intervention for Shoulder Impingement

How commonly do you include each of these approaches in your treatment of impingement syndrome?

- Rotator cuff strengthening
  - A. All patients
  - B. Most patients
  - C. Some patients
  - D. Few patients

- Joint Mobilization
- Muscle Stretching
- Scapular Stabilization

Primary impingement
1. Degenerative structural changes to acromion/coracoid
2. Capsular tightness
3. Faulty posture / position
4. Weakness of RC musculature ***

Secondary Impingement
1. Change in F couple / muscle dynamics at GH jt ***
2. Abnormal movement patterns of GH / Scapulothoracic jt
3. Instability of scapula or GH jt

Abnormal mechanical and/or structural relationship between the rotator cuff and the coracoacromial arch

Narrowing of the subacromial space due to glenohumeral or scapulothoracic joint instability
Obligate Translation

- Tightness of posterior capsule changes humeral mechanics

- If cannot migrate posteriorly where will it go?

- Treatment?
  - Joint mobilization

Possible Associated Exam Findings

**Primary impingement**
1. Abnormal posture
2. ↓ed capsular mobility
3. RC “weakness”
4. Radiographic findings
   1. Abnormal acromion type
   2. Osteophytes
   3. Sub-coracoacromal thickening

**Secondary Impingement**
1. GH/ST joint hypermobility
   - General hypermobility of GH jt with mobility testing
   - Sulcus sign
   - A/P translation or drawer tests
   - Subluxation relocation tests
2. Scapular dyskinesis
3. (+) Beighton index
4. (+) subluxation / relocation test
5. RC “dysfunction”
Subluxation Relocation Test / Jobe’s Relocation Sign

- Sn=65%; Spec=90%
- Apprehension test position
  - 90 deg ABD, full possible ER
- Pain here goes away with posterior pressure

Other Exam Considerations …

- Range of Motion
  - *GH Internal Rotational Deficiency (GIRD)*
    - Excess ER ROM
    - Decreased IR ROM
    - Be sure to stabilize scapula when measuring
    - Total arc of motion = 160 degrees then NOT GIRD !!!

- Assessment of scapular mechanics
  - At rest and during upper extremity movements
  - Especially assess timing / recruitment of serratus, lower/middle traps, upper traps
  - Scapular assistance test
  - Retraction / Reposition test
Scapular Dyskinesia / Mechanics Assessment

- Scapular assistance test
- Scapular retraction / reposition test
- Kibler Qualitative Assessment of Scapular Mechanics
  a) Type I - ↑ed anterior tilt (prominent inferior angle)
  b) Type II - ↑ed Internal Rotation (prominent medial border)
  c) Type III - ↑ed elevation of superior border

Internal Impingement Syndrome

Key Clinical Exam Findings

- Loss of GH Internal Rotation
- Excess External Rotation
- Weakness of Rotator Cuff, Scapular Retractors & Upward Rotators
- (+) Impingement Tests
- (+) Internal rotation resisted strength test
Intervention Plans for Impingement Syndrome
Individualizing your approach based on Exam Findings

Saul is a 70 year old male with complaints of left shoulder pain with overhead arm movements. During your interview, you notice he has a slumped posture and limited neck and trunk motion. He reports that motion in his shoulder is quite “stiff” during all function. Based on this presentation, Saul is MOST likely to present with:

A. Primary External Impingement
B. Secondary External Impingement
C. Internal Impingement
If your hypothesis holds true, the focus of your treatment will be MOST likely to include interventions which:

A. Reduce the presence of his likely shoulder instability
B. Recruiting muscles to contract at the proper time during shoulder elevation
C. Increase mobility of the glenohumeral capsule and scapula
D. Provide external support of the shoulder such as McConnell taping

General Implications for Treatment

- Postural training /education
- Capsular mobilization
- Stretching into IR
- Training of RC musculature
  - Strength
  - Recruitment
- Training of scapular stabilizers
  - Strength
  - Recruitment
  - Balance
- Stretching of shortened soft tissue structures
Intervention for Shoulder Impingement

- Avoid impingement positions / tasks
- Recruit / Strengthen RC mm (especially IR/ERs)
- Recruit / Strengthen Scapular Stabilizers
- Promote proper recruitment of these during function (PNF)
- Core Stability
- Flexibility of pec minor
- Mobility of shoulder capsule – especially posterior
  - Obligate Translation !!!

Sleeper Stretch (Posterior Capsule)
Recruitment of Specific Shoulder Girdle Musculature

Which exercises are most effective?

Townsend, Jobe, et al. (1991)  
Summary of Findings

- Most EMG activity:
  - Supraspinatus
    - Military Press, Empty Can***
  - Infraspinatus
    - Horizontal ABD w/ER, Sidelying ER
  - Teres Minor
    - Side-lying ER, Horizontal ABD w/ER
  - Subscapularis
    - Empty can***, Military press
Local Shoulder Exercises
Reinold JOSPT 2009

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Exercise</th>
<th>Anatomical Implications</th>
<th>Biomechanical Implications</th>
<th>Clinical Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraspinatus</td>
<td>1. Full can</td>
<td>1. Enhances scapular position and subacromial space</td>
<td>1. Decreased deltoid involvement compared to full can</td>
<td>1. Minimizes chance of superior humeral head migration by</td>
</tr>
<tr>
<td></td>
<td>2. Prone full can</td>
<td></td>
<td>2. High posterior deltoid activity with similar</td>
<td>deltoid overpowering supraspinatus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>supraspinatus activity</td>
<td>2. High supraspinatus activity and also good for</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>lower tripeps</td>
</tr>
<tr>
<td>Infraspinatus</td>
<td>1. Side-lying ER</td>
<td>1. Position of shoulder stability, minimal capsular stress</td>
<td>1. Increased moment arm of muscle at 0° abduction</td>
<td>1. Most effective exercise in recruiting infraspinatus</td>
</tr>
<tr>
<td>and teres minor</td>
<td></td>
<td></td>
<td>2. Greatest EMG activity</td>
<td>activity, good when cautious with static instability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Allows for proper form without compensation</td>
<td>stability, also good for lower tripeps</td>
</tr>
<tr>
<td></td>
<td>3. ER with towel roll</td>
<td></td>
<td>3. Increased EMG activity with addition of towel, also</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>incorporates adductors</td>
<td></td>
</tr>
<tr>
<td>Subscapularis</td>
<td>1. ER at 0° abduction</td>
<td>1. Position of shoulder stability</td>
<td>1. Similar subscapular activity between 0° and 90°</td>
<td>1. Effective exercise, good when cautious with static</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>abduction</td>
<td>stability</td>
</tr>
<tr>
<td></td>
<td>2. IR at 90° abduction</td>
<td>2. Position of shoulder instability</td>
<td>2. Enhances scapular position and subacromial space, less</td>
<td>2. Strengthens in a challenging position for shoulder</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>periscapular activity</td>
<td>stability</td>
</tr>
</tbody>
</table>

EMG Analysis of Scapular Muscles During a Shoulder Rehabilitation Program
Mosely, Jobe, et al. (1992)

(Combined % Max Voluntary Contaction & Duration of Exercise Active)
## Peri-scapular Muscle Strengthening

Reinold JOSPT 2009

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Description</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Push-up with plus</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>2.</td>
<td>Dynamic hug</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>3.</td>
<td>Serratus punch 120°</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Lower trapezius</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Prone full can</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>2.</td>
<td>Prone ER at 90° abduction</td>
<td><img src="image5.png" alt="Image" /></td>
</tr>
<tr>
<td>3.</td>
<td>Prone horizontal abduction at 90° abduction with ER</td>
<td><img src="image6.png" alt="Image" /></td>
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<tr>
<td><strong>Middle trapezius</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Prone row</td>
<td><img src="image7.png" alt="Image" /></td>
</tr>
<tr>
<td>2.</td>
<td>Prone horizontal abduction at 90° abduction with ER</td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Upper trapezius</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Shrug</td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
<tr>
<td>2.</td>
<td>Prone row</td>
<td><img src="image10.png" alt="Image" /></td>
</tr>
<tr>
<td>3.</td>
<td>Prone horizontal abduction at 90° abduction with ER</td>
<td><img src="image11.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Rhomboids and Serratus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Prone row</td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
<tr>
<td>2.</td>
<td>Prone horizontal abduction at 90° abduction with ER</td>
<td><img src="image13.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**Notes:**
- Effective exercises for improving scapular control.
- Performing push-ups with dynamic stability.
- High BMD activity.
- Good dynamic activity to combine upward rotation and scapular control.
Is Conservative Management of Impingement Syndrome Effective?

Exercises versus arthroscopic decompression in patients with subacromial impingement: a randomised, controlled study in 90 cases with a one year follow up

J P Hoahr, S Østergaard, J Dalsgaard, K Norup, P Frost, S Lausen, E A Holm, J H Andersen


Objectives: To compare the effect of graded physiotherapeutic training of the rotator cuff versus arthroscopic subacromial decompression in patients with subacromial impingement. METHODS: Randomised controlled trial with 12 months' follow up in a hospital setting. Ninety consecutive patients aged 18 to 55 years were enrolled. Symptom duration was between six months and three years. All fulfilled a set of diagnostic criteria for rotator cuff disease, including a positive impingement sign. Patients were randomised either to arthroscopic subacromial decompression, or to physiotherapy with exercises aiming at strengthening the stabilisers and depressors of the shoulder. Outcome was shoulder function as measured by the Constant score and a pain and dysfunction score. *Intention to treat* analysis was used, with comparison of means and control of confounding variables by general equation estimation analysis.

Results: Of 90 patients enrolled, 84 completed follow up (41 in the surgery group, 43 in the training group). The mean Constant score at baseline was 34.8 in the training group and 33.7 in the surgery group. After 12 months the mean scores improved to 57.0 and 52.7, respectively, the difference being non-significant. No group differences in mean pain and dysfunction score improvement were found.

Conclusions: Surgical treatment of rotator cuff syndrome with subacromial impingement was not superior to physiotherapy with training. Further studies are needed to qualify treatment choice decisions, and it is recommended that samples are stratified according to disability level.
Take Home Messages?

- Determine if impingement is truly the issue
  - When interpreting exam findings:
    - Understand accuracy of individual tests
    - Cluster findings from multiple tests

- If present, determine cause of impingement
  - Internal vs. External
  - Aspects of Primary Impingement vs. Secondary Impingement

- Design treatment program accordingly using most effective exercises

References

References


Questions?