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

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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.

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Background

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FOUNDED 1899

Sports **2014**, *2*, 1-13; doi:10.3390/sports2010001

OPEN ACCESS

sports

ISSN 2075-4663

www.mdpi.com/journal/sports

Article

Overuse Injuries Associated with Mountain Biking: Is Single-Speed Riding a Predisposing Factor?

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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

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CONTINUED

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?

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CONTINUED

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

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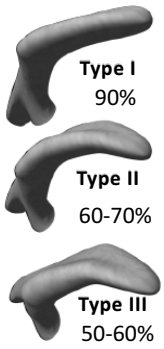
Shoulder Impingement – Additional causes

- **Acromioclavicular Morphology**
  - Acromion Typing *(see % chance of success with rehab)*
  - Sub-acromial Spurring or Osteophyte Formation
- Acute Inflammatory Condition
  - Bursitis, RC tendonitis
- Degenerative tear of RC



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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

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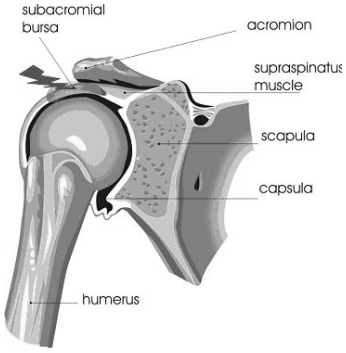
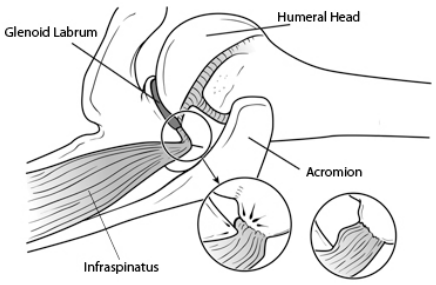
Internal vs. External Impingement





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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**

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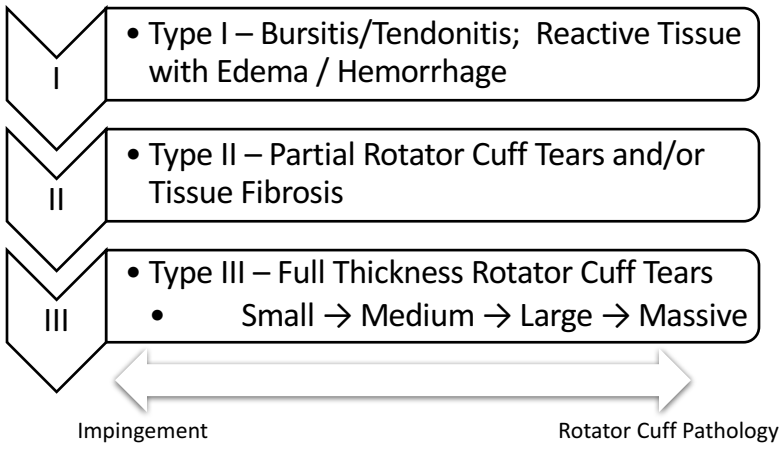
Shoulder Impingement Stages



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Examination Considerations

Subjective Presentation

Tests and Measures Overview

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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?

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CONTINUED

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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CONTINUED

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

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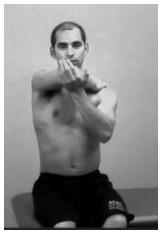
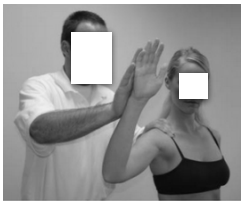
Common Tests for Patients with Suspected Impingement

Symptom Provocation Tests

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





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Common Tests for Patients with Suspected Impingement

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?

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

DIAGNOSTIC ACCURACY

Positive Likelihood Ratio	Negative Likelihood Ratio	Interpretation Ratio
Greater than 10	Less than 0.1	Generate large and often conclusive shifts in probability
5–10	0.1–0.2	Generate moderate shifts in probability
2–5	0.2–0.5	Generate small but sometimes important shifts in probability
1–2	0.5–1	Alter probability to a small and rarely important degree

Table 1–5: *Interpretation of Likelihood Ratios*[28]

Published Accuracy of Impingement Tests

Test	Sensitivity	Specificity	(+) Likelihood Ratio	(-) Likelihood Ratio
Neer's	***0.72***	***0.60***	***1.79***	***0.47***
Hawkins-Kennedy	***0.80***	***0.56***	***1.84***	***0.35***
Painful Arc	***0.53***	***0.76***	***2.25***	***062***
Yocum's	0-70 - 0.79	0.40 – 0.92	1.32 – 8.80	0.33 – 0. 53
IRRST	0.88	0.96	8.2	0.13
Impingement Relief	?	?	?	?
Scapular Assistance	Established to increase sub-acromial space; Acceptable reliability			
Scapular Repositioning	Provided ↓ in pain and/or ↑ strength in high % of patients with (+) impingement signs			
Infraspinatus Test	0.56	0.87	4.39	0.50
Empty Can Test	0.50	0.87	3.9	0.57

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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 can 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

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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

Sn = 0.75
Sp = 0.74
+ LR = 2.93
- LR = 0.34

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

Park et al., 2005

- Combination of 3 positive tests significantly increases diagnostic accuracy
  - *(+ LR 10.6)*
    - Hawkins-Kennedy
    - Painful Arc Sign
    - Infraspinatus

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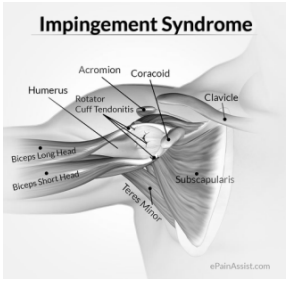
Question #2

What might be causing the impingement?

Identification of Key Impaired Body Structures and Limitations



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What might be causing the impingement?

- *Why is this important?*
- *How do we determine this?*
- *What exam findings are helpful for this purpose?*

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CONTINUED

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

Primary vs. Secondary Impingement

A. Very often
B. Sometimes
C. Rarely

Internal vs. External Impingement

A. Very often
B. Sometimes
C. Rarely

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

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CONTINUED

Intervention for Shoulder Impingement

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

- **Rotator cuff strengthening**
- **Joint Mobilization**
- **Muscle Stretching**
- **Scapular Stabilization**

A. All patients
B. Most patients
C. Some patients
D. Few patients

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CONTINUED

Primary impingement

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

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

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

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

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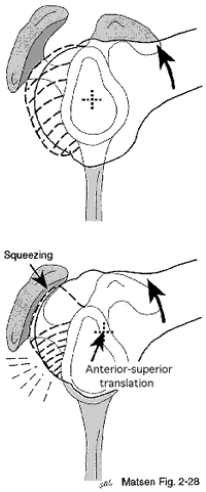
Obligate Translation

- Tightness of posterior capsule changes humeral mechanics
- If cannot migrate posteriorly where will it go?
- Treatment?
  - Joint mobilization



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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"

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CONTINUED

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

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CONTINUED

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

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Scapular Dyskinesis / 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

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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***

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Intervention Plans for Impingement Syndrome

Individualizing your approach based on Exam Findings

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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

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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

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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

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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 !!!*

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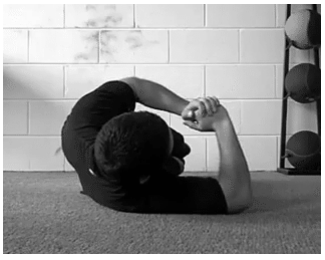
Sleeper Stretch
(Posterior Capsule)



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Recruitment of Specific Shoulder Girdle Musculature

Which exercises are most effective?

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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

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CONTINUED

Local Shoulder Exercises

Reinold JOSPT 2009

Muscle	Exercise	Anatomical Implications	Biomechanical Implications	Clinical Implications
Supraspinatus	1. Full can	1. Enhances scapular position and subacromial space	1. Decreased deltoid involvement compared to empty can	1. Minimizes chance of superior humeral head migration by deltoid overpowering supraspinatus
	2. Prone full can	2. Enhances scapular position and subacromial space	2. High posterior deltoid activity with similar supraspinatus activity	2. High supraspinatus activity and also good exercise for lower trapezius
Infraspinatus and teres minor	1. Side-lying ER	1. Position of shoulder stability, minimal capsular strain	1. Increased moment arm of muscle at 0° abduction. Greatest EMG activity	1. Most effective exercise in recruiting infraspinatus activity. Good when cautious with static stability
	2. Prone ER at 90° abduction	2. Challenging position for stability, higher capsular strain	2. High EMG activity	2. Strengthens in a challenging position for shoulder stability. Also good exercise for lower trapezius
	3. ER with towel roll	3. Allows for proper form without compensation	3. Increased EMG activity with addition of towel, also incorporates adductors	3. Enhances muscle recruitment and synergy with adductors
Subscapularis	1. IR at 0° abduction	1. Position of shoulder stability	1. Similar subscapularis activity between 0° and 90° abduction	1. Effective exercise, good when cautious with static stability
	2. IR at 90° abduction	2. Position of shoulder instability	2. Enhances scapular position and subacromial space. Less pectoralis activity	2. Strengthens in a challenging position for shoulder stability
	3. IR diagonal exercise	3. Replicates more functional activity	3. High EMG activity	3. Effective strengthening in a functional movement pattern

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EMG Analysis of Scapular Muscles During a Shoulder Rehabilitation Program

Mosely, Jobe, et al. (1992)

(Combined % Max Voluntary Contaction & Duration of Exercise Active)

Upper Trap Rowing	**Middle Trap** Horiz ABD (neutral) Horiz ABD (ER)
Rhomboids Horiz ABD (neutral)	**Levator Scap** Rowing
Serratus Push up plus	

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CONTINUED

Peri-scapular Muscle Strengthening

Reinold JOSPT 2009

Serratus anterior	1. Push-up with plus	1. Easy position to produce resistance against protraction	1. High EMG activity	1. Effective exercise to provide resistance against protraction, also good exercise for subscapularis
	2. Dynamic hug	2. Performed below 90° abduction	2. High EMG activity	2. Easily perform in patients with difficulty elevating arms or performing push-up. Also good exercise for subscapularis
	3. Serratus punch 120°	3. Combines protraction with upward rotation	3. High EMG activity	3. Good dynamic activity to combine upward rotation and protraction function
Lower trapezius	1. Prone full can	1. Can properly align exercise with muscle fibers	1. High EMG activity	1. Effective exercise, also good exercise for supraspinatus
	2. Prone ER at 90° abduction	2. Prone exercise below 90° abduction	2. High EMG activity	2. Effective exercise, also good exercise for infraspinatus and teres minor
	3. Prone horizontal abduction at 90° abduction with ER	3. Prone exercise below 90° abduction	3. Good ratio of lower to upper trapezius activity	3. Effective exercise, also good exercise for middle trapezius
	4. Bilateral ER	4. Scapular control without arm elevation	4. Good ratio of lower to upper trapezius activity	4. Effective exercise, also good for infraspinatus and teres minor
Middle trapezius	1. Prone row	1. Prone exercise below 90° abduction	1. High EMG activity	1. Effective exercise, good ratios of upper, middle, and lower trapezius activity
	2. Prone horizontal abduction at 90° abduction with ER	2. Prone exercise below 90° abduction	2. High EMG activity	2. Effective exercise, also good exercise for lower trapezius
Upper trapezius	1. Shrug	1. Scapular control without arm elevation	1. High EMG activity	1. Effective exercise
	2. Prone row	2. Prone exercise below 90° abduction	2. High EMG activity	2. Good ratios of upper, middle, and lower trapezius activity
	3. Prone horizontal abduction at 90° abduction with ER	3. Prone exercise below 90° abduction	3. High EMG activity	3. Effective exercise, also good exercise for lower trapezius
Rhomboids and levator scapulae	1. Prone row	1. Prone exercise below 90° abduction	1. High EMG activity	1. Effective exercise, good ratios of upper, middle, and lower trapezius activity
	2. Prone horizontal abduction at 90° abduction with ER	2. Prone exercise below 90° abduction	2. High EMG activity	2. Effective exercise, also good for lower and middle trapezius
	3. Prone extension with ER	3. Prone exercise below 90° abduction	3. High EMG activity	3. Effective exercise, unique movement to enhance scapular control

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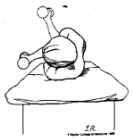
ER with Towel

Side-lying ER



Horizontal ABD ER (Thumb Up)

Horizontal ABD IR (Thumb Down)

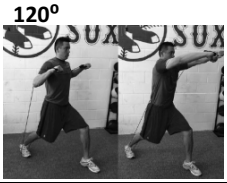
Full Can

Push Up w/ a "plus"

Rowing

Dynamic Hug

Serratus Punch 120^0



Prone Full Can

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Is Conservative Management of Impingement Syndrome Effective?

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

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

Ann Rheum Dis 2005;**64**:760–764. doi: 10.1136/ard.2004.021188

See end of article for authors' affiliations

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Accepted 18 September 2004

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 decompressors 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.

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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

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