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Foundations of Strength Testing:
Techniques for Shoulder Extension, Adduction and Internal Rotation

Tuesday June 18th, 2024

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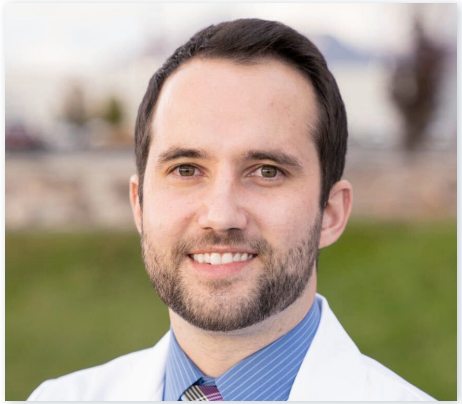
Introductions:



Dr. Daniel G. Stewart,

PT, DPT

Gus Morrison,

BSc, MSc

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Agenda

- Introduction to Shoulder Strength Testing: Shoulder Extension, Adduction and Internal Rotation
- Overview of how to test the shoulder
  - Extension
  - Adduction
  - Internal Rotation
- Case Study- Analyzing the data
- Case Study- Possible rehab interventions

Extension

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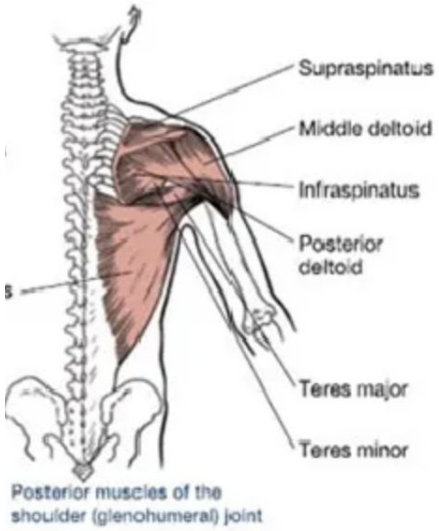
Shoulder Extension



Posterior muscles of the shoulder (glenohumeral) joint

The main muscles that extend the shoulder are the latissimus dorsi, posterior deltoid, and teres major.

These muscles are important for lifting yourself up and are often used together with other muscles for actions like lifting a box.

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Shoulder Extension

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https://app.clinicalpattern.com/view/rom_mmt/fe88cdbefb056570c313870d18789c8620348c14a393f013/?ctx=pt&lng=en

- Can test in **Standing, Supine, Prone, Sitting, Side Line**
- Testing at different angles.

Extension

Why?

Preliminary evidence supports an association between low shoulder extension strength and the development of shoulder pain in young male swimmers.

Furthermore, predictive outcomes suggest that low shoulder extension strength may be a risk factor for the development of shoulder pain

(McLaine 2019).

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Extension

How?

Varies significantly between papers
No agreement on patient position
No agreement on short or long lever
No agreement on make or break test

Most common protocol:

- Patient in prone with the dynamometer 2cm proximal to the patients elbow.
- The examiner holds the dynamometer in position while the patient lifts their arm off the table.
- Patients are asked to complete three maximal isometric contractions of 3–4 s with a rest interval of 3–5 s between efforts.

(Cheung 2018)

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Extension

What is a good result?

Benchmark Score (Male 1.32 N/kg, female ?): A male patient should ideally exert around 13.5% of body weight during shoulder extension when tested in supine.

Reliability (?): Due to variation in test procedures, low sample sizes and lack of reporting, its not possible to provide reliability metrics.

True Change (MDC ?): For the above reasons, it is not possible to say how far the needle has to move before we can consider the result a true change.

(Cheung 2018)

Adduction

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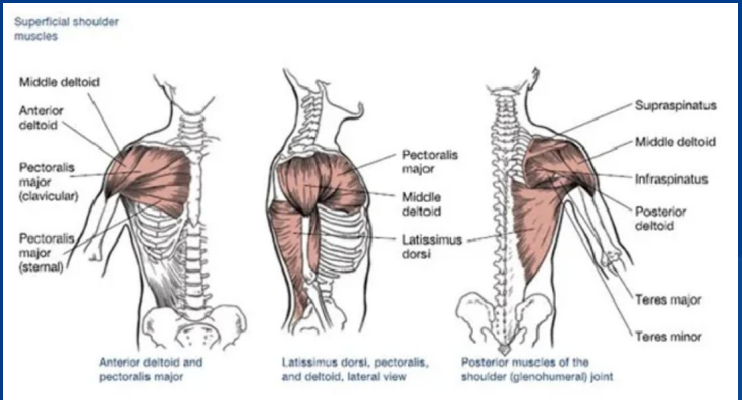
Shoulder Adduction



The primary muscles responsible for shoulder adduction are the pectoralis major, latissimus dorsi, and teres major.

Other muscles that contribute to shoulder adduction include the coracobrachialis and the long head of the triceps brachii.

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Shoulder Adduction

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- Can test in **Standing, Supine, Prone, Sitting, Side Line**
- Testing at different angles: **Neutral, 90 degrees, End Range,** etc

Adduction

Why?

Very rarely studied so very limited evidence as to the benefits of high levels of shoulder adduction on pain or function.

Higher maximum isometric muscle strength in shoulder flexors, extensors, abductors, and adductors than recreational swimmers.

Adductor muscle strength may be some inherent physical capacity of the elite swimmers.

(Cheung 2018)

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Adduction

How?

Patient in supine with the arm abducted to 90 degrees and the elbow fully extended.

The dynamometer 2cm proximal to the patients elbow.

The examiner holds the dynamometer in position while the patient lifts their arm off the table.

Patients are asked to complete three maximal isometric contractions of 3–4 s with a rest interval of 3–5 s between efforts.

(Cheung 2018)

Horizontal adduction is being demonstrated here – a different test option.

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Adduction

What is a good result?

Benchmark Score (Mixed: 1.58 N/kg): A patient should ideally exert around 16.15% of body weight during shoulder adduction when tested in supine.

Reliability (?): Due to variation in test procedures, low sample sizes and lack of reporting, its not possible to provide reliability metrics.

True Change (MDC ?): For the above reasons, it is not possible to say how far the needle has to move before we can consider the result a true change.

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Internal Rotation

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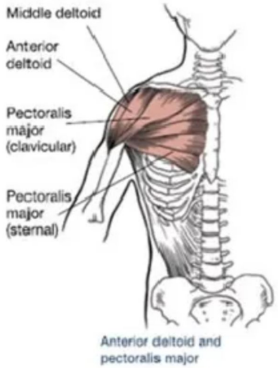
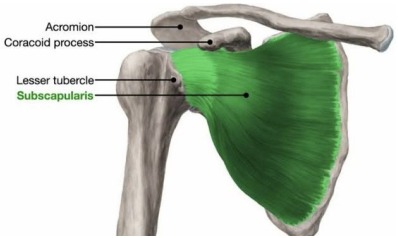
Shoulder Internal Rotation



Anterior deltoid and pectoralis major



The muscles responsible for internal rotation of the shoulder are the subscapularis, pectoralis major, latissimus dorsi, teres major, and the anterior aspect of the deltoid.

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Shoulder Internal Rotation

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- Can test in **Standing, Supine, Prone, Sitting, Side Line**
- Testing at different angles: **Neutral, 45 degrees, End Range,** etc

Internal Rotation

Why?

Weakness of external rotation and supraspinatus strength has been indicated with an increased risk of in-season throwing-related injury, resulting in surgical intervention in professional baseball pitchers (Byram 2010).

Internal rotator and external rotator weakness was associated with recurrent anterior instability (Edouard 2011).

Limited evidence support external and internal rotator weakness as a risk factor for shoulder pain in overhead athletes (Kwan 2021).

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Internal Rotation

How?

Prone position, 90° of shoulder abduction and 90° of elbow flexion.

The dynamometer is placed 2 cm proximal to the ulnar styloid on the ventral aspect of the patients' distal forearm.

The examiner maintains a forward lunge position with the examiner's elbow fixed against the anterior aspect of the hip.

Patients are asked to complete three maximal isometric contractions of 3–4 s with a rest interval of 3–5 s between efforts.

(Cools 2016)

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Internal Rotation

What is a good result?

Benchmark Score (Male 2.1 N/kg, female 1.8 N/kg): A patient should ideally exert around 2.1 Newtons per kilogram of their body weight during shoulder internal rotation.

Reliability (ICC of 0.83-0.94): When measuring shoulder internal rotation strength, the results are very consistent and reliable across repeated tests.

True Change (MDC of 20.6 Newtons): To confidently state that an individual's strength has truly changed (improved or worsened) rather than fluctuated due to measurement error, the observed change must be greater than 20.6 Newtons.

(Cools 2016)

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Athletic Shoulder Test

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Athletic Shoulder Test

Why?

The athletic shoulder test (ASH test) is a long-lever isometric test, used to quantify an athlete's ability to transfer force across the shoulder girdle (Ashworth 2019). The I position measures extension, whereas the T position measures horizontal adduction in standardized positions.

Shoulder proximal force has been significantly associated with increased ball velocity when pitching. (Stodden 2005)

The ASH test is a viable option to quantify peak force into horizontal adduction and extension, which relate to several athletic movements.

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Athletic Shoulder Test

How?

Patient in prone with the arm abducted to 90 degrees (T), 135 degrees (Y), or 180 degrees (I) and the elbow fully extended.

The dynamometer is on the floor and the heel of the hand resting against the dynamometer.

The other hand is placed behind the back when testing the T and Y position and by the pocket for the I position.

Patients are asked to complete three maximal isometric contractions of 3–4 s with a rest interval of 3–5 s between efforts.

(Ashworth 2019)

Athletic Shoulder Test

What is a good result?

Benchmark Score (1.26 N/kg male, 1.01N/kg female): A male athlete should ideally be able to produce 12.85% of their bodyweight in a T position whereas females would be expected to hit 10.29% of bodyweight.

Reliability (ICC of 0.94-0.98): The results of shoulder internal rotation strength measurements are extremely consistent and reliable across repeated tests.

True Change (MDC of 10.7%): To confidently state that an athlete's strength has truly changed (improved or worsened) rather than fluctuated due to measurement error, the observed change must be greater than 10.7% of the initial measurement.

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SUBJECTIVE EXAMINATION

History of present condition –
22 year old female with a six month history of left sided shoulder pain. Pain came on insidiously but following a climbing competition for which she increased her training loads significantly. She has seen a consultant who made a diagnosis of supraspinatus tendinopathy and referred for physiotherapy.

Aggravating factors –
Lying on her left side
Climbing overhangs
Climbing easy routes for more than 30 minutes

Eases –
Rest
Heat

Diurnal pattern –
Dependent on activity
Worst at night but only when lying on the left side

Drug history –
Nil

Social history –
No significant life stressors
Mood is stable
Climbing instructor
Generally active lifestyle

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OBJECTIVE EXAMINATION & DIAGNOSIS

Observation –
Nil of note

Range of movement –
Full range of movement in all directions
Painful arc on abduction on left side
Pain at end of range flexion on left side

Special tests –
Hawkins Kennedy, Jobes and Neers tests +ve
Speeds and Yergassons tests –ve
Scarf test –ve
Sulcus and load and shift tests +ve
Apprehension test +ve with +ve relocation sign

Palpation –
No tenderness on palpation of ACJ

Diagnosis –
Supraspinatus tendinopathy (likely reactive)
Anterior instability

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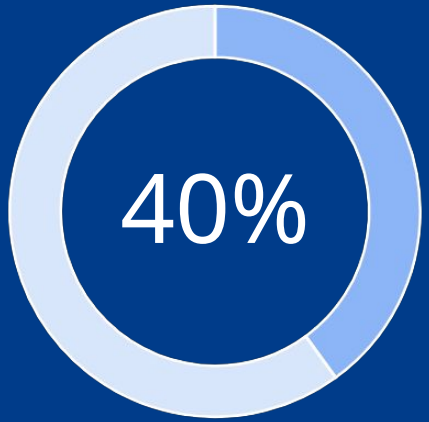
FUNCTION SCORE

Patient specific functional scale –
Bouldering more than 30 minutes = 2/10
Carrying anything overhead = 6/10
Pushing a heavy door = 4/10

Mean score = 4/10



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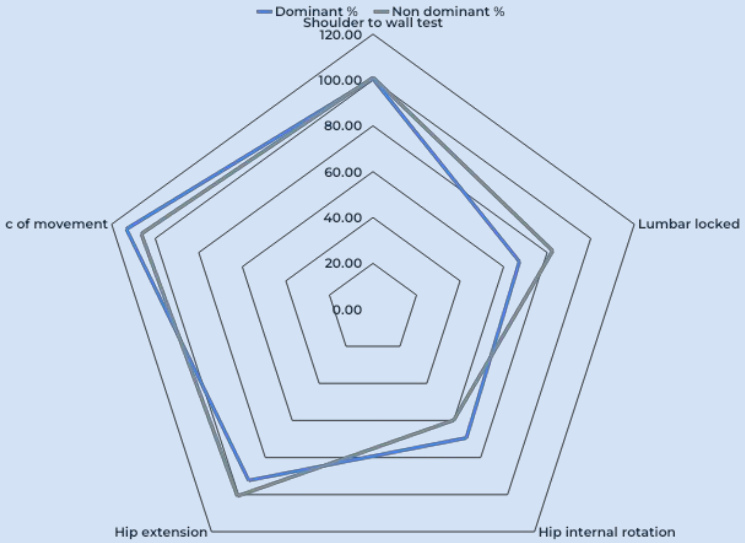
MOBILITY TESTING

Scores on the graph above are expressed as a percentage of their expected value. Expected scores are based off demographic information such as age, sex and weight.



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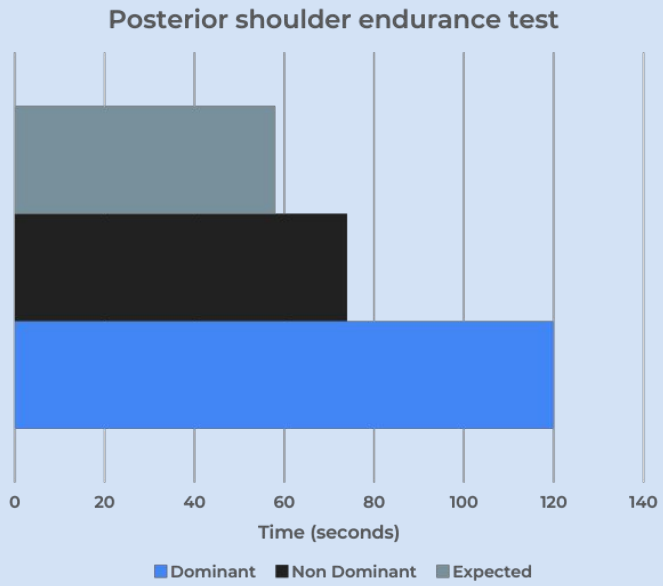
ENDURANCE TESTING



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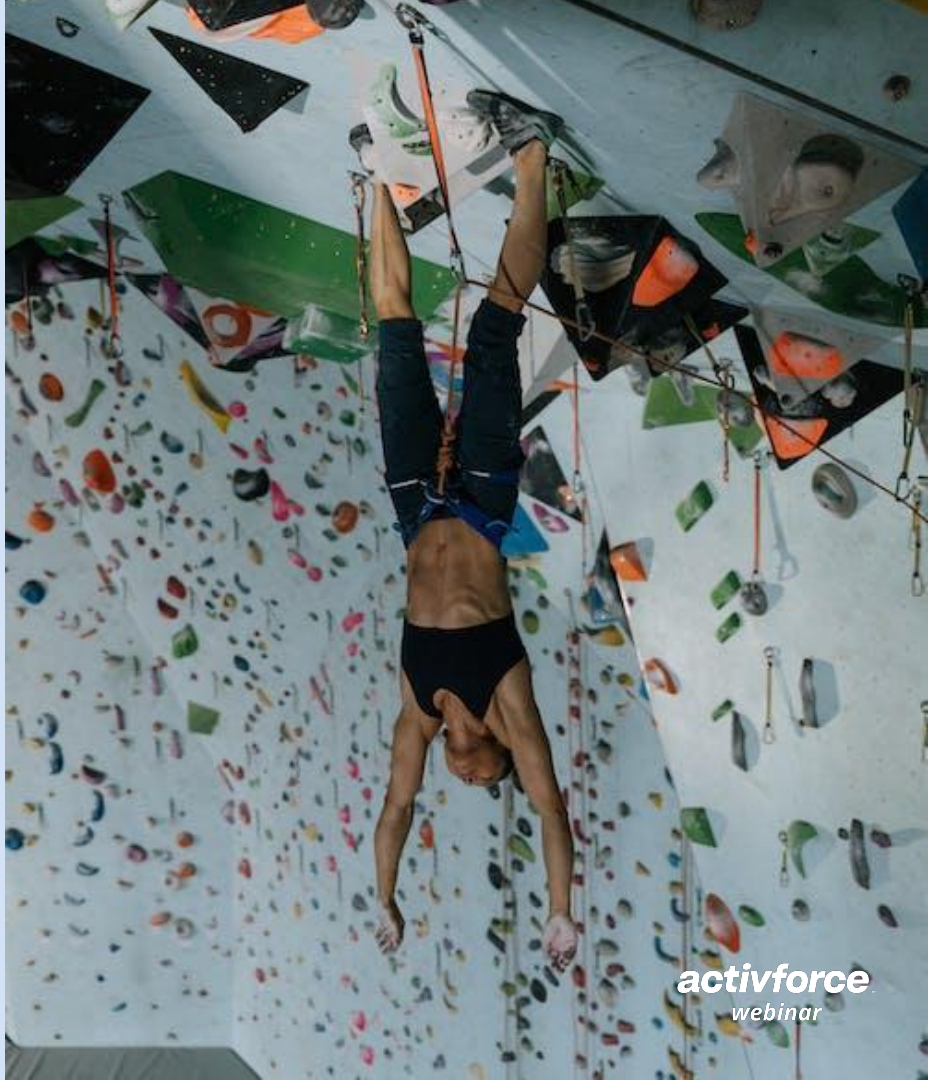
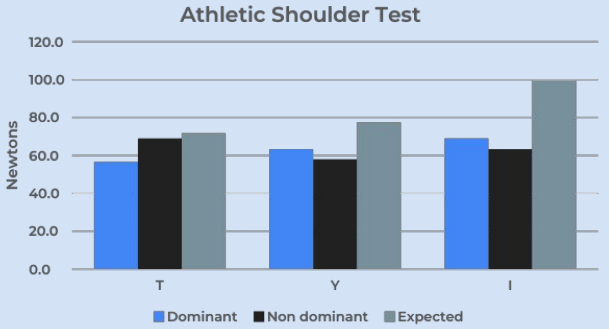
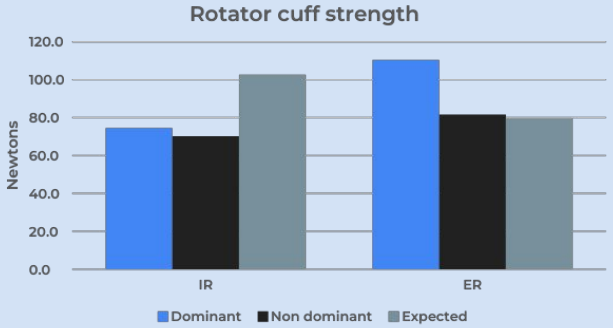


STRENGTH TESTING





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PROBLEM LIST

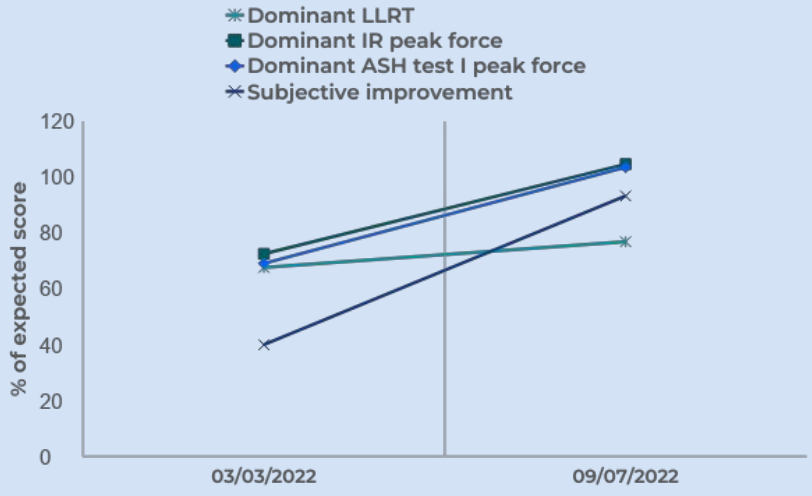
Top 3 deficits
- Decreased range into thoracic rotation (Lumbar locked rotation test)
- Low internal rotation strength
- Inability to produce force in overhead positions (I position athletic shoulder test)

Data driven rehabilitation
- Block 1 objectives: Education regarding training load and the effects of acute spikes in workload.
Daily mobility exercises into thoracic rotation

- Block 2 objectives: Increase endurance posterior shoulder muscles
High volume, low load exercises into neck flexion 3 x per week

- Block 3 objectives: Improve strength of the internal rotators and in overhead positions
High load, low volume exercises 3 x per week
Shoulder internal rotation and shoulder extension from full flexion
Performed using equipment in the climbing gym to remove barriers to exercise

IMPROVEMENT



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Benchmark performance systems

Our suggested strength battery

- Internal rotation
- External rotation
- Athletic shoulder test T, Y, I (Y only if time limited)

(Morrison 2024)

General HHD guidelines:

Comfortable
Stable
External fixation
Biomechanically advantaged
Dynamic correspondence

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