

Posterior Shoulder Tightness in The Overhead Athlete

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Goals and Objectives

- ROM discrepancies in overhead athletes
 - GIRD
- “Posterior shoulder tightness”
- Overuse pathology
- Arthrokinematics of shoulder
- Assessment and Treatment options

Introduction

- Overhead athletes
 - Water Polo
 - Baseball/ Softball
 - Cricket
 - Volleyball
 - Tennis
- Common biomechanics



Overhead biomechanics

- 90 degrees GH abduction + max ER
- Trunk rotation and lateral flexion
- Kinetic chain
- GH IR important to generate, then dissipate forces
- Deceleration phase



Range of Motion

- Compared with non-throwers:
 - Dominant arm
 - Increased ER
 - Decreased IR
 - Non-Dominant arm
 - No difference

Grossman et al 2005, Whiteley et al 2006, Borsa et al 2005, Vad et al 2003, Pieper et al 1998, Crockett et al 2002, Laudner et al 2006, Myers et al 2007, Wang and Cochrane 2001

Decreased shoulder IR

- Professional Tennis players Myers et al 2007, Vad et al 2003
- Baseball pitchers
 - Adolescents
 - Collegiate Myers et al 2007, Myers et al 2006, Chant et al 2007
 - Professional level Crockett et al 2000, Reinold et al 2008, Burkhart et al 2003, Laudner et al 2006, Lintner et al 2007, Borsa et al 2005
- Female fast bowlers Stuelcken et al in press
- International Volleyballers Wang and Cochrane 2001

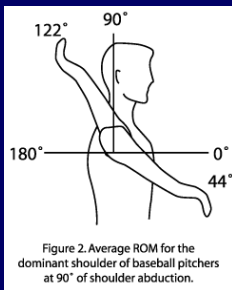
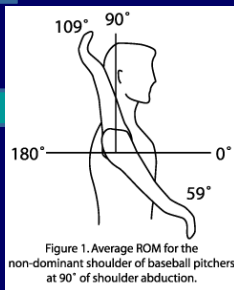
Thrower's Shoulder Concept

- Increased ER due to anterior capsular laxity
 - Possible instability/ impingement symptoms
- Decreased IR due to posterior capsular contracture
 - Further pathological implications

Total ROM Concept Wilk et al 2002

Overall rotation ROM in throwing shoulder
=
Overall rotation ROM in contralateral shoulder

- Normal physiological adaptation
- Protective Pieper 1998, Crockett et al 2002



GIRD Myers et al 2006

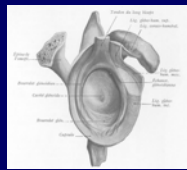
- Glenohumeral Internal Rotation Deficit

Overall rotation ROM in throwing shoulder
<
Overall rotation ROM in contralateral shoulder

- Lost Internal rotation
 - ?posterior shoulder tightness Laudner et al 2006

“Posterior Shoulder Tightness”

- Structures limiting GH IR or Horiz Flx:
 - Soft tissue
 - Posterior capsule
 - Posterior cuff/ deltoid
 - Latissimus Dorsi
 - Fascia
 - Bony
 - Glenoid orientation
 - Humeral torsion
- How to determine what is restricting?

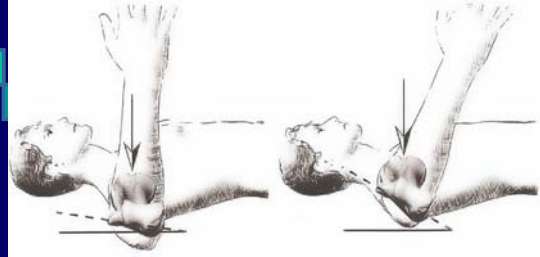


Bony adaptation

- Humeral retrotorsion
 - variable in normal population Norkin and Levangie
- Proximal epiphyseal stresses
- Plausible explanation for total ROM concept
- ?Protective Pieper 1998
 - Shoulder pain group did not demonstrate as much retrotorsion

Humeral Retrotorsion

- Demonstrated in throwing populations
 - Professional handballers Pieper 1998
 - Elite adult pitchers Crockett et al 2003
 - Collegiate baseballers Chant et al 2007
 - Adolescent baseballers Whiteley et al 2006
- Assessed with X-ray/ CT/ Ultrasound
 - Palpatory methods not reliable Whiteley et al 2006



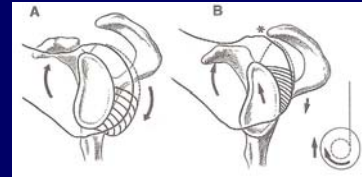
From Whiteley et al 2006

Pathomechanics

- Historically proposed that posterior capsular tightness
 - ➔ altered glenohumeral mechanics
 - ➔ pathological changes/ pain

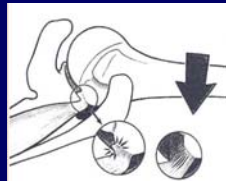
Pathology

- Subacromial impingement Tyler et al 2000
 - Antero-superior HH migration
 - “wind-up” mechanism



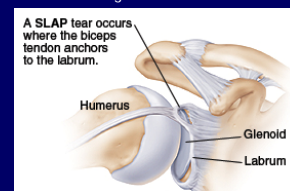
Pathology

- “Internal Impingement” Myers et al 2006
 - Postero-superior HH migration
 - Posterior labrum and articular cuff damage



Pathology

- SLAP lesions Burkhart and Morgan 1998



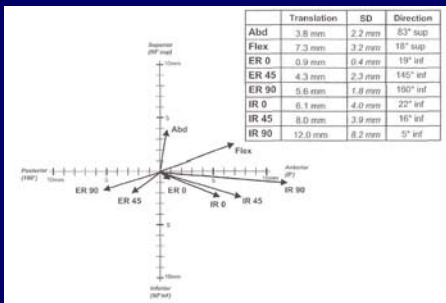
Normal Arthrokinematics

- Rolls and Glides
 - Through ROM
 - 1-3mm superiorly in flexion
 - 4.5mm posteriorly
- End range translations
 - Normal shoulders
 - Due to tightening "capsular restraint mechanism" Harryman et al 1990

End range translation (normal)

- Abduction + External rotation
 - Posteriorly approx 4mm Harryman et al 1990
 - Single plane radiographs
 - Postero-inferior 4.8-5.5mm Werner et al 2004
 - Posteriorly 16.5mm, inferiorly 7.9mm Grossman et al 2005
 - 3D digital mapping "Microscribe"

Normal translation



From Werner et al 2004

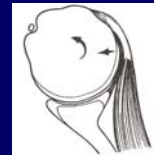
Plication studies

- Cadaveric models
 - Dissect all soft tissue except capsule
- Posterior capsular plications
 - 1-2cm commonly
- +/- Anterior capsular stretching
 - To replicate concept of "thrower's shoulder"
- Decrease IR ROM, but Varying results!

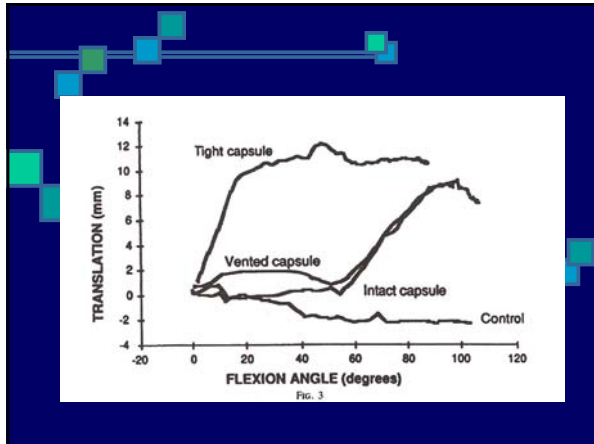
Pathomechanics

- Harryman et al 1990
 - Used single plane radiographs
 - 20mm post plication
- Grossman et al 2005
 - Anterior laxity created + 10mm post capsule shift
 - Motion at 60deg GH abduct

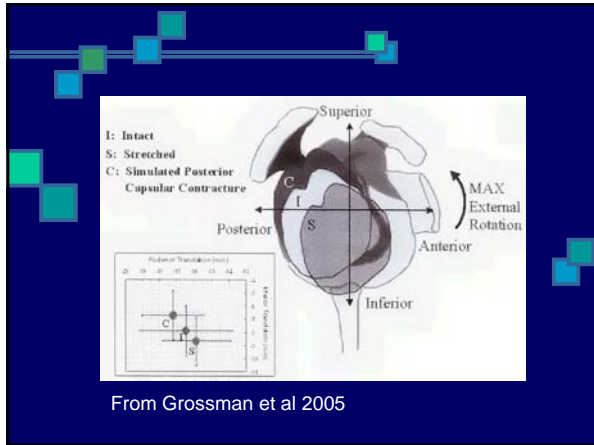
Harryman et al 1990



- Increased and earlier anterior translation
 - Flexion and internal rotation
 - Cross body adduction 2- 14mm
- No change to normal post translation with external rotation (neutral)
- Didn't investigate throwing position

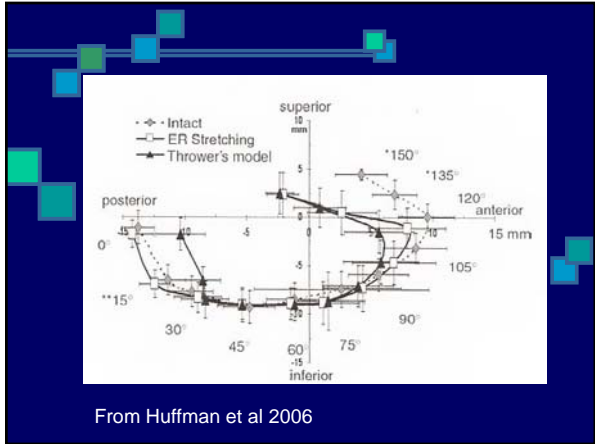


- ### Grossman et al 2005
- Increased ER and total ROM with Ant laxity
 - Decreased IR, ER and total ROM with post plication
 - No significant change in HH position at EROM
 - Some increased postero-superior translation
 - ?protective role of anterior capsule laxity
 - Antero-inferior translation



- ### Huffman et al 2006
- Thrower's shoulder model
 - Computerised 3D system
 - Posterior 10mm plication
 - Accounted for gravity with positioning
 - Tracked humeral translation through throwing motion

- ### Huffman et al 2006
- Simulated late cocking
 - 7.5mm post, 1.5mm superior shift HH
 - Follow Through
 - 3.5mm ant, 2.8mm inferior shift HH
 - Mid ROM unchanged
 - Implicate follow through as MOI, not "Peel back"



Clinical studies

- Normals vs pathological overhead athletes
- Consistently show Decreased IR (*PST)
 - Tennis* Vad et al 2003, Myers et al 2007
 - Female fast bowlers Stuelcken et al 2007
 - Baseball Pitchers* Myers et al 2006, 2007
 - Volleyballers Wang and Cochrane 2001
 - Handball Pieper et al 1998
- Retrospective

Assessment

- Posterior shoulder tightness
 - Clinically easier
 - ?Screening pre-season
- Humeral retroversion
 - Imaging necessary
 - Recent Ultrasound evaluation Whiteley et al 2006

Assessing PST

- IR ROM 90 degrees abduct
 - Relevant for GIRD/ Total rotation
 - Possible retrorsion bias
- Horizontal flexion ROM
 - Supine or sidelying positioning?
 - less likely influenced by retrorsion



PST Horizontal Adduction

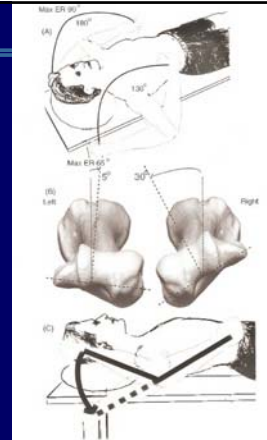
Assessment	Intraseasion		Intersession		Intertester	
	ICC	SEM	ICC	SEM	ICC	SEM
PST Sidelying Myers et al 2007	0.83	0.9 cm	0.42	1.7 cm	0.69	1.4 cm
PST Supine Myers et al 2007	0.91	1.1deg	0.75	1.8deg	0.94	1.8deg
PST Supine Laudner et al 2006	0.93	1.64deg			0.91	1.71deg

PST Horizontal Adduction

- 3.1 – 4.1 deg scapular motion with testing
- Correlation with IR ROM
 - R = -0.164 - 0.347 Myers et al
 - R = 0.72 Laudner et al
 - R = 0.5 Tyler et al
- Sidelying method unable to demonstrate difference between overhead and normals (23% IR deficit)
- Supine method demonstrated PST in baseball pitchers

Retrotorsion assessment

- CT, X-ray
 - Not clinically available
 - Research "Gold standard"
- Ultrasound vs. Palpation
 - Whitely et al 2005
 - RTUS assessment reliable Intertester ICC 0.94-0.98
 - Palpation ICC 0.49-0.51
 - Allow decision as to which direction has been lost



From Whiteley et al 2005

Treatment

- Which Direction?
- Soft tissue techniques
 - ? Neuromuscular vs capsular
- Stretching
 - Therapist vs. Home stretch
 - Hold/Relax
- Surgical
 - More likely for capsulitis

Stretching

- "Sleeper stretch"
 - Sidelying/ Standing
- Cross body stretch
 - Found to be more effective McClure et al 2007
- Therapist assisted
 - Maitland mobilisation
 - Horizontal Flexion +/- IR +/- Post/Inf glide



Stretching Results

- Able to maintain IR and Total ROM over time
 - Baseball pitchers Lintner et al 2007
- Increase IR over 1 year period
 - Junior Tennis players Kibler and Chandler 2003
- ?effects on PST measurements

Other considerations

- Proprioceptive function of capsule
 - Ruffini and Pacini receptors Vangness et al 1995, Guanche et al 1999
 - ?Altered afferent feedback mechanisms
 - Neuromuscular control implications
 - Solomonow et al 1996: feline reflex arc to cuff/ biceps
- Alterations in scapular positioning
 - Lin et al 2006

Conclusion

- A shift in ROM is expected in overhead athletes but must maintain total ROM
- Posterior shoulder tightness can affect the arthrokinematics of the shoulder
- Causal relationship to pathology not established
- Stretching can maintain/ improve IR ROM
- Humeral retroversion should be considered when making treatment decisions

Questions?

Thankyou