Overhead Athletes: More Than Just The Shoulder

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Objectives

- Biomechanics of overhead athletes
- Posture
- Trunk
- Lower extremity
- Assessment & treatment

Biomechanics of Overhead Athletes

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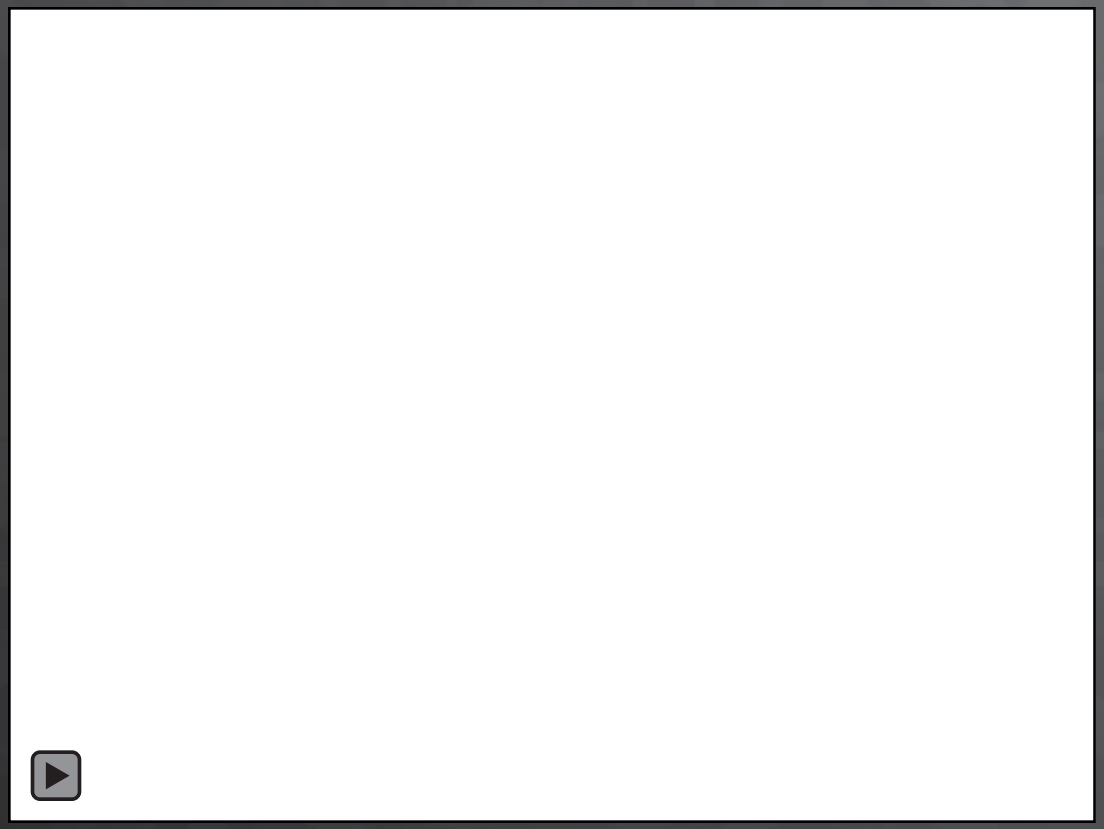
Throwing Motion

- Includes:
  - Wind-up
  - Early cocking
  - Late cocking
  - Acceleration
  - Deceleration & follow through

Throwing Motion

- Wind-up
- Early cocking
- Late cocking
- Acceleration
- Deceleration & follow through

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Windmill/Softball Pitch

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Windmill/Softball Pitch

- Shoulder & elbow forces are equal between baseball & softball pitches

  (Barrentine et al., JOSPT, 1998; Werner et al., AJSM, 2006; Werner et al., AJSM, 2005)

- 73% of collegiate pitchers had injury during season

  (Hill et al., JSCR, 2004)

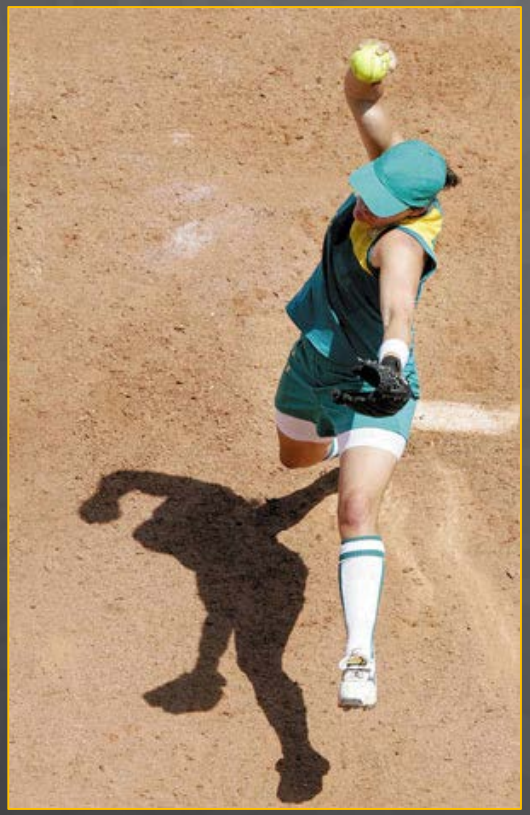
- 45% of high-level pitchers missed time due to injury

  (Meyers et al., Sports Med, 2001)

What type of injuries?

Wind-Up

- Weight shift towards back foot
- Maximum shoulder extension
- Begins generation of momentum



Stride

Delivery & Follow-Through

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Swim Stroke

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Swimming

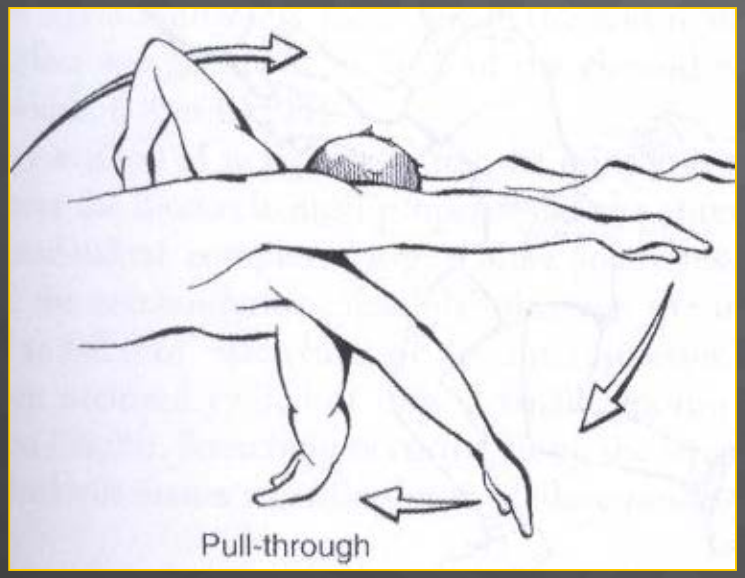
- ~10,000 – 14,000 meters/day
- 16,000 shoulder revolutions per week
- 2,500 shoulder revolutions/day

(Tate, ASSET, 2018; Tate et al., JAT, 2012; Krishnan et al., 2004)

Swimming

Pull-Through Phase

- Hand entry “catch”
  - Shoulder abduction & internal rotation
- Mid-pull-through
  - Shoulder adduction
- End of pull-through
  - Shoulder internal rotation & full adduction

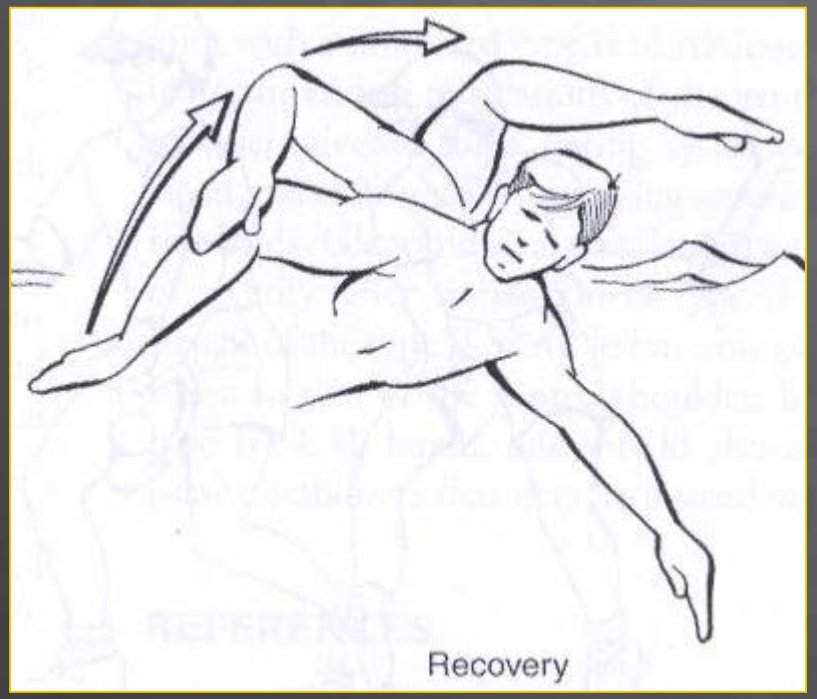


(Yanai et al., 2000; Krishnan et al., 2004/ Tate & Kuppens, ASSET, 2018)

Swimming

Recovery Phase

- Elbow lift
  - Shoulder begins to abduct & external rotation
- Mid-recovery
  - 90° shoulder abduction & external rotation
- Hand entry
  - Shoulder external rotation & max abduction



(Yanai et al., 2000; Krishnan et al., 2004)

Kicking drills?

Kinetic Chain

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Influence of Kinetic Chain

- "Upper extremity" sports use entire kinetic chain

  (Hirashima et al, 2008; Kibler & Thomas, 2012)

- Work proximal to distal

- Disruption of kinetic chain may cause greater force generation at subsequent joints

Clinical Case

- 25° GIRD in throwing arm
- 10° bilateral difference in total arc
- Trunk rotation ROM?
- Hip external rotation ROM?

Assessment & Treatment

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Postural Abnormalities

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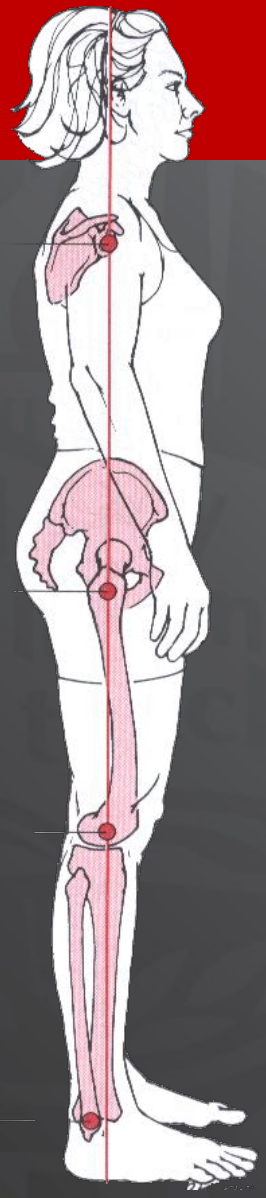
Assessing Posture

- Plumb line
  - Ear
  - Shoulder
  - Hip
  - Knee
  - Ankle

(Kendall et al., 2005)



Postural Deviation	Description
Forward head	Mastoid process anterior to cervical spine
Rounded shoulders	Acromion anterior to cervical spine/scapular protraction
Thoracic kyphosis	Excessive/flattened
Lumbar lordosis	Excessive/flattened


RANGERS

Forward Head

- Increased scapular:
  - Anterior tilt
  - Downward rotation

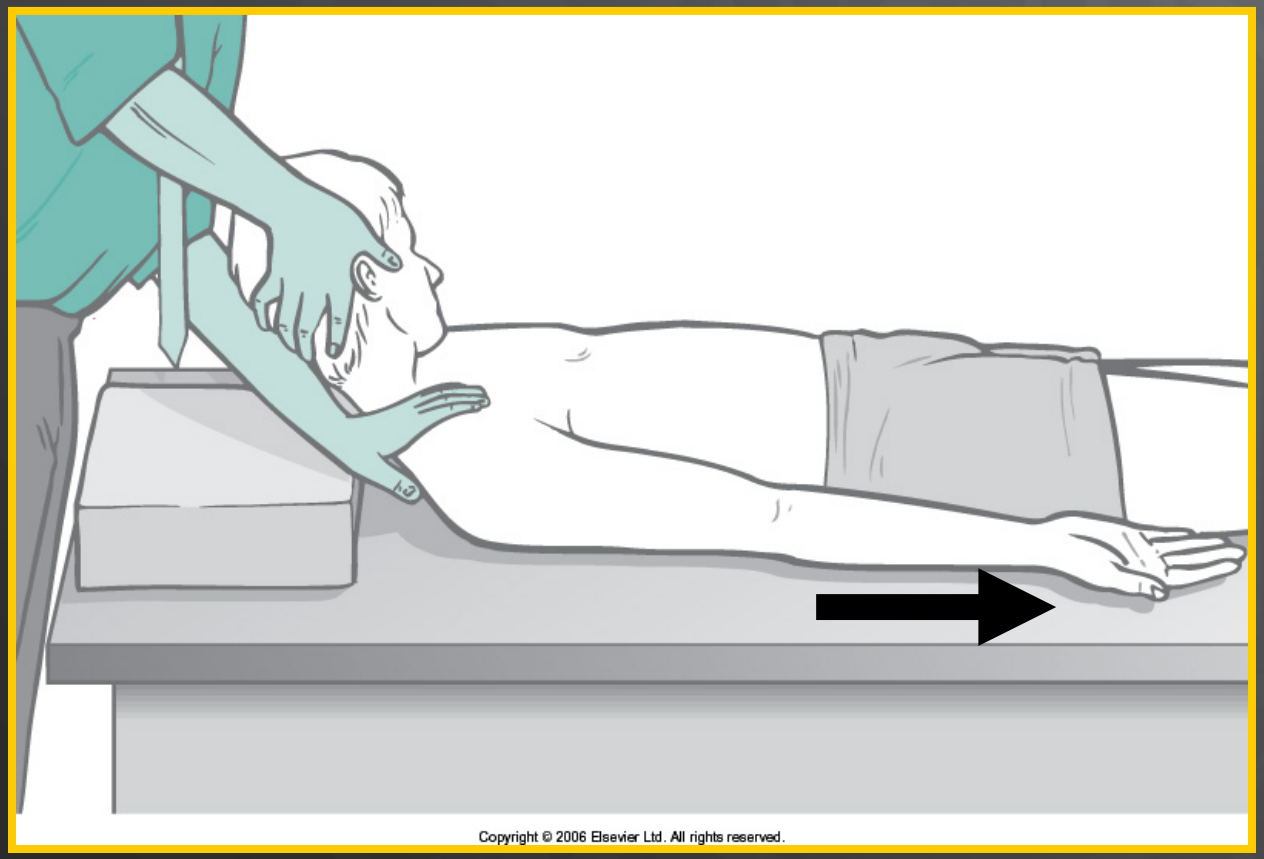
  (Ludewig et al., J Occup Rehab 1996)

- Subacromial impingement

  (Ludewig et al., 2000)
- Shoulder instability

  (Kibler & Sciascia, 2016)

Levator Scapulae Stretch



(Chaitow. 2006)

Levator Scapulae (Active MFR)

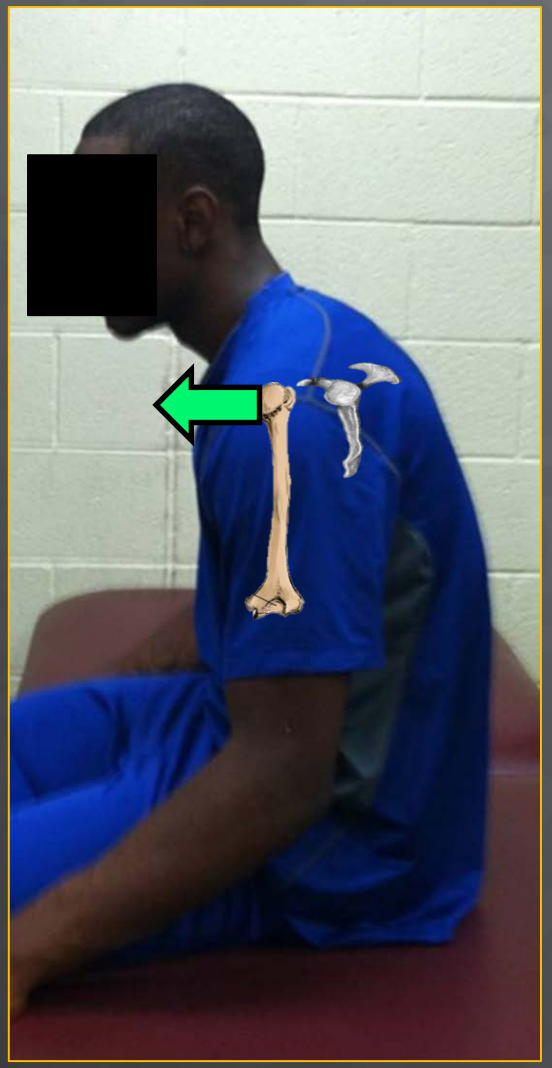
(Johnson, 2009)

Rounded Shoulders/Thoracic Kyphosis

- Tight serratus anterior, pectoralis minor & major
- Weakness of upper, middle, & lower trapezius

(Kendall et al., 2005)

- Rotator cuff tears *(Moor et al., 2014)*
- Subacromial impingement *(Solem-Bertoft* et al., 1993)
- Internal impingement *(Myers et al., 2006)*
- Shoulder instability *(Kibler & Sciascia, 2016)*

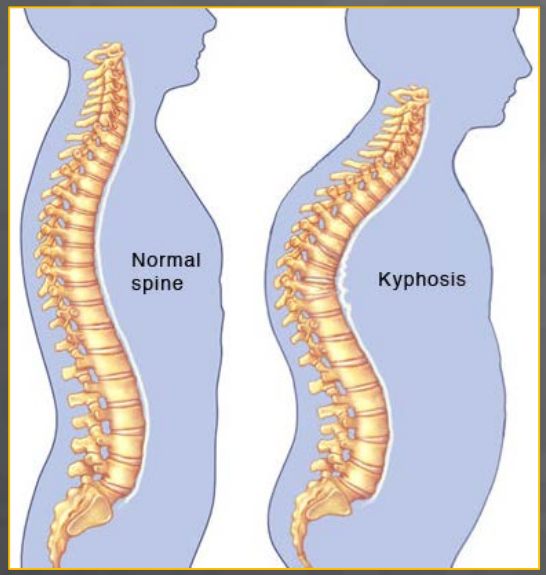


Assessing Rounded Shoulders/Thoracic Kyphosis

(Peterson et al, JOSPT 1997)

Excessive Thoracic Kyphosis

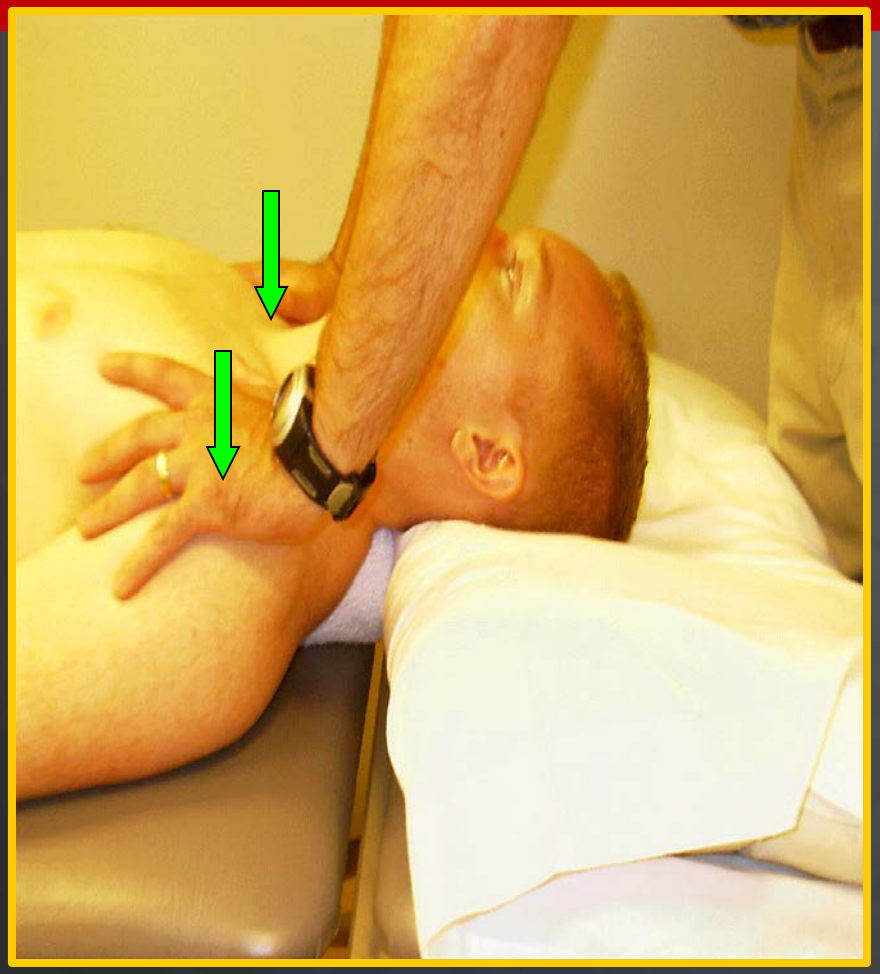
- Tight internal oblique, shoulder adductors, pectoralis minor
- Weakness of middle & lower trapezius



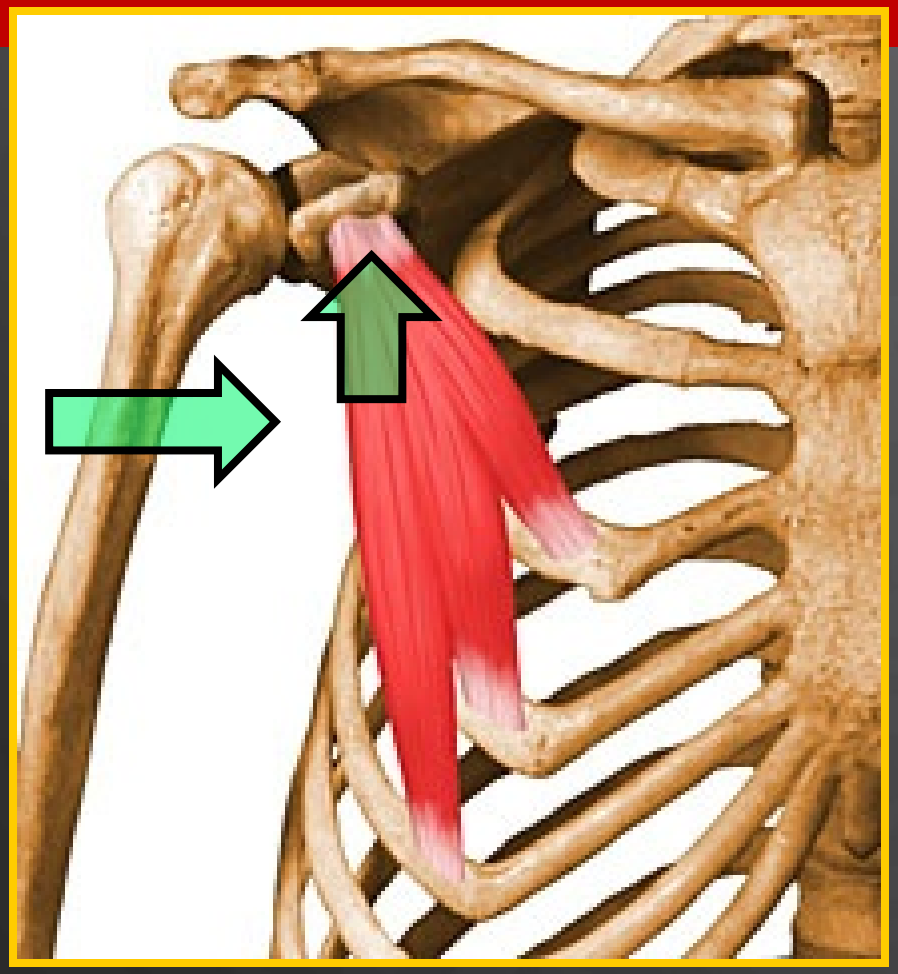
- Increased scapular downward rotation, anterior tilt, & internal rotation *(Kebaetse et al., 1999; Ludewig & Reynolds, 2009)*

- Subacromial impingement *(Otoshi et al., 2014)*
- Glenohumeral instability *(Ludewig & Reynolds, 2009)*

Pectoralis Minor Stretch



Pectoralis Minor Stretch



Trunk Flexion During Throwing

- Trunk flexion associated with elbow force

  (Solomito et al, Ortho J Sports Med, 2018)

- Contralateral trunk tilt
  - Less trunk flexion at stride foot contact
  - Less upper torso rotation & and greater contralateral tilt at late cocking & ball release

  (Oyama et al, AJSM, 2013)

Trunk Rotation ROM

Proper mechanics require good trunk flexibility

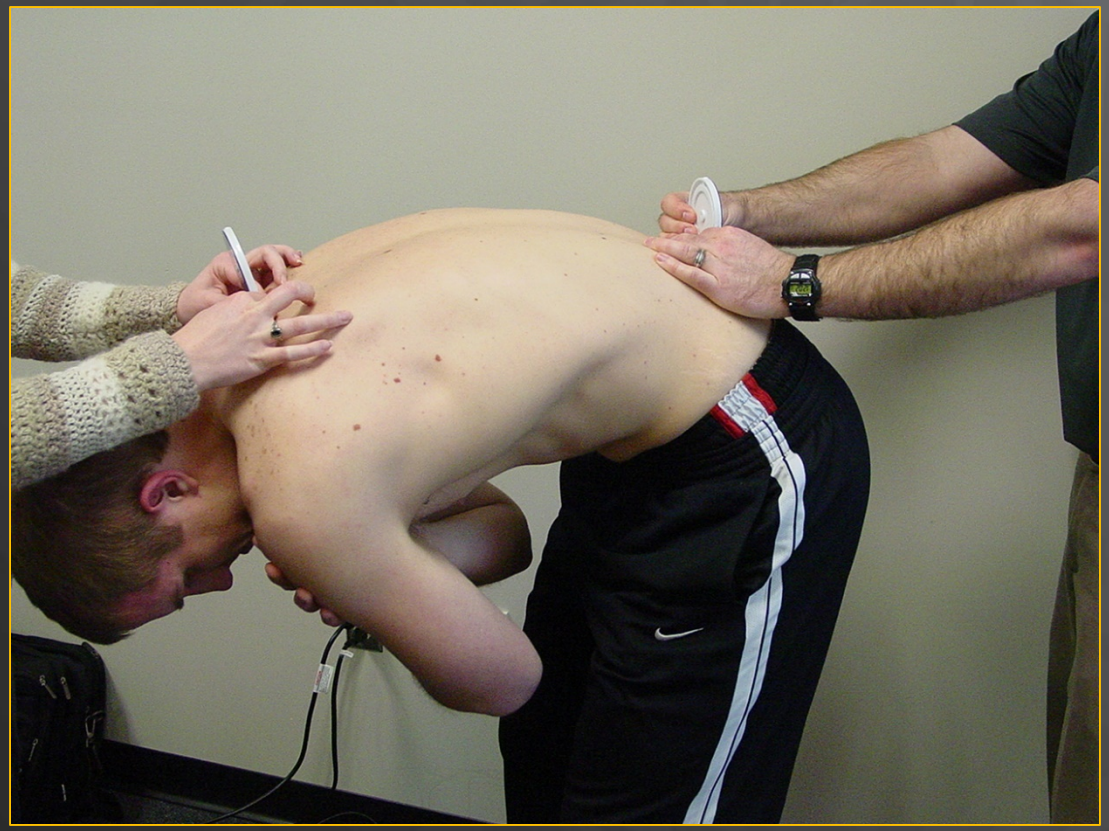
- Pitchers have a greater trunk rotation ROM towards the non-throwing arm side

  (Laudner et al., Intern J of Sports PT, 2013)

Lumbar-Locked Thoracic Rotation Test

(Feijen et al., Phys Ther in Sport, 2018)

Thoracolumbar Rotation Measurement



(Laudner et al., Intern J of Sports PT, 2013)

Trunk Rotation

Trunk Rotation

Core Endurance in Swimmers

- Adolescent swimmers with weaker core endurance (side bridge position) have higher risk of shoulder pain

(Tate et al., JAT, 2012)

Lumbopelvic Control

- Pitchers have decreased lumbopelvic control in both legs

(Laudner et al., J Strength Cond Res, 2018)

Lumbopelvic Control

- Pitchers with less lumbopelvic control produce more walks and hits per inning

  (Chaudhari et al., J Strength Cond Res, 2011)

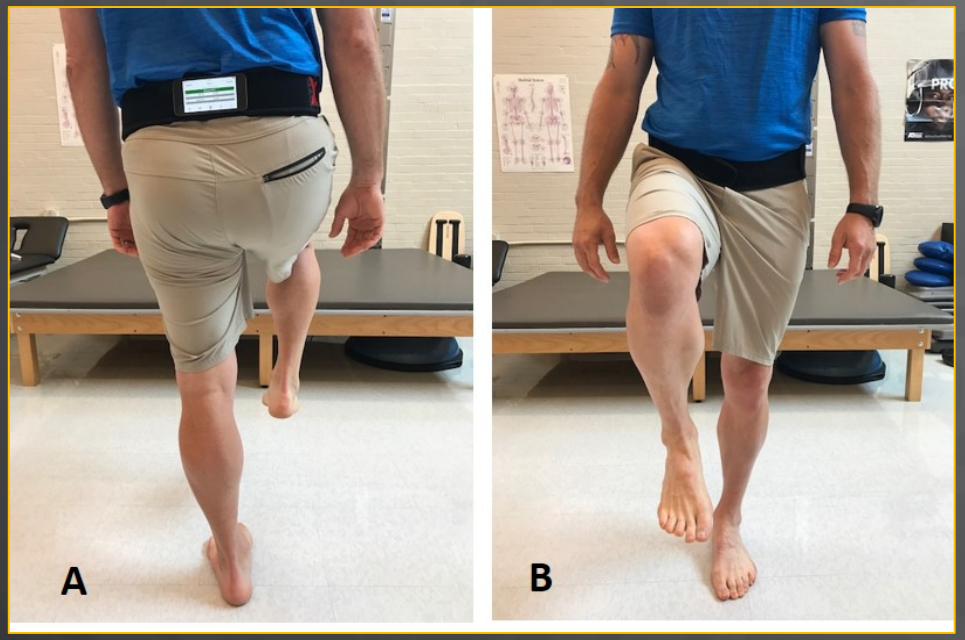
- Pitchers with less lumbopelvic control have increased likelihood of injury

  (Chaudhari et al., AJSM, 2014;

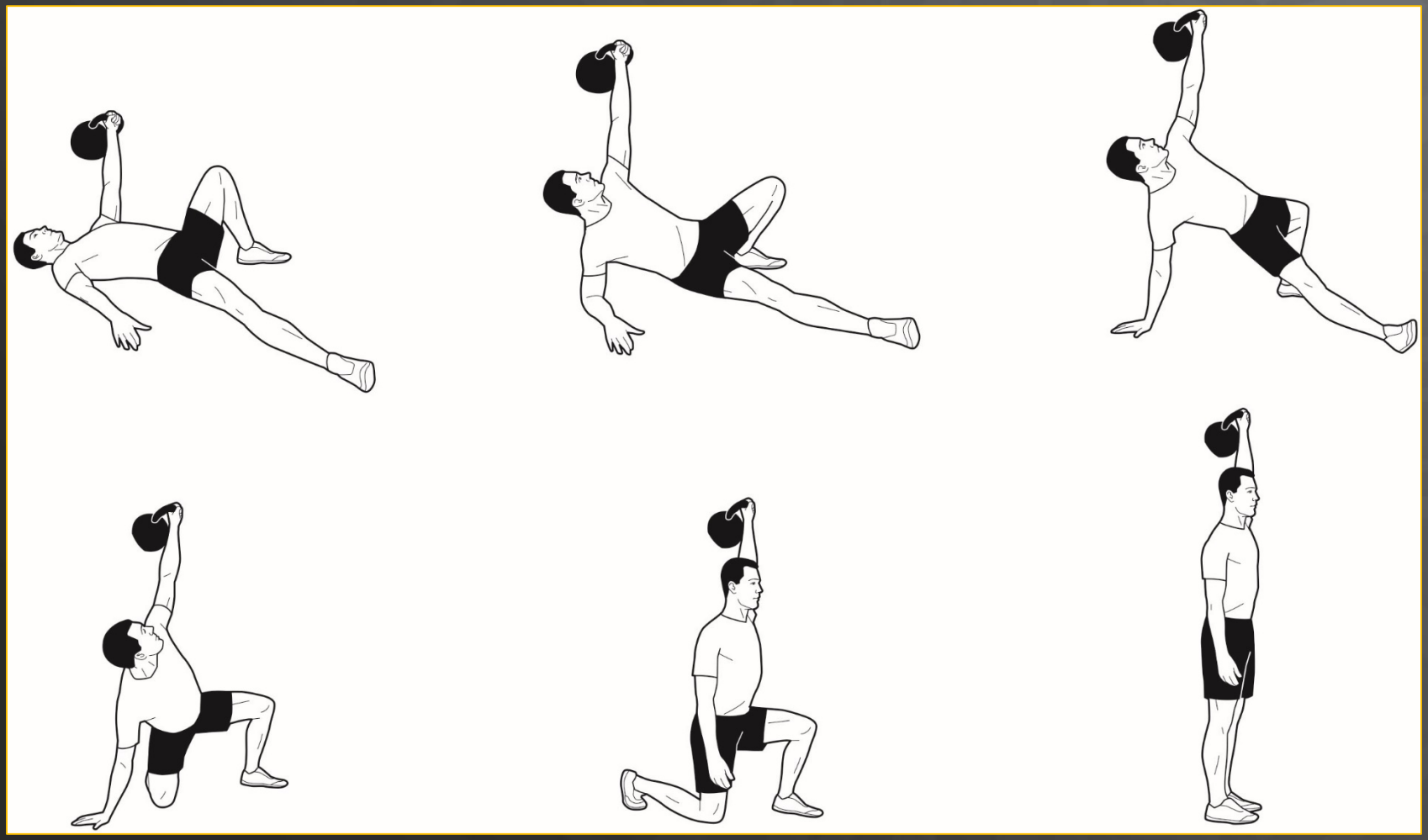
  Hannon et al., Int J Sports PT, 2014)

Lumbopelvic Control

- Drive leg control negatively associated with:
  - Maximum shoulder horizontal force
  - Elbow valgus force *(Laudner et al., J Shld & Elb Surg, in press)*



Turkish Get-Up



Hip Abnormalities

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Stride Length

- Average stride length: 66% of height

- Stride length associated with:
  - Vertical jump
  - Single-leg balance

(Fry et al., Sports Health, 2017)

Functional Tests

- Y-balance upper quarter test
- Medicine ball throw for distance
- Power hop for distance

What about clinical measurements?

Relationship between Hip ROM & Pitching Biomechanics

Lead & trail leg hip external rotation ROM (clinically)

Shoulder horizontal adduction ROM (pitching)

Relationship between Hip ROM & Pitching Biomechanics

Lead leg hip external rotation ROM (clinically)

Shoulder external rotation torque (pitching)

Hip Rotation ROM

- Decreased hip rotation ~~does~~ cause pitcher to throw across body

(Dillman et al, 1993; Wight et al, 2004)

- Lead foot should contact ground with toes pointed towards target

(Fleisig et al, 1989)

Addressing Gluteal Weakness

(Plummer & Oliver, J Strength Cond Res, 2014)

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Fire Hydrants

Fire Hydrants

Side Plank Leg Raises

Ranking of Gluteus Medius Exercises

- Side plank abduction with dominant leg on bottom
- Side plank abduction with dominant leg on top
- Single limb squat
- Clamshell
- Front plank with hip extension

(Boren et al., Int J Sports Phys Ther, 2011)

Ranking of Gluteus Maximus Exercises

- Front plank with hip extension
- Gluteal squeeze
- Side plank abduction with dominant leg on top
- Side plank abduction with dominant leg on bottom
- Single limb squat

(Boren et al., Int J Sports Phys Ther, 2011)

Ranking of Gluteus Medius & Maximus Exercises

- Front plank with hip extension
- Side plank abduction with dominant leg on top
- Side plank abduction with dominant leg on bottom
- Single limb squat

(Boren et al., Int J Sports Phys Ther, 2011)

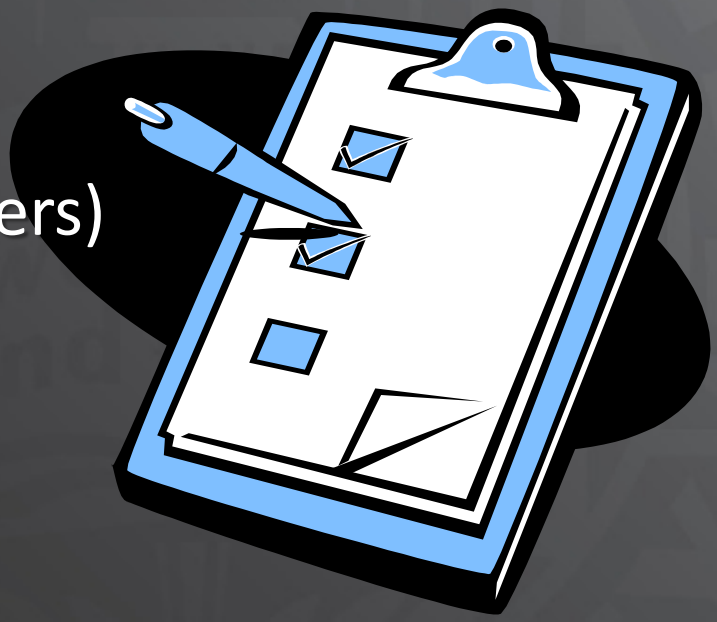
Clinical Case

- 13° GIRD in throwing arm
- 8° bilateral difference in total arc
- Limited trunk rotation ROM
- Limited hip external rotation ROM

Take-Home Points

Need to look at entire picture

- Posture
  - Cervical
  - Thoracic (rounded shoulders)
  - Lumbar
- Hip ROM
- Trunk ROM
- Strength and neuromuscular control



THANK YOU

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