Normal Scapular Function

Scapular Osseous Components
- Inferior Angle

- Arise from several ossification centers with varying ages of coalescence:
  - Coracoid: 14-18yo
  - Acromion: 19-20yo
  - Inferior Angle: 18-20yo
  - Glenoid Fossa: 20-25yo

Presentation Goals
- Provide an understanding of normal Scapular Function and Motion.
- Discuss the importance of the Scapula within the Kinetic chain of the Throwing athlete.
- Describe clinical examination techniques for evaluation of Scapular Function and pathology.
- Define Scapular Dyskinesis and the role it plays in shoulder injury and pathology.
Normal Scapular Function

**Basic Anatomy:** Scapula is enveloped by multiple muscular layers.

- **Anterior Scapular Muscle Attachments:**
  - Triceps
  - Biceps (Short and Long Heads)
  - Coracobrachialis
  - Subscapularis
  - Serratus Anterior
  - Pectoralis Minor
  - Omohyoid

- **Posterior Scapular Muscle Attachments:**
  - Triceps
  - Biceps (Long Head)
  - Deltoid
  - Supraspinatus
  - Infraspinatus
  - Teres Major
  - Teres Minor
  - Levator Scapulae
  - Latissimus Dorsi
  - Rhomboid Major and Minor

**Scapular Bursae:**

- **Infra serratus Bursa (Bursa Musculorum Serrata):**
  - Lies between Serratus Anterior and Chest Wall
  - Inflamed = Inferior Angle Pain

- **Supraserratus Bursa (Bursa Musculorum Angularis Superioris Scapulae):**
  - Lies between Subscapularis and Serratus Anterior
  - Inflamed = Superior Angle Pain

- **Scapulotrapezial Bursa:**
  - Lies between Supraspinatus and Trapezius
  - Contains the Spinal Accessory Nerve.
Normal Scapular Function

- Scapular Anatomic Positioning at Rest:
  - Anteriorly Rotated (relative to trunk) approx 30°
  - Medial Border Rotated
    - Inferior Pole diverged 3-5° from Spine
  - Anteriorly Tilted 20° in sagittal plane

Normal Scapular Function

- Scapulothoracic Anatomy & Function:
  - Scapular Postural Support
    - Levator Scapulae & Upper Trapezius
  - Scapular Retraction
    - Middle Trapezius & Rhomboids
  - Scapular Protraction
    - Serratus Anterior
  - Upward Scapular Rotation
    - Serratus Anterior & Trapezius
  - Scapular Elevation
    - Upper Trapezius & Levator Scapulae

Normal Scapular Function

- A. Scapular Posterior Tilting
- B. Scapular Superior Rotation
- C. Scapular External Rotation
- D. Clavicular Elevation
- E. Clavicular Protraction
Normal Scapular Function

**Dynamic Anatomy:**
- Humeral movement in relation to Glenoid.
- Glenohumeral Ligament and Labral static constraint on Humeral Translation.
- Rotator Cuff dynamic constraint on Glenohumeral Motion.

_The Scapula is intimately involved in each one of these functions._

Normal Scapular Function

**Glenohumeral Articulation**
- Scapula must continually move to maintain instant center of rotation.
- Proper glenoid alignment optimizes function of articulations and rotator cuff to allow concentric GH-Motion.
- Scapulothoracic positioning determines position and inclination of both Glenoid and Inferior Glenohumeral Ligament.
- Improper alignment can lead to GH Instability.

Normal Scapular Function

**Thoracic Wall Articulation**
- Scapular Retraction (external rotation) facilitate cocking position.
- Scapular Lateral Protraction (internal rotation) allows acceleration.
- Scapular Anterior Thoracic Translation allows maintenance of normal GH position and dissipation of deceleration forces.
Normal Scapular Function

**Acromial Elevation**
- Serratus anterior activation results in traction related superior acromial elevation.
- Occurs during cocking and acceleration phases of throwing, and during arm elevation.
- Allows for reduction of impingement and coracoacromial arch compression.

Normal Scapular Function

**Kinetic Chain**
- Scapula serves as a link in Proximal-to-Distal sequencing of Velocity, Energy, and Forces of shoulder function.
  - Generation, Summation, Transference
  - Scapula serves as pivotal link of transference of large forces/high energy from lower body/core to the arm/hand.
- Allows arm stabilization to absorb force loads through long lever dynamics to reduce injury.

Scapular Motion

**Normal Scapular Dynamics:**
- Bilateral Posterior Tilting, External Rotation, & slight Superior Translation during elevation of arm.
- Symmetrical motion patterns.
- No prominent medial or superior scapular borders.
Scapular Dyskinesis

**Scapular Dyskinesis**

- Alterations in **STATIC** scapular position and **DYNAMIC** scapular motion resulting in scapular asymmetry in gross postural assessment and function movement.

**Scapular Dyskinesis**

- Affects normal Scapulohumeral Rhythm (SHR).
- May lead to articular and/or soft tissue shoulder dysfunction.
- May result in shoulder pathology and injury.
- May result from injury causing inhibition of scapular stabilization.

*Nonspecific Response*: No specific pattern of dyskinesis is associated with a specific shoulder diagnosis.

**Contributing Factors**

- **Bony Posture & Injury**
  - Increased Thoracic Kyphosis
  - *Scapular Protraction*
  - Acromial Depression
  - Clavicle Fractures
  - AC Joint Injury
  - Disrupt normal progression of scapular rotation
Scapular Dyskinesis

**Contributing Factors**

- **Muscle Function Alteration**
  - Long Thoracic Nerve → Serratus Anterior
  - Spinal Accessory Nerve → Trapezius

- **Muscle Inhibition/Weakness**
  - Common in Glenohumeral Pathology
  - Nonspecific response to shoulder pain
  - 68% RC Abnormalities
  - 94% Labral Tears
  - 100% GH Instability

- **Contracture/Inflexibility**
  - Pectoralis Minor/SH-Biceps
  - Anterior Tilted Scapula
  - **GIRD**
    - "Wind-Up" Effect
    - Glenoid and Scapula pulled in forward inferior direction
    - May result in ↑ protraction during arm-ADDucted position

**Associated Shoulder Pathology:**

- Subacromial Impingement
- Glenohumeral Instability
- Glenoid Labral Injury
- Rotator Cuff Injury
Assessing Scapular Dyskinesis

**Clinical Examination**
- Kinetic Chain Evaluation:
  - Leg/Trunk Muscle Strength
  - Lumbar Lordotic Posture
  - Pelvic Alignment
  - Iliac Rotations, SI Instability/Dysfunction
  - Hip ROM
  - Thoracic Alignment/Posture
  - Thoracic Kyphosis, Scoliosis
  - Cervical Posture
  - Cervical Lordosis

Assessing Scapular Dyskinesis

- Examine patient from behind with arms at rest at sides.
- Examine Scapular Motion as arms are elevated and lowered within scapular plane.
- Examine Scapular Motion as arms are elevated and lowered within the sagittal plane.

Types of Scapular Dyskinesis

- **Type I**
  - Prominence of Inferior Medial Scapular Angle
  - Primarily abnormal rotation around a transverse axis
  - Results in excessive anterior scapular tilt

- **Type II**
  - Prominence of entire Medial Scapular Border
  - Results in abnormal rotation around a vertical axis
  - Associated with excessive scapular internal rotation

- **Type III**
  - Prominence of Superior Scapular Border
  - Results in excessive superior scapular translation

- **Type IV**
  - Normal, Symmetrical scapular motion
Assessing Scapular Dyskinesis

Observational Clinical Assessment
- 4-Type Method versus Yes/No Method
  - Easily available
  - Wide variance of Inter-Rater Reliability
    - (4-Type) Sensitivity 10%-54%; Specificity 62%-94%
    - (Yes/No) Sensitivity 74%-78%; Specificity 31%-38%
  - Limited assessment of multiple-plane asymmetries

3D EM Kinematic Analysis
- Lab-based, limited availability
- Allows for multiple-plane assessment
- Detected asymmetry may not be clinically relevant

Uhl et al. Arthroscopy, 25(11); 2009

Assessing Scapular Dyskinesis

Yes/No Method
- Improved Inter-Rater Agreement (79%)
  - Allows consideration beyond a single-plane of motion
  - PPV = 74%
- Displays Sensitivity (76%) & Specificity (35%) similar to other clinical shoulder exam tests.
  - Clinical SLAP tests: Mean Sensitivity 57%; Specificity 41%
  - Clinical Instability tests: Mean Sensitivity 71%; Specificity 38%
  - Clinical Impingement tests: Mean Sensitivity 68%; Specificity 49%

Scapular Dyskinesis

Prevalence of Scapular Asymmetry
- 71%-78% (3D Kinematics) of population at large

Symptomatic vs. Asymptomatic
- Additional factors:
  - Ligamentous Laxity, Muscle Imbalance, Side Dominance
- Plane of Assessment may determine clinical relevance
  - Forward Flexion Motion Asymmetry increased in Symptomatic (54%) versus Asymptomatic (14%) patients.
  - Increased Serratus Anterior activity
Effects of Scapular Dyskinesis

**Loss of Retraction/Protraction**
- **Retraction Loss**
  - stable “Cocking” point or base for arm elevation.
  - ↑ Impingement as scapula rotates inferior and anterior.
- **Protraction Loss**
  - ↑ deceleration forces in GH Joint.
  - Functional Glenoid Anteversion.
  - ↑ shear stresses on anterior stabilizing structures.
  - ↑ posterior impingement

**Loss of Superior Elevation**
- Decreased Acromial Elevation
- Predisposes Subacromial Impingement.
- Inhibition of Serratus Anterior and Lower Trapezius

**Loss of Kinetic Chain Function**
- Disruption of transferal of lower extremity and core forces to the upper extremity.
  - ↓ Strength and Energy Use
  - ↓ Acceleration Velocity

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10/24/13

References