Hand Therapy Review Course
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Shoulder Anatomy and Kinesiology
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Bones

- **Clavicle**
  - Connects axial skeleton and upper limb
  - Serves as attachment site for muscles controlling upper extremity
  - Protects the neurovascular bundle from neck to arm

- **Scapula**
  - Lies over ribs 2-7
  - 30° anterior to the coronal plane, 10° on the frontal tilt.
  - Provides a stability for shoulder complex
  - Serves as an attachment site for muscles
  - Transmits energy proximal to distal
  - Landmarks: Spine, Acromion process, Glenoid fossa, Coracoid process

Definitions of Scapular Motion

- Adduct/Retract
- Abduct/Protract
- Upward/Downward rotation

Figure 1. Scapular Motions. A) Upward/downward rotation about an axis perpendicular to the plane of the scapula; B) Internal/External rotation about a superiorly directed axis; and C) Anterior/posterior tilting about a laterally directed axis.
### Functional Biomechanics

- **Plane of the Scapula or Scaption (POS)**
  - 30°-45° anterior to the frontal plane
  - True plane of movement of the shoulder

### Bones

- **Humerus**
  - Proximal lever arm of the upper limb
  - Attachment site for prime movers of shoulder and elbow

- **Landmarks**
  - Greater tubercle: insertion for supraspinatus, infraspinatus, teres minor
  - Lesser tubercle: insertion for subscapularis
  - Surgical neck
  - Anatomical neck
  - Shaft

### Sternoclavicular Joint (SC)

- **Proximal clavicle and sternum**
- **Only articulation between the axial skeleton and the upper limb**
- **Movement:** protraction, retraction, rotation, elevation and depression
- **Stability:**
  - Ligaments: costoclavicular, sternoclavicular (anterior and posterior), interclavicular
  - Articular disk
  - Joint capsule

### Acromioclavicular (AC) Joint

- **Formed by acromion of the scapula and distal clavicle**
- **Synovial plane joint**
- **Movement:** Primarily slides during shoulder motion to conform to changes in the relationship between the scapula & the humerus

The AC capsule limits anterior and posterior translation of distal clavicle.

### Glenohumeral Joint

- **Formed by glenoid fossa of the scapula and the head of the humerus**
- **Ball and socket joint that sacrifices stability for mobility**
- **Movement:** flexion, extension, abduction, adduction, external and internal rotation

25% or 1/3 contact helps to keep humerus in socket with arm at side.
Glenohumeral Joint

- Subacromial space: space between acromion, coracoacromial ligament, coracoid process and the superior humeral head

Scapulothoracic (ST) Joint

- Formed between the scapula and the thoracic wall
- Not a "true" articulation
- Movement: protraction, retraction, elevation, depression, upward & downward rotation
- Stabilized by muscles
- Provides a stable base for glenohumeral mobility and stability; shoulder movement depends on it

Static Stabilizing Structures

- Superior Glenohumeral Ligament (SGHL)
  - Restrains inferior translation and ER in 0 degrees adducted arm
  - Restrains posterior translation in flexion, adduction and IR
- Middle Glenohumeral Ligament (MGHL)
  - Restrains anterior translation at 45 ABD/ER
  - Originates with SGHL and inserts medial to lesser tuberosity

Glenohumeral joint

- Includes:
  - RTC tendons
  - Long head of biceps
  - Sub-acromial - sub-deltoid bursa
  - Subscapularis bursa
  - Subcoracoid bursa
  - Coracohumeral ligament

Static Stabilizers Structures

- Articular surface
  - Poor congruity; likened to a golf ball on a tee
  - Humeral head is 3-4 times larger than the glenoid fossa
- Glenoid Labrum
  - Fibrocartilaginous complex that deepens the glenoid fossa
  - Generally loose superiorly and tighter inferiorly

These structures along with RC are responsible for stability in the midranges of motion.

* laxity causes a 'Sulcus sign'
Static Stabilizing Structures

- **Inferior glenohumeral ligament (IGHL)**
  - Primary anterior restraint in position of 90° abduction, 90° ER. Anterior portion
  - Thickened bands that form a hammock to support the humerus in the axillary pouch
  - Primary restraint to posterior translation in ABD/IR. Posterior portion
  - Primary restraint to inferior translation with arm at 90 degrees ABD

Dynamic Stabilizing Structures

- **Rotator cuff** (force couple)
  - Supraspinatus
  - Infraspinatus
  - Teres minor
  - Subscapularis
  - Biceps tendon

  These muscles provide GH ER which helps clear the greater tuberosity from under the coracoacromial arch with overhead movements.

Dynamic Stabilizing Structures

- **Posterior deltoid**
  - Provides external rotation and assist with horizontal Abduction

Rotator Cuff

- The subscap, infraspinatus, and teres minor depress the humeral head, counteracting the upward pull of the deltoid.
- The infraspinatus becomes a head depressor with the arm at 90 degrees of abduction and neutral rotation
- The subscap acts as a head depressor in external rotation.
- The RC provides direct joint compression, keeps the humeral head centered within the glenoid and allows the deltoid to function.

Dynamic Stabilizing Structures

- **Anterior deltoid**
  - Initiates flexion and provides horizontal Adduction
**Dynamic Stabilizing Structures**

**Middle Deltoid:** initiates Abduction primarily to 90 degrees while producing upward shear of the humeral head.

**Dynamic Stabilizing Structures:**

**Supraspinatus**
- Origin: Supraspinatus fossa to superior facet of greater tuberosity
- Function: Initiates and asst deltoid in ABD
- Nerve: Suprascapular nerve
- Blood supply: Suprascapular artery

**Infraspinatus**
- Origin: Infraspinatus fossa to middle facet of greater tuberosity
- Function: ER of arm and supports head of humerus in glenoid
- Nerve: Suprascapular nerve
- Blood supply: Suprascapular and Circumflex arteries

**Teres Minor**
- Origin: Superior part of lateral border of scapula to inferior facet of greater tuberosity
- Function: ER arm and helps stabilize humeral head in glenoid
- Nerve: Axillary nerve
- Blood supply: subscapular & circumflex scapular arteries

**Subscapularis**
- Origin: Subscapular fossa to lesser tuberosity
- Function: IR and Adduction
- Nerve: Upper and lower subscapular nerves
- Blood supply: subscapular artery
Muscles: Scapular Motion

- **Upwards rotation:** Upper and middle trapezius, Serratus
- **Downwards rotation:** Rhomboids, Pectoralis minor
- **Elevation:** Levator, Upper traps, Rhomboid

Muscles: Scapular Motion

- **Depression:** Pecs minor-major, lower traps.
- **Protraction (abd):** serratus, pecs minor-major
- **Retraction (add):** middle traps, rhomboids
Muscles: Humeral Motion

- **Flexion:** anterior deltoid, coracobrachialis, biceps short head
- **Extension:** Latissimus, teres major, posterior deltoid, infraspinatus, teres minor, long head of triceps
- **Abduction:** middle deltoids, supraspinatus
- **Adduction:** pec major, latissimus, teres major, coracobrachialis, subscapularis

Muscles: Humeral Motion

- **External rotation:** Infraspinatus, teres minor, posterior deltoid
- **Internal rotation:** Subscapularis, latissimus, teres major, anterior deltoid, pec major
- **Horizontal adduction:** anterior deltoid, clavicular head of pec major, coracobrachialis
- **Horizontal abduction:** posterior deltoid, infraspinatus, teres minor

Quadrangular Space

- **Quadrangular (HTTT)**
  - Posterior circumflex artery
  - Between Teres minor, teres major, long head of triceps and humeral shaft.

Triangular Space

- **Triangular Space**
  - Superior: Teres Minor
  - Inferior: Teres Major
  - Lateral: Long Head of Tricep
  - Contains: Scapular Circumflex Artery

Functional Biomechanics: Plane of the Scapula (POS)

- Shoulder abductors and rotators are at optimum length-tension ratio
- Joint capsule is relaxed or untwisted
- Improved joint congruity of GH joint
- **Clinical Pearl:** It is most advantageous and comfortable for the patient to mobilize the GH joint and to stretch, test and strengthen the GH rotators in this plane

Early Phase of Elevation

0-90°: Setting phase of scapula
2:1 GH to ST movement (60/30)

- **Glenohumeral joint**
  - Deltoid produces upward shear of humeral head
  - supraspinatus compresses
  - subscapularis depresses
  - Infra/teres minor stabilize

- **Scapulothoracic**
  - UL and SA produce upward rotation of the scapula
  - Acromioclavicular and Sternoclavicular joints
  - Elevate to permit movement
Late Phase of Elevation
90 - 180 deg.: Critical phase
1:1 GH to ST ratio

- Glenohumeral Joint
  - at 60° deltoid shear force is maximal
  - Supraspinatus and infraspinatus provide compressive and depressive force to counteract deltoid
  - Force couple of deltoid and rotator cuff: shear and compressive forces are equal at 90°
  - Other force couple: triceps/rhomboid to deltoid, pec minor to serratus anterior and levator.

Last Phase of Elevation
140-180°
2:1 GH to ST movement

- Scapular rotators now become stabilizers
- Must have good extensibility of teres major and subscapularis and latissimus dorsi and pec major for humerus to disengage
- 60 degrees UR scap (AC and SC), 120 degrees GH

Phases of Elevation
60-140°: Critical phase

- Scapulothoracic Joint
  - Greatest scapula rotation occurs in this phase
  - Force couples: equal forces between UT, LT, SA produce rotation
  - If rotation is not adequate—pathological movement pattern or impingement

References