Anatomy, Joint Orientation and Arthrokinematics

Glenohumeral Joint

Joint Orientation
- Glenoid fossa of scapula faces laterally, anteriorly and slightly superiorly
- Glenoid fossa is pear shaped in outline
- The fossa is relatively shallow and deepened by the glenoid labrum
- The humeral head represents 2/5 of a sphere and faces superiorly, medially and posteriorly
- The ratio of the humeral head to glenoid fossa is similar to a golf ball on a tee

Glenoid Labrum
- Acts to deepen the glenoid fossa
- Fibrocartilaginous ring around the glenoid cavity
- Superior outer margin gives the attachment of the long head of biceps
- Inferior margin gives rise to the long head of triceps tendon

Ligamentous Anatomy

Coracohumeral Ligament
- Lateral border of coracoid passing laterally dividing into two heads
- Each head attaches to the intertubercular groove onto the transverse humeral ligament
- Anterior border of medial part blends with Subscapularis and the joint capsule
- Posterior part blends with the tendon of supraspinatus

Transverse Ligament
- Upper end of the intertubercular groove between the greater and lesser tubercles
- Holds the biceps tendon in the intertubercular groove

Superior Glenohumeral Ligament
- Upper part of the glenoid margin and adjacent labrum anterior to the attachment of the long head of biceps
- Runs laterally to the upper surface of the lesser tubercle
- Taught at neutral and slackens as abduction increases
- Adhesion can restrict flexion, extension or abduction
- Adhesion can restrict external rotation at 0°

Middle Glenohumeral Ligament
- Inferior to attachment of superior glenohumeral ligament
- To lesser tubercle inferior to insertion of Subscapularis
- More slack than superior glenohumeral ligament in neutral
- Tension increases to 45° abduction then slackens again as abduction continues
- Adhesions can restrict external rotation at 45°
Inferior Glenohumeral Ligament

- Glenoid margin below the notch and adjacent anterior border of glenoid labrum
- Attaches to anteroinferior neck of the humerus
- Made up of an anterior band and a posterior band
- Relaxed at neutral and increases in tension with abduction
- Adhesion restrict end range flexion, extension and abduction
- Adhesion in the anterior band restrict external rotation at 90°
- Adhesion in the posterior band restricts internal rotation at 90°

- The Superior, Middle and Inferior glenohumeral ligaments are all thickenings of the anterior joint capsule

Joint Capsule

- Attaches to glenoid labrum on scapular and passes horizontally to anatomical neck of humerus medial to greater and lesser tubercles
- Inferiorly the capsule joins the medial surface of the shaft
- Superoposterior aspect of capsule is strengthened by the attachment of the coracohumeral ligament
- Rotator cuff tendons spread over posterior capsule blending with it at the humeral attachment

<table>
<thead>
<tr>
<th>Capsular Tightness</th>
<th>Restriction in Motion</th>
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<tbody>
<tr>
<td>Anterior capsule - Coracohumeral ligament, superior</td>
<td>Flexion, extension and abduction</td>
</tr>
<tr>
<td>glenohumeral ligament</td>
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<td>Inferior capsule – inferior glenohumeral ligament</td>
<td>End range flexion, extension and abduction</td>
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<tr>
<td>Anterosuperior capsule – Coracohumeral ligament,</td>
<td>External rotation @ 0°</td>
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<td>superior glenohumeral ligament</td>
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<td>Anterior capsule- middle glenohumeral ligament</td>
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<td>Inferior capsule- anterior band of the inferior</td>
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<td>Posterior capsule</td>
<td>Internal Rotation @ 0 and 45°</td>
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<td>Posteroinferior capsule</td>
<td>Internal Rotation @ 90°</td>
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Arthrokinematics

Rules of concavity and convexity

- Movements at joint surfaces follow the rules of concavity and convexity
- Each joint involves two bony surfaces one that is convex and one that is concave
- When the concave surface is fixed and the convex surface moves on it, the convex surface rolls and glide in opposite directions
- When the convex surface is fixed and the concave surface moves on it the concave surface rolls and glides in the same direction
### Glenohumeral Joint

<table>
<thead>
<tr>
<th>Capsular Pattern</th>
<th>External Rotation limited more than Abduction, limited more than Internal Rotation and Flexion</th>
</tr>
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<tbody>
<tr>
<td>Resting Position</td>
<td>55° Abduction, 30° Shoulder Flexion, 20° Elbow flexion</td>
</tr>
<tr>
<td>Close Packed Position</td>
<td>Full Abduction and External Rotation</td>
</tr>
</tbody>
</table>

**End Feel**
- Flexion - **ELASTIC** – tissue stretching; posterior and inferior capsules become tight
- Extension - **ELASTIC** – tissue stretching; anterior capsule becomes tight
- Abduction - **HARD** – humerus contacting acromial arch. **Elastic** – tissue stretching; inferior capsules become tight
- Adduction - **SOFT** – tissue approximation
- Internal Rotation – **ELASTIC** – tissue stretching; posterior capsule, infraspinatus, or teres minor becomes tight
- External Rotation – **ELASTIC** – tissue stretching; anterior and inferior capsules become tight
- Horizontal Abduction – **ELASTIC** – tissue stretching; anterior capsule becomes tight
- Horizontal Adduction – **SOFT** – tissue approximation. **FIRM** – tissue stretching; posterior capsule, infraspinatus, teres minor becomes tight

**Movements**
- Convex on Concave rule – Opposite directions
- Flexion- humerus rolls anteriorly and glides posteriorly
- Abduction- humerus rolls superiorly and glides inferiorly
- External Rotation- Humerus rolls posteriorly and glides anteriorly. Humeral head then glides posteriorly due to restraint from anterior band inferior glenohumeral ligament

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### Acromioclavicular Joint

**Joint Orientation**
- Slightly convex lateral clavicle
- Facet of clavicle faces laterally and posteriorly
- Slightly concave anteromedial border of acromion
- Facet of acromion faces medially and anteriorly

**Joint Capsule and Intra-articular Structures**
- Fibrous capsule surrounds the joint
- Thickest superiorly as reinforced by trapezius fibres
- Superior and inferior thickenings of capsule considered acromioclavicular ligaments
- Wedge shaped fibro cartilaginous articular disc partially divides the joint
Ligamentous Anatomy

Coracoclavicular Ligament
Split into 2 parts

- Conoid
  - From posteromedial aspect of coracoid process to conoid process of under surface of clavicle
  - Limits forward movement of the scapula
  - Prevents acromion passing medially under the lateral end of the clavicle when a laterally directed force is applied to the shoulder

- Trapezoid
  - From a roughened surface of the coracoid process and passes anteromedially to trapezoid line on the under surface of clavicle
  - Limits backward movement of the scapula
  - Prevents acromion passing medially under the lateral end of the clavicle when a laterally directed force is applied to the shoulder

Arthrokinematics

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<th>Acromioclavicular Joint</th>
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<td>Capsular Pattern</td>
<td>Pain at extremes of range of motion especially Horizontal Adduction and Full Elevation</td>
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<tr>
<td>Resting Position</td>
<td>Arm by Side</td>
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<tr>
<td>Close Packed Position</td>
<td>90° Abduction</td>
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<tr>
<td>End Feel</td>
<td>• NA</td>
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<tr>
<td>Movements</td>
<td>• Unknown</td>
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Sternoclavicular Joint

Joint Orientation

- Medial clavicle articulates with the superolateral angle of the manubrium

Joint Capsule and Intra-articular Structures

- Fibrous capsule surrounds the joint
- Thickenings anteriorly, posteriorly and superiorly by ligaments
- Joint is separated by an intra-articular fibro cartilaginous disc
- Attaches to superior aspect of clavicle and attaches inferiorly to the sternum and superior aspect of the 1st costal cartilage
- Disc provides cushioning between articulating surfaces, provides some congruity to the joint and holds medial clavicle to sternum
- Disc prevents clavicle moving upwards and medially along the sternochondral surface
**Ligamentous Anatomy**

**Anterior Sternoclavicular Ligament**
- Attaches clavicle to manubrium anteriorly
- Capsular thickening
- Reinforced by sternocleomastoid
- Limits anterior translation of the medial end of the clavicle on the manubrium

**Posterior Sternoclavicular Ligament**
- Attaches clavicle to manubrium posteriorly
- Capsular thickening
- Limits anterior and posterior translation of the medial clavicle on the manubrium
- Limits clavicle depression (medial end moves superiorly and medially)

**Interclavicular Ligament**
- Passes from medial clavicle to contralateral medial clavicle over the jugular notch
- Thickens the capsule superiorly
- Limits clavicle depression (medial end moves superiorly and medially)

**Costoclavicular Ligament**
- Extracapsular
- Attaches superior 1st costal cartilage to the inferior surface of the medial clavicle
- Limits clavicle elevation (medial end moves inferiorly and laterally)
- Limits excessive anterior and posterior translation of the medial clavicle

**Arthrokinematics**

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<td>Movements</td>
<td>Elevation – Convex on Concave Rule - Medial clavicle rolls superiorly and glides inferiorly</td>
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<td>Depression– Convex on Concave Rule - Medial clavicle rolls inferiorly and glides superiorly</td>
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<tr>
<td></td>
<td>Protraction- Concave on Convex Rule - Medial clavicle rolls anteriorly and glides anteriorly</td>
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<tr>
<td></td>
<td>Retraction- Concave on Convex Rule- Medial clavicle rolls posteriorly and glides posteriorly</td>
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Anterior and Posterior clavicular rotation occurs during glenohumeral flexion. There is no consensus as to the direction.
Sternoclavicular and Acromioclavicular Joint Contributions to Scapulohumeral Rhythm

**Key Terms**

**Elevation**
- The forward movement of the arm as a result of glenohumeral, scapulothoracic, acromioclavicular and sternoclavicular movement

**Flexion/Abduction**
- The movement of the arm as a result of the glenohumeral joint ONLY

**Scapulohumeral Rhythm**
- Scapulohumeral rhythm is the coupling motion between the glenohumeral joint and the shoulder girdle during flexion and abduction
- For every 2° of glenohumeral abduction or flexion, there will be 1° of upward rotation of the scapula
- For every 3° of shoulder elevation, 2/3 comes from the glenohumeral joint and 1/3 comes from the scapula
- Therefore during the total 180° of elevation there is
  - 120° of glenohumeral movement
  - 60° of scapular movement
- During the first 30° of elevation there is no scapula movement
- Total elevation consists of 180°
  - Early phase – First 90°
    - 60° of humerus movement
    - 30° of scapular rotation
      - 20° clavicular elevation
      - 10° upward rotation at the acromioclavicular joint
  - Late Phase- Last 90°
    - 60° of humerus movement
    - 30° of scapular rotation
      - 5° clavicular elevation
      - 25° upward rotation from acromioclavicular joint

**Scapulothoracic Joint**
- Not a true “joint” but important to be stable for the rest of the shoulder complex to move properly
- Formed between the scapula and posterior thorax
- No capsular pattern, end feel, closed or loose packed positions
Scapular Movements

*Elevation/ Depression*
- Usually do not occur in isolation and requires movements at the Sternoclavicular and acromioclavicular joints
- **Elevation**
  - Movement of the entire scapula in a superior direction
- **Depression**
  - Movement of the entire scapula inferiorly back to neutral

*Upward Rotation/ Downward Rotation*
- Named in relation to the moving glenoid in an anteroposterior axis
- **Upward rotation**
  - Glenoid faces upwards
- **Downward rotation**
  - Glenoid faces down

*Anterior Tilting/Posterior Tilting*
- Tilting or tipping in the mediolateral axis (coronal)
- **Anterior Tilting**
  - Superior portion of scapula and glenoid fossa move anteriorly, inferior angle moves posteriorly
- **Posterior Tilting**
  - Superior portion of scapula and glenoid fossa move posteriorly, inferior angle moves anteriorly

*Protraction/Retraction*
- Made up of two movements
  - **Abduction/ Adduction**
    - Movement of scapula away from the midline of spine (abduction) or towards the spine (adduction)
  - **Internal Rotation/ External Rotation**
    - Medial border of scapula moves posteriorly and glenoid anteriorly (internal rotation) or medial border moves anteriorly with glenoid moving posteriorly (external rotation)
  - **Protraction**
    - Abduction and Internal Rotation
  - **Retraction**
    - Adduction and External Rotation