

Functional Kinesiology of the Shoulder Girdle

Joseph Burris, MD

Associate Professor of Clinical PM&R

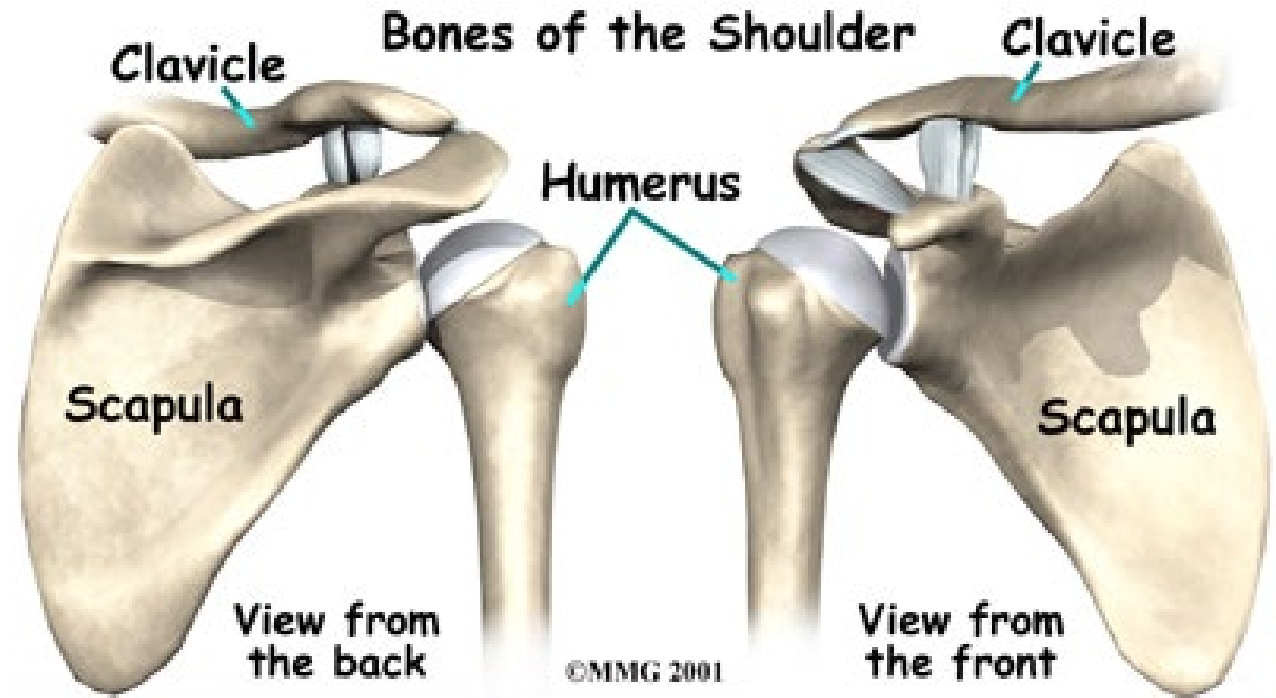
Director, Amputee Rehabilitation Program

Overview

- Bony skeleton
- Anatomic/functional articulations
- Other anatomic considerations
- Motor control—muscles
- Functional kinesiology

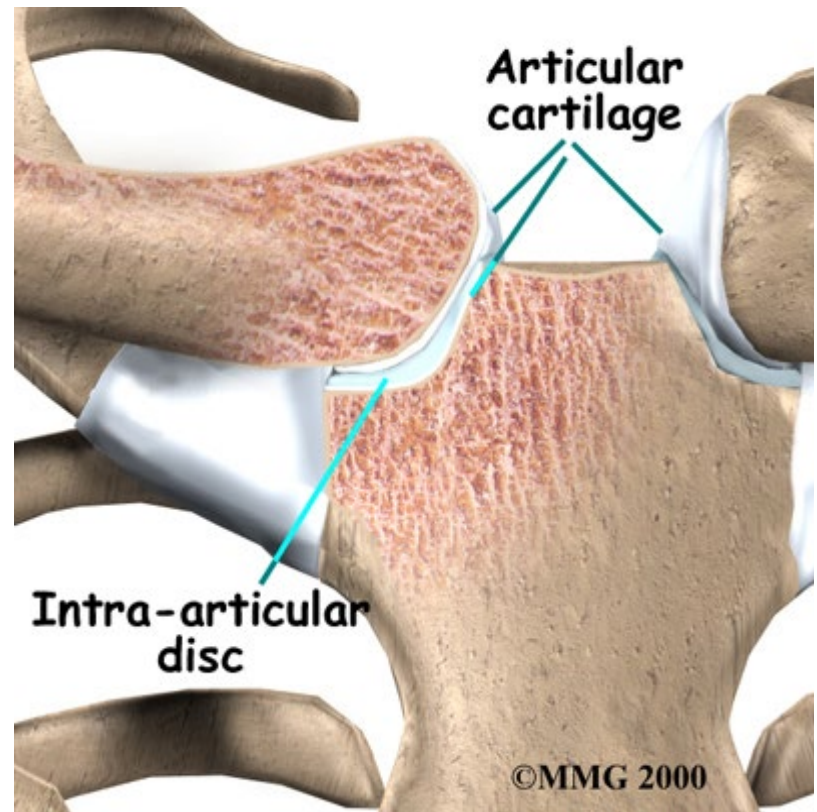
Bony skeleton

- Clavicle
- Scapula
- Humerus



Anatomic articulations

- Sternoclavicular joint
- ONLY anatomic articulation joining shoulder complex to axial skeleton

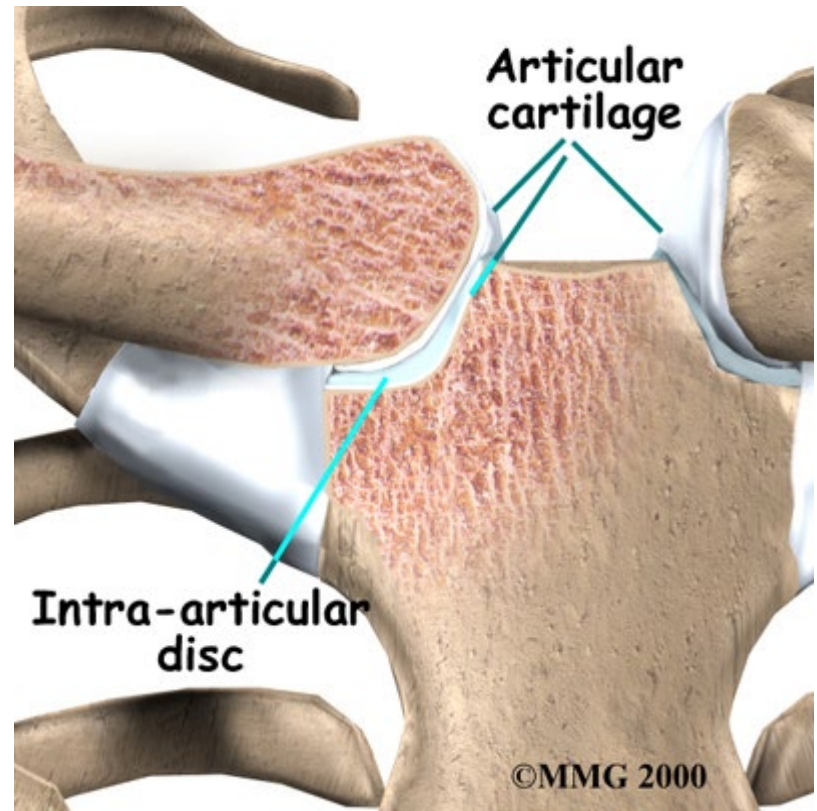


Anatomic articulations

SC Joint

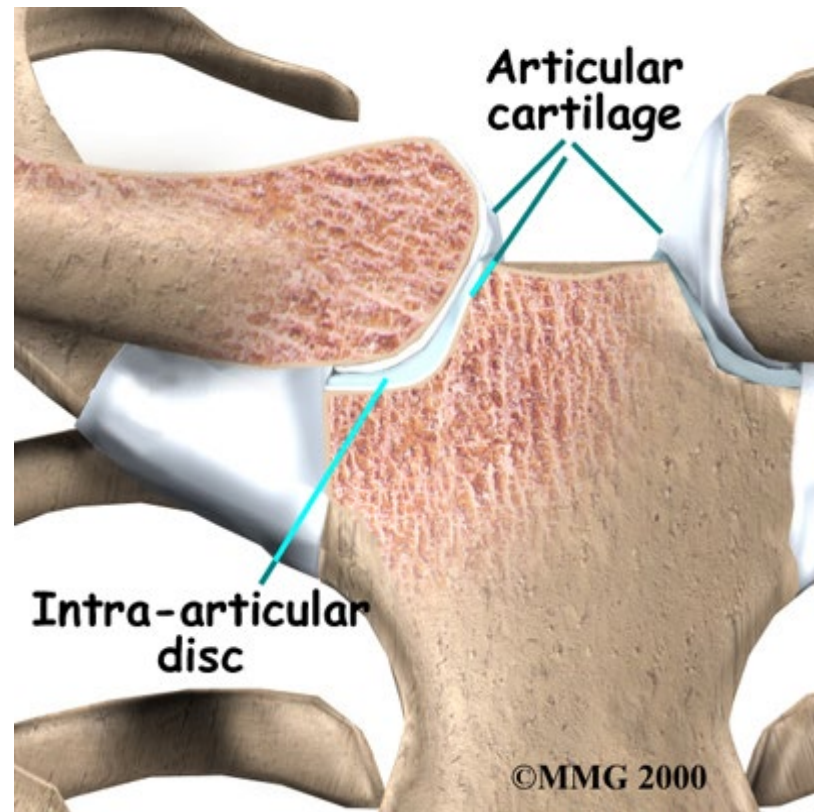
Reinforced by:

- Sternoclavicular ligament
- Costoclavicular ligament
- Interclavicular ligament



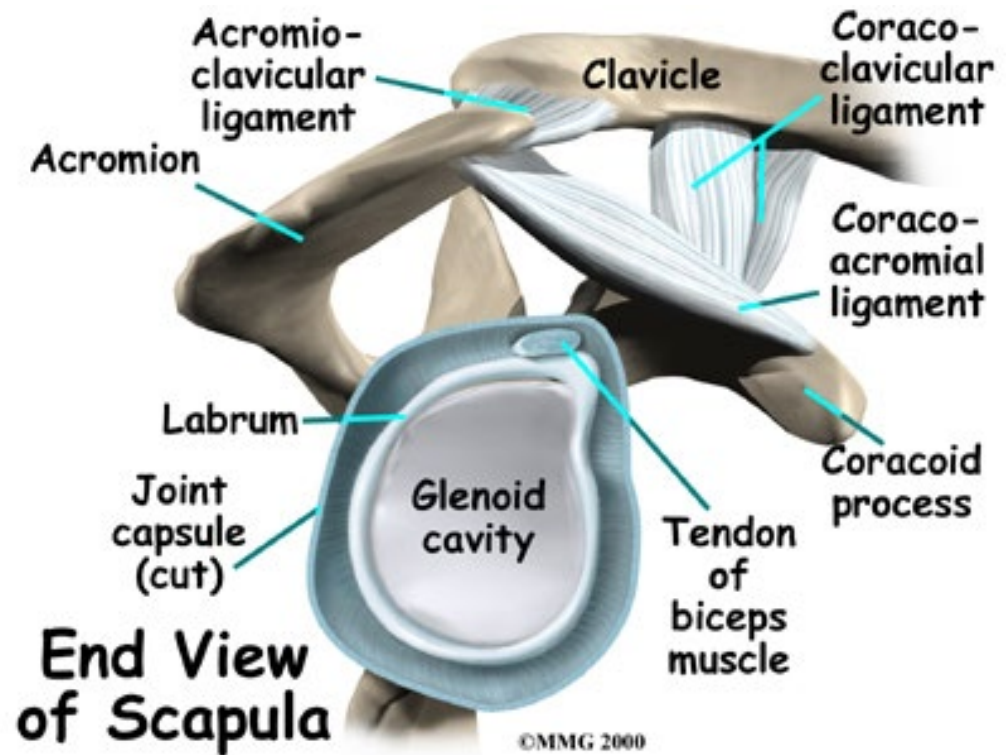
Anatomic articulations

- Elevation/depression
- Abduction/adduction (pro/retraction)
- Anterior/posterior tilt



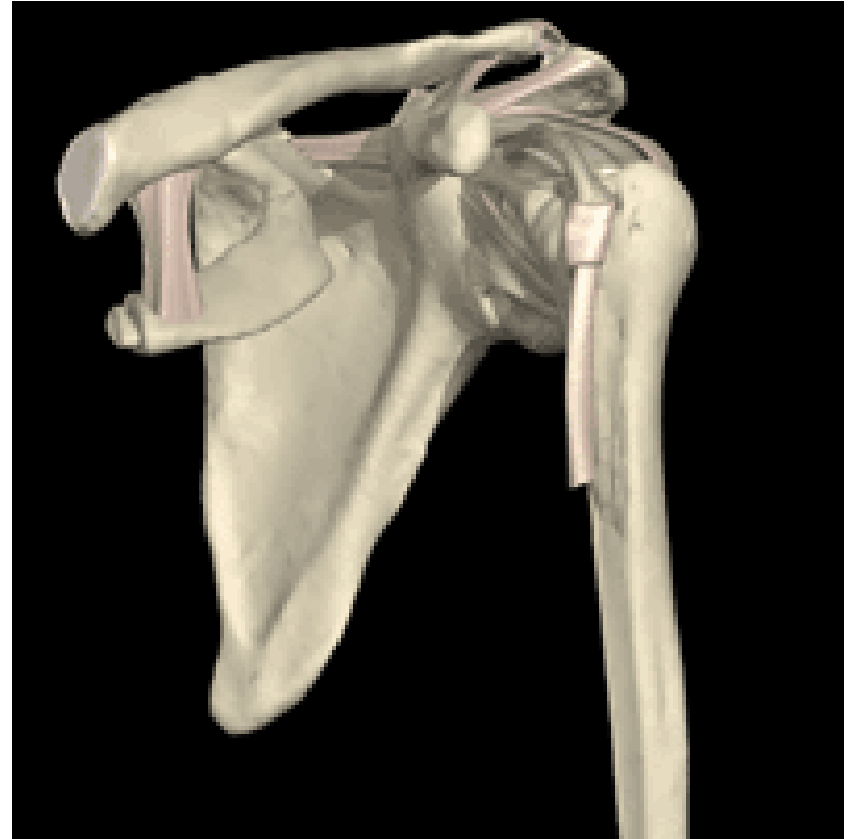
Anatomic articulations

- Acromioclavicular joint
- Medial-lateral rotation
- Anterior-posterior tilt



Anatomic articulations

- Glenohumeral joint
- Flexion/extension
- Abduction/adduction
- Medial/lateral rotation
 - Internal/external

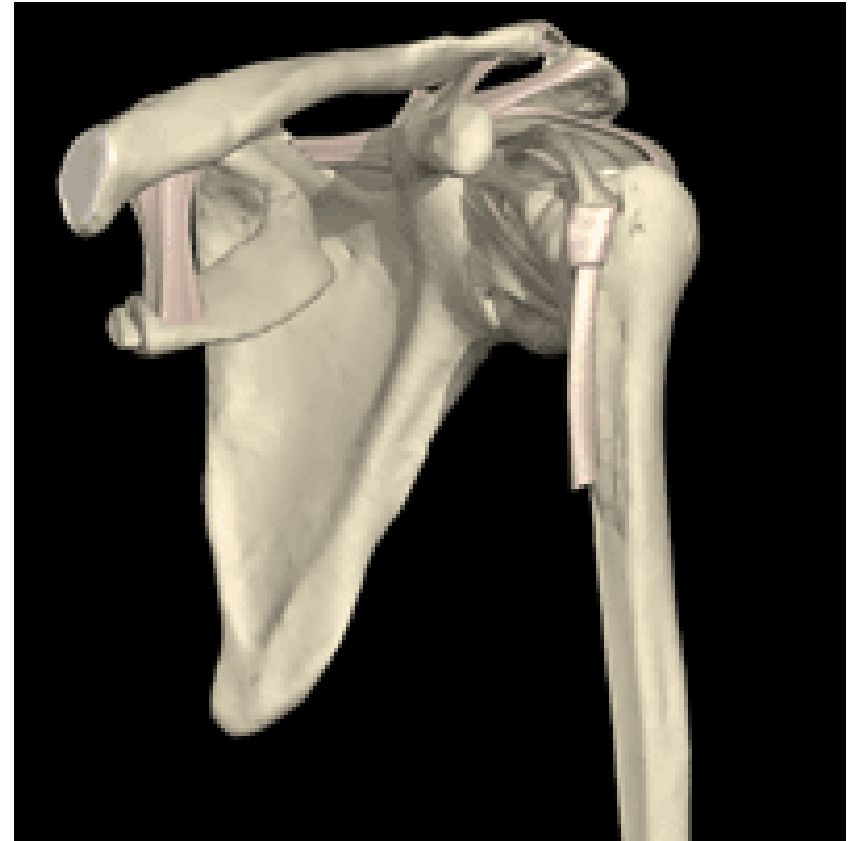


Anatomic articulations

Glenohumeral joint

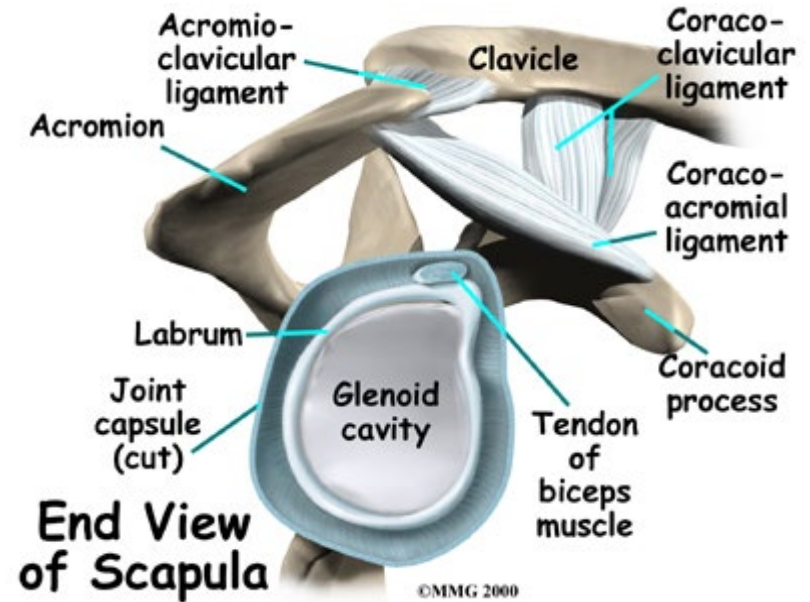
Reinforced by:

- Glenohumeral joint capsule
- Superior glenohumeral ligament
- Middle glenohumeral ligament
- Inferior glenohumeral ligament
- Superior acromioclavicular ligament



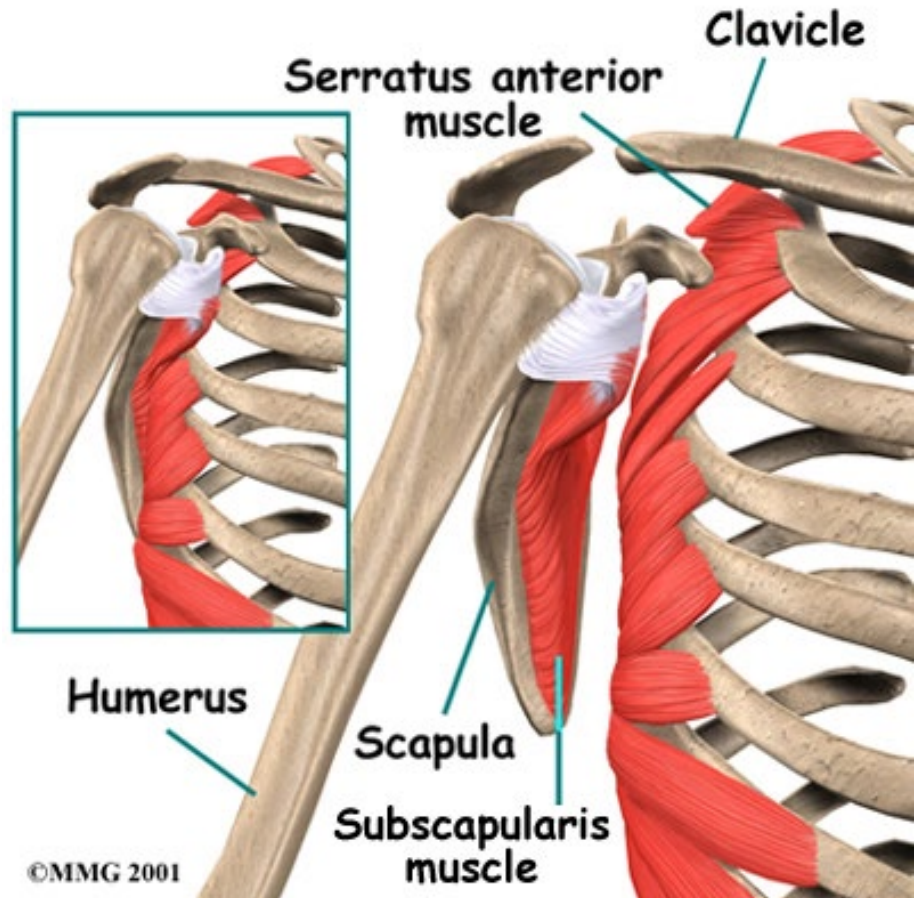
Functional articulations

- Suprhumeral joint
- Coracoid
- Acromion
- Coracoacromial ligament



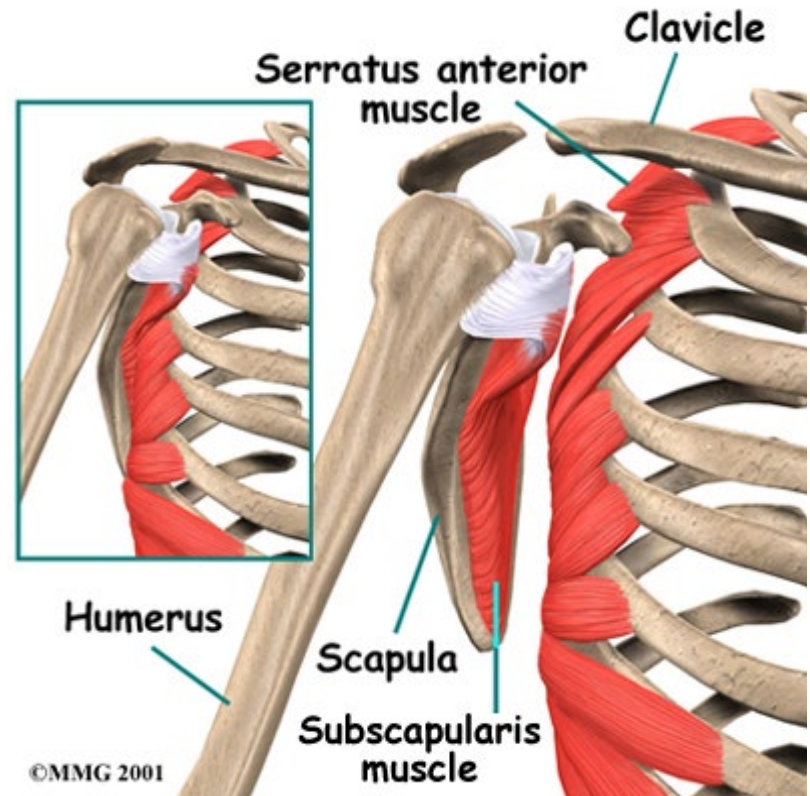
Functional articulations

- Scapulothoracic joint
- Scapula to thorax



Functional articulations

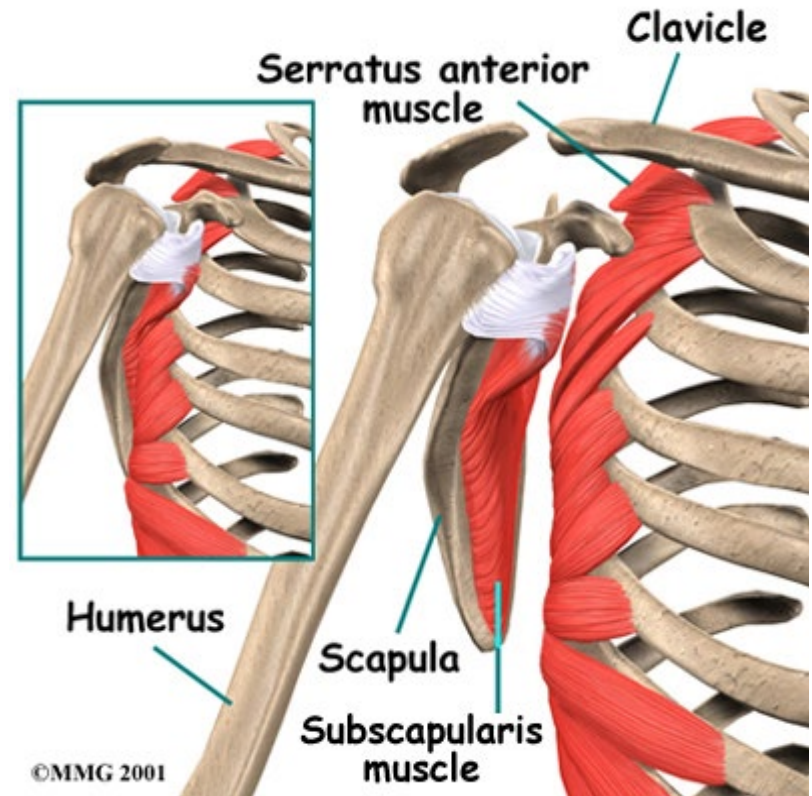
- ST joint
- Structures to maintain integrity of AC and SC joints



Functional articulations

Function of scapular motions:

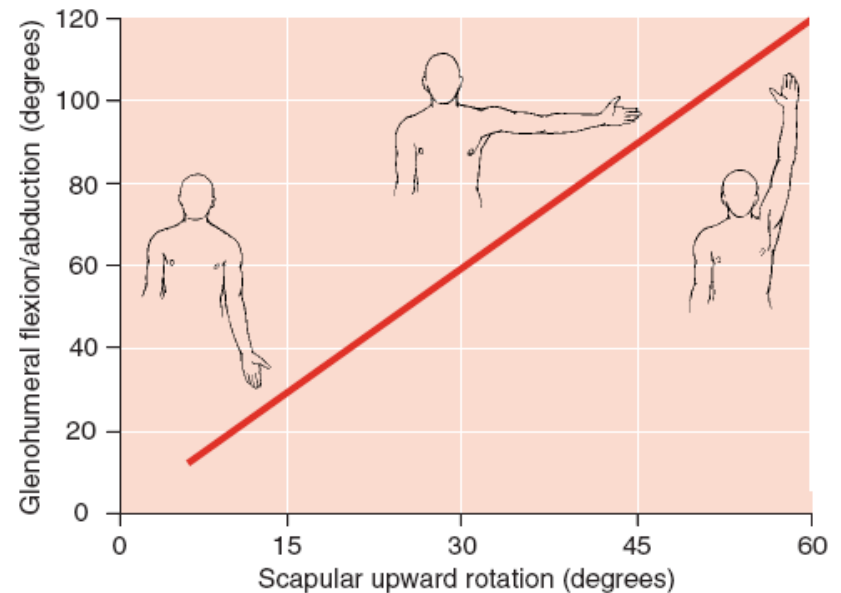
- Orient glenoid fossa for optimal contact with upper limb during motion
- Add range to elevation of upper limb



Scapulohumeral rhythm

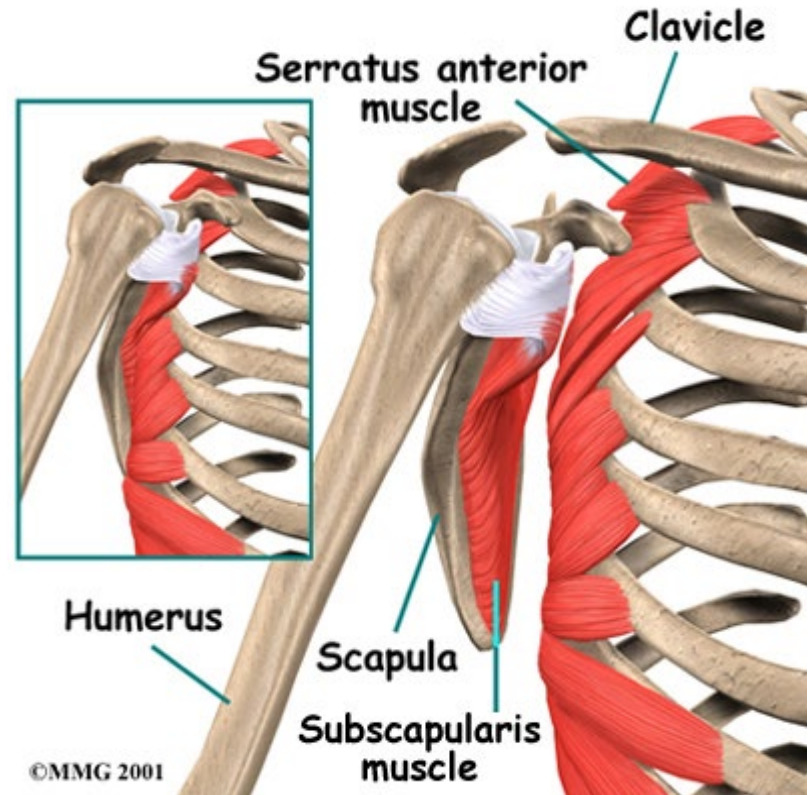
For every two degrees of glenohumeral motion, there is one degree of scapulothoracic motion

Begins after the first 30 degrees of glenohumeral abduction

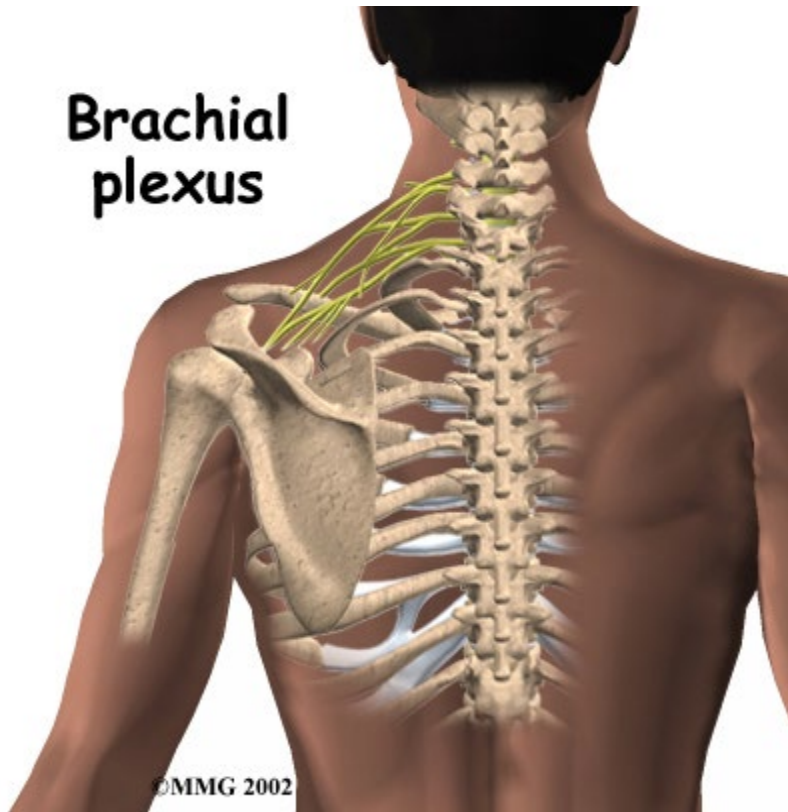


Functional articulations

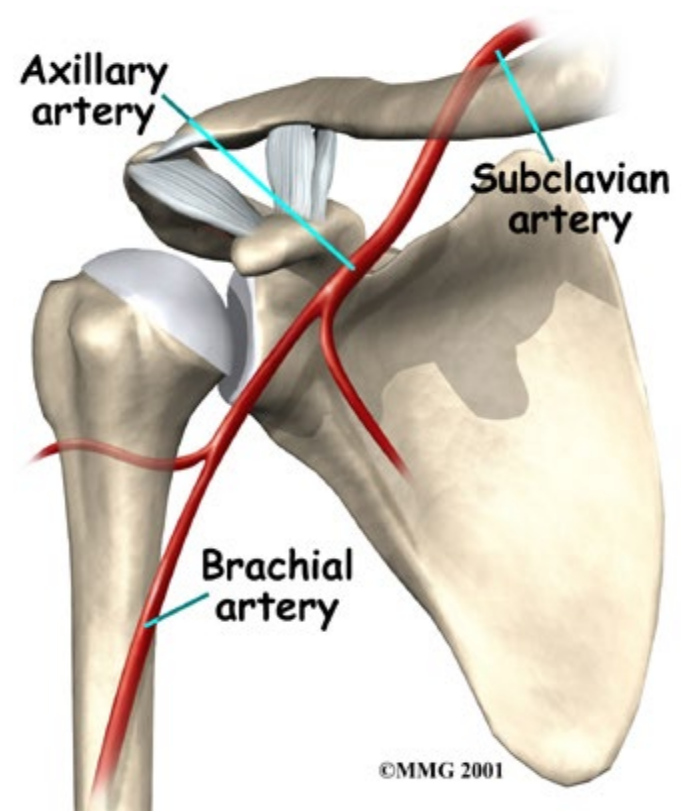
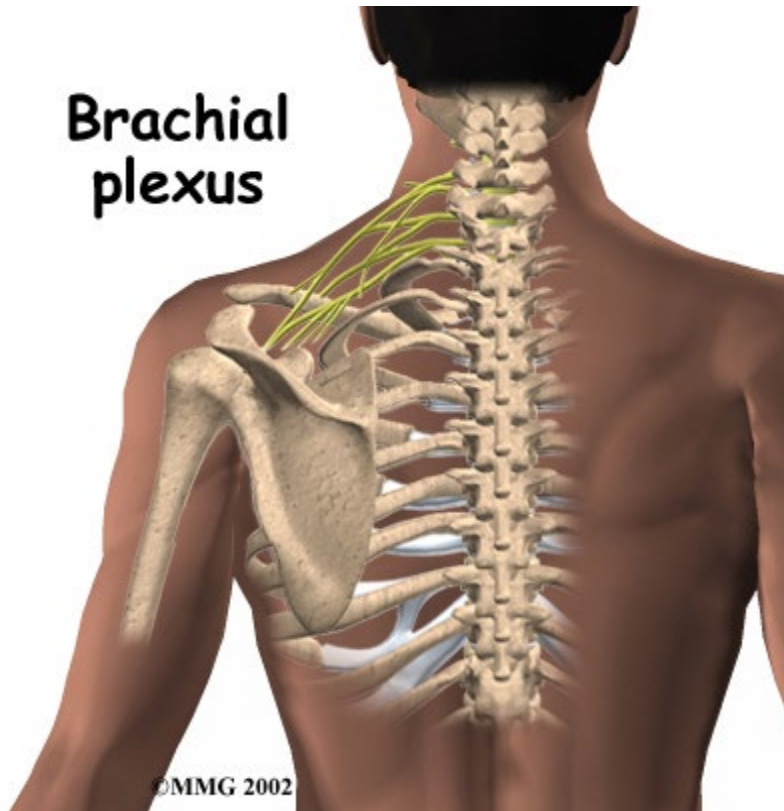
- Elevation/depression
- Abduction/adduction
- Upward/downward (lateral/medial) rotation
- Anterior/posterior tilt



Other considerations



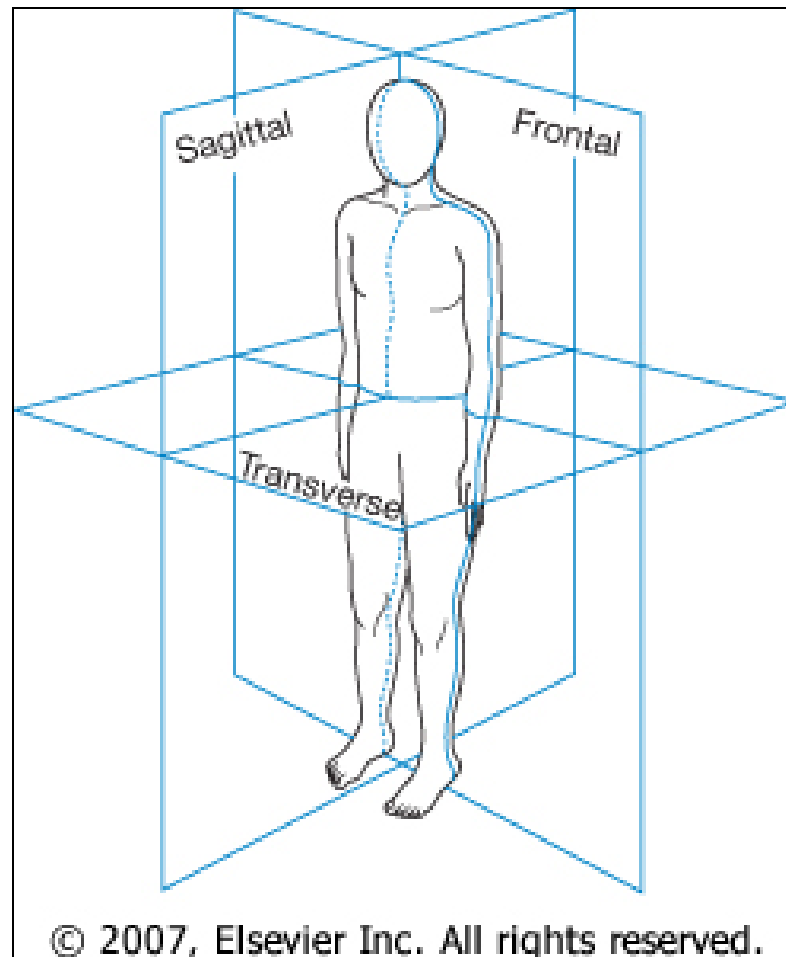
Other considerations



Motor control—shoulder girdle

- Provides fixation for upper limb movements
- Scapulohumeral control
- Ability to use upper limb in a variety of positions

Anatomic planes of motion



Scapulothoracic and scapulocervical muscles

- Serratus anterior
- Trapezius
- Rhomboid major/minor
- Pectoralis minor
- Levator scapulae

Scapulohumeral muscles

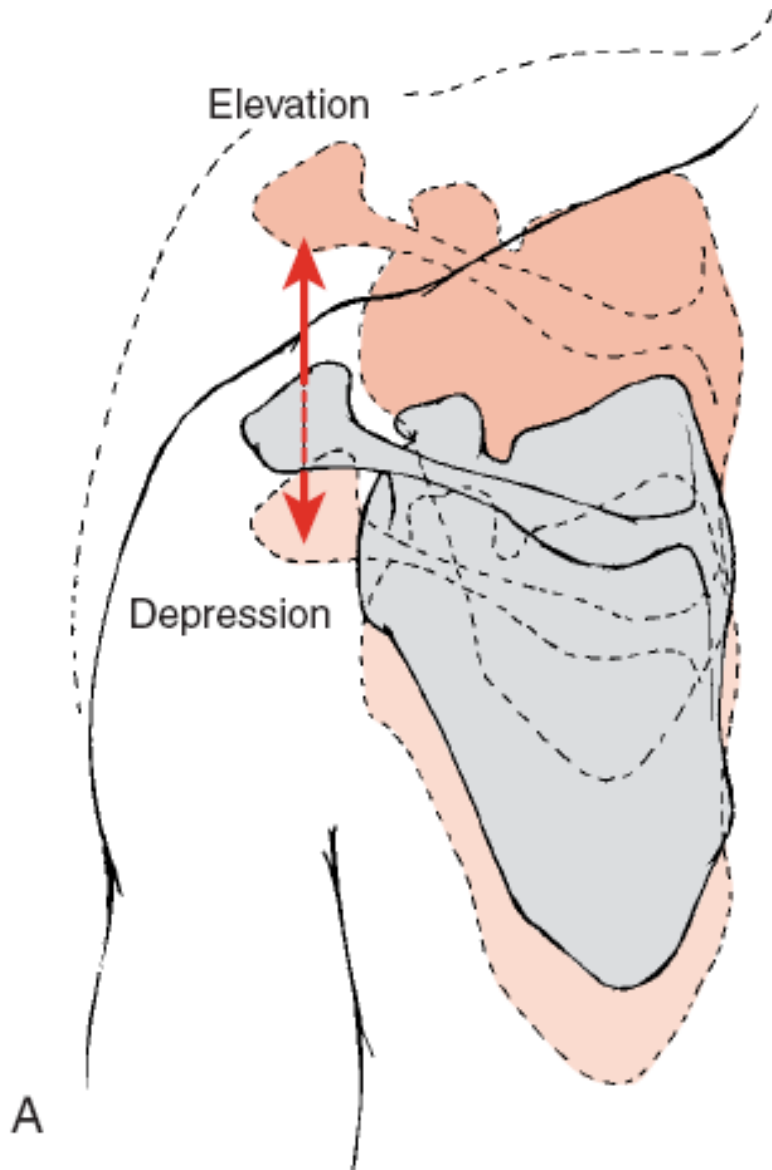
- Deltoid
- Supraspinatus
- Infraspinatus
- Teres minor
- Subscapularis
- Teres major
- Coracobrachialis

Thoracohumeral muscles

- Latissimus dorsi
- Pectoralis major

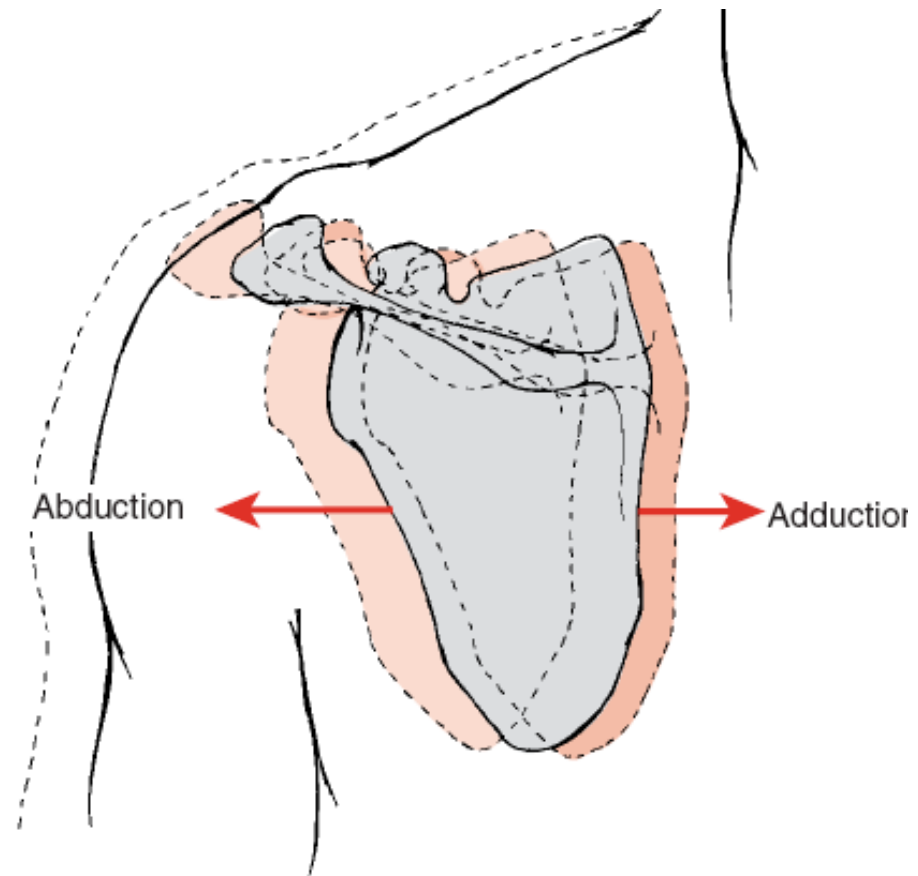
Shoulder girdle movements

- Elevation: movement of distal clavicle and acromion superiorly
- Depression: movement of distal clavicle and acromion inferiorly



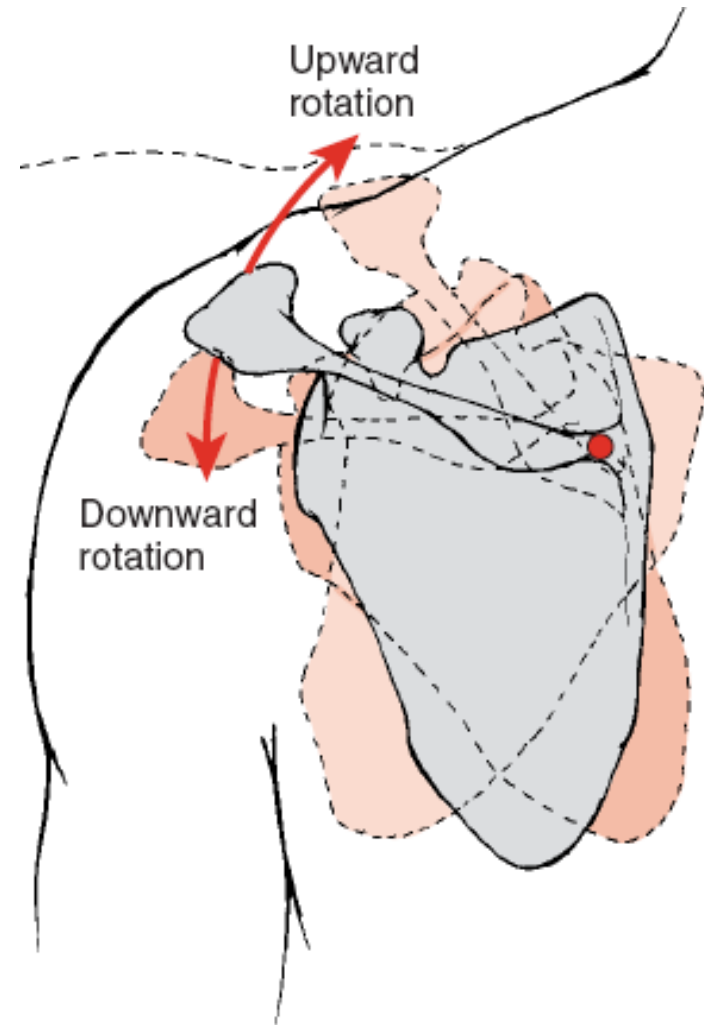
Shoulder girdle movements

- Abduction (protraction): movement of distal clavicle and scapula anteriorly around thorax, with scapula medial border moving away from midline
- Adduction (retraction): movement of distal clavicle and scapula posteriorly around thorax, with scapula medial border moving toward midline



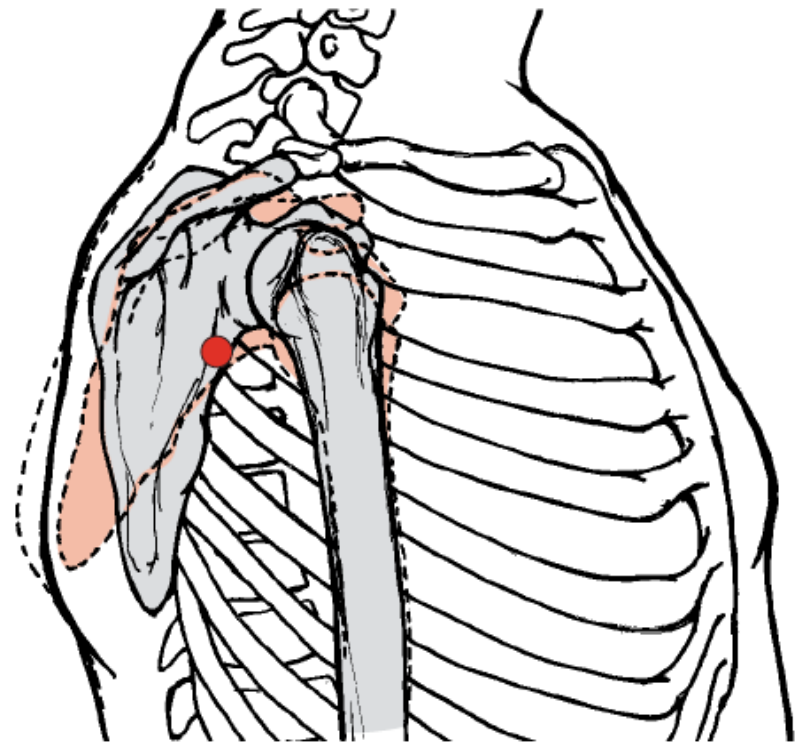
Shoulder girdle movements

- Upward rotation (lateral rotation): movement of glenoid fossa superiorly with inferior angle of scapula sliding anterolaterally along thorax
- Downward rotation (medial rotation): movement of glenoid fossa inferiorly with inferior angle of scapula sliding posteromedially along thorax

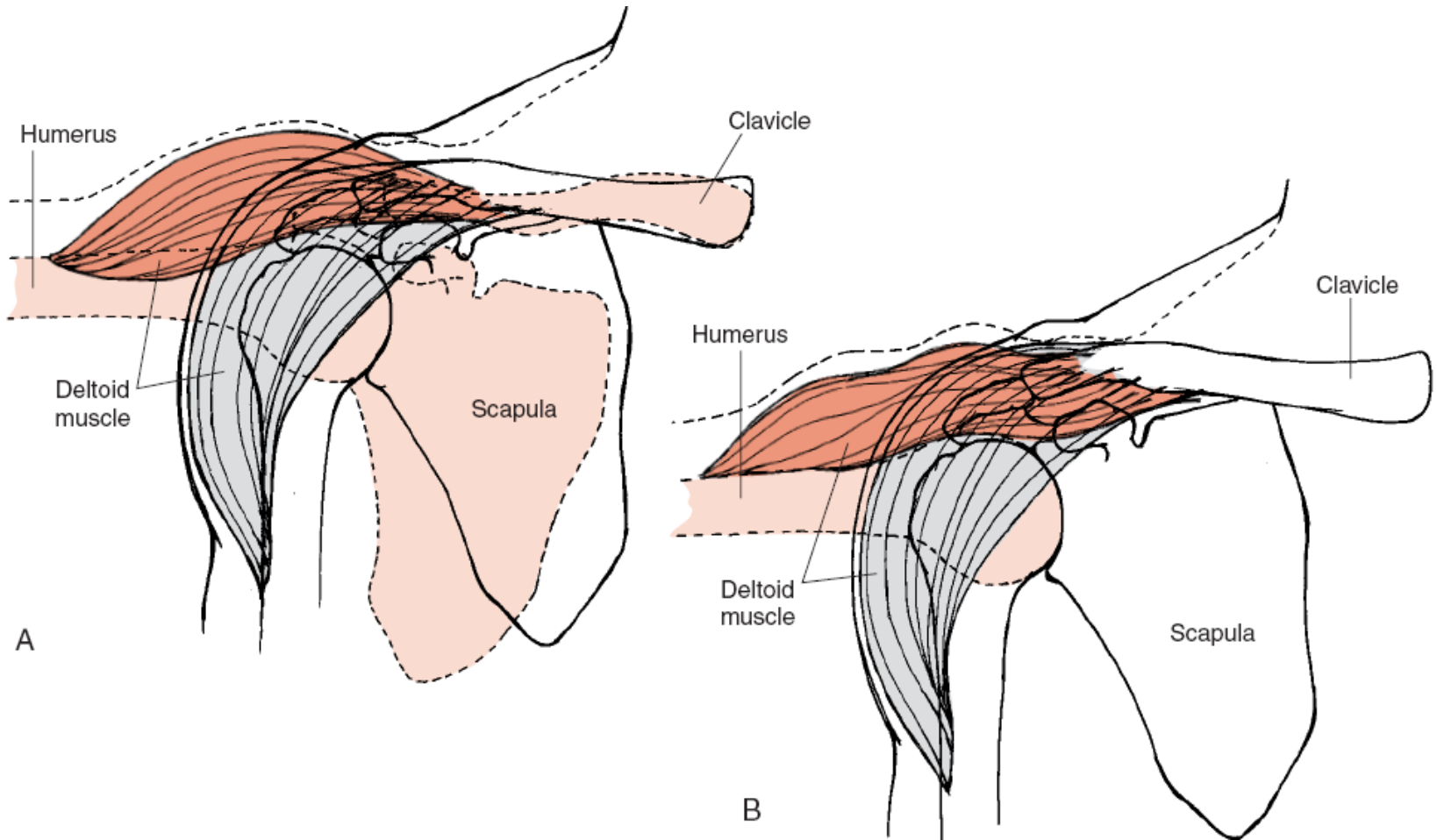


Shoulder girdle movements

- Anterior tilt: anterior movement of superior border of scapula along with posterior movement of inferior border of scapula to maintain scapulothoracic relationship during scapular elevation
- Posterior tilt: posterior movement of inferior border of scapula along with anterior movement of inferior border of scapula to maintain scapulothoracic relationship during scapular depression

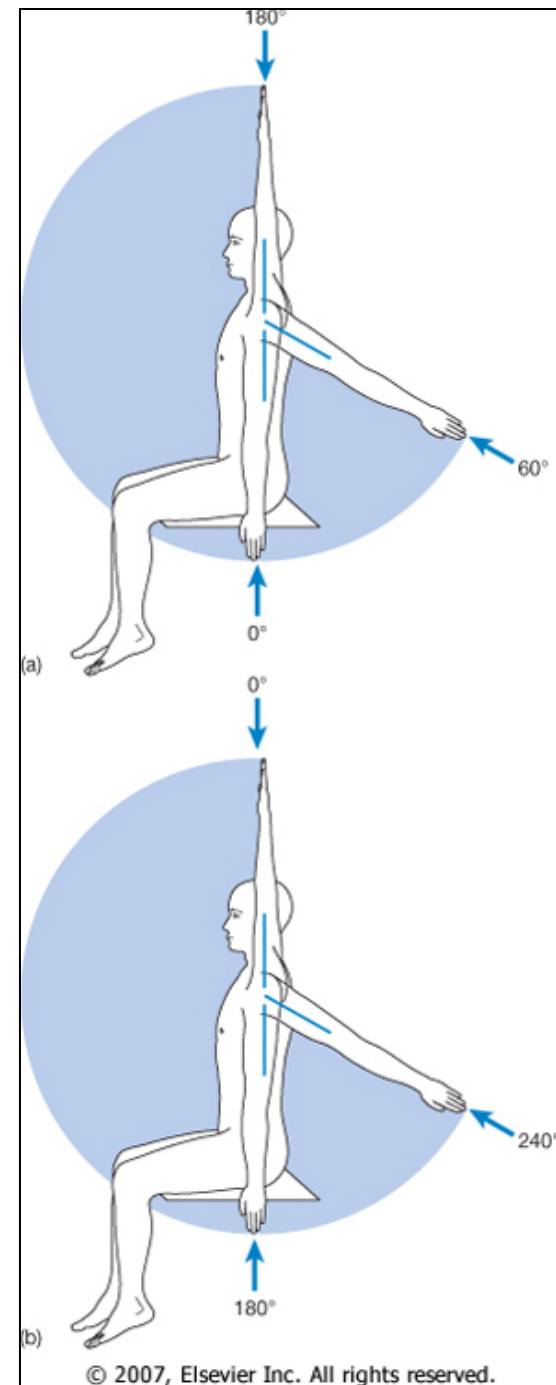


Scapulohumeral rhythm



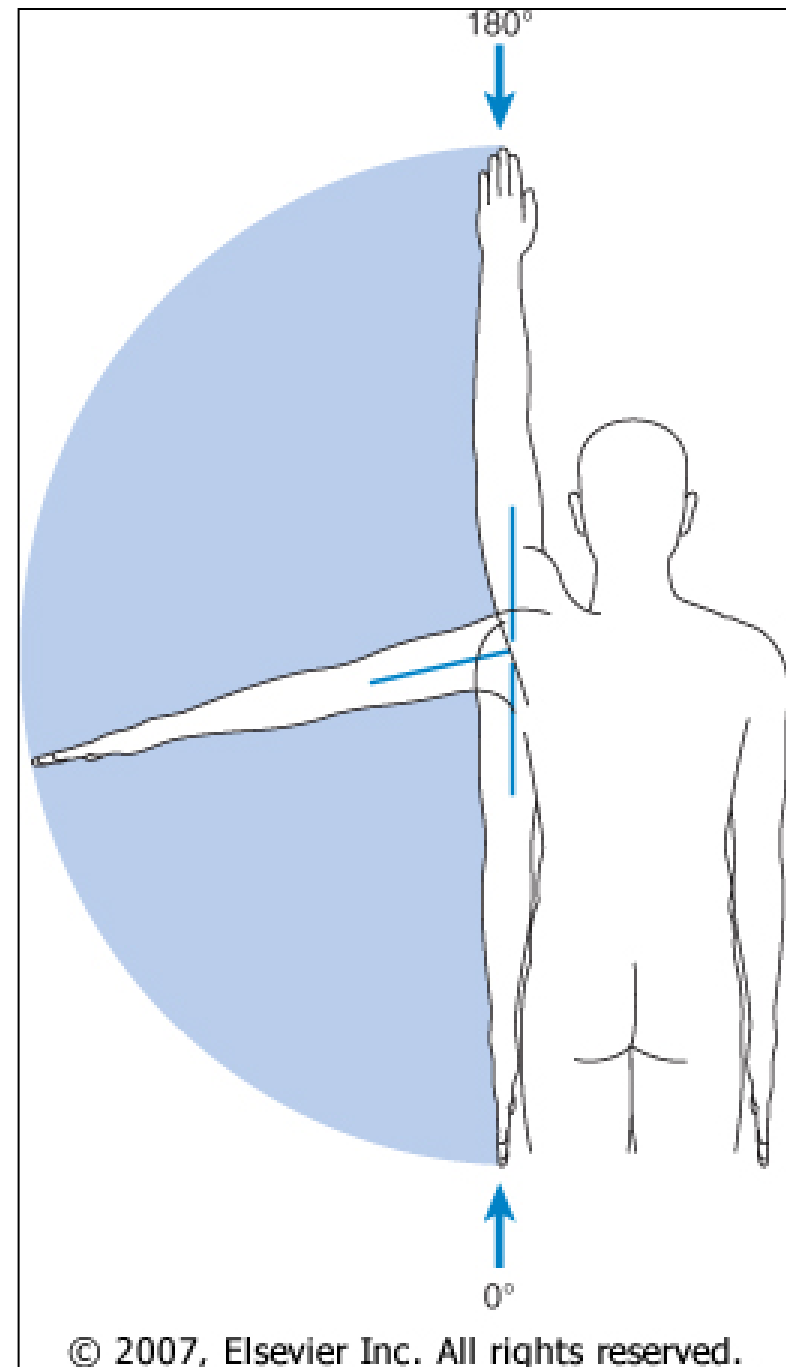
Glenohumeral movements

- Flexion: forward movement of humerus in sagittal plane
- Extension: return from flexion. May also refer to posterior movement of humerus in sagittal plane (hyperextension).



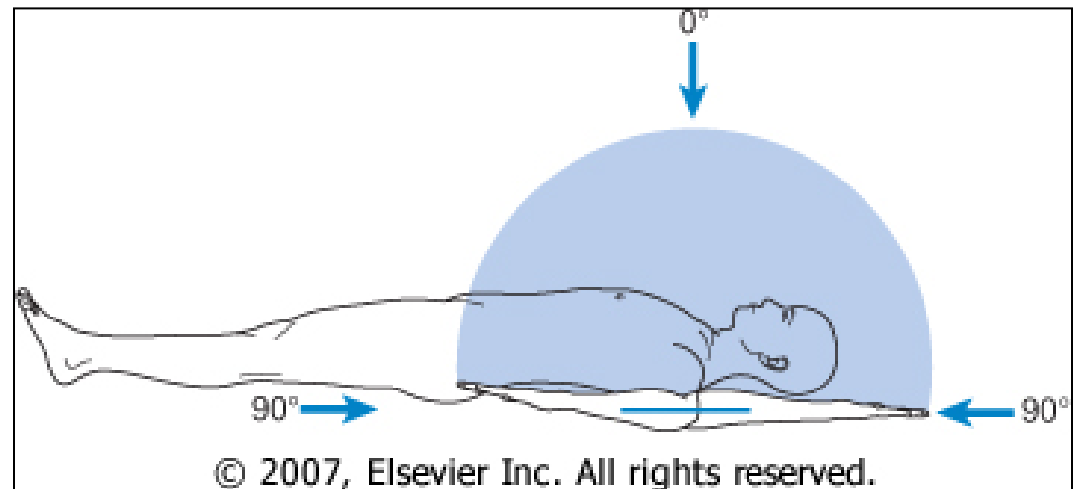
Glenohumeral movements

- Abduction: sideward, upward movement of humerus in frontal plane
- Adduction: return from abduction



Glenohumeral movements

- Lateral (external) rotation: lateral movement of the humerus around its longitudinal axis
- Medial (internal) rotation: medial movement of the humerus around its longitudinal axis



Glenohumeral movements

- Horizontal flexion (adduction): anterior movement of the distal humerus in a horizontal plane, after placement of the humerus in 90 degrees of abduction
- Horizontal extension (abduction): return from horizontal adduction. May also include posterior movement of the distal humerus in horizontal plane

Corresponding movements

Glenohumeral movement	Scapulothoracic movement
Flexion	Upward rotation, abduction
Extension	Downward rotation, adduction
Abduction	Upward rotation
Adduction	Downward rotation
Lateral rotation	Adduction
Medial rotation	Abduction
Horizontal flexion	Abduction
Horizontal extension	Adduction

Glenohumeral and Scapulothoracic Joints Associated Movements -- Kinesiology

- <https://youtu.be/uNXMRZSPRsQ>

Scapulothoracic action/muscles

Elevation	Upper trapezius, levator scapulae, rhomboids
Depression	Pectoralis minor, lower trapezius, (pec major and lat dorsi act on humerus)
Protraction	Serratus anterior, pectoralis minor
Retraction	Trapezius, rhomboids

Scapulothoracic action/muscles

Upward rotation	Upper and lower trapezius, serratus anterior
Downward rotation	Pectoralis minor, rhomboids

Glenohumeral action/muscles

Flexion	Pectoralis major, anterior deltoid, coracobrachialis, biceps brachii
Extension	Latissimus dorsi, teres major, triceps long head, posterior deltoid
Abduction	Deltoid, supraspinatus, biceps brachii

Glenohumeral action/muscles

Adduction	Pectoralis major, latissimus dorsi, teres major, triceps long head, posterior deltoid
External rotation	Infraspinatus, teres minor, posterior deltoid
Internal rotation	Subscapularis, teres major, pectoralis major, latissimus dorsi, anterior deltoid

Kinesiology summary

- So what?
- Who cares?
- Blah blah blah...
- Yada yada yada...

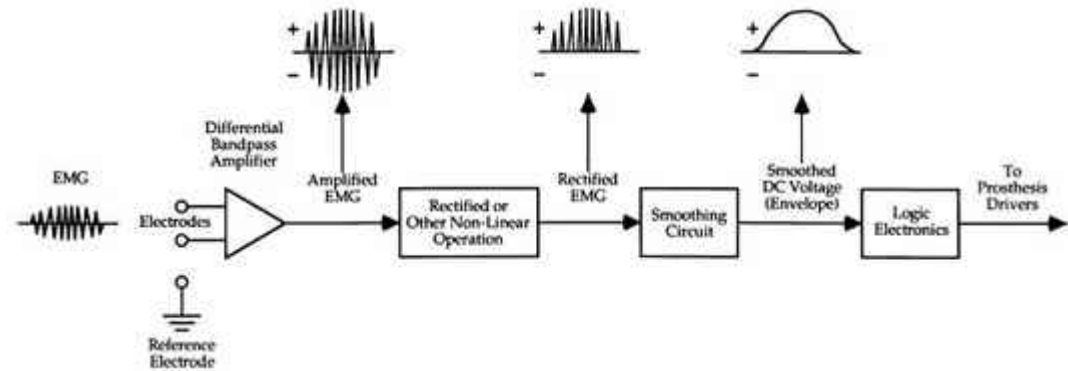
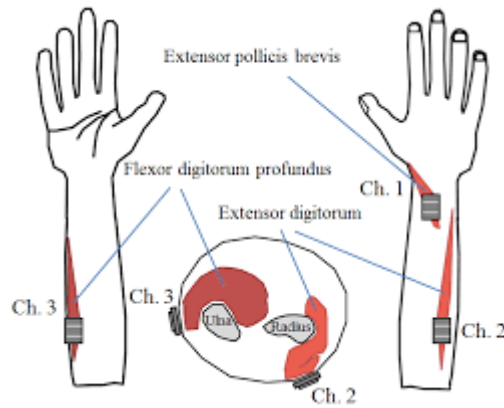
Anatomy video – muscles of the upper arm/shoulder region

- <https://youtu.be/kCNfvyCIHsw>

WE DO!!

- Motor control for manual prostheses
 - Control cable excursion for manually operated componentry
- Myoelectric control for myoelectric prostheses
 - Myoelectric signal processing from remaining muscles to electrically operated componentry

Myoelectric signal acquisition, manipulation, and output



Upper limb prosthetic control

Prosthesis	Elbow flexion	Terminal device	Elbow lock
Forequarter	Lat dorsi, scapular abduction contralateral side	Lat dorsi, scapular abduction contralateral side	Nudge control
Shoulder disarticulation	Lat dorsi, biscapular abduction	Lat dorsi, biscapular abduction	Scapular elevation ipsilateral side, chest expansion

Forequarter amputation myo testing and control

<https://www.youtube.com/watch?v=FtE3whNSz7s>

Upper limb prosthetic control

Prosthesis	Elbow flexion	Terminal device	Elbow lock
Transhumeral	Biscapular abduction and humeral flexion	Biscapular abduction, humeral flexion	Shoulder depression, humeral abduction & extension
Transradial	NA	Biscapular abduction humeral flexion	NA

AEA manual device operation

<https://www.youtube.com/watch?v=IHDik5MPk6M>

<https://youtu.be/UR3tv-tLTel>

BEA myotesting + device - iLimb

<https://www.youtube.com/watch?v=IKeBH8in7Zg>

BEA manual device operation

<https://www.youtube.com/watch?v=li7ByNe5SiM>

BEA donning and myo sensors for myoelectric device operation

<https://www.youtube.com/watch?v=4QfhGoogle4Y>

BEA myoelectric gesture control operation

- <https://youtu.be/nxPToKzuXF4>