**ANATOMY -SHOULDER JOINT**

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 ABSTRACT

The glenohumeral joint in the shoulder has the widest range of motion of any ball and socket joint in the body. The scapula, which is the primary bone in the shoulder joint, performs a number of functions including flexion, extension, abduction, adduction, internal rotation, and circumduction. The glenoid labrum, supporting ligaments for the shoulder joint capsule, and the rotator cuff muscles' tendon attachments surround and support the glenoid cavity on both sides. At the glenohumeral joint's articular surface, all of the muscles are in contact with one another on the lateral side of the scapula. The shoulder muscle stabilizes and permits movement of the shoulder joint.The three primary muscle groups responsible for moving the shoulder girdle are supraspinatus, infraspinatus teres minor, and subscapularis.

**Ⅰ. INTRODUCTION**

The shoulder joint is the synovial joint of the ball and socket variety. The joint is formed by the head of humerus and the glenoid cavity of the scapula. The articular head of the humerus is rounded like a hemisphere. Which is thickest in the center and thinnest at the periphery thus increase the convexity. The cavity is shallow.

**Ⅱ. STRUCTURE**

The sternoclavicular joint, together with the coracoclavicular and acromioclavicular joints, are what connect the upper extremity to the axial skeleton. The clavicle, scapula, and humerus make up the pectoral girdle. The distal aspect of the clavicle articulates with the acromial and coracoid process of the scapula to form the acromio and coracoclavicular joint. The glenohumeral and coracoacromial ligaments are the most important structural ligaments. The lateral aspect of the clavicle does not provide much structural support to the shoulder joint. However, the coracoid acromi the scapula is a flat bone that supports the shoulder joint and has numerous muscle attachments.

**Ⅲ. EMBRYOLOGY**

The osteogenic process begins in week 10 for the humeral head and week 11 for the scapula. At stage 19 the interzone becomes apparent, which will form the glenohumeral joint. In the next stage the glenohumeral joint will begin delaminating and exhibiting a looser central band. Denser lateral bands will join the humeral head and the margins of the articular surface of the scapula thus forming the glenoid labrum it can be fully appreciated by stage 22. In 24mm embryos biceps tendon observe in this stage and the intertubercular sulcus, is apparent since week12, Limb musculature is first seen around the seven weeks, The muscle of shoulder develops earlier than the distal muscles of the upper extremity.

**Ⅳ. ARLICULOR SURFACE**

Shoulder joint is formed by articulation of the glenoid cavity of scapula and the head of the humerus. Therefore, it is also known as the glenohumeral articulation. Structurally, it is a weak joint because the glenoid cavity is too small and shallow to hold the head of the humerus in. However, this arrangement permits great mobility. Stability of the joint is maintained by the coracoacromial arch or secondary socket for the head of the humerus The musculotendinous cuff of the shoulder, glenoidal labrum (Latin lip) helps in deepening the glenoid fossa. Stability is also provided by the muscles attaching the humerus to the pectoral girdle, the long head of the biceps brachii, the long head of the triceps brachii. Atmospheric pressure also stabilises the joint.

**GLENOIDAL LABRUM**

The depth of the cavity is also increased by the presence of an arm of fibro cartilage attached to the margin of the glenoid cavity.

**THE FIBROUS CAPSULE**

It is attached medially to the margin of the glenoid cavity beyond the glenoid labrum. Superiorly, the line of attachment extents above the origin of the long head of the biceps from the supraglenoid tubercle on the lateral side the capsule is attached to the head of the humerus just beyond the articular surface.

**Ⅴ. MUSCLE**

The primary muscle group that supports the shoulder joint is the rotator cuff muscles.  The four rotator cuff muscles are the supraspinatus, infraspinatus, teres minor, and subscapularis.  Together the rotator cuff muscles form a musculotendinous cuff as they insert on the proximal humerus. The rotator cuff muscles attach to the proximal humerus anteriorly at the greater tuberosity. The rotator cuff muscles provide considerable structural support to the glenohumeral joint and keep the humeral head in a firm position by articulating with the scapula within the glenoid cavity.  The muscles of the chest also provide structural support to the shoulder joint. The origin of the supraspinatus is from the supraspinatus fossa above the spine of the scapula crossing the shoulder joint, passing under the coracoacromial arch, and above the glenohumeral joint where it inserts at the greater tubercle of the humerus. The supraspinatus muscle functions by abduction of the humerus up to 30 degrees and stabilizing the glenohumeral joint. the infraspinatus muscle originates from the infraspinatus fossa below the spine of the scapula and inserts on the greater tubercle of the proximal humerus below the supraspinatus tendon. The infraspinatus muscle functions by externally rotating the humerus. The teres minor muscle is positioned immediately inferior to infraspinatus, originating at the inferior aspect of the dorsal scapula at the lateral border of the scapula. The teres minor inserts on the greater tubercle of the humerus below the infraspinatus.  The Teres minor acts to externally rotate the humerus and assists with abduction of the humerus. The subscapularis originates from the subscapular fossa of the scapula and inserts on the lesser tubercle of the humerus as well as a portion of the anterior capsule of the shoulder joint. A large bursa separates the muscle from the neck of the scapula—the subscapularis functions by internally rotating and abducting the humerus. The rhomboid minor originates from the nuchal ligament and spinous processes of C7-T1. The rhomboid major originates from the spinous processes of T2-T5. The rhomboid muscles insert on the medial border of the scapula and work in combination with the levator scapulae muscles to elevate the medial border of the scapula. The only muscle which acts to depress the shoulder is the lower trapezius, which is assisted by gravity in the upright position. the trapezius is a large triangular-shaped muscle that overlies the shoulder posteriorly. The trapezius originates from the superior aspect of the nuchal line in the occipital, cervical, and upper thoracic region and inserts at the lateral aspect of the clavicle, the acromion, and spine of the scapula. The function of the trapezius muscle is both elevation and depression of the shoulder depending on whether the upper or lower muscle fibers are activated.  When the entire trapezius muscle contracts, the fibers are geometrically opposed, and the forces are balanced, resulting in no shoulder movement. The deltoid muscle overlies the shoulder superficially and functions to abduct the humerus. The deltoid muscle has three origins; the body of the clavicle, the spine of the scapula, and the acromion. The deltoid muscle has its insertion on the deltoid tuberosity of the humerus.  The function of the deltoid muscle is variable depending on which muscle fibers are activated.  The anterior deltoid flexes and medially rotations the humerus, the middle deltoid abducts the humerus, and the posterior deltoid performs the actions of extension and external rotation of the humerus. The short head of the biceps brachii originates from the coracoid process, and the long head originates from the supraglenoid tubercle, passing through the intertubercular groove of the proximal humerus. The biceps brachii is not actually considered a shoulder muscle, but the tendon of its long head originates on the superior lip of the glenoid labrum.

**Ⅵ. BURSAE**

Bursa is a synovial fluid filled sac, it acts as a cushion between tendons and joint structures, there are several bursae present in the shoulder joint, Subacromial bursa Located deep to the deltoid and acromion and superficial to the supraspinatus tendon and joint capsule, Subscapular bursa located between the subscapularis tendon and the scapula it reduces friction on the tendon during the movement of shoulder joint. The subacromial bursa and the subdeltoid bursae are commonly continuous with each other but may be separate. Collectively they are called the subacromial bursa, which separates the acromion Process and the Acromion Supraspinatus I infraspinatus Posterior fibers of deltoid Teres minor Glenoidal labrum Long head of triceps brachii Axillary nerve and posterior circumflex humeral vessels coracoacromial ligaments from the supraspinatus tendon and permits smooth motion. Any failure of this mechanism can lead to inflammatory conditions of the supraspinatus tendon

**Ⅶ. RELATIONS**

Superiorly Coracoacromial arch, subacromial bursa, supraspinatus and deltoid. Inferiorly Long head of the triceps brachii, axillary nerves and posterior circumflex humeral artery, Anteriorly Subscapularis, coracobrachialis, short head of biceps brachii and deltoid, Posteriorly Infraspinatus, teres minor and deltoid, Within the joint: Tendon of the long head of the biceps brachii.

**Ⅷ. NERVE SUPPLY**

Axillary nerve.

Musculocutaneous nerve.

Suprascapular nerve.

**Ⅸ. BLOOD SUPPLY**

The shoulder joint is supplied by the anterior and posterior circumflex humeral arteries both are branches of the axillary artery. There are also contributions from the suprascapular artery (itself a branch of the thyrocervical trunk).

 **Ⅹ. MOVEMENTS**

The shoulder joint is an extremely mobile joint, with a wide range of movement possible:

Extension (upper limb backwards in sagittal plane) posterior deltoid, latissimus dorsi and teres major.

Flexion (upper limb forwards in sagittal plane) pectoralis major, anterior deltoid and coracobrachialis. Biceps brachii weakly assists in forward flexion, Abduction (upper limb away from midline in coronal plane) The first 0-15 degrees of abduction is produced by the supraspinatus, the middle fibers of the deltoid are responsible for the next 15-90 degrees.

Past 90 degrees, the scapula needs to be rotated to achieve abduction – that is carried out by the trapezius and serratus anterior, Adduction (upper limb towards midline in coronal plane) pectoralis major, latissimus dorsi and teres major, Internal rotation (rotation towards the midline, so that the thumb is pointing medially) subscapularis, pectoralis major, latissimus dorsi, teres major and anterior deltoid., External rotation (rotation away from the midline, so that the thumb is pointing laterally) infraspinatus and teres minor, Circumduction (moving the upper limb in a circle) produced by a combination of the movements described above.

**LIGAMENT**

**THE GLENOHUMARAL LIGAMENT**

Superior, middle and inferior are attached medially to the upper part of the anteromedial margin of the glenoid cavity and are fused with the glenoidal labrum.

**THE CORACOHUMARAL LIGAMENT**

It is a thickening of the upper part of the capsule. Medially it is attached to the root of the coracoid process and laterally to the greater tubercle of the humerus.

**TRANSVERSE HUMERAL LIGAMENT**

Which stretching between two tubercles of the humerus there is a gap in the bony attachment of the capsule, Stability of the joint depends upon muscles that surround it. These are the supraspinatus, the subscapularis, the infraspinatus and teres minor (behind) the long head of triceps (below) the tendon of these muscles behind with the capsule forming the rotator cuff. The joint is surrounded by a number of bursae. They facilitate movement between structures surrounding the joint, the synovial membrane lines the inside of the capsular ligament, both side of the glenoidal labrum. The tendon of the biceps is enclosed in a tubular sheath of synovial membrane. The shoulder joint is supplied by the anterior and posterior circumflex humeral and the suprascapular arteries and by the suprascapular, axillary and lateral pectoral nerves.

**Ⅻ. BIOMECHANICS OF SHOULDER JOINT**

The shoulder joint is a ball and socket synovial joint. It has a capsule and several associated ligament and bursae. The articulation is made up of the large head of the humerus and the small glenoid fossa. Since the glenoid fossa of the scapula of the proximal segment of the shoulder joint function. The shoulder has sacrificed vial congruency to serve the mobility needs of the hand.

**OSTEOKINEMATICS**

The glenohumeral joint describes 3 degrees of freedom. Flexion, extension, abduction-adduction, medial rotation/lateral rotation. The range of each of these motions occurring safely at the GH joint varies considerably. The range of medial/lateral rotation of humerus varies with position with the arm at the side medial and lateral rotation may be limited to as littile as 50 degrees of combined motion.

The range of motion for flexion and abduction of the gleno-humeral joint are reported to be anywhere from 90 degree to 120 degree or as much as 135-degree, active abduction to be limited to 90 degrees when the scapula did not participate in the motion but claimed 120 degree of motion was available passively. The restriction of glenohumeral joint abduction to 90 degree of active motion is evident when the scapula is immobilized

**ARTHROKINEMATICS**

The glenoid fossa and humeral head are incongruent surfaces. The convex humeral head is a substantially large surface and may have a different radius of curvature than the shallow concave fossa. Given this incongruence, rotation of the joint in any direction cannot take place as a pure spine but requires that the motion of the humerus to be accompanied by rolling and gliding of the head of humerus on the glenoid fossa in a direction opposite to the movement of the shaft of humerus. It is the function of muscle that cross the glenohumeral, the muscles are 1) move the humerus 2) provide intraarticular gliding 3) maintain opposition of joint surface. The last two are necessary for dynamic stability requirement of the glenohumeral joint and effectively performed in the normal glenohumeral joint, impact of the humeral head on the acromion or the coracoacromial ligament.

**SMALL AMPLITUTE MOTION OF BONES AT JOINT SURFACE**

* Roll
* Glide (or slide)
* Spin

**CLOSE-PACKED POSITION OF THE GH JOINT**

* Horizontal abduction and external rotation (Hertling &kessler, 1996)
* Flexion and internal rotation (Culham &peat, 1993)

**Ⅻ. RHYTHM**

**SCAPULO- HUMERAL RHYTHM**

The scapulothoracic joint contributes to both flexion and abduction of the humerus by upwardly rotating the glenoid fossa 60 degree from its resting position. If the humerus were fixed to the fossa this alone would result in 60 degrees of elevation of the humerus. The humerus is not fixed of course, but can move independently on the glenoid fossa. Tha GH joint contributes 120-degree flexion and anywhere from 90 degree to 120 degree of abduction. The combination held to be a maximum range of elevation to 180 degree and in an overall ratio 2 degree of GH to 1 degree of scapulothoracic motion. As already noted, there is disagreement over the available range of GH joint. Not surprisingly, then there to humeral movement. When maximum range is sited for GH joint, the ratio may be close to 3 degree of GH movement to 2 degrees of scapulothoracic movement. During the initial 60 degree of flexion or initial 30 degree of abduction of the humerus, an inconsistent amount and type of scapular motion take place relative of GH motion. During this period of scapula seeks a position of stability in relation to the humerlus. this early phase motion takes place relative to glenohumeral motion. During this period the scapula seeks a position of stability in relation to the humerus. In this early phase, motion occurs primarily at the glenohumeral joint, although stressing the arm may increase the scapular contribution with increasing approaching a 1:1 ration with glenohumeral movement. In the later part of the range, the glenohumeral joint again increase its contribution popped and walker found the glenohumeral to scapulothoracic ratio to be 5:6 between 24 degree and maximum elevation in the plane of the scapula. They mentioned however that the absolute angle achieved at each joint yield on overall ratio of 2 degree of glenohumeral motion for each 1 degree of scapulothoracic motion while the ratio of scapulohumeral rhythm is both individualistic and nonlinear, one can incestualize the concerted movement of the humerus and scapular as being 2 degrees of glenohumeral motion for every 1 degree of scapulothoracic motion.

**REVERSE SCAPULO-HUMERAL RHYTHM**

Scapula moves more than the humerus; this is seen in condition such as frozen shoulder. The patient appears to hike the entire shoulder complex rather than produce a smooth coordinated abduction movement.

**REFERENCE**

1.Textbook of Human anatomy - BD Chaurasia’s

2.Textbook of Gray’ Anatomy; The anatomical basis of clinical practice 4th edition

3.Textbook of joint structure and function -Cynthia C Norkin

4.McCausland Sawyer E, Eovaldi BJ Varacallo M Anatomy, Shoulder and Upper limb, Shoulder Muscles published 07 Dec 2018 [ Abstract]

5.Textbook of Atlas of human anatomy 5th edition

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