

BIOMECHANICS OF THE SHOULDER JOINT

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Shoulder joint:requires the coordinated function of four joints a balance of mobility and stability

Stenoclavicuiar joint
Acromioclavicular joint
Glenohumeral joint
Scapulothoracic articulaion

Mobility of the Shoulder Joint

Glenohumeral motion:rotation and translation

Three actions

- spinning : simple rotation of the humeral head on the articular surface of the glenoid
- sliding : pure translation of the humerus head on the articular surface of the gleniod.
- rolling : a combination of translation and rotation of the humerus with respect to the glenoid

translation

:defined as the allowed movement of the center of the humeral head with respect to the face of the glenoid

- . at the initial and the extreme of motion
- . in unstable joints:passive translation
- . in an asymmerically tightened capsule; obligate transiation glenohumeral movement

Condman's paradox vs the global movement

humerothoracic rhythm

glenohumeral motion plus scapulothoracic motion

over the entire arc of abduction,GH joint moves more than ST joint, but the difference is greatest at the begining of abduction and is minimal at the end of abduction

(Harryman 2:1, Poppen5:4)

maximum elevation

an obligatory external rotation of the humerus
in the posterior scapular plane
; internal rotation of the arm

3 dimensional mobility ; plantar elevation
axial rotation
horizontal angulation
protraction and retraction

4 basic direction ; sagittal plane-flexion
scapular plane-scapion
coronal plane-abduction
posterior plane-extension

Thoraco-scapular-humeral articulation ; 17 muscles

- . prime mover and synergist
- . dynamic stabilizer of the humeral head
 - Deltoid ; vertical and upward shear
 - most important prime mover
 - rotator cuff ; fulcrum for the humeral head upon the glenoid

Subscapularis

internal rotator
humeral head depressor
compressive joint stabilizer

Supraspinatus

active scapulohumeral elevation
derotation
compressive stabilization
prevention of translation superior or inferior

Infraspinatus

powerful scapulohumeral external rotator
reducing the load on ant. capsular ligament in extreme
provide posterior glenohumeral stability

Long head biceps brachii

most related to elbow function
contribute to stability as a humeral head depressor during
overhead action
contribute to anterior and posterior stability

Pectoral girdle Muscles

Trapezius ; assist upward rotation.
enable maximum active scapular rotation.
active in abduction, esp, as the arm reaches the
horizontal plane.

Serratus anterior, Levator scapulae, Rhomboid group;
protraction and retraction
medial stabilization during overhead

Latissimus dorsi ;
extensor and internal rotator
deceleration in the follow-thru

Pectoralis major ;
no active in abduction
forward flexion

Teres major ;
medial rotation, adduction, extension

Stability of the Shoulder Joint

contributed by static and dynamic mechanisms
Static ; balance and concavity compression mechanism
joint conformity
limited joint volume
adhesion and cohesion
intra-articular negative pressure
ligament and capsular restraints
Dynamic ; muscle balance

Ball and socket kinematics

ball and socket joint

ball ; 1/3 of the surface of a sphere an arc of 120 °
upward tilt-45 °
retroversion-35 °

socket ;
35 % of the humeral head
9mm deep in superoinferior direction an arc of 75 °
(3.5-4.0cm)
5mm deep in anteroposterior direction an arc of 50 °
(2.5-3.0cm)
upward tilt of 5 ° and 7 ° retroversion
glenoid labrum ; enlarger contract area about 50-75%
lessen the shock

anterosuperior ; loosely attached
inferior ; firmly attached
glenolabral socket ; balance and concavity compression

BLANCE

CONCAVITY COMPRESSION

stability ratio and angle

labral resection reduces the effectiveness of compression
stabilization by 20%

Joint Conformity

glenohumeral index ; maximum diameter of glenoid
maximum diameter of humeral head
the humeral head is not perfectly spherical
variance in the congruity of the glenoid and humeral head
the equal glenoid and humeral radii of curvature ;
no-translation

Adhesion & Cohesion

Intra-articular negative pressure

Capsuloigamentous restraints

coroachumeral ligament

support dependent arm

restrain external rotation below 60 ° abduction

form tunnel for support of biceps tendon

SGHL

primary restraint to inferior translation of the adducted
shoulder

MGHL

support dependent arm
restraint external rotation upto 90 ° abduction
provide anterior superior buttress for humeral head

IGHL

primary static capsuloligamentous restraint to AP translation of the abducted shoulder
main static stabilizer resisting inferior translation with progressive abduction

SUMMARY

1. The static restraints are important in maintaining balance between shoulder mobility and stability. But the shoulder musculature plays the vital role in moving the joint and providing stability.
2. Study of the dynamic restraints continues and study of the combined effect of the static and dynamic restraints is demanded.