Functional model of the shoulder-joint

natural size, made of SOMSO-PLAST

Unlike the lower limbs the arm possesses very considerable movement in relation to the body through the shoulder girdle. The shoulder girdle comprises **scapula** and **clavicle**, between each of which there is a joint **(internal and external clavicular joint).** Together with the humerus the clavicle forms another joint, the shoulder joint **(Articulatio humeri).** The shoulder girdle is only connected to the sternum through the internal clavicular joint, otherwise it can be freely moved on the sternum. In this manner the arm acquires considerable freedom of movement in the shoulder-joint, since the shoulder girdle, as the initial basis for movements of the arm, can also be transposed itself. All 3 joints are 3axis enarthrodial joints, of which however, the shoulder-joint has the greatest freedom of movement, the two clavicular joints **(Art. sternoclavicularis** and **acromioclavicularis)** are considerably restricted in their movement through rigid ligaments between the thorax and clavicle.

Shoulder-joint (Articulatio humeri)
The triangular, flat bone of the **scapula** forms on the outside a flat, pear-shaped glenoid cavity, which is about three times smaller than the convex articular surface of the humerus, which glides on it and is therefore increased in size through a cartilaginous joint lip. The shoulder-joint is the most flexible joint of the body. The articular capsule is broad and hardly reinforced through ligaments. Individual ligament-type supplemental bands in the capsule wall vary in strength **(Ligg. glenohumeralia)** and play no great rôle functionally. The shoulder-joint is therefore mainly protected through the muscles (joint with muscle system), which surrounds the joint on all sides with a sheath. In addition, the tendon of the long biceps head, one of the strongest muscles of the upper arm, runs in a bone groove through the joint, finally to be attached to the scapula above the glenoid cavity. This also helps to hold the joint elements together.

Functional mechanisms
The most important forms of movement in the shoulder-joint are the following: Raising the arm forwards, lowering and guiding the arm backward through a transverse axis, inward and outward rotation (60-80° in each case) through a longitudinal axis and finally abduction (90°) and adduction (5-10°) through a sagittal axis. This freedom of movement can be considerably increased by rotating the scapula so that, for example, it is possible to raise the arm forwards through the horizontal plane (90°) virtually to a vertical plane (160-170°), so-called elevation of the arm. This applies similarly to the other planes of movement.

Ligamentous apparatus of the shoulder girdle
The scapula forms a ridge of bone at the back, the spine of the scapula **(Spina scapulae),** which broadens towards the shoulder-joint and ends in a flattened process **(Acromion).** This process articulates with the clavicle but is also connected to the coracoid process of the scapula **(Proc. coracoideus)** through several ligamentous bands. This forms an arched vault over the shoulder-joint, which restricts the upwards forward movement of the arm but on the other hand holds the bone elements of the shoulder girdle more firmly together.

I. Ligaments of the shoulder-joint

1. = articular capsule **(Capsula articularis),** loose capsule around the two joint elements.
2. = supplemental ligaments of the articular capsule **(Ligg. glenohumeralia)** - longitudinal ligamentous bands on the upper and inner surface of the articular capsule, which have little significance functionally.
3. = tendon of the biceps brachii muscle.

II. Ligaments of the external clavicular joint

4. = **Lig. coracoacromiale** (coracoacromial ligament) - connection between acromion and coracoid process.

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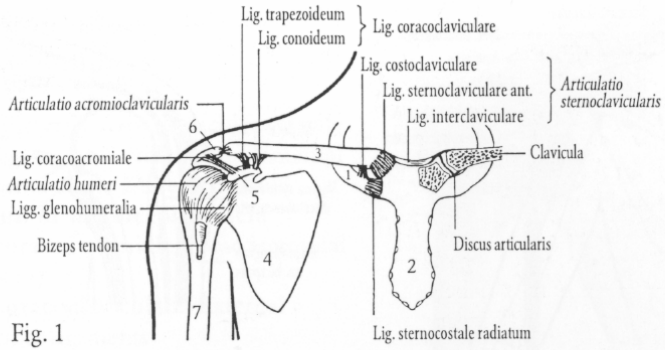

Fig. 1

Figure 1. Constructional elements and ligamentous apparatus of the shoulder girdle (seen from the front) (by BENNINGHOFF). On the left sternoclavicular joint is frontally intersected to show the intraarticular disk. 1 = 1st rib, 2 = sternum, 3 = clavicle, 4 = scapula, 5 = coracoid process, 6 = acromion, 7 = humerus.

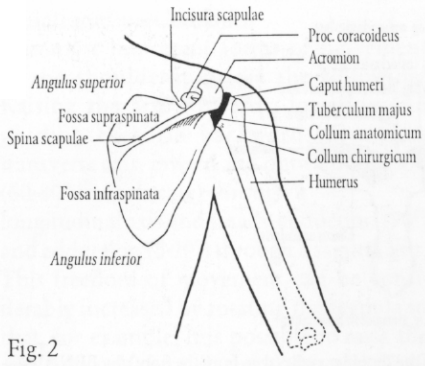

Fig. 2

Figure 2. Position and construction of the shoulder-joint (viewed dorsally)

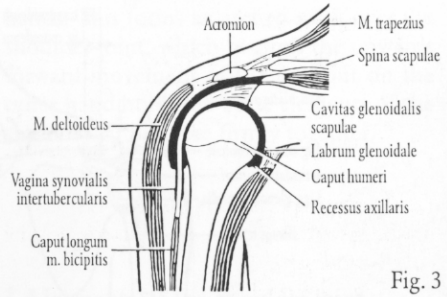

Fig. 3

Figure 3. Frontal section through the shoulder-joint, joint cavity black. The bicipital tendon is intersected in its entire course through the joint (modification of TÖNDURY).

III. Ligaments of the shoulder girdle

5. = external clavicular ligament **(Lig. coracoclaviculare)**. This comprises 2 parts: A conically shaped ligament located more in the interior (**Lig. conoideum**, 5a) and a trapezium shaped ligament (**Lig. trapezoideum**, 5b) connected externally. These ligaments safeguard the connection between scapula and clavicle during the multifarious movements of the arm and shoulder girdle.

6. = transverse ligament of the scapula **(Lig. transversum scapulae)**. It stretches over the incisura scapulae (scapular notch) and divides the vascular nerve system to the shoulder muscles.

Notes on how to use the model:

One should first try to determine the extent of the freedom of movement in the shoulder-joint alone by moving the humerus backwards and forwards.

By turning or moving the scapula the freedom of movement of the arm in the shoulder-joint can be increased.

The clavicle can be moved in all 3 planes in the external clavicular joint as in an enarthrodial or ball-and-socket joint. However, the rigid ligamentous apparatus considerably restricts the extent of movement.