Shoulder injuries part 1

Throughout our careers as volleyball players, personal trainers and coaches we are always concerned with both physical fitness and injury prevention. As important as performance and physical fitness are (see article on how to increase the jump), they need to be supported by good physical injury prevention practices so as to avoid any absences during the championship or matches.

One of the primary injuries we always take into consideration is the shoulder injury.

We wrote this articles to help everybody with our knowledge, to help prevent injuries and to try and keep you in perfect form for your performances.

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Anatomy of Shoulder joint

The shoulder joint consists of the Humerus, Scapula, Clavicle, Sternum and indirectly the Ribs and Vertebral Column. The shoulder joint actually consists of four different joints,
making it a complex joint with a large range of movement. It is important to know each joint very well, to begin to understand where certain injuries are located.

The four joints that make up the shoulder are:

- Gleno Humeral
- Acromio-clavicular
- Sterno-clavicular
- Thoracic bacherol

It is really important to know the anatomy of this joint, because it is indispensable for any treatment. Shoulder pains can be due to intrinsic factors, periarticular pathologies or can otherwise be referred pain originating from the rachis, thoracic, or visceral.

**Gleno Humeral**

This joint is a ball-and-socket joint between the glenoid cavity (socket) and the humeral head (ball), it can move in a range of directions. The movements made by the joint are categorised into 3 planes; sagittal, frontal and horizontal planes. Around this joint there are some muscles, bone and ligament that support and preserve it.

The gleno humeral consists of: *glenoid labrum* - a fibre cartilage ring that surrounds and enhances the glenoid cavity; *joint capsule* - an envelope surrounding the synovial joint, reinforced from the ligament gleno humeral superior, medium and inferior which originate from the antro-superior side of the glenoid cavity and insert into the front face of the surgical neck of the humerus; *rotator cuff* - formed from the
tendons of the supraspinatus, infraspinatus, teres minor and infra scapularis muscles situated around the humerus maintaining the glenoid cavity in the centre. The gleno humeral joint is innervated from the branches of the brachial plexus, the infra scapularis nerves, axillary and lateral pectoral nerves.

**Acromio-clavicular**

A full joint that improves the movement of the arch. It is composed from the acromion of the scapula and the lateral end part of the clavicular divided from a meniscus and surrounded from capsular tissue and reinforced from 2 ligaments: acromion-clavicular and coracoacromial clavicular; is innervated from the pectoral lateral nerves and subscapularis nerves.

**Sterno clavicular**

This joint allow the humerus to perform a complete abduction of 180 degrees. It is formed from the manubriosternal joint and the medial part of the clavicular. These 2 surfaces are separated by a disc and coated from the capsule.

**Scapula thoracic**

Although this is not technically a joint, it still forms part of the shoulder joint. It is made from the thoracic inferior surface and from the shape of the scapula. Because is not a real joint it doesn't have any capsular joint.
The muscles that form the shoulder are: deltoid, supra-spinatus, infra-spinatus, teres minor and teres major; they originate from the thoracic girdle. The muscles supra-spinatus, infra-spinatus, teres minor and sub-scapularis work together, so they are agonists, dropping the humerus head and making it closer to the glenoid cavity. In addition to this the muscles of the rotator cuff work in intra rotation with sub-scapularis and external rotation with supra-spinatus, infra-spinatus and teres minor. The deltoid muscle is the principal muscle at work in the abduction of the shoulder. Its anterior bundles work in flexion, mild adduction and inter rotation; the medial bundles work in adduction, while the posterior bundles work in extension, abduction and external rotation.

The teres major muscle works in adduction, extension and inter rotation.

There are other muscles that work to move the shoulder, and they are: biceps brachii, coraco brachialis, brachialis, anteriorly; triceps brachii, posteriorly.

The biceps brachii has a long head that originates from the supra-glenoid tubercle of the scapula and a short head, that originates from the coracoid process of the scapula. Both of them insert with one unique tendon into the radial tuberosity. They keep the head of the humerus in contact with the glenoid cavity of the scapula. They contribute to flexion and adduction movement of the shoulder.

The coraco brachialis muscle works in flexion and adduction of shoulder.

The triceps brachii muscle has 3 heads, a long head that originates from the infra-glenoid tubercle and lateral and medial heads which originate from the humerus. All of them insert with one unique tendon into the olecranon of the Ulna. The action of the triceps brachii muscle on shoulder is adduction with the action of long head.

In addition other muscles from torso act on the shoulder. They are the latissimus dorsi and pectoralis major, both work in adduction and internal rotation of shoulder.

Then there are muscles that act on the scapula or on the clavicular. The serratus anterior moves the scapula in forward, in out and upper. The elevator scapularis, lifts the scapula. The trapezium, of which the superior bundles help lift the scapula, the intermediate bundles adduce the scapula and the inferior bundles lower and adduce the scapula. The major and minor rhomboid assist with medial rotation of the shoulder. The pectoralis minor moves the shoulder forward and assists internal rotation. The subclavian lowers the clavicular.

We can describe the full range of shoulder movement in these ways: abduction, adduction, flexion, extension, inter and extra rotation.

Abduction: from 0 to 90 degrees, the muscles working are supra-spinatus, deltoid, biceps brachii.

From 90 to 150 degrees. The muscles working in this range of motion are trapezium, the serratus anterior.

From 150 to 180 degrees, the muscles working are deltoid, supra-spinatus, trapezium and serratus anterior.

Adduction: ventral, the muscles working in this movement are pectoralis major, anterior deltoid, biceps brachii, flexor of shoulder, latissimus dorsi, teres major.
Dorsal, the muscles working are triceps brachii, posterior deltoid, shoulder extensors.

**Flexion:** from 0 to 60 degrees, the muscles working are anterior deltoid, biceps brachii, pectoralis major, coraco brachialis.
From 60 to 120 degrees, the muscles working are serratus anterior, upper trapezium.
From 120 to 180 degrees, the muscles working are intrinsic muscles of the spine.

**Extension:** in this movement the latissimus dorsi, teres major, teres minor, triceps brachii, posterior deltoid are all involved.

**Rotation:** Inter, the muscles that work are anterior deltoid, sub-scapularis, pectoral major and minor, serratus anterior.
External, the muscles that work are posterior deltoid, infra-spinatus, teres minor, major and minor rhomboid, middle trapezium.

The athletic movement often repeated is the throw, it is used in a lot of sports. During the throw, the shoulder works through all its whole range of motion. The throw can
be defined as an “oscillation of the upper limb with the purpose to follow a trajectory to an object in space” (Pirola, 1998).

There are 3 types of throw: overarm, underarm, sidearm. Several sport use a throw-like movement, including athletic sport, baseball, basket, handball, volleyball, netball, tennis, cricket, football and water polo.

**Injury of shoulder**

Shoulder injuries are common in sport where the shoulder is often in continue use. We can divide shoulder injuries in two ways: *acute injuries* and *overuse injuries*.

Acute injuries occur instantly, such as a fracture or dislocation; while overuse injuries involve overload, such as impingement, instability of shoulder, and injury of rotator cuff.

We will explain just the overuse injuries of the shoulder, because acute injuries are often serious injuries that can require professional medical assistance.

Overuse injuries occur in many sports such as volleyball, tennis, handball etc.

One of the more infrequent overload injuries is *impingement*. This is attrition in the rotator cuff from bony structures and some tissue surrounding creating mechanical wear and pain in shoulder.

Impingement has multifactorial origins and the mechanical wear happens between the inferior surface of rotator cuff and posterior superior portion of the glenoid labrum. Impingement is classified in 3 stages:

- First stage: presence of edema of the rotator cuff with sub-acromial bursitis;
- Second stage: fibrosis and tendinosis of the rotator cuff;
- Third stage: partial or complete rupture of the rotator cuff.

Another typical injury in sports like baseball, tennis, swimming, volleyball, handball, etc is the *rupture of the rotator cuff*. As we showed before, the rotator cuff is the muscle tendon structure that keeps the head of humerus stable and stops it crashing against the Glenoid cavity.

The movements most likely to be involved in this type of injury are hyper-abduction and external rotation of shoulder.

Often in young athletes (under 35) impingement, partial and complete rupture of rotator cuff are due to an anterior instability of the shoulder, whereas in older athletes more common causes could be a old impingement of the supra-spinatus muscle or the establishment of a degenerative disease.
Shoulder instability is when the humeral head does not have the ability to maintain its place in the glenoid fossa. The glenohumeral joint has a very wide range of motion, potentially making it easier to injure. Shoulder instability is described as **traumatic** or **atraumatic** and **unidirectional** or **multidirectional**. Generally, the unidirectional instability occurs alongside traumatic instability, while multidirectional instability occurs alongside atraumatic instability. Dislocation and anterior sub-dislocation usually create instability in the shoulder. Posterior instability of the shoulder is determined by episodes of sub-dislocation rather than dislocation.

Mentioned above are the three most common types of shoulder injury. Other forms of shoulder injury are:
- Sub-acromial conflict
- Secondary instability at ligament injury
- Instability due by capsul ligamentousis with conflict
- Anterior instability

In the first type of injury athletes that have a shoulder pain after a sub-acromial conflict will show positive at impingement test. They present a partial lesion of rotator cuff on the articular surface alongside the anterior ligament and labrum. The second type includes athletes with instability due to a lesion in the caspul ligamentousis and the anterior labrum. They will show positive at the impingement test and pain during the apprehension test. There can also be damage to the labrum and the cartilage of the humeral head. The third type includes athletes with instability in the caspul ligamentousis with secondary conflict. Again athletes will show positive on the impingement test and pain during the apprehension test. The fourth type includes athletes with shoulder instability not caused by sub-acromial conflict but by traumatic episode. Impingement test shows negative while pain shows during the apprehension test. The rotator cuff is intact, but we may observe a Hill-Sachs lesion at the humeral head and notice damage to the anterior labrum.

How do we recognize what type of shoulder injury our athletes are afflicted by?

With sub-acromial impingement, athletes show pain when the arm is lifted overhead. At this stage we perform the Neer and Hawkins test for impingement. For the rupture of the rotator cuff, the principal symptom is pain during rest, with reduction of mobility and weakness. For shoulder instability the case is little bit more complex, as it can originate from either dislocation or something called dead arm syndrome. If the shoulder is dislocated, the symptom will be pain. If the athlete experiences paresthesias and weakness throughout arm then this is more likely to be dead arm syndrome. Shoulder instability often leads to pain during activity, especially during overhead movements.
These types of injury should be treated by a medical professional rather than a personal trainer or physiotherapist. This injury requires specialist checks such as RMN, TC; and in some case they require the use medicine or FANS.

With sub-acromial impingement, the personal trainer or physiotherapist can assist with prevention of the injury via a good shoulder warm up programme, proper stretching and correction of athletic movement. After the injury has been dealt with medically personal trainers can help with rehabilitation through:
- Stretching,
- Plyometric exercises,
- Proprioceptive exercises,
- Neuromuscular control,
- Eccentric exercises.

All rehabilitation phase with all exercises will be explained in part 2 of shoulder injury.

This article is written by Mauro Ceccarini BSc, Personal Trainer.

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