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GLENOHUMERAL DISLOCATION, ANATOMICAL DESCRIPTION, EPIDEMIOLOGY, MECHANISMS OF ACTION, CLASSIFICATION, CLINICAL PRESENTATION, IMAGING PRESENTATION, TREATMENT AND COMPLICATIONS

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SUMMARY

Introduction: *Acute shoulder injuries that are common here include acromioclavicular joint injuries, clavicle fractures, glenohumeral dislocations, proximal humerus fractures and rotator cuff tears. Glenohumeral dislocations are frequently attributed to contact sports, as well as bicycle accidents, falls and high-impact trauma. Patients present several specific characteristics that will depend on the type of dislocation.*

Objective: *to detail the current information related to glenohumeral dislocation, in addition to its description, epidemiology, classification, clinical evaluation, imaging presentation, treatment and complications of the different types of glenohumeral dislocation.*

Methodology: *a total of 32 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 20 bibliographies were used because the other articles were not relevant for this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: glenohumeral dislocation, shoulder pain, upper limb dislocation, shoulder reduction, shoulder dislocation.*

Results: *Shoulder dislocations are usually anterior. In recurrent anterior dislocation, most recurrences occur in the first 2 years and mostly in males. Age at the time of initial dislocation has the greatest influence; incidence is not related to the duration or type of immobilization. The approximate recurrence rate in all age zones is 50%, however it increases to 89% in 14 to 20 year olds.*

Conclusions: *The shoulder joint is frequently associated with dislocations, accounting for a large percentage of all dislocations, with anterior shoulder dislocations being more common. Anatomical, clinical and imaging knowledge play an important role in the diagnosis, allowing a better classification of the type of dislocation, which has a better impact on the treatment. The immobilization and physiotherapeutic approach will vary depending on the pathology, the age of the patient, the existence of recurrence and other complications.*

KEY WORDS: *glenohumeral dislocation, shoulder reduction, shoulder dislocation.*

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INTRODUCTION

Acute shoulder injuries are common and include acromioclavicular joint injuries, clavicle fractures, glenohumeral dislocations, proximal humerus fractures and rotator cuff tears. Acromioclavicular joint disruptions and clavicle fractures occur mostly in young adults as a result of direct trauma or sports-related injuries. Most non-displaced or minimally displaced injuries are usually treated conservatively, including pain management, short-term use of a sling, and physical therapy. Glenohumeral dislocations are frequently attributed to contact sports, as well as bicycle accidents, falls and high-impact trauma. Patients present several specific characteristics that will depend on the type of dislocation, however most commonly they will hold the affected arm with the contralateral hand and present with pain on movement and reduced range of motion. Reduction maneuvers usually require intra-articular lidocaine or intravenous analgesia and sometimes sedation. Shoulder radiographs play an important role in pathology(1,2).

METHODOLOGY

A total of 32 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 20 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: glenohumeral dislocation, shoulder pain, upper limb dislocation, shoulder reduction, shoulder dislocation.

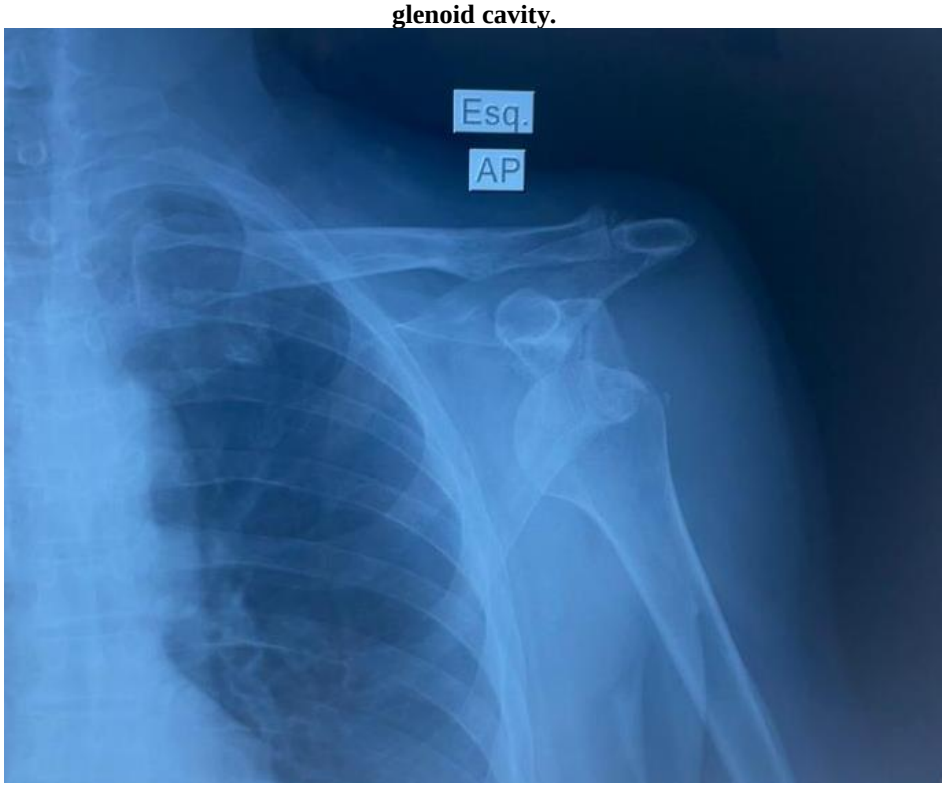
The choice of bibliography exposes elements related to glenohumeral dislocation; description, epidemiology, classification, clinical evaluation, imaging presentation, treatment and complications of the different types of glenohumeral dislocation.

DEVELOPMENT

EPIDEMIOLOGY

The shoulder joint is frequently associated with dislocations, accounting for up to 45% of all dislocations. Shoulder dislocations are usually anterior; their incidence is 8 to 9 times more common than the incidence of posterior dislocations, which represents the second most common type. The incidence of glenohumeral dislocation is approximately 17 cases per 100,000 inhabitants per year, with the peaks located between 21 and 30 years of age in men and between 61 and 80 years of age in women. The approximate recurrence rate in all age groups is 50%, but increases to 89% in those between 14 and 20 years of age. Inferior dislocations, also called erect dislocations, as well as superior dislocations are infrequent. Dislocations due to fracture of the proximal humerus are complex injuries that require special considerations; chronic glenohumeral dislocations are infrequent injuries that represent less than 2% of all shoulder dislocations(3-7).

Figure 1. Anteroposterior radiograph of the left shoulder showing an anterior dislocation of the humerus with respect to the glenoid cavity.



Source: The Authors.

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Figure 2. Fluoroscopic image showing reduction of the dislocation shown in figure 1.

Source: The Authors.

ANATOMY

The shoulder is an unstable joint due to a shallow glenoid cavity that articulates with only a small part of the humeral head. Glenohumeral stability requires multiple mechanisms, active and passive.

Active:

1. long head of the biceps.
2. Rotator cuff.

Coordinated movements of the shoulder include:

1. glenohumeral.
2. Scapulothoracic.
3. Clavicular and sternoclavicular.
4. Acromioclavicular.

Passive:

1. Adhesiveness and cohesion due to synovial fluid.
2. Vacuum effect due to the limited surface of the joint.
3. Joint congruence.
4. Scapula inclination: generally in more than 90% of the shoulders, the critical angle of scapula inclination is between 0° and 30°, below this it gives to infer that the glenohumeral joint is unstable and prone to inferior dislocation.
5. Ligaments and capsular restrictor components:

- Superior glenohumeral ligament: is the primary component that limits inferior translation of the shoulder when the shoulder is in adduction.
- Inferior glenohumeral ligament: composed of three bands, the superior band is the most important to prevent anterior dislocation of the shoulder. It limits external rotation when the shoulder is between 45° and 90° of abduction.
- Medial glenohumeral ligament: it is a modifiable component, sometimes poorly defined or missing 30% of the time. It confines external rotation with the shoulder in 45° of abduction.
- Joint capsule: its redundancy prevents restriction of motion, except for the last few degrees. The anteroinferior capsule prevents anterior subluxation when the shoulder is in abduction. The anterior capsule and the underside of the subscapularis muscle limit external rotation. The posterior capsule and teres minor limit internal rotation.

6. Glenoid impeller.
7. Bone restrictors: coracoid, acromion and glenoid cavity.

Pathologic anatomy of shoulder dislocations:

-Avulsion of the glenohumeral ligaments, mostly of their glenoid insertion and sometimes of their humeral insertion.
-Elongation or rupture of the capsule.
-Rupture of the glenoid impeller.
-Bankart's lesion: avulsion of the anteroinferior part of the glenoid impeller from its insertion in the periphery of the glenoid cavity. Sometimes related to fracture of the glenoid margin called bony Bankart.
-Hill-Sachs lesion: damage to the posterolateral portion of the head of the humerus caused by an impact fracture against the

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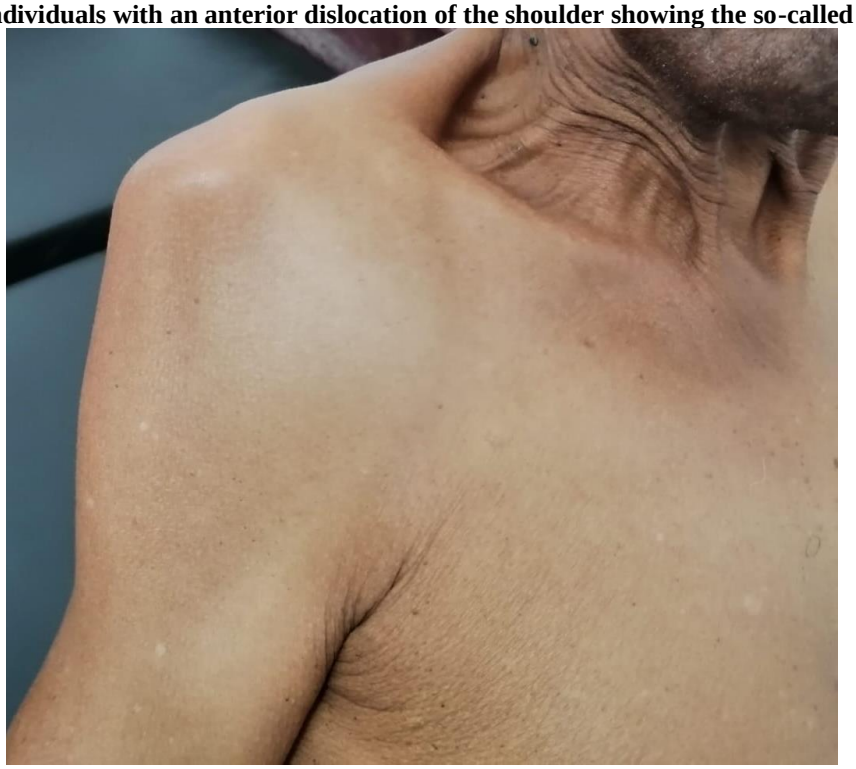
glenoid ridge; seen in 74% of recurrent anterior dislocations and 27% of acute anterior dislocations.
Shoulder dislocation linked to rotator cuff rupture:
Mostly in the elderly:
- Over 40 years between 35 % to 40 %.
- Over 60 years of age can reach 80%.

It should be taken into account in elderly individuals who are not able to lift the arm after a dislocation(3,4,8-12).

Figure 3. Affected individuals with an anterior dislocation of the shoulder showing the so-called epaulette shoulder.



Source: The Authors.

ANTERIOR GLENOHUMERAL DISLOCATION

Incidence.

Approximately 90% of all shoulder dislocations.

Mechanism of Injury

Anterior glenohumeral dislocation can occur following trauma, due to direct or indirect forces. Usually an indirect trauma to the upper extremity while the shoulder is in abduction, extension and external rotation. An anterior dislocation may also occur as a result of a direct mechanism with a force impacting the posterior shoulder area. Seizures and electric shocks typically result in posterior shoulder dislocations, but are not exempt from causing anterior dislocations. Sometimes anterior dislocations are evidenced with minimal trauma when there is recurrent instability interconnected with laxity, congenital or acquired, or with voluntary mechanisms(3,4,13).

Clinical Evaluation

The management of a first episode of anterior shoulder dislocation begins with an analysis of the causative mechanism and a physical examination to establish the diagnosis. The type of trauma, pattern of recurrence, triggering mechanisms, chronicity of dislocation, laxity and history of instability in the contralateral shoulder should be measured. The affected individual presents with great pain, muscle contracture and characteristically comes with the injured arm held in slight abduction and external rotation. A neurovascular evaluation is of utmost importance, observing the integrity of the axillary nerve. Physical examination may reveal a loss of shoulder contour due to the relative prominence of the acromion, with a posterior depression located below the acromion and a palpable mass in the anterior shoulder area. Tenderness in the area near the deltoid should be assessed; this muscle may show atony and should not be confused with axillary nerve impairment. The integrity of the musculocutaneous nerve can be assessed by testing both the sensation in the anterolateral aspect of the forearm. If the affected individual does not have acute pain, the examination may show a positive apprehension test, in which passively placing the arm in abduction, extension and external rotation generates a sensation of pain and instability(3,4,14).

Imaging Evaluation

Trauma series of the injured shoulder:
-Anteroposterior
-Scapular Y.
-Axillary in the plane of the scapula.
-Velpeau axillary projection: if the standard axillary X-ray cannot be performed because of pain, the individual should be placed in

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a sling and tilted posteriorly on the frame at an obliquity of 45°. The X-ray beam goes in a caudal direction, perpendicular to the chassis, which provides a magnified axillary projection. Special projections:
-Hill-Sachs projection: this anteroposterior projection can be obtained with the shoulder in maximum internal rotation in search of a possible posterolateral defect.
-West Point axillary projection: it provides a tangential image of the anteroinferior glenoid rim. It can be obtained with the affected individual in a prone position and with the X-ray beam in cephalic direction towards the axilla creating an angle of 25° with the horizontal and 25° with the medial plane.
-Stryker's notch projection: it shows up to 90% of the posterolateral alterations of the humeral head. The affected individual is placed in the supine position with the ipsilateral palm on the crown of the head and the elbow facing upwards. The X-ray beam is positioned 10° cephalad, in relation to the coracoid process.
-Computed tomography can sometimes be used to demarcate bony lesions of the anterior impeller, free bodies and compression fractures of the glenoid or humeral head. Contrast arthrography can be performed to evaluate rotator cuff pathology. The role of MRI is to determine rotator cuff alterations, Bankart's lesion and capsular lesions(3,4).

Classification
According to the level of stability: dislocation, subluxation.
According to chronology:
- Congenital.
- Acute versus chronic.
- Incarcerated.
- Recurrent.
- Acquired.

According to forces:
- Atraumatic
- Traumatic

According to patient contribution:
- Voluntary.
- Involuntary.

According to direction:
- Subcoracoid.
- Subglenoid.
- Intrathoracic.

Treatment
Conservative Treatment
After a correct clinical evaluation and after a good analgesic management, closed reduction, intra-articular block and/or sedation should be attempted. Among the maneuvers described for such action are:

- **Stimson's technique:** after administering analgesics and/or sedatives, the affected individual is placed in a prone position with the upper extremity hanging freely from the edge of the stretcher. A light manual traction is exerted, as well as a 2.5 kg weight can be hung from the wrist, the reduction will take approximately 15 to 20 minutes.
- **Hippocrates technique:** with this technique the reduction is achieved with only one individual, placing one foot on the axillary fold and on the thoracic wall and exerting axial traction on the upper extremity with slight internal and external rotation.
- **Milch technique:** with the affected individual in the supine position and the upper extremity in abduction and external rotation, pressure is exerted with the thumb to slide the head of the humerus into place.
- **Spaso technique:** the affected individual in the supine position while the examiner grasps the wrist or distal forearm and lifts it vertically with gentle vertical traction and external rotation.
- **Tracción-contratracción.**
- **Maniobra de Kocher:** no se recomienda por el alto riesgo de fractura,la cabeza del húmero se apalanca sobre la parte anterior de la glenoides para permitir la reducción. Posterior a la reducción, el tratamiento incluye inmovilización por 2 a 5 semanas. Se recomienda un periodo menor de inmovilización en añosos debido a la posible rigidez, por el contrario jóvenes con antecedentes de luxación recurrente pueden requerir más tiempo. Posterior a la inmovilización, es necesario realizar rehabilitación, mejorando progresivamente la rotación externa, la flexión y la abducción, además ejercicios para recuperar la amplitud de movilidad(3,4,11,15).

Surgical Treatment
Surgical indications include
- Glenoid rim fracture greater than 5 mm.
- Soft tissue interposition.
- Displaced fracture of the greater tubercle with a displacement greater than 5 mm in a superior direction posterior to reduction.
- Acute stage repair in individualized cases as in some young athletes.

Surgical alternatives for stabilization include:
- Arthroscopic repair of the ligaments and anterior glenoid impeller.
- Capsular slippage
- Capsulorrhaphy
- Tendon transfers.
- Muscle transfers
- Bone transfers, reserved for recurrent cases.

The latter are generally used for the treatment of recurrent dislocation. Postoperatively, a shoulder immobilizer should be used for a maximum of 3 weeks in individuals of 30 years of age, 2 weeks in the age range of 30 to 40 years and 1 to 2 weeks in individuals over 50 years of age, this will also depend on the type of procedure performed. The affected individual is usually released to remove the immobilization system 2 to 4 times every

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24 hours in order to perform a range of motion exercises of the hand, wrist and elbow.

Physiotherapeutic treatment focuses on active and passive range-of-motion activities, in addition to exercises to restore strength to the limb(3,4).

Complications

Recurrent anterior dislocation: Most recurrences occur in the first 2 years and mostly in males, this is related to alterations in the ligaments and capsule. Age at the time of initial dislocation has the greatest influence, the incidence is not related to the duration or type of immobilization.

Bone injuries:

- Fracture of the greater tubercle (trochleter).
- Hill-Sachs lesion.
- Fracture of the acromion or coracoid.
- Fracture of the glenoid rim or Bankart bone lesion.
- Post-traumatic degenerative changes.

Soft tissue injuries: such as capsular or subscapularis tendon ruptures, as well as rotator cuff injuries, especially in older individuals.

Vascular injuries: they are usually generated in elderly people with arteriosclerosis and alternate to the axillary artery. They may occur at the time of open or closed reduction.

Nerve injuries: they occur mostly in the musculocutaneous and axillary or circumflex nerves. More commonly in the elderly; frequently the neuropraxia recovers, if symptoms continue after 3 months, it is necessary to perform a thorough analysis and even a surgical exploration(3,4,8,15).

Figure 4. Anteroposterior radiograph of the left shoulder showing an anterior dislocation.

Source: The Authors.

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POSTERIOR GLENOHUMERAL DISLOCATION

Incidence

This type of dislocation occurs in approximately 10% of shoulder dislocations and 2% of all shoulder injuries. It is usually not identified in primary care or the emergency department, so 60% to 80% of the time it goes unnoticed at the first examination. Recurrent posterior dislocations occur in 30% of patients and predispose the joint to degenerative changes.

Mechanism of Injury

Indirect trauma: this is the most common. The shoulder is positioned in a particular way, in adduction, flexion and internal rotation. A posterior dislocation can be generated secondary to an electric shock or during a seizure due to the greater muscular strength of the internal rotators, specifically the pectoralis major, latissimus dorsi and subscapularis, in relation to the external rotators of the shoulder, specifically the infraspinatus and teres minor.

Direct trauma: it is the consequence of exerting a direct force to the anterior area of the shoulder, resulting in a posterior translation of the head of the humerus(3,4,16).

Clinical Assessment

In the evaluation of posterior glenohumeral dislocation, a very noticeable deformity is usually not visualized, because the injured upper extremity remains in the sling position, in other words with the shoulder in internal rotation and adduction. Sometimes these injuries often go unnoticed in case a total radiographic series is not performed. A thorough neurovascular evaluation should be done in order to rule out circumflex nerve injury, although this is rare compared to anterior glenohumeral dislocation. On evaluation, limitation of external rotation usually to 0° and shoulder antepulsion usually to 90° may be seen. Flattening of the anterior area, palpable protrusion in the posterior region of the shoulder and prominence of the coracoid process may be seen(3,4).

Imaging Evaluation

Trauma series of the injured shoulder:

- Anteroposterior
- Scapular Y.
- Axillary.

An axillary Velpeau projection is sometimes indicated when the affected individual is unable to position the shoulder to perform a standard axillary projection.

On the standard anteroposterior view, features suggestive of posterior glenohumeral dislocation are:

-Sinker sign: impacted fracture of the anterior part of the humeral head upon impact against the posterior glenoid ridge.

-Sign of the empty glenoid: the glenoid cavity appears partially empty with a space between the anterior rim and the humeral head > 6 mm.

-Existence of a gap in the superior/inferior glenoid cavity.

-Absence of the normal elliptical overlap of the humeral head over the glenoid.

-Loss of the contour of the neck of the humerus.

Glenohumeral dislocation is best evaluated in the axillary projection; CT scan allows us to evaluate the percentage of the humeral head affected in an impacted fracture(3,4).

Classification

Etiological Classification.

-Atraumatic: congenital, acquired and voluntary.

-Traumatic: dislocation, recurrent dislocation, incarcerated dislocation, sprain and subluxation.

Anatomical classification.

-Subglenoid: it is infrequent, the head of the humerus is placed posterior and inferior to the glenoid cavity.

-Subacromial: it is the most common up to 98%, the articular surface goes in a posterior direction without a wide displacement of the humeral head, contrary to the anterior dislocation; the lesser tubercle characteristically occupies the glenoid cavity; it is usually related to an impacted fracture of the anterior zone of the humeral head.

-Subspinous: infrequent, the head of the humerus is placed medial to the acromion and below the spine of the scapula(3).

Treatment

Conservative Treatment.

Closed reduction requires complete muscle relaxation, sedation and analgesia. Pain in posterior glenohumeral dislocation following acute trauma is usually more intense compared to anterior dislocations, so anesthesia may be required for reduction. With the individual in the supine position, traction is exerted on the adducted arm in line with the deformity, raising the head of the humerus slightly toward the glenoid socket. External rotation of the shoulder should not be forced, because it can generate a fracture of the humeral head if it presents an impacted fracture locked on the posterior glenoid rim, if the radiographs show this type of fracture, in addition to axial traction should be applied lateral traction on the limb allowing unlocking the head of the humerus. Subsequently a sling with rotation locking should be placed if the shoulder is stable, in case of subluxation or new dislocation, a shoulder cast with a degree of external rotation can be placed to allow the greatest stability. These immobilizations should be kept for 3 to 6 weeks. While the patient is immobilized, isometric external rotation and deltoid exercises can be performed. After the immobilization is removed, an intense strengthening program of the internal and external rotators should be performed(3,4,16).

Surgical Treatment

Surgical indications include:

- Large posterior glenoid fragment.
- Trochlear fracture with significant displacement.
- Irreducible dislocation.

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- Impacted fracture of the posterior part of the glenoid that does not allow reduction.
- Impacted fracture of the anteromedial part of the head of the humerus, called Hill-Sachs inverted lesion.
- Open dislocation.
- Involvement of 20% to 40% of the humeral head: modified McLaughlin technique, transposition of the trochlea with insertion of the subscapularis inside the bony defect.
- Involvement of more than 40% of the humeral head: hemiarthroplasty placing the prosthesis with a neutral degree of version.

Among the surgical alternatives we find:

- Humeral osteotomies.
- Osteotomies of the glenoid.
- Capsulorrhaphy.
- Inverted Putti-Platt technique, infraspinatus muscle/tendon plication.
- Boyd-Sisk technique, transfer of the long head of the biceps to the posterior margin of the glenoid.
- Open reduction.

Voluntary dislocations should be managed conservatively, with strengthening exercises advised(3,11,17).

Complications

-Fractures: such as fractures of the humeral diaphysis, trochleter, trochlea, posterior glenoid rim and humeral head.

-Relapse of the dislocation: generally in atraumatic posterior glenohumeral dislocations, when there is a wide anteromedial alteration of the head of the humerus as a consequence of an impaction fracture of the glenoid rim, as well as when there is a large fracture of the posterior glenoid rim. These may require surgical stabilization to avoid recurrence.

-Neurovascular injury: infrequent in the posterior dislocations in comparison with the previous ones, nevertheless an injury of the circumflex nerve can be presented in the exit of the quadrangular space or also an alteration of the infraspinatus nerve when it crosses the spinoglenoid notch.

-Anterior subluxation: usually occurs due to excessive tension on the posterior structures, displacing the head of the humerus anteriorly. It can lead to limitation of adduction, flexion and internal rotation(3).

INFERIOR GLENOHUMERAL DISLOCATION (DISLOCATION ERECT)

Infrequent disorder, however the most affected population is the elderly. Inferior dislocations of the shoulder have an incidence of approximately 1 in 200 of all dislocations. The diagnosis can usually be made from the door.

Mechanism of Injury

Usually originating from a hyperabduction force that gives an entrapment of the neck of the humerus over the acromion, levering the head of the humerus and heading in an inferior direction. The superior portion of the articular area is directed inferiorly, without rubbing against the inferior glenoid rim. The diaphysis of the humerus is directed upward. Avulsion and rotator cuff tears, axillary artery injury, pectoralis pectoris injury, brachial plexus injury and fracture of the proximal humerus are common.

Clinical Assessment

Affected individuals usually exhibit pain and a saluting position, presenting with a locked humerus in 110° to 160° of abduction and in antepulsion. The head of the humerus is often palpated over the lateral aspect of the thorax in the axilla. A meticulous neurovascular examination is essential because it is common to find related neurovascular lesions that complicate this type of dislocation.

Image Evaluation

Traumatologic series of the injured shoulder:

- Anteroposterior
- Scapular Y.
- Axillary.

Usually the anteroposterior projection gives the diagnosis when presenting the inferior dislocation of the humeral head, with the diaphysis of the humerus directed superiorly in the course of the glenoid margin. X-rays should be carefully evaluated for associated fractures, which are common and complex to appreciate clinically because of the generalized pain in the shoulder.

Treatment.

Conservative Treatment

Reduction is usually achieved through traction-countertraction maneuvers, although it is usually painful. Axial traction is guided in the axis of the bony humerus in a superolateral direction, reducing the level of abduction of the shoulder in a stepwise manner. Countertraction is exerted by placing a sheet around the affected individual and applying force in the same direction, but in the opposite direction to the traction vector. The shoulder must be immobilized with a sling for 3 to 6 weeks, depending on the age range of the individual; older patients need less time to reduce possible shoulder stiffness(3,4,15,18-20).

Surgical Treatment

Sometimes, the dislocated humeral head creates a kind of buttonhole in the inferior capsule and nearby soft tissues, which limits closed reduction. In these cases, open reduction is indicated by increasing the capsular disruption and restoring the injured components.

Complications.

Neurovascular involvement: most patients with inferior glenohumeral dislocation show neurovascular involvement, which improves after reduction(3,20).

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UPPER GLENOHUMERAL DISLOCATION

It is an infrequent injury, even more difficult to find compared to inferior glenohumeral dislocation.

Mechanism of Injury

When an extreme force is exerted in an anterior and superior direction produced directly by the limb being in adduction, as in a fall from a certain height on the upper limb, so that the head of the humerus is directed superiorly from the glenoid cavity. This type of dislocations is associated with some fractures such as those of the clavicle, trochleter, trochlea as well as the coracoid process and injuries of the acromioclavicular joint. It is also classically presented with soft tissue alterations such as biceps tendon, rotator cuff, glenohumeral capsule and musculature.

Clinical Assessment

The affected individual usually arrives with the upper limb in adduction, which is shortened. Examination reveals a palpable humeral head above the acromion. Neurovascular lesions are common and should be ruled out in any case.

Image Evaluation

Traumatologic series of the affected shoulder consisting of projections:

- Anteroposterior; allows to clarify the diagnosis by showing the dislocation of the humeral head above the acromion.
- Scapular in Y.
- Axillary.

Radiographs should be evaluated meticulously to rule out associated fractures, which are common and may not be detected in the exploration because of the generalized pain in the shoulder.

Treatment

Closed reduction should be attempted with analgesics and sedatives to allow for better reduction; axial traction in the inferior direction with countertraction can be generated along with a lateral traction component. As with inferior dislocations, soft tissue injuries and associated fractures are common; an irreducible dislocation may require open reduction.

Complications

Neurovascular complications, due to traction injuries, usually occur and subsequently return to normal after reduction(3).

CONCLUSIONS

The shoulder joint is frequently associated with dislocations, representing a large percentage of all dislocations, with anterior shoulder dislocations being the most common. Anatomical, clinical and imaging knowledge play an important role in the diagnosis, allowing a better classification of the type of dislocation, which has a better impact on the treatment. The immobilization and physiotherapeutic approach will vary depending on the pathology, the patient's age, the existence of recurrence and other complications.

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