Glenohumeral Instability – an Overview

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Contents

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Introduction

Glenohumoral dislocation is defined as
a complete loss of contact between the glenoid
and the humeral head. The dislocation may be
traumatic, non-traumatic or voluntary. It may
be uni-directional, anterior-posterior or infe-
rior, or multi-directional. Subluxation implies
a partial loss of contact between the joint sur-
faces. Instability is an impression expressed
by the patient. Objectively it may range from
fleeting episodes of subluxation to outright
dislocation. Laxity is a clinical finding where
more than "normal" passive motion or transla-
tion may be generated during the physical
examination [1].

    Most anterior dislocations are of traumatic ori-
gin. The circumstances of the dislocation will give
useful indications as to the extent of the damage
inflicted upon the joint. Usually the dislocation is
caused by a fall on the outstretched hand. In some
areas a high prevalence of sports injuries of
a specific type is found. Mountainous and Nordic
regions will see winter sports-related dislocations
while in other areas the injury-producing activities

will be soccer or rugby. Interestingly shoulder dislocations at the workplace are relatively uncommon.

Age is an important factor: Younger patients tend to have higher recurrence rates for antero-inferior dislocations than older patients. Young patients tend to dislocate a previously healthy shoulder in a high energy trauma causing cartilaginous and capsuloligamentous damage while older patients will dislocate after low energy falls because of a pre-existing degenerative changes or torn rotator cuff.

The first episode of dislocation is usually due to a memorable traumatic event but the following tend to occur with decreasing amounts of trauma, some patients reporting dislocations after turning in bed. The patient must be questioned as to the frequency of unstable or dislocating events. This information is useful, in assessing the amount of ligamentous insufficiency, for example. High energy injuries such as rugby tackles or high speed ski falls are more likely to produce fractures of the glenoid than a countered overhand pass [2]. Patients with an accompanying fracture of the greater tuberosity tend not to recur.

It is imperative to know whether the patient has been able to reduce the dislocation by himself or whether he had to be reduced in a hospital setting under anaesthesia. It is also important to have the patient precisely describe the events leading to the dislocation. This will often not be possible for patients that are victims of seizures; the origin of which needs careful appraisal.

Family history is important; other family members may have had episodes of shoulder dislocations or recurrent sprains of other joints indicating familial laxity, congenital malformations or even Marfan's syndrome [2, 3].

The examiner must question the patient attentively as to the existence of apprehension. Some patients may come to fear that even raising the arm above shoulder level will cause dislocation. This is important information before proceeding with the physical examination, an iatrogenic dislocation in the examining room is a particularly embarrassing situation!

Clinical Examination of the Post-Traumatic Unstable Shoulder

In the non-acute setting *inspection* of the seated patient's shoulder will reveal global muscular atrophy, a tell-tale sign of upper extremity disuse, due to the apprehension associated with multiple of dislocations. Deltoid atrophy will indicate an axillary nerve injury. The position of the humeral head should be noted and in case of a prominent coracoid and a posterior fullness a posterior dislocation may be suspected. An anterior fullness and a subacromial depression are pathognomonic of a chronic anterior dislocation. Atrophy of the supraspinatus and infraspinatus fossae are indicative of a rotator cuff tear or supraspinatus nerve injury and fullness all around the joint represents an effusion.

Strength in internal and external rotation, abduction, antepulsion and retropulsion should be assessed isometrically with the arm at the side. At the same time the examiner observes the contractions of the different muscles. Loss of strength in a particular direction may signal a tendinous or neurological injury.

Range of motion is first tested actively. Limitations may be linked to an underlying glenohumeral or subacromial disorder. The onset of *apprehension* signals the limits of passive range of motion testing. In cases of instability the range of motion of the shoulder should not be limited except for the apprehension that occurs in abduction and external rotation with the arm above the horizontal. Generally in the normal situation, elevation does not exceed 170° and if so laxity is suspected. External rotation with the arm at the side exceeding 85° is certainly indicative of capsular laxity. *Gagey's sign* is positive when abduction is unilaterally greater than 90° with a blocked scapula [4, 5]. An *anteroposterior drawer test* is then performed to evaluate laxity [6]. Usually it is not possible to subluxate the shoulder anteriorly but posteriorly the compressive

abduction-adduction test may cause a "clunk" accompanied by pain or discomfort. *Jobe's apprehension re-location test* is most informative and assesses inflammation or scarring of the anterior capsule-labro-ligamentous complex [7, 8]. The shoulder of the supine patient is brought to 90° of abduction and maximal external rotation. At some point, the patient will feel a painful sensation. The examiner then presses his palm on the humeral head, chasing it posteriorly; this produces immediate relief and external rotation can be maximized painlessly. *O'Brien's test* explores the labrum, the bicipital insertion and the AC joint. The physician standing behind the patient applies a downward pressure on the maximally-internally rotated and pronated upper extremity in 90° of elevation and 10°–15° of adduction. The provoked pain should disappear when the pressure is applied to the arm in the same position with the arm in external rotation with the extremity maximally supinated [9].

The rotator cuff and acromioclavicular joint are checked clinically for integrity and stability [1, 2].

Always keep in mind that an acutely dislocated shoulder may be accompanied by severe collateral injuries. Stretching or tearing of the brachial plexus or axillary nerve occurs especially in the elderly or after high energy injuries. The axillary artery or vein may be torn with the ensuing well-known problems if not diagnosed at an early time. Erecta type dislocations may entail a passage of the humeral head through the ribs into the thorax and even into the abdomen. Caution must be exercised in this situation. With these possible additional injuries in mind, a careful neurological and vascular examination must be undertaken for every patient presenting with a shoulder dislocation [1, 11].

Investigations

Because clinical evaluation and tests are not always reliable or diagnostic, imaging modalities will be necessary to assess the existing lesions [11].

Standard X-Rays

The investigation of the painful and unstable shoulder includes standard X-rays, and specialized studies. AP and axillary views are mandatory to evaluate the joint space, the glenoid and the humeral head. Bony Bankart lesions are best seen on the AP view and Hill-Sachs lesions are evaluated on the axillary view. Other standard views developed the pre-CT era such as the Y view, the transthoracic view, the Westpoint view or the Bernageau views all still retain their usefulness to delineate glenoid rim or humeral head defects [1, 12–14].

Computed Tomography

CT scan will allow accurate description of any bony abnormalities (Hill-Sachs, reverse Hill-Sachs or bony Bankart lesions of the antero-inferior glenoid). Arthro-CT will outline cartilage defects, labral fissures or tearing and capsular stretching by delineating the intervening pouches.

Magnetic Resonance Imaging

MRI and athro-MRI will be used to image capsulolabral lesions as well as cartilage defects. The rotator cuff is also well delineated. Muscle atrophy or changes are well highlighted by both CT and MRI [15].

In case of clinical suspicion vascular studies as well as electroneurological studies might prove necessary to fully evaluate the patient's condition.

Patho-Anatomy of Shoulder Instability

Unstable shoulders present a multitude of capsuloligamentous and bony lesions identified by plain X-ray, MRI, CT or by direct observation, either arthroscopic or open.

In many cases of antero-inferior instability a bony trough in the posterior-superior region of
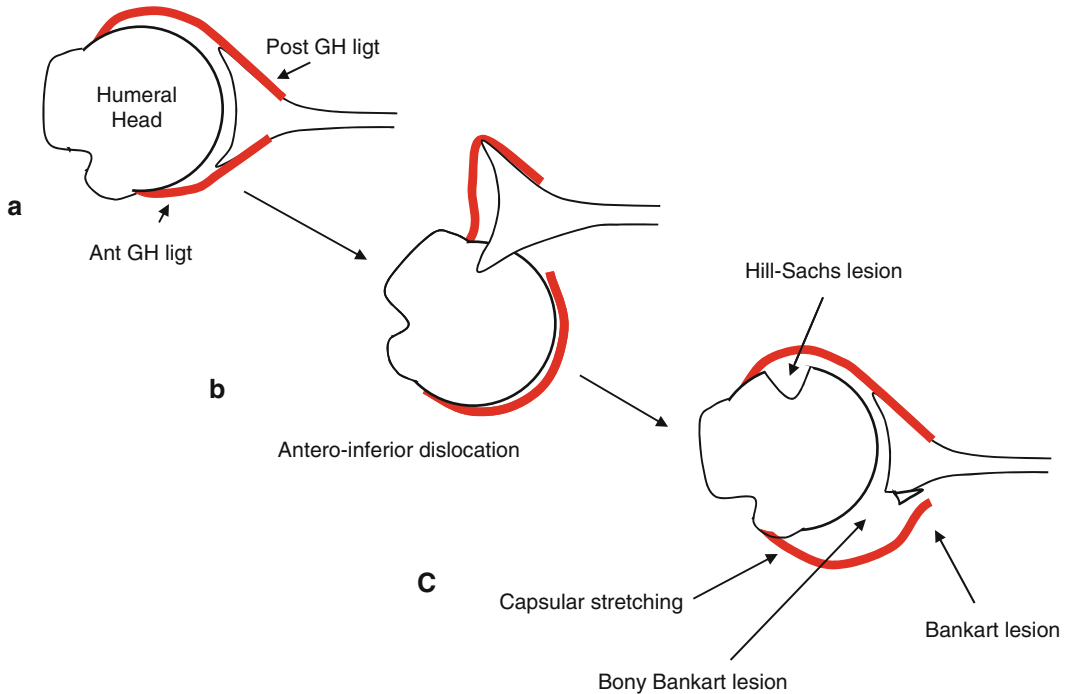
Fig. 1 Mechanism of sequellar lesions leading to recurrence of anterior dislocations (**a–c**). Pre-dislocation situation (**a**). Dislocation: Impaction of the humeral head against the glenoid or Hill-Sachs lesion, bony and ligamentous Bankart lesions due forceful passage of the humeral head (**b**). Sequellar lesions: Capsular stretching and loss of glenohumeral ligamentous and/or bony integrity responsible for recurrence (**c**)

the head may be caused by the impaction of the humeral head against the glenoid rim which if violent enough can fracture off the greater tuberosity: The *Hill-Sachs lesion*. With MRI bony oedema without actual fracture may be seen at the antero-inferior glenoid and in the postero-superior head region, corresponding to impacts and spongiosa oedema without fracture (Fig. 1). In rare cases a fracture of the coracoid may be seen in association with a dislocation usually after a seizure. An isolated *coracoid fracture* should always prompt the question: Was this due to a self- reduced dislocation? Appropriate measures and investigations should be undertaken.

The *Bankart lesion* is defined as an avulsion of the antero-inferior labrum from the anterior rim of the glenoid with a disrupted periosteum. Bony lesions are also frequent with the *bony Bankart* lesion involving a fracture of the antero-inferior glenoid due to the violent passage of the head during an episode of dislocation. Multiple passages may also erode the glenoid to give it a rounded appearance. A defect of the glenoid may thus appear and augment giving rise in some cases to an "*inverted pear*" appearance. The *Perthes lesion* is an antero-inferior labral avulsion continued by a peeling off of the intact periosteum from the anterior glenoid neck. The anterior labrum periosteal sleeve avulsion (*ALPSA*) is an avulsion of the antero-inferior labrum that is displaced and rolled over medially. The humeral avulsion of the glenohumeral ligament (*HAGL*) is a peeling off of the inferior glenohumeral ligament on its insertion on the humeral neck. The superior labral tear from anterior to posterior (*SLAP*) represents various levels of avulsion of the proximal attachment of the long head of the biceps on the glenoid which may be associated with glenohumeral
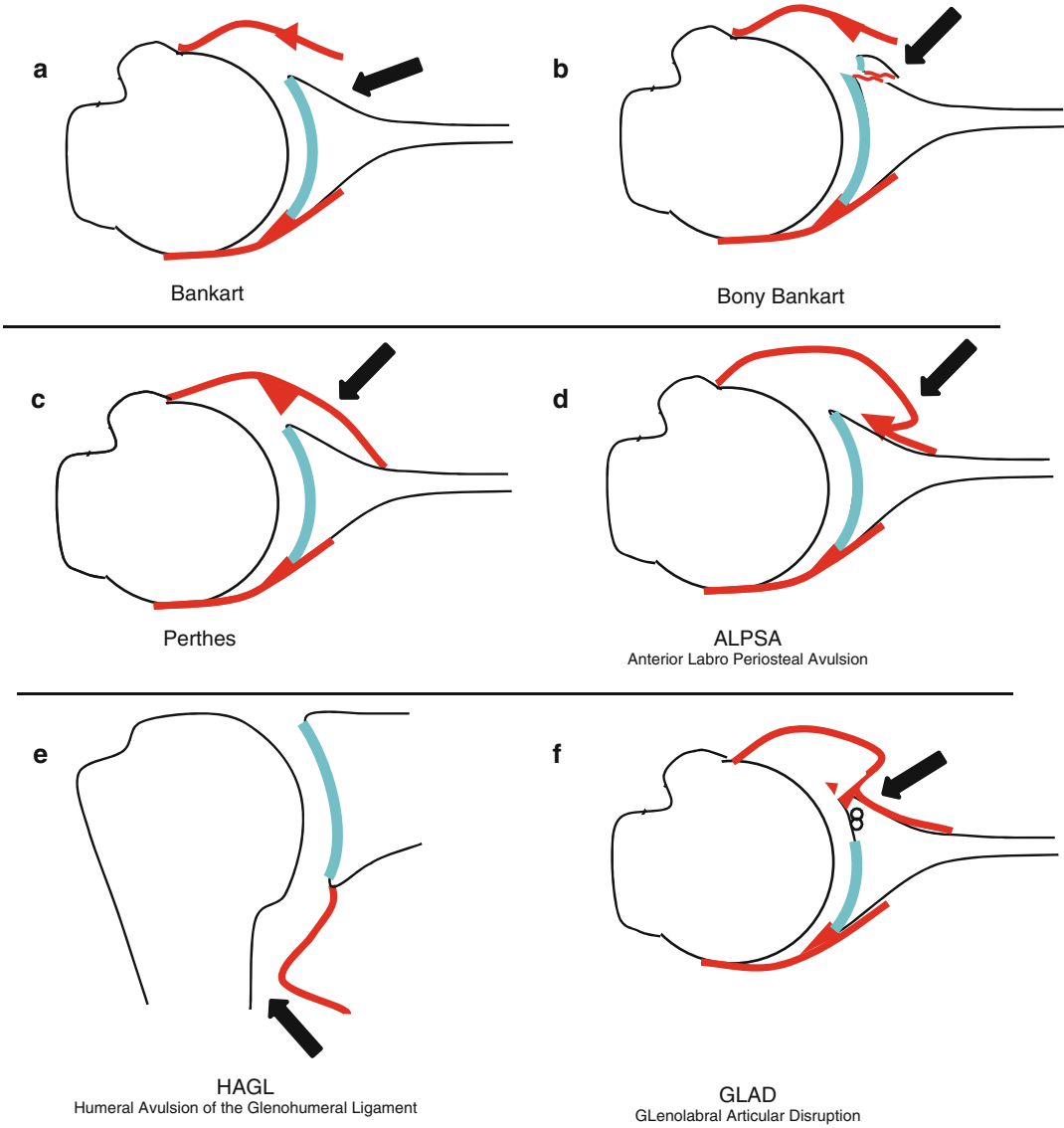
Fig. 2 Patho-anatomy of traumatic instability (**a–f**). *Bankart* lesion (*Arrow*) (**a**). *Bony Bankart* lesion (*Arrow*) (**b**). *Perthes* lesion (*Arrow*) (**c**). *ALPSA A*nterior **l**abrum **p**eriosteal **s**leeve **a**vulsion (*Arrow*) (**d**). *HAGL H*umeral **a**vulsion of the **g**lenohumeral **l**igament (*Arrow*) (**e**). *GLAD Gl*enolabral **a**rticular **d**isruption (*Arrow*) (**f**)

dislocations. Shoulders with multi-directional instability will present large and distended capsular pouches. The lesion glenolabral articular disruption (*GLAD*) was first described by Neviaser as a superficial tear of the antero-inferior labrum with an associated injury of the adjacent glenoid articular cartilage. As a rule this lesion is not associated per se with instability but is the cause of shoulder pain [9, 12, 14, 16–21] (Fig. 2).

Dislocation and Instability Types

Anterior Dislocation

This is usually related to sports activities (soccer, skiing etc.) or falls. Recurrence rates are high in patients below 20 years (up to 90 %), between 20 and 40 years 60 %
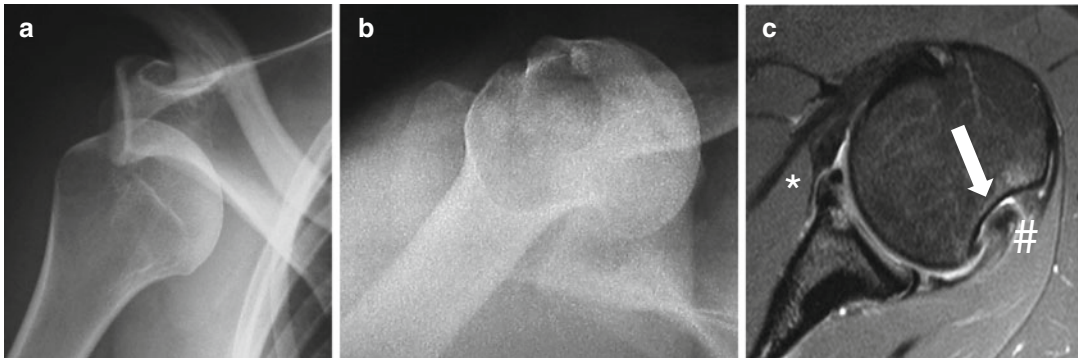
Fig. 3 Anterior dislocation (**a**, **b**). Anteroposterior (**a**) and axillary view (**b**). MRI (**c**) depicting a Hill-Sachs lesion (*arrow*) and a GLAD lesion (*) (For definition see text). A partial avulsion of the infraspinatus is also present (#)

recurrence rates, above 40 years 10 %. These numbers vary depending on the authors but trends remain [1, 2, 22].

Clinical examination is dominated by apprehension in abduction and external rotation. Signs of generalized laxity are often present: Anteroposterior drawer, inferior sulcus sign, joint hyperlaxity (fingers, thumb, and elbow).

In acute cases plexular or axillary nerve injury occurs in 5 % of patients. Imaging involves AP and axillary views (Fig. 3). Arthro-CT scans delineate precisely bony morphology of fractures; Hill-Sachs lesions, glenoid brim fractures or rounding-off are well visualized. MRI may be helpful to image the rotator cuff and the capsulolabral soft tissue lesions but demonstrate poorly bony lesions.

Closed reduction techniques for acute antero-inferior dislocations abound and should only be performed after precise neurovascular testing: Care-axillary nerve! (Fig. 4). Some of the more popular techniques are briefly described below:

Hippocrates: With the patient under general anaesthesia, traction is exerted on the arm in slight abduction and elevation with the operator's heel simultaneously pushing in the axilla or better with an aide pulling on a folded bed sheet placed around the axilla). This manoeuvre is traumatic should only be performed when other non- traumatic techniques have failed [23].

Fig. 4 Axillary nerve injury. Area of cutaneous sensate deficit or numbness on the lateral aspect of the shoulder after an axillary nerve neurapraxia following an anterior glenohumeral dislocation. This zone may be quite small and its identification requires meticulous assessment

Stimson: Patient lies prone with arm left hanging down; 1–3 kg weights are taped to the wrist for traction [24, 25].

Saha: In this technique a slow elevation in the plane of the scapula is performed [26].

Kocher: This is a classical technique but seen by many as dangerous. It consists in adducting the dislocated arm in internal rotation followed by abduction in external rotation [23]).

Davos (*Boss-Holzach-Matter method*): The patient in sitting position hands locked by intertwining his fingers around his ipsilaterally flexed knee with elbows extended is then instructed to let himself gradually lean backwards [27].

All of these techniques may be facilitated by an intra-articular injection of lidocaïne or equivalent [25].

Post-reduction treatment includes, after neurovascular testing, immobilisation in internal rotation or in an external rotation splint. The rationale for the external rotation immobilisation is to force the Bankart lesion to stay fixed to the anterior glenoid rim pressured in place by the subscapularis [28, 29]. Immobilisation should be 2–4 weeks followed by strengthening exercises [24].

Caution

Closed reduction manoeuvres after an *inaugural* episode should be approached with caution. A fracture may be associated and it is prudent to obtain an X-ray before embarking on manoeuvres that could have disastrous results. Beware of interpositions of the labrum, subscapularis, rotator cuff, biceps tendon or other structures that may result in a widened joint space on the post-reduction X-ray [30].

Surgical Stabilisation

Indications for surgical stabilisation of recurrent antero-inferior dislocations include one episode of dislocation too many, or severe apprehension. Techniques include capsuloplasty, Bankart lesion re-fixation and bony augmentation if there is severe rounding-off or fracture of the glenoid rim. Open or arthroscopic techniques are both suitable. Balg and Boileau have delineated the conditions where open repair is more suitable than arthroscopic repair. Factors such as patient age less than 20 years, competitive or contact sports, forced overhead activity, shoulder hyperlaxity, a Hill-Sachs lesion present on an anteroposterior radiograph of the shoulder in external rotation with loss of the sclerotic inferior glenoid contour, all tend to indicate open repair with a bone block (Latarjet-Bristow) according to these authors [31, 32]. Closed arthroscopic techniques are advocated in traumatic Bankart lesions, open techniques are recommended in cases of capsular stretching or of large Hill-Sachs lesions. Recurrence rates range between 5 % and 30 % depending on the type of technique used, solidity of reconstruction and patient compliance.

Patients are immobilized from 3 to 6 weeks in internal rotation; rehabilitation emphasizes muscular strengthening in the first weeks followed by range of motion exercises. Patients are advised to avoid contact sports for a year following stabilisation [33–41].

Posterior Dislocation

Posterior dislocation is relatively rare; less than 5 % of all instabilities. Falls on the outstretched hand, epileptic seizures or electrical shocks are the main causes of posterior dislocations. Aprehension can be elicited in adduction and internal rotation in posterior instability. When dealing with locked or chronic posterior dislocation one has to be beware of the diagnosic difficulties: The cardinal signs are active and passive limitation of external rotation, fixed abduction and limitation of supination.

AP shoulder X-rays and especially axillary views are the mainstay of the diagnosis. On the AP view the diagnosis may be missed by the unwary even though the joint space is not visible because of overlapping with the glenoid rim. The axillary view is *always* diagnostic. Scapular Y views and transthoracic views are often misinterpreted. In case of doubt a CT scan will solve the issue (Cadet, [13, 42–44]).

If a small (i.e. less than 10 % of head surface) reverse Hill-Sachs impaction fracture is present, gentle traction will generally reduce the shoulder which should then be immobilized in an external rotation splint for 3–6 weeks. Rowe has suggested keeping the affected arm at the side in

neutral rotation fixed with a wide tape across the back [45]. A rehabilitation programme should follow with muscle strengthening and range of motion exercises.

Indications for surgical stabilisation of a posterior dislocation are an irreducible dislocation or recurring dislocations. When no major reverse Hill-Sachs lesion is present an open posterior approach with a cruciate capsulorraphy and fixation of the reverse Bankart lesion may be performed. A bone graft taken from the spine of the scapula or of the iliac crest may be necessary if a bony defect is present [46, 47]. Arthroscopic stabilisation is also an option in experienced hands [48].

If a larger reverse Hill-Sachs lesion is present, a McLaughlin procedure will be necessary and if insufficient an adjunct posterior procedure may be required. The McLaughlin operation consists in suturing the subscapularis tendon into the reverse Hill-Sachs defect. This creates an adequate barrier for any recurrence. Neer has modified the technique where the lesser tuberosity is osteotomized along with the subscapularis attachment and screwed into the defect. The shoulder is then immobilized in neutral, or slightly external, rotation for 6 weeks followed by a rehabilitation programme [47, 49, 50] (Fig. 5).

Multi-Directional Instability

This is a clinical entity formally identified by Neer and Foster [51]. The patient complains of a loose and unstable shoulder in multiple positions such as external rotation and abduction, adduction and internal rotation. Frequently, patients report pain, discomfort, apprehension and even paraesthesiae in the hand especially when carrying loads with the arm at the side. On clinical examination, external rotation is more than 90° both in the R1 (Arm at the side) or in the R2 position (Arm at 90° of abduction). Further clinical tests include the inferior sulcus test; the patient expresses discomfort as the examiner pulls down the arm held at the side

creating a subacromial sulcus. For these signs indicative of laxity to be clinically relevant, they must provoke patient discomfort [51–53] (Fig. 6).

Standard X-rays, arthro-CT or MRI will delineate the existing lesions. Surgery is indicated only after 1 year of serious muscle strengthening physiotherapy and exercises [51, 54].

The most commonly accepted operation is Neer's capsular shift which may be performed through an anterior deltopectoral approach but in certain cases may need an adjunct posterior approach. The axillary nerve must be protected during this demanding and complex intervention. Six weeks of immobilisation in neutral (handshake) position is necessary which should be followed by a muscle- strengthening programme. In experienced hands arthroscopic techniques may be used [51, 54, 55].

Voluntary Dislocation

This is usually encountered in adolescents and young adults who have found a way to dislocate their shoulder joint posteriorly. This is used by the patient to relieve psychic tensions (Tic), to show off to their friends and family or both. Treatment should consist of re-assurance and counselling to avoid dislocating the joint as this augments capsular laxity. Physiotherapy may be helpful. Sometimes psychiatric help may be needed. Surgery should be avoided at all costs because of the near 100 % recurrence rate.

Some patients will evolve to involuntary dislocation after a period of voluntary dislocation. This is due to excessive capsular stretching. Physiotherapy and re-harmonization exercises should be started. If not effective, an operative intervention consisting of a capsular tightening procedure such as a capsuloplasty (Described below), may be advocated. The surgeon must be certain however that the voluntary aspects of the dislocation have disappeared.

Positional dislocation may be falsely diagnosed as voluntary dislocation. Some patients will dislocate their shoulder posteriorly only in a certain
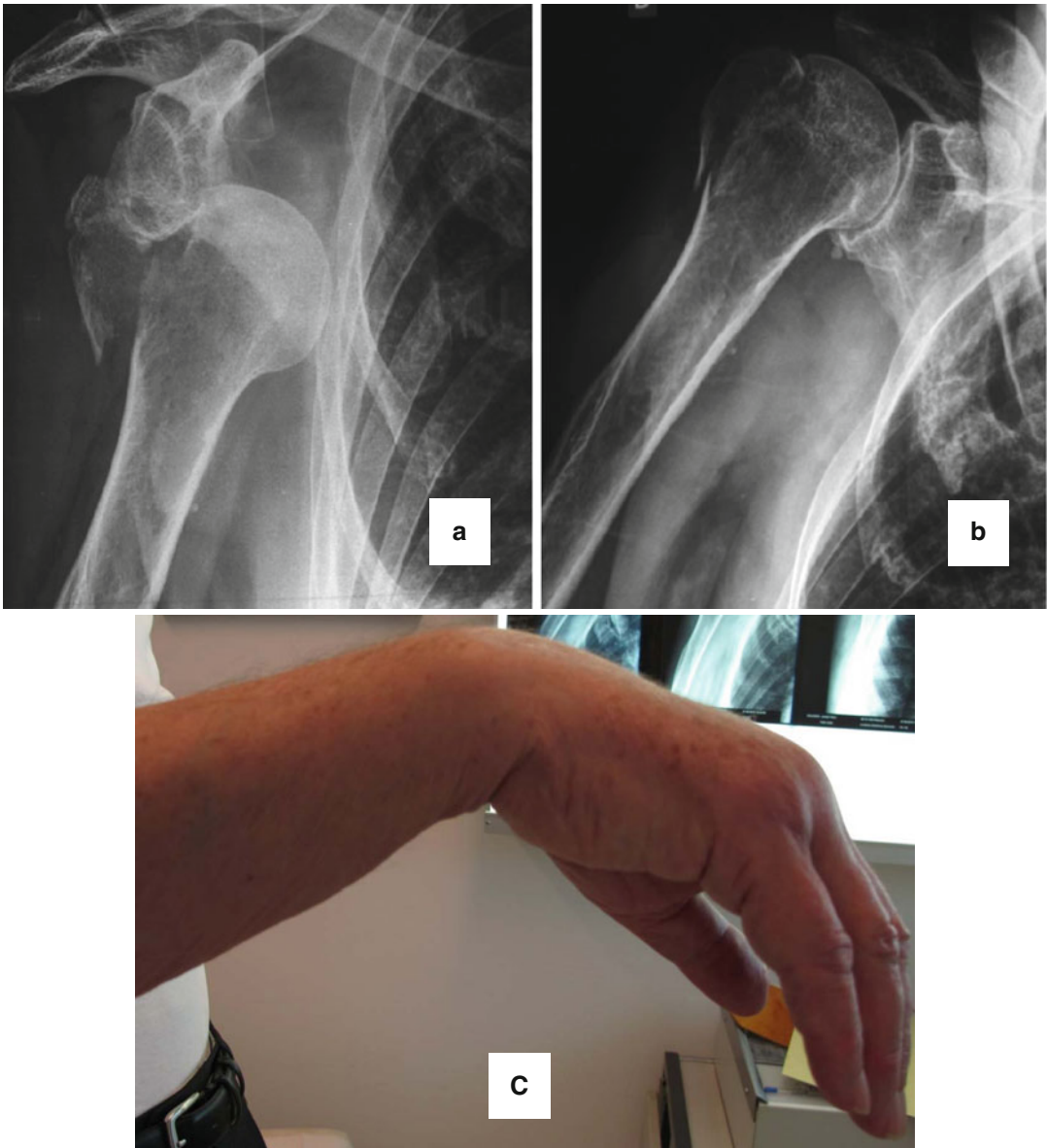
Fig. 5 Anterior fracture dislocation associated with neurological injury (**a**–**c**). Anterior dislocation with an associated fracture of the greater tuberosity (**a**). Reduction (**b**). Associated paraesthesiae and loss of strength due a radial nerve injury causing a wrist drop (**c**)

position usually in 90° of forward flexion, slight adduction and internal rotation. In this position with a lax capsule combined with a glenoid defect or hypoplasia, the humeral head will tend to dislocate. Again after thorough investigation and adequate physiotherapy a stabilizing capsuloplasty procedure may be performed [56].

Recurrent Dislocation in the Elderly Patient

Often these dislocations are associated with minor trauma. A massive rotator cuff tear is the usual cause. If repairable the supra- and infraspinatus lesions should be repaired. If not repairable the
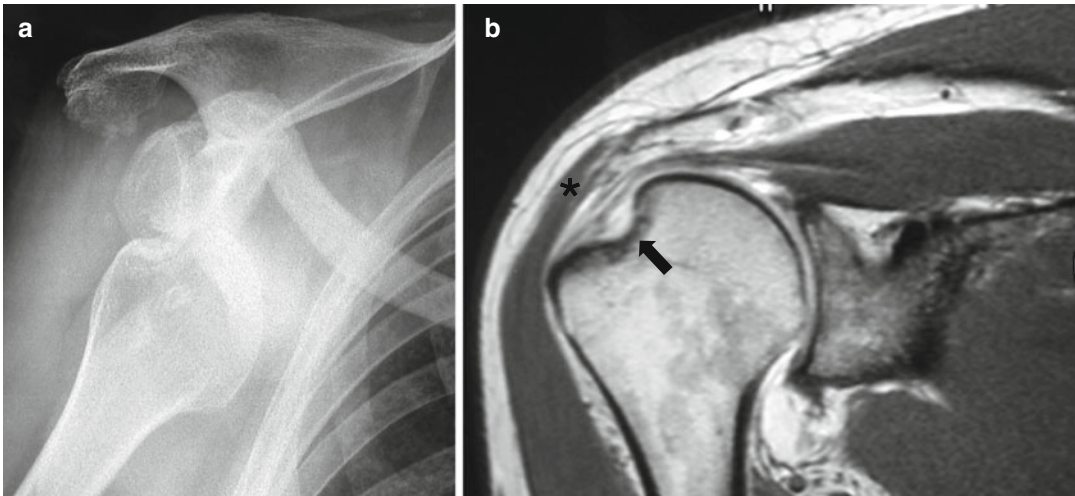
Fig. 6 (AB) Anterior dislocation (**a**), with resulting rotator cuff tear (*) and Hill-Sachs impaction (*arrow*) in an elderly patient (**b**)
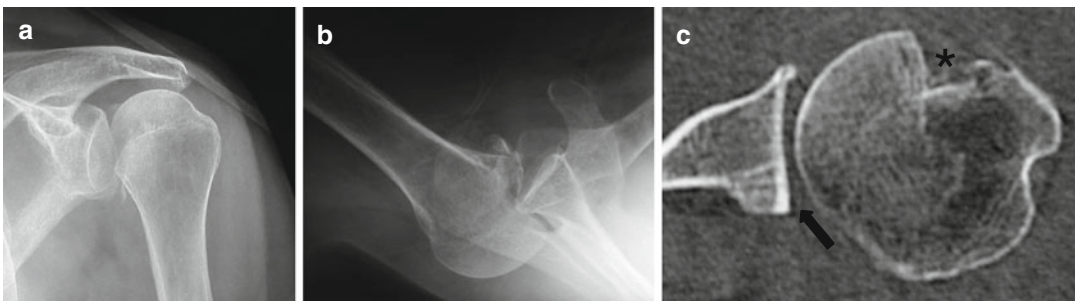

Fig. 7 Posterior dislocation (**a–c**). Anteroposterior (**a**) and axillary view (**b**). The CT (**c**) depicts dislocation sequellae: Reverse Hill-Sachs fracture impaction (*) and glenoid impaction (*arrow*)

reverse prosthesis may be an option and if not glenohumeral fusion may have to be performed [57] (Fig. 7).

Chronic Dislocation

This condition is usually seen in debilitated, neglected or epileptic patients. The dislocation may be anterior or posterior. Closed reduction is usually not successful and attempts at reduction may even be dangerous after some weeks in a chronically dislocated shoulder. In many cases the best option may be no treatment, the patient adapting to the situation. It is often surprising to see how much mobility is preserved.

In cases of a *chronic antero-inferior* dislocation with pain and discomfort, open reduction with a rotator cuff repair and glenoid augmentation procedure using a coracoid transfer or an iliac bone graft, may be attempted. A prosthetic replacement may also be used. It is prudent to use a bigger head than usual in a little more retroversion. Some authors advocate the reverse prosthesis but the danger of postoperative dislocation remains a high risk.

In cases of *chronic posterior* dislocation a McLoughlin procedure is indicated whereby, after open reduction, the detached subscapularis is fixed into the reverse Hill-Sachs impaction fracture, the Neer variation involves osteotomizing the lesser tuberosity and fixing it into the anterior
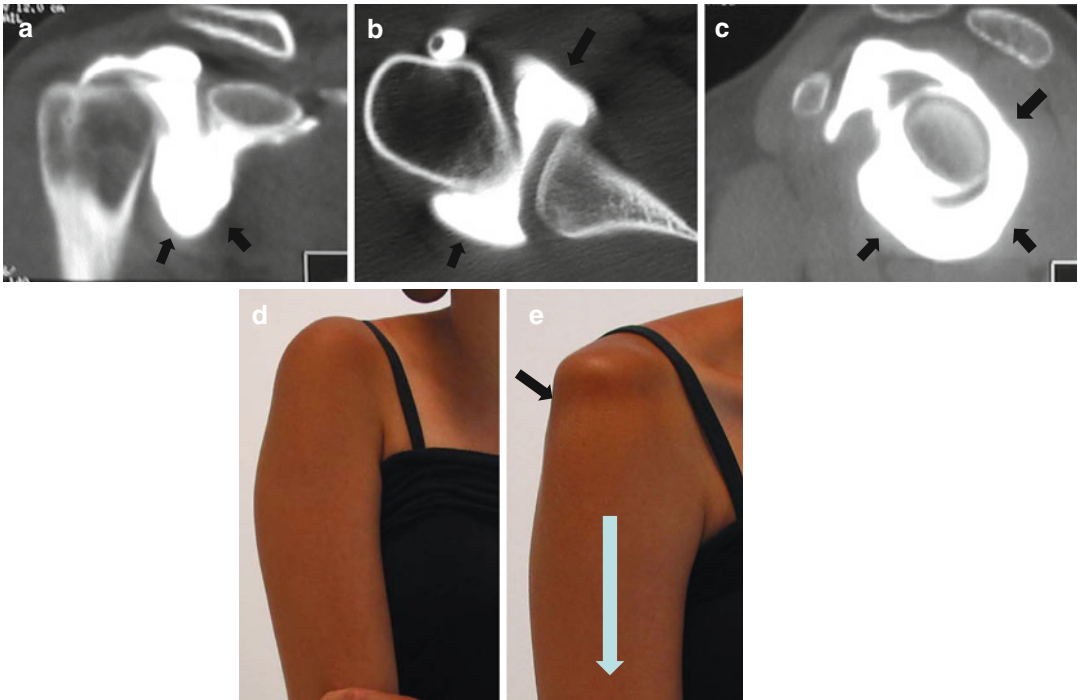
Fig. 8 Multi-directional instability (**a–e**). Arthro-CT demonstrates a large capsular pouch (*arrows*) seen in the transverse (**a**), frontal (**b**) and sagittal (**c**) cuts. Normal contour (**d**), Sulcus sign produced by pulling down on the arm held at the side (**e**)

impaction area with screws. When the head impaction is too large, i.e. more than 30 % or 50 % of the head surface, a hemi-prosthesis can be inserted. A larger head with a little less anteversion is a wise choice. Some authors advocate a reverse prosthesis but the risk of dislocation is significant. In cases of major instability with avulsed rotator cuff tendons a shoulder fusion may be contemplated [47, 58, 59].

Complications of Glenohumeral Dislocations

Neurovascular complications are common; most pertain to infra-clinical lesions of the axillary nerve. Plexular lesions may occur and are more frequent in elderly patients. Rarely vascular lesions may occur after a dislocation with the axillary artery being either sectioned (rarely) and more frequently presenting intimal tears leading to arterial occlusion. Post-immobilisation or post-operative stiffness can occur in patients not following the rehabilitation regimen. Late-onset post-dislocation arthritis of varying intensity may occur in a fair number of patients up to 100 %. In most instances this radiographic finding is clinically irrelevant but it may become symptomatic, needing specific treatment [60–65] (Fig. 8).

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