Management of acute anterior shoulder dislocation

Benan Dala-Ali,1 Marta Penna,1 Jamie McConnell,2 Ivor Vanhegan,1 Carlos Cobiella1

ABSTRACT
Shoulder dislocation is the most common large joint dislocation in the body. Recent advances in radiological imaging and shoulder surgery have shown the potential dangers of traditional reduction techniques such as the Kocher’s and the Hippocratic methods, which are still advocated by many textbooks. Many non-specialists continue to use these techniques, unaware of their potential risks. This article reviews the clinical and radiographic presentation of dislocation; some common reduction techniques; their risks and success rate; analgesia methods to facilitate the reduction; and postreduction management. Many textbooks advocate methods that have been superceded by safer alternatives. Trainees should learn better and safer relocation methods backed up by the current evidence available.

INTRODUCTION
Shoulder dislocation is the most common large joint dislocation in the body, with an incidence of 1.7%1 or 8.2–17 per 100 000 per year.2–3 Practitioners should be aware of the potential complications and risks of different reduction techniques and that they know a safe technique that they are confident in performing.

Recent advances in radiological imaging and shoulder surgery have shown the potential dangers of traditional reduction techniques such as the Kocher’s and the Hippocratic methods, which are still advocated by many textbooks. Many non-specialists continue to use these techniques, unaware of their potential risks.

We review the clinical and radiographic presentation of dislocation, some common reduction techniques, their risks and success rate, analgesia methods to facilitate the reduction, and postreduction management.

PATHOANATOMY
The bony architecture of the glenohumeral joint allows for a large range of movement but confers little inherent stability. The shoulder thus relies on a network of critical structures to steady it: both static (such as the glenoid labrum and glenohumeral ligaments—see table 1) and dynamic (chiefly the rotator cuff muscles). Their compromise can lead to traumatic dislocation and even recurrent instability.4 5

CLINICAL PRESENTATION
Ninety-six percent of all shoulder dislocations are anterior,6 and the patient typically describes a fall onto an outstretched arm. Posterior dislocation can occur following a fall, electrocution or seizure.

The patient will have pain on movement and have an obvious shoulder deformity. Clinical examination typically reveals a ‘squared-off’ deformity. The humeral head may be both visible and palpable anteriorly, while the acromion may be prominent laterally, with a cavity inferiorly where the humeral head would normally lie.

It is important to check for neurovascular damage, particularly of the axillary nerve, which provides sensation to the ‘regimental badge’ region of skin over the inferior part of deltoid (figure 1). Arterial damage is rare, but has been reported,7 and should be assessed by palpating the radial pulse and assessing capillary refill time (CRT) in the fingers of the injured side. If there is any doubt, an urgent surgical review should be sought. Damage to these structures is more common in elderly patients, and in those that present with a haematoma or with an associated fracture.8–10

RADIOLOGICAL EVALUATION
Anterior–posterior, scapular (‘Y’) and axillary radiographs (table 2 and figure 2) should be requested to confirm the diagnosis and reveal any associated fractures (table 3). The scapular and axillary view will help differentiate an anterior from a posterior dislocation of the humeral head and help visualise the position of the humeral head in three-dimensional space in relation to the glenoid fossa.

Pre-reduction radiographs are recommended in all first-time dislocations, patients over 40 years old and following high-energy trauma. A large retrospective case–control study over 5 years found that significant fractures occur more commonly in these groups and are present in approximately one-quarter of shoulder dislocations overall.11 Post-reduction radiographs are recommended, both to ensure successful reduction and to confirm that no fracture has been caused by the procedure.

An orthopaedic opinion is recommended in the presence of a fracture dislocation, to ensure that reduction does not lead to further damage (table 4). For example, attempting to reduce a dislocation with a humeral head fracture could lead to possible avascular necrosis of the humeral head, and increase risk of neurovascular damage. A prospective study with extensive electrophysiological assessment found that 45% of patients with associated fractures also sustained nerve damage.9

The most common injuries associated with dislocation are Bankart and Hill-Sachs lesions. During an anterior dislocation the humeral head is forced anteriorly out of the glenoid socket, potentially causing damage to the anterior capsule and labrum of the glenoid rim (Bankart lesion). As the final, posterior part of the head is forced out of the joint, it can collide with the anterior aspect of the glenoid rim, leading to a compression fracture of the posterior aspect of the humeral head (Hill-Sachs lesion). Hills-Sachs lesions can be seen...
on plain radiographs; their presence signifies an increased risk of recurrent shoulder dislocation. A MRI scan is required to visualise a Bankart lesion, and to assess the ligaments and muscles around the shoulder joint. Damage to the glenoid labrum (the Bankart lesion) and the inferior glenohumeral ligament (the primary stabiliser of the shoulder with an outstretched arm) have been reported in 90–97% of anterior dislocations of the shoulder.51 2 Between 14 and 65% of acute anterior shoulder dislocations are associated with rotator cuff tears with the incidence increasing in older patients (over 40 years) and to lesser extent female gender.13–16 As a consequence, it is imperative to clinically evaluate the rotator cuff function after a dislocation. Some authors advocate ultrasound screening of patients with first-time dislocations over the age of 40 years.15 17 Shoulder MRI is generally recommended on all young, active first-time traumatic dislocators, as it provides accurate and detailed images of the joint, which assist the surgeon in deciding whether an open or arthroscopic exploration (+/− repair) of the joint is necessary to prevent recurrence of the problem. CT scans are also useful in assessing the extent of glenoid damage.18 19 However, some surgeons may opt to proceed directly to surgery without the scans.

### ANALGESIA AND SEDATION

Appropriate relaxation of the musculature is the key to successful reduction. This can be achieved safely in several ways (table 5). The method used depends on the patient, the clinician’s preference and the equipment available at the time of reduction.

### No analgesia

Some surgeons prefer not to use any analgesia at all, thereby avoiding the potential side effects caused by analgesic agents. This is only possible in specific circumstances, for instance in atraumatic, early (within 6 hours) and recurrent dislocations. However, only a reduction technique with minimal traction should be employed (such as Milch’s or scapular technique) by an experienced clinician in these circumstances. O’Connor et al20 reported successful reduction of 76 consecutive acute anterior shoulder dislocations without any analgesia using Milch’s traction technique (see below).

### Table 1 Pathoanatomy: static stabilisers of the shoulder

<table>
<thead>
<tr>
<th>Origin</th>
<th>Insertion</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coracohumeral ligament</td>
<td>Base of coracoid process</td>
<td>Greater tuberosity (a few fibres to LT)</td>
</tr>
<tr>
<td>Superior GH ligament</td>
<td>Supraglenoid tubercle</td>
<td>Lesser tuberosity (on medial ridge of intertubercular groove)</td>
</tr>
<tr>
<td>Middle GH ligament</td>
<td>Supraglenoid tubercle</td>
<td>Lesser tuberosity (just inferior to SGHL)</td>
</tr>
<tr>
<td>Inferior GH ligament complex</td>
<td>Anterior and posterior glenoid labrum and glenoid neck</td>
<td>Inferior margin of articular surface humerus and anatomic neck</td>
</tr>
</tbody>
</table>

LT, lesser tuberoisty; GH, glenohumeral; SGHL, superior glenohumeral ligament.

### Table 2 Radiographs

<table>
<thead>
<tr>
<th>Radiographic view</th>
<th>What it shows</th>
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<tbody>
<tr>
<td>Anterior–posterior (AP) view</td>
<td>Beam taken from anterior to posterior</td>
</tr>
<tr>
<td>Scapular view—‘Y’</td>
<td>View taken parallel to scapular Y or ‘Mercedes Symbol’ formed by coracoid, body and spine. Glenoid located in centre of the Y</td>
</tr>
<tr>
<td>Axillary view</td>
<td>Radiograph taken with at least 15° of abduction through the axilla to a plate on top of the shoulder</td>
</tr>
<tr>
<td>True AP—‘Grashey’</td>
<td>The x-ray beam is directed perpendicular to the plane of the scapula by laying the scapula flat on the cassette and centring the beam on the coracoid process. This view reveals a better separation between the humerus and glenoid</td>
</tr>
<tr>
<td>West point axillary view</td>
<td>Radiograph taken at a tangent to the anterior-inferior glenoid rim to help define the extent of glenoid bone loss</td>
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</table>

Figure 1 Picture illustrating the sensational area supplied by the axillary nerve.

Figure 2 Typical anterior–posterior radiograph of an anterior dislocation.
Intravenous analgesia and sedation

A survey of UK trauma clinicians found that the most popular methods were intravenous analgesia (primarily opiates) with sedation (primarily benzodiazepines). This combination is highly effective, but side effects include respiratory depression and continued reduced consciousness following reduction, which necessitates continuous monitoring, both during the procedure and until the patient is fully alert. This can be time-consuming and requires an assistant to manage the patient’s airway.

Nitrous oxide and oxygen (Entonox)

Advantages include rapid onset of pain relief, ease of use and non-invasive administration. There are minimal side effects. A recent prospective study comparing nitrous oxide/oxygen with the common intravenous agents showed significantly reduced time in the emergency department (77 vs 177 min). A prospective randomised trial demonstrated adequate analgesia for 80.9% of successful relocations.

Intra-articular analgesia

This has recently grown in popularity. Local anaesthetic (10 ml of 1% lidocaine) is infiltrated into the glenohumeral joint through a lateral approach. This is a safe, effective, has few side effects and avoids the need for monitoring the airway. It also provides the opportunity to drain a haemarthrosis; however, there is a risk of introducing infection. Studies looking at the efficacy of intra-articular analgesia generally exclude fracture dislocations in their studies and there is currently insufficient evidence for its use with fractures. Experienced clinicians can use this method outside the hospital, for instance on a sports field, where monitoring facilities are not available. However, caution is warranted given the potential risk of infection. A recent meta-analysis and a Cochrane review have shown that intra-articular analgesia permits the same pain control and reduction success as intravenous agents, while markedly reducing time in the emergency department and treatment cost. There were fewer adverse effects and no cases of infection. Recent in vitro research has demonstrated that local anaesthetic agents can lead to chondrotoxicity in the joint. There is a greater risk of chondrolysis with longer exposure to a higher concentration of anaesthetic, for instance, with a post-operative pain pump, than with a single injection.

TECHNIQUES FOR THE RELOCATION OF THE SHOULDER

The optimal technique should be quick, effective, simple to perform and should require minimal force, analgesia and assistance.

Throughout the years, many different techniques have been described, dating as far back as Hippocrates in 460 BC. The newer techniques are essentially adaptations of earlier methods which have evolved, thanks to modern imaging modalities that have enabled complications to be identified. The techniques can be classified into two main groups: leverage and traction.

LEVERAGE

Kocher’s technique

Instruct the patient to flex the elbow of their injured arm and adduct it against the side of the body. Then slowly externally rotate the arm (push the forearm outwards) until you feel resistance. Then, keeping the forearm externally rotated, lift the arm across the chest. Finally, internally rotate the forearm so that the hand is placed on the opposite shoulder (figure 3).

This technique is popular and effective, and has been known since 1870. However, it can lead to complications including humeral shaft fractures, axillary vein rupture and rotator cuff lesions. The techniques can be classified into two main groups: leverage and traction.

<table>
<thead>
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<th>Table 3</th>
<th>Fractures associated with anterior shoulder dislocations</th>
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<tr>
<td>Fracture</td>
<td>What is it?</td>
</tr>
<tr>
<td>Greater tuberosity fracture</td>
<td>Rotator cuff avulses its bony attachment</td>
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<tr>
<td>Hill-Sachs deformity</td>
<td>Compression fracture on posterior-lateral of the humeral head</td>
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<td>Neck of humerus fracture</td>
<td>Fracture of the surgical or anatomical neck of the humerus</td>
</tr>
<tr>
<td>Bankart lesions</td>
<td>Damage to the anterior capsule and labrum of the glenoid rim</td>
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<table>
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<th>Table 4</th>
<th>Indications for orthopaedic consultation</th>
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<td>Indication</td>
<td>Examination</td>
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<tr>
<td>Arterial injury</td>
<td>Clinical assessment for 6Ps (pain, pallor, pulselessness, paralysis and perishing in cold)</td>
</tr>
<tr>
<td>Humeral neck fracture</td>
<td>Radiological assessment</td>
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<tr>
<td>Nerve injury</td>
<td>Clinical assessment for brachial nerve damage (especially axillary nerve)</td>
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<td>Late presentation (&gt;1 week)</td>
<td>History from patient</td>
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<th>Table 5</th>
<th>Sedation and analgesia: advantages and disadvantages of each drug</th>
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<td>Agents</td>
<td>Examples</td>
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<tr>
<td>Inhalation</td>
<td>Entonox</td>
</tr>
<tr>
<td>Intravenous analgesia + sedation</td>
<td>Opiates, pethidine/ Midazolam, ketamine</td>
</tr>
<tr>
<td>Intra-articular local anaesthetic</td>
<td>Lidocaine, marcaine</td>
</tr>
<tr>
<td>Nerve block and General anaesthetic</td>
<td>Propofol</td>
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</table>

cuff and pectoralis major rupture. As a result, many surgeons now prefer alternative methods.

There have been several adaptations of this method. Leidelmeyer advocated gentle, smooth traction to the arm while externally rotating it, omitting the final adduction and internal rotation steps of Kocher’s technique, and thus avoiding unnecessary torque.

Milch’s technique
The patient lies supine. Place your hand on the injured shoulder, fixing the head of the humerus in position with a thumb. Then slowly and smoothly abduct and externally rotate the injured arm over the patient’s head. Once the arm is completely abducted overhead, the rotator cuff muscles will be relaxed such that the humeral head can be easily and atraumatically pushed over the glenoid rim back into the joint (figure 4).

This technique, first described by Cooper in 1825, became popular when Milch reintroduced it in 1938. The key to the success of this technique is the total relaxation of the shoulder muscles. The muscles are optimally balanced and relaxed at full shoulder abduction. Limitation of muscle spasm reduces the amount of force required to reduce the shoulder, reducing the risk of iatrogenic injury. There are numerous case series showing high success rate and minimal analgesia requirements. A recent systematic review comparing Milch’s with Kocher’s techniques found no statistical difference in effectiveness, but recommended Milch’s technique for its lower complication rate.

Other leverage techniques
The Cunningham technique, first described in 2003, relies on gentle massage to relocate the shoulder. The doctor kneels next to the seated patient who has a fully flexed elbow and adducted arm. The doctor’s wrist is rested on the patient’s forearm and massages the shoulder muscles, thus elongating them and removing dynamic obstruction. The humeral head reduces painlessly and without traction, although it may take some time for the patient to relax. The original report only included a small sample size of five patients.

TRACTION
The principle aim of traction is to counteract the muscle spasms which prevent the shoulder from returning to its normal anatomical position.

Hippocratic technique
Place the injured arm in approximately 45° of abduction and apply a firm and steady traction force. Traditionally, a foot in the axilla acted as counteraction; this has been linked to brachial plexus and axillary vessel injury and so is generally discouraged. A less traumatic alternative is to use a folded sheet held by an assistant (figure 5). A further modification is for the
patient to hang their injured arm over the back of a chair and then stand while their wrist is held by the doctor.\textsuperscript{41}

Another similar method is the Snowbird technique. The patient is again placed on a chair and asked to support his affected arm. A Stockinette tubular bandage is placed on the patient’s wrist, with the elbow held at 90° of flexion. The patient is then asked to stand up while the physician’s foot is placed in the stockinet loop to provide downward traction. This method was successfully employed at the Snowbird Emergency Department in the USA to reduce 97% of 118 anterior dislocations with no complications.\textsuperscript{42}

**Stimson technique**

This simple technique, first described in 1900,\textsuperscript{43} requires little effort from the physician. Place the patient prone, with the injured arm hanging off the edge of the bed, pointing towards the ground. This places the shoulder in flexion. Apply 10lb of traction to the patient’s wrist (figure 6). After 5–10 min the shoulder will painlessly relocate due to muscle relaxation.

**Scapular manipulation technique**

Place the patient as in Stimson’s technique. However, once the patient is relaxed, push the inferior tip of the scapula medially and inferiorly, while holding the superior and medial edge of the scapula stationary\textsuperscript{44} (figure 7). This rotates the scapula so that the glenoid faces inferiorly and accepts the inferiorly displaced humeral head.

A case series involving 51 patients showed a 92% success rate with this technique with no complications.\textsuperscript{44} To date, there has been only one comparative study of scapular manipulation versus Kocher’s technique; this found that both methods are successful but the scapular manipulation technique less painful.\textsuperscript{45}

**Other traction techniques**

The Spaso technique was introduced in 2001. It is similar to Milch’s method, but with the application of some traction. The patient is placed in the supine position and the arm is slowly lifted towards the ceiling. The physician applies traction while holding the wrist and slowly externally rotating the arm. A case series involving 52 patients found a 75% success rate of relocation using this method without anaesthesia or assistance and no reported complications.\textsuperscript{46} This is a modern and potentially useful technique; however, there is limited evidence at present to support its use.

The Eskimo technique is another type of traction technique. The patient lies laterally on their unaffected side and then the physician, standing on a stool, grasps the wrist of the affected side and pulls upwards, lifting the shoulders off the floor. Poulsen described the technique in 1988 and reduced 17 of 23 dislocations using intravenous sedation.\textsuperscript{47} Despite its success and simplicity, there is little about it in the literature.

Manes introduced his method in 1980, specifically intended for the frail elderly patient.\textsuperscript{48} After adequate analgesia and muscle relaxant, the surgeon stands behind the seated patient and inserts a flexed forearm into the axilla of the patient’s affected side. The surgeon’s free hand is placed on the flexed forearm of the patient and gentle traction applied. The
Once the shoulder has been relocated, radiographic confirmation is advised. A study involving 73 patients found that 37.5% of fractures could only be seen in the post-reduction radiographs.

Traditionally, the arm was immobilised in a sling or collar and cuff with the shoulder in adduction and internal rotation (figure 8). Recent studies from the USA and Japan recommend shoulder immobilisation in external rotation (figure 9), which may reduce the rate of redislocation. Cadaveric and MRI studies have shown improved healing of the torn labrum to bone and reduced haemoarthrosis and Bankart lesions with immobilisation in external rotation.

A small prospective randomised study showed no recurrence in those immobilised in external rotation compared with 30% in internal rotation. However, a recent larger randomised controlled trial (RCT) found that immobilisation in external rotation did not reduce the rate of reoccurrence following first-time traumatic shoulder dislocation.

A Cochrane review found insufficient evidence to inform choice of immobilisation and recommended more good-quality trials on the subject.

**FOLLOW-UP**

All dislocations should be followed up in the outpatient’s department after 1 or 2 weeks for a clinical assessment, with a further appointment after 3 months to check for stability of the joint. An MRI scan of the shoulder may be performed to evaluate the full extent of an injury in young active patients with traumatic first-time dislocations.

There is weak evidence (level 4 and 5) that return to sport is safe once motion and strength are nearly normal; however, there remains an increased risk of recurrence while playing. A small study found that most young athletes were able to return to their sport within 10 days after intense physiotherapy; however, one-third suffered from recurrent instability.

The risk of recurrence for primary anterior shoulder dislocation is highest with young patients, with up to 87% being noted within 2 years with conservative treatment. Studies have found patients younger than 20 years showed a shorter interval to redislocation and a higher frequency of dislocation, with recurrence rates as high as 83% and 90% in two large series.

Other factors found to increase the risk of recurrence includes participation in contact sports and occupational overhead activities.

Arthroscopic shoulder surgery outcomes have improved through the years and it is now common to proceed with an early arthroscopic exploration, especially in young, active patients and repair of any shoulder damage, to help prevent recurrence of the dislocation. A recent survey found that 19% of British trauma clinicians would recommend an early arthroscopy for first-time shoulder dislocations. A Cochrane review identified four well-conducted trials, and recommended surgery on young, active, male adults. The review found that those who underwent surgery after their first dislocation had more stable

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**Table 6** Textbook recommendations

<table>
<thead>
<tr>
<th>Textbook</th>
<th>Technique 1</th>
<th>Technique 2</th>
<th>Technique 3</th>
<th>Technique 4</th>
<th>Technique 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical fracture treatment</td>
<td>Kocher</td>
<td>Hippocratic</td>
<td>Stimson</td>
<td>Milch</td>
<td>X</td>
</tr>
<tr>
<td>Emergency medicine: the principles of practice</td>
<td>Spaso</td>
<td>Stimson</td>
<td>Kocher</td>
<td>Milch</td>
<td>X</td>
</tr>
<tr>
<td>Oxford handbook of emergency medicine</td>
<td>External rotation</td>
<td>Kocher</td>
<td>Milch</td>
<td>Scapular</td>
<td>Stimson</td>
</tr>
<tr>
<td>Musculo-skeletal problems in emergency medicine</td>
<td>Modified Kocher</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Rosen’s emergency medicine: concepts and clinical practice</td>
<td>Stimson</td>
<td>Milch</td>
<td>Liedelmeyer</td>
<td>Snowbird</td>
<td>Scapular</td>
</tr>
<tr>
<td>Pocketbook of orthopaedics and fractures</td>
<td>Kocher</td>
<td>Hippocratic</td>
<td>X</td>
<td>X</td>
<td>X</td>
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**Figure 9** A photograph showing immobilisation in external rotation.
CONCLUSION

The key to successful reduction is relaxation of the patient. Experienced clinicians may attempt reduction initially without any analgesia or sedation. If unsuccessful, one could then proceed to intra-articular analgesia, as it has proven to be safe and effective in reducing the shoulder.

Orthopaedic follow-up should be arranged for one or two weeks after the injury.

Young athletes should undergo an arthroscopic exploration.

and functionally better joints compared to those who were treated conservatively.67

There is strong evidence in favour of arthroscopic evaluation and primary surgical repair following such injuries.68–70 A level 1 RCT demonstrated recurrent dislocation in 3% at 2 years in those treated surgically versus 54% in those treated conservatively. At 10 years’ follow-up, subjective function was good or excellent in 70% of surgically treated cases versus 75% unsatisfactory outcome in conservatively managed cases.70

It is important to be aware of the potential complications and risks of different reduction techniques. Traditional techniques such as Kocher’s are effective but with potential complications and therefore should not be encouraged. Newer methods are safer and just as effective.

Many textbooks advocate methods that have been superseded by safer alternatives (table 6). Trainees should learn better and safer relocation methods backed by the current evidence available.

Correction notice An uncorrected version of this paper was mistakenly uploaded to Online First. Our apologies to the author for this oversight.

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