The Occasional elbow reduction

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INTRODUCTION

Elbow dislocations are the second most common joint dislocation in adult and paediatric populations with a prevalence of 5/100,000.[1] Simple posterior elbow dislocations are the most common and have a good prognosis for recovering full range of motion if treated appropriately.[2,3] Compromise of the neurovascular bundles and missed elbow fractures are highly associated with reduced range of motion, subsequent surgeries and prolonged pain. Thus, physical examination and review of X-rays are critical components in treating elbow dislocations.[4] In rural settings lacking orthopaedic surgery coverage, acute dislocations are commonly treated with closed reduction and temporary stabilisation if surgery is required.

ANATOMY AND PHYSIOLOGY

The elbow is a complex joint consisting of three articulations: radiocapitellar, ulnohumeral and proximal radioulnar joint, providing pivoting motion, flexion/extension and supination/pronation respectively.[5] The elbow is stabilised through bony structures, medial collateral ligament (MCL) and lateral collateral ligament (LCL). The LCL consists of annular ligaments, radial collateral ligament, accessory LCL and lateral ulnar collateral ligament (LUCL) which provide stability to the elbow through a range of motion. The LUCL also provides resistance to varus stress and posterolateral rotatory instability.[5]

The anterior compartment of the elbow contains the brachial artery, median and ulnar nerve while the posterior compartment contains the radial artery and nerve. The brachial artery is responsible for extensive collateral circulation of the arm.[6]

Elbow dislocations are classified by the direction of dislocation, ligamentous injury and concomitant fractures. Simple dislocations have associated ligamentous injury while complex dislocations have an associated fracture. Most elbow dislocations in adults and children are posterior and posterolateral by the mechanism of force applied on an outstretched hand, also known as FOOSH, causing damage to the LUCL and MCL.[2,3,7]

Anterior and divergent elbow dislocations are rare but highly associated with fractures and neurovascular compromise. Fall on a flexed elbow should have a high index of suspicion for an anterior dislocation. In children, Monteggia fractures are the most common type of anterior dislocation with fracture to the proximal ulna and anterior radial

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head dislocation.[1] Divergent dislocations are a separation of the proximal radius and ulna by the humerus, most commonly seen in children.[8]

Coronoid, radial head and head and avulsion fractures of the medial and lateral condyles are the most common fractures associated with posterior elbow dislocation in adults.[1,9] The so-called 'terrible triad' is a subtype of elbow dislocation defined by posterior dislocation with LUCL tear, radial head fracture and coronoid tip fracture.[10] Approximately 50% of paediatric elbow dislocations are accompanied by a fracture, most commonly of the medial epicondyle.[3]

DIAGNOSIS

A FOOSH mechanism, high-impact collisions and non-accidental injuries in both adults and children should raise a high index of suspicion for an elbow dislocation.[11] Patients with elbow dislocations commonly present holding their arm in 45° flexion, with forearm shortening and a prominent olecranon.[12] Disruption of the equilateral triangle between the olecranon and distal humeral epicondyles compared to the non-affected side can indicate dislocation.[13] Screen for signs of compartment syndrome of the forearm including tense, tender and swollen tissues, pain out of proportion to injury, and pain not relieved by analgesia, rest or anti-inflammatories.[14] Compartment syndrome is a surgical emergency.

Neurovascular assessment of the affected arm includes radial and ulnar pulses compared bilaterally, capillary refill, motor assessment including finger flexion, extension, abduction, adduction and thumb flexion at interphalangeal with first digit distal interphalangeal flexion and sensation over the medial and lateral palmar hand and dorsum of the hand. Collateral circulation of the forearm can account for peripheral pulses, cap refill and warm pink palms regardless of vascular injury to the elbow. Vascular injury cannot be ruled out with the presence of a pulse but complete ischaemia is infrequent.[11] In children, a pink, pulseless hand is an indication of collateral circulation with disruption to the brachial artery requiring surgical consultation.[11] Damage to the ulnar and median nerves is most common in closed dislocation, also requiring surgical consultation if suspected.[2]

IMAGING

X-rays in anteroposterior and lateral views should be done before attempted reduction for suspected elbow dislocation or undifferentiated elbow injury. X-rays are evaluated for bony cortex, fat pads and alignment via anterior humeral line and radiocapitellar line.

Anterior humeral line

A vertical line drawn from the anterior humerus should intersect the middle third of the capitellum [Figure 1].[15] Deviations from this line can indicate a lateral condyle fracture or dislocation of the radial head as in a Monteggia fracture.[16] In children under the age of 4, the anterior humeral line can intersect with the anterior or middle third of the capitellum [Figure 1].[11]

Radiocapitellar line

Radiocapitellar lines [Figure 1] are drawn horizontally from the radial neck and should intersect with one-third of the ossification centre of the capitellum regardless of the positioning of the elbow or the radiograph being assessed.[17] Radiocapitellar lines are especially useful in the diagnosis of Monteggia fractures [Figure 1].[18]

Fat pad sign

Occult radial head fractures are commonly associated with elbow dislocations but cannot be visualised using X-ray, thus, the fat pad sign can be helpful. The anterior fat pad [Figure 1] is anterior

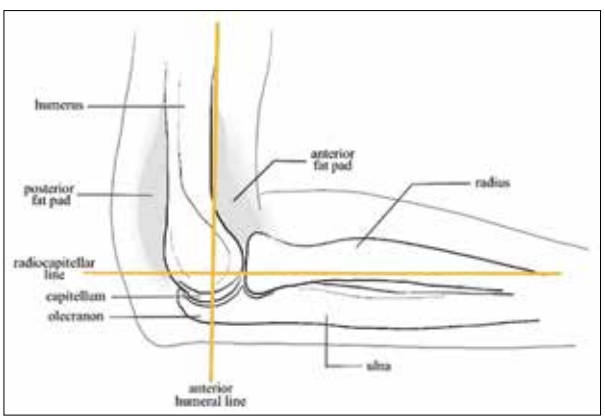

Figure 1: Illustrated anatomy of the elbow in anterior-posterior view. Anterior humeral line. Radiocapitellar line. Anterior and posterior fat pad sign.

to the coronoid and radial fossa in the radiolucent area and can be viewed in a 90° lateral X-ray. The posterior fat pad [Figure 1] lies posterior to the olecranon fossae and is not normally visible on lateral X-ray but can be visualised with flexion of the elbow.[19] Fat pad signs occur because of displacement from the joint capsule. A flailing of the anterior fat pad and visualisation of the posterior fat pad on proper lateral X-rays are indicators of disease within the joint capsule or occult non-displaced fracture.[20] The anterior fat pad sign has a sensitivity of 96%.[19] A posterior fat pad sign has a sensitivity of 87.5% for adults and 75% for paediatrics [Figure 1].[16,19]

Baumann's angle

The Baumann Angle technique is only used for paediatric elbows. Baumann's Angle is the angle between the physeal line of the lateral condyle of the humerus and the line perpendicular to the long axis of the humeral shaft. Normal Baumann's Angle ranges from 9° to 26°. A small Baumann's Angle of <9° is indicative of a paediatric supracondylar humeral fracture.[16,21] Baumann's angle has a sensitivity of 55% and specificity of 80%.[22]

INDICATIONS AND CONTRAINDICATIONS FOR CLOSED REDUCTION

Closed reductions are indicated for acute simple dislocations and recurrent instability after simple dislocation. Immediate closed reduction is also indicated for suspected neurovascular compromise to relieve stretch and impingement of the neurovascular structures.[23] If an elbow cannot be reduced in the ED or is presenting with acute instability after reduction, this suggests entrapment of soft tissue or bone within the joint requiring orthopaedic consultation. Urgent referral to orthopaedics is required for complex fracture dislocations, recurrent elbow instability, irreducible dislocations or continued signs of neurovascular compromise after reduction.

TREATMENT

The goal of a closed reduction in the emergency department is to provide timely relief to the ligaments and joint capsule of the dislocated joint and restore vascular and nerve function if affected.

Treatment of an elbow dislocation should begin with adequate analgesia and sedation. Muscle relaxation is important for this procedure. This requires informed consent, IV access, airway assessment and adequate patient monitors. The most common procedural sedation and analgesia include fentanyl and propofol.[24] Ketamine is commonly used for paediatric sedation.[24,25] If further pain management is required, intra-articular anaesthetic can be used.[1] Reduction can be performed without sedation based on patient preference, but care should be taken to reduce the number of attempts of reduction for patient comfort and risk of chondral injury.[1]

TECHNIQUES FOR CLOSED REDUCTION

Reduction of posterolateral and posteromedial dislocations should first involve correction of the lateral/medial deviation followed by traction-countertraction allowing the olecranon to pass the humeral trochlea anteriorly and distally.[2] Although rare, it is important to note the associated risk of brachial artery injury by closed elbow reduction.[26]

Supine positioning

With the patient in the supine position, several techniques can be used to attempt reduction of the elbow. Two-person traction-countertraction is done by placing the patient's arm flexed by their side [Figure 2]. One provider applies traction to the forearm or upper arm while the other provider applies traction to the distal humerus and slight downward pressure with traction to facilitate reduction. Patient-assisted reduction also can be done from the supine position. The patient lies with the affected arm flexed and towards the opposite shoulder position across the chest, with the elbow pointed upward. Provider will place traction with one hand and counter traction with the other, against the distal humerus while the patient maintains flexion.[1,27]

Prone positioning (modified Stimson technique)

Similar to that of a shoulder reduction, the modified Stimson technique requires the patient to be in the prone position with the affected arm

Figure 2: Single-provider posterior elbow reduction in the prone position.

Figure 3: Positioning for reducing a dislocated elbow.

abducted and placed over the side of the table [Figure 3]. Slow downward pressure is placed on the forearm while countertraction is placed on the distal humerus.[28] Alternatively, slow manipulation of the olecranon until reduction is achieved, with or without the use of an assistant providing traction on the humerus [Figure 2].[29] This process can take 1–10 min of slow manipulation. As it can be difficult to monitor the airway in this position, sedation is contraindicated for this technique.

POSTREDUCTION CARE AND EXAMINATION

Post-reduction range of motion assessment including varus and valgus stress and extension can be performed while the patient is sedated. All simple elbow dislocations will cause damage to the LCL and MCL making the reduced elbow vulnerable to valgus stress specifically.[2] Significant instability to range of motion may signify unstable joints that require further investigation and intervention.[2] Crepitus of the joint during the range of motion may indicate a missed fracture.[13] Post-reduction neurovascular examination and repeat X-rays are used to assess for proper reduction and missed fractures.

The arm is splinted in a posterior long arm splint, with the arm positioned at 90° flexion with slight pronation. Mobilisation of the joint can begin as soon as tolerated, preferably within 1 week of dislocation. While immobilisation provides greater pain relief, early mobilisation has been associated with less extension deficits, greater range of motion and greater fitness for work.[4]

Follow-up X-rays at day 5 and day 14 are recommended to ensure proper reduction and stabilisation of the joint. This is especially important in paediatric and elderly patients.[2]

GUIDELINES AND TIMELINE FOR REFERRAL

Elbows that are stable post-reduction have a good prognosis for recovery.[30] Immediate referral or consultation of orthopaedic surgery is recommended for complex elbow dislocations, unstable elbows post-reduction and suspected neurovascular compromise. The neurovascular compromise includes pink-pulseless hands before or after closed reduction and deficits of the median, radial or ulnar innervation.

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