Assessment and decision making in the unstable elbow: management of simple dislocations

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Abstract

Simple elbow dislocations are usually treated conservatively. Radiographs are negative in simple dislocations. Results are generally good, although a small percentage of patients may develop chronic instability. Ligamentous repair can be indicated in high demand patients or if the elbow remains unstable following a closed reduction. Chronic instability is classified per their direction. Surgery is often indicated in the chronically unstable elbow.

Keywords

elbow, instability, ligament

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Introduction

Elbow instability can be acute or chronic. Clinical examination and treatment options greatly depend on the differentiation between acute and chronic. Acute dislocations can often be treated conservatively. Ligamentous repair can be indicated and often leads to good results. Patients presenting with chronic instability have often had failure of conservative treatment. Surgery can be more complex because ligaments may be scarred and retracted so that a direct repair may no longer be an option. Several mechanisms can lead to an elbow dislocation, or chronic instability in a later stage. Elbow dislocations can be classified as simple or complex. Simple dislocations occur in approximately 75%¹ to 70%² of cases. By definition, there is no associated fracture in simple dislocations. When there is an associated fracture, the dislocation is classified as being complex. Chronic instability patterns are usually classified according to their direction. Varus or valgus instability patterns or posterolateral and posteromedial rotatory chronic instability patterns are possible.

treatment and outcome of complex fracture dislocations are often dictated by the associated fracture (Fig. 1). Fractures can include the distal humerus, radial head, proximal ulna or coronoid process. As stated above, the majority of elbow dislocations are classified as simple dislocations, without an associated fracture (Fig. 2).

Schreiber et al.³ analyzed online video footage of patients whose traumatic episode was filmed and posted online. They were able to analyze 62 patients and found the most common mechanism of an elbow dislocation to be an axial and valgus force on an extended elbow.³ This typically leads to a rupture of the medial structures, including the medial collateral ligament (MCL) or the flexor-pronator mass. In these patients, the lateral structures may remain intact.⁴ Another common mechanism includes a rotatory force from a fall on the semi-flexed elbow, with the forearm supinated.⁵ In this case, the lateral collateral ligament (LCL) complex needs to rupture for the elbow

Acute Instability

Aetiology

Acute instability usually arises from a traumatic incident, such as a fall on the outstretched hand. The

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Figure 1. Anteroposterior radiograph of an elbow after a complex elbow dislocation. The elbow has been reduced and is congruent but there is a medial condylar fracture (courtesy of MoRe Foundation).

Figure 2. Anteroposterior radiograph of a simple elbow dislocation (courtesy of MoRe Foundation).

to dislocate. It is possible for the elbow to dislocate when the MCL remains intact.

Diagnosis

A dislocated elbow will be clearly deformed and the diagnosis can often be made by inspection alone. Palpation of the osseous structures will further reveal the deformity of the joint. Larger fractures can often be palpated as well. As a general rule, the medial

epicondyle, olecranon tip and the lateral epicondyle form a straight line when the elbow is extended and an isosceles triangle with the elbow flexed at 90°. The patient may not be able to actively move the elbow and will be very apprehensive with attempted passive motion. As a rule, we do not mobilize the elbow when a fracture or a dislocation is suspected. However, it is very important to perform a thorough neurovascular examination before imaging studies are ordered. A radial pulse should be present. An absent radial pulse with a cold hand may indicate a brachial artery blockage or rupture. The wrist and fingers are extended to rule out radial nerve palsy. The O-sign is indicative for median nerve function. Froment's sign and active spreading of the fingers can be used as tests for the ulnar nerve.

Radiographs (Fig. 2) are the first choice of imaging if a dislocation is suspected. If this does not show any clear fractures, the elbow can be reduced under general anaesthesia or sedation. Radiographs should be repeated after a successful reduction (Fig. 1). The threshold to obtain more advanced imaging is low when an associated fracture is suspected. Computed tomography (CT) scanning with three-dimensional reconstructions may reveal a subtle coronoid or radial head fracture that was not visible on plain radiographs (Fig. 3). Magnetic resonance imaging is usually not indicated but may be useful to analyze the status of the ligaments if the elbow remains unstable and surgery is contemplated (Fig. 4).

Treatment

The first line of treatment for a simple dislocation is a closed reduction. We prefer to do this under general anaesthesia. One hand cups the proximal ulna and applies traction in line of the humerus. This dislodges the forearm from the distal humerus. The other hand of the investigator subsequently applies traction in line with the forearm. Unless there is an interposed bony fragment or soft tissue, reduction is usually performed with relatively little force. Stability is evaluated once the elbow is reduced. The elbow is taken through a full range of flexion to extension with the forearm in neutral rotation. Rotational, varus or valgus stress are avoided. Because of the bony anatomy, the elbow is more stable in flexion and becomes increasingly unstable when it is moved to extension. It is not uncommon for the elbow to dislocate once it is brought into full extension. If the elbow remains stable to full extension, we prefer conservative treatment. If the elbow 'spontaneously' dislocates at flexion angles higher than 30° of flexion, early surgical repair is usually advocated.⁶ The decision to perform surgery obviously also depends on the patient and surgery may be indicated sooner in manual labourers or high performance athletes.^{7,8}

Figure 3. Three-dimensional reconstruction computed tomography image showing a small coronoid fracture (courtesy of MoRe Foundation).

Figure 4. Magnetic resonance imaging of an elbow still in plaster following a closed reduction of a dislocated elbow. This image shows a complete rupture of the medial collateral ligament and lateral collateral ligament complexes and clear bony edema in the posterior part of the capitellum (courtesy of MoRe Foundation).

The decision to immobilize the elbow is multifactorial. It has been shown that immediate mobilization of the elbow does not increase the risk of recurrent instability^{9–12} and may lead to improved functional results.¹⁰ However, if the patient is very apprehensive or if the elbow is extremely swollen and painful, a short period of immobilization in a posterior splint may still be

indicated.¹³ A recent randomized controlled study compared immobilization of 3 weeks with immediate mobilization. Although functional recovery was faster in the immediate mobilization group, there was no difference after 1 year,¹¹ showing that a short period of immobilization will not necessarily lead to detrimental results.

In our practice, if the elbow is immobilized, the splint is removed in less than 1 week and the elbow is re-examined. Swelling will have decreased compared to the initial phase, although often there is some residual swelling. The contours of the joint are palpated and should be normal. There will still be some apprehension when the elbow is moved from flexion to extension. Because of this, full extension can usually not be achieved. Tracking of the elbow should be normal within the limited range of motion and crepitus should be absent. Routine radiographs are again taken to evaluate the position of the joint. At this point, the joint may still show some degree of subluxation.¹⁴ This is not necessarily pathological and avoidance of valgus stress and stabilizing exercises are usually sufficient to restore stability.¹⁵ We do not routinely use stress radiographs to evaluate acute instability but these may be indicated in some patients. Dynamic fluoroscopic control could also offer additional information on the instability pattern and tracking of the joint. If there is any doubt on the severity of the instability, the patient may again be sedated and a clinical and fluoroscopic examination under anaesthesia may be performed.⁷

Conservative treatment

There is no clear consensus on the necessity to protect the elbow following a simple dislocation. Some advocate a sling for comfort only and immediate unrestricted motion of the elbow.^{11,12} Patients are instructed not to abduct the shoulder because this increases varus stress on the elbow. In our practice, we use a dynamic brace (Fig. 5) as the basis for conservative treatment of the dislocated elbow.¹⁶ A progressive protocol is used, with a stepwise increase in extension, to mobilize the elbow. Full flexion is permitted immediately. In the first 2 weeks, extension is allowed up to 60°, followed by 30° for a second period of 2 weeks. After 4 weeks, the patient is allowed to mobilize the elbow completely. The brace is used to avoid varus and valgus stress. The brace is discontinued after 6 weeks. This progressive protocol not only serves to protect the elbow, but also is used with respect to goals that need to be reached at certain points in time. The patient should, for example, be able to extend the elbow to 30° after 4 weeks. If these goals are not reached, physiotherapy is aimed at mobilizing the elbow in the brace. Isometric exercises are started as soon as the inflammatory phase has decreased. Active contraction of the anconeus may aid to increase

Figure 5. Dynamic brace to protect the elbow when motion is permitted (courtesy of MoRe Foundation).

lateral stability^{17,18} and strengthening of the flexor-pronator group will increase medial stability.^{15,19,20}

Results of conservative treatment are considered to be good to excellent in most patients. However, in the long-term, patients may have an increased risk of degenerative arthritis of the elbow and some will still experience some signs of instability.²¹

Surgery

A surgical repair is indicated if a closed reduction is not possible or if the elbow remains grossly unstable following closed reduction. As was stated earlier, the elbow is taken through a full range of motion. If the elbow dislocates at flexion angles greater than 30°, a surgical exploration and repair of the ligaments is indicated.⁶ Other indications are patient specific, depending on their functional needs.

Surgery can be performed under general or locoregional anaesthesia. Our preference is to use a supraclavicular block because this also ensures optimal pain relief in the early postoperative period. The clinical examination is repeated to better assess the pattern of instability. Depending on this, a lateral, medial or posterior incision can be made. In patients with lateral or posterolateral rotatory, a 4-cm lateral incision is made, centred over the lateral epicondyle. The extensor tendon mass may have been avulsed from the lateral epicondyle, together with the LCL complex. The

Figure 6. Intraoperative photograph showing reinsertion of the avulsed lateral collateral ligament and extensor tendon complex. A bone anchor was used and sutures were placed lateral collateral ligament and extensor tendon mass (courtesy of MoRe Foundation).

ligament and extensor tendon mass are can be reinserted with the use of a single bone anchor (Fig. 6). In the case of medial, valgus instability, or if the elbow remains unstable even after the LCL reinsertion, a medial incision is made. The ulnar nerve is palpated prior to making the incision and protected throughout the procedure. A flexor tendon split can be performed to gain access to the MCL and medial capsule. The MCL will typically be avulsed from its humeral insertion, together with a longitudinal tear in the capsule (Fig. 7). A bone anchor is again used to reinsert the ligament and repair the capsule.

At the end of the procedure, the elbow is immobilized in a posterior splint. This is changed to a dynamic brace on the first postoperative day. Full flexion is permitted immediately. We use a progressive protocol for extension. Extension is blocked to 60° for the first 2 weeks, 30° for the next 2 weeks and full range of motion in the brace is permitted between 4 weeks and 6 weeks postoperatively.

Chronic Instability

Aetiology

Many patients will have had a traumatic incident leading to a dislocation or subluxation. Recurrent

Figure 7. Intraoperative photograph of a complete medial collateral ligament tear. A longitudinal rent in the anteromedial capsule is also visible (courtesy of MoRe Foundation).

Figure 8. Varus stress test. This test needs to be repeated in multiple angles of flexion as different structures will be responsible for stability at different angles (courtesy of MoRe Foundation).

dislocations are relatively rare but recurrent subluxations may lead to symptoms such as clicking or weakness. A second mechanism is iatrogenic injury to the LCL from multiple cortisone injections or surgery for lateral epicondylitis.

Medial instability can occur in throwing athletes. Attenuation of the MCL complex can lead to symptomatic but often subtle medial instability. With valgus stress, the olecranon will hit the side of the olecranon fossa when the elbow is brought to extension. This will lead to osteophytes and impingement. Radiocapitellar degenerative changes will occur in later stages. This is the so-called valgus extension overload syndrome.²² This can also present itself in an acute-on-chronic fashion, where the MCL acutely ruptures as a result of chronic stress and weakening of the ligament.

Finally, hyperlaxity syndromes, such as Ehlers–Danlos could lead to symptomatic elbow instability. It is important to check for signs of general hyperlaxity because the treatment of these patients may differ as a result of the changes in their native collagen.

Diagnosis

The diagnosis of chronic instability is usually made by clinical examination. The past medical history will be suggestive. Patients may have a clear history with one or multiple documented elbow dislocations. If there has not been a complete dislocation, the history may be less clear. Some patients will only have had a minor trauma with recurrent subluxations. Patients may complain of clicking or blocking of the elbow. Some patients complain of decreased strength or decreased range of motion. It is important to ask for symptoms of nerve compression, such as paresthesia or decreased sensation. Inspection of the elbow may show surgical or

trauma scars. The hand is inspected for signs of atrophy. Atrophy of the first web space is indicative for ulnar nerve pathology.

Patients may have decreased motion of the elbow. It is important to test for impingement pain at the ends of flexion and extension range of movement. Varus (Fig. 8) and valgus stress testing may reveal laxity. If generalized hyperlaxity is suspected, other signs, such as hyperextension at the knees or fingers, need to be evaluated. This is repeated in multiple degrees of flexion, because the stabilizing properties of the different structures vary depending on the position of the elbow. Valgus stress in extension may increase impingement pain in patients with medial laxity because the medial tip of the olecranon touches the medial column at the olecranon fossa.

Medial stability is tested with several specific tests. They include the milking maneuver and the moving valgus stress test²³ (Fig. 9). Lateral stability is tested with the pivot shift (Fig. 10),²⁴ posterior drawer table top, chair (Fig. 11) and push-up tests.²⁵

Standard anteroposterior and lateral radiographs are often normal but may show sign of trauma or degeneration. Calcification of the ligament may also be visible. The outcome of surgery depends on the pre-operative status of the elbow and degenerative changes will have a negative effect on the final outcome.²⁶ CT scanning may reveal loose bodies or signs of posteromedial impingement. Magnetic resonance imaging often shows scar tissue in the damaged ligament and may show cartilage lesions and hydrops.

Treatment

Treatment depends on the timing, severity and pattern of instability. Patient needs also dictate treatment.

Figure 9. Valgus stress test of the elbow (courtesy of MoRe Foundation).

Figure 10. The pivot shift test is performed by applying compression and valgus stress to the supinated forearm, when it is moved from flexion to extension (courtesy of MoRe Foundation).

Figure 11. The chair test to test posterolateral rotatory instability. The test is positive if the patient is unable to fully extend the elbow when loading, whereas unloaded extension is no problem (courtesy of MoRe Foundation).

Conservative treatment will be aimed at specific strengthening of the wrist flexors and extensors.²⁷ It has been shown that 42% of pitchers were able to return to play after 6 months of conservative treatment after a MCL tear.²⁸

Surgery may be indicated if conservative treatment fails or if it is expected to fail as a result of the severity of the instability or the needs of high demand patients. Simple repair of the medial or lateral structures may not be sufficient to achieve a fully functional result for many patients and a formal reconstruction using a tendon graft may be indicated.^{26,29} In selected cases, synthetic ligaments can also be used instead of tendon grafts.

Ligament reconstruction

Both open and arthroscopic¹³ techniques have been described to repair or reconstruct the LCL complex. In our practice, an arthroscopic technique is indicated in patients with symptomatic grade 1 or 2 posterolateral rotatory instability.^{13,30} Arthroscopic surgery has the added benefit of providing an excellent view at the joint surfaces. Loose bodies and osteophytes can easily be removed and stability can be tested under direct view. The MCL is tested with the scope in the posterior compartment. Valgus stress may open the medial joint

space if the MCL is insufficient. The drive through test is performed with the scope entering the ulnohumeral joint from the lateral gutter.³¹ This test can be positive in patients with posterolateral rotatory instability or in patients with an MCL deficiency. The adapted pivot shift test is the second way to evaluate the lateral stabilizing structures. The forearm is supinated and the elbow is moved from flexion to extension. The difference is that we now apply a varus stress. In a positive test, the joint will open and the radial head can be seen to translate posteriorly.

An open ligament reconstruction is indicated in more severe grades of lateral instability or in patients with tissue loss. Open ligament reconstruction is also indicated for patients with medial instability. Several techniques have been described. There is variation between individuals with respect to the use of grafts and fixation techniques. We use a cortical button technique with an allograft extensor hallucis longus allograft.¹³

A dynamic elbow brace is used from the first post-operative day. Unrestricted active flexion is permitted immediately, whereas extension is blocked at 60°. After 2 weeks, extension is allowed up to 30° and, in the final 2 weeks, unrestricted extension is allowed. Strength training can be started at 6 weeks and sports activities are allowed at 3 months.

In some severe cases of multidirectional instability both the medial and the lateral ligamentous complexes are insufficient. We then use a circumferential technique³² to simultaneously reconstruct both the medial and the lateral side. Postoperative rehabilitation is the same as described above. This technique is reserved as a salvage procedure.

Conclusions

The treatment of patients with symptomatic elbow instability is usually very satisfying if the correct diagnosis is made at the outset.

Patients with elbow instability are a mixed group. Acute and chronic instability require a tailored clinical examination and imaging. Conservative treatment plays an important role in the treatment of simple, acute elbow dislocations. Surgery can be indicated depending not only on the severity of instability, but also on the needs of the patients.

The treatment of symptomatic chronic elbow instability is often a surgical one. Conservative treatment has usually failed in these patients. The clinical examination of these patients must contain several specific tests to diagnose the pattern and severity of instability. Arthroscopic treatment may be useful to further objectify the diagnosis and to treat the associated pathology, such as loose bodies,

synovitis or osteophytes. Arthroscopic acute repair of the lateral ligament complex has also been described and lateral ulnar collateral ligament imbrication has been shown to be quite successful in chronic cases of grade 1 and 2 posterolateral rotatory instability.

Ligament reconstruction using a tendon graft is indicated in patients with medial instability patterns or patients with more severe types of lateral instability. A specific type of patient includes overhead athletes who may not have had an acute incidence of instability but instead a more chronic attenuation of the MCL, leading to symptomatic laxity when high loads are applied to the elbow during the throwing motion. In these patients, ligament reconstruction with a graft is often indicated once conservative treatment fails.

Finally, some patients may require both a medial and lateral reconstruction with extreme instability or tissue loss. In these cases, we perform a circumferential graft technique as a salvage procedure. Stability is often restored but the pre-operative post-traumatic changes to the elbow are usually more important with respect to the final outcome.

Declaration of Conflicting Interests

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