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# Management options of lateral Condyle Fractures

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**Abstract:** Lateral humeral condyle fractures are the second most commonly encountered elbow fractures after the supracondylar fractures in the pediatric age group. These injuries are peculiar as they are intra articular but displacement-prone owing to the forearm extensor muscles' attachment on the lateral epicondyle close to the condylar area. Thus, complications, including elbow deformity, can emerge if this condition is not appropriately treated. Diagnostic and management challenges may arise in cases of incomplete fractures and when extensive growth plate areas are involved. Understanding the injury mechanisms behind lateral humeral condyle fractures and the treatment nuances is crucial in navigating these challenges and optimizing patient outcomes. Reduction with percutaneous fixation is a minimally invasive option, mainly for Weiss type 2 and Song stages 2 to 4 fractures. Using 2 instead of 3 Kirschner wires during percutaneous fixation is recommended to achieve stability. This technique can improve the elbow's range of motion and reduce bone spur formation. The wire may be removed when clinical and radiological evidence of fracture healing has been obtained. Removal typically occurs around 4 to 6 weeks.

**Keywords:** *lateral Condyle Fractures*

## Introduction

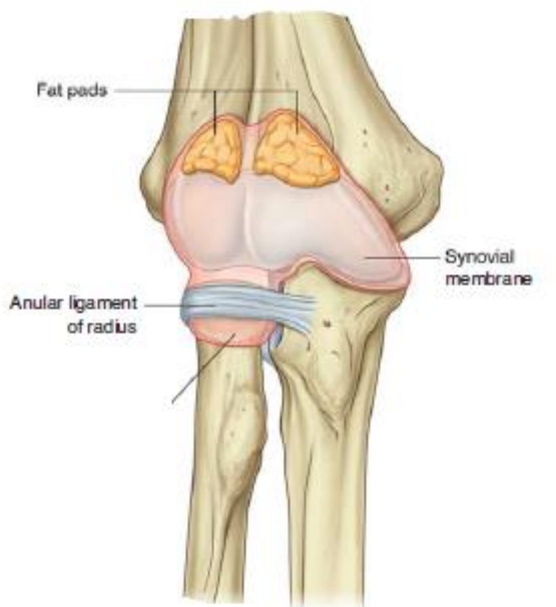
The elbow joint is a complex joint that connects the arm to the forearm, it is a synovial hinge joint made up of articulations of mainly the distal humerus and the proximal ulna. However, articulations exist between the proximal radius and the humerus as well as the proximal radius and ulna. The three articulations are referred to as the ulnohumeral, radiohumeral, and proximal radioulnar joints respectively. The ulnohumeral joint allows flexion and extension of elbow, the radiohumeral joint participates in flexion and extension but more importantly in supination and pronation of forearm, the proximal radioulnar joint, a pivot joint formed by the radius and ulna, it participates in supination and pronation as well [1-8].

The three most prominent bony landmarks of elbow; lateral and medial epicondyle, tip of olecranon are in straight line with elbow fully extended and in flexion form an isosceles triangle. It could be altered relative to opposite side in cases of elbow dislocation, olecranon fracture and lateral or medial condyle fractures [9]. (Fig 1)


**Figure (1):** A & B Hueter line C Hueter triangle [6]

**Joint capsule**

The capsule has an outer fibrous layer and inner synovial layer which are separated from each other by fat pads (Fig 2). These fat pads are located superficial to areas of stress. These areas include the olecranon, coronoid and radial fossa. During flexion and extension, these fat pads are pulled away by attachments to the brachialis and the triceps brachii to allow space for bony processes. Displacement of any of the fat pads can indicate an occult fracture [7].



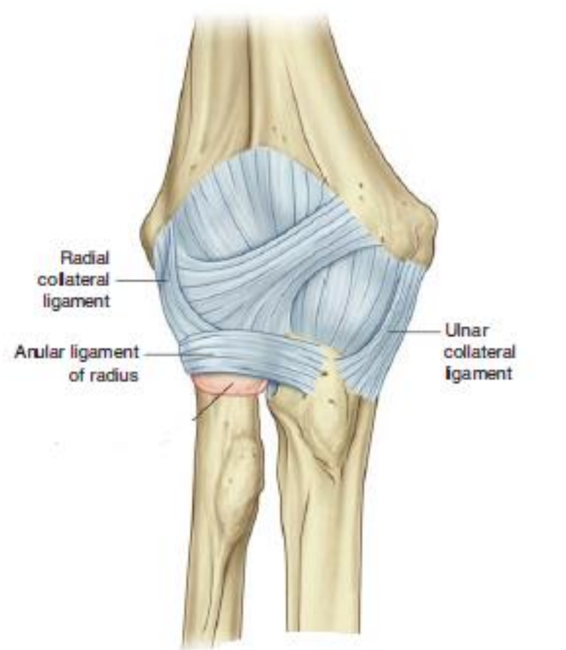




**Figure (2):** Synovial membrane of elbow joint ant. view[7].

**Figure (3):** Joint capsule and ligaments of elbow joint [7].

**Ligaments of the elbow joint**

Collateral ligaments are located on the medial and lateral sides of hinge joints to provide medial/lateral stability to the joint and to keep joint surfaces in apposition. [20]

The two main ligaments associated with the elbow joints are the medial (ulnar) and lateral (radial) collateral ligaments.

**Medial collateral ligament (MCL):**

Triangular and consists principally of three strong bands [20, 21] and they are:

- The anterior band, which passes from the medial epicondyle of the humerus to the medial margin of the coronoid process.
- The posterior band, which passes from the medial epicondyle of the humerus to the medial side of the olecranon.
- The transverse band, which passes between the ulnar attachments of the two preceding bands.

**Lateral Collateral ligament (LCL):**

Lateral (radial) collateral ligament (LCL) is triangular and is attached by its apex to the lateral epicondyle of the humerous and by its base to the upper margin of the annular ligament. Annular ligament stabilizes the proximal radioulnar joint and originates and inserts at the sigmoid notch of the ulna as it wraps around the neck of the radius. the LCL provides reinforcement for the humeroradial articulation, offers some protection against Varus stress in some positions of the elbow, and assists in providing resistance to distraction of the joint surfaces. Some fibers of the LCL remain taut throughout the flexion ROM with either a varus or valgus moment applied [8,10, 20].

**Muscles of the Elbow Joint:**

Many muscles cross over and attach around the elbow joint. These muscles are responsible for the secondary stabilization of the joint. Most of the muscles originating from the elbow joint provide very little motion at the elbow joint itself, but rather act as flexors and extensors of the wrist, hand, and digits [8].

The biceps brachii, brachialis, brachioradialis, and pronator teres all flex the elbow and lie anteriorly. The triceps brachii and anconeus serve to extend the elbow and lie posteriorly**.** The supinator and biceps brachii function to supinate the forearm at the elbow and the pronator teres pronate the forearm [8].

**Bursae:**

There are seven bursae around the elbow, subcutaneous bursa of medial epicondyle, subcutaneous bursa of lateral epicondyle, bursa of anconeus, bursa at origin of extensor carpi radialis brevis, sub tendinous bursa of triceps, intra tendinous bursa of triceps and subcutaneous bursa of olecranon [11].

**Nerve supply to the elbow joint:**

Articular nerves are mainly from the musculocutaneous and radial, but the ulnar, median and sometimes anterior interosseous nerves contribute. The musculocutaneous branch is from the nerve to brachialis and innervates an anterior part of the capsule; branches of the radial supply its posterior and anterolateral regions and come from the nerve to anconeus and the ulnar collateral branch to the medial head of triceps. The ulnar nerve supplies the ulnar collateral ligament behind the medial epicondyle [13].

**Blood Supply**

There is a rich arterial network around the elbow. The major arterial trunk, the brachial artery, lies anteriorly in the antecubital fossa. Most of the intraosseous blood supply of the distal humerus comes from the anastomotic vessels that course posteriorly so, the dissection should be anteriorly to avoid the injury of blood supply which come posteriorly [14].

**Intra-articular Structures**

The articular surface lies within the confines of the capsule, but non-articulating areas involving the coronoid and radial fossae anteriorly and the olecranon fossa posteriorly are also within the confines of the articular cavity. [15] The capsule attaches just distal to the coronoid and olecranon processes. Thus, these processes are intra-articular. [16] The entire radial head is intra-articular, with a recess or diverticulum of the elbow's articular cavity extending distally under the margin of the orbicular ligament. The medial and lateral epicondyles are extra-articular. The anterior capsule is thickened anteriorly. These longitudinally directed fibers are very strong and become taut with the elbow in extension. In hyperextension, the tight anterior bands of the capsule force the ulna firmly into contact with the humerus.

**The Ossification Process of Pediatric Distal Humerus**

The process of differentiation and maturation begins at the center of the long bones and progresses distally. The ossification process begins in the diaphysis of the humerus, radius, and ulna at the same time. By term, ossification of the humerus has extended distally to the condyles. In the ulna, it extends to more than half the distance between the coronoid process and the tip of the olecranon. The radius is ossified proximally to the level of the neck [17,18] (Table 1).

**Table (1):** The Ossification Process [17]

| **Ossification center** | **Years at ossification** (appear on xray) | **Years at fusion** (appear on xray) |
|---|---|---|
| Capitellum | 1 | 12-14 |
| Radial head | 3 | 14-16 |
| Internal (medial) epicondyle | 5 | 16-18 |
| Trochlea | 7 | 12-14 |
| Olecranon | 9 | 15-17 |
| External (lateral) epicondyle | 11 | 12-14 |
| +/- one year, varies between boys and girl. | | |

***Lateral Condyle:***

Usually, the lateral condyle ossification center starts to appear just before the age of one year, but may be delayed as late as 18 to 24 months [19]. When the ossific center of the lateral condyle appears, the distal humeral metaphyseal line becomes asymmetric.

The lateral border slants and becomes straight to conform to the lateral condyle ossific center by the end of the second year; this border becomes well defined. This ossification center is almost spherical when it appears early. With maturation of the distal humerus, it becomes more hemispherical [12] and start to extend into the lateral side of the trochlea.

**Fracture lateral condyle humerus in children**

***Epidemiology***

Lateral condyle fractures account for 17% of all distal humerus fractures and 54% of distal humeral physeal fractures. The frequency of lateral condyle fractures peaks in children aged 6 years. Most fractures occur in children aged 5-10years. Cases have been reported in patients as young as 2 years and as old as14 years [22].

***Mechanism of injury:***

Two theories of the mechanism of injury for this fracture exist. The first is the pull-off theory, in which avulsion of the lateral condyle occurs at the origin of the extensor/supinator musculature. This may occur as a varus stress is applied to the extended elbow with the forearm supinated. This is thought to be the most common mechanism of injury, the second is the push-off theory, in which a fall onto the extended hand leads to impaction of the radial head into the lateral condyle, causing the fracture [1].

***Pathophysiology***

The lateral condyle fracture is a Salter-Harris II or IV fracture pattern and follows physeal injury principles. The fracture fragments in these patients are primarily cartilaginous because of the young age of the patients. The radiographic interpretation may be misleading because the visible fragment appears smaller than the actual size and, in addition, the amount of displacement is not appreciated [23].

Fractures with minimal displacement must be carefully monitored, as they have a high tendency to displace, once these displaced fractures consolidate in a mal-united position, treatment is difficult, dangerous, and fraught with complications. For these reasons, surgical reduction should be performed and is recommended within the first 48 hours after the fracture [24].

***Classification***

**Salter–Harris type**

Salter and Harris classified these lateral humeral condylar fractures as a Salter–Harris IV injury because the fracture line was thought to cross the physis. Although this may occur, it is uncommon and more frequently the fracture passes along the physis and exits into the joint between the medial and lateral condylar physis at the apex of the trochlea, thus constituting a Salter–Harris II injury.

The less common type IV injury has a higher propensity for growth disturbance because of contact between the ossification center of the epiphysis and the exposed metaphyseal bone. As this contact is not present in the type II injury, growth arrest is unlikely to occur [25].

**Anatomical location**

Lateral condylar physeal fractures can be classified by either the fracture line's anatomic location or by the amount of displacement. In 1964, Milch described an anatomic classification system that divided lateral condyle fractures into the following two types based on the location of the fracture line: [18]

**Milch I: Salter-Harris IV** fracture in which the fracture traverses the ossification center of the capitellum so that the lateral wall of the trochlea remains attached to the main portion of the humerus. Because fracture line lies lateral to capitellotrochlear groove, elbow is stable and relationship between the forearm and humerus remains intact. Less common variant than type II fractures [23].

**Milch II (more common)**: the fracture extends across the physis and exits through the apex of the trochlea producing a Salter-Harris type II fracture pattern; the lateral crista is in the fracture fragment, and the trochlea is no longer intact, rendering the elbow unstable [23].

The milch classification is used infrequently because of its poor reliability and poor predictive value and is primarily of historic interest [26,27].

***Jakob et al.* described three stages of displacement [28]:**

- **Stage I** – the fracture is relatively un-displaced but may be tilted and the fracture does not breech the articular surface at its medial aspect.
- **Stage II** – the fracture line penetrates into the joint through the articular cartilage. There is a greater likelihood of displacement and there may be lateral subluxation of the proximal radius and ulna.
- **Stage III** – there is complete displacement of the lateral condylar fragment. It is displaced laterally and rotated coronally and horizontally.

***Clinical diagnosis***

**History:**

Similar to mechanisms that produce the T-type fracture pattern in adults, this injury is mostly caused by an axial load onto an outstretched arm or a direct blow to the flexed elbow [51].

**Examination:**

**Observation:**

Localized swelling, ecchymosis, deformity, and other skin changes at the fracture site [29, 30].

**Palpation:**

- Isolated point of tenderness over area of humerus that was fractured (38).
- Signs and symptoms of compartment syndrome such as intense pain upon mild extension or stretching of the fingers, paresthesia/numbness, diminished pulses, and pallor [30].

**Neurological Examination:**

- Assess radial nerve injury with wrist extension and sensation in the dorsal aspect of the first web space.
- Assess median nerve injury with the patient's ability to make the "OK sign" and sensation over the palmar tip of the index finger (autonomous area of the median nerve).
- Assess ulnar nerve injury with strength testing of intrinsic muscles of the hand and sensation over the palmar tip of the little finger [29].

**Assessment of joints above and below injury:**

- Range of motion in all planes
- Strength

**Circulatory/Vascular:**

- Allen's test: To assess radial and ulnar artery compromise due to close proximity to the epicondyles. [40].
- White/pale and/or cool extremities indicate arterial compromise, which requires immediate referral to the emergency department [30].

**Differential Diagnosis**

- **Radial head subluxation or nursemaid's elbow:** Patient presentation is similar to supracondylar fracture. The history of traction mechanism with nursemaid's elbow as opposed to a compression mechanism associated with fractures can help with the diagnosis [31].
- **Normal ossification centers** at capitellum, radius, medial epicondyle, trochlea, olecranon and lateral epicondyle approximately appear at 1, 3, 5, 7, 9, and 11 years of age respectively. It is important to know this sequence to be able to distinguish a fracture from a normal finding. The ages may vary and ossification centers often appear earlier in females [30].

**Imaging Studies**

**Plain X-ray**

The standard radiographs of the elbow include: [15]

**1-True AP view**

Of the distal humerus, rather than of the elbow, allows more accurate evaluation of the distal humerus and decreases the error in determining angular malalignment in the distal humerus [15].

**Anteroposterior Landmarks**

**Carrying angle:**

When the upper extremity is in the anatomic position, the long axis of the humerus and the long axis of the ulna form an acute angle medially at the elbow which is called the carrying angle This angle marginally greater in female than in male. The average angle is 5 to 10 in males and 10 to 15 in females. This angle is important in walking, swinging, and carrying objects [33].

**Baumann's angle:**

It is another radiographic measurement that may be used to assess the normal relationships of the distal humerus and is measured on the AP projection of the elbow. It is used to evaluate for the presence of a supracondylar or other types of distal humerus fracture, drawing a line parallel to the longitudinal axis of the humeral shaft as well as a bisecting line parallel to the lateral condylar physis creates Baumann's angle A normal angle is 70-75 degrees or within 5 degrees of the contralateral elbow. This measurement is also useful both during operative fixation and during follow up evaluations to assess for any residual varus or valgus malalignment [34].

**2-Lateral view**

Should be taken as a true lateral with the humerus held in the anatomic position and not externally rotated [15].

**Lateral Landmarks**

**Radio capitellar line:**

Assessment of the radio capitellar joint is performed by drawing a line down the middle of the radial neck or shaft on standard anteroposterior (AP), oblique and lateral radiographs, this line should intersect the capitellum at approximately its middle third on all radiographic views Understanding this relationship is critical in assessing the joint [34].

**The fat pad sign**

Is indicative of intra-articular elbow pathology even when a fracture is not apparent on standard elbow radiographs. The fat pad, or sail sign, is caused by an intra-articular elbow effusion or hemarthrosis either anteriorly or posteriorly on lateral radiographs of the elbow [34].

**Anterior Humeral Line**

If a line is drawn along the anterior border of the distal humeral shaft, it should pass through the middle third of the ossification center of the capitellum. This is referred to as the anterior humeral line

Passage of the anterior humeral line through the anterior portion of the lateral condylar ossification center or anterior to it indicates the presence of posterior angulation of the distal humerus [45].

Internal oblique view most accurately shows fracture displacement because the fracture is posterolateral [32].

**Arthrography**

Assesses the size of the cartilaginous fragment and the articular displacement and can help in decision making in difficult cases, however, this study is difficult to achieve without sedation and should be reserved for the operating room [35].

**CT scan**

when in doubt, it is advised to perform additional CT-imaging to appreciate the extent of injury to the elbow joint fully, define the proper classification, and execute the suitable treatment method [57].

**Magnetic resonance imaging**

MRI may be used to determine the size and degree of displacement It has taken the place of preoperative arthrography in cases that are difficult to manage, sedation may be required [36] (Fig 4).

**Figure (4):** MRI of lateral condyle fracture. Milch II and unstable elbow. T2 image with fat saturation on the right shows cartilaginous fracture [36]

***Lines of treatment:***

Proper treatment of the lateral humeral fracture in children requires recognition that the injury is an intra articular trans epiphyseal fracture and four factors cause difficulty in treatment:

1. The pull of the extensors of the wrist and fingers originating on the condylar fragment tends to displace and rotate that fragment. This force makes the reduction difficult to obtain and maintain.
2. The articular surface must be anatomically reconstructed.
3. Segmental injury of the epiphyseal plate increases the possibility for deformity because of disturbance of growth.
4. Synovial fluid bathing the fracture line may discourage union [37]

**Methods of treatment**

Fractures involving the lateral condylar physis can be treated with immobilization alone, closed reduction and percutaneous pinning, or open surgical reduction and internal fixation depending on the degree of displacement and amount of instability [39].

***(1) Non operative treatment (immobilization)***

For stage I Jakob, fractures with less than 2 mm of displacement, simple immobilization is recommended in an above-elbow back slap or cast with the forearm in neutral rotation and the elbow flexed 60 to 90 degrees.

Careful follow-up, however, is required to check for late displacement. Radiographs are obtained every week during the first 3 weeks after injury with the cast removed and the elbow extended. Immobilization is continued until fracture union is apparent, usually between 4 and 6 weeks after injury. If any question remains regarding joint stability or the possibility of delayed displacement, closed pinning is done [40].

***(2) Operative treatment***

**a- Closed reduction and percutaneous pinning:**

For stage II Jakob, fractures with 2-4 mm of displacement, closed reduction and percutaneous pinning is the most satisfactory method to achieve the reduction without compromising the circulation, introducing infection or precipitating growth disturbance in children [41].

Fracture reduction through closed reduction percutaneous pinning (CRPP) is achieved by flexing the elbow and supinating the wrist while applying pressure to the lateral side of the elbow. Simultaneous imaging should be performed to deduce the effects of the closed reduction. Successful reduction shows an anatomical articular surface during imaging [43]. Next, the surgeon performs a percutaneous fixation of the reduced fracture by placing two smooth Kirschner wires perpendicular to the fracture line. Crossed Kirschner wires may reduce fracture stability [44], third Kirschner wire can be placed through the condyles, parallel to the joint, to increase fracture stability and minimize rotation. Kirschner wires can be buried underneath the skin or exposed for easy removal. Buried or exposed K-wires show similarly low complication rates, low infection rates, and high successful union rates. Kirschner wires are left in place for 4 weeks after surgery. In addition, the patient receives a long arm cast with elbow back slab support for 4 weeks [42].

**b- Open reduction and internal fixation:**

For unstable and irreducible fractures with stage II and stage III Jackob, fractures with displacement more than 4mm, open reduction and internal fixation is the recommended treatment.

The key is to have accurate reduction that is done by direct visualization. With open reduction, care must be taken to avoid dissection at the posterior aspect of the fragment as this is the site of the fragment's blood supply. The fixation is performed with smooth K-wires or screws. The pins can be buried or left protruding through the skin [46].

**Surgical approach**

There are two surgical approaches for open reduction of lateral humeral condyle.

***1)Standard lateral Kocher approach:*** **(Fig 5)**

The lateral approach provides sufficient exposure of the fragment without significant dissection. Dissection between the triceps muscle posteriorly and brachioradials and extensor carpi radials longus muscles anteriorly exposes the lateral condyle, often a transverse tear in muscular aponeurosis of the brachioradials muscle laterally leads directly to the fracture site. Care must be taken to avoid dissecting near the posterior portion of the fragment because this is the entrance of the blood vessels supplying the lateral condyle epiphysis [48].

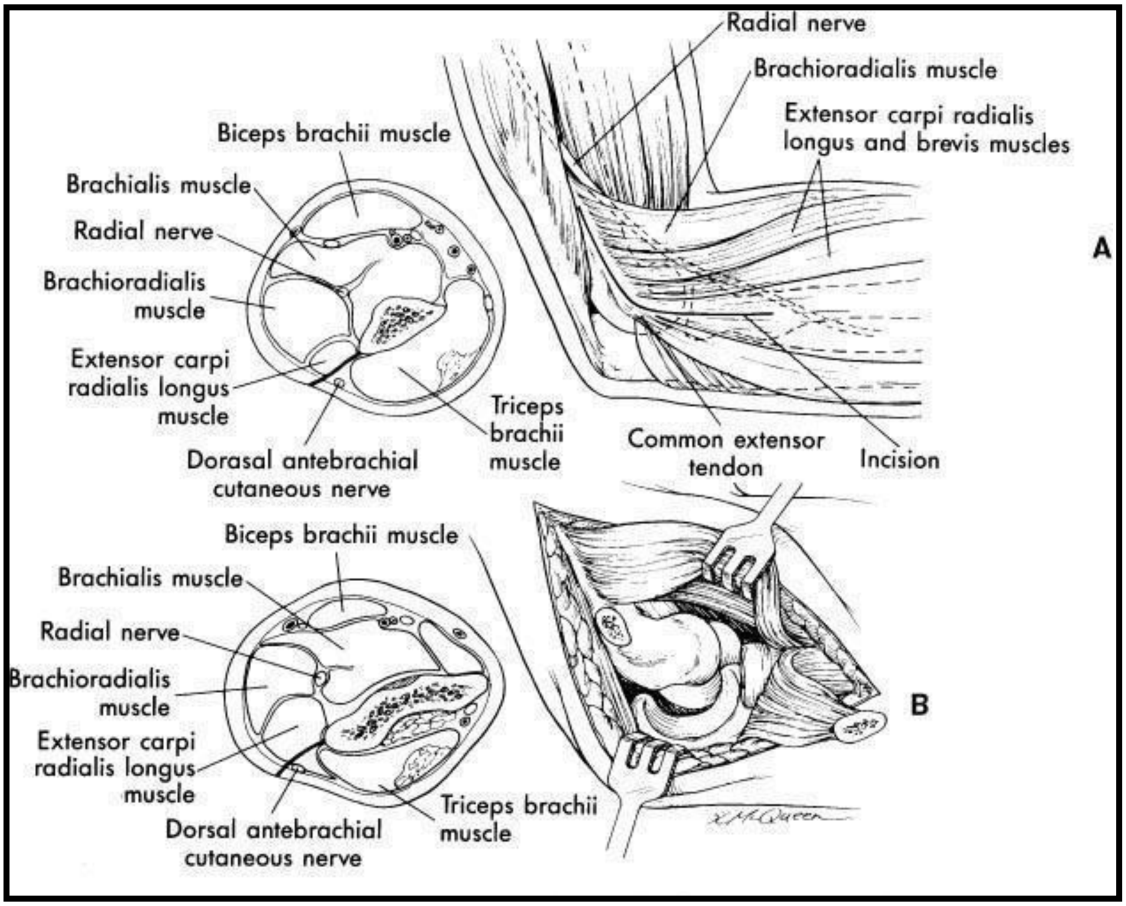



**Figure (5):** Standard lateral Kocher approach. [48]

***2) Posterolateral approach:*** **(Fig 6)**

It has been recommended because of proposed advantages of excellent exposure with minimal dissection and improved cosmetic results because of more posterior placement of the surgical scar [47].

Conversely, an anterolateral approach with subperiosteal dissection on the anterolateral side of the lateral humeral condyle does not damage the crucial blood supply from the posterior side. Therefore, to prevent damaging the posterior blood supply of the lateral humeral condyle, we recommend that surgeons refrain from a posterior approach for lateral condyle fracture (LCF) in children [54].

**Operative technique:**

The patient is placed supine or in the lateral position with the arm supported and the forearm hanging freely. An incision is made posterolaterally starting at the distal third of the humerus and continuing for a short distance past the olecranon, deviating radially. After dissection through the subcutaneous tissue, the fascial layer covering the triceps is incised at its lateral border. The intramuscular plane between the triceps and

brachioradials is then utilized to gain access to the distal humerus, retracting the lateral border of the triceps medially. Minimal soft tissue dissection is required, and the fracture is visualized directly.
The joint line is seen well, and an accurate reduction can be achieved with the fracture under direct vision. The fixation is achieved by k-wires or screws. The stability of the elbow is tested through its full range of movement. Subcutaneous and skin closure is carried out, and the elbow protected in a plaster backslap [47].

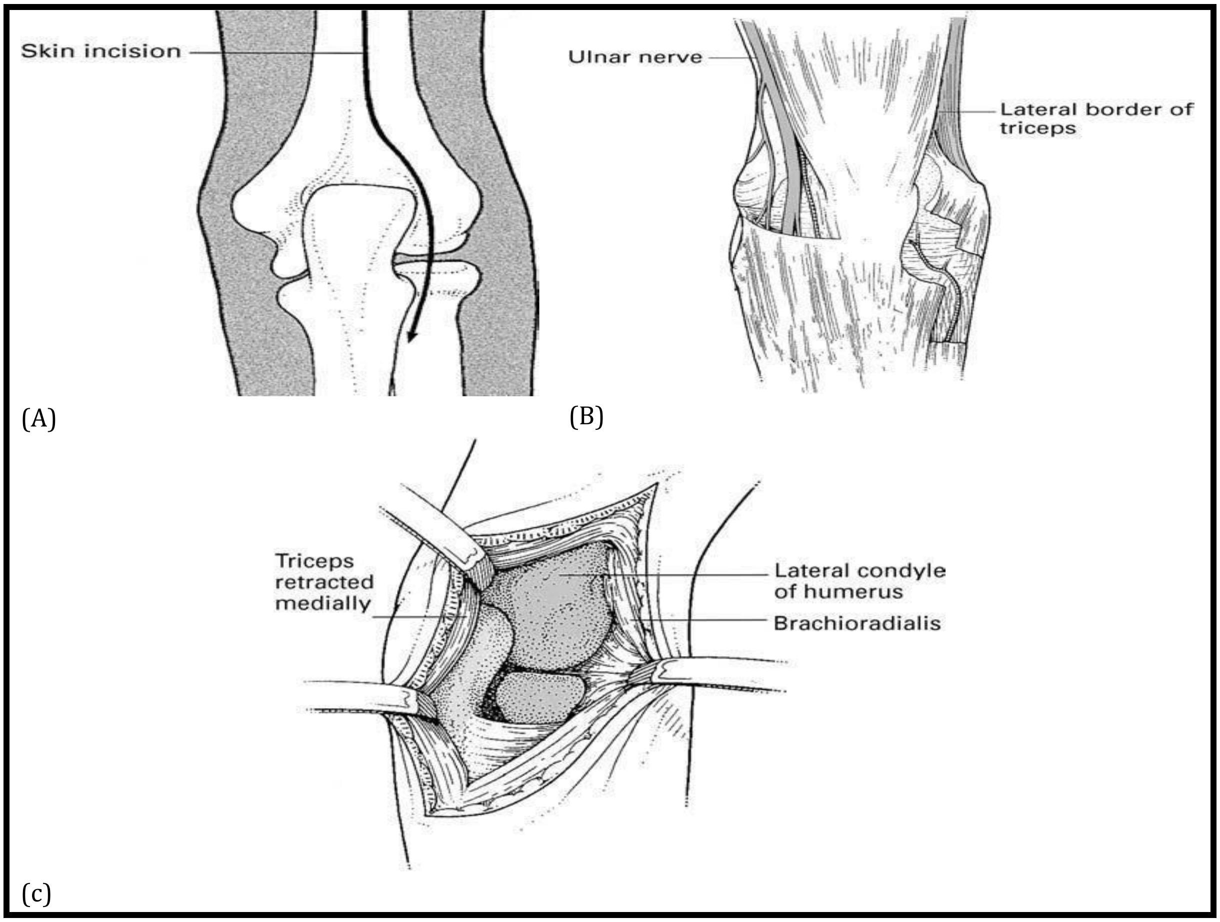



**Figure (6):** Posterolateral approach. **A**-Skin Incision **B**-Posterior view showing ulnar nerve and triceps muscle. **C**-deep dissection between the triceps muscle and the brachioradialis [47].

**Different authors have suggested various forms of fixation including:**

a) Suture fixation, which is inadequate.
b) Smooth pin fixation preferably with two pins, either through the epiphysis or through the metaphyseal spike providing the high success rate for fracture healing and the ease of removing Kirshner wires in an office setting and disadvantages of the possibility of loss of fixation with brief use of K-wires or occurrence of infection with their prolonged use [60,61] (Fig 7).
c) Screw fixation preferably through the metaphyseal area providing more stable fixation, resulting in a higher union rate, with decreased duration of casting leading to an improved range of motion, the largest disadvantage of screw fixation is the need for subsequent surgery for implant removal, along with the cost and risks associated with a second surgery [60] [62] (Fig 8).

**Figure (7):** Smooth pin fixation of lateral humeral condyle [46]

**Figure (8):** Screw fixation lateral humeral condyle (47)

**Complications**

***1. Lateral Spur Formation:***

The most common complication following lateral condyle fracture is lateral condylar overgrowth or spur formation occurring in up to 73% of cases. It is considered to be related to coronal mal-rotation of the distal fragment leading to displacement of the periosteum and new bone formation. Lateral condylar spur formation occurs more commonly following displaced fractures and has a marginally higher incidence following ORIF than following CRPP. Lateral condyle spurs are rarely symptomatic but can occasionally cause pain and/or decreased range of motion (55,56).

**Figure (9):** Radiograph showing a lateral spur secondary to a lateral condyle fracture (64)

***2. Elbow Stiffness:***

Elbow stiffness can occur following lateral condylar fractures, but most patients regain full elbow range of motion within 4 to 6 months after cast removal (50).

***3. Cubitus Valgus:***

Cubitus valgus is much less common after united lateral condylar fractures than cubitus varus. The primary etiology is lateral condylar nonunion that drifts into a valgus deformity. It has rarely been reported to result from premature epiphysiodesis of the lateral condylar physis. As with cubitus varus, it is usually minimal and rarely of clinical or functional significance (52,63).

**Figure (10):** AP X-ray with established lateral condylar nonunion and valgus deformity [66]

***4. Cubitus Varus:***

Reviews of lateral condylar fractures show that a surprising number heal with some residual cubitus varus angulation [50]. The exact mechanism resulting in this deformity is not completely understood but is postulated to be related to either inadequate fracture reduction and/or growth stimulation of the lateral condylar physis. A cubitus varus deformity is rarely symptomatic [59].


**Figure (11):** AP elbow view. Cubitus varus with Bauman augmentation [65]

***5. Delayed Union and Nonunion:***

Some of these fractures may go unrecognized or untreated for a prolonged period. Even in modern medical settings, elbow injuries may be treated as "sprains," and the diagnosis of a displaced lateral condylar fracture is not made, especially in young children. Thus, patients can present weeks later with a delayed union or months or even years later with a non-united or mal-united fracture fragment [53].

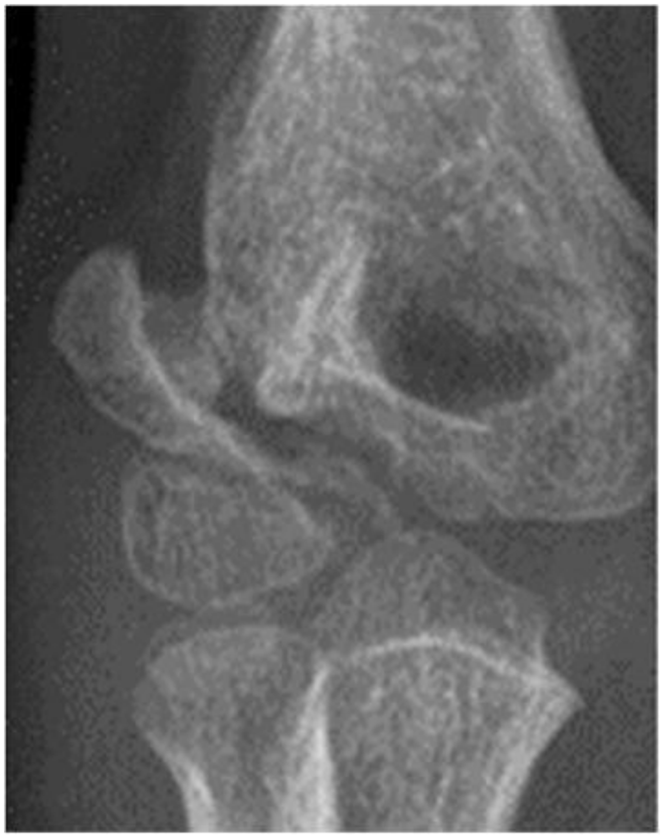


**Figure (12):** AP elbow view Lateral condyle non-union [65]

***6. Neurologic Complications:***

Neurologic complications can be divided into two categories: acute nerve problems at the time of the injury and/or treatment and delayed neuropathy involving the ulnar nerve (the so-called tardy ulnar nerve palsy) [49].

***7. Osteonecrosis:***

Osteonecrosis of the condylar fragment may be iatrogenic and is most commonly associated with the extensive dissection. Partial osteonecrosis has been described in an essentially non-displaced fracture of the lateral condylar physis that had a radiographic appearance and clinical course similar to those of osteochondritis dissecans [52].

**Figure (13):** AP elbow view Lateral condyle osteonecrosis [16]

***8. Growth Disturbance: Fishtail Deformity:***

Two types of "fishtail deformity" of the distal humerus may occur. The first is more common and is a sharp-angled wedge. It was believed that this type of malformation is caused by persistence of a gap between the lateral condylar physis ossification center and the medial ossification of the trochlea. Because of this gap, the lateral crista of the trochlea may be underdeveloped, which may represent a small "bony bar" in the distal humeral physis.

The second type of fishtail deformity is a gentler, smooth curve. It is believed to be associated with osteonecrosis or larger growth arrest of the lateral part of the medial crista of the trochlea [58]

**Figure (14):** X-ray of the elbow joint (anteroposterior view) showing premature closure of the epiphysis and fishtail deformity [(45)]

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