Section A-Research paper

Treatment Options for Lateral Condylar Fracture

Abdelsalam Eid, Tarek Abdelsamad Elhewala, Mohamed Mohamed Abdelsalam Elsyed *, Ahmed Mashhour Gaber

Department of Orthopaedic Surgery, Faculty of Medicine, Zagazig University, Egypt

Email: **Bika1188@icloud.com**

Article History: Received 10th June, Accepted 5th July, published online 10th July 2023

Abstract

Background: Fractures involving the lateral condylar physis can be treated with immobilization alone, closed reduction and percutaneous pinning, or open surgical reduction depending on the degree of displacement and amount of instability. About 40% of lateral condylar physeal fractures are nondisplaced, are not at risk for late displacement, and can be treated with immobilization alone. If the facture line is barely perceptible on the original radiographs, including internal oblique views (stage I displacement), the chance for subsequent displacement is low. Immobilization of nondisplaced or minimally displaced (less than 2 mm) fractures in a posterior splint or cast is adequate. Radiographs are obtained during the first 3 weeks after injury to ensure that rare late displacement does not occur. Many procedures are available in fixation of the fracture LHC through open or closed operation by K-wirs, mital screws or bioabsorbable screws. Screws used in fixation of fracture LHC are of two types, metal screws or bioabsorbable screws. screw fixation of lateral condyle fractures results in satisfactory union with a low risk of complications. The use of bioabsorbable screws is a reasonable alternative to the traditional use of metallic materials for the treatment of lateral condyle fracture of the elbow in children

Keywords: Lateral Condylar Fracture

DOI: 10.53555/ecb/2023.12.Si12.297

Introduction

Lateral Condylar is relatively common and accounts for 12% to 20% of pediatric elbow fractures making it the second most common fracture about the elbow in children. Fractures are most common in children between 5 and 10 years of age. Malgaigne is credited with describing the injury in 1849, and Milch created the first classification **(1).**

Mechanisms of Injury:

Two mechanisms for this fracture have been proposed. "**Pull off**" or avulsion of the lateral condyle of the humerus may result from a fall on the outstretched hand with the forearm supinated. A varus force on the arm transmits through the forearm extensor muscles (extensor carpi radialis longus and brevis and brachioradialis), which attach to the lateral condyle, resulting in avulsion of the condyle **(2).**

Stimson, Fahey, and Milch, however, believed that this fracture was the result of a "**push-off**" or compression injury. The theory is that fracture of the lateral condyle occurs as the result of a force directed upward and outward along the radius through the lateral condyle. Undoubtedly, both mechanisms of injury are possible **(3).**

Classifications:

There are several schemes for classifying lateral condyle fractures. The most known is the one described by Milch **(4).**

In **Milch classification**: type I fracture extends through the secondary ossification center of the capitellum and enters the joint lateral to the trochlear groove. A Milch type II fracture extends farther medially, with the trochlea remaining with the lateral fragment, thus making the ulnohumeral joint unstable. Unfortunately, although widely known and frequently used, the Milch classification provides little prognostic information regarding treatment and potential complications **(5).**

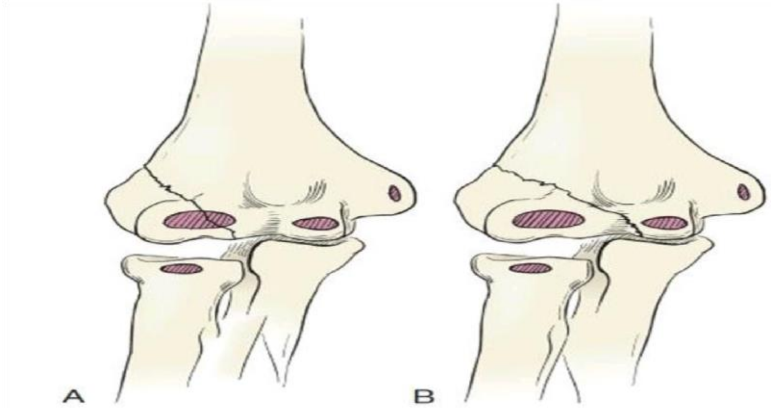

Fig (1): Milch's classification of lateral condyle fractures. **A,** Type I, the fracture extends through the secondary ossification center of the capitellum. **B,** Type II, the fracture crosses the epiphysis and enters the joint medial to the trochlear groove. Thus the ulnohumeral joint is potentially unstable **(6).**

Fig (2): A) Anteroposterior (AP) radiograph of a Milch type I fracture. **B, C)** AP and lateral radiographs shows Milch type II fracture of the lateral condyle **(4).**

Salter and Harris classified fractures of the lateral humeral condyle as type IV fractures because the fracture line begins in the metaphysis, crosses the physis, and enters into the epiphysis. Some believe that because the trochlea is not ossified at the age when this fracture usually occurs, the fracture does not actually cross the physis and should therefore be called a type II fracture in the Salter–Harris classification **(7).**

Neither the Milch classification, which is mechanistic, nor the Salter– Harris classification is helpful in defining treatment **(8).**

Jakob and colleagues classified this fracture according to the amount of displacement into 3 stages**.** The practical implications of this classification are that if the articular cartilage is intact (stage I), the fracture is stable and may be treated closed, and if the fracture is complete (stage II or III) (i.e., extends to the articular surface); it is not and requires an operation **(9).**

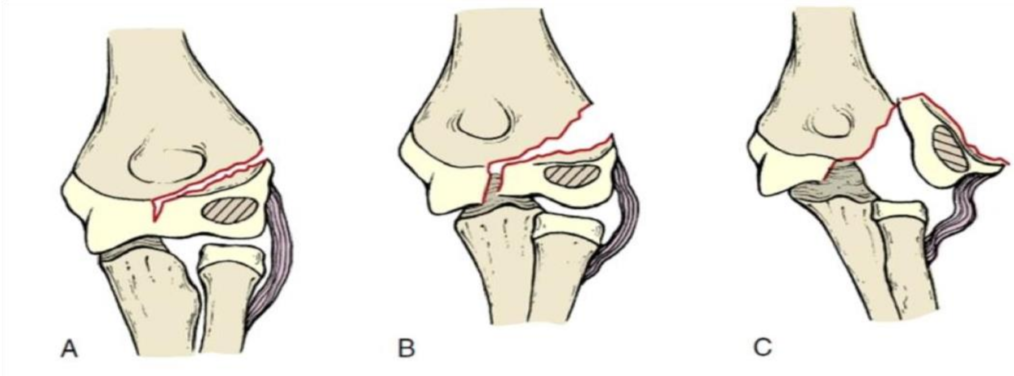

Fig (3): Jakob classification of lateral condylar fractures according to the amount of displacement. **A,** Stage I fracture. Note that the fracture line enters the cartilaginous surface of the distal end of the humerus between the capitellum and trochlea but that the fracture is not complete into the articular surface and is therefore nondisplaced. **B,** Complete fracture (stage II). The fracture is complete through the articular surface but is not displaced from the elbow joint. **C,** Complete fracture with displacement and rotation of the lateral condyle (stage III) **(9).**

Because of the developmental anatomy of the distal humerus in children who sustain these fractures, it is often difficult to assess whether the articular surface is intact in "non- or minimally" displaced fractures; hence, it is difficult to know whether the fracture is truly stable or not **(9).**

Finnbogason and colleagues performed a prospective study to identify radiographic criteria that would predict displacement in otherwise innocuous-appearing fractures that they treated closed. They classified stage I "non- or minimally" displaced (<2-mm) lateral condylar fractures into three categories. **(10).**

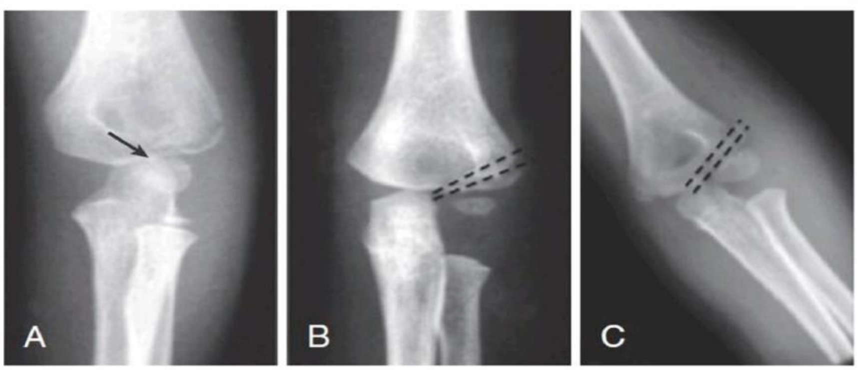

Fig (4): Finnbogason classification of Jakob I non/minimally displaced (<2 mm) fractures of the lateral humeral condyle. **A,** Type A fractures are incomplete. They have a minimal gap laterally but do not extend through the epiphysis. **B,** Type B fractures extend through the epiphyseal cartilage, and the fracture gap is wider laterally than medially. **C,** Type C fractures are complete, and the fracture gap is as wide medially as it is laterally **(10).**

More recently, **Song** and colleagues have proposed a more expanded classification that incorporates the degree of displacement and fracture patterns previously defined separately by Jakob and associates and Finnbogason and associates **(11&12).**

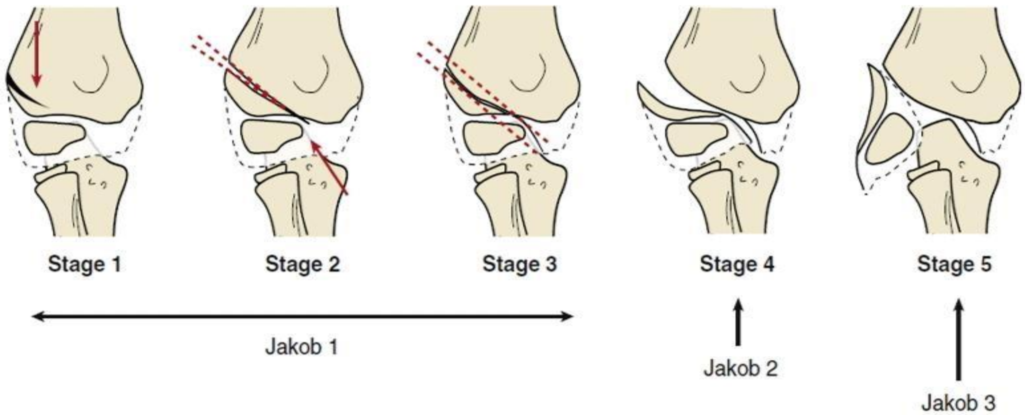

Fig (5): Song classification of lateral condylar humeral fractures. This classification accounts for instability that can be seen in fractures with less than 2 mm of displacement by incorporating Finnbogason's classification of Jakob I fractures into those that are truly undisplaced **(stage 1)**, those of indeterminate stability based on the presence of a lateral gap larger than the medial gap **(stage 2)**, and those that are likely unstable based on a fracture gap that is as wide laterally as medially **(stage 3)**; Song **stage 4** are fractures that are displaced more than 2 mm (like Jakob II). **Stage 5** fractures are, like Jakob III, widely displaced and rotated **(11).**

<u>II. Complications of the fracture lateral condyle humerus</u>

Wilkins-characterizes issues influencing treatment results after lateral condylar fractures-into2 wide classes:

1. Biological (issues connected with the healing-process).
2. Technical (mistakes in management) .

Biologic-related complications incorporate lateral condylar spur formation due to overgrowth of the periosteal-flap that is separated from the proximal fragment .The prominence might take the shape of cubitus varus (pseudovarus). Technical complication incorporates non-union, cubitus varus, cubitus valgus & avascular necrosis **(13).**

1) <u>Delayed union and Non-union:</u>

Without question, the most frequent problematic complication of lateral condyle fractures is delayed union or nonunion. Nonunion is more common after lateral condyle fractures of the humerus than with other fractures in children **(14).**

The term delayed union refers to a minimally-displaced fracture which does not heal with six weeks of immobilization or an unmanaged fracture that is initially diagnosed more than 2 weeks (but by convention less than 3 months) after the injury. Also the term nonunion refers to a fracture that has not healed within three months **(15).**

2) <u>Cubitus Varus and Lateral Spur Formation:</u>

Cubitus varus is the usually reported complication after lateral condyle fractures; it occurred in 40% of patients in one series **(16).**

The high incidence of cubitus varus is probably the result of the fact that true cubitus varus and lateral spur formation, which gives the appearance of varus deformity, are often reported as cubitus varus. Cubitus varus and lateral spur formation are multifactorial in origin **(17).**

True cubitus varus may be the result of malunion, growth arrest, or growth stimulation of the lateral condylar physis, or a combination of factors. It is probably a result of slight displacement of the metaphyseal fragment in addition to disruption of the periosteal envelope **(18).**

Apparent lateral condylar overgrowth has been noted in up to 77% of displaced fractures, regardless of treatment method **(19).**

Usually cubitus varus after lateral condylar fractures is only a coronal plane deformity and does not have the hyperextension and rotatory deformity present with supracondylar malunion **(20).**

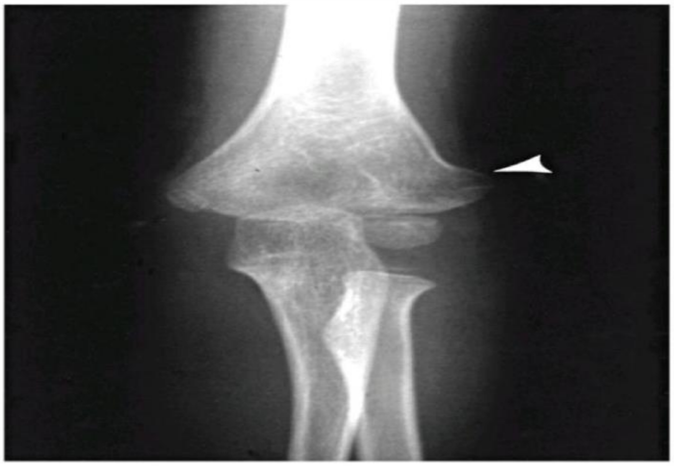

Fig (6): Anteroposterior radiograph demonstrating lateral spur formation (arrowhead) after operative treatment of a displaced lateral condyle fracture. The prominent lateral spur creates the clinical appearance of mild cubitus varus **(17).**

3) Cubitus valgus:

A standout amongst the most widely recognized complications optional to lateral humeral condyle fractures nonunion is, actually, cubitus valgus. Nonunion of lateral humeral-condyle fractures is accepted to be a technical problem & can bring progressive cubitus valgus disfigurement & tardy ulnar nerve paralysis. So cubitus-valgus happens from nonunion& proximal relocation of the lateral condyle, not from early closure of the capitellar-physis **(21).**

4) Tardy ulnar nerve palsy:

Miller-in 1924 observed 47% of his cases with tardy ulnar nerve paralysis had a fracture of lateral-condylar-physis during childhood. Normally the onset of side effects is progressive &frequently seen as a long term effect of untreated, unstable lateral condylar nonunion and cubitus valgus. There is a reverse relation between carrying angles of the elbow & NCV of ulnar nerve recommending increased carrying angle that causes a tendency for ulnar nerve dysfunction **(22).**

The pathomechanism of ulnar neuropathy incorporates two possible explanations.

1. An increased carrying angle may enhance angulation of the ulnar nerve pathway and enhance the tension or lead to chronic stretching damage of the ulnar nerve.
2. The ulnar nerve is angulated at the entry of the 2 heads of the flexor carpi ulnaris muscle by forward movement of the ulnar nerve because of forward movement of the medial head of the triceps brachii muscle in patients with cubitus valgus or cubitus varus deformation **(23).**

Chronic entrapment neuropathy of ulnar nerve at the elbow is harm to the myelinating fibers may start in the huge filaments reaching to the little strands followed by axonal degeneration in the influenced nerve.

5) Fish's tail deformity (Avascular Necrosis of the Trochlea):

The cause of fishtail deformity of the distal humerus is uncertain. Rutherford noted this deformity in 9 of 10 patients who had unreduced lateral condyle fractures and hypothesized that malunion at the medial extent of the fracture results in growth arrest of the lateral trochlea However, Morrissey and Wilkins noted it after a variety of fractures of the distal humerus and attributed it to AVN **(18).**

Pathology and pathogenesis:

According to Nwakama and colleagues, the deformation might be the aftereffect of any of 3 distinct causes:

a. Early growth arrest of the mid-portion of the distal humeral physis.

b. Inability to anatomically reduce an intercondylar fracture of the distal humerus leaving a gap in reduction in the intercondylar notch.

c. Avascular necrosis of the trochlea, starting on the medial side of the elbow & often including the whole trochlea **(24).**

6) <u>Elbow Stiffness</u>

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 **(19).**

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

Conservative treatment (non obrative) :

About 40% of lateral condylar physeal fractures are nondisplaced, are not at risk for late displacement, and can be treated with immobilization alone. If the facture line is barely perceptible on the original radiographs, including internal oblique views (stage I displacement), the chance for subsequent displacement is low. Immobilization of nondisplaced or minimally displaced (less than 2 mm) fractures in a posterior splint or cast is adequate. Radiographs are obtained during the first 3 weeks after injury to ensure that rare late displacement does not occur.

Operative treatment:

Many procedures are available in fixation of the fracture LHC through open or closed operation by K-wirs, mital screws or bioabsorbable screws.

1-K-wire fixation:

The oldest and common way of fixation of the fracture LHC through open or closed procedure.

Advantage:

- Simple maneuver in fixation and removal.
- Get liability to many directions during fixation.
- Less liability to AVN or growth arrest.

Disadvantage:

- Doesn’t get stiff fixation.
- Doesn’t allow early motion.
- Pin tract infection.

So Percutaneous K-wire fixation is effective of treatment for the stable displaced lateral condylar fractures of the humerus in children specially in closed maneuver. But if fracture displacement after closed reduction exceeds 2mm, open reduction and internal fixation is recommended.

2-Screw fixation:

Screws used in fixation of fracture LHC are of two types, metal screws or bioabsorbable screws. screw fixation of lateral condyle fractures results in satisfactory union with a low risk of complications. The use of bioabsorbable screws is a reasonable alternative to the traditional use of metallic materials for the treatment of lateral condyle fracture of the elbow in children.

Advantage:

- Get stiff fixation.
- Allow starting early motion (about 4wks).
- Less liability to infection.
- Bioabsorbable screws doesn’t need to be removed .

Disadvantage:

- Need 2nd procedure for removal.
- Allow limited directions of fixation.
- Suspected AVN according to the site of placement .

- Suspected growth arrest if neglected according to the site of placement.

Results:

The result of the treatment of each case depending on the decision made according to the class of the fracture of the LHC, immobilization alone, closed reduction and percutaneous fixation, or open surgical reduction depending on the degree of displacement and amount of instability.

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