

## Symposium II



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## Management of Acute Lateral Condyle Fractures of Humerus

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### Abstract

Lateral condyle fractures of humerus are one of the common elbow injuries seen in children. These fractures are often difficult to visualise as fracture line passes through unossified cartilage and may need additional investigations to properly assess the fracture pattern.

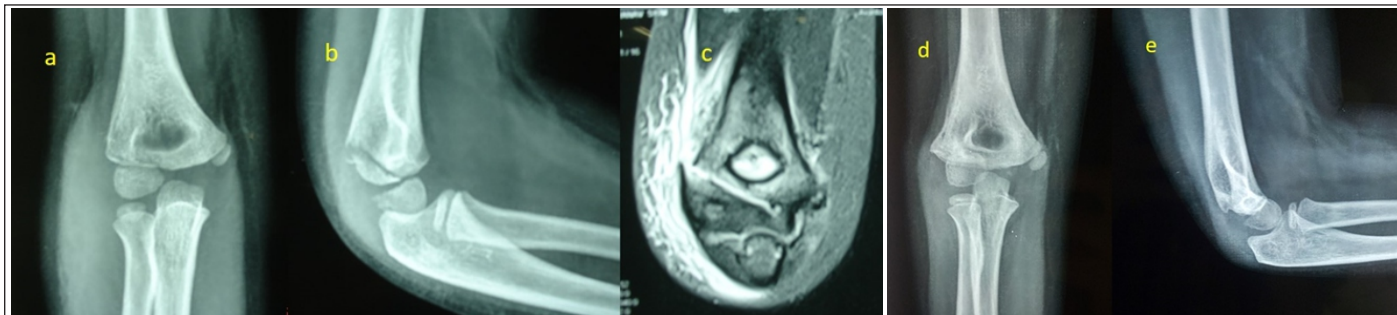
Non operative management is generally indicated for fractures having <2mm displacement. Closed reduction and percutaneous pinning is recommended for those fractures with >2mm displacement and loss of articular cartilage hinge. Intraoperative arthrogram helps to confirm the fracture reduction and restoration of congruent articular surface. Open reduction and fixation may become necessary for fractures with gross displacement and malrotation of the fragment. Complications of lateral condyle fractures include delayed presentation, malunion, lateral spurring and fishtail deformity.

**Keywords:** Lateral condyle fractures, Internal oblique view, Arthrogram, Aartilage hinge, Displacement.

### Introduction

Lateral condyle fractures (LCF) account for 12% to 17% of all distal humerus fractures in children, making it amongst the commonest pediatric elbow injuries [1, 2]. Treatment of these fractures depends on proper preoperative evaluation which includes classification of fracture pattern, its exit point at the articular surface, fracture displacement and stability. Plain X-rays (AP, lateral, internal oblique views) are the gold standard for evaluating lateral condyle fractures. Among these, the internal oblique radiograph has shown to be more accurate in assessing the fracture gap and pattern. Fracture classification should be based on the greatest displacement seen on at least three radiographic views, especially the internal oblique view [3]. The exit line of the fracture may not be visible on X-rays as it may pass through unossified cartilage medially and magnetic resonance imaging (MRI), ultrasonography or arthrography may be needed for proper evaluation in selected cases. MRI helps to determine the integrity of cartilage hinge which influences the stability of fracture and its subsequent management [Figure 1c] [4, 5]. Song classification of lateral condyle fractures is based on degree of displacement and fracture pattern and has been grouped into 5 stages. Stage 1 & 2 fractures are considered stable with fracture displacement ≤ 2mm and an intact medial cartilage hinge. Stage 3, 4 and 5 fractures are unstable; where there is wide lateral and medial fracture gap, with or without fragment rotation [6]. We have based our treatment algorithm on the Song classification.

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**Figure 1:** 1a and 1b- Anteroposterior and internal oblique views of radiograph showing Song stage 2 fracture type. 1c- coronal section of MRI demonstrating intact medial cartilage hinge. 1d and 1e- 1 year follow up radiographs with fracture union following non operative treatment with long arm cast.

### Nonoperative Management with Follow up Protocol

Non operative management for Song stage 1 and 2 lateral condyle fractures includes application of long arm cast with elbow in  $90^\circ$  flexion and forearm in supination with close follow up to identify any subsequent displacement. Patients are reviewed after one week to check for cast loosening and fracture displacement which may happen once the initial swelling subsides. Check radiographs are taken (anteroposterior, lateral and internal rotation oblique views) to confirm alignment and the long arm cast is continued for a further 4 weeks (Figure 1). If loss of initial alignment is noted, such patients are recommended for closed reduction and internal fixation.

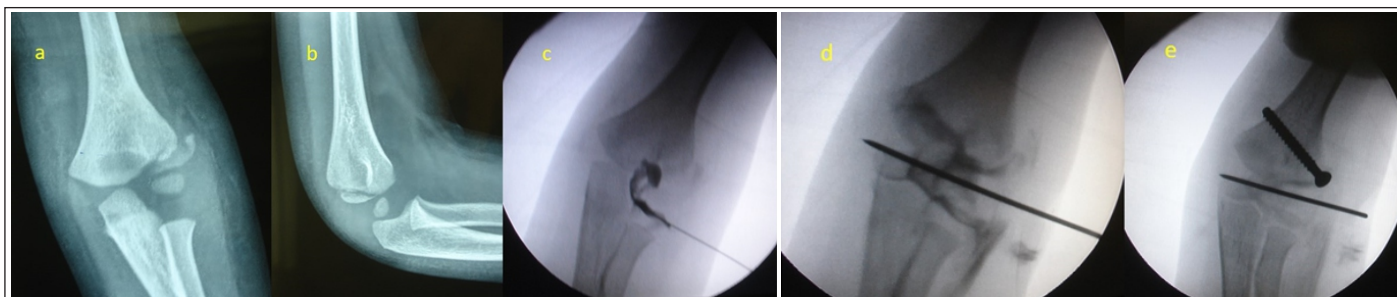
During follow-up, check radiographs are performed to confirm radiological union prior to cast removal. If signs of fracture union such as adequate bridging callus are not present, cast is continued for a further 2-3 weeks. Following removal of plaster, gentle range of motion (ROM) exercises at the elbow and prono-supination exercises of the forearm are advised. Patients are instructed to avoid contact sports, loading of limb, weight lifting for 1 month. If the range of movements do not return within a week and formal physiotherapy sessions can be commenced. The parents are to be warned about the possibility of a prominence over the outer aspect of the elbow, due to overgrowth of the lateral condyle during the remodeling phase [7].

### Closed Reduction, Choice of Implants, Follow-up, Pearls

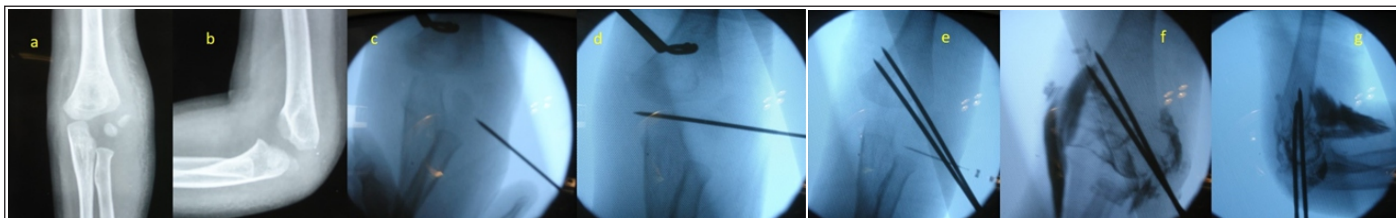
We prefer closed reduction and fixation with Kirschner (K)

wires for Song stage 3 and 4 type of fractures where the fracture gap is  $> 2\text{mm}$  and fragment is unstable. With elbow in  $30^\circ$  of flexion, the arm in internal rotation and forearm in pronation, the fragment is pushed to its place from the posterolateral aspect using surgeon's thumb. (Figure 2). If the fragment is rotated as in Song stage 5 fracture, a 2.5 mm K-wire with a T-handle is used to manipulate, derotate and reduce the distal fragment (Figure 3). The fracture reduction is temporarily held with K-wires and checked under fluoroscopy in all three views. At this point of time, an arthrogram is performed by injecting Iohexol dye into the radiocapitellar joint space. Articular congruity is confirmed with fluoroscopy. Definitive fixation is undertaken with two divergent K-wires (2 mm to 2.5 mm wires depending on age) from a posterolateral-to-anteromedial direction having bicortical purchase. An additional K-wire can be passed transversely to secure the lateral condyle fragment to the trochlea. A 4 mm cannulated cancellous screw (CCS) is preferred in older children having a large metaphyseal component in the distal fragment. The screw is inserted percutaneously in the same direction as described for K-wires (figure 2).

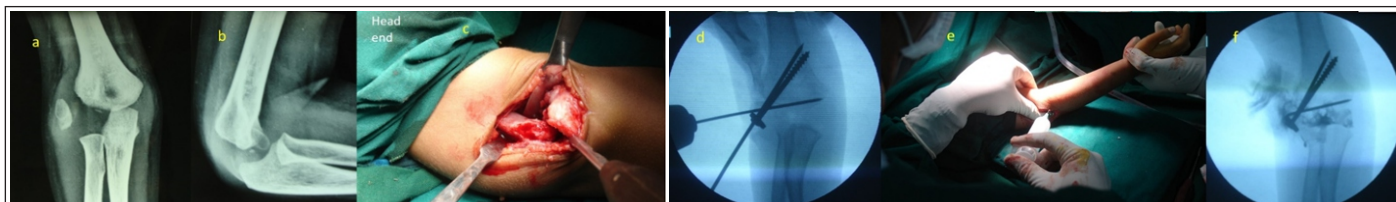
We prefer to leave the tip of K-wires outside the skin as they are not associated with increase in total infection rate, superficial infections or reoperation rate with the added advantage of early removal on an outpatient basis [8, 9]. A long arm cast is applied with the elbow in  $90^\circ$  flexion and forearm in supination. Patient is reviewed after one week for a cast check. K-wires are removed in the clinic after confirmation of radiological union.



**Figure 2:** 2a and 2b – Anteroposterior and internal oblique views showing Song stage 4 lateral condyle fracture. 2c- Intraoperative arthrogram with dye leaking into the fracture gap. 2d- Arthrogram outlining the articular congruency with reduction of fracture and provisional fixation with k wire. 2e- Fluoroscopic image showing definitive fixation with cannulated screw.



**Figure 3:** 3a and 3b – Anteroposterior and internal oblique views showing Song stage 5 lateral condyle fracture with rotated fragment. 3c and 3d- Fluoroscopic images demonstrating derotation and reduction of fragment using k wire as joy stick. 3e- Fixation of fracture with k wires and needle in radiocapitellar joint space for arthrography. 3f and 3g- Arthrogram showing congruous articular surface.



**Figure 4:** 4a and 4b- Radiographic views (AP, internal oblique) showing Song stage 5 lateral condyle fracture. 4c- Exposure of fracture with lateral approach with limited posterior soft tissue dissection. 2d- Fluoroscopic image following fixation of fracture. 2e- Injection of dye into the medial joint space to check for articular alignment. 2f- Arthrogram demonstrating articular congruency.

### Open Reduction, Choice of Implants and Follow-up

We have a high threshold for open reduction even for Jakob type 3 or Song stage 5 fractures as the fragment can be derotated by the joystick maneuver with a K-wire and can be reduced into its place (Figure 3) [10]. Fracture malalignment with an incongruous joint surface after attempts at closed reduction which is confirmed under fluoroscopy and arthrography warrants open reduction.

### Technique of Open Reduction:

With an upper arm tourniquet, a lateral incision measuring around 3–4 cm over the lateral condyle is made extending towards the proximal radius. Following superficial dissection, the rent created by the injury usually leads to the fracture site. The plane between extensor digitorum communis and extensor carpi radialis brevis (Kaplan approach) can be used. As the fragment is exposed, posterior soft-tissue dissection should be avoided because blood supply to the distal humerus can be disrupted, potentially leading to osteonecrosis of the fragment (Figure 4c) [11, 12]. With gentle elevation of periosteum anteriorly up to the extent required, fracture is reduced under vision. If the fragment is rotated, a K-wire can be inserted as a joystick to help maneuver the fragment back into alignment and reduction held provisionally with k wires. Radiopaque dye is injected into the medial joint space and fluoroscopic images are performed to check reduction of articular surface (figure 4e). This indirect method using an arthrogram prevents excessive soft dissection anteriorly. Two divergent K-wires with bicortical purchase placed percutaneously posterior to skin incision are used for stabilizing the fracture. The indication for CCS insertion remains the same as described above (Figure 4).

After confirming fracture stability under fluoroscopy, the wound is closed in layers with absorbable suture material (preferably subcuticular skin closure) and a long arm cast is applied. Cast check is performed at 1 week post operatively and reviewed after 4–5 weeks. Following confirmation of bridging callus on check radiographs, the cast and K-wires are removed. ROM exercises are commenced. If a screw has been used, its removal is advised after 10–12 months of the index surgery.

### Complications

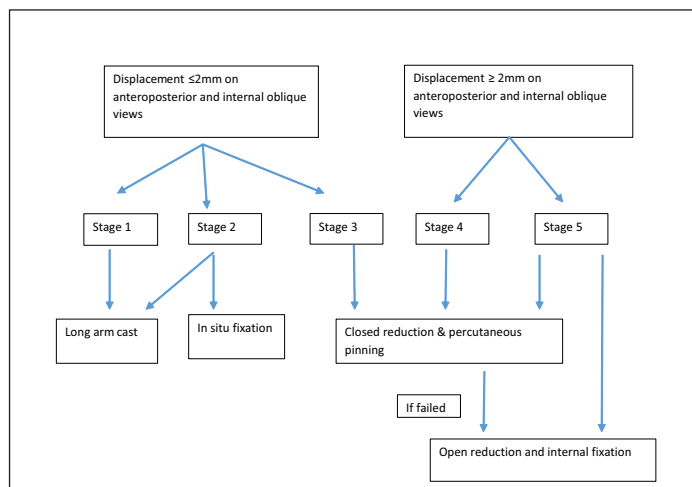
Malunion is a frequent complication associated with these fractures. It results from healing of lateral condyle fragment in a non-anatomical position giving rise to cubitus valgus or varus deformity [13]. Early post-traumatic arthritis can occur if the articular surface is malreduced.

Delayed presentation and nonunion are other complications which may present either as a pseudoarthrosis between the distal humerus and fractured fragment or no bony union greater than 3 months after the injury [14, 15]. This can occur because of a missed fracture, displacement of a non-surgically treated fracture, or after surgical fixation [15, 16]. These patients present with valgus deformity of elbow, lateral condyle tenderness, and painful and/or restricted elbow ROM [14].

Fishtail deformity is a late complication typically occurring 4–8 years after the initial injury. It presents as a concavity visible on radiographs where the lateral trochlear ossification center fails to develop because of disrupted blood supply to the trochlea [11, 17]. It may present as limited ROM, stiffness, pain, loose bodies and cubitus valgus deformity.

Growth arrest of ossification centres of the trochlea and capitellum can occur as a delayed complication resulting in cubitus varus and valgus deformity respectively [18].



**Treatment Algorithm [6]****Summary Points**

- Lateral condyle fractures can be challenging in terms of diagnosis, treatment and complications.
- A high index of clinical suspicion and appropriate radiographic investigations are required to avoid missing a fracture and its potential complications.
- When the fracture displacement is  $\leq 2$  mm and articular surface is congruent, it can be managed nonoperatively.
- Operative fixation is recommended when fracture displacement is  $> 2$  mm and/or there is malrotation of fragment with loss of articular cartilage hinge.
- Delayed presentation and/or non-union are still amenable to surgical correction.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil; **Source of support:** None

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