Management of lateral condyle fractures of the humerus in children

Woo Jae Kim[1]
Chang Park[2]
Douglas Evans[3]
Khaled Sarraf[3]
Author details can be found at the end of this article
Correspondence to:
Woo Jae Kim;
wjkim1992@gmail.com

Abstract

Lateral condyle fracture of the humerus is the second most common paediatric elbow fracture and is often missed, which can result in severe consequences including malunion, growth arrest and tardy ulnar nerve palsy. The difficulty in managing this fracture stems from a lack of awareness and the often subtle findings on radiographs. Patients can also present with quite vague symptoms; clinicians who do not have a high index of suspicion may not investigate beyond the initial clinical assessment and could miss vital cues. This article provides a guide to managing this common paediatric fracture, from initial presentation to definitive treatment, and discusses the complications that can ensue if managed incorrectly.

Key words: Complications; Elbow; Lateral condyle of humerus; Paediatric orthopaedics; Upper limb

Received: 13 December 2020; accepted following double-blind peer review: 17 March 2021

Introduction

Lateral condyle fracture of the humerus is common, constituting 12–20% of all elbow fractures in children between the ages of 4–10 years (Abzug et al, 2020). However, it is an injury that is commonly missed or mismanaged as a result of misinterpretation of imaging or lack of awareness. The paediatric elbow has multiple ossification centres at different ages and thus radiographs can be challenging to interpret. This is not a diagnosis to be missed as it can have long-term sequelae including malunion, potentially leading to tardy ulnar nerve palsy and cubitus valgus. This review provides a comprehensive guide to ensure that lateral condyle fractures of the humerus are managed to best practice.

Anatomy

The ossification centre of the lateral condyle usually appears by the age of 11 years (Shaerf et al, 2018). Generally the capitellum and lateral condyle fuse by the age of 10 years in girls and 12 years in boys (Little, 2014), with the epiphysis fusing with the metaphysis of the humerus at 12–14 years for girls and 13–16 years for boys (Silberstein et al, 1979). The blood supply to the lateral condyle of the elbow is derived primarily from the radial collateral artery, which enters posteriorly and has an implication for the choice of surgical approach if open fixation is required (Shaerf et al, 2018). Table 1 summarises the age at which the ossification centres appear and fuse.

Mechanism of injury

Children sustain this injury when falling onto an outstretched hand in two theorised ways: the pull-off and push-off mechanisms. The pull-off mechanism has the forearm in supination and elbow in extension, which leads to an avulsion-type fracture. The push-off mechanism is where the fall results in a valgus force on the elbow, with the radial head impacting on the lateral condyle of the humerus (Abzug et al, 2020).

Classifications

There are two common classifications used to help determine how lateral condyle fractures are managed. The Milch classification (Figure 1) has two subcategories: Milch type I is

How to cite this article:
Kim WJ, Park C, Evans D, Sarraf K. Management of lateral condyle fractures of the humerus in children. Br J Hosp Med. 2021. https://doi.org/10.12968/hmed.2020.0733

© 2021 MA Healthcare Ltd

Table 1. Age of appearance of ossification centres and fusion

Ossification centre	Age of ossification (years)	Age of fusion (years)
Capitellum	1	12–14
Radius	3	14–16
(Internal) medial epicondyle	5	16–18
Trochlea	7	12–14
Olecranon	9	15–17
(External) lateral epicondyle	11	12–14

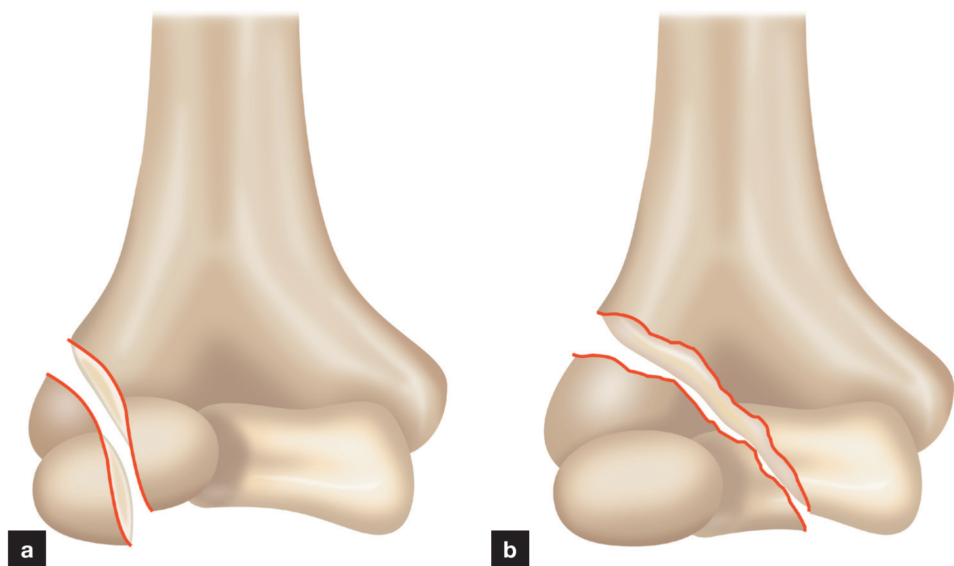

Figure 1. Milch classification of fractures. a. Type I. b. Type II.

through the capitellum, lateral to the trochlear groove presenting as a stable Salter–Harris type 4 fracture, and Milch type II extends medially into the trochlear groove, presenting as an unstable Salter–Harris type 2 fracture (Shaerf et al, 2018).

The Jakob classification is based around the degree of displacement and helps determine the treatment method; type 1 fractures have less than 2 mm of displacement, type 2 fractures have more than 2 mm of displacement with an intact cartilaginous hinge and type 3 fractures have significant displacement and loss of articular congruity as the capitellum is rotated from the joint (Zale et al, 2018).

Assessment

A child who has sustained a lateral condylar fracture of the humerus will typically present following a fall from height onto an outstretched hand. On examination, the child will have a painful, swollen elbow with possible ecchymosis visible (Song and Waters, 2012). The patient's neurovascular status must be assessed. A lateral condylar fracture may not have an obvious deformity like a supracondylar fracture does, thus a high index of suspicion and appropriate imaging modalities is required when assessing a child with a painful elbow (Gaston et al, 2012).

Imaging

The most appropriate form of imaging modality are plain radiographs with ideally three different views; anteroposterior, lateral and an internal oblique view (Song et al, 2007).

© 2021 MA Healthcare Ltd

Subtle fractures may be missed by the two orthogonal views of anteroposterior and lateral given the posterolateral nature of this fracture (Song and Waters, 2012). The contralateral elbow could also be imaged to compare with the affected side.

The development of the skeletally immature elbow means that a lateral condyle fracture may not be obvious on plain film radiographs. Key features to raise the index of suspicion are a raised fat pad and lateral soft tissue swelling (Figure 2). As the paediatric elbow is developing, the bony aspect may appear small, but in truth it represents a large intra-articular cartilaginous fragment that is radio-lucent.

Further forms of imaging may be necessary to achieve diagnosis and correctly manage the patient. Both computed tomography and magnetic resonance imaging scans could be used to aid diagnosis, but computed tomography scans have the drawback of ionising radiation exposure for the child, and magnetic resonance imaging scans may not be readily available and take a relatively long time to perform (Shaerf et al, 2018). Alternatively, examination under anaesthesia with an intra-articular arthrogram can be performed to determine the fracture pattern and proceed with appropriate management immediately (Abzug et al, 2020).

Management

Undisplaced or minimally displaced (≤2 mm) lateral condyle fractures of the humerus can be managed non-operatively. The patient requires immobilisation of the elbow in flexion with the forearm in supination and the wrist in slight extension (Figure 3). This is to reduce the risk of the extensors pulling on the lateral condyle, resulting in poor articular alignment (Song and Waters, 2012).

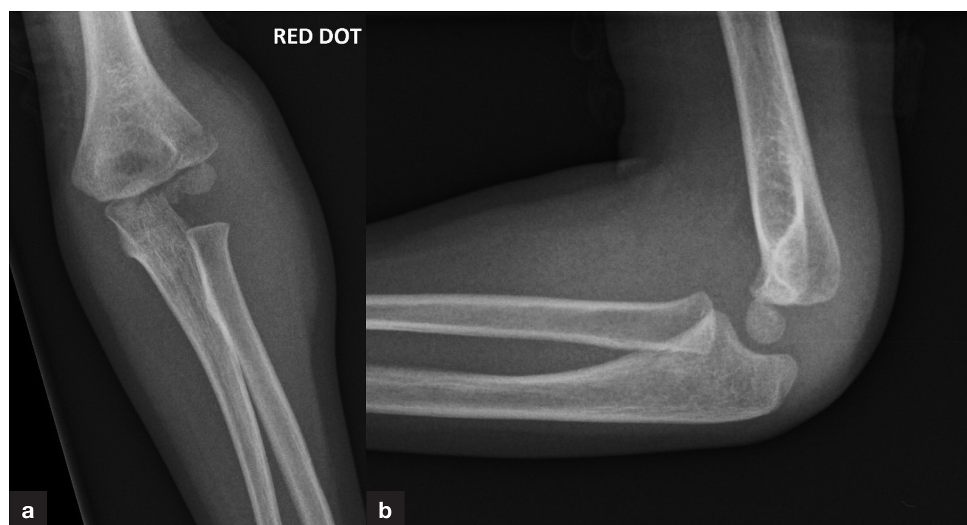

Figure 2. a. Anteroposterior radiograph and (b) lateral radiograph of the left elbow.

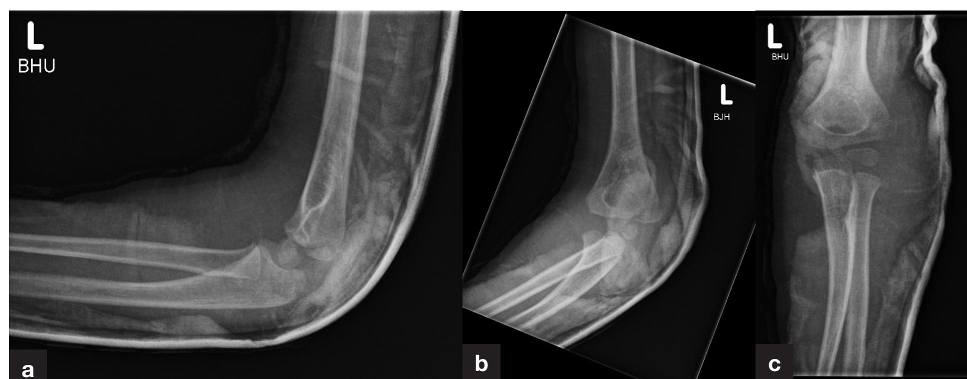

Figure 3. a. Lateral radiograph of elbow in plaster. b. Internal oblique of elbow in plaster. c. Anteroposterior radiograph of elbow in plaster.

© 2021 MA Healthcare Ltd

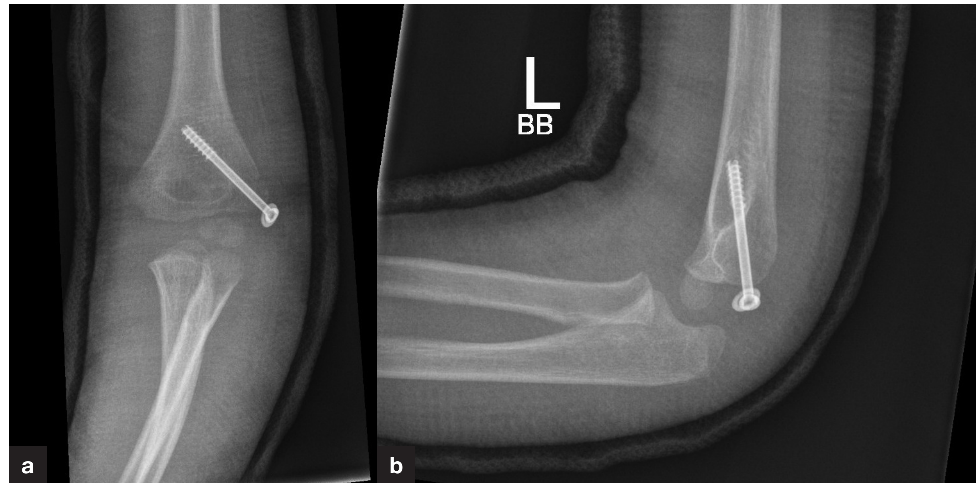

Figure 4. a. Anteroposterior radiograph and (b) lateral radiograph of the elbow 1 week post screw fixation.

Patients should have regular weekly follow up with radiographs to assess for displacement, with early surgical intervention if there is displacement of the fracture (Pirker et al, 2005).

Surgical intervention reduces the rate of non-union as anatomical reduction and compression across the epiphysis is necessary for the fracture to heal. Various surgical fixation methods are available, either by closed reduction with percutaneous pinning or open reduction and internal fixation (Conaway et al, 2018). In a closed reduction technique, the fracture is anatomically aligned and two to three divergent Kirschner wires (one being transepiphyseal) are used to stabilise the fracture. Alternatively, a single percutaneous cannulated screw can be used if the metaphyseal fragment is large enough (Figure 4) (Thapa et al, 2019). Following fixation, the patient is placed in a protective plaster cast (Thapa et al, 2019) for 3–6 weeks depending on surgeon preference. Any longer and the immobilisation risks elbow joint stiffness, which can be challenging to overcome. The K-wires can be buried or left protruding through the skin. If unburied, the K-wires are usually removed at 4 weeks (Ormsby et al, 2016), which does not require analgesia or sedation; by contrast, buried wires require a further procedure in theatre. A systematic review showed that unburied wires have a lower risk of adverse effects and are more cost effective than buried wires (Wormald et al, 2017).

When anatomical reduction via closed reduction cannot be achieved, open reduction of the fracture is necessary. For many surgeons, this is the technique of choice as it best allows anatomical reduction of the chondral surfaces and restoration of joint congruence to minimise the risk of malunion and growth arrest. The radiographic images can be deceptive to the surgeon; even with intraoperative imaging available, the large non-ossified nature of the lateral condyle means it is only on open reduction that true anatomical reduction can be achieved. Surgery is usually performed through a lateral approach of the elbow, although some advocate the posterior approach (Conaway et al, 2018). Caution must be taken when handling the posterolateral soft tissue as this could disrupt blood supply and cause avascular necrosis of the lateral condyle. Once the fracture has been successfully reduced, K-wires or cannulated screws are used to stabilise the fracture (Gilbert et al, 2016). Again, intraoperative arthrograms can be used to confirm the anatomical reduction of the fracture fragment (Figure 5).

Complications

The most common complication following fractures to the lateral condyle of the humerus is lateral spur formation. This is often asymptomatic but can rarely present with pain and decreased range of motion of the elbow (Pribaz et al, 2012). If buried wires or screws need to be removed, debridement of the spur can be performed at the time of operation. When unburied, pin site infections are a common complication following K-wire fixation (Li and Xu, 2012).

© 2021 MA Healthcare Ltd

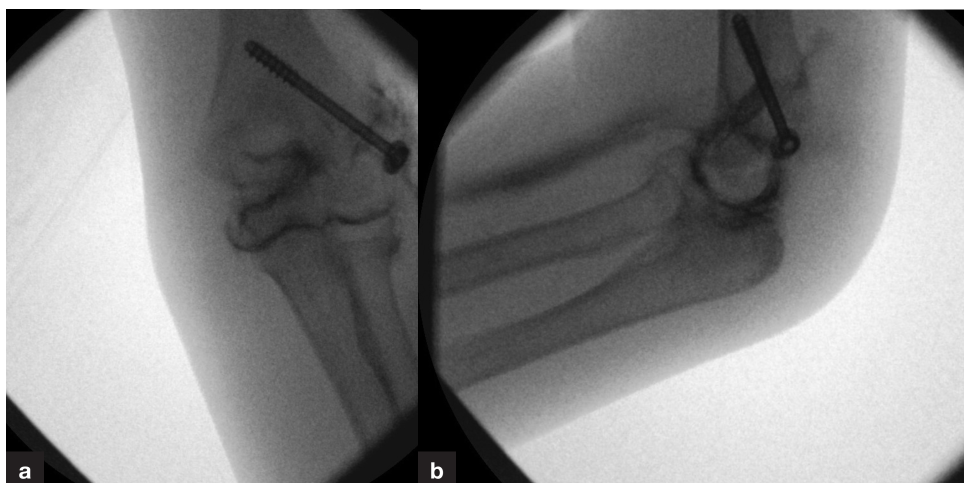

Figure 5. Intraoperative arthrogram: (a) anteroposterior view and (b) lateral view of the left elbow.

A major complication with lateral condyle fractures of the humerus is malunion, which can lead to a cubitus valgus deformity at the elbow and a painful post-traumatic arthritis of the elbow joint (Abzug et al, 2020). Furthermore, non-unions are a serious complication of lateral condylar fractures, defined as a failure of the fracture to heal by 12 weeks (Park et al, 2015). This is often the case for those with delayed presentations, early removal of fixation and displacement of conservatively managed fractures. Surgical fixation is recommended to treat non-unions as they have respectable outcomes (Flynn, 1989).

As the carrying angle from a non-union and growth arrest progresses into cubitus valgus, this causes not only functional limitations but also a gradual stretch of the ulnar nerve leading to a tardy ulnar nerve palsy (Rubin et al, 2019). Patients present with weakness and atrophy in the intrinsic hand muscles, sensory changes in the ulnar nerve distribution and clawing of the ring and small fingers (Rubin et al, 2019). Such a deformity may require further operative intervention in the form of an osteotomy to correct this deformity and reduce the strain on the ulnar nerve.

Conclusions

Lateral condyle fractures of the humerus are the second most common paediatric elbow fractures. They can be easily missed and thus inappropriately treated. They can have devastating long lasting effects for patients, leading to significant morbidity with loss of function and need for further intervention.

Increased awareness is required across the multidisciplinary team to ensure that patients with suspected lateral condyle fractures are referred promptly to the trauma and orthopaedic team to consider early operative intervention.

Author details

[1] Department of Surgery, Walsall Healthcare NHS Trust, Walsall, UK

[2] Department of Trauma and Orthopaedics, Kingston Hospital NHS Foundation Trust, Kingston Upon Thames, UK

[3] Department of Trauma and Orthopaedics, Imperial College Healthcare NHS Trust, London, UK

© 2021 MA Healthcare Ltd

Conflicts of interest

The authors declare that they have no conflicts of interest.

References

Abzug JM, Dua K, Kozin SH, Herman MJ. Current concepts in the treatment of lateral condyle fractures in children. J Am Acad Orthop Surg. 2020;28(1):e9–e19. https://doi.org/10.5435/JAAOS-D-17-00815

Key points

- Lateral condyle fracture of the humerus can be a radiologically difficult fracture to diagnose.
- Clinicians must have a high index of suspicion when treating paediatric elbows and should obtain further imaging if unsure of fracture.
- Lateral condyle fracture of the humerus must be managed optimally, either non-operatively or operatively, to ensure complications do not arise.

Conaway WK, Hennrikus WL, Ravanbakhsh S, Winthrop Z, Mahajan J. Surgical treatment of displaced pediatric lateral condyle fractures of the humerus by the posterior approach. J Pediatr Orthop B. 2018;27(2):128–133. https://doi.org/10.1097/BPB.0000000000000481

Flynn JC. Nonunion of slightly displaced fractures of the lateral humeral condyle in children: an update. J Pediatr Orthop. 1989;9(6):691–696. https://doi.org/10.1097/01241398-198911000-00012

Gaston MS, Irwin GJ, Huntley JS. Lateral condyle fracture of a child's humerus: the radiographic features may be subtle. Scott Med J. 2012;57(3):1–4. https://doi.org/10.1258/smj.2012.012028

Gilbert SR, Maclennan PA, Schlitz RS, Estes AR. Screw versus pin fixation with open reduction of pediatric lateral condyle fractures. J Pediatr Orthop Part B. 2016;25(2):148–152. https://doi.org/10.1097/BPB.0000000000000238

Li WC, Xu RJ. Comparison of Kirschner wires and AO cannulated screw internal fixation for displaced lateral humeral condyle fracture in children. Int Orthop. 2012;36(6):1261–1266. https://doi.org/10.1007/s00264-011-1452-y

Little KJ. Elbow fractures and dislocations. Orthop Clin North Am. 2014;45(3):327–340. https://doi.org/10.1016/j.ocl.2014.03.004

Ormsby NM, Walton RDM, Robinson S et al. Buried versus unburied Kirschner wires in the management of paediatric lateral condyle elbow fractures: a comparative study from a tertiary centre. J Pediatr Orthop B. 2016;25(1):69–73. https://doi.org/10.1097/BPB.0000000000000226

Park H, Hwang JH, Kwon YU, Kim HW. Osteosynthesis in Situ for Lateral Condyle nonunion in children. J Pediatr Orthop. 2015;35(4):334–340. https://doi.org/10.1097/BPO.0000000000000353

Pirker ME, Weinberg AM, Höllwarth ME, Haberlik A. Subsequent displacement of initially nondisplaced and minimally displaced fractures of the lateral humeral condyle in children. J Trauma Inj Infect Crit Care. 2005;58(6):1202–1207 10.1097/01.TA.0000169869.08723.C8

Pribaz JR, Bernthal NM, Wong TC, Silva M. Lateral spurring (Overgrowth) after pediatric lateral condyle fractures. J Pediatr Orthop. 2012;32(5):456–460. https://doi.org/10.1097/BPO.0b013e318259ff63

Rubin G, Orbach H, Bor N, Rozen N. Tardy ulnar nerve palsy. J Am Acad Orthop Surg. 2019;27(19):717–725. https://doi.org/10.5435/JAAOS-D-18-00138

Shaerf DA, Vanhegan IS, Dattani R. Diagnosis, management and complications of distal humerus lateral condyle fractures in children. Shoulder Elb. 2018;10(2):114–120. https://doi.org/10.1177/1758573217701107

Silberstein MJ, Brodeur AE, Graviss ER. Some vagaries of the capitellum. J Bone Jt Surg Ser A. 1979;61(2):244–247. https://doi.org/10.2106/00004623-197961020-00013

Song KS, Kang CH, Min BW, Bae KC, Cho CH. Internal oblique radiographs for diagnosis of nondisplaced or minimally displaced lateral condylar fractures of the humerus in children. J Bone Jt Surg - Ser A. 2007;89(1):58–63. https://doi.org/10.2106/JBJS.E.01387

Song KS, Waters PM. Lateral condylar humerus fractures: Which ones should we fix? J Pediatr Orthop. 2012;32:S5–S9. https://doi.org/10.1097/BPO.0b013e318257642a

Thapa P, Sapkota K, Wahegaonkar K et al. Comparison of Kirschner wires and Cannulated screw internal fixation for displaced lateral humeral condyle fracture in children. Asian J Med Sci. 2019;10(6):75–79. https://doi.org/10.1007/s00264-011-1452-y

Wormald JCR, Park CY, Eastwood DM. A systematic review and meta-analysis of adverse outcomes following non-buried versus buried kirschner wires for paediatric lateral condyle elbow fractures. J Child Orthop. 2017;11(6):465–471. https://doi.org/10.1302/1863-2548.11.170119

Zale C, Winthrop ZA, Hennrikus W. Rate of displacement for jakob type 1 lateral condyle fractures treated with a cast. J Child Orthop. 2018;12(2):117–122. https://doi.org/10.1302/1863-2548.12.170124

© 2021 MA Healthcare Ltd