CASE REPORT

T-condylar fractures of the distal humerus in children: report on three cases

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SUMMARY

T-condylar fractures of the distal humerus are very rare in children. Because of their rarity, there is a lack of evidence in the literature on the best method to treat such fractures. We report the cases of three paediatric patients with T-condylar fracture of the distal humerus. A high degree of attention is needed in order not to miss the presence of intra-articular fracture, especially in the case of a low supracondylar fracture and in those with a history of high-energy trauma. Anatomic intra-articular fracture reduction is the key to success in managing this rare injury.

BACKGROUND

T-condylar fractures of the distal humerus are very rare in children. When they do occur they tend to affect those approaching skeletal maturity.¹ They are infrequent in children and adolescents. They are the result of a higher energy force than that encountered in supracondylar fractures. It has been postulated that during the axial load of a direct fall on the flexed elbow, the semilunar notch of the olecranon acts as a wedge that splits the trochlea and the fracture line goes through the central groove of the trochlea and propagates proximally to the supracondylar fracture line separating the medial and lateral condyle.¹⁻⁴ Because of the rarity of such fractures, there is a lack of evidence in the literature on the best method to treat them. We studied three paediatric patients with T-condylar fracture of the distal humerus. The outcomes after open reduction and internal fixation are presented.

CASE PRESENTATION

Case 1

A 10-year-old boy fell from a height of 5 feet and landed on his right elbow on 31 July 2002, resulting in painful swelling of the elbow. There were no open wounds and no neurovascular injury. Radiographs showed a low supracondylar fracture of the right distal humerus with a suspected intra-articular fracture line (figure 1).

Case 2

An 8-year-old girl fell from bed at a height of around 1 m on 11 June 2008 and landed on her left elbow at a flexed position. There were no open wounds and no neurovascular injury. Initially, an X-ray showed a displaced medial condylar fracture of the left distal humerus with a suspected lateral condylar fracture (figure 2).

Case 3

A 10-year-old girl fell from a set of stairs on 12 August 2002 and suffered a direct contusion to her left elbow. There were no open wounds and no neurovascular injury. An X-ray showed a low supracondylar fracture together with a medial epicondylar fracture (figure 3).

TREATMENT

Case 1

An emergency operation was performed on the day following the injury. Close reduction was attempted and the fracture was temporarily fixed using two 1.6 mm K-wires. An arthrogram was performed to assess the reduction of the articular surface. The reduction was not satisfactory, and an open

Figure 1 Radiographs of the patient of case 1 showed low supracondylar fracture of the right distal humerus with a suspected intra-articular fracture line.

Figure 2 X-ray of the left elbow of case 2 showed a displaced medial condylar fracture of the left distal humerus with a suspected lateral condylar fracture.

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Figure 3 X-ray of case 3 showed a low supracondylar fracture together with a medial epicondylar fracture.

reduction through the posterior triceps sparing approach⁵ was performed. The articular fracture was reduced and fixed with one transverse K-wire, and the transcondylar fragments were fixed to the humerus with one medial and two lateral 1.6 mm K-wires. Postoperatively, a long-arm dynacast was applied.

Case 2

An emergency operation was performed on the next day. Intraoperative fluoroscopy showed a T-condylar fracture of the left distal humerus, with the trochlear fragment rotated and blocking the movement of the elbow. It was possible to closely reduce the lateral column. A medial condylar fragment required open reduction through the medial approach. Two 1.6 mm K-wires were used to fix the lateral condyle to the humerus and one 1.6 mm K-wire was used to fix the medial condylar fragment. A long-arm cast was applied.

Case 3

An emergency operation was performed on the day following admission. Close reduction was attempted but failed. Open reduction was performed through the posterior triceps-sparing approach and the fractures were fixated with K-wires (figure 4). A long-arm cast was applied. A complication in the form of a wound infection 3 weeks after the operation led to the need for surgical debridement and an intravenous antibiotic treatment.

Figure 4 Postoperative X-rays showed anatomic reduction of the articular surface with cubitus varus deformity.

Figure 5 Postoperative X-rays of case 1 showed a fragment anterior to the distal humerus.

OUTCOME AND FOLLOW-UP

Case 1

The long-arm dynacast was applied for a period of 8 weeks. The K-wire was removed under general anaesthesia 14 weeks after the operation. No wound or neurovascular complications were noted. Postoperative X-rays showed a fragment anterior to the distal humerus (figure 5). The fracture healed uneventfully. The range of movement improved from 20° to 100° 3 months after the operation, to 5°–120° 6 months after the operation with full range in pronation and supination. At the 94-month follow-up session, no deformity of the right elbow was noted. There was a slight limitation of elbow flexion as compared with the contralateral side, with full range in extension, pronation and supination. The patient was asymptomatic and was able to resume sporting activities. A radiograph showed no degenerative change in the right elbow, but an anterior bony prominence of the distal humerus was noted (figure 6), which may account for the limitation of elbow flexion (figure 7).

Case 2

The cast as well as K-wire were removed 6 weeks after the operation. No complications were encountered and the serial X-rays showed that the fracture had healed in 10 weeks. The patient had recovered well. The flexion and extension range of her left elbow was 0°–130° and she had full forearm rotation motion at 10 weeks. The carrying angle of the injury side was 0° compared with the normal side, which was 4° valgus. She was followed up 51 months after the operation. X-rays showed no degenerative change with cubitus varus and anterior bony prominence at the distal humerus (figure 8).

Case 3

Elbow mobilisation was started 8 weeks after the initial operation and the K-wire was removed at 12 weeks. The elbow joint was stiff with limited flexion-extension range of motion (20°–90°). X-rays showed no evidence of heterotopic ossification or articular malunion. Arthroscopic capsular release was performed on 22 December 2004. Arthroscopic findings showed marked fibrosis at the posterior compartment with the posterior capsule adhering to the olecranon fossa. There was cartilage destruction at the trochlea. Arthroscopy of the anterior compartment of the left elbow was attempted but failed because of the marked arthrofibrosis. Open exploration of the anterior compartment was performed. The anterior capsule was markedly thickened and fibrotic. There was bony outgrowth at the

Figure 6 (A) No deformity of right elbow of case 1. (B) Slight limitation of the right elbow flexion. (C and D) Radiographs of the patient's right elbow after the patient was skeletally mature. There was no degenerative change of his right elbow but an anterior bony prominence of the distal humerus.

radial fossa impinging onto the radial head during elbow flexion. Anterior capsulectomy and removal of the bony prominence was performed. The elbow motion improved to full extension and 125° flexion after the procedure. On subsequent follow-up, the elbow motion became static (5–90°) with cubitus varus. X-rays showed degeneration of the ulnohumeral articulation (figure 9), but the patient did not experience any significant elbow pain.

DISCUSSION

T-condylar fracture is a very rare injury in children. Moreover, the vertical fracture line can be missed in the initial radiological examination because the majority of the distal humerus is still cartilaginous. In this series, only case 2 had a clear intracondylar fracture line. T-condylar fracture was only suspected in the remaining two cases and confirmed by intraoperative fluoroscopy. An intraoperative arthrogram is needed if the fracture line

passes through the cartilage or if the majority of the distal humeral epiphysis remains cartilaginous.^{1–6} A high degree of attention is needed in order not to miss the intra-articular fracture, especially in case of a low supracondylar fracture and a history of high-energy trauma.^{1–6} A preoperative CT and MRI can provide a better preoperative assessment and facilitate the planning of the operation. These procedures are feasible even when a long-arm cast or slab is used to immobilise the fracture.

Because of the rarity of T-condylar fractures, it is not known what the best treatment option is. Different treatment options have been proposed, including cast immobilisation, olecranon skeletal traction, closed reduction and pinning,^{1–7} and open reduction and pinning.^{5–6} Proposers of the non-operative treatment have argued that although open reduction provides a direct assessment of the articular surface, it results in extensive stripping of soft tissue and disturbs the supply of blood to the condylar fragments, with the potential risks of avascular necrosis and growth disturbance.¹ Conservative treatment is indicated in the case of undisplaced fractures. However, with the lack of ossification of the distal humerus in the paediatric group, accurate assessments of the congruity of the articular surface using radiography or CTs can be difficult. A MR examination is needed to confirm the integrity of the articular surface before conservative treatment is offered.

Whether open reduction or closed reduction should be performed if an operation is indicated is a matter of controversy. The thicker periosteum and elasticity of the articular cartilage in young children makes displacement of fracture fragments less likely, and the intact thick periosteum provides a fulcrum for the fragments to be reduced by closed means.^{1–2} Moreover, a small degree of imperfect reduction of the articular surface is acceptable in young children given the greater potential for remodelling following a fracture union.¹ This was the reason for attempting closed reduction in our patients. However, closed reduction failed to achieve a reasonable reduction of the condylar fragments, and we therefore proceeded with open

Figure 7 Lateral X-rays with the elbow maximally flexed showed that the flexion was blocked by the anterior bony prominence of the distal humerus.

Figure 8 (A) Postoperative X-rays of case 2 showing K-wires in situ and anterior humeral bone fragment. (B) X-rays showing that the fracture healed with anterior humeral bony prominence.

reduction. A posterior triceps sparing approach was used in cases 1 and 2. Compared to the triceps-splitting approach,^{8 9} the triceps sparing approach may lead to less scar formation in the olecranon fossa and to less triceps muscle adherence.^{2 5} Olecranon osteotomy was not used because of the presence of open apophysis.

After anatomic intra-articular fracture reduction, the distal fragments were stabilised by a transcondylar wire.¹ This transformed a three-piece T-condylar fracture of the distal end of the humerus into a two-segment Gartland type III supracondylar fracture.⁷ Finally, the condylar fragments were fixated to the distal humerus with K-wires to achieve a triangular configuration of fixation. No intercondylar pin was used in case 2, as the

fracture was found to be fairly stable with condylar columnar fixation only.¹⁰ Postoperatively, the fractures were immobilised by a long-arm cast.^{1 6 10}

Because most of the injuries were characterised by significant soft tissue injury along with the disruption of the articular surface, residual limitation of flexion and extension could be expected regardless of the mode of treatment.^{6 7} Moreover, open reduction causes further iatrogenic injury to the surrounding soft tissues and may contribute to postoperative stiffness.⁷ Immediate postoperative CPM has been advocated to improve the range of motion.^{2 5} The cast was kept for 6 to 8 weeks in our series. We preferred to keep the cast on for a longer period than usual because the blood supply to the condylar fragments

Figure 9 (A and B) Clinical photos showing the limitation of elbow motion. (C and D) Radiographs showing degeneration of the ulnohumeral articulation with cubitus varus deformity.

may have been jeopardised by the fracture and the soft tissue dissection during exposure, and the union may have been delayed. There was mild limitation of the elbow flexion range in cases 1 and 2. This was due to anterior bone block rather than to soft tissue contracture. Early postoperative CPM cannot resolve this problem. The complication in case 3 was that the patient experienced significant elbow stiffness requiring capsular release. This may have been partly caused by the postoperative infection of the wound, leading to significant fibrosis and scarring around the fracture. The recurring stiffness of the elbow was due to post-traumatic degeneration of the ulnohumeral articulation due to the intra-articular comminution.²

Cubitus varus was observed in two patients (cases 2 and 3) and was due to the metaphyseal comminution associated with this high-energy injury. Similar to that associated with the supracondylar fracture of the distal humerus, the deformity had not progressed and was unlikely to have been due to growth disturbance of the distal humerus.

Learning points

- ▶ T-condylar fractures of the distal humerus are very rare in children.
- ▶ High degree of suspicion and then further imaging are needed for these types of injuries to be detected.
- ▶ T-condylar fractures can have a high chance of complications.
- ▶ Parents should be warned about the likelihood of an unsatisfactory outcome.
- ▶ Anatomical reduction is the single most important factor in achieving a favourable outcome.

Contributors CYJM contributed by preparing the articles and literature review. THL provided the initial ideas, assessed the patient and the clinical data.

Competing interests None.

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