

Traumatic Separation of the Distal Humeral Epiphysis

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Abstract: Traumatic separation of the distal humeral epiphysis with or without a metaphyseal wedge fragment is rarely encountered in the literature before 1978. Once recognized, larger series appeared in the literature, so it is now well documented that it is not such a rare injury, although the initial diagnosis of the lesion is a major problem. A correct diagnosis would only be possible with the aid of arthrography, ultrasound, or magnetic resonance imaging (MRI), especially if there is no significant displacement or in neonates and infants, because the ossification center of the capitellum, which usually appears after the age of 8 months, is not radiographically visible.

1. EDITORIAL

Most fractures involving the entire distal humeral physis usually occur in neonates, infants and young children before the age of 2 years. The physeal line is transverse and smooth in neonates and infants. It is also quite proximal, so it is cited closely to the centre of the olecranon fossa. A hyperextension injury in this age group is more likely to result in a physeal separation than a bony supracondylar fracture. Before the age of 7 years the distal humeral epiphysis includes the secondary ossification of the medial epicondyle. In older children, only the lateral and medial condylar physeal lines are included. The physeal line progresses more distally, with maturation of the humerus, to form a central 'V' between the medial and lateral condylar physes. This V-shaped configuration of the physeal line protects the distal humerus from physeal injuries.

Physeal separations of the distal humerus may be due to birth injuries, child abuse, falls or direct injuries. Birth injuries have occurred after both vaginal and cesarean deliveries. Confirmed or suspected child abuse in infants and young children has also been reported. Traumatic separation of the distal humeral epiphysis may also be due to a fall or direct injury. It has been shown that in young infants a physis is more likely to fail with rotary shear forces than with pure bending or tension forces, which produce other fracture patterns in older children. These fractures are almost always extension-type injuries with the distal epiphyseal fragment

posterior to the metaphysis. A rare flexion type of injury may occasionally occur in which the epiphyseal fragment is displaced anteriorly.

Fractures of the entire distal humeral physis are classified into three groups, based on the appearance of the primary ossification centers of the distal humerus. Group A fractures occur in infants up to 12 months of age, before the secondary ossification center of the capitellum appears. They are usually Salter-Harris type I physeal injuries. This injury is often missed, or misdiagnosed as elbow dislocation on radiographs, due to the lack of an ossification center in the capitellum (Fig. 1).

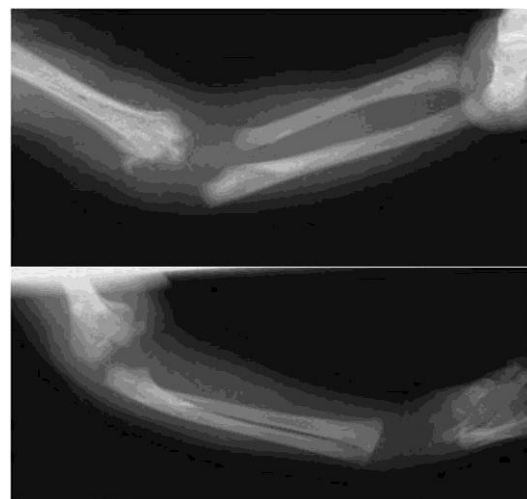


Figure 1. This 20-day-old boy had a swollen left elbow after a difficult delivery. The true nature of this injury as a fracture-separation of the entire distal humeral physis was not appreciated until periosteal new bone became visible on both sides of the humerus.

Group B fractures occur most often in children 12 months to 3 years of age in whom there is definite ossification of the capitellum (Fig. 2).



Figure2. A 2-year-old boy with a swollen right elbow after a fall. Initial radiographs indicate a displaced fracture of the distal humerus. The radius and capitellum remain congruent so the diagnosis of a displaced flexion type distal humeral physeal injury was made. Computed tomography 3 weeks later shows anterolateral displacement of the radius and ulna, as well as periosteal callus formation on the lateral side. Radiographs two months post-injury reveal callus formation on the posterolateral aspect of the distal humerus.

There may be a small flake of metaphyseal bone indicating a type II Salter-Harris physeal injury. Group C fractures occur in older children, from 3 to 7 years of age and result in a large metaphyseal fragment that is most commonly lateral but may also be medial or posterior. They occur before the ossification of trochlea, which usually appears after the age of 7 years. Type C fractures with a large metaphyseal fragment may be confused with either a low supracondylar fracture or with a fracture of the lateral humeral condyle (Fig. 3).

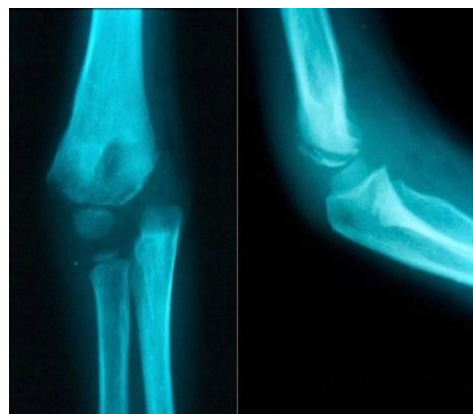


Figure3. A 7-year-old boy with an elbow injury. The radius and capitellum remain congruent, so the diagnosis of a displaced distal humeral physeal injury is made. Note the medial displacement of the proximal radius and ulna and the posteriorly based large metaphyseal (Thurston-Holland) fragment. The patient was treated by closed reduction and cast immobilization.

The clinical appearance includes a painful elbow swelling, decreased movement or disuse and ‘muffled’ crepitus on movement. In an infant less than 2 years of age with pseudoparalysis and a swollen elbow, secondary to trauma or suspected trauma, a fracture involving the distal humeral physis should always be considered.

Radiographic diagnosis may be difficult, especially if the ossification center of the capitellum is not visible. In this young age group, the proximal radius and ulna maintain an anatomic relationship to each other but are usually displaced posteromedially in relation to the distal humerus, although displacement in any direction may be encountered.

The only secure radiographic relationship that can be determined is that of the primary ossification centers of the distal humerus to the proximal radius and ulna. Once the capitellum ossification centre appears displacement of the entire distal epiphysis is much more obvious. The anatomic relationship of the capitellum ossification centre with the radial head is maintained in fracture-separations of the distal epiphysis of the humerus.

The lesion is usually confused with elbow dislocations, isolated fractures of the lateral condyle, dislocations combined with fractures of the lateral condyle, transcondylar intraarticular fractures and supracondylar fractures of the distal humerus (Fig. 4).

The relationship between the lateral condyle and the proximal radius is disrupted in displaced fractures of the lateral condyle. Elbow

dislocations have not been reported in birth trauma or in children less than 4 years of age. In elbow dislocations, the displacement of the proximal radius and ulna is almost always posterolateral, and the relationship between the proximal radius and capitellum is also altered. Furthermore, their anatomic relationship is also disrupted in elbow dislocations associated with fractures of the lateral humeral condyle.



Figure 4. Differential diagnosis includes:

- A. Elbow dislocation in a 5-year-old boy.
 - B. Elbow dislocation associated with a displaced fracture of the lateral condyle in a 7-year-old boy.
 - C. Displaced fracture of the lateral condyle in a 9-year-old boy.
- In all A, B and C the line drawn through the radius does not transect the capitellar ossification centre.
- D. Fracture-separation of the distal humeral epiphysis in a 6-year-old boy. The relationship between the ossification center of the lateral condyle and the proximal radius has been maintained. The marked medial displacement of the distal fragment helps to make the diagnosis.

The correct diagnosis may be supplemented by arthrography and MRI. In neonates and infants ultrasonography may also be used to outline the distal epiphysis of the humerus. Compared with MRI, ultrasound is less expensive, faster and there is no need for sedation. In cases with a missed diagnosis, new periosteal bone forms around the distal humerus, and the whole epiphysis may remain displaced.

Closed reduction, by mild traction, and immobilization is the treatment of choice in

early treated cases. Untreated fractures may remodel completely without any residual deformity. Whenever treatment is delayed more than 3 to 5 days, the epiphysis is not freely movable, so reduction should be avoided and the only offered treatment is elbow immobilization in a splint or cast. It is probably better to treat any resulting deformity later with a supracondylar osteotomy rather than risk the complication of physeal injury or osteonecrosis of the epiphysis by performing a delayed closed or open reduction. Only occasionally does an untreated patient have a deformity severe enough to require surgical correction at a later date. Because the articular surface is intact, complete functional recovery is usually expected. The blood supply to the trochlea may be interrupted following an injury through the physis, which may lead to avascular necrosis of the medial humeral condyle. The most common complication is cubitus varus caused by a malunion, osteonecrosis of the medial condyle, or growth arrest. Therefore, early operative fixation with percutaneous pins should be considered in cases with an early diagnosis.

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