ISOLATED TRAUMATIC DISLOCATION OF THE RADIAL HEAD IN CHILDREN

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Isolated traumatic dislocation of the radial head in children is not as rare as sometimes supposed. Attention to detail in radiographic interpretation is the key to diagnosis. Early closed reduction and immobilisation in an above-elbow plaster in 90° of flexion and full supination for three to six weeks is recommended. Seven cases are presented, two of which were treated operatively and had unsatisfactory results. The applied anatomy, management and complications are discussed.

Isolated traumatic dislocation of the radial head in children has been described in the literature as "an extremely rare injury" (Hamilton and Parkes 1973). Seven patients with this injury were seen at the Red Cross Children's Hospital, Cape Town, between January 1984 and June 1985 (Table I). Instances of "pulled elbow" and patients with associated fractures of the radius or ulna were excluded. No patients with features suggestive of congenital radial head dislocation were encountered. The pathophysiology, problems, management and complications are discussed, together with a review of the literature.

FINDINGS

Incidence. A review of the English language literature revealed a total of 46 reported cases; the largest single series of 12 (Stelling and Cote 1956) was seen over a period of 20 years. They found that isolated traumatic radial head dislocation in children occurred mainly between the age of two and seven years, with no sex or ethnic predominance. The criteria for congenital dislocation, defined by McFarland (1936) and Mardam-Bey and Ger (1979) are shown in Table II, but were not seen in our cases.

Congenital dislocation of the radial head is a well-described entity (Gunn and Pillay 1964; Almquist, Gordon and Blue 1969). However, when the dislocation is unilateral, a congenital aetiology has been questioned

by many, because missed traumatic dislocation appears more likely. In addition, as isolated traumatic radial head dislocation has been reported in a neonate after difficult breech delivery (Schubert 1965), the discovery of dislocation in the neonatal period does not necessarily preclude a traumatic origin. A further difficulty in determining the aetiology is that a chronically dislocated radial head, even if traumatic, will subsequently develop radiological changes similar to those of congenital dislocation (Lloyd-Roberts and Bucknill 1977). Stelling and Cote (1956), in their review of isolated traumatic radial head dislocations, stated that "it is our feeling that a significant number of these cases remain undiagnosed, or are loosely ascribed to the group of congenital dislocation and that, for this reason alone, the true incidence of this condition is underestimated". This paper supports these views.

Applied anatomy. The normal anatomy has been extensively reviewed by Wiley, Pegington and Horwich (1974). They found the annular ligament to be the most crucial factor in maintaining the stability of the radial head. Complete dislocation of the radial head cannot occur without complete disruption of this ligament. Lesser supporting structures include the interosseous membrane (taut in supination and neutral rotation); the quadratus ligament (anterior fibres taut in supination, posterior fibres taut in pronation), and the oblique cord (taut in supination). These are shown in Figure 1.

Three types of dislocation have been described, posterior, lateral and anterior. Anterior dislocation occurs more commonly and was the only variety encountered in our series.

Mechanism of injury. Two possible mechanisms have been proposed: a hyperpronation force applied to the (partly) extended elbow with or without additional varus strain (Evans 1949; Vesely 1967); or a hyperextension force applied to the fully supinated forearm with or without the superimposed pull of the biceps (Smith 1972).

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Table I. Details of 7 patients all of whom had anterior dislocation of the radial head

Case	Age (years)	Sex	History	Examination	Management	Immobilisation	Follow-up period	Final result
1	6	F	Fell 4 days before presentation, injuring L arm	Tender, swollen elbow; decreased range of all movements	Closed reduction	Collar and cuff for 4 weeks	1 year	Full range of movement
2	7	F	Direct blow to L elbow	Tender, swollen elbow; decreased range of all movements	Closed reduction	Plaster cast—90 flexion, full supination; collar and cuff for 4 weeks	3 months	Full range of movement
3	1	M	Fell injuring L elbow	Tender, swollen elbow; decreased range of all movements	Closed reduction	Plaster cast—90 flexion, full supination; collar and cuff for 4 weeks	4 weeks	Full range of movements
4	5	F	Fell 6 weeks before presentation, injuring R elbow	Flexion: 45°–120° Pronation: 0°–45° Supination: 0°	Open reduction; reefing of annular ligament; K-wire fixation	Plaster backslab—90° flexion, full supination; collar and cuff for 3 weeks; then K-wire removed	1 year	Radial head redisplaced Flexion: Nearly full Extension: Full Supination: Full Pronation: 0°–45°
5	8	M	Fell 6 weeks before diagnosis; initially treated as soft-tissue injury	Tender, swollen L elbow; decreased range of all movements	Open reduction; Bell-Tawse procedure; K-wire fixation	Plaster cast—90° flexion, full supination; collar and cuff for 3 weeks; then K-wire removed	6 months	Flexion: 40°–135° Supination: 0° Pronation: 0°–15°
6	8	M	Fell onto L arm	Tender, swollen elbow; decreased range of all movements	Closed reduction	Plaster cast—90° flexion, full supination; collar and cuff for 3 weeks	2 months	Full range of movement
7	5	F	Pedestrian in road accident, multiple injuries	Tender, swollen L elbow; palpable anterior dislocation of radial head	Closed reduction	Plaster cast—90° flexion, neutral rotation; collar and cuff for 4 weeks	2 months	Full range of movements

Table II. Criteria for diagnosing congenital dislocation*McFarland 1936*

1. Relatively short ulna/long radius
2. Hypoplastic/absent capitulum
3. Partially defective trochlea
4. Prominent ulnar epicondyle
5. Dome-shaped radial head with a long narrow neck
6. Grooving of the distal radius

Mardam-Bey and Ger 1979

1. Bilateral involvement
2. Concurrence of other congenital anomalies
3. Familial occurrence
4. No history of trauma
5. Irreducibility by closed methods
6. Dislocation seen at birth

Fig. 1

Diagram of the interconnections between the radius and ulna: *a*, interosseous membrane; *b*, annular ligament; *c*, oblique cord; and *d*, quadrate ligament.

Fig. 2

A seven-year-old girl in whom the diagnosis of dislocation is confirmed by the fact that a line drawn through the mid-shaft of the radius misses the capitulum.

However, in our series it has been impossible to establish a mechanism of injury in all instances, and this experience coincides with that of other authors.

Diagnosis. The child usually presents with a painful swollen elbow. Passive movement may be surprisingly free in flexion and extension, but is limited in pronation and especially supination. However, in the acute stage, associated pain usually restricts all movements at both the elbow and radio-ulnar joints. The injury can result from surprisingly minor trauma (Lloyd-Roberts and Bucknill 1977), and therefore a high index of suspicion is imperative, together with careful assessment of the radiographic findings. Both anteroposterior and lateral views of the elbow are required. On the lateral view, a line drawn through the long axis of the radial shaft should always pass through the centre of the capitulum, irrespective of the degree of flexion of the elbow (Støren 1958). The radiological findings are conclusive in the diagnosis of this condition (Fig. 2).

Management. Whether the management should be conservative or operative depends on the ease of reduction and of maintenance, as well as the delay before management starts. In the acute case, reduction may be effected by traction and full supination with the application of direct pressure over the radial head (Wiley *et al.* 1974). The elbow is usually immobilised in an above-elbow plaster cylinder with the elbow flexed 90° and the forearm in full supination (Vesely 1967; Hamilton and Parkes 1973; Živković 1978). This position adds to the stability of reduction by diminishing the pull of the biceps and tensing both the interosseous membrane (Wiley *et al.* 1974) and the anterior fibres of the quadratus ligament (Spinner and Kaplan 1970). In addition, maintenance of reduction may be supplemented by a percuta-

neous trans-capitular Kirschner wire which, however, has not been proved necessary in this series.

The duration of immobilisation varies from three to six weeks (Hume 1957; Vesely 1967; Hamilton and Parkes 1973), being three to four weeks in our series. Five of our acute dislocations were easily reduced by closed means. However, an instance of acute irreducibility necessitating open reduction has been reported by Neviaser and LeFevre (1971) who described an irreducible button-holing of the radial head through a transverse tear in the annular ligament. Management of the patient whose diagnosis has been excessively delayed (by three weeks or more) is controversial. Recommendations include open reduction, with or without repair or reconstruction of the annular ligament (Vesely 1967; Lloyd-Roberts and Bucknill 1977), as well as non-intervention with possible delayed excision of the radial head, should this prove necessary once maturity has been reached (Stelling and Cote 1956).

Complications. In this series, no myositis ossificans or neurovascular complications were encountered. However, myositis ossificans is described in the literature, especially if reduction is delayed or after operative intervention. One patient (Case 4, Table I) redisplaced, but it has been shown that this may cause surprisingly little disability (Vesely 1967).

DISCUSSION

Isolated traumatic dislocation of the radial head has been regarded by many as a "para-Monteggia" lesion (Živković 1978). The absence of a concomitant ulnar fracture is at least in part due to the plasticity of the ulna in children. This permits transient bowing of the bone

without it fracturing; up to 45° of bending may occur before a greenstick fracture results (Handelsman 1983). However, as in the case reported by Živković, follow-up radiographic examination in our series failed to demonstrate evidence of either periosteal reaction or bowing of the ulna. This negative finding raises the possibility that weakness of the annular ligament predisposes to rupture, with consequent radial head dislocation even without significant ulnar trauma. While the Monteggia lesion undoubtedly occurs more frequently, it appears that an isolated dislocation of the radial head is not as rare as has been previously thought. The diagnosis may easily be missed because the history is often vague, the clinical

findings inconclusive, and the radiological features relatively subtle. Careful radiological examination is the key to the diagnosis.

The small numbers of this series precludes our proposing a definitive protocol regarding management. However, after early diagnosis, closed manipulation together with immobilisation in an above-elbow plaster in 90° of flexion and full supination for three to six weeks proved satisfactory in five patients; two patients treated operatively had unsatisfactory results.

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