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CASE REPORT

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Ultrasonography of the annular ligament partial tear and recurrent "pulled elbow"

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Abstract A 2-year-old boy had multiple episodes of radial head subluxation, recurrent "pulled elbow." On initial ultrasonography, there was subluxation of the radial head in relation to the capitellum, and the annular ligament was partially disrupted. Following brace treatment, subluxation of the radial head was corrected and annular ligament disruption healed. As shown by ultrasonography, these findings correlated well with the clinical course and can be utilized to guide treatment.

Keywords Musculoskeletal · Ultrasound · Radial head dislocation · Annular ligament displacement

Introduction

Radial head subluxation—also termed annular ligament displacement secondary to traumatic rupture of the annular ligament—has been well described in clinical orthopedic literature; there is one previous report of use of ultrasound to evaluate displacement of the radial head [1–7]. This report did not include evaluation of the ligament itself [1]. Ultrasonography was performed on a child with recurrent pulled elbow to evaluate a possible tear in the annular ligament or radial head subluxation and to assess the radiohumeral joint. We believe ultrasonography is of value in documenting the pattern of recurrent pulled elbow and for reevaluating the elbow after treatment.

Pulled elbow is a common injury among young children. The diagnosis is usually made from the history and clinical findings, and the radiography is normal [2, 4]. We report the use of ultrasonography in the case of partial annular ligament tear and recurrent pulled elbow.

Case report

A 2-year-old boy first had pulled elbow when he was with a baby-sitter. He had three additional episodes, each occurring with traction on an extended elbow and reducing spontaneously. After a fourth episode

requiring reduction by his primary care physician, he was referred to our pediatric orthopedic surgery clinic for further evaluation and treatment. He had full active and passive elbow and forearm range of motion. AP and lateral radiographs of the elbow were interpreted as normal. Ultrasonography was requested for pretreatment evaluation of the annular ligament and radiohumeral joint.

Real-time ultrasonography was performed with a 12-MHz linear transducer (Advanced Technology Laboratories, HDI 5000). This transducer is more suitable for imaging superficial structures [3]. Later studies also included an 8-MHz sector transducer. Ultrasonography was done during both pronation and supination with the elbow extended, flexed to 45° and flexed to 90°. Ultrasound examination of a healthy 22-month-old boy was performed in the lateral longitudinal view during pronation and supination and views also obtained at 45° flexion of the elbow for comparison (Fig. 1). On the initial examination of the pulled elbow patient, there was subluxation of the radial head in relation to the capitellum with 3.4 mm of displacement as compared with the normal contralateral elbow (Fig. 2). Initially, the annular ligament was partially disrupted and swollen (Fig. 3). The marginal distance between the radial head and the capitellum was increased. This finding could represent partial marginal entrapment of the annular ligament.

After 10 weeks of treatment in a long-arm orthosis with the elbow flexed 90° and the forearm in full supination, the ultrasound examination was repeated. The subluxation of the radial head was improved (Fig. 4), and only 1.2 mm displacement of the radial head was seen when the elbow was stressed in the same way as in the previous evaluation. The partial tear of the annular ligament was improved as shown by a decrease in echogenicity and thickening (Fig. 5). The marginal distance between the radial head and capitellum was decreased, and there was no marginal entrapment of the annular ligament. Dynamic subluxation of the radial head was no longer seen on the ultrasound done 14 weeks after initiation of treatment (Fig. 6). There remained thickening of the annular ligament when compared with the opposite elbow (Fig. 7). Based on these findings, the brace was reduced to night-time wear. When clinically reassessed 1 month later, the child had had no further episodes of subluxation, and the orthosis was discontinued. Subsequently, the child remained asymptomatic for 6 months.

Discussion

We have performed ultrasonography on more than 30 patients with a possible diagnosis of pulled elbow. We have not been able to subluxate the radial head on the "normal" (contralateral) elbows. More data are needed to develop standards as to how much subluxation is within the normal range. There will undoubtedly be some interobserver variability about degree of subluxa-

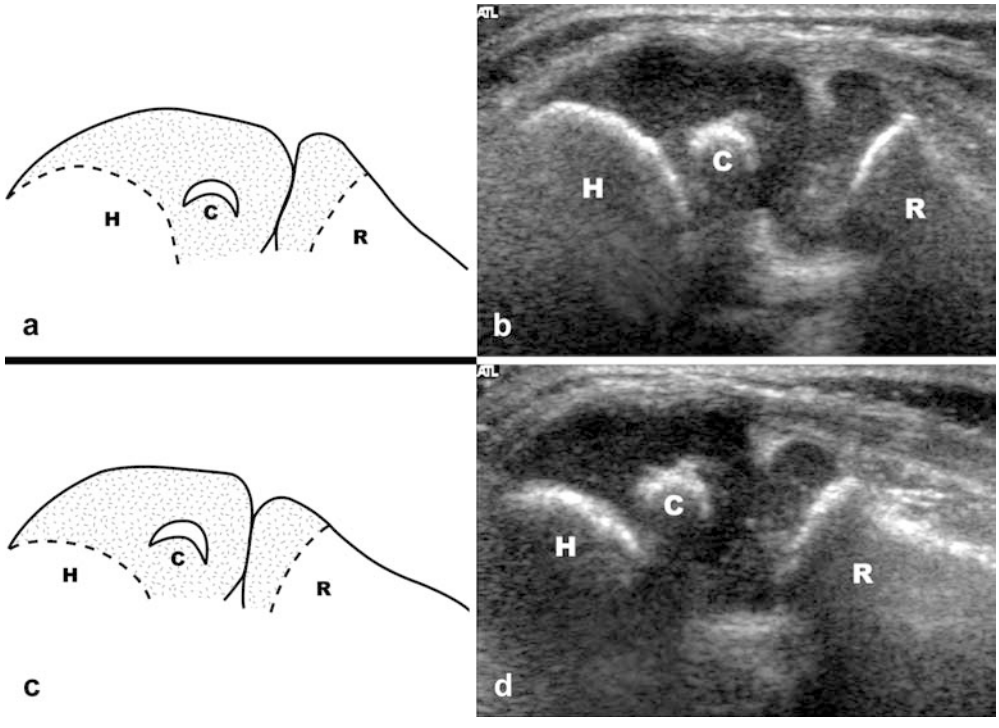

Fig. 1 Normal ultrasonography of the elbow. Drawing (**a**) and US (**b**) of a 22-month-old normal boy, showing the lateral longitudinal view during pronation with 45° flexion of the elbow. **c**, **d** The same patient with a drawing (**c**) and US (**d**) showing the lateral longitudinal view during supination with 45° flexion. *H* humerus, *C* capitellum, *R* radius

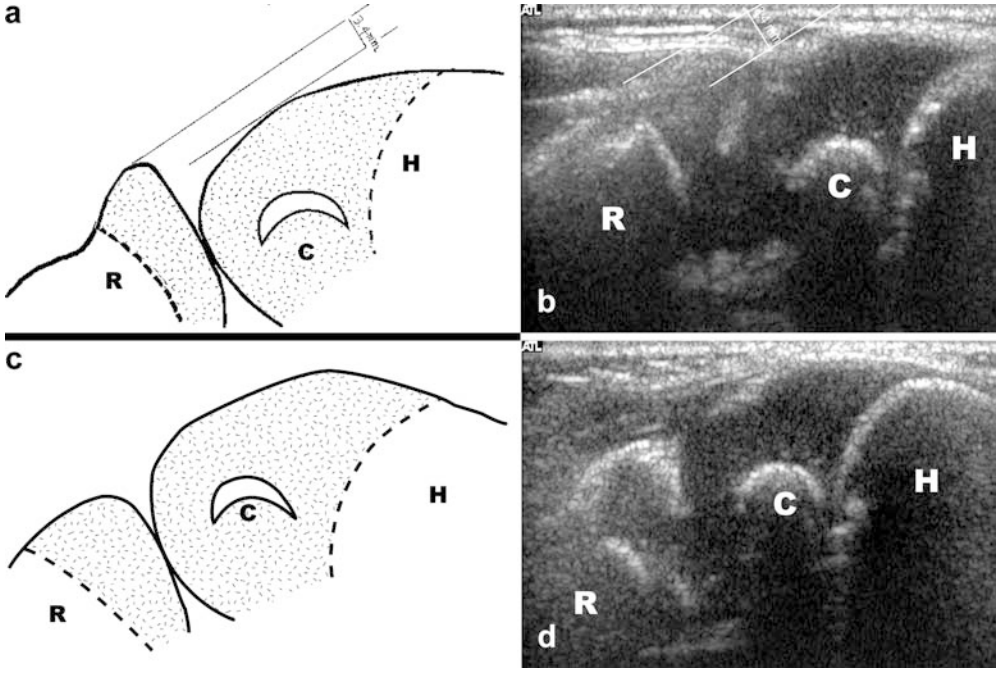

Fig. 2 Recurrent "pulled elbow" in a 2-year-old. The drawing (**a**) and US (**b**) in the lateral longitudinal view during pronation with 45° flexion of the elbow reveals a 3.4 mm subluxation of the radial head in relation to the capitellum. The distance between the radial head and the capitellum is increased. Drawing (**c**) an US (**d**) show the normal radius–capitellum relationship on supination with 45° flexion. *H* humerus, *C* capitellum, *R* radius

tion, position of the probe, forearm motion (pronation and supination) and angles of the elbow joints.

Radial head subluxation is a common pediatric presentation, generally occurring when children are between 1 and 3 years old (mean age 2 years). Girls are somewhat more commonly affected than boys. The classic mechanism of injury is longitudinal traction on the arm with the forearm in pronation [3, 6]. There is no literature support for the common assumption that a relatively small head of the radius in relation to the neck of the radius predisposes the young to this injury, and the radial head was actually larger than the neck in an anatomic investigation [7]. The pathologic lesion is generally felt to be a tear in the attachment of the annular ligament to the periosteum of the radial neck with the detached portion sometimes becoming trapped between the head of the radius and capitellum [1, 5–7]. The recurrence rate is about 20% for this injury and is thought to be secondary to laxity of the annular ligament [2, 3]. Swelling, ecchymosis and deformity are nonspecific findings [4]. Stretching of the annular ligament allows fibers to slip over the head of the radius, resulting in instability of the joint during pronation and supination of the arm.

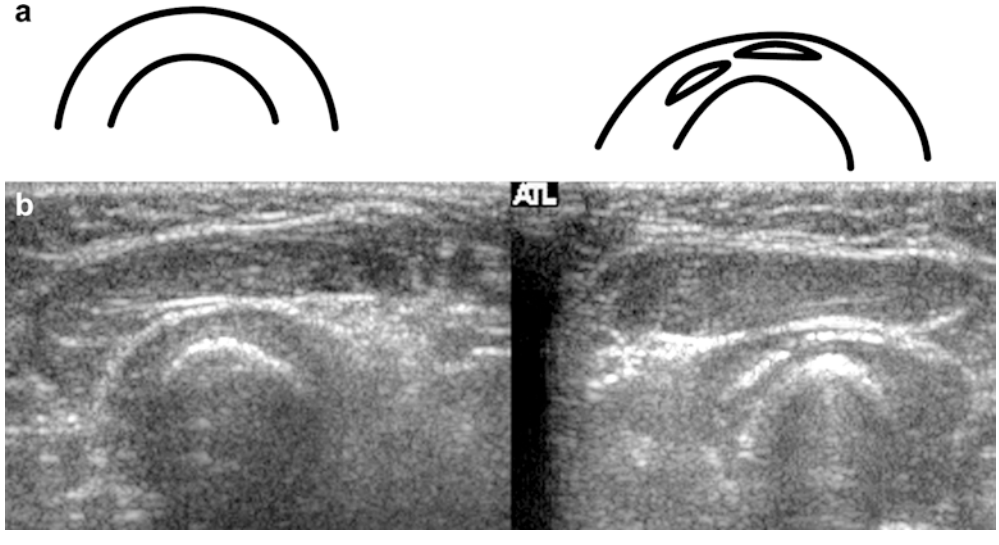

Fig. 3 Ultrasonography of the annular ligament. **a** Drawing of the anterior transverse view of the radial neck. The normal (*left*) and lesion site (*right*) with curvilinear echogenic sites at the annular ligament caused by partial tears and further thickening at the medial site as compared with the normal. **b** US images equivalent to the drawings

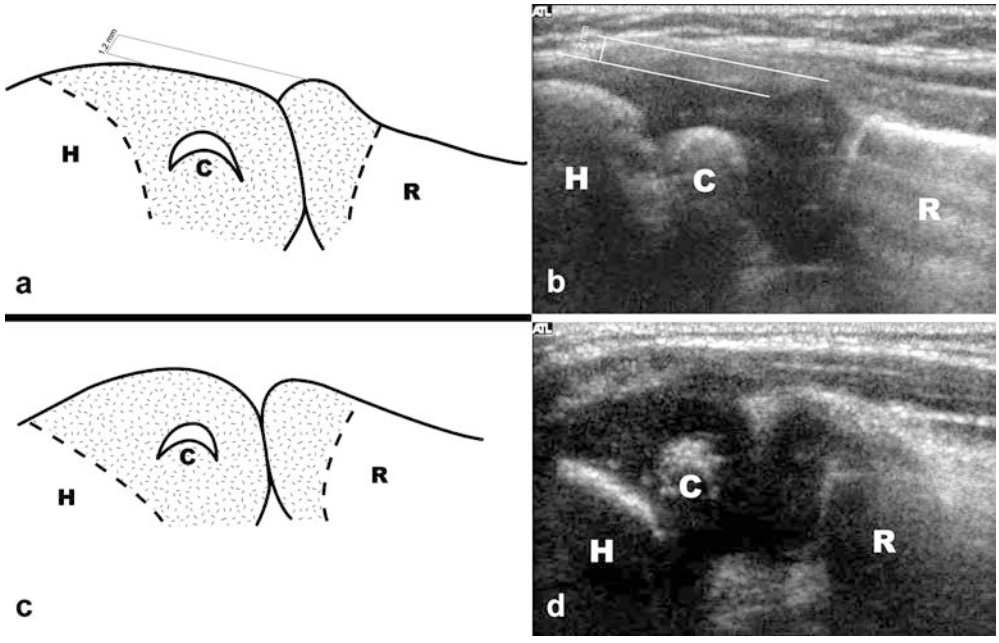

Fig. 4 Follow-up examination at 10 weeks. Drawing (**a**) and US (**b**) shows 1.2 mm subluxation of the radial head on the lateral longitudinal view during pronation. The distance between the radial head and capitellum is decreased and there is no trapping of soft tissue between them. Drawing (**c**) and US (**d**) shows the normal radius–capitellum relationship during supination. *H* humerus, *C* capitellum, *R* radius

Ultrasonography of the elbow joint allows the examiner to distinguish cartilage from bone and soft tissue and shows changes in anatomical relationships with different planes and views. It is easy to compare the symptomatic side with the normal opposite side. It is useful to find the thickened and sometimes torn annular ligament, quantitate radial head subluxation, and measure the distance between radial head and capitellum, when the arm is pronated. These findings were well correlated with the clinical course in this case. Ultrasonography can be utilized as a tool to measure the progress and outcome of recurrent radial head subluxation during treatment.

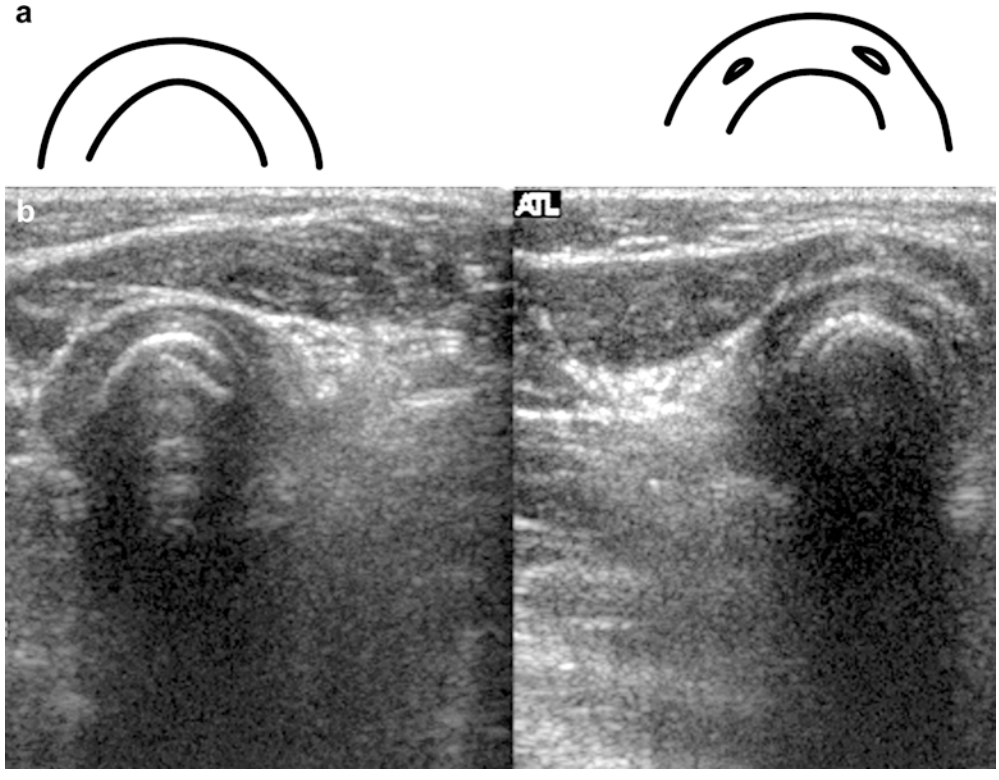

Fig. 5 Follow-up of the annular ligament at 10 weeks. **a** Drawings showing the normal (*left*) and improvement of the partial tear (*right*) with decrease in echogenicity and thickening. **b** Ultrasound showing these findings

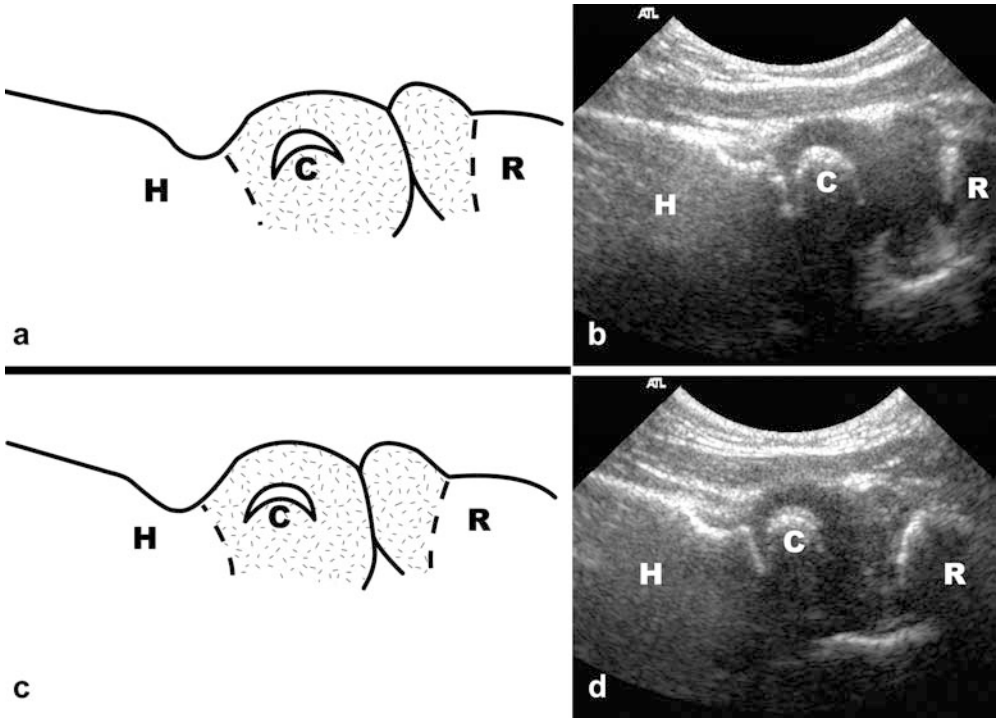

Fig. 6 Follow-up at 14 weeks. Drawing (**a**) and US (**b**) show no subluxation of the radial head when examined in the lateral longitudinal view during pronation and a normal distance between the radial head and capitellum. Drawing (**c**) and US (**d**) show the normal radius–capitellum relationship on supination. *H* humerus, *C* capitellum, *R* radius

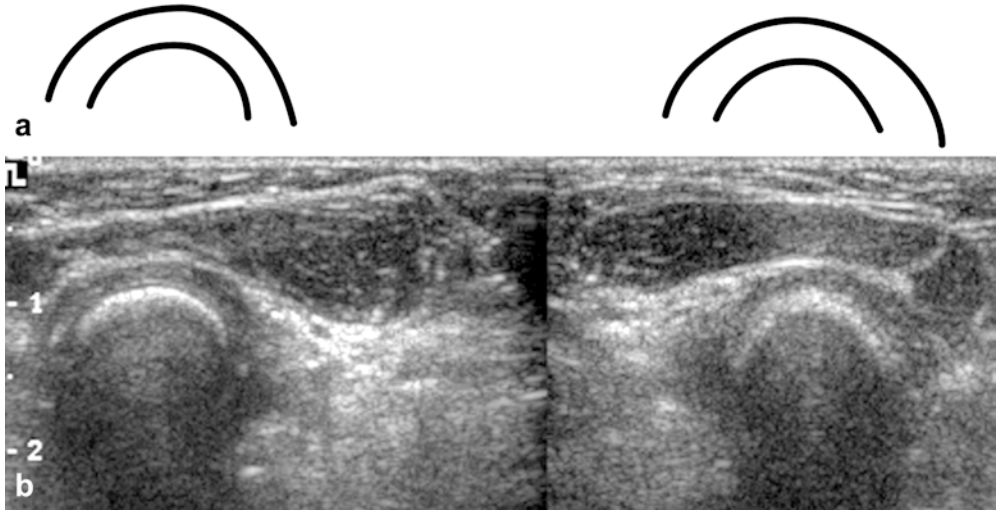

Fig. 7 Follow-up of the annular ligament at 14 weeks. Drawing (**a**) and US (**b**) shows resolution of the partial tear of the annular ligament with minimal focal thickening remaining

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