

## Case report

# Fracture separation of the proximal humeral epiphyses in neonate: a case report and literature review

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**P**roximal humeral epiphyseal injuries in neonate are rare. We reported a case of proximal humeral epiphyseal injury diagnosed by ultrasonography. This kind of injury usually occurs during birth or is caused by child abuse,<sup>1-9</sup> and mostly present as Salter-Harris type I or II injuries.<sup>1-3,10</sup> It is difficult to be diagnosed on radiography. Though the treatment is generally conservative, early diagnosis is important to avoid complications and ultrasonography can serve as a guide for the treatment and prognosis.

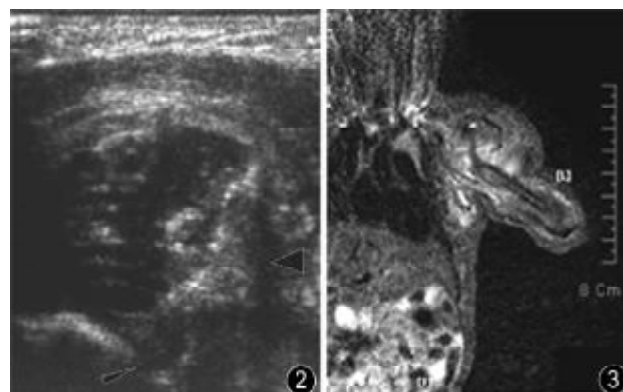
### CASE REPORT

A four-day old female was born by cesarean section at full term with a weight of 2.8 kg. After birth she was observed to not actively move her left upper limb, and passive motion made her irritable. Based on a presumed diagnosis of shoulder dislocation, attempted manual reduction in another hospital had failed. At our institution, physical examination revealed swelling and tenderness on her left shoulder. Dislocation was suspected according to conventional radiographs which were obtained four days after birth (Figure 1). Subsequently, an ultrasound image was obtained. As demonstrated in Figure 2, the humeral head was inside the capsule and it was easy to identify the fracture line across the epiphysis and the discontinuity of the *substantia corticalis ossiu*, so fracture separation was

confirmed. Ten days after injury, MRI showed the fracture separation of the proximal epiphysis clearly (Figure 3). The involved limb was stabilized against the lateral chest with the shoulder in adduction and internal rotation. Two weeks later, active motion began to recover on the involved shoulder. Radiography showed the angulation between the humeral head and shaft and abundant callus formation twenty-four days after injury (Figure 4).



**Figure 1.** X-ray image with shoulders in abduction 4 days after birth. Bilateral humeral head ossification centers are not visible. Left proximal humeral metaphysis is migrated to a medial and inferior position. The relationship between proximal humeral metaphysis and glenoid is normal on the contralateral side.



**Figure 2.** Coronal ultrasound. Left humeral head is inside the capsule. The fracture line (big arrow) and the discontinuity at the *substantia corticalis ossiu* (small arrow) are observed. **Figure 3.** Coronal STIR MRI. Fracture separation of the proximal humeral epiphysis is easy to identify.

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**Figure 4.** X-ray image with shoulders in abduction 24 days after trauma. Bilateral humeral head ossification center is visible. The left humeral head ossification center lies eccentrically and lateral to the longitudinal axis of the humeral shaft. There is angulation between humeral head and shaft and abundant callus formation.

At six months follow-up, there was no evidence of deformity and no limitation of range of motion (ROM) on the involved shoulder as compared with contralateral one according to telephone follow-up with her father. Short-term outcome was satisfactory.

## DISCUSSION

Neonatal proximal humeral epiphysis fracture separations are rare, and usually present with swelling, tenderness, decreased active motion diagnosis and irritable passive motion. It is important to avoid misdiagnosis or misdiagnosis of the injury as clavicular fracture, shoulder dislocation, humeral shaft fracture, brachial plexus injury, Erb's palsy,<sup>11</sup> arthritis, or osteomyelitis. Delayed diagnosis and treatment lead to humeral shortening, rotation and angulation, and osteotomy is inevitable in some patients.<sup>9</sup> Some authors suggest that when the injury of shoulder is suspected, physical examination with the neonate under sedation or general anesthesia would be helpful,<sup>12</sup> but this may be impractical in most cases.

The ossification center in newborns is not visible on conventional radiographs, and so it is difficult to diagnose physeal injuries. Conventional radiographs of non-displaced or minimally displaced epiphysis fracture separation can be normal or only demonstrate an increase of joint space. On the other hand, plain X-ray may show obvious migration of epiphysis fracture separation as an abnormal relationship between the humeral shaft and glenoid which appears similar to dislocation. Although shoulder dislocation in neonates has been reported,<sup>13</sup> the capsule and its accessory structure are much stronger than the epiphyseal cartilage. If shoulder dislocation is suggested on radiography, fracture separation of epiphysis should be considered. In this

case, four days after injury, radiography with the shoulders in abduction was obtained. The bilateral humeral head ossification center was not visible yet. The left proximal humeral metaphysis was migrated to a medial and inferior position, which appeared similar to a dislocation of the shoulder. This appearance resulted in misdiagnosis in another hospital.

When the ossification center is visible on conventional X-ray, as the humeral head ossification center lies central to the longitudinal axis of the humerus with the involved shoulder in internal rotation, in this position it is easy to confuse the presentation with Erb's palsy. The ossification center lies eccentric and medial to the longitudinal axis of the humeral shaft with the shoulder in external rotation. This position helps to demonstrate the abnormal relationship between humeral head and shaft. If this still cannot confirm the diagnosis, it is helpful to position the shoulder in abduction and compare with the contralateral shoulder. In the case, 24 days after trauma, the bilateral ossification center was visible and angular deformity was noted between the left humeral head and shaft.

Arthrography was obtained and the diagnosis was confirmed if the humeral head and shaft were in discontinuity.<sup>6,12</sup> Because of large radiation dosage and the high risk of secondary infection, this method became less appealing in clinical practice. Ultrasound can provide good images of the periosteum, capsule, ossification center of the humeral head and epiphyseal plate which has not yet ossified.<sup>1,6</sup> Many cases of epiphysis fracture separation have been diagnosed by ultrasonography.<sup>1,3,5-8,14</sup> With the shoulder in adduction, the fractured humeral head and humeral shaft are reduced by the force of ligaments and muscles around the shoulder. Even by ultrasound, it is hard to detect the abnormal relationship between the humeral head and shaft in this position. However, in the supine position and with the shoulder in abduction, ultrasound can detect them better in coronal plane.<sup>6</sup> If fracture separation occurs, angulation and a varying relationship between the humeral head and shaft with passive movement of the involved shoulder can be demonstrated. Discontinuity of substantia corticalis ossiu also suggests physeal injuries. The use of ultrasound for evaluation of joint injuries avoids the shortcomings of ionizing radiation. Contralateral joints can be examined for comparison and functional dynamic studies can be performed easily.<sup>15</sup>

The treatment of proximal humeral epiphyses fracture separation in neonates is conservative. Dressing or bandage can be used to stabilize the involved limb to the lateral chest with the shoulder in adduction and neutral position or slight internal rotation for 2-3 weeks. Seven to ten days later, callus formation can be seen on radiography; two weeks later active motions begin to recover.<sup>1, 6, 7, 12</sup> Because of the powerful remodeling ability of fractures in neonates, many authors are optimistic about long-term outcome of proximal humeral epiphyses fracture separation. Ellefsen et al<sup>9</sup> reported that varus, shortening and rotational deformity occurred after proximal humeral epiphyses injuries and osteotomy was unavoidable in some cases. In contrast, Husain<sup>16</sup> suggests that anything more than the simplest immobilization methods in infants is unnecessary due to their remodeling ability.

Fracture separation of the proximal humeral epiphyses in newborns is rare and difficult to diagnose on radiography. Ultrasonography has the advantages of being economical and noninvasive. It is sufficient to confirm the diagnosis of these physeal injuries and serves as a guide for their treatment and prognosis. We recommend ultrasonography if fracture separation of the epiphyses is suspected. Arthrography and physical examination under general anesthesia should be replaced.

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