

# Fractures of the Humerus in the Neonatal Period

Nir Sherr-Lurie MD, Gad M.Bialik MD, Abraham Ganel MD, Amos Schindler MD and Uri Givon MD

Pediatric Orthopedic Unit, Safra Hospital for Children, Sheba Medical Center, Tel Hashomer, affiliated with Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Israel

**ABSTRACT:** **Background:** Fractures of the humerus in neonates can pose a diagnostic challenge, especially when the fracture occurs in the proximal or distal epiphysis.

**Objectives:** To review our experience in the diagnosis and treatment of birth-related humeral fractures.

**Methods:** Between the years 2001 and 2009, seven newborn patients and two patients treated in the neonatal intensive care unit sustained a fracture of the humerus. Four of the fractures occurred in the humeral shaft, three in the proximal epiphysis and two in the distal epiphysis. In all the newborn patients the diagnosis was made on the first day of life using radiography and ultrasonography. The fractures of the shaft and of the distal epiphysis were treated by gentle manipulation and casting, and the fractures of the proximal epiphysis were treated by swaddling.

**Results:** All of the patients demonstrated fracture union within 2 weeks, and radiographs at the age of 6 months demonstrated complete remodeling of the fracture.

**Conclusions:** Ultrasonography is a simple, readily available and inexpensive modality for the diagnosis of birth-related fractures of the humerus, especially in the yet unossified epiphyses.

IMAJ 2011; 13: 363–365

**KEY WORDS:** neonates, fractures, humerus, ultrasonography

Humeral fractures in the neonatal period are usually treated conservatively, with or without closed reduction. Immobilization is usually achieved using clothing, traction, splints or plaster casts [1-3]. We present here our experience with humeral fractures that occurred in the neonatal period, focusing on ultrasonographic diagnosis of epiphyseal fractures.

## PATIENTS AND METHODS

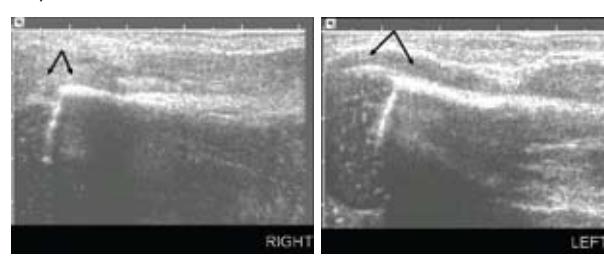
We performed a computerized search of the medical records at the Sheba Medical Center during the years 2001–2009 for patients diagnosed with a humeral fracture immediately after delivery. Seven such neonates were identified. Two other neonates, born prematurely and treated in the neonatal intensive care unit, were diagnosed with fractures of the humerus 2 and 4 months after delivery, respectively. These fractures are usually due to transient neonatal osteoporosis and share the difficulty of diagnosis with fractures occurring at birth [4]. Clinical data were obtained from the patients' files, and all their imaging studies were reviewed.

All neonates had initial radiographs [Figure 1] and in all the neonates with epiphyseal fractures ultrasonography was added [Figure 2]. One neonate underwent an MRI examination of

**Figure 1.** Radiograph of the elbow demonstrating a physeal fracture of the distal part of the humerus, or an elbow dislocation



**Figure 2.** Ultrasound examination of the left and right distal humerus demonstrating a fracture on the left. The fracture displacement is visible



**F**ractures of the long bones in otherwise healthy neonates are of interest to obstetricians, neonatologists and pediatric orthopedic surgeons. Fractures of the humerus are the second most common long bone fractures in the neonate, after fractures of the clavicle, and may occur in the epiphyseal regions or in the shaft. The early diagnosis of humeral fractures, which occur in mostly cartilaginous regions of the bone, poses a challenge to clinicians. The diagnosis is usually late, occasionally only after callus formation is seen on the X-ray [1-3]. There is no precise method for clinical diagnosis. Proximal and distal fractures may mimic dislocations, and inexperienced surgeons may attempt unnecessary reduction attempts. New diagnostic tools such as ultrasonography or magnetic resonance imaging improve the diagnostic abilities, but in some cases a diagnostic arthrography may still be required for a correct diagnosis.

**Table 1.** Patient and fracture characteristics

Gender	Delivery mode	Birth weight (g)	Side	Fracture site	Imaging
M	CS	495	L	Shaft	XR
F	CS	3645	R	Proximal epiphysis	XR,US,MRI
F	CS	2440	R	Proximal epiphysis	XR, US
M	VD	2930	R	Shaft	XR
F	VD	1930	L	Distal epiphysis	XR,US
M	VD	680	L	Proximal epiphysis	XR
M	VD	4125	R	Shaft	XR
M	CS	3540	R	Shaft	XR
F	CS	3265	R	Distal epiphysis	XR,US

CS = cesarean section, VD = vaginal delivery, XR = radiographs, US = ultrasound, MRI = magnetic resonance imaging

the shoulder. The patients' gender, injured side, fracture type, imaging modalities, method of delivery and birth weight are detailed in Table 1. Fractures of the shaft and distal humerus were treated by gentle manipulation and above-elbow plaster casts for 2 weeks, with the upper limb held against the body by the baby's shirt. The proximal humerus fractures were treated by holding the upper limb against the body using the baby's clothing. The neonates did not demonstrate any sign of pain or discomfort once the fractures were immobilized. All the patients were seen at the outpatient clinic 2 weeks later for cast removal and again at the age of 6 months.

## RESULTS

During the period 2001–2009 a total of 92,882 live births were recorded at Sheba Medical Center. Of these, 19,187 (20%) were delivered by cesarean section. The nine neonates who sustained a birth-related fracture of the humerus represent an incidence of 0.09/1000 births. Five neonates were delivered by cesarean section and four were born after a vaginal delivery. Six of the nine fractures were on the right side. The distribution between the proximal, mid-shaft and distal epiphysis fractures was relatively equal. The gender distribution was equal. Three of the babies were born weighing less than 2500 g. All seven newborns were diagnosed during the first day of life.

Radiography was diagnostic in all the babies with a humeral shaft fracture, i.e., diaphyseal fractures. In the neonates who were suspected of sustaining a proximal, distal or proximal epiphyseal fracture, radiographs did not yield a diagnosis. Ultrasonography on the other hand was diagnostic in four of five patients and suspicious in one. This last patient underwent an MRI examination of the shoulder which demonstrated the fracture line. None of the babies required an arthrography. The fractures were all immobilized with a gentle manipula-

tion when necessary, and the corrected alignment was verified using ultrasonography before cast application.

All the casts were removed 2 weeks following application, and the fractures demonstrated good callus formation on radiographs. Follow-up at the age of 6 months showed good range of motion and good alignment of the upper limbs in all the patients.

## DISCUSSION

Fractures of the long bones of otherwise healthy neonates are relatively rare complications of delivery, and the diagnosis and treatment of femoral and humeral fractures have been reported [1–5]. The exact incidence of fractures of long bones in neonates, and specifically of humeral fractures, varies significantly [1–3,5–8]. The most comprehensive data were published by Madsen [1], who documented 30 years experience. He reported an incidence of 0.75% for all birth-related long bone fractures including fractures of the clavicle. The incidence of humerus, femur and tibial fractures (in this order) for the same series was 0.056%. He did not find any fractures of forearm in neonates, but quoted historical data [1]. Husain et al. [3] recently reported a series of diaphyseal fractures of the humerus, while Jacobsen and co-authors [5] reported six distal humeral epiphysis separations in neonates, in addition to 22 previous cases quoted in the literature. The incidence of 0.09/1000 live births in our series does not correlate to the above-mentioned literature. This variability is not well understood, but it may be explained by improved obstetric practice.

Neonatal humeral fractures can occur in the proximal or distal epiphysis or in the diaphysis. Madsen [1] found that the most common fractures were transverse mid-shaft ones, followed by fractures of the proximal and distal epiphysis. Our series showed an almost equal distribution of fracture types.

Surprisingly, a significant number of fractures occurred in babies born via cesarean section, which is considered to be safer than vaginal delivery. The reasons for this observation are further discussed in the obstetric literature and are beyond the scope of this study [1,4]. However, the incidence of these fractures in cesarean sections should alert obstetricians to the risk of fractures occurring during limb extraction.

The diagnosis of neonatal humeral diaphyseal fracture is usually simple [3]. Clinical appearance with typical X-ray findings is highly suggestive of the diagnosis. The real challenge is the diagnosis of the epiphyseal separation, clinically sometimes mimicking (mainly for inexperienced physicians) dislocation in the adjacent joint, or pseudo-paralysis of the limb. The yet unossified proximal and distal epiphyses are not visible on plain radiographs, and radiographic diagnosis is delayed until callus formation is seen [1,2]. Jacobsen et al. [5] reported that traumatic separation of the distal epiphysis is usually diagnosed late and the majority of their patients were

diagnosed 9–30 days after birth. They suggested using plain X-rays, ultrasonography, MRI or arthrography as imaging modalities. Both MRI and arthrography require general anesthesia, and MRI is expensive and not always accessible. In contrast to these methods, ultrasonography is simple to perform, readily available, non-invasive, non-irradiating and inexpensive, and no sedation is necessary. Ultrasound imaging can be performed in the NICU and is useful even when the patients are on respirators. All of our newborn patients were diagnosed at the bedside using a mobile ultrasound machine, and all were treated during the first day of life.

Treatment options for the humeral fractures are still controversial. There are many treatment options suggested by different authors, mainly closed reduction followed by different splinting or traction techniques [1-3,5]. We found that a reduction and application of a cast for 2 weeks with the upper limb held against the body is the optimal treatment and the results are excellent. Husain and colleagues [3] recommended simple swaddling for humeral shaft fractures, but in our experience the parents prefer casting or splinting, and limited swaddling for the treatment of fractures of the proximal epiphysis.

Previous authors have reported good remodeling of birth-related fractures [1,3-5]. Our experience is similar, and no deformity was found in follow-up radiographs performed at the age of 6 months. We believe that the main aim of treatment is the comfort of the baby and the caregivers, and that

simple immobilization is sufficient for the treatment of birth-related humeral fractures.

In conclusion, both diaphyseal and epiphyseal fractures of the humerus can be easily diagnosed using ultrasonography. This diagnostic tool allows early identification of fractures of the humeral epiphysis, and we suggest using it prior to other modalities such as radiographs or MRI.

#### Corresponding author:

**Dr. U. Givon**

Pediatric Orthopedic Unit, Safra Hospital for Children, Sheba Medical Center, Tel Hashomer 52621, Israel

**Phone:** (972-3) 530-5034

**Fax:** (972-3) 530-5033

**email:** ugivon@zahav.net.il, urigi@sheba.health.gov.il

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