

Undisplaced spiral humeral fracture in a non-ambulant infant: Is it always a non-accidental injury?

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Background

Fractures in non-ambulant children are highly suspicious of non-accidental injuries. A meta-analysis of humeral fractures in infants up to 18 months of age report a positive predictor value for confirmed or suspected abuse as 43.8%¹. Humeral shaft, including spiral fractures, are more frequently associated with abuse than supracondylar fractures, which are more commonly seen in accidents and in older children. Establishing the cause of an injury therefore requires a rigorous multi-disciplinary assessment. The credibility of the mechanism presented is essential as part of the process of differentiating between accidental and non-accidental injury^{2,3}. Hymel and Jenny presented a case with video evidence of a five-month-old infant who sustained a spiral humeral shaft fracture whilst being rolled from prone to supine by a three-year old sibling⁴, a mechanism that was not previously accepted as possible. To date, there remains limited evidence in support of this mechanism for fracture.

Case presentation

A five-month-old infant was brought to the Paediatric Emergency Department by his parents as he was not moving his left arm. The mother reported that she had placed the child down for a nap on the side of the bed adjacent to the wall, whilst she lay on the outside. He had slept for approximately 10 minutes when he attempted to roll towards her from supine to prone position, which trapped his left arm underneath his body. A “pop” sound was reported; he began to cry vigorously and stopped moving his left arm. There were no discrepancies in parental

history when interviewed independently. Both parents promptly attended the Paediatric Emergency Department. The infant was well-kempt, content and the parental interaction was appropriate.

He was moving his arm spontaneously, albeit, reluctantly. Examination of his arm was unremarkable with no swelling or bruising. There were no other injuries noted. His weight was following the 95th centile. His development was age-appropriate and he was witnessed in hospital to roll exactly as his mother had described. Anterior-posterior and lateral radiographs of the left shoulder, humerus, radius and ulna were obtained. These showed an undisplaced spiral fracture of the left distal humerus (Figure 1).



Figure 1: Undisplaced spiral fracture of left distal humerus

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Subsequently, computed tomography (CT) of head and a skeletal survey were performed, neither of which revealed any abnormalities. Blood results, including full blood count, renal and liver function tests, bone profile (calcium 2.27 mmol/L, phosphate 1.98 mmol/L), coagulation screen, Vitamin D (108

nmol/L) and copper (12.9 $\mu\text{mol/L}$) levels were normal.

The Paediatric Orthopaedic Trauma Team recommended an arm sling for symptomatic relief. There was no other specific management of the fracture required. A safeguarding strategy meeting was attended by the Paediatric team, safeguarding team, social services and police. The multi-disciplinary team meetings did not reveal any social, parental or environmental circumstances that might highlight a safeguarding risk and the assessments did not reveal factors that would escalate concerns that this injury was caused non-accidentally.

Children's Social Care carried out a child and family assessment which did not yield any concerns. His follow-up skeletal survey two weeks later showed the healing humeral fracture and no other abnormalities. At two- and six-monthly follow-up, he was recovering well with no sequelae.

Discussion

Fractures in non-ambulant infants are highly suggestive of non-accidental injury and require thorough investigation. Worlock P, *et al*⁵ noted that there were no accidental humeral fractures in infants in their cohort, with spiral fractures of the humeral shaft predominating in infants with non-accidental injury. It had been generally accepted that non-ambulant infants are unable to sustain such a fracture through their own actions or from minor domestic accidents such as trapping the arm in cot bars or falling out of bed⁶⁻¹³.

The case report by Hymel KP, *et al*⁴ has led to a re-think of credible mechanisms of such an injury⁴. Somers JM, *et al*¹⁴ added further support to this when they presented seven cases of non-ambulant infants who presented with isolated humeral fracture. In all cases, the fracture occurred as the infant was being rolled over, with the majority occurring during a roll from the prone to supine position. In almost all the reported cases, the fracture occurred while the infant was being rolled by another person.

Thus, an important question arises as to whether an infant can cause this when manoeuvring independently. The infant's developmental stage is crucial; an infant who has mastered this skill is more likely to co-ordinate a fluid movement of the arm, shoulder and back. Therefore, an infant who has newly mastered this skill could be considered to be more likely to trap their arm due to the overall lack of control as the body and contralateral shoulder and arm rotates through 90°. We report an infant in whom a fracture occurred during an independent roll from the supine to prone position. He was on the higher centiles for weight, which may be a

contributing factor when considering poorly controlled movement from supine to prone.

In our case, the history was very clearly and consistently stated. There were no additional injuries, nor concerns found during the multi-disciplinary assessment. We therefore report our conclusions of an accidental mechanism of spiral fracture of the humerus in a five-month-old baby, adding to the evidence base for wider understanding of potential mechanisms seen in this type of injury.

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