

## PedsCases Podcast Scripts

This is a text version of a podcast from PedsCases.com on “**The Medical Assessment of Fractures in Suspected Child Maltreatment: Infants and Young Children with Skeletal Injury – CPS Podcast.**” These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at [www.pedscases.com/podcasts](http://www.pedscases.com/podcasts).

### **The Medical Assessment of Fractures in Suspected Child Maltreatment: Infants and Young Children with Skeletal Injury – CPS Podcast**

Developed by Dr. Dominique Piché, Dr. Laurel Chauvin-Kimoff, Dr. Claire Allard-Dansereau and Dr. Margaret Colbourne for PedsCases.com.  
September 27, 2018

#### **Introduction:**

Hello everyone, my name is Dominique Piché and I am a third year paediatric resident at the IWK Health Centre in Halifax, NS. This podcast was made in conjunction with PedsCases and the Canadian Paediatric Society (CPS) and aims to summarize the recently published 2018 CPS practice point on the medical assessment of fractures in suspected child maltreatment: infants and young children with skeletal injury.

The podcast was developed with Dr. Laurel Chauvin-Kimoff, a staff paediatrician specializing in child maltreatment at the Montreal Children’s Hospital, Dr. Claire Allard-Dansereau of l’Hopital Ste Justine and Dr. Margaret Colbourne of BC Children’s Hospital. Dr. Laurel Chauvin-Kimoff is the lead author of the CPS practice point that we will be reviewing today.

For additional information and to review the complete practice point, please visit [www.cps.ca](http://www.cps.ca) while the script for this podcast can be viewed at [www.pedscases.com](http://www.pedscases.com)

#### **The goals for this podcast include:**

1. To review red flags of inflicted trauma in a young child with fractures.
2. To establish what medical assessments are required when one is suspecting child maltreatment.
3. To explore what assessments are required to evaluate for other medical conditions that may predispose to fractures.

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Skeletal injuries are one of the most common presentations that paediatric clinicians may encounter during their day-to-day practice. Fractures are found in 11-30% of cases of suspected physical abuse. It is clearly quite important to differentiate inflicted from accidental fractures. A good understanding of fracture type, combined with relevant clinical information and developmental context can help a clinician ascertain the plausibility of a reported injury mechanism.

### **Clinical Case**

Let's start with a clinical case. You are a first year paediatrics resident working in the emergency department of a tertiary care paediatrics centre. A mother brings in her 12 week old, previously well term infant, stating that he's been using his right arm less than his left for the past week. She reports that he seems to cry more when she's putting on his clothes than before. The baby was previously well with an unremarkable pregnancy history and an uncomplicated spontaneous vaginal delivery. His APGAR scores were 8,9 and he was sent home from hospital at 24 hours. He takes Vitamin D drops daily and he received his 2 month immunizations.

You assess the baby and note that he seems comfortable lying on the bed, when he's not being examined. Vital signs are normal. Growth parameters are 25-50% for length, weight and head circumference. He does start to cry when you remove his sleeper, particularly when moving that right arm. Cardiovascular, respiratory, abdominal and neurological exams are normal. Inspection of his right arm reveals a slight deformity of the upper arm with mild swelling at the mid shaft. It is tender to palpation. The infant's other extremities are normal without any obvious deformities. You ask the mother if she is aware of any possible injury that the baby may have sustained. She replies no. A thorough dermatological examination reveals a small, 0.5 cm bruise behind his left ear which the mother had not noticed before. Skin examination is otherwise unremarkable. Examination of the oropharynx reveals intact labial and lingual frenulum. Eye examination demonstrates white sclerae without any conjunctival injection or hemorrhage. You discuss this case with your staff and decide to order an X-ray of the right arm to evaluate for possible fracture.

### **Differentiating Inflicted from Accidental Fractures**

Fractures are common injuries in children making it difficult to differentiate inflicted from accidental skeletal injuries. We will next go over specific elements that help one to differentiate fractures which are concerning for an inflicted etiology from accidental injuries.

## **Age**

When evaluating a child for suspected inflicted fracture, it is important to consider the age of the child, the patterns of skeletal injury and the presence of other injuries. Accidental fractures are uncommon in children under 18 months of age. Importantly, 25-56% of all fractures in children under 1 year of age are due to an inflicted injury. The child's developmental age provides important clues to verify if a reported history is compatible with a fracture, therefore a detailed developmental history is essential.

In assessing the patterns of skeletal injury, numerous studies have demonstrated the significant association between multiple fractures and physical abuse. This association is particularly pertinent when a child is found to have fractures of different ages or old fractures for which medical attention was not sought.

## **Patterns of skeletal injury**

Now, let's go back to the patterns of skeletal injury. Remember that the plausibility of a fracture being accidental is dependent on the age of the child, the developmental context as well as the type and location of the fracture.

Rib fractures are uncommon in infants and young children. Non-inflicted rib fractures are only seen in the setting of a significant trauma (i.e. a motor vehicle collision) or in the context of an underlying bone disorder. In the absence of these two factors, rib fractures have a very high specificity for abuse. Abusive rib fractures are frequently multiple, may be unilateral or bilateral, seen at any part of the rib and may be of different ages.

Another fracture that may raise suspicion for inflicted trauma are humeral fractures. Children under the age of 18 months will very rarely sustain humeral fractures. When they are accidental, they are typically supracondylar. In contrast, inflicted humeral fractures are more likely to be oblique or spiral and are mid shaft or proximally located.

Classic metaphyseal fractures at the end of developing long bones are fairly unique to young infants and highly specific for abuse. Classic metaphyseal fractures are frequently asymptomatic and may only be identified on skeletal imaging. Lastly, scapular, spinous process and sternal fractures are uncommon and are highly suspicious for inflicted injury.

Accidental femur fractures may occur with a short fall, less than 5 ft, in an ambulatory child. A fall sustained while in the arms of a caregiver could potentially result in a femur fracture.

Accidental femur fractures may be spiral or oblique, transverse or buckle. Femur fractures in a very young, non-ambulatory child are rarely accidental.

### **Medical Assessment**

The medical assessment of a potentially inflicted skeletal injury begins with a detailed inquiry as to the onset and progression of symptoms. This inquiry should include both recent and remote histories of trauma and any known medical conditions. History should also include the child's dietary history and if breastfed, any dietary restrictions the mom may have. It is important to review the child's birth history, paying special attention to premature birth, birth trauma or any past injuries. Also review current medication use, including vitamin supplementation, such as Vitamin D. Family history should include any known metabolic or bone disorders, consanguinity, hearing impairment, connective tissue disorders or dental hypoplasia.

### **Physical Examination**

Physical examination of an infant or child presenting with skeletal injury must be thorough and include general appearance as well as growth parameters. Patients should be exposed fully to assess for any bruises, abrasions or scarring. The head should be assessed for general shape, size, soft tissue swelling or dysmorphic features. Eyes should be examined for sclera colour, as children with osteogenesis imperfecta can have blue sclera. Also examine for any sign of hemorrhage. The oropharynx should be examined for any mucosal or dental injuries with attention to overall dentition and presence of intact frenula. Chest and abdomen should be assessed for distension, organomegaly or any tenderness. All limbs should be assessed for swelling, tenderness, limitation in range of motion or any deformities.

### **Red Flags for Inflicted Trauma**

It is important to review red flags for inflicted trauma in a young child with a fracture. Red flags on history include a lack of history for a trauma or injury, an injury incompatible with age/developmental stage, a proposed mechanism incompatible with the injury, changes in details of the history and a delay in seeking medical attention.

The presence of high-risk fractures including rib, metaphyseal or humerus fractures in those less than 18 months and femur fractures in a non-ambulatory child are red flags for possible abuse. The presence of multiple fractures, fractures of different ages and presence of other injuries are further red flags for inflicted injury.

### **Clinical Case Cont.**

Let's return to our case of the 12 week old infant with a right arm deformity, swelling and decreased use and a retroauricular bruise. X-ray shows a mid-shaft, spiral humeral fracture. Based on what we have reviewed thus far, this case demonstrates multiple red flags for abuse, including the child's age, the lack of reported injury, the delay in seeking medical attention and the mid-shaft humeral fracture in a young infant. Furthermore, the presence of a retroauricular bruise is quite concerning. Any bruise found on a pre-mobile child should raise suspicion for abuse and bruises found on the ears, neck, scrotum, buttocks or trunk are locations where accidental bruises are unlikely to occur.

Having now identified concerns for suspected abuse in this infant, you discuss with your staff the differential diagnoses of skeletal injuries in children.

### **Differential Diagnosis:**

The differential diagnosis for a suspected fracture based on radiographic findings can be broken down into groups, including trauma, genetic bone disorder, nutritional/metabolic disorder, infection, toxicity and neoplastic. It's important to remember that child abuse is far more common than bone disorders, nevertheless we must consider the possibility of pre-existing medical conditions contributing to the presentation of a fracture. Traumatic causes of skeletal injury include trauma experienced perinatally, accidental trauma and inflicted trauma. Genetic disorders that may predispose to fractures include Osteogenesis imperfecta, Menkes disease, infantile cortical hyperostosis and hypophosphatasia.

Nutritional or metabolic disorders may predispose to fractures and include vitamin D deficiency rickets, osteopenia of prematurity, copper deficiency, scurvy or chronic renal insufficiency. Toxicity from hypervitaminosis A or methotrexate, neoplastic processes such as leukemia and Langerhans cell histiocytosis and infections including osteomyelitis and congenital syphilis, can present with radiographic changes that may look like fractures.

Having reviewed the differential, you then ask your staff what laboratory investigations are required when inflicted skeletal injury is suspected. Your staff tells you that you must order a complete blood count, renal and liver function tests, serum calcium, phosphate and alkaline phosphatase and a urinalysis. Parathyroid hormone, 25-hydroxy-vitamin D, ceruloplasmin and serum copper will also be considered depending on initial results. AST and ALT levels are used as screening for occult abdominal injury. Abdominal CT should be performed if there are clinical suspicions for abdominal injury or if screening liver function test levels are elevated.

Further, you must complete a skeletal survey which will provide important information on general bone health and identify occult skeletal injury. A skeletal survey is particularly important in preverbal children and those under the age of 2. Clinicians should consider a skeletal survey in children aged 2-5 if there is strong suspicion for child abuse. In both positive and negative initial skeletal surveys, a follow up skeletal survey is recommended 2 weeks post the initial survey when concerns for child maltreatment remain.

Finally, you must call your region's Children's Aid Services to report the suspected abuse to start the required investigation in your patient as well as to notify Children's Aid Services should there be other children at risk in the home and their possible need for medical assessment.

### **Clinical Case Cont.**

You order the previously mentioned bloodwork for this patient and admit the child to hospital for further workup. You also arrange neuroimaging to assess for possible abusive head trauma and consult paediatric ophthalmology to assess for retinal hemorrhages.

CBC, renal and liver tests are normal with normal calcium, phosphate and alkaline phosphatase. Urinalysis from a bag demonstrates a few WBCs but is otherwise unremarkable. Skeletal survey demonstrates the right humeral fracture as well as fractures of the third and fourth ribs (bilaterally). Your staff reports this case to your region's Children's Aid Services and you consult your local Child Maltreatment team.

### **Summary**

Let's take a moment to summarize some take home points from this PedsCases podcast on the medical assessment of fractures in suspected child maltreatment:

- Remember, musculoskeletal injury is one of the most common injuries presenting for medical care in pediatrics and fractures are found in 11-30% of cases evaluated for suspected physical abuse.
- A thorough history of any injury event, including the child's developmental age are required to evaluate the plausibility of a caregiver's explanation.
- The presence of additional injuries, such as other fractures, bruises, ocular or neurological findings, increases concern for child abuse.
- A full skeletal survey should be performed when evaluating an infant or young child with skeletal injury that raises concern for inflicted trauma.

- Additional studies may include bloodwork, retinal examination by a pediatric experienced ophthalmologist, neuro-imaging and potentially an abdominal CT depending on the patient's age and clinical presentation.

Thank you for listening to this PedsCases podcast summarizing the CPS practice point on the medical assessment of fractures in suspected child maltreatment. Stay tuned for more PedsCases podcasts!

### **References**

1. American Academy of Pediatrics, Section of Radiology. Diagnostic imaging of child abuse. *Pediatrics* 2009;123(5):1430–35.
1. Chauvin-Kimoff L, Allard-Dansereau C, Colbourne M. Canadian Pediatric Society, Child and Youth Maltreatment Section. *Paediatr Child Health* 2018, 23(2):156-160.

