PedsCases Podcast Scripts

This is a text version of a podcast from Pedscases.com on “Pediatric Fractures.” 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.pedcases.com/podcasts.

Pediatric Fractures

Developed by Laura Vogels and Dr. Sukhdeep Dulai for PedsCases.com.
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Hi Everyone. My name is Laura Vogels and I’m a medical student at the University of Alberta. This podcast was developed in conjunction with Dr. Sukhdeep Dulai, a pediatric orthopedic surgeon at the University of Alberta.

The objectives of this podcast are to review the anatomy and classification of pediatric fractures, to highlight some of the unique skeletal differences in children, and to briefly review the management of pediatric fractures.

Let’s first start with some basic anatomy and terminology:

There are four main parts that make up a long bone in a child. In order, starting at the end of a long bone these parts are: the epiphysis, the physis, which is also known as the growth plate, the metaphysis, and the diaphysis. Say we are looking at the proximal end of the humerus, the epiphysis (which is defined as the area between the growth plate and the joint space) would be the area of the bone above the growth plate, the diaphysis is the long shaft of the bone, and the metaphysis is located between the growth plate and the diaphysis.

When describing a fracture it is important to comment on a few characteristics.

The first step is to describe the location and fracture pattern. Fractures are typically described as being localized to the epiphysis, physis, metaphysis, or diaphysis. There are also many different patterns of fractures. Some of the more common ones include transverse, oblique, spiral, and comminuted.

Transverse fractures are perpendicular to the bone’s axis, oblique fractures are at an angle to the bone’s axis, and spiral fractures run around the axis of the bone in a spiral pattern. When a bone breaks into more than two pieces it is considered a comminuted fracture.

Second, you should comment on the apposition, angulation, and rotation. If a fracture is displaced it means that when the bone broke into two or more pieces, the pieces shifted

and are no longer perfectly aligned. That is, there is a loss of end-to-end contact (known as apposition), the bone appears bent at the fracture site (known as angulation) or one of the pieces is rotated with respect to the other or any combination thereof. In an undisplaced fracture, the bone is broken but the pieces still maintain normal anatomic position relative to one another. When describing angulation, the direction in which the end of the distal bone fragment is pointing compared to the proximal bone is described. If the apex of the fracture is away from the midline it is referred to as 'varus' or medial angulation, whereas if the apex is towards the midline it is referred to as 'valgus' or lateral angulation. Apex volar or anterior represents posterior angulation of the distal fragment and Apex dorsal or posterior represents anterior angulation of the distal fragment. Identifying a rotated fracture is most commonly done during physical examination. For example, in a tibia fracture, if when the knee is pointing directly forwards, the ankle is pointing sideways, it would be described as being rotated 90degrees.

Lastly, fractures may be either open or closed. An open fracture is one where the skin has been breached and the fracture is exposed to the environment. If a bone is broken and yet the skin is still intact, this is known as a closed fracture.

When assessing a patient with a possible fracture, starting the assessment with a thorough history and physical are key. Once the child is stable two x-rays of the injured limb segment taken at 90 degrees to one another should be obtained.

There are a few main differences between the skeleton of an adult and that of a child

The first major difference is that unlike adults, children have growth plates (physes) still present. This allows for longitudinal growth, and damage here can impede future growth. It can sometimes be difficult to identify a fracture on x-ray in children because the growth plates can sometimes be mistaken for a fracture and a fracture through the growth plate can sometimes be only subtly different from normal.

Second, the composition of bone in children is slightly different than that seen in adults. The bones in a child are made up of more water and less minerals and are therefore less brittle than those seen in adults. Since their bones are softer, their bones are more likely to bend rather than to break completely. However, ligaments in children are also stronger than the physis and so children are more likely to present with a fracture than a sprain when the injury is localized to the area around a joint.

Thirdly, the bones in a child tend to heal faster than they would in an adult and therefore there is a shorter window for successful intervention than in adults, especially in younger children and fractures involving the growth plate. This is due to the child's thicker and more metabolically active periosteum as well as their growth potential.

So now we will move on to some of the unique fracture patterns seen in children as a result of these key skeletal differences.

We will start with physeal fractures:
Unlike in adults where the ligaments are the weakest point surrounding a joint, the physes are the weakest in children. Thus, this is a common location for injury or fracture. The most commonly used system to classify physeal fractures is the Salter-Harris system. Using this system, fractures are classified into five different types.

Type I fractures are those that go straight through the growth plate and thereby completely separate the epiphysis from the metaphysis. Type II fractures are those that start by going through the growth plate but then continue through the metaphysis. Type III fractures are those that go along the growth plate and then through the epiphysis, breaching the joint surface. Type IV fractures are those fractures that go through the epiphysis, through the growth plate and then through the metaphysis. And finally, type V fractures are crush injuries of the growth plate.

So how do we manage a patient with a physeal fracture?

Management of a physeal fracture in a child is highly dependent on the type of fracture. Type II physeal fractures are the most common followed by Type I. Both type I and II fractures have the best prognosis and growth arrest is uncommon. These fractures are most often managed by closed reduction and cast immobilization. Rarely, in unstable fractures, surgical fixation may be required to maintain the reduction. Remember, reducing a fracture involves realigning the bones back to the anatomical position and should always be done using sedation or adequate analgesia.

Type III and IV fractures should be referred to a pediatric orthopedic surgeon, as they tend to have a worse prognosis. Type III and IV fractures involve the articular surface, which is a site of no remodeling. As such, no displacement can be accepted in these fractures. The pluripotent cells in the reserve zone of the growth plate can also be damaged in these fracture types resulting in growth arrest. Complications of growth arrest include limb length inequality and angular deformity. Management for displaced type III and IV fractures involves open reduction and internal fixation, performed in the operating room.

Type V fractures have the worst prognosis because again the cells in the reserve zone of the growth plate can be damaged and there is no specific treatment. Type V fractures can be difficult to see on initial x-rays since there is usually no displacement of the bones. These fractures are primarily diagnosed on the basis of clinical suspicion and require close follow-up to look for growth arrest.

Depending on the age of the child and the bone involved, a physeal fracture will require between 3-6 weeks in a cast until fully healed. Due to the greater potential for remodeling in children, some deformity is acceptable and every effort to minimize further damage to the growth plate is imperative.

It is always important to educate the parents about the possibility for growth arrest and the likelihood based on the Salter-Harris classification system. All physeal fractures

should be monitored for 6-18 months to ensure growth arrest does not occur.

Two other common fracture patterns seen in pediatrics are buckle and greenstick fractures.

A Buckle or Torus fracture is a compression failure of bone, usually occurring where the metaphysis and diaphysis meet. These fractures are commonly seen in the distal radius, are stable and tend to heal with immobilization in 3-4 weeks.

Greenstick fractures occur because of the plasticity of the bones in children. In this type of fracture, you have an incomplete fracture of one cortex. Essentially, the bone fractures in tension on one side and remains intact but bent on the other side.

Due to their growth potential, children have a greater potential for remodeling which is why some deformity or malalignment can be accepted at the time of initial injury or after a reduction and will straighten out over time with normal growth.

Most remodeling occurs in the metaphysis because of the proximity to the growth plate. In addition, younger children tend to remodel fractures better than older children because they have more growth remaining. Fractures that are at a right angle to the plane of movement typically do not remodel, whereas fractures in the plane of joint movement do have potential to remodel. Also, malrotation and significant shortening at the fracture site do not remodel.

Overall, in older children and where the fracture is located further from the growth plate, less remodeling can be expected.

Our last point of discussion is about fractures resulting from non-accidental injury.

Some fractures may be a result of physical abuse in children. Child abuse is potentially life threatening, therefore it is critical for healthcare professionals to be aware of this possibility and to be able to identify red flags. For more information please refer to the Pedscases podcast ‘Physical Abuse of Children’.

Overall, you should remember the following things:

1. When describing a fracture, always comment on the location, type of fracture, apposition, angulation, and rotation.
2. The main anatomical and physiological differences between a child and an adult are greater remodeling potential, thicker and stronger periosteum, active physes, softer and more elastic bones, rapid growth and faster healing.
3. Physeal fractures are classified using the Salter-Harris classification system. Types I and II are usually managed by immobilization with or without closed reduction. Types III and IV are usually managed with open reduction and internal fixation. Type V fractures are crush injuries and are managed by splinting and close monitoring.

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4. Children have a greater potential to remodel than adults. The younger the child and the closer the fracture is to the growth plate, the greater the chance of remodeling.
5. Always be aware of the possibility of child abuse, especially if the fracture is incompatible with the mechanism of injury or stage of development.

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