Greenstick Fractures

'Fracture' is a break in a bone usually due to result of trauma. They can be 'complete' or 'incomplete' as the name suggests. A child's bone is much more pliable than adult bone and hence, incomplete fractures are common. One of the types of incomplete fractures pertaining to long bones mainly is a "greenstick fracture". This means that one side of the fracture has broken and one side is bent and therefore is classified as an incomplete break.

The name 'greenstick fracture' comes from the analogy of breaking a young, fresh tree twig. The broken twig snaps on one side (the outer side of the bend – tension side), while the inner side (compression side) is bent and still in continuity. The same occurs in a long bone of a child mainly because of the thick fiborous periosteum of immature bone. A person's bones become harder (calcified) and more brittle with age and the periosteum becomes thinner and less restrictive. Greenstick fractures usually occur most often during infancy and childhood when bones are soft.

There are some unique fracture patterns seen in children which are as follows:

- *Greenstick fractures* are incomplete fractures that result in a fracture through the tension side of a bone undergoing a deforming stress. These fractures are typically angulated and may require conversion to a complete fracture in order to correct the deformity.
- *Torus fractures* (buckle) involve a failure of bone with a compressive mechanism. These fractures occur over the metaphyseal region. Torus or buckle fractures are very common, stable, and heal readily when immobilized. Complications are quite rare.
- *Bowing* occurs when the bone undergoes plastic deformation after an injury and does not recoil back to its original position. Microfractures which are not visible on x-ray are the reason. The fibula and ulna are most commonly involved. If there is a fracture of the adjacent bone, bowing can inhibit reduction of the fractured bone.

Greenstick fractures are stable fractures as a part of the bone remains intact and unbroken. There could be a 'bend' to the injured part. Pain at the injured area is the commonest symptom. An older child will be protective of the fractured part and babies may cry inconsolably. As per a standard fracture, the area may be swollen and either red or bruised.

The initial evaluation of an injured child includes a thorough history of the injury, a complete physical examination, and plain radiographs that include the joints above and below the fracture site. The assessment begins with a thorough history of the trauma which enables the physician to anticipate the full extent of the injury and any likely associated injuries. Details of the mechanism of injury can be difficult to obtain from the child and his or her parents. Newborns and infants frequently sustain their fractures during child abuse, which should always be suspected when treating this age group for fractures. Most injuries occur while the child is at play. As every age group from infancy to adolescence has its own typical injury pattern, the common mechanisms of injury also vary with age. In young children, a common mechanism is falling onto an outstretched hand. Thus, the incidence of upper extremity and clavicle fractures far exceeds rate of lower extremity fractures in this age group. As a child approaches the teen

years, the history of injury begins to resemble that of adults. The physical examination must include a neurovascular assessment and a thorough search for associated injuries.

All obviously fractured limbs should be temporarily immobilized prior to obtaining radiographs. Immobilization provides comfort for the patient and minimizes soft tissue trauma at the fracture site. Obtaining quality radiographs of the fracture site is mandatory for accurate diagnosis. The physician should obtain views in the anteroposterior and lateral planes and include the joint above and below the fracture site whenever possible. Associated bone and joint injuries may be missed if attention is focused on the most obvious injury. Comparison views of the contralateral limb in the anteroposterior and lateral plane can be helpful when reading films of injured elbows or trying to distinguish a fracture line from a growth plate.

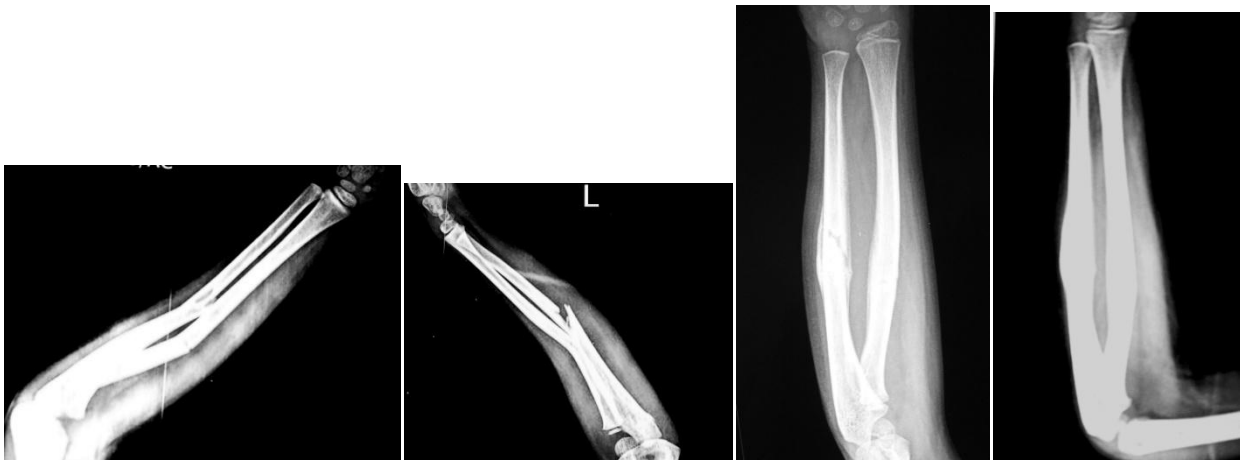
When interpreting children's radiographs, one must keep in mind the anatomic differences between adult and pediatric bones. Because of the amount of radiolucent cartilage in pediatric bone, comparison films are often necessary to determine whether a radiograph is abnormal. The most notable anatomic difference is the presence of growth plates or physes. A second anatomic difference is the presence of the thick periosteum surrounding children's bones. The periosteum aids in reducing the amount of fracture displacement and is the reason for the inherent stability of fractures in children. In addition, the bone-forming potential of a child's periosteum is greater than that in adults; therefore, faster healing occurs. Nonunion fractures are rarely problematic in children. A third difference is the increased porosity of children's bones. Pediatric bone is less dense than adult bone and thus is more prone to buckle in compression or bow when bent. Such plastic deformation of bone is impossible in a dense adult bone, and similar trauma leads to complete fractures in older individuals. Lastly, the remodeling potential of pediatric fractures is important in accordance with the part of the long bone involved. The shaft or diaphysis would heal in a relatively longer time than the fracture near the bone ends or metaphysis. The younger the child is the greater the amount of remodeling that can be expected. (Legends 1 to 4)

Whenever there is a clinically evident deformity, the greenstick fracture must be bent back into a proper position (called a "reduction"). Under adequate sedation/anaesthesia and preferably x-ray control, reduction is achieved satisfactorily by “breaking of the opposite intact cortex” (osteoclasis). This maneuver helps in preventing a possibility of a gradual increase of the deformity during the fracture union. This is due to a differential accumulation of new bone called ‘callus’ which concentrates only on the side of the break. The limb is casted appropriately for an adequate time period. Torus or buckle fractures do not require any reduction but need to be protected by splintage or cast till fracture union.

Proximal Tibial Metaphyseal Fracture, especially valgus greenstick fracture deserve special mention. An associated fracture of the proximal end of the fibula is infrequent. These injuries most commonly occur in children younger than 10 years and are usually the result of low-energy trauma such as playground falls or bicycle accidents. Associated neurovascular problems are uncommon. Despite their innocuous appearance, a progressive valgus angulation often develops in these fractures during the period of fracture healing, as well as after union of the fracture. This is best treated by closed reduction under anaesthesia. The most common problem associated with a greenstick fracture of the proximal tibial metaphysis is progressive valgus angulation. The angulation occurs most rapidly during the first 12 months after the injury and

continues at a slower rate for as long as 18 to 24 months. It is important to emphasize to parents the possibility of subsequent deformity despite adequate and appropriate treatment of the fracture. Even though the valgus deformity resulting from the proximal tibial metaphyseal fracture is unsightly to parents, the surgeon should be in no hurry to perform a corrective valgus osteotomy. Several authors have reported spontaneous improvement of the deformity with time. In addition, both recurrence of deformity and compartment syndrome have been reported after corrective tibial osteotomy for this problem. Hence, early corrective osteotomy is not recommended.

Legends:



1. Pre-op radius & ulna greenstick

2. Pre-op radius & ulna greenstick

3. After union AP view

4. After union lateral view

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