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Physeal Injuries are Special

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Abstract

Secondary ossification centers for the epiphysis and apophysis evolve through different stages until complete fusion. This evolution leads to variations in fracture patterns and based on mechanism and anatomical location. This is important as roughly 15% of all children fractures involve a physeal injury [1]. In this review, we will briefly touch on the mechanism, pathophysiology, diagnosis, investigations and management of physeal injuries related to secondary ossification. Three stages of secondary ossification, including: pre-ossification, pre-fusion, and incomplete fusion selected. Apophyseal injuries represent a special subset as their injury can fall into several categories based on stage of development.

Pre-Ossification

Distal humerus separation is a common injury in children <3 yrs. of age but can be difficult to diagnosis. Difficult labor, accidental and non-accidental are common causes [2]. Difficulty in diagnosis is attributed to the absence of bony landmarks, which may be missed on radiographs. A diagnosis of elbow dislocation is often made. Sonography illustrates a distal humerus separated and accompanying bare area of the distal humerus not covered by epiphyseal cartilage [3]. Early identification and immobilization is important.. Distal femoral physeal fractures and femoral neck epiphyseal fractures are other patterns of abuse and often can be missed on plain radiographs. Femoral neck epiphyseal fractures is an interesting pattern of abuse as often they are initially diagnosed clinically as developmental dysplasia of the hip. However the femoral head lies in the acetabulum, which is confirmed by sonography [4].

Pre-Fusion

Typically this occurs in the zone of provisional calcification of the hypertrophic zone, the weakest point after secondary ossification [1]. Often these injuries go unrecognized or mistaken for others. Distal and medial clavicle physeal injuries occur typically in the adolescent population and often initially diagnosed as acromioclavicular and sternoclavicular dislocations respectively [5]. At times CT is necessary to confirm diagnosis and guide management [5]. Age and activity level play a role in apophyseal injuries. Seen in the adolescent population, especially around the pelvis and proximal femur and often go initially diagnosed as muscle strains or other soft tissue injuries. An incongruity lies between the load tolerance and stain of the epiphysis, resulting in a dynamic process causing an avulsion type injury [6]. Often the diagnosis is made clinically and confirmed radiographically or with advanced imaging with US or MRI [7].

Incomplete Fusion

The transitional ankle injuries, Triplane and Tillaux fractures have unique patterns based on incomplete fusion (Figure 1). These injuries occur 18 months prior to fusion with physeal

Figure 1: From left to right shows A-P, Oblique, and lateral x-ray of right ankle of 13 years old boy with triplane fracture, note the partial physeal closure, and the pattern of fracture is Salter Harris III in A-P view, and Salter Harris II in the lateral view.

closure [8]. No extension of the fracture fragment posteriorly in the coronal plane distinguishes the two. Adjuvant imaging with CT can be used to further delineate fracture pattern and presence of joint incongruity [9]. Patellar sleeve and tibial tubercle fractures also ossify in a predictable manner, which leaves them susceptible to injury. Tibial tubercle physeal closure occurs closure to the adolescent with the distal aspect susceptible to injury. Patellar sleeve may mimic a patellar tendon injury and often requires surgical management [10].

Summary

Physeal injuries vary significantly around the evolution of secondary ossification centers. They can broadly broken down in to pre-ossification, pre-fusion, and incomplete fusion. This provides an understanding of particular patterns, mechanisms, diagnosis, and management options. This is a brief overview of the more common injuries seen with a more extensive review to follow.

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