CASE REPORT

Should you fix again? An unusual fracture of a distal epiphyseal radius fracture — A case report

Sabit Numan Kuyubasi,[1] Bunyamin Ari,[2] Sermet Inal,[3] Alaaddin Oktar Uzumcugil,[4] Suleyman Kaan Oner[5]

Abstract

Currently, Salter-Harris (SH) classification is generally used in physeal fractures, as it is reliable and valuable in many cases. Although this clasification system describes many different fracture configurations, still there is an unclassifed group of fractures.

Here, we present the case of an 11-year-old boy who underwent surgery after fracture of distal radial epiphysis,of the type still unclassified according to SH classification. The main reason for ourresearch was that the line of treatment could not be decided initially after the first operation. The current classsifications that are close to SH and essentials on the neccesity of surgical approach were dicussed.

Surgery must be attempted in cases in which it cannot be decided whether it is a SH type 2 or 3. Besides this situation, an attempt must be made for the classification of the fracture (Ogden tip 2b, Sferoupulos tip 3). Another important point is to decide where the fracture line goes in the layers of physis.

Keywords: Salter-harris type II, Physeal layers, Surgical management.

DOI: https://doi.org/10.47391/JPMA.597

Introduction

The growth plate fractures of the distal radius are generally evaluated according to the classification system introducedby Salter and Harris (SH). This classification system is designed to determine where the fracture line passes through the physeal layers and how this situation is reflected in clinical practice. Although the SHclassification gives a good idea about prognosis in general, it is inadequate in some growth cartilage fractures of the distal radius. Therefore, different classifications other than SH have been made. Although classifications guide in terms of radiologic treatment management, they do not provide histopathological insight. The surgical indications of the 11-year-old male patient were discussed, which could not be classified according to SH after reviewing the available findings about the surgical treatment and evaluating the parts related to the present case. It is believed that the surgical indications should be expanded after careful examination in such fractures. This case provided a chance to consider whether surgical treatment should be performed in minimally dissociated fractures that longitudinally traversed only the metaphyseal portion of the distal radius and reached physis.

Case Report

At July 2018, an 11-year-old male patient presented to the emergency department of Kutahya Health Science University Evliya Çelebi Research and Training Hospital, Kutahya, Turkey. Complaining of a simple fall on the left wrist. The physical examination revealed swelling, crepitation, deformity in the wrist, and no neurovascular

Figure-1: Pre-operative anterio-posterior and lateral wrist X-ray. Anteror cortical bending and small cortical fragment can be seen on the lateral graph.

Figure-2: After the first operation, anterio-posterior and lateral wrist X-ray.

[1,3-5]Department of Orthopaedics and Traumatology, Kutahya Health Sciences University, Kutahya, [2]Department of Orthopaedics and Traumatology, Evliya Celebi Training and Research Hospital, Turkey.

Correspondence: Bunyamin Ari. Email: drbunyaminari@hotmail.com

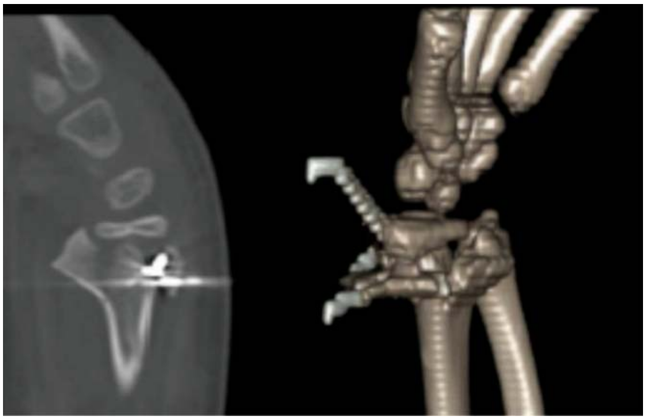

Figure-3: Before the second operation, 3D wrist CT image.

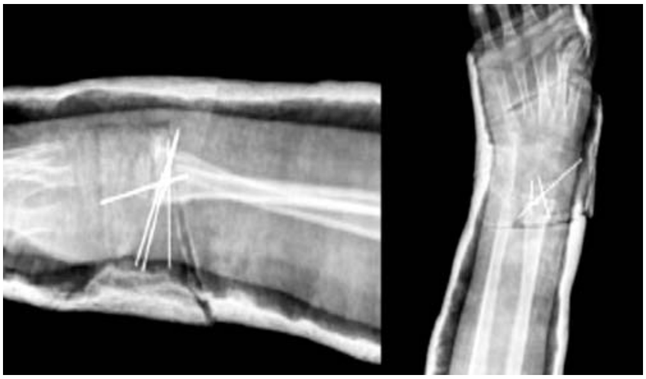

Figure-4: After the second operation, anterio-posterior and lateral wrist X-ray in the cast.

deficits. The X-ray examination showed a distal radius epiphyseal fracture on the anterior-posterior side of the left wrist (Figure-1). First, closed reduction and long-arm splint were applied to the patient. Surgical treatment was planned because of a loss of reduction during the follow-up.

Under general anaesthesia, the fracture was reduced closely and fixed with three Kirschner wires. Reduction was found to be appropriate with scopy control. The long-arm splint was applied. An evaluation of the postoperative control with direct X-ray examination showed a separate fragment in the distal metaphyseal region extending to the physis besides the SH type 2 fracture (Figure-2). A three-dimensional (3D) computed tomography (CT) was requested to monitor the fracture configuration in detail. CT images showed that the fragment extending from the metaphyseal to the physeal region had volar dislocation, and the distal part was almost completely separated from the physis. Whether this fragment occured secondary to a pre-existing fracture line or iatrogenic, could not be evaluated precisely because a pre-operative CT of the wrist was not available. However, a bend in the anterior cortex and a small fragment in this area on pre-operative lateral radiography showed that there might be a nondisplaced fracture here. After the first operation, the displacement in this region became apparent,which led to the opinion that this happened iatrogenically. The available findings were reviewed for a second surgical intervention, and the criteria related to the nature of fracture and the prognosis were interpreted (Figure-3). As a result, a second surgical intervention was decided and the fracture was reduced openly and fixed with four Kirschner wires. Reduction was approved with scopy control. The extremity was fixed with forearm cast, and the operation was completed (Figure-4). No loss of reduction or complications were reported in the follow-ups. The parents consent was taken from family by us.

Discussion

The second surgical treatment indication was discussed after a detailed literature review. SH described two main types of epiphyseal plaques in 1963: pressure epiphysis and traction epiphysis. Pressure epiphyses are located at the end of the long bones and provide longitudinal growth. They are intra-articular and used to bearing weight. In contrast, traction epiphyses provide appositional growth and are located in the origin or attachment regions of the muscles. They are extra-articular and do not bear weight. An examination of the layers of pressure epiphyseal plate revealed four regions: resting region, proliferative region, hypertrophic region (maturation, degeneration, and provisional calcification), and calcification region.[1] Physeal fractures occur consistently across the same histological plane in the temporary calcification region. This area within the hypertrophy region represents the transition point between calcified and noncalcified extracellular matrix proteins. This makes the bone surrounding it weaker than ligamentous structures and is therefore more susceptible to injury.[2,3]

The first detailed description of epiphysis plate injuries was made by Foucher in 1863.[4] Foucher described the pathology of the lesion and commented on the injury mechanism. A need for classification for physis fractures has been considered for long, and three types of fractures have been described. One of the three types involves the actual injury of physis (epiphysis separation or SH type I injury). The other two types are juxta-physeal injuries that do not involve physis.[5]

In 1898, Poland classified physis fractures into four types. The historical study of Poland at the time was very detailed. He documented four specific injuries, provided the drawings of each, and thus constituted the first true classification.[6] The classification of Poland types 1,2, and 3 was in accordance with SH types 1, 2, and 3, respectively. Poland type 4 is the fracture in the epiphysis, which is caused by the complete dissociation of the physeal layer and the longitudinal fracture.[5]

Aitken described the characteristics of different types of physis in 1936 in terms of structure, localisation, load-bearing status, and injury risk, and then suggested that prognosis should be addressed individually.[5,7]

In 1963, SH constituted a fracture classification system based on the anatomy, fracture model and prognosis, and identified five types of physis fractures. Type 1 fractures directly affect the physeal region, resulting in the separation of epiphysis from the metaphysis. Type 2 involves a metaphyseal part by incorporating the physeal region. Type 3 are intra-articular fractures along the epiphysis starting from the physeal region. Type 2 fractures are less common than type 3, but growth arrest (GA) and post-traumatic arthritis are more common in these fractures. Type 4 starts from the physeal region and extends along the epiphysis and metaphysis. Type 5 is the crush type injury in the physeal area after an exposure to a compression force.[1,8] Some researchers have expanded the original classification system of SH with broader initiatives. In 1981, Ogden proposed a more complex classification system consisting of nine types of fractures and various subtypes. This revised classification system includes subclassifications of the original five SH patterns to stratify the risk of GA based on injury patterns. Despite its great importance, it is generally not used in everyday practice. However, recently the use of this classification has been found to be significant in predicting the incidence of early physeal arrest following fractures of the distal forearm bones.[9]

In 1994, Peterson defined a new classification by adding two new types of physeal fractures (Peterson types I and VI) to the SH classification. Peterson I injury was defined as a longitudinal fracture extending along the metaphysis towards the transverse fracture and the physis but not reaching the physis plate.[10] Peterson Type VI injury represents a modified version of SH type 4 injury in which the loss of a portion of physis is associated with a portion of epiphysis and metaphysis.[11]

Sferopulos type 3 injury is consistent with the description of Ogden as type 2B lesion. The propagation of fracture forces on the stress side after SH type II breakage can lead to the creation of an additional free metaphysical fragment separated from the epiphysis. The displacement at varying degrees makes the reduction of the free metaphyseal part more difficult and may adversely affect the result.[12]

The fracture in the present case can be considered as type 2 when classified according to SH. However, fixation of a metaphyseal fracture before deciding to perform the second surgery, the fracture could be classified according to Sferopulos type 3, and Ogden type 2B. It is believed that this may change the management of fractures that cannot be classified with SH in the present case.

The aim of the treatment in physeal fractures is to minimise the severity of the injury and complete the fracture healing in the usual way close to perfection. Although conservative treatment is sometimes appropriate to reduce the negative prognosis of these fractures and prevent possible deformities, anatomical reduction is almost always required with surgical treatment.[10,13]

In astudy by Larsen et al involving long-term clinical outcomes of nonoperative treatments in SH type 2 fractures, the rate of complications was 5%.[13] The frequency of premature physeal arrest after SH type 2 fractures ranged from 0% to 4.3%. Although the SH type 2 fracture pattern of histopathological physeal injury layer originates from the temporary calcification of the hypertrophic region, physeal arrest at the rates of 0%-4.3% in this study suggested that the proliferative zone might have been damaged in these injuries.[14]

The volar displaced fracture extending from the metaphyseal region to the physeal line in the first postoperative 3D CT images does not show the histopathological zones of the physis. Hence, it is argued that such fractures should be treated surgically regardless of which of the physeal layers is present. This situation influenced the decision to perform the second surgery. We believe that pre-operative and postoperative CT procedures should be performed in such fractures. This is essential for correct treatment management. It is important to prevent further displacement of the fracture and iatrogenic growth cartilage damage as a result of persistent multiple closed reductions undue forces.

In conclusion, the fracture formation mechanism according to SH type 2 is thought to be compatible with the conservative treatment of the metaphyseal fracture extending from the histopathological hypertrophic layer of the physis. However, when the classification of Sferopulos type 3 and Ogden type 2B is used, it is impossible to determine from which layer of physis the fracture starts histopathologically. Therefore, this study aimed to minimise negative results by considering the proliferative zone affected. Thus, it would be appropriate to take the decision of surgical treatment. It is believed that, physeal layers can be examined in more detail in the future using high resolution imaging methods, and the fracture can be managed with an appropriate treatment method and a minimum error margin.

Disclaimer: None to declare.

Conflict of Interest: The person who signed the Ethical Review Approval is the co-author of this article.

Funding Sources: None to declare.

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