Clinical Case Report

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Physeal fracture in the wrist and hand due to stress injury in a child climber

A case report

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Abstract

Rationale: In competitive athletes, the upper extremity is subject to tremendous torsional forces with axial loading due to repetitive weight bearing. Approximately 25% of injuries in sports are related to the hand or wrist. Skeletal deformity on the wrist physis is common in athletes due to repetitive loading and presents at early ages between 6 and 13 years. Additionally, it is more common in female than in male athletes.

Patient concerns: An 11-year-old girl who was a climber complained of pain on her left wrist without direct trauma. She had participated in climbing exercise for several years and had no medical history. Thorough radiological evaluation, we diagnosed physeal injury of the left radius. After healing of the physeal injury of the radius, she complained of pain on fourth finger of right hand and radiographs revealed physeal injury of the right fourth finger.

Diagnosis: Radiographs revealed physeal injury of the left radius. Magnetic resonance imaging revealed epiphyseal widening of the radial aspect of the wrist and bone marrow signal increase on T2-weighted imaging. Likewise, radiographs showed physeal injury of the right fourth finger

Interventions: No surgery was performed and we applied wrist brace and finger splint for conservative treatment.

Outcomes: The patient's pain was immediately relieved. The patient had no complications or recurrence of symptoms and was undergoing regular check-ups every 6 months.

Lessons: During climbing exercise, repeated high pressure causes damage of the hand and wrist joints in young patients. Chronic pain in this group must be carefully evaluated, and radiographs should be obtained for diagnosis and early treatment. Conservative treatment of these injuries has good results, and avoiding intensive power training avoids the risk of this injury.

Abbreviations: CT = computed tomography, MRI = magnetic resonance imaging.

Keywords: climber, growth plate, physeal fracture, stress injury

1. Introduction

In competitive athletes, the upper extremity is subject to tremendous torsional forces with axial loading due to repetitive weight bearing. Approximately 25% of injuries in sports are related to the hand or wrist.[2] Skeletal deformity on the wrist physis is common in athletes due to repetitive loading and presents at early ages between 6 and 13 years. Additionally, it is more common in female than in male athletes.[3] In this report, we describe an 11-year-old patient with a left wrist physeal fracture of the radius and a right hand physeal fracture of the middle phalanx.

2. Case description

This case report was approved by the Institutional Review Board of Soonchunhyang University Hospital, and informed consent was given by patient.

An 11-year-old girl who was a climber complained of pain on her left wrist without direct trauma. She had participated in climbing exercise for several years and had no medical history. After examination, symptoms included pain and swelling with normal neurovascular test. Radiographs revealed physeal injury of the left radius (Fig. 1). Magnetic resonance imaging revealed epiphyseal widening of the left radial aspect of the wrist and bone marrow signal increase on T2-weighted imaging (Fig. 2). The patient required the use of a wrist brace for 4 weeks, and she stopped exercising. No specific physiotherapy was done for the patient during immobilization period. At the 1-month follow-up, physeal injury was observed to have healed spontaneously (Fig. 3), and the patient returned to her climbing activity. After 3 months (since the wrist healing), she complained of pain in her right hand. Radiography showed physeal injury of the right

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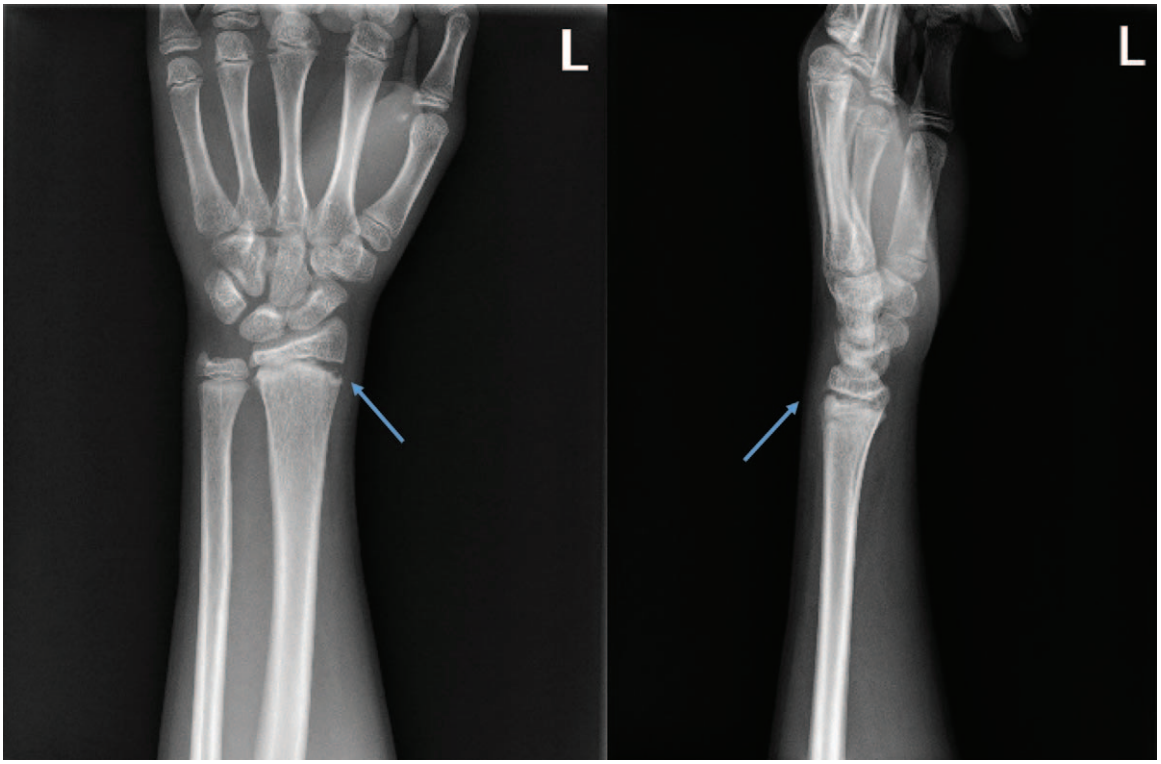

Figure 1. Anteroposterior and lateral radiographs showing the physeal fracture of the radius.

Figure 2. Coronal and sagittal magnetic resonance imaging scan showing the wide distal radial physis and irregular, low-signal intrusions into the metaphysis, typical of focal failure of ossification of the physeal cartilage.

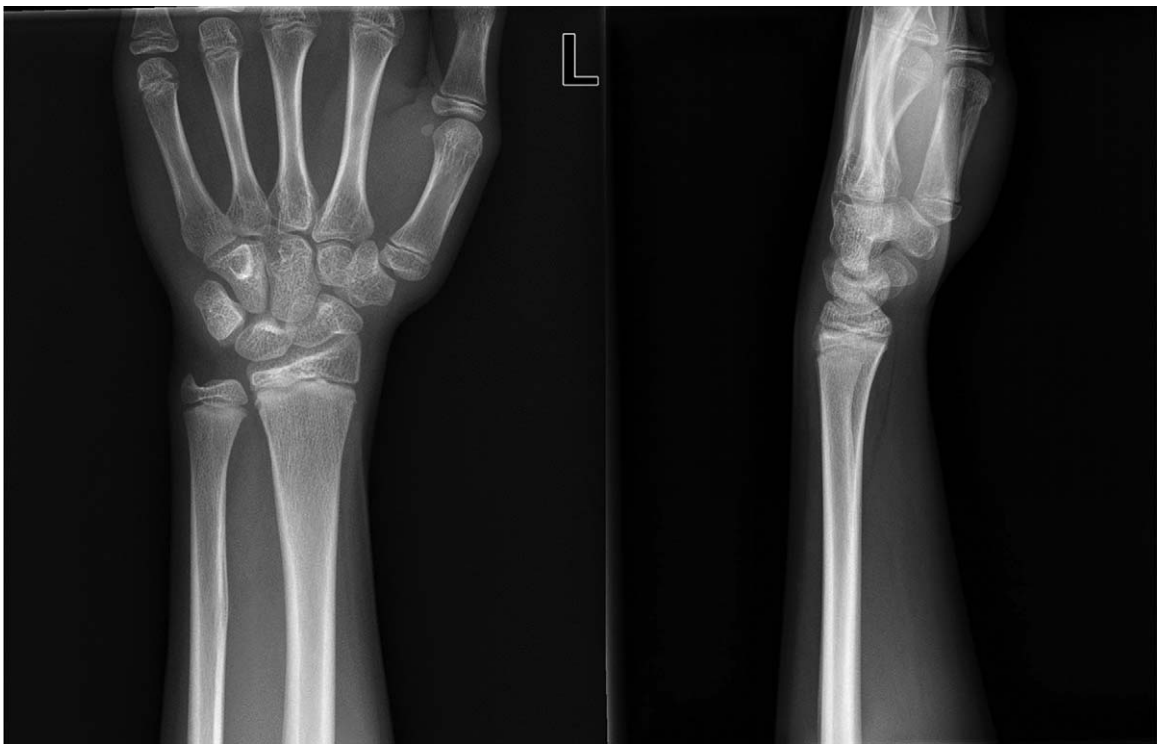

Figure 3. Anteroposterior and lateral radiographs showing the healed physeal fracture.

Figure 4. Lateral radiographs showing the epiphyseal fracture of the middle phalanx.

fourth finger (Fig. 4). A small bony fragment was noted at the base of the middle phalanx of the right fourth finger. We applied a splint on her finger for 2 weeks, and the fracture stabilized thereafter. After the fracture healed, the patient resumed climbing as a sports activity. However, she often experienced pain in her right finger. Currently, the fracture has healed (Fig. 5). Nevertheless, the patient has been followed-up and is undergoing regular check-ups every 6 months. During the follow-up period the patient did not complain of pain or discomfort on wrist and hand.

3. Discussion

The epiphyseal plate is composed of hyaline cartilage in the metaphysis at each end of a long bone. A site for endochondral ossification is responsible for the initial bone development. The radius is a cylindrical long bone, and its ossification is completed at age 2-3 years, and fusion is completed at age 16 to 18 years. Longitudinal bone formation in children results from the process of calcification with the cartilage cells of the growth plate. The calcification of the matrix is conditioned by the metaphyseal vessels, degenerated chondrocyte was removed by giant cells, and surrounded by the osteoblasts, which are responsible for the laying down of the lamellar bone.[4] Hypertrophied chondrocyte release angiogenic molecules,[5] the invasion of the metaphyseal vessles initiate chondrocyte death and ossification.[6] These alteration of the physeal cartilage lead to bone deposition.[6] A disturbance of the metaphyseal vessels supply to the physeal cartilage does not affect chondrogenesis or cartilage maturation, but hinder endochondral ossification.[7]

Read[8] first described the stress injury of the distal radius in young gymnasts. In 3 female gymnasts, the abnormalities on radiographs of the epiphysis and metaphysis were reported and this injury was called a stress fracture.[8] Stress changes of the distal radial epiphysis in a series of young gymnasts were described by Roy et al.[9] The physeal injury is caused by a

Figure 5. Lateral radiographs showing the healed epiphyseal fracture of the middle phalanx.

compromise of the metaphyseal and epiphyseal vessels.[10] A continuous or repetitive insult like intense sports can cause disturbance of endochondral ossification by damaging vessels in the metaphysis and/or epiphysis.[7,10] Our patient was using her wrist for climbing high altitudes, and this interrupts the blood supply in the metaphysis. There is radiographic criteria for diagnosis of stress injury, which was suggested by Roy et al[9]: the growth plate widening, cystic changes of the metaphysis, a beaked effect of the epiphysis, and haziness of the radiolucent area in the growth plate.[9] Conservative treatment includes the rest from weight-bearing exercise, bracing of the wrist, and physiotherapy.[11] Without early recognition and treatment, repetitive injury causes early closure of the physis, and it can lead to growth arrest, instability, and chronic pain.[1,7] In this case, the patient had repeated fractures, but the sites of fractures were different. The finger fracture occurred due to repetitive stress and microtrauma, such as distal radius fracture. Moreover, the fracture occurred in the middle joint because the highest pressure peaks occur when the middle joint is flexed.[12]

4. Conclusion

During climbing exercise, repeated high pressure causes damage of the hand and wrist joints in young patients. Chronic pain in this group must be carefully evaluated, and radiographs should be obtained for diagnosis and early treatment. Conservative treatment of these injuries has good results, and avoiding intensive power training avoids the risk of this injury.

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Author contributions

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References

[1] Bak K, Boeckstyns M. Epiphysiodesis for bilateral irregular closure of the distal radial physis in a gymnast. Scand J Med Sci Sports 1997;7:363–6.
[2] Amadio PC. Epidemiology of hand and wrist injuries in sports. Hand Clin 1990;6:379–81.
[3] Cook PA, Yu JS, Wiand W, et al. Madelung deformity in skeletally immature patients: morphologic assessment using radiography, CT, and MRI. J Comput Assist Tomogr 1996;20:505–11.
[4] Trueta J, Morgan JD. The vascular contribution to osteogenesis. I. Studies by the injection method. J Bone Joint Surg Br 1960;42-B:97–109.
[5] Alini M, Marriott A, Chen T, et al. A novel angiogenic molecule produced at the time of chondrocyte hypertrophy during endochondral bone formation. Dev Biol 1996;176:124–32.
[6] Farnum CE, Wilsman NJ. Cellular turnover at the chondro-osseous junction of growth plate cartilage: analysis by serial sections at the light microscopical level. J Orthop Res 1989;7:654–66.
[7] Laor T, Hartman AL, Jaramillo D. Local physeal widening on MR imaging: an incidental finding suggesting prior metaphyseal insult. Pediatr Radiol 1997;27:654–62.
[8] Read MT. Stress fractures of the distal radius in adolescent gymnasts. Br J Sports Med 1981;15:272–6.
[9] Roy S, Caine D, Singer KM. Stress changes of the distal radial epiphysis in young gymnasts. A report of twenty-one cases and a review of the literature. Am J Sports Med 1985;13:301–8.
[10] DiFiori JP, Caine DJ, Malina RM. Wrist pain, distal radial physeal injury, and ulnar variance in the young gymnast. Am J Sports Med 2006;34:840–9.
[11] Magrini D, Dahab KS. Musculoskeletal overuse injuries in the pediatric population. Curr Sports Med Rep 2016;15:392–9.
[12] Hochholzer T, Schoffl VR. Epiphyseal fractures of the finger middle joints in young sport climbers. Wilderness Environ Med 2005;16:139–42.