Concurrent capitate and hamate fractures in a child: the diagnostic value of magnetic resonance imaging and computed tomography at the rare wrist injury

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Introduction
Fractures of the carpal bones are rarely seen in children, particularly in the first decade of life. Scaphoid fractures are the most common carpal bone injuries seen in this period of life.\(^1\) Fractures of the other carpal bones are rarely seen and have generally been described as case reports or small series of patients in the literature.\(^2\,^3\,^4\) The mechanism of injury is usually hyperextension, and falling on an outstretched hand accounts for more than 80% of these injuries. It is difficult to detect carpal bone fractures via direct radiographs in skeletally immature patients. Anteroposterior and lateral radiographs of the wrist may not always be adequate for the diagnosis. Therefore, additional diagnostic methods are required. Computed tomography (CT) should be employed to explain the pain in the wrist and to investigate associated osseous pathology, if any. Moreover, CT is also quite beneficial in detecting hardly noticeable or small fractures, complex fractures, and fracture displacement. Magnetic resonance imaging (MRI) provides more detailed information about cartilaginous structure, in
skeletally immature patients, particularly when there is a clinical suspicion. To our knowledge, there are just 2 case report in the literature in which the fracture of the concurrent capitate and hamate fractures in childhood. In literature, our case is the first one treated successfully with conservative methods.

In this paper, we present a case with concurrently capitate and hamate fractures, which is a quite rare combination in childhood. The purpose of the study was to emphasize the diagnostic value and importance of CT and MRI in carpal bone injuries of childhood.

Case Report

A 7-year-old male patient was admitted to our emergency outpatient clinic due to pain and edema in his right wrist after falling. Physical examination revealed marked edema and tenderness on palpation of the wrist. There was no evidence of a neurologic or vascular deficit. Both active and passive motions of the wrist were restricted and were extremely painful. Following the taking of consent form from the patient, conventional radiographic examination of the wrist in the emergency outpatient clinic demonstrated nondisplaced capitate and hamate fractures, without dislocation of the bodies of the capitate and the hamate (Fig. 1). Since ossification of the carpal bones was not yet complete in this period of skeletal development, accurate information about the other carpal bones could not be obtained. CT showed coronal plane fracture in both the capitate and the hamate (Fig. 2). MRI was planned in order to identify potential associated osseous or soft-tissue injuries. T2-weighted MRI images showed bone marrow edema and a distinct fracture line in both the capitate and the hamate (Figs. 3a and b). There was no evidence of other carpal injuries, especially not of a scaphoid injury. Following the taking of consent form from the patient, extremity was immobilized in a short arm plaster cast for four weeks. Active exercises were started after removal of the plaster cast, and a complete range of motion was achieved within two weeks. The last control visit after thirteen months revealed no problem, complete union of the fracture, and painless activities of daily living.

Discussion

Carpal bones are largely cartilaginous at birth and remain largely cartilaginous until late childhood. Such a cartilaginous structure acts as a cushion to protect the carpal bones from fracture in small children. Both because fractures of the carpal bones are quite rare and because of their anatomical features, there may be a delay in diagnosis or a misdiagnosis.

Although wrist injuries are one of the significant reasons for admission to the emergency departments in child-

![Fig. 1. The image of the fracture line on conventional radiography.](image1)

![Fig. 2. Coronal computed tomography scan showing fractures of the capitate and hamate.](image2)
hood, fractures of the carpal bones are quite rare in this age group. There are a relatively small number of papers in the literature on multiple carpal bone fractures in the pediatric population. Scaphoid fractures are more common than fractures of the other carpal bones. Nevertheless, it accounts for only 0.39% of all pediatric injuries [5]. Isolated or combined fractures of the capitate and hamate are even rarer. Capitate fractures are usually seen in association with scaphoid fractures the so-called scaphocapitate syndrome.[2,5,6] This is usually the result of a high-energy trauma. To establish a diagnosis is even more difficult in young children since ossification of the carpal bones is not complete. Conventional radiography may be inadequate for the diagnosis or may lead to misdiagnosis. The cartilaginous components of the carpal bones or fractures of the carpal bones can be visualized by ultrasonography, CT, scintigraphy, and MRI.[7] However, ultrasonography is not commonly used for the diagnosis of fractures, except for displacement of unossified epiphyseal cartilage.[1] There are only a limited number of studies in the literature, which describe the diagnostic importance of these additional imaging methods in early childhood.[2] It is known from adult studies that conventional radiographs are of low negative predictive value (NPV). Dorsay et al.[8] reported that the mean NPV of conventional radiographs of the hand was 74% in a meta-analysis of eight studies comprising 366 patients with high clinical suspicion. False negative values may also be obtained in high proportions even in adults, in whom osseous carpal bone development has already been completed, with suspected examination findings.

CT may play a role in case of complex fractures. It is also valuable in defining the extent of displacement of the physeal component and in determining the need for internal fixation.[2] Osteochondral lesions can also be visualized on CT. CT can assist surgical planning by providing detailed depiction of the position and alignment of fracture lines and fracture fragments. CT should be employed to explain the pain in the wrist and to investigate associated osseous pathology, if any.

MRI may provide more detailed information about cartilaginous structure when there is a clinical suspicion. Therefore, MRI is a sensitive, reliable and quite important technique for detecting carpal bone injuries in children, in whom osseous development is progressing and the cartilaginous structure is predominant, particularly when there is a clinical suspicion. MRI may demonstrate bone marrow changes and cortical disruption and can clearly delineate fracture lines, particularly if the imaging is performed in more than one plane.[2] MRI also makes it possible to detect nondisplaced compression fractures. MRI has the advantage of detecting associated soft-tissue changes around the wrist joint and joint effusions between the carpal bones. Furthermore, MRI may be beneficial in evaluating the vascularity of the fracture fragments and in

Fig. 3. Axial (a) and coronal (b) T1-weighted MR images show bone marrow and cortical fractures.
evaluating revascularization during follow-up visits. CT or MRI can provide optimal visualization of the fracture, and close follow-up should be considered for cases, in which the suspicion of a possible capitate or other carpal fracture is strong.

The treatment of carpal bone fractures as well shows variations in the literature. Generally, the majority of pediatric carpal injuries heal uneventfully with simple cast immobilization. Displaced fractures may require open reduction and percutaneous K-wire fixation [6]. In the present case, we performed conservative therapy owing to the absence of displacement in the fracture line. At the end of thirteen months, we obtained radiographically and functionally normal wrist, which was completely functional.

Conflicts of Interest: No conflicts declared.

References