Evaluation of Cuboid Fractures in Pediatrics by MRI: A Case Series
Javier F. Quintana M.D., Neil Vachhani, M.D., Diego Jaramillo, M.D., M.P.H.
Departments of Radiology: The Children’s Hospital of Philadelphia, University of Pennsylvania School of Medicine, Philadelphia, PA.

Abstract
We report seven cases of children with cuboid stress fractures diagnosed by MRI. All cases demonstrated linear areas of low T1 signal intensity surrounded by a halo of high T2 signal intensity within the calcaneus just anterior to the cuboid on axial MR images. Some of the available plain radiographs ranged from normal films to frank dislocations within the cuboid. The clinical presentation of some patients with cuboid stress injury can be very confusing. The characteristic appearance of cuboid fractures by MRI can be very helpful in the radiologist’s ability to confidently differentiate from osteomyelitis or traumatic injury elsewhere in the extremity.

Introduction
Traditionally, “the cuboid fracture”, as described by Stewart and Gordon-Kibart, describes injury to the cuboid as it is trapped between the fourth and fifth metatarsals and the calcaneus. This typically occurs when there is axial abduction and internal rotation force of the hindfoot, with subsequent compression of the cuboid. In young patients, this type of fracture often occurs without a direct episode of trauma and can be placed under the umbrella term “island fractures”. The significance of this fracture is greater in the adult as this injury is usually associated with avulsion of ligamentous and capsular structures, and disruption of the peroneal alignment of the foot. Ankle fractures of the cuboid do occur in the adult but they are rare and less common.

On physical examination, there is focal pain in the cuboid. Although initial radiographs are usually unremarkable, follow-up radiographs will typically show denudation of the cuboid joint, which is consistent with a stress fracture. Clinical assessment of the fracture location in young children in this group is more difficult. For this subset of patients that MRI can help demonstrate characteristic imaging findings to help guide the clinician appropriately.

Methods
This was a retrospective imaging review. Examinations were approved by the institutional review board. MRI examination was performed during 2006-2008, for the following keywords: cuboid, cuboid stress fracture. Imaging was performed by both a pediatric fellow and attending pediatric radiologist with extensive pediatric musculoskeletal experience, but extremely rare in this younger group was extensively doped and based on children aged and under 6 years of age. Repeat or follow-up exams were relooked.

In children and young adolescents, a linear area of low T1 signal intensity was visualized with the cuboid, usually at the calcaneocuboid joint (Figures 1a-c).

Results
A query with the above keywords revealed 76 studies for 20 patients. The 76 studies were reviewed. Ten of the exams were follow-up studies and excluded. Fifty-eight patients were reported to have some type of cuboid injury. In the remainder of the cohort, 9 cases of children 5-19 years of age demonstrated cuboid fractures not adjacent or associated with the calcaneocuboid joint. This was a total of seven patients. Eight children, older than 7 years of age had cuboid fractures. In the cohort of these children, the linear areas of low T1 signal intensity representing fracture lines were seen from the calcaneocuboid joint (Figures 5). The remaining 12 patients demonstrated only cuboid edema. Of these twelve patients, 5 were under the age of 6.

Discussion
Stress injuries to the cuboid are thought to be undiagnosed and underestimated, primarily because of their rare occurrence in young patients. These fractures are common in sports settings and can be a source of significant pain and disability. The absence of direct trauma to the foot should draw the clinician from considering this injury.

Although radiographs taken two weeks apart can demonstrate sclerosis within the cuboid and confidently diagnose the injury, the wasting period may have for young children already finished, when which such as infection is accessible need not be excluded. The diagnosis may be made with confidence, but the lack of narrowing and even swelling (most common symptom) affects the mainstay of initial therapy. Studies which have previously reported the MRI findings of this stress-related injury in a single patient. Our series of patients confirms these findings.

17-18 year old images demonstrated all fractures, decreased signal intensity consistent with fracture lines in all patients 8 years of age and under and in some. These fractures were usually located at the calcaneocuboid joint. Exams recently were performed within the cuboid on all fluid sensitive sequences. The distribution of signal abnormalities within the cuboid supports the hypothesis that the cuboid compartment between the metatarsal and calcaneus could be a more frequent site of injury and abduction. In older children, cuboid fractures were found to be removed from the region of the calcaneocuboid joint (Figure). One of these fractures, age 11 years, did have a fracture to the proximal tibia to the cuboid joint, but not identifies the fracture location in the younger group. Fracture in the cuboid is not a common fracture in older patients, perhaps because their skeletal structure are more resilient to stress. Treatment of these fractures is relatively straightforward. The earlier immobilization is instituted, the quicker the healing and resolution of symptoms. This increases the importance of early diagnosis, as delayed treatment carries a 40% risk of injury recurrence.2

In summary, the diagnosis of a cuboid fracture in a younger child can be difficult to make, as both clinical and initial radiographic findings may be subtle. MRI can be a useful modality to diagnose cuboid stress fractures, as the signal abnormalities in the vicinity of the calcaneocuboid joint are consistent.

References