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Case Report

Open Reduction with Internal Fixation of Midfoot Fractures in a Pediatric Football Player

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Abstract

Surgical management of midfoot fracture/dislocations in the adult population has been extensively studied. The majority of the literature discusses open reduction with internal fixation versus primary arthrodesis; however there is a paucity of literature regarding surgical management of pediatric midfoot fracture/dislocations. To our knowledge, there are no case reports in the literature for open reduction with internal fixation of a pediatric midfoot fracture involving multiple tarsal bones. This case study describes the successful treatment and follow-up of a 13-year-old male who sustained multiple midfoot fractures/dislocations while playing football.

Keywords: *Open Reduction; Internal Fixation; Midfoot Fractures*

Introduction

Midfoot fractures are uncommon injuries in the adult population; reports suggest these injuries represent up to 9% of all adult foot and ankle fractures [1]. There is a wide spectrum of midfoot injuries in the adult population, including purely ligamentous injuries, fractures, and fracture/dislocations. The mechanism of injury in midfoot fractures is often a direct, high velocity trauma but a subset of these injuries occur from indirect rotational forces on a plantarflexed foot. This injury type can occur during sporting events such as football or basketball [2]. While the epidemiology of these injuries is well described in the literature for the adult population, little has been reported on pediatric midfoot fractures.

Case Report

Surgical management of midfoot fracture/dislocations in the adult population has been extensively studied. The majority of the literature discusses open reduction with internal fixation versus primary arthrodesis [3,4]; however there is a paucity of literature regarding surgical management of pediatric midfoot fracture/dislocations. Literature is limited to case reports on pediatric midfoot fractures which employ cast immobilization and occasional closed reduction and percutaneous fixation [5,6]. To our knowledge, there are no case reports in the literature for open reduction with internal fixation of a pediatric midfoot fracture involving multiple tarsal bones. This case study describes the treatment and follow-up of a 13-year-old male who sustained multiple midfoot fractures and dislocations while playing football. The injury occurred when another player rolled-up on the posterior aspect of his foot while he was blocking. This presentation of longitudinal loading on a plantarflexed foot is the classic mechanism of indirect loading resulting in a midfoot injury [7]. Plain radiographs and computed tomography revealed comminuted fractures to the cuboid, intermediate, and lateral cuneiforms (Figure 1), along with simple fractures to the anterior process of the calcaneus, medial cuneiform and navicular. The films also revealed dorsal dislocation at the naviculocuneiform joints. He was subsequently treated with open reduction and internal fixation and followed for one year.

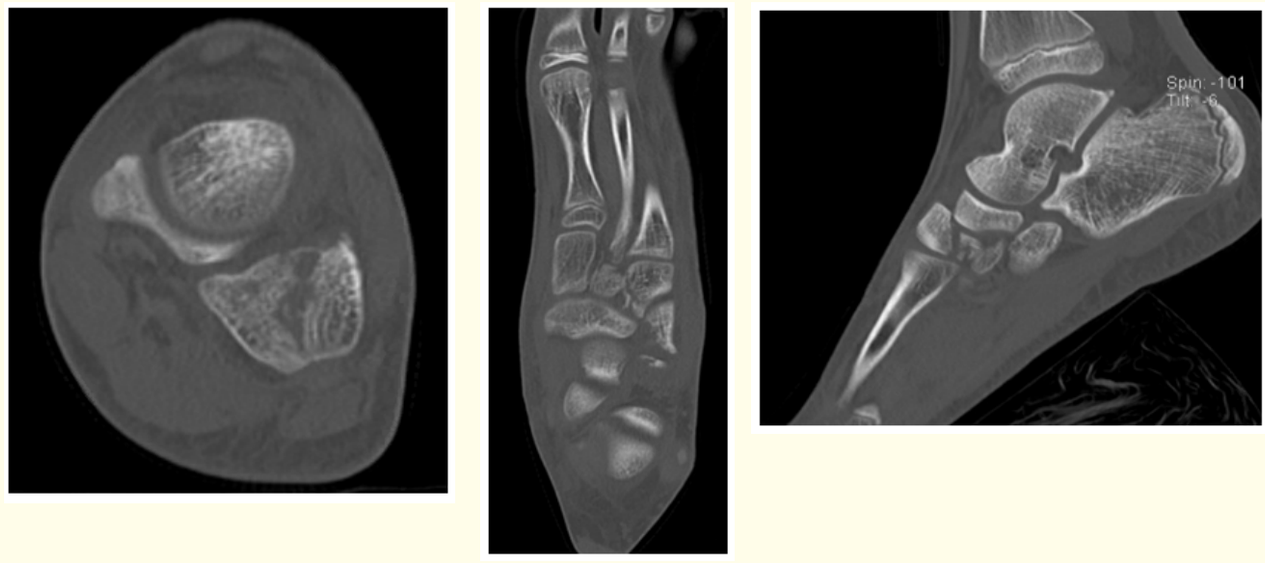

Figure 1: *Injury*

Surgical technique

The case presented is that of a 13-year-old male who sustained multiple fractures in the midfoot during a football game; he had fractures at the cuboid and cuneiforms with dorsal dislocation at the naviculocuneiform joints. The patient underwent open reduction with internal fixation of the fractures with multiple plates and screws spanning many midfoot joints. The surgery was performed in its entirety by the senior author (AS).

The initial incision was made over the lateral aspect of the foot just superior to the peroneal tendons. The comminuted cuboid fracture was reduced and fixated with a locking "X-plate". A second incision was then made at the first and second tarsometatarsal joints. Plantar comminution of the cuneiforms was appreciated as well as significant dorsal dislocation of the medial and intermediate naviculocuneiform joints. Due to the nature of the fractures as well as the presence of ligamentous injury, the decision was made to bridge plate the first and second columns. Fixation was achieved with limited contact dynamic compression plates extending from the body of the navicular, spanning the cuneiforms, to the metatarsals. Additional stability was obtained with a cortical screw from the medial cuneiform to the base of the second metatarsal. The lateral cuneiform was non-displaced and stable, thus not requiring further fixation. Final fluoroscopic images revealed anatomic reduction and well aligned joints (Figure 2). Fluoroscopic stress views demonstrated excellent stability. A posterior splint was applied for protection and splinting and the patient remained non-weight bearing for several weeks.

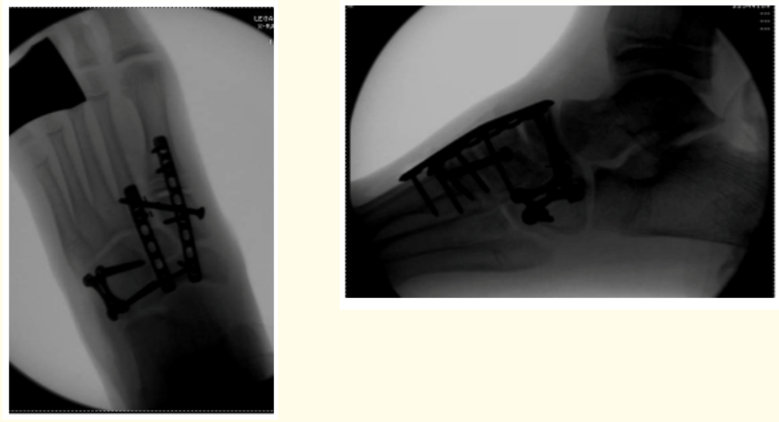

Figure 2: *Intraoperative*

Follow-Up

The patient remained non-weightbearing in a cast for six weeks, at which point he slowly transitioned to weightbearing in a boot over the next four weeks. At ten weeks he transitioned to normal shoe gear and full activities. The patient returned four months postoperatively with hardware irritation along with a broken screw in the navicular. The patient underwent hardware removal at 16.5 weeks after the index procedure. Intraoperatively, the cuboid appeared to have complete union and the calcaneal-cuboid joint was anatomic with viable cartilage and smooth motion. The decision was made to leave the broken screw in the navicular as removal would require extensive intraarticular dissection and could potentially disrupt the blood supply to the navicular. Intraoperative stressing of the foot under fluoroscopy revealed stable tarsometatarsal joints and a rectus foot structure. The patient returned to full activity four weeks after hardware removal. At final follow-up, one-year status post index procedure, he was maintaining a very active lifestyle filled with full, un-restricted involvement in football, basketball, and baseball. Radiographs at this visit revealed an anatomic foot structure without signs of arthritis or malalignment (Figure 3).

Figure 3: *Final follow up.*

Discussion

Midfoot fractures are an uncommon traumatic injury that can lead to significant complications for the patient. Operative treatment for midfoot fractures, including the tarsometatarsal joints, navicular, and cuboid has been widely discussed in the adult population. Treatment of the tarsometatarsal joint fracture dislocations is divided between primary arthrodesis and open reduction and internal fixation (ORIF). While frequently cited literature advocates for primary arthrodesis [4], ORIF with anatomic reduction has also been shown to have successful outcomes [8-10]. Literature is limited on treatment of navicular and cuboid fractures with ORIF but small sample size studies have shown positive outcomes [11-13].

Despite the available research involving adult midfoot fractures, reports regarding operative treatment of midfoot injuries in the pediatric population are rare. Many of the available studies are case reports and small sample size studies that recommend conservative treatment. In 1981, Wiley [6] reported on 18 cases of patients under 16 years old that sustained tarsometatarsal joints. These patients were

treated conservatively with immobilization, closed reduction, percutaneous pinning, or a combination of the above and were not followed for outcomes. In 2001, Buoncristiani [5] also reported on conservative care of 8 pediatric midfoot fracture dislocations with successful outcomes at an average of 32 months follow up.

To our knowledge, this case study is the only report that details treatment of a pediatric male patient with multiple midfoot fractures and dislocation treated with ORIF. Studies have detailed the correlation between anatomic reduction of the midtarsal joints with a successful outcome in treatment of these injuries [9]. The importance of anatomic alignment and joint preservation in the midfoot is evident when evaluating the biomechanics. The cuboid is the sole osseous structure of the lateral midfoot and the is responsible for the plantar and dorsal motion of the lateral column. The cuneiforms and tarsometatrsal joints are essential in creating a stiff transverse and longitudinal arch that creates a rigid lever arm for transfer of weight from the ankle to the forefoot. Individual joint motion in the midfoot also helps to adjust specific metatarsal heads to accommodate for uneven ground and to maintain even ground pressures across the foot [7]. Preserving the intrinsic biomechanics of the midfoot with ORIF may be even more important to future long-term function in the pediatric population. This study shows evidence that ORIF in a pediatric midfoot fracture can return to high levels of activity and athletics.

Despite our positive outcome, higher level studies are needed to evaluate long term outcomes of ORIF of midfoot fractures in pediatric populations as well as outcomes versus other treatment modalities. Further studies are also needed to evaluate postoperative protocols in terms of optimizing time non-weightbearing, time to hardware removal, and time to return to full activities.

Conclusion

The goal of this procedure is to restore anatomic alignment of multiple midtarsal joints, limit future osteoarthritis, and allow return to full athletic activities in a pediatric male patient. To our knowledge, this study presented is the first to report on a successful outcome of an ORIF of multiple midfoot fractures and dislocations in a pediatric male football player.

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