

Two Cases of Missed Salter-Harris III Coronal Plane Fracture of the Lateral Femoral Condyle

Sanjeev Sabharwal, MD, Patrick Henry, MD, and Fred Behrens, MD[†]

ABSTRACT

Coronal plane fractures of the lateral femoral condyle can be difficult to diagnose, especially in children with open physis. Two adolescents who sustained this uncommon Salter-Harris III fracture of the knee were misdiagnosed after initial clinical examination and standard x-rays. Oblique x-rays, computed tomography, and magnetic resonance imaging were valuable in arriving at the correct diagnosis and in decision making.

Salter-Harris type III physal fractures traverse the epiphyses and exit at the articular surface.¹ These fractures involve biologically active cells of the growth plate and carry a guarded prognosis. They can cause angular deformities, limb-length discrepancy, and, in cases of intra-articular step-off, degenerative arthritis.^{2,3}

Dr. Sabharwal is Associate Professor, and Dr. Henry is a Resident, Department of Orthopaedics, New Jersey Medical School, University of Medicine and Dentistry of New Jersey, Newark, New Jersey.

[†]Deceased. Dr. Behrens was the former Chairman, Department of Orthopaedics, New Jersey Medical School, University of Medicine and Dentistry of New Jersey, Newark, New Jersey.

Address correspondence to: Sanjeev Sabharwal, MD, Department of Orthopaedics, New Jersey Medical School, University of Medicine and Dentistry of New Jersey, 90 Bergen St, Suite 7300, Newark NJ 07103 (tel, 973-972-0246; fax, 973-972-1080; e-mail, sabharsa@umdnj.edu).

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Because Salter-Harris III fractures of the distal femur are often concealed by the overlying patella, they can be difficult to recognize on plain x-rays.⁴

There are few reports of coronal plane fractures of the femoral condyle in adults⁵⁻⁷ and none in children, according to our literature search. To create awareness of diagnostic pitfalls, we report 2 such cases in skeletally immature patients. In both, the diagnosis was missed with initial clinical examination and plain x-rays. Our patients and their families were informed that data on their case would be submitted for publication.

CASE REPORTS

Case 1

A boy 10 years old tripped, fell on his left knee, and sustained a 7-cm transverse laceration and a grade 2 open displaced fracture of the patella (Figure 1). No other injuries were identified. Rather than making a sec-

ond longitudinal incision, the surgeon extended the transverse laceration to expose the patella fracture site. After internal fixation of the patella fracture, the patient was placed in a knee immobilizer and allowed partial weight-bearing with crutches.

On follow-up 11 days later, the knee incision was healing well, and the patient denied any recent trauma. X-rays of the left knee revealed a well-reduced patella fracture and a fracture of the lateral femoral condyle (Figure 2). A computed tomography (CT) scan confirmed an undisplaced coronal plane Salter III fracture of the lateral femoral condyle (Figure 3).

The patient was placed in a long leg cast with the knee in extension, and he was mobilized toe-touch weight-bearing. Serial x-rays and CT scan obtained 1 week after cast application revealed no further displacement of the femur fracture. The cast was removed 6 weeks later. The patient

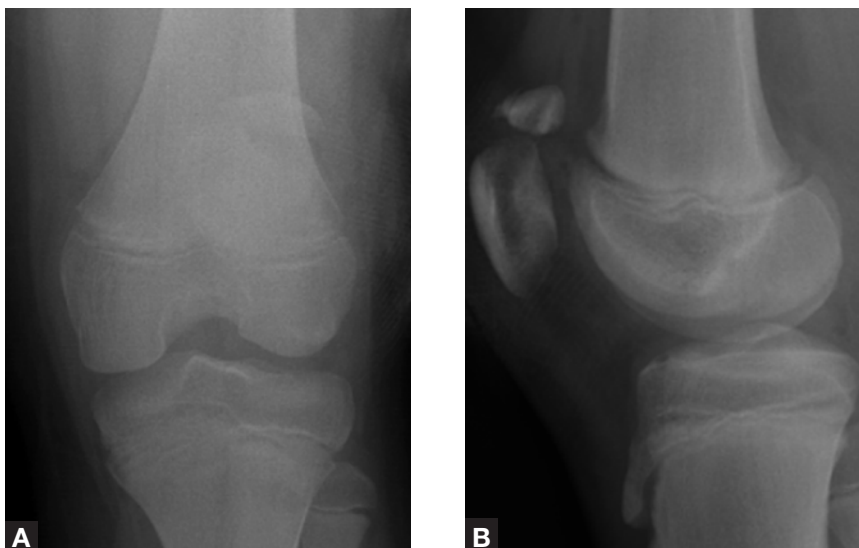


Figure 1. Case 1—Initial anteroposterior (A) and lateral (B) x-rays of open left patella fracture in a boy 10 years 8 months old.

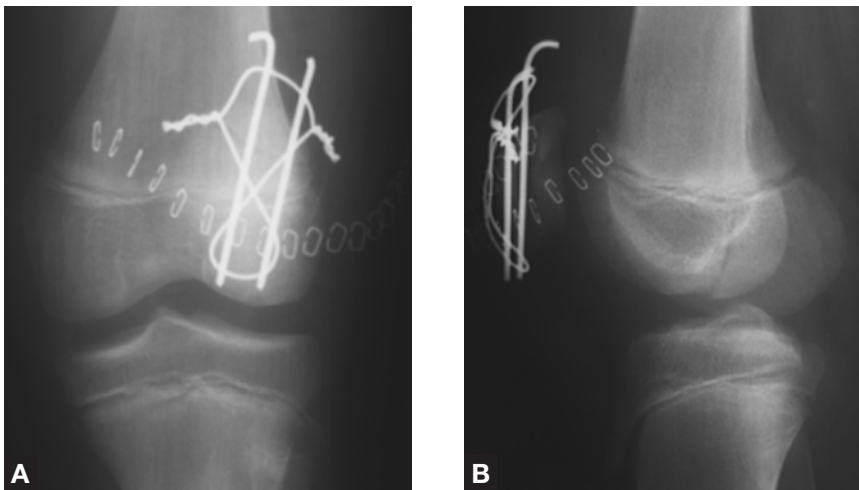


Figure 2. Case 1—Anteroposterior (A) and lateral (B) x-rays 11 days after open reduction and internal fixation of the patella fracture. Note the Salter III fracture line of the distal femur (not visible on prior x-rays).

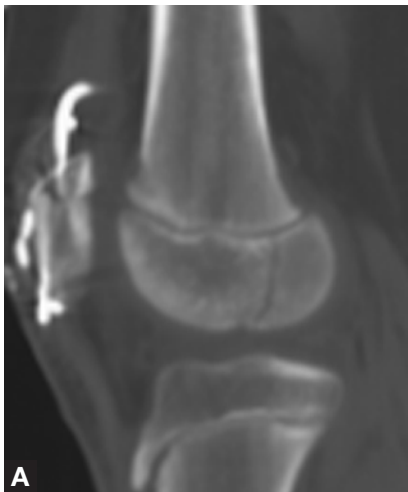


Figure 3. Case 1—Computed tomography (CT) scan of undisplaced coronal plane Salter III fracture of the lateral femoral condyle. There is no significant metal artifact, despite the presence of hardware for the patella fracture.

regained full strength and mobility of the left knee over the next 2 months.

Six months after injury, a CT scan (Figure 4) confirmed that both fractures had healed in satisfactory position. The patient underwent removal of the patellar hardware 9 months after surgery. At the latest follow-up (16 months after injury), there was no evidence of angular deformity, premature physal closure, or articular step-off (Figure 5).

Case 2

A 15-year-old boy, a pedestrian injured in a low-speed motor vehicle accident, sustained abrasions to the

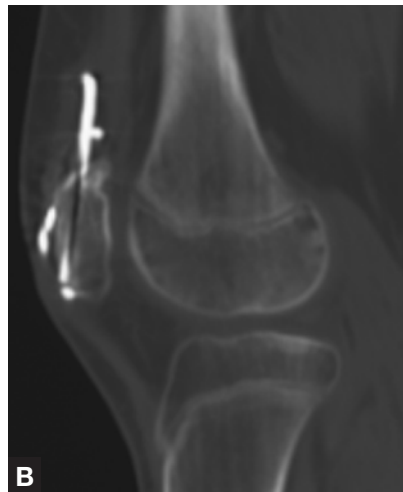


Figure 4. Case 1—Computed tomography (CT) scan 6 months after injury confirmed lack of displacement and satisfactory healing of the femur fracture.

face and both knees, with questionable knee effusion and no discrete tenderness over the distal femoral physis. Standard x-rays of both knees appeared normal. The patient started walking with crutches.

At 10-day follow-up, repeat x-rays of the right knee revealed a fracture of the lateral femoral condyle. CT and magnetic resonance imaging (MRI) scans (Figures 6, 7) confirmed an 11-mm displaced coronal plane Salter III fracture of the lateral femoral condyle. A skeletal age was not obtained before surgery, though knee x-rays showed near closure of the physis of the distal femur and proximal tibia.

The patient underwent open reduction and internal fixation of the distal femur fracture through an anterolateral approach. Three interfragmentary screws were placed from the nonarticular anterolateral surface of the femoral condyle directed posteriorly to engage the fractured condylar fragment.

After surgery, the patient was allowed toe-touch weight-bearing in a knee immobilizer. The fracture healed uneventfully (Figure 8). There was no evidence of angular deformity, leg-length discrepancy, or articular pathology at 2.5-year follow-up, by which time the patient had reached skeletal maturity.

DISCUSSION

In 1904, Hoffa⁵ described isolated coronal plane fractures involving the femoral condyle in adults. These fractures are often overlooked.^{6,7} Nonoperative treatment of coronal plane fractures has been associated with further displacement, which leads to poor functional results.⁶

Nork and colleagues⁷ recently reported a 38% incidence of coronal plane fractures associated with adult supracondylar-intercondylar distal femoral fractures. Most involve the lateral condyle. Only 69% of the coronal plane fractures were identified on plain x-rays. CT scanning improved the diagnostic yield and substantially helped with preoperative planning.

Lewis and colleagues⁶ reported on 7 adults with coronal plane fractures of the lateral femoral condyle. Three of the undisplaced fractures displaced within a short time after conservative management. In 2 of these fractures, plain x-rays were inadequate in confirming the diagnosis. The authors recommended further imaging studies such as tomograms or CT scans. They recommended immobilization in full extension for undisplaced fractures treated nonoperatively, as in this position the posterior capsule is taut, and longitudinal load is transmitted to the anterior part of the femoral condyles. Our case 1 was treated with cast immobilization with the knee in full extension; healing occurred without further displacement.

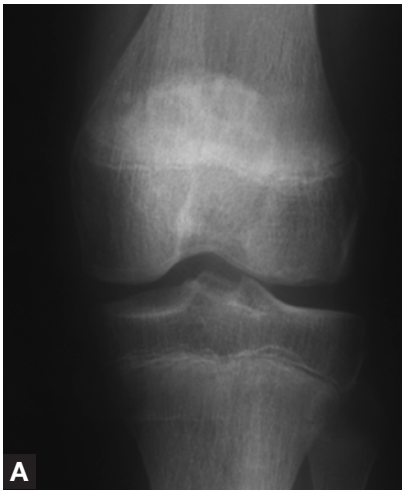


Figure 5. Case 1—Anteroposterior (A) and lateral (B) x-rays 16 months after injury show healed patella and femur fractures with no evidence of angular deformity or asymmetric physeal closure of the distal femur.

Figure 7. Case 2—Magnetic resonance imaging (MRI) scan confirmed computed tomography findings and absence of associated ligament or meniscal injury.

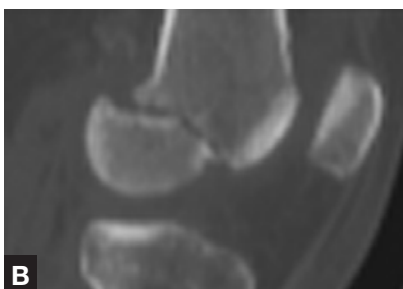
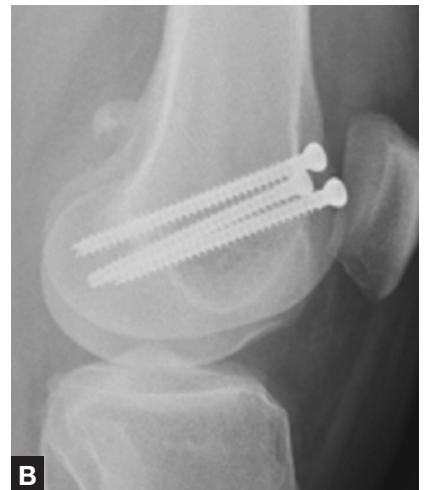
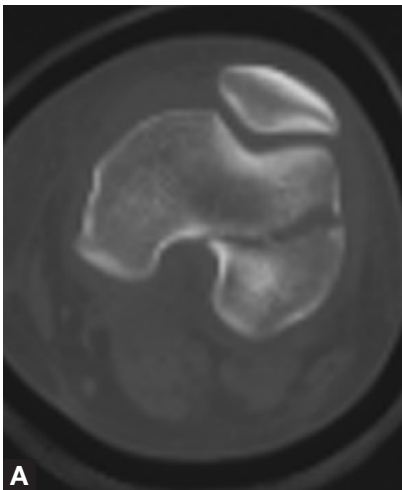


Figure 6. Case 2—Axial (A) and sagittal (B) computed tomography (CT) sections show displaced coronal plane Salter III fracture of the right lateral femoral condyle in a 15-year-old boy.

Figure 8. Case 2—Anteroposterior (A) and lateral (B) x-rays 2 years after open reduction and internal fixation (3 lag screws) of the intra-articular fracture show satisfactory healing of the fracture and no angular deformity or intra-articular step-off.

Most reported cases of distal femoral Salter-Harris type III injuries in children involve the medial femoral condyle and are caused by a valgus stress sustained during contact sports. Some have associated tears of the anterior cruciate ligament.^{4,8-10} Several

of these cases were initially mistaken for a sprain of the medial collateral ligament. Although both our patients were misdiagnosed at initial presentation, their injuries were not sports related and involved a coronal plane fracture of the lateral femoral condyle without any evidence of an associated ligamentous injury.

Imaging. In pediatric extremity trauma, physeal fractures of the knee may not be visualized on standard x-rays.^{11,12} Although stress x-rays have been advocated,^{10,13} they can be false-negative and are unlikely to show the coronal plane fractures reported here. If there is a high index of suspicion for an occult fracture

based on the mechanism of injury or physical findings, such as hemarthrosis, and the standard anteroposterior and lateral x-rays do not reveal any pathology, oblique views of the knee should be considered. Any abnormalities on this initial set of x-rays may require advanced imaging studies. We have found CT scans most helpful in assessing intra-articular fracture components and in planning operative interventions. MRI scans allow identification of injuries to ligaments, menisci, articular cartilage, subchondral bone, and unossified epiphyses in young children.^{3,8,14,15}

In summary, coronal plane Salter-Harris type III fracture involving the

lateral femoral condyle is an uncommon diagnosis that requires a high index of suspicion, especially when plain x-rays are unrevealing. It is imperative to recognize these injuries to avoid further displacement, impact on future growth, impaired function, and angular deformities and premature arthritis. Although the addition of routine oblique x-rays of the knee may identify these difficult-to-diagnose fractures, CT and MRI scans are best used in delineating details of the fracture pattern.

AUTHORS' DISCLOSURE STATEMENT AND ACKNOWLEDGMENT

The authors report no actual or potential conflict of interest in relation to this article.

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