Salter Harris III Medial Femoral Condyle Fracture with Concomitant Complete Anterior Cruciate Ligament Tear. A Case Report and Review of the Literature

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Citation

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Abstract

Several reports in the literature detail a Salter-Harris III medial femoral condyle fracture caused by valgus stress. Many report delayed medial meniscal tears, early degenerative changes, and subsequent need for medial menisectomy. This may indicate that ACL injury in these patients goes unrecognized. This case report describes successful closed treatment of a Salter-Harris III medial femoral condyle fracture and a delayed ACL reconstruction, where all others in the literature advocate surgical treatment of the fracture. The indications for surgical management of the fracture and the literature on this combined injury are reviewed. Index of suspicion should remain high for the possibility of ligamentous instability associated with fractures about the knee in skeletally immature patients. The potential for further injury can be avoided by performing a thorough exam. Magnetic resonance imaging confirms situations where provocative ligament exams are limited by guarding and pain.

INTRODUCTION

Adolescent athletes are a unique patient population subset. The presence of an open physis subjected to stresses placed on the knee during high demand pivoting, cutting activities creates opportunity for a variety of injuries not normally seen in skeletally mature patients. Biomechanical testing in animal models has shown a higher incidence of physeal failure compared to ligamentous failure.[5] This implies that a mechanism creating a ligamentous injury in an adult knee may not produce the same injury in someone who is skeletally immature.

It has been clearly documented in the literature that the mechanism to produce a Salter-Harris III fracture of the medial femoral condyle is by a valgus stress to the knee.[3, 9, 11, 13] There are eight reported cases of this fracture with an associated ipsilateral complete anterior cruciate ligament tear.[2, 3, 9, 13] The astounding and expanding amount of adolescent athletic participation, makes it important to clearly outline this injury pattern and the treatment options. In addition, it may also raise awareness to what is likely an underreported entity.

CASE REPORT

A sixteen year old high school football player sustained a valgus injury to his left knee during a Friday evening game. He reported hearing a pop. Subsequently he noted significant swelling and inability to bear weight on the extremity secondary to pain. Due to the aforementioned symptoms, he sought evaluation in a Saturday morning injury clinic. An initial exam, there was a marked effusion with significant patient guarding that limited a clear ligamentous evaluation. Plain radiographs demonstrated a nondisplaced Salter-Harris III medial femoral condyle fracture (Figure 1A-D).

Figure 1 A-D. Initial injury radiographs demonstrating Salter-Harris III fracture of the medial femoral condyle (A - anteroposterior, B - lateral, C - notch, D - sunrise view)

The patient was placed in a knee immobilizer, strict non-weight bearing status with crutch assistance.

Follow up exam at two weeks revealed much improved pain level but with continued large effusion. Range of motion was limited at 30 degrees shy of full extension, and 90 degrees of flexion. Ligament exam yielded 2+ laxity with Lachman, and 1+ laxity with valgus stress. Plain radiographs showed no displacement of the fracture fragment.

An MRI was performed due to the above laxity. The imaging confirmed the nondisplaced Salter-Harris III medial femoral condyle fracture, and also demonstrated a complete disruption of the ACL from the femoral attachment (Figure 2A-D).

Figure 2 A-D. MRI images showing the Salter-Harris III medial femoral condyle fracture and the ACL tear from the femoral insertion. (A - T2 weighted sagital image, B - T1 sagital, C - T2 coronal, D – T2 axial)

He was placed in a hinged knee brace, locked in extension and made touch-down weight bearing. Physical therapy was ordered for quadriceps strengthening, passive, and active assisted range of motion. It was agreed that the fracture would be treated nonoperatively with a delayed ACL reconstruction once the fracture was stable.

At the one month injury follow up visit, the patient had obtained range of motion from 0 to 110 degrees and his pain was well controlled. Lachman's exam continued to demonstrate 2+ laxity, with 1+ laxity on valgus stress. Plain radiographs demonstrated callus formation with incomplete bony union and no displacement of the fracture fragment. His physical therapy continued focusing on quadriceps strengthening and range of motion exercises. He was transitioned to partial weight bearing in the brace with crutch assistance. Weight bearing was allowed to progress in the brace to as tolerated, and crutch assistance could be weaned when he was able to ambulate without pain or a limp.

Follow up evaluation at two months revealed full knee range of motion, good quadriceps function, no effusion, and radiographs showed bony union in an anatomic position of the medial femoral condyle (Figure 3A-B).

Figure 3 A&B. Anteroposterior (A) and lateral (B) radiographs two months after initial injury.

He was ambulating pain free with the brace only. The 2+ laxity with Lachman's persisted however the valgus instability was no longer detectable.

The patient elected to undergo an ACL reconstruction due to his residual instability and his desire to return to high demand athletic activities. At three months after his initial injury he was taken to the operating room for reconstruction. An exam under anesthesia prior to the procedure yielded 2+ laxity with Lachman, a positive anterior drawer sign, and a positive pivot shift. Valgus stress produced 1+ laxity at 30 degrees of flexion, and no laxity in full extension. An ipsilateral bone patella tendon bone auto graft ACL reconstruction was then performed without incident. Post procedure exam under anesthesia showed no laxity with Lachman or valgus stress, with trace excursion on anterior drawer. His immediate post-operative course included a continuous passive motion device and weight bearing as tolerated with crutch assistance in a hinged brace locked in extension. Five days after surgery, he returned to physical therapy to begin ACL rehabilitation.

Two weeks after surgery, his was seen for his initial post-op evaluation. His pain was well controlled, there was a minimal knee effusion, and range of motion was 5 degrees shy of full extension with 95 degrees of flexion (Figure 4).

Figure 4 A&B. Anteroposterior (A) and lateral (B) radiographs after ACL reconstruction.

At this point his brace was unlocked to allow a motion arc from 0 to 90 degrees for ambulation. Seven months post operatively the patient was evaluated one final time. His knee exam was without laxity on Lachman, and 1+ laxity on valgus stress. He reported being able to perform straight line jogging for a distance of two miles without pain or feelings of instability. Functional testing by physical therapy reported greater than 90% compared to contralateral knee. The patient requested clearance to return to high school football play, which was granted and he was given a release from our clinic. It was recommended he wear a functional ACL brace for the next upcoming football season. If he had no problems, he could then discontinue the brace.

DISCUSSION

Within the literature, all of the reported cases of Salter-Harris III medial femoral condyle fractures involve a valgus stress. A very nice description of this fracture mechanism was presented by McKisic et al.[11] They likened this to a juvenile Tillaux fracture in adolescents in reference to the pattern of physeal closure. Harcke et al determined the closure of the distal femoral physis begins around 14 to 15 years of age.[8] This was demonstrated by the loss of signal at the physis on T2 weighted MRI images. Sasaki et al called this loss of signal the "drop out sign," and noted that the distal femoral physis proceeded to close from central to peripheral.[12]

McKissick and Torg both hypothesized that with a valgus impact to the knee, the medial aspect of the knee would open placing the medial collateral ligament as well as the posterior cruciate ligament under tension.[11, 13] The medial aspect of the distal femoral physis separates until reaching the closed portion of the physis, at which point it will propagate through the intercondylar notch completing the medial condylar fracture. The ACL originates on the medial wall of the lateral femoral condyle no more anteriorly than the intercondylar ridge.[10] Paletta et al has shown that the origin of the ACL is 3mm from the distal femoral physis.[1] With the early closure of the central portion of the physis, the force creating the fracture through the medial femoral condyle could then be transmitted slightly more obliquely due to a slight rotational component. With the close proximity of the ACL to the distal femoral physis, the ACL is vulnerable to femoral avulsion completing the mechanism of injury.

Torg and Morris reported two patients with Salter-Harris III fractures of the medial femoral condyle with anterior cruciate laxity.[13] Both were treated with nonoperative management of the fractures but both required subsequent medial menisectomies. It was hypothesized that the anterior cruciate ligament injury was initially unrecognized leading to chronic anterior tibial translation. This would in turn increase the stress and ultimately producing the medial meniscal tears. Unfortunately, there was no follow up data concerning their prior activity levels or if they experienced limitation from residual instability.

Bertin reported on two patients with Salter-Harris fractures of the medial femoral condyle and ACL injures from football related valgus contact mechanisms.[2] One was a fourteen year old male and the other a thirteen-year-old male. One of these patients later sustained a medial meniscal tear requiring menisectomy. This patient also had symptomatic degenerative changes demonstrated by radiograph. Once again, no post injury activity level or limitations were reported.

Herrera and Brone reported on four total patients with the combined Salter-Harris III medial femoral condyle fracture, ACL rupture injury.[3, 9] All four patients underwent closed reduction with percutaneous pinning of the femoral condyle fracture. All four patients were treated with a delayed bone patella tendon bone auto graft ACL reconstruction at approximately 3 months after their injury. They all returned to their pre-injury level of competition. Two of the four patient experienced anterior knee pain. There were no reports of leg length discrepancy.

Treatment criteria for non-surgical verses surgical management of medial femoral condyle fractures has been taught and is well accepted to be based on the amount of fracture fragment displacement.[7] Because this is an intraarticular injury of a weight bearing joint it is essential that anatomic position must be maintained. If there is any displacement, anatomic reduction must be obtained. Non-displaced fractures can be managed non-operatively, but close follow up is necessary. If closed reduction is successful then percutaneous fixation that avoids the physis is acceptable. Otherwise open reduction to restore the articular surface, with internal fixation that avoids the physis is required.

Complete physeal arrest is rare and largely a factor of the patients age. It is more common to see partial physeal arrest that will result in angular deformities.[7] This is what can occur in Salter-Harris III fractures. Once again, the degree of the deformity is a function of the patients' age at the time of injury.[6] However, Czitrom et al showed that Salter–Harris III and IV injuries to the distal femoral physis can often lead to shortening and angular deformities.[4] Making injury to this area of the knee important to pay close attention to. However, most patients experiencing medial femoral condylar fractures with ACL injuries are nearing end of growth due to beginning closure of the physis. Regardless, it is still important to discuss the potential for both angular and longitudinal deformities with the patient and their family at the time of injury.

CONCLUSION

It is clear that an injury to the distal femoral physis can lead to leg length discrepancy or angular deformity. There is also well-documented evidence of the potential for chondral injury, meniscal injury, and early degenerative changes in an ACL deficient knee. Combining these two injuries can produce significant disability if not treated appropriately.

With the popularity and rapid growth of school sponsored and recreational sports it only stands to reason that the incidence of this type of injury will increase. Training regiment intensity, duration, and age at onset are developing bigger, faster, and stronger athletes. This is likely to also increase the frequency with which this injury occurs.

Increased awareness of the potential for concomitant ACL injury in patients with a medial femoral condyle may help to prevent further avoidable morbidity. A complete ligamentous exam should be performed when the clinical scenario and the stability of the fracture will allow. MRI is a helpful tool to rule out concomitant ligament, meniscal, or chondral injuries.

Treatment needs to provide anatomic restoration of the joint surface. It is possible to treat non-displaced fractures with brief immobilization, and progressive range of motion. Close follow up is imperative to evaluate for displacement or deformity development, particularly when there is significant skeletal growth remaining. ACL reconstruction can be staged when the fracture is well healed, quadriceps strength, and range of motion have returned. This is at approximately three month from the initial injury.

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