Arthroscopic Assisted Fixation of Juvenile Intra-articular Epiphyseal Ankle Fractures

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The purpose of this study was to present the long-term follow-up of a case series of arthroscopically assisted fixation of juvenile intraarticular epiphyseal ankle fractures. The functional and radiographic outcomes of 6 patients with a range of follow-up of 1 to 5 years were evaluated. Five of the 6 patients had triplane injuries, whereas the remaining patient sustained a juvenile Tillaux fracture. All of the patients returned to full activity within 14 weeks of surgery, and none of the patients had any restriction in the ankle range of motion at the time of last follow-up. The results of this small series of patients suggest that arthroscopic-assisted, percutaneous fixation of intraarticular juvenile epiphyseal ankle fractures is an effective, less invasive surgical technique. Several surgical maneuvers that are helpful in the consistent execution of this technique are also mentioned. (The Journal of Foot & Ankle Surgery 46(5):376–386, 2007)

Key words: ankle injuries, arthroscopy, epiphyseal plate, fracture fixation, triplane ankle fracture, tubercle of Tillaux-Chaput

Up to 38% of physeal injuries have been reported to occur in the ankle (1), and the incidence of tibial physeal fractures is reported to be second only to those of the distal radius (2). Closure of the distal tibial physis begins centrally, extends medially, and concludes in the anterolateral region of the joint. This process is complete by about 15 years of age in girls and 17 years of age in boys. The asymmetrical closure is thought to lead to triplane and transitional-type fractures (Salter-Harris types 3 and 4) in the adolescent age group (3–6).

Disruption and incongruity of the articular surface can lead to posttraumatic arthritis, even in younger patients (7–9). The current standard of treatment for intraarticular fractures in the adolescent age group with >2 mm of displacement is open reduction and internal fixation, in an effort to achieve precise restoration of the articular surfaces (3, 5, 8–12). Open reduction and internal fixation, however, compromise joint capsular integrity and may lead to increased healing time and limitation of ankle motion.

Arthroscopy has been used for many diagnostic and treatment purposes in multiple joints, and arthroscopically assisted reduction and internal fixation for the management of intraarticular fractures has also been discussed in the literature. Ruch et al concluded that arthroscopically assisted reduction and fixation of intraarticular distal radius fractures permitted a more thorough inspection of the injury, and that patients had a greater degree of motion postoperatively than those who underwent fluoroscopic-assisted surgery (13). Other authors have reported the use of arthroscopic assistance for reduction and repair of Tillaux and triplane fractures of the distal tibia on a 1- or 2-case basis (14–19). However, one of these reports included a mini-arthrotomy, and the repair was not purely arthroscopic (14). Another of these reports was in an adult patient with a Tillaux fragment (17). Furthermore, the length of follow-up in any of the published reports was considerably short, ranging from a few weeks to 1 year.

At our institution, we have adopted an arthroscopic technique for reduction and percutaneous fixation of distal tibial intraarticular, transitional epiphyseal fractures in juvenile patients. The purpose of this paper is to present a small series of patients with long-term follow-up and provide guidance in the arthroscopic reduction of these fractures.

Patients and Methods

Six consecutive cases of juvenile distal tibial intraarticular, transitional epiphyseal fracture, treated during the 4 year 7 month period from November 2001 to June 2006, were identified in the case logs of the senior author (J. M. S.). Data, including radiographic findings, were abstracted from the medical records, and retrospectively considered. The criteria for arthroscopic reduction of juvenile distal tibial intraarticular, transitional epiphyseal fractures included the presence of an

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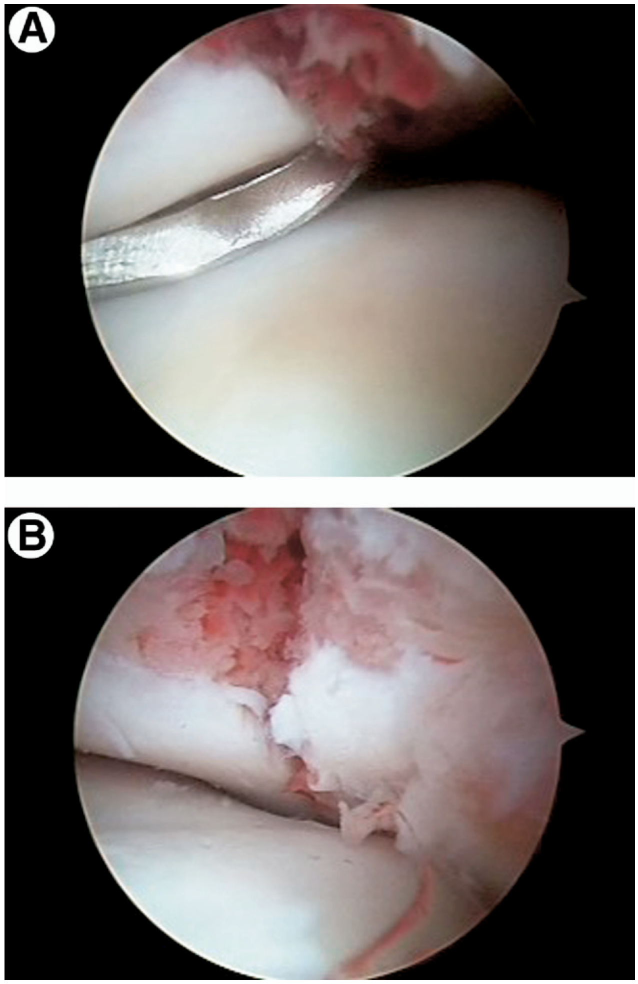

FIGURE 1 (*A*) Intraoperative arthroscopic view of a right ankle with a triplane fracture. Note the bone pick debriding the hematoma within the fracture site. (*B*) Same patient after excavation of the hematoma.

intraarticular fracture of the distal tibial epiphysis with more than 2 mm of separation of the fragments. In most instances, this was confirmed with computerized tomography scans immediately after injury, because the actual amount of separation of the articular surface was not easily determined with standard radiographic views of the injury.

Each patient was taken to the operating room and placed in a supine position on the operating table with a bolster under the ipsilateral hip. Standard medial and lateral arthroscopic portals were developed, and a 4.0-mm, 70° arthroscope was placed into the ankle via the medial portal. With a small bone pick placed into the ankle via the lateral portal the fracture surfaces and joint space were debrided of hematoma (Figure 1). Thorough debridement of the injured joint was often facilitated by forced external rotation of the foot on the leg, in an effort to open the fracture site. After debridement, a large bone clamp was placed with one jaw in the lateral portal and the other positioned on the posterior-medial crest of the tibia, just superior to the physis as shown in Figure 2. The lateral jaw of the reduction clamp was placed on the distal tibial epiphysis, just medial to the edge of the fibula. As the clamp was tightened, arthroscopic and fluoroscopic inspection was used to assure anatomic reduction. Either a solid core or cannulated screw, or screws, were inserted from a percutaneous medial approach. The drill or guide wire was delivered under fluoroscopic control and was confined to the epiphyseal portion of the tibia, and care was taken to make sure that the drill, or guide wire, did not cross the physeal plate. The target of the drill or guide wire was always the lateral-most portion of the lateral fragment, so that the screw would traverse the fracture line as perpendicular as possible (Figure 2C). Final screw fixation was then delivered with fluoroscopic control from medial to lateral. Either a fully threaded cortical or cancellous screw was placed, after overdrilling the medial fragment, or a partially threaded cancellous screw was placed in a similar fashion (Figure 2D). As the screws were tightened, arthroscopic visualization confirmed interfragmentary compression and anatomic reduction (Figure 2E). Thereafter, the operated leg was immobilized in a splint or cast for 4 to 6 weeks, and then the patient was allowed gradual weight bearing in a walking boot or cast. Radiographs of the ankle were taken to assess healing before full weight bearing was allowed.

Results of the Case Series

The 6 cases described in this report are summarized in Tables 1 and 2, and the details are described herein. There were 5 boys and 1 girl in the case series. The mean age of the patients was 13.77 ± 1.69 years (median, 13.75; range, 11.5–15.67 years). Most of the injuries entailed triplane fractures of the distal tibial metaphysis, and adjunct operative interventions, including repair of the fibula or decompression fasciotomy, were undertaken in 3 (50%) of the patients. Each of the patients sustained his or her injury before the anticipated age of distal tibial physeal closure, and healing occurred in a timely fashion after the operative reduction and fixation. Specifically, all of the fractures were observed to be united at the time of the 6-week postoperative radiographs. Union was defined as radiographic evidence of osseous trabeculae bridging the fracture line and no evidence of fragment instability, and the images were inspected by each of the contributing authors who concurred as to the outcome. The average time to return to preinjury activity was 10.92 ± 1.86 weeks (median, 10.5; range, 9–14 weeks), and the mean follow-up period was 2.75 ± 1.61 years (median, 2.75; range, 1–5 years).

Specific details related to each of the cases in the series are described below.