Adult Periarticular Locking Plates for the Treatment of Pediatric and Adolescent Subtrochanteric Hip Fractures

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Abstract

Two cases are presented in which adult, precontoured, lower-extremity periarticular locking plates were utilized for fixation of subtrochanteric femur fractures in pediatric patients. Recognition of the fact that a distal tibial locking plate in a small child and a proximal tibial locking plate in an adolescent anatomically fit the proximal femur in each case may provide a surgeon treating subtrochanteric hip fractures in this population increased options for operative stabilization.

According to Canale, hip fractures in children are of interest because of the frequency of complications rather than the frequency of fractures. Pediatric subtrochanteric hip fractures, although rare, can be devastating injuries that may result in serious complications, such as avascular necrosis, nonunion, malunion, overgrowth, and premature physeal closure. The osseous lower extremity anatomy in a child is very complex and sensitive, consisting of a proximal femoral physis, trochanteric apophysis, dense bone, and a small neck. The vascular anatomy is immature and variable as well. While there are no stringent guidelines for treatment of these injuries, minimally displaced fractures in younger children (less than 4 years of age) are often treated nonoperatively in a hip spica cast, with or without traction. Significantly displaced fractures in older children (more than 4 years of age) may require surgical intervention, but there is no consensus on the optimal implant used to gain fixation.

Implant selection is often a challenge in the treatment of these fractures. Constructs that have been utilized historically include: smooth pins, cannulated screws, pediatric compression hip screws, and fixed angle screw and sideplate constructs (blade plate). We offer an alternative method of fixation that the senior investigator has found to be simple to use. In one case, a proximal tibial periarticular locking plate was placed along lateral cortex of the proximal femur following open reduction in its appropriate orientation while the medial distal tibia periarticular locking plate was applied to the proximal femur requiring rotation of 180°. The plates were used for fixation of adolescent and pediatric and subtrochanteric hip fractures, respectively, with great ease and success in two cases. In both cases presented, the plates did not have to be contoured and conformed anatomically to the native pediatric proximal femur.

Case 1

The first case is that of a six-year-old male, who sustained an open, displaced subtrochanteric femur fracture from a three story fall. He was initially treated in his native country with irrigation, debridement, and spica casting. When the patient presented to our institution, at three weeks post injury, his fracture was nonunion and angulated, and the leg was shortened by 2.5 cm (Fig. 1A and B). Based on this amount of shortening, he was indicated for open reduction and internal fixation. A lateral approach to the femur was performed. The iliotibial band was incised, and the vastus lateralis elevated off the intermuscular septum. Care was taken to preserve as much perforating blood supply to the fracture fragments as possible. Next, an open reduction of the fracture site allowed for anatomic restoration of the proximal femur anatomy. A medial distal tibia locking plate (Stryker, Mahwah, New Jersey) was used to secure fixation (Fig. 1C and D). The two...
parallel locking screw holes in the proximal aspect of the plate allowed for the placement of three screws below the trochanteric physis, with no diminution of fixation stability. The wound was closed in layers over a suction drainage tube. No postoperative immobilization was utilized. The patient’s postoperative course was unremarkable, and the fracture healed at 6 weeks postsurgery.

**Case 2**

The second case involved a 13-year-old male with a history of cerebral palsy, who sustained a displaced subtrochanteric femur fracture following a motor vehicle accident (Fig. 2A and B). His past surgical history was significant for an ipsilateral pelvic osteotomy. The patient was initially placed in skeletal traction until operative fixation was undertaken. Again, a lateral approach to the proximal femur was done, with a direct open reduction of fracture fragments performed. Due to the valgus neck, a lateral proximal tibia locking plate with variable angle screws (DePuy, Warsaw, Indiana) was utilized. The ability to angle screws into the neck of the femur, yet for them to remain shy of the proximal femoral physis was an advantage to this construct (Fig. 2C and D). The wound was closed in a similar manner and again no postoperative immobilization was utilized. The patient was kept...
non-weightbearing for 6 weeks, then progressed as tolerated. The fracture achieved union by 8 weeks postoperatively.

**Discussion**

The introduction of periarticular locking plates, made specifically for the proximal and distal tibia, has produced encouraging results. Although these plates have been designed purposefully for the proximal and distal tibia, this does not preclude their use at alternative sites. Subtrochanteric hip fractures in the pediatric and adolescent population are complex and difficult to treat. We have found that using adult tibial periarticular locking plates is an amenable solution for this purpose. In both cases, application of adult tibial locking plates provided adequate precontoured plate-bone interface and allowed for stable fracture constructs that precluded postoperative immobilization. Furthermore, neither patient...
experienced any hardware-related pain.

The anatomic constraints of the proximal femur, including the small diameter of the femoral neck and the presence of the capital femoral physis, may limit the type of internal fixation used in this population. Segal presented his favorable preliminary experience with a custom 95° condylar blade plate for subtrochanteric fractures in older children and adolescents. The majority of the patients had pathologic fractures, reflecting the rare occurrence of this injury due to trauma in otherwise normal older children and adolescents. Although only a small series of four patients were included in the study, all of the patients’ fractures went on to union in 3 months, with painless full range of motion of the hip. One patient demonstrated a Trendelenburg gait, and two patients were being monitored for a recurrence of the pathologic process.4

Jarvis and colleagues investigated the management of subtrochanteric femoral fractures in skeletally immature adolescents, a rare injury that had not been previously investigated. His group performed a retrospective review of all subtrochanteric femoral fractures treated at a major pediatric trauma center since 1990. The results demonstrated that operative treatment provided more satisfactory results than nonoperative methods. There were 13 adolescents with an average age of 13.5 years. The average length of follow-up was 2 years and 3 months. Eight of the 10 operatively treated patients had a satisfactory result, whereas the outcome was unsatisfactory in all three patients treated nonoperatively. Complications included three limb-length discrepancies, one case of avascular necrosis of the femoral head, one transient peroneal nerve palsy, and one case of asymptomatic heterotopic ossification. At the time of most recent follow-up, all had returned to preinjury level of function.5

Vigler and associates looked at seven children that were treated surgically due to a pathologic fracture through a simple bone cyst in the subtrochanteric region of the proximal femur. Average age at surgery was 10.6 years. Six children were treated primarily. One child was operated for a refracture through a persistent cyst and malunion of a previous fracture that had been treated nonoperatively. Surgery included curettage of cysts in all patients. The cysts were filled with autologous bone graft in five patients and OsteoSet® Bone Graft Substitute (Wright, Arlington, Tennessee) in two patients. The fracture was stabilized using a blade plate in three patients, a screw and sideplate in three patients, and an external fixator in one. At an average follow-up of 4.7 years, all fractures had healed uneventfully. The cyst was fully obliterated in five patients and partially obliterated in two patients. One patient had a relative lengthening of 2 cm on the affected side. All patients were asymptomatic, fully active, and had full range of motion.6

The use of the lateral proximal tibia locking plate for adolescent subtrochanteric hip fracture and medial distal tibia locking plate for pediatric subtrochanteric hip fracture appears to be a viable option for the treatment of these fractures and adds another implant to the armamentarium of orthopaedic surgeons to treat the injury of subtrochanteric hip fracture.

Disclosure Statement
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