

Treatment of Subtrochanteric Fractures in Adolescent Patients with Reconstructive Trochanteric Antigrade Nail

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INTRODUCTION:

It has now been well established through more than one study that the management of fractures of femur in pediatrics of the adolescent age group are best managed by reduction and secure internal fixation rather than non surgical conservative sort of treatment. This results in better outcomes including quicker healing and the less eventful complication of avascular necrosis (AVN) of the head of femur and length discrepancy, earlier ambulation and weight bearing, better psychosocial results and shortened hospital stay.¹⁻⁸

It has also been recognized that subtrochanteric fractures of the femur implement more challenges in management as they hold limited ability to compensate for malalignment with the presence of deforming muscle forces that render maintenance of reduction difficult. In addition, there is a lack of agreement regarding definition of the fractures. A proposed definition by Mathew and Jeffrey, after reviewing the literature and cases in their hospital retrospectively, defined subtrochanteric femoral fracture in pediatrics as the fracture distance to

be less than 10% from lesser trochanter compared to total shaft length, an area in which the muscle deforming action results in difficulty to control reduction.⁹

Modalities of internal fixation include titanium elastic nails (TEN), cephalomedullary nails (CM), interlocking nails, Smith Peterson plates, plate and hip screw, nail and intramedullary hip screw and cancellous screws. Yet these methods of internal fixation have not addressed the challenges of this fracture type sufficiently with respect to the operative wound, dissection, maintenance of reduction, post operative ambulation and weight bearing. For the management of this injury we use trochanteric antigrade nail (TAN) a rigid intramedullary nail with a trochanteric entry point.

The Purpose of presenting these cases is to decrease wound dissection and to provide secure fixation that will enhance ambulation and full weight bearing which in turn will make a more satisfactory post-operative period, thus a quicker return to pre-operative activities, and augment bone healing.

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Case One:

Male, age of 12, otherwise healthy, with traumatic subtrochanteric fracture of right femur. It was oblique, directly distal to the lesser trochanter, undisplaced with mild medial tilt of the distal fragment and lateral fracture gap of 1 cm. He underwent surgery the same day of injury and discharged the next day.

Case Two:

Male, age of 13, who presented with undisplaced pathological femur fracture in the proximal femur at the level of lesser trochanter extending to the subtrochanteric area through a unicameral bone cyst occupying a length of 8 cm. in the area. He was investigated with CT scan, MRI, bone scan and tissue pathology, all consistent with the diagnosis. The patient underwent surgery and discharged the next day.

Reconstruction TAN nail technique:

The patient was positioned supine with bump underneath the ipsilateral hip. With the assistance of fluoroscopy, the threaded guide pin was inserted through entry point at the tip of the greater trochanter avoiding the piriformis fossa. The usual pattern of reaming was completed; ball tip guide wire insertion to 1.5 cm proximal to the distal femoral growth plate and insertion of nail 1.5 mm less diameter than reaming was completed. Two reconstruction screws were inserted percutaneously through lateral upper thigh percutaneously under fluoroscopy guidance such that the screws were totally incased in the neck and not encroaching into the growth plate. Distal locking screws were then inserted under fluoroscopy.

Post Operative Course:

Post operative day one, joint motion and ambulation assisted by crutches with non weight bearing was begun. At two weeks patients are progressed to partial weight bearing with crutch assistance, then weight bearing as tolerated.

DISCUSSION:

Traditionally, most pediatric femur fractures have been treated with flexible IMN, cancellous screws or the DHS and plate. Each has a potential complication. Although flexible nails take less surgical time compared to compression plate,¹⁰ for example, they are less secure¹¹ and might result in post operative angulation at the fracture site.^{9,12,13} They allow early mobilization, yet they don't allow early full weight bearing.^{12,14} A rigid IMN is advocated for children over 8 years old^{7,15} and is generally encouraged in the adolescent age.¹⁶ Plate and screw fixation, although it is stable yet with weight bearing, the bending load is increased because it is far from the central axis of the femur, and it is less load sharing for withstanding cyclic loading and early weight bearing,¹⁷ the things that intramedullary nailing offer^{17,18} by its closeness to the center axis position. Sliding hip screws have higher failure rates¹⁷ than the use of trochanteric nail which has significantly lower reoperation rate than the plate device.²³

IMN have proven to have enhanced early mobilization, had less joint stiffness, decreased hospital stay,^{4,19} and been associated with less longitudinal overgrowth.⁸ Its use in adolescents has been limited due to the association with femoral head avascular necrosis. Several studies to address this complication has been completed. It is now well established that the major cause for AVN is the entrance point of the nail being through the piriformis fossa^{11,19-22} that interferes with the medial circumflex femoral artery, one of the main sources of blood supply to the head of femur in this age group. This complication was overcome by changing the entrance point to the lateral aspect of greater trochanter^{7,12,15,20,23} or tip of greater trochanter,^{18,24} with no clinical or radiographic changes including AVN, neck valgus or narrowing.^{15,25} Entry through the greater trochanter apophysis has been safe and has not led to recognizable complications, as even if growth arrest of trochanteric physis occurred after the age of 8 years, it shouldn't result in

significant slowing in trochanteric growth⁷ in spite of this noticeable epiphysiodesis.¹¹ The use of closed locked IMN had proved to be advantageous, safe and well tolerable when applied also to the adolescent age group.^{7,11,12,16,24.}

In regard to the control at fracture site itself it was showed that the use of two small screws (6.3 mm) in the neck was equal in rigidity and stability to the use of one large screw with the more advantages of better rotational control and less dissection.²⁶ It goes without saying that the neck screws are not to encroach into the growth plate of the femoral head and to be totally in the neck insured by fluoroscopy in all directions.

Applying these principles that have mostly been studied mostly in shaft fractures to subtrochanteric fractures has resulted in fewer incisions and tissue dissection, a more secure and load sharing device, a portal through the lateral aspect of the greater trochanter, improved satisfactory post-operative course, less hospital stay and earlier mobilization and weight bearing, we used the TAN nail through greater trochanteric entrance point, with 2 femoral neck reconstructive screws and distal locking.

TAN has decreased fluoroscopic time, decreased operative time especially in obese patients, and has similar advantages of conventional antigrade nail.²² In adolescents it solves the great issue of entrance point not to be through piriformis fossa thus giving this age group the chance to benefit from the advantages of IMN after sustaining a subtrochanteric femur fracture.

CONCLUSION:

It is possible to use the reconstructive TAN nail with two proximal 6.3mm and two 5.0 distal locking screws to treat adolescents' fractures of the subtrochanteric region of the femur. It spares the devastating complication of AVN of the femoral head and the possible postoperative angulation or rotational deformities at fracture site, it requires fewer incisions, provides better

patient tolerance, earlier motion to the full weight bearing, all of which contribute to a better outcome of the surgery and more convenient post operative course for the patient, the family, the physiotherapy and the treating surgeon.

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