Fixator-Assisted Femoral Lengthening After Intramedullary Exchange Nailing for Subtrochanteric Nonunion

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Summary: Nonunions in the femur can be a severely debilitating condition. When a nonunion results in significant shortening and leg length discrepancy, simple activities of daily living become extremely difficult and painful tasks. Here, we present a 36-year-old man who presented 3 years after a motor vehicle accident, complaining of severe left thigh pain and a short left lower extremity. Initially treated in Egypt with an intramedullary nail (IMN) and distal screws, workup revealed an aseptic subtrochanteric femoral nonunion with a leg length discrepancy of approximately 6.5 cm. The patient subsequently underwent exchange nailing with afixator placement and was lengthened over the nail. After achieving adequate length, the patient underwent a second exchange nail, which was complicated by IMN instability. Because of the IMN instability, the patient underwent a third exchange nail with blocking screws and finally healed. On final follow-up, the patient was pain free and no longer felt the leg length discrepancy, with an overall discrepancy of approximately 1.5 cm.

Key Words: subtrochanteric femur fracture, nonunion, femoral lengthening, rail fixator, intramedullary nail

INTRODUCTION

With contemporary fixation options, subtrochanteric nonunions of the femur are a rare occurrence. However, when they do occur, exchange nailing is often a popular and well-received first option. Although a systematic approach to treating an isolated aseptic nonunion may offer a reliable road to healing, coupling nonunion with concomitant leg length discrepancy exponentially increases the overall difficulty of the treatment regimen.

Here, we present a 36-year-old man presenting with both subtrochanteric femoral nonunion and concurrent leg length discrepancy. We outline our workup, our treatment regimen, rationale, and tips to avoid specific pitfalls encountered during the case. Informed consent was obtained from the patient.

CASE PRESENTATION

Our patient is a 36-year-old man who presented to our office complaining of debilitating left thigh pain and a short left lower extremity. He is a healthy, nondiabetic, nonsmoker without a significant medical history. Three years before presentation, he suffered a closed left subtrochanteric femur fracture after a high-energy motor vehicle accident. The patient was treated in Egypt with 20 cm laterally based open reduction and intramedullary nail (IMN) placement.

On initial presentation to our office, the patient was afebrile with stable vitals. In a wheelchair, the patient was able to ambulate short distances with a large shoe lift under the left lower extremity. Physical examination was notable for a large, nonerythematous, dry, healed wound over the left lateral thigh measuring approximately 20 cm in length. The patient reported pain. Radiographs revealed a subtrochanteric femoral nonunion and a left femur that was approximately 6.5 cm shorter than the contralateral side (Figs. 1A–C).

DIAGNOSTIC FOCUS—SURGICAL MANAGEMENT

Infection workup, including ESR, CRP, WBC, and nuclear studies, as well as a nonunion site biopsy, was negative. The goals were limb lengthening, promoting healing, and alleviating instability/pain. Initially, a narrow diameter IMN was placed with a monolateral external fixator to allow for distraction (Figs. 2A–C).
After 7 months of lengthening over an exchanged IMN, scant regenerate was exhibited even after cycling of compression/distraction. The patient had a sensation of equal leg lengths although scanogram revealed a >1 cm remaining discrepancy. The patient did not suffer known complications of femoral lengthening (ie, patella subluxation, hip subluxation, significant knee motion restriction, etc.). Thus, it was determined to discontinue further distraction. Exchange IMN with application of harvested intramedullary autograft (harvested with the reamer–irrigator–aspirator; Depuy Synthes, West Chester, PA) and bone marrow aspirate concentrate from the pelvis was performed. The application of a medial Poller screw in the proximal fragment allowed for acceptable alignment although the original capacious entry point was lateral to the tip of the greater trochanter (Figs. 3A–C).

**FOLLOW-UP OUTCOMES**

Five months after the exchange nail, the patient reported improved but continued pain. Radiographs revealed signs of instability with lateralization of the nail in the distal fragment (Fig. 4). Thus, the patient underwent a repeated exchange nail with placement of a lateral Poller screw in the distal fragment. As well, a nail with an intended starting point that mimicked his original starting point had been released and used in the final

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**FIGURE 1.** A–C, A 36-year-old man presenting to our office with radiographs exhibiting femoral nonunion with a limb length discrepancy of approximately 6.5 cm.

**FIGURE 2.** A–C, After a negative infection workup that included blood work, nuclear studies, and an open biopsy, the patient underwent exchange IMN, bone grafting, and placement of a monolateral fixator.
Nearly 5 years from his original injury, 2 years from his index procedure, and approximately 1 year after the last exchange nail, the patient reported that he was pain free, back to work, healed, and pleased with his overall length alignment and rotation (Figs. 5A, B).

**DISCUSSION**

Even in an intact femur, and when planning to lengthen over an IMN, advantages and disadvantages exist in choosing a specific osteotomy site. Choosing the subtrochanteric region of the femur has its advantages, especially because of its vascular network and potential to heal. However, the disadvantages that are innate to this anatomic region are the deforming forces causing persistent varus and procurvatum to the proximal fragment. These are the same deforming forces that occur during the proximal fragment in an acute subtrochanteric femur fracture, making anatomic reduction notoriously difficult to achieve and before a better understanding and implant technology, lead to high nonunion rates and unacceptable clinical outcomes.

Control of the proximal fragment, whether in an acute fracture or in a nonunion setting such as ours, is the most important factor in achieving appropriate fixation and stability to promote union. Haidukewych and Berry emphasized the importance of fixation into the femoral head and neck to achieve maximum control. Even in the setting of nonunion, they were able to get excellent union rates by using cephalomedullary IMNs. This was the rationale behind our second exchange IMN, which used a trochanteric entry IMN with crossing proximal locking screws, noted to have superior biomechanical properties when compared with a parallel configuration. Furthermore, attempting to control the proximal fragment and achieve acceptable alignment, the placement of the medial Poller screw was an effort to prevent varus deformity of the

**FIGURE 3.** A–C, After 7 months of lengthening, scant regenerate was seen on radiographs. However, despite a limb length discrepancy of over 1 cm (A), the patient felt clinically even, thus distraction was discontinued. Because of the scant regenerate, repeat exchange IMN was performed with autograft and placement of a medial Poller screw (arrow) to aid in achieving acceptable alignment, despite the capacious lateralized start point in the index procedure (B–C).

**FIGURE 4.** Five months after exchange nail, with improved but persistent pain, radiographs revealed instability exhibited by distal lateralization of the IMN (arrow).
proximal fragment and counteract the large lateral start point used in the index procedure. However, an unbalanced construct was created with too rigid fixation proximally and relatively weaker distal fragment fixation. By ignoring the distal fragment and not accounting for an overpowering proximal valgus force, lateralization of the IMN occurred distally. Furthermore, with a slightly medial start point for the trochanteric entry nail, inherent valgus was built into this construct. Thus, on revision and the final exchange nail, a more balanced construct was placed with a proximal parallel screw configuration (enough to prevent varus cutout) coupled with distal locking screws and a lateral Poller screw to prevent recurrent valgus deformity. The final nail was also a lateral trochanteric entry nail, which by design avoids varus deformity (for our case using the original start point), but for this case, also avoided undesired valgus, which caused prior instability.

CONCLUSIONS

Applying the basic principles of both nonunion repair and lengthening concurrently can lead to a good clinical result. However, one must take into account the importance of achieving proximal fixation into the head neck junction to counteract the deforming forces inherent to the subtrochanteric region but without ignoring the distal fragment. One should be cognizant of the nail type, the starting point, and the subsequent deformity that can be caused by each. Poller screws placed medial to the nail proximally and lateral to the nail distally can also aid in avoiding instability and maintaining proper alignment. Finally, clinical success is achieved not only by evaluating radiographic evidence of healing but more importantly with the patient’s shared decision making, which in this case, led to clinical success despite a residual 1.5 cm discrepancy.

REFERENCES


FIGURE 5. A–B, Repeat exchange nailing used a newer IMN design that took advantage of the original lateralized start point used at the index surgery. Cephalomedullary fixation with a distally placed lateral Poller screw (arrow) aided in maintaining alignment and appropriate stability until final follow-up (A–B).