Unstable intertrochanteric fractures: lessons learned from a clinical study of the trochanteric femoral nail.

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Trochanteric femoral nail

**Introduction** Unstable intertrochanteric hip fractures can be difficult surgical challenges. Screw and side plate devices reliably stabilize stable fracture patterns [1,2], but unstable fractures require a mechanically optimized device and better implant purchase in the femoral head. These fractures have been more prone to implant failure with standard devices [3,4]. The trochanteric femoral nail (TFN) is a helical blade device which has fins that compact the cancellous bone as it is inserted into bone and may provide improved fracture stabilization characteristics [5,6]. A retrospective study of 273 patients with intertrochanteric hip fractures who were treated with a TFN was conducted at two institutions between 2001 and 2005. Patients underwent closed fracture reduction using traction and manipulation techniques. When the reduction was unacceptable as determined by the surgeon, adjunctive percutaneous reduction techniques were utilized. Implants were placed percutaneously, and compression of the fracture was performed in the majority of fractures. Precise measurement of movement of the blade within the femoral head and the nail was performed on all radiographs according to a previously described technique ([Fig 1]) [6]. The amount of telescoping was then measured as the lateral prominence of the blade lateral to the edge of the nail. X-ray measurements were made immediately postoperatively, at six weeks postoperatively, and at subsequent follow-up.

**Notable findings**
- The average blade tip migration was 2 mm. In a multivariate regression, fracture stability, calcar reduction achieved, age, and gender showed no correlation to blade migration. This implies that the strong purchase of the blade in the cancellous bone of the femoral head may be able to overcome imperfect reductions of the posteromedial cortex and provides adequate stability in elderly patients.
- The length of the nail was also not related to blade tip migration.
- Increased telescoping in unstable fractures was controlled and limited, maintaining abductor tendon length, but did not predict subsequent cut out or additional blade migration in the femoral head. Less telescoping also occurred with a greater initial lateral blade prominence (as a result of initial fracture impaction).
- After the six-week follow-up, minimal additional blade migration and telescoping occurred, indicating these movements resulted in fracture settling in a stable position.
- Blade penetration through the subchondral bone occurred in some unstable fracture patterns and could be attributed to technical error, including varus neck-shaft angle, superior blade placement in the femoral head, or distraction at the fracture site.

![Fig 1](image1.png) A coordinate system, based on the center of the femoral head, was used to calculate the change in position of the implant over time. Measurements were corrected for rotation and magnification.
• Four of the five mechanical complications were among the initial 50 cases performed. Subsequently, focus was shifted to technical aspects of reduction techniques. Blade placement is strictly in the central or slightly inferior region of the femoral head, and meticulous direct and indirect percutaneous reduction techniques were performed consistently to optimize reduction (Fig 2). The compression wheel was invariably used to reduce the fracture, impact the fracture surfaces and ensure immediate fracture stability (Fig 3).
• Basilar femoral neck fractures are best treated with alternative devices, such as screw and side plate devices.
• Catastrophic “reverse migration” phenomenon of the blade can occur with this device. This phenomenon has been previously as the Z-effect [7–9]. The biomechanical environment and fracture variables which predispose to reverse migration movement are unclear and are currently under investigation.

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Conclusion The TFN, which utilizes a helical blade device in lieu of a hip screw, appears to provide adequate mechanical stability for intertrochanteric hip fractures [10]. It is important to achieve the best reduction possible to enhance postoperative stability and minimize complications as well as assure that surgical implantation of the device is correct.

Bibliography