

MECHANICAL FAILURE OF A GAMMA NAIL IN A PATIENT WITH AN IMPENDING PATHOLOGIC SUBTROCHANTERIC FRACTURE

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Mechanical failure of a Gamma nail (Howmedica, Guelph, Ont.) is a rare complication of treatment for subtrochanteric femoral fractures, having been reported only once.¹ We report on a patient having a rare form of osteomalacia who had fixation of an impending pathologic subtrochanteric fracture with a Gamma nail.

CASE REPORT

A 45-year-old woman presented with a history of a pathologic right subtrochanteric femoral fracture 18 months earlier. The fracture had been fixed with a sliding pin and plate. Mechanical failure of the plate had necessitated revision surgery, which eventually resulted in successful union. A diagnosis of osteomalacia was made and she was referred for an open bone biopsy of her iliac crest to determine the etiology of her condition.

Her medical history included intermittent thoracic back pain with evidence of old compression fractures involving the T5 to T10 vertebrae (thought to be due to her metabolic bone disease). She had undergone a craniotomy 20 years earlier for an aneurysm. Recent radiographs showed that the bone flap had not healed. Her daughter had experienced bony nonunion following 2 simple closed fractures.

At the time of initial presentation to our clinic, her radiographs showed a lytic defect of the lateral cortex of the left femur with

surrounding sclerosis at a level just below the lesser trochanter similar to a "pseudo-fracture"² seen in osteomalacia. Over the next 2 months, her left hip pain worsened and she stated that her left hip "feels just like my right one did before it broke." On the basis of her worsening pain and the previous problems with her right hip, prophylactic fixation of the fracture was advised (Fig. 1).

Preoperative laboratory findings were all within normal limits. Her serum calcium, phosphorus, alkaline phosphatase and vitamin D levels were all normal. There was no detectable abnormality of her calcium and phosphorus metabolism. The report from her iliac crest bone biopsy was in keeping with the diagnosis of osteomalacia, with an increased osteoid thickness of 21 μ m and diffuse uptake of tetracycline. Pseudohypophosphatasia, a rare form of osteomalacia, was diagnosed in both the patient and her daughter. In this form of hypophosphatasia, the serum alkaline phosphatase levels are normal.

Because of the problems encountered with pin-plate fixation of her right hip, intramedullary nailing of the pathologic fracture with a 12-mm Gamma nail with a 125° angle was used. The procedure was complicated by a long oblique split in the lateral femoral cortex, beginning at the inferior margin of the lesser trochanter, exiting the cortex just above the more proximal locking screw. We thought that the iatrogenic fracture was adequately stabilized by the Gamma nail (Fig. 2).

Her postoperative course was complicated by a proximal deep venous thrombosis requiring anticoagulant therapy. Although initially her pain subsided, 10 months postoperatively her pain suddenly became worse. Radiographs revealed failure of the nail and collapse of the fracture (Fig. 3). She was admitted for revision of her fixation. The Gamma nail was removed. The proximal portion was removed easily. However, to remove the dis-



FIG. 1. A subtrochanteric stress fracture of the lateral cortex of the left femur. The femoral neck-shaft angle is approximately 120°.

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FIG. 2. Immediate postoperative view of the left femur after insertion of the Gamma nail. There is an iatrogenic oblique fracture of the femur below the lag screw and above the locking screws.

tal nail fragment, the fracture site had to be opened and a pair of sturdy vise grips used to grasp the fragment and deliver it from the intramedullary canal. A long, 95° blade plate was inserted using the plate-



FIG. 3. A new transverse fracture of the left proximal femur can be seen. The angulation between the proximal and distal portions of the implant illustrates failure of the Gamma nail.

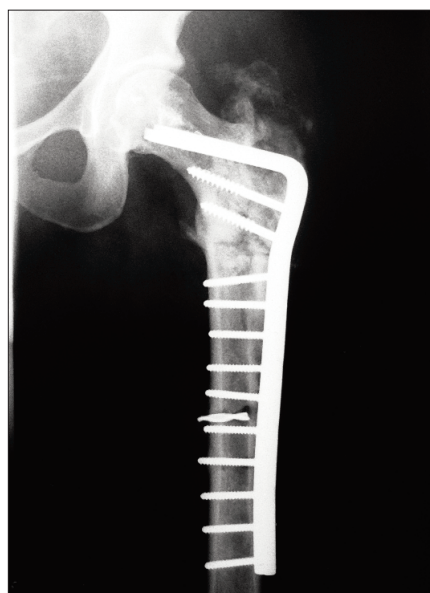


FIG. 4. The most recent view of the patient's left proximal femur after valgus osteotomy, autologous bone grafting of the fracture and insertion of a long, 95° blade plate. The fracture has healed.



FIG. 5. Failure of the Gamma nail at the junction of the lag screw and the intramedullary portion of the nail.

tensioning device to provide compression at the fracture site. A 20° proximal femoral valgus osteotomy was performed and autologous bone graft from her iliac crest was placed in the fracture site (Fig. 4).

At follow-up 3 years postoperatively she had no complaints of hip pain and radiographs showed that her fracture had united. She walked without aids.

DISCUSSION

Many have advocated the preferential use of the Gamma nail for subtrochanteric fractures.³⁻⁷ Indeed, its main advantage over pin-plate constructs lies in its application for subtrochanteric and unstable (reverse obliquity) femoral fractures. The nail provides better stress transmission by bridging the fracture site. Biomechanical studies have shown that the nail unloads both the medial and the lateral cortices in unstable subtrochanteric fractures. The pin-plate implants unload the medial but not the lateral cortex.⁸ In unstable fractures, both distal locking screws are required to ensure rotational control and provide mechanical stability. The intramedullary position of the nail is more medial than the plate (which is affixed to the lateral cortex), thereby decreasing the lever arm and thus the force moment at the sliding screw-implant interface.

Numerous prospective trials have compared the Gamma nail to standard (pin-plate) fixation for hip fractures.^{3,4,7} Although most show no clinically significant differences between the two methods, there are some complications specific to the Gamma nail. Fracture of the femur either around or beneath the nail is the commonest complication. The likelihood of fracture during insertion of the nail is affected by the difference in medial-lateral angle between the nail and the average proximal femur (12°).⁹⁻¹³ It seems likely that both the abnormal proximal femoral architecture (femoral neck-shaft angle of 120°) and the intrinsic abnormality of bone quality due to metabolic bone disease was a contributing factor to the iatrogenic fracture seen in our patient.

Although we are aware of other similar cases, the literature yielded only one other case in which a Gamma nail failed in a similar manner. Zafiropoulos and Pratt¹ reported Gamma nail fracture at the insertion point of a lag screw into the

intramedullary portion of the nail. In their paper, revision to another nail resulted in a fracture of the second nail in exactly the same location as the first. They eventually revised the nail to a pin-plate construct, adding bone graft to the fracture site and performing a valgus osteotomy of the proximal femur. This approach did result in successful union of the fracture.

Zafiropoulos and Pratt¹ offered several hypotheses for failure of the Gamma nail. Several voids in the nail were identified on scanning electron microscopy. These would weaken the implant. Scanning electron microscopy also identified troughs in the fracture surface of the implant suggestive of a ductile-type failure (as opposed to fatigue failure). The first nail had distracted the fracture site and therefore the cortices were not providing any additional support. Unfortunately, even when the fracture site was compressed during the second nail insertion, the implant still failed eventually.

We did not examine our nail with scanning electron microscopy, so we cannot comment on the microstructure of the nail. We concur with Zafiropoulos and Pratt that our nail failed at its weakest part; namely the lag screw-implant interface where the nail is 73% thinner¹ (Fig. 5). The patient described by Zafiropoulos and Pratt also had a varus deformity of her femoral neck, and it is possible that the varus angulation was responsible for failure of the nail.

A newer design of the Gamma nail, the long Gamma nail, with a full length in-

tramedullary section,¹⁴ is now available for use. Although it may decrease the incidence of periprosthetic fracture, the proximal section of the nail is identical to the implant we used. Thus, theoretically, it presents a similar risk for mechanical failure as the implant we used.

There is no single implant that is ideal for subtrochanteric fractures. Treatment options must be carefully explored and planned preoperatively. The Gamma nail is susceptible to failure at its weakest point, the lag screw-implant interface. It should be used with caution when prolonged healing is expected.

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