

MECHANICAL FAILURE OF THE LONG GAMMA NAIL IN TWO PROXIMAL FEMUR FRACTURES

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ABSTRACT

Mechanical failure of the long gamma nail was encountered in two elderly patients with proximal femur fractures over a 6-month period. One of the patients had a known history of lymphoma. The other patient had a history of rheumatoid arthritis but no history of cancer or other metabolic bone disease. Both nails failed at the junction of the compression screw and the nail. The angle of failure of the nail was the same in both cases. The index of suspicion for imminent mechanical failure of the gamma nail should be higher in pathologic fractures and fractures which are malreduced during nailing.

INTRODUCTION

With an increase in the life span of the general population, a significant rise in the number of fractures of the proximal femur has occurred.¹ The gamma nail has been used in treatment of traumatic and pathologic peritrochanteric femur fractures throughout the world since its development in 1985. Prior to this report, ten cases of mechanical failure of the gamma nail in nine patients have been reported in the English literature.¹⁻⁵ We present two cases of mechanical failure of the long gamma nail.

CASE SUMMARY

Case 1

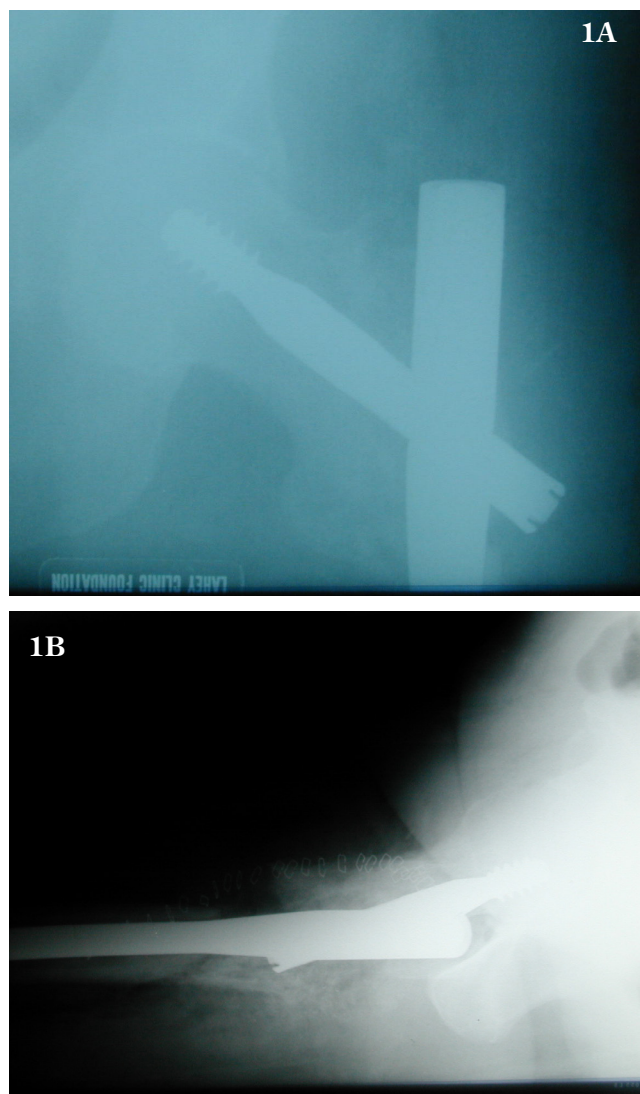
78-year-old female with diagnosis of non-Hodgkin's lymphoma with involvement of the liver, spleen, retroperitoneum, and left proximal femur, sustained a patho-

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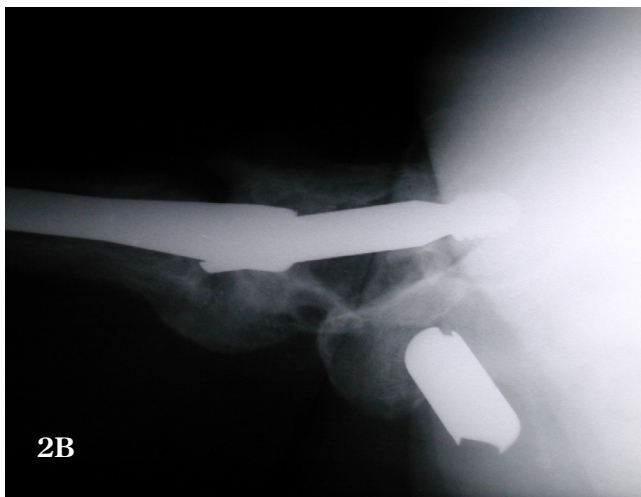
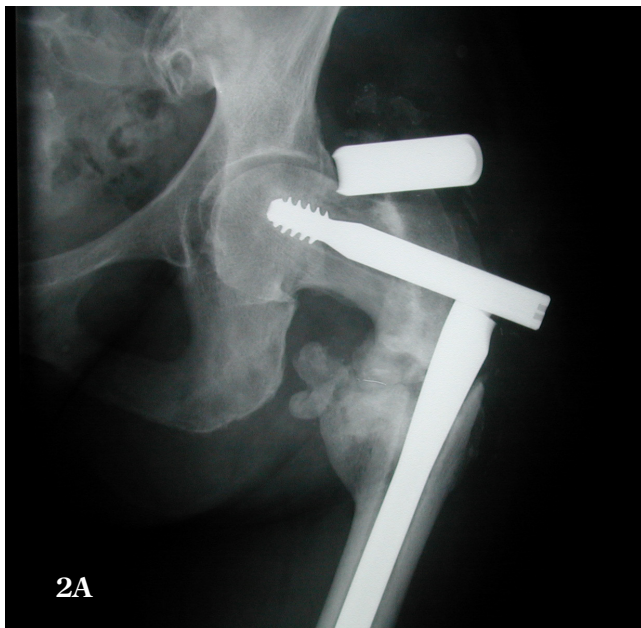
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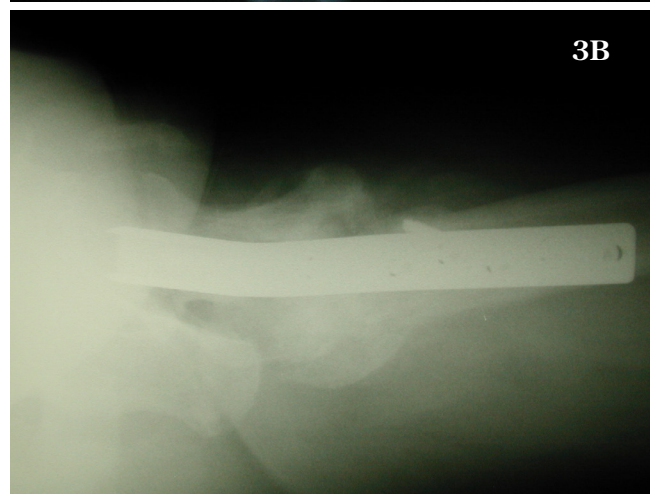
Figures 1A, B. 78 year old female treated for pathologic left subtrochanteric femur fracture with a long gamma nail.

logic subtrochanteric fracture of the left femur. She underwent fixation with a long gamma nail by another surgeon at a different institution than the author (Figures 1A, B). The reduction of the fracture intra-operatively was noted to be difficult secondary to severe comminution. A 135-degree, 340 mm nail and a 95 mm lag screw were used. The nail was locked distally with two distal locking screws and the set screw and cap screw were



Figures 2A, B. Mechanical failure of the long gamma nail at thirteen months post op.

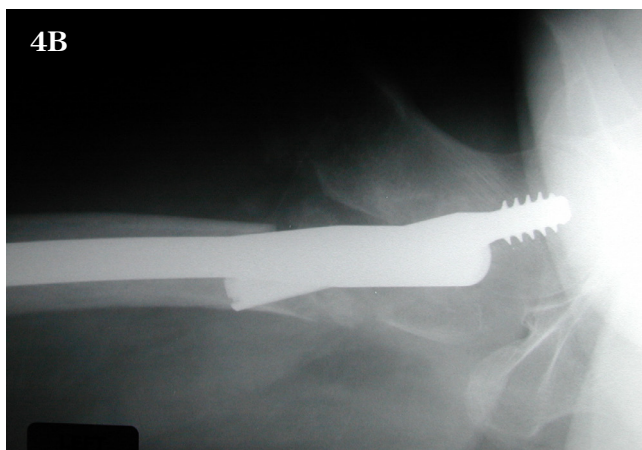
used in the proximal portion of the nail. The estimated blood loss was 1300 milliliters. The patient received four units of PRBC's intraoperatively. The patient's weight bearing status was increased gradually over the next several weeks to as tolerated. Thirteen months after implantation of the long gamma nail, the patient had severe left hip pain and was unable to ambulate. Radiographs obtained showed mechanical failure of the gamma nail (Figures 2A, B). Revision open reduction and internal fixation with a 95 degree blade plate was performed (Figure 3). Twelve months after revision ORIF, 25 months after the index procedure, the patient is weight bearing as tolerated with a cane and the fracture shows radiographic signs of healing.



Figures 3A, B. Radiographs demonstrating revision open reduction and internal fixation with a 95 degree blade plate.

Case 2

76-year-old female with a history of severe end stage rheumatoid arthritis, sustained a subtrochanteric fracture of the left femur as a result of a fall. She underwent fixation of the fracture with a long gamma nail by another surgeon at a different institution than the author (Figures 4A, B). A 130-degree, 340 mm nail and a 95



Figures 4A, B. 76 year old female who sustained a left subtrochanteric femur fracture after a fall that was treated with a long gamma nail.

mm lag screw were used. The nail was locked distally with a single distal locking screw in the more proximal locking hole with a 6.26 x 30 mm screw. The set screw was placed in and tightened to lock the lag screw within the nail. The estimated blood loss was 500 milliliters. No blood products were transfused intraoperatively.

The patient's weight bearing status was increased slowly from non-weight bearing to weight bearing as



Figure 5. Radiographs of the left hip showing mechanical failure of the gamma nail at ten months post op.

tolerated over the following 4 months. She was able to ambulate with a walker without pain until 10 months from the index procedure. The patient reported increasing pain in the left thigh and hip over a five-day period without a preceding traumatic event or fall. Ten months post operatively, she was unable to bear weight. Radiographs of the left hip showed mechanical failure of the Gamma nail (Figure 5). Revision open reduction and internal fixation with a dynamic compression screw and autologus bone grafting was performed. Her weight bearing status was increased gradually to as tolerated. Four months from the revision ORIF, fourteen months from the index surgery, the patient was again unable to bear weight and had increasing pain in the left hip. Radiographs of the left hip revealed mechanical failure of the DCS plate (Figure 6). The patient underwent revision of ORIF with a DCS and anterior plate, and bone graft fourteen months from the index surgery (Figure 7). On follow up, five and half months from revision ORIF, nineteen and half months from the index surgery, the weight bearing was advanced to as tolerated and radiographic exam revealed healing at the fracture site.

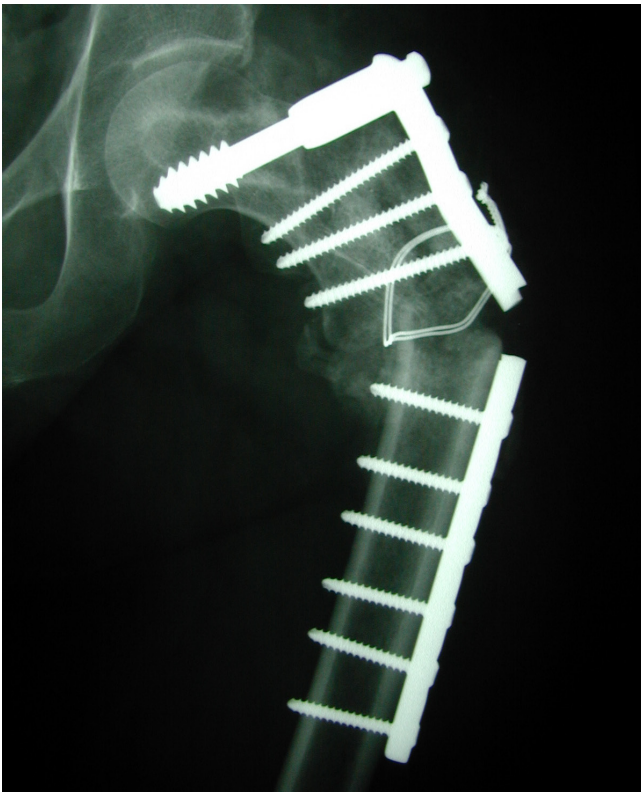


Figure 6. Radiographs demonstrating mechanical failure of the DCS plate.

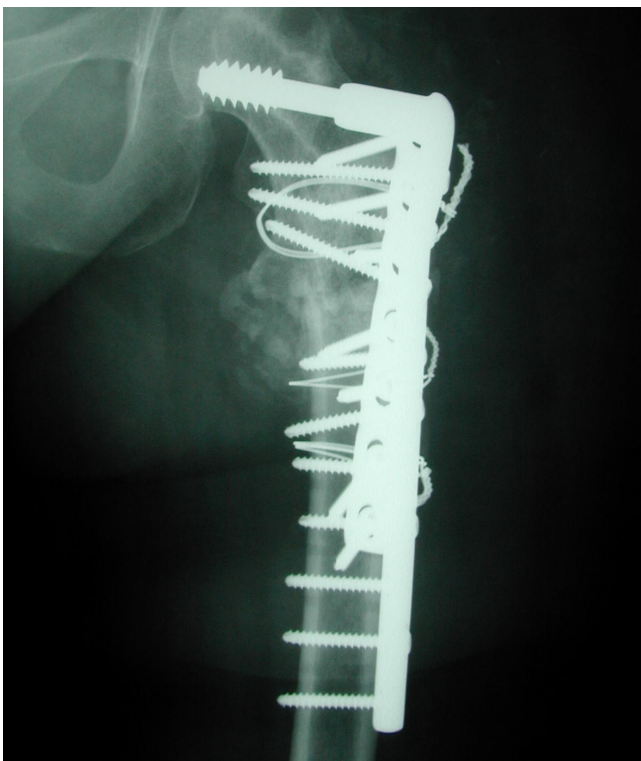


Figure 7. Radiograph demonstrating revision ORIF with a DCS and anterior plate with bone grafting.



Figure 8. Two long gamma nails after removal demonstrating an identical obliquity and location of mechanical failure.

Figure 8 shows the two long gamma nails which were removed. The angle, obliquity and location of the mechanical failure in both nails is identical.

DISCUSSION

The gamma nail combines the sliding feature of a hip screw with the load sharing properties of an intramedullary nail. This combination allows for 25 to 30% reduction in the bending stress on the nail as compared to extramedullary devices.^{6,7} This would theoretically reduce the implant failure rate for the gamma nail as compared with the extramedullary devices, and indeed the very low rate of mechanical failure of gamma nail attests to this.

The gamma nail and other third generation cephalomedullary nails are used in treatment of unstable

TABLE 1

Author	Disease	Fracture	Nail	Failure time	Failure location	Salvage procedure
Zafiroopoulos One Case	none	subtrochanteric	Short Short	4 months * 10 months	screw-nail junction screw-nail junction	Exchange Gamma Nail Richards Plate
Van den Brink Four cases						
Case 1	Breast Carcinoma	Subtrochanteric	Short	14 months	screw-nail junction	Exchange Gamma Nail
Case 2	None	Subtrochanteric	Short	15 months *	screw-nail junction	95 Degree Blade plate
Case 3	Breast Carcinoma	Subtrochanteric	Short	6 months	screw-nail junction	Exchange Gamma Nail
Case 4	None	Subtrochanteric	Short	7 months*	screw-nail junction	none
Randle One Case	Metabolic Bone Disease	Subtrochanteric	Short	10 months	screw-nail junction	95 Degree Blade plate
Valverde	N/A	N/A	Short	N/A	Screw-Nail Junction	N/A
Van Doorn Two Cases						
Case 1	Metastasis	N/A	Long	7 months	Screw-Nail junction	Exchange Gamma nail
Case 2	Renal Carcinoma	femoral shaft	Long	9 months	Middle of the nail	Exchange gamma nail
Present report						
Case 1	Lymphoma	Subtrochanteric	Long	13 months	Screw-nail junction	95-degree Blade plate
Case 2	None	Subtrochanteric	Long	10 months*	Screw-nail junction	DCS plate

* The fracture was distracted, i.e., no cortical contact after nailing, which led to eventual mechanical failure of the nail.

proximal femur fractures, including subtrochanteric and reverse oblique intertrochanteric femur fractures. These cephalomedullary nails allow load sharing by the medial and lateral cortex, and decreases the moment arm at the sliding screw. As with any implant these nails have complications, and once implanted, is subject to the same race between fracture union and implant failure. Including the two cases in this report, we were able to find 10 other cases of gamma nail mechanical failure in the English literature. This attests to the high rate of success with this implant in achieving union in peritrochanteric fractures. The first case of gamma nail mechanical failure was reported by Zafiroopoulos et al.². This nail was a short gamma nail, which had distracted the fracture site. The cortices were not in contact and hence were not load sharing. This nail fractured at the lag screw-nail interface where the nail is 73% thinner. However, after revision of the fractured nail and compression of the fracture site, the second nail eventually failed at the same location as the first nail.

Including the two cases presented in this report, there are a total of 12 gamma nail failures in eleven patients

in the English literature (Table 1). Of these, eight are short and four are long gamma nails. Five patients out of eleven had metastatic disease; one had metabolic bone disease. Four patients (five nails) had no documented metastatic or metabolic bone disease. Of these five nails, four had distraction at the fracture site. The mean time to failure for the long and short gamma nails was 9.5 ± 3.4 months (n=11). The mean time to failure for the long gamma nail was 9.8 ± 2.5 months (n=4), and for the short gamma nail was 9.4 ± 4.1 months (n=7). Eleven of the twelve nails failed at the hip screw-nail junction. The symptoms were increasing pain with weight bearing in the effected hip four to five days prior to inability to ambulate.

Metabolic bone disease, metastatic disease, and mal-reduction of the fracture with distraction of the fracture site are risk factors for non-union and eventual failure of the implant. Presence of any of these factors should alert the surgeon to possibility of implant failure. Our review of the literature shows that 10 of 12 failures occurred at or after 6 months subsequent to implantation of the gamma nail. None of the four long gamma nails

failed before six months. The average time to failure for the long gamma nail was 9.8 ± 2.5 months. Follow up with radiographic and physical examination in the first six months in the post operative period is necessary to evaluate the process of fracture healing in peritrochanteric fractures treated with the gamma nail. Hence, if there is little or no radiographic evidence of healing at the fracture site six months postoperatively, the surgeon may consider changing the weight bearing status to non-weight bearing and plan for exchange nailing of the gamma nail to avoid fatigue failure of the nail.

In our hands, a third generation cephalomedullary nail is the implant of choice in treatment of unstable proximal femur fractures and impending pathologic fractures as a result of metastatic disease afflicting the proximal femur. Van den Brink et al³ reported a 0.16% mechanical failure rate of the gamma nail. This rate of mechanical failure of the gamma nail is lower than that of extramedullary devices. However rare, mechanical failure is a possible complication of the gamma nail especially in pathologic or impending fractures and distracted or malreduced fractures. It is incumbent upon the surgeon to have a high index of suspicion to evaluate the patient and recognize this complication.

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