

Management of gamma nail breakage with bipolar hemi-arthroplasty

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ABSTRACT

Gamma nail breakage is an uncommon occurrence that often arises from fatigue failure of the implant, with a reported incidence ranging from 0.2 to 5.7 percent. We report a 73-year-old woman with a three-part intertrochanteric fracture and who presented two years postoperatively with gamma nail failure secondary to fracture non-union. This patient underwent a revision long-stem bipolar hemi-arthroplasty and has been followed-up for 24 months, with good functional and radiological results.

Keywords: bipolar hemi-arthroplasty, gamma nail, hip implant, implant failure, intertrochanteric fracture

Singapore Med J 2009;50(1):e44-e47

INTRODUCTION

Intertrochanteric fractures are common in the elderly population, and usually occur as a result of pre-existing osteoporosis and minor trauma. In patients with optimal physiological status, operative treatment facilitates early rehabilitation with an improved quality of life and function.⁽¹⁾ Surgical treatment depends on the fracture configuration and typically consists of either the use of a dynamic hip screw or a condylar blade plate. The gamma nail was designed for the management of unstable intertrochanteric fractures, in particular the reverse oblique type, as well as for the fixation of subtrochanteric fractures.⁽²⁻⁴⁾

The gamma nail combines the biomechanical advantages of a sliding hip screw with those of an intramedullary nail. It is usually positioned within the femoral anatomical axis and is thus nearer to the weight-bearing axis, resulting in a decreased lever arm; when compared to extramedullary devices, there is up to a 30% reduction in bending stresses.^(5,6) The cephalic lag screw functions similarly to a dynamic hip screw by allowing controlled impaction of the fracture. The use of such an intramedullary fixation device for intertrochanteric fractures offers many advantages – stable fixation thereby permitting early postoperative mobilisation, minimal intraoperative blood loss (due to the minimally invasive method) and preservation of the periosteum,



Fig. 1 (a) Radiograph shows a left intertrochanteric hip fracture with subtrochanteric extension. (b) Radiographs show primary internal fixation with a gamma nail.

which facilitates bony union.^(2,6) Disadvantages reported with this technique include: implant failure, usually as a result of fracture non-union (proximal cervical lag screw); iatrogenic diaphyseal fractures resulting from excessive reaming or using an inappropriately-sized nail; and diaphyseal fractures at the distal locking screw-hole site related to the use of large diameter drills.⁽⁵⁻⁷⁾ In addition, the disadvantages of fat embolism and endosteal blood supply disruption associated with all intramedullary techniques of fixation also apply to this technique.

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Fig. 2 Radiograph shows gamma nail breakage two years after initial surgery, with breakage at proximal cervical screw and distal interlocking screw.

The authors present a patient who was previously treated for an intertrochanteric fracture using a gamma nail. She presented with the uncommon complication of gamma nail breakage at the cephalic screw-hole junction and was subsequently treated using a bipolar hemi-arthroplasty. To the authors' knowledge, the use of a long-stem bipolar hemi-arthroplasty as salvage surgery in cases of broken gamma nails has not been reported in the literature.

CASE REPORT

A 73-year-old Chinese woman, who had no significant past medical history, sustained a left hip fracture following a fall from a standing height. Radiographs revealed a left three-part intertrochanteric hip fracture with subtrochanteric extension (Fig. 1a). Fracture stabilisation was done using a gamma nail, and she was started on immediate weight-bearing ambulation. Although her initial postoperative follow-up was uneventful, radiographs done at three months following the index procedure revealed fracture non-union with a broken distal interlocking screw (Fig. 1b). She denied having hip pain and declined any surgical intervention to address the fracture non-union.

She defaulted follow-up, and was admitted to our institution approximately two years after the index surgery for acute onset of left hip pain. This was associated with an inability to weight-bear. The patient did not have any recent history of a fall or trauma. Radiographs of the left hip showed persistent non-union of the old intertrochanteric fracture, compounded by gamma nail breakage at the cephalic lag screw-hole site (Fig. 2). Both clinical history and radiographical review did not reveal any feature of acetabular degenerative disease. The patient was offered the choice between fracture re-fixation with bone graft augmentation and the



Fig. 3 Postoperative radiograph taken after removal of the gamma nail shows bipolar hemi-arthroplasty, with cable plate fixation of anterior femoral cortical perforation.

option of bipolar arthroplasty; she opted for the latter.

Due to the persistence of fracture non-union, a trans-trochanteric approach was favoured. Intraoperatively, the proximal segment of the broken gamma nail and the cephalic lag screw were found within a "false bursa" anterior to the gluteus medius. Although the head of the distal interlocking screw was removed with ease, the tip was embedded in the hypertrophied medial cortex of the femur and was thus left *in situ*. The acetabulum was found to be relatively pristine with no features of degenerative arthritis. Following removal of the broken gamma nail, the trochanter was stabilised to the femoral diaphysis using a trochanteric claw-plate construct (Cable-ready, Zimmer, Warsaw, USA). The screw-holes at the distal lateral femoral cortex and in the greater trochanter were bone grafted to improve periprosthetic stress distribution and also to prevent cement extrusion during femoral stem implantation.⁽⁸⁾ Following femoral preparation, a long-stem bipolar prosthesis was cemented using tobramycin-impregnated cement. However, the authors noted a small anterior diaphyseal perforation intraoperatively related to the use of straight femoral reamers, despite its blunt tip. Although the femur diaphysis was stable, the decision was made to augment it using a second cable-ready trochanteric plate system to facilitate early rehabilitation.

The duration of surgery was approximately 121 minutes. The total intraoperative blood loss was less than 500 ml. Subcutaneous low-molecular weight heparin and thromboembolic deterrent stockings were used until the patient was ambulating well. She was permitted partial weight-bearing from the second postoperative day, and full weight-bearing after the sixth week. Clinical examination at subsequent outpatient clinic visits showed excellent recovery of function, with a good range of flexion (0°–110°), abduction (0°–50°)

Table I. Review of the literature.

	Alvarez et al ⁽²⁾	Gaebler et al ⁽³⁾	Valverde et al ⁽⁶⁾	Pervez and Parker ⁽⁵⁾	Sehat et al ⁽⁴⁾	Docquier et al ⁽⁷⁾
Type of study	Retrospective, 843 cases; 1990–2002	Retrospective, 839 cases; 1992–1996	Retrospective, 224 cases	Prospective, 35 cases	Retrospective, 100 cases 1993–2002	Retrospective, 439 cases
No. of broken nails	5 broken gamma nails (0.6%)	2 broken gamma nails (0.3%)	1 broken gamma nail (0.4%)	2 broken nails (5.7%)	1 broken gamma nail (1.0%)	1 broken gamma nail (0.2%)
Site of breakage	2 proximal cervical screw opening; 1 distal locking screw; 1 proximal cervical screw opening and at the opening for the distal screw; 1 midshaft.	Both broke at the aperture for the distal screw.	Proximal cervical screw opening.	1 along the shaft; the other was not described in the report.	Along the shaft.	Site not described in the report.
Cause of implant failure	Non-union in all 5 cases.	1 occurred due to direct trauma sustained in a fall; the other was due to non-union.	Cause not described in the report.	Delayed union in both cases.	Due to incomplete fracture reduction.	Delayed union.
Treatment	3 cases treated with long gamma nails; 1 treated with a Kuntscher IM nail; 1 patient treated with total hip arthroplasty.	First case was treated with long gamma nail; Second case dynamised, but then treated with a long gamma nail due to non-union.	Treatment not described in the report.	Both cases treated with long gamma nails.	Treated with long gamma nail.	Treated with long gamma nail.

and external rotation (0°–35°). Interval radiographs showed good implant alignment and no evidence of loosening at 24 months postsalvage surgery (Fig. 3). She is currently ambulating with the use of a walking stick, and has returned to independent activities of daily living.

DISCUSSION

Gamma nail breakages are rare occurrences, with reported incidences of 0.2%–5.7%.⁽²⁻⁷⁾ Gamma nail breakage can be classified according to the site of occurrence, viz. (a) cervical lag screw-hole; (b) nail shaft; (c) distal screw-hole; and (d) distal locking screw. The commonest cause is metal fatigue secondary to delayed union or malunion of the fracture, particularly at the point of insertion of the proximal lag screw, where the cross-sectional diameter of the gamma nail narrows by 73%.^(2,3,9) This is the critical region where the forces from the femoral neck are transmitted to the nail in the diaphysis.^(2,9) The other weak point of the implant is at the aperture for the distal locking screw, where the nail diameter is reduced.⁽²⁾ In the patient described in this case report, the initial failure of the distal locking screw should have facilitated dynamisation of the nail. However, it is probable that it also increased the forces

being transmitted through a very much narrowed cross-sectional diameter at the cephalic screw-hole, thus leading to eventual implant failure.

A meta-analysis of the published literature revealed six large outcome series with the use of gamma nails where implant failure was identified as a reported complication (Table I). A total of 2,480 cases of gamma nail fixations were performed for proximal femoral fractures, with 12 broken implants (overall incidence of 0.5%).⁽²⁻⁷⁾ Breakages occurred at the opening for the proximal cervical lag screw in three cases, along the nail shaft in three cases, at the aperture for the distal locking screw in three cases and the distal locking screw in one case. There was one case where breakages occurred at both the openings for both the proximal lag screw and the distal locking screw. The site of implant breakage was not described in two cases. Aetiologies for implant failure included delayed or non-union of the primary fracture in ten cases (83.3%), direct trauma in one case (8.3%) and was not specified in one case.⁽⁶⁾ Salvage of implant failures was achieved with long gamma nails in nine cases (75.0%), Kuntscher intramedullary nail in one case (8.3%), total hip arthroplasty in one case (8.3%) and was not specified in one case. The decision to perform a salvage total hip arthroplasty in one case was attributed

to the patient's relatively young age (60 years) and her excellent general condition but poor bone quality.⁽²⁾

Non-union in intertrochanteric fractures is an uncommon event. In our patient, the possible causes of the gamma nail failure could be attributable to the initial suboptimal reduction, as well as the subtrochanteric extension of the fracture configuration. Persistent non-union of the primary fracture was the cause of implant failure at both the distal locking screw and the proximal lag screw-hole. Although conservative treatment can be considered in such instances, the eventual functional outcomes would be significantly compromised. Both internal fixation and arthroplasty have been found to be optimal salvage procedures for the management of failed primary fixation of intertrochanteric fractures.^(8,10,11) Re-stabilisation of the fracture would require the use of a long gamma nail or a long 95° blade plate so as to bypass the cortical defect secondary to the distal locking screw-hole.⁽⁸⁾ Due to the doubtful viability of the femoral head and the osteoporotic nature of the proximal femur, the decision was made for a bipolar hemi-arthroplasty.

Should we have considered a total hip arthroplasty as suggested by some authors?⁽¹²⁾ Cavaderic studies previously performed by Hoaglund and Low demonstrated that Asian females have a smaller acetabulum as compared with Caucasians.⁽¹³⁾ In the likely presence of hip capsular attrition related to chronic non-union of the fracture, the possibility of postoperative implant dislocation is hence higher. The use of a large universal head in bipolar hemi-arthroplasties is aimed at mitigating this risk, and also provides a stable hip joint, thereby facilitating early postoperative ambulation. In conclusion, gamma nail failures are uncommon occurrences and usually occur in elderly osteopenic

patients with non-union of the primary fracture site. In the absence of acetabular disease, a cemented long-stem bipolar hemi-arthroplasty may be considered as an appropriate salvage procedure that provides optimal hip stability and facilitates early rehabilitation.

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