S. R. Samsani · V. Panikkar · D. Georgiannos
D. Calthorpe

Subtrochanteric metastatic lesions treated with the long gamma nail

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Abstract From 1996 to 2002, 39 consecutive intramedullary reconstructions (three bilateral) in 36 patients were performed in a group of subtrochanteric femoral metastatic bone disease using the long gamma nail (LGN). Reconstruction was performed prophylactically in 28 femurs and, for actual fractures in 11. All patients achieved good functional results with pain relief and improved mobility. No major intraoperative complication or long-term mechanical failures were observed. Minor technical, medical and implant related complications were seen in 14 patients. The LGN is a valuable intramedullary reconstruction device with good functional outcome for the treatment of subtrochanteric femoral metastatic bone disease.

Résumé De 1996 à 2002, 39 reconstructions intramédullaires consécutives (3 bilatérales) chez 36 malades ont été exécutées dans un groupe de métastases fémorales sous-trochantériennes en utilisant un Clou long Gamma. La reconstruction a été exécutée comme prophylaxie pour 28 fémurs et, pour traiter des fractures réelles 11 fois. Tous les malades ont eu de bons résultats fonctionnels avec soulagement de la douleur et mobilité améliorée. Aucune complication intraopératoire majeure ou échec mécanique à long terme n'a été observée. Des complications mineures, techniques, médicales ou liées à l'implant ont été vues chez 14 malades. Le long clou Gamma est un appareil de reconstruction intramédullaire

précieux donnant de bons résultats fonctionnels pour le traitement des métastases osseuses fémorales sous-trochantériennes.

Introduction

Metastasis is the most common neoplasm of the bone, and about 80% of patients with advanced carcinoma exhibit skeletal deposits at autopsy [3, 8]. Aggressive palliative treatment of patients with disseminated cancer has resulted in significantly improved prognosis. Survival rates have significantly improved, especially in those with breast and prostate carcinoma [8, 14]. As a result of these advances, orthopaedic surgeons are encountering an increasing incidence of bony metastasis [6].

The femur is the most common long bone involved in bony metastasis with an incidence of 30 to 50%, two thirds of which are in the proximal femur [1, 6, 8]. Approximately 10% of patients with skeletal metastasis will eventually develop pathological fractures, and 65% of all pathological fractures requiring surgical intervention occur in the femur [8, 16]. About one third of the impending and actual pathological femur fractures occur in the subtrochanteric region and are the most challenging to treat [1, 2, 4, 6, 20].

Pathological fractures in the lower limb have disastrous consequences on the quality of the remaining life in these patients due to pain, loss of function, nursing and psychological problems [2, 14, 20]. The primary objective of surgical management is to stabilise the fracture to relieve pain and restore functional mobility. Since these patients have a shorter life span and their general health deteriorates with time, initial surgical management should be definitive [14, 15]. Any operative intervention should provide immediate stability to relieve pain, allow unlimited weight bearing and should last for the patient's remaining life span [2, 4, 14, 15].

Intramedullary fixation devices have a biomechanical advantage over extramedullary devices in the treatment of these lesions. Various intramedullary devices have

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S. R. Samsani · V. Panikkar · D. Georgiannos · D. Calthorpe
Derbyshire Royal Infirmary,
Derby, UK

S. R. Samsani (✉)
Fracture Clinic,
St. Thomas' Hospital,
Lambeth Palace Road, London, SE1 7EH, UK
e-mail: srsamsani@aol.com
Tel.: +44-207-9289292, Fax: +44-207-9228019

Table 1 Primary pathology and fracture type

Primary tumour	Number	Impending fracture	Actual fracture
Breast	15 (3 bilateral)	14	4
Prostate	6	4	2
Lung	5	4	1
Lymphoma	2	1	1
Myeloma	2	2	0
Kidney	1	1	0
Leukaemia	1	0	1
Thyroid	1	1	0
Tongue	1	0	1
Oesophagus	1	1	0
Stomach	1	0	1
Total	36	28	11

been used in the treatment of metastatic subtrochanteric femoral bone disease with varied results. The long gamma nail (LGN) is a load-sharing intramedullary device that stabilises the entire femoral shaft and neck.

Little has been published on the use of the LGN in the management of metastatic subtrochanteric femoral lesions [4, 5]. We present our results of LGN use in the management of a homogenous group of metastatic subtrochanteric femoral bone diseases at a teaching hospital attached to a regional oncology unit.

Materials and methods

Between 1996 and 2002, 36 patients with 39 femoral subtrochanteric metastatic lesions were treated with the LGN. Fractures were classified as actual or impending based on the criteria of Harrington [7]. Medical notes and radiographs were carefully reviewed to collect the data. A multidisciplinary pre-operative assessment and post-operative care was provided. A standard surgical technique was used, with the patient lying supine on the fracture table. Entry point for the nail was at the tip of the greater trochanter. The proximal femur was reamed to 17 mm to accommodate the wide proximal part of the nail. A cephalic screw was inserted using the jig, and distal locking was performed by the free-hand technique.

Results

The series comprised 36 patients (39 nailings), 20 women and 16 men, with an average age of 65 (38–90) years. The left side was involved in 23 femurs and right side in 16. Breast, prostate, and lung were the most common primary malignancies. Prophylactic stabilisation was performed in 28 femurs, with fracture fixation in 11 (Table 1).

Metastasis

Metastatic disease involving the subtrochanteric region alone was present in 27 femurs (Fig. 1a and b), subtrochanteric region and greater trochanter in six, subtrochanteric region and shaft in four (Fig. 2a and b) and

Fig. 1 **a** Pre-operative radiograph of left femur showing osteoblastic subtrochanteric metastasis. **b** Post-operative radiograph of the same case after prophylactic long gamma nail reconstruction

Fig. 2 **a** Pre-operative radiograph of right femur showing osteolytic bifocal metastases with a fracture. **b** Post-operative radiograph of the same case after long gamma nail reconstruction

Table 2 Complications

Type of complication	Number
General	
Renal failure	1
Cardiac failure	1
Chest infection	1
Superficial wound infection	1
Early post-operative death (within 1 week)	1
Technical	
Broken drill bit	2
Short nail	1
Varus fracture reduction	1
Locking screws missing nail	1
Implant related	
Broken distal locking screws	2
Migration of nail in to patellofemoral joint	1
Cephalic screw cut-out in to hip	1
Total	14

subtrochanteric region, greater trochanter and shaft in two.

Implant

An LGN with a 130° cephalic screw was used in all patients. Nail diameter was 11 mm in 37 femurs and 12 mm in two. Distal locking with two screws was performed in 29 femurs and with a single screw in eight. No distal locking was performed in two femurs.

Bilateral nailing

Three patients with metastatic breast carcinoma had bilateral nailings with an interval of 2–3 weeks. None of these patients had intraoperative problems.

Hospital stay and follow-up

Mean hospital stay was 10 (range 4–21) days. Average hospital stay for prophylactic nailing was 9 (range 4–21) days and was markedly shorter than nailing after fracture, which was 14 (range 10–20) days.

Mean orthopaedic follow-up was 14 (range 8–24) weeks. Patients were discharged from the orthopaedic clinic when the wound healed and the patient was able to mobilise independently. Patients remained under the care of oncologists.

Pain relief and mobility

All patients reported marked reduction in pain and analgesic intake. Patients were allowed unrestricted mobilisation as soon as possible after surgery, and all regained

pre-operative mobility with or without the help of walking aids.

Complications

Complications are noted in Table 2. Peri-operative mortality and morbidity was seen in five patients. One patient died on the fifth post-operative day due to bronchopneumonia. Another patient developed superficial wound infection and was treated with antibiotics. Three patients developed medical complications but were treated successfully.

Intraoperative technical problems were encountered in five patients. A drill bit was broken during distal locking in two patients. One of two distal locking bolts missed the nail in one patient. The nail was found to be short in one patient, and varus fracture malreduction was observed in another patient; in both cases mechanical stability was maintained with no subsequent problems.

Implant-related complications were noticed in four patients. The distal locking screws were broken in two patients, but mechanical stability was maintained. In a third patient in whom the distal locking was not performed, the nail migrated in to the patellofemoral joint. However, the patient remained asymptomatic with good range of knee movement. Another patient had cut-out of the cephalic screw into the hip joint but was asymptomatic due to low functional demand.

Survival after surgery

At the time of this study, 20 patients had died with an average survival of 44 weeks (11 months) and 16 patients were alive with an average survival of 60 weeks (15 months). In the breast cancer group, ten patients died with an average survival of 35 (range 8–88) weeks, and five were alive with an average survival of 128 (range 56–232) weeks.

Discussion

Pathological fractures in the subtrochanteric region of femur can be challenging to treat due to peculiarities in biomechanics and anatomy [10, 20]. Eccentric loading of the subtrochanteric region, combined with loss of bone substance and strength seen in metastatic lesions, create problems for internal fixation [7, 10]. Non-union is common with pathological fractures, and its presence stresses the fixation device used to the limits of failure. Of all fixation failures in the femur, 60% occur in the subtrochanteric region [2]. Because of these factors, this region demands a strong implant capable of withstanding long-term cyclical loading. Modern internal fixation devices, endoprosthesis and use of polymethylmethacrylate (PMMA) have improved the management of these fractures [7].

Endoprosthetic replacement is a major procedure in these patients and is associated with increased morbidity and dislocation rate up to 15% [20, 21]. The conventional extramedullary implants are not only load-bearing devices but also do not adequately neutralise the torque and shear forces in this area. The so-called "type 1 errors" of using these devices for metastatic disease around the hip are associated with failure rates varying from 19% to 23% [12, 18, 21]. Neither the endoprosthesis nor the extramedullary implants protect the remaining femoral shaft from existing or future metastasis.

Intramedullary stabilisation is the procedure of choice for long-bone metastatic diaphyseal lesions [7, 14, 19]. It is a load-bearing device and stabilises the entire length of bone. When locked proximally and distally, a standard intramedullary nail provides bony stability to neutralise bending, compression, distraction and torque forces in the entire femoral shaft. However, it leaves the femoral neck region unprotected against pathological fractures from existing or future metastases [13, 15]. Vander Hurst et al. reported 18% incidence of femoral neck fractures due to occult metastases following treatment with standard intramedullary nails [17].

When treating metastatic subtrochanteric disease, it is essential to stabilise the entire femoral shaft along with femoral neck. Traditionally, Zickel nails have been used in the treatment of these lesions, but these nails have produced problems with insertion, removal, leg-length discrepancy and fixation failure [7, 10, 11, 19, 22, 23]. Various standard and reconstruction nails have now been used with satisfactory results [5, 7, 15, 19].

The LGN was introduced following difficulties associated with the standard gamma nail and has been used to treat both subtrochanteric and bifocal fractures of traumatic and pathological origin [4]. Little evidence has been published on the use of the LGN in metastatic femoral disease, including subtrochanteric lesions and, to our knowledge, none exclusively dealing with subtrochanteric metastatic lesions. Edwards et al. reported LGN use in the management of 25 pathological femoral fractures, including 11 subtrochanteric fractures, with good results [4]. Van Doorn et al. reported their results of the LGN in 101 patients with metastatic femoral fractures from 20 hospitals in the Netherlands. They reported better functional results and fewer complications with the LGN compared with other devices [13]. Prophylactic fixation is preferable to fixation of actual fractures, as these are easier to perform and associated with lower morbidity and shorter recovery time [11, 17, 19]. In our series prophylactic fixation was performed in 75% (28 LGN) of femurs.

All implants will ultimately fail when subjected to continuous mechanical loading, and fixation failure is common with pathological femoral fractures. A failure rate of 10% has been reported in patients with pathological femoral fractures, irrespective of the type of fixation used; 60% of all femoral implant failures are reported to occur in the subtrochanteric region [2, 13]. The LGN is a strong device with acceptable complication

rates. Edwards et al. reported no implant failures in their series of 26 pathological femoral fractures treated with the LGN [4]. Gibbons et al. in their comparative study of 24 metastatic femoral fractures treated with the LGN and another 32 treated with AO nail and spiral blade plate, reported no implant failures in the LGN group but one failure in the AO nail group due to spiral blade plate breakage [5]. The probability of implant failure increases with longer survival after surgery, and the possibility of non-union in pathological fractures increases this risk significantly [2, 4]. However Van Doorn et al. reported a 5% incidence of major technical problems, including breakage of two LGNs, in their series of 110 metastatic femoral fractures [13]. In our series there were no major implant failures, but minor implant-related complications were seen in four patients. Distal locking screw breakage was observed in two patients when only one screw was inserted. Distal migration of the nail into the patellofemoral joint occurred in one patient when distal locking was not performed. This patient remained asymptomatic and required no further intervention. One patient had perforation of the cephalic screw into the hip joint but remained asymptomatic due to low functional demand.

Distal locking is essential in the intramedullary fixation of metastatic femoral lesions to prevent shortening, rotational instability, perforation into the knee joint and fracture of impending lesions [4, 19]. In our series some minor implant-related complications could have been prevented by inserting two distal locking screws.

Cardiac arrest during nail insertion has been reported with unilateral and bilateral nailings; use of un-reamed, solid nails does not seem to prevent this [5, 9]. Insertion of the LGN involves proximal fragment reaming, but this did not lead to complication in our series.

Our series demonstrates that intramedullary reconstruction of metastatic subtrochanteric femoral lesions with the LGN is a safe and effective procedure. All the patients achieved good pain relief and ambulatory status. There was an acceptable incidence of general (13%), technical (13%) and implant-related (10%) complications. At the time of death there were no implant-related complications, and all fixations were painless. Our study also demonstrated that, with good understanding of fracture biomechanics, awareness and communication between orthopaedic surgeons and oncologists, the majority of these reconstructions could be performed prophylactically with its added advantages.

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