# Unreamed intramedullary nailing for pathological femoral fractures

## Good results in 30 cases

**Panagiotis V Giannoudis, Salah S Bastawrous, Jose A Bunola, David A Macdonald and R Malcolm Smith**

We have used the AO unreamed femoral nail for stabilization of impending and complete pathological fractures since March 1994.

27 patients with 30 pathological fractures (23) or impending fractures (7) of the femur were retrospectively analyzed. These included 18 subtrochanteric fractures, 11 shaft fractures and 1 distal fracture. The mean age of the patients was 68 (51–84) years. All patients were treated with a solid femoral nail inserted by an unreamed technique. The nail was inserted through a minimally invasive approach and with a median surgical time of 55 (35–70) minutes. A reconstructive proximal locking option (spiral blade) was used in 25 cases.

There were no intraoperative complications, no operative mortality. Reliable skeletal stability was obtained in all cases and most were able to mobilize early with minimum discomfort. 1 case was revised for a secondary fracture through a distal metastasis at 6 months. The median survival was 5 (2–9) months. Unreamed nailing with the AO solid femoral nail appears to be a good option for the stabilization of pathological femoral fractures.

Departments of Trauma and Orthopaedics, St James University Hospital, Beckett Street, Leeds, LS9 7TF, U.K.
Tel +44 113-2433144. Fax -2065156. Correspondence: Dr. R M Smith.
Submitted 98-02-28. Accepted 98-09-17

We use the AO solid femoral nail (URFN) since March 1994. It can be inserted without reaming and allows modular proximal locking including a standard or a retrograde proximal locking option. We have reported this device in stabilizing femoral fractures following trauma (Smith et al. 1996, Giannoudis et al. 1997), but have also experience with this technique for the stabilization of pathological fractures.

We report our initial experience of its use in the treatment of impending and complete pathological fractures of the femur in 27 patients.

## Patients and methods

We reviewed the medical records, and radiographs of all patients treated with the AO solid femoral nail for pathological fractures of the femur. Between March 1994 and December 1997, 27 patients (18 women) were treated. The mean age was 68 (51–84) years. 3 patients had bilateral nailing procedures. In total, 30 nails were inserted (Table). 23 cases had a fracture, 7 cases had an impending fracture.

An impending pathological fracture was diagnosed from the plain radiographs or from isotope bone scintigraphy in patients with known primary tumor. Im-

Patient data

| Case | Age | Sex | Primary tumor | Region of metast. | F-U months | Survival | Months |
|---|---|---|---|---|---|---|---|
| 1 | 60 | m | lung | p | 6 | no | 7 |
| 2 | 66 | m | lung | m | 3 | no | 3 |
| 3 | 56 | f | breast | p; m | 6 | no | 7 |
| 4 | 81 | f | breast | m | 5 | no | 6 |
| 5 | 84 | f | breast | p | 12 | alive | 15 |
| 6 | 68 | m | prostate | p | 9 | alive | 12 |
| 7 | 70 | f | lung | m | 7 | alive | 9 |
| 8 | 71 | m | prostate | m | 6 | no | 7 |
| 9 | 63 | m | renal | m | 5 | no | 6 |
| 10 | 59 | f | breast | m | 8 | no | 9 |
| 11 | 66 | f | lung | p | 9 | alive | 12 |
| 12 | 65 | f | breast | p | 6 | alive | 9 |
| 13 | 80 | f | breast | p | 10 | alive | 14 |
| 14 | 51 | m | renal | d | 5 | no | 5 |
| 15 | 69 | f | breast | p | 12 | alive | 15 |
| 16 | 80 | f | breast | p | 12 | alive | 14 |
| 17 | 69 | f | lung | m | 8 | alive | 12 |
| 18 | 74 | f | breast | p | 4 | no | 5 |
| 19 | 60 | m | lung | m | 7 | alive | 8 |
| 20 | 68 | m | lung | p | 4 | no | 4 |
| 21 | 56 | f | breast | p | 10 | alive | 13 |
| 22 | 82 | f | breast | p | 5 | no | 5 |
| 23 | 73 | f | breast | m | 4 | no | 5 |
| 24 | 81 | f | breast | p | 6 | no | 6 |
| 25 | 69 | m | lung | p; m | 3 | no | 5 |
| 26 | 74 | f | breast | m | 4 | no | 5 |
| 27 | 51 | f | breast | p; p | 5 | no | 6 |

Region of metastasis: p proximal, m middle, d distal third
Cases 3, 25 and 27 bilateral

*Copyright* © Scandinavian University Press *1999. ISSN 0001–6470. Printed in Sweden – all rights reserved.*

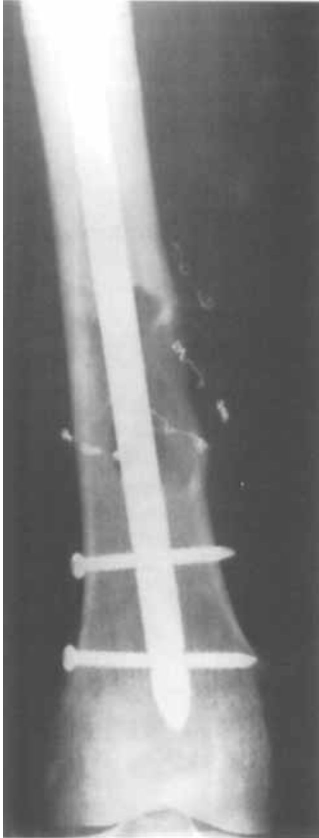


Figure 1. Case 14. Stabilization of a renal cancer metastasis in the distal femur after embolization.

pending fractures were stabilized in the presence of persisting local pain and when fracture was considered likely, more than 50% of the cortex being destroyed (Haentjens et al. 1993).

The surgery was performed with the patient supine on a fracture table or free on a radiolucent table, according to the surgeon's preference. A stab incision about 3 cm long was made approximately 10–15 cm above the tip of the trochanter, and a proximal guide wire was passed. The canal was opened with the 13 mm cannulated drill bit.

In all cases, a 9 mm nail was inserted manually into the medullary cavity and locked proximally and distally, as described by Krettek et al. (1996). Standard proximal locking was performed in 5 cases, whereas the retrograde modular option with the spiral blade was used in 25 cases. A distal venting hole was used on 3 occasions. All the nails were inserted by consultants.

When the primary lesion was not known (3 cases), a tissue biopsy was performed to establish the diagnosis. 7 nailing procedures were open and 23 closed. Preoperative embolization of pulsatile renal cancer metastasis was performed on 2 patients (Figure 1). Prophylactic antibiotics were given to all patients. 11 patients underwent local radiotherapy (20 Grays given in 5 fractions over a period of a week) postoperatively for lesions that were not sensitive to chemotherapy. Full active weight-bearing was encouraged, according to the patient's tolerance. All the patients were followed up clinically and radiographically.

## Results

The median operation time was 55 (35–70) minutes. There was no operative mortality and the median time in hospital was 10 (7–15) days. Of the 27 patients, 10 patients were alive median 13 (9–15) months after the operation. The median survival time of the other 17 patients was 5 (2–9) months. Skeletal stability was restored initially in all cases. Skeletal stability was subsequently lost in 1 case where a distal secondary metastasis developed 6 months after the nailing and required further surgical stabilization with a 95° angled blade plate inserted into the condyles and locked to the distal locking holes of the nail. The reduction of the fractures was satisfactory. There was no deformity exceeding 5° and no leg length inequality greater than 1 cm.

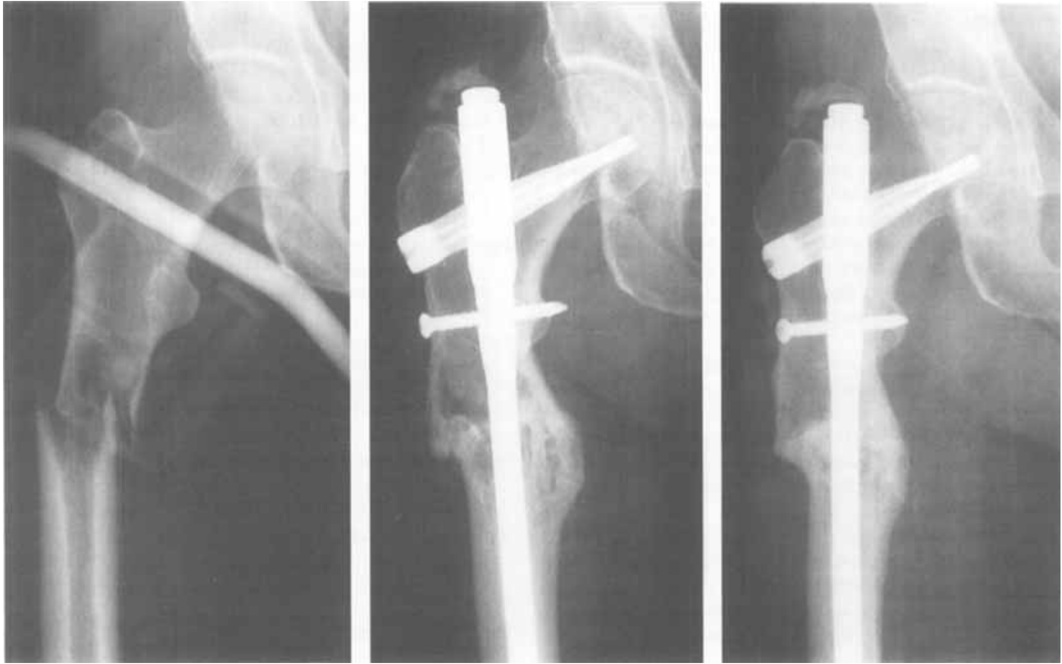
24 patients were mobilizing postoperatively with crutches or a frame. All the patients were encouraged to full weight-bearing and regained their previous walking capacity within 2 weeks of the operation. 3 patients were only able to mobilize from bed to chair and were discharged to a hospice for terminal care, due to poor medical condition. 3 patients developed superficial infections that responded to antibiotics. None of the patients developed clinical signs of ARDS/fat embolism intra- or postoperatively. There was no implant failure. The fractures united in a median union time of 7 (5–10) months (Figure 2) in all survivors.

## Discussion

Intramedullary nailing is a well accepted method for the stabilization of femoral metastasis, providing pain relief and allowing mobilization (Wilkins and Sim 1992, Broos et al. 1993).

All the commonest implants used today require reaming prior to nail insertion. This carries a risk of fat embolus, tumor embolus and prolonged operation time (Bouma et al. 1983). The unreamed technique uses a smaller device with theoretical advantages re-

Figure 2. Case 15



Pathological subtrochanteric fracture of the femur secondary to breast metastasis.

Lesion stabilized with an unreamed femoral nail, proximally locked with a spiral blade alone and a static screw, 4.5 months following surgery.

Union of fracture 7 months after surgery.

garding all these risks. Kropfl et al. (1997) reported that bone marrow intravasation occurred less frequently in unreamed than in reamed intramedullary femoral fracture stabilization.

However, a thinner device in the wider canal of these patients will not produce a rigid bone nail-construct and may therefore not be so effective mechanically. In our series, bone stability was satisfactory despite this potential mechanical disadvantage. Mobility was optimized and good pain relief was achieved.

There was 1 case of tumor spread distally which required revision surgery. We found no device-related problems. There was no failure of the nail. The proximal locking with the spiral blade was satisfactory, but in contrast to other reports of reconstruction nailing (Cooke et al. 1996) where major problems with locking into the femoral neck have been encountered.

Reamed intramedullary nailing is associated with marrow embolization in both human and animal experiments and this may cause considerable pulmonary damage (Kuntscher 1950, Wenda et al. 1988, Pape et al. 1992, Pell et al. 1993). Pulmonary complications have been reported after reamed femoral nailing—particularly after bilateral nailing for metastatic disease (Kerr et al. 1993, Roumen et al. 1995). Heinz et al. (1989) analyzed 595 patients treated over a 20-year period for pathological fractures in 16 Austrian hospitals and reported 20% systemic complications due to surgery.

We saw no systemic intra- or postoperative complications, even in the 3 patients who had bilateral unreamed procedures. Our findings agree with those of other authors (Weikert and Schwartz 1991, Holmenschlager et al. 1996, Nargol et al. 1996) who likewise found no systemic complications in their series of 10, 23 and 10 patients, respectively.

We used a distal venting hole on 3 occasions, although no systemic complications were noted when this procedure was not used. We are unable to make any further recommendations with regard to this procedure, but we have noted from cadaveric work that proximal and distal venting holes reduce the intramedullary pressures significantly in the intact femur and this practice may be useful in patients with pre-existing pulmonary disease (Martin et al. 1996) and help to reduce the risk of hypotension in reaming of the medullary canal in femoral metastases (Persson and Bauer 1994).

The minimal morbidity and zero mortality in our series is such that we now feel confident when performing bilateral procedures. The single pass of the thin nail may be important in this regard.

We would like to acknowledge the support of all the Trauma and Orthopedic Consultants at St James University Hospital. Dr. P Giannoudis was supported by a grant from AO International.

Bouma W H, Mulder J H, Hop W C. The influence of intramedullary nailing upon the development of metastases in the treatment of an impending pathological fracture: an experimental study. Clin Exp Metastasis 1983; 1 (3): 205-12.

Broos P, Reynders P, Van den Bogert W et al. Surgical treatment of metastatic fracture of femur improvement of quality of life. Acta Orthop Belg (Suppl 1) 1993; 59: 52-6.

Cooke E A, Tandon S C, Elliot J R M, McCoy G F. Experiences with the Russel Taylor femoral reconstruction nail. Injury 1996; 27 (5): 377.

Giannoudis P V, Furlong A J, Macdonald D A, Smith R M. Reamed against unreamed nailing of the femoral diaphysis: A retrospective study of healing time. Injury 1997; 28: 15-8.

Haentjens P, Casteleyn P P, Opdecam P. Evaluation of impending fractures and indication for prophylactic fixation of metastases in long bones. Review of literature. Acta Orthop Belg (Suppl 1) 1993; 59: 6-11.

Heinz T, Stoik W, Vecsei V. Treatment and results of pathologic fractures. A collaborative study from 1965 to 1985 of 16 Austrian hospitals. Unfallchirurg 1989; 92 (10): 477-85.

Holmenschlager F, Baranowski D, Winckler S et al. Efficacy of intramedullary stabilisation of pathologic femoral shaft fractures. Langenbecks Arch Chir Suppl Kongressbd 1996; 113: 987-90.

Kerr P S, Jackson M, Atkins R M. Cardiac arrest during intramedullary nailing for femoral metastases. J Bone Joint Surg (Br) 1993; 75: 972-3.

Krettek C, Rudolf J, Schandelmaier P et al. Unreamed intramedullary nailing of femoral shaft fractures: operative technique and early clinical experience with the standard locking option. Injury 1996; 27: 233-54.

Kropfl A, Berger U, Neureiter H et al. Intramedullary pressure and bone marrow fat intravasation in unreamed femoral nailing. J Trauma 1997; 42 (5): 946-54.

Kuntscher G. Fortschritte auf dem Gebiet der Marknagelung. Arch Clin Chir 1950: 264: 547.

Martin R, Ross K, Petrie D et al. Effects of proximal and distal venting during intramedullary nailing. Clin Orthop 1996; 332: 80-9.

Nargol A V, Port A, Seif-Asaad S S. Pathological fractures of the proximal femur treated with the Variwall reconstruction nail. Injury 1996; 27 (5): 307-9.

Pape H C, Dwenger A, Regel G et al. Pulmonary damage after intramedullary femoral nailing in traumatized sheep: is there an effect from different nailing methods? J Trauma 1992; 33: 574-81.

Pell A C H, Christie J, Keating J F, Sutherland G R. The detection of fat embolism by transoesophageal echocardiography during reamed intramedullary nailing. A study of 24 patients with femoral and tibial fractures. J Bone Joint Surg (Br) 1993; 75: 921-5.

Persson E V, Bauer H C F. Sudden hypotension and profuse bleeding during intramedullary nailing of the femur in cancer patients. Acta Orthop Scand 1994; 65 (5): 564-7.

Roumen R M H, Lako S J, Schoots F J. Acute lung damage after bilateral insertion of femoral intramedullary interlocking nails for metastatic bone disease. Eur J Surg 1995; 161 (6): 451-3.

Smith R M, Giannoudis P V, Macdonald D A. The St James's University Hospital experience with the unreamed femoral nail. Injury 1996; 27: 367.

Weikert D R, Schwartz H S. Intramedullary nailing for impending pathological subtrochanteric fractures. J Bone Joint Surg (Br) 1991; 73: 668-70.

Wenda K, Ritter G, Degreif J et al. The pathogenesis of pulmonary complications following intramedullary nailing. Unfallchirurg 1988; 91: 432.

Wilkins R M, Sim F H, Springfield D S. Metastatic disease of the femur. Orthopedics 1992; 15 (5): 621-30.