# Treatment of pathological humeral shaft fractures with a distally threaded unreamed humeral nail

Amr S. Elgazzar

Hospital Orthopedic Department, Benha University, Banha, Egypt

Correspondence to Amr S. Elgazzar, MD, 13111 Benha University, Banha, Egypt
Tel: +0201062903895;
e-mail: dr.amrelgazzar@gmail.com

**Received** 15 February 2012
**Accepted** 25 March 2012

**The Egyptian Orthopedic Association** 2013, 48:249–253

**Background**
Bone metastasis is a severe complication in patients with cancer. Not only does it cause intractable pain and other clinical problems such as fracture after a trivial injury, it also signifies that the malignant process is incurable. Since the life expectancy of metastasized cancer patients has improved because of advanced oncological treatment, although still limited, appropriate surgical interventions have increased.

**Objective**
To analyze the results of intramedullary fixation of pathological humeral shaft fractures using a distally threaded unreamed locked humeral nail.

**Patients and methods**
Between November 2004 and November 2009, seven patients with seven humeri fractures secondary to metastatic disease were treated in Benha University and Benha Teaching Hospitals. The primary tumors included carcinomas of the breast (two), kidney (one), prostate (one), and unknown origin (three). All fractures were stabilized with antegrade distally threaded unreamed locked humeral nailing. The mean age of the patients was 65 years (range 55–82 years); the male to female ratio was 2 : 5. The mean follow-up duration was 14 months (range 3–24 months).

**Results**
A Likert scale was used to assess the level of satisfaction; overall, there was a good outcome. Four of six patients reported a good result of 'satisfied' and two of six patients reported an unsatisfactory outcome. Bony union was achieved in 67% (four of six patients) of all the cases.

**Conclusion**
Distally threaded unreamed humeral nailing led to a high rate of satisfaction and should be considered a palliative treatment for patients with pathological humeral shaft fractures because of metastatic disease. It provides immediate stability and pain relief, short operative time, no blood loss, and avoids complication of distal locking screws.

**Keywords:**
pathological fractures, pathological humeral shaft fractures, unreamed humeral nail

Egypt Orthop J 48:249–253

1110-1148

## Introduction

Metastatic involvement of bone is a significant cause of patient morbidity. The humerus is the second most commonly affected long bone after the femur. The majority of patients present with pain and disability because of the loss of functional use of their arm [1]. An impending or an actual pathological fracture of the humerus significantly interferes with the patient's ability to perform activities of daily living and hence reduces the patient's remaining quality of life.

Nonoperative management is unreliable in providing complete relief of pain, fracture healing, or return of function to the extremity [2–4].

The most frequent primary tumors to cause metastases to bone are those of the breast, prostate, kidney, thyroid, and lung [5–10]. Multiple myeloma has been reported in some series [8,11].

This involvement will progressively destroy bone, creating areas of lysis or sclerosis within cancellous or cortical bone. The usual end result, especially with lytic lesions, is a weakened bone prone to fracture. Fracture may be caused by minor trauma [8,9] including daily activities [12], and the presence of considerable arm or shoulder pain in a patient with a history of cancer indicates the possibility of bone metastases, whose common characteristics include pain at rest, at night, and unresponsive to NSAID [8].

The aim of this study is to evaluate the role of distally threaded unreamed humeral nailing (UHN) in the management of pathological humeral fractures because of metastatic disease. Little has been reported to date on this management approach [13].

## Patients and methods

Between November 2004 and November 2009, seven patients who had six pathological actual fractures and

one impending fracture of the humerus were treated with distally threaded unreamed intramedullary humeral nailing at Benha University, insurance, and teaching and hospitals. All the humeral diaphyseal fractures with destructive bony lesions from 2 to 3 cm below the level of the greater tuberosity to ~5 cm above the olecranon fossa were considered to be appropriate for intramedullary nail fixation. Severe pain and loss of function in the extremity because of actual or impending pathological fractures were the main indications for surgery. Five patients had coexisting medical problems, which included ischemic heart disease, diabetes mellitus, hypertension, and paroxysmal atrial fibrillation.

All patients were staged before surgery with imaging studies, including bone scan and CT for visceral or cerebral involvement. Patients deemed appropriate for operative intervention had at least 6 weeks' life expectancy and could tolerate general or regional anesthesia.

Of the seven patients, five were women and two were men. In four patients, the right humerus was affected and in three patients, the left humerus was affected because of pathological fractures. The mean age of the patients was 65 years (range 55–82 years). The diagnosis of primary malignancies was breast cancer in two, renal-cell carcinoma in one, prostate cancer in one, and carcinoma of unknown origin in three patients.

#### Adjuvant treatment

Preoperative radiation therapy was used in two humeri. Postoperatively, radiation therapy was applied in two humeri. Chemotherapy was instituted in one case.

#### Surgical technique

All surgical procedures were performed under general or scalene block anesthesia. The beach-chair position was preferred in all patients. A deltoid-splitting approach was used. We used a standard technique for anterograde nail insertion, and the appropriate size nail was inserted with small rotatory movements over the guide wire. No reaming was performed and no cement was added.

The distally threaded UHN was used in all seven extremities. A supine position on a radiolucent table with elevation of the scapula of the involved side was used for all the patients and nails were inserted antegrade using a deltoid-splitting approach. In total, seven patients with seven humeri were operated using the closed technique.

In all the procedures, both the proximal locking screws were used and the distal stability depended on the fitting of the distal nail threads on the distal flat humeral medulla without the need for the distal locking screws.

#### Postoperative period

Slings were applied as an external support during the early postoperative period and pendulum shoulder exercises were started under the supervision of physiotherapists. The patients were encouraged to use their arm immediately after the operation and those with additional surgeries of the lower limbs were instructed to learn how to use walking aids.

The patients were examined in the outpatient clinic. The clinical follow-up evaluation was carried out according to two criteria: Gain of function and pain status. Physical examination and patient satisfaction constituted the basis of follow-up assessment. Gain of extremity function was considered satisfactory if the patient was able to function normally or with no impairment in activities of daily living. Extremity function was rated as fair when there was some limitation in the use of the extremity in activities of daily living. The function was rated as poor if the patient was unable to use the extremity postoperatively.

Postoperative pain status specific to humerus was rated as excellent if pain was completely resolved; good if the decrease in pain was remarkable; and fair when there was continued pain, although allowing for improved function. Pain relief was rated as poor if there was no difference or if there was an increase in pain. Analgesic use is not a valid measure of humerus-specific pain relief as almost all the patients in our series had other bony metastasis for which analgesia was required [14] (Fig. 1).

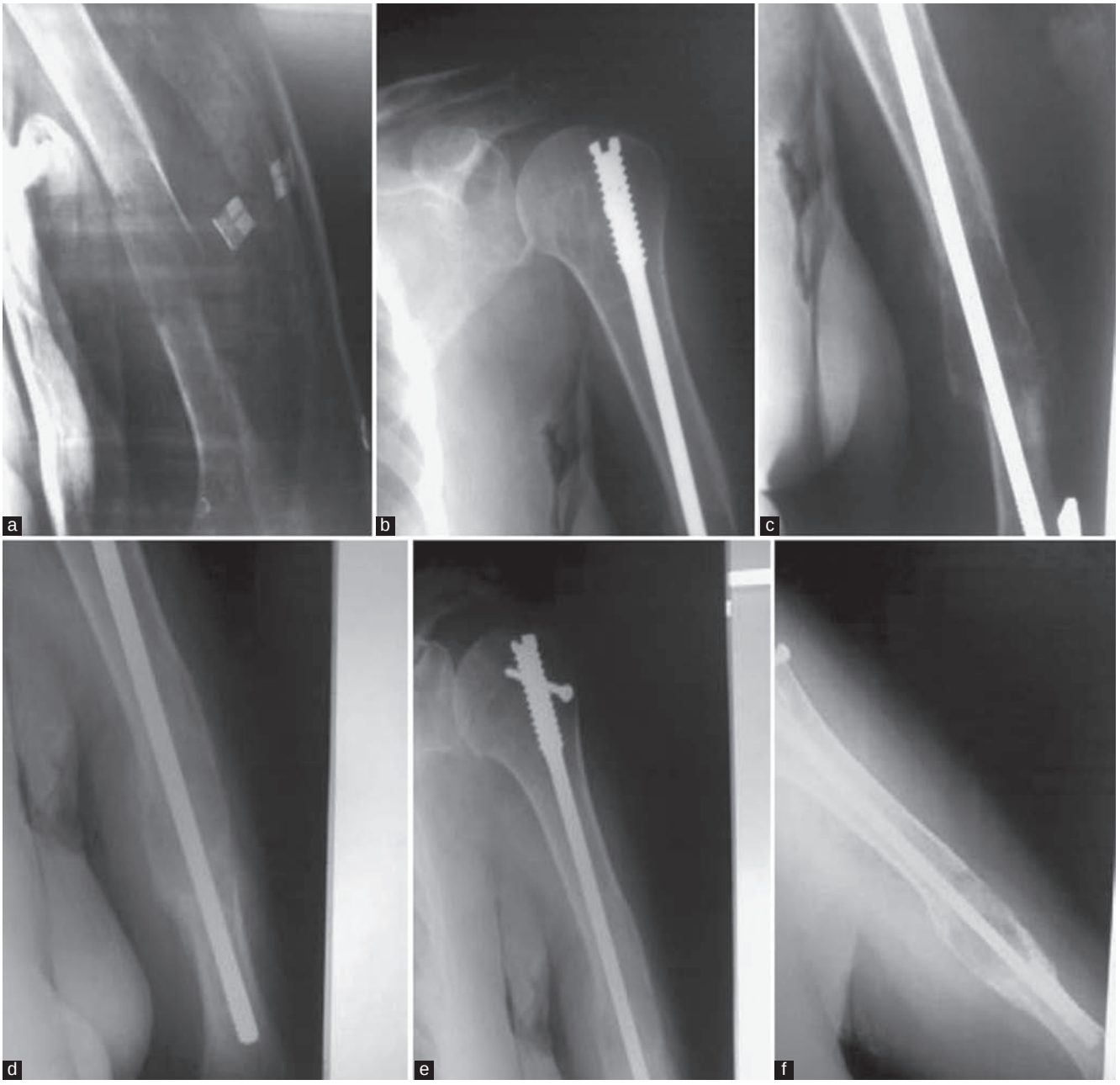
## Results

Perioperative blood transfusion: Only two patients who underwent concomitant surgeries (hemiarthroplasty and IMN femur) during the same operative session required blood products. A total of 3 U of packed cells were administered to these two patients.

#### Postoperative hospital stay

The longest durations of postoperative hospitalization occurred in two patients, where multiple extremities were stabilized in one surgical setting humerus and the neck of the femur – 16 days (case 3) and humerus and shaft femur – 8 days (case 4). For the rest of our study group in whom we performed single UHN procedures during admission, the mean duration of hospitalization after surgery was 3 days, with a range of 2–7 days.

**Figure 1**




A 67-year-old woman with breast carcinoma. (a) Preoperative radiograph. (b,c) Immediate postoperative radiograph. (d,e) Six weeks postoperatively. (f) Three months after surgery.

Pain relief and gain of function pain improved significantly immediately after surgery. By 6 weeks, relief of pain was rated as good in all patients, except one, in whom the pain relief was rated as fair because of continuous pain around the shoulder. In all patients who survived, there was a satisfactory return to full use of the limb for prefracture activities of daily living within 8–10 weeks.

The mean follow-up duration was 14 months (range 3–24). All patients were assessed using a visual analogue scale score for pain (range 0–100), except one, who died during the first 3 weeks in hospital. The mean score improved from 91.6 (range 80–100) to 15 (range 0–40) (Table 1).

The return to full use of the affected limb for daily activities was also assessed in patients who survived at least 3 months. One patient showed no improvement.

In the majority of all the other patients, there was a satisfactory return to daily activities within 8–10 weeks. A Likert scale was used to assess the level of satisfaction; overall, there was a good outcome. Four of six patients reported a good result of 'satisfied' and two of six patients reported an unsatisfactory outcome.

**Table 1 Details of the seven patients who underwent distally threaded intramedullary nail fixation**

| Patient (humerus) | VAS score before surgery | VAS score after surgery | Survival time (months) |
|---|---|---|---|
| 1 | 90 | 10 | 06 |
| 2 | 100 | 20 | 02 |
| 3 | 90 | 10 | 13 |
| 4 | 90 | 00 | 24 |
| 5 | 100 | 10 | 03 |
| 6 | 80 | 40 | 24 |
| 7 | 100 | – | 4 days |

VAS, visual analogue scale.

### Complications

No intraoperative or early postoperative complications related to stress of the procedure or to anesthesia were observed.

No local complications related to the surgical procedure were reported (shoulder pain, radial nerve injuries, stiffness, infection, or heterotopic ossifications) and the average operation time for the humeral nailing was 40 min (range 25–130 min). The longest duration included the surgical stabilization of both the femur and humerus in one patient at the same surgical setting.

### Union and reoperation

Excluding the patient who did not survive until 3 months, bony union was achieved in 67% [4–6] of the procedures. Nonunion was reported in one patient with breast carcinoma that required revision with plating 1 year after original surgery because of local recurrence of the carcinoma at the fracture site.

### Survival

One patient died within 3 weeks of surgery and a further two survived only to 12 weeks. Four patients survived between 12 weeks and 2 years postoperatively.

## Discussion

The expected length of survival of the patient is one of the most important factors in deciding the mode of treatment of a pathological humeral fracture because of metastatic disease. Although it was reported that nonsurgical management should be reserved for patients with a short life expectancy, even terminally ill patients with a very short life expectancy could benefit from surgical fixation. In addition to this, conservative management of a pathological fracture is not advised because of the high incidence of nonunion and poor relief of pain [15–17]. There are two techniques for surgical fixation of pathological humeral shaft fractures: Plating and intramedullary nailing. In their study, Dijkstra *et al.* [15] reported more blood loss and local complications with plate fixation in comparison with nailing. In this series, none of the patients who underwent distally threaded undreamed humeral nailing alone because of their pathological fractures of humerus received blood products perioperatively. Damron *et al.* [18] showed that the proximally and distally locked intramedullary nail has biomechanical advantages over plate or Rush rod fixation in a cadaveric model for middle-third impending fractures. Locking screws insertion with UHN allows for rotational and axial control, whereas, when using Rush rods, Lewallen *et al.* [3] reported that augmentation with polymethylmethacrylate is beneficial in order to achieve better stability.

The disadvantages of plate fixation include the risk of radial nerve injury and inability to protect as much humeral length compared with intramedullary nailing. In this study, there were no neurovascular complications.

Intramedullary nail fixation has become the most popular method used for humeral shaft lesions. The major advantage of intramedullary nail fixation is that it can protect a long segment of the humerus. In the procedures in this series, proximal locking screws were used and the distal stability depended on the fitting of the distal nail threads on the distal flat humeral medulla without the need for the distal locking screws.

When augmented with methylmethacrylate, it can also provide rigid fixation of a long segment of diseased bone. Other advantages include a low risk of implant failure and the fact that the nail can be placed in a closed manner. In the current series, there was no additional pathological impending or actual fractures of the same humerus. The only fixation failure we observed was in a patient with breast carcinoma, where the nail was broken because of nonunion 1 year after the operation. This particular patient had functioned very well until the nail breakage. The major disadvantage of antegrade intramedullary nailing is the mandatory incision and repair of the rotator cuff, which may cause residual rotator cuff tendinitis and weakness [8]. However, the postoperative expectations in elderly and fragile metastatic cancer patients are very different compared with a younger trauma patient group in whom the rotator cuff symptoms may become more severe during recovery.

The primary aim of surgical treatment in an oncology patient should be a rapid return to activities of daily living and decrease in pain around the fracture site with the least invasive method.

Closed nailing is the preferred technique for both impending and actual fractures when the bony destruction is not severe. To achieve better mechanical benefit, cement felling, especially in radio-resistant tumors such as hypernephroma and thyroid carcinoma, is preferred as surgical debulking is the only option to achieve a decrease in tumor mass around the fracture site in these patients.

The only tumor recurrence at the previous fracture site in our series was in a patient with hypernephroma in whom open debulking and cementation was not performed during primary nailing.

Metastatic involvement of the humerus generally occurs late in the course of the disease and operative treatment should be considered in patients with a life expectancy of a minimum of 6 weeks. Although in our series we considered this time period as a landmark for the assessment of extremity function and pain status, there was a very fast recovery in extremity function and pain even during the first couple of days after the operation. From the current series, even the patients with additional pathological fractures of the femur who were operated on together with UHN during the same surgical session did not develop any complications and were satisfied with the intervention. They recovered quickly mostly because of the possibility of early postoperative ambulation with the use of walking aids.

## Conclusion

Distally threaded UHN showed a high rate of satisfaction and should be considered a palliative treatment for patients with pathological humeral shaft fractures because of metastatic disease. It provides immediate stability and pain relief, short operative time, no blood loss, and avoids complication of distal locking screws (failure, neurovascular injury, long c-arm exposure, and long operative time), minimum morbidity, and early return of function to the extremity.

## Acknowledgements

### Conflicts of interest

There are no conflicts of interest.

## References

1 Bashore CJ, Temple TH. Management of metastatic lesions of the humerus. Orthop Clin North Am 2000; 31:597–608.

2 Gainor BJ, Buchert P. Fracture healing in metastatic bone disease. Clin Orthop 1983; 178:297–302.

3 Lewallen RP, Pritchard DJ, Sim FH. Treatment of pathologic fractures of impending fractures of the humerus with Rush rods and mehylmethacrylate. Clin Orthop 1982; 166:193–198.

4 Yazawa Y, Frassica FJ, Chao EY, Pritchard DJ, Sim FH, Shives TC. Metastatic bone disease. A study of the surgical treatment of 166 pathologic humeral and femoral fractures. Clin Orthop 1990; 251:213–219.

5 Atesok K, Liebergall M, Sucher E, Temper M, Mosheiff R, Peyser A. Treatment of pathological humeral shaft fractures wit unreamed humeral nail. Ann Surg Oncol 2007; 14:1493–1498.

6 Dutka J, Sosin P. Time of survival and quality of life of the patients operatively treated due to pathological fractures due to bone metastases. Orthop Traumatol Rehabil 2003; 30:276–283.

7 Ekholm R, Adami J, Tidermark J, Hansson K, Törnkvist H, Ponzer S. Fractures of the shaft of the humerus. An epidemiological study of 401 fractures. J Bone Joint Surg Br 2006; 88:1469–1473.

8 Frassica JF, Frassica DA. Metastatic bone disease of the humerus. J Am Acad Orthop Surg 2003; 11:282–288.

9 Gebhart M, Dequanter D, Vandeweyer E. Metastatic involvement of the humerus: a retrospective study of 51 cases. Acta Orthop Belg 2001; 67:456–463.

10 Sarahrudi K, Wolf H, Funovics P, Pajenda G, Hausmann JT, Vécsei V. Surgical treatment of pathological fractures of the shaft of the humerus. J Trauma 2009; 66:789–794.

11 Flinkkilä T, Hyvönen P, Leppilahti J, Hämäläinen M. Pathological fractures of the humeral shaft. Ann Chir Gynaecol 1998; 87:321–324.

12 Frassica FJ, Frassica DA. Evaluation and treatment of metastases to the humerus. Clin Orthop Relat Res 2003; 415 (Suppl): S212–S218.

13 Redmond BJ, Biermann SJ, Blasier BR, Arbor A. Interlocking intramedullary nailing of pathological fractures of the shaft of the humerus. J Bone Joint Surg 1996; 78-A:891–896.

14 Perez CA, Bradfield JS, Morgan HC. Management of pathologic fractures. Cancer 1972; 29:684–693.

15 Dijkstra S, Stapert J, Boxma H, Wiggers T. Treatment of pathological fractures of the humeral shaft due to bone metastases: a comparison of intramedullary locking nail and plate osteosynthesis with adjunctive bone cement. Eur J Surg Oncol 1996; 22:621–626.

16 Dion N, Rock MG. Management of metastatic tumors of the humerus. OKU-Musculoskeletal Tumors Chap 41 AAOS 2002; 373–379.

17 Douglass HO, Shukla SK, Mindell E. Treatment of pathological fractures of long bones excluding those due to breast cancer. J Bone Joint Surg Am 1976; 58-A:1055–1061.

18 Damron TA, Rock MG, Choudhury SN, Grabowski JJ, An KN. Biomechanical analysis of prophylactic fixation for middle third humeral impending pathological fractures. Clin Orthop 1999; 363:240–248.