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ORIGINAL PAPER

Treatment of pathological humeral shaft fractures with intramedullary nailing. A retrospective study

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Abstract A consecutive series of 22 pathological fractures of the humeral shaft in 21 patients treated at one institution were included in this retrospective study. Patients were treated with anterograde locked intramedullary nailing. Mean follow-up was 22.7 months (range 3–60). Mean VAS score improved from 89.5 (range 80–100) to 14.5 (range 0–40). In most patients there was a satisfactory return to daily activities within six weeks of surgery. Seventeen of 19 patients reported to be satisfied. Mean duration of hospitalization after surgery was 4.3 days (range 2–15). There were no complications related to the implants. There were no operative complications and the average operation time was 48 minutes (range 35–160). The consolidation rate was 80%. We emphasize that suspicion of fracture and interdisciplinary work between oncologists and orthopaedic surgeons are of crucial importance for survival time and individual treatment.

Introduction

Tumour involvement of the humerus may be seen occasionally by any orthopedic surgeon. Metastatic disease becomes more frequent over the age of 40 years and is the most frequent origin of neoplastic involvement of the humerus [10].

Pathological fractures of the humeral shaft occur late in the course of malignant disease [7] and are reported to occur in only 8–10% of metastases to this bone [10]. The humerus is the second most involved bone, accounting for 16–39%, with actual or impending pathological fractures [3, 4, 14, 17].

The most frequent primary tumours to cause metastases to bone are those of the breast, prostate, kidney, thyroid and lung [1, 4, 6, 9, 10, 17]. Multiple myeloma has been reported in some series [7, 10].

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 [9, 10] including daily activities [8], and the presence of substantial arm or shoulder pain in the patient with a history of cancer indicates the possibility of bone metastases, for which common characteristics include pain at rest, at night and unresponsive to NSAID [9].

When fracture is present, non surgical management gives poor results [9], and internal fixation is recommended provided that the patient is medically fit for surgery [2]. The goals of surgical treatment are immediate reduction of pain by stabilising the fracture, return to mobility with full weightbearing as soon as possible, reducing morbidity, facilitation of nursing care and restoration of function of the affected extremity [2, 9, 10, 11].

Intramedullary nailing is the most popular method used for these fractures and can be done either closed or open through an anterograde or retrograde approach [9, 12]. Even though a retrograde approach has been associated with good results and has the advantage of not affecting elbow and shoulder function [13], it is not widely used because of the increased risk of iatrogenic fractures [2].

The aim of our study was to analyse the results of closed intramedullary locked nailing in our department in patients with humeral shaft fractures due to bone metastases and, in particular, we considered functional results, relief of pain, complications and consolidation rate.

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Materials and methods

This was an observational case series study, between January 2000 and March 2007, of 22 pathological humeral shaft fractures, in 21 patients, treated in one institution with close, unreamed, antegrade, locked, intramedullary nailing. The medical case files and relevant radiological studies of all the identified patients were analysed. One patient sustained fractures in both humeri, giving a total of 23 fractures in 22 patients. Patients were treated with anterograde locked intramedullary nailing.

All patients were staged before surgery with imaging studies, including whole body bone scanning for skeletal survey and CT for visceral or cerebral involvement according to the oncology service protocol of our institution. In patients with hypervascular metastasis, angiography and selective arterial embolisation was done before surgery.

There were 13 men (13 humeri) and nine women (10 humeri). The mean age of the patients at the time of surgery was 63 years (range 42–86). The right arm was the most commonly affected limb with a 59% prevalence. The most frequent associated neoplasm was multiple myeloma with a 40% prevalence. Other malignancies were rectal neoplasm (3), hepatocellular carcinoma (2), renal carcinoma (1), breast carcinoma (2), melanoma (1), prostate carcinoma (2), larynx carcinoma (1), urinary bladder carcinoma (1) and epidermal carcinoma (1).

The middle third of the humeral shaft (12 humeri) was most commonly involved, followed by the proximal third (ten humeri) and finally the distal third (one humerus) (Fig. 1).

Symptoms were present for a mean period of 18 days (range 1–90) before admission, characterised by a diffuse pain in the affected arm associated with functional limitation.

All surgical procedures were performed under general or scalene block anaesthesia. 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 rotary movements over the guide wire. No reaming was done and no cement was added. A specimen for biopsy was taken. The nails were locked proximally with two or three screws and distally with one screw. In eight fractures a Polarus nail (Acumed, Hillsboro, OR, USA) was used. In nine fractures an UHN (Synthes, Switzerland) was used, and in six fractures a TriGen nail (Smith & Nephew, TN, USA) was used.

The follow-up appointments were at two, six and 12 weeks and later according to patient's availability (usually oncology's appointments were priority).

In five patients a bone marrow transplantation was done; four patients received radiotherapy before and after surgery. Chemotherapy was used in nine patients prior to surgery. Three patients received chemotherapy after surgery, and two patients did not receive adjuvant therapy.

Fig. 1 A 43-year-old patient with renal carcinoma reported diffuse pain and functional limitation within his right arm and no previous trauma. X-ray showing a pathological fracture in the proximal third of the humeral shaft

For outcome assessment we used a Lickert scale for satisfaction (5 items), return to full use of the affected limb for activities of daily living, VAS for pain, length of post-op hospital stay, complications post-op and consolidation rate.

Radiological assessment was made in patients with at least six months survival and the other parameters in patients with at least three months.

Results

The mean follow-up was 22.7 months (range 3–60). All patients were assessed using a VAS score for pain (range 0–100) except one who died during the fourth day in hospital from a lower digestive hemorrhage. The mean score improved from 89.5 (range 80–100) to 14.5 (range 0–40) (Table 1).

We also assessed the return to full use of the affected limb for daily activities in patients who survived at least three months. There were three deaths and one with no improvement. In the majority of all the other patients there was a satisfactory return to daily activities within six weeks (Fig. 2).

A Lickert scale was used to assess the level of satisfaction; globally there was a good outcome. We used telephone calls for 12 patients and revision of the patients charts for seven; thus, in total we had 19 responses for this parameter. Seventeen of 19 patients reported a good result ("very satisfied" and "satisfied"), and two of 19 reported an unsatisfactory outcome.

The mean hospital stay was 13 days (range 5–70), and the mean duration after surgery was 4.3 days (range 2–15).

Table 1 Details of the 22 patients (23 humeri) who underwent intramedullar nail fixation

Patient (humerus)	VAS score presurgery	VAS score postsurgery	Postoperative survival time (months)
1	90	00	14
2	100	20	02
3	90	10	13
4	90	40	24
5	100	10	36
6	90	00	48
7	100	20	28
8	90	10	27
9	80	10	02
10[a]	80		4 days
11	90	10	12
12	80	20	34
13	90	20	33
14	90	10	24
15	80	40	21
16	90	10	41
17	100	10	18
18	90	30	13
19	80	10	33
20	90	10	13
21	90	10	60
22	80	10	13
23	90	10	12

[a] A 76-year-old man with larynx cancer who died from a lower intestinal haemorrhage during the fourth day after intramedullary nailing

The longest hospital stay occurred in one patient where multiple extremities were stabilised in one surgical setting (Table 2).

There were no complications related to the implants. Six patients presented medical complications including acute anaemia after surgery (2), gastrointestinal haemorrhage (2) and pneumonia (2), representing a 27% prevalence; of these patients one died.

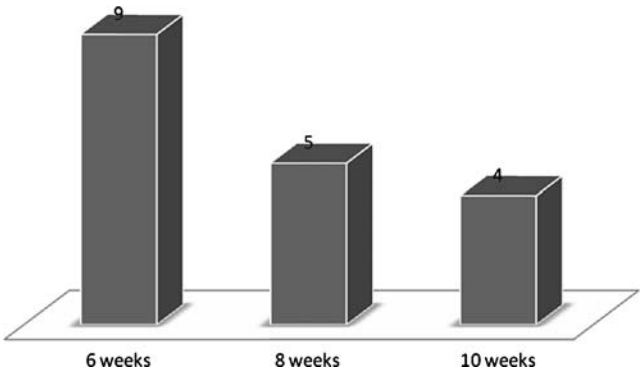

Fig. 2 Time to return to full use of the affected limb for daily activities in patients who survived at least 3 months

At the time of the revision, 12 patients were still alive. None of the deaths were related to the humeral nailing procedure. The mean postoperative survival time was 22.7 months (range, four days to 60 months). There were no deaths in the immediate postoperative period; however, three patients survived less than three months after the intramedullary nailing.

No local complications related with 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 48 minutes (range 35–160 min). The longest duration includes the surgical stabilisation of both femurs in one patient at the same surgical setting.

Table 2 Length of post-op hospital stay of the 22 patients (23 humeri) who underwent intramedullar nail fixation

Patient (humerus)	Total hospital stay (days)	Postsurgery hospital stay (days)	Postoperative survival time (months)
1	12	04	14
2	14	07	02
3[a]	25	15	13
4	10	03	24
5	07	04	36
6	70	04	48
7	05	03	28
8	06	03	27
9	09	06	02
10[b]	12	04	4 days
11	09	02	12
12	06	03	34
13	08	03	33
14	05	03	24
15	07	04	21
16	05	02	41
17	08	03	18
18	17	04	13
19	06	04	33
20	06	03	13
21	06	03	60
22	30	05	13
23	18	08	12

[a] A 61-year-old man with multiple myeloma who had lytic lesions in both femurs and surgical stabilisation at the same time as the humeral fracture

[b] A 76-year-old man with larynx cancer who died from a lower intestinal haemorrhage during the fourth day after intramedullary nailing

Fig. 3 A 42-year-old woman with breast cancer showing healing of the fracture after intramedullar locked nail fixation and adjuvant radiotherapy. X-ray at 9 months follow-up

The consolidation rate was 80%. We included nineteen patients (20 fractures) who survived at least six months for this assessment (Fig. 3).

Discussion

An active approach is needed in the management of metastatic skeletal disease in order to enable these often frail patients to retain a satisfactory quality of life. Secure stabilisation must be achieved with the least operative morbidity. For that reason the treatment of these fractures continues to be an evolving science [11].

In recent years some studies have reported intramedullary nailing in pathological humeral shaft fractures [1, 8, 9, 14, 17] with outcomes depending on the experience of each team. We think that this is consistent with the idea of an individual approach for these patients and that is why it is important to know about the experience of different groups of workers in this field.

We report a total of 23 pathological humeral shaft fractures with a mean age of 63 years, a frequent age in which metastatic disease could be present. In our series the most prevalent primary neoplasm was multiple myeloma. This finding is similar to the series of Bauze et al.; however, in the majority of series, breast cancer in women and prostate cancer in men are the most prevalent [1, 4, 6, 17].

A very important finding described in our series that we emphasise is the suspicion of a pathological fracture at the humeral shaft. There are no reports about the time of clinical symptoms referred by the patient before admission, but the mean time that we found was 18 days (range 1–90). Our institution is a general hospital similar to the majority in different countries in which orthopaedic surgeons work, so it is very important to carefully monitor patients with medical history of neoplasm to avoid this long wait before treatment and a faster return to daily activities.

We used anterograde intramedullary nailing without reaming and no cement added. We agree with the idea that surgical treatment should be done in patients with at least six weeks of expected survival [1, 15]. Cementation usually is performed to reconstruct large defects and enhance fixation [2, 11] and is also used in radioresistent tumours [1]; however, Hunt et al. found that fixation failure was not reduced. Also, by using advanced intramedullary implants, the use of PMMA at the site of the fracture is frequently unnecessary [9, 11]. Unreamed nailing without intramedullary cementation is less likely to result in embolic phenomena [14].

We only used radiation therapy in selective cases in coordination with our oncology service. Radiation therapy by itself may weaken the underlying bone [10] and may not stop the progression of disease [2]. It should be applied in appropriate individuals [10].

This was a retrospective study with oncology patients that speedily deteriorate and are lost to follow-up. Collecting information brings extra difficulties to performing validated outcome measurements and thus function was not assessed by a validated scoring system.

All patients achieved good relief of pain. This finding is in agreement with other studies [1, 3, 4, 7, 8–10, 13, 15, 16] and is one of the advantages of using IM nailing. Our patients returned to full use of the affected limb in daily activities at six weeks in most cases as reported by Atesok et al. [1]. Only two out of 19 patients were unsatisfied, reflecting a good procedure from the patient's point of view, which is similar to the results reported by Gebhart et al.

There was a mean hospital stay after surgery of 4.3 days. This reflects a low length of stay which improves the patient outcome (lowering possible intrahospital infections). We only had medical complications that were not directly related to the surgical procedure; this also agrees with findings in the literature [1, 2, 10, 13–15, 18]. The survival time after surgery in our series is the largest reported, and we think this is due to the type of primary neoplasm and the specific treatment received. In patients with sufficient survival time we can expect high consolidation rates as confirmed by our study and reported by Atesok et al. [1] (88%) and D'Ythurbide et al. [5] (92%).

In conclusion we think that IM nailing is a safe, rapid and effective procedure for treating pathological fractures

of the humeral shaft. We emphasise the idea of suspicion of the fracture and the interdisciplinary work between oncologists and orthopaedic surgeons, being of crucial importance for the survival time and individual treatment.

Conflict of interest The authors declare that they have no conflict of interest.

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