

S.M. Kumta · A.D. Quintos · J.F. Griffith
Louis T.C. Chow · K.C. Wong

Closed retrograde nailing of pathological humeral fractures

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Abstract We treated 19 patients with 21 pathological humeral fractures secondary to metastatic disease. All patients were stabilized using retrograde Ender's nails. Open reduction was required in one patient and mean operative time was 40 min (range 30–65 min). All patients retained satisfactory elbow and shoulder function while 16 patients reported good pain relief. Functional recovery was rated as good in 15 patients, fair in three, and poor in one. In our experience the retrograde technique using Ender's nails provides secure stabilization with minimal morbidity, minimal blood loss, and short operative time, and is well suited for this category of patients.

Résumé Nous avons traité 19 patients pour 21 fractures pathologiques de l'humérus secondaires à la maladie métastatique. Tous les patients ont été stabilisés par un enclouage rétrograde d'Ender. La réduction ouverte a été nécessaire chez un patient et le temps opératoire moyen était de 40 (30–65) minutes. Tous les patients ont retrouvé une fonction satisfaisante de l'épaule et du coude pendant que 16 patients ont rapporté le bon soulagement de la douleur. La récupération fonctionnelle a été estimée comme bonne 15 fois, moyenne 3 fois et mauvaise pour 1 patient. Dans notre expérience la technique rétrograde qui utilise les clous d'Ender fournit une stabilisation solide, avec une morbidité et une perte de sang minimales, un temps opératoire court et a bien convenu pour cette catégorie de patients.

S.M. Kumta (✉) · A.D. Quintos · K.C. Wong
Department of Orthopaedics & Traumatology,
Prince of Wales Hospital,
The Chinese University of Hong Kong, Shatin,
NT, Hong Kong SAR, China
e-mail: sm-kumta@cuhk.edu.hk
Tel.: +852-26322722, Fax: +852-26377889

J.F. Griffith
Department of Diagnostic Radiology and Organ Imaging,
The Chinese University of Hong Kong, Shatin, NT,
Hong Kong SAR, China

L.T.C. Chow
Department of Anatomical and Cellular Pathology,
Prince of Wales Hospital, Shatin, NT,
Hong Kong SAR, China

Introduction

Skeletal metastases from primary carcinomata are often complicated with pathological fractures. Operative fixation of pathological fractures provides skeletal stability, pain relief ease of nursing care, and thus maintains function over a longer period of time [4, 8].

Methods of fixation for pathological humeral fractures include plates and screws (with or without augmentation with methylmethacrylate cement) [5, 7], interlocking intramedullary nails [2] and tumor resection with replacement by prosthesis [1]. Closed intramedullary splintage using flexible intramedullary nails is an alternative treatment option that offers a relatively stable fixation with minimal operative morbidity. Antegrade humeral nailing has the disadvantage of affecting shoulder function through rotator impingement. Retrograde nail insertion through the olecranon fossa may also jeopardize elbow function as a result of triceps impingement and nail migration. An alternative distal site of nail entry is the lateral epicondyle of the humerus. A three-point splintage is effected as the nail follows a curved path from epicondyle to the proximal humerus.

Materials and methods

From 1997 to 1999 the authors treated 19 patients (eight men and 11 women) of average age 58 (39–88) years with 21 pathological humeral fractures secondary to metastatic lesions. Lung and breast carcinomas were the main primary tumors (Table 1). The majority of lesions occurred in the humeral diaphysis ($n=13$), but the proximal metaphysis ($n=5$) and the distal humeral metaphysis ($n=1$) were involved as well.

Table 1 Site of primary carcinoma

Site	Number of cases
Lung carcinoma	5
Prostate carcinoma	2
Breast carcinoma	5
Colon carcinoma	3
Renal cell carcinoma	2
Unknown primary	2



Fig. 1 A 68-year-old man with metastatic prostate carcinoma. Frontal and lateral radiographs show fixation with three Ender's nails for a large diaphyseal lesion. Bone cement was utilized as a plug at the lateral entry point and is visible on the frontal film

Operative Technique

Regional anesthesia was used in nine patients while general anesthesia was used in ten. Retrograde nailing was performed under radiological control. The patient was positioned supine on a standard orthopedic table with a hand table extension. The humerus, includ-

ing the elbow and shoulder joints, were screened prior to operative preparation. Fluoroscopic visualization of the proximal humerus including the shoulder joint is essential during the nailing procedure. Ender's nails were inserted from the lateral epicondyle of the distal humerus. The epicondyle and supracondylar ridge were exposed through a lateral incision. A sharp awl was used to make an entry site to facilitate insertion of the nail. The optimal direction and orientation of the entry portal was selected under fluoroscopic screening. A 3.5 mm nail was introduced through this portal into the medullary canal and its position confirmed under fluoroscopic imaging. While an assistant maintained traction the nail was negotiated past the fracture site through a combination of twisting and rotating movements as well as impaction. At least two nails were used in all patients, but in four the medullary canal was wide enough to accept three nails (Fig. 1). Proximally, the nail extended all the way up to the humeral head. Careful screening of the proximal shoulder and humeral head ensured that no migration into the joint or rotator cuff took place. The ends of the nails were cut, and the nails were then driven into the bone cortex to decrease skin impingement. A cement plug was used to cover the nail ends distally to prevent nail back out (Fig. 1). A Sarmiento-type external humeral brace was used postoperatively for additional support. Mobilization of the arm was started as soon as pain permitted, and adjuvant therapy as indicated was given when the operative wound had healed.

All patients were followed for at least 12 months after operation or until death, and were assessed for pain relief, upper limb function, operative complications, survival, and fracture healing. Pain relief were divided into three categories as good (no analgesic required), partial (needed analgesics but with a decreasing daily requirement of analgesics), and poor (regular analgesic similar to before operation). Upper limb function was evaluated using a Musculoskeletal Tumor Society Functional Score [3].

Results

Patients were followed up by the authors at a joint orthopedic and oncology clinic and assessed for pain, upper

Fig. 2 A 72-year-old woman with metastatic breast carcinoma. **a** Frontal radiographs show good fixation was achieved with two Ender's nails. **b** The patient achieved good functional range of motion of shoulder and elbow joints after the procedure



extremity function, operative complications if any, and survival.

No major complications were reported, and the average operative time was 40 (30–65) min. Pain relief was observed in 16 out of 19 patients: pain relief was good in 12 and partial relief was noted in four. Three patients had poor relief from pain. Patient survival was related to the primary carcinoma, and there were no surgical mortalities. Functional evaluation showed that 18 of the 19 patients were able to use their arm for activities of daily living (Fig. 2). Function was rated as good in 15, fair in three, and poor in one. The solitary patient with poor function had progression of disease and failure of humeral stability. He became bed-bound within 2 months of surgery and succumbed at 3 months. Median survival in this study was 11 months. Healing of metastatic fracture with callus formation following surgery and radiation therapy was noted in 11 of the 19 fractures.

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 stabilization must be achieved with the least operative morbidity. Rigid fixation is difficult to achieve in pathological fractures because of generalized bone weakness and cortical destruction by tumor infiltration. Stabilization with plates and screws (with or without augmentation with methylmethacrylate cement), or segmental tumor resection and replacement by custom-made prosthesis, are alternative options that have been used in the management of metastatic skeletal lesions [6]. However, these open procedures entail the risk of operative blood loss, radial nerve palsy, and postoperative infection. Postoperative adjuvant radiation can only be applied after satisfactory wound healing in these patients. Closed antegrade rigid intramedullary nailing has been used with satisfactory results [2], but concerns with possible shoulder impingement and stiffness prevail.

The retrograde entry of the Ender's nails through the lateral epicondyle has obvious advantages when compared with an alternative surgical approach using open transcortical retrograde placement of Rush pins through

the olecranon fossa [9]. Neither elbow nor shoulder movements are affected, and stabilization of very distal metaphyseal fractures is possible.

Closed flexible intramedullary nailing using a distal entry portal has provided a secure internal splintage in our patients and has been effective in achieving pain palliation. Moreover, adjuvant radiation therapy could be continued and started immediately following surgery as the operative site was well away from the tumor and the incision required was small. The short operative time and low morbidity is an advantage, especially in frail patients who may not withstand a major surgical procedure at the late stage of metastatic disease.

Pathological fractures of the humerus may be satisfactorily treated using closed flexible intramedullary nailing. The retrograde Ender's nailing procedure is simple and safe, ensures rapid and effective stabilization, and may be considered particularly in frail patients with late stage metastatic disease.

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