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Treatment of fractures of the proximal end and humeral shaft by locked intramedullary nailing in adults: Case series and literature review

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Abstract

Introduction: Intramedullary nailing is a good indication for stabilizing displaced fractures of the proximal end and shaft of the humerus in adults.

Methods: This was a prospective series of 24 patient, over a period of 9 months. The aim of this study is to report the epidemiological and clinical aspects of patients treated with a locked humeral nail and to show the medium-term interest, of this therapeutic method, thus discussing the complications.

Results: All patients had received intramedullary nailing of the humerus. The average age was 77.08 years. The female sex was more represented with 66.66% and the right side was frequently fractured with 83.33%. We distinguished 50% of cases involving the proximal end of the humerus, 45.27% of cases of the humeral shaft and one case of concomitant fracture of the proximal end and that of the humeral shaft. The postoperative infection rate is zero in our series and we reported 1 case of distal locking screw breakage, 1 case of iterative fracture on short Telegraph nail, 1 case of proximal screw retraction on long Telegraph nail and 1 case of perforation of the humeral head with a proximal locking screw.

Conclusion: humeral intramedullary nailing is a good alternative in fixing proximal end and humeral shaft fractures without considerable complications and damages for the rotator cuff muscles.

Keywords: Proximal humeral fractures; Humeral shaft fractures; Intramedullary nailing; Telegraph nail; Closed focus

Introduction

Humeral fractures, according to Seidel, account for around 5-6% of all fractures with 80% for proximal extremity fractures, 15% for shaft fractures and 5% for distal fractures [1]. Note that the origin of intramedullary nailing of long bones dates to the 1850s, the father of modern nailing is Gerhard Küntscher who, in 1939, proposed an anterograde intramedullary nail introduced with a closed method [2]. However, in France, it was Seidel in 1986 who described for the first time a nailing system for shaft fractures of the humerus with distal locking by intramedullary expansion [3], then thanks to a nailing material allowing locking. Proximal and distal with better control of rotational stresses [1, 4].

The indications for nail internal fixation at the level of the humerus mainly concern displaced fractures of the proximal end [5,6] and of the diaphysis, which makes it possible to obtain better stability and control of stresses, particularly rotational [5] [7]. We conducted a prospective study on a series of 24 patients with a humerus fracture treated with closed method locked intramedullary nailing (short and long nails) over a period of 9 months. The aim of this study is

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to present the epidemiological and clinical aspects of patients treated with a locked humeral nail and the anatomical and functional results in the medium term of this internal fixation technique.

Material and methods

This was a prospective series of 24 patient files including 8 male and 16 females with a sex ratio of 2, over a period of 9 months from January 1 to September 30, 2019. Our study was carried out. In the orthopedics and traumatology department of the Ibn Rochd University Hospital in Casablanca. Were included in the study, patients over 16 years of age, operated and followed for displaced fractures of the proximal end of the humerus and for fractures of the humeral shaft, patients who had benefited from locked intramedullary nailing (nails short and long). Not included in the study were patients with pallet fractures, non-displaced proximal end fractures, shaft and proximal end humerus fractures treated by others surgical methods. There was a total of 11 fractures of the proximal end of the humerus, 12 fractures involving the humeral shaft and 1 case of bifocal fracture concomitantly associating a fracture of the proximal end and the shaft. All the patients had been operated on urgently. The Stryker T2 and Telegraph nails (short for fractures of the proximal end of the humerus and long for fractures of the shaft) were used for internal fixation. Two surgeons used the Telegraph nail exclusively, two others exclusively the Stryker T2 nail, and one surgeon used both types of nails. An anterolateral approach from the shoulder directly to the acromion was performed in all of our patients, and internal fixation was performed under an image intensifier, the patient in a semi-seated position. Reaming before nail placement was necessary in 75% of cases (n = 18 patients) and the majority for long nails, i.e. 61.11% of cases (n = 11) of shaft fractures. Bone grafting was necessary in a single case of complex head and tuberosity fracture before nail placement (Figure 1).

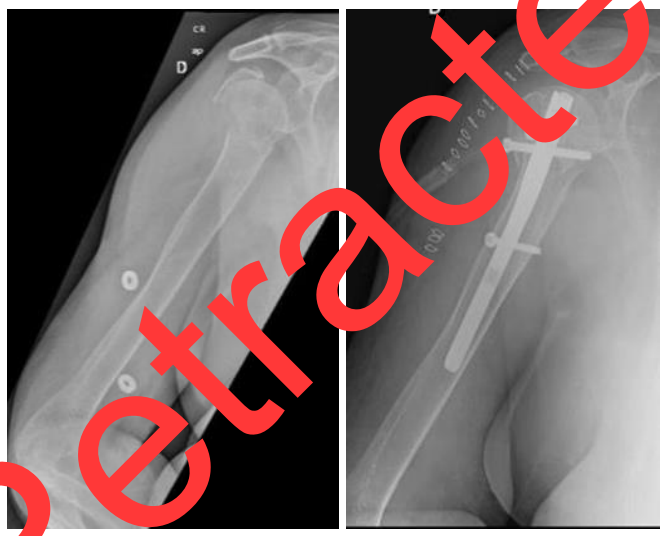

Figure 1 Complex head and tuberosity fracture (left); Good radiological reduction of tuberosities after placement of a T2 Stryker nail and bone graft (right)

Locking was static in 100% of cases (n = 24). Complementary immobilization of the shoulder by sling against sling was systematically done in all of our patients. The patients were systematically reviewed at one, three and six months postoperatively unless there was a particular problem, and a clinical and radiological examination was carried out to assess the function of the shoulder according to the Constant score, to assess consolidation and to look for possible complications.

Results

24 patients had received intramedullary nailing of the humerus. The average age was 77.08 years with extremes ranging from 29 to 94 years. The female sex was more represented with 66.66% (n = 16). The right side was frequently fractured with 83.33% (n = 20) against 16.67% (n = 4) for the left side.

The circumstances of the occurrence were largely dominated by mechanical falls, i.e. 91.66% of cases (n = 22) against only 8.34% (n = 2) for accidents on public roads. The mechanism was direct in 50% of cases (n = 12), indirect in 37.5% of cases (n = 9) and mixed in 12.5% of cases (n = 3).

Regarding the site of the fracture on the humerus, we distinguished 50% of cases (n = 12) involving the proximal end of the humerus, 45.87% of cases located at the level of the humeral shaft (n = 11) and one case of concomitant fracture of the proximal end and that of the humeral shaft, i.e. 4.16% (figure 2).

For fractures of the proximal end of the humerus, type II and VI of NEER were more encountered with respectively 45.45% of cases (n = 5) against only 9.1% (n = 1) for type III and for fractures of the humeral shaft were largely dominated by type A of the AO classification with 75% (n = 9).

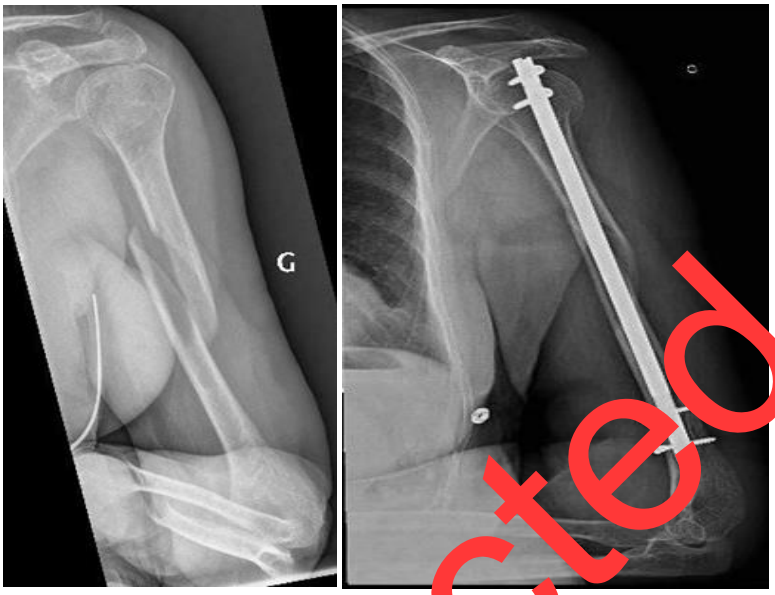

Figure 2 Closed head and tuberosity fracture and displaced in lateral humeral shaft (left). Placement of a long Telegraph nail with good reduction (right) immediately postoperatively and good consolidation 3 months postoperativ

The fracture was open only in one patient in our series, i.e. 4.17%. It is a type II according to the classification of Gustilo and Anderson (Figure 3).

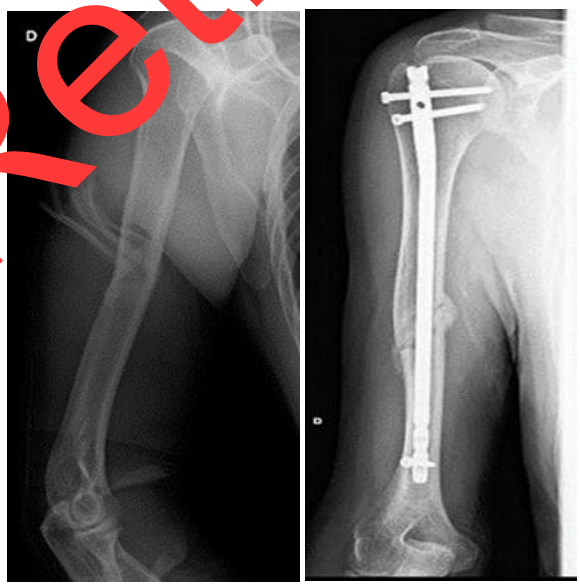

Figure 3 Gustilo and Anderson type II open fracture of the mid-shaft of the humerus (left); good consolidation in the 5th month after trimming and placement of a long Stryker T2 nail in an emergency (right)

Vascular and nervous status were normal in all of our patients on admission. 33.33% (n = 8) had lesions associated with the fracture of the humerus (head trauma, fracture of other limb segments). In 20.83% of cases (n = 5) of patients with

a fracture of the proximal end of the humerus, a CT scan of the shoulder was necessary in addition to the standard radiograph due to the complexity of the fracture injury.

The condition of the rotator cuff was assessed intraoperatively on each occasion before nail placement. The macroscopic characteristics concerning the condition of the cuff are highlighted in Table 1.

Table 1 Distribution of patients according to the condition of the rotator cuff

Condition of the rotator cuff	Number of patients	Percentage
Normal appearance	8	33.3
Degenerative but continuous	10	41.6
Transfixing rupture	5	20.8
Scarring	1	4.1
Total	24	100

The Telegraph nail and T2 Stryker were used in equal proportion for internal fixation the short nail for fractures of the proximal end and the long nail for those concerning the humeral shaft. All patients were immobilized postoperatively with a sling against a sling while immediately starting self-rehabilitation. The mean duration of postoperative additional immobilization was 4.75 weeks.

The immediate postoperative consequences were marked by the occurrence of a neurological complication such as radial nerve palsy in one patient, i.e. an overall rate of 4.17%, which had progressed well with complete clinical recovery and sign of reinnervation at the EMG in the 6th month. The postoperative infection rate is zero in our series. The rate of bone union at 6 months was 75% (n = 18) compared to 25% of patients not yet union (n = 6). The mechanical complications related to the nail at 6 months are: 1 case of distal locking screw breakage on Stryker T2 nail, 1 case of iterative fracture on short Telegraph nail, 1 case of proximal screw retraction on long Telegraph nail, 1 case of perforation of the humeral head with a proximal locking screw on a Stryker T2 nail.

For shoulder function, the average shoulder abduction at 6 months is 97.29° with extremes ranging from 50 to 180°. The weighted constant score is very good in 45.83% (n = 11), good in 45.83% (n = 11) and bad in 8.33% (n = 2).

4. Discussion

Locked intramedullary nailing is the best treatment for fractures in the long bone [8]. The principle is to place an internal stent intramedullary, in order to obtain rapid recovery, by proposing a stable assembly which allows immediate mobilization, the objective being to respect the anatomical and biomechanical axes of the bone segment by controlling the length and rotation and performing biological internal fixation (closed focus nailing) [2].

In our series, 75% of patients consolidated at the 6th month, this confirms the biological advantage of closed-method nailing as it was practiced in our context, despite the advanced age of our patients, with an average age of 77.08 years which may presage poor bone quality. In addition, the postoperative infection rate is zero in our series, which is in accordance with the results of certain authors such as G. Gaumet et al. [9], and thus shows the advantage of closed intramedullary nailing in the humerus in the prevention of postoperative infections.

The mechanical complications encountered in this series are generally in agreement with those found in the literature with regard to nailing of the humerus. In 2002 Cuny [10], when publishing the first series of Telegraph, found 15 conflicts secondary to a protruding nail or mobilization of a locking screw (26%). In 2004, Chassat [11] found 4 Telegraph nail protrusions (16%) and 5 broken screws (20%). In 2007, Boughebri [12] found 2 Telegraph nail protrusions (6%) and 4 proximal screw mobilizations (12%). Problems with locking screws appear to be the most frequent complications resulting in the protrusion of the subacromial nail over time. Intramedullary nailing allows robust synthesis, at the cost of a limited approach to the rotator cuff for anterograde nailing [9]. We were not able to make the direct link in our series between the approach of the rotator cuff in the placement of the nails and the functional deficit resulting due to the advanced age of the majority of our patients and which had pre-existing

degenerative cuff lesions before surgery, assessed intraoperatively with 41.67% of patients with a degenerative but continent cuff (n = 10), 20.83% transfixing rupture (n = 5) and one case scar cap.

The anterograde introduction of the humeral nail requires exact location of the entry point to avoid extensive lesions of the rotator cuff [13]. Clinical and anatomical studies have evaluated the disadvantages of proximal and distal nail insertion. Gaullier et al. [14] retrospectively studied rotator cuff trophicity using ultrasound. It turns out that it all depends on the nail insertion site. They recommend approaching the cavity, median in the articular area, but in line with the muscle-tendon junction of the cuff, which heals more safely. Gaullier et al. Seidel [1] as well as Kempf et al. [15] introduce the nail at the cartilage-major tubercle junction. Habernek and Orthner [16], Robinson et al. [17] use an external entry point, trochiterian.

In our series, the nail is systematically static locked in all of our patients. Locking prevents the development of vicious calluses in rotation, however, presents a risk of damage to the axillary nerve proximally and distally. Locking by screw carries neurological risks for the radial and musculocutaneous (Rupp et al. [18)], Blyth et al. [19]) as seen in our series with a favorable case of radial nerve involvement. Comparative biomechanical studies give contradictory results with regard to locking: for some (Dalton et al. [20], Henley et al. [21], Schopfer et al. [22]), distal locking by endomedullary expansion (nail of Seidel) provides lower quality rotational stress locking compared to screw-locked nails; but Mazirt et al. [23] showed that the main locked humeral nails retained similar mechanical properties.

For fractures of the proximal end of the humerus including cephalotuberosal fractures, the T2 nail offers a good possibility of placing four cephalic screws, allowing reconstruction and solid fixation of the tuberosities. The comminuted nature of the fracture sometimes makes this gesture even more uncertain and it is not uncommon to observe an early secondary displacement of the fracture site [9] and in the long term a vicious callus of the tuberosities.

Thus, intramedullary nailing in the surgical treatment of fractures of the humerus in adults is of great interest because, if done well, it proves to be of little damage for the rotator cuff with a low complication rate and represents an alternative to the screw-retained plate, because unlike the latter, nail placement does not seem to cause much neurological damage.

Conclusion

Anterograde intramedullary nailing of the humerus allows a stable internal fixation of the proximal extremity and the shaft. It is operated by a simple surgical technique, it is a good alternative in fixing fractures of the humerus, and for us, and despite some mechanical complications that can surely influence the function of the limb, it remains a good choice for proximal end and humeral shaft fractures without considerable damage for the rotator cuff muscles.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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