Centro-medullary nailing for the treatment of diaphyseal fractures of the humerus: Do we need a distal lock?

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ABSTRACT

Osteosynthesis of humeral shaft fractures using a centro-medullary nail is a reliable means of achieving bone consolidation and allows early mobilization of the upper limb. The main hypothesis of the present study is that a good primary stability of the impacted nail in the distal part of the medullary shaft allows the nail to free itself from the distal locking without impact on bone consolidation. The secondary hypothesis is that distal locking increases the operating time, the fluoroscopy time and the risk of iatrogenic neurovascular lesions, mainly radial paralysis.

Key words: Medullary nailing, humeral diaphyseal, distal locking, radial nerve.

INTRODUCTION

Osteosynthesis of fractures of the humeral shaft by means of a centro-medullary nail is a reliable means of achieving bone consolidation, allowing early mobilization of the injured upper limb, especially in the elderly, thus minimizing the risk of retractile capsulitis and stiffness (Bonnevialle, 1996).

The rate of bone consolidation after nailing is similar to that of plate osteosynthesis. It is a closed-focus "biological" synthesis with a lower risk of infection and radial paralysis as compared with plate (Gottschalk et al., 2016).

Distal locking is not systematic. Indeed, the humeral medullary cavity is funnel-shaped and is truncated cone-shaped (Figure 1). The nail impinges on the distal conical portion of the medullary shaft. Stability is thus ensured by direct contact between the nail and the bone below the fracture line. The main hypothesis of the present study is that a good primary stability of the nail impacted in the distal part of the medullary shaft would allow the nail to free itself from the distal locking without impact on bone consolidation and minimize the risk of radial paralysis and exposure to ionizing radiation.

MATERIALS AND METHODS

This non-randomized prospective study, conducted from 2015 to 2019, included 46 patients who had an osteosynthesized long medullary nail fracture of the humeral shaft. Regarding surgical technique, it is crucial to measure the exact length of the nail in order to avoid any proximal protrusion causing conflict with the cuff or distraction of the fracture site causing pseudoarthrosis.

The holding of the nail is related to sufficient distal length, so the nail must be impacted in the distal epiphysis to have satisfactory stability. Proximal locking was systematic after impaction of the nail in the distal conical portion of the humeral medullary shaft.

Rotational stability is tested by passive mobilization of the operated limb. Fluoroscopic and visual checks are envisaged in order to avoid displacement of the nail holder. We then fluoroscopically tested the rotational stability of the fracture. If this was the case, distal locking of the nail was not achieved.

If distal locking is required, there is no room for lateromedial distal locking in our study. Locking is always antero-posterior, so a minimal distal mini approach is systematically used in our practice in order to have direct visual control of the bone during drilling (Figure 2). Distal locking was often indicated in 1/3 distal humeral shaft fractures. All patients were evaluated clinically and radiologically (Figure 3) with a minimum of 6 months of follow-up.
RESULT

The mean age of the present study was 62 years, of which 12 patients were over 82 years old, with a sex ratio of females to males approaching 1, of which 76% of the traumas were low energy, 24% were polytrauma. Distal nail locking was achieved in 24 patients with a mean age of 70 years (50-90 years), and 22 patients with a mean age of 61 years (26-83 years) had no distal nail locking. The mean operative time with distal locking was 97 min and 82 s of fluoroscopy versus 57 min of operative time and 43 s of fluoroscopy for the group that did not have distal locking (p < 0.05) (Figure 4). Distal locking was found to prolong the duration of the procedure and increase exposure to ionizing radiation. All fractures consolidated at a rate of 95% within an average of 6 months in both groups, with only one case
Figure 3: Radiological examinations of consolidated diaphyseal humeral fractures.

Figure 4: Distal locking extends procedure time and increases exposure to ionizing radiation.
of pseudoarthrosis. In contrast, 3 post-operative radial paralyses were observed in the locked group, and 2 patients had an iterative fracture at the distal locking screw of the nail (Figure 5).

In summary, when the nail impacts in the medullary cone, it is not essential to lock it distally to obtain bone consolidation, which also reduces the operating time, fluoroscopy and the risk of neurological injury and iterative fractures.

DISCUSSION

The reference technique for centro-medullary nailing of humeral shaft fractures described by Klemm and Schellmann (1972), requires bipolar locking to control rotational stress and allows bone consolidation. Nevertheless, the technical difficulties (Tyllianakis et al., 2013) of distal locking lead to an increase in iatrogeny: the duration of the surgical intervention, the duration of intraoperative scopies (Ehlinger et al., 2012), responsible for additional radiation exposure for the patient and the surgical team, as well as the number of incisions exposing the patient to vascular and cerebral risks (Lefèvre et al., 2004; Rupp et al., 1996). Meyrues and Cazenave (2004) showed that “moderate instability” of the focus favors consolidation for about 6 weeks after the fracture.

A meta-analysis comparing compression plate osteosynthesis with nails locked in humeral shaft fractures did not show superiority of one method over the other (Bhandari et al., 2006). In a study by Cuny (2007), it was found 32 nails out of 104 without distal locking with 3 pseudoarthroses, no radial damage, and no infection [10]. Similar study conducted by Colombi (2017) demonstrated that isolated proximal locking in the humeral centromedullary nailing gave similar results in terms of consolidation and functional results as compared with the reference technique, bipolar locking. It was shown that the benefit-risk ratio of isolated proximal locking appears favourable, so bipolar locking does not appear to be recommended. This is true regardless of the location, type, or degree of comminution of non-pathological humeral shaft fractures (Colombi, 2017).

In the humerus in particular, difficulties in obtaining optimal lateral vision, the flattened and slippery surface of its distal part and the relatively narrow holes of humeral nails are additional problems when a lateral-medial approach is chosen (Garnavos, 2005, 2011). Numerous researchers have proposed either an open lateral-medial approach for direct vision or the use of antero-posterior screws only.

Studies have shown that not only the radial nerve can be affected, but also the ulnar and median nerves as well as the brachial artery are at high risk when the lateromedial

Figure 5: Distal locking increases the risk of neurological injury and iterative fractures.
locking technique is applied (Rupp et al., 1996; Blyth et al., 2003; Noger et al., 2007).

In our case, when the nail impacts in the medullary cone, it is not necessary to lock it distally to obtain bone consolidation, thus reducing the operating time, fluoroscopy and the risk of neurological injury. We did not observe any rotational disorders clinically. The nails were not locked in younger patients, probably due to a narrower medullary canal. Randomization was unethical because the goal of the surgery was to achieve consolidation.

Conclusion

Isolated proximal locking in the centro-medullary nailing of diaphyseal fractures of the humerus allows a bone consolidation rate and clinical results comparable to bipolar locking, with a reduction in operating time and exposure time to iatrogenic radiation from the image intensifier, while avoiding possible risks associated with distal approaches. In clinical practice, exclusive proximal locking reduces the risks for both patient and operator.

REFERENCES


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