Injury, Int. J. Care Injured 47S (2016) S64–S70

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Long endomedullary nail in proximal third humeral shaft fractures

Marco Caforio[a,*], Pietro Maniscalco[a], Massimiliano Colombo[b], Giorgio Maria Calori[b]

[a] Department of Orthopaedics and Traumatology, Piacenza Hospital, Italy
[b] Reparative Orthopaedic Surgery Department, G. Pini Institute, University of Milan, Italy

ARTICLE INFO

Keywords:
Proximal humeral fracture
Humeral shaft fractures
Distal locking
Long humeral nail

ABSTRACT

Introduction: Proximal humeral fractures with a spiral line of fracture extending from the humeral head to the diaphyseal region are increasing. Treatment for these fractures is comparable to that for shaft fractures. The purpose of this study was to evaluate the use of a new "Long" humeral nail for this type of lesion and identify the best distal locking.
Materials and methods: Forty-three patients treated with a Long Diphos Nail® were selected for this study: main exclusion criteria were poor cognitive and responsive ability to physical therapy, four-part fracture requiring humeral head replacement, an isolated greater or lesser tubercle fracture and a head-splitting fracture. All patients were divided into two groups according to the distal locking (single or double) and clinically evaluated at 1, 3, 6 and 12 months after surgery. The following parameters were evaluated: fracture healing on radiographic images every month; level of pain with Visual Analogue Scale (VAS); recovery of shoulder function or ability to resume normal daily activities according to the Constant Scoring System (CSS); patient satisfaction; and complications, like fracture consolidation defect or delay. A statistical analysis was performed.
Results: Improvements in pain, satisfaction and shoulder functional recovery were recorded. Patients reached fracture healing in two to six months. The mean healing time was better for double distal locking ($p = 0.04$).There was a clinically greater difference ($p = 0.006$) between the groups for the mean Constant score at 3 months follow-up, with better results for the double distal locking group. Complications were: one patient with a consolidation delay with a single distal locking screw breakage; it was necessary to remove the nail and perform a second treatment.
Conclusions: The results of the study indicate the efficacy of Long Diphos Nail® in the treatment of fractures with a line of fracture extending to the proximal diaphyseal region. The features of a multiplane stabilisation above the fracture and a distal double locking may represent the key for a good fixation for 11-A2, A3 or B2 fractures with a long spiral line. A double distal locking reduces fracture micro-instability and so patients recover function and strength quicker because of less pain at the fracture site.
Study design: retrospective, cohort of cases.
Level of evidence: IV.

Introduction

Proximal humeral fractures are becoming increasingly common because of the aging population, the rising incidence of osteoporosis and an upsurge in physical activity; a particular increase is observed in proximal humeral fractures with a fracture line that extends to the proximal diaphyseal region [1,2]. The target of osteosynthesis is to restore the anatomical alignment of the diaphysis with the humeral head and the tuberosities to enable early rehabilitation. There are many treatments for proximal humeral fractures [3]. A careful preoperative study of individual fragment size and position enables the surgeon to establish the best kind of fixation [4]. The main indication for using an endomedullary nail is two-part: surgical neck fracture that extends to the metaphysis/proximal diaphysis region in which the humeral head and tuberosities are a single fragment [5]; however, some authors also described good results with the use of a new type of endomedullary nail for multifragment proximal humeral fractures [6]. The most important requirements of this nail design are the ability to put proximal screws in many multiplanar configurations and to lock epiphysis and metaphysis fragments to the nail and then with the diaphyseal shaft.

* Corresponding author. Department of Orthopaedics and Traumatology, "Guglielmo da Saliceto" Hospital,Piacenza, Via Taverna,49-20121 Piacenza, Italy.
E-mail address: marco.caforio@tiscali.it (M. Caforio).

http://dx.doi.org/10.1016/j.injury.2016.07.037
0020-1383/

With regard to the breakdown forces the humeral metaphysis may be assimilated to a diaphyseal region. Authors compare these proximal humeral shaft fractures to subtrochanteric and distal tibial shaft fractures [7]: there is often a spiral rhyme with different grades of comminution and a great proportion of fractures extend into the humeral head with growing rates of displacement. Diverging traction of deltoid and pectoralis muscle causes typical displacement if the fracture line runs in between their attachments, substantiating the term intermuscular fracture [7]. Although Muller AO classification does not separate them as a real type of lesion, their treatment requires important consideration and differs to that for proximal or diaphyseal humeral fractures [4]. These fractures can be assimilated to 11-A2, A3 or B2 fracture (Fig. 1).

Although a *meta*-analysis in 2013 showed that plating in humeral shaft fractures may reduce the occurrence of shoulder problems like rotator cuff impairment, stretching of the radial nerve, shoulder impingement and restriction of shoulder motion, many authors also described good results with endomedullary nail in this fracture type [8]. Proximal humeral fractures that extend to the proximal diaphyseal region can lead to angle, rotation or shortening defects, but angulation (up to 20° of bending and 30° of varus), rotation (up to 40°) or shortening (up to 3 mm) defects are considered tolerable [5]. In our Orthopaedics and Traumatology Department most proximal humeral fractures are usually treated with endomedullary nail, to reduce soft tissue damage and blood loss.

The aim of this study was to evaluate the preliminary efficacy results of a new type of endomedullary nail, the Long Diphos Nail® (Lima Corporate) in proximal humeral fractures that extend to the proximal diaphysis and to assess which distal locking technique (single or double) is better in these fractures.

Materials and methods

Between January 2010 and January 2013 in our Orthopaedics and Traumatology Department 75 surgical neck fractures with the rhyme extended into the proximal diaphyseal region were treated: 15 patients were treated with plate and screws, 12 with external fixator and 48 with endomedullary nail.

This study included all patients treated with endomedullary nail. Inclusion criteria were as follows: patients with displaced proximal epiphysis humeral fracture extending to the proximal diaphysis, Body Max Index (BMI) between 18.50 and 24.99 and a Long Diphos Nail® treatment. Exclusion criteria were as follows: patients treated with other techniques, poor cognitive and responsive ability to physical therapy, counter indication for non-operative treatment due to fractures lacking severe comminution, four-part fracture requiring humeral head replacement, an isolated greater or lesser tubercle fracture and a head-splitting fracture. The study included 43 patients: 26 female (60.5%) and 17 male (39.5%), with mean age 77.1 ± 7.4 years (range 60–92 years). The types of closed fractures were as follows: 13 patients with fracture 11-A2 (30.2%), 12 with 11-A3 (27.9%) and 18 with 11-B2 (41.9%) (Table 1).

Trans-olecranic traction was not required in this study because vascular or nervous deficits did not present at arrival in the emergency room, fractures were not very displaced and surgical treatment had been programmed for the next day in all cases.

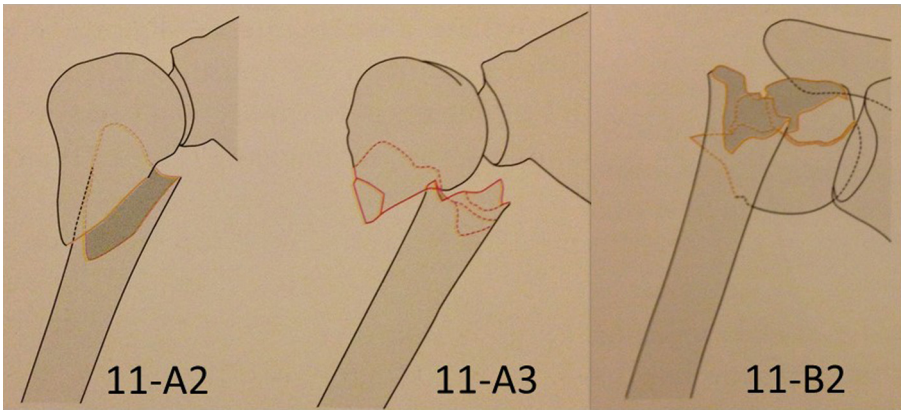

Fig. 1. 11-A2, 11-A3 and 11-B2 type fractures of proximal humeral epiphysis that we treated with Long Diphos Nail® when rhyme of fracture is extended in diaphyseal region.

Table 1
Design Overview.

		Type of fracture with AO class			Sex	
		A2	A3	B2	Female	Male
Age	under 70 years old	3 14.30%	6 28.60%	12 57.10%	11 52.40%	10 47.60%
	over 70 years old	10 45.50%	6 27.30%	6 27.30%	15 68.20%	7 31.80%
Total		13 30.20%	12 27.90%	18 41.90%	26 60.50%	17 39.50%
Sex	Female	6 23.10%	11 42.30%	9 34.60%		
	Male	7 41.20%	1 5.90%	9 52.90%		