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Double plating for bicolumnar distal humerus fractures in the elderly

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KEYWORDS

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ABSTRACT

Distal humerus fractures are uncommon injuries requiring specific clinical and radiographic analysis in order to plan the optimal therapeutic strategy. In particular, bicolumnar distal humerus fractures (Type A2, A3 and C) are complex fractures. In the last years, double plating fixation became the standard treatment: this procedure helped surgeons to obtain a stable and anatomical fixation and an early mobilization, which is the main outcome for obtaining valuable functional results. In this retrospective study, we evaluated the use of open bicolumnar 90–90 plating for fixation of acute fragility fractures of the distal humerus in elderly patients, using the olecranon osteotomy as surgical approach.

Introduction

Bicolumnar distal humerus fractures need a complex and accurate management. They represent approximately 2–6% of all the fractures and 30% of the fractures of the elbow [1]; the estimated incidence in the United States has been reported 287 patients for 100,000 people each year [2]. In young people, these fractures are usually caused by high-energy trauma (sports injuries, car accidents); in elderly people with osteoporosis, they are caused by low-energy trauma. Even if their incidence is not very high, a neurovascular injury and an open fracture can often be present due to the anatomical site and traumatic mechanisms [3–5]. Fragility fractures of the distal humerus in elderly patients, especially the low transcondylar fracture pattern, can be difficult to be managed in an optimal manner. In the past, non-operative treatment and percutaneous surgery (Kirschner wires) needed prolonged periods of cast, increasing the risk of subsequent local complications such as joint stiffness, muscle atrophy, mal-union and non-union. Nowadays, it is generally accepted that internal fixation with double plating provides the most favorable outcome for distal humeral fractures due to reconstitution of joint congruity, the restoration of the functional bone axis, the stable fixation provided and the early mobilization of the affected joint [6–8]. In elderly people, Total Elbow Replacement (TER) is now the treatment of choice for unreconstructable fractures of the distal humerus [9,10]. This option should therefore be available at the time of surgery for all distal humeral fractures in this patient population. Our experience however, suggests that a technique of 90–90 bicolumnar planning may be the best therapeutic option for the management of these injuries, particularly in selected patients with fragility distal humeral fractures, requiring multiple points of fixation in various planes [11–13].

The aim of this study therefore was to evaluate in elderly patients the clinical results of distal humeral fractures managed with double plating.

Materials and methods

Between 2010 and 2014, 15 consecutive patients aged >60 years (no formal bone density measurement was required) requiring open reduction internal fixation (ORIF, double plating 90–90) for fractures of the distal humerus caused by low-energy trauma, were reviewed. A clinical and radiographic follow-up was performed at months 1, 3, 6, 9, 12. Only complete clinical data and radiographs were accepted for this retrospective study. The mechanism of the fractures, the site and the characteristics of the fractures were carefully analyzed. We used the Comprehensive AO Classification [14] to classify the fracture pattern on preoperative radiographs. Institutional board review approval was obtained for this study.

AO/muller classification

Many classifications have been proposed for this bone segment, such as Mehne-Mehta and Riseborough-Radin classifications for intercondylar humerus fracture. The correct classification has an

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impact on the timing of surgery and allows the best choice of the surgical approach and the specific instrumentation. However, AO/Muller classification is the best and the most commonly used one. According to this classification, bicolumnar distal humerus (1.3) fractures include A2, A3 and C pattern:

A2: extra-articular fracture, metaphyseal simple;
A3: extra-articular fracture, metaphyseal multifragmentary;
C1: complete articular fracture, articular simple, metaphyseal simple;
C2: complete articular fracture, articular simple, metaphyseal multi-fragmentary;
C3: complete articular fracture, articular multifragmentary.

Preoperative treatment

The pre-operative planning is based on both physical examination and a careful study of the radiographic (AP, LL and oblique) and Computed Tomography (CT) images (sagittal, frontal and 3D reconstruction, if possible).

Surgical technique

The patient is placed in prone or lateral decubitus position. The most widely used surgical approach is the osteotomy according to Chevron [15]; this is the only one that can be extended. The alternatives approaches include surgical techniques that raise the triceps, as the Bryan-Morrey Approach or the TRAP (Triceps Reflecting Anconeus Pedicle) [16,17], although they can lead to an avulsion of the triceps, leading to a weakness in the final phase of the forearm extension. The skin incision is 5 cm proximally to the apex of the olecranon and it continues longitudinally and medially on the posterior surface of the elbow (performing a slight lateral curvature around the olecranon). Subsequently, at the medial edge of the triceps, the ulnar nerve is isolated and protected by a loop after the release of the "cubital tunnel." The radial nerve must be isolated only in case of proximal extension of the surgical approach. The osteotomy according to Chevron allows the proximal retraction of the triceps and the subsequent exposure of the posterior surface of the distal humerus. In case of severe comminution, no fragment should be eliminated, even those whose size does not allow a fixation. Only in some cases, the use of a bone graft is mandatory. With regard to the olecranon osteotomy osteosynthesis can be performed by tension band wiring or, alternatively, with plate or compression screw. Finally, the ulnar nerve must be repositioned, avoiding its entrapment during the suture. The direct evaluation of the obtained reduction should not be sacrificed at the expense of the mini-invasiveness of surgical approach. However specifical mini-invasive approaches, like triceps-sparing, does not involve this risk. It has been shown that satisfactory result may be achieved by triceps-sparing including anatomical reduction and fixation of the fractures, avoidance of ulnar nerve injury, preservation of the extensor mechanism, decrease in incidence of myositis ossificans around the elbow and decrease in post-operative stiffness [18].

Results

Fifteen patients (11 females, 4 males, mean age 74 years) were enrolled in the study. The fractures were AO-type A2 ($n = 7$), type C1 ($n = 3$), type C2 ($n = 4$), and type C3 ($n = 1$). A surgical approach consisting of olecranon osteotomy according to Chevron was performed in all the patients. The postoperative management consisted of an immobilization with a brace at 90° of flexion for about 20 days, but from the third day it was recommended to start active assisted exercises (flexion/extension). In order to prevent heterotopic ossification [19], celecoxib 200 mg two times daily was administered for 20 days. Anatomic reduction was assessed by post-operative CT in cases of multi-fragmented or comminuted fractures. Fourteen patients recovered after a mean of 84 days from surgery (range 46–130 days) with an average arc of motion of 100° (range 65–135°). Only one case of fixation failure was observed (Figure 1): the frail elderly patient presents with poor bone stock and a variety of medical co-morbidities increasing the risk of developing this complication [20].

Discussion

The correct use of the plates, in terms of placement, size and number of screws, can obtain a stable and painless elbow and prevent complications such as stiffness or nonunion. The distal humerus can be represented as a triangular structure, consisting of three columns [16]: medial, lateral and transverse intercondylar; its stability depends on the integrity of this triangle. Recently Kumar et al. [21] showed that it is possible to obtain excellent outcomes in distal third fractures using only a single 4.5-mm LCP with two-screw (4-cortices) purchase in the distal fragment. Nonetheless, according to our observations, it is mandatory to use two reconstruction plates (normally 3.5 mm) positioned in a perpendicular or parallel manner, in order to restore the triangle. Currently, there are different opinions about the parallel or orthogonal positioning of the plates. Shin et al. in 2010 and Lan et al. in 2013 reported similar results: they concluded that there are no

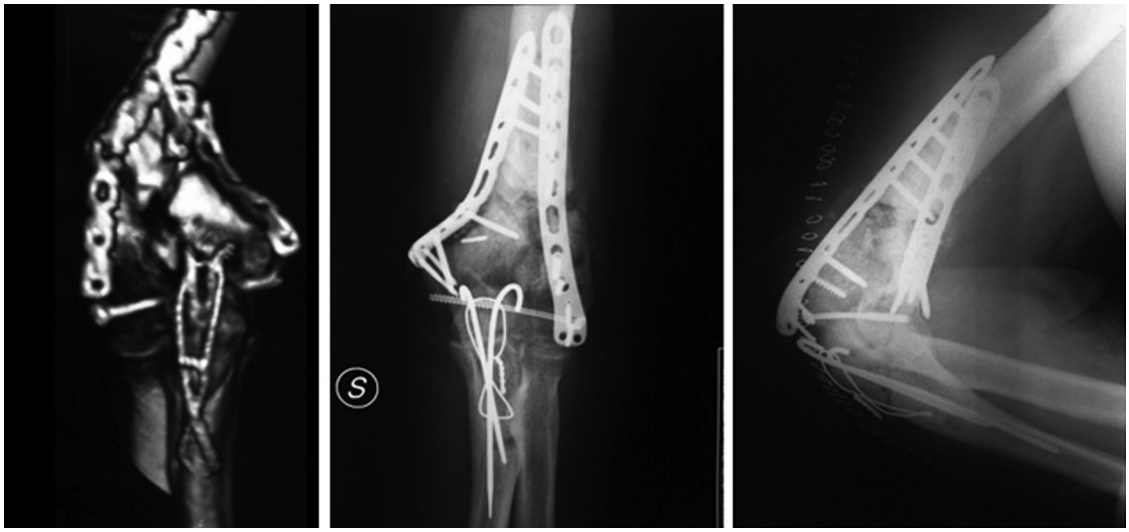

Fig. 1. Case of fixation failure.