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Original article

Treatment of intra-articular fracture of distal radius fractures with fluoroscopic only or combined with arthroscopic control: A prospective tomodensitometric comparative study of 40 patients

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ABSTRACT

Background: Considering articular distal radius fractures treated with volar plate, we hypothesized that articular radio-carpal displacement was better reduced with arthroscopic control than with only fluoroscopic control.
Methods: Forty patients with similar articular radius fracture (type C according to AO classification) and high functional needs were treated with volar plate fixation. They were divided in two comparative groups: 20 patients in Fluoroscopic group and 20 patients in Arthroscopic group. Pre and postoperative radiographs and tomodensitometric images were analysed by an independent observer. We evaluate extra and intra-articular displacements according to "Patient Accident Fracture" classification.
Results: We observed a better reduction of the radio-carpal step-off and gap in the arthroscopic group, with a statistically significant difference ($p < 0.05$). The index of postoperative intra-articular reduction was better in the fluoroscopic group (5.5) than in the arthroscopic group (2.2) with a significant difference ($p < 0.05$).
Conclusions: According to these results, arthroscopy is useful to perform a better articular radio-carpal reduction in distal radius fracture.
Level of evidence: Level 3.

1. Introduction

The distal radius fractures, which are the most common fractures of the upper limb, are a public health problem by their functional impact. The objectives of their acceptance differ according to the condition and the functional needs of the population. In young patients, the distal radius fractures are most often made of high-energy traumatism. These fractures are readily articular and associated with ligament injuries due to the fact of wounding mechanism and energy.

The CT evaluation of distal radius fractures allows better analysis of articular fracture line [1]. The aim of the treatment of articular distal radius fractures in active individuals is definitely an anatomical restoration, limiting the risk of osteoarthritis development [2]. Articular involvement of the distal radius and ligament injuries lead the surgeon to treat these fractures by anterior plate with arthroscopic assistance.

There are no prospective study comparing arthroscopically and fluoroscopically-assisted techniques with pre- and postoperative CT-scan.

The purpose of this study was to compare the reduction in articular distal radius fracture with and without arthroscopy assistance according to a tomodensitometric evaluation.

2. Methods

A total of 40 consecutive patients, operated between November 2008 and January 2013, were included in the study. All patients had similar demographics (age, gender, functional needs type 3 from "Patient Accident Fracture classification" [3]), accident and fracture characteristics according to AO classification. Those included in the study had an articular fracture AO type C with a preoperative wrist tomodensitometry exam and were treated with a volar plate fixation. Patients with open fracture, carpal tunnel syndrome or others injuries were excluded. All patients were treated by a surgeon supervised by the senior surgeon. We included 40 patients

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distributed in 2 groups of 20 patients: a group with reduction under control fluoroscopic only (Fluoroscopic Group) and a group with reduction under control arthroscopic associated with fluoroscopic control (Arthroscopic Group). There were 21 women and 19 men. The average age at the time of the traumatism was 44 years old (from 18 to 66 years old). In Fluoroscopic group, there was one fracture type C1, 2 type C3 and 17 type C2. In arthroscopic group, there was 1 fracture type C1 and 19 fractures type C2. We found 9% fracture type C1; 87% type C2 and 4% type C3 according to AO classification. An independent observer studied pre- and postoperative radiologic and tomodensitometric criteria.

All the patients had a standardized operation included a first common operating time for both techniques, fluoroscopic and arthroscopic. After an anterior approach and a primary reduction, a proximal screw was positioned in the elongated hole of the anterior plate in both groups. The second time was different according to the used technique: arthroscopic and fluoroscopic control or only fluoroscopic control.

After fluoroscopic control, the reduction was stabilized by implementation of volar plate with distal locked screws and temporary k-wires. Then, the last proximal screw was inserted. We used 9 plates Aptus (Medartis®) et 11 Distal Radius Plates (Synthes®) in each group.

In the arthroscopic group, the next step was to control the reduction with arthroscopic assistance. The wrist was positioned vertically on the table with a vertical traction.

A 2.7-mm, 30° small-joint scope was inserted in the 3-4 radiocarpal portal. A 6R portal was established to make an automatic wash-out [4,5].

Haematomas and loose bodies were removed using lavage. We made MCR and MCU portals to have a look to the interosseous ligament. We classified scapholunate and lunotriquetral ligament using Dautel's classification [6]. We tested Triangular FibroCartilage Complex ligament (TFCC) with a trampoline test and a hook test.

Then we checked the radial articular surface. When there was a gap or step-off larger than 1 mm, we mobilized small fragments, corrected step-offs with small probe and temporarily fixed them with K-wires. We finally fixed with the distal screws of the plate and we checked the position of the screws in the articular view. If a screw was malpositioned or intra-articular, the screw was redirected. A fluoroscopic control allowed estimating a scapho-lunate diastasis in ulnar deviation, a radio-ulnar subluxation or a diastasis on frontal radiographs in order to diagnose a Triangular Fibrocartilage lesion (TFCC), a scapho-lunate injury or to evaluate the reduction of the ulnar styloid fracture. All patients were immobilized with a short arm during 3 weeks. When an ulna fracture or a distal radio-ulnar instability was associated, we immobilized the elbow at 90° of flexion. All patients performed their rehabilitation by their own with active and passive mobilization of their fingers and wrist.

We performed a radiological analysis from the software Centricity Enterprise Web © 2006 GE Medical Systems. The measurements were performed by an independent observer. We studied pre and postoperative radiographic and tomodensitometric criterias from the Patient-Accident-Fracture (PAF) classification [3]. We used tomodensitometric analysis with 3D reconstruction in order to plan our reduction and temporary fixation.

The extra-articular displacement was estimated on anteroposterior and lateral radiograph. We measured radial inclination, ulnar variance, volar tilt and sagittal translation. For every criterias, the tolerable values were defined by a score at 1. We calculated the extra-articular displacement index (EAd index) by adding the score of the 4 radiologic scores. The score was scaled from 4, which was the tolerable value, to 12.

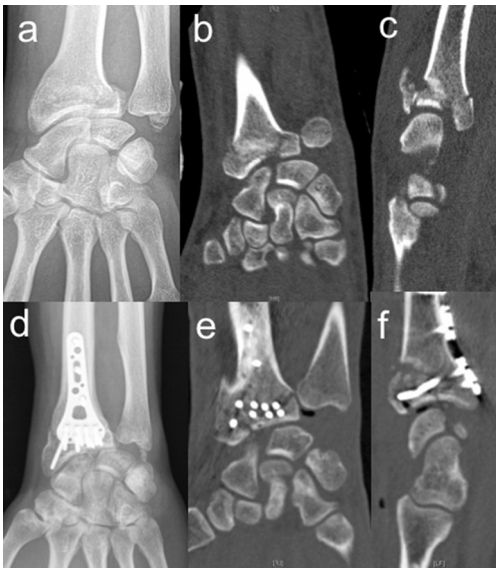

Fig. 1. Patient no. 4 of the series treated with arthroscopic control for articular distal radius fracture: a: PA preoperative radiograph; b: coronal preoperative CT-scan slide; c: lateral preoperative CT-scan slide; d: PA postoperative radiograph; e: coronal postoperative CT-scan slide; f: lateral postoperative CT-scan slide.

The articular displacement was estimated on tomodensitometric images with axial, frontal and sagittal views (Fig. 1). We individualized radio-carpal and radio-ulnar distal gap or step-off. For each of these values, we retained the maximal measurements on the various CT-scan images. The radio-carpal displacement was measured on frontal and sagittal views while the radio-ulnar displacement was estimated on the axial views. The measurements were performed from the unit software and then were classified from 0 to 3 according to PAF classification: 0 for no displacement, 1 for a displacement of 1 mm, 2 for displacement of 2 mm, 3 for a displacement superior to 2 mm. The tolerable values were 0 or 1. We chose this value because it has been well described in the literature as the most tolerable articular displacement [7–9]. We added these 4 criterias to calculate the articular displacement (IAd index) and the score was scaled from 0 to 16.

We compared preoperative measurements of the extra-articular displacement between the arthroscopic (AG) and fluoroscopic group (FG).

Statistical analysis: we calculated the averages on the Excel software (Microsoft office, version 15.37). Ordinal measures were compared using the Chi^2 test. We considered a statistical significant value when p was inferior to 0.05.

3. Results

3.1. Preoperative measurements

There was no statistical significant difference between the two groups (Fig. 2) for the patient's characteristics. Preoperative radial inclination was superior in the fluoroscopic group (2.1 according to the PAF classification) than in the arthroscopic group (1.5) with a significant difference ($p = 0.02$). The extra-articular displacement was comparable between the two groups with 4.3 in the arthroscopic group and 4.2 in the fluoroscopic group ($p = 0.45$).

There was no statistical significant difference between both groups concerning preoperative tomodensitometric measurements (radio-carpal gap and step-off, and radio-ulnar gap and step-off) (Table 1). The preoperative articular index displacement was comparable ($p = 0.45$).

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