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An original internal fixation technique by tension band wiring with steel wire in fractures of the coronoid process

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ABSTRACT

Fractures of the coronoid process, which is a key element in anterior elbow joint stability, represent 14% of proximal ulnar fractures. Optimal treatment should stabilize all fractures associated with elbow instability. Different techniques have been described: suture repair, screws, plates... We propose a series of 5 patients who were treated with an original, easy, tension band wiring fixation technique using steel wire with easy hardware removal.

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1. Introduction

The coronoid process (CP), located on the proximal, ventral [1] and intra-articular [2] part of the ulna, is the site of insertion of different structures: the anterior articular capsule, the tendon of the brachialis anterior muscle (deep head), and the medial collateral ligament. The CP plays a role in the stability of the elbow: as an anterior buttress against spontaneous posterior translation of the ulna [3,4] (primary element of stability according to Morrey [5]; element of anterior and medial column stability according to the column theory established by Jupiter and Ring [6]). Fractures of the CP have serious consequences to elbow stability [7–9] and require CT scan exploration [10].

Different classifications of CP fractures have been established: first by Regan et Morrey [11], then O’Driscoll et al. [12], and finally Adams et al. [13]. At present, the consensus is to stabilize all fractures of the CP (except for Morrey stage 1 fractures) associated with elbow instability. The goal of treatment is to obtain a stable, pain-free, functional elbow. Treatment should be begun as early as possible and be associated with early rehabilitation and short lasting immobilization. Different surgical techniques have been described: suture lasso, screws, plates... We propose an original internal fixation technique by tension band wiring with steel wire.

2. Surgical techniques

The basis is an intrasosseous tension band wiring technique with steel wire that provides stable fixation and is easy to perform, inexpensive, without sophisticated material as well as allowing early physical rehabilitation. The procedure can be performed under general or locoregional anaesthesia with a tourniquet. The surgical approach is determined by the associated injuries: lateral (fracture of the radial head), medial or posterior. The different steps of the technique are shown in Figs. 1 and 2. Associated ligament or bone injuries are then repaired. Besides the recommended prophylactic antibiotics, non-steroidal anti-inflammatories are associated to limit the development of heterotopic calcifications. Immediately rehabilitation begin with limited range of motion for the first month, protected during the sessions by brachial-antebrachial-palmar type immobilization.

3. Clinical series

Seven patients underwent surgery with this technique from 2004 to 2012. Two patients were excluded from the study: one patient died before revision and another presented with a fracture-dislocation of the homolateral carpal bone, which interfered with the clinical results. Five patients (4 men and 1 woman; 3 right sides and 2 left; 60% dominant sides) (Table 1) were seen retrospectively by an independent observer after a mean follow-up of 5.7±1.3 years [1.1–8.3 years]. The mean age at surgery was 39.3±5.6 years old [23.7–58.6]. All fractures were closed without neurovascular injuries. The distribution of fractures is shown in Fig. 3. The procedure was performed under general anaesthesia in all cases associated with locoregional anaesthesia in one case. The
tourniquet was used for a mean 97.5 ± 9.7 min [75–120 min]. The surgical approach was lateral (3/5), medial (1/5) or posterior (1/5).

Elbow range of motion at the final follow-up is shown in Table 2 (Fig. 4). All elbows were stable with no sensation of instability. Elbow muscular strength was normal (80 to 100% on the balance test) in all cases. The mean «Quick-DASH» score was 17.05 ± 8.93/100 and 91.0 ± 4.0/100 for the «Mayo Elbow Performance Score»: 2 excellent results (>90) and 3 good results (between 70 and 89). Union was obtained in all CP fractures and no dislocation or subluxation of the elbow was observed (Fig. 5).

Patients returned to work after 4 months. Hardware was removed in 4/5 cases after a mean 9.4 ± 2.0 months [4.3–13.1 months], because of local discomfort or preventively. No hardware failure or infection was noted.

4. Discussion

Internal fixation of CP fractures has better mechanical resistance than suture anchors used for fixation of small fragments [14,15]. Screws are indicated when there is a large fragment. For large
Fig. 2. Lateral perioperative fluroscopic view. A. Before reduction of the fracture. B. After placement of the wire. C. Tension band, intermediate X-ray before final tightening of the tension band and ligament repair.

Table 1
Clinical series.

<table>
<thead>
<tr>
<th></th>
<th>Patient 1</th>
<th>Patient 2</th>
<th>Patient 3</th>
<th>Patient 4</th>
<th>Patient 5</th>
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<tr>
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<td>Male</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Male</td>
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<tr>
<td>Age (years)</td>
<td>38.40</td>
<td>35.10</td>
<td>58.62</td>
<td>23.70</td>
<td>40.42</td>
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<tr>
<td>Classification of fractures</td>
<td>Morrey II 3</td>
<td>Morrey II B</td>
<td>Morrey III B</td>
<td>Morrey II 3</td>
<td>Morrey II 2</td>
</tr>
<tr>
<td>O'Driscoll</td>
<td>III 3</td>
<td>II 2</td>
<td>III 1</td>
<td>II 2</td>
<td>II 2</td>
</tr>
<tr>
<td>Motion (in degrees)</td>
<td>Flexion 135°</td>
<td>Extension +30°</td>
<td>Range of motion 105°</td>
<td>Pronation 80°</td>
<td>Supination 80°</td>
</tr>
<tr>
<td></td>
<td>130°</td>
<td>+45°</td>
<td>140°</td>
<td>85°</td>
<td>95°</td>
</tr>
<tr>
<td></td>
<td>140°</td>
<td>0°</td>
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<td>90°</td>
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</tr>
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<td>+10°</td>
<td>115°</td>
<td>85°</td>
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<td>+30°</td>
<td>120°</td>
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<td>90°</td>
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Table 2
Mobility at review.

<table>
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<th>Motion</th>
<th>Mean ± sd</th>
<th>Extreme series values</th>
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<tr>
<td>Flexion</td>
<td>137.0° ± 2.0°</td>
<td>130°–140°</td>
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<tr>
<td>Extension</td>
<td>+21.0° ± 7.81°</td>
<td>0°–45°</td>
</tr>
<tr>
<td>Range of motion</td>
<td>115.0° ± 9.62°</td>
<td>85°–140°</td>
</tr>
<tr>
<td>Pronation</td>
<td>86.0° ± 1.87°</td>
<td>80°–90°</td>
</tr>
<tr>
<td>Supination</td>
<td>85.0° ± 4.47°</td>
<td>70°–95°</td>
</tr>
</tbody>
</table>

sd: standard deviation.

fragments, a custom designed plate can be used. Articulated external fixation is not the first line treatment, but it is additional treatment, in particular to protect fragile fixation and/or persistent instability. Tension band wiring with steel wire seems to be a satisfactory alternative: easy to use without sophisticated hardware and inexpensive. Its main limitation is comminuted fractures.

The deep intra-articular location of the CP makes an approach by open surgery, as well as reduction, difficult. Arthroscopy is an interesting technique in these cases. It can help obtain intra-articular control of fracture reduction. Different authors have suggested using this technique to stabilize CP fractures [16,17]. In
Fig. 3. Distribution of different fractures in the series in reference to the Morrey (A) and O'Driscoll (B) classifications.

Fig. 4. Photographs of range of motion at follow-up.
our series, internal fixation was obtained by open surgery in all fractures. Although arthroscopic tension band wiring seems interesting because it would provide complete control of reduction, it remains difficult in these traumatic fractures.

Hardware removal is easy using the same surgical approach with a small incision, which is an advantage compared to internal plate fixation of the CP, because it limits damage to the soft tissues during removal.

5. Conclusion

Tension band wiring with steel wire is an interesting technique for internal fixation of CP fractures: it is easy to perform with any surgical approach, does not require sophisticated hardware, and provides a good radiological and clinical outcome. Its main limitation is comminuted fractures. This technique could be used for internal fixation of small bone fragments in other joints.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References