Long-term outcome of distal ulna resection–stabilisation procedures in post-traumatic radio-ulnar joint disorders

P. Mansat*, J.-E. Ayel, N. Bonnevialle, M. Rongières, M. Mansat, P. Bonnevialle

Department of Orthopaedic and Traumatology, Purpan Teaching Hospital Center, place du Docteur-Baylac, 31059 Toulouse cedex, France

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Summary
Introduction: Distal radius fractures represent 20% of fractures in adults. Although good results are usually obtained with treatment, functional sequelae are not uncommon, with injury of the distal radio-ulnar joint (DRUJ) being the most frequent. Various treatments have been described to address these disorders. Distal ulna resection-stabilisation (DURS) is our technique of choice when preservation of the DRUJ is impossible.

Patients and method: Twenty patients operated between 1985 and 1996 were reviewed with minimum 6-year follow-up. Nine of them were men and 11 were women, with an average age 45 years. The initial trauma was a distal radius fracture in all cases. The main complaint was ulnar pain with no limitation of mobility in five patients, painful limitation of pronation-supination in 14, and palmar subluxation of the ulna in one case. Radiographic evaluation and CT scan showed DRUJ incongruence in 14 patients with ulna head instability, and ulno-carpal abutment with degenerative changes at the DRUJ in six cases. In three patients, malunion of the distal radius was associated with degenerative DRUJ lesions.

Results: The satisfaction rate was 95% at an average follow-up of 11 years (range 6.7 to 18.6 years). Pain scores decreased progressively from 2.2 to 0.5 post-operatively. Range of motion improved in supination from 37° to 80°, and in pronation from 66° to 84°. Improvements were 15° in ulnar inclination, 9° in radial inclination, 16° in flexion, and 23° in extension. Distal ulna palpation was not painful, and no instability was observed on movement. Wrist strength was equivalent to 80.8% of the healthy contra-lateral side. Radiographic results showed no anomaly of the resected ulna, no sign of abutment on the radius and no ulnar translation of the carpus at follow-up. Only one patient, who presented algoneurodystrophic syndrome after the initial trauma, had a recurrence after DURS.
Introduction

Distal radius fractures represent 20% of fractures in adults and one-sixth of fractures seen in a trauma service. Although the results of treatment of these fractures are usually good, functional sequelae are not uncommon [1]. Injuries of the distal radio-ulnar joint (DRUJ) are the most frequent sequelae of a limited and painful wrist in 15 to 50% of cases [2,3]. Different approaches have been described for the treatment of these sequelae. Distal ulna resection-stabilisation (DURS), derived from Darrach’s technique [4], is our technique of choice in addressing this problem when preservation of the DRUJ is impossible. The objective of this study was to analyse our experience with the technique in a continuous, monocentric series of 20 patients with an average follow-up of 11 years. The surgical technique, clinical and radiographic results as well as its indications are described.

Patients and method

Patients

Between 1985 and 1996, 27 patients were treated for traumatic sequelae of the DRUJ by DURS. The inclusion criterion in this study was minimum follow-up of 6 years, with seven patients being excluded because of insufficient follow-up. Twenty patients were thus investigated: nine men and 11 women, with an average age of 45 years (range 16 to 71 years). Nineteen were right-handed, and one was ambidextrous. The dominant side was injured in 13 cases. Eight patients worked in a manual profession, and five did not. Three patients were not working, and four were retired. The initial trauma was a distal radius fracture in all cases. The injury was work-related in seven cases, secondary to a fall at home in nine cases, due to sports in one case, and involved a public accident in three cases. Initial treatment of the radius fracture was orthopaedic with simple reduction and immobilisation in eight cases, and surgery in 12 cases. The latter involved the installation of pins in seven cases, a palm cast in three cases, and an external fixator in two cases.

The average time period between the initial trauma and DURS was 22.5 months (range 3 to 228 months). The main complaint was ulnar pain in five cases without limited mobility, painful limitation on pronosupination in 14 cases, and palmar subluxation of the ulna in one case. Radiographic evaluation (Fig. 1A and 1B) and CT scan (Fig. 1C and 1D) revealed DRUJ incongruence in 14 cases with ulna head dislocation in eight cases, simple subluxation in six cases, and ulno-carpal abutment with inversion of the DRUJ index and degenerative injury of the joint in six cases. In three cases, vicious callus of the distal radius was associated with degenerative lesions of the DRUJ. Ulnar variance was estimated to be +3.65 mm (range -2 mm to +8 mm). Preoperative strength was evaluated by dynamometry (JAMAR®) in 11 patients.

Surgical technique

Patients were placed in a dorsal decubitus position with the injured limb on a hand table. A tourniquet was posi-
tioned at the base of the limb. A 6- to 7-cm longitudinal dorsal incision was made lateral to the ulna head. Subcutaneous dissection allowed protection of the dorsal veins and sensitive dorsal branch of the ulnar nerve. The extensor retinaculum was incised relative to the 6th compartment, then reclinmed medio-laterally up to the 4th compartment. Longitudinal and dorsal capsulotomy was performed at the level of the DRUJ, and the ulna head was exposed. Transversal osteotomy of the ulna head was undertaken with an oscillating saw at the head-neck junction (Fig. 2A). The ulna head was then excised and the ulnar stump was adjusted by gouge forceps and rasp to avoid any conflict with the extensors and the radius. The capsule was then sutured with reduction of the ulna maintained by dorsal pressure in the direction of the palm, thus re-installing tension on the ulnocarpal ligaments (Fig. 2B). The extensor retinaculum was passed under the extensor carpi ulnaris (EUC) tendon and sutured inside the 6th compartment. A retinacular flap was then created to dorsalise the EUC tendon on the ulna for its dynamic stabilisation (Fig. 2C). Nothing was done to the radius. Hemostasis was undertaken after loosening of the tourniquet. The skin was closed in two layers with a suction drain. Post-operative immobilisation with a wrist splint was maintained for six weeks. Slight movements at the level of the fingers were allowed within the limits of the splint during this period. Specific rehabilitation for flexion-extension recovery and prono-supination did not begin until the end of the 6th week. Wrist reinforcement was only allowed from the 3rd month.

Evaluation method

All patients were evaluated at last clinical and radiographic follow-up. Subjective patient satisfaction was noted. The post-operative pain level was evaluated on a visual analog scale and scored as: 0 = no pain; 1 = minimal pain; 2 = pain on activities with strength; 3 = pain on light activities; 4 = permanent pain. Joint mobility was measured with a goniometer in flexion, extension, pronation, supination, ulnar inclination and radial inclination. Wrist strength of the operated and healthy contra-lateral sides was evaluated with a dynamometer (JAMAR®).

Radiographic analysis consisted of anterior and lateral X-rays. Ulna morphology and all changes at the level of the radius were studied. Ulnar translation of the carpus was estimated according to the index of Bouman et al. [5], and its normal value was equivalent to 0.87 ± 0.04. This index corresponds to the length of the radius joint surface in the frontal plane, divided by the distance between the styloid process of the radius and the ulnar side of the os lunatum.

Results

Overall satisfaction

The satisfaction rate reached 95% at 11-year follow-up (range 6.75 to 18.6 years). The 13 patients who were professionally active before the intervention were able to resume work afterwards.

Clinical results

Pain scores decreased progressively from 2.2 pre-operatively (range 0 to 4) to 0.5 post-operatively (range 0 to 1). Range of motion basically progressed from 37° in supination pre-operatively to 80° post-operatively (average improvement of 43°), but also in pronation from 66° to 84° (average improvement of 18°). The improvements achieved were 15° in ulnar inclination (from 20 to 35°), 9° in radial inclination (from 15 to 24°), 16° in flexion (from 41 to 57°) and 23° in extension (from 40 to 63°). The ulna was not painful on palpation, and no ulnar stump instability was found during movements. Wrist strength was 80.8% of the healthy contra-lateral side. Of the 11 wrists that were evaluated pre-operatively, post-operative improvement was 28.2%, that is, 10 kg.

Radiographic results

There was no anomaly at the level of the resected ulna and no sign of abutment with the radius. In some cases, however, remodelling of the radial metaphysis was observed without clinical consequences (Fig. 3). No ulnar translation of the
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DRUJ is impossible [8,9]. Conservative treatment is contra-
treatment consists of resecting the distal ulna or fusing it indicated when there are degenerative lesions of the DRUJ without shortening of the ulna [6,7]. In contrast, radical the DRUJ by correcting vicious callus of the radius with or of conservative treatment is to preserve and reconstruct radial metaphysis, and the absence of carpi ulnaris translation.

carpus was seen at follow-up with the index of Bouman et al. [5] equal to 0.9 mm post-operatively (range 0.8 to 1.12 mm).

Complications

No complications were associated with the surgery. However, one patient, who presented algoneurodystrophic syndrome after the initial trauma, manifested a new algo-
dystrophic syndrome after DURS.

Discussion

Distal fractures of the radius may lead to significant sequelae responsible for 20 to 35% of unsatisfactory results, with DRUJ injury being the most frequent and varying from 15 to 19% of cases in the literature [1,2]. The clinical consequences range from isolated pain in the ulnar side of the wrist to limitation of the prono-supination curve, with decreased strength and instability of the ulna head [6,7]. Degenerative lesions appear on follow-up [3].

Two surgical solutions for the treatment of these seque-
lae may be discussed: conservative or radical. The goal of conservative treatment is to preserve and reconstruct the DRUJ by correcting vicious callus of the radius with or without shortening of the ulna [6,7]. In contrast, radical treatment consists of resecting the distal ulna or fusing it with the radius when reconstruction of a normal and mobile DRUJ is impossible [8,9]. Conservative treatment is contra-
indicated when there are degenerative lesions of the DRUJ or when the joint is incongruent [9,10]. Radical interventions are numerous: distal resection of the ulna according to the Darrach technique, partial resection of the ulna according to Bowers or Watson, the “wafer procedure”, or the Sauvé-Kapandji approach [11,12].

Bain et al. [13] reported the results obtained with tech-
niques similar to those described by Bowers [14] and Watson et al. [15]. Forty-nine patients were reviewed with an average follow-up of 36 months. Only 35 of 49 patients (71%) showed improvement of painful symptoms, 16 presented persistent discomfort in extreme rotation positions and 19 during DRUJ compression. The rotation curve was 67° in supination and 72° in pronation. Abnormal ulnar sway was found in 16 patients. Radiography showed evidence of ulno-
carpal abutment in nine of 49 cases (18%). Surgical revision was necessary in four cases to treat the abutment. Using the same technique, Bowers [14] reported persistent pain in 11% of cases, and Watson and Gabuzda, in 27% [16] to 32% of cases [15]. The results were better in our series with longer follow-up, including the suppression of painful symp-
toms, the recovery of joint amplitudes and strength, and a low complication rate.

Darrach popularised distal resection of the ulna in 1913 [4,17]. Although the initial results were encourag-
ing, complications were reported: painful instability of the ulna [11,18—20], painful abutment on contact with the radius [14—22], significant diminution of wrist strength [11,12,16,22—25], carpus instability with sliding of the ulna [11,16,18,22,26], or rupture of the extensor tendons [12]. Changes of the original technique were then proposed to stabilise the ulnar stump: ligament plasty and capsuloplasty [26], stabilisation with the square pronator muscle [19], dor-
salisation of the EUC tendon [27—30], or tendinoplasty with the EUC tendon [31,32]. In 1952, Dingman demonstrated that the more resection of the ulna was reduced, the better were the results, far from Darrach’s description, which recom-
manded resection equivalent to the “length of an inch” [4,33].

The failure rate associated with resections of the distal ulna varies from 10 to 50% in the literature [21,22]. However, most of these failures were linked with excessive resection of the ulna. Although abutment between the residual ulna and radius has been reported [19], no such cases were found in our series. However, McKee and Richards [21] observed remodelling of the radial metaphysis, frequently without clinical consequences. Ulna translation of the carpus, often related to radio-carpal or intra-carpal lesions, is rarely seen in traumatic sequelae, unlike rheumatoid wrists [34].

Satisfactory results have also been reported after distal resection of the ulna. Hartz and Beckenbaugh [35] obtained satisfactory results in 82% of 62 patients, with an average follow-up of 87 months. Asymptomatic ulnar translation was found in four cases. The improvement in mobility was mainly in supination. Wrist strength was equivalent to 79% of the opposite limb. Nolan and Eaton [29] similarly reported satisfactory results in eight patients treated for an injury of the triangular complex with significant improvement of wrist strength at an average follow-up of 40 months. The mobility arc was close to normal with recovery to 85% of contra-lateral wrist strength. These authors insisted on the necessity of performing capsulo-dorsal and ligament plasties to stabilise the distal end of the ulna in associa-
tion with dorsalisation of the EUC tendon. Tulipan et al. [36], analyzing the results in 33 patients at an average follow-up of 54.4 months, reported 91% satisfactory results, with all of them resuming their activities. Recovery of strength was equivalent to 84% of that of the healthy wrist. Two patients complained of EUC tendonitis after activities requiring strength. These authors underscored the importance of dorsalisation of the EUC tendon to stabilise the ulna.

The Sauvé-Kapandji technique is an alternative to DURS for the treatment of traumatic DRUJ sequelae [11,20]. With 33 months of average follow-up, Sanders et al. [37] reported excellent results in six patients and good results in three, with moderate pain persistence on effort. Talesnik et al. [38] noted the absence of pain in 11 of 17 operated patients, and pain during effort in five patients at an average follow-up of 39 months. One patient showed no improvement with the persistence of permanent pain. Strength was increased in all except one case. The ulna was unstable in two cases. Millroy et al. [25] found 100% instability of the distal ulna in a rheumatoid patient population, but with satisfactory results involving the recovery of joint amplitudes as well as strength, and suppression of pain. Nakamura et al. [39] reported satisfactory results for pain, mobility and strength in a post-traumatic patient population with DRUJ instability and degenerative lesions, but noted one case on 15 of pseudo-arthroisis of the ulna head, persistent pain in eight cases, and instability of the resected ulna in eight cases that required surgical revision. Brunet et al. [40] described their results in a series of 14 patients treated by the Sauvé-Kapandji technique for post-traumatic DRUJ injury. Seven patients (50%) reported pain at the resection site, mainly in pronosupination. Cracking on the ulna side of the wrist was noted in three patients, and protrusion of the proximal stump of the ulna in two cases. Examination revealed sagittal plane instability in all patients and in the frontal plane in four patients. At follow-up, all patients in this series presented true instability (2 cases) or hypermobility (12 cases) of the proximal stump of the ulna. Finally, mixed results were reported at 41-month follow-up by Voche et al. [8] after the treatment of 21 patients by the Sauvé-Kapandji technique. Pain was persistent in six cases, and modest recovery of strength was equivalent to 55% of that of the opposite side. Surgical revision for the ablation of osteosynthesis screws was necessary in eight cases because of persistent pains.

**Conclusion**

DRUJ injuries are frequent after wrist trauma. Underestimated or not diagnosed in emergency care, they may lead to residuals involving wrist pains, limitation of joint amplitudes, and loss of strength. Radiographic evaluation and arthoscan can assess the status of the DRUJ, distal radius and radio-carpal joint, facilitating the choice of conservative or radical surgical treatment. If DRUJ surfaces are preserved, conservative treatment consists of correcting vicious callus of the distal radius, and stabilisation or shortening the ulna is the treatment of choice. In contrast, when the DRUJ surfaces are damaged with joint incongruence and degenerative lesions, DURS is our treatment of choice. This technique, with its low complication rate and more than 90% satisfactory results, is frequently able to restore a pain-free and mobile wrist with satisfactory strength. However, a rigorous surgical, approach with limited resection of the distal ulna, dorsal capsuloplasty, refection of the extensor retinaculum, and dorsalisation of the EUC tendon, is necessary for the success of this intervention.

**Conflict of interest statement**

None.

**References**

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