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Original article

Radiocarpal dislocation: A retrospective study of 14 patients

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ABSTRACT

Introduction: Radiocarpal dislocation (RCD) is defined as total loss of contact between the carpal and radial joint surfaces. The condition is rare, with few published series. The aim of the present study was to assess functional results of RCD surgery, notably without ligament reconstruction.
Hypothesis: Functional outcome of RCD surgery is satisfactory for everyday use of the wrist.
Materials and methods: A retrospective study was performed for the period January 2012 to July 2017. Inclusion criteria comprised: RCD on preoperative X-ray, in adult patients, with a minimum 6 months' follow-up; exclusion criteria comprised: unclosed growth plate, and distal radial epiphyseal fracture with large displacement. RCD type was assessed on Dumontier's classification. Functional results were assessed as postoperative range of wrist motion, grip strength (Jamar®), and QuickDASH and Green-O'Brien (modified by Cooney) functional scores.
Results: Fourteen patients were followed up at a mean 31 months (range, 7–60 months). Three showed type I RCD and 11 type II. All were treated surgically; no ligament sutures were performed. Mean flexion was 63° (range, 20–90°), extension 51° (25–90°), pronation 79° (60–90), supination 80° (50–90), and grip strength 27.9 kg (8–40). Mean QuickDASH and modified Green-O'Brien scores were respectively 25.6 (4.54–40.9) and 74 (35–100).
Discussion: The present functional results were satisfactory and comparable to those of the literature, despite no use of radiocarpal ligament suture in type-1 RCD.
Level of evidence: IV.

1. Introduction

Radiocarpal dislocation (RCD) is defined as total loss of contact between the carpal and radial joint surfaces, and may be associated with comminuted distal radial joint fracture. It is a rare condition, at 0.2% of wrist lesions according to Dunn et al. [1]. It implicates high-energy trauma, with dorsal predominance. Lesion mechanism is unclear but probably associates hyperextension, pronation and radial deviation of the wrist [2]; some authors suggest a mechanism in flexion [3]. The most widely used classification is that of Dumontier et al. [4] (Figs. 1 and 2). Few series have been reported, and the literature consists mainly of case reports. Surgery generally consists in internal fixation of comminuted fractures, radiocarpal ligament suture and stabilization by radiocarpal pinning, external fixation or cast/splint [4–7].

The main objective of the present study was to assess functional results of RCD surgery, notably without ligament suture. The secondary objective was to assess the adverse effects of RCD. The study hypothesis was that functional results in RCD are satisfactory for everyday wrist use.

2. Patients methods

2.1. Inclusion and exclusion criteria

Patients were treated between January 2012 and July 2017. Inclusion criteria comprised: adult patient with a minimum 6 months' follow-up. Exclusion criteria comprised: age < 18 years, unclosed growth plate, and distal radial epiphyseal fracture with large displacement.

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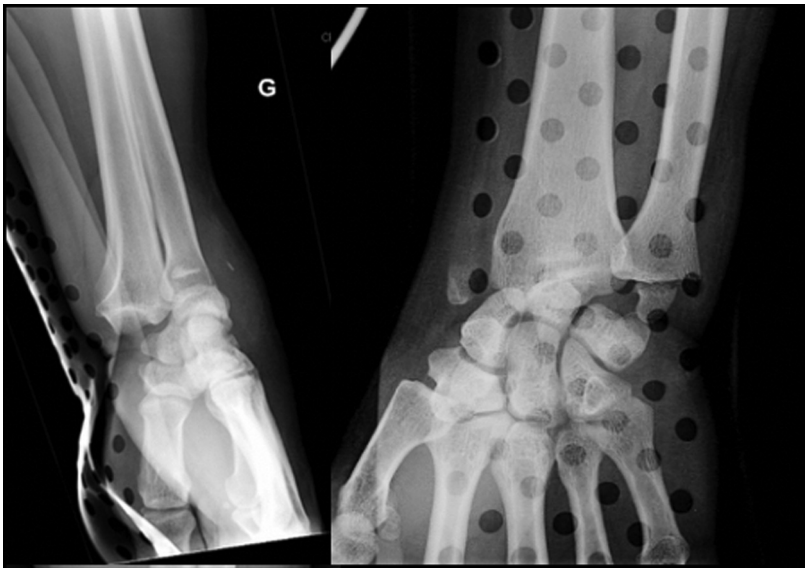

Fig. 1. Example of dorsal Dumontier [4] type 1 radiocarpal dislocation: radial styloid fracture involving less than one-third of the radial joint surface, with or without associated posterior or anterior marginal fracture.

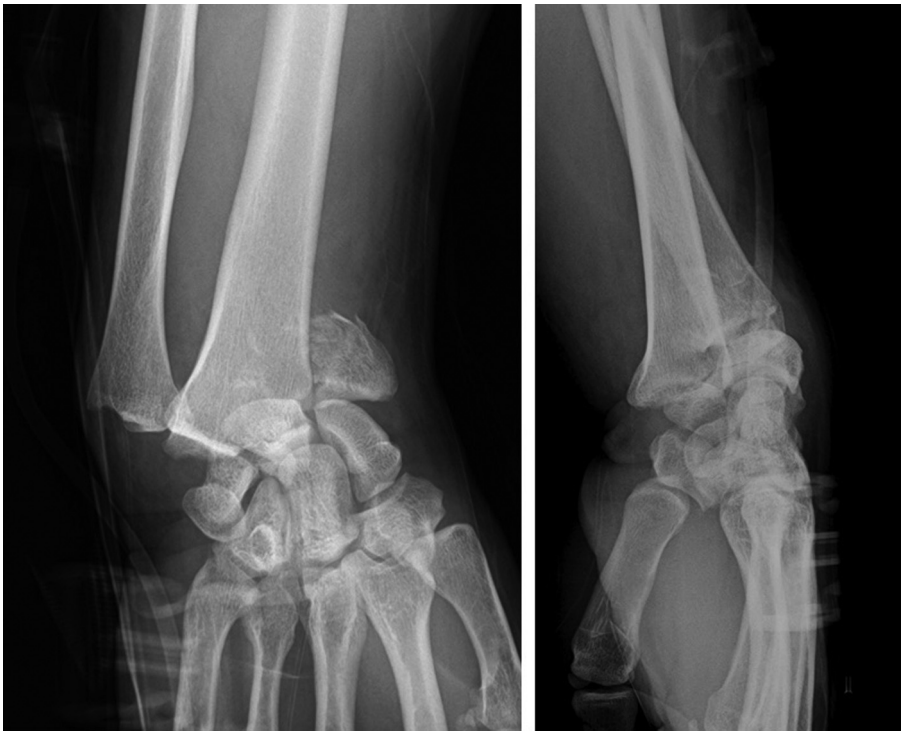

Fig. 2. Example of dorsal Dumontier [4] type 2 radiocarpal dislocation: radial styloid fracture involving more than one-third of the radial joint surface.

2.2. Assessment

Epidemiological data comprised age, gender, handedness and occupation. Lesion mechanism, RCD type according to Dumontier [4], associated lesions (ulnar fracture, distal radioulnar dislocation), surgical procedures and type of immobilization were recorded.

The main endpoint was assessed on: range of motion in both wrists on goniometry, grip strength in both wrists on dynamometry (Jamar®), QuickDASH score [8], Green-O'Brien test [9] modified by Cooney [10] (Table 1), and return to work/sport.

The secondary endpoint was assessed on AP and lateral wrist X-ray: Bouman's R/P-Lu index screening for ulnar translation of the carpus (Fig. 3) [11], radioscaphoid, radiolunate or intracarpal osteoarthritis. Postoperative complications were recorded: infectious, neurologic or material discomfort.

2.3. Statistics

Qualitative data were reported as number and percentage, and continuous quantitative data as mean (range). Range of motion and grip strength were compared bilaterally on Wilcoxon test. Analyses used SPSS software, version 20.0 (IBM Corp., Armonk, NY, USA). The significance threshold was set at $p < 0.05$.

Table 1
Green-O'Brien score modified by Cooney [10].

Points	Pain (25 points)	Functional status (25 points)	Flexion extension (25 points)	Grip strength % (25 points)
25	None	Returned to work	120°	100
20	Occasional	Restricted activity		
15	Moderate tolerable	Able to work	90–120°	75–100
10			60–90°	50–75
5			30–60°	25–50
0	Severe	Pain preventing work	0–30°	0–25

Excellent result: 90–100 points; good: 80–89 points; moderate: 65–79 points; poor: < 65 points.

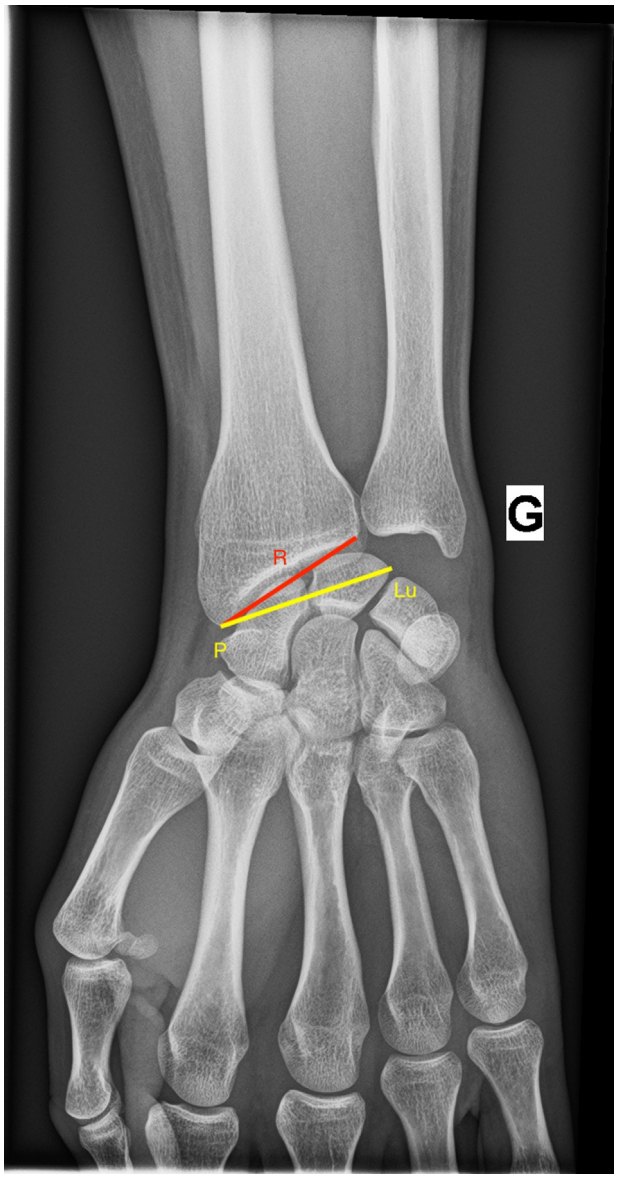

Fig. 3. Bouman's R/P-Lu ratio [11]. R: radial joint surface area; P-Lu: line through radial styloid process and superomedial lunate corner. R/P-Lu < 0.83 indicates ulnar translation of the carpus.

3. Results

Between January 2012 and July 2017, 16 patients were admitted with RCD. One declined to take part in the study, and 1 died of unrelated causes. All others were followed up for a mean 31 months (range, 7–60 months). Table 2 shows demographic data. Initial trauma was systematically high-energy: 9 road accidents (64%) and 5 high falls (36%). Eleven dislocations were dorsal (79%), 3 palmar (21%); 2 were open (14%). Eleven (79%) were Dumontier type II, and 3 (21%) type I; in the latter, mean radial styloid fracture size was 6.46 mm (range, 4.4–7.9 mm) for a radial joint surface of 33 mm (range, 31.6–34 mm). Nine (64%) patients had fracture of the posterior radial margin, and 2 (14%) of the anterior margin. Two patients (14%) had distal radioulnar palmar dislocation. Nine (64%) had ulnar styloid fracture: 6 of the base, 3 of the tip.

Management was surgical in all cases, performed by different surgeons. Table 3 shows the main procedures. There was no ligament suture or radiocarpal pinning. For 6 patients (42.8%),

Table 2
Epidemiological characteristics of patients, lesions and complications found at emergency treatment.

Patient	Gender	Age	Occupation	Dumontier classification	Dislocation direction	Associated fractures	Associated complications
1	M	24	Non-manual	II	Dorsal	PM	
2	M	23	Non-manual	II	Dorsal	PM	
3	M	28	Manual	II	Dorsal	PM	MNC, UNC
4	M	23	Manual	II	Dorsal	PM	MNC, OF
5	M	71	Retired	I	Dorsal		
6	M	27	Manual	II	Palmar	AM	
7	F	71	Non-manual	II	Dorsal	PM	OF
8	M	46	Non-manual	I	Palmar	AM	
9	M	71	Retired	II	Dorsal		
10	M	56	Non-manual	II	Dorsal	PM	
11	F	50	Non-manual	II	Dorsal	PM	
12	M	30	Manual	II	Palmar		
13	M	47	Non-manual	I	Dorsal	PM	
14	M	27	Manual	II	Dorsal	PM	
	F = 2M = 12	42,43		Type I: 3 Type II: 11	10 Dorsal 4 Palmar	9 PM 2 AM	

AM: anterior marginal radius fracture; PM: posterior marginal radius fracture; OF: open fracture; MNC: medial nerve compression; UNC: ulnar nerve compression.

Table 3
Results: types of treatment and functional results.

Patient	Approach	Treatment	Follow-up (months)	RoM (°)	Jamar® (kg)	Quick DASH	Green-O'Brien	Osteoarthritis	Green O'Brien
1	Palmar	Radial styloid screwing + posterior marginal fracture screwing	11	F80, E40, P60, S90	38	22	85	No	100
2	Percutaneous	EF + radial styloid pinning	7	F90, E35, P70, S90	30	27	45	Yes	85
3	Percutaneous	Radial styloid pinning	11	F60, E25, P70, S80	8	38,63	35	No	45
4	Palmar	EF + radial styloid pinning + DRU pinning	14	F65, E40, P90, S80	30	40,9	90	No	35
5	Percutaneous	Radial styloid screwing	9	F65, E55, P80, S90	40	25	50	No	90
6	Palmar	Plate + Radial styloid screwing	26	F80, E60, P70, S80	25	29,54	90	Yes	50
7	Percutaneous	EF + DRU pinning	35	F45, E50, P80, S70	20	34,09	85	Yes	90
8	Palmar	Plate + radial styloid pinning	46	F55, E90, P90, S50	40	4,54	80	Yes	85
9	Percutaneous	EF + radial styloid pinning	40	F60, E45, P80, S90	30	4,54	70	Yes	80
10	Percutaneous	EF+ radial styloid pinning	50	F45, E45, P80, S70	26	18	90	No	70
11	Percutaneous	Styloid pinning + screwing	60	F80, E70, P80, S90	28	31,81	90	No	90
12	Palmar	Plate + radial styloid pinning	58	F59, E54, P90, S70	20	31,81	70	No	70
13	Percutaneous	EF only	48	F20, E30, P80, S90	25	38,63	60	No	60
14	Percutaneous	Radial styloid pinning + screwing	25	F80, E70, P80, S90	30	22	100	Yes	100
Total	Palmar 5 Percutaneous 9		31	F63, E51, P79, S80	27,9	25,6	75	6/14	74

RoM: range of motion; EF: external fixator; F: flexion; E: extension; P: pronation; S: supination; DRU: distal radioulnar joint.

postoperative immobilization was by external fixator, and for the others by splint: resin wrist cast for 4 patients (29%), resin brachial-antebrachio-palmar cast for 1 (7%) and simple removable splint for 2 patients with plate fixation (14%). Mean immobilization time was 5.8 weeks (range, 4–12 weeks). Rehabilitation was initiated at a mean 6 weeks (range, 3–12 weeks).

Mean flexion on the injured side was 63° (range, 20–90°) versus 76° (25–100°) contralaterally ($p = 0.004$), extension 51° (25–90°) versus 66° (35–90°) ($p = 0.005$), ulnar inclination 30° (10–40°) versus 26° (20–55°) ($p = 0.057$), radial inclination 30° (10–30°) versus 28° (15–60°) ($p = 0.062$), pronation 79° (60–90°) versus 80° (60–90°) ($p = 0.317$), and supination 80° (50–90°) versus 86° (70–90°) ($p = 0.167$). All wrists were stable. Mean grip strength was 27.9 kg (8–40 kg) versus 36.9 kg (28–55 kg) ($p = 0.053$). Mean Quick-DASH score [8] was 25.6 (4.54–40.9), and mean Green-O'Brien score [10] 75 (35–100) (Table 3). Six of the 12 working patients (50%), half of whom were manual workers, returned to work.

All patients showed a reduced radiocarpal joint, without residual subluxation, on AP and lateral radiographs. None showed ulnar translation; mean R/P-Lu ratio [11] was 0.89 (range, 0.84–0.91) (normal range, 0.83–0.91). Six patients (43%) had signs of osteoarthritis at a mean 30 months' follow-up (range, 7–46 months): 4 isolated radioscaphoid, 1 radioscaphoid associated with radioulnar, 1 radioscaphoid associated with intracarpal (capitolunate osteoarthritis). The osteoarthritis was painful in only 3 cases (21%).

Two patients showed post-traumatic nerve compression: 1 medial nerve, 1 medial and ulnar nerves, both spontaneously resolved. One patient had discomfort due to material (plate fixation screw); 1 patient had complex regional pain syndrome. There were no infectious complications (Figs. 4 and 5).

4. Discussion

Most publications on RCD are case reports, with few reports of larger-scale results [4–7,12–15]. Surgical management depends on initial lesion assessment, and radiocarpal ligament suture is the rule, especially in type-1 dislocation, to prevent ulnar translation of the carpus and residual instability. In the present series, functional results were satisfactory, with systematic return to daily home activities. In type-1, moreover, despite there being no ligament suture, there were no cases of ulnar translation or residual

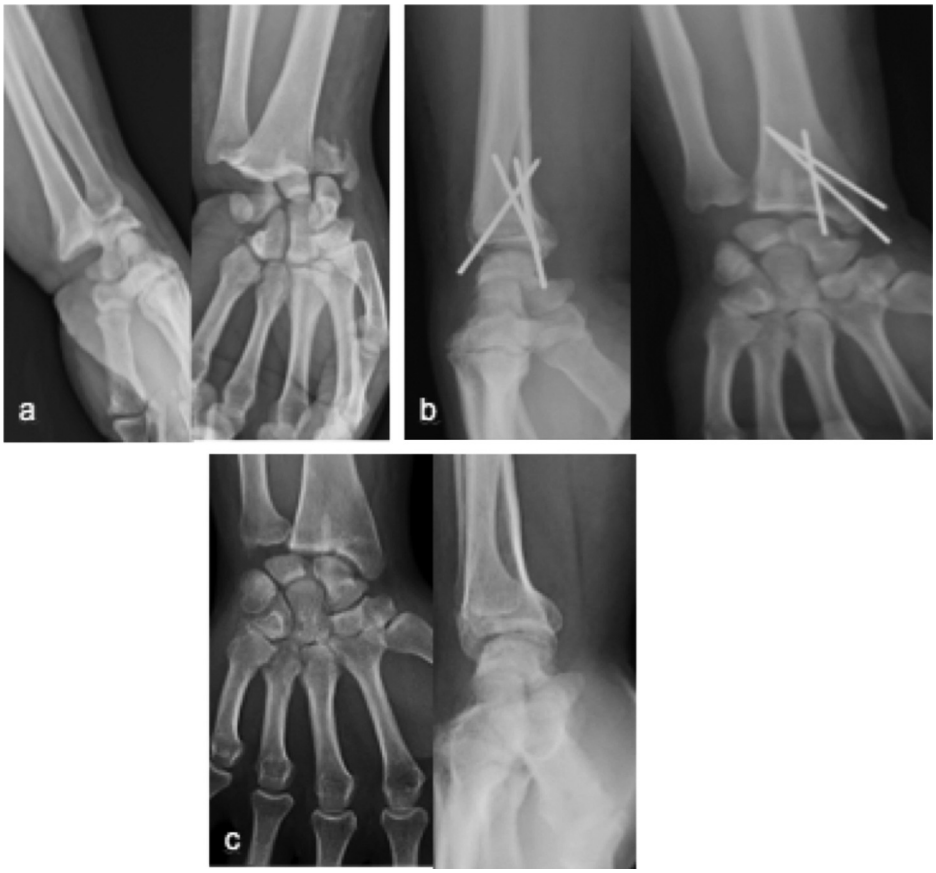

Fig. 4. Example of 28 year-old patient: a) Dorsal Dumontier [4] type 2 radiocarpal dislocation; b) Postoperative radiograph; c) Wrist X-ray at 11 months.

instability, even when the joint was not immobilized by pinning or external fixation.

Range of motion notably showed 15–25% loss of flexion and extension with respect to contralateral values; although the deficits were significant, range of motion remained within functional limits. In the literature, Dumontier et al. [4] reported similar results: in type-1 RCD, mean flexion was 54° (range, 40–80°), extension 54° (40–80°), pronation 76° (60–90°) and supination 66° (40–80°). In type-2, flexion was 51° (5–65°), extension 56° (25–75°), pronation 63° (10–90°) and supination 76° (50–80°). The present mean modified Green-O'Brien score [10] of 75 was likewise comparable to literature findings: 71 for Girard et al. [6], and 72.4 for Dhamani et al. [12]. In the present series, half of the working patients had returned to work at follow-up. This criterion was little reported elsewhere but, for Mudgal et al. [13], 8 out of 12 patients returned to work, at a mean 36 months (range, 7–96 months).

Many authors recommend not only anatomic reduction of the fracture site but also complex palmar ligament reconstruction [5,7,12,16]. According to Dumontier et al., type-2 RCD should be reduced via a dorsal approach with internal fixation by pinning or screwing, and immobilization by external fixator or cast; type-1 should be reduced with associated palmar suture of the radiolunate and/or radioscaphocapital ligaments and radiolunate pinning or external fixation to protect the ligament suture. Radiolunate and radioscaphocapital ligament suture is claimed to be necessary to prevent ulnar translation of the carpus and residual instability [17]. The technique can be open by direct suture [4], anchor suture, [16,18] brachioradial graft suture [19] or arthroscopic [20,21], mainly in type 1. Yuan et al., in 13 cases of palmar radiocarpal ligament suture, reported 3 ulnar translations of the carpus [5]. Spiry et al. recommended suturing the dorsal capsule and dorsal radiocarpal ligaments [7]. In the present series, no ligament reconstruction was performed, yet, at last follow-up, there was neither ulnar translation or radiocarpal subluxation, suggesting that simple internal fixation associated to stable rigid immobilization of the wrist for 6 weeks is enough to achieve ligament healing.

In the present series, 6 out of 14 patients (42.8%) showed radiocarpal or intracarpal osteoarthritis on X-ray, only 3 of whom experienced pain. Radioscaphoid osteoarthritis was the most common, mainly in type-2 RCD (5 out of 6 cases). Radiocarpal osteoarthritis rates in the literature range between 11% and 83%: Yuan et al. reported 31% [5], and Girard et al., 25% [6]. Le Nen et al. [14] reported an osteoarthritis rate of 83% (5 out of 6 patients), with a single case of pain, in the distal radioulnar joint, requiring a Sauvé-Kapandji procedure.

In the main series, medial or ulnar nerve involvement ranged from 0 to 58% [4,6,12,13,15], with systematic spontaneous resolution after reduction. In the present series, only 2 patients showed medial or ulnar nerve involvement, likewise with resolution after reduction.

The present study had several limitations. The retrospective design incurred a risk of information bias, limited, however, by the detailed pre- and intra-operative and follow-up data, largely sufficient for endpoint assessment. Treatment was heterogeneous, but this was largely due to the heterogeneity of these rare radial lesions, presence of associated lesions and number of surgeons. As RCD is so rare, selecting a more homogeneous series would be difficult.

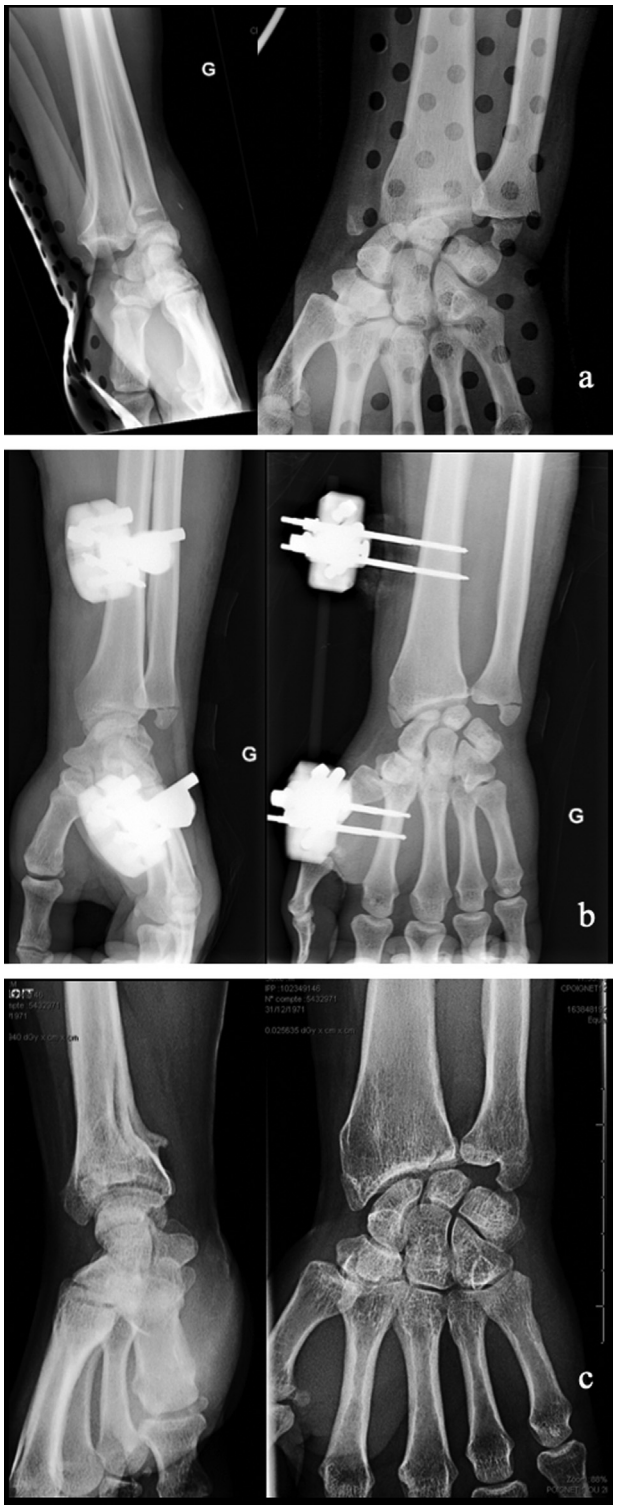

Fig. 5. Example of 47 year-old patient: a) Dumontier [4] type 1 radiocarpal dislocation; b) Postoperative radiograph; c) Wrist X-ray at 48 months.

5. Conclusion

RCD is rare, implicating high-energy wrist trauma. While most authors recommend palmar or dorsal radiocarpal ligament suture, the present series showed that no ligament suture is necessary. The present functional results were comparable to those in the literature, with no ulnar translation of the carpus or residual instability. A prospective study using postoperative CT arthrography of MRI would be useful for precise assessment of osteoarthritic lesions in the long term and any ligament sequelae.

Disclosure of interest

The authors declare that they have no competing interest.

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None.

Author contribution

Alexandre Cornu: data collection, author.
Nadine Sturbois-Nachef: writing, reviewing.
Matthieu Baudoux, Thomas Amouyel: reviewers.
Marc Saab: data collection, reviewer.
Christophe Chantelot: writing, reviewing, Head of service.

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