

# Proximal row carpectomy in the third millenium: is it still a valid indication?

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**Summary.** Proximal row carpectomy (PRC), which was initially described by Stamm in 1944, is a surgical procedure for degenerative disorders of the proximal carpal row of the carpus. Despite the good results reported in the literature, this technique has been gradually replaced over the years by others considered more modern and actual, such as wrist arthroplasty and arthrodesis. In this context the authors performed the following study and analyzed retrospectively 14 patients who underwent PRC during an eighteen years period, between June 1996 and June 2013, in order to determine if this surgical operation can be considered still indicated. The results of this study confirm that PRC, more or less associated with the use of capsular flaps and/or osteochondral grafts, is nowadays a valid and simple procedure in selected patients, ensuring a satisfactory functional recovery and regression of pain. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** wrist, osteoarthritis, carpectomy, carpus, flaps and osteochondral grafts

## Introduction

Proximal row carpectomy (PRC) is an accepted motion-sparing procedure for a variety of degenerative conditions of the wrist which involves excision of the scaphoid, lunate and triquetrum (1, 2).

Stamm (3) in 1944 first described PRC as a method of restoring function to the wrist by converting it from a complex link system to a simple ball-and-socket joint. This technique allows the capitate to settle into and articulate with the lunate fossa of the distal part of the radius.

The reported advantages of PRC are its technical ease, preservation of a functional arc of motion, pain relief and high patient satisfaction (2, 4-6). Criticism includes postoperative loss of carpal height and of grip strength and formation of an incongruous joint, thus potentially facilitating the progression of degenerative of the radiocapitate articulation (1, 2, 4). For these reasons this surgery has been gradually replaced over the years, especially in the late 90's, by others considered

more modern and actual such as wrist arthroplasty and arthrodesis, but problems encountered with implant failure and silicone synovitis following joint replacement and a high complication rate in arthrodesis have recently increased again the interest in surgical options that use residual biological articular surfaces such as PRC (2, 7, 8).

Its primary indications are scapholunate advanced collapse (SLAC), scaphoid nonunion advanced collapse (SNAC), advanced Kienbock's disease, failed lunate or scaphoid implants and chronic perilunate dislocation (1). Contraindications include capitulunate arthritis, inflammatory arthropaties such as rheumatoid arthritis and, historically, the loss of cartilage either on the head of the capitate or in the lunate fossa of the distal radius (1, 9, 10-13), however, osteochondral resurfacing of the capitate (OCR) and/or interposition of capsular flaps have been proposed as a potential solutions for these latter cases (11, 14).

In this context the authors performed the following study and analyzed retrospectively 14 patients

who underwent PRC during an eighteen years period, between June 1996 and June 2013, in order to determine if this surgical technique can be considered still indicated.

## Materials and methods

From June 1996 to June 2013, 20 patients underwent PRC at the Orthopaedic Clinic of the University of Parma. Fourteen of the 20 patients were evaluated, as 4 died and 2 were not available for the visit.

For each patient age, gender, side, preoperative diagnosis, type of surgical technique and additional procedures were assessed (Table 1).

Patients were positioned supine on the operating table with the affected arm abducted 90° on a hand table. A tourniquet placed high on the brachium was used in order to achieve a bloodless field. The wrist was always approached through a dorsal longitudinal incision centered between the third and fourth compartment with care taken to protect the sensory branches of the radial and ulnar nerves. After identification and retraction radially of the extensor pollicis longus and extensor carpi radialis brevis tendons, the posterior interosseous nerve was identified and a 1-cm segment was resected. Afterwards, a quadrangular capsulotomy with a distal base was performed. In ten patients, characterized by absence of cartilage degeneration of the head

of the capitate and of the lunate fossa of the radius, a carpectomy, as described by Stern (15), was carried out (Figure 1). In the remaining 4 cases, characterized by initial degeneration of these joint surfaces and chondritis of the head of the capitate < than 1 cm, interposition of capsular flaps and/or OCR of the head of the capitate (Figure 2 and 3), taken from one of the bones of the proximal row previously removed, were associated. Radial styloidectomy was necessary in one case.

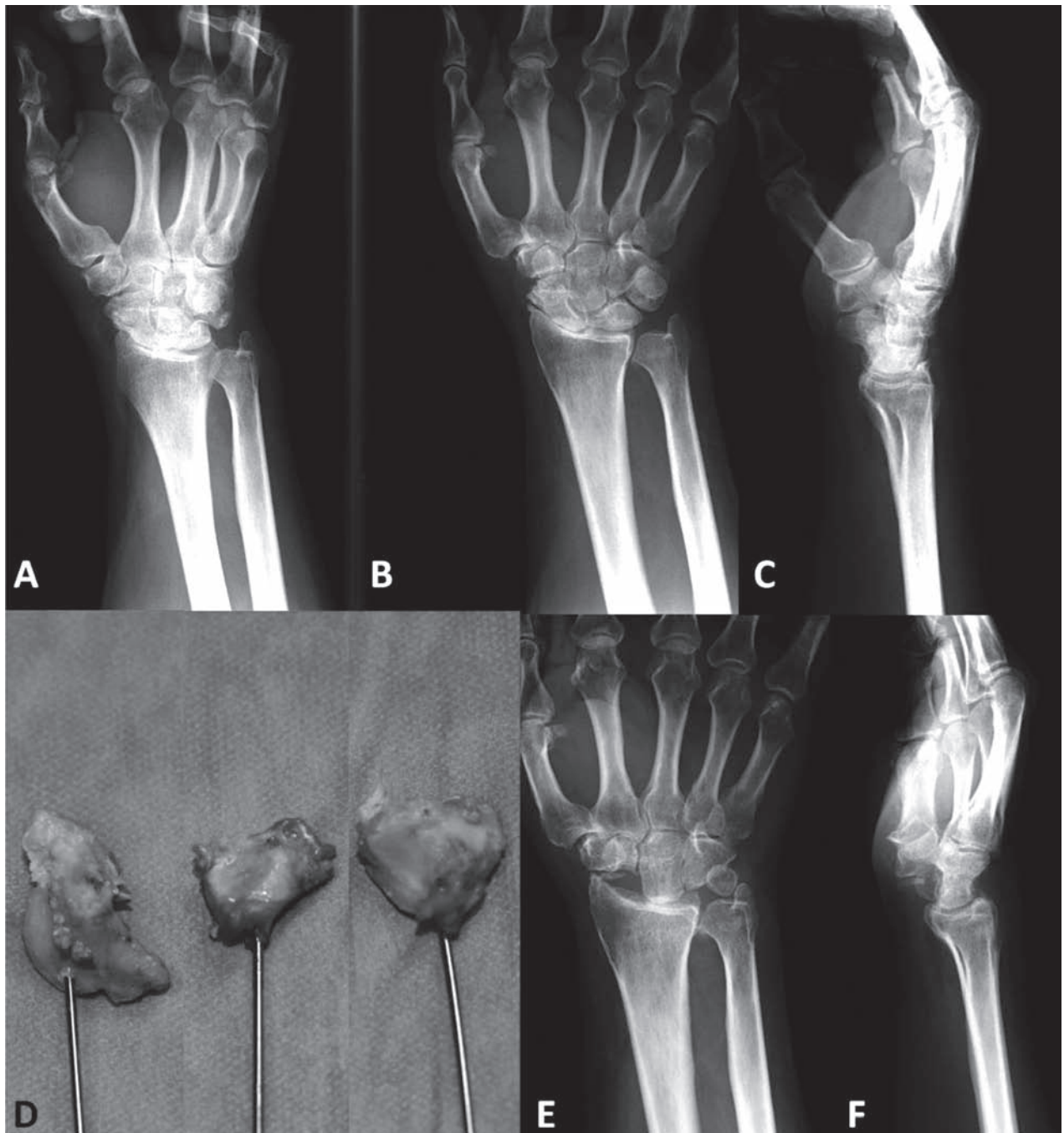
In the postoperative period digital motion was immediately encouraged. The wrist was immobilized in a plaster for three weeks, after which a range of motion was initiated, with the supervision of a qualified hand therapist. The patient wore a neutral thermoplastic splint, when he or she was not doing physiotherapy, for an additional three weeks. If there was swelling, an elastic garment was applied for edema control. The immobilization was abandoned six weeks after surgery and a more aggressive strengthening program was initiated. Patient returned to full unrestricted activities after a mean period of three months.

All patients were subjected to a functional subjective evaluation using the Disabilities of the Arm, Shoulder and Hand (DASH) Score and the Patient-Rated Wrist and Hand Evaluation (PRWHE), before surgery and at follow-up.

Furthermore, all patients underwent to a functional objective evaluation using the Jamar dynamometer in order to quantify the grip strength and a goni-

**Table 1.** Characteristic of the patients (F: female, M: male, R: right, L: left, PRC: proximal row carpectomy, OCRPRC: osteochondral resurfacing in the setting of PRC)

N°	Age	Gender	Side	Follow-up (years)	Diagnosis	Treatment	Additional procedures
1	68	M	R	18	SNAC II	PRC + capsular flap	
2	80	M	L	17	SNAC II	PRC	
3	69	F	R	15	Kienbock IIIA	PRC + capsular flap	Radial styloidectomy
4	59	M	R	14	SLAC II	PRC	
5	49	M	R	5	SLAC II	PRC	
6	59	F	L	5	SNAC II	PRC	
7	75	F	R	4	SLAC III	PRC	
8	40	M	L	4	SLAC II	OCRPRC + capsular flap	
9	69	M	R	4	SNAC II	PRC	
10	50	M	R	4	Kienbock IIIA	PRC	
11	52	M	L	3	SLAC II	PRC	
12	61	F	L	2	SLAC II	PRC	
13	40	M	L	2	SLAC III	OCRPRC + capsular flap	
14	60	F	L	1	SLAC II	PRC	



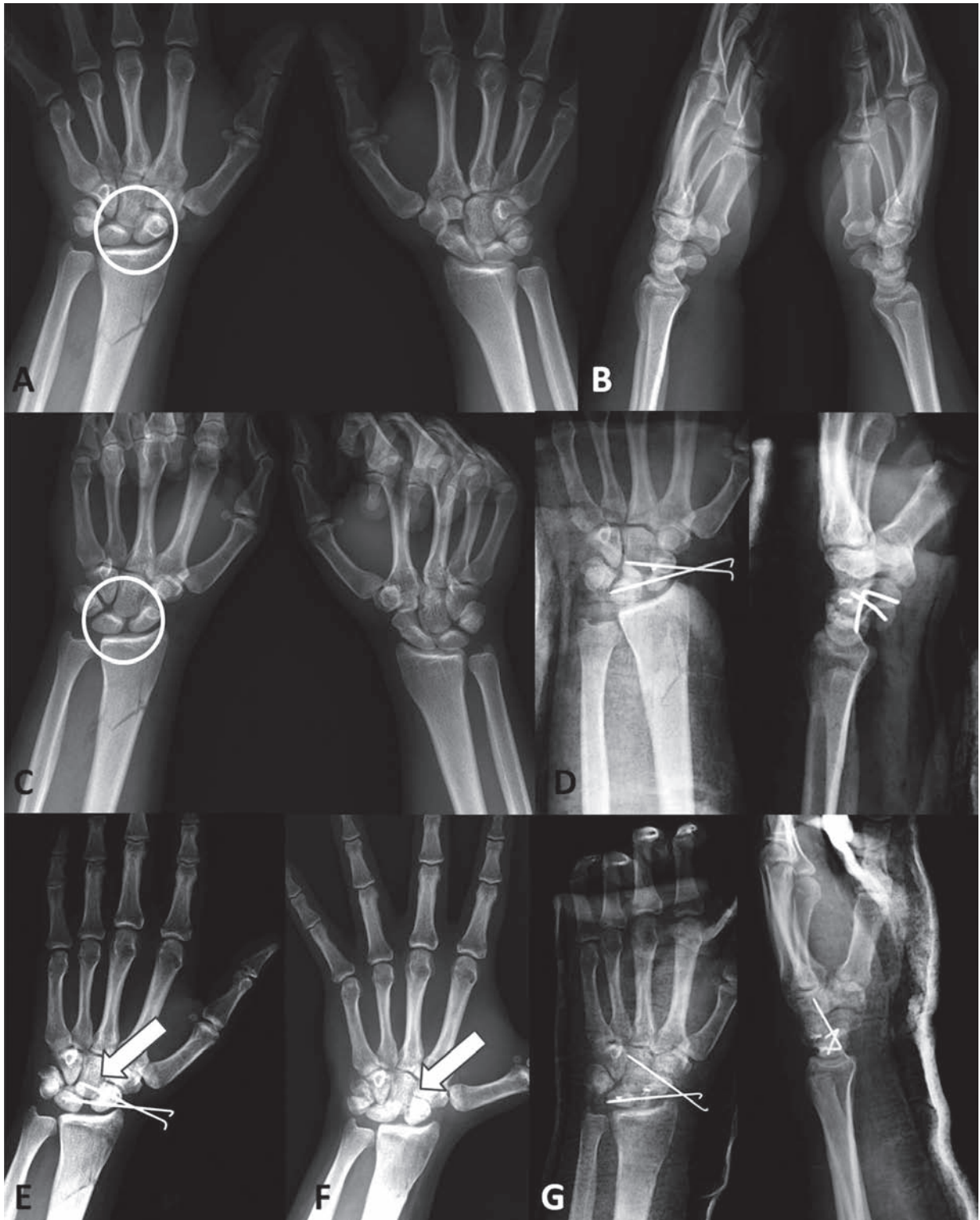
**Figure 1.** SLAC II of the right wrist in a patient of 49 years of age. A, B and C; pre-operative x-rays. D; intraoperative view of scaphoid, lunate and triquetrum after their removal. E and F; x-ray performed 48 months after PRC

ometer in order to assess the arc of movement (flexion, extension, ulnar and radial deviation) before and at follow-up.

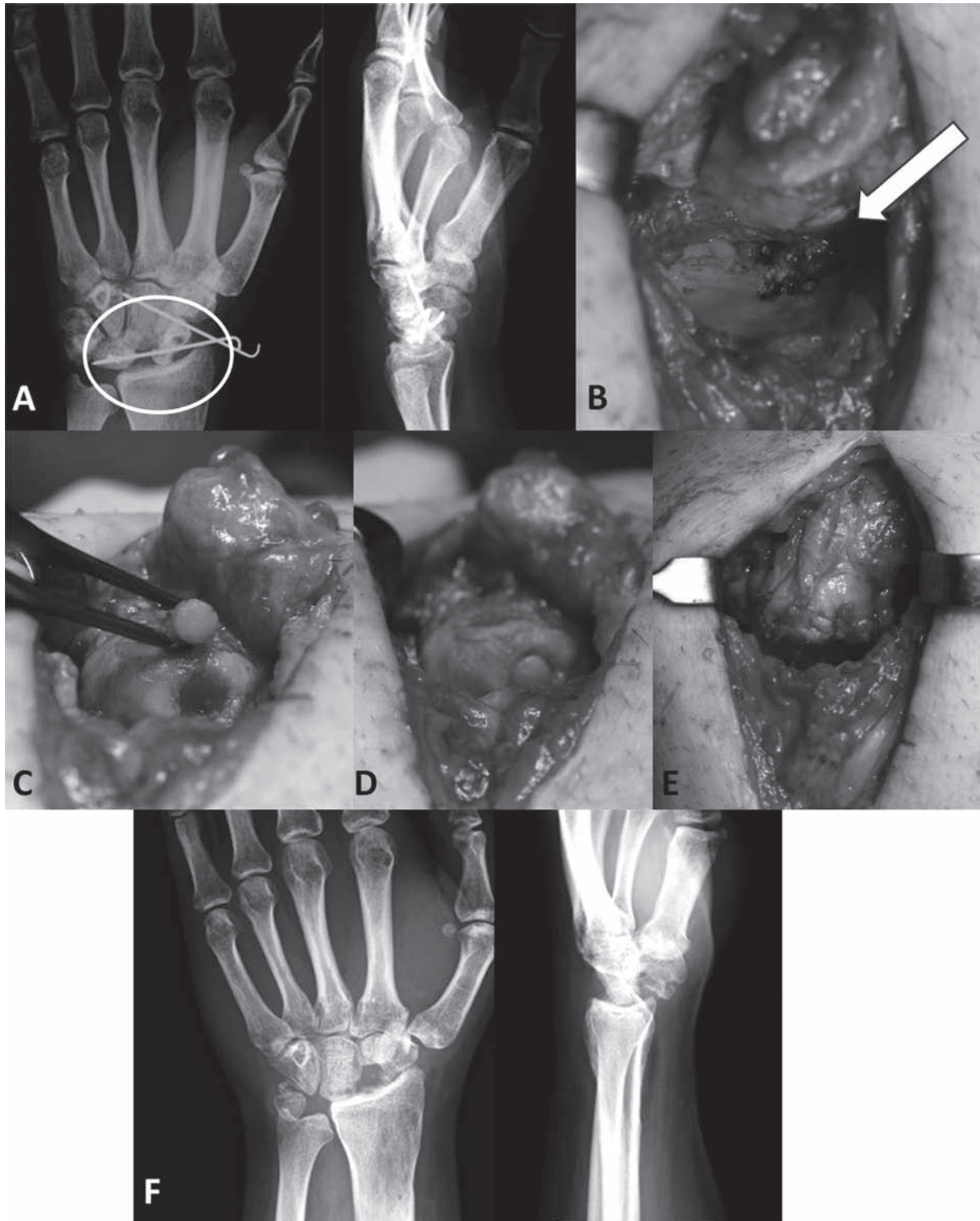
Pre operative X-Rays of the wrist were used in order to diagnose the pathology. Radiographs performed

at follow-up were utilized in order to visualize signs of degeneration of the new joint between capitate and lunate fossa of the radius.

The functional results were compared using the Mann-Whitney test and statistical analysis was elabo-



**Figure 2.** Metaphyseal fracture of the left wrist associated with S-L dissociation (circles) in a patient of 40 years of age. A and B; pre-operative x-rays. C; pre-operative x-rays under stress. D; post-operative x-rays after reduction and fixation with kirschner wires and anchor. E and F; recurrence of the S-L lesion (arrows). G; x-rays after Brunelli's tenodesis



**Figure 3.** Second recurrence of left S-L dissociation after Brunelli's tenodesis (circle). A; x-rays. B; condral damage of the radial portion (arrow). C and D; osteochondral graft before and after positioning. E; intraoperative view after suture of the capsular flap. F; x-rays performed 16 months after PRC

rated using the SPSS software (20.0 version) as following:

1. differences between each parameter of the arc of movement of the affected wrist before surgery and at follow-up
2. differences between each parameter of the arc of movement of the affected versus unaffected wrist at follow-up
3. differences between the grip strength of the affected wrist before surgery and at follow-up
4. differences between the grip strength of the affected versus unaffected wrist at follow-up
5. differences between the DASH and PRWHE scores of the affected wrist before surgery and at follow-up
- 6.. differences between the DASH and PRWHE scores of the affected versus unaffected wrist at follow-up.

The difference was considered significant when  $p$  value was less than 0.05.

## Results

The mean follow-up was 7 years (range 1-18).

The average age of the 14 patients at the time of surgery was 59.4 years (range 40-80); there were 9 males (64.3%) and 5 females (35.7%).

Preoperative diagnosis, type of surgical technique and additional procedures are summarized in Table 1.

DASH and PRWHE results and the presence of radiographic signs of joint degeneration at follow-up are synthesized in Table 2.

Each parameter of the arc of movement of the wrist (flexion, extension, ulnar and radial deviation) and grip strength mean results are reported in Table 3.

Statistical analysis of the 6 comparison that were analyzed showed in all cases a significant difference with a  $p$  value <0.05.

Complications related to the surgical procedures were not encountered.

**Table 2.** DASH and PRWHE results and radiographic signs of joint degeneration

N°	DASH preop affected	DASH follow-up affected	DASH follow-up unaffected	PRWHE preop affected	PRWHE follow-up affected	PRWHE follow-up unaffected	Follow-up X-ray degeneration
1	55	17	10	47	39	35	Severe
2	88	40	10	82	28	10	Moderate
3	74	62	20	78	40	20	Moderate
4	78	40	0	70	50	0	Moderate
5	36	3	0	35	0	0	Mild
6	11	0	5	13	0	5	Mild
7	25	3	0	22	4	0	None
8	36	8	0	33	10	0	Mild
9	29	0	0	19	0	0	None
10	62	1	0	55	0	0	None
11	44	10	0	48	2	0	None
12	78	12	0	74	12	0	None
13	96	30	10	89	30	15	Mild
14	47	0	0	49	0	0	None
Average	54.2 (11-96)	16.1 (0-62)	3.9 (0-20)	51 (13-89)	15.4 (0-50)	6.1 (0-35)	

**Table 3.** Arc of motion and grip strength

Average score	Flexion (°)	Extension (°)	Radial deviation (°)	Ulnar deviation (°)	Grip strength (Kg)
Affected side before surgery	18	15	3	12	8.1
Affected side at follow-up	43.4	40	7.5	25,1	21.2
Unaffected side at follow-up	66.4	65.2	17.4	41.4	34.9

## Discussion

PRC is a generally accepted motion-preserving surgical procedure for the treatment of advanced radiocarpal osteoarthritis with the aim to create a new joint between the capitate and the radius.

Imbriglia pointed out that the head of the capitate and the lunate facet of the distal part of the radius have different radii of curvature, which result in both rotational and translation motion at the capitate-radius interface with a variable center of movement that determines an enlargement of the contact surfaces. This biomechanic allows a better distribution of the loads, a sufficient joint congruity and a good recovery of motion without pain, despite these bones have different conformations (the capitate was found to have a radius of curvature of only 64% of the lunate fossa on anteroposterior radiographs and 60% on true lateral radiographs) (16).

Several studies have demonstrated pain relief and minimal functional limitation following PRC (4, 17, 18). Other studies, on the contrary, criticized PRC and indicated that patients were more likely to complain of weakness in grip strength and feelings of wrist instability (1, 19, 20).

For these reasons and as consequence of the development of new surgical techniques and devices this surgery has been gradually replaced over the years, especially in the late 90's, by others considered more modern and actual such as wrist arthroplasty and arthrodesis.

Problems with implant failure and silicone synovitis following wrist joint replacement and a high complication rate in arthrodesis have recently increased again the interest in less aggressive surgical solutions, such as limited intercarpal fusion and PRC (2, 7, 8, 21-23).

The latter is easy to perform and guarantees a rapid return to function with relatively few post-operative complications; however, there is still some question regarding the procedures durability beyond 10 years and long-term patient satisfaction (17). Few studies have assessed patient satisfaction or functional outcomes scores beyond 10 years and this lack of numerous long-term follow-ups of patients having undergone PRC has prevented a clear consensus of whether this

procedure is capable of providing a permanent solution for those suffering from radiocarpal arthritis. Progressive narrowing and osteoarthritis of the radiocapitate articulation inevitably occurs, as PRC changes a complex carpal articulation to a hinge joint. The clinical implications of these radiographic changes have been difficult to interpret and, nowadays, the severity of radiocapitate osteoarthritis has yet to be directly linked to poorer outcomes, pain, or clinical function (1, 2, 4-8). Recently Chim (24), in a systematic review, confirmed the long-term durability of PRC when used for the treatment of wrist arthritis and concluded that, although radiocapitate arthritis develops over time in most patients, the clinical significance of this finding is undetermined and does not necessarily correlate with failure of proximal row carpectomy. Also in this study these assumptions were confirmed. Osteoarthritis of the new joint was mainly observed in the older cases but this finding did not correlate to poorer functional outcomes. Furthermore, this study confirms the efficacy of PRC for treatment of these degenerative conditions of the wrist. The results showed that a functional arc of wrist motion was maintained as measured by the flexion/extension arc and radial/ulnar deviation even if significantly lesser than the unaffected side.

A significant decrease in grip strength was recorded, thus confirming that PRC may be better suited for patients not involved in heavy manual labor, as mentioned by previous researchers (8, 11, 12). Upper extremity function, as measured by the DASH and PRWE scores compared favorably with those reported following four-corner arthrodesis, (23, 25, 26), thus assuring that both procedures result in subjectively equivalent functional outcomes when graded by the patient (21, 27).

The authors believe that, in order to obtain durable positive results, is important a precise selection of the patients to submit to PRC and contraindicated this technique in capitulunate arthritis, inflammatory arthropaties such as rheumatoid arthritis and heavy manual labor. Capitate chondrosis historically has been a contraindication to proximal row carpectomy (1, 9, 10-13). However, OCR of the capitate has been proposed as a potential treatment for these cases (10-13). Proximal row carpectomy with soft tissue interposition is another option for patients with capitate

degeneration as reported by Kwon (28) who showed satisfactory results at a mean follow-up of 41 months in 8 patients treated by proximal row carpectomy associated with capsular interposition flap.

In this study OCR and/or capsular flaps interposition were performed in 4 cases characterized by initial degeneration of the joint surfaces and chondritis of the head of the capitate < than 1 cm.

Additional procedures such as radial styloidectomy and temporary pinning of the radius to the distal carpal were frequently recommended in the past. The authors do not routinely perform a radial styloidectomy because they believe that the impingement of the trapezium on the styloid in radial deviation is not so frequent because, anatomically, the trapezium is anterior to the styloid. Furthermore, with an overly generous styloidectomy, there is a risk of detaching the volar radiocarpal ligaments (specifically the radioscapocapitate ligament), which could lead to ulnar translation of the carpus. The authors moreover do not pin the radius to the capitate because they believe that pinning does not offer any benefit if a good capsular closure is performed, and also because pinning is associated with the risk of pin-track infection.

Finally the authors consider as important the postoperative management of these patients that would be performed by a specialist in hand rehabilitation.

## Conclusions

The results of this study confirm that PRC, more or less associated with the use of capsular flaps and / or osteochondral grafts, is still a valid and simple surgical procedure in selected patients, ensuring a satisfactory functional recovery and regression of pain. Long-term positive outcomes depends also on correct surgical indication and precise postoperative rehabilitation programme, which would be managed by a hand therapist.

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