



Four-corner fusion versus proximal row carpectomy : a retrospective review with a minimal follow-up of 9 years

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A retrospective survey on the long-term outcomes of both proximal row carpectomy (PRC) and scaphoidectomy with 4-corner arthrodesis (4CA) was conducted. Seventeen PRC and nine 4CA wrists were retrieved with a minimal follow-up of 9 years. Pain, satisfaction and disability were not significantly different. There was a better flexion and ulnar deviation in the PRC wrists.

Conclusion : at long term, the outcome for PRC remains stable despite some series recently reported worsening of the results due to progressive degenerative arthritis. PRC seems to yield comparable clinical results compared to 4CA but a slightly better range of motion than 4CA.

Keywords : wrist ; proximal row carpectomy ; arthrodesis ; salvage procedure ; long term.

INTRODUCTION

Arthrodesis of the wrist has been considered the gold standard for osteoarthritis of the wrist due to collapse or avascular necrosis of carpal bones for a long time. However, preservation of motion gives less disability and better patients satisfaction than the radiocarpometacarpal arthrodesis. In order to preserve some motion, other alternative procedures have been proposed : proximal row carpectomy (PRC) and scaphoidectomy combined with a four-corner arthrodesis (4CA).

The outcome for both procedures has been

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described as satisfactory, but comparative studies are mostly in favour for the PRC (7,11,39,46,55). Recently more critical outcomes, mostly at long term, for the PRC were reported (1,19,27,57).

The aim of this study was to compare retrospectively both procedures with a minimal follow-up of 9 years.

MATERIAL AND METHODS

We retrieved 16 patients from our operation records who underwent 17 proximal row carpectomies and 9 patients with one 4CA procedure each, with a minimal follow-up of 9 years. All patients were operated in our tertiary referral center between October 1998 and October 2004. Patients with cerebral palsy and those in which other procedures (e.g. Sauvé-Kapandji procedure) were performed at the same time were excluded. This yielded a total

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of 70 eligible patients who underwent a PRC and 16 who underwent a 4CA. Patients were invited by mail and telephone for clinical and radiological examination at our institution. Due to the length of the follow-up, many of the patients were lost to follow-up, deceased or unwilling to participate. Approval of the ethical committee of our institution was obtained for this study.

All patients were operated through a standard dorsal approach, a dorsal Berger flap was created and the scaphoid was resected in both groups. In the PRC group, the lunate and triquetrum were also resected, whereas in the 4CA a fusion between lunate, capitate, hamate and triquetrum was performed. The fixation of the 4CA was done using a dorsal Hub Cap system (Acumed, Hillsboro, Oregon, USA) The details of both groups are summarized in table 1 .

Patients were asked if they were satisfied with the operation and to rate this satisfaction and the presence and severity of any persisting pain using a visual analogue score (1-10). Range of motion was measured with a standard goniometer. Gripping force was evaluated using a Jamar Dynamometer (Asimov Engineering Company, Santa Fe Spring,

Table 1. — Patient characteristics

	PRC	4CA
Number of patients	16	9
MALE/FEMALE	4/12	2/7
MEAN AGE in years (range)	61 (33-81)	66 (38-85)
SLAC	6	7
SNAC	3	1
AVN	8	1
FOLLOW UP in years (range)	12 (10-15)	11 (9-17)

SLAC : scapholunate advanced collapse. SNAC : scaphoid nonunion advanced collapse. AVN : avascular necrosis.

CA). The patients filled out the quick DASH (Disability of the arm, shoulder and hand) and the PRWE (Patient Rated Wrist Evaluation) questionnaires. All patients were examined by one of the first two authors (M.V.N or M.V.H).

Standard wrist radiographs were taken and joint space narrowing, the presence of subchondral cysts, subchondral sclerosis and osteophytes were recorded. Radiographs were examined by the first two authors and a third independent observer (L.M.).

The outcomes between PRC and 4CA were compared using Student's Test. Chi-Square test was used to analyze the radiological outcome. Signi-

Table 2. — Results. All values for the clinical data are mean values with the standard deviation between brackets. Radiological findings are mentioned as incidence rates with the percentage between brackets

Clinical data	PRC	4CA	P value
Satisfaction rate (percentage of patients)	14/17 (82%)	9/9 (100%)	0.5
VAS satisfaction	8.75 (2.29)	8.10 (1.36)	0.8
VAS pain in rest	1.4 (1.09)	0.9 (0.162)	0.3
VAS pain during activity	3.4 (2.59)	2.3 (2.34)	0.9
DASH	15 (17.4)	19 (41.6)	0.7
PRWE	16 (17.1)	20 (24.3)	0.6
Flexion (degrees)	46 (10.5)	36 (8.0)	0.02
Extension (degrees)	32 (9.0)	29 (8.8)	0.4
Radial deviation (degrees)	15 (6.3)	13 (6.7)	0.5
Ulnar deviation (degrees)	34 (8.1)	23 (12.2)	0.01
Gripping force (kilogram)	32 (9.0)	28 (12.0)	0.3
Radiological findings			
Joint space narrowing	15/17 (88%)	8/9 (89%)	0.96
Subchondral cysts	1/17 (6%)	6/9 (67%)	<0.01
Subchondral sclerosis	16/17 (94%)	8/9 (89%)	0.63
Osteophytes	1/17 (6%)	8/9 (89%)	<0.01

VAS : Visual Analogue Score. DASH : Disability of the arm, shoulder and hand (0-100). PRWE : Patient Rated Wrist Evaluation (0-100)

ficance was set at $p < 0.05$.

RESULTS

The outcome data are summarized in table 2 ; 14 of the 17 patients who underwent PRC were satisfied, whereas all the patients underwent a 4CA were satisfied. However, this difference did not reach statistical significance.

Both procedures had a similar outcome except for a significant better flexion and ulnar deviation for the PRC. Pain, patient satisfaction, disability (DASH and PRWE), extension/flexion and gripping force were not significantly different. On radiographies, patients with a 4CA showed significantly more subchondral cysts and osteophytes than patients after PRC, but this did not seem to correlate with the clinical outcomes. In both groups, the clinical outcome seemed independent of the radiological findings.

DISCUSSION

Biomechanically, both 4CA and PRC convert a complex link joint system to a simple hinge joint, but these motion preserving salvage procedures for the arthritic wrist have been reported to show satisfactory results, at least at the short term. The clinical results for PRC are satisfactory in most follow-up series (2,4,8,9,14,16,20,24,25,26,27,28,34,36,41,42,44,46,49,51,52,53,60). Some authors however reported less favorable results. Jebson et al (27) and Didonna (19) revealed only a trend toward an increasing prevalence and degree of osteoarthritis with longer follow-up evaluation. Wall et al (2013) had 17 patients with a follow-up of minimum 20 years . The average time to failure of PRC, defined as the time from PRC to radiocarpal arthrodesis, was 11 years (range, 8 mo to 20 y). Eleven patients who did not undergo radiocarpal arthrodesis had a QuickDASH of 16, a PRWE of 26, a flexion-extension arc of 68° , and a grip strength 72%. (57) Ali et al reported the experience of 81 patients in the Mayo clinic in 2012. They had an average follow-up 19.8 years (minimum 15 years). The range of motion and grip strength were not significantly different from the preoperative values. The radiographic follow-up revealed joint narrowing and arthritic

changes within the radiocapitate joint. Forty-six (74%) were not satisfied due to persistent pain or inability to return to previous occupational activities ; 12 patients were converted to a wrist arthrodesis. They concluded : “The results of this study suggest that long-term patient satisfaction following PRC can be poor and the surgeon may wish to consider alternative treatment options for younger patients and those with high-demand jobs” (1).

In 1984 Watson and Ballet (57) described the SLAC pattern (scapholunate advanced collapse) and proposed the scaphoid replacement by a silicone spacer combined with a 4CA. Due to the ongoing problems with silicone implants, scaphoid excision was proposed rather than replacement. Since then, numerous investigators have reported favorable outcome of this procedure (3,4,10,18,19,29,31,32,48,56,61). Trail et al undertook a retrospective review of 116 of these procedures performed in 110 patients. The follow-up period ranged from 3 to 19 years. All patients reported a significant improvement in pain relief with 50% of flexion extension, and 40% of radioulnar deviation. Grip strength was 50% of the contralateral side. Most patients reported a significant improvement in function with 87% returning to work. Their research has demonstrated that four-corner fusion resulted in a satisfactory outcome (53).

A few authors compared PRC with 4CA, none of them observed significant differences (7,32,37,40,54,61). Dap et al (11) Van Hove et al (55), Brinkhorst et al (7) compared 4CA with PRC patients ; all in favor of the PRC. Mulford et al (39) and Saltzman et al (46) in a systematic review of published series came to the same conclusion. A study done by Berkhout et al. showed similar results. They included 14 wrists in the PRC group and 8 wrists in the 4CA group with a mean follow-up of 17 years. The active range of motion was slightly better after PRC. There were no differences in grip strength and patient-reported outcomes between groups. (5) This survey confirms these findings, showing that PRC gives similar clinical results to 4CA in the long term, with slightly better range of motion in flexion and ulnar deviation. A possible deterioration of the newly formed radiocapitate joint did not influence the clinical outcome at a follow-up of at least nine

years.

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