Clinical outcomes of proximal row carpectomy versus four-corner arthrodesis for post-traumatic wrist arthropathy: A systematic review

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What is This?
Clinical outcomes of proximal row carpectomy versus four-corner arthrodesis for post-traumatic wrist arthropathy: A systematic review


Abstract
We conducted a systematic review of studies reporting clinical outcomes after proximal row carpectomy or to four-corner arthrodesis for scaphoid non-union advanced collapse or scapholunate advanced collapse arthritis. Seven studies (Levels I–III; 240 patients, 242 wrists) were evaluated. Significantly different post-operative values were as follows for four-corner arthrodesis versus proximal row carpectomy groups: wrist extension, 39 (SD 11º) versus 43 (SD 11º); wrist flexion, 32 (SD 10º) versus 36 (SD 11º); flexion-extension arc, 62 (SD 14º) versus 75 (SD 10º); radial deviation, 14 (SD 5º) versus 10 (SD 5º); hand grip strength as a percentage of contralateral side, 74% (SD 13) versus 67% (SD 16); overall complication rate, 29% versus 14%. The most common post-operative complications were non-union (grouped incidence, 7%) after four-corner arthrodesis and synovitis and clinically significant oedema (3.1%) after proximal row carpectomy. Radial deviation and post-operative hand grip strength (as a percentage of the contralateral side) were significantly better after four-corner arthrodesis. Four-corner arthrodesis gave significantly greater post-operative radial deviation and grip strength as a percentage of the opposite side. Wrist flexion, extension, and the flexion-extension arc were better after proximal row carpectomy, which also had a lower overall complication rate.

Level of evidence: Level III (Level I–III studies), Systematic Review. Therapeutic.

Keywords
Four-corner arthrodesis, four-corner fusion, proximal row carpectomy, scaphoid nonunion advanced collapse, wrist arthrosis

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Introduction
Scapholunate advanced collapse and scaphoid non-union advanced collapse are two frequently observed patterns of post-traumatic wrist arthritis. For individuals with degenerative disease that affects the radioscapohoid joint with sparing of the midcarpal joint and the radio-lunar joint, there are two options for motion-preserving reconstruction: four-corner arthrodesis (4-CA) and proximal row carpectomy (PRC) [Mulford et al., 2009]. However, a selection bias may inherently be created in comparing these two procedures as patients with arthritis of the midcarpal joint are not amendable to the PRC procedure.

It has been reported that 4-CA provides better post-operative grip strength and a decreased risk of progression of radio-carpal arthritis. However, it has also been associated with an increased risk of complications including nonunion, painful hardware, or implant failure [Dacho et al., 2008; Mulford et al., 2009; Watson et al., 1981]. In contrast, PRC is thought
to have fewer post-operative complications and is easier to carry out (Ali et al., 2012; Diao et al., 2005; DiDonna et al., 2004; Imbriglia et al., 1990; Wyrick, 2003). It remains unclear if one procedure provides a better range of motion. Although several studies have found both procedures to be successful in the treatment of wrist arthropathy, there are no Level I prospective randomized controlled studies to compare them (Bisneto et al., 2011; Cohen and Kozin, 2001; Dacho et al., 2008; De Smet et al., 2006; Krakauer et al., 1994; Vanhove et al., 2008; Wyrick et al., 1995).

We carried out a systematic review of publications that have compared the short- and medium-term outcomes of these two procedures.

**Methods**

We carried out a qualitative systematic review using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to determine whether there are differences in any of the following categories when the pre-operative demographics were not significantly different: active range of motion (flexion-extension, radial-ulnar deviation), grip strength, severity and frequency of pain, subjective functional limitations, satisfaction (willingness to have procedure again), hospital length-of-stay, objective functional assessments (i.e. Jebsen-Taylor, Jamar), time before return-to-work, outcome surveys (i.e. Short Form-36, Disabilities of the Arm, Shoulder and Hand (DASH), Mayo wrist score), radiographic imaging, rates of complication, and failure.

**Search strategy**

We searched Medline on Medscape, PubMed, and the Cochrane Central Register of Controlled Trials (CCRCT) for all publications from 1 January 1970 to 1 May 2013 using the following key words: proximal row carpectomy AND (four corner arthrodesis OR four corner fusion OR 4 corner arthrodesis OR 4 corner fusion OR midcarpal arthrodesis) OR scapholunate advanced collapse OR scaphoid nonunion advanced collapse. General search terms were used to prevent the possibility of missing relevant studies. The abstracts of all citations were reviewed for potential relevance, and those of significance were fully evaluated. To ensure all possible articles were considered for inclusion, the references of all applicable studies and review articles were manually cross-referenced. We included only studies that directly compared the patient-oriented outcomes of 4-CA and PRC at all lengths of follow-up.

**Data extraction**

For each study, the publication year, publication journal, study type, level of evidence, and study period were noted. The recorded demographic data were: number of patients; age; gender; rate of dominant hand involvement; arthritis aetiology; and history of previous operations. Follow-up data included: number of patients at latest follow-up; number of patients lost at follow-up; and duration of follow-up. The surgical technique for each patient was noted. We collected any pre-operative and post-operative assessments of: range of wrist motion (flexion-extension, radial-ulnar deviation); grip strength; pain; functional limitation; general health; functional ability; satisfaction; analgesic medications; complications; and re-operations.

**Statistical analysis**

Data were extracted from sources and then standardized to arithmetic means and standard deviation. Standard deviation was calculated from the measure of variance if reported by authors when the value itself was not specifically reported. A comparison of the weighted means (the average of means across multiple studies with weighting based on individual sample sizes) and calculated standard deviations were completed for those categories that were reported on by multiple individual studies. In all cases a p-value of <0.05 was considered to be statistically significant. Data that were reported as proportions were compared using Z-test calculators, which allow statistical comparison between two groups with different sample sizes.

**Results**

**Search of publications**

A total of 282 studies were initially identified using our search algorithm. After applying the inclusion and exclusion criteria, seven studies remained eligible for analysis (Figure 1).

**General characteristics and surgical technique**

Five of the seven articles detailed the surgical techniques and post-operative rehabilitation protocols for 4-CA and PRC. Four articles delineated the 4-CA procedure step-by-step, which in each included a dorsal approach, use of cancellous autologous bone graft from the radius or iliac crest, and Kirschner wire (K-wire) fixation of the bony structures. A short arm cast was used for between 6 and 9 weeks, at which
time the K-wires were removed in all but two studies, which described removal of the K-wires at 12 weeks. The fifth study (Krakauer et al., 1994) was the only one in which staples and Herbert screws were used in several patients instead of K-wires. The same five studies described the PRC procedure. Two studies included temporary K-wire fixation from the radial styloid into the radial side of the capitate for a maximum of 3 weeks if the capitate had a tendency to translate radially into the scaphoid fossa. Short-arm splints remained in place for between 3–4 weeks after operation, and gradual strengthening exercises

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**Figure 1.** PRISMA flowsheet. 4-CA/4CA: four-corner arthrodesis; CCTR: Cochrane Central Register of Controlled Trials; PRC: proximal row carpectomy.
The Journal of Hand Surgery (Eur) began between 4–8 weeks after operation. Two studies reported a concomitant radial styloidectomy in several patients, which was routinely done at the start of the studies but later discontinued. In each study, range of motion was measured using a hand-held goniometer, and grip strength was measured with a Jamar dynamometer.

Demographic data

Tables 1 and 2 summarize the demographic data, follow-up, and study designs. One study was a prospective uncontrolled randomized trial (Level I). There were two prospective comparison cohort studies (Level II), and four retrospective comparison studies (Level III). The total number of patients was 240 patients (118 4-CA, 122 PRC) with 242 wrists (119 4-CA, 123 PRC) (85% male; 15% female). The effective follow-up was reported in four of seven studies only and ranged from 83%–100% for 4-CA, and 86%–100% for PRC. The mean length of follow-up in all studies was at least 12 months, and the weighted mean follow-up was not different between groups (Table 3). Patients who underwent 4-CA (48) were significantly older than those treated by

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**Table 1. Characteristics of studies.**

<table>
<thead>
<tr>
<th>Reference</th>
<th>No. of patients [No. wrists]</th>
<th>Type of study</th>
<th>Level of evidence</th>
<th>No. of patients [no. wrists] 4-CA:PRC</th>
<th>Effective follow-up (%) 4-CA:PRC</th>
<th>Follow-up length [months] Mean [SD] 4-CA:PRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyrick et al., 1995</td>
<td>27 (28)</td>
<td>Prosp. II</td>
<td>II</td>
<td>17 (17):10 (11)</td>
<td>85:100</td>
<td>27 (12):37 (20)</td>
</tr>
<tr>
<td>De Smet et al., 2006</td>
<td>44 (44)</td>
<td>Retro. III</td>
<td>II</td>
<td>18 (18):26 (26)</td>
<td>100:100</td>
<td>31 (24):68 (35)</td>
</tr>
<tr>
<td>Bisneto et al., 2011</td>
<td>20 (20)</td>
<td>PRT I</td>
<td>II</td>
<td>10 (10):10 (10)</td>
<td>NR:NR</td>
<td>12 (NR):12 (NR)</td>
</tr>
<tr>
<td>Dacho et al., 2008</td>
<td>47 (47)</td>
<td>Retro. III</td>
<td>II</td>
<td>17 (17):30 (30)</td>
<td>NR:NR</td>
<td>42 (NR):27 (NR)</td>
</tr>
</tbody>
</table>

4-CA: four-corner arthrodesis; No.: number; NR: not reported; PRC: proximal row carpectomy; Prosp.: prospective study; PRT: prospective randomized trial; Retro.: retrospective study; SD: standard deviation.

**Table 2. Demographics of studies.**

<table>
<thead>
<tr>
<th>Reference</th>
<th>4-CA group</th>
<th>PRC group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohen and Kozin, 2001</td>
<td>47 (15)</td>
<td>17 (90)</td>
</tr>
<tr>
<td>Wyrick et al., 1995</td>
<td>46 (8)</td>
<td>15 (88)</td>
</tr>
<tr>
<td>Vanhove et al., 2008</td>
<td>38 (7)</td>
<td>10 (67)</td>
</tr>
<tr>
<td>De Smet et al., 2006</td>
<td>56 (11)</td>
<td>14 (78)</td>
</tr>
<tr>
<td>Bisneto et al., 2011</td>
<td>42 (10)</td>
<td>NR</td>
</tr>
<tr>
<td>Dacho et al., 2008</td>
<td>44 (10)</td>
<td>16 (94)</td>
</tr>
<tr>
<td>Krakauer et al., 1994</td>
<td>56 (NR)</td>
<td>22 (96)</td>
</tr>
</tbody>
</table>

4-CA: four-corner arthrodesis; N: number; NR: not reported; PRC: proximal row carpectomy.
There was no significant difference in gender, dominant hand involvement, and the number of manual labourers (Table 3).

**Range of wrist motion**

Only three studies reported pre-operative wrist flexion and extension, whereas six of seven studies reported post-operative wrist flexion and extension. The weighted mean pre-operative wrist flexion was significantly higher for the PRC cohort. The weighted mean post-operative wrist flexion was also significantly higher after PRC. However, the proportional change in wrist flexion from pre-operative to post-operative was not significantly different between the two treatment groups. The weighted mean pre-operative value for wrist extension was similar. However, even though the mean post-operative wrist extension was similar in the two groups, it was significantly greater in the PRC group, primarily owing to a larger sample size. The proportional change in wrist extension was not significantly different between the two groups after operation (Table 3). Five of seven studies reported the post-operative wrist flexion-extension arc in degrees and another reported the results as a percentage of the contralateral side. The weighted mean post-operative wrist flexion-extension arc was significantly greater after PRC. There were no significant differences in wrist flexion and extension between the 4-CA and PRC groups in any of the individual studies. Five of seven studies reported pre-operative and post-operative radial and ulnar deviation of the wrist. The weighted mean pre-operative wrist radial deviation was greater in the PRC cohort, although statistical comparison could not be done since variance was

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**Table 3.** Weighted means and weighted standard deviations of the demographics of the patients and for the outcome measures in the two groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>4-CA (N=119)</th>
<th>PRC (N=123)</th>
<th>Z-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up (months)</td>
<td>33 ± 16</td>
<td>27 ± 18</td>
<td>1.5693</td>
<td>0.1166</td>
</tr>
<tr>
<td>Age (years)</td>
<td>48 ± 10</td>
<td>44 ± 10</td>
<td>2.8182</td>
<td>0.0068</td>
</tr>
<tr>
<td>Male gender [%]</td>
<td>86 —</td>
<td>81 —</td>
<td>1.0023</td>
<td>0.3162</td>
</tr>
<tr>
<td>Dominant hand involvement [%]</td>
<td>60 —</td>
<td>53 —</td>
<td>0.9332</td>
<td>0.3507</td>
</tr>
<tr>
<td>Manual labourers [%]</td>
<td>54 —</td>
<td>63 —</td>
<td>0.743</td>
<td>0.4575</td>
</tr>
<tr>
<td>Pre-op. flexion [°]</td>
<td>37 ± 10</td>
<td>42 ± 6</td>
<td>3.0986</td>
<td>0.0019</td>
</tr>
<tr>
<td>Post-op. flexion [°]</td>
<td>32 ± 10</td>
<td>36 ± 11</td>
<td>2.6994</td>
<td>0.0069</td>
</tr>
<tr>
<td>Proportional change in flexion from pre- to post-op. [%]</td>
<td>−13 —</td>
<td>−14 —</td>
<td>0.134</td>
<td>0.8934</td>
</tr>
<tr>
<td>Pre-op. extension [°]</td>
<td>39 ± 12</td>
<td>43 ± 8</td>
<td>1.8258</td>
<td>0.0679</td>
</tr>
<tr>
<td>Post-op. extension [°]</td>
<td>39 ± 11</td>
<td>43 ± 11</td>
<td>2.6686</td>
<td>0.0076</td>
</tr>
<tr>
<td>Proportional change in extension from pre- to post-op. [%]</td>
<td>&lt;+1% —</td>
<td>&lt;+1% —</td>
<td>0.1427</td>
<td>0.8865</td>
</tr>
<tr>
<td>Post-op. flexion-extension arc [°]</td>
<td>62 ± 14</td>
<td>75 ± 10</td>
<td>5.7668</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Pre-op. radial deviation [°]</td>
<td>9 —</td>
<td>14 —</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Post-op. radial deviation [°]</td>
<td>14 ± 5</td>
<td>10 ± 4</td>
<td>5.1515</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Proportional change in radial deviation from pre- to post-op. [%]</td>
<td>+55 —</td>
<td>−30 —</td>
<td>2.3015</td>
<td>0.0214</td>
</tr>
<tr>
<td>Pre-op. ulnar deviation [°]</td>
<td>21 —</td>
<td>23 —</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Post-op. ulnar deviation [°]</td>
<td>22 ± 8</td>
<td>22 ± 9</td>
<td>0.2044</td>
<td>0.838</td>
</tr>
<tr>
<td>Proportional change in ulnar deviation from pre- to post-op. [%]</td>
<td>+1.0 —</td>
<td>−4.8 —</td>
<td>1.0806</td>
<td>0.2799</td>
</tr>
<tr>
<td>Post-op. radial-forearm arc [°]</td>
<td>30 ± 9</td>
<td>32 ± 5</td>
<td>1.8573</td>
<td>0.0633</td>
</tr>
<tr>
<td>Hand grip pre-op. strength [% of contralateral]</td>
<td>63 —</td>
<td>56 —</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Hand grip post-op. strength [% of contralateral]</td>
<td>74 ± 13</td>
<td>67 ± 16</td>
<td>3.7516</td>
<td>0.0002</td>
</tr>
<tr>
<td>Proportional change in hand grip strength from pre- to post-op. [%]</td>
<td>+17 —</td>
<td>+19 —</td>
<td>0.19</td>
<td>0.8493</td>
</tr>
<tr>
<td>Pre-op DASH score</td>
<td>42 —</td>
<td>48 —</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Post-op DASH score</td>
<td>28 ± 31</td>
<td>21 ± 17</td>
<td>1.6348</td>
<td>0.1021</td>
</tr>
<tr>
<td>Proportional change in DASH score from pre- to post-op. [%]</td>
<td>−34 —</td>
<td>−56 —</td>
<td>1.7695</td>
<td>0.0768</td>
</tr>
<tr>
<td>Overall complication rate [%]</td>
<td>29 —</td>
<td>14 —</td>
<td>2.5618</td>
<td>0.0104</td>
</tr>
</tbody>
</table>

4-CA: four corner arthrodesis; DASH: Disabilities of the Arm, Shoulder, and Hand; N: number of patients; Pre-op.: pre-operative; Post-op.: post-operative; PRC: proximal row carpectomy.

NR: not reportable, meaning that because of a lack of reported variance (as range or SD) the Z-statistic and p-value could not be calculated.

*No SD is given in values reported as proportions in the groups.*
not reported in the studies. The weighted mean post-operative radial deviation of the wrist was significantly higher after 4-CA. The proportional change in radial deviation after operation was significantly greater after 4-CA. There were no differences in weighted means for ulnar deviation between the groups at final follow-up, or differences in proportional change in ulnar deviation values after operation between the groups [Table 3]. Three of the seven studies reported the post-operative wrist radial-ulnar arc in degrees; two did not explicitly report these values but they could be calculated by the provided data. Another study compared the two groups in terms of percentages of the contralateral side. There were no differences between the weighted means for the post-operative radial-ulnar arc for the pooled data. One study reported a significantly greater post-operative radial deviation (23° vs 7°, \( p < 0.05 \)) when the 4-CA group was compared with the PRC group [Cohen and Kozin, 2001].

Grip strength

All studies reported post-operative mean grip strength as a percentage of the contralateral, unaffected, hand at final follow-up. The weighted mean postoperative grip strength was significantly greater after 4-CA, although the proportional increase in hand grip strength after operation was not significantly different after 4-CA or PRC [Table 3].

Clinical outcomes: pain severity and satisfaction

Pain severity at rest at final follow-up was reported in three of seven studies, although each reported the outcome differently, including by various descriptive terms and by a visual analogue score; therefore, the data could not be pooled for analysis. No studies reported significant differences in pain severity outcomes between the two procedures.

Satisfaction with the procedure at final follow-up was reported in three of seven studies, although each again reported the outcome in qualitatively different manners so the data could not be pooled. No significant differences in satisfaction outcomes were reported between the two procedures in any individual study.

DASH outcome scoring

Two of seven studies reported the pre-operative DASH score. Although there were no statistically significant differences, there was a trend towards a lower weighted mean post-operative DASH score and towards a proportionally greater decrease in the postoperative DASH score from after PRC [Table 3]. There were no significant differences reported between the 4-CA and PRC groups in any of the individual studies.

Complications/ re-operations

Six studies reported post-operative complications. The highest incidence of a specific post-operative complication in the 4-CA cohort in any study was carpal tunnel syndrome [six of ten wrists] [Vanhove et al., 2008]. The highest incidence of a specific post-operative complication in the PRC group was synovitis and significant oedema [three of ten wrists] [Bisneto et al., 2011]. Taking the six studies together [101 wrists for 4-CA, 97 wrists for PRC], the most common post-operative complications were non-union (6.9%) in the 4-CA group and synovitis and significant oedema (3.1%) in the PRC group. The overall complication rate in the 4-CA group was significantly higher and double that in the PRC group.

Only two studies explicitly reported the conversion rate from the index procedure to total arthrodesis [Dacho et al., 2008; Krakauer et al., 1994]. The 4-CA groups in these studies had conversion rates of 12% and 8.7%, respectively, with a mean weighted conversion rate of 10%. The PRC groups in these two studies had conversion rates of 3.3% and 17%, with a mean weighted conversion rate of 7.1%. There was no statistical difference.

Discussion

In general, the conclusions drawn by the seven studies that we reviewed [Table 1] were similar, and included relatively favourable results from both procedures in terms of pain relief and satisfaction. There were some differences in variables such as grip strength, range of motion, and complications.

Studies of 4-CA carried out by various techniques have shown that at up to 10 years follow-up there are generally satisfactory union rates, functional scores, and objective motion, and strength with low complication rates and revision rates to total wrist arthrodesis [Bain and Warts, 2010; Ball and Bergman, 2012; Bedford and Yang, 2010; Goldfarb et al., 2004; Gonzalez del Pino et al., 2012; Khan et al., 2013; Luegmaier and Houvet, 2012; Ozurekoglu and Turker, 2012; Rhee and Shin, 2013]. However, there are reports of higher rates of complications with circular plate fixation including non-union, delayed union, and dorsal impingement [Shindle et al., 2007; Skie et al., 2007; Vance et al., 2005]. Unglaub et al. [2011] reported that the most frequent location of pseudarthrosis after 4-CA was
between the hamate and triquetrum owing to incomplete cartilage debridement. Re-arthrodesis has been noted to have high rates of radiographic bone consolidation, but with only moderate clinical results (Skie et al., 2007; Unglaub et al., 2011). Many studies of PRC alone have shown similarly favourable results with satisfactory motion, grip strength, and pain relief with follow-up as long as 10 to 29 years (DiDonna et al., 2004; Drac et al., 2009; Liu et al., 2009; Streich et al., 2008; Wall et al., 2013). In this systematic review we found that there were generally few complications after the two procedures, but they were significantly different and twice as frequent after 4-CA.

Consistent with previous studies, there was more post-operative wrist extension, flexion, and total flexion-extension motion arc after PRC; however, because the pre-operative total arc of flexion-extension was greater for PRC, the proportional change in flexion-extension arc values from pre- to post-operative was similar in the two treatment groups. There was no pre-operative difference in wrist extension between the two groups. There was significantly greater post-operative radial deviation and a significantly superior proportional change in radial deviation from pre- to post-operative after 4-CA. This may be relevant for those patients who require maximal radial deviation, such as manual labourers or golfers. However, even in the range of motion values that were statistically significantly different, the differences of only a few degrees of motion may not be clinically significant.

There was a significantly greater post-operative grip strength as a percentage of the contralateral side after 4-CA. Nevertheless the proportional change from pre-operative to post-operative was not significantly different since the pre-operative grip strength in those who underwent PRC was several percentage points lower than those treated by 4-CA.

The difference in DASH scores after operation was not significant and the comparative proportional change in DASH score from pre-operative to post-operative was additionally not of statistical significance. The analysis was limited in that only two of the seven studies used the DASH as an outcome measure, and thus there may have been too few patients to detect a statistical difference.

In deciding between the two procedures, it may be worth giving more consideration to factors other than the small differences in post-operative range of motion and strength, which may not be clinically relevant. These factors include the complication rate, which was less in the PRC group, the DASH scores, which trended towards improved function in the PRC group, and the surgeon’s perception of differences in the difficulty of the procedure and length of rehabilitation. It should be taken into consideration that poorer results of PRC have been reported in young patients, especially those under 35 years of age (Wall et al., 2013).

The quality of this review is limited by the studies included for analysis, as with any systemic review. There was heterogeneity in the reporting of pre-operative variables, outcome scoring scales and examination findings that precluded the use of these data for analysis. Scoring systems, such as the Mayo wrist score and the Michigan Hand Outcomes Questionnaire, would have been valuable in comparing the groups, had they been reported. The heterogeneity in clinical outcome tools and lack of reported outcome variance or standard deviations prevented a formal meta-analysis of some data from the studies. Therefore, our results may not provide sufficient information to direct clinical practice entirely for or against either procedure. The inclusion of standard deviations, confidence intervals, and outcome assessments, as both discrete quantitative values and as a percentage of the contralateral extremity, would allow for improved systematic analysis.

Finally, there may be an inherent selection bias as, in the individual studies, the surgeons decided which of the two procedures should be done. A scaphoid nonunion advanced collapse or scapholunate advanced collapse wrist with an unaffected midcarpal joint can be treated by either 4-CA or PRC; traditionally only 4-CA is done when there is destruction of the midcarpal joint. Two of the studies had no patients with pre-operative midcarpal joint involvement (Bisneto et al., 2011; Dacho et al., 2008), and three did not distinguish if or how many patients had midcarpal involvement (De Smet et al., 2006; Vanhove et al., 2008; Wyrick et al., 1995). In one study, almost all patients [22 of 23] treated by 4-CA had involvement of the midcarpal joint, against only one of 12 treated by PRC (Krakauer et al., 1994). Another study had one patient out of 19 in the group treated by 4-CA with midcarpal joint degeneration (Cohen and Kozin, 2001). The selection bias is possibly reflected by the fact that pre-operative wrist motion in the PRC group was better than in the 4-CA group. This may also play a significant role in the reported post-operative flexion-extension, given that the same percentage differences in pre- to post-operative flexion-extension between groups were seen at follow-up. This suggests that the chosen procedure (PRC or 4-CA) does not have a differential effect on the final flexion-extension range in the wrist.

Conflict of interests
None declared.
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References