FUNCTIONAL OUTCOMES OF PROXIMAL ROW CARPECTOMY AND POSTERIOR INTEROSSEOUS NEURECTOMY IN DEGENERATIVE ARTHRITIS OF THE WRIST

MURAT DEMIROĞLU
Medeniyet Univ. Goztepe EAH, Orthopaedics, Dr. Erkin Cad. Kadıkoy, Istanbul, Turkey

ABSTRACT

Introduction: Degenerative wrist arthritis can develop from osteoarthritis, rheumatoid arthritis, posttraumatic arthritis. Common symptoms of degenerative wrist arthritis are pain and stiffness. Though, there is no cure for arthritis at the present time, there have been many treatment options to help recover pain and stiffness.

The aim of this study was to determine the contribution of posterior interosseous nerve denervation and proximal row carpectomy to the improvement of pain and functional condition of patients who developed degenerative arthritis of the wrist.

Materials and methods: The differences in the preoperative and postoperative 1st month, 6th month and 1st year VAS (Visual analogue scale) values of 9 patients, who underwent the same surgical procedure between January 2014 and June 2016, were recorded. The preoperative and postoperative 3rd-month and the 1st-year Quick DASH (The Disabilities of the Arm, Shoulder and Hand Score) scores were determined and the mean value was obtained. The range of the wrist motion was evaluated preoperatively and postoperatively.

Results: The postoperative follow-up period was 22 (15-42) months. One (11%) patient developed postoperative pin site infection, which regressed with local dressing and oral antibiotherapy. One (11%) patient developed complex regional pain syndrome. A significant decrease was obtained in the mean postoperative VAS scores compared to the preoperative VAS scores (p <0.01). The difference was 3.67. A significant improvement was obtained between the mean values of preoperative and postoperative Quick DASH scores (p <0.01). The difference in Quick DASH score was 46%.

Conclusion: We concluded that proximal row carpectomy along with posterior interosseous nerve neurectomy is movement-preserving surgery and that it is effective for pain control in patients with degenerative arthritis of the wrist and also advanced Kienböck’s disease.

Keywords: Proximal row carpectomy, posterior interosseous nerve denervation, degenerative arthritis of the wrist.

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Introduction

Radiocarpal arthritis may cause significant pain and weakness\(^{(1)}\). A history of trauma and intense hand-related work are common in the history of patients who develop arthritis. Surgical treatment options include total wrist arthroplasty, total wrist fusion, four-corner fusion of the wrist and proximal row carpectomy and posterior interosseous nerve denervation in case that conservative treatment provides inadequate results\(^{(2,3)}\).

Proximal row carpectomy has become a common surgical procedure since the majority of patients desire to maintain the motion of the wrist.
The presence of chondral lesion at the lunate fossa of the distal radius is a contraindication. A lot of literature has been published about the outcomes of PRC. Although PRC is recommended for patients with moderately to high demand patients, four-corner fusion is recommended to those with midcarpal arthritis or who needs a high hand-grip strength after surgery, they are not alternative to each other. In general, the PRC provides more increase in the postoperative movement arc. Posterior interosseous nerve denervation (PINN) is well described and used in the treatment of chronic wrist pain, and current systematic evaluations provide high clinical success rates in reducing pain.

The aim of this study was to determine the efficacy of combined posterior interosseous nerve denervation in mid-term functional outcomes and in reducing the pain of all patients for whom we performed PRC.

Materials and methods

This retrospective study was carried out by the evaluation of patients operated between January 2014 and June 2016. Ethics committee’s approval was obtained for the study and the patients gave their consent for the study during their follow-ups. The study was conducted in accordance with the principles of the Declaration of Helsinki (2008).

All patients, who underwent PRC and posterior interosseous nerve neurectomy (PINN) and attended regular follow-up visits for a minimum follow-up period of 15 months, were included in the study. In this study, randomization was not performed because there was only one group of patients.

Patients with rheumatologic, neurological disease and an inadequate number of follow-up visits were not included in the study.

A total of 9 patients (3 males, 6 females, the mean age 45.33 ± 11.10 years) aged between 36 and 68 who met the criteria were included in the study. The demographic characteristics of the patients are shown in Table 1.

Patients’ ages, follow-up period, disease etiology, preoperative VAS and Quick DASH value, the mean VAS and Quick DASH scores during the postoperative follow-ups were recorded.

In addition to preoperative radiographs, radiographs of patients were taken after the postoperative 3rd month and 1st year.

Surgical Technique

An single surgeon who has experience in hand surgery performed operation on all patients. The same surgical technique was used for all patients. A straight incision passing through the 3-4th extensor compartments of the wrist was made in all patients under general anesthesia and tourniquet control. The extensor pollicis longus (EPL) pulley was carefully opened and pulled towards the radial side. The extensor digitorum communis tendon group was carefully pulled towards the ulnar side. Posterior interosseous nerve was identified and resected (Figure 1).

A sufficient size was given to the joint capsule by a longitudinal incision so as to allow full visualization of the proximal row. The lunate facet of the radius should be observed before the proximal row is begun to be removed. The presence of a severe degeneration may make it difficult to obtain a good outcome, so soft tissue interposition should be considered in such a case. The scaphoid bone was removed after the removal of the lunate bone by performing wrist traction. Finally, the triquetrum bone was removed. The Volar radiocarpal ligaments were preserved. Radial styloidectomy was not performed. Radiocapitellar fixation was obtained with retrograde K wire in all patients. Fluoroscopy control was performed. The capsule was anatomically closed up, using non-absorbable 2-0 suture. The skin was closed up after bleeding control. Following sterile dressing on the palmar side, a splint was placed. The metacarpophalangeal joint was released.
Postoperative Care
Next day, the wound was checked. Radiography was taken. The wound dressing was changed every 3 days. The sutures were removed on the 12th day. The pins were pulled out on the 3rd week. After 4 weeks of splint treatment, removable splint was recommended for an additional 2 weeks. The patient was recommended to remove it three times a day and perform wrist extension and flexion movements for 20 minutes. The splint was completely removed after the 6th week and passive ROM exercises were initiated. It was waited for 10 weeks for the patient to return to full activity. Patients were not routinely directed to physiotherapy.

Evaluation parameters
The patients were asked to show the level of pain they felt during rest and activity, showing a visual analog scale (VAS) preoperatively and postoperatively (0: no pain, 10: very severe pain). The mean value of the VAS scores during the follow-ups at the postoperative 3 month and one year was calculated.

The pre- and post-operative movement arc of patients (flexion + extension) were determined (Table 1).

<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Age</th>
<th>Side</th>
<th>Etiology</th>
<th>Preop VAS</th>
<th>Postop VAS</th>
<th>Preop Quick DASH</th>
<th>Postop Quick DASH</th>
<th>Preop F+E</th>
<th>Postop F+E</th>
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<tr>
<td>1</td>
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<td>36</td>
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<td>Kienböck</td>
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<td>R</td>
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<td>18.2</td>
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<tr>
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<td>R</td>
<td>SNAC</td>
<td>6</td>
<td>2</td>
<td>29.5</td>
<td>13.6</td>
<td>40</td>
<td>100</td>
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<tr>
<td>4</td>
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<td>37</td>
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<td>15</td>
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<td>70</td>
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<td>NeglectedPerilunate dislocation</td>
<td>6</td>
<td>1</td>
<td>47.7</td>
<td>27.3</td>
<td>20</td>
<td>50</td>
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</tbody>
</table>

Table 1: Demographic values of patients and results of parameters of evaluation.
R: right; L: left; F+E: total degree of flexion and extension. VAS: visual analog score. Quick DASH: The Disabilities of the Arm, Shoulder and Hand Score

The patients were preoperatively and postoperatively evaluated in terms of upper limb functions using a quick arm, shoulder and hand questionnaire (Quick DASH). Patients were asked to answer 11 questions and 5 options in which they were requested to rate whether they had any difficulties with their activities or any symptoms last week. The low score indicated a good function^{20}.

Statistical Analysis
The NCSS (Number Cruncher Statistical System) 2007 Statistical Software (NCSS LLC, Kaysville, Utah, USA) program was used for the statistical analysis. During the evaluation of the study data, besides descriptive statistical methods (mean, standard deviation, median, frequency and ratio), the Wilcoxon signed rank test was used for the intra-group comparisons of variables that do not show normal distribution due to the number of cases. The results were evaluated with a confidence interval of 95% and significance level of p<0.05.

Results
The ages of patients ranged between 36 and 68 years with a mean age of 45.33± 1.10 years. 33.3% of the cases (n=3) were male and 66.7% (n = 6) were female. While 77.8% (n = 7) of the cases were operated from the right side, 22.2% (n = 2) of cases were operated from the left side. The right hand was dominant in eight (88%) of the patients, whereas the left hand was dominant in one (11%) of the patients.

The reason for surgery was advanced Kienböck in six (66%) patients, SNAC in 2 (22%) patients, and neglected perilunate dislocations in one (11%) patient.

One patient developed pin site infection, which regressed using local dressing and oral antibiotherapy within 3 days.
One patient (11%) developed complex regional pain syndrome and healed in 3 weeks with physiotherapy.

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>Quick DASH</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Min-Max (median)</td>
<td>Mean±SD</td>
</tr>
<tr>
<td>Preop</td>
<td>4-6 (5)</td>
<td>5.11±0.78</td>
</tr>
<tr>
<td>Postop</td>
<td>1-2 (1)</td>
<td>1.44±0.53</td>
</tr>
<tr>
<td>( \cdot )</td>
<td>0.007***</td>
<td>( 0.008^{**} )</td>
</tr>
<tr>
<td>Difference</td>
<td>2-5 (4)</td>
<td>3.67±0.87</td>
</tr>
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</table>

**Table 2**: Evaluations according to VAS and Quick Dash scores.

*Wilcoxon Signed Rank test

**\( p<0.01 \)**

![Fig. 2](image1.png)

**Fig. 2**: The first figure shows lateral X-ray on the first postoperative day. The second and the third figures show there is no sign of radiocapitellar degenerative arthritis in the second postoperative year.

Although all patients expressed their satisfaction with the reduction of postoperative pain, 2 patients reported that they expected to have more improvement in the wrist arc. The postoperative results were 20 degrees in one of the patients and 30 degrees in the other patient.

All patients stated that after the 3rd month they could easily do the works that they had difficulty before the surgery, and expressed their satisfaction.

The mean follow-up period was 22 months (15-42 months). There was no patient required a revision surgery.

While the mean preoperative Quick Dash measurement was 35.57±8.16, it regressed in the postoperative period (17.58 ± 4.59), and the mean difference was 49.38%, which was statistically significant (\( p <0.01 \)).

While the preoperative mean value of VAS was 5.11, the postoperative mean value of VAS decreased to 1.44. The difference was significant (\( p <0.01 \)). (Table 2)

While the preoperative mean value of movement arc was 40 (20-50) degrees, the mean value measured postoperatively during the follow-ups was 83 (50-120) degrees. The difference was significant (\( p <0.01 \)).

Radiological evaluation revealed no sign of radiocapitellar arthrosis (Figure 2).

**Discussion**

Proximal row carpectomy is a technically simple surgical procedure with a 40-year history in the radiocarpal degenerative arthritis\(^{21,22}\). The most advantageous aspects of the procedure are a rapid gain-of-function and a low postoperative complication rate.

Advanced Kienböck disease had the greatest rate in our small series of degenerative wrist causes. Since the lunate bone volume decreases, four-corner arthrodesis surgery, which is most commonly compared to PRC, has no place in the management. Four-corner arthrodesis is an alternative to PRC as a movement-preserving surgery in SLAC and SNAC-related degenerative wrist arthritis. PRC is a technically simple procedure that allows early movement of the wrist, and does not require fracture union. On the other hand, a more stable wrist is formed in four-corner arthrodesis. Although the outcomes of both techniques have been published in a number of studies\(^{5,9,12,13,16,17,19,22,23,25}\), only a few studies directly compared these two techniques\(^{6,11,14,15,18}\). It has been generally found that the grip strength was similar but the movement arc of the wrist was superior in PRC. PRC has been recommended, if there was no arthrosis on the head of the capitate bone. A similar but different result was found in the study of Cohen and Kozin\(^{10}\). Flexion-extension articulation has been found to be similar in both studies. The level of pain relief and satisfaction has been found to be similar in both surgeries, but the radioulnar deviation angle was better in those underwent 4-corner fusion. The authors have recommended two techniques for short-term follow-up of the degenerative SLAC wrist.
PENN was implanted to all patients in our study. The neurectomy, which is initially performed in 1985 in patients with chronic wrist pain(21), became popular in the following years and was found to be extremely effective in reducing pain, and did not cause any morbidity(22,24).

Postoperative immobilization is important for healing of the fixed capsule, prevention of subluxation and pain relief(20). Although there are publications stating that post-operative immobilization is not necessary(26), we recommend immobilization for at least 4 weeks. No patient with severely limited wrist motion was encountered during the frequent polyclinic follow-ups of patients who were initiated active exercise, as well as passive exercise after the 6th week. Patients were not routinely directed to physical therapy rehabilitation center.

The current degenerative changes in the capitate may make it difficult to obtain a good outcome, as the motion of the wrist after the surgery will be created by radiocapitellar joint(21). Interposition arthroplasty is recommended in the case of arthritis(27,29). Soft tissue interposition is recommended in the case of significant arthrosis on the head of the capitate bone(29).

From PRC studies that has been carried out arthroscopically instead of open technique, Weiss et al.(30) reported the outcomes of 16 patients in their article and emphasized that all patients were satisfied with the procedure, and that 80% improvement was detected in the movement arc and hand-grip strength, and that switching to an open technique was not required in any patient.

It has been reported in the etiology that in a study of 22 patients(31) in which the average follow-up period in a mixed patient population was 14 years, 4 of the patients required wrist arthrodesis at the 7th year follow-up, and all of these 4 patients were younger than 35 years. Similarly, Jebson et al.(32) emphasized that radiocapitellar joint changes on radiographs would not indicate a bad outcome and the procedure would produce satisfactory results in those 35 years of age or older.

PRC is a technique that has been utilized for indications in cases of acute hand clinical conditions such as hand replantation, severe open wrist injuries(32,33). Della Santa et al. compared PRC in irreducible perilunate dislocation and chronic cases. Patient satisfaction was found to be higher in acute cases in this series of 12 cases.

The preoperative hand-grip strength could not be determined in our patients, as it could not be performed since the majority of patients felt pain during the hand-grip strength test that was determined by taking the mean value after 3 measurements. When the hand-grip strength results of patients were compared with the opposite limb at the first postoperative year follow-up, the mean hand-grip strength exceeded 70 percent of the opposite limb.

The limitations of our study are the small number of sample and retrospective design.

The advantageous aspect of our study is PRC combined with PINN. Generally in literature combination with PINN does not exist on every series.

As a result, we consider that application of PRC in combination with PINN as a preserving surgery will provide a high patient satisfaction rate in conditions leading to degenerative arthritis of the wrist (SLAC, SNAC, chronic perilunate dislocations, and Kienbock’s disease).

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