

Original Research Article

A prospective study on outcome of function after proximal row carpectomy

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ABSTRACT

Background: Proximal row carpectomy (PRC) is a procedure with varied indications. The purpose of this study was to evaluate functional outcomes with PRC in wrist flexion deformities, neuromuscular disorders and also post-traumatic wrist arthritis.

Methods: A prospective study was performed on all patients who underwent PRC between April 2015 and December 2017, in BIRRD (T) hospital, Tirupati, Andhra Pradesh with a minimum follow up of 6 months. Outcome was assessed in terms of range of motion (ROM), grip strength, quick disabilities of the arm, shoulder, and hand (QDASH) score and pain score. Data was analyzed using the Student t-test.

Results: Thirty-two patients underwent PRC of which 12 are neuromuscular disorders, 10 are wrist flexion deformities, 10 are post-traumatic wrist arthritis. On the final follow-up, significant improvement in ROM was observed in wrist flexion deformities and neuromuscular disorders, whereas grip strength and QDASH scores showed a significant difference in post-traumatic wrist arthritis. Pain was studied only in post-traumatic wrist arthritis, all were very much pleased with pain reduction.

Conclusions: PRC is fairly a reliable procedure for all the indications in our study. We consider that PRC is a promising procedure in correcting wrist flexion deformities. Though there has been significant improvement in all the parameters for all the cases, we consider this procedure is best suited for post-traumatic arthritis group.

Keywords: QDASH, PRC, Post-traumatic arthritis, Neuromuscular disorders, Wrist flexion deformity, ROM, Grip strength

INTRODUCTION

Proximal row carpectomy (PRC) is an accepted motion sparing surgical procedure for treatment of post traumatic arthritic wrists as seen in fracture scaphoid non-union, Keinbock's disease, perilunate dislocations, carpal instabilities, wrist flexion deformity as seen in volkmann's ischemic contracture and neuromuscular disorders like, arthrogryposis, hemiplegia.¹⁻⁵

PRC entails removal of the scaphoid, lunate, triquetrum, turning a complex link joint into a simple hinge.⁶ The

purported advantages include its technical ease, preservation of a functional arc of motion, satisfactory strength, pain relief, and high patient satisfaction.⁷⁻⁹

Disadvantages include loss of carpal height, formation of an incongruous joint and the potential for progressive degenerative arthritis of the radiocarpitate articulation.^{10,11}

Despite numerous reports documenting clinically successful outcomes, criticism includes postoperative loss of grip strength, unsatisfactory range of motion, prolonged rehabilitation time and the potential for progressive painful arthritis. There are mixed reviews

regarding the outcome of the procedure. Hence we conducted a prospective study on functional outcomes after proximal row carpectomy.

METHODS

The prospective study followed cases treated with PRC for various indications namely, post-traumatic arthritic wrists (as seen in fracture scaphoid non-union, Keinbock's disease, perilunate dislocations, carpal instabilities), Volkmann's ischemic contracture (Figure 1), and neuromuscular disorders (arthyrogryposis, hemiplegia) between April 2015 and December 2017, in Balaji Institute of Surgery, Research and Rehabilitation for Disabled, Tirupati, Andhra Pradesh with a minimum follow up period of 6 months. Patients with poor general condition, inflammatory arthropathy or preexisting radiocarpitate arthritis were excluded from the study.

Detailed history and proper clinical examination was done. Range of movements of the wrist with goniometer, grip strength (hand, pincer and key grip) in kilo pascals (kPa) with dynamometer, quick disabilities of the arm, shoulder, and hand (QDASH) score calculated with QDASH questionnaire and pain score calculated with numerical pain rating scale. Radiographs of the wrist anteroposterior and lateral views of the involved side were taken and evaluated.

Surgical technique

All patients were operated under brachial block, using the dorsal approach. Patients were positioned supine with arm support. A transverse incision was given on the dorsum of the wrist, 5 to 10 mm distal to the radiocarpal joint; extending from the dorsal aspect of the ulnar styloid to the radial styloid. Dissection was deepened to extensor retinaculum and reflected as a flap laterally. Extensor tendons were retracted and the dorsum of the proximal row of carpal bones exposed with transverse capsulotomy. Intercarpal ligaments were released and carpal bones divided using an osteotome. Scaphoid, lunate, triquetrum were then excised. Capsule, extensor retinaculum and skin were closed in layers and immobilized in a plaster cast.

Postoperative protocol

Mobilization of metacarpophalangeal and interphalangeal joints were initiated immediately post-operatively, and suture removal done on 12th post-op day. Patients were discharged with a cock-up splint and advised to do range of motion exercises at wrist at 3 weeks post-operatively. They were advised not to lift heavy objects and not to restore sporting activities with the limb. Patients were followed up at 6 weeks, 3 months and 6 months to assess range of motion, grip strength, QDASH scores and pain assessment at each visit.

Statistical analysis

Student's paired t-test was used to find out the significance of difference between pre-operative and post-operative range of motion, grip strength and QDASH score. Differences were regarded as significant at $p < 0.05$.

RESULTS

All 32 patients in the study returned for clinical examination subsequently. Four cases were hemiplegia, 8 cases were arthyrogryposis, 10 cases were non-union scaphoid and 10 were Volkmann's ischemic contracture. Patients were reviewed at 6 weeks, 3 months and 6 months post operatively. Mean age was 22.6 years, minimum age was 7 years and maximum age was 45. 27 of these patients were males (84.4%).

Mean fixed flexion deformity (FFD) at wrist pre operatively was 35°, which was reduced significantly to 3.1° intra-operatively and then slightly increased to 4°, 5°, 5.2° at 6 weeks, 3 months and 6 months follow up respectively (Figure 1).

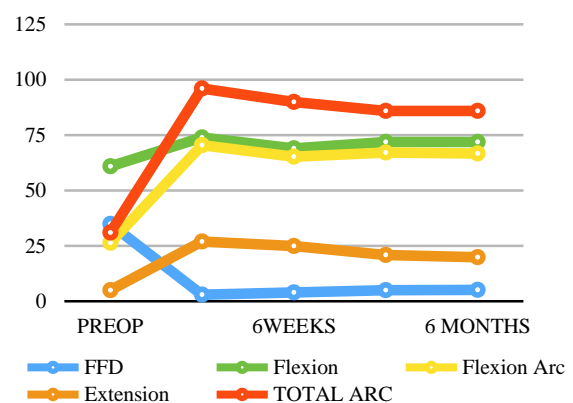


Figure 1: Range of movement parameters at different stages through the study.

Mean flexion at wrist pre operatively was 61°, which was increased to 74° intra-operatively. At 6 weeks, 3 months, 6 months follow ups it was 69°, 72°, 72° respectively (Figure 1).

Mean flexion arc at wrist pre operatively was 26.4°, which was increased significantly to 70.78° intra operatively and were 65.31°, 67.187°, 66.71° at 6 weeks, 3 months and 6 months follow up respectively (Figure 1).

Mean extension at wrist pre operatively was 5°, which was increased significantly to 27° intra operatively and were 25°, 21°, 20° at 6 weeks, 3 months and 6 months follow up respectively (Figure 1).

Mean total arc of motion at wrist pre operatively was 31°, which was increased significantly to 96° intra operatively and were 90°, 86°, 86° at 6 weeks, 3 months and 6 months follow up respectively. (T value=-28.664, p value<0.0001) (Figure 1).

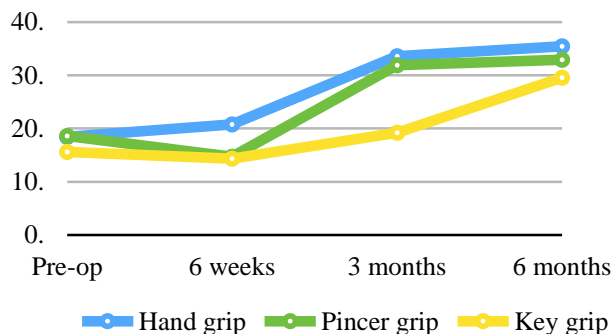


Figure 2: Grip strengths at different stages through the study.

Mean hand grip strength pre operatively was 18.43 kPa, which was increased to 20.78 kPa, 33.59 kPa, 35.47 kPa at 6 weeks, 3 months and 6 months follow up respectively (Figure 2).

Mean pincer grip strength pre operatively was 18.59 kPa, which was decreased to 14.68 kPa at 6 weeks follow up and then increased to 31.87 kPa, 32.9 kPa at 3 months and 6 months follow up respectively (Figure 2).

Mean key grip strength pre operatively was 15.62 kPa, which was slightly decreased to 14.313 kPa at 6 weeks follow up and then increased to 19.218 kPa, 29.53 kPa at 3 months and 6 months follow up respectively (Figure 2).

Mean QDASH score was 69.27 preoperatively which decreased to 50.83 at 6 months follow up (T value=7.508; p<0.0001).

Grip strength percentage to contralateral side

Pain scores were calculated only for non-union scaphoid cases as their chief complaint was pain. The mean pre-operative pain score for 10 cases of non-union scaphoid was 6.9 which significantly reduced to 1.3 at 6 months follow up (T value =11.225; p value<0.0001).

Table 1: Means of grip percentages to contralateral side.

	Pre-op	6 months post-op	T value	P value
Hand grip	48.57	95.05	-6.254	<0.0001
Pincer grip	56.35	106.07	-6.843	<0.0001
Key grip	50.52	79.35	-3.534	<0.0001

DISCUSSION

The objective of the study was to evaluate the functional outcomes after PRC for varied indications. This is a prospective study comprising of 32 cases who underwent PRC for varied indications which is comparable to studies by Didonna, Ali, Jebson, Liu.^{4,5,12,13} We divided them into 3 groups for comparison which are as follows:

Volkmann’s ischemic contracture (VIC) group

Ten cases whose chief complaint was fixed wrist flexion deformity.

Neuromuscular disorders group

Twelve cases included cases of both arthrogryposis (8 cases) and hemiplegia (4 cases) whose chief complaints were weak hand grip and flexion deformity at wrist.

Post traumatic arthritis group

Ten cases all of them were non-union scaphoid whose chief complaints were pain, decreased range of motion and grip strength.

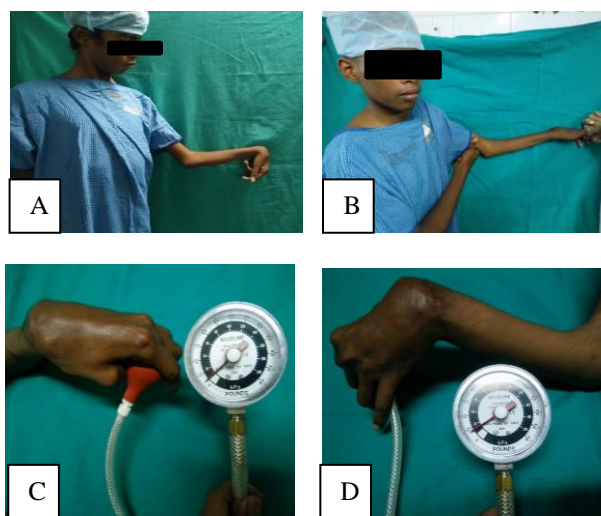


Figure 3: A case of Volkmann’s ischemic contracture (A): Pre-operative range of motion; (B): 6 months post-operative range of motion; (C): Pre-operative grip strength; (D): 6 months post-operative grip strength.

Of these 32 patients, most patients (50%) were of 11-20 years age group.

The mean FFD, in our study significantly dropped down from pre-operative mean value of 35° to 5.2° at 6 months follow up. Hence we consider that PRC is a useful procedure in patients whose chief complaint is wrist flexion deformity as seen in Volkmann’s ischemic contracture and neuromuscular disorders groups of our study.

Mean flexion arc improved from 26.4° pre-operatively to 66.71° at 6 months follow-up. We observed most of the improvement is contributed by Volkmann's ischemic contracture group and neuromuscular disorders group.

The mean extension improved from 5° pre operatively to 20° at 6 months follow up. In our study we couldn't achieve extension in Volkmann's ischemic contracture group and one patient in neuromuscular disorders group. Satisfactory improvement was observed in post-traumatic arthritis group and neuromuscular disorders group. The mean extension in neuromuscular disorders group was -38.3° (representing wrist flexion contracture), that increased to 20.4° post operatively which is comparable to the study done by Ali where they observed improvement from -13° (representing wrist flexion contracture) to 21° following surgery.⁵

Overall, patients had improved mean arc of motion which is comparable to other studies.^{6,10-12,14-16} Mean values increased from 31° pre operatively to 86° at 6 months follow up which are comparable to 72° in the studies done.^{2,5} Our results are contrary to the studies done by Ali, Randal, Didonna, where they observed decreased arc of motion.^{5,9,11} Within the groups of our study, neuromuscular group showed the best results in terms of arc of motion.

Of the total 32 patients, mean QDASH score improved from 69.27 to 50.83 which is statistically significant. The post-traumatic group showed the best improvement whose mean score reduced drastically from 72.2 pre-operatively to 15.7 at 6 month follow up, as opposed to Volkmann's ischemic contracture group and neuromuscular disorder group which didn't show much improvement.

We observed marked improvement in grip strength % of contralateral side following surgery, which is in accordance with most studies.⁹⁻¹⁶ (Table 2) The mean preoperative hand grip strength was 48.57% of contralateral side, which markedly increased to 95.05% of contralateral side at 6 month follow up. However, studies done by Ali, Stamm, Jorgensen, stated decrease in grip strength following surgery.^{5,6,8} Post traumatic arthritis group had the best improvement in mean grip strength percentage of contralateral side.

Table 2: Means of post op grip strengths in various studies.

Study	Post op % of contralateral side
Croog ¹⁵	87
Didoonna ¹¹	91
Jebson ¹²	83
Liu ¹³	75-99
Lumsden ¹⁶	92
Our study	95.05

Volkmann's ischemic contracture group has shown the best outcome in mean pincer grip strength percentage to contralateral side, while the post-traumatic group showed the most improvement in key grip percentage to contralateral side.

Pain outcome was studied only in post-traumatic group as their chief complaint was pain. Mean pain score pre-operatively was 6.9 that has reduced to 1.3 post operatively at 6 months follow up. Patients of this group were very much pleased with the pain relief. This is comparable to the study done on PRC for post traumatic and degenerative disorders by Jebson, where he states that there was high patient satisfaction in terms of pain relief.¹² However, Ali observed 72% patients had persistent pain, unable to do occupational activities and weren't satisfied with the result.⁵

CONCLUSION

PRC is a fairly reliable procedure for all the indications mentioned in our study. It has proved to increase the arc of motion, grip strength, improvement in QDASH scores and pain relief. We also consider that PRC is a promising procedure in correcting wrist flexion deformities. Though there has been significant improvement in all the parameters for all the cases, we consider this procedure is best suited for post-traumatic arthritis group.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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