Original Article

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Evaluation of Results of Pronator Quadratus Repair Following Volar Plate Fixation of Distal Radius Fracture: A Prospective Study

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Abstract

Background: Volar plating is increasingly used in distal radius fracture as it helps in the fixation of radial and intermediate column. Now volar locking plate, polyaxial volar locking plate, which are low profile are increasingly used. During operation, pronator quadratus is incised. This has led to the question, whether pronator quadratus repair is necessary for better wrist function.

Purpose: The objective of this study was to evaluate the efficacy of pronator quadratus repair after volar plating of distal radius fracture.

Materials and Methods: During the period of 2011-2014, 50 distal radius fractures treated operatively with volar plate are assigned to receive a repair of pronator quadratus versus no repair. Surgical exposure, reduction, and postoperative rehabilitation are equivalent in both groups. Patients are followed up for a period of 12 months. Results are assessed via wrist motion, grip strength, disabilities of the arm, shoulder and hand (DASH) score, and visual analog scale (VAS).

Results: A total of 50 distal radius fractures were treated operatively. Full follow-up data are available for 27 patients repair group versus 20 patients in the control group. At 12 months, there is no significant statistical difference between two groups regarding wrist motion, DASH scores, and VAS scores. In addition, we found no significant differences in any of the parameters at the 2 weeks, 6 weeks, 3 months, and 12 months intervals. Reoperation was not required in any of the patient.

Conclusion: Pronator quadratus repair after volar plating of a distal radius fracture does not significantly improve postoperative results.

Keywords: Distal radius fractures, Pronator quadratus, Volar plating

INTRODUCTION

Distal radius fractures represents 16% of all fracture treated in the emergency department and 21% of all fractures treated in young adults.[1] It is the most common fracture in the upper extremity. The most common cause of such a fracture is due to fall on the outstretched hand. Distal radius fractures often result in long-term functional impairment, pain, and deformity. The three-column model (Figure 1) of distal forearm helps in understanding the fractures and assists in planning for internal fixation.[1] The volar locking plate has become the technique of choice in recent years for fixation of these fractures[2] as it exhibits the potential for decreased functional disability and lower complication rate than the alternative such as external fixator, dorsal plating, and percutaneous pinning. By volar plating, we can stabilize both the radial column and intermediate column.

The modified Henry approach was preferred by us,[1] it utilizes the plane between flexor carpi radialis and radial artery. The radial artery is retracted radially and flexor carpi radialis tendon medially retracted. The bone is exposed by complete division of pronator quadratus muscle.

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It is believed that pronator quadratus muscle repair is necessary for better wrist movement, grip strength, and most important in preventing flexor tendon injury from friction of the plate. Some surgeons do not believe that.

This is a prospective study to evaluate whether pronator quadratus muscle repair is necessary after volar plating for better function.

MATERIALS AND METHODS

This is a prospective study performed on 50 patients with 50 distal radius fractures in our institution from January 2011 to December 2014. All the fractures are intra-articular ([Arbeitsgemeinschaft für Osteosynthesefragen] AO classification 23-B3 to 23-C3) (Figure 2).[2] Patients with open fracture, bilateral wrist fracture, and with other fractures in the same upper limb were excluded. A clearance was obtained from the Ethical Committee of IPGMER and SSKMH and a detailed consent was taken from each of the patients explaining pros and cons of the surgical procedure involved along with pros and cons of other treatment modalities for similar fracture patterns. Among these 50 patients, 3 patients were lost during follow-up. The rest of the patients were followed up for a period of one year. All the operations were performed by the same surgeon. Computerized tomography (CT) full forms should be used. All the words that are to be expanded are highlighted in red scan has been done in Type C fractures for better understanding of fracture configurations.

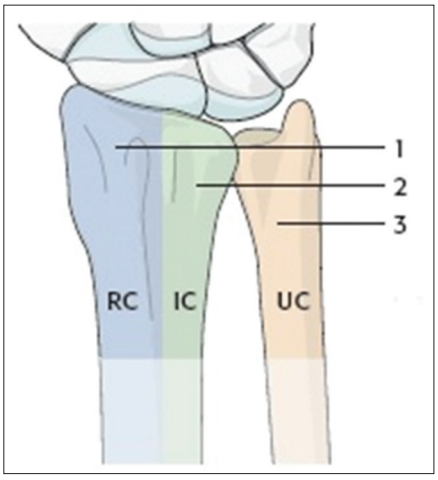

Figure 1: 3 column theory of distal radius, RC: Radial column, IC: Intermediate column, UC: Ulnar column1,2

Figure 2: With pronator quadratus repair

All the patients were operated in the supine position with forearm placed on hand table. The modified Henry approach was found to be suitable for most fractures. Radial artery was palpated and marked. Tourniquet was applied. Incision was given between flexor carpi radialis muscle and radial artery. Flexor carpi radialis with deep flexor was retracted radially and radial artery medially. Exposure of the bone was completed by the division of pronator quadratus. Fracture was reduced by hyperextension of the wrist. In some cases, dorsal approach became necessary for a dorsal fragment or impacted intermediate fragment reduction. In some cases, radial lateral plate and dorsal plate were needed for proper fixation. Reduction was confirmed under image intensifier. Pronator quadratus was repaired with 3-0 bio-absorbable braided suture in 20 patients. Wound was closed in layers. Stich off was done after 12 days.

Immediately after surgery, patients were encouraged to elevate the limb, and mobilize the digits, elbow, and shoulder. Patients were followed up on 2 weeks, 6 weeks, 3 months, 12 months interval. Wrist movements, (disabilities of the arm, shoulder and hand) DASH score, (visual analog scale) VAS scale, and grip strength ratio were used to compare the operated side with the normal side.

RESULTS

During this 3 year period, 50 distal radius fractures were treated operatively. Complete follow-ups are available in 47 patients. Among them in 27 patients pronator quadratus was repaired. The average age group was 50 years (range 19-70 years) in the repair group and 60 years (range 25-70 years) in the non-repair group. The repair group consisted of 12 male and 15 female, the non-repair group consisted of 13 female and 7 male. Among the 47 fractures 15 fractures were Type B3 group, 13 in Type C1, 12 in Type C2, and 7 in Type C3 group (Figures 2 and 3)

In the pronator quadratus not repaired group, the average wrist motion at the end of 12 months: Flexion 82° (78-85), extension 80° (75-85), supination 86° (75-88), pronation

86° (73-87), ulnar deviation 36° (32-35), radial deviation 20° (15-25). DASH score 6 (4-8), VAS scale 1 (0-2), jammer grip strength ratio to contralateral limb 0.65 (0.55-0.68) (Figure 4).

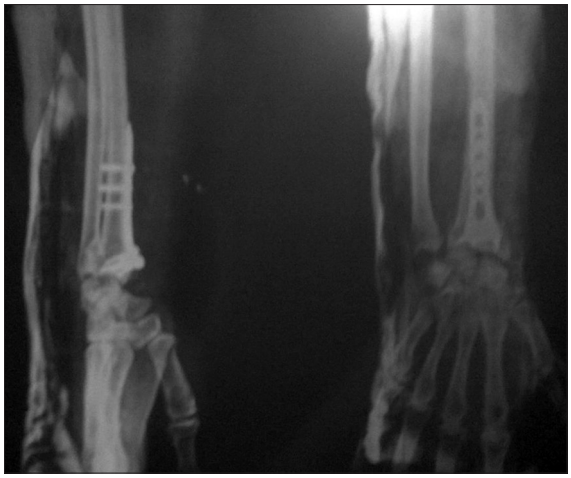

Figure 3: Immediate post-operative X-ray

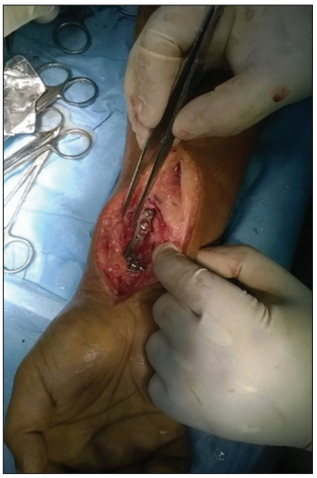

Figure 4: Without pronator quadratus repair

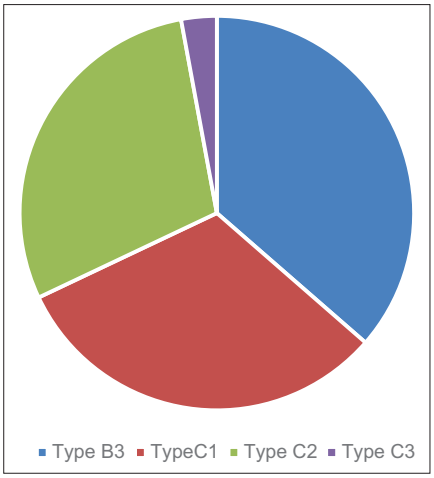

Figure 5: Patient division

In the pronator quadratus repaired group, the average wrist motion at the end of 12 months: Flexion 84° (80-86), extension 82° (75-85), pronation 80° (83-87), supination 80° (82-87), ulnar deviation 36° (30-37), radial deviation 20° (17-23), DASH score 8 (6-10), jammer grip strength to contralateral limb ratio 0.61 (0.57-0.68) (Figures 5 and Table 1).

Complications included 2 cases of superficial infection, which was treated with antibiotics. No deep infections were found. Reoperation was not required for any fracture.

No statistical difference in the range of motion, DASH score, and grip strength was found between pronator quadratus repaired and not repaired group (Figures 6-9 and Table 1)

DISCUSSION

During volar plating pronator, quadratus muscle is incised and it is damaged during reduction and plate fixation. Surgeons face difficulty in repairing the damaged muscle. Sometimes it is not possible to repair it or only partial repair is feasible.[3] Even after hardware removal it is found that the average length of pronator quadratus is 68%. The length of healed Pronator quadratus muscle does not affect the isokinetic forearm rotation. It suggests that tight repair of Pronator quadratus is not necessary for achieving improved forearm function.[4] Volar plating is now the most common procedure done in distal radius fracture. A variety of complications pertaining to volar plate fixation for the management of distal radius fracture has been reported. Incidence of flexor pollicis longus tendon rupture has been reported from 2% to 12%. In most of the cases, it is due to plate prominence, faulty plate positioning, high profile locking plate.[5,6] Positioning of the plate proximal to the watershed line and early removal of plate in cases with plate prominence or warning symptoms can reduce the risk of this complication.[7] Plate prominence at the watershed line predisposes individual to flexor pollicis longus (FPL) rupture and may be avoided by thorough fluoroscopic examination from multiple angles. In our study, there were no cases of FPL rupture. Other complication like reflex sympathetic dystrophy was not found in our study.

No statistical difference was found in the range of motion and grip strength between repair and non-repair group. The range of motion and grip strength is not significantly different at 95% confidence interval. These findings suggests functional equivalence between repair and not repair group.[8]

CONCLUSION

During the surgical procedure, surgeons are usually very cautious regarding pronator quadratus repair after

Table 1: Follow-up grand chart

	2 weeks		6 weeks		3 months		6 months	
	Repaired	Not repaired	Repaired	Not repaired	Repaired	Not repaired	Repaired	Not repaired
Extension	30°	30°	58°	50°	75°	71°	82°	80°
Flexion	35°	38°	55°	57°	75°	68°	84°	82°
Pronation	77°	77°	82°	80°	86°	84°	86°	86°
Supination	65°	55°	75°	70°	85°	85°	86°	86°
Ulnar deviation	31°	27°	31°	30°	35°	38°	36°	36°
Radial deviation	7°	8°	16°	12°	19°	18°	20°	20°
DASH score	58	54	32	26	14	16	8	6
VAS scale	7	7	4	3	1	1	1	1
Grip strength to normal limb	0.04	0.06	0.12	0.15	0.32	0.35	0.61	0.65

DASH: Disabilities of the arm, shoulder and hand, VAS: Visual analog scale

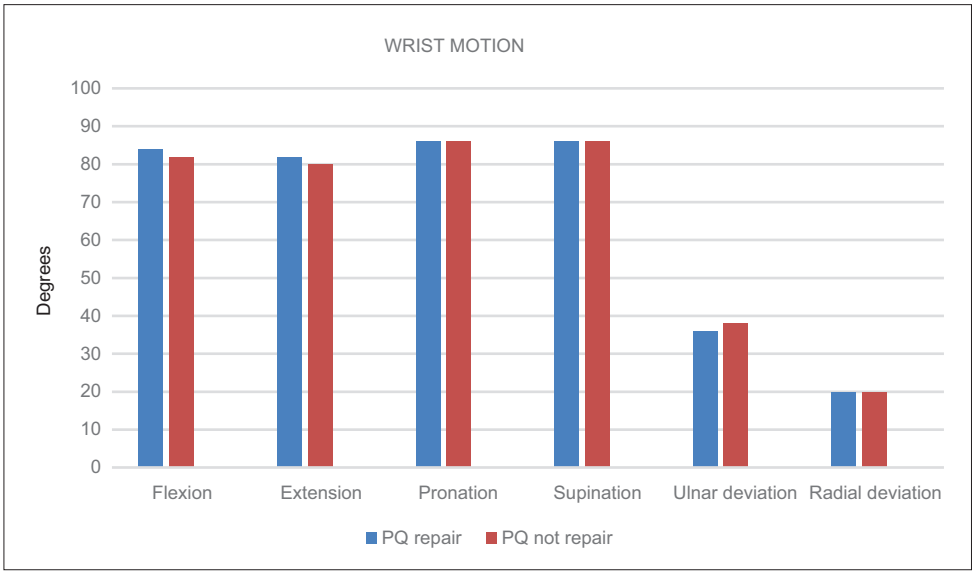

Figure 6: Range of wrist motion is both groups

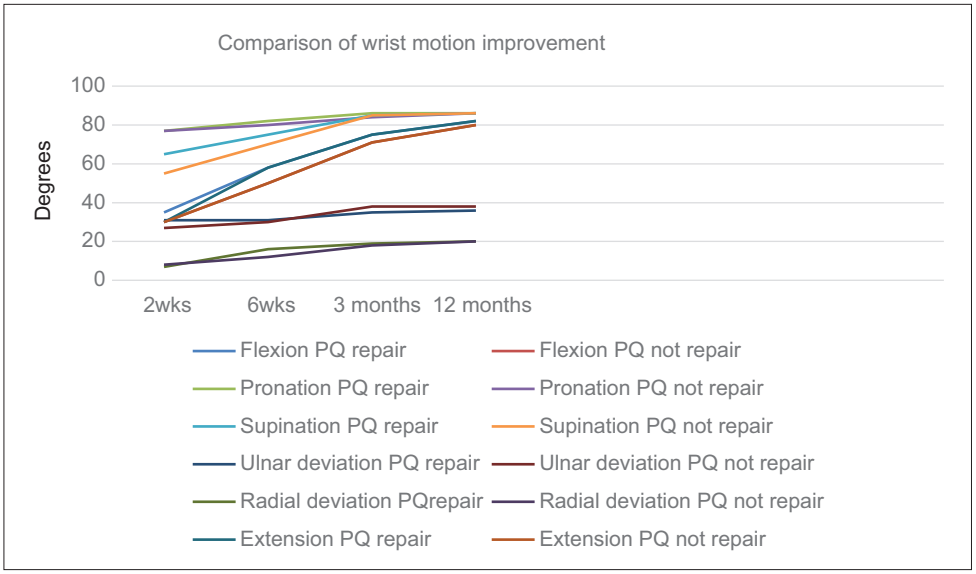

Figure 7: Comparison of wrist motion improvement in both groups

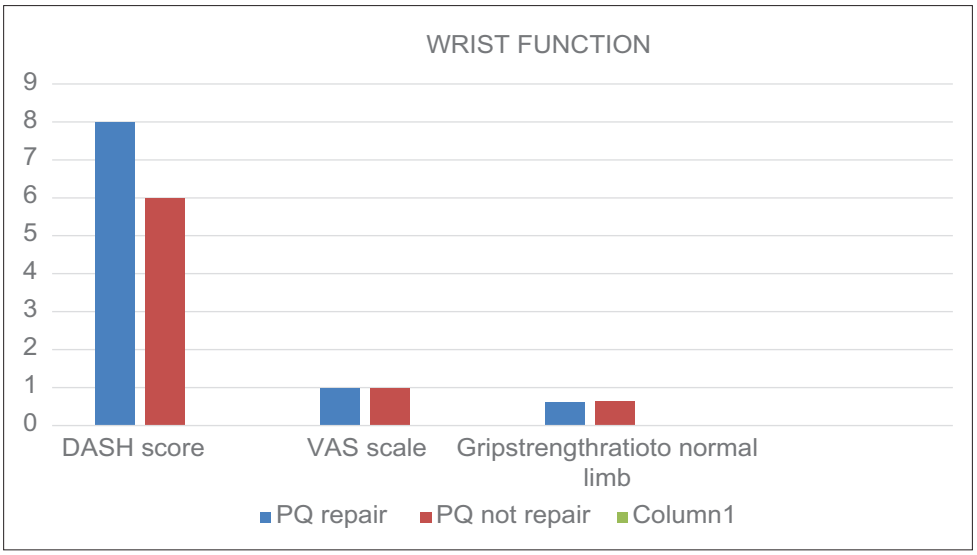

Figure 8: Comparison of wrist function in both groups measured in scores

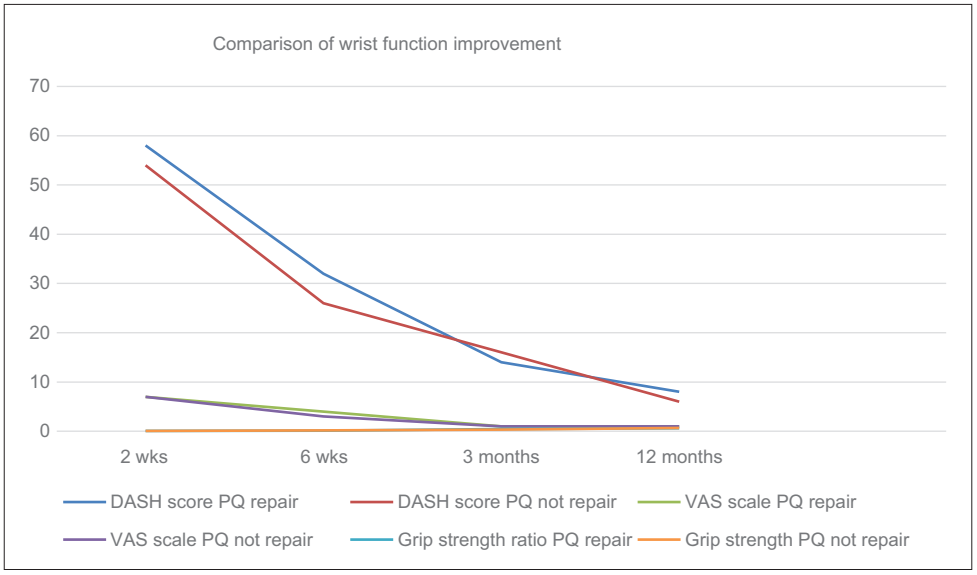

Figure 9: Comparison of wrist function improvement

the plate has been fixed to the bone. Our comparative study suggests that there is no differences in terms of function or clinical outcomes between two groups. It appears that repair of pronator quadratus does have no significant impact on the outcome for these fractures, therefore, the additional step may be avoided. However, further studies with a larger and more varied ethnic and occupations group may be warranted to bring certainty in this dilemma.

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