

Does repair of pronator quadratus muscle after volar plating change the functional outcome in patients with distal radius fracture?

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ABSTRACT

INTRODUCTION: Fracture of distal radius is a common fracture and the treatment modality varies from conservative to operative technique. Volar plating is a common operative fixation for distal radius fracture. During volar plating pronator quadratus muscle is incised for proper visualization of fracture and reduction. There is always a debate whether to repair the muscle after fixation or not.

METHODS: This is a prospective comparative study done in Manipal Teaching Hospital from June 2017 to February 2020. There were total 80 patients included in this study. The total patients were divided into two groups. Group A included the patients who had repair of the pronator quadratus and group B patient did not have repair of pronator quadratus. The aim of our study was to compare the outcome of repair of pronator quadratus muscle to unrepaired group in terms of quick DASH score, grip strength VAS score and ROM post-operatively at 6weeks, 12 weeks, 6 month and 1 year time. Statistical analysis was done using SPSS statistical software version 13.0.

RESULTS: There was no statistical difference in quick DASH score, grip strength, visual analog score (VAS) score and range of movement (ROM) in 6 months and 1 year follow up in both the group.

CONCLUSION: The repair of pronator quadratus muscle after volar plating does not have additional benefit in functional outcome.

KEYWORDS: Plating, pronator quadratus muscle, radius fracture

INTRODUCTION

Distal radius fracture is the commonest fracture accounting about 25% of total fracture encountered in orthopedics department.¹ The distal radius fracture in young age group is mostly due to high velocity injuries like road traffic accident and sports injury whereas in geriatric age group it is usually because of low velocity injuries due to osteoporosis.

There are many treatment methods for distal radius fracture. Open reduction and plate

fixation is considered as gold standard fixation technique for displaced distal radius fracture.² The volar plate fixation stabilizes the distal radius fracture by distributing the load in distal subchondral bone and minimizes the load in fracture site.³ During volar plating the surgeon has to release the pronator quadratus muscle for the exposure of the fracture and reduction of fracture.⁴ Repair of this muscle after fixation always remain debated.

Studies shows better grip strength, better VAS score, better ROM and additional benefit of

protection of flexor tendon in patients who had repair of pronator quadratus.⁵⁻⁷ Many studies shows that there is no significant variation in grip strength, VAS score and ROM in long term follow up in both the group.⁸⁻¹⁰ So the repair of pronator quadratus still remains in debate as there are very few studies that have compared the functional outcome in patients who have undergone repair versus unrepaired.

The aim of our study was to evaluate and compare the functional outcomes of patients with repair of pronator quadratus versus the patient with unrepaired pronator quadratus in distal radius fracture treated with volar plate.

MATERIAL AND METHODS

This is a prospective comparative cohort study done in Manipal Teaching Hospital from June 2017 to February 2020. Ethical clearance was taken prior to the study from the IRC (Internal Research Committee), Manipal College of Medical Sciences, Pokhara, Nepal.

All patients with distal radius fracture attending the emergency and OPD of our hospital who fulfilled the inclusion criteria were enrolled in this study. Informed written consent for the study was obtained from each patient.

In a pilot study done prior to the original study with 10 sample size, it showed 90% of distal radius fracture had comparable outcomes. With a 95% CI, the sample required was 68.¹¹

There were total 98 patients of distal radius fracture who underwent open reduction and volar plating. Eighteen patients lost to follow up, so the total size of the patients in our study was only 80. Patients were divided into two Groups (40 patients in each group) using alternative basis to either repair of the pronator quadratus or to leave it unrepaired. In group A patient had repair of pronator quadratus whereas in group B the pronator quadratus was not repaired.

Inclusion criteria:

1. Fracture duration less than 7 days
2. Fracture in distal radius with fused physis.

3. Close fracture without neurovascular involvement.
4. AO fracture type A2, A3, B3, C1 and C2

Exclusion criteria:

1. Previous history of surgery in fractured wrist.
2. Fracture of more than 7 days of duration
3. Bilateral fracture.
4. Patient with head injuries.
5. Associated fracture of ipsilateral arm and forearm.

Surgical procedure:

All the patients were operated under general anesthesia or regional block. All the patients were positioned in supine position. Tourniquet was used in all patients. After painting with 10% povidone iodine solution the part was draped with standard technique. Volar approach was used in all patients and after the exposure of pronator quadratus muscle, it was incised longitudinally at the radial boarder and elevated as a flap. The fracture was exposed, reduced and fixed with appropriate size plate and screws. After the completion of fixation the pronator quadratus muscle was repaired using polyfilament absorbable synthetic suture in group A whereas the muscle was repositioned to anatomical position without suturing in group B patients.

Post-operative protocol for all patients was same. Volar slab was applied for 2 weeks duration. The dressing was done on 3rd, 7th and 10th post-operative day. The suture and slab was removed after 2 weeks and 6 pack exercises were started. The patients were followed up on 6 weeks, 12 weeks, 6 months and the final follow up was done in 1 year.

Statistical analysis was done using Independent sample t-test to compare success, clinical outcome and Visual Analog Scale (VAS) score for both the procedure. Fisher exact test was done to analyse the patient's satisfaction. In each follow up the grip strength was recorded

using hand dynamometer and compared to non-injured hand. Quick DASH score and wrist ROM was also checked in each follow up. Any associated complications were also noted.

Statistical analysis was performed using SPSS statistical software version 13.0. The p value of less than 0.05 was considered statically significant.

RESULTS:

The average age of the patients enrolled in this study was 48.85 years (19-70 years). The mean age of patient in group A and group B was 47 years and 50.70 years respectively. The involvement of dominant hand was 55% in group A patients whereas it was 60% in group B patients (Table 1).

Table 1: Demographic data of patient enrolled in study.

	Group A	Group B
Mean age	47 years (22-69 years)	50.70 years (19-70 years)
Sex		
Male	21	18
Female	19	22
Dominant hand involvement	22	24
AO classification		
2 3 A 2	8	5
2 3 A 3	5	6
2 3 B 3	12	11
2 3 C 1	8	10
2 3 C 2	7	8

Mechanism of injury:

In group A fall from height was the main mechanism of injury which account about 37.5% of total case followed by sports injury (22.5%), RTA (20%) and fall in ground (20%). In group B, 35% of patient had fall from height followed by fall in ground (25%), RTA (22.5%) and sports injury (17.5%).

Range of movements:

The mean ROM in both groups was compared at each follow up (Table 2).

Table 2: Mean ROM in group A and group B patients in follow up.

Follow up	Range of movements in degrees					
	Flexion	Extension	Pronation	Supination	Radial deviation	Ulnar deviation
6 weeks						
Group A	48.48 ±7.65	40.00 ±5.22	39.65 ±7.07	41.90 ±6.55	7.48 ±1.43	38.05 ±4.73
Group B	48.18 ±6.98	37.90 ±5.58	41.50 ±9.62	40.45 ±7.41	7.18 ±1.58	35.58 ±4.38
12 weeks						
Group A	65.55 ±7.74	49.40 ±5.32	52.65 ±6.18	56.08 ±6.89	9.92 ±1.57	45.08 ±4.63
Group B	62.72 ±8.04	49.87 ±5.88	52.30 ±8.25	54.02 ±8.41	9.32 ±1.80	42.00 ±4.64
6 months						
Group A	75.75 ±5.08	59.10 ±6.44	63.50 ±6.94	66.60 ±6.04	11.92 ±2.12	51.40 ±3.82
Group B	75.52 ±4.35	60.12 ±5.93	62.90 ±7.84	64.72 ±7.28	11.18 ±2.21	48.60 ±4.79
1 year						
Group A	82.52 ±2.88	68.77 ±5.27	73.15 ±6.45	77.10 ±5.81	14.32 ±2.06	57.25 ±3.38
Group B	82.62 ±2.89	69.25 ±4.53	71.92 ±7.62	74.80 ±6.53	13.22 ±2.24	54.78 ±4.69

There was no significant difference in ROM in both the groups. At final follow up the mean flexion, extension, pronation, supination, radial deviation and ulnar deviation in group A was 82.52, 68.77, 73.15, 77.10, 14.32 and 57.25 respectively whereas in group B it was 82.62, 69.25, 71.92, 74.80, 13.22 and 54.78 respectively.

VAS score:

VAS score was recorded at 6 weeks, 12 weeks, 6 month and 1 year. At 6 weeks time the mean VAS score in group A patient was 5.20±1.28

whereas it was 4.8 ± 1.5 in group B with p value of 0.02, which showed significant pain relief in patients who underwent pronator quadratus repair. But there was no significant difference in pain relief in subsequent follow up (Table 3).

Table 3: VAS score in group A and group B patient in follow up.

VAS score	6 weeks	12 weeks	6 months	1 year
Group A	5.20 ± 1.28	6.47 ± 1.17	7.40 ± 1.00	8.32 ± 0.79
Group B	4.80 ± 1.50	6.30 ± 1.47	7.42 ± 1.12	8.50 ± 0.67
p value	0.02	0.44	0.70	0.88

Grip strength:

The grip strength was compared to uninjured limb. At 12 weeks the grip strength in group A patients were better compared to group B but the p value was 0.09 which was statically not significant (Table 4).

Table 4: Mean grip strength in percentage compared to contralateral side.

Grip strength	6 weeks	12 weeks	6 months	1 year
Group A	27.88 ± 7.29	45.88 ± 10.37	63.12 ± 9.85	76.70 ± 9.76
Group B	26.58 ± 7.99	36.72 ± 7.15	60.75 ± 8.51	78.00 ± 8.90
p value	0.54	0.09	0.34	0.87

Quick DASH score:

We compared the mean quick DASH score in both the groups and did not find any significant change at regular follow up (Table 5). The mean quick DASH score at final follow up was 8.30 in group A whereas it was 9.60 in group with p value of 0.751.

Table 5: Mean Quick DASH score

Quick DASH score	6 weeks	12 weeks	6 months	1 year
Group A	53.46 ± 7.98	38.34 ± 10.54	22.22 ± 7.92	8.30 ± 6.75
Group B	55.22 ± 8.52	41.42 ± 7.05	27.11 ± 6.28	9.60 ± 6.5
p value	0.021	0.861	0.108	0.751

Complications:

Stiffness of wrist and fingers was the most common complication. There were total 17 patients (7 in group A and 10 in group B) who had stiffness of wrist and finger joint which improved gradually by aggressive physiotherapy. Three patients developed complex regional pain syndrome (1 in group A and 2 in group B) which was treated with oral pregabalin and methylcobalamin. We did not find other complications like wound infection, tendon irritation and hardware prominence in our study groups.

DISCUSSION

Repair of pronator quadratus muscle after volar plating in distal radius fracture always remains a subject of debate. There is always a hypothesis that the repair of this muscle does help in better pronation of hand and better stability.^{5,12} The repair of pronator quadratus does help in less irritation of the flexor tendon and prevents from tendon injuries.^{4,13} According to recent survey, it has been noted that every surgeon do try to repair the pronator quadratus muscle after fixation.¹⁴

In our study, there was no significant difference in ROM. At the final follow up the flexion, extension, pronation, supination, radial deviation and ulnar deviation was comparable. The grip strength at 12 weeks was much better in group A patients compared to group B patients but at final follow up it was also 76.70% in group A and 78% in group B. There was no significant change in VAS score in both the groups which

proved that there is no relationship of pain with pronator quadratus muscle repair. The quick DASH score also did not show any significant change in both the groups.

The prospective study done by Torsti et al. to evaluate the functional outcome after repair versus no repair of pronator quadratus after volar plate fixation in 60 patients found a significant difference in grip strength and flexion in pronator quadratus repair group in 6 week time but there was no significant difference in ROM, grip strength, DASH score and VAS score in 12 months follow up.¹⁵ Similarly the study done by Ahsan et al. also showed no difference in ROM and grip strength in 3 months follow up in 108 patients.¹⁰ A study done by Hershman et al. in 112 patients also concluded that there is no advantages of repair of pronator quadratus muscle after volar plating.⁸ Haberle et al. compared isometric pronation strength between the pronator quadratus repair and no repair group in 72 patients after volar plating. They concluded that there is no difference in pronator strength in both the group but there was reduced pain in early postoperative period in pronator quadratus repair group.¹⁶ Mulders et al. studied the functional outcome and complications in 169 patients and found no statistically significant difference in functional outcome and complications in both the groups.⁹ These all studies favored our study.

Rupture of flexor pollicis longus (FPL) is one of the most common complications that accounts about 2-12%.^{3,17} In our study we did not find any case of FPL injury. The reason may be due to the placement of plate proximal to watershed line which avoided irritation of FPL to hardware. Another complication is complex regional pain syndrome (CRPS) which accounts about 3-10%.^{3,18,19} In our study we had 3 patients (3.75%) with CRPS, one in group A and 2 in group B. The possible cause can be inflammatory response or neuropathic cause. All the patients with CRPS were treated with oral pregabalin and methylcobalamin.

The limitation of our study was the duration of follow up. Longer duration of follow up could

give us the idea of long term change in functional outcome and hardware related complications.

CONCLUSION

The repair of pronator quadratus muscle after volar plating has no significant role in post-operative ROM, grip strength, quick DASH score and VAS score as compared to non-repaired group. The option to repair or not depends upon the choice of the operating surgeon.

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