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Comparison of Functional Outcome and complications Associated With Dorsal and Volar Approach for Proximal Radial Shaft Fracture Fixation

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Abstract

Background: The proximal radius is made up of the radial head and the neck. Fractures of the radial head are frequent and are typically the result of a fall onto an outstretched hand. The average age of affected patients is 45 years. The incidence rate has been reported as 2.5 per 10,000 individuals annually. Objective: To compare mean DASH score in dorsal versus volar approach for proximal radial shaft fracture fixation. To compare frequency of post-operative complications in dorsal versus volar approach for proximal radial shaft fracture fixation.

Methodology: This randomized controlled trial was carried out in the orthopedic department of Bolan Medical Complex Hospital in Quetta from January 2, 2023, to January 31, 2024. Patients who presented at the outpatient department with closed fractures and Gustilo Grade I open fractures of the proximal half of the radius, with or without accompanying ulna fractures, were randomly assigned to two groups using block randomization generated by computer software. One block was designated as group A, while the other was designated as group B. Patients in group A received treatment via the volar approach, whereas those in group B were treated using the dorsal approach. The researcher personally assessed the patients for complications on the 7th post-operative day, and functional outcomes were recorded at 6 weeks.

Results: Wound infections were observed in 13.4% of patients in Group A and 16.0% of patients in Group B, ($p=0.583$). Posterior interosseous nerve palsy was identified in 10.1% of patients in Group A and 9.2% of patients in Group B, ($p=0.826$). The average DASH score at 6 weeks for Group A and Group B was 61.18 ± 11.32 and 60.93 ± 10.92 , respectively, ($p=0.861$).

Conclusion: The surgical methods volar (Henry) and dorsal (Thompson) exhibited comparable results regarding functional outcomes, intra-operative metrics, and complications. While instances of PIN palsy were noted in both groups, the variation in occurrences was not statistically significant.

Keywords; Proximal Femur, Dorsal (Thompson) approach, Fracture, Volar (Henry) approach, DASH score

INTRODUCTION

The proximal radius is made up of the radial head and the neck. Fractures of the radial head are prevalent and are typically the result of a fall onto an outstretched hand. The average age of affected patients is 45 years. Research indicates an incidence rate of 2.5 per 10,000 individuals annually. Fractures of the radial head and neck represent 0.2% of all presentations to accident and emergency departments. [1] These injuries predominantly occur in young males with robust bone density, often in the context of high-energy trauma such as motor vehicle collisions or sports-related injuries. [2] The interaction between the radius and ulna is essential for proper function, particularly during pronation and supination; therefore, the forearm is referred to as a 'functional joint'. Consequently, it is crucial to restore both length and rotation to the forearm to preserve its dynamic functionality. [3] Open reduction and internal fixation using plates is widely regarded as the optimal treatment approach for displaced diaphyseal fractures of the forearm in adult patients.[4,5]

Both the volar and dorsal techniques have been suggested for the fixation of proximal radius shaft fractures. The dorsal technique, situated between the extensor carpi radialis brevis and extensor digitorum communis, offers advantages such as the superficial positioning of the radius in this area, which facilitates accessibility, the potential for more proximal fixation compared to the volar technique, and the opportunity to directly visualize and safeguard the posterior interosseous nerve (PIN). Despite this guidance, numerous surgeons prefer the volar Henry technique, which is located between the supinator and the pronator teres. The benefits of the volar technique include improved soft tissue coverage for implants, greater familiarity with the approach, and the capacity to avoid direct dissection of the PIN. A previously noted potential disadvantage of the volar technique is related to the biceps insertion, which has been reported to restrict proximal exposure, lead to impingement, and possibly hinder the placement of fixation directly on the volar surface of the radius.[6,7,8]

A research study carried out in Nepal included 23 participants in each group, namely the dorsal group and the volar group. The majority of the individuals involved in this research were male (33 patients, 66%). The average age was 38.16 years (S.D. 13.03 years) for Group A (Volar approach group) with an age range of 16-66 years, while Group B (Dorsal approach group) had a mean age of 35.16 years (S.D. 12.77 years) with an age range of 16-61 years. The surgeries were conducted by senior consultants, and all intraoperative parameters were meticulously documented. The functional outcomes were evaluated at six weeks using the Disabilities of the Arm, Shoulder and Hand (DASH) score system. At the six-week follow-up, the mean DASH score was 60.83 ± 7.21 for group A and 63.76 ± 8.81 for group B, with a p-value of 0.115. Posterior interosseous nerve palsy was observed in 4.23% of group A and 8.6% of group B, with a p-value of 1. Wound infection was noted in 4.23% of patients in group A, while none were reported in group B. Additionally, a study conducted in Pakistan revealed that the mean age of patients in the Volar approach group (VA) and Dorsal approach group (DA) was 25.31 ± 7.34 and 26.5 years, respectively. There were 26 males and 13 females in the VD group, and 22 males and 9 females in the DA group. Radial nerve injuries occurred in three patients in the VA group and two in the DA group, with one case of infection (2.6%) and one case of nonunion (2.6%) reported in each group. No significant differences were found in the duration of the procedure or the time to union between the two approaches, with a p-value of 0.643. The mean forearm rotation was measured at 135.6 ± 11.13 degrees in the VA group and 138.87 ± 7.03 degrees in the DA group at six months post-surgery. [9]

METHODOLOGY

After approval from hospital ethical board, patients who met the inclusion criteria were recruited from the orthopedic ward of Bolan Medical Complex Hospital, Quetta. A written informed consent was obtained after the purpose of the study was thoroughly explained. Demographic information, including age, gender, and duration of injury, was recorded.

Patients were randomly assigned to two groups using block randomization generated by computer software; one block was designated as group A and the other as group B. Patients in group A received treatment via the volar approach, while those in group B were treated using the dorsal approach. All surgical procedures were performed by a consultant orthopedic surgeon with a minimum of five years of post-fellowship experience. The researcher personally assessed patients for complications on the seventh postoperative day, and functional outcomes were evaluated at six weeks.

Data were entered and analyzed using SPSS version 22.0. The mean and standard deviation were calculated for quantitative variables such as age, duration of injury, and DASH score. The DASH scores

were compared between the two groups using an independent t-test, with a p-value of ≤ 0.05 considered statistically significant. Frequency and percentage were calculated for categorical variables, including gender and complications. Complications were compared between the two groups using the chi-square test, with a p-value of ≤ 0.05 deemed statistically significant. Effect modifiers such as age, gender, and duration of disease were addressed through data stratification against the DASH score. An independent t-test was applied post-stratification for the DASH score, and a chi-square test was used for complications, with a p-value of ≤ 0.05 regarded as statistically significant.

RESULTS

Among 238 patients, 119 were assigned to Group A and 119 to Group B. The average age for Group A was 39.56 ± 8.47 years, while for Group B it was 40.50 ± 6.95 years, with no significant difference ($p=0.957$). The majority of patients were aged between 20 and 40 years in both groups, showing no significant difference ($p=0.513$). In Group A, there were 68 (57.1%) males and 51 (42.9%) females, whereas Group B comprised 77 (64.7%) males and 42 (35.3%) females, with no significant difference ($p=0.232$). The average duration of injury for Group A was 5.46 ± 2.15 hours, compared to 6.55 ± 2.03 hours for Group B, which was not statistically significant ($p=0.733$). A majority of patients experienced an injury duration exceeding 5 hours, with no significant difference ($p=0.434$). Regarding diabetes status, 27 (22.7%) patients in Group A were diabetic, while 37 (31.1%) in Group B were diabetic, with no significant difference ($p=0.144$). In terms of smoking status, there were 55 (46.2%) smokers in Group A and 50 (42.0%) in Group B, with no significant difference ($p=0.514$). Additionally, 33 (27.7%) patients in Group A were classified as obese, compared to 24 (20.2%) in Group B, with no significant difference ($p=0.172$). Wound infections were reported in 16 (13.4%) patients in Group A and 19 (16.0%) in Group B, with no significant difference ($p=0.583$). Posterior interosseous nerve palsy was observed in 12 (10.1%) patients in Group A and 11 (9.2%) in Group B, with no significant difference ($p=0.826$). (Table 1)

The average DASH score at 6 weeks for Group A was 61.18 ± 11.32 , while for Group B it was 60.93 ± 10.92 , with no significant difference ($p=0.861$). (Table 2)

Post-stratification analysis for the Disabilities of the Arm, Shoulder, and Hand (DASH) score, considering age groups, gender, and duration of injury, indicated that these factors did not modify the DASH score between Group A and Group B, with no significant difference ($p>0.050$). (Table 3)

Table 1: Age distribution, Gender distribution, Duration of injury, Diabetes status, Smoking status, Obesity status, wound infection at 1 week, Posterior interosseous nerve palsy of the study groups

groups			
Age (years)	Group A	Group B	p-value
20-40 years	65 54.6%	70 58.8%	0.513
41-60 years	54 45.4%	49 41.2%	
Mean ± S.D	39.56±8.47	40.50±6.95	0.957
Gender			
Male	68 57.1%	77 64.7%	0.232
Female	51 42.9%	42 35.3%	
Duration of injury			
≤5 hours	56 47.1%	50 42.0%	0.434
>5 hours	63 52.9%	69 58.0%	
Mean±S.D	5.46±2.15	6.55±2.03	0.733
Diabetes			
Yes	27 22.7%	37 31.1%	0.144

No	92 77.3%	82 68.9%	
Smoking status			
Yes	55 46.2%	50 42.0%	0.514
No	64 53.8%	69 58.0%	
Obesity status			
Yes	33 27.7%	24 20.2%	0.172
No	86 72.3%	95 79.8%	
Wound infection			
Yes	16 13.4%	19 16.0%	0.583
No	103 86.6%	100 84.0%	
Posterior interosseous nerve palsy			
Yes	12 10.1)	11 (9.2)	0.826
No	107 (89.9)	108 (90.8)	
Total	119 (100.0)	119 (100.0)	

Table 2: DASH score at 6 weeks of the study groups

DASH score at 6 weeks	Group A	Group B	p-value
Mean±S.D	61.18±11.32	60.93±10.92	0.861

Table 3: Post-stratification for Disabilities of the Arm, Shoulder, and Hand (DASH) score with age groups gender distribution, duration of injury and both the study groups

Age Groups		Group		P-value
		A (n=119)	B (n=119)	
20-40 years	DASH score	61.88±11.45	59.24±12.04	0.183
41-60 years		60.35±11.21	63.35±9.82	0.154
Sex				
Male		60.35±10.45	61.31±10.22	0.578
Female		61.81±11.96	60.73±11.35	0.658
Duration of injury				
≤5 hours		62.07±11.98	60.90±11.01	0.603
>5 hours		60.40±10.72	60.96±10.94	0.767

DISCUSSION

Compression plating is the conventional method for treating forearm shaft fractures in adults. Numerous studies advocate for a dorsal Thompson approach when addressing proximal radius fractures, as it facilitates more proximal fixation points and aids in the identification and protection of the posterior interosseous nerve (PIN) [10]. Conversely, other research supports the extensile volar Henry approach, which entails a medial release of the supinator to safeguard the PIN while in the supinated position, thus avoiding its dissection. The objective of this study was to evaluate these two surgical techniques concerning functional outcomes, intraoperative variables, complications, and time to union [11]. CR

Jockel et al [12] indicated that the dorsal approach is preferable for the proximal radius up to 2.6 cm distal to the elbow joint to avert injury to the posterior interosseous nerve (PIN). Our results align with the findings of Cross et al [12], which noted no significant difference in the exposed area between the two surgical approaches. Dashe J et al [13] observed that patients who underwent the dorsal approach had a slightly higher incidence of proximal fractures (p-value 0.0006), yet this did not lead to an increase in fixation proximal to the fracture, suggesting that there was no notable difference in the necessary exposures for adequate fixation between the two methods.

In this study, the follow-up period for outcomes was 6 weeks, with the mean DASH scores at 6 weeks for Group A and Group B being 61.18 ± 11.32 and 60.93 ± 10.92 , respectively ($p=0.861$). It is noted that a duration of 6 to 9 months may be necessary to observe recovery in PIN neurapraxias, indicating that the length of our study was insufficient, as all three patients still exhibited PIN palsies during the final follow-up at 6 months. In a multicenter study conducted by Dashe J et al [14], only three neurologic injuries were reported, with two occurring in the volar group and one in the dorsal group.

Nasab SAM et al [8] reported that radial nerve injury was present in three patients from the volar group (one with injury to the superficial radial nerve and two with injury to PIN) and in two patients from the dorsal group (both with injury to PIN). Their findings also indicated that the differences in results were not statistically significant. In a retrospective study by Kwasny et al [15], which included 80 patients with proximal radius fractures treated via the volar approach, only two instances of incomplete injury to the superficial radial nerve were noted, both of which resulted in spontaneous recovery.

During the follow-up of patients, there was a gradual reduction in the DASH scores, suggesting an enhancement in functional outcomes. Group A exhibited slightly lower DASH scores, which aligned with the marginally improved range of motion noted in this group. Nevertheless, the differences in results were not statistically significant, and the functional outcomes between the two groups were comparable. Furthermore, the presence of an ulna fracture did not affect the functional outcome in either group, which is consistent with the findings of Dashe J et al [6].

CONCLUSION

The surgical techniques of volar (Henry) and dorsal (Thompson) were found to be similar regarding functional outcomes, intra-operative metrics, and complications. While instances of PIN palsy were noted in both groups, the variation in occurrences was not statistically significant. Given that both methods are linked to a low complication rate, either approach may be selected according to the preference of the operating surgeon.

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