

Functional and Radiological outcome of volar plates in distal end of radius fractures

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Abstract

Background: Distal end of radius fracture incidence is increasing in younger age group due to road traffic accident and no residual deformity is acceptable nowadays. So Hence, we need to assess whether the good radiological outcome which is achieved by open reduction can cause an excellent functional outcome, along with that we need to address its disadvantages.

Methods: A total of 50 patients (males 36 and females 14) were followed for a period of 1 year. Fracture classified using AO classification. They were selected for the operative procedure based on the Lafontaine's criteria. During the operative procedure, we used locking plate for 20 patients and T plate for 30. Patient The patient was evaluated for the functional outcome- QuickDASH scoring system and radiological outcome- Lindstorm criteria.

Results: Mean age was 41.76 ± 12.2733 . Predominant mode of injury was a road traffic accident (32 patients) of which 30 were males and fall at home (16 patients) and majority were females (12). Type of fracture involved (according to AO classification) was C1 (26 patients) followed by B3 (11 patients). Mean QuickDASH was 5.752 ± 6.67 which indicates good functional outcome. Lindstorm criteria score (radiological criteria) at 6 months and 1 year was same indicates that there is no collapse at cortico cancellous junction and no implant failure occurred and no screw pullout. Decreased range of motion observed in 5 cases and range has improved at the end of 1 year. Age and Quick DASH Correlation Coefficient (r) 0.260 and P value = 0.068 which suggest age and functional outcome inversely proportional. Excellent radiological outcome has a better functional outcome (5.263 ± 6.5197) when compared to good radiological outcome (11.375 ± 6.6805).

Conclusion: Volar plates are a good modality of treatment in the distal end of radius. It has a good functional and radiological outcome. When correlating functional outcome and radiological outcome excellent radiological outcome has a better functional outcome when compared to good radiological outcome.

Keywords: AP- Anteroposterior, PA- Posteroanterior, DRUJ- Distal radioulnar joint, CRP- Central reference point, TFCC- Triangular fibrocartilagenous complex, DASH- Disabilities of arm, shoulder, and hand, EPL- Extensor pollicis longus, SRN- Superficial branch of the radial nerve.

Introduction

The distal radius fracture (DRF) is an injury that predates our species, with a significant milestone in our evolution being the transition to bipedal ambulation. This elevated posture likely represents a significant risk factor that has played a role in DRFs being the most common fracture treated by physicians [1].

Since the days of Abraham Colles, we know that the number of DRFs is increasing [2]. Today, it is the most

common of all fractures [3]. The burden of treatment on the orthopedic community and society in general is obvious.

Various methods of treatment evolved such as conservative method using casting, operative methods like percutaneous pinning, and external fixation and open reduction internal fixation using various types of volar plates [4]. Numerous studies have come until now showing functional outcome is excellent in any of the above treatment options [5]. However, advantages of the open reduction using volar plate are need to be meticulously studied because it is a current trend.

The distal end of radius fracture incidence is increasing in younger age group due to road traffic accident and no residual deformity is acceptable nowadays [6]. Hence,



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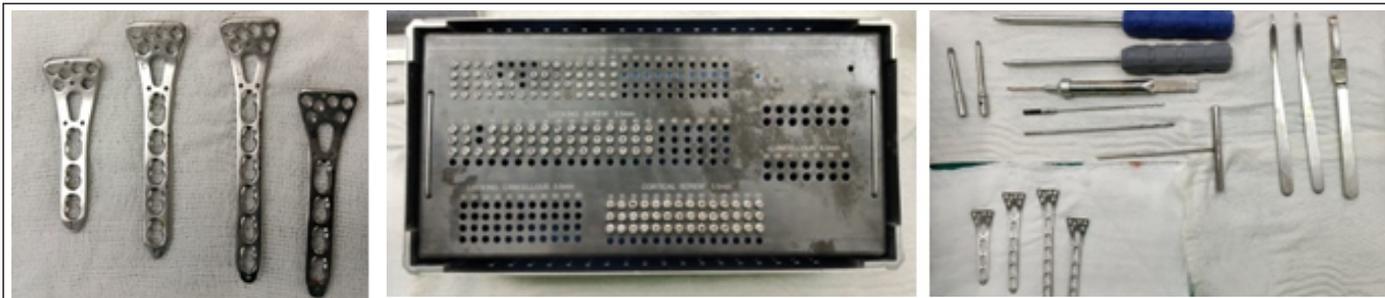


Figure 1: Volar locking plates.

Figure 2: Locking plates screw system instruments used in fixation.

Mean age		
	Mean	SD
Age	41.76	12.2733
Age distribution		
Age	Frequency	Percent
≤20	3	6
21–30	7	14
31–40	15	30
41–50	14	28
51–60	7	14
≥61	4	8
Total	50	100
Sex distribution		
Sex	Frequency	Percent
Female	14	28
Male	36	72
Total	50	100
Side Study		
Side	Frequency	Percent
Left	15	30
Right	35	70
Total	50	100
Mode of injury		
Mode of injury	Frequency	Percent
Fall at home	16	32
Fall at worksite	2	4
RTA	32	64
Total	50	100

we need to assess whether the good radiological outcome which is achieved by open reduction can cause an excellent functional outcome, along with that we need to address its disadvantages.

Primary objective is to determine the functional outcome using QuickDASH scoring system and the radiological outcome using Lindstorm criteria. Secondary objectives are to correlate the radiological outcome with functional outcome.

Methods

We studied the distal end of radius fractures treated with volar plates for a period of 1 year. This was conducted from the data collected from January 2018 to November 2020. The study design is that of an “ambi directional cohort”. The study was done in the Department of Orthopaedics at Amala Institute of Medical Sciences. Time of study period is from 2014 to 2020. Inclusion criteria are Lafontaine’s criteria [7] for unstable fractures of the distal end of radius: (1) Initial dorsal angulation $>20^\circ$, (2) dorsal comminution, (3) radiocarpal intraarticular involvement, (4) associated ulna fractures, and (5) age >60 years three or more of these factors correlated with loss of position despite cast immobilization and were thus considered unstable and included in the study. Exclusion criteria are as follows: (1) Open fractures, (2) fractures associated with vascular injuries, and (3) any other major fractures in the same limb.

All male and female patients were more than 18 years and sustained a distal end of radius fracture with the inclusion and exclusion criteria in mind. The distal end of radius fractures is initially managed in the emergency department. The diagnosis is made by clinical and radiological. The patient under adequate analgesics and sedation, the fracture is reduced and immobilization done using the slab. The patient is reviewed after 1 week and assessed (clinical and radiological). Volar plates application done according to the inclusion and exclusion

Type of fracture		
Type of fracture	Frequency	Percent
A2	6	12
A3	5	10
B3	11	22
C1	26	52
C2	2	4
Total	50	100

Plate used and QuickDASH		
Plate used	Frequency	Percent
Locking plate	20	40
T plate	30	60
Total	50	100

	Mean	Std. Deviation
QuickDASH	5.752	6.6764

Lindstorm score at 6 months		
Lindstorm score 6 months	Frequency	Percent
Excellent	46	92
Good	4	8
Total	50	100

Lindstorm score at 1 year		
Lindstorm score at 1 year	Frequency	Percent
Excellent	46	92
Good	4	8
Total	50	100

criteria. After obtaining an informed written consent, patients fulfilling the inclusion criteria will be taken up for open reduction and internal fixation with plate osteosynthesis. The total sample size was 50. During the operative procedure, we used a locking plate for 20 patients and T plate for 30.

Postoperatively, radiographs are taken to evaluate the reduction and fixation. All patients are followed up at 1 month, 3 months, 6 months, and at the end of 1 year postoperatively. At the time of follow-up,

6 months follow-up on the range of motion			
	Median	Minimum	Maximum
Dorsiflexion at 6 months	70	40	70
Palmarflexion	70	45	70
Radial deviation	15	5	15
Ulnar deviation	30	10	30
Pronation	90	75	90
Supination	90	70	90

1 year follow-up on the range of motion			
	Median	Minimum	Maximum
Dorsiflexion at 1 year	70	40	70
Palmarflexion	70	60	70
Radial deviation	15	10	15
Ulnar deviation	30	20	30
Pronation	90	80	90
Supination	90	80	90

Correlation between age and QuickDASH (Spearman's rank correlation)		
	Correlation coefficient(r)	P value
Age *QuickDASH	0.26	0.068

anteroposterior and lateral view radiographs of both wrists are taken on a single exposure for analysis and Lindstorm criteria are assessed. Assessment of functional outcome using QuickDASH and range of movements assessed using goniometer.

The data collected were analyzed using IBM's SPSS (Statistical Package for the Social Sciences) software Version 23. ANOVA test will be used to analyze the association between functional outcome and radiological outcome.

QuickDASH and sex, side, and plate used				
		QuickDASH		P value (Mann-Whitney U)
		Mean	SD	
Sex	Male	4.769	5.8265	0.149
	Female	8.279	8.1893	
Side	Right	6.074	6.9947	0.528
	Left	5	6.0271	
Plate used	Locking plate	4.655	4.3197	0.871
	T plate	6.483	7.8554	

QuickDASH and mode of injury, type of fracture				
		QuickDASH		P value (Kruskal-Wallis test)
		Mean	SD	
Mode of injury	Fall at home	7.5104	1.8776	0.367
	Fall at worksite	6.4347	4.55	
	RTA	6.3225	1.1177	
Type of fracture	A2	6.083	8.231	0.259
	A3	6.36	7.0847	
	B3	1.864	2.8412	
	C1	7.035	7.2632	
	C2	7.95	4.879	

Lindstorm score 6 months and QuickDASH				
		QuickDASH		P value(Mann-Whitney U)
		Mean	Std. Deviation	
Lindstorm score 6 months	Excellent	5.263	6.5197	0.083
	Good	11.375	6.6805	

Results

- The study was done on a total of 50 patients and mean age was 41.760 ± 12.2733 , as shown below in the chart of age frequency.

- Of the patients studied 14 were female and 36 males.

- All patients were having unilateral involvement as any other injury to the opposite limb was excluded from the study. Fifteen were left studied and 35 were right.

- Fracture is classified based on AO classification.

- Plate used was locking plate (20) and T plate (30) and mean QuickDASH is 5.752 ± 6.674 .

- Lindstorm score at 6 months shows excellent in 46 patients and good in 4 patients.

- Lindstorm score at 1 year shows excellent in 46 patients and good in 4 patients

- Spearman's rank correlation between age and QuickDASH

- Correlation of variable with the QuickDASH (sex, side, plate used, mode of injury, type of fracture, and Lindstorm at 6 months and 1 year.

- Postoperatively intra-articular step >2 mm noted on 1 patient (QuickDASH-18.2) T plate used.

- Positive ulnar variance noted on 2 patients (QuickDASH score 18.2 and 13.6) T plate used.

- Major complaints of patients after 1 year of surgery were pain on exertion (8 patients), pain at rest (2 patients), decrease range of motion (5 patients), and stiffness of fingers (1 patient). No complications reported such as screw penetration into joint and superficial wound infection.



X-ray of T plate and locking plate at the end of 1 year

Discussion

Predominant age group is from 30 to 50 years (29 patients); this may be due to younger patients were willing for surgery and we insist for the same. As far sex is concerned males are involved more (36) and females (14) this can be correlated to the mode of injury since road traffic accident is the predominant mode of injury (32 patients). Most of the studies show that the incidence of the distal end of radius in young is low when compared to older age groups and females are more affected due to osteoporosis [8].

Side of injury– the right hand is involved in 35 patients and the left hand in 15 patients. Mode of injury– predominant one is road traffic accident with 32 patients of which 30 are males and fall at home (16 patients) and majority were females (12), study by Kate W. Nellans on the epidemiology of DRFs showed that car accidents and sports are known to be one of the most common causes of DRFs in young [8].

Type of fracture – C1(AO classification) is predominant (26 patients) followed by B3 (11 patients), usually A Type of fracture(11 patients) if acceptable reduction, conservative may be considered so the number of patients is less in this group. B Type of fracture which includes Barton fracture is usually an indication for open reduction internal fixation [9].

Mean QuickDASH score is 5.752 ± 6.67 which indicates good functional outcome with volar plates in the distal end of radius fracture. The disabilities of the arm, shoulder, and hand (DASH) outcome measure are a 30-item, self-report questionnaire designed to assess the patient's health status during the previous week [10]. Shortened form– the QuickDASH— which is a two-part questionnaire, the first consisting of a disability/symptom section (consisting of 11 items, each scored 1–5) and the optional high-performance sport/music or work modules (consisting of four items, each scored 1–5). Both are valid and reliable and can be used for clinical and/or research purposes. QuickDASH can be used instead of the DASH to measure disability/symptom severity with similar precision in a variety of arm disorders [11]. DASH score ranging from 0 to 29 was thought by most respondents to be the point where patients/clients were “no longer considering their upper limb disorder a problem.” One of the difficult challenges is the ability to interpret an individual's numeric score because a lot of confidence and experience with an instrument is required. There is no established benchmark

for interpreting the scores. DASH can detect and differentiate small and large changes of disability overtime after surgery [12].

Lindstorm score at 6 months and 1 year is the same which indicates that there is no collapse at corticocancellous junction and no implant failure occurred and no screw pullout. Criteria showed excellent for 46 patients and good for 4 patients. Excellent score means insignificant deformity which is very relevant nowadays [13].

Decreased range of motion observed in 5 cases and range has improved at the end of 1 year. Functional outcome assessment with individual factor showed age and QuickDASH Correlation Coefficient® 0.260 and $P=0.068$ which suggest age and functional outcome inversely proportional.

Sex and functional outcomes showed that males have improved outcome than females (males – 4.769 ± 5.8265 and females – 8.279 ± 8.1893), a study done by Louis F. Amorosa showed that the elderly female patients who had functional outcome scores did worse in terms of the DASH scores than their male counterparts. The results suggest that elderly males have perhaps better healing potential or have differences in the perception of outcome and disability and may be able to compensate better for their injuries than elderly women [14].

No much difference functional outcome between locking plate and T plate, (locking plate – 4.655 ± 4.3197 and T plate – 6.483 ± 7.8554). No much difference in functional outcome regarding side of injury and mode of injury.

Type of fracture B3 (1.864 ± 2.8412) showed better functional outcome when compared to other fracture types. This may be due to by conserving the radial height and congruence of the joint surface, the more precise the reduction of the fracture achieved by surgical means, which is easy in Type B fracture compared to Type C fracture and the better the functional outcome [15].

When correlating functional outcome and radiological outcome, excellent radiological outcome has a better functional outcome (5.263 ± 6.5197) when compared to good radiological outcome (11.375 ± 6.6805) not statistically significant may due to conserving the radial height and congruence of the joint surface which is significant on functional outcome [15].

M. Hakimi, on functional results and complications following locking palmar plating on the distal radius, showed good to excellent functional and radiological results as well as good results on the DASH score. A3 fractures in elderly patients and the majority of C1 and C2 fractures can be safely treated with locking palmar plating [16]. Ying-Chao, on volar 2.4 mm titanium locking plate fixation for AO Type C3 dorsally comminuted DRFs, showed treatment with dorsal or volar locking plates can provide satisfactory radiographic and functional outcomes for AO type C3 dorsal comminuted DRFs [17]. Chavhan, functional and radiological outcome in DRFs treated with locking compression plate, showed volar plating for fracture distal end radius reduces chances of wrist joint stiffness and loss of reduction and good results can be obtained [18].

Major complaints of patients after 1 year of surgery were pain on exertion (8 patients), pain at rest (2 patients), decrease range of motion (5 patients), and stiffness of fingers (1 patient). No complications reported like screw penetration into joint superficial wound infection and periarthritis shoulder [19].

Cost of implant was 3500 rupees for locking plate and for T plate below 2000 rupees. The total cost of procedure and hospital stay being under 35,000 rupees. Total number of hospital visit comparable with other modality of treatment [20].

The limitation of the study is that at initial part of the study we were using T plate than locking plate because T plate was readily available in our hospital. Later on, locking plate was available and preferred in severely comminuted and osteoporotic fractures.

Conclusion

Volar plates are a good modality of treatment in the distal end of radius. It has a good functional and radiological outcome. When correlating functional outcome and radiological outcome, excellent radiological outcome has a better functional outcome when compared to good radiological outcome (not statistically significant). Males are involved more this can be correlated to the mode of injury since road traffic accident is the predominant mode of injury in young age group. In mode of injury predominant, one is road traffic accident, majority are males and in fall at home majority were females. Lindstorm score at 6 months and 1 year is same which indicates that there is no collapse at

corticocancellous junction and no implant failure occurred and no screw pullout. Type of fracture B3 showed better functional outcome when compared to other fracture types. Volar plates are a good modality of

treatment in the distal end of radius. It has a good functional and radiological outcome, advantage of volar plates is that it will prevent deformity and early mobilization which is important in this fast-moving

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