International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Can an Ulnar Styloid Fracture Affect the Range of Motion of Wrist Joint when Associated with Extra Articular Distal Radius Fracture Undergo Non-Surgical Treatment?

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Abstract: ***Introduction: The most frequent fracture we encounter in daily practice is distal radius fracture. It has impact on people of all ages, from teenagers to the elderly. Different forms of treatment have developed, from conservative ones using casting to surgical ones including percutaneous pinning, external fixation, and internal fixation. Numerous studies conducted up to this point have demonstrated various treatment methods, all provide outstanding functional outcomes. But there is a paucity of studies which address the associated ulnar styloid fractures and its association to the functional outcomes of the wrist joint. In this study we are studying the Range of movement of wrist joint when an ulnar styloid fracture is associated with distal radius fractures that undergo a non-surgical modality of treatment. Objectives: Our objective is to determine the functional outcome of wrist joint by assessing the range of movements of wrist joint in extra articular distal end of radius fracture with and without an associated ulnar styloid fracture. Methodology: A total of 60 patients coming to our hospital OPD /Casualty with extra articular distal radius fracture were followed in the 1.5 years study period. In our study, patients received non-operative care, as closed reduction and below the elbow casting. Each patient was analyzed for six months, during which time each patient received three functional evaluations on range-of-motion. Assessments were performed in first month (1^{ST} assessment), third months (2^{ND} assessment), and sixth (3^{RD} assessment) months respectively after the injury. Statistical Analysis was done using SPSS23. Results on continuous measurements are presented on mean ± SD and result on categorical measurements is presented in numbers (%). Significance is assessed at 5% level. Normality of numerical data was checked. The significance of distal radius fracture with and without ulnar styloid fracture was expressed in mean ± SD statistical significance is assessed using repeated measured anova test and t test. Results: The mean age was 54.3 ± 15.1years with 38 females and 22 males. In our study, out of 60 participants all the subjects received non-surgical treatment (100%). P value of distal end of radius fracture associated with ulnar styloid fracture for of ulnar deviation (0.003), supination (0.004) and pronation (0.004) were statistically significant. p value for radial deviation (0.1) palmar flexion (0.1) and dorsi flexion (0.9) pain (0.1) were >0.05 and they are found to be statistically not significant. Conclusion: When ulnar styloid fracture was associated with distal radius fracture, there was significant statistical difference in terms of ulnar deviation, supination and pronation. There was no significant difference in radial deviation, dorsiflexion or palmar flexion if the distal radius fracture is associated with ulnar styloid fracture or not. This study can be however useful in determining if to fix the ulnar styloidfractures when associated with extra articular distal radius fractures***

Keywords: Distal radius fracture, Ulnar styloid fracture, wrist functional outcome, triangular fibro cartilage complex, Range of motion wrist.

1. Introduction

The most common upper extremity fractures are distal radius and ulna fractures, which account for at least one-sixth of all fractures seen in the emergency room. In 1814, Abraham Colles published his ideas in "On the Fractures of the Carpal Extremity of the Radius, " which led to the first description of distal radius fractures in English literature

In orthopedic practice, a distal radius fracture is one of the most frequent injuries observed. [1]All adult bone injuries comprise 8 to 15% of what they are. Around 120, 000 and 607, 000 fractures occur annually in the UK and the USA, respectively [2, 3].

There are a lot of studies in the literature which addressing the functional outcome of distal radius fractures whether it is intra articular or extra articular. But those studies which addresses associated ulnar styloid fractures are less. At the same time the fate of wrist joint when the ulnar styloid fracture is associated with extra articular distal radius fracture which undergoing a on surgical modality of treatment isseldom studied. Some studies showed that functional outcome in terms of range of motion is affected while some other studies doesn't make this point clear.

Range of motion of wrist plays a vital role in day-to-day life. One need proper supination and pronation to carry out various day to day activities. [4]TFCC (Triangular Fibro Cartilaginous complex) attaches to the styloid and act as major stabilizer of wrist joint. When ulnar styloid is fractured TFCC can be injured and hence the stability is altered which in turn can affect he wrist mobility.

Almedghio et al [5] in a study, treated distal radius fractures (DRF) associated with ulnar styloid fractures (USF) reveals that, wrist discomfort and reduced flexion being linked to Ulnar styloid fracture. [6]Daneshvar et alin 2014, range of motion and grip strength were impaired in distal radius fractures associated with ulnar styloid fracture. However long-term follow-up showed not much change. In a study done by [7]Gogna et al in a prospective analysis showed that there is no significance in the ulnar styloid fracture in wrist mobility. Ayalon et al [8]retrospectively assessed 315 ulnar styloid fracture. Data on grip strength and wrist range of motion, were gathered and found that patients with USFs

had higher pain and had worse functional ratings in both the operative and the non-operative group than patients without ulnar styloid fracture

Objectives
To determine the functional outcome of wrist joint by assessing the range of movements of wrist joint in extra articular distal end of radius fracture with and without an associated ulnar styloid fracture

2. Methods

Study design: Cohort Study

Study setting: Department of Orthopaedics, Amala Institute of Medical Sciences, Thrissur, Kerala

S**tudy period:** One and half years from the date of approval of Institutional research committee

Study subjects:
Patients with extra articular distal end of radius fracture > 20 years who have presented to our hospital casualty /Ortho OPD

Inclusion criteria

All patients coming with extra articular distal end of radius fracture in a our hospital with an age >20years

Exclusion criteria
1) Patients with associated traumatic and non-traumatic neurological manifestation
2) Those patients whose long-term follow-up is not possible
3) Patient who presents late for treatment
4) Polytrauma with distal end of radius fracture
5) Patient with any other fracture on the same limb
6) Patient with vascular injury around distal end of radius fracture.
7) Patient withintra articular distal end of radius fracture

Sampling sample size:
According to Study by Souer et al. published in the Journal of Bone and Joint Surgery in 2009, sample size was estimated.
$N=Z^2_{1-\alpha/2}\sigma^2 / d^2\mu^2$

σ = STANDARD DEVIATION (8.3)
d = RELATIVE PRECISION (10)
μ = MEAN (21)
1-α/2 = DESIRED CONFIDENCE LEVEL

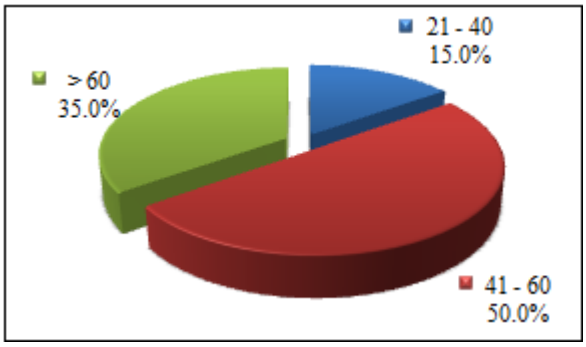
N (sample size) = 60

Sampling Method: consecutive sampling non random sampling

Procedure
Range of motion in terms of degrees viz Radial deviation Ulnar deviation, Palmar flexion, Dorsiflexion, Supination and Pronation were measured using goniometer. The data was collected in three phases in which 1st assessment was done after 4 weeks (1 month) of the injury 2nd after 12weeks (3 month) of the injury.3rd after was done 24 weeks (6 months) of the injury. Data was recorded in excel sheet.

3. Results

The study was done on a total of 60 patients Ages at initial presentation ranged from 21 years to 84 years. The mean age of our study participants was 54.3 years with standard deviation 15.1 years.



Pie diagram 1: Distribution of age

Table 1: Distribution of styloid fracture

	Number	Percentage
No Styloid fracture	33	55%
Styloid fracture	27	45%
TOTAL	60	100%

Out of 60 participants, 33 (55%) sustained no styloid fracture whereas 27 (45%) participants sustained fracture of ulnar styloid

Range of Movements Assessment
The ROM viz dorsiflexion, palmar flexion radial deviation, ulnar deviation, supination and pronation was assessed in the three follow-ups

Table 2: Relationship between radial deviation and styloid fracture

RADIAL DEVIATION	No Styloid fracture		Styloid fractured		P-value	P-value
	Mean ± SD	% Change	Mean ± SD	% Change		
1st assessment	5.45 ± 2.60		4.56 ± 2.59		0.1	
2nd assessment	9.61 ± 3.02	76.1%	8.30 ± 2.73	82.1%	0.08	
3rd assessment	14.8 ± 2.82	171.7%	12.2 ± 2.30	167.5%	0.00	0.1

Radial deviation (Table 2) T test was done p value was not statistically significant for 1st and 2nd assessments p value 0.1 (>0.05) 0.08 (>0.05) and for the 3rd the same was significant p value 0.00 (<0.05). Repeated measured Anova test showed. p value of 0.1. Hence not significant statistically. The table shows that the radial deviation change is almost same in case with styloid fractured or not.

Table 3: Relationship between ulnar deviation change and styloid fracture

ULNAR DEVIATION	No Styloid fracture		Styloid fracture		p value	p value
	Mean ± SD	% Change	Mean ± SD	% Change		
1ST assessment	7.94 ± 3.66		3.93 ± 3.30		4.46	
2ND assessment	14.2 ± 4.21	79.4%	12.7 ± 2.88	223.6%	0.11	0.000
3RD assessment	22.9 ± 5.27	188.9%	16.1 ± 4.00	310.4%	7.47	

Ulnar deviation in degree (Table 3). T test was done and was not statistically significant for all the three assessments. P value 4.46 (>0.05), 0.11 (>0.05), 7.47 (>0.05). Using Repeated measured Anova test the p value was 0.00 (<0.05) the association between ulnar deviation change and styloid fracture is significant.

Table 4: Relationship between palmar flexion change and styloid fracture

Palmar Flexion	No Styloid fracture		Styloid fractured		p value	p value
	Mean ± SD	% Change	Mean ± SD	% Change		
1ST assessment	15.9 ± 6.27		13.2 ± 7.10		0.12	
2ND assessment	47.3 ± 7.54	197.9%	42.4 ± 5.28	221.6%	0.01	
3RD assessment	68.1 ± 4.68	328.6%	67.0 ± 4.00	408.1%	0.35	0.1

Palmar flexion in degrees (Table 4). T test was done was found statistically significant for 2nd assessment 0.01 (<0.05) and was not statistically significant for 1st and 3rd assessment p value 0.12 (>0.05) 0.35 (>0.05). Repeated measured Anova test, showed p value 0.1 (>0.05) was not significant. Hence it shows that the palmar flexion change is almost same in case with no styloid fracture and with styloid fracture.

Table 5: Relationship between dorsi flexion change and styloid fracture

DORSI FLEXION	No Styloid fracture		Styloid fractured		p value	p value
	Mean ± SD	% Change	Mean ± SD	% Change		
1st assessment	15.9 ± 4.76		13.4 ± 5.20		0.06	
2nd assessment	42.7 ± 4.85	168.2%	40.8 ± 3.93	204.1%	0.10	
3rd assessment	55.6 ± 6.47	249.3%	53.0 ± 7.54	295.0%	0.15	0.9

Dorsiflexion in degrees (Table 5). T test was done and was not statistically significant p values 0.06 (>0.05) 0.1 (>0.05) 0.15 (>0.05). Repeated measured Anova test, P value as 0.9 (>0.05). The association between dorsi flexion change and styloid is not significant. The table shows that the dorsi flexion change is almost same in case with no styloid and with styloid fracture

Table 6: Relationship between supination change and styloid

SUPINATION	No Styloid fracture		Styloid fractured		P value	P value
	Mean ± SD	% Change	Mean ± SD	% Change		
1st assessment	15.1 ± 5.60		18.0 ± 3.73		0.03	
2nd assessment	48.9 ± 14.3	224.1%	41.4 ± 11.1	129.6%	0.03	0.00
3rd assessment	67.5 ± 6.83	347.0%	50.3 ± 9.84	178.6%	6.83	

Supination in degree was measured in 3 different assessments and mean and SD deviation were recorded as table 6. T Test proved statistically significant findings for 1st and 2nd assessments 0.03 (<0.05).0.03 (<0.05) and was not statistically significant for 3rd assessment p value 6.8 (>0.05). Repeated measured Anova test showed significant p-value, 0.000. (<0.05).

Table 7: Relationship between pronation change and styloid fracture

Pronation	No Styloid fracture		Styloid fractured		p value	p value
	Mean ± SD	% Change	Mean ± SD	% Change		
1st assessment	15.9 ± 4.78		11.5 ± 6.59		0.01	
2nd assessment	34.1 ± 8.47	113.7%	32.1 ± 10.2	179.4%	0.41	
3rd assessment	47.5 ± 10.3	198.3%	53.9 ± 14.7	369.7%	0.04	0.004

Pronation in degree was measured in 3 different assessments and mean and SD deviation were recorded as Table7. T test was done and statistically significant for 1st and 3rd assessment p value 0.01 (<0.05) 0.04 (<0.05). For the 2nd assessment it was not statistically significant p value 0.4 (>0.05). Repeated measured Anova test showed, p value 0. 004 (<0.05). Hence the association between Pronation and styloid fracture is significant.

4. Discussion

Mean age is 54.3years ± 15.1years. Predominant age group is from 41 to 60 years (50% case i.e., 30 patients). Majority of the participants belongs to female gender 38 (63%) rest of them belongs to male gender i.e., 22 (37%). In our study all the patient received a closed reduction and plaster application (100%)

Range of movements viz palmar flexion, dorsiflexion, ulnar deviation, radial deviation, supination and pronation were assessed in our study.

Out of 60 participants for Palmar flexion when styloid vs no styloid fractures were studied, for 1st, 2nd 3rd assessment mean and SD was respectively recorded as (15.9 ± 6.27) (47.3 ± 7.54) (68.1 ± 4.68) for no styloid fracture group and (13.2 ± 7.10) (42.4 ± 5.28) (67.0 ± 4.00) styloid fracture group. T test was done was found statistically significant for 2nd assessment 0.01 (<0.05) and was not statistically significant for 1st and 3rd assessment p value 0.12 (>0.05) 0.35 (>0.05). Repeated measured Anova test, done was found to be not statistically significant with p value 0.1 (>0.05).

For dorsiflexion when styloid vs no styloid fractures were studied, for 1st, 2nd, 3rd assessment mean and SD respectively recorded as (15.9 ± 4.76) (42.7 ± 4.85) (55.6 ± 6.47) for no styloid fracture group and (13.4 ± 5.20) (40.8 ± 3.93) (53.0 ± 7.54) styloid fracture group. T test was done and was not statistically significant p values 0.06 (>0.05) 0.1 (>0.05) 0.15 (>0.05). Using Repeated measured Anova test the P value was calculated. p value for that is 0.9 (>0.05); the association between dorsi flexion change and styloid is not significant.

ForRadial deviation when styloid vs no styloid fractures were studied. For 1st, 2nd 3rd assessment means and SD was respectively recorded as (5.45 ± 2.60) (9.61 ± 3.02) (14.8 ± 2.82) for no styloid fracture group and (4.56 ± 2.59) (8.30 ± 2.73) (12.2 ± 2.30) styloid fracture group. T test was done p value was not statistically significant for 1st and 2nd p value 0.1 (>0.05) 0.08 (>0.05) and for the 3rd the same was significant p value 0.00 (<0.05). Repeated measured Anova test, the P value was calculated which comparing the significance of styloid fractured and no styloid fractured groups as wholep value for that is 0. 1 (<0.05). Hence statistically insignificant.

For Ulnar deviation, when styloid vs no styloid fractures were studied for 1st, 2nd 3rd assessment mean and SD deviation was respectively recorded as (7.94 ± 3.66) (14.2 ± 4.21) (22.9 ± 5.27) for no styloid fracture group and (3.93 ± 3.30) (12.7 ± 2.88) (16.1 ± 4.00) styloid fracture group. T test was done and was not statistically significant for all the three assessments. P value 4.46 (>0.05), 0.11 (>0.05), 7.47 (>0.05). Repeated measured Anova test the P value was calculated which compares the significance of styloid fractured and no styloid fractured groups as whole, p value for that is 0.00. (<0.05) the association between ulnar deviation change and styloid fracture is significant

For pronation when styloid vs no styloid fractures were studied for 1st, 2nd 3rd assessments mean and SD respectively recorded as (15.9 ± 4.78) (34.1 ± 8.47) (47.5 ± 10.3) for no styloid fracture group and (11.5 ± 6.59) (32.1 ± 10.2) (53.9 ± 14.7) styloid fracture group. T test was done and statistically significant for 1st and 3rd assessment p value 0.01 (<0.05) 0.04 (<0.05). For the 2nd assessment it was not statistically significant p value 0.4 (>0.05) Using Repeated measured Anova test the P value was calculated which compares the significance of styloid fractured and no styloid fractured groups as whole. Found to be statistically significant p value 0. 004 (<0.05)

For Supination, was (16.41±5.03) (45.5±13.4) and (59.7±11.9) for 1st 2nd and 3rd assessments respectively. P value was obtained as 1.45 and was statistically insignificant. When styloid vs no styloid fractures were studied For 1st, 2nd 3rd assessments mean and SD respectively recorded as (15.1 ± 5.60) (48.9 ± 14.3) (67.5 ± 6.83) for no styloid fracture group and (18.0 ± 3.73) (41.4 ± 11.1) (50.3 ± 9.84) styloid fracture group. T Test was done and was statistically significant for 1st and 2nd assessments 0.03 (<0.05).0.03 (<0.05) and was not statistically significant for 3rd assessment p value 6.8 (>0.05) Using Repeated measured Anova test the P value was calculated which comparing the significance of styloid fractured and no styloid fractured groups as whole. p value for that is 0.000. (<0.05).

None of our range of movements parameters has shown a significant change except that for supination ulnar deviation and pronation which showed significant overall difference when ulnar styloid group is compared with the group of no styloid fracture. Radial deviation showed significant difference in the final assessment, but ulnar styloid fracture doesn't make any different in the final outcome p>0.1. In a study done by [7]*Gogna* et al as they found no statistical significance between ulnar styloid fractures with regard any of the wrist movements. So, fixing the ulnar styloid for improving the ROM of the wrist is not advisable according to them.

[5]Almedghio et al pointed out that ulnar styloid fracture can negatively affect the wrist palmar flexion this result doesn't agrees with our study finding, in our study findings palmar flexion showed no statistically significant findings. [6]Daneshwar et al in his study proved that there is no long-term difference in wrist movements even if the distal radius fracture is associated with an ulnar styloid fracture. But our study result showed significant results in terms ulnar deviation pronation and supination.

5. Conclusion

When distal radius fractures were associated with ulnar styloid fracture, in terms of range of movements, the degree of pronation showed statistically significant overall results along with 1st and 3rd assessment. But the 2nd assessment showed statistically insignificant finding.

Ulnar deviation also showed statistically significant overall results. But the rest of assessments of ulnar deviations were statistically insignificant. Similarly, supination also showed statistically significant overall results along with significant 1st and 2nd assessment. No other assessment on ulnar deviations showed a significant finding.

In addition to this, Palmar flexion in degrees showed no significant findings except for the 2nd assessment. Radial deviation showed significant findings only in the final assessment rest of the assessments were insignificant. No assessments of the degree of dorsiflexion showed statistically significant finding.

Even though some of the initial assessments showed statistically significant findings the overall movements viz pronation supination and ulnar deviation has only showed significant finding

Funding: No funding source

Conflict of interest: Not declared

Ethical approval: The study was approved by Institutional Ethics Committee

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