

## TO COMPARE THE OUTCOME OF FRACTURES OF DISTAL END OF RADIUS TREATED CONSERVATIVELY WITH IMMOBILIZATION IN PALMARFLEXION AND DORSIFLEXION

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### ABSTRACT:-

Fractures of the distal end radius represent one-sixth of all fractures of the human skeleton<sup>1</sup> treated in emergency department. Closed reduction and cast immobilization has been the mainstay of treatment of these fractures. Restoration and maintenance of anatomy correlates well with function.<sup>5</sup> Distal radius fractures are easy to reduce closed when the fractures are recent and the hematoma has not yet organized. All stable distal radial fractures can be treated with closed manipulation and below elbow cast with wrist in slight dorsiflexion. The crux to restoration of normal anatomy and best hand function lies with selectively flexing the dorsally displaced fracture fragment without flexing the carpals. According to the John Charley,<sup>10,12</sup> colle's fracture should be treated in palmar flexion and ulnar deviation as dorsal periosteal hinge provides stability. Traditionally extra-articular fracture of the distal end of radius were classically treated by closed reduction, cast immobilization in palmar flexion and ulnar deviation. But few studies have showed, higher chance of redisplacement with this conventional position. Ajay Gupta<sup>11</sup> reported on treatment of colle's fracture comparing immobilization of the wrist in palmar flexion, neutral position and dorsiflexion. He concluded that immobilization of the wrist in dorsiflexion appears to provide better maintenance of reduction. Fractures immobilized with the wrist in dorsiflexion showed the lower incidence of redisplacement, especially of dorsal tilt and had the best early functional results. In the past, very few studies have compared the results depending on the position of immobilization. Thus we decided to compare the outcome of fracture of the lower end of radius immobilised in traditional palmar flexion and ulnar deviation and dorsiflexion.

### AIMS AND OBJECTIVES

The aim of our study is to evaluate and compare the radiological and functional outcome in fractures of lower end radius treated conservatively with respect to its position of immobilization.

### MATERIAL AND METHODS



Thirty patients, coming to SGRDIMS&R Amritsar, having fractures of distal end of radius grouped as per A.O. Classification treated by colle's cast will form the part of study. The study will have prospective component only. We plan to use colle's cast in palmarflexion & dorsiflexion randomly in all cases to better understand the properties and outcomes of this new technology.

#### **Inclusion criteria**

All patients having fracture of distal end of radius will be grouped as per A.O. classification<sup>9</sup>. Patients having age above 10 yrs will be included in this study.

Type A: Extra-articular fractures involving neither the radiocarpal nor the radioulnar joint.

Type B: Simple articular fracture affecting a portion of the articular surface, but with the continuity of the metaphysis and epiphysis intact.

Type C: Complex articular fracture affecting the joint surface and the metaphyseal area.

#### **Exclusion criteria**

- Patients with concomitant upper extremity injuries (carpal bone, proximal forearm, elbow, or humeral fracture).
- Patients with systemic, multiple-organ, or head injuries.
- Patients who were managed surgically for more than three weeks i.e. old fractures.
- Patients having fractures associated with neurovascular injuries, inflammatory arthritis, open fractures and malunited fractures.

#### **Reduction protocol**

The patient placed in the supine position with affected limb positioned to expose the injury site. Reduction of fractures was done under image intensifier guidance using appropriate reduction maneuver. Dorsal bending type fractures (Colle's) having increased dorsal angulations, shortening and radial deviation of distal fragment were reduced by applying longitudinal traction, ulnar deviation and palmar flexion at fracture site. Similarly palmar bending fractures (Smith's) having a reverse deformity of palmar angulations, shortening and radial deviation were reduced by producing opposite deformity by giving longitudinal traction, ulnar deviation and extension at fracture site. Once the fracture was reduced as seen under C-arm, the patients were allocated dorsal or palmar flexed attitude of the wrist alternately, irrespective of the fracture geometry and immobilized with a below elbow POP cast. The degree of immobilization was either 15° PF or 15° dorsiflexion. A below-elbow plaster cast was applied, and moulded very carefully around the fracture. The distal radial fragment was pressed in a volar direction with counter pressure against the proximal fragment in a dorsal direction. This local moulding holds the fracture in flexion, maintaining the normal anterior tilt of the distal radialarticular surface. While the surgeon was moulding the plaster, an assistant, holding the fingers, moved the wrist to the selected position of palmar flexion, neutral position or dorsiflexion. It is essential that the volar pressure is applied to the lower end of the radius and not to the carpal bones. This is best ensured if the wrist is moved into dorsiflexion: volar pressure can then only be applied to the distal radius. The final movement, as the plaster hardened was to bring the wrist into slight ulnar deviation. A check radiograph was taken immediate. Extra-articular fractures with extreme displacement or grossly comminuted fractures that were not amenable to reduction by manipulation were treated surgically and not included in the study. All patients will be allowed to perform activities of daily living while wearing the cast. Active finger movements were taught during period of cast immobilization. Plaster removal was done at five weeks. It was followed by active exercises during the first week and

following active and passive exercises one week later. Assessment of pain, disability, i.e. limitation of motion, subjective evaluation was done. Radiological parameters, radial tilt, palmar tilt and ulnar variance were measured immediately post reduction, at five weeks (at cast removal), 3 months and 6 months to know the residual deformity..

The collected data and results obtained assessed with Demerit scoring system of Satio<sup>62</sup> were subjected to standard statistical analysis using chi-square tests.

### OBSERVATIONS

The results were evaluated from 30 patients 15 were males and 15 were females respectively. Randomly Dorsiflexion and Palmarflexion immobilization were allocated. Thus 16 were immobilized in Dorsiflexion and 15 in Palmar flexion. Because 1pt had B/L distal end radius fracture.

### Subjective Evaluation

It was done on the basis of Pain, restriction of movements and disability. At final follow up 13 patients (81.25%) of dorsiflexion immobilized group had excellent results as compared to 9 patients (60%) of palmarflexion immobilized group.

### Objective Evaluation

- Residual Deformity

### Radial Tilt

Successive follow up showed decrease in tilt in both groups. At final following 14 (87.5%) patients of dorsiflexion group had 13° to 33° radial tilt as compared to 7 (46.6%) patients in palmarflexion group. In both groups 14 in dorsiflexion and 12 in palmarflexion patient showed radial tilt in 13-33 in immediate post-reduction period

### RADIAL TILT

	FUI Pre-red		Post red		FU II At 5 weeks		FU III At 3 months		FU IV At 6 Months	
	DF	PF	DF	PF	DF	PF	DF	PF	DF	PF
<13°	10	10	2	3	2	3	2	4	2	8
13-33°	6	5	14	12	14	12	14	11	14	7
>33°	0	0	0	0	0	0	0	0	0	0

### Showing Mean Radial Tilt Movements at different time intervals

Time	Group DF Flexion (n = 16) Mean ± SD	Group PF Flexion (n = 15) Mean ± SD	't' value	P value
Pre -red	11.13 ± 1.96	11.13 ± 2.03	0.012	0.991 <sup>NS</sup>
Post- red	24.63 ± 5.90	22.33 ± 5.91	1.079	0.290 <sup>NS</sup>
At 5 week	21.69 ± 5.98	19.07 ± 5.57	1.259	0.028*

At 3 months	19.63 ± 5.11	16.73 ± 5.04	1.584	0.014*
At 6 months	18.88 ± 5.05	15.13 ± 5.47	1.978	0.008*

NS: p > 0.05; Not Significant; \*p < 0.05; Significant

**Palmar Tilt**

At final follow up 6 month 12 patient (75%) in dorsiflexion group had 11 to 21° tilt as compared to 8 patients (53.33%) in palmarflexion group

**PALMAR TILT**

	FUI Pre-red		Post red		FU II At 5 weeks		FU III At 3 months		FU IV At 6 Months	
	DF	PF	DF	PF	DF	PF	DF	PF	DF	PF
<11°	10	9	1	2	2	4	4	6	4	7
11-21°	6	6	15	13	14	11	12	9	12	8
>21°	0	0	0	0	0	0	0	0	0	0
Total	16	15	16	15	16	15	16	15	16	15

**Showing Mean Palmar Tilt Movements at different time intervals**

Time	Group DF Flexion (n = 16) Mean ± SD	Group PF Flexion (n = 15) Mean ± SD	't' value	P value
Pre-red	9.56 ± 1.36	10.00 ± 1.30	0.910	0.371 <sup>NS</sup>
Post-red	14.13 ± 1.78	13.60 ± 2.06	.759	0.454 <sup>NS</sup>
At 5 week	13.06 ± 1.87	12.00 ± 1.81	1.601	0.120 <sup>NS</sup>
At 3 months	12.56 ± 1.89	11.20 ± 1.65	2.125	0.042*
At 6 months	12.31 ± 1.74	10.93 ± 1.53	2.334	0.027*

NS: p > 0.05; Not Significant; \*p < 0.05; Significant;

**Ulnar Variance**

At final follow up 6 month 11 patients (68.75%) in dorsiflexion group had normal variance upto 0 to 2 mm as compared to 6 patients (40%) in palmarflexion group

**ULNAR VARIANCE**

	FUI Pre-red	Post red	FU II At 5 Weeks	FU III At 3 months	FU IV At 6 months
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	DF	PF	DF	PF	DF	PF	DF	PF	DF	PF
<-2	4	3	0	0	0	0	0	0	0	4
-2 to 0	10	11	0	0	0	4	1	7	5	5
>0 to+2	2	1	16	15	16	11	15	8	11	6
< +2	0	0	0	0	0	0	0	0	0	0

### Showing Mean Ulnar Variance Movements at different time intervals

Time	Group DF Flexion (n = 16) Mean ± SD	Group PF Flexion (n = 15) Mean ± SD	't' value	P value
Pre-red	-1.38 ± 1.40	-1.53 ± 1.24	0.331	0.743 <sup>NS</sup>
Post- red	1.81 ± 0.40	1.47 ± 0.51	2.086	0.046*
At 5 week	1.69 ± 0.47	0.73 ± 0.88	3.771	0.001*
At 3 months	1.38 ± 0.61	0.33 ± 1.04	3.399	0.002*
At 6 months	0.81 ± 1.04	-0.67 ± 1.71	2.916	0.007*

NS:  $p > 0.05$ ; Not Significant; \* $p < 0.05$ ; Significant;

### Range of Movements

#### Dorsiflexion

A Greater number of patient in the dorsiflexion Group showed faster improvement as compared to palmarflexion group. At 6 months all 15 patients (100%) in dorsiflexion group had dorsiflexion more than 45° as compared to 7 patients (46.66%) in palmarflexion group.

#### Palmar flexion

At final follow up 6 month 15 patients (100%) of dorsiflexion group had palmarflexion more than 30° as compared to 8 patients (53.33%) in palmarflexion group.

#### Supination

At final follow up 15 patients (100%) had more than 50° supination in the dorsiflexion group as compared to 8 patients (53.33%) in palmarflexion group.

#### Pronation

At final follow up 14 patients (87.5%) in the dorsiflexion group had more than 50° pronation as compared to 11 patients (73.33%) in palmarflexion group.

#### Ulnar Deviation

At final follow up 14 patients (87.5%) in the dorsiflexion group had more than 25° ulnar deviation as compared to 7 patients (46.66%) in palmarflexion group.

#### Radial Deviation



At final follow up 13 patients (81.25%) in dorsiflexion group had more than 20° radial deviation as compared to 4 patients (26.6%) in palmarflexion group.

### Grip Power

It was measured in both dominant and non-dominant hand and scoring was done accordingly. There were 13 patients in dorsiflexion group with more than 1/2 grip recovery of normal side as compared to only 8 patients in palmarflexion group.

### Arthritis Changes

Arthritic changes seen in dorsiflexion Group only in one patient due to Collapse because patient removed, plaster of its own at 2½ weeks. Rest No other Arthritic changes seen in any patients in both groups.

### Complication

They were seen only in the palmarflexion group where one patient presented with stiff finger in first-follow up and one more patient presented stiffness in second follow up. However, none of the patient in either group showed any complication at final follow up.

### End results

At final follow up 13 patients in the dorsiflexion group showed excellent results and 2 good results as compared to 9 patients excellent in palmarflexion group and 5 patients in good.

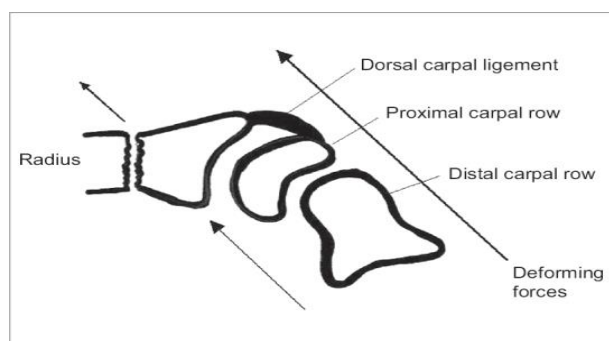
	6 Months	
	DF	PF
Excellent (0-3)	13	9
Good (4-8)	2	5
Fair (9-15)	1	1
Poor (16-26)	0	0
	16	15

## DISCUSSION

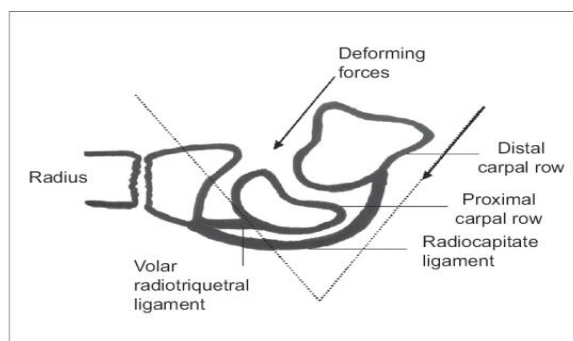
We were influenced by the study conducted by Ajay Gupta<sup>12</sup> in 1991 on 204 patients in which displaced Colle's fractures were subjected to closed reduction and plaster immobilization randomly allocated to one of the three groups with respect to wrist position: Palmar flexion, neutral or dorsiflexion. He explained that the major problem is maintenance of reduction, this is partly due to its anatomical site, adjacent to the multilinked system of the carpus, and partly to our poor understanding of the mechanics of the fracture itself. After a Colle's fracture, whatever the position of the wrist, the extensors of the carpus tend to increase the posterior displacement of the fracture while the wrist flexors act in the direction of over reduction. The radial extensors of the wrist are more powerful than the radial flexors (Von Lanz and Wachsmuth 1959). This implies that the best position for immobilisation with balanced forces is dorsiflexion, where the wrist extensors are placed at a relative mechanical disadvantage. The periosteal



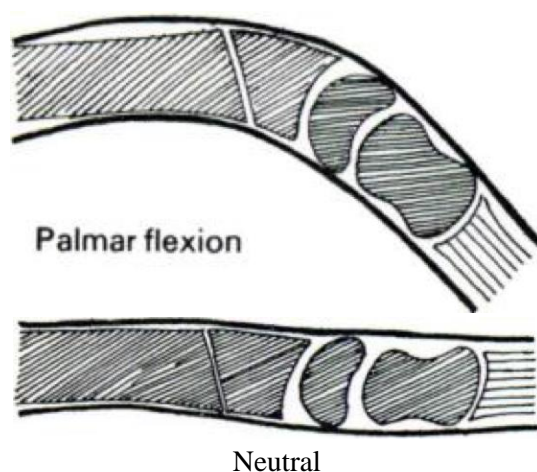
hinge on the concave, dorsal side of a Colles' fracture can be an important stabilising factor. When it is intact, it prevents over reduction; it should be exploited by being kept under tension by slight volar angulation at the fracture. Tension can be maintained in the periosteal hinge by moulding the plaster in the direction of over correction. Flexion at the fracture site is important since it makes the best use of the dorsal periosteal hinge, but the flexed position need not be maintained at the wrist joint. When the wrist is palmar flexed the dorsal carpal ligament, attached mainly to the dorsal aspect of the triquetrum, limits flexion of the proximal carpal row, so that most palmar flexion takes place at the mid-carpal radius, and resist any deforming forces by providing a volar pull on the distal fracture fragment. Moreover, forces applied in the line of the dorsiflexed carpus act at an angle which tends to reduce the fracture. In palmar flexion these forces act in a direction tending to increase displacement (Figs. 1 and 2). In a grossly comminuted fracture some collapse is probably inevitable, but this is likely to be minimised when the wrist is immobilised in dorsiflexion. Figure 3 shows that collapse or impaction, especially of the dorsal cortex, is more likely inside a straight or smoothly curved tube than in a tube with a double curve in an 'S' shape.

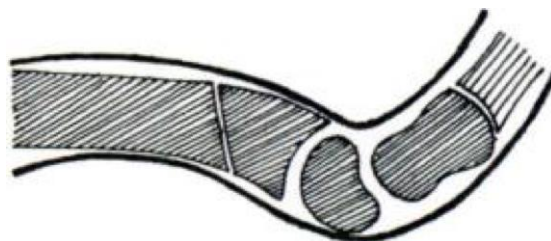


**Fig. 1: Diagram of palmarflexion**



**Fig. 2: Diagram of dorsiflexion**





Dorsiflexion

**Fig. 3: The fracture will collapse most easily inside a straight tube.  
When the wrist is dorsiflexed, the plaster forms a tube with a  
double curve in an 'S' shape.**

In this study we compared the functional and radiological results of extra-articular fractures of lower end radius treated conservatively in two groups, one with wrist immobilized in DF and the other in PF. Functional & Radiological results were compared using Demerit Scoring System of Saito<sup>62</sup> by using various parameters like Dorsiflexion, Palmarflexion, supination, pronation, ulnar and radial deviation as well as total range of movements & ulnar variance, palmar tilt and radial tilt as residual deformity respectively.

In our series, mean palmar tilt immediate after the reduction in palmarflexion group was 13.60° and at final follow up there was 10.93° and loss of 2.6°. In our study 13 (86.66%) patient in the PF group fall in the range of 11-21° post reduction and 8 (53.3%) Patient fall in the same range at final follow up, whereas, mean palmar tilt in dorsiflexion group after reduction was 14.13° and at final follow up 12.31° and loss of 2° as. In our study 15 (93.75%) patient in the dorsiflexion group fall in the range of 11-21° post reduction and 12 (75%) Patient fall in the same range at final follow up. In our study mean Palmar Tilt at the final follow up were higher in dorsiflexion group as compared to Palmarflexion group.

In our series, mean Ulnar variance immediate after reduction in palmarflexion group was 1.47 mm and at final follow up there was 0.67 mm and loss of 0.8 mm. In our study 15 (100%) patient in the palmarflexion group fall in the range of >0 to +2mm post reduction and 6 (40%) patient in same range at final follow up. Whereas, mean Ulnar Variance in dorsiflexion group after immediate reduction was 1.81 mm and at final follow up there was 0.81 mm and loss of 1 mm. In our study 16 (100%) patient in the dorsiflexion group fall in the range of >0 to +2 post reduction and 11 (68.75%) patient in same range at final follow up. In our study mean Ulnar variance at final follow up was higher in dorsiflexion and as compared to palmarflexion group.

In our series, mean Radial tilt after the reduction in palmarflexion group was 22.33° and at the final follow up there was 15.13° and loss of 7.2°. In our study 12 (80%) patient in the palmarflexion group fall in the range of 13-33° post reduction and 7 (46.66%) patient fall in the same range at final follow up. Whereas, mean radial tilt in dorsiflexion group after reduction was 24.63° and at final follow up there was 18.88° and loss of 5.7°. In our study 14 (87.5%) patient in the dorsiflexion group fall in the range of 13-33° post reduction and 14 (87.5%) patient fall in the same range at final follow up. In our study mean Radial Tilt at the final follow up were higher in dorsiflexion group as compared to palmarflexion group.

In our study we also compared patients below 40 years above 40 years in both groups. In dorsiflexion group, 7 patients fall in <40 years group and 9 patients fall in >40 years group. Similarly in palmarflexion group, 7 patients fall in <40 years group and 8 patients fall in >40 years group. Statistically below 40 years group in dorsiflexion showed both radiological and functional parameters better and



significant. But, above 40 years patient showed only functional parameters significant whereas radiological parameters were not significant considering p value in both groups. So it is difficult to maintain reduction in elderly people above 40 years.

In our study different range of movements i.e. dorsiflexion, palmarflexion, supination, pronation, radial deviation, ulnar deviation showed better functional results after immobilizing the wrist in dorsiflexion position.

## SUMMARY AND CONCLUSION

It was prospective study correlating the finding of Radiological and Functional parameter in fracture of distal end radius treated conservatively with in respect to immobilization in palmarflexion and dorsiflexion. A total of 30 patients with recent distal end fracture were included from O.P.D. and Emergency Department. All of these patient had clinical examination done by consultant followed by X-ray of wrist joint AP and Lateral views. After getting X-ray done, and only including colle's fracture from wrist injuries and excluding smith's and barton fracture. Colle's was applied in palmarflexion and dorsiflexion randomly in all cases.

The results of this study are summarized as below:

1. Out of the Thirty patients, fifteen were males and fifteen were females respectively.
2. Patient included in our study were of average 45 years ranging from 10-61 onwards.
3. We also compared 2 groups >40 years and <40 years and found that loss of reduction is more in the >40 years age group.
4. Mode of Injury was fall on outstretched hand in fourteen patients. Road side accident in thirteen patient and violence in three patients.
5. Radiological parameter showed better results in dorsiflexion than palmarflexion at final follow up in both patient wise and statistically.
  - In palmar tilt there is loss of 2° in dorsiflexion as compared to 2.6° in palmarflexion.
  - In radial tilt there is loss of 5.7° in dorsiflexion as compared to 7.2° in palmarflexion.
  - In ulnar variance there is loss of 0.8mm in palmarflexion as compared to 1mm in dorsiflexion.
6. Functional parameters also showed better results in dorsiflexion group then palmarflexion group in flexion, extension, supination, pronation, radial deviation, ulnar deviation.
7. Only one patient showed arthritic changes but functional movements were better.

## Conclusion

It is concluded that:

1. Immobilization of the wrist in dorsiflexion in distal and radius fractures gives better anatomical results by maintaining the reduction.
2. Dorsiflexion is the functional position for the wrist and immobilization in dorsiflexion gives better functional results with improved range of movements of the wrist joint.
3. It is difficult to maintain reduction in elderly people above 40 years.
4. Thus we recommend immobilization of wrist in dorsiflexion.

## Limitations



- Bone mineral density and osteoporosis has major impact on the fracture reduction and maintenance. So, we have not included this in our study.
- Sample group was small.

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