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Outcome of Differential period of immobilization (4 weeks Vs 6 weeks) of Colles' Type Fractures of the Distal Radius in Geriatric population: A prospective study

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Abstract

Background: Perkin-Colles' fracture however may leave behind a deformed wrist.

Aim: To evaluate how the period of immobilization in conservative treatment of extra-articular Colle's type fractures of the distal radius affects functional outcome.

Objective: One group was immobilized for 4 week another group for 6 weeks.

Null Hypothesis: There is no difference between two groups in terms of functional outcome.

Methods: This prospective study included 70 patients and was carried in S.C.B. Medical College in Department of Orthopedics from 2017-19.One group was immobilized for 4 week another group for 6 weeks. Standard radiographs were made of both wrists in two directions after the fracture, then of the injured side on day 11 following repositioning, and at 3month and 6 month. Anatomical results were assessed by evaluating the dorsal angulation, loss of radial inclination, and loss of radial length. Functional results were assessed by the evaluation of pain, range of active motion, grip strength, and appearance of the wrist joint.

Results: 1-No Statistically significant difference between two groups in terms of functional outcome in 6 months 2- Statistically significant difference between two groups in terms of functional outcome in 3 months.

Conclusion: In long term follow up there is no difference in functional outcome with respect to period of immobilization rather it is more related to the radiological (anatomical) outcome.

Keywords: Casts, Conservative, Mayo score, Colles' fracture, hand strength, prospective studies, radiography, range of motion, articular; treatment failure.

Introduction

The fracture of the radial bone in a typical zone accounts for 10-17% of all fractures treated at emergency care units [1,2]. It also accounts for 74.5% of all forearm fractures [3]. This type of fracture occurs most commonly between the age 6 and 10, and between the age 60 and 69 [4]. In the group of patients aged above 60, women suffer this type of fracture nearly 7 times more often than men [4].

Many physicians assume that the distal radial bone fracture does not require special attention since the resulting deformity rarely damages the wrist function [5,6]. However, there exists some controversies. Colles' fracture can lead to prolonged functional impairment, especially in older patients [7]. Some authors have noted that over 17% of patients had poor function one year after injury [8,9], but others have reported more encouraging recovery as early as six months after the fracture [10,11]. The disability after Colles' fracture has been attributed to bony deformity, and the importance of obtaining an anatomical reduction has been repeatedly emphasized [8,12]. Cooney, Dobyns and Lindsceid [13,14], however, pointed out that the soft-tissue injury was partly responsible for the resulting stiffness. After early mobilization of an injury, the blood supply to bone and soft tissues returns rapidly to normal and joint stiffness is decreased [15,16]. Sarmiento et al. [11] encouraged wrist movement in a cast brace applied one week after Colles' fractures and claimed 82% satisfactory results without significant deformity. On the other hand Stewart et al. [17], using an orthoplast brace 10 days after injury, were unable to demonstrate any advantage in early mobilization over conventional treatment six months after the fracture.

We performed a prospective study to assess the anatomical and functional results of the conservative treatment of extra-articular fracture of the radial bone in the typical zone. We evaluated correlations between single parameters of the anatomical results (dorsal angulation, loss of radial inclination, and loss of radial length) and functional end results to determine the borderline value of each anatomical parameter that would correspond the best with a functional end result.

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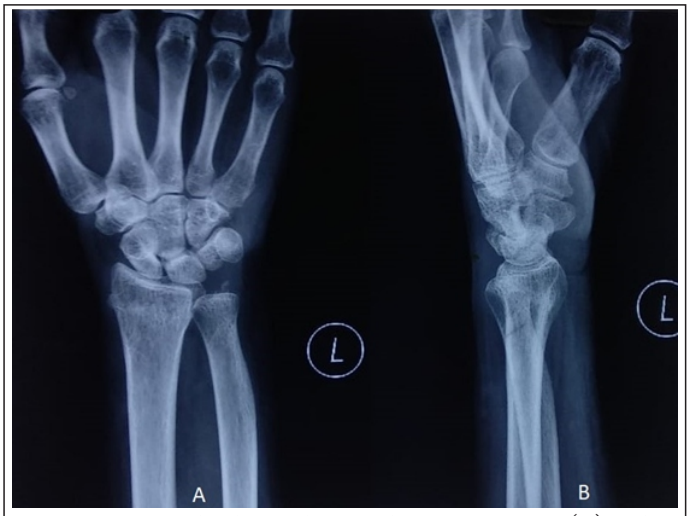

Figure 1: Initial radiographs. Initial postero-anterior (A) and lateral (B) radiographs of extraarticular fracture of the distal radius.

Table1: Anatomical assessment of treatment results of radial bone fracture in a typical zone

Dorsal angle (degrees)	Loss of radial length (mm)	Loss of radial angle (degrees)	Score*
Neutral	0-3	0-4	0
1-10	4-6	5-9	1
11-14	7-11	10-14	2
>15	>12	>15	4

*Rating: combined score dorsal angle, radial length, and radial angle; excellent=0; good=1-3; fair=4-6; poor=7-12 (ref. 14).

Mayo wrist score

Category	Score	Findings
Pain (25 points)	25	No pain
	20	Mild pain with vigorous activities
	20	Pain only with weather changes
	15	Moderate pain with vigorous activities
	10	Mild pain with activities of daily living
	5	Moderate pain with activities of daily living
	0	Pain at rest
Satisfaction (25 points)	25	Very satisfied
	20	Moderately satisfied
	10	No satisfied, but working
	0	No satisfied, unable to work
Range of motion (25 points)	25	100% percentage of normal
	20	75~99% percentage of normal
	10	50~74% percentage of normal
	5	25~49% percentage of normal
	0	0~24% percentage of normal
Grip strength (25 points)	25	100% percentage of normal
	15	75~99% percentage of normal
	10	50~74% percentage of normal
	5	25~49% percentage of normal
	0	0~24% percentage of normal

Final result (total points)	
90~100	Excellent
80~89	Good
65~79	Fair
<65	Poor

Patients and Methods

The study was carried out at the S.C.B. College and Hospital during 2017-19. We followed up 70 patients with simple and impacted extra-articular fractures of the distal segment of radial bone in the typical zone (Colles' type) who underwent conservative treatment (Fig. 1).

Inclusion criteria

1. Age- 60-80 years
2. Unilateral distal radius fracture
3. Extra-articular fracture
4. Closed fracture

The patients were classified according to Müller's classification [18] into A2 group of the distal segment of radial bone fractures (extra-articular fracture of the radius, simple and impacted), location 2-3 (2 signifying forearm and 3 signifying the distal segment). There were 28 male and 42 Female patients. The mean age of 66.3±3.2 years (range, 60-80 years). In 65 patients the right hand was dominant, whereas in 5 patients left hand was dominant in 42 patients, the fracture occurred in the dominant and in 28 patients in the non-dominant hand. The incidence of fracture was highest in patients aged 60-69 years. In this age group, the incidence of fractures was

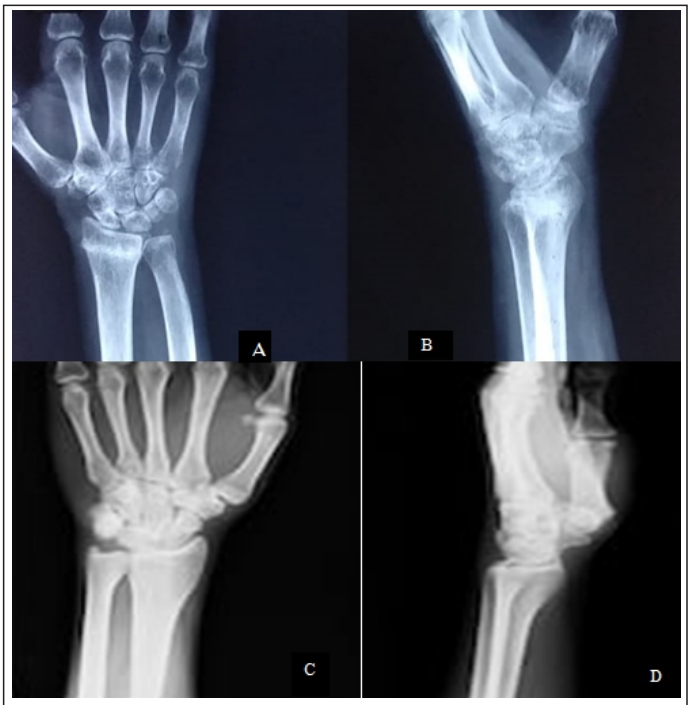

Figure 2: Final radiographs compared with radiographs of contralateral wrist.
[A] AP view of the injured wrist after 4 month Cast Immobilization, [B] Lateral view of the injured wrist after 4 month Cast Immobilization, [C] AP view of the contralateral healthy wrist, [D] Lateral View of the contralateral healthy wrist.

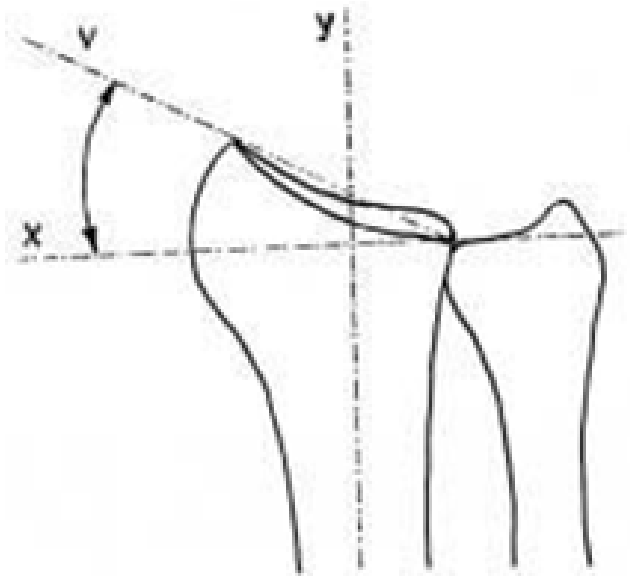

Figure 3: Radial inclination measurement. For radial inclination measurement a line perpendicular (line x) to the central axis (line y) of the radius is drawn. Another line (line v) joins the distal tip of the radial styloid and the ulnar corner of the ulnar fossa. The angle between lines x and v is called radial inclination.

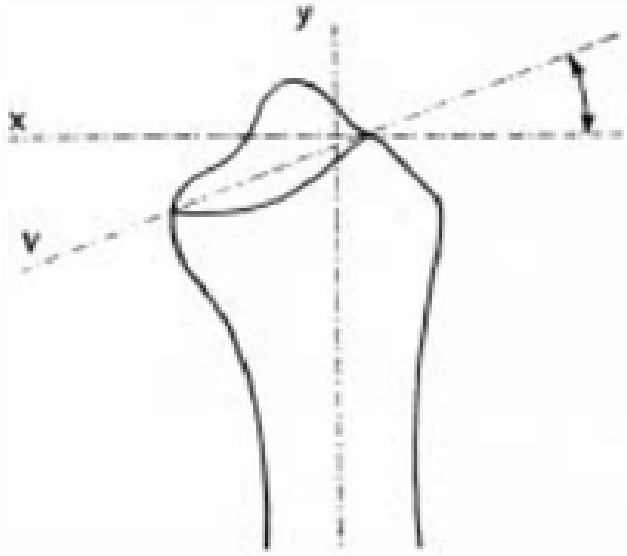

Figure 4: Palmar tilt measurement. A line (line x) perpendicular to the central axis of the radius (line y) is drawn through the dorsal rim of the distal radius. Another line (line v) joins the dorsal and ventral rim of the radius. The angle between lines x and v is called palmar tilt.

higher in women than in men (there were 20 men and 24 women in age group 60-70 years), which corresponds with data reported in literature [2,4].

Treatment

Standard radiographs were made of both wrists(injured & Healthy side) in AP & Lateral directions after the fracture. A hematoma block was given followed by the closed manipulation of fracture under the guidance of C-Arm. After the reduction of the fracture, the forearm was immobilized by below elbow plaster cast, with the wrist joint at

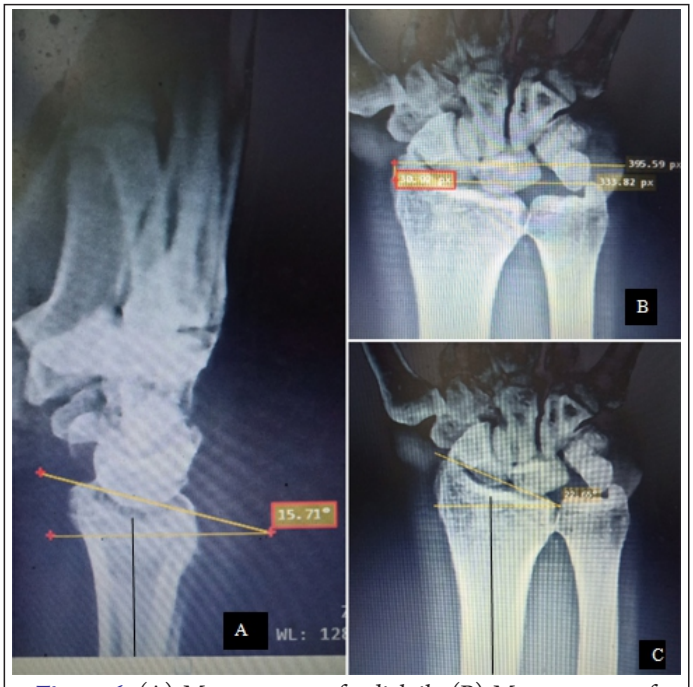

Figure 6: (A)-Measurement of radial tilt ,(B)-Measurement of radial height , (C)-Measurement of radial inclination

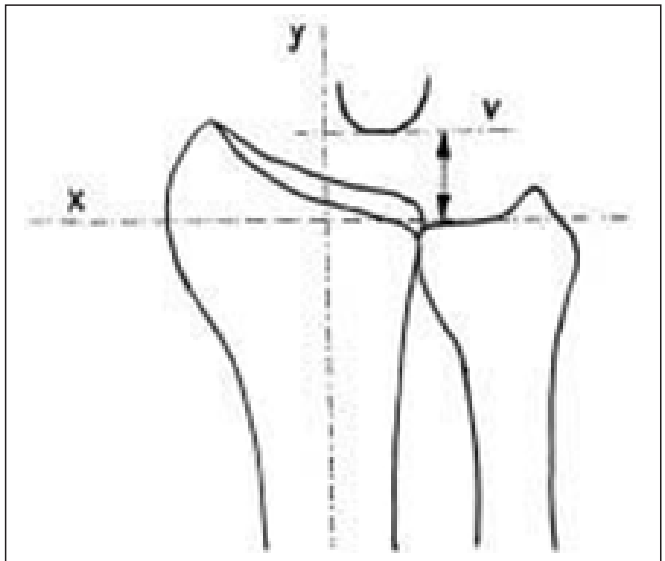

Figure 5: Radial length measurement. The method of measuring radial shortening (13). y- long axis of radius, x- perpendicular to long axis of radius drawn through the distal articular surface of the ulna, v- perpendicular to long axis of radius drawn through the capitate's vertex. The distance between lines x and v is called radial length.

neutral position or mild ulnar deviation. A below elbow plaster cast was applied for 4 weeks in 32 patients for 6 weeks in 38 patients.

Anatomical Evaluation

The X-rays were used to determine radial inclination (Fig. 3), palmar tilt (or palmar slope) (Fig. 4) of the distal radial bone segment, and the radial bone length (Fig. 5) according to Bilic et al [19]. The method of measurement of the radial bone length according to Bilic et al [19], when compared with other measurement methods, is not so much affected by the changes in the radial and palmar angles and the result is significantly less influenced by the rotation of the distal fragment in frontal and sagittal planes. Anatomical results (Table 1) were assessed on the basis of criteria established by Stewart et al [17]. Anatomical parameter was compared with functional out come at 6 months.

Functional Evaluation

The functional outcome was measured at 3 months and 6 months by Mayo wrist score. A goniometer was used for the measurement of the flexibility of wrist joint of the healthy and injured hand at 3 months and 6 months after treatment. Dynamometer was used to measure the strength of the wrist grip.

Statistics

We analyzed functional result of two groups using chi-square test of association. The chi square test of association, shown in 2x2 table where the fields with excellent and good results and the fields with tolerable and poor results were combined, was used in the analysis of association between anatomical and functional results. P-value <0.001 was considered statistically significant. To examine strengths of associations, we computed odds ratios (OR) with 95% confidence intervals (CI) for the functional result in relation to the anatomic result.

Results

The radial inclination in healthy hands was 20-30 degrees (mean±SD, 25.6±2.8degrees). Palmar angulation of healthy hands was 0-15 degrees (mean ± SD, 7.9±4.2). The length of the radial bone varied from 8 mm to 18 mm (mean ± SD, 13.4±1.7mm).

The functional result was excellent in 5 patients, good in 20, fair in 3, and poor in 4 patients in 4 weeks cast group at 3 months. The functional result was excellent in 1 patient, good in13, fair in12, and poorin12 patients in 6 weeks cast group at 3 months.

There was a statistically significant association between period of immobilization by cast and functional results at 3 months. [Chi-square=1.99, d.f.=1, p<0.001(0.0005). Odds ratio = 6.12 , (95% CI, 2.1-17.78)](table-2)

The functional result was excellent in 9 patients, good in 19, fair in 4, and poor in 3 patients in 4 week cast group at 6 months. The functional result was excellent in 8 patient, good in 21, fair in 5, and poor in 6 patients in 6 weeks cast group at 6 months.

Functional result (no. of patients)		
Duration of cast	Excellent/good	Fair/poor
4weeks.	25	7
6weeks.	14	24

*Chi-square=1.99, df.=1, p<0.001(0.0005). Odds ratio = 6.12, (95% CI, 2.1-17.78)

Tables 2: Comparison of functional scores between two groups treated conservatively for extra-articular Colles' type fractures of the distal radius at 3 months*

Functional result (no. of patients)		
Duration of cast	Excellent/good	Fair/poor
4weeks.	28	4
6weeks.	27	11

*Chi-square=2.79, df.=1, p>0.001(0.094). Odds ratio = 2.8, (95% CI, 0.81-10.0)

Tables 3: Comparison of functional scores between two groups treated conservatively for extra-articular Colles' type fractures of the distal radius at 6 months*

Functional result (no. of patients)		
Anatomical result	Excellent/good	Fair/poor
Excellent/good	43	5
Fair/poor	12	10

*Chi-square=10.99, df=1, p<0.001(0.0009). Odds ratio = 7.17, (95% CI, 2.01-25.01)

Tables 4: Relation between anatomical and functional outcome at 6month*

*Chi-square=11.75, df=1, p<0.001(0.0006). Odds ratio = 7.67, (95% CI, 2.18-26.92)

<10 degree	46	6
>10degree	9	9

Tables 5: Relation between dorsal angulation and functional outcome at 6month*

Functional result (no. of patients)		
Loss of radial angle	Excellent/good	Fair/poor
<9 degree	41	7
>9 degree	14	8

*Chi-square=11.77, df.=1, p<0.001(0.0006). Odds ratio = 7.67, (95% CI, 2.18-26.92)

Tables 6: Relation between Loss of radial angulation and functional outcome at 6month*

Functional result (no. of patients)		
Loss of height	Excellent/good	Fair/poor
<6mm	40	4
>6mm	15	11

*Chi-square=3.63, df.=1, p>0.001(0.0568). Odds ratio = 3.05, (95% CI, 0.94-9.87)

Tables 7: Relation between Loss of radial height and functional outcome at 6 month*

There was no statistically significant association between period of immobilization by cast and functional results at 6 months.. [Chi-square=2.79, d.f.=1, p>0.001(0.094). Odds ratio = 2.85 , (95% CI, 0.81-10.0)](table-3).

So total excellent or good functional result was in 45 patients (excellent in 9 patients, good in 19 in 4 weeks cast group and excellent in 8 patient, good in 21 in 6 weeks cast group) and fair or poor functional result in 15 patients (fair in 4, and poor in 3 patients in 4 weeks cast group and fair in 5, and poor in 6 patients in 6 weeks cast group) out of 70 patient at 6 months.

The anatomical result was excellent in 18 patients, good in 4, fair in 4, and poor in 6 patients in 4 weeks cast group at 6 months. The anatomical result was excellent in 23 patient, good in 3, fair in 6, and poor in 6 patients in 6 weeks cast group at 6 months.

So total excellent or good anatomic result was in 48 patients (excellent in 18 patients, good in 4 in 4 weeks cast group and excellent in 23 patient, good in 3 in 6 weeks cast group) and fair or poor anatomical result in 22 patients (fair in 4, and poor in 6 patients in 4 weeks and fair in 6, and poor in 6 patients in 6 weeks cast group) out of 70 patient at 6 months.

There was a statistically significant association between anatomical and functional results. [Chi-square=10.99, d.f.=1, p<0.001(0.0009). Odds ratio = 7.17 , (95% CI, 2.01-25.01)] (table-4).

Out of 70 patients dorsal angulation was < 10 degree in 52 patients (46 with excellent or good functional result and 6 with fair or poor functional result) > 10 degree in 18 patients (9 with excellent or good results and 9 with fair or poor results) at 6 months.

There was a statistically significant association was found between the dorsal angulation and functional results at 6 months.[Chi-square=11.75, d.f.=1, p<0.001(0.0006). Odds ratio = 7.67 , (95% CI, 2.18-26.92)](table-5)

Out of 70 patients los of radial angulation was < 9 degree in 45 patients (41 with excellent or good functional result and 4 with fair or poor functional result) > 9 degree in 18 patients (14 with excellent or good results and 11 with fair or poor results) at 6 months.

There was a statistically significant association was found between the loss of radial angulation and functional results at 6 months.[Chi-square=11.77, d.f.=1, p<0.001(0.0006). Odds ratio = 7.67 , (95% CI, 2.18-26.92)](Table-6).

Out of 70 patients loss of radial height was < 6 mm in 47 patients (40 with excellent or good functional result and 7 with fair or poor functional result) > 6mm in 18 patients (15 with excellent or good results and 8 with fair or poor results) at 6 months.

There was no statistically significant association was found between the loss of radial height and functional results at 6 months.[Chi-square=3.63, d.f.=1, p>0.001(0.0568). Odds ratio = 3.05 , (95% CI, 0.94-9.87)](table-7)

According to Stewart et al (17), acceptable dorsal angulation was 10 degrees, acceptable loss of radial inclination was 9 degrees, and acceptable loss of radial bone length was 6 mm (Table 1).

Discussion

Due to a wide range of measured parameters in healthy hands, it is necessary to make a comparative X-ray of both wrists, because measured parameters in healthy hand can be used as control criteria for the assessment of treatment results. Excellent or good anatomical and functional results were obtained in 55 out of 70 patients, whereas in 15 patients both cast group outcomes were assessed as satisfactory or poor. The limitations of our study were a small number of patients and wide range of their age. Our results are close to other studies that found closed reduction and solid cast immobilization acceptable methods of the treatment in 75-80% of fractures of distal radial bone [2,20]. We got 78.5% excellent or good fuctional result. Cassebaum (5) reported obtaining 94.1% excellent or good functional results in 135 patients with radial bone fracture. Altissimi et al [21] obtained 87% excellent or good anatomical results in 297 patients treated for radial bone fracture by closed reduction.

In our study, the radial inclination in healthy hands ranged from 20 to 30 degrees, which is in accordance with literature data [22,23]. However, the mean value of 25.6±2.8 degrees is higher than the 20 degree average described by Metz et al [22], 22 degrees described by Taleisnik et al [24], or 23 degrees reported by Sceck [25]. It is close to the average radial inclination value of 25.4 degrees as reported by Friberg and Lundström [26]. The palmar tilt in our study ranged from 0 to 15 degrees, which is in accordance with other relevant studies reporting the range of values from 0 to 22 degrees [2,21,23,26]. The mean value of 7.9±4.2 degrees is lower than the most commonly reported average value of 14.5 degrees [22,23]. The length of radial bone measured by us was ranged from 8 to 18 mm (mean value of 13.4±1.7mm) which is similar to result obtained by Biliæ et al [19].

In short term (3 months) there is better functional outcome in 3 weeks cast group as compared to 6 weeks group. But in long term (at 6 months) there is no correlation between period of immobilization with functional outcome ($p<0.001$). There is significant correlation between anatomical and functional out come at 6 months. We obtained significant correlation between anatomical and functional results, which differs from the results obtained by Gartland and Werley [8], who obtained surprisingly good functional results despite poor repositioning and inadequate immobilization. Our results also differ from those reported by Cassebaum [5], Pool [10], and Young and Rayan [27], who obtained good function in cases where anatomical results were poor. However, the majority of authors report about significant correlation between anatomical and functional results [28-30].

When we compared individual anatomical parameter with functional outcome at 6 months we got significant correlation between dorsal angulation and loss of radial inclination but there is no significant correlation between radial heights. Higher the dorsal angulation and loss of radial height related to worse prognosis.

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