ORIGINAL ARTICLE

Treatment of Colle's Fracture with Wrist Immobilization in Palmar flexed & Dorsiflexed Position

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ABSTRACT

Objective: To evaluate and compare the radiological and functional results of immobilization of Colle's fracture treated conservatively in two different positions of wrist i.e. palmarflexion(PF) & dorsiflexion (DF).

Study Design: A Descriptive Cross Sectional Study.

Materials & Methods: Sixty patients with closed Colle's fracture who were treated conservatively by close reduction and below elbow cast application were included in this study. The study was conducted at Department of Orthopedics, Railway Hospital, Westridge, Rawalpindi from November 2008 to May 2011. The patients were alternately allocated to dorsal or palmar flexed immobilized position of wrist. Patients were followed up for a minimum six-month period. The radial tilt, palmar tilt and ulnar variance were measured at 6 month follow up. The results were scored by Demerit Scoring System of Saito.

Results: All fractures were united. Individual movement of dorsiflexion, palmar flexion, supination, and radial-ulnar deviation (except pronation) were all significantly better in the dorsiflexed-immobilized group as compared with the palmar flexed immobilized group. Grip strength recovery with subjective assessment was better in the dorsiflexed group as compared to the PF group. Radiological parameters were markedly better in the dorsiflexed group. 100% of patients in the dorsiflexed group had overall excellent results as compared to 23.3% in the palmar flexed group in terms of radiological & functional outcome.

Conclusion: Functional & radiological results of Colle's fractures are superior if the fractures after reduction are immobilized in dorsiflexion of wrist rather than in conventional palmar flexion position.

Keywords: *Colle's fracture, immobilization, dorsiflexion.*

Introduction

About 200 years have passed since Colle's described a fracture of the distal end of the radius, and it is one of the most common fractures encountered by the orthopedic surgeon. [1] Such injuries account for approximately one-sixth of fractures treated in emergency departments.[2]

The majority of distal radius fractures occur as isolated injuries in two distinct populations: youth involved in sports who sustain a relatively high-energy fall, and seniors with osteoporotic bone who sustain a low-energy fall. Fracture examination includes an assessment of neurovascular status. Range of motion of the wrist, including supination, pronation, flexion, and extension should be evaluated if possible. Accurate assessment of standard radiographs is essential for appropriate management.[3] And includes true posterior-anterior (PA) and true lateral projections.[4]

Each view contains a small number of important landmarks and measurements for proper interpretation. Distal radius fractures can be described using either a fragment-specific classification or the standard Frykman classification.

The Frykman classification system divides the fractures among four main groups based upon joint involvement.

For immobilization we generally need to avoid positions of marked palmar flexion and ulnar deviation (Cotton-Loder position); a truly stable fracture will probably be stable in any position once it is reduced; fractures which are stable in only extreme positions, should be considered to be unstable and probably require additional methods of fixation (pins, external fixation, ORIF).[5] While most orthopedists probably

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immobilize distal radius fractures in slight flexion and pronation, but there is some evidence to suggest that distal radius fractures should be immobilized with the wrist extended; as noted by Gupta et al. Position of wrist made no difference with regards displacement, in displaced extra-articular fractures with no comminution; in comminuted fractures, both extra articular and intra articular, best results occurred in fractures treated in dorsiflexion; functional results were superior when fractures were treated in dorsiflexion and in contrast palmar flexion was associated with higher rate of fractures displacement. Dorsiflexion is also a better position for rehabilitation of the fingers.[6]

Numerous previous studies have taken the amount of displacement into consideration but very few have dwelt on the role of the position of immobilization as a parameter for comparing radiological and functional outcome.[7,8,9,10] The present study was undertaken to evaluate the functional and radiological outcome of conservatively treated extra-articular fractures when wrist was immobilized in DF compared to immobilization in PF.

Materials and Methods

This prospective study included 60 patients in the age group of 16-75 years with closed extra-articular fractures of the lower end radius from November 2008 to May 2011 in the Orthopedics Unit of Railway General Hospital (RGH) Rawalpindi. The study was conducted after approval from the hospital ethical committee. The study included extra-articular fractures of Frykman category I and II. Extra-articular fractures with extreme displacement or grossly comminuted fractures that were not amenable to reduction by manipulation were treated surgically were not included in the study. Patients who did not complete a six month follow up were also excluded.

Standard anteroposterior (AP) and lateral radiographs of injured wrist were taken. All were treated initially by below elbow plaster of Paris (POP) slab for a period of approximately five days followed by closed reduction and below elbow cast application under general anesthesia. 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 (Smiths) 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° DF.

Plaster removal was done at four weeks. It was followed by active exercises during the first week and following active and passive exercises one week later. During the first two weeks of cast removal a crepe support was given.

The results were scored by Demerit Scoring System of Saito and by taking AP and lateral

radiographs. Assessment of pain, disability, i.e. limitation of motion, subjective evaluation was done. Radiological parameters, radial tilt, palmar tilt and ulnar variance were measured at 6 month follow up.

Radial tilt: is the angle between one line drawn perpendicular to the long axis of the radius and a second line drawn between the distal tip of the radial styloid and the central reference point (CRP).

The CRP lies midway between the palmar ulnar corner and the dorsal ulnar corner of the distal radius. The average angle is approximately 20 to 25 degrees.

Palmar tilt: is the angle formed by the intersection of one line perpendicular to the longitudinal axis of the radial shaft and a second line drawn through the apices of the palmar and the dorsal rims of the radius. The normal palmar tilt on a standard lateral projection averages 11.2 ± 4.6 degrees.

Ulnar variance: is the distance between two lines drawn perpendicular to the longitudinal axis of the radial shaft: one through the distal articular surface of the ulnar head and the second through the CRP. Normally, the radial surface is distal to the ulnar surface by 1 to 2 mm (negative ulnar variance).

Movements were measured in degrees from neutral position with the help of goniometer. Grip strength was measured as mm of Hg with the help of a dynamometer.

The functional results of both groups using the Saito's scoring system were calculated by adding all the points and were finally graded as follows:

Excellent 0-3, Good 4-9, Fair 10-15 and Poor 16-26. Both the DF group and PF group were compared with each other on the above mentioned parameters of Saito.

Results

The study included 60 patients with Frykman category I/II Colles fractures. The age ranged from 16-75 years with a mean age of 55.2512.34 years. Thirteen (21.7%) were males, whereas 47 (78.3%) were females. Forty two (70%) fractures were on right side. After reduction 30 patients were immobilized in PF and 30 patients immobilized in DF. These patients were scored at the end of 6 month follow up.

Subjective evaluation:

It was done on the basis of pain, restriction of movements and disability. At final follow-up out of 30 patients of DF immobilized group 23, 7, 0 and 0 had excellent, good, fair and poor results respectively as compared to 12, 15, 2 and 1 patient in PF immobilized group; this difference was statistically significant (p value = 0.025).

Objective evaluation:

Residual deformity

Radial tilt: At final follow-up 27 (90%) patients of DF group had 13 to 33° radial tilt as compared to 17 (56.7%) patients in PF group (p value = 0.004).

Palmar tilt: At six months 23 (76.6%) patients of DF immobilized group had 1 to 21° palmar tilt as compared to 11 (36.6%) patients in the PF immobilized group (p value = 0.002).

Ulnar variance: At six months 28 patients (93.3%) in the DF group had normal variance i.e. -2 to 0 mm. In the PF group only 15 patients (50%) had normal ulnar variance (p value = 0.00).

Range of movements:

Dorsiflexion: At six months all 30 patients (100%) in the DF group had dorsiflexion more than 45° as compared to 11 patients

(36.6%) in the palmarflexion group (p value = 0.00).

Palmar flexion: At final follow-up all 30 (100%) patients of the DF group had palmar flexion more than 30° as compared to 21 patients (70%) in the PF group (p value = 0.001).

Supination: 30 patients (100%) had more than 50° supination in the DF group as compared to 24 patients (80%) in the PF group (p value = 0.010).

Pronation: 28 patients (93.3%) in the DF group had more than 50° pronation as compared to 24 patients (80%) in the PF group (p value = 0.129).

Ulnar deviation: 29 patients (96.6%) in the DF group had more than 15° ulnar deviation as compared to 20 patients (66.7%) in the PF group (p value = 0.003).

Radial deviation: 28 patients (93.3%) in the DF group had more than 15° ulnar deviation as compared to 18 patients (60%) in the PF group (p value = 0.002).

Grip strength It was measured in both dominant and non-dominant hand and scoring was done accordingly in the final follow-up. There were 27 patients (90%) in the DF group with more than two third grip recovery of normal side as compared to only 15 patients (50 %) in the PF group (p value = 0.003).

Arthritis changes They were not seen in any of the cases in both the PF as well as DF group as the follow up was short.

Complications None of the patients in either group showed any complication at final follow-up.

Final Follow-up : At the final follow-up, 30 (100%) patients in the DF group showed overall excellent results in terms of radiological & functional outcome as compared to 7 (23.3%), 22 (73.3%) and 1 (3.3%) patient with excellent, good and fair results respectively in the PF group (p value = 0.000)

Discussion

No clear consensus exists as to the best position for immobilizing the wrist in a cast in extra-articular fracture of lower end radius. Sarmentio et al, advocated immobilization in the position of supination to decrease the deforming force of the brachioradialis, which may cause loss of reduction.[12,13]

In contrast, Wahlstrom recommends immobilization in pronation because he claims that the pronator quadratus causes the deforming force and is responsible for loss of reduction.[14]

According to the John Charnley. Colle's fracture should be treated in palmar flexion and ulnar deviation as dorsal periosteal hinge provides stability. Following this, traditionally, extra-articular fractures of the lower end of radius were classically treated by closed reduction, cast immobilization in palmar flexion and ulnar deviation. But this conventional position has higher chance of redisplacement, inhibits hand functions and has greater associated complications like median nerve compression.[15]

Van der Linden conducted a study by applying cast in different positions of wrist and compared between complete cast and splint. He studied the anatomical and functional outcome and found that the results were surprisingly same; thereby concluding that the technique of immobilization plays a subordinate role.[16]

The concept of our study was influenced by the original recommendation by Zuppinger in 1910 and Bohler in 1929

proposed that the position of the wrist should be changed from slight palmar flexion at initial post reduction to neutral or slight extension but maintaining ulnar deviation at 10 to 14 days post reduction.[17,18]

Our study resembles to some extent the study done by Gupta A[12] in 1991 on 204 patients in which displaced Colles' 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. They reported that in displaced extra-articular fractures with no comminution the position of the wrist made no significant difference in regards to later displacement. In comminuted fractures, both extra-articular and intra-articular, the best anatomical results were in fractures treated in dorsiflexion. Functional results in all fractures, regardless of the classification were superior if the fractures were treated in dorsiflexion.

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, we found that individual movements of DF, PF, supination, ulnar and radial deviation are significantly better when the wrist is immobilized in DF as concluded by Gupta A. Further, grip strength recovery and subjective assessment of pain, disability and limitation of the movements was also better as well as faster in DF immobilized patients. Radiological parameters as measured by ulnar variance, palmar tilt and radial tilt were significantly better in the DF group as compared to the PF group. The residual deformity seemed to be greater in the PF group. Although arthritic changes were not seen in any of the groups possibly in view of very short follow up. Complications were also not seen at final follow up in both groups.

According to Gupta A the reasons for the better results in the DF immobilized wrist can be understood by understanding the biomechanics of the wrist joint and fracture reduction. In the PF group the dorsal carpal ligament is taut, but cannot stabilize the fracture because of its lack of attachment to the distal carpal row. Thus the deforming forces and the potential displacement of the fracture are parallel. While in DF immobilization the volar ligament is taut which has attachment to the distal as well as proximal carpal row and tends to pull the fracture anteriorly. The deforming forces act at an angle that tends to reduce the displacement of the fracture thus preventing redisplacement. Since the wrist in extension is the optimal position for hand function and rehabilitation of the fingers, along with the fact that PF is associated with a higher rate of fracture displacement, Gupta concluded that flexion at the fracture site is important to make use of the dorsal periosteal hinge but the flexed position need not be maintained at the wrist joint.

Conclusion

It is concluded that in conservatively treated Colle's fractures, the wrist should be immobilized in position of slight dorsiflexion. Better results in DF immobilized wrist are perhaps because DF is needed for the rehabilitation of fingers, and the optimal functional position for the hand is wrist in extension.

Table I: Frykman categories

Grade	Degree of deformity
Types I/II	Completely extra-articular; complications are uncommon once anatomic alignment has been achieved
Types III/IV	Extend into the radiocarpal joint
Types V/VI	Extend into the distal radioulnar joint (DRUJ)
Types VII/VIII	Involve both radiocarpal and DRUJ articular surfaces and are highly unstable

Table II: Demerit point system (Saito)

Subjective evaluation:
Excellent (No pain, No disability, No limitation of movements) 0
Good (Ocassional pain, No disability, slight limitation of movements) 2
Fair (Ocassional pain, No particular disability if careful, some limitation of movements, feeling of weakness in wrist, activity slightly restricted) 4
Poor (Pain, disability, slight limitation of movements, activities markedly restricted) 6
Objective evaluation:
a) Residual deformity (out of the range of)

Ulnar variance	0±2mm	1
Palmar tilt	0 11±10 degrees	1
Radial tilt	23±10 degrees	1
b) Range of movement		
Dorsiflexion	<45 degree	1
Palmer flexion	<30 degree	1
Ulnar flexion	<15 degree	1
Radial flexion	<15 degree	1
Supination	<50 degree	1
Pronation	<50 degree	1
c) Grip Power		
Dominant	<1/2 Power of opposite hand	1
	< 2/3 Power of opposite hand	2
Nondominant	<1/2 Power of opposite hand	1
	< 2/3 Power of opposite hand	2
d) Arthritic changes		
None		0
Minima Irregularity of articular surface, sharpening of articular margin.		1
Moderate	Narrowed joint space, osteophytes	2
Severe	Marked Osteophytes, Ankylosis	3
e) Complications		
Nerve complications		1-2
Stiff fingers		1-2
Ruptured tendons		1-2

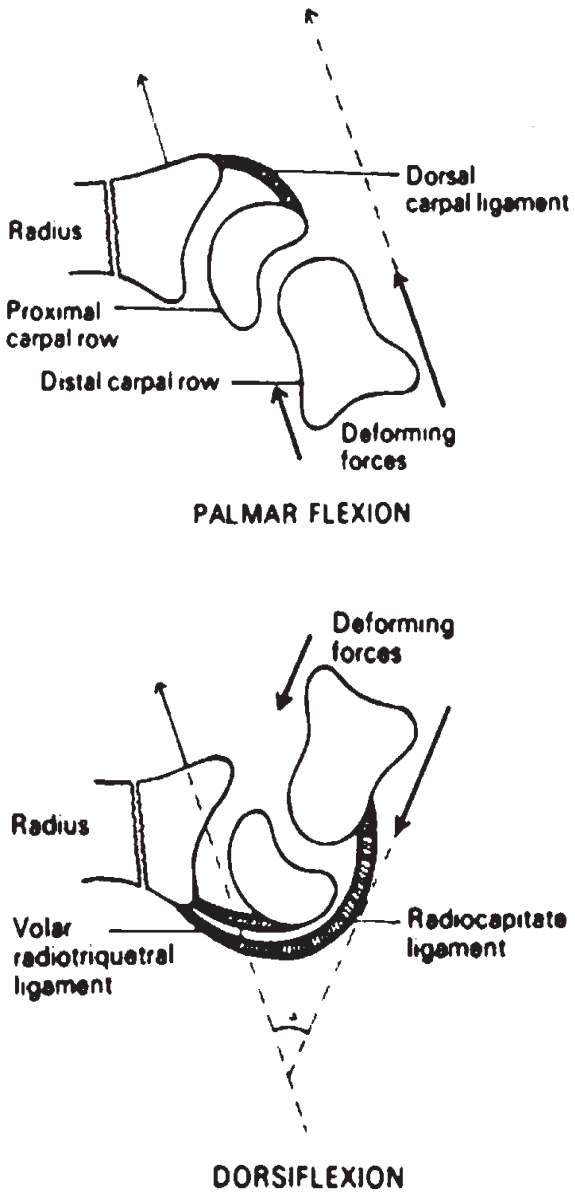

Figure 1: Modes of immobilization

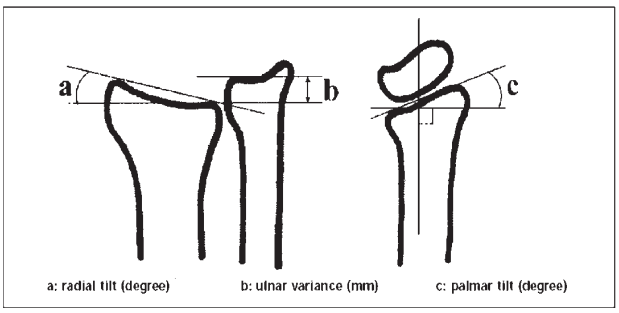

Figure 2: Measurement used for the Anatomical results

AP view

Lateral view

Figure 3: Colle's fracture (Frykman I distal radius fracture)

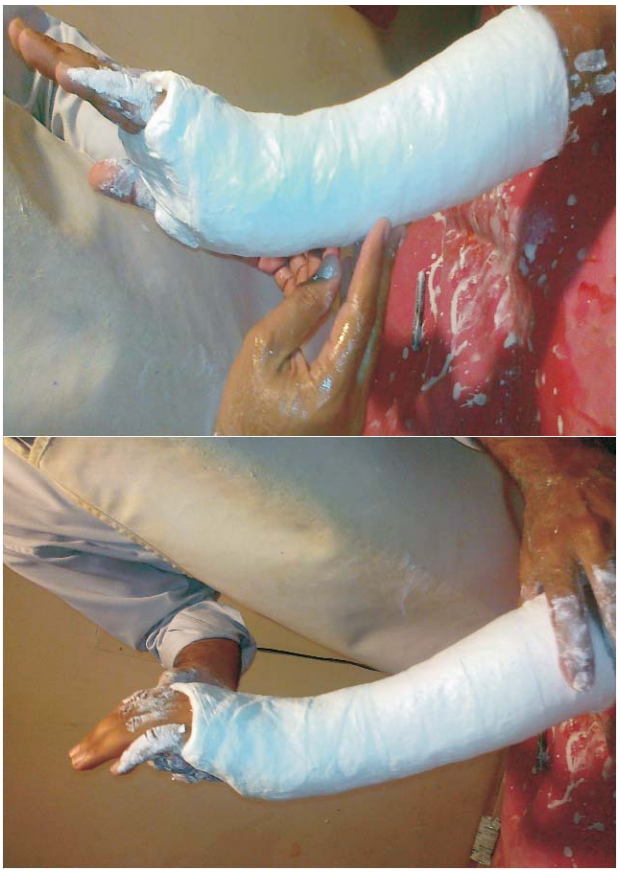

Figure 4:Cast with wrist immobilization in Dorsiflexed position

Figure 5: Result after healing of fracture in Dorsiflexed position

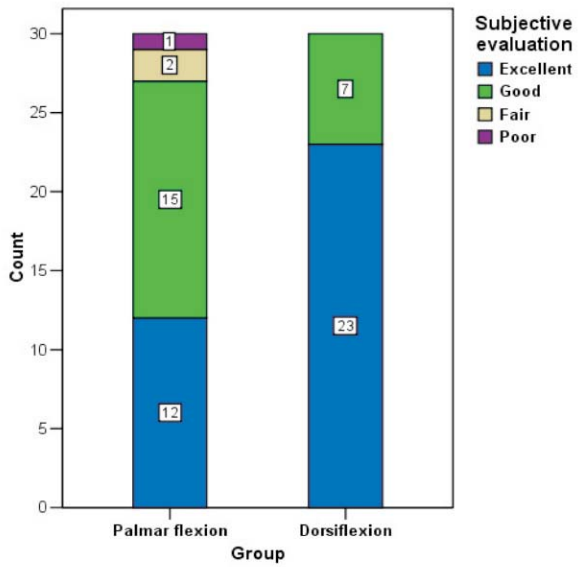

Figure 6: Subjective Evaluation

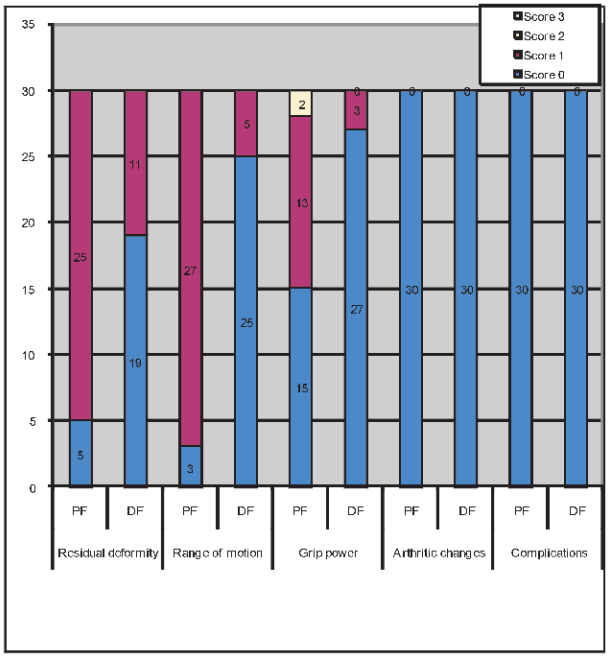

Figure 7: Objective Evaluation.

Table III: End result at final follow-up according to Saito's scoring system

	GROUPS		
	Palmer flexion	Dorsiflexion	*P* value
End Result			
Excellent	7 (23.3%)	30 (100%)	
Good	22 (73.3%)	0	
Fair	1 (3.3%)	0	0.00
Poor	0	0	
Total	30	30	

References

1. Fujii K, Henmi T, Kanematsu Y, Mishiro T, Sakai T, Terai T. Fractures of the distal end of radius in elderly patients: A comparative study of anatomical and functional results. Journal of Orthopaedic Surgery 2002;10: 915.
2. Chung, KC, Spilson, SV. The frequency and epidemiology of hand and forearm fractures in the United States. J Hand Surg Am 2001;26:908.
3. Bozentka, DJ, Beredjiklian, PK, Westawski, D, Steinberg, DR. Digital radiographs in the assessment of distal radius fracture parameters. Clin Orthop Relat Res 2002;12:409.
4. Medoff, RJ. Essential radiographic evaluation for distal radius fractures. Hand Clin 2005;21:279.
5. Batra, S, Gupta, A. The effect of fracture-related factors on the functional outcome at 1 year in distal radius fractures. Injury 2002;33:499.
6. Gliatis, JD, Plessas, SJ, Davis, TR. Outcome of distal radial fractures in young adults. J Hand Surg 2000; 25:535.
7. Fujii K, Henmi T, Kenematsu Y, Mishiro T, Sakai T, Terai T. Fractures of distal end of radius in elderly patients: A comparative study of anatomical and functional results. J Orthop 2002;10:9-15.
8. Mae Kenney PJ, Me Queen MM, Elton R. Predictions of instability of fractures of the distal radius. J Orthop Trauma 2000;14:121-2.
9. Young BT, Rayan GM. Outcome following non-operative treatment of displaced distal radius fractures in low -demand patient older than 60 years. J Hand Surg Am 2000;25:19-28.
10. Van der Linden W, Erison R. Colles fracture: How should its displacement be measured and how should It be immobilized? J Bone Joint Surg Am 1981;63:1285-8
11. Fernandez, JJ, Gruen, GS, Herndon, JH. Outcome of distal radius fractures using the short form 36 health survey. Clin Orthop Relat Res 1997; 341: 36-41
12. MacDermid, JC, Donner, A, Richads, Rs,, Roth, JH. Patient versus injury factors as predictors of pain and disability six months after a distal radius fracture. J Clin Epidemiol 2002; 55:849
13. Fernandez DL, Jupiter JB. Fracture of distal radius - A practical approach to management. First Ed. New York: Springer and Verlag; 1996. p. 54-65.

14. Sarmentio A, Latta LL. The evolution of functional bracing of fractures. J Bone Joint Surg Br 1995;88:141-8.
15. Sarmiento A, Zagorski JB, Sinclair WF. Functional bracing of Colles' fractures: A prospective study of immobilization in supination vs. pronation. Clin Orthop Relat Res 1980;146:175-83.
16. Wahlstrom O. Treatment of colles fracture. Acta Orthop Scand 1982;53:225-8.
17. Charnley J. The colles' fracture: The closed treatment of common fractures 4th ed. Vol 4, 1999. p. 128-42.
18. Van der Linden W, Erison R. Colle's fracture: How should its displacement be measured and how should It be immobilized? J Bone Joint Surg Am 1981; 63:1285-8.
19. Fernandez DL, Jupiter JB. Fracture of distal radius -A practical approach to management. First Ed. New York: Springer and Verlag; 1996. p.23-52.
20. Bohler L. The treatment of fractures, 3 rd Ed. New York: Grune and Stratton; 1932. p. 90-6.
21. Gupta A. The treatment of Colles fracture Immobilization with the wrist in dorsiflexion. J Bone Joint Surg Br 1991;73:312-5.