Distal radius fracture treated with cast application in wrist dorsiflexion

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ABSTRACT

Cast immobilization following successful closed reduction is the standard treatment for displaced extra-articular fractures of the lower end of the radius. The optimal position for the wrist during immobilization remains debated. Keeping the wrist in dorsiflexion helps prevent redisplacement after the reduction.This study aims to assess the effectiveness of wrist immobilization in dorsiflexion in extraarticular distal radius fracture and to evaluate both anatomical and functional outcomes. By using a prospective cohort design, a total number of 120 patients were observed, with an average follow-up period of 6 months. The wrist was maintained in 15 degree of dorsiflexion during plaster immobilisation. Anatomical measurements, including radial height, radial inclination, and volar tilt, were evaluated using the Lindstrom criteria and functional outcomes were measured through the PRWE score. At the 6-month follow-up, the average reduction in radial height was 3.21mm, radial inclination loss was 6.75 degrees, and volar tilt decreased by 7.12 degrees. According to the Lindstrom criteria, 86% of patients had excellent to fair anatomical outcomes, and 91% achieved excellent to fair functional results based on the PRWE score. So it was concluded that Cast immobilization in distal radius fractures with the wrist dorsiflexion prevents redisplacement giving better anatomical and functional outcomes.

Keywords: *Cast application, Distal radius fracture, Dorsiflexion, Lindstrom, PRWE*

INTRODUCTION

Fractures of the distal radius are the most prevalent type of fracture, accounting for approximately 18% of cases.[1] These fractures typically occur due to falls onto an outstretched hand and are often linked to osteoporosis, making them more common in women over 50.[2] Distal radius fractures are the most frequently encountered upper extremity fractures, representing 75% of all forearm fractures.[3]

Traditionally, closed reduction followed by cast immobilization has been the primary treatment for Colles' fractures, and it remains effective for selected cases. While several treatment options exist including cast immobilization, percutaneous K-wire fixation, external fixation, and open reduction with internal fixation cast immobilization is generally the best choice for most patients with distal radius fractures (DRFs).[1] while an above-elbow cast is generally favored, a forearm cast is adequate.[4] In this study, we aimed to assess the functional and anatomical outcomes of

closed reduction and cast immobilization of extra-articular distal radius fractures (Colles' type) with the wrist positioned in dorsiflexion.[1]

The study was conducted at National Trauma Center, Kathmandu. We included all patients over 20 years of age, regardless of sex, who presented with closed fractures of the distal radius and met the defined inclusion and exclusion criteria during the study period from March 1, 2020, to september 30, 2020. Patients with isolated metaphyseal radius fractures were included, while those with pathological fractures, underlying neuromuscular disorders and open fractures were excluded.

A thorough history and physical examination were performed, along with AP and lateral X-rays of both the wrists. Patients were informed about the treatment process. The affected limb was first immobilized with a dorsal slab for 3 days to reduce swelling, accompanied by elevation. Closed reduction was performed using a hematoma block and C-arm guidance. After reduction, a below-elbow cast was applied while maintaining the reduction. The wrist was positioned at 15 degrees of dorsiflexion and slight ulnar deviation while maintaining traction. The surgeon applied continuous palmar flexion pressure on the distal fragment to maintain its palmar tilt, ensuring dorsiflexion at the wrist The cast was molded to fit the wrist properly. (fig 1) After reduction, a below-elbow cast was applied for four weeks, with follow-up X-rays taken immediately after the cast application to confirm fracture reduction. Active finger and thumb exercises began on the same day as casting, and patients were instructed on elbow and shoulder exercises.[1]

Data were collected using a proforma, and follow-ups were conducted at one week, four weeks, and three months, and six month during which repeat X-rays were taken and radiological parameters noted.[6] The Patient Rated Wrist Evaluation (PRWE) scores were recorded at the time of injury and at the final follow-up.[7] Radiological parameters, including dorsal tilt, radial shortening, and loss of radial inclination, were measured pre-reduction, immediately post-reduction, at one week, four weeks, three-month and final 6 month follow-up. The radiological results were classified using the Lindstrom criteria.[1]

Fig 1 wrist in dorsiflexion

STATISTICAL ANALYSIS

Data were compiled and checked for discrepancies. Statistical analyses were performed using the Wilcoxon method for non-parametric data, paired t-tests for matched pairs, unpaired t-tests for group comparisons, and χ^2 tests for multivariate analysis. A p-value of less than 0.005 was considered significant.

RESULTS

A total of 120 patients participated in the study, with a mean age of 42.1 years, ranging from 21 to 79 years. Among the patients, 80 (66%) were female and 40 (34%) were male. The right hand was affected in 35 patients. The majority of patients (82.12%) sustained injuries from falls onto an outstretched hand, while 17.88% were due to road traffic

accidents. The loss of radial height in the distal radius ranged from 3 mm to 11 mm, with an average loss of 5.8 mm pre-reduction, 1.9 mm post-reduction, and 3.21 mm at the final follow-up. Notably, 109 patients (90%) experienced less than 6 mm of loss.

Table 1 Loss of radial length at final followup.

S. No	Radius Height (mm)	No. of Cases	%
1	<3	35	29
2	3-6	62	51
3	7-11	28	21
4	>12	0	-
5	Total	120	100

The loss of radial inclination ranged from 7 to 22 degrees, averaging 11 degrees pre-reduction, 5.3 degrees post-reduction, and 6.75 degrees at the final follow-up, with 80% of patients losing less than 9 degrees. The average loss of volar tilt varied from 0 to 23 degrees, with averages of 12.2 degrees pre-reduction, 3.8 degrees post-reduction, and 7.12 degrees at the final follow-up; 67% of patients maintained a normal volar tilt.

Radiological assessments showed residual dorsal angulation, radial shortening, and loss of radial inclination, analyzed according to Lindstrom criteria, with 41.7% achieving excellent outcomes, 38.3% good, 6.7% fair, and 13.3% poor.

Table 2 Loss of radius angle at final follow up.

S. No	Radius Inclination	No. of Cases	%
1	0-4	50	41.7
2	5-9	46	38.33
3	10-14	8	6.7
4	>15	16	13.33
5	Total	120	100

Table 3 volar tilt at final follow up.

S. No	Volar Tilt	No. of Cases	%
1	0 to +8	69	57.5
2	0 to -5	17	14.16
3	-6 to -10	19	15.8
4	-11 to -18	15	12.5
5	Total	120	**100**

Table 4 Distribution of anatomical outcome.

S. No	Grades	No. of Cases	%
1	Excellent	50	41.7
2	Good	46	38.33
3	Fair	8	6.7
4	Poor	16	13.33
5	Total	120	100

Table 5 distribution of functional outcome.

S. No	Grading	PRWE Score	No. of Cases	%
1	Excellent	<20	50	41.7
2	Good	21-40	42	35
3	Fair	41-60	16	13.3
4	Poor	61-80	12	10
5	Worst	81-100	0	0
6	Total		120	100

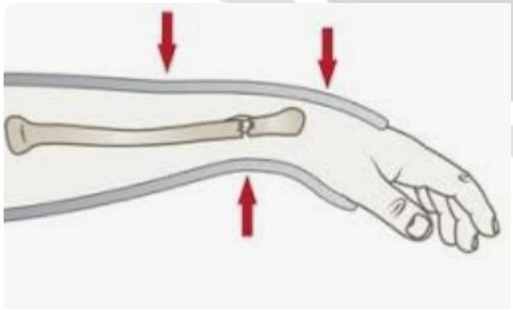

Fig 2 Three point fixation

DISCUSSION

Closed reduction and cast immobilization remain standard treatments for distal radius fractures. There is consensus that the anatomical outcome of plaster cast immobilization depends on fracture stability. Managing Colles' fractures poses challenges due to their anatomical proximity to the wrist joint and the complex mechanisms of injury involved. The distal radial articular surface, lunate, scaphoid, capitate, and trapezoid form the primary force-bearing column of the wrist. The flexors and extensors of the wrist affect displacement.[1] Recovery of grip strength and subjective assessment of pain, disability and limitation of the movements were also encouraging.[5]

Sarmiento classified distal epiphyseal radius fractures and recommended immobilizing the arm in a cast that extends from the fingers to above the elbow, keeping the elbow at a 90-degree flexion, the forearm in pronation, and the wrist in slight flexion and ulnar deviation. He identified the brachioradialis muscle as a key factor contributing to loss of reduction, noting that its attachment to the distal radius can easily displace a reduced fracture, especially if there is axial instability. He concluded that post-reduction stabilization in supination is preferable to pronation.[6]

Sarmiento also developed a forearm brace that allows elbow flexion while restricting forearm pronation and limiting elbow extension to about the last fifteen degrees, allowing slight wrist flexion while preventing dorsiflexion and radial deviation.[6]

In a study done by Verma et al found that 93% of patients had excellent to fair result according to Lindstrom criteria which is similar to our study.[1]

Most important radiological parameter to assess fracture instability is loss of radial height. Other includes whether or not volar cortex is reduced.[7] Increasing age, presence of osteoporosis and dorsal comminution leads to increased fracture instability.[8]

Gupta et al. noted that following a Colles' fracture, regardless of the wrist position, the carpal extensors tend to exacerbate the backward displacement of the fracture, whereas the wrist flexors work to reduce it. [9]

The stability provided by the periosteal hinge at the fracture site plays a crucial role. Immobilizing the wrist in dorsiflexion optimizes this stabilization by maintaining tension in the periosteum, reducing the likelihood of displacement.[1] Studies indicate that dorsiflexion leads to better maintenance of reduction and minimizes collapse compared to other positions.

Charnley introduced a three-point fixation technique when applying a molded plaster cast, which involves reducing the fracture and then molding the plaster to exert pressure at the fracture site and both proximal and distal to it.[7]

Our findings indicate that the average loss of radial height was 4.13 mm at the final follow-up, consistent with previous studies suggesting that dorsiflexion provides superior outcomes. The results indicate that patients immobilized in dorsiflexion experienced better functional outcomes and reduced deformities.

CONCLUSION

Wrist immobilization in dorsiflexion yields better results preventing redisplacement compared to immobilization in plantar flexion, resulting in improved functional outcomes and less residual deformity.

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