

A PROSPECTIVE ANALYSIS TO COMPARE THE COLLES CAST VERSUS ABOVE ELBOW CASTING WITH PRESSURE ON DORSAL AND LATERAL SIDE ON DISTAL FRAGMENT WITH COUNTER TRACTION (MOHENDRA'S METHOD) AT TERTIARY CARE CENTER

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Abstract

Background: A variety of cast options are available for the non-surgical treatment of distal radius fractures (DRF) in adults. Reduction with the conventional Colles casting get displaced many a times even with hard restrictions of activities. In order to prevent displacement of fracture from rotational forces transmitted while rotating elbow joint we applied above elbow cast with counter forces on dorsal and lateral side of the distal fragment, Mohendro's method. This study aimed to evaluate the most appropriate method of immobilization between conventional colles casting and above-Elbow (AE) with counter pressures on dorsal and lateral part on distal fragment groups at the end of six-month follow-up. **Material and Methods:** This is a prospective analysis of the two casting methods. There are two non-surgical interventions: colles casting and above elbow casting method. Patients were randomly assigned. A hundred twenty-eight consecutive adult patients with acute (up to 7 days) displaced DRF of type A2, A3, C1, C2 or C3 by the Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification were included. The primary outcome was the maintenance of reduction by evaluation of radiographic parameters and Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH). Secondary outcomes include function measured by Patient Rated Wrist Evaluation (PRWE), pain measured by the Visual Analogue Scale (VAS), objective functional evaluation (goniometry and dynamometry) and rate of complications. Patients were evaluated at 12 and 24 weeks. We consider an extra 10% for balancing follow-up losses results in 64 patients per group. **Results:** At 6 months, the mean (CI for difference in means) PRWE score was 14.38 and 20.2 ($p > 0.05$), the qDASH score was 15.68 and 19.57 ($p > 0.05$), and the VAS was 11.9 and 14.5 ($p > 0.05$) for the above elbow casting with counter traction (Mohendra's Method) group and Colles cast group respectively. The radiographic confirmation of the differences between the two immobilization methods was performed using measurements of ulnar deviation of the third metacarpal compared with the radial axis and angulation of the wrist comparing second metacarpal flexion/extension to radial axis, having differences in means was significant ($p < .001$) and degrees of difference was significant ($p < .001$) between the groups, respectively. **Conclusion:** Results from this study protocol will help to define the need for elbow immobilization and counter pressures on lateral and dorsal part of distal fragment in maintenance of reduction, as well as functional performance in comparison to conventional colles cast immobilization during the immobilization period.

INTRODUCTION

Distal radius fracture (DRF) is the most common fracture in adults, and patients aged over 65 years are most at risk of suffering DRF. Although Distal radius fracture (DRF) is the most frequent fracture of upper limb,^[1] the best method of treatment and outcome of this fracture has not yet been fully defined.^[2,3] Regarding non-surgical treatment, Cochrane review based on randomized controlled trials has concluded that there are controversial in terms of the type of casting to be applied after the initial fracture reduction and there is no conclusive evidence of difference in outcome between different positions and methods of plaster and brace management for the common types of DRF.^[4-6]

Colles casting is easier to apply, is lower in cost, lighter, provides greater comfort, better function for daily life activities and less articular stiffness of the elbow.^[7-9] Casts that include the elbow joint, which prevents the rotation of the forearm, may result in greater stability of the fracture and less risk of loss of reduction and need for re-reduction.^[10-12] Other studies found similar results between immobilization methods in maintaining the initial fracture reduction.^[13,14]

This study was based on the hypothesis that Mahendra's method of immobilization in patients with DRF will present better results for reduction, prevention of loss of reduction and radiographic parameters. There is less complication rate and better functional outcomes when compared to conventional colles cast immobilization methods at the end of a six-month follow-up. The aim of this study to determine the most appropriate method of immobilization in patients with distal radius fractures at the end of a six-months: colles cast versus above-elbow with counter pressures on dorsal and lateral part of distal fragment cast, Mahendra's method.

MATERIALS AND METHODS

A randomized controlled trial developed at District Hospital Daporijo and TRIHMS, Naharlagun, Arunachal Pradesh, India. Adults of both genders with growth plate closure, with unilateral and closed acute displaced DRF (up to 1 week), associated with or without the ulnar styloid fractures with no other fractures, which may be closed reduced and meet inclusion criteria .

Inclusion criteria: Displaced and reducible fractures classified by AO as type A2, A3, C1, C2 and C3 will be included if one of the following conditions is present-

- Radial height – loss >2 mm.
- Radial Inclination - loss >4°.
- Dorsal angulation >10°.
- Positive ulnar variance – loss >3 mm.
- Intra-articular step off or gap – >2 mm.
- Carpal malalignment.

- The contralateral side is used as a reference.
- Exclusion criteria: Patients presenting one or more of the following criteria will be excluded from this study:
 - Open fractures, bilateral fracture or associated with tendon or neurovascular lesions.
 - Associated carpal fractures.
 - Marginal fractures or fractures from shearing mechanism.
 - Fractures with palmar deviation (Smith's fracture).
 - Irreducible fractures (closed method).
 - Prior history of a degenerative or traumatic disorder of the affected or contralateral wrist joint.
 - Systemic diseases or traumatic lesions associated with fracture that restrict the application of methods or the evaluation of results.
 - Cognitive deficit that does not allow the patient to understand the elements of the functional evaluation.
 - Consent Form Refusal.

Radiological measurements

The volar tilt, the radial inclination, the radial height, the ulnar variance and the intra-articular step off or gap were determined on postero-anterior (PA) and lateral (L) radiographs views obtained using a standardized procedure.^[15]

The standard method of obtaining a PA radiograph is with the shoulder in 90° of abduction, the elbow in 90° of flexion and the wrist in a neutral position. For the lateral view, the shoulder is adducted and the elbow is in 90° of flexion with the hand positioned in the same plane as the humerus.^[16]

The volar tilt, also called palmar tilt is measured on the lateral view and refers to the distance between a line through the dorsal and palmar boundary points of the radial joint surface and the perpendicular to the longitudinal axis of the radial shaft.

The radial inclination, also know as radial deviation is measured on the PA view and refers to the distance between a line through the radial and ulnar boundaries of the radial joint surface and the perpendicular to the longitudinal axis of the radial shaft.

The radial height, also called radial length is measured on the PA view and refers to the difference in axial direction of the radius between the distal tip of the radial styloid and the most distal aspect of the ulnar articular surface.

The ulnar variance, also called the radioulnar index is measured on the PA view and refers to the vertical distance between a line parallel to the medial corner of the articular surface of the radius and a line parallel to the most distal point of the articular surface of the ulnar head, both of which are perpendicular to the long axis of the radius.

The intra-articular step off or gap is measured on PA or lateral view and refers articular incongruity. The carpal alignment is measured on lateral view. Two lines are drawn, one along the long axis of the

capitate and other along the long axis of the radius. The lines do intersect within the carpus.

Initial treatment

All the patients with a distal radius fracture who arrived at the emergency room were gone through a standard protocol with clinical and radiographic examination (bilateral x-rays of the wrist in PA and lateral views). Patients having reducible fracture and fulfilling the inclusion criteria were randomized and treated by one of the two methods of the study. Patients that do not have closed reducible fracture were excluded from the study and advised surgical treatment (open reduction and internal fixation) accordingly.



Figure 1: Types of immobilizations. (a): Below-elbow cast (colles) (b): Above-elbow cast (Mahendra's Method)

Method for closed reduction and immobilization

Closed reduction of fracture was done through a traction and counter-traction technique. In conventional Colles casting, after reduction the distal fragment was locked with 20 degree of ulnar deviation palmar flexion. In Mahendra's method, traction was applied at 90 degree elbow flexion with first three fingers and arm. Cast was applied and pressed on dorsal and lateral part of distal fragment with counter traction on proximal part of forearm. Once the plaster is set, it was extended upto armpit.

The elbow was immobilized at 90 degrees, and in a neutral position to block pronosupination. Cotton tubular mesh, cotton stripes and crepe bandage were used in both bindings. Regardless of the immobilization adopted, all wrists were positioned with slight flexion and ulnar deviation. Patients were encouraged to actively move their fingers and the ipsilateral shoulder.

Patients with Mahendra's method of immobilization were kept for 4 weeks with the splint followed by 2 weeks of below-elbow immobilization. The immobilization was removed after 6 weeks.

The minimum clinical follow-up will be 24 weeks, with the following parameters being considered to evaluate the results:

Statistical methods

All statistical analysis will be performed following intention to treat principle. Statistical advisors will be blinded to the treatment groups as an effort to decrease bias.

RESULTS

The primary outcome measure, PRWE score with intention-to-treat analysis, was measured at 6 months. Results from the primary and secondary outcome measures are summarized in Table 1. At 6 months, the mean (CI for difference in means) PRWE score was 14.38 and 20.2 ($p > 0.05$), the qDASH score was 15.68 and 19.57 ($p > 0.05$), and the VAS was 11.9 and 14.5 ($p > 0.05$) for the above elbow casting with counter traction (Mahendra's Method) group and Colles cast group respectively. The mean (CI) grip strength of the fractured side in proportion to the controlled side measured at 3 months was 8.6 for the above elbow casting with counter traction (Mahendra's Method) group and 10.2 for the Colles cast group.

The radiographic confirmation of the differences between the two immobilization methods was performed using measurements of ulnar deviation of the third metacarpal compared with the radial axis and angulation of the wrist comparing second metacarpal flexion/extension to radial axis, having differences in means was significant ($p < .001$) and degrees of difference was significant ($p < .001$) between the groups, respectively. [Table 2]

Table 1: Primary, intention-to-treat analysis of outcome measures for the Colles cast group and Above elbow casting with counter traction (Mohendra's Method) group at three and six months

Evaluation	Colles cast group	Above elbow casting with counter traction (Mohendra's Method) group
PRWE		
3 months	35.3±15.64	28.67±19.97
6 months	20.2±13.56	14.38±12.56
Quick-DASH		
3 months	33.8±10.54	30.5±13.24
6 months	19.57±16.28	15.68±14.59
VAS (mm)		
3 months	22.8±11.3	20.6±15.2
6 months	14.5±9.24	11.9±10.3
PCS		
3 months	10.2±9.45	8.6±6.77
6 months	11.56±7.88	8.4±6.92

Table 2: Mean values of radiographic outcome measures and mean differences between Colles cast group and above elbow casting with counter traction (Mohendra's Method) group.

Evaluation	Colles cast group	Above elbow casting with counter traction (Mohendra's Method) group
Ulnar variance		
Before CR	3.6±1.05	3.3±1.12
After CR	1.12±0.97	1.48±0.65
At 3 months	3.15±1.26	4.46±1.55
Inclination		
Before CR	15.4±0.65	16.8±0.78
After CR	18.9±0.02	18.9±0.05
At 3 months	17.23±0.88	16.35±0.69
Dorsal angulation		
Before CR	27.4±2.56	23.65±3.62
After CR	7.32±3.78	8.92±4.26
At 3 months	12.7±1.93	11.82±1.87
3-MCP-Radius ulnar deviation		
After CR	8.56±0.28	4.48±0.35
Wrist flexion (+) or extension (-)		
After CR	15.4±0.66	3.2±0.72

DISCUSSION

The secondary outcomes of grip strength, qDASH score and PRWE score at 3 months and qDASH score and VAS of pain at ^[12] months showed a small but constant difference between the studied groups. The mean (CI) grip strength of the fractured side in proportion to the controlled side measured at 3 months was 8.6 for the above elbow casting with counter traction (Mohendra's Method) group and 10.2 for the Colles cast group, which is in line with two other RCTs on elderly DRF patients that reported grip strength in proportion to controlled side at 3 months to be 58% and 47% in non-operative groups.^[17,18]

In 1991, Gupta published the results of three different immobilization positions with 204 patients: volar-flexion, neutral, and dorsal-flexion, and found in favor of the dorsal-flexion group.^[19] Van der Linden and Ericson studied 250 patients randomly assigned to five different immobilization positions and found that position had no importance regarding the final results.^[20] Rajan et al. found better grip strength and less pain, disability, and limitation of movements in a dorsal-flexion group compared with a volar-flexion group.^[21] Grle et al. studied 100 patients and found that dorsal-flexion was of minor benefit compared with volar flexion at 2-month follow-up.^[22]

This publication presents a randomized clinical trial of the non-operative treatment of DRF. Casts may be applied either "above elbow" (Mahendra's Method) or "below elbow", depending on the particular type of injury and physician preference. Often, the plaster may extend above the elbow to help provide additional stability and neutralize the extensive forces that can be generated by natural movements of the arm and forearm. Above-elbow immobilization is the conservative treatment used by most of the Brazilian orthopedic surgeons (74%).^[23]

Short arm immobilization has been used by many orthopedic surgeons around the world, who claimed equally beneficial results.^[8,13] In our study we found excellent maintenance of reduction and functional outcome.

CONCLUSION

In summary, we suggest that above elbow Casting with counter pressures in Mahendra's method of cast immobilization lead to more beneficial subjective functional outcomes with fewer complications when compared with colles casting of below elbow immobilization in the treatment of this common fracture and the similarity of the outcomes in 95% confidence interval could be excluded. In the clinical context of DRF treatment, the arm has to be immobilized to some cast position and, taken together with the results of our and previous studies, above elbow cast with counter pressures in tayas method is more likely to result in superior outcomes than conventional below colles casting.

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