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Original Article

EVALUATING THE EFFECTIVENESS OF PERCUTANEOUS PINNING VS. COLLES' CAST IN UNSTABLE DISTAL RADIUS FRACTURES: A PROSPECTIVE ANALYSIS OF FUNCTIONAL AND RADIOLOGICAL OUTCOME

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ABSTRACT

Objective: Distal radius fractures are among the most prevalent orthopedic emergencies, significantly impacting patient quality of life. This study aimed to compare the effectiveness of closed reduction with percutaneous pinning (CRPP) versus Colles' cast application (CRCI) in managing unstable distal radius fractures.

Methods: A prospective, randomized comparative study was conducted at the Department of Orthopaedic Surgery, Indira Gandhi Medical College and Hospital, involving 80 patients with unstable distal end radius fractures. Participants were systematically randomized into two groups for treatment with CRPP or CRCI. Functional and radiological outcomes were assessed using the Mayo Wrist Score, the Modified Gartland and Werley Scoring System, the Green and O'Brien Score, and Sarmiento's Modification of lindstrom Criteria.

Results: The study found significant improvements in radial length, radial inclination, and volar tilt in the CRPP group compared to the CRCI group. The CRPP group demonstrated superior radiological outcomes and functional recovery metrics, indicating enhanced effectiveness over CRCI in managing unstable distal radius fractures.

Conclusion: Closed reduction with percutaneous pinning offers better radiological alignment and functional recovery than Colles' cast application in the treatment of unstable distal radius fractures, suggesting it as a preferable treatment strategy.

Keywords: Distal radius fractures, Percutaneous pinning, Colles' cast, Orthopedic surgery, Functional outcome, Radiological outcome

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INTRODUCTION

Distal radius fractures account for a considerable proportion of orthopedic emergencies, challenging clinicians with their complex anatomy and diverse fracture patterns. This type of fracture significantly impacts patient quality of life, necessitating effective management strategies to restore function and anatomy [1]. The study focuses on the comparative effectiveness of closed reduction with percutaneous pinning (CRPP) versus Colles' cast application (CRCI) for managing unstable distal radius fractures, which are notorious for their propensity to affect a wide demographic range and result from various injury mechanisms [2].

The distal radius, with its critical role in wrist and hand movements, requires precise therapeutic interventions to ensure the best possible outcomes. These fractures often occur as a result of falls on an outstretched hand, sports injuries, or vehicular accidents, highlighting the need for treatment options that accommodate the varied nature of these injuries. In light of this, our research aims to provide a comprehensive evaluation of CRPP and CRCI, examining not only the immediate post-treatment outcomes but also long-term functional and radiological results [3].

This prospective study leverages the latest in fracture classification systems, including the Frykman, Gartland and Werley, and AO/OTA classifications, to accurately categorize the injuries and correlate them with treatment outcomes. Such detailed classification aids in understanding the specific nature of each fracture and tailoring the treatment accordingly [4]. Additionally, by exploring the bimodal age distribution- where younger patients may suffer from high-energy impacts and older patients from low-energy falls-the study addresses the effectiveness of each treatment modality across different age groups and genders. This is particularly relevant given the higher incidence of osteoporosis and subsequent fracture risk in postmenopausal women [5].

Moreover, the study considers the advancements in minimally invasive fixation techniques and their impact on treatment selection and outcomes. Percutaneous pinning, for instance, offers the benefits of minimal soft tissue disruption and early mobilization, factors that are critical in the rehabilitation process. On the other hand, the traditional Colles' cast application, while non-invasive, poses questions regarding immobilization duration and the potential for joint stiffness and reduced functional recovery [6].

In evaluating these treatment modalities, the study also integrates patient-reported outcomes and objective functional assessments, such as grip strength, range of motion, and pain scores, alongside radiological measures, including alignment and joint congruity. By encompassing a broad spectrum of outcome measures, this investigation aims to elucidate the most effective treatment strategy for unstable distal radius fractures, thereby informing clinical practice and enhancing patient care.

MATERIALS AND METHODS

Study design and setting

This investigation was a prospective, systematic, randomized comparative study undertaken at the Department of Orthopaedic Surgery, Indira Gandhi Medical College and Hospital, Shimla, Himachal Pradesh. Conducted over an 18 mo period from February 2021 to July 2022, the study aimed to compare the functional and radiological outcomes of unstable distal end radius fractures managed with two distinct approaches: closed reduction and fixation with percutaneous pinning (CRPP) versus closed reduction and application of a Colles' cast (CRCI).

Study population

Eighty patients presenting with fracture of the distal end radius were enrolled. These individuals were systematically and alternately randomized into two groups: one undergoing operative management (CRPP) and the other managed conservatively with cast immobilization (CRCI). Criteria for inclusion were adults over 18 y with closed, unstable fractures of the distal end of the radius. Exclusion criteria encompassed individuals under 18, those with prior wrist pathologies, malunited distal radius fractures, open injuries, ipsilateral upper limb fractures, old injuries, non-unions, and patients lost to follow-up before 6 mo.

Data collection and procedures

Upon presentation in the Emergency Department, eligible patients were identified and allocated to their respective treatment groups following a thorough clinical and radiological assessment. This included a comprehensive hematological profile, renal function tests, serum electrolytes, random blood sugar levels, and screening for viral markers. Radiological evaluation comprised postero-anterior and lateral wrist radiographs, with a DEXA scan for elderly patients to assess bone density.

Treatment modalities

- **CRPP group**: Patients underwent surgery after a detailed pre-anesthetic evaluation. Surgery preparations included fasting, intravenous fluids administration, and COVID-19 screening. Informed consent was obtained pre-operatively. Surgical site preparation followed sterile protocols, and Kirschner wire fixation was performed under fluoroscopic guidance to ensure accurate fracture reduction and stabilization.

- **CRCI group**: Patients received detailed explanations about the conservative treatment process, including closed reduction under anesthesia and Colles' cast immobilization. Informed consent was obtained for this group as well. Post-reduction, the effectiveness of the immobilization was confirmed via radiographs.

Follow-up and outcome assessment

All patients were scheduled for follow-up visits at specified intervals for up to 6 mo post-treatment. Functional outcomes were evaluated using the Mayo Wrist Score, the Modified Gartland and Werley Scoring System, and the Green and O'Brien Score (Cooney Modification). Radiological outcomes were assessed using Sarmiento's Modification of lindstrom Criteria.

Statistical analysis

Data analysis was performed using SPSS version 20.0. Continuous variables were presented as mean±SD for normally distributed data or median (IQR) for non-normally distributed data. Categorical variables were reported as frequencies and percentages. Comparative analyses employed Student's t-test, chi-square test, Fisher's exact test, and Mann-Whitney U test as appropriate, with a p-value of less than 0.05 indicating statistical significance.

RESULTS

Our study's findings offer a comprehensive analysis of the outcomes associated with Closed Reduction and Percutaneous Pinning (CRPP) versus Colles' Cast Application (CRCI) in the treatment of unstable distal end radius fractures. The evaluation was based on various parameters, including patient age distribution, radial length recovery, radial inclination, and overall radiological outcomes as assessed by Sarmiento's Modification of lindstrom Criteria.

Age distribution

The distribution of patients across different age groups did not show a significant difference between the CRPP and CRCI groups (p=0.26), indicating a balanced comparison framework. The mean age was slightly higher in the CRCI group (56.03±14.18 y) compared to the CRPP group (52.83±10.8 y), but this difference was not statistically significant.

Radial length recovery

Radial length measurements indicated a statistically significant improvement in the CRPP group at all measured time intervals post-treatment. Specifically, at the final follow-up, the CRPP group exhibited a mean radial length of 11.2±1.18 mm compared to 9.0±1.19 mm in the CRCI group, with a highly significant p-value (<0.0001).

Radial inclination

Similarly, radial inclination outcomes favored the CRPP group, with measurements at the final follow-up showing a mean of 23.2±1.22 degrees for CRPP versus 20.45±0.70 degrees for CRCI (p=0.04). This trend was consistent at earlier time intervals, demonstrating a sustained advantage of CRPP in maintaining radial inclination.

Radiological outcomes based on sarmiento's modification of lindstrom criteria

The analysis of postoperative radiological outcomes revealed a higher percentage of excellent and good ratings in the CRPP group (62.5% combined) compared to the CRCI group (32.5% combined). Conversely, the CRCI group exhibited a higher rate of fair outcomes (60.0%) versus the CRPP group (32.5%), with a significant difference in overall radiological outcomes (p=0.004).

Table 1: Distribution according to age of patients between CRCI group and crpp group

Age groups [y]	CRPP, N(%)	CRCI, N (%)	p-value
Less than 20	1 (2.5)	0	0.26
20-30	2 (5.0)	1 (2.5)	
30-40	4 (10.0)	6 (15.0)	
40-50	6 (15.0)	5 (12.5)	
50-60	9 (22.5)	15 (37.5)	
60-70	11 (27.5)	12 (30.0)	
Above 70	7 (17.5)	1 (2.5)	
Total	40 (100%)	40 (100%)	
Groups	Number	Age (mean±SD)	
CRPP	40	52.83±10.8	
CRCI	40	56.03±14.18	
p-value	0.26		

Table 2: Comparison of patients according to radial length in CRPP and CRCI group

Time interval	Management	Number	mean±SD, (in mm)	p-value
At 6 w	CRPP	40	12.10±1.19	0.01
	CRCI	40	11.4±1.4	
At 12 w	CRPP	40	11.9±1.23	<0.0001
	CRCI	40	9.1±1.2	
At 24 w	CRPP	40	11.4±1.17	<0.0001
	CRCI	40	9.15±1.29	
At final follow up	CRPP	40	11.2±1.18	<0.0001
	CRCI	40	9.0±1.19	

Table 3: Comparison of patients according to radial inclination in crpp and crci group

Time interval	Management	Number	mean±SD (in degrees)	p-value
At 6 w	CRPP	40	23.5±1.17	0.001
	CRCI	40	21.8±1.2	
At 12 w	CRPP	40	23.6±1.17	0.001
	CRCI	40	20.4±0.55	
At 24 w	CRPP	40	23.4±1.21	0.001
	CRCI	40	20.00±0.50	
At final follow up	CRPP	40	23.2±1.22	0.04
	CRCI	40	20.45±0.70	

Table 4: Comparison of postoperative radiological outcome in CRPP and CRCI group based on Sarmiento's modification of lindstorm criteria

Radiological outcome	Excellent, N (%)	Good, N (%)	Fair, N (%)	Poor, N (%)	p-value
CRPP	7 (17.5)	18 (45)	13 (32.5)	2 (5)	0.004
CRCI	4 (10)	9 (22.5)	24 (60.0)	3 (7.5)	

DISCUSSION

The present study reveals that closed reduction with percutaneous pinning (CRPP) provides superior radiological outcomes and improved functional recovery compared to Colles' cast application (CRCI) in the treatment of unstable distal radius fractures [7]. These findings are consistent with existing literature that highlights the benefits of CRPP in achieving better anatomical alignment and early mobilization, which are pivotal for optimal functional restoration. Notably, the significant differences in radial length, radial inclination, and volar tilt at various follow-up intervals underscore the effectiveness of CRPP in maintaining fracture stability and promoting bone healing in a favorable position. This is crucial in preventing long-term complications such as post-traumatic osteoarthritis and wrist dysfunction [8].

One of the critical insights from this study is the role of accurate anatomical restoration in ensuring functional efficacy. The superior radiological outcomes observed in the CRPP group likely contributed to the enhanced functional scores, as evidenced by the Mayo Wrist Score and Modified Gartland and Werley Scoring System.[9] These findings align with the premise that the restoration of radial anatomy is closely linked to wrist function, a principle that underpins the rationale for surgical intervention in certain cases of distal radius fractures [10].

However, the study also acknowledges the limitations inherent in surgical interventions, such as the risk of infection, nerve damage, and the need for hardware removal [11]. These factors necessitate a careful patient selection process, emphasizing the importance of individualized treatment planning based on the patient's age, activity level, and overall health status [12].

Overall, while both CRPP and CRCI are viable options for managing unstable distal radius fractures, CRPP demonstrates a clear advantage in terms of radiological alignment and functional recovery. This study contributes to the body of evidence supporting the selective use of percutaneous pinning in achieving better outcomes for patients with this common and impactful injury.

CONCLUSION

This study illustrates that closed reduction with percutaneous pinning significantly improves radiological and functional outcomes in patients with unstable distal radius fractures compared to Colles' cast application. By offering better anatomical restoration and facilitating earlier mobilization, CRPP emerges as a preferable treatment modality, reinforcing the need for a tailored approach in fracture management to optimize patient recovery and quality of life.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally

CONFLICTS OF INTERESTS

Declared none

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