BEYOND THE BREAK: A COMPARATIVE STUDY OF RECOVERY METRICS POST-MANAGEMENT OF UNSTABLE DISTAL END RADIUS FRACTURES WITH PERCUTANEOUS PINNING VERSUS COLLES' CAST

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ABSTRACT

Background: Unstable distal end radius fractures represent a significant challenge in orthopedic trauma care, demanding effective management strategies to restore anatomical integrity and ensure functional recovery. This study compares the outcomes of closed reduction and percutaneous pinning (CRPP) versus Colles' cast application (CRCI) in treating these fractures, focusing on recovery metrics across different patient demographics.

Methods: Conducted at the Department of Orthopaedic Surgery, Indira Gandhi Medical College and Hospital, this prospective, systematic, randomized comparative study involved 80 patients

with unstable distal end radius fractures. Patients were alternately randomized into two groups to receive CRPP or CRCI. Outcome measures included palmar flexion, radial deviation, supination movements, and postoperative functional outcomes assessed using the Mayo Wrist Score.

Results: CRPP demonstrated superior outcomes in functional recovery metrics, including palmar flexion (p=0.038 at final follow-up), radial deviation (p=0.001 at final follow-up), and supination (p=0.001 at final follow-up). Additionally, patients treated with CRPP showed significantly better results in the Mayo Wrist Score, indicating enhanced overall functional recovery compared to those managed with CRCI.

Conclusion: Closed Reduction and Percutaneous Pinning (CRPP) offers better functional and radiological outcomes in the management of unstable distal end radius fractures compared to Colles' cast application (CRCI). Despite these findings, treatment selection should be individualized, considering the patient's specific needs and the fracture's characteristics to optimize recovery outcomes.

Keywords: distal radius fractures, percutaneous pinning, Colles' cast, functional recovery, orthopedic trauma.

INTRODUCTION

The optimal management of distal end radius fractures, a prevalent concern within orthopedic trauma care, involves a delicate balance between achieving anatomical integrity and ensuring functional recuperation.[1] This study aims to undertake a detailed comparative analysis of recovery metrics post-management of unstable distal end radius fractures, employing closed reduction followed by percutaneous pinning (CRPP) versus Colles' cast application (CRCI). Given the distal radius's complex anatomy and the significant impact these fractures can have on a patient's ability to perform daily activities, our investigation seeks to provide an in-depth evaluation of the effectiveness of these treatment modalities across various patient demographics.[2]

Unstable distal radius fractures present a unique challenge due to their potential to disrupt wrist function significantly, necessitating interventions that not only correct the anatomical disfigurement but also restore the full range of motion and strength.[3] The study meticulously evaluates functional recovery metrics, such as range of motion, grip strength, and patient-reported outcomes, alongside radiological parameters that include alignment, articular congruity, and the incidence of post-treatment complications. These metrics are crucial for understanding the extent to which each treatment modality supports the return to pre-injury levels of functionality and well-being.[4]

Furthermore, this research acknowledges the importance of fracture classification in guiding treatment choices and predicting outcomes. By categorizing fractures according to established systems and examining the outcomes within the context of these classifications, the study aims to shed light on the relationship between the specific characteristics of the fracture and the success of the treatment modality employed.[5] This approach allows for a nuanced understanding of how different types of unstable distal end radius fractures respond to CRPP and CRCI, highlighting the potential for tailored treatment strategies based on fracture classification.[6]

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

The study also considers the dynamic interplay between patient demographics—including age, gender, and activity level—and treatment outcomes. This demographic analysis is essential for identifying potential disparities in recovery and guiding clinicians in making informed decisions that account for individual patient needs and expectations. By integrating a broad spectrum of recovery metrics with a detailed consideration of patient and fracture characteristics, this investigation aims to provide a comprehensive overview of the comparative effectiveness of CRPP and CRCI. Through this exploration, we endeavor to inform clinical practice by identifying optimal strategies for managing unstable distal end radius fractures, thereby facilitating enhanced patient outcomes and a quicker return to normalcy.

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-month 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 years 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 months.

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 months 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 comparative analysis between Closed Reduction and Percutaneous Pinning (CRPP) and Colles' Cast Application (CRCI) for the management of unstable distal end radius fractures yielded the following results across multiple functional and radiological parameters.

Palmar Flexion Movement: At the initial 6-week follow-up, palmar flexion movement showed no significant difference between the CRPP and CRCI groups (p=0.07). However, subsequent assessments demonstrated a statistically significant improvement in the CRPP group at 24 weeks (p=0.045) and at the final follow-up (p=0.038), indicating superior recovery in palmar flexion with CRPP treatment.

Radial Deviation Movement: The CRPP group exhibited significantly better radial deviation movement as early as 6 weeks post-treatment (p=0.01), with continued superiority at 12 weeks (p=0.001), 24 weeks (p=0.001), and at the final follow-up (p=0.001). These results suggest that CRPP facilitates better restoration of radial deviation compared to CRCI.

Supination Movement: Significant improvements in supination movement were observed in the CRPP group at all time intervals (6 weeks, p=0.001; 12 weeks, p=0.001; 24 weeks, p=0.001; final follow-up, p=0.001). This indicates a consistently better outcome for supination with CRPP across the treatment period.

Postoperative Functional Outcome (Mayo Wrist Score): The evaluation based on the Mayo Wrist Score revealed that 20% of patients in the CRPP group had excellent outcomes, compared to only 7.5% in the CRCI group, with a statistically significant difference (p=0.007). Furthermore, the CRCI group had a higher proportion of patients with fair outcomes (67.5%) compared to the CRPP group (30%).

TABLE 1: COMPARISON OF PATIENTS ACCORDING TO PALMER FLEXION MOVEMENT OF WRIST IN CRPP AND CRCI GROUP.

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

Time interval	Management	Number	Mean ± SD (in degrees)	p value
At 6 weeks	CRPP	40	61.7 ± 3.6	0.07
	CRCI	40	60.2 ± 3.7	
At 12 weeks	CRPP	40	66.0 ± 2.58	0.30
	CRCI	40	65.2 ± 3.74	
At 24 weeks	CRPP	40	68.5 ± 2.81	0.045
	CRCI	40	67.00 ± 3.05	
At final follow up	CRPP	40	68.8± 2.51	0.038
	CRCI	40	67.00 ± 2.05	

TABLE 2: COMPARISON OF PATIENTS ACCORDING TO RADIAL DEVIATION MOVEMENT OF WRIST IN CRPP AND CRCI GROUP.

Time interval	Management	Number	Mean ± SD (in degrees)	p value
At 6 weeks	CRPP	40	14 ± 3.4	0.01
	CRCI	40	12.2 ± 2.5	
At 12 weeks	CRPP	40	18.5 ± 3.92	0.001
	CRCI	40	15.0 ± 2.26	
At 24 weeks	CRPP	40	20.2 ± 4.37	0.001
	CRCI	40	15.25 ± 1.95	
At final follow up	CRPP	40	21.2 ± 4.27	0.001
	CRCI	40	16.25 ± 1.75	

TABLE 3: COMPARISON OF PATIENTS ACCORDING TO SUPINATION MOVEMENT OF WRIST IN CRPP AND CRCI GROUP.

Time interval	Management	Number	Mean ± SD (in degrees)	p value
At 6 weeks	CRPP	40	66.9 ± 5.78	0.001
	CRCI	40	62.2 ± 4.9	
At 12 weeks	CRPP	40	71.5 ± 6.22	0.001
	CRCI	40	66.2 ± 5.02	
At 24 weeks	CRPP	40	73.5 ± 5.7	0.001
	CRCI	40	67.5 ± 4.96	
At final follow up	CRPP	40	74.8 ± 5.4	0.001
	CRCI	40	68.3 ± 4.36	

TABLE 4 : COMPARISON OF POSTOPERATIVE FUNCTIONAL OUTCOME IN CRPP AND CRCI GROUP BASED ON MAYO WRIST SCORE

Result:	Excellent, N (%)	Good , N (%)	Fair , N (%)	Poor , N (%)	p value
CRPP	8 (20)	19 (47.5)	12 (30)	1 (2.5)	0.007
CRCI	3 (7.5)	7 (17.5)	27 (67.5)	3 (7.5)	

DISCUSSION

The comparative study between Closed Reduction and Percutaneous Pinning (CRPP) and Colles' Cast Application (CRCI) for the management of unstable distal end radius fractures provides insightful revelations into the recovery trajectories facilitated by these two widely adopted interventions.[7] Our findings suggest that CRPP offers superior outcomes in terms of functional recovery metrics such as palmar flexion, radial deviation, and supination movement of the wrist, as well as better postoperative functional outcomes based on the Mayo Wrist Score.[8]

A pivotal aspect of our investigation revolves around the precise restoration of anatomical alignment achieved through CRPP. This method's ability to accurately reposition bone fragments under direct visualization significantly contributes to the enhanced functional recovery observed.[9]

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

The direct correlation between anatomical restoration and functional outcome underpins the importance of choosing a treatment modality that offers the best potential for anatomical integrity, particularly in cases of unstable fractures that pose a high risk for malunion and subsequent functional impairment.[10]

Furthermore, the study highlights the necessity of considering patient-specific factors in treatment decision-making. Although CRPP shows a general trend towards better outcomes, the choice between CRPP and CRCI should not be prescriptive but tailored to the individual's needs, fracture characteristics, and potential for rehabilitation. Factors such as patient age, activity level, comorbidities, and the patient's ability to comply with postoperative care protocols should inform this decision-making process.[11]

The nuanced understanding of fracture mechanics, coupled with advancements in imaging techniques and surgical instrumentation, has allowed for more refined approaches to fracture stabilization and mobilization. [12]The success of CRPP in our study underscores the evolution of surgical techniques and their contribution to optimizing patient outcomes. However, the role of conservative treatment, exemplified by CRCI, remains indispensable, particularly in patient cohorts where surgery presents higher risks or when the fracture pattern allows for effective non-operative management.

CONCLUSION

Our study delineates clear advantages of Closed Reduction and Percutaneous Pinning (CRPP) over Colles' Cast Application (CRCI) in managing unstable distal end radius fractures, evidenced by superior functional recovery and radiological outcomes. However, the selection of treatment modalities should remain judicious, emphasizing a personalized approach that considers the fracture's complexity, patient demographics, and individual recovery potential. As orthopedic practice continues to evolve, the integration of technological advancements and a deeper understanding of fracture biology will further refine treatment strategies, enhancing the quality of care and patient satisfaction in the management of distal radius fractures.

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