

AGE, GENDER, AND INJURY MECHANISM: INFLUENCERS ON THE OUTCOME OF DISTAL RADIUS FRACTURES MANAGED BY PERCUTANEOUS PINNING AND COLLES' CAST

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ABSTRACT

Background: Distal radius fractures significantly affect patient outcomes, influenced by demographics and injury mechanisms. This study evaluates the impact of age, gender, and injury mechanism on the outcomes of distal radius fractures treated with closed reduction and percutaneous pinning (CRPP) versus Colles' cast application (CRCI).

Methods: A prospective, randomized comparative study was conducted with 80 patients at Indira Gandhi Medical College and Hospital. Participants were divided into two treatment groups (CRPP vs. CRCI) and assessed for functional and radiological outcomes using established scoring systems.

Results: Age and gender distributions showed varied susceptibility to fracture types and outcomes between treatment modalities. The mode of injury significantly influenced the choice of treatment and its effectiveness, with CRPP showing better outcomes in high-energy trauma cases.

Conclusion: The study highlights the importance of considering age, gender, and injury mechanism in choosing between CRPP and CRCI for managing distal radius fractures, with CRPP often leading to better outcomes in cases of high-energy trauma.

Keywords: distal radius fractures, percutaneous pinning, Colles' cast, age, gender, injury mechanism.

INTRODUCTION

Distal radius fractures are among the most common injuries encountered in orthopedic emergency departments, with significant implications for patient mobility, daily functioning, and overall quality of life.¹ The complexity of these fractures, influenced by the distal radius's unique anatomy and the wide range of mechanisms that cause injury, necessitates a refined approach to management that considers the patient's age, gender, and the specific nature of the injury.² This study delves into the nuanced interplay between these demographic factors and injury mechanisms to assess their influence on the outcomes of distal radius fractures managed by two prevalent treatment modalities: closed reduction and percutaneous pinning (CRPP) versus Colles' cast application (CRCI).³

Age and gender are pivotal in the context of distal radius fractures due to their association with bone density, lifestyle, and risk of osteoporosis, which can significantly affect fracture patterns, healing rates, and the likelihood of complications. For instance, younger individuals may experience these fractures through high-energy trauma such as sports injuries or road traffic accidents, often resulting in complex fracture patterns.⁴ In contrast, older adults, particularly postmenopausal women, are more susceptible to fractures from low-energy mechanisms, such as falls from standing height, due to reduced bone density. These distinctions are crucial for tailoring treatment approaches to optimize outcomes for each patient group.⁵

Moreover, the mechanism of injury — whether high-energy trauma or a simple fall — can influence the type and severity of the fracture, subsequently affecting the choice of treatment and its efficacy. Understanding these dynamics is essential for predicting outcomes and guiding clinical decision-making. This investigation aims to bridge the gap in knowledge regarding how these factors interact and affect the effectiveness of CRPP and CRCI in managing distal radius fractures.⁶

Our study incorporates a comprehensive review of current fracture classifications and leverages recent advancements in surgical techniques and materials to explore the impact of these demographic and injury-related factors on functional recovery and radiological outcomes. Through a detailed analysis of patient demographics, fracture characteristics, and treatment outcomes, this research aspires to underscore the importance of individualized treatment planning. By doing so, it seeks to enhance the precision of clinical interventions for distal radius fractures, ensuring that each patient receives the most appropriate and effective treatment based on their specific circumstances.

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 \pm 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

The study compared Closed Reduction and Percutaneous Pinning (CRPP) with Colles' Cast Application (CRCI) in managing unstable distal end radius fractures across various demographics and injury mechanisms. The results are as follows:

Table 1: Age Distribution showed a broad age range across both treatment groups, with the highest concentration of patients in the 50-60 and 60-70 age groups for both CRPP and CRCI, respectively. Although more patients above 70 were treated with CRPP, the distribution did not significantly differ between groups ($p=0.26$).

Table 2: Gender Distribution revealed a higher percentage of females in the CRCI group (72.5%) compared to the CRPP group (55.0%). Despite this discrepancy, the difference in gender distribution between the two groups was not statistically significant ($p=0.16$).

Table 3: Age and Gender Distribution highlighted a statistically significant difference in the distribution of patients below 20 years old, with males predominating in this category ($p=0.005$). This table underscores the variations in fracture incidence across different age and gender cohorts, indicating a higher incidence of fractures among females, especially in the 50-60 and 60-70 age groups.

Table 4: Mode of Injury showed that falls were the most common cause of injuries in both groups, accounting for 90% in the CRCI group and 82.5% in the CRPP group. Injuries from road side accidents were slightly more prevalent in the CRPP group. The difference in the mode of injury between the two treatment groups was statistically significant ($p=0.04$), suggesting that the nature of the injury may influence the choice of treatment modality.

TABLE 1: DISTRIBUTION ACCORDING TO AGE OF PATIENTS BETWEEN CRCI GROUP AND CRPP GROUP.

| Age groups [years] | 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%) | |

TABLE 2: DISTRIBUTION OF PATIENTS ACCORDING TO GENDER BETWEEN CRPP AND CRCI GROUP

| Gender | CRPP | CRCI | p value |
|--------|-----------|-----------|---------|
| Female | 22 (55.0) | 29 (72.5) | 0.16 |
| Male | 18 (45.0) | 11 (27.5) | |

TABLE 3 DISTRIBUTION OF PATIENTS ACCORDING TO AGE AND GENDER

| Age groups (years) | Female, N (%) | Male, N (%) | Total | p value |
|--------------------|---------------|-------------|-------|---------|
| Below 20 | 0 (0%) | 1 (3.4%) | 1 | 0.005 |
| 20-30 | 2 (3.9%) | 1 (3.4%) | 3 | |
| 30-40 | 3 (5.8%) | 7 (24.1%) | 10 | |
| 40-50 | 3 (5.8%) | 8 (27.5%) | 11 | |
| 50-60 | 19 (37.2%) | 5 (17.2%) | 24 | |

| | | | | |
|----------|------------|-----------|----|--|
| 60-70 | 17 (33.3%) | 6 (20.6%) | 23 | |
| Above 70 | 7 (13.7%) | 1 (3.4%) | 8 | |
| Total | 51 (100%) | 29 (100%) | 80 | |

TABLE 4: DISTRIBUTION OF PATIENTS ACCORDING TO MODE OF INJURY IN CRPP AND CRCI GROUP.

| | Fall, N (%) | Road side accidents N,(%) | p value |
|------|-------------|---------------------------|---------|
| CRCI | 36 (90) | 4 (10) | 0.04 |
| CRPP | 33 (82.5) | 7 (17.5) | |

DISCUSSION

In the exploration of distal radius fracture management, our study delves into the nuanced interplay between patient demographics such as age and gender, and the mechanism of injury, assessing their impact on treatment outcomes for closed reduction and percutaneous pinning (CRPP) versus Colles' cast application (CRCI).⁷ The results underscore the importance of considering these factors in clinical decision-making, revealing that the choice of treatment modality can significantly influence recovery trajectories.⁸

Age emerged as a critical determinant of treatment efficacy, aligning with previous studies indicating that younger patients tend to exhibit more robust healing responses, possibly due to better bone quality and fewer comorbidities. This demographic is often associated with high-energy mechanisms of injury, which might favor the stability provided by CRPP to ensure proper bone alignment and healing.⁹ Conversely, older adults, particularly those with osteoporotic bone, are more prone to fractures from low-energy falls. For these patients, the less invasive CRCI method may suffice, provided the fracture pattern and patient's functional demands are carefully considered.¹⁰

Gender differences in fracture outcomes highlight the impact of biological variations on fracture management. Males, typically sustaining fractures through higher energy impacts, may benefit more from CRPP due to the method's ability to address complex fracture patterns more effectively. Females, particularly postmenopausal women at a higher risk for osteoporosis, present a different challenge. The decreased bone density common in this group necessitates a treatment approach that balances the need for immobilization with the risk of further bone weakening, making CRCI an attractive option in cases of less severe fractures.¹¹

The mechanism of injury significantly influences the choice and success of treatment modalities. High-energy impacts, more common in younger individuals and males, often result in complex fractures that require the stability offered by CRPP for optimal healing. In contrast, low-energy falls, typically seen in older adults and females, may result in simpler fracture patterns where CRCI can effectively promote healing.¹²

Our study's findings advocate for a personalized approach to managing distal radius fractures, emphasizing the need to consider patient-specific factors such as age, gender, and injury mechanism in treatment planning. This approach not only enhances the precision of treatment but also optimizes outcomes by aligning intervention strategies with individual recovery potentials.

The implications of this research extend beyond clinical practice, suggesting directions for future studies on fracture management. Investigations into the long-term outcomes of these treatments across different demographic groups could further refine treatment guidelines, ensuring that each patient receives the most appropriate and effective care based on their unique circumstances. As the field of orthopedics continues to advance, the integration of personalized medicine into fracture management will likely become increasingly important, offering patients tailored treatments that maximize recovery and functional return.

Conclusion

The influence of age, gender, and injury mechanism on the outcomes of distal radius fractures treated with CRPP versus CRCI is undeniable. This study reinforces the need for a tailored approach to fracture management, ensuring that treatment decisions are informed by a comprehensive understanding of how these factors interact to affect recovery. Prioritizing personalized care in the management of distal radius fractures can significantly improve patient outcomes, emphasizing the critical role of demographic and injury-specific considerations in treatment planning.

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