

ORIGINAL ARTICLE

PERCUTANEOUS FIXATION FOR DISPLACED COLLES FRACTURES; A PRACTICAL INSIGHT FROM A PUBLIC HOSPITAL

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ABSTRACT

Introduction: Displaced Colles fractures are common injuries affecting patient functionality and quality of life. Percutaneous treatment efficacy requires a thorough evaluation, especially in postgraduate trainees managing it.

Material & Methods: This was a descriptive retrospective study that was conducted at the Department of Orthopedics, Civil Hospital Karachi, from 15 June 2022 to 15 August 2023. Non-probability consecutive sampling was used to select 96 patients who underwent percutaneous fixation for displaced Colles fractures. Data was collected through clinical examinations and radiographs, using a pre-designed protocol. The surgical procedures utilized two divergent 1.8 mm smooth K-wires. Follow-up evaluations were conducted to assess both radiological union and functional outcomes.

Results: The radiological assessment showed an 88.54% union rate, and the functional outcomes at six months post-treatment were excellent 69.79%, good 16.67%, fair 8.33%, and poor 5.21%. No significant differences were found based on age, gender, residence, employment status, BMI, fracture duration, or injury mechanism.

Conclusion: Percutaneous fixation successfully restored structural integrity and functional capacity for displaced Colles fractures, with a radiological union rate of 88.54% and 86.46%, despite the limitations due to a single-center design. Further research should explore individualized treatment strategies.

Keywords: Displaced Colles Fractures, K-Wires, Percutaneous Fixation, Radiological Outcomes.

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INTRODUCTION

Distal Radius Fractures (DRFs) stand as a prevalent challenge in the domain of musculoskeletal injuries, accounting for approximately 17% of all body fractures.¹ According to the National Hospital Ambulatory Care Survey in the United States, an estimated 643,000 cases of Distal Radius Fractures (DRFs) occur annually, highlighting the significant orthopedic burden. Notably, 57% of these cases are

observed in individuals aged 65 years and older.^{2,3} Colle's fracture is the most prevalent cause of DRFs, first described by Dr. Colles in 1814.⁴ This extraarticular metaphyseal phenomenon positioned approximately 1.5 inches proximal to the carpal articulation, manifests with a distinctive dorsal angulation and the displacement of the distal radius fragment.⁵ Trauma is the primary cause of Colles

fractures, often resulting from athletic activities or road traffic accidents (RTAs). However, falls are a significant contributing factor to Colles fractures, particularly in the elderly population.⁶ The force is transmitted dorsally through the wrist when a person falls on an outstretched hand, leading to a fracture of the distal radius. This injury is typically associated with dorsal displacement and often dorsal comminution, resulting in the characteristic "dinner fork" deformity. It is commonly accompanied by pain, swelling, and a notable reduction in the range of motion.^{5,7} Dr. Colles managed the complexities of these fractures in the absence of radiography, aseptic surgical interventions, or anesthesia, but varying degrees of disability following malunion can occur. This malunion can lead to mid-carpal instability, chronic wrist discomfort, and post-traumatic arthritis.⁸ The degree of residual deformity correlates directly with the degree of impairment, as persistent wrist discomfort is associated with radial shortening and an irreversible loss of the palmar angle.^{8,9}

The management of distal radius fractures has evolved significantly due to growing concerns about occupational disability and the prolonged care required for previously independent elderly individuals. For unstable distal radius fractures, various techniques are used to minimize the loss of reduction. These techniques include percutaneous pinning, external skeletal fixation, substantial open reduction, internal fixation, and limited open reduction with or without bone grafting. Closed reduction and immobilization are part of non-operative care, and they are particularly appropriate for extra-articular fractures with minimal displacement.¹⁰⁻¹²

Percutaneous pinning is a minimally invasive technique that reduces soft tissue disruption and enhances patient comfort compared to open surgical interventions. It uses C-arm fluoroscopy to provide real-time imaging, allowing for precise pin placement and accurate alignment of fracture fragments. This hands-on experience also serves as a valuable learning experience for residents, enabling them to develop essential skills in

performing minimally invasive procedures under the guidance of experienced mentors.

The research aims to evaluate the functional and radiological outcomes of percutaneous pinning performed by residents in a local setting for patients with displaced Colles fractures. By assessing the effectiveness of this technique, the study aims to contribute to the growing body of evidence supporting percutaneous pinning as a reliable treatment option which will enhance patient care and provide valuable insights to inform future practices in orthopedic surgery.

MATERIAL AND METHODS

This was a descriptive retrospective study that was conducted at the Department of Orthopedics, Civil Hospital Karachi, from 15 June 2022 to 15 August 2023 to explore the outcomes of percutaneous fixation in individuals with displaced Colles fractures operated by postgraduate trainees. The sample size was 96, calculated through the WHO sample size calculator, considering a 93.33% frequency of acceptable functional outcomes, a 5% margin of error, and a 95% confidence interval. Non-probability consecutive sampling was used to select 96 patients who underwent percutaneous fixation for displaced Colles fractures.

Inclusion criteria encompassed patients presenting with wrist pain VAS >6, swelling, tenderness, and deformity in the wrist joint, diagnosed with displaced Colles's fracture, aged between 18 and 70 years of any gender, and with ASA class ≤ 3 . The exclusion criteria included those with inflammatory disorders such as rheumatoid arthritis, people with bilateral wrist fractures, fractures linked to nerve, vascular, or tendon injuries, and people who presented after one week of trauma.

The study received ethical approval from the Ethical Review Committee of the College of Physicians and Surgeons Pakistan. Participants meeting the inclusion criteria were recruited from the orthopedic outpatient and emergency departments of Civil Hospital Karachi, with each providing informed consent. Comprehensive clinical histories and comorbidity profiles were documented

for all participants. Physical examinations were performed to assess the injured and contralateral wrists for deformities and evaluate the status of nerves, vessels, and tendons. Anteroposterior (AP) and lateral radiographs were utilized to evaluate distal radius fractures. Study variables, encompassing demographic details, mechanism and duration of fracture, employment status, height, weight, BMI, Frykman classification, and radiological and functional outcomes, were recorded in a pre-designed Performa.

Surgical Procedure

All surgical procedures took place in the operating room using regional or general anesthesia. Percutaneous procedures were used to achieve reduction and fixation using two crossed 1.8 mm smooth K-wires. The procedures were performed by an orthopedic resident working in the emergency department under the supervision of a senior consultant.

Postoperative Care and Follow-up

Following surgery, patients were discharged with a short arm dorsal plaster slab. Follow-up appointments were scheduled for one month, three months, and six months postoperatively. During each visit, both radiological and functional outcomes were evaluated. Additionally, patients were encouraged to begin active mobilization of the shoulder, elbow, and finger joints starting from the first day after surgery to promote early recovery and prevent joint stiffness.

Data Analysis Procedure

Data obtained from the study was analyzed using SPSS version 24. Descriptive statistics, including mean \pm standard deviation or median (interquartile range), were used for quantitative variables such as age, height, weight, BMI, duration of fracture, and Cooney's functional score. While gender, place of residence, employment status, mechanism of fracture, ASA class, and functional and radiological outcomes were presented as frequencies and percentages. Effect modifiers, namely age, gender, place of residence, employment status, BMI, duration of fracture, and mechanism of

fracture, were controlled through a rigorous stratification process.

Post-stratification, the Chi-square or Fischer exact test was applied. A significance level of $p \leq 0.05$ was considered statistical significance. This analytical approach allowed for a comprehensive exploration of the data, ensuring that potential confounding factors were considered and appropriately addressed through stratification. The selected statistical tests were applied to ascertain meaningful insights into the relationships between various variables, providing a robust foundation for the interpretation of study outcomes.

RESULTS

A total of 96 patients diagnosed with displaced Colles fractures and treated with percutaneous fixation were included in the study. The mean age of the patients was 48.21 ± 13.04 years.

Demographic characteristics, including weight, height, and BMI, are shown in *Table 1*. Of the 96 participants, 43 (44.79%) were male, and 53 (55.21%) were female. Urban residents comprised 62% of the study population, with 53% being educated. ASA status and hand dominance details are outlined in *Table 1*.

The mean duration of the fracture was 3.23 ± 1.24 days, with a corresponding mean duration of hospital stay reported as 9.64 ± 2.76 days. The Cooney score, assessing functional outcomes, averaged 86.10 ± 12.75 . Regarding the mechanism of injury, falls accounted for 60.42%, while RTA was reported at 39.58%.

Radiological outcomes, specifically in terms of union, were observed in 88.54% of cases. Functional outcomes at six months postoperatively were categorized as excellent at 69.79%, good at 16.67%, fair at 8.33%, and poor at 5.21%. According to the operational definition, an acceptable functional outcome was achieved in 86.46% (83/96) of the patients.

Stratification analysis was performed to explore the impact of potential effect modifiers. It was observed that acceptable functional and radiological outcomes did not exhibit statistical significance among the

stratified effect modifiers. These results collectively provide a comprehensive overview of the patient characteristics, injury mechanisms, and outcomes associated with percutaneous fixation in displaced Colles fractures. The non-significant differences observed in the stratification analysis suggest that the evaluated variables may not significantly influence the achieved functional and radiological outcomes.

Table 1: Baseline Demographics and Clinical Characteristics

| Variables | Mean ± SD OR Frequency | Median OR Percentage |
|----------------------------------|------------------------|----------------------|
| Age (Years) | 48.21±13.04 | 48.50(18) |
| Weight (kg) | 72.73±16.82 | 70(21.3) |
| Height (cm) | 160.54±9.65 | 160(13.8) |
| BMI (kg/m ²) | 28.24±6.56 | 27.43(6.6) |
| Duration of Fracture (days) | 3.23±1.24 | 3(2) |
| Duration of hospital stay (days) | 9.64±2.76 | 9(4) |
| Cooney Score | 86.10±12.75 | 91(12) |
| Address | | |
| Urban | 59 | 61.50% |
| Rural | 37 | 38.50% |
| Employment Status | | |
| Employed | 51 | 53.10% |
| Un-employed | 45 | 46.90% |
| ASA Class | | |
| I | 25 | 26% |
| II | 49 | 51% |
| III | 22 | 22.90% |
| Hand Dominance | | |
| Right | 55 | 57.30% |
| Left | 41 | 42.70% |

Table 2: Acceptable Functional outcome after 6 Months stratified by effect modifiers

| Variable's | Radiological outcome in terms of Union | | | | Total | P-Value |
|--------------------------|--|----|-------|----|-------|---------|
| | Acceptable functional outcome | | | | | |
| Variable's | Yes | | No | | Total | P-Value |
| | n | % | n | % | | |
| Age (Years) | ≤40 | 22 | 91.7% | 2 | 8.3% | 0.756 |
| | 41-50 | 27 | 81.8% | 6 | 18.2% | |
| | 51-60 | 21 | 87.5% | 3 | 12.5% | |
| | >60 | 13 | 86.7% | 2 | 13.3% | |
| BMI (kg/m ²) | ≥30 | 37 | 82.2% | 8 | 17.8% | 0.255 |
| | <30 | 46 | 90.2% | 5 | 9.8% | |
| Gender | Male | 36 | 83.7% | 7 | 16.3% | 0.480 |
| | Female | 47 | 88.7% | 6 | 11.3% | |
| Address | Urban | 54 | 91.5% | 5 | 8.5% | 0.067 |
| | Rural | 29 | 78.4% | 8 | 21.6% | |
| Employment Status | Employed | 46 | 90.2% | 5 | 9.8% | 0.255 |
| | Un-employed | 37 | 82.2% | 8 | 17.8% | |
| ASA Class | I | 23 | 92.0% | 2 | 8.0% | 0.367 |
| | II | 40 | 81.6% | 9 | 18.4% | |
| | III | 20 | 90.9% | 2 | 9.1% | |
| Duration of fracture | ≤3 | 54 | 83.1% | 11 | 16.9% | 0.161 |
| | >3 | 29 | 93.5% | 2 | 6.5% | |
| Mechanism of Injury | Fall | 48 | 82.8% | 10 | 17.2% | 0.191 |
| | RTA | 35 | 92.1% | 3 | 7.9% | |

DISCUSSION

The intricate relationship between functional and anatomical outcomes highlights the importance of precision in fracture treatment,

particularly in older patients.¹⁵ The significance of anatomical repair in achieving favorable functional outcomes has been well-documented in various studies. The choice between conservative and surgical methods for treating distal radius fractures remains a topic of ongoing debate within the orthopedic community.^{14,15}

Advances in the understanding of wrist and hand functional anatomy have enabled orthopedic surgeons to employ various techniques, including closed reduction, external fixation, open reduction, internal fixation, percutaneous pinning, and casting reduction.^{4,5} The decision-making process is influenced by patient characteristics, fracture type, and surgeon expertise.

Historically, Colles advocated plaster cast stabilization as a preventive measure against deformity.¹⁶ However, evidence suggests that re-displacement is common with conservative treatment, with up to 70% of cases exhibiting significant displacement. The challenge of avoiding displacement in unstable fractures has given rise to a number of internal and exterior stabilization devices throughout time, including external fixation, the Roger Anderson device, Rush® pins, and different plaster methods.¹⁷

In our study, the radiological outcome, characterized by an 88.54% union rate, signifies the effectiveness of the intervention in promoting healing and structural consolidation. Such a high union rate is not only encouraging for patients but also reflects positively on the medical team's expertise and the chosen treatment modality. Functional outcomes at the six-month mark exhibited a spectrum from excellent (69.79%) to poor (5.21%), with a substantial percentage reporting good outcome (16.67%). These results align with the patient-centered care approach, emphasizing the impact on daily life and overall well-being. Notably, a significant percentage of patients achieved excellent and good functional outcomes, indicating a successful intervention in restoring function and quality of life.

Comparisons with previous studies highlight the variety of approaches to distal radius

fracture treatment. Studies by Panthi et al. emphasize the importance of anatomical restoration, reporting various techniques and outcomes. The range of results, from excellent to fair, highlights the complexity of these fractures and the need for tailored interventions.¹⁸

Reports from Stein et al. and Dixon et al. reinforce the challenges of radial shortening and the potential for improvement in treatment outcomes.^{19,20} Walton et al. advocate for percutaneous K-wire fixation, reporting favorable functional and radiological results.²¹ Scheck et al. published a longitudinal study, and the comparative cohort study further contributes to the body of evidence supporting the efficacy of certain fixation methods.²²

Karantana et al. published a meta-analysis comprising 21 randomized controlled trials and five quasi-randomized controlled trials, which investigated percutaneous pinning versus cast immobilization for distal radial fractures in 1946 patients.¹⁴ The trials were found to have a high risk of bias due to challenges in blinding and incomplete reporting. Comparisons of pinning versus cast immobilization showed inconclusive evidence regarding patient-reported function, with uncertain complication rates. Different pinning methods and materials, such as biodegradable pins, demonstrated uncertain outcomes and potential risks. Additionally, there was a lack of definitive evidence regarding wrist positioning during cast immobilization and the duration of postoperative immobilization. The study highlights the limited quality and incompleteness of available evidence, emphasizing the need for robust research to guide treatment decisions in distal radial fractures.¹⁴ The scarcity of reliable data and the conflicting findings in the literature are believed to stem from variations in orthopedic and musculoskeletal conditions, as well as surgeons' preferences.

Our study contributes valuable insights into the treatment of distal radius fractures, emphasizing the importance of anatomical restoration and the varied approaches

available. The high union rate and spectrum of functional outcomes underscore the success of the intervention in restoring both structural integrity and functional capacity. The findings contribute to the ongoing discourse on optimal fracture management, particularly in the context of the aging population. Future studies may look more closely at long-term results and customized treatment plans to improve the general standard of care for individuals with distal radius fractures.

This study's short follow-up period and single-center design suggest future research should focus on long-term follow-ups to evaluate functional and radiological outcomes after percutaneous pinning in distal radius fractures, with randomized controlled trials for elderly populations. The short 12-month follow-up duration restricts insights into long-term outcomes and potential late complications. The absence of randomization and a control group in the study design limits the ability to establish causation and make direct comparisons with alternative treatments. Furthermore, the study's focus on functional and radiological outcomes may overlook nuanced patient perspectives and experiences. Heterogeneity in fracture severity and the potential for recall bias in patient-reported data add layers of complexity. Recognizing these limitations underscores the need for cautious interpretation and motivates future research for a more comprehensive understanding of percutaneous fixation in distal radius fractures.

CONCLUSION

The result of distal radius fracture fixation with percutaneous pinning is preferable to conservative treatment in union and functional outcome. Elderly women are more likely to suffer from a Colles fracture. One great method for stabilizing a displaced Colles' type fracture is percutaneous pinning. Dorsal angulation and ulnar variation were better restored and maintained after percutaneous pinning. Acceptable reduction is required for unstable Colles fractures.

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