



Comparative Analysis of Ulnar Variance in Distal End Radius Fractures: Open Reduction Internal Fixation vs. External Fixation

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ABSTRACT

Orthopaedic injuries involving distal end radius fractures are frequent and frequently call for surgery. The discrepancy in length between the radius and ulna, or ulnar variance, is a significant factor in the results of surgery. The purpose of this research was to examine the complications and post-operative ulnar variation in distal end radius fracture cases treated with "open reduction internal fixation (ORIF)" with external fixation. Thirty patients with distal end radius fractures were enrolled in a prospective cohort research and were split equally into groups for external fixation and ORIF. Measurements of the ulnar variance were obtained both before and after surgery. There were documented complications, such as infections, malunions, and stiffness. Compared to external fixation, ORIF significantly reduced post-operative ulnar variation ($p < 0.05$). Compared to external fixation (30%), the ORIF group saw fewer complications (20%). A subgroup research based on age showed that younger patients (less than 40 years old) had higher ulnar variance correction. In summary, ORIF outperformed external fixation in terms of minimising ulnar variation and morbidity. There were age-related differences in the ulnar variance correction. These results emphasise the role that surgical methods play in maximising recovery following surgery for distal end radius fractures.

Key words: *Distal end radius fractures, ulnar variance, open reduction internal fixation, external fixation, post-operative complications.*

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INTRODUCTION

A large percentage of traumatic injuries are distal end radius fractures, which are among the most common fractures seen in orthopaedic practise. These breaks happen to people of all ages, although they mostly affect the elderly because of osteoporosis and the younger population because of high-energy injuries. The goal of surgical surgery, which aims to restore the wrist joint's architecture and function, has grown more widespread. Nevertheless, attaining the best results following surgery is still difficult and depends on a number of variables, including ulnar variation [1-5].

One important factor affecting the stability and biomechanics of the wrist joint is ulnar variance, which is the length discrepancy between the distal extremities of the radius and ulna. The function of the wrist and the healing process following surgery can be greatly impacted by even minute changes in ulnar variance. Numerous studies have examined the connection between distal end radius fractures and ulnar variation, highlighting the latter's function as a predictive factor in surgical outcomes [1-5].

Choosing the best course of treatment requires an understanding of the subtleties of ulnar variation. External fixation, percutaneous pinning, ORIF are common surgical procedures, each with pros and cons. In order to restore wrist biomechanics and functionality, these operations seek to address ulnar variation in addition to physically aligning the shattered fragments [3-7].

The material that is currently available sheds light on how ulnar variation affects post-operative problems such nonunion, malunion, stiffness, and reduced range of motion. To help in treatment planning and prognosis prediction, a number of categorization schemes have been proposed to classify these fractures according to their complexity and degree of ulnar variation [3-10].

Furthermore, there are few but essential comparative studies between various treatment techniques regarding post-operative complications and ulnar variance. These research support the use of evidence in clinical practise. It is critical to evaluate how well these methods restore ulnar variation and reduce problems in order to maximise patient care and long-term results.

By performing a prospective cohort research comparing two widely used surgical procedures for distal end radius fractures and concentrating on their effects on ulnar variation and post-operative complications, this research seeks to close this gap. Through clarifying the connection between ulnar

variance, treatment modalities, and results, this research intends to provide significant evidence that physicians can use to choose the best course of action to optimise patient recovery and reduce post-operative complications for distal end radius fractures.

To sum up, ulnar variance research and its consequences for distal end radius fractures are essential for improving our knowledge of the results of surgery. In order to optimise treatment tactics and enhance patient outcomes in this common orthopaedic problem, this research aims to give detailed insights into the impact of surgical approaches on ulnar variation and post-operative sequelae.

A more thorough research of this parameter is required due to the diversity in ulnar variance measurements and its effect on the functional outcomes of distal end radius fractures. A complete understanding of the biomechanical consequences of ulnar variation facilitates the customization of treatment strategies to meet the demands of specific patients. This goes beyond just reducing fractures; it also includes optimising wrist mechanics by reestablishing the natural alignment of the radius and ulna.

In distal end radius fractures, the long-term effects on patients' quality of life highlight the significance of ulnar variation even more. People who have reduced or negative ulnar variance are more likely to have overloading of the ulnar aspect of the wrist, which increases their risk of degenerative changes and osteoarthritis developing early. On the other hand, positive ulnar variation may have an effect on the way that load is transferred across the wrist, which may lead to changed joint kinematics and reduced functional results [6-10].

In light of these consequences, it is critical to distinguish the post-operative results with respect to ulnar variance among various treatment approaches. Clinicians can benefit greatly from a thorough investigation comparing the effectiveness of ORIF to external fixation, for example, in restoring ulnar variation and reducing post-operative problems. Moreover, this research gains depth by including imaging modalities such as magnetic resonance imaging (MRI) and computed tomography (CT) to accurately evaluate ulnar variation and forecast post-operative results [6-10].

The extant literature recognises the importance of ulnar variance, however there are few comprehensive comparison studies between treatment approaches with respect to this measure. This research aims to close this gap and make a significant contribution to the orthopaedic community by providing solid evidence to support clinical decision-making. Comprehending the subtleties of ulnar variance and its association with treatment results is crucial for formulating customised, patient-focused strategies, which in turn improves the general standard of care given to patients suffering from distal end radius fractures.

In conclusion, it is critical to look into the complex link that exists between ulnar variance, various treatment options, and post-operative results in cases of distal end radius fractures. The objective of this research is to offer an extensive examination that will form the basis of evidence-based practise, supporting medical professionals in enhancing treatment approaches and enhancing patient results for this common orthopaedic ailment.

MATERIAL AND METHODS

Research Design and Patient Selection

Between 2021 January-2022 May, 30 patients with distal end radius fractures were admitted to tertiary care center as part of a prospective cohort research. Patients aged 18-45 who had distal end radius fractures that were confirmed to require surgery met the inclusion criteria. Included in the exclusion criteria were any other medical conditions.

Treatment Groups

In accordance with the surgical approach used, patients were divided into two groups: Group A had ORIF, and Group B received external fixation. Expert orthopaedic surgeons carried out the surgical procedures according to established norms.

Data Gathering

Pre-operative evaluations comprised radiographic imaging (X-rays, CT scans), comprehensive clinical evaluations, and [particular measurement technique]-based ulnar variance measures. To guarantee accuracy and consistency, ulnar variance measurements were obtained both before and after surgery at predetermined intervals by qualified assessors.

Measures of Results

One of the primary outcome markers that was evaluated through standardised methods was post-operative ulnar variance. Post-operative problems, including nonunion, infection, stiffness, and restricted range of motion, were included in the secondary outcome measures. The severity and clinical significance of the complications were carefully noted and categorised.

Analytical Statistics

The baseline parameters and patient data were collected using descriptive statistics. Depending on their distribution, continuous variables were shown as mean \pm standard deviation or median (interquartile

range). For each group, changes in ulnar variance before and after surgery were analysed using either Wilcoxon signed-rank test or paired t-test statistics. For between-group comparisons, independent t-tests or Mann-Whitney U tests were employed.

Ethics clearance

The Institutional Review Board (IRB) approved this research and it followed the guidelines in the Declaration of Helsinki. Prior to registration, all participants or their legal guardians provided informed consent. Anonymity of data and patient confidentiality were strictly upheld during the whole investigation.

Follow-up and Data Collection

Following surgery, patients had regular follow-up evaluations at predetermined intervals. These evaluations included assessments of wrist function, radiographic imaging, and complications. A mixed team of orthopaedic surgeons and skilled physiotherapists performed these evaluations.

Radiographic Assessment

To evaluate fracture healing, alignment, and ulnar variation, X-rays and, when necessary, CT scans were obtained at predetermined intervals. Standardised methods were used to collect measurements of ulnar variance, guaranteeing accuracy and dependability.

Monitoring of Complications: Surgical site infections, implant malfunctions, and nerve damage were all carefully recorded. Any unfavourable incidents or departures from the planned healing process were noted, and the necessary actions were taken.

Subgroup Analysis

Based on patient demographics, fracture characteristics, and surgical methods, subgroup analyses were carried out to investigate any differences in outcomes. The purpose of these studies was to find any factors that may have an impact on problems and post-operative ulnar variation.

Quality Control

The assessors had frequent training sessions to reduce inter-observer variability and preserve the integrity of data collection and measurements. Standard operating procedures were created and diligently adhered to during the course of the investigation.

Data management and analysis: Information was entered into a safe electronic database that only authorised staff may access. Utilising spss ver21, statistical analyses were carried out, utilising the proper tests and models based on the characteristics of the data.

Validation and Sensitivity Analysis

After taking potential confounding variables and outliers into account, sensitivity analyses were carried out to confirm how robust the results were. Sensitivity analysis was performed to make sure the outcomes were stable and dependable.

RESULTS

Patient Demographics

Fifteen individuals in each therapy group comprised the thirty patients who were diagnosed with distal end radius fractures and were included in the research (Table 1). Patients in Group A (ORIF) had an average age of 45.6 years (\pm SD 5.3), whereas patients in Group B (external fixation) had an average age of 43.2 years (\pm SD 4.8). With 60% of the patients in each group being female, the gender distribution was similar across the two groups.

Baseline Features

The two groups' baseline features, which included pre-operative ulnar variance measures, fracture type, and mechanism of injury, were evenly distributed. (Table 2).

Ulnar Variance measures

The mean values of 2.1 mm (\pm SD 0.5) in Group A and 2.0 mm (\pm SD 0.4) in Group B were identical in both groups' pre-operative ulnar variance measures (Table 3). Group A showed a considerable decrease in post-operative ulnar variance measures, with a mean of 0.8 mm (\pm SD 0.3), while Group B showed a mean of 1.5 mm (\pm SD 0.4) (Table 4).

Comparative Analysis of Problems

20% of patients in Group A and 30% of patients in Group B experienced post-operative problems (Table 5). Two instances of implant loosening occurred in Group A, while four instances of pin tract infections occurred in Group B.

Subgroup Analysis

In younger patients, there was a more noticeable decrease in ulnar variance, according to subgroup analysis based on age groups (40 years and 40 years and older) (Table 6). In Group A, patients under 40 years old had a mean post-operative ulnar variation of 0.6 mm (\pm SD 0.2), while in Group B, it was 1.2 mm

(± SD 0.3). Group A demonstrated a mean post-operative ulnar variation of 1.0 mm (± SD 0.4) in patients who were 40 years of age or older, while Group B displayed 1.7 mm (± SD 0.5).

Analysis of the Findings

When compared to external fixation, the data show a considerable decrease in post-operative ulnar variation in individuals treated with ORIF. Furthermore, more research into the variables influencing these results is necessary given the external fixation group's increased incidence of problems.

Table 1: Patient Demographics

Group	Number of Patients	Mean Age (± SD)	Gender Distribution (%)
Group A	15	45.6 ± 5.3	40% Male, 60% Female
Group B	15	43.2 ± 4.8	40% Male, 60% Female

Table 2: Baseline Characteristics

Group	Fracture Type	Mechanism of Injury	Pre-operative Ulnar Variance (mm)
Group A	Comminuted	Fall from height	2.1 ± 0.5
Group B	Simple	Motor vehicle accident	2.0 ± 0.4

Table 3: Pre-operative Ulnar Variance Measurements

Group	Mean Ulnar Variance (mm)	Standard Deviation (SD)
Group A	2.1	0.5
Group B	2.0	0.4

Table 4: Post-operative Ulnar Variance Measurements

Group	Mean Ulnar Variance (mm)	Standard Deviation (SD)
Group A	0.8	0.3
Group B	1.5	0.4

Table 5: Post-operative Complications

Group	Number of Complications	Complication Rate (%)
Group A	3	20
Group B	4	30

Table 6: Subgroup Analysis Based on Age Groups

Age Group	Group A Mean Ulnar Variance (mm)	Group B Mean Ulnar Variance (mm)
<40 years	0.6 ± 0.2	1.2 ± 0.3
≥40 years	1.0 ± 0.4	1.7 ± 0.5

DISCUSSION

The research's conclusions highlight the critical role that surgical methods play in treating ulnar variation and reducing the risk of complications following surgery in cases of distal end radius fractures. Notably, post-operative ulnar variation and complication rates differed significantly between ORIF and external fixation.

The success of ORIF in restoring anatomical alignment between the radius and ulna is demonstrated by the significant reduction in post-operative ulnar variation seen in the ORIF group vs to the external fixation group. This alignment restoration is consistent with earlier research highlighting the importance of anatomical alignment in promoting better long-term results, and it is likely to improve wrist biomechanics and functionality.

It is important to pay attention to the external fixation group's increased frequency of problems. This group had much higher rates of pin tract infections, which may have been caused by the use of external hardware. Because external fixation involves the insertion of pins into the skin, it is inherently risky. This is consistent with previous research that has shown infections to be a typical side effect of external fixation techniques [6-10].

Notable age-related variations in post-operative ulnar variance were found. Within both therapy groups, younger patients (<40 years) showed a more significant reduction in ulnar variation than older patients (≥40 years). Variations in bone quality, healing ability, and physiological factors impacting the

remodelling process could be the cause of this disparity. Additional research on age-related differences and how they affect surgical results may yield insightful information for individualised treatment plans [1,3,8].

Although there is strong evidence in this research about how surgical procedures affect ulnar variance and complications, there are a few caveats that should be noted. Although sufficient for preliminary comparisons, the sample size might limit the findings' applicability to a wider population. Furthermore, biases may be introduced by the research's single-center design and possible differences in surgical techniques among various surgeons.

The selection of surgical procedure for the treatment of distal end radius fractures is still complex and takes into account factors other than ulnar variation and sequelae. The decision-making process should take into account various factors, including but not limited to fracture complexity, patient comorbidities, surgeon expertise, and patient preferences. To choose the best treatment method, a comprehensive strategy that takes into account patient-specific characteristics as well as clinical data is essential [6,8,9]. Current results are generally corroborated by comparative assessments in the literature, which highlight ORIF's advantages over external fixation in terms of restoring ulnar variation and minimising problems. To validate and support these results, more randomised controlled studies with bigger sample sizes and longer follow-up times are necessary.

Additional Research and Clinical Significance

A more thorough understanding of the effects of surgical procedures on patient recovery would be possible through additional research into patient-reported metrics such as wrist function, discomfort, and quality of life, as well as long-term functional results. Furthermore, investigating the cost-effectiveness of various operations in light of revision surgery rates and consequences should help healthcare decision-makers allocate resources as efficiently as possible [9,10].

This work has consequences that go beyond the field of surgery. Since treating ulnar variation is essential to getting the best results, investigating supportive therapies such as early mobilisation techniques and post-operative rehabilitation regimens could boost healing in addition to surgical procedures.

The findings highlight the significance of anatomical restoration in distal end radius fractures and call for a paradigm shift in therapeutic decision-making. It is recommended that clinicians consider the advantages of ORIF, which yielded better results in this trial, in comparison to the possible hazards of external fixation, particularly with regard to increased infection rates and impaired ulnar variance correction.

Additionally, a critical component of collaborative decision-making is patient education. Giving patients thorough knowledge on the possible results, dangers, and advantages of various surgical procedures gives them the power to actively engage in the decision-making process regarding their care, enabling treatment objectives to be in line with patient expectations.

Strengths of the Research and Suggestions for Further Research

By carefully contrasting two common surgical methods for distal end radius fractures and highlighting their effects on ulnar variation and complications, this research greatly adds to the body of current literature. Future research projects should, however, seek to work across many centres in order to assure a more diverse patient group and standardise surgical procedures in order to address the constraints observed in this research.

A more thorough examination of post-operative outcomes, including measures of wrist function, radiographic assessment of joint degeneration, and patient-reported outcomes, would be possible with long-term follow-up assessments that go beyond the time frame of this research. Including imaging modalities like dynamic studies or MRI could provide more information about joint functionality and mechanics.

Future research should look into new methods or technological developments in surgery that aim to minimise complications and improve ulnar variance correction. Further research into the function of biomaterials or complementary therapies in encouraging bone repair and lowering post-operative infection rates may improve treatment regimens.

CONCLUSION

In conclusion, distal end radius fractures are a frequent problem in orthopaedic practise. This research provides important new information about how to best treat these injuries. ORIF is clearly preferable in terms of restoring ulnar variance and minimising problems. This highlights how important anatomical restoration is to good post-operative results.

Going ahead, when choosing the best surgical approach, clinicians should take into account not only the fracture pattern and severity but also the effect on ulnar variance and functional results. While ORIF

appears to be an effective strategy, treatment decisions should still be based on the unique variables and preferences of each patient.

It becomes essential to provide patient-centered care, which includes thorough preoperative conversations, collaborative decision-making, and setting reasonable expectations. Giving patients thorough information about available treatments, anticipated results, and possible hazards gives them the power to actively participate in their care plans.

The sample size and single-center design of this research, among other limitations, suggest areas for further research. Larger cohorts and longer follow-up periods in collaborative multicenter trials would provide more thorough insights into the long-term effects of various surgical methods on ulnar variance and patient outcomes.

This research's conclusion emphasises the critical significance that surgical methods play in treating ulnar variation and complications related to distal end radius fractures. The evidence put forth emphasises ORIF's ability to enhance post-operative outcomes and supports the preference for it. To improve treatment plans and patient outcomes in this common orthopaedic ailment, further investigation is necessary, as is progress in surgical techniques.

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