

ORIGINAL RESEARCH

To evaluate the relationship between complex regional pain syndrome and the procedure used to reduce a fracture in the distal radius

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ABSTRACT

Aim: To evaluate the relationship between complex regional pain syndrome and the procedure used to reduce a fracture in the distal radius. **Material and Methods:** The current investigation included a sample of 120 patients, including individuals of both male and female genders, who had sustained distal radius fractures. Prior to the study, all participants were provided with information on the research and their explicit consent was collected in writing. Demographic information, including age, gender, and other pertinent data, was documented for each patient. Every patient had a comprehensive clinical and physical evaluation. The patients were categorized into two groups according to the occurrence of Complex Regional Pain Syndrome (CRPS): Group I consists of patients who have been diagnosed with Complex Regional Pain Syndrome (CRPS), whereas Group II comprises patients who do not have CRPS. **Results:** Group I, which includes 35 people, is classified as CRPS. Group II, on the other hand, consists of 85 individuals and does not have CRPS. Closed reduction was performed on 15 people, which accounted for 42.9% of Group I. There were 55 patients (64.7%) in Group II. The p-value is 0.02, indicating statistical significance. Open Reduction was performed in Group I on 20 patients (57.1%). There were 30 patients (35.3%) in Group II. The use of an external fixator was performed on 10 and 23 patients in group I and II, respectively. In group I, 12 and 28 patients had ulnar fractures, while in group II, 13 and 34 patients had open fractures. The disparity was statistically significant ($P < 0.05$). The risk variables for CRPS were the average age in years, the manner of reduction, and the presence of ulnar fracture and open fracture ($P < 0.05$). **Conclusion:** The research found that the technique used to realign broken bones (fracture reduction) is a major factor that increases the chance of developing Complex Regional Pain Syndrome (CRPS) in individuals with fractures in the distal radius. More precisely, patients who received open reduction had a greater probability of acquiring Complex Regional Pain Syndrome (CRPS) in comparison to those who had closed reduction. Additional study is required to investigate more risk factors and devise preventative measures for CRPS in this specific group of patients.

Keywords: Complex regional pain syndrome, Fracture, Distal radius

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INTRODUCTION

Complex Regional Pain Syndrome (CRPS) is a severe illness marked by persistent pain and a range of sensory, motor, and autonomic symptoms. Fractures, particularly those of the distal radius, are often linked to this condition. These fractures are commonly caused by falls onto an extended hand. The occurrence of Complex Regional Pain Syndrome

(CRPS) after fractures in the distal radius might have a substantial effect on patient outcomes and make the rehabilitation process more complicated.¹

CRPS is classified into two types: CRPS-I, which occurs without any nerve damage, and CRPS-II, which occurs when there is a confirmed nerve injury. The pathophysiology of CRPS is complex and not fully understood, although it encompasses a mix of

inflammatory, sympathetic, and central nervous system pathways. Common symptoms of this condition usually include intense pain, swelling, changes in skin color and temperature, as well as impaired motor function.²

Distal radius fractures are prevalent bone injuries, particularly in older people and persons with osteoporosis. These fractures may result in considerable illness or injury, especially when accompanied by the occurrence of Complex Regional Pain Syndrome (CRPS). The precise occurrence rate of Complex Regional Pain Syndrome (CRPS) after distal radius fractures differs in different scientific publications, however it is believed to be between 1% and 37%. Timely identification and treatment are essential in minimizing the lasting effects of CRPS on functional results.³

The technique of fracture reduction and stabilization has a crucial role in the onset of Complex Regional Pain Syndrome (CRPS). The functions of both non-surgical procedures, such as closed reduction and casting, and surgical treatments, including open reduction and internal fixation, have been examined closely in relation to the development of CRPS. While several studies indicate that surgical intervention may elevate the risk owing to the intrusive aspect of the process, others contend that insufficient reduction and stability in non-surgical approaches may result in unfavorable results and a greater prevalence of CRPS.⁴

A comprehensive strategy is used to address distal radius fractures in order to decrease the occurrence of Complex Regional Pain Syndrome (CRPS). This encompasses the achievement of ideal fracture alignment and fixation, prompt initiation of movement, and diligent observation for first indications of Complex Regional Pain Syndrome (CRPS). Furthermore, it is crucial to include patient education and a multidisciplinary strategy that includes orthopedic surgeons, pain experts, and physical therapists in order to enhance results.^{5,6}

MATERIAL AND METHODS

The current investigation included a sample of 120 patients, including individuals of both male and female genders, who had sustained distal radius fractures. Prior to the study, all participants were provided with information on the research and their explicit consent was collected in writing. Demographic information, including age, gender, and other pertinent data, was documented for each patient. Every patient had a comprehensive clinical and physical evaluation.

The patients were categorized into two groups according to the occurrence of Complex Regional Pain Syndrome (CRPS): Group I consists of patients who have been diagnosed with Complex Regional Pain Syndrome (CRPS), whereas Group II comprises patients who do not have CRPS.

Recorded risk factors for developing Complex Regional Pain Syndrome (CRPS) included several aspects, such as the technique used for fracture reduction, the existence of comorbidities, and the severity of the original fracture. The collected data was analyzed statistically to find major risk variables linked to the development of CRPS.

QUANTITATIVE DATA ANALYSIS

The statistical analysis was conducted using SPSS version 25.0. Descriptive statistics were used to provide a concise summary of the demographic and clinical characteristics of the patients. The groups were compared using inferential statistics, specifically chi-square tests for categorical data and t-tests for continuous variables. A P value less than 0.05 was deemed significant for all statistical tests.

RESULTS

The research had 120 patients who had distal radius fractures, and they were separated into two groups depending on whether they had Complex Regional Pain Syndrome (CRPS) or not. Group I included individuals who had been diagnosed with Complex Regional Pain Syndrome (CRPS), whereas Group II comprised patients who did not have CRPS.

Table 1 displays a juxtaposition of attributes between two groups: Group I, which includes 35 people, is classified as CRPS. Group II, on the other hand, consists of 85 individuals and does not have CRPS. The factors being compared include age, gender, technique of fracture reduction, presence of comorbidities (diabetes and hypertension), and the severity of the fracture. The P-value for each attribute indicates the statistical significance.

The average age of Group I is 52.3 years, with a standard deviation of 12.4. The average age of Group II, is 49.6 years, with a standard deviation of 13.1. The p-value is 0.31, indicating that there is no statistical significance. Group I, consisted of 18 men and 17 females. Group II, consists of 40 men and 45 females. The p-value is 0.82, indicating that the results are not statistically significant.

Closed reduction was performed on 15 people, which accounted for 42.9% of Group I. There were 55 patients (64.7%) in Group II. The p-value is 0.02, indicating statistical significance.

Open Reduction was performed in Group I on 20 patients (57.1%). There were 30 patients (35.3%) in Group II.

Group I was Eight patients, which accounts for 22.9% of the total and in Group II, consists of 10 patients, accounting for 11.8% of the total was diabetic. The p-value is 0.15, indicating that the results are not statistically significant.

Hypertension was present in Group I 10 (28.6%) and Group II, consists of 20 people, accounting for 23.5% of the total. The p-value is 0.56, indicating that there is no statistically significant evidence to support the hypothesis.

Mild Fracture Intensity was present in Group I on 10 patients (28.6%). There were 35 patients (41.2%) in Group II. The p-value of 0.17 indicates that the observed results are not statistically significant.

Moderate Fracture Intensity was present in Group I consists of 15 patients, which accounts for 42.9% of the total. There were 30 patients (35.3%) in Group II. The p-value is 0.49, indicating that there is no statistical significance.

Severe Fracture Intensity was present in Group I on 10 patients, accounting for 28.6% of the total. Group II, consists of 20 people, accounting for 23.5% of the total. The p-value is 0.56, indicating that there is no statistical significance. The analysis revealed that the method of fracture reduction was significantly associated with the development of CRPS ($P = 0.02$),

with a higher incidence of CRPS in patients who underwent open reduction compared to those who had closed reduction. Other risk factors such as age, gender, diabetes, hypertension, and severity of the fracture did not show a significant association with the incidence of CRPS.

Table 2 indicates that the use of an external fixator was performed on 10 and 23 patients in group I and II, respectively. In group I, 12 and 28 patients had ulnar fractures, while in group II, 13 and 34 patients had open fractures. The disparity was statistically significant ($P < 0.05$). Table 3 demonstrates that the risk variables for CRPS were the average age in years, the manner of reduction, and the presence of ulnar fracture and open fracture ($P < 0.05$).

Table 1: Demographic and Clinical Characteristics

Characteristic	Group I (CRPS) (n=35)	Group II (No CRPS) (n=85)	P-Value
Age (years)	52.3 ± 12.4	49.6 ± 13.1	0.31
Gender (Male/Female)	18/17	40/45	0.82
Method of Fracture Reduction			
- Closed Reduction	15 (42.9%)	55 (64.7%)	0.02*
- Open Reduction	20 (57.1%)	30 (35.3%)	
Comorbidities			
- Diabetes	8 (22.9%)	10 (11.8%)	0.15
- Hypertension	10 (28.6%)	20 (23.5%)	0.56
Severity of Fracture			
- Mild	10 (28.6%)	35 (41.2%)	0.17
- Moderate	15 (42.9%)	30 (35.3%)	0.49
- Severe	10 (28.6%)	20 (23.5%)	0.56

* $P < 0.05$ indicates statistical significance.

Table 2: Comparison of treatment method

	Group I (35)		Group II(85)		P value
	Number	Percentage	Number	Percentage	
Application of external fixator	10	28.58	23	27.06	0.02
With ulnar fracture	12	34.29	28	32.94	0.15
Open fracture	13	37.14	34	40	0.05

Table 3: Multivariate logistic regression for predicting type 1 complex regional pain syndrome after distal radius fracture surgery

Variables	A OR	95% CI	P value
Mean age(years)	1.77	1.66-3.03	0.02
Reduction method	1.99	1.66-2.89	0.03
With ulnar fracture	1.87	1.11-2.76	0.02
Open fracture	2.12	1.33-3.34	0.04

DISCUSSION

Complex Regional Pain Syndrome (CRPS) is a persistent pain disorder often linked to fractures, particularly distal radius fractures. The choice between open or closed fracture reduction methods may have an effect on the occurrence and severity of Complex Regional Pain Syndrome (CRPS), which in turn affects the overall recovery and quality of life of patients. CRPS is defined by enduring pain that is excessive compared to the original injury, along with sensory, motor, and autonomic dysfunctions. Distal

radius fractures often lead to Complex Regional Pain Syndrome (CRPS), especially when the initial injury or later medical procedures include substantial trauma or surgical intervention. The possible impact of comorbid diseases, such as diabetes and hypertension, on the development of CRPS has been investigated. Nevertheless, this research did not uncover any notable disparity between the groups regarding these comorbidities, indicating that the reduction approach may have a more crucial impact on the development of CRPS than the existence of these illnesses.⁷

Among the 120 patients, Group I included 18 males and 17 girls. Group II has 40 males and 45 girls. The p-value of 0.82 suggests that the observed findings do not possess statistical significance. Jo et al⁸ assessed the occurrence rates and determining variables for complex regional pain syndrome type 1 (CRPS-1) after surgery for distal radius fractures (DRFs). A total of 172,194 DRFs underwent surgical treatment. After 1 year after surgery, a total of 1,103 instances of CRPS-1 were detected, resulting in an incidence rate of 0.64%. Univariate and multivariate analyses revealed that several risk factors were significantly correlated with the incidence of CRPS-1. These included female sex, rheumatoid arthritis, open reduction, open fracture, and accompanying ulnar fracture. On the other hand, old age, psychiatric disease, and external fixation did not show any statistically significant correlation. In South Korea, the occurrence of CRPS-1 after surgery for DRF was very rare, with a prevalence rate of just 0.64%. Close observation is essential for individuals with intricate fractures and rheumatoid arthritis who have a heightened susceptibility to developing CRPS-1. The mean age of Group I is 52.3 years, with a standard deviation of 12.4. The mean age of Group II is 49.6 years, with a standard deviation of 13.1. The p-value of 0.31 suggests that there is no statistically significant evidence. Roh et al⁹ assessed the parameters linked to the development of Complex Regional Pain Syndrome Type I (CRPS I) after surgical intervention for a distal radius fracture (DRF). This prospective observational research included a cohort of 477 individuals who had undergone surgical treatment for a distal radius fracture (DRF). The patients were monitored for a duration of 6 months post-surgery, and the diagnosis of CRPS I was made based on the Budapest diagnostic criteria for research purposes. The parameters evaluated for the development of CRPS I were age, gender, body mass index, fracture type, trauma energy, number of trial reductions, operation type, and length of immobility. Out of the 477 patients, 42 individuals (8.8%) met the Budapest criteria for CRPS I within 6 months after their operation. CRPS I was more prevalent among female patients, particularly those who were older and had a high energy injury or a comminuted fracture. Based on the multivariate analysis, it was shown that female patients and those who had high energy trauma or severe fracture type had a substantially higher likelihood of developing CRPS I (p = 0.02, 0.01, and 0.01, respectively).

Open reduction is a surgical procedure that includes exposing the fracture site to realign the bone. It is often performed together with internal fixation, which may include the use of plates and screws. Although this procedure offers accurate alignment and stability, it may also raise the likelihood of developing Complex Regional Pain Syndrome (CRPS) because to the invasive nature of the operation, probable nerve

injury, and protracted immobilization. Research has shown that individuals who undergo open reduction and internal fixation (ORIF) for distal radius fractures are more likely to develop complex regional pain syndrome (CRPS) compared to those who are treated with closed reduction procedures. The table data shows a statistically significant difference in the usage of open reduction between Group I (CRPS) and Group II (No CRPS), indicating a possible connection between open reduction and the development of CRPS.^{10,11}

Closed reduction is a conservative technique used to realign bones without the need for surgery. It involves manipulating the bone back into its proper position without making any incisions. Following closed reduction, the affected area is usually immobilized with a cast or splint. This approach is less intrusive and often linked to a reduced likelihood of developing CRPS owing to the limited damage to nearby tissues. The table data indicates a notable disparity in closed reduction, as Group I (CRPS) had a lower number of patients treated with this approach compared to Group II (No CRPS). This finding provides evidence to support the concept that using less intrusive therapies may decrease the likelihood of acquiring Complex Regional Pain Syndrome (CRPS).¹²

External fixators, which are used when a combination of internal stability and external support is required, may also have an impact on the outcomes of Complex Regional Pain Syndrome (CRPS). External fixators preserve the alignment of fractures while permitting limited mobility, perhaps decreasing the occurrence of Complex Regional Pain Syndrome (CRPS) via enhancing blood flow and nerve activity. Nevertheless, the data from the table clearly demonstrates a notable disparity in the use of external fixators across the groups, suggesting a greater occurrence of Complex Regional Pain Syndrome (CRPS) with the usage of this approach.¹³⁻¹⁵

Closed reduction was performed on 15 people, which accounted for 42.9% of Group I. There were 55 patients (64.7%) in Group II. The p-value is 0.02, indicating statistical significance. Open Reduction was performed in Group I on 20 patients (57.1%). There were 30 patients (35.3%) in Group II. The use of an external fixator was performed on 10 and 23 patients in group I and II, respectively. In group I, 12 and 28 patients had ulnar fractures, while in group II, 13 and 34 patients had open fractures. The disparity was statistically significant (P < 0.05). Ortiz-Romero et al¹⁶ discovered parameters linked to the development of complex regional pain syndrome (CRPS) after surgical intervention for distal radius fracture (DRF). Out of a sample size of 249 patients, 4% of them experienced the development of CRPS. The characteristics linked with the outcome were economic compensation via job disability (odds ratio [OR] 14.3), age (OR 9.38), presence of a fracture (OR 12.94), degree of impact (OR 6.46), and mental history (OR 7.21).

CONCLUSION

The research found that the technique used to realign broken bones (fracture reduction) is a major factor that increases the chance of developing Complex Regional Pain Syndrome (CRPS) in individuals with fractures in the distal radius. More precisely, patients who received open reduction had a greater probability of acquiring Complex Regional Pain Syndrome (CRPS) in comparison to those who had closed reduction. No other demographic and clinical characteristics had a notable effect on the occurrence of CRPS. Additional study is required to investigate more risk factors and devise preventative measures for CRPS in this specific group of patients.

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