

# Fracture of the Wrist and Incidence of the Complex Regional Pain Syndrome Type 1: A Case Series Study

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## Abstract

**Background:** Complex regional pain syndrome (CRPS) is a painful syndrome with signs such as swelling, restriction of motion, and discoloration of the skin and bone. CRPS is divided into two types based on neurological injuries. Type 1 CRPS (CRPS-I), which is more common, has no nerve damage. In this study, we used the Budapest Criteria to investigate the incidence of CRPS. We also evaluated the risk factors for the incidence of CRPS.

**Methods:** This single-center case series study was performed at Shariati Hospital of Tehran University of Medical Sciences, Tehran, Iran, during 2018-2019. We evaluated CRPS-I, two and six weeks after treatment based on Budapest Criteria. The inclusion criteria included distal radius fracture confirmed by clinical and radiographic investigations. The exclusion criteria were patients with fractures in another part of the body, associated nerve damage, vascular injury, and an open fracture.

**Results:** Sixty-two patients with distal radius fracture who underwent casting or surgical treatment enrolled in the study. A total of 9 (14.5%) patients had CRPS-I after distal radius fracture. In 5 (8.1%) patients, CRPS-I occurred within two weeks after fracture. Also, 4 (6.5%) patients had CRPS-I after six weeks from fracture. There was no significant difference between the two sex groups in terms of CRPS ( $P = 0.345$ ). This complication was significantly higher in the surgical group than in the casting group ( $P = 0.004$ ).

**Conclusions:** Given the significant incidence of CRPS and its impact on patient's quality of life, further studies are recommended to explore solutions to reduce this complication.

**Keywords:** Complex Regional Pain Syndrome; Upper Extremity; Incidence

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## Background

Distal radius fracture is a common fracture, especially in elderly patients (1). This type of fracture is associated with side effects such as non-union, mal-union, neural injuries, tendon injuries, and complex regional pain syndrome (CRPS).

CRPS is a painful syndrome with signs such as swelling, restriction of motion, and discoloration of the skin and bone (2). Various causes such as soft tissue contusions, fracture, and tendon rupture can cause CRPS, but the most common cause is the fracture. The severity of these symptoms is disproportionate to the extent of the injury (3). CRPS is divided into two types based on neurological injuries. Type 1 CRPS (CRPS-), which is more common, has no nerve damage (4).

Various studies have reported the incidence of CRPS after distal radius fractures in the range of 1% to 37% and in this respect, CRPS has the highest association with distal radius fractures (5).

The diagnosis of CRPS-I is made using clinical diagnostic criteria. Many attempts have been made to achieve a single diagnostic criterion, but this has not yet been achieved (6). Different criteria are used to diagnose CRPS-I. The most commonly-used ones are the criteria developed by Veldman et al. (7), Bruehl et al. (8), and Budapest Criteria (9).

The pathogenesis of CRPS is not well understood, so future studies to investigate the risk factors of this syndrome may help to better understand its pathogenesis in the future.

We aimed to evaluate the incidence of this syndrome following distal radius fracture according to different gender and treatment groups.

## Methods

This single-center case series study was performed at Shariati Hospital of Tehran University of Medical Sciences, Tehran, Iran, during 2018-2019. Patients with distal radius fracture confirmed by clinical and radiographic investigations, who underwent casting or surgery treatment, were included in this study. The exclusion criteria included patients with fractures in another part of the body, associated nerve damage, vascular injury, and open fracture. Budapest Criteria as valid criteria for diagnosis of CRPS-I were used to evaluate the patients two and six weeks after treatment (Table 1) (9). This study was conducted by following the Declaration of Helsinki and was approved by the Ethics Committee of Tehran University of Medical Sciences. The ethical registration code of the study is IR.TUMS.MEDICINE.REC.1397.219.

Statistical analysis was performed using SPSS software (version 24, IBM Corporation, Armonk, NY, USA). Qualitative variables were shown by number and percentage and quantitative variables were demonstrated by mean and standard deviation (SD). Fisher's exact test was used to compare the significant difference of CRPS-I between different gender and treatment groups.

**Table 1.** Budapest criteria in diagnosing complex regional pain syndrome type 1 (CRPS-I)

**1. Continuing pain that is disproportionate to any inciting event**

**2. One symptom in three of the four categories:**

- Sensory (hyperesthesia and/or allodynia)
- Vasomotor (temperature asymmetry and/or skin color changes)
- Sudomotor/edema (sweating changes and/or swelling)
- Motor/trophic (altering motion, weakness, tremor, dystonia, trophic changes in hair, nail, skin)
- Sensory (hyperesthesia to pinprick, allodynia to light touch and/or deep somatic pressure and/or joint movement)

**3. One sign in two or three of the following categories:**

- Vasomotor (evidence of temperature asymmetry and/or skin color changes)
- Sudomotor/edema (evidence of sweating changes and/or swelling)
- Motor/trophic (evidence of altering motion, weakness, tremor, dystonia, trophic changes in hair, nail, skin)

**4. No other diagnosis can better explain the symptoms and signs.**

**Results**

Sixty-two patients with distal radius fracture between August 2018 and August 2019, who underwent casting or surgical treatment, enrolled in the study. The mean and SD of the patient's age was  $44.08 \pm 21.13$  years. 34 (54.8%) patients were male and 28 (45.2%) were female. Non-invasive treatment (casting) was performed on 35 (56.5%) patients and surgical treatment was performed on 27 (43.5%) patients.

A total of 9 (14.5%) patients had CRPS-I after distal radius fracture. 5 (8.1%) patients experienced CRPS-I within two weeks after fracture. Also, 4 (6.5%) patients had CRPS-I after six weeks from fracture.

Of 34 male patients, 18 (52.9%) had a casting and 16 (47.1%) had surgical treatment. In the male population, 2 (5.9%) had CRPS-I within two weeks after fracture. Also, 4 (11.8%) had this complication in the sixth week after the fracture. Of 28 female patients, 17 (60.7%) had a casting and 11 (39.3%) had surgical treatment. In the female population, 3 (10.7%) experienced CRPS-I within two weeks. However, none of the patients had CRPS-I in the sixth week after the fracture. The mean age in the female group was  $46.32 \pm 21.79$  years and in the male group was  $42.24 \pm 20.72$  years. There was no significant difference between the two sex groups in terms of age ( $P = 0.453$ ) and treatment modalities ( $P = 0.361$ ).

Table 2 shows the incidence of CRPS-I by gender groups.

**Table 2.** Incidence of complex regional pain syndrome type 1 (CRPS-I) by gender groups

	Male	Female	P-value
CRPS-I in two weeks after fracture	2	3	-
CRPS-I in six weeks after fracture	4	0	-
Total	6	3	0.345

A total of 35 patients received non-invasive treatment (casting). None of these patients had complications within two weeks after fracture. However, in one case (2.9%), this complication was found within six weeks after fracture. 27 patients underwent surgical treatment. In the surgical treatment group, 5 patients (18.5%) developed CRPS-I in two weeks after fracture and 3 patients (11.1%) developed this complication in the sixth week.

The mean age in the casting group was  $47.71 \pm 23.21$  and in the surgical group was  $39.37 \pm 17.39$ . There was no

significant difference in age between the two groups ( $P = 0.111$ ).

Table 3 shows the incidence of CRPS-I by treatment groups.

**Table 3.** Incidence of complex regional pain syndrome type 1 (CRPS-I) by treatment groups

	Male	Female	P-value
CRPS-I in two weeks after fracture	0	5	-
CRPS-I in six weeks after fracture	1	3	-
Total	1	8	0.004

The incidence of CRPS-I was not significantly different between the two sex groups ( $P = 0.345$ ). This complication was significantly higher in the surgical group than in the casting group ( $P = 0.004$ ).

**Discussion**

Although several studies have evaluated the incidence of CRPS-I (10-12), a comprehensive study in Iran has not been conducted to determine the incidence of this complication. The incidence of CRPS-I in different studies has been in the range of 1% to 37% (13, 14). In our study, the incidence rate was 14.5%.

Most studies have reported a higher incidence of CRPS-I in the female population than in men (15-17). Our study showed that this value was not significantly different between the two sex groups ( $P = 0.345$ ), which may be due to the greater use of the surgical approach in men and the use of different diagnostic criteria in this study.

In our study, the incidence of CRPS-I was significantly higher in patients who underwent surgery than in the casting group ( $P = 0.004$ ). Given the greater use of the surgical technique in more severe injuries, it can be predicted that severe fractures and high-energy injuries increase the risk of this complication. The results of previous studies were similar in terms of differences in the incidence of CRPS-I in different treatment modalities (12, 18).

Budapest Criteria that have the highest specificity for CRPS-I diagnosis were used in our study (9).

**Conclusion**

Based on the high incidence rate of CRPS-I after fracture of the distal radius, multi-center studies with a larger sample size are recommended for investigating the exact incidence rates and risk factors.

## Conflict of Interest

The authors declare no conflict of interest in this study.

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