



# Incidence of Complex Regional Pain Syndrome Following the Carpal Tunnel Release Surgery

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## Abstract

**Background:** Complex regional pain syndrome (CRPS) is a chronic syndrome of pain usually caused by an initiating noxious event in the periphery. Carpal tunnel release (CTR) surgery has been known to associate with the development of CRPS.

**Objectives:** The incidence rate of CRPS has been attributed to the differences in ethnic and socioeconomic background of the cohort. Here, we aimed at evaluating the incidence of CRPS after CTR surgery in Iranian population for the first time.

**Methods:** In a prospective study, a total of 106 patients with carpal tunnel syndrome (CTS), who underwent CTR surgery, were included in this cohort. The patients' medical records were evaluated and the incidence of CRPS after CTR surgery was assessed accordingly. Visual analogue scale (VAS) was used to subjectively evaluate the pain level in each CRPS patient.

**Results:** In this study, 7 (6.6%) cases of postoperative CRPS including 1 (14.2%) male and 6 (85.8%) females were identified at a mean follow-up period of  $6.1 \pm 2.4$  months, ranging from 2 to 7 months. The mean age of CRPS cases was  $49.5 \pm 10.6$ , ranging from 31 to 74 years. In 2 patients the dominant hand and in 5 patients nondominant hand were involved. The mean preoperative VAS was 2.9, ranging from 2 to 4, which increased to 8.1 in CRPS patients, ranging from 7 to 9.

**Conclusions:** CRPS could be seen frequently following the CTR surgery, giving rise to a pain level of significantly higher than the initial pain level. Consequently, the patients should be informed of this potential adverse consequence of CTR surgery, especially those having the risk factors of this condition including gender, age, and hand dominance.

**Keywords:** Complex Regional Pain Syndrome, Carpal Tunnel Release, Incidence

## 1. Background

Complex regional pain syndrome (CRPS) is a chronic syndrome of pain and sudomotor or vasomotor instability. This syndrome is usually caused by an initiating noxious event in the periphery and is not limited to the distribution of a single nerve (1, 2). The pain, which is disproportionate to the inciting event, can be associated with abnormal skin discoloration, changes in limb temperature, and increased sweating or edema (1, 2).

Several types of orthopedic surgeries including carpal tunnel release (CTR) surgery have been known to associate with the development of CRPS (3).

Carpal tunnel syndrome (CTS) is a medical condition caused by the compression of the median nerve as it passes through the wrist at the carpal tunnel. The main symptoms of this syndrome are pain, numbness, and tingling in the hand. During open carpal tunnel release surgery, the transverse carpal ligament is transected. This intervention releases the existing pressure on the median nerve and re-

lieves the symptoms of carpal tunnel syndrome (4, 5).

The literature reports an incidence of 2.1% to 5% for CRPS after CTR surgery (6, 7). However, several other factors such as motor nerve injury, ethnic factors, and gender have been reported to affect this incidence (3, 8).

## 2. Objectives

To the best of our knowledge, the incidence of CRPS following the CTR surgery has not been previously assessed in Iranian CTS population. Thus, we aimed at evaluating the incidence of CTR associated CRPS for the first time in Iranian population.

## 3. Methods

This study was approved by institutional review board of Iran University of Medical Sciences, and informed consent was obtained from all patients to use their data.

In a prospective study, a total of 106 CTS patients, who underwent CTR surgery in our center during 2015 and 2016, were included. The patients' medical records were evaluated and the incidence of CRPS after CTR surgery was assessed accordingly.

Budapest diagnostic criteria were used for the diagnosis of CRPS following the CTR surgery. These diagnostic criteria consist of 4 components including sensory, vasomotor, sudomotor/edema, and motor/trophic categories (9).

Three different surgeons performed open CTR under local anesthesia in all cases. Briefly, the incision was made 5 mm ulnar to the thenar crease, just distal to the Kaplan oblique line and extended 3.0 to 4.0 cm proximally toward the distal wrist crease (Figure 1). The superficial palmar fascia, transverse carpal ligament, and antebrachial fascia were divided. After dressing a dorsal short arm, splint was applied for 2 weeks. Patients were advised to use the involved hand and fingers to promote better range of motion. We did not prescribe any medication after CTR.

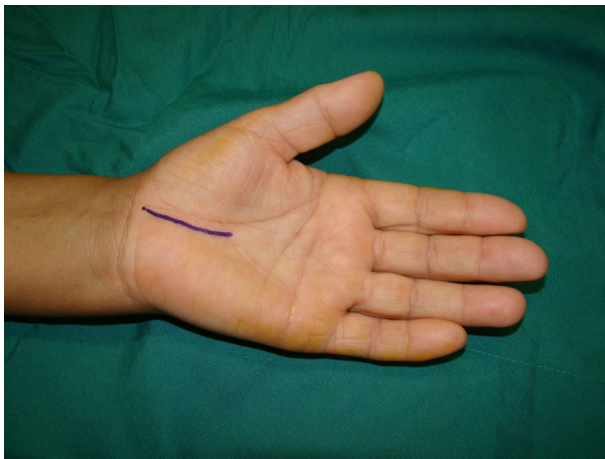


Figure 1. Line of Incision Photograph of Carpal Tunnel Release Surgery

The patients were visited at intervals of 2 to 4 weeks for at least 4 months. In each follow-up session, improvement was assessed and complications of the surgical procedure were recorded. Visual analogue scale (VAS) was used to subjectively evaluate the pain level in each CRPS patient (10).

#### 4. Results

In total, 23 male and 83 female with the mean age of  $49.5 \pm 10.6$ , ranging from 31 to 74 were evaluated. The mean follow-up period of the patients was  $6.1 \pm 2.4$  months, ranging from 2 to 7 months (Table 1). Associated diseases such as hypertension, diabetes, and migraine were observed in

25 patients; and in 78 (73.5%) patients, dominant hand and in 28 (26.5%) patients nondominant hand were involved.

Table 1. Baseline Characteristics of CTR Patients

Variable	Mean $\pm$ SD / No. (%)
Age, y	49.5 $\pm$ 10.6
<b>Gender</b>	
Male	23 (21.6)
Female	83 (78.4)
<b>Associated disease</b>	
None	68 (64.1)
Hypertension	19 (18)
Diabetes mellitus	8 (7.5)
Migraine	11 (10.4)
<b>Symptom duration, mo</b>	19.8 $\pm$ 8.6
<b>Disease onset, y</b>	48.7 $\pm$ 7.3
<b>Dominant hand</b>	
Right	88 (83)
Left	18 (17)
<b>Affected hand</b>	
Right	47 (44.4)
Left	25 (23.5)
Both	34 (32.1)
<b>Follow-up, mo</b>	6.1 $\pm$ 2.4

Abbreviation: CTR, Carpal Tunnel Release.

A total of 7 (6.6%) cases of postoperative CRPS including 1 (14.2%) male and 6 (85.8%) females were identified. Associated disease was observed in 4 patients, which included 1 case of diabetes, 2 cases of hypertension, and 01 case of migraine. The clinical and demographic characteristics of CRPS patients are demonstrated in Table 2.

In CRPS group, the dominant hand of 2 patients was affected, while in the rest of the 5 patients nondominant hand was involved. The mean time of disease onset was 4 weeks after the surgery. A combination of CRPS symptoms and signs including sensory, vasomotor, motor, and trophic changes were observed in our patients (Table 3). Sensory and sudomotor signs and symptoms were present in all CRPS patients in our cohort, while motor and vasomotor signs and symptoms were absent in some of them (Table 3).

The mean preoperative VAS was 2.9, ranging from 2 to 4, which increased to 8.1 in CRPS patients, ranging from 7 to 9.

Oral non-steroidal anti-inflammatory drug (NSAID)

**Table 2.** Clinical and Demographic Characteristics of the CRPS Patients

Patient ID	Age, y	Gender	Affected Hand	Follow-Up, mo	Post-Op Disease Onset, mo	Associated Disease	Preoperative VAS	Last Follow-up VAS
1	51	Female	Non Dominant	6	1	-	4	9
2	35	Female	Dominant	4	1	DM	3	8
3	46	Female	Non Dominant	5	1	-	2	8
4	51	Female	Dominant	4	1	HTN	2	7
5	54	Female	Dominant	4	1	Migraine	3	8
6	72	Female	Dominant	5	1	-	3	9
7	74	Male	Dominant	6	2	HTN	3	8

Abbreviations: CRPS, Complex Regional Pain Syndrome; DM, Diabetes Mellitus; HTN, Hypertension.

**Table 3.** The Distribution of Symptoms and Signs Among the CRPS Patients

Symptom/Sign	Patient ID						
	1	2	3	4	5	6	7
Sensory	+	+	+	+	+	+	+
Vasomotor	+	-	+	-	+	+	-
Sudomotor/edema	+	+	+	+	+	+	+
Motor/trophic	+	+	+	-	-	+	+

Abbreviation: CRPS, Complex Regional Pain Syndrome.

and physiotherapy were used to manage the pain of the CRPS patients.

## 5. Discussion

A wide range of conditions have been introduced to precede CRPS. Trauma is the most common cause introduced in most series, accounting for 30% to 77% of the cases (11).

The development of CRPS following the surgical trauma is not uncommon, and the incidence varies according to the type of intervention, site of surgical trauma, and time of evaluation (12). The incidence rate for CRPS was reported to be 6.28 per 100,000 person-years (13). However, a subsequent population-based study by de Mos et al. estimated the incidence rate of CRPS to be approximately 4 times greater (26.2 per 100,000 person-years), which has been attributed to the differences in ethnic and socioeconomic background of the cohort as well as the application of the diagnostic criteria (14). With respect to the effects of ethnic and socioeconomic background on the incidence of CRPS, the reported incidence varies according to the geographical region where the study was undertaken (3), and the incidence might be different from one region to another. The main aim of this study was to

evaluate the incidence of CRPS in the Iranian population following CTR surgery.

Da Costa et al. reported an incidence of 8.3 % for CRPS following the CTR surgery (15), which was higher than the incidences reported earlier (2.1% to 5%) (6). We found an incidence of 6.6% for CRPS following the CTR surgery, which was comparable to the results of previous reports (6).

According to previous published data, a greater prevalence of CRPS was expected in the female population (8, 15). A considerably higher incidence of CRPS was also observed in female population of our study (85.8%).

Demir et al. evaluated the risk factors of complex regional pain syndrome in patients with traumatic extremity injury. Their results revealed that the affected hand was dominant in 64.2% of patients with CRPS (8). Five out of 7 (71%) CRPS cases of cohort were also observed in the dominant hand.

Based on the study of Veldman et al., the median age of CRPS patients was 42 years, varying between 9 to 85 years (16). The mean age of the CRPS patients of our study was 54.5 years, while all patients of our study were older than the patients of the mentioned study (16).

Da Costa et al. found no association between CRPS and concomitant diseases such as hypertension, diabetes mellitus, and migraine. We also observed no association be-

tween the occurrence of CRPS and these comorbidities (15).

Forouzanfar et al. reported a mean VAS of  $7.1 \pm 1.5$  in 61 posttraumatic CRPS patients (17). Kumar et al. also reported a mean VAS of 8.4 in 25 CRPS patients (18). We recorded a mean VAS of 8.1 in 7 CRPS patients of ours, which was comparable to the results of earlier reports. Forouzanfar et al. also reported a relative pain reduction of 50% or more and an absolute pain reduction of at least 3 units on the VAS as accurate factors in predicting the successful pain reduction after a given treatment. However, since we did not follow the CRPS patients after treatment, the pain reduction data were not available to report.

Although non-steroidal anti-inflammatory drugs (NSAIDs) reduce inflammation and have been widely used in the treatment of CRPS, it is evident that these medications might be inefficacious in some patients suffering from CRPS, which may be attributed to the multifactorial and heterogeneous nature of the condition (19). Consequently, other therapeutic options such as anti-oxidants and anticonvulsant drugs could be kept in mind (20).

Based on the earlier reports, the incidence of postoperative CRPS may vary according to the period and time of the follow-up. In this aspect, the incidence of CRPS has a tendency to decrease over the first 3 months after the surgery and stabilize approximately after 6 months. Thus, studies that follow the development of CRPS early in the postoperative period can detect a higher incidence of the disease (8). We followed all patients from the first dressing to at least 6 months after the surgery to cover both early and late CRPS postoperative development, which could be regarded as the strength of our study.

This study has some limitations. The main limitation of this study was the small number of CRPS patients, which did not allow us to statistically analyze the potential associations between different clinico-demographic variables and CRPS incidence.

In conclusion, according to our results, CRPS may be found in a considerable number of patients following the CTR surgery, giving rise to a pain level of significantly higher than the initial pain level. Thus, the patients should be informed of this potential adverse consequence of CTR surgery. In addition, more attention should be paid when the patient has the risk factors of this condition including female gender, age older than 42 years, and CTR surgery of the dominant hand.

#### Footnote

**Authors' Contribution:** Study design, Hooman Shariatzadeh; data collection, drafting, and critical revision of the manuscript, Hooman Shariatzadeh and Mohammad

Mujeb Mohseni; study supervision, Hooman Shariatzadeh.

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