Patients with Cervical Radiculopathy or Upper Limb Compressive Neuropathies Should Be Counselled about the Risk of CRPS Following Distal Radius Fracture

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INTRODUCTION:

Complex Regional Pain Syndrome (CRPS) type 1 is most commonly reported after distal radius fracture (DRF). Numerous studies have identified factors such as female gender, higher BMI, older age, high-energy trauma, severe comminuted fractures, psychiatric disorders, and fibromyalgia as significantly increasing the risk of CRPS, while preventive measures like vitamin C supplementation have shown mixed results. Early fracture management and educational interventions have proven effective in reducing CRPS incidence. The association between comorbid compressive neuropathies or cervical radiculopathy and the development of CRPS after DRF has not been explored in the contemporary literature.

METHODS:

The PearlDiver Mariner 165 (M165) database, a HIPAA-compliant national database covering 165 million patients with private insurance and Medicare claims from 2010 to 2022, was queried for this study. Patients with distal radius fractures (DRF) were identified using ICD-10 codes, and those diagnosed with CRPS after DRF fracture were identified similarly. The control group comprised patients without a CRPS diagnosis after DRF, while the study group included patients diagnosed with CRPS after DRF. Study and control groups were matched in a 1:10 ratio based on age, sex, and Charlson Comorbidity Index (CCI) to minimize confounding.

We compared the following variables between our study and control groups using their ICD-10 and CPT codes: cervical radiculopathy, brachial plexus injury, carpal tunnel syndrome, cubital tunnel syndrome, and radial, ulnar, and median nerve injuries. Additionally, we compared the coincidence of de Quervain's tenosynovitis, tenosynovitis, tendinopathies of the shoulder, arm, forearm, and hand, carpal tunnel surgeries, cubital tunnel surgeries, first dorsal compartment release, trigger finger diagnosis, total number of emergency department (ED) visits, 90-day ED visits, history of drug use, history of opioid use, and diagnosis of autoimmune diseases. All these variables were analyzed using chi-square tests for categorical variables and student t-tests for continuous variables.

RESULTS:

The study identified several factors significantly associated with the development of CRPS following DRF. Patients with CRPS following DRF demonstrated significantly higher odds of having a history of cervical radiculopathy, brachial plexus injury and radial nerve injury. Other significant histories associated with CRPS after DRF include carpal tunnel syndrome and its surgical release, as well as cubital tunnel syndrome and its surgical release. The p-value for all the above factors is < 0.001. Notably, the diagnosis of de Quervain's tenosynovitis was significant but first dorsal compartment release did not reach significance. Other significant associations were also observed for tenosynovitis of the forearm ($p = 0.012$) and hand ($p = 0.009$), whereas tenosynovitis of the arm and shoulder were not significant. We also found no significant correlation between brachial plexus surgery and trigger finger surgery, despite their diagnoses being significantly associated with CRPS diagnosis after DRF.

Table 1 present 12 variables we studied, depicted with their respective column graphs of odds ratios (OR). Our analysis focused on the anatomical locations of the pathology and their historical implications as risk factors for CRPS following distal radius fractures (DRF), based on ICD-10 codes.

Table 2 illustrate that the cohort of patients with CRPS following DRF exhibited higher odds of fibromyalgia, history of autoimmune disease, drug abuse, depression, opioid abuse, overall emergency department (ED) visits, and 90-day ED visits. The p-values for all these factors are less than 0.001. Additionally, female gender is a significant risk factor ($p < 0.001$).

The graph in Figure 1 illustrates the percentage of patients diagnosed with CRPS stratified by CPT codes. It reveals an upward trend, with higher CPT codes indicating more complex fracture treatments, and a corresponding increase in CRPS incidence. The linear trendline ($R^2 = 0.901$) highlights a strong positive correlation between the complexity of fracture management and the likelihood of developing CRPS.

DISCUSSION AND CONCLUSION:

This study highlights significant associations between the development of CRPS following DRF and a history of cervical radiculopathy, brachial plexus injury, radial nerve injury, carpal and cubital tunnel syndromes and surgeries, and certain compressive tendinopathies like de Quervain's tenosynovitis and trigger finger. Given the increased odds of drug and opioid use, fibromyalgia, and elevated emergency department visits in patients with CRPS, it is crucial for clinicians to identify high-risk patients early and consider comprehensive management strategies. Educating patients with a history of

cervical radiculopathy or upper limb compressive neuropathies about their increased risk is essential. Proactive identification and targeted interventions can significantly reduce the impact of CRPS and enhance patient outcomes.

Figure 1: The graph represents the incidence rate of CRPS according to CPT codes of management.

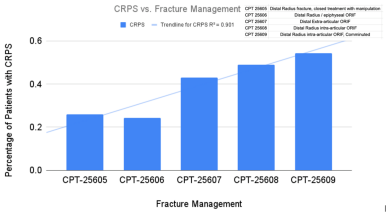

Table 1

Anatomical Location	Conditions	DRF w/o CRPS (N = 25956)	DRF w/ CRPS (N = 2596)	Odds Ratio	CI lower	CI upper	P value
Head & Neck	Cervical Radiculopathy	1853	436	**2.631570947**	**2.3255814**	**2.941176471**	**<0.001**
	Brachial Plexus Injury	75	23	**3.125**	**1.92307692**	**5**	**<0.001**
Non Specific	Radial Nerve Injury	46	20	**4.347826087**	**2.56410256**	**7.142857143**	**<0.001**
Elbow	Cubital Tunnel Diagnosis	549	147	**2.777777778**	**2.3255814**	**3.333333333**	**<0.001**
	Cubital Tunnel Surgery	103	31	**3.030303503**	**2**	**4.545454545**	**<0.001**
Forearm	Tenosynovitis Forearm	78	16	**2.057483623**	**1.119968607**	**3.528623599**	**0.01247**
Wrist	Carpal Tunnel Diagnosis	2632	545	**2.380952381**	**2.127659597**	**2.631578947**	**<0.001**
	Carpal Tunnel Surgery	860	182	**2.222222222**	**1.85185185**	**2.564102564**	**<0.001**
	Radial Styloid Tenosynovitis (DQ) Diagnosis	219	45	**2.073078935**	**1.500314454**	**2.864503814**	**<0.001**
	Radial Styloid Tenosynovitis (DQ) Surgery	84	15	**1.790003902**	**1.03183681**	**3.105252535**	**0.05415**
Hand	Tenosynovitis Hand	132	24	**1.825533374**	**1.179463933**	**2.825498086**	**0.009281**
Fingers	Trigger Finger Diagnosis	455	84	**1.886792453**	**1.47058824**	**2.380952381**	**<0.001**

Table 2

Conditions	DRF w/o CRPS (N = 25956)	DRF w/ CRPS (N = 2596)	Odds Ratio	CI lower	CI upper	P Value
Autoimmune Disease	2357	278	**1.20481928**	**1.05263**	**1.36986**	**0.007**
Depression	12776	1333	**1.08932462**	**1.00402**	**1.18064**	**0.041**
Drug Abuse	3965	491	**1.2987013**	**1.1655**	**1.43472**	**<0.001**
Opioid Abuse	22634	2387	**1.666666667**	**1.44928**	**1.93798**	**<0.001**
Gender (female)	16031	2254	**3.6**	**4**	**3.1**	**<0.001**
ED Visits	21124	2222	**1.35135135**	**1.21951**	**1.51515**	**<0.002**
90 Day ED Visit	3708	558	**1.64278711**	**1.49254**	**1.81818**	**<0.001**
Fibromyalgia	1794	279	**1.62176749**	**1.85273**	**1.4196**	**<0.001**