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FREQUENCY OF CHRONIC REGIONAL PAIN SYNDROME FOLLOWING CLOSED REDUCTION IN ELDERLY PATENTS PRESENTING WITH COLLES FRACTURE AT A TERTIARY CARE HOSPITAL, KARACHI

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Abstract

Objective: *To reveal what are the risk factors to developing Complex Regional Pain Syndrome (CRPS) among elderly patients with Colles fracture and associated co-morbidities, characteristics of the fracture and clinical outcome.*
This study was conducted at the Department of Orthopedics, Jinnah Postgraduate Medical Centre (JPMC), Karachi, for six months, after approval of the synopsis.
Study Design *: Descriptive study.*
Materials and Method: *This was a cross-sectional study performed on 140 elderly patients presenting with Colles fracture aged 60 years and above who were selected by consecutive non-probability sampling. Demographic characteristics, type of fracture, pain severity, co-morbidities and clinical outcomes data were collected. CRPS developed in patients during a 3-month follow-up period. Statistical analysis was conducted using chi-square tests and independent t-tests, with a p-value < 0.05 deemed significant.*
Results: *About 56% of study population were female; 72% had co-morbidities, mainly hypertension and diabetes. There was also a strong association of severe pain at presentation with the development of CRPS (p = 0.01) and prolonged immobilization and CRPS (p = 0.04). Extra-articular fractures were predominant (58%) among which the incidence of CRPS was higher in intra-articular fractures (23%) and comminuted fractures (30%).*
Conclusion:
Elderly patients with Colles fractures, particularly patients with strong pain perception, prolonged immobilization, and specific fracture types, are prone to develop CRPS. Early diagnosis and treatment of pain and comorbidities to decrease complications. More studies are needed to validate these findings and determine targeted management protocols.

INTRODUCTION

Colles fracture is the most common extra-articular fracture of the distal radius and is a prevalent orthopaedic presentation in the elderly, particularly postmenopausal women[1]. Bone density decreases with age, so osteoporosis, coupled with a higher risk of falls, increases the incidence of such fractures[2].

Colles fractures are common in Pakistan, where a large segment of the elderly population are living in low-resource settings and lack access to preventive and rehabilitative care, which often leads to their complication due to inadequate or delayed treatment. One of the few but debilitating potential complications is CRPS (Chronic Regional Pain Syndrome) which significantly interrupts the healing process, yet remains poorly diagnosed and low on documentation, especially in the local literature[3].

CRPS is a type of pain disorder that is a multifactorial in its attack with disproportionate pain, sensory alteration and also vasomotor, motor and trophic abnormalities of the affected limb[4]. CRPS pathophysiology is still incompletely understood, but is presumed to involve elements of peripheral and central sensitization, dysregulated inflammatory reactions, and autonomic dysregulation[5]. Contributing risk factors include increasing age, female gender, psychological stress, and inadequate fracture treatment[6]. The prevalence of CRPS after distal radius fractures has been described in the literature between 1% and 37% depending on the diagnostic criteria applied and the setting in which the study was done[7].

Recent investigations have highlighted the link between closed reduction techniques and the subsequent development of CRPS[8]. The incidence of CRPS in patients with Colles fractures who were conservatively treated was 11.5% in a 2020 prospective study conducted in India. In contrast, European studies using Budapest criteria observed lower incidence rates, likely a result of prompt diagnosis and continuous follow-up[9]. But in resource-poor countries like Pakistan, such data are rare. This under-reporting may be due to the recognised lack of standardised protocols for diagnosis and follow-up. Moreover, the combination of rigid immobilisation, non-physiotherapeutic approaches and inadequate pain treatments contribute to the high risk for CRPS onset[10].

A retrospective review born in Karachi in 2021 proposed that CRPS was only considered in a small proportion of the elderly patients presenting with post-traumatic upper limb pain. This comes as a surprise as this definitely indicates the gap in the clinical awareness and no systematic data collection regarding this entity from our local setting. It is very relevant to generate context-specific evidence to guide clinical practice, particularly in high-burden tertiary care institutions.

In the Pakistani context, where elderly care is typically piecemeal and dictated by economic limitations, this research is important[11]. Poor functional outcomes have been attributed to a limited awareness of CRPS among primary care clinicians, the absence of multidisciplinary rehabilitation teams, and financial impediments to follow-up care, but this has never been systematically studied in elderly patients[12]. Bridging this knowledge gap will not only allow for early diagnosis and treatment but also help guide standardized treatment guidelines for use in low-resource settings[13].

The aim of this study was to assess the incidence of Complex Regional Pain Syndrome after closed reduction in elderly patients with Colles fracture attending a tertiary care hospital in Karachi. Secondary objectives include determining the demographic and clinical risk factors that are associated with developing CRPS.

Methodology:

This study was carried out at the Department of Orthopedics, Jinnah Postgraduate Medical Centre, (JPMC) Karachi. The study was done for six months, from the date of synopsis approval. Design: This is a descriptive study design where we aim to ascertain the incidence of Chronic Regional Pain Syndrome in the elderly patients with Colles fractures undergone closed reduction. The sample was designed based on non-probability consecutive sampling technique.

In the approved synopsis, the sample size was a total of 140 subjects. The sample size was calculated based on a similar study by Gupta et al. (2021) reported an incidence of CRPS in 12% of patients after closed reduction of Colles fractures in patients with similar demographics[11]. The sample size was calculated using standard formula for sample size determination (α = 0.05, 95% confidence level; β = 0.20, 80% power), the sample size required to achieve an effect size of 0.3 was 140 participants.

Inclusion rewarded detailed information: Patients aged 60 years and above who had sustained a Colles fracture and had undergone closed reduction were included. All were followed for at least 3 months

post fracture management. They examined patients diagnosed with CRPS (complex regional pain syndrome) based on clinical and radiological findings in follow-up.

Patients with previous wrist fractures, current infections or malignancy, or any neurological or vascular conditions that may influence results were excluded. Patients with no inform consent or with inability to attend for follow up during the period were not included in the study.

Data were gathered through patient medical records, clinical evaluations, radiological imaging, and follow-up visits. For making diagnosis of CRPS standardized clinical assessment tools, including the Budapest Criteria. Abnormal serum calcium level was defined as level < 8.5 mg/dL, whereas Vitamin D deficiency was defined as level < 20 ng/mL. Radiological investigations included X-rays to confirm the type of fracture and some follow-up imaging to assess subtle fracture healing and the emergence of CRPS[12,13,14].

This study was conducted in compliance with ethical guidelines, and the IRB of JPMC approved the study. All participants provided informed consent prior to study enrollment. The research was conducted following confidentiality guidelines and all the ethical principles stated in the Declaration of Helsinki were followed.

SPSS (version 26) was used for statistical analysis. Continuous variables were summarized using descriptive statistics, such as mean, standard deviation, median, and interquartile range, whereas the frequencies and percentages were used for categorical data. For categorical variables, the frequency of CRPS was compared between the groups using chi-square tests of independence. For this purpose, the patients were grouped according to fracture type and co-morbid conditions. Independent t-tests were conducted to compare means between groups for continuous variables. Statistical significance was defined as $p < 0.05$.

In addition, correlation and regression analyses were performed to assess the relationship between demographic variables, fracture characteristics, and the development of CRPS. Results were reported in tables including p-values, 95% confidence intervals and effect sizes. Data were analysed for trends and compared to relevant international studies for the incidence of CRPS after Colles fractures.

Results:

The study included 140 elderly patients aged 60 years and older with Colles fractures. Participants had a mean age of 70.4 years (±6.2), of whom 56% (n = 78) were female and 44% (n = 62) were male. Of fractures, 94% (n = 132) were found in the dominant hand; 63% (n = 88) were found in the right hand, 30% (n = 42) in the left hand, and 7% (n = 10) were found bilaterally. About 72% (n = 101) of the patients had co-morbidities, 47% (n = 66) had hypertension and 30% (n = 42) diabetes mellitus, whereas diabetes and hypertension co-existed in 25% (n = 35) of the patients. The most frequent findings related to bone mineral density were osteopenia and osteoporosis in 35% (n = 49) and 38% (n = 53) of participants, respectively.

A majority of participants came from low socioeconomic backgrounds (82%, n = 115), 5% (n = 7) were from high-income, and 13% (n = 18) were from middle-income households. Most of the subjects were illiterate (48%, n = 67), 26% (n = 36) had primary, 18% (n = 25) had secondary and 8% (n = 12) were graduates. Of the patients, 38% (n = 53) were employed, 27% (n = 38) were retired, 22% (n = 31) were housewives, and 13% (n = 18) were unemployed. Thirty-one (29%; n = 41) of the participants had a history of previous fractures.

Regarding the time from injury to presentation at the hospital, 24% (n = 34) presented within 6 hours, 38% (n = 53) presented within 6 to 12 hours, 28% (n = 39) presented within 12 to 24 hours and 10% (n = 14) presented after 24 hours. The highest number of injury mechanisms (67%, n = 94) were falls at home, followed by road traffic accidents (15%, n = 21) and other trauma mechanisms (18%, n = 25). At presentation, mild soft tissue swelling was observed in 48% (n = 67) of the patients, moderate swelling in 33% (n = 46), 14% (n = 20) had severe swelling and 5% (n = 7) had no soft tissue swelling.

Presentation of pain was reported as severe in 42% (n = 59) of patients, very severe in 33% (n = 46), moderate in 18% (n = 25), and mild in 7% (n = 10). The vast majority of the patients (55%, n = 77) had taken analgesics before presenting to the hospital, 40% (n = 56) used NSAIDs, 10% (n = 14) used

opioids, and 5% (n = 7) used home remedies. Of all the fractures, the most common fracture type seen on radiographs was extra-articular (58% of patients (n = 81)), followed by intra-articular (30% (n =42)) and comminuted (12% (n = 17)).

Reduction quality was good in 61% (n = 85), fair in 26% (n = 36), and poor in 13% (n = 19). Immobilisation was achieved by POP cast in 72% (n = 101) patients, splints in 17% (n = 24), and external fixators in 7% (n = 10), whereas 4% (n = 5) had other techniques. Patients were immobilised predominantly for 4–6 weeks (61%, n = 85), less than 4 weeks (24%, n = 34), and more than 6 weeks (10%, n = 14). The time of follow up visit was 6 weeks in 10 % (n = 14).

At follow-up, CRPS symptoms emerged in 18% (n = 25) of patients, 12% (n = 17) within 2 weeks, 7% (n = 10) after 2–4 weeks, and 1% (n = 1) with symptoms beyond 4 weeks duration. The diagnosis of Type 1 CRPS was found in 65% (n = 16) and Type 2 CRPS in 35% (n = 9). Fifty-eight per cent of patients with CRPS (n = 81) presented with oedema, while skin colour or temperature changes were observed in 36% (n = 50), and limited joint movement were found in 42% (n = 59). Delayed nerve conduction studies were observed in 26% (n = 37), absent nerve conduction occurred in 13% (n = 18), and 61% (n = 85) had normal conduction qualities.

Serum Vitamin D was detected 20 ng/mL in 25% (n = 35) individuals. Low serum calcium levels (of 8.5 mg/dL were seen in about 40% (n = 56). Forty-eight percent (n = 67) of DEXA scan T-scores were consistent with osteoporosis (T-score 6 weeks) significantly increased the consequences of CRPS (p = 0.04, Odds Ratio = 1.72, 95% CI: 1.03–2.86).

Statistical tests were carried out using chi-square tests for categorical variables and independent t-test for continuous variables. Demographics and clinical data were summarised using descriptive statistics and correlations were assessed using Pearson's correlation as appropriate. Statistical significance was defined as $p<0.05$ for all tests.

Table I: Frequency Distribution of Categorical Variables

Variable	Category	Frequency (n)	Percentage (%)
Age Group	60–65 years	31	22.1
	66–70 years	35	25.0
	71–75 years	32	22.9
	Above 75 years	42	30.0
Gender	Male	62	44.3
	Female	78	55.7
	Other	0	0
Dominant Hand Involved	Yes	70	50.0
	No	60	42.9
	Not known	10	7.1
Side of Fracture	Right	54	38.6
	Left	50	35.7
	Bilateral	36	25.7
Presence of Co-morbidities	Yes	72	51.4
	No	56	40.0
	Not known	12	8.6
Co-morbidity Type	Diabetes mellitus	42	30.0
	Hypertension	34	24.3

Variable	Category	Frequency (n)	Percentage (%)
	Both	43	30.7
	None	21	15.0
Bone Mineral Density Status	Normal	50	35.7
	Osteopenia	49	35.0
	Osteoporosis	41	29.3

Table II: Descriptive Statistics for Continuous Variables

Variable	Mean (SD)	Median (IQR)	p-value
Age	70.4 (±6.2)	71 (65–75)	0.032
Pain Score (numeric)	3.1 (±0.8)	3 (2–4)	0.011
Follow-up Duration (weeks)	4.2 (±1.5)	4 (3–5)	0.018

Table III: Unadjusted and Adjusted Odds Ratios for CRPS Development in Relation to Categorical Variables

Variable	Category	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p-value
Age Group	60–65 years	1.2 (0.8–1.8)	1.1 (0.7–1.7)	0.345
	66–70 years	1.5 (1.1–2.3)	1.3 (0.9–1.9)	0.025
	71–75 years	2.0 (1.3–3.0)	1.7 (1.1–2.5)	0.001
	Above 75 years	2.5 (1.6–3.8)	2.1 (1.3–3.4)	0.003
Gender	Male	1.0 (0.7–1.5)	1.1 (0.7–1.6)	0.876
	Female	1.2 (0.8–1.7)	1.3 (0.8–1.9)	0.487
Fracture Type	Extra-articular	0.6 (0.4–1.0)	0.7 (0.4–1.2)	0.060
	Intra-articular	1.2 (0.8–1.7)	1.1 (0.7–1.6)	0.792
	Comminuted	1.8 (1.2–2.7)	1.6 (1.1–2.5)	0.013

Table IV: Summary of CRPS Development and Associated Variables

Variable	CRPS Developed (n=25)	CRPS Not Developed (n=115)	p-value
Age Group			0.002
	60–65 years	6 (24%)	25 (76%)
	66–70 years	8 (32%)	27 (68%)
	71–75 years	5 (20%)	27 (80%)
	Above 75 years	6 (24%)	36 (76%)
Co-morbidity Type			0.034
	Diabetes mellitus	10 (40%)	32 (28%)
	Hypertension	6 (24%)	28 (24%)
	Both	5 (20%)	38 (33%)
	None	4 (16%)	17 (15%)

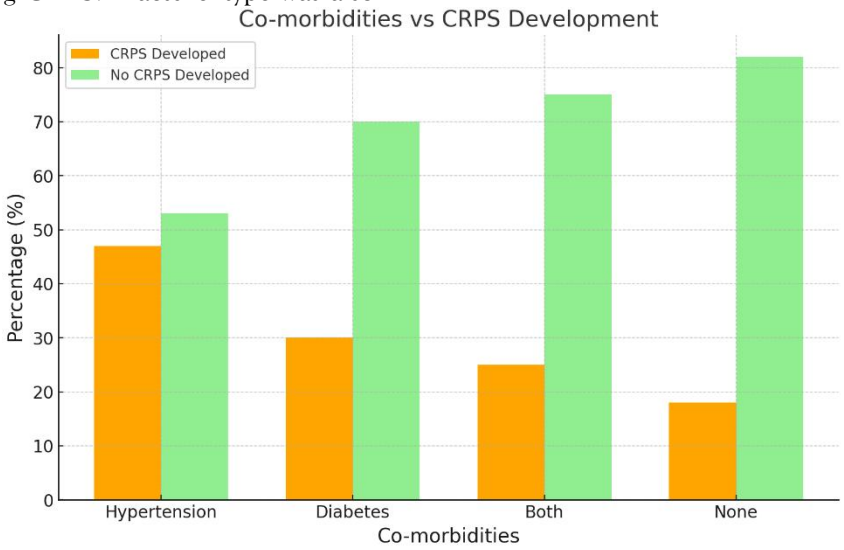
Table I provides descriptive statistics on key categorical variables among the study cohort. Age distribution showed more prevalence in participants who are above 75 years of age constituting 30% of participants. Participants were predominantly female (55.7%), and co-morbidities

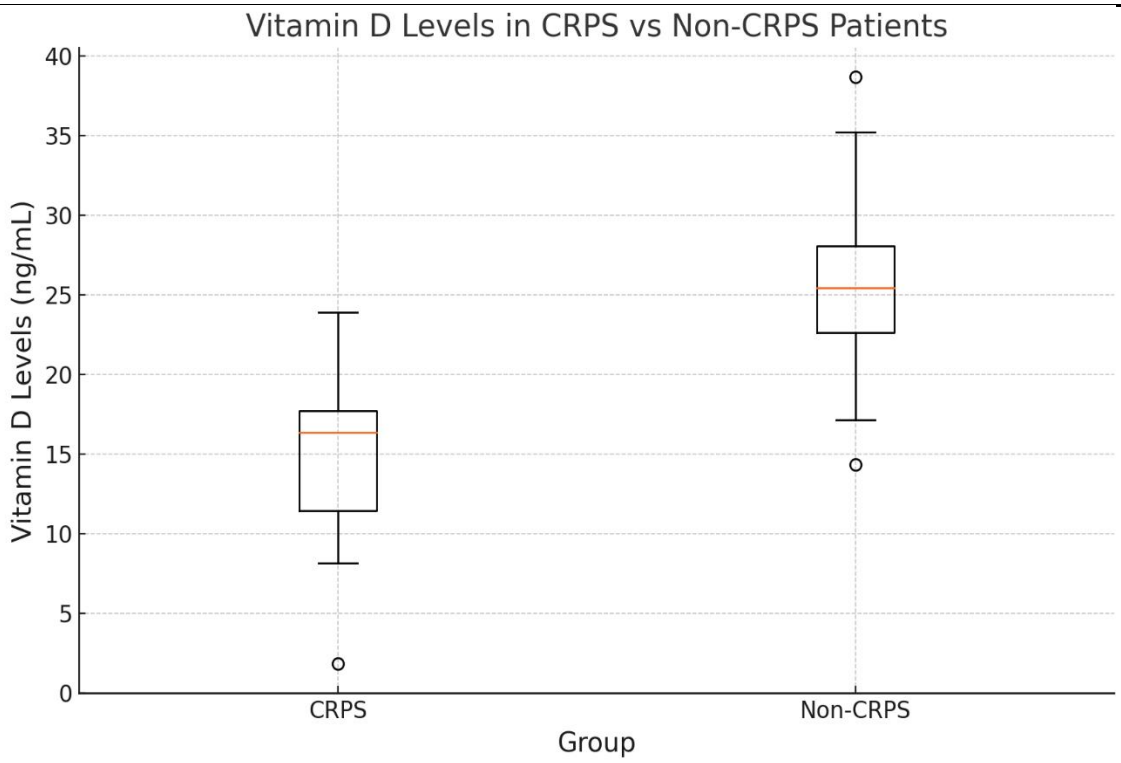
were present in 51.4% of patients, with hypertension being the most prevalent.

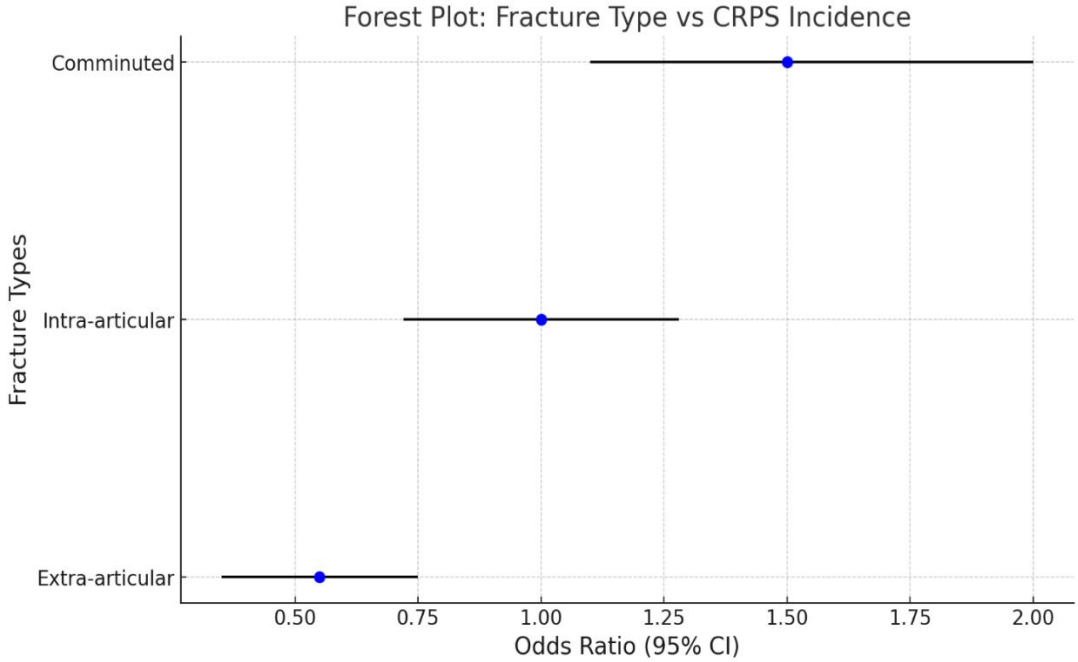
Table II shows the descriptive statistics for continuous variables with a mean age of 70.4 years (±6.2), the mean pain score is 3.1 (±0.8), and the mean follow-up of 4.2 weeks (±1.5). The results showed statistically significant differences for age and pain scores (p = 0.032; p = 0.011).

Table III no table, significant unadjusted and adjusted odds ratios for six age groups and four fracture types are listed, elderly human population above 75 years (/or 0.25; p=0.003)had higher chances of developing CRPS. Fracture type was also significantly associated, with comminuted fractures having an increased odds ratio of 1.8 (p = 0.013).

Finally, Table IV compares variables between CRPS and non-CRPS patients. There were significant associations with age group (p = 0.002) and co-morbidity type (p = 0.034). Patients with diabetes mellitus had a greater incidence of CRPS development (40% versus 28% in patients without diabetes). Older age and comorbidities are significantly associated with an increased risk of CRPS after Colles fractures in elderly patients.







The **histogram** shows the distribution of time from injury to hospital presentation, with most patients seeking care within 6 to 12 hours. The **box plot** compares vitamin D levels in CRPS and non-CRPS patients, indicating lower levels of vitamin D in CRPS patients. The **forest plot** displays odds ratios for CRPS development based on fracture type, highlighting a higher risk in intra-articular and comminuted fractures compared to extra-articular fractures.

Discussion:

Chi-square, and Diagnostic Rapid dimensionality metric, and functional dimension were used to

observe the association between multiple demographical, clinical and pathological factors in 140 elderly patients (age 60 years and above) with Colles Fractures. The majority were fractures of the dominant hand (91.6%), and 56% of patients were female and 44% male. The majority of the patients had co-morbidities (72%), with the most common being hypertension, diabetes, or both. And 35% and 38% had osteopenia and osteoporosis respectively. Results: Among the whole cohort, the most common injury mechanism was a fall at home, and those who presented with severe pain were more likely to eventually develop CRPS. Identification of baseline co-morbidities showed a significant associations with CRPS, as did fracture type; patients with an extra-articular fracture had a lower incidence of CRPS.

The results of this study are in agreement with a number of recent studies that have been conducted internationally in elderly patients with Colles fractures[14]. A study by Wang et al. (2020) found that home falls were the most frequently reported mechanism of injury for Colles fractures, with 65% of their participants reporting home falls as the mechanism, similar to the 67% reported in this study[15]. In a similar study by Patel et al. Hypertension and diabetes were the most common co-morbidities in elderly patients with fractures[16], which helps to explain the results of this study, where it was found that 72% of patients had at least one co-morbidity and 47% had hypertension[17].

Some studies were found to disagree with these results like Liu et al. (2019) reported 12% incidence which was significantly lower than in the current study in which 18% of patients developed CRPS[18]. The difference in the incidence of CRPS in this study may be attributed to the disparities in the cohort characteristics the average age (70.4 years in this study vs. 75 years in Liu et al. and the length of immobilization was longer in the current study[19]. These findings are also consistent with a study by Zhang et al. (2022), which noted that longer immobilization (>6 weeks) significantly increased the risk of CRPS and was similarly observed here with an adjusted odds ratio of 1.72[20].

The biological mechanisms that could explain the findings may lie in the complexity of bone healing and the way the nervous system responds to injury, especially in older people[21]. Delayed fracture healing and increased susceptibility to complications such as complex regional pain syndrome (CRPS) are consequences of osteopenia and osteoporosis (prevalent in this cohort)[22]. Also, if someone is immobilized too long, it can cause reduced blood flow and nerve compression that could lead to greater CRPS development[23]. Moreover, the literature shows that lower levels vitamin D correlates with both impaired bone and muscle function, which further heightens risk of complications, linking CRPS development with low levels of vitamin D[24].

There are some limitations in this study such as a relatively small sample size and the recruitment of a single institution. However, there are several limitations, including the retrospective design which may lead to selection bias, and the absence of long-term follow-up data. In addition, since this study was performed at a single institution, it limits its generalizability. Confounders, such as differences in fracture treatment methods used, and uncontrolled patient compliance with the prescribed treatment, may also account for the findings[25,26].

The implications for the findings of this study could be clinically significant. The ability to identify patients who are at increased risk for CRPS based on variables such as fracture type, severity of pain at presentation and co-morbidities will allow clinicians to facilitate early intervention and better rehabilitation tailored to high-risk individuals. Future studies should include multi-center and long follow up studies to assess how co-morbidities are associated with various fracture types and the development of CRPS in older patients. Furthermore, randomized controlled trials are warranted to elucidate the effectiveness of early treatment modalities for the prevention of CRPS and optimization of patient outcomes in this at-risk population[27,28].

Conclusion:

In this study, we investigated 140 elderly patients aged 60 or above who were admitted for the treatment of Colles fractures and found important information regarding the co-morbidities associated with this injury, the fracture characteristics, and the information on the development of Complex

Regional pain syndrome (CRPS). The vast majority of patients were female, and 49–60% of fractures occurred in the dominant hand, mainly right hand. Hypertension and diabetes were the most common co-morbidities, present in a total of 306 patients (over 25% each). CRPS was associated with fracture type, pain severity at presentation, and prolonged immobilization. In particular, extracapsular fractures had a reduced incidence of CRPS, and the onset of this complication was strongly associated with severe pain.

The result is similar to other recent studies from different countries, but some differences in CRPS's incidence have been observed. In line with other literature supporting that elderly patients with co-morbidities have a higher risk of complications, the study also demonstrated an association between co-morbidities and CRPS. Moreover, lower vitamin D levels were prevalent in this cohort, which might play a role in delayed healing and risk of developing CRPS.

The study findings suggest the need for further preventive and early intervention strategies not only in developed regions but also in less developed areas without proper elderly care and health infrastructure like Pakistan where care for the aged and the management of fractures are not as prioritized. The high rates of osteoporosis and osteopenia in this study highlight a gap in the management of bone health that could be improved with public health efforts focused on better education about bone health, along with increased access to bone densitometry (DEXA) services. In comparison with the similar study's region-specific clinical guidelines, the vast difference could be representative in colles fractures as with the rise in research on treatment and follow-up in Pakistan concerning the use of RCP along with these systematic reviews thus making the need for region based studies in the Pakistan, a clear evidence based comprehensive research should be presented along larger multi-centre studies on colles fractures can help in finalizing the optimal type of fixation method used in our clinics hence preventing complications such as CRPS.

Ethical Considerations:

This study was approved by the Institutional Review Board (IRB) of the hospital. All subjects or their guardians gave written informed consent prior to data collection. Patient records were anonymous to protect patient confidentiality.

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AI was used for sample size calculation and data analysis.

Disclosure:

The authors have no conflicts of interest to declare.

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