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EVALUATION OF THE EFFECT OF VITAMIN C IN PREVENTING REFLEX SYMPATHETIC DYSTROPHY IN DISTAL RADIUS FRACTURES

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ABSTRACT

Background: Complex regional pain syndrome (CRPS), previously termed reflex sympathetic dystrophy (RSD), is characterized by disproportionate and persistent pain accompanied by vasomotor disturbances, trophic changes, regional osteoporosis, and functional impairment following injury. **Objective:** To evaluate the effect of vitamin C supplementation in preventing RSD following conservatively managed distal radius fractures. **Methods:** A comparative cohort study was conducted from March to October 2022 in four hospitals. A total of 100 patients aged 20–69 years with conservatively treated distal radius fractures were enrolled. Patients were divided into two groups: 50 patients received vitamin C (500 mg/day), while 50 patients did not receive vitamin C. Patients with diabetes, pregnancy, or surgically treated fractures were excluded. Demographic and clinical characteristics and the occurrence of RSD were assessed during follow-up. **Results:** Of the 100 participants, 55% were female, 45% were male, and 68% were aged 40–69 years. Overall, 55 patients developed RSD, whereas 45 remained free of RSD. Vitamin C supplementation was significantly associated with a lower occurrence of RSD compared with no supplementation ($p<0.05$). **Conclusion:** Vitamin C supplementation at 500 mg/day was associated with a significantly reduced occurrence of RSD following conservatively managed distal radius fractures. Vitamin C may therefore represent a simple and inexpensive prophylactic strategy, although larger randomized studies with longer follow-up are recommended.

KEYWORDS: Complex regional pain syndrome; Vitamin C; Distal radius fracture; Reflex sympathetic dystrophy.

INTRODUCTION

Complex regional pain syndrome (CRPS), previously known as reflex sympathetic dystrophy (RSD), is a chronic and potentially disabling pain disorder characterized by pain that is disproportionate in intensity and duration to the initial precipitating injury. It may be accompanied by vasomotor instability, edema, trophic skin changes, regional osteoporosis, joint stiffness, and functional impairment.[1] CRPS can occur following different forms of trauma and is particularly recognized after fractures of the extremities. Approximately 30% of patients with extremity fractures have been reported to develop features suggestive of this condition.[1] Wrist fractures, especially fractures of the distal radius, represent an important precipitating event, and CRPS may develop following either conservative or surgical treatment.[2] Distal radius fractures are among the most frequently encountered orthopedic injuries and include several patterns, such as Colles, Smith, Barton, and comminuted intra-articular fractures.[1] CRPS is considered one of the most troublesome complications following wrist fractures because persistent pain, stiffness, and functional limitations can considerably affect patients' daily activities and quality of life. Previous studies have reported variable rates of CRPS after distal radius fractures, with estimates reaching approximately 37% in some populations.[3,4] The associated morbidity, healthcare costs, prolonged rehabilitation, and loss of working time emphasize the importance of identifying effective preventive

strategies.[5] The pathophysiology of CRPS is complex and remains incompletely understood. Earlier theories primarily attributed RSD to excessive sympathetic nervous system activity; however, current evidence suggests that several interacting mechanisms are involved, including neurogenic inflammation, abnormal cytokine release, altered pain processing, and sympathetic enhancement of nociceptive responses.[1] Oxidative stress may also contribute to tissue injury following trauma. Reactive oxygen species (ROS) are normally generated during cellular metabolism and have important physiological roles in cellular signaling and homeostasis.[6] Excessive ROS production or inadequate antioxidant defenses, however, can result in protein oxidation, lipid peroxidation, and nucleic acid damage.[7] This imbalance may adversely influence tissue recovery and bone healing following fractures.[8] Oxidative damage has also been associated with age-related deterioration in skeletal muscle function.[9] Vitamin C (ascorbic acid) is a water-soluble vitamin with potent antioxidant properties and serves as a cofactor for numerous enzymes involved in normal tissue growth, repair, and physiological function.[10] Through its antioxidant activity, vitamin C may reduce oxidative stress generated following fractures and potentially modify processes contributing to the development of CRPS. Therefore, vitamin C supplementation has attracted attention as a simple, inexpensive, and potentially effective preventive intervention following distal radius fractures. **Aim of the study:** To evaluate the effect of vitamin C supplementation in the prevention of complex regional pain syndrome (reflex sympathetic dystrophy) following distal radius fracture.

PATIENTS AND METHODS

Study Design and Setting: A comparative cohort study was conducted from March to October 2022 to evaluate the effect of vitamin C supplementation on the prevention of complex regional pain syndrome (CRPS), formerly known as reflex sympathetic dystrophy (RSD), following distal radius fracture. The study was carried out at Al-Kharkh General Hospital, Al-Kadhimiya Teaching Hospital, Al-Yarmouk Teaching Hospital, and Mohammed Baqir Al-Hakim Hospital. The study was reported according to general recommendations for observational studies.

Study Population: A total of 100 patients aged 20–69 years with distal radius fractures managed conservatively were included. Twenty-one additional eligible patients declined participation. Participants were allocated into two groups according to vitamin C use. Group 1 comprised 50 patients who received vitamin C, including 30 females and 20 males. Group 2 comprised 50 patients who did not receive vitamin C, including 25 females and 25 males. All fractures were managed conservatively with immobilization for approximately 6–8 weeks. Patients aged 20–69 years of either sex with conservatively managed distal radius fractures were eligible. Pregnant women, patients treated surgically, patients with diabetes mellitus, and those with chronic use of antituberculosis or antimalarial medications, hydralazine, or amiodarone were excluded.

Data Collection and Follow-up: Data were collected during attendance at orthopedic clinics and subsequent follow-up visits. Recorded variables included age, sex, medical history, medication history, vitamin C exposure, and development of clinical features of CRPS. CRPS was assessed clinically during follow-up based on characteristic manifestations, including disproportionate pain and sensory, vasomotor, sudomotor/edema, and motor/trophic abnormalities, consistent with established diagnostic principles.

Ethical Considerations: Verbal informed consent was obtained from all participants after explanation of the study objectives and procedures. Confidentiality of participants' information was maintained throughout the study.

Statistical Analysis: Data were analyzed using IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized using frequencies and percentages. The chi-square test was used to examine associations between categorical variables and to compare CRPS occurrence between the vitamin C and non-vitamin C groups. A two-sided **P-value <0.05** was considered statistically significant.

RESULTS

Table 1 demonstrates the sociodemographic and clinical characteristics of the 100 study participants. Most patients were aged 40–59 years (68%), while 32% were aged 20–39 years. Females represented 55% of the participants and males 45%. The majority were right-handed (93%), whereas only 7% were left-handed. Regarding occupation, 50% were unemployed, 16% were workers, and 34% had other occupations. The participants were equally distributed according to vitamin C supplementation, with 50% receiving vitamin C and 50% not receiving it. Regarding social history, 29% were smokers, 2% reported alcohol use, 10% reported both smoking and alcohol use, while 59% reported neither. Overall, reflex sympathetic dystrophy (RSD) developed in 55% of the participants, whereas 45% did not develop RSD.

Table 1: Demographic and Clinical Characteristics of the Study Participants (N = 100).

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	20–39	32	32.0
	40–59	68	68.0
Gender	Male	45	45.0
	Female	55	55.0
Hand	Right	93	93.0
	Left	7	7.0
Occupation	Worker	16	16.0
	Unemployed	50	50.0
	Other	34	34.0
Vitamin C supplementation	Received vitamin C	50	50.0
	Did not receive vitamin C	50	50.0
Social history	Smoker only	29	29.0
	Alcohol use only	2	2.0
	Neither smoking nor alcohol use	59	59.0
	Both smoking and alcohol use	10	10.0
CRPS/RSD occurrence	Present	55	55.0
	Absent	45	45.0

Table 2 demonstrates the association between vitamin C supplementation and the occurrence of reflex sympathetic dystrophy (RSD) following distal radius fracture. Patients who received vitamin C had a significantly lower occurrence of RSD compared with those who did not receive vitamin C. The chi-square test showed a statistically significant association between vitamin C supplementation and reduced occurrence of RSD (**$p < 0.05$**). These findings suggest that vitamin C supplementation may have a protective effect against the development of RSD following distal radius fracture.

Table 2: Association Between Vitamin C Supplementation and Occurrence of RSD.

Category	No. of Participants	Chi-square (χ^2)	P-value
Received vitamin C	50		
Did not receive vitamin C	50		
RSD absent with vitamin C supplementation	45	74.707	<0.001*
RSD present without vitamin C supplementation	55		
Total	**100**		

Figure 1. Distribution of Participants by Age Group

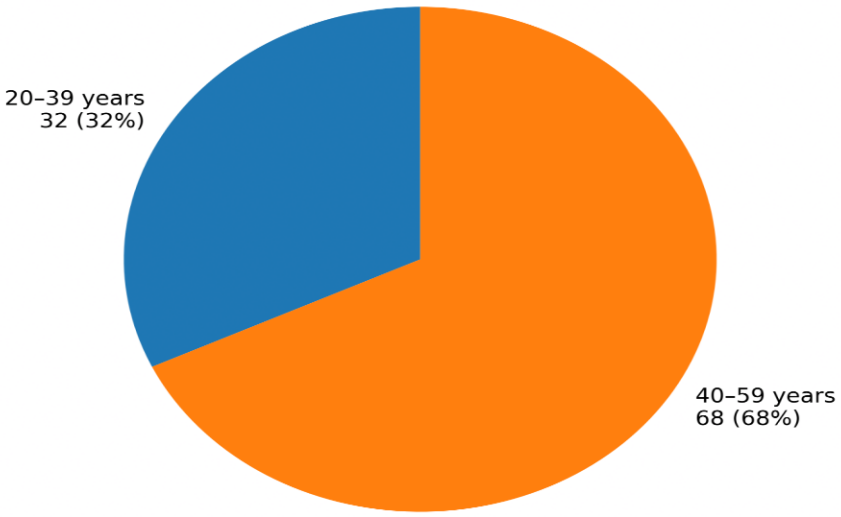

Figure 1: Represents age group. Most participants from age group 40-59(68%) least from age group 20-39 (32%).

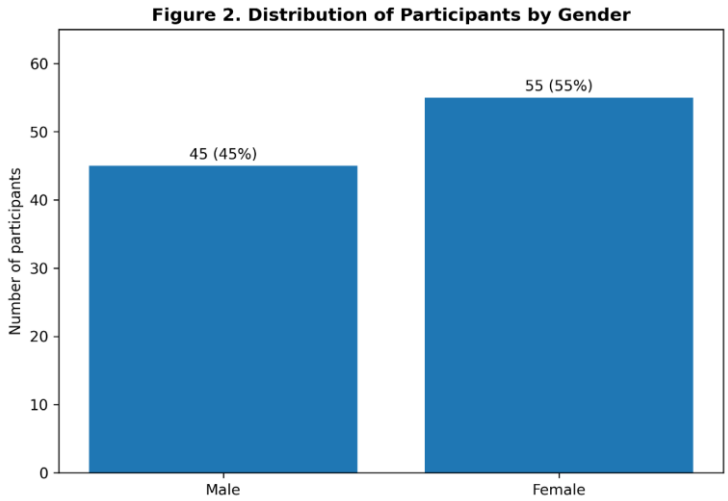

Figure 2: Most participants are females (55%)while males are less(45%).

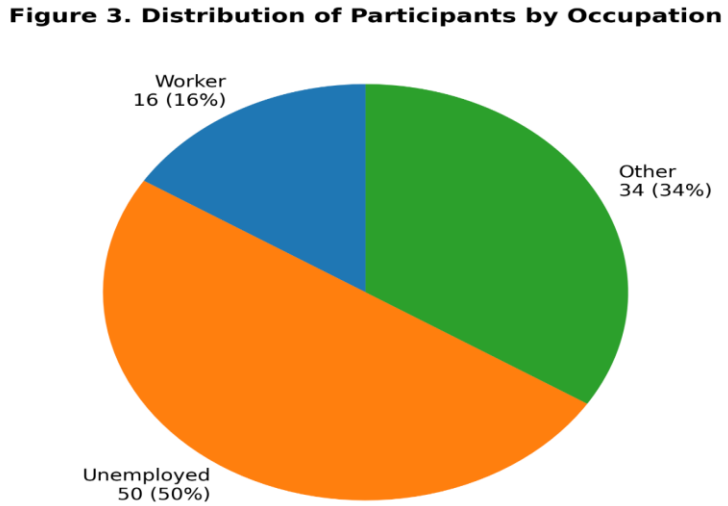

Figure 3: Represents jobs. Least participants are workers (16%) most are unemployed (50%) While (34%) are from other jobs.

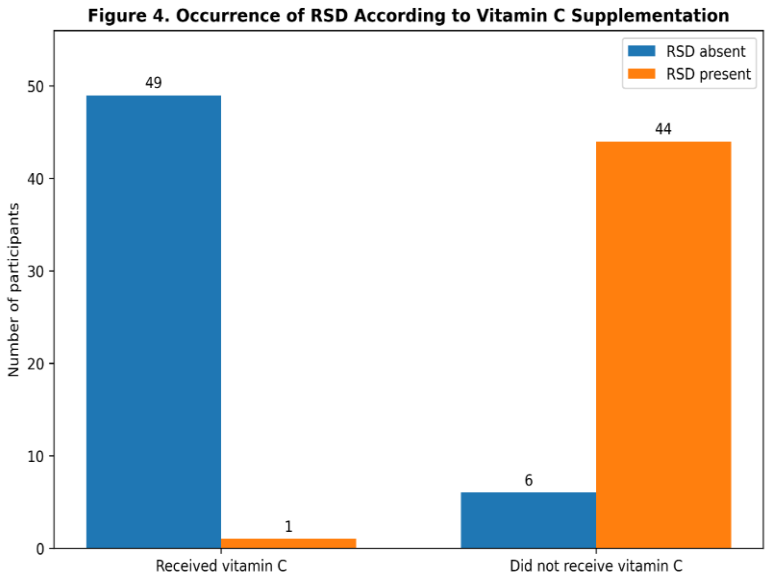

Figure 4: Those who took vitamin c about 98% didn't develop RSD while only 2% develop RSD. About 88% who didn't take vitamin c develop RSD while only 12% didn't develop RSD.

DISCUSSION

Complex regional pain syndrome (CRPS), previously known as reflex sympathetic dystrophy (RSD), is an important complication following distal radius fractures and may result in persistent pain, stiffness, functional impairment, and reduced quality of life. Although its pathophysiology is multifactorial, oxidative stress and lipid peroxidation have been proposed as contributing mechanisms. Lipid peroxidation may damage vascular endothelial cells and increase capillary permeability, thereby promoting edema and tissue injury. Vitamin C is a potent natural antioxidant and may reduce oxidative damage after fracture, providing a biological rationale for its potential preventive effect against CRPS.[18] In the present study, 68% of patients were aged 40–59 years, whereas 32% were aged 20–39 years. This predominance of older patients may reflect the increasing susceptibility to distal radius fractures with advancing age. Females represented 55% of participants compared with 45% males. A previous study[19] also included a greater number of females than males, although the absolute numbers were higher (97 females and 47 males), which may partly be explained by differences in sample size and study population. Regarding hand dominance, 93% of participants were right-handed and only 7% were left-handed, which is consistent with the predominance of right-handedness in the general population. Half of the participants were unemployed, 16% were workers, and 34% reported other occupations. These findings primarily describe the characteristics of the study population and should not necessarily be interpreted as risk factors for CRPS. The most important finding was the marked difference in CRPS occurrence according to vitamin C supplementation. Among patients receiving vitamin C, only 1 of 50 (2%) developed RSD, compared with 44 of 50 (88%) among patients who did not receive vitamin C. Conversely, RSD was absent in 49 (98%) vitamin C recipients and only 6 (12%) patients who did not receive supplementation. This difference was statistically significant ($p < 0.05$), supporting an association between vitamin C supplementation and reduced occurrence of RSD. The direction of this finding agrees with study[19], in which RSD occurred in 18.8% of patients receiving vitamin C compared with 26% of those not receiving supplementation. However, the substantially larger effect observed in the present study should be interpreted cautiously because of the relatively small sample size, observational design, and potential confounding factors. Regarding social history, 29% were smokers, 2% reported alcohol consumption, 10% reported both, and 59% reported neither. Overall, the findings support a potential protective role of vitamin C against CRPS following conservatively managed distal radius fractures.[18,19] Nevertheless, larger prospective randomized studies with standardized diagnostic criteria and longer follow-up are required to confirm the magnitude of this association.

CONCLUSION

Vitamin C supplementation at a dose of 500 mg/day was significantly associated with a lower occurrence of reflex sympathetic dystrophy following conservatively managed distal radius fractures. These findings suggest that vitamin C may represent a simple, inexpensive, and potentially effective prophylactic option. However, larger randomized studies with longer follow-up are required to confirm its preventive effectiveness and long-term benefits.

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