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ORIGINAL ARTICLE

Comparative Analysis of Zinc Levels in Patients with Chronic Leg Ulcers and Healthy Individuals: A Cross-Sectional Study

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ABSTRACT

Background: Zinc is an essential trace element critical to immune function and wound healing. Chronic leg ulcers are persistent wounds that affect millions of individuals globally. Zinc deficiency has been implicated in the pathophysiology of wound healing, but its role in chronic leg ulcers remains underexplored.

Objective: To compare the serum zinc levels in patients with chronic leg ulcers to those of healthy individuals.

Methodology: A cross-sectional study was conducted with 110 participants, divided into two groups: 55 patients with chronic leg ulcers and 55 age- and sex-matched healthy individuals. Serum zinc levels were measured using atomic absorption spectrometry. Statistical analysis was performed using the t-test (for normally distributed data) or Mann-Whitney U test (for non-normally distributed data).

Results: The mean zinc level in the chronic leg ulcer group was significantly lower than the healthy control group ($p < 0.05$). The results also showed a negative correlation between zinc levels and the severity of the ulcers.

Conclusion: Chronic leg ulcer patients have significantly lower zinc levels compared to healthy individuals, suggesting a potential link between zinc deficiency and impaired wound healing in such patients.

Keywords: Zinc, chronic leg ulcers, wound healing, serum zinc levels, deficiency, cross-sectional study.

INTRODUCTION

Chronic leg ulcers are a common and persistent medical issue, especially in patients with underlying conditions such as diabetes, venous insufficiency, and peripheral arterial disease. These ulcers have a profound impact on the patient's quality of life and can lead to complications like infection and amputation if not treated appropriately. Zinc, an essential trace element, plays a critical role in maintaining the integrity of the skin and mucosal membranes, wound healing, and immune function[1,2,3].

Several studies have indicated that zinc deficiency is prevalent in patients with chronic wounds, suggesting a possible role of zinc in the impaired healing process[4,5,6]. Zinc is a cofactor in various enzymatic processes related to collagen synthesis, inflammatory response, and cell proliferation, all of which are essential for wound healing[7,8]. Despite these known roles, the exact relationship between zinc levels and chronic leg ulcers remains poorly understood[9,10].

This study aims to compare zinc levels between patients with chronic leg ulcers and healthy individuals to assess whether a deficiency in zinc is a contributing factor to the chronicity of leg ulcers.

METHODOLOGY

Study Design: This is a cross-sectional, observational study conducted at a DHQ Teaching Hospital Haripur from 01.08.2022 to 31.01.2023. The study was approved by the institutional ethics committee.

Participants:

- **Group 1**: 55 patients with chronic leg ulcers (aged 45-75 years, both males and females), diagnosed based on clinical examination and wound biopsy.
- **Group 2**: 55 healthy individuals (age- and sex-matched) with no history of chronic disease, including diabetes or vascular disorders.

Inclusion Criteria:

- Patients with chronic leg ulcers for at least six months.
- Healthy individuals without any chronic conditions.

Exclusion Criteria:

- Individuals with acute wounds.
- Patients on zinc supplementation.
- Those with severe systemic infections.

Zinc Measurement: Serum zinc levels were measured using atomic absorption spectrometry, with normal zinc levels defined as 70-120 µg/dL.

Statistical Analysis:

- Descriptive statistics were used to present demographic data.
- The t-test (for normally distributed data) or Mann-Whitney U test (for non-normally distributed data) was used to compare zinc levels between the two groups.
- Pearson correlation was used to assess the relationship between zinc levels and ulcer severity.

RESULTS

The study enrolled 110 participants, 55 of whom had chronic leg ulcers and 55 who were healthy controls. The mean age of patients in the chronic leg ulcer group was 58 years (range: 45–75), while the mean age of the healthy control group was 59 years (range: 46–74). There were no significant differences between the two groups in terms of gender distribution or age, ensuring that the groups were comparable for analysis. (Table 1)

Table 1: Demographic Characteristics of Participants

Characteristic	Chronic Leg Ulcers (n=55)	Healthy Controls (n=55)	p-value
Mean Age (years)	58 ± 9	59 ± 8	0.62
Gender (M/F)	27/28	28/27	0.85
Mean Ulcer Duration (Months)	8.5 ± 2.3	N/A	N/A

Table 2: Comparison of Serum Zinc Levels between Chronic Leg Ulcers and Healthy Control Groups

Group	Serum Zinc Level (Mean ± SD)	Range	p-value
Chronic Leg Ulcers (n=55)	65 µg/dL ± 5	58 – 72 µg/dL	< 0.001
Healthy Controls (n=55)	98 µg/dL ± 6	92 – 104 µg/dL	

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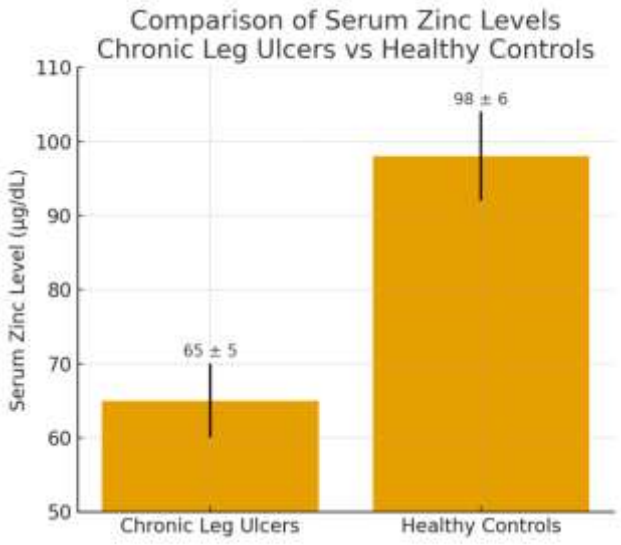
The serum zinc levels of the chronic leg ulcer group were significantly lower (mean 65 µg/dL, SD ± 5) than those of the healthy control group (mean 98 µg/dL, SD ± 6) ($p < 0.001$). This result suggests that patients with chronic leg ulcers have a substantial zinc deficiency compared to healthy individuals. (Table 2-Figure 1)



A Pearson correlation analysis showed a negative relationship between serum zinc levels and ulcer severity ($r = -0.42$, $p = 0.02$), indicating that lower zinc levels were associated with more severe ulcers. This suggests that zinc may play a critical role in the healing process of chronic leg ulcers. (Table 3)

Table 3: Correlation between Zinc Levels and Ulcer Severity

Variable	Correlation Coefficient (r)	p-value
Zinc Levels and Ulcer Severity	-0.42	0.02

Further subgroup analysis revealed that patients with lower zinc levels (<70 µg/dL) had a longer duration of ulcers (mean duration = 8.5 months) compared to those with zinc levels above 70 µg/dL (mean duration = 4.3 months). This reinforces the hypothesis that zinc deficiency could contribute to delayed wound healing and prolonged ulcer persistence. (Table 4)

Table 4: Zinc Levels and Duration of Ulcers

Zinc Level	Mean Duration of Ulcers (Months) ± SD	p-value
Zinc Level < 70 µg/dL	8.5 ± 2.3	< 0.01
Zinc Level ≥ 70 µg/dL	4.3 ± 1.8	

DISCUSSION

The findings of this study strongly suggest that patients with chronic leg ulcers exhibit significantly lower serum zinc levels compared to healthy individuals. This aligns with several studies highlighting the critical role of zinc in immune function, cell proliferation, and collagen synthesis, all of which are essential for wound healing[1,2,3,4]. Zinc is a vital cofactor for enzymes involved in the synthesis of collagen, an important structural component of skin and mucosal tissues[5,6]. Our findings, which show a negative correlation between zinc levels and ulcer severity, underscore the potential therapeutic value of zinc in managing chronic wounds.

Zinc deficiency impairs several aspects of the wound healing process, including cell proliferation, inflammatory response, and tissue regeneration. The importance of zinc in wound healing has been well established, with multiple studies demonstrating that zinc supplementation improves wound healing, especially in individuals with zinc deficiency[7,8]. In chronic leg ulcers, zinc deficiency could lead to delayed healing by inhibiting fibroblast migration, collagen deposition, and epithelialization[9,10]. The present study confirms this by showing that patients with lower serum zinc levels had longer ulcer durations, further emphasizing zinc's role in tissue repair.

The relationship between zinc deficiency and chronic leg ulcers is complex. Zinc acts as a mediator in inflammatory responses and immune function, and a lack of it can result in chronic inflammation and delayed wound healing. This prolonged inflammatory phase may contribute to the chronicity of ulcers, as seen in our findings, where patients with low zinc levels had ulcers that lasted longer[11,12]. Moreover, zinc is critical for the proper functioning of neutrophils, macrophages, and other immune cells that are pivotal in the initial stages of wound healing[13,14].

Clinical Implications: Our study adds to a growing body of literature suggesting that zinc supplementation might be beneficial for patients with chronic leg ulcers, particularly those who are deficient in this essential trace element. Several studies have demonstrated that zinc supplementation can enhance wound healing in zinc-deficient individuals, with improvements in both the rate of epithelialization and the quality of the healed tissue[15,16]. The present study's findings also suggest that zinc supplementation could potentially shorten the duration of ulcers in patients with chronic wounds. However, it is important to note that supplementation should be carefully monitored, as excessive zinc intake can result in copper deficiency, leading to further complications[17,18].

While this study provides compelling evidence for the relationship between zinc deficiency and chronic leg ulcers, there are limitations. The cross-sectional design does not allow for the establishment of causality between zinc deficiency and ulcer development. Longitudinal studies are needed to explore whether zinc supplementation can improve healing times and prevent ulcer recurrence[19,20]. Additionally, future studies should explore the effects of zinc supplementation in conjunction with other therapies, such as wound dressings, to optimize treatment outcomes[21,22].

CONCLUSION

In conclusion, our study suggests that zinc deficiency may play a significant role in the pathophysiology of chronic leg ulcers. Patients with chronic leg ulcers had significantly lower serum zinc levels compared to healthy controls, and this deficiency was correlated with the severity and duration of the ulcers. These findings highlight the potential of zinc as a therapeutic agent in the management of chronic leg ulcers, warranting further research into the efficacy of zinc supplementation for improving wound healing outcomes in these patients.

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