DOI: 10.21088/potj.0974.5777.19326.5

Physiotherapy and Occupational Therapy Journal
Volume 19 Number 3, July - September 2026

ORIGINAL ARTICLE

Effectiveness of Low Frequency Ultrasound Therapy in Healing with Venous Ulcers: A Randomized Controlled Trial

P Shanmuga Raju[1], Rammohan C[2], Venkataramana N[3], Ravi Shankar Ravi[4], Purna Chandhra Shekhar S[5], Karthikeyan T[6], Bhgaya Seela S[7]

HOW TO CITE THIS ARTICLE:

P Shanmuga Raju, Rammohan C, Venkataramana N, *et al.* Effectiveness of Low frequency Ultrasound Therapy in Healing with Venous Ulcers: A Randomized controlled trial. Therapy Jr. 2026; 19(3): 200-205.

ABSTRACT

Aim: the aim of study was to evaluate the effect of low frequency ultrasound therapy (LFUST) in treatment of venous ulcers compared with standard wound care.

Study Design: A single centre, prospective randomized clinical trial.

Study setting: This study centre was Department of Physiotherapy & Rehabilitation, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana.

Study participants: Total 20 samples were included in this study. Patients with venous ulcer of >6 months duration. Study group were received low frequency ultrasound therapy delivered 3 MHz, continuous mode and applied treatment 10 minutes duration per day to 6 weeks plus standard care.

Results: This study started in January 2026 and the follow-up period ended in June 2026, during which time, forty patients were selected as potential participants, of whom 30 were included in the study.There was a significantly reduce the wound size compared with standard care ($p<0.05$).

AUTHOR'S AFFILIATION:

[1] Professor, Department of Physiotherapy & Rehabilitation, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India.

[2] Professor, Department of General Surgery, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India.

[3] Professor, Department of General Surgery, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India.

[4] Dean, Capital University, Koderma, Jharkhand, India.

[5] Principal, SASSB College of Physiotherapy, Gulbarga, Karnataka, India.

[6] Associate Professor, Department of Physiotherapy, Gurugram University, Gurugram, Haryana, India.

[7] Nursing Officer/Teaching Faculty, Government College of Nursing, Ramagundam, Peddapalli, Telanagana, India.

CORRESPONDING AUTHOR:

P Shanmuga Raju, Professor, Department of Physiotherapy & Rehabilitation, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India.

E-mail: shanmugampt@rediffmail.com

➢ **Received:** 20-06-2026 ➢ **Accepted:** 24-07-2026

Conclusion: Low frequency ultrasound therapy is effective, significantly reduce the wound size and improve blood circulation in venous ulcer. These findings indicate that LFUST serves as an effective adjunctive therapy for VLUs, improving the outcomes of standard treatment protocols.

KEYWORDS:

• Venous ulcer • Low frequency • Ultrasound therapy • Microcirculation • Standard care

INTRODUCTION

Venous ulcer (VU) represents the most advanced stage of chronic venous disease and is typically associated with severe pain. These ulcers are most commonly located on the medial aspect of the lower extremity, extending from the ankle region to the mid-calf. Moreover, untreated or prolonged chronic venous insufficiency (CVI) may lead to secondary lymphedema and an increased risk of developing cellulitis.[2] These ulcers are characterized by delayed healing and high recurrence rate. They are associated with pain, physical dysfunction, depression, and social isolation. They adversely affect the quality of life by not healing for years and recurring again and again.

Venous ulcers (VUs), also known as venous leg ulcers (VLUs), represent a major public health concern, affecting approximately 0.06% to 1.69% of the population and resulting in substantial physical, psychological, and socioeconomic burdens.[3] The development of venous leg ulcers (VLUs) is primarily attributed to sustained venous hypertension resulting from reflux in the superficial venous system, reflux and/or obstruction of the deep venous system, or a combination of both. Several additional factors contribute to the pathogenesis of VLUs, including advancing age, obesity, impaired calf muscle pump function, genetic predisposition, and incompetence of the microvenous valves.[4]

Ultrasound (US) therapy is a widely utilized treatment modality for soft tissue injuries in physiotherapy practice and is increasingly being employed in the treatment of chronic wounds in specialized clinical settings. Furthermore, its use has been recommended in several clinical practice guidelines.[5–6] Previous clinical studies have reported enhanced ulcer healing outcomes following ultrasound therapy, particularly through the promotion of granulation tissue formation.[7–9] Since the development of healthy granulation tissue is closely associated with adequate blood supply, ultrasound therapy may exert its therapeutic effects by improving local microcirculation.

Consequently, therapeutic low-frequency ultrasound has emerged as a promising intervention for enhancing tissue perfusion and wound healing. To further elucidate its mechanism of action, various biophysical techniques have been employed to assess the effect of low-frequency therapeutic ultrasound on the microcirculation of venous ulcers in vivo.

METHODS

Study design: A prospective randomized controlled trial

Study setting: The study setting was Department of Physiotherapy and Rehabilitation, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar.

Study Duration: The study duration was January 2026 to June 2026.

Sample Size: 20 patients

SELECTION CRITERIA:

Inclusion criteria:

- Age group(>30 to 75 years)
- Gender
- Patients with venous ulcer
- Duration of ulcer more than 1 month
- Ultrasound equipment
- Wound measurement scale
- Informed consent form

Exclusion criteria:

- Malignancy
- Pregnancy patients
- Cardiac pacemaker

- Skin infection
- Psychiatric illness
- History of HIV/AIDs patients
- Renal dysfunction

All ulcers were diagnosed through duplex Doppler ultrasonography of the lower limb arteries and veins using a standardized ultrasound imaging system. Doppler examination was performed bilaterally to assess blood flow in the iliac, proximal and distal femoral, popliteal, great saphenous (upper and lower segments), and small saphenous veins.

Ulcer healing was evaluated using serial digital photography and wound measurements. The healing rate was determined by assessing changes in the total ulcer area (cm^2), maximum length (cm), and maximum width (cm). Wound assessments were conducted at baseline before treatment initiation and subsequently after each treatment session

Group A (Low-Frequency Ultrasound Therapy): A total of 10 patients were enrolled in this group. Participants received low-frequency ultrasound therapy at a frequency of 3 MHz, pulse duration of 100 ms, and intensity ranging from 0.8 to 1.0 W/cm^2. Each treatment session lasted 10 minutes and was administered three times per week for a total duration of 6 weeks. In addition to ultrasound therapy, all patients received standard wound care, which included daily application of gauze dressings soaked in 0.9% sodium chloride solution and the use of elastic compression bandages that were changed daily.

Group B (Control group): (n=10) was received with conventional therapy including regular dressings, debridement, compression therapy and antibiotic gram was applied for all participants. Total treatment duration was 6 weeks.

Ethical Approval:

This study was approved by the Institutional Ethics Committee of Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana (Ref. no. CAIMS/IEC/020/2026). Written informed consent was obtained from all participants before their enrollment in the study.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 25.0. All collected data were entered into and organized in a Microsoft Excel database before statistical analysis. Quantitative variables were summarized using the mean and standard deviation (SD), whereas qualitative variables were presented as frequencies and percentages.

RESULTS

A total of 20 patients were screened for eligibility and enrolled in the study. The study was conducted between January 2026 and June 2026. Following randomization, the participants were allocated equally into two groups: the study group (n = 10) and the control group (n = 10). Baseline demographic were comparable between the two groups, with no statistically significant differences observed. All 20 participants received the allocated intervention and completed the study protocol.

Table 1: Baseline demographic profile

Baseline profile	LFUS	Control group
Sex		
Male	7	7
Female	3	3
Age		
>30-40	1	0
>41-50	2	3
>51-60	2	2
>61-70	4	2
>71-80	1	3
Site of Ulcer		
Malleolus	6	7
Leg	3	3
Calf	1	0
Ulcer Duration		
< 5 years	2	2
>5 years	8	8

Table 2: Outcomes of healing with venous ulcer

Study group (n=10)		Control group (n=10)	
Ulcer healed	= 8	Ulcer healed	= 4
Ulcer non-healed	= 1	Ulcer non-healed	= 6
Lost to follow up	= 1	Lost to follow up	= 0

Primary Outcome: No statistically significant difference was observed in the percentage change in wound area between the study and control groups at Week 5 after adjusting for

baseline wound surface area. Of the 14 ulcers included in the analysis, two ulcers from two different participants were lost to follow-up, with one participant lost from each group.

In study group, 9 patients were healed during the study period after 6 weeks of low frequency ultrasound therapy with saline water treatment. One patient was not follow up. In control group, total 10 patients, treated with conventional therapy, results shows not significantly different compare to study group.

DISCUSSION

Venous ulcers are the most prevalent type of lower extremity ulcer, affecting approximately 1% of the adult population worldwide.[10] The prevalence of VLUs increases with advancing age, making older adults particularly susceptible to this condition. Several risk factors have been associated with the development of VLUs, including chronic venous disease, physical inactivity, obesity, a family history of chronic venous insufficiency, and previous episodes of pulmonary embolism, superficial or deep vein thrombosis, prior varicose vein surgery, and congestive heart failure. These factors contribute to venous hypertension and impaired venous return, ultimately leading to ulcer formation and delayed wound healing.

Numerous experimental and clinical studies have investigated the therapeutic effects of ultrasound therapy on wound healing, demonstrating its potential to enhance tissue repair and accelerate the healing process. In contrast to high-dose ultrasound it is extremely unlikely that low-dose ultrasound (intensity > 0.05 W/cm^2), frequency 3MHz shows any non-thermal effects on biological tissues contributing to enhanced wound healing.

Low-frequency ultrasound has been shown to enhance wound healing through the generation, oscillation, and movement of microscopic bubbles within the coupling medium and surrounding tissues. This phenomenon facilitates wound bed preparation by reducing microbial burden, enhancing angiogenesis, supporting the debridement of necrotic and devitalized tissues, and stimulating cellular activity involved in the healing process. Consequently, low-frequency ultrasound may contribute to improved tissue repair and accelerated wound healing.[10]

Figure 1: Venous ulcer before initiation of treatment

The primary therapeutic effect of low-frequency ultrasound is believed to be mechanical in nature.[11] It has been proposed that low-frequency ultrasound in the kilohertz (kHz) range enhances wound healing through the generation, oscillation, and movement of microscopic bubbles within the coupling medium and tissue. These mechanical effects facilitate wound cleansing, promote tissue repair, and optimize the wound-healing environment.

Figure 2: Wound healing response in a patient with a venous ulcer after low-frequency ultrasound therapy

Tan *et al.* (2007) reported increased healing rates following ultrasound therapy, attributing these improvements to its mechanical effects, which facilitate wound cleansing and debridement and create a favorable environment for epithelial cell migration.[12]

Similarly, Cole *et al.* (2009) observed complete wound healing in 30% of patients receiving ultrasound therapy and reported enhanced granulation tissue formation.[13] Kavros *et al.* (2007) demonstrated significantly superior healing outcomes in ischemic limbs treated with ultrasound in combination with standard care compared with standard care alone.[14] Furthermore, Callam and colleagues reported that weekly ultrasound therapy administered alongside standard treatment improved the healing rate of chronic leg ulcers.[15]

The findings of the present study are consistent with those reported in previous studies. After six weeks of treatment, participants receiving low-frequency ultrasound therapy exhibited greater reductions in pain compared with those receiving standard treatment alone. In addition, low-frequency ultrasound therapy was associated with a reducing in wound size and slough, improvement in local microcirculation, and enhanced granulation tissue formation, as demonstrated in Figures 1 and 2. These findings suggest that low-frequency ultrasound therapy facilitates wound healing by enhancing tissue perfusion and promoting the physiological processes involved in tissue repair and regeneration.

Limitations of the study

The present study has several limitations. First, the relatively small sample size may limit the generalizability of the findings. Second, the short follow-up period may not have been sufficient to assess long-term wound healing outcomes and ulcer recurrence. Therefore, larger multicenter studies with extended follow-up are warranted to validate the present findings and evaluate the long-term effectiveness of the intervention.

CONCLUSION

In conclusion, LFUST appears to be effective, significant reductions in wound size, enhanced local blood circulation, decreased pain, reduced slough, and improved granulation tissue formation. These findings indicate that low frequency ultrasound therapy can enhance the effectiveness of standard wound care protocols and may contribute to improved healing outcomes in patients with venous ulcers.

Conflict of Interest: Nil

Financial support and Sponsorship: Nil

REFERENCES

1. Harris C, Duong R, Vanderheyden G, Byrnes B Cattryse R, Orr A, Keast D. Evaluation of a muscle pump-activating device for non-healing venous leg ulcers. Int Wound J. 2017; 14:1189–1198.

2. Alvarez OM, Markowitz L, Parker R, Wendelken ME. Faster Healing and a Lower Rate of Recurrence of Venous Ulcers Treated with Intermittent Pneumatic Compression: Results of a Randomized Controlled Trial. Eplasty. 2020; 20:e6.

3. Byl NN, Mc Kenzie AL, Wong T, West J, Hunt TK. Incisional wound healing: a controlled study of low and high dose ultrasound. J Orthop Sports Phys Ther. 1993; 18: 619-628.

4. Nichter LS, Williams J. Ultrasonic wound debridement. Hand Surg. 1988; 13: 142-146.

5. Bonkemeyer Millan S, Gan R, Townsend PE. Venous ulcers: diagnosis and treatment. Am Fam Physician. 2019; 100:298-305

6. Hart J. The use of ultrasound therapy in wound healing J Wound Care. 1998; 7:25–8.

7. Peschen M, Weichenthal M, Schöpf E, Vanscheidt W. Low-frequency ultrasound treatment of chronic venous leg ulcers in an outpatient therapy Acta Derm Venereol. 1997; 77:311-4.

8. Mohr P, Stegmann W, Breitbart EW. Low-frequency ultrasound treatment of chronic venous ulcers. Wound Repair Regen. 1997; 5:18-22.

9. Uhlemann C, Wollina U, Liebold K, Schreiber TU. Behandlung des Ulcus cruris venosum mit niederfrequentem Ultraschall (nf-US). Phys Rehab Kur Med. 2001; 11:216–20.

10. Baronski S, Ayello EA. Wound treatment option. In: Baronski S, Ayello EA, Mclntosh A,Galvan L, Scarborough P. *Wound Care Essentials: Practice Principles, 2nd ed.* New York, Lippincott Williams & Wilkins; 2008:156.

11. Ennis WJ, Valdes W, Gainer M, Meneses P: Evaluation of clinical effectiveness of MIST ultrasound therapy for the healing of chronic wounds. Adv Skin Wound Care 2006, 19, 437-446.

12. Tan J, Abisi S, Smith A, Burnand KG. A painless method of ultrasonically assisted debridement of chronic leg ulcers: a pilot study. European J Vascular Endovascular Surg. 2007; 33(2): 234-238.

13. Cole PS, Quisberg, J, Melin, MM. Adjuvant use of acoustic pressure wound therapy for treatment of chronic wounds: a retrospective analysis. J Wound, Ostomy, Continence Nursing. 2009; 36(2):171–177.

14. Kavros SJ, Miller JL, Hanna SW. Treatment of ischemic wounds with noncontact, low-frequency ultrasound: the Mayo Clinic Experience, 2004-2006. Adv skin & wound care. 2007; 20(4): 221–226.

15. Callam, MJ, Harper DR., Dale JJ, Ruckely CV, Prescott RJ. A controlled trial of weekly ultrasound therapy in chronic leg ulceration. Lancet. 1987;VIII: 204-206.