Original Article

DOI: 10.7860/IJARS/2025/80330.3073

Surgery Section

Topical Insulin versus Topical Phenytoin in Healing of Diabetic Foot Ulcers: A Prospective Observational Study

ANANTHA BHANU PRAKASH[1], YAKKALI AVINASH[2], PADMANABH INAMDAR[3], PULIVARTHI SRIHARSHA[4], FOTHEDAR PRAVALIKA[5], NARU SABARINATHA REDDY[6], YERRAGOPU ANUDEEPIKA[7]

ABSTRACT

Introduction: Insulin, when applied as a local dressing, stimulates the growth and development of keratinocytes, endothelial cells, and fibroblasts, which aid in proliferation and tissue healing. Phenytoin, when used as a local dressing, has been extensively studied due to its positive effects on ulcer healing. These effects include increased fibroblast proliferation, collagen deposition, neovascularisation, enhanced granulation tissue formation, decreased collagenase activity, and reduced bacterial contamination.

Aim: To compare the efficacy of topical insulin with topical phenytoin in Diabetic Foot Ulcers (DFUs).

Materials and Methods: This prospective observational study was conducted in the Department of Surgery, at Mamata Medical College, Khammam, Telangana, India from August 2022 to July 2024. It included 64 cases of DFU (32 in each group), randomised by the envelope method. Group A: Topical insulin dressing (0.5 mL insulin with 5 mL normal saline). Group B: Topical phenytoin dressing (100 mg in 5 mL normal saline). Outcomes were measured in terms of wound size and percentage of wound contraction on days 7, 14, and 21, compared to Day 1 of the study. An unpaired t-test was used for the analysis of continuous data, while Pearson's Chi-square test was used for the analysis of categorical data. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 24.0.

Results: The mean age of subjects in Group A was 49.72±12.28 years, and in Group B, it was 52.28±12.79 years. The male-to-female ratio was 2.5:1 in Group A and 1.285:1 in Group B. The mean ulcer size for Group A on Day 1 was 17.88±3.148 cm^2, and for Group B, it was 17.3±3.47 cm^2, with a p-value > 0.05. The mean reduction in ulcer size for the topical insulin group was 2.6 cm^2, while for the topical phenytoin group, it was 6.33 cm^2 (p-value <0.0001). The percentage of reduction in mean ulcer size was greater in the topical phenytoin group (36.41%) compared to the topical insulin group (14.5%), with a p-value < 0.0001. The mean duration for complete epithelialisation of the ulcer, or when the ulcer bed was ready for split skin grafting, was 26.75 days in the topical insulin group and 20.8 days in the topical phenytoin group (p-value<0.0001). A total of 27 (84.375%) and 30 (93.75%) cases in the topical insulin group and the topical phenytoin group, respectively, underwent split skin grafting. Five patients in the topical insulin group and two patients in the topical phenytoin group achieved complete healing of the ulcer by secondary intention.

Conclusion: Topical phenytoin was found to be relatively more effective than topical insulin in enhancing wound healing in terms of percentage reduction in ulcer size and duration for complete epithelialisation.

Keywords: Complete epithelialisation, Local dressing, Wound healing

INTRODUCTION

According to the World Health Organisation (WHO), Non Communicable Diseases (NCDs) accounted for 74% of deaths globally in 2019, with diabetes resulting in 1.6 million deaths, making it the ninth leading cause of death worldwide [1]. DFUs are one of the most common sequelae following trauma or infection, primarily occurring around the distal ends of limbs, where vascularity is relatively decreased. Diabetic patients also have altered immune responses, leading to delayed wound healing [2,3]. A DFU is defined as a break in the epidermis and at least part of the dermis in a person with diabetes [4]. Most cases of ulcer formation arise from repetitive minor trauma, typically due to elevated pressure at plantar weight-bearing sites, friction, shearing from poorly fitting shoes or gait abnormalities, or unrecognised injuries on an insensate foot (e.g., puncture wounds, burns, or ingrown toenails) [2]. Structural deformities, such as Charcot neuroarthropathy, further increase the risk of DFUs [4]. Following a minor traumatic event, complex and multifactorial pathways ultimately lead to ulceration.

Wound healing is a complex biological process influenced by several factors, including Insulin-like Growth Factor (IGF) and human acidic Fibroblast Growth Factor (rh-aFGF) [5]. Among the numerous topical medications used to promote ulcer healing, two of the most commonly utilised agents are insulin and phenytoin. When applied as a local dressing, insulin stimulates the growth and development of keratinocytes, endothelial cells, and fibroblasts, which contribute to proliferation and tissue healing [6]. Phenytoin, used as a local dressing, has been investigated in many studies due to its positive effects on ulcer healing, such as increased proliferation of fibroblasts, collagen deposition, neovascularisation, enhanced granulation tissue formation, reduced collagenase activity, and decreased bacterial contamination [7]. Phenytoin also enhances gene expression of the platelet-derived growth factor β chain in macrophages and monocytes. Furthermore, phenytoin exhibits antibacterial action against *Staphylococcus aureus, Escherichia coli, Klebsiella species*, and *Pseudomonas* [8].

The topical application of insulin for wound healing dates back to the 1960s and 1970s. Although the use of topical insulin for wound healing decreased after that period, a few studies emerged in the late 1990s [9,10]. Phenytoin has been researched for treating ulcers, epidermolysis bullosa, and inflammatory conditions. Allergic and idiosyncratic cutaneous side-effects have been reported with its use [11,12]. A frequently observed and undesirable side-effect of phenytoin, an anticonvulsant medication, is gingival hyperplasia, especially in children [13]. This side-effect suggests that phenytoin can induce connective tissue growth and may promote wound

healing. The beneficial effects of phenytoin on wound healing were reported in 1945 and were first observed in a clinical trial for gingival wounds in 1958 by Shapiro [13].

The present study was undertaken to compare the efficacy of topical insulin and topical phenytoin dressings in the healing of DFUs.

MATERIALS AND METHODS

This was a prospective observational study conducted in the Department of Surgery at Mamata Medical College, Khammam, Telangana, India from August 2022 to July 2024. Institutional Ethical Committee (IEC) approval (MMC/IEC: 57/2022) was obtained. The study comprised 64 cases of DFUs (32 in each group), randomised by the envelope method.

Inclusion criteria:

- Diabetic patients aged 18 to 75 years.
- Patients with grade I and II ulcers according to Wagner's classification [14].
- Ulcer size of less than 10×10 cm.
- Patients willing to participate in the study.

Exclusion criteria:

- Patients aged <18 years and >75 years.
- Chronic non healing ulcers of other aetiology.
- Patients with grade III, IV, and V ulcers according to Wagner's classification [14].
- Patients with absent peripheral pulses in the dorsalis pedis, popliteal, posterior tibial, and anterior tibial arteries.
- Patients with other co-morbid conditions such as renal failure, generalised debility, and other factors that adversely affect wound healing.
- Patients with a past history of hypersensitivity to phenytoin.
- Patients not willing to participate in the study.

Following the acquisition of informed written consent from patients with DFUs, a comprehensive history of the ulcers was documented. The patients then underwent a detailed clinical examination. Routine investigations, including Haemoglobin (Hb), Fasting Blood Sugar (FBS), Post-Lunch Blood Sugar (PLBS), Glycated Haemoglobin (HbA1c), were conducted for both groups. Before commencing the therapeutic procedure, cultures and sensitivity swabs were obtained from all ulcers, which were cleansed with normal saline. Debridement of dirty and crusted wounds was performed. Optimal glycaemic control was achieved through the use of oral hypoglycaemic agents and/or insulin therapy. Debridement was carried out as necessary during the study period. Wound swabs for culture and sensitivity analysis were submitted weekly throughout the study duration.

All patients were treated empirically with cefpodoxime and clavulanic acid 325 mg twice daily at the time of admission. Antibiotics were adjusted later according to the ulcer swab culture and sensitivity results. Dressings were changed daily, and off-loading of pressure from the affected area was applied in both groups.

Once the wound bed was clean and healthy, patients were randomly divided into two groups: Group A (Insulin group) and Group B (Phenytoin group), using the envelope method. Group A patients received a suspension consisting of 0.5 mL of human soluble insulin in 5 mL of sterile normal saline. Group B patients were administered a suspension prepared from a single 100 mg phenytoin sodium tablet, which was crushed into powder and mixed with 5 mL of sterile normal saline. Sterile gauze was soaked in the suspension and placed over the wound. Before applying the dressing, the wound was cleaned with normal saline. Wounds were inspected at the end of 7, 14, and 21 days.

The endpoint of the study was defined as complete wound epithelialisation or the appearance of granulation tissue, ensuring the wound bed was ready for split-skin grafting or secondary healing, whichever occurred first. The wound was covered with sterile gauze, and the edges were marked; the long axis of the wound (length) and the perpendicular long axis (width) were measured using a ruler and multiplied to calculate the surface area of the wound. This was done individually for each patient, and then the mean surface area for each group was calculated on days 1, 7, 14, and 21. The efficiency of both topical agents was assessed by comparing the differences in wound size and the percentage of wound contraction on days 7, 14, and 21 compared to day 1 of the study.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS software version 24.0. An unpaired t-test was used to analyse continuous data, while Pearson's Chi-square test was used for categorical data. Differences were considered statistically significant if p-value <0.05.

RESULTS

The mean age of subjects in group A was 49.72±12.28 years, and in group B, it was 52.28±12.79 years [Table/Fig-1].

Age (years)	Group A (n=32)		Group B (n=32)	
	Male	Female	Male	Female
18-30	1 (1.5%)	1 (1.5%)	2 (3.1%)	1 (1.5%)
31-40	6 (9.3%)	2 (3.1%)	1 (1.5%)	1 (1.5%)
41-50	5 (7.8%)	1 (1.5%)	5 (7.8%)	5 (7.8%)
51-60	6 (9.3%)	2 (3.1%)	3 (4.7%)	2 (3.1%)
61-75	5 (7.8%)	3 (4.7%)	7 (10.9%)	5 (7.8%)
Mean	49.72±12.28		52.28±12.79	

[Table/Fig-1]: Age distribution of study participants.

In group A, 24 patients (75%) developed DFUs spontaneously, while in group B, 21 patients (65.6%). The remaining 19 patients (8 in group A and 11 in group B) had a history of trauma. In the present study, 26 patients (13 in each group) had a history of diabetes ranging from six months to five years. In group A, 18 patients were treated with oral hypoglycaemic agents, while in group B, 21 patients were on the same treatment. The remaining patients included 14 in group A and 11 in group B, who were receiving insulin therapy for blood sugar control [Table/Fig-2].

Diabetic profile	Group A	Group B
Aetiology of diabetic ulcer		
Spontaneous	24	21
Trauma	8	11
Duration of diabetes		
6 months-5 years	13	13
5-10 years	7	5
10-15 years	6	7
15-20 years	4	3
20-25 years	1	3
25-30 years	1	1
Mode of treatment		
Oral hypoglycaemic agents	18	21
Insulin	14	11
HbA1c values		
HbA1c 7-8	9	10
HbA1c 8.1-9	8	12
HbA1c 9.1-10	6	5
HbA1c 10.1-11	4	3
HbA1c 11.1-12	3	1
HbA1c 12.1-13	2	1
Mean	9.00%	9.01%

[Table/Fig-2]: Diabetic profile of study participants.

A total of 19 patients (29.68%) were classified as Grade 1, and 45 patients (70.32%) were classified as Grade 2, as shown in [Table/Fig-3]. *Pseudomonas aeruginosa* was identified in 16 cases (Group A: 9; Group B: 7). Sterile growth was found in 15 cases (Group A: 6, Group B: 9) [Table/Fig-4].

	Group A (n=32)	Group B (n=32)	p-value
Wagner's Grading of ulcer			
Wagner's Grade 1	11	8	0.41177
Wagner's Grade 2	21	24	
Site of ulcer			
Dorsum of foot	20	18	0.3997
Plantar aspect of foot	12	14	

[Table/Fig-3]: Wagners grading of ulcers in both groups.
Chi-square test

Organism	Group A (n=32)	Group B (n=32)	Total (n=64)
*P. aeruginosa**	9	7	16
Citrobacter spp.	0	4	4
Acinetobacter spp.	2	3	5
Klebsiella spp.	5	4	9
E. coli†	4	2	6
MRSA‡	5	2	7
MSSA§	1	1	2
Sterile	6	9	15

[Table/Fig-4]: Bacteriological profile of ulcers in both groups.
**Pseudomonas aeruginosa*; †*Escherichia coli*; ‡Methicillin Resistant *Staphylococcus aureus*; §Methicillin Sensitive *Staphylococcus aureus*

The average number of debridements required was 1.7 in the insulin group and 1.8 in the phenytoin group, with a range of 1 to 3 debridements. At the end of the study, culture-negative results were achieved in 29 (90.62%) subjects in the topical insulin group and 32 (100%) subjects in the topical phenytoin group.

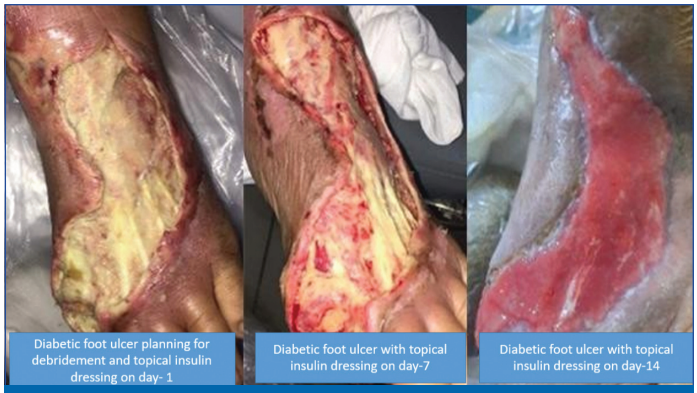
The mean ulcer size in the insulin group on Day 1 was 17.88 cm^2, while in the phenytoin group, the mean ulcer size was 17.3 cm^2 (p-value=0.4864). The mean ulcer size at Day 21 in the insulin group was 15.325 cm^2, and in the phenytoin group, it was 10.8 cm^2 (p-value <0.0001) [Table/Fig-5]. The mean reduction in ulcer size in Group A was 2.6 cm^2 ±0.393, while in Group B, it was 6.33 cm^2 ±2.049 at the end of 21 days [Table/Fig-6]. Representative images (pre- and post-treatment in both groups) are shown in [Table/Fig-7,8].

Mean ulcer size (in cm^2)	Group A (n=32) Mean±SD	Group B (n=32) Mean±SD	p-value
Day 01	17.88±3.148	17.3±3.47	0.4864
Day 07	16.91±3.063	15.0±2.9	0.0129
Day 14	16.0375±3.01556	12.5±2.9	<0.0001
Day 21	15.325±2.96089	10.8±2.2	<0.0001

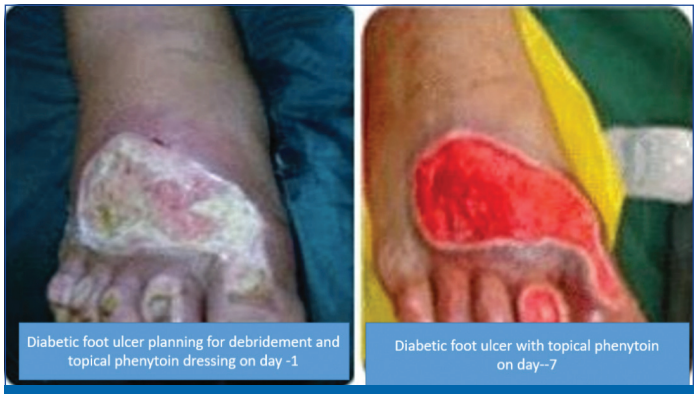
[Table/Fig-5]: Mean ulcer size on day(s) 1, 7, 14 and 21 in both groups.
Unpaired t-test

Category	Group A	Group B	p-value*
Mean reduction in ulcer size (in cm^2)	2.6	6.33	<0.0001
Percentage of reduction (wound contraction) in mean ulcer size	14.5%	36.41%	<0.0001
No. of ulcers achieving complete epithelisation/ulcer bed ready for SSG at the end of the study	32 (100%)	32 (100%)	-
No. of cases underwent SSG	27	30	-
Mean duration for complete epithelisation of ulcer/ulcer bed ready for SSG (in days)	26.6875	20.8125	<0.0001

[Table/Fig-6]: End point variables in both groups.
SSG: Split skin grafting; *p-value calculated using unpaired t-test



[Table/Fig-7]: Images of pre and post application of insulin dressing.



[Table/Fig-8]: Images of pre and post application of phenytoin dressing.

DISCUSSION

In the present study, the mean age was 49.72±12.28 years in Group A and 52.28±12.79 years in Group B. The mean ages in the studies conducted by Jayalal JA et al., Bharadva PB et al., and Nagaraj J and Subbiah V, were comparable to those in the present study [8,15,16]. Male predominance was observed in the current study (Male: 64%, Female: 36%), similar to the findings of Jayalal JA et al., (Male: 66.6%, Female: 33.3%), Bharadva PB et al., (Male: 85.71%, Female: 14.2%), Nagaraj J and Subbiah V, (Male: 60%, Female: 40%), and Sanjay P et al., (Male: 70%, Female: 30%) [8,15-17].

Citron DM et al., reported that 83.8% of cultures were polymicrobial, with 48% consisting solely of aerobic bacteria, 43% being mixed with aerobes and anaerobes, and only 1.3% showing purely anaerobic growth [18]. In the study conducted by Jayalal JA et al., *Staphylococcus* and *E. coli* constituted the major organism group [8]. However, in the present study, *Pseudomonas* was predominantly isolated (25%). This difference may be attributed to variations in the institutional microbiological profile.

At the end of this study, culture-negative results were achieved in 29 (90.62%) subjects in the topical insulin group and 32 (100%) subjects in the topical phenytoin group. The culture negativity achieved in the phenytoin group at the end of the current study (100%) was higher when compared to the findings of Jayalal JA et al., (50%) and Bharadva PB et al., (54%) [8,15].

In the present study, the initial mean ulcer size in the insulin group was 17.88 cm^2, while in the phenytoin group, it was 17.3 cm^2. The final mean ulcer size in the insulin group was 15.325 cm^2, whereas in the phenytoin group, it was 10.8 cm^2. This result was larger compared to studies conducted by Nagaraj J and Subbiah V and Sanjay P et al., [16,17]. This discrepancy in comparison to other studies can be explained by the inclusion of larger ulcers (up to 10 cm × 10 cm) as an inclusion criterion in the present study.

The mean reduction in ulcer size in this study was 2.6 cm^2 in the insulin group and 6.33 cm^2 in the phenytoin group (p-value <0.0001), which was different from the findings of Nagaraj J and Subbiah V, (3.805 cm^2 in the phenytoin group and 4.985 cm^2 in the insulin

group) and Sanjay P et al., (3.2 cm^2 in the insulin group), as well as Dubhashi SP and Sindwani RD (1.0404 cm^2 in the phenytoin group) [16,17,19]. The percentage of reduction (wound contraction) in mean ulcer size in the current study was 14.5% in the insulin group and 36.41% in the phenytoin group, both of which were statistically significant (p-value <0.0001). This percentage of wound contraction differs from that reported by Jayalal JA et al., (66% in the phenytoin group and 46% in the control group, with p-value=0.045) [8].

In the present study, the mean duration for complete epithelialisation of the ulcer, or for the ulcer bed to be ready for split skin grafting, was 26.68 days in the insulin group and 20.8 days in the phenytoin group. This duration in the phenytoin group was comparable to the studies conducted by Jayalal JA et al., (19 days), Bharadva PB et al., (23.96 days), and Dubhashi SP and Sindwani RD (29.6 days) [8,15,19].

Limitation(s)

The limitations of the study included the small sample size and the lack of blinding. A randomised comparative study with a much larger population may help to substantiate the findings further. Present study did not analyse several factors other than topical application (such as additional nutritional support and oral/i.v. antibiotics), which can also influence wound healing.

CONCLUSION(S)

Topical phenytoin was found to be relatively more effective than topical insulin in enhancing wound healing, as indicated by a reduction in ulcer size, percentage reduction in ulcer size, and duration for complete epithelialisation of the ulcer or ulcer bed ready for split skin grafting. However, further studies with a larger population will be necessary in the future before topical phenytoin dressing can be added to the broad spectrum of treatment modalities available for managing diabetic ulcers and ulcers of other aetiologies.

REFERENCES

[1] Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. Indian J Ophthalmol. 2021;69(11):2932-38. Doi: 10.4103/ijo.IJO_1627_21. PMID: 34708726; PMCID: PMC8725109.

[2] Boulton AJ. The pathway to foot ulceration in diabetes. Med Clin North Am. 2013;97(5):775-90. Doi: 10.1016/j.mcna.2013.03.007. Epub 2013 Apr 29. PMID: 23992891.

[3] Yotsu RR, Pham NM, Oe M, Nagase T, Sanada H, Hara H, et al. Comparison of characteristics and healing course of diabetic foot ulcers by etiological classification: neuropathic, ischemic, and neuro-ischemic type. J Diabetes Complications. 2014;28(4):528-35. Doi: 10.1016/j.jdiacomp.2014.03.013. Epub 2014 Mar 29. PMID: 24846054.

[4] McDermott K, Fang M, Boulton AJM, Selvin E, Hicks CW. Etiology, epidemiology, and disparities in the burden of diabetic foot ulcers. Diabetes Care. 2023;46(1):209-21. Doi: 10.2337/dci22-0043. PMID: 36548709; PMCID: PMC9797649.

[5] Goenka G, Athavale VS, Nirhale DS, Deshpande N, Agrawal K, Calcuttawala M. Role of topical use of insulin in healing of chronic ulcer. Med J DY Patil Univ. 2014;7:579-83. Doi: 10.4103/0975-2870.140400.

[6] Ramarao K, Ramu L. Comparative study between the effect of topical insulin and normal saline dressing in healing of diabetic foot ulcers. Int J Contemp Med Res. 2017;4(6):1337-39.

[7] Vardhan A, Garg P, Sehgal VK, Naidu CD, Bankar M, Mittal S. Efficacy of topical phenytoin in healing diabetic foot ulcer. Int J Basic Clin Pharmacol. 2016;5:2645-48. Doi: 10.18203/2319-2003.ijbcp20164139.

[8] Jayalal JA, Kumar SJ, Dhinesh, Thambithurai D, Kadar JMA. Efficiency of topical phenytoin on healing in diabetic foot ulcer: A randomized controlled trial. Int J Sci Stud. 2015;3(3): 84-89. Doi: 10.17354/ijss/2015/276.

[9] Hanam SR, Singleton CE, Rudek W. The effect of topical insulin on infected cutaneous ulcerations in diabetic and nondiabetic mice. J Foot Surg. 1983;22(4):298-301. PMID: 6358335.

[10] Greenway SE, Filler LE, Greenway FL. Topical insulin in wound healing: A randomised, double-blind, placebo-controlled trial. J Wound Care. 1999;8(10):526-28. Doi: 10.12968/jowc.1999.8.10.26217. PMID: 10827659.

[11] Silverman AK, Fairley J, Wong RC. Cutaneous and immunologic reactions to phenytoin. J Am Acad Dermatol. 1988;18(4 Pt 1):721-41. Doi: 10.1016/s0190-9622(88)70096-1. PMID: 2967311. Bethedsa MD. ASHP drug information 2001, American Society of Health System Pharmacists. 2001.

[12] Kimball OP, Horan TN. The use of Dilantin in the treatment of epilepsy. Ann Intern Med. 1939;13:787-93.

[13] Shapiro M. Acceleration of gingival wound healing in non-epileptic patients receiving diphenylhydantoin sodium (dilantin, epanutin). Exp Med Surg. 1958;16(1):41-53. PMID: 13537920.

[14] Wagner FW Jr. The dysvascular foot: A system for diagnosis and treatment. Foot Ankle. 1981;2(2):64-122. Doi: 10.1177/107110078100200202. PMID: 7319435.

[15] Bharadva PB, Choksi DB, Damor S, Shah J. Topical phenytoin dressing versus conventional dressing in diabetic ulcers. Int Surg J. 2017;4:1682-86.

[16] Nagaraj J, Subbiah V. The efficacy of local insulin versus topical phenytoin or normal saline in diabetic foot ulcer management: A prospective comparative study. Cureus. 2022;14(10):e30461. Doi: 10.7759/cureus.30461. PMID: 36407151; PMCID: PMC9673053.

[17] Sanjay P, Sandeep K, Vishal M, Sumit K, Avirl T, Ankit G. Efficacy of topical insulin dressings v/s normal saline dressing on diabetic foot ulcer- A hospital based study. IOSR J Dent Med Sci. 2018;17:47-50. Doi: 10.9790/0853-1701064750.

[18] Citron DM, Goldstein EJ, Merriam CV, Lipsky BA, Abramson MA. Bacteriology of moderate-to-severe diabetic foot infections and in vitro activity of antimicrobial agents. J Clin Microbiol. 2007;45(9):2819-28. Doi: 10.1128/JCM.00551-07. Epub 2007 Jul 3. PMID: 17609322; PMCID: PMC2045270.

[19] Dubhashi SP, Sindwani RD. A comparative study of honey and phenytoin dressings for chronic wounds. Indian J Surg. 2015;77(Suppl 3):1209-13. Doi: 10.1007/s12262-015-1251-6. Epub 2015 Mar 8. PMID: 27011538; PMCID: PMC4775671.

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.
2. Senior Resient, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.
3. Professor, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.
4. Assistant Professor, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.
5. Senior Resient, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.
6. Postgraduate Student, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.
7. Postgraduate Student, Department of General Surgery, Mamata Medical College, Khammam, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Anantha Bhanu Prakash,
501, VK Lake View Apartment, Sbi Backside, Mamata Road, Khammam-507002, Telangana, India.
E-mail: drbhanuprakash.kmc@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Aug 23, 2025
- Manual Googling: Oct 10, 2025
- iThenticate Software: Oct 13, 2025 (15%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **May 05, 2025**
Date of Peer Review: **Aug 23, 2025**
Date of Acceptance: **Oct 14, 2025**
Date of Publishing: **Nov 01, 2025**