



## COMPARATIVE STUDY OF TOPICAL INSULIN AND CONVENTIONAL DRESSINGS IN THE MANAGEMENT OF NON-HEALING DIABETIC ULCERS

Dr. Vinu Gopinath<sup>1</sup>, Dr. Mohammed Naufel K<sup>2\*</sup>

<sup>1</sup>Professor, <sup>2</sup>Junior Resident, Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam, India.

**Corresponding Author\*:** Dr. Mohammed Naufel K, Postgraduate, Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam, India.

**Email ID:** [kmnoufel@gmail.com](mailto:kmnoufel@gmail.com)

**DOI:** <https://doi.org/10.59551/IJHMP/25832069/2026.7.2.123>

**How to cite this article:** Gopinath V, Mohammed Naufel K. Comparative Study of Topical Insulin and Conventional Dressings in the Management of Non-Healing Diabetic Ulcers. *Indian J. Health Care, Med. Pharm. Pract.* 2026;7(2):151-155.

**COPYRIGHT@ 2026, IJHMP** | This work is licensed under a [Creative Commons Attribution 4.0 International Licence](https://creativecommons.org/licenses/by/4.0/) 

Received: 25 May, 2026, Decision for Acceptance: 27 July, 2026

### ABSTRACT

**Background:** Diabetic foot ulcers (DFUs) are one of the most devastating consequences of diabetes mellitus, frequently resulting in infection, amputation, and extended morbidity. Traditional dressings generally aim to provide a moist environment and avert infection, although frequently do not expedite healing in chronic wounds. Topical insulin has evolved as an innovative, economical treatment alternative owing to its anabolic, angiogenic, and anti-inflammatory characteristics that facilitate cellular proliferation and tissue healing.

**Aims:** The study aims to compare the efficacy of topical insulin dressings versus conventional dressings in the management of non-healing diabetic ulcers.

**Materials and Methods:** This prospective comparative study was conducted over a period of 10 months at the Department of General Surgery, including 70 patients with non-healing diabetic ulcers fulfilling inclusion criteria. Patients were randomly divided into two groups of 35 each. Group A received topical regular insulin dressing, prepared by diluting 1 mL (10 IU) of insulin in 1 mL of normal saline and applied once daily under aseptic precautions. Group B received conventional normal saline dressings following standard wound care protocols. All patients underwent strict glycemic control and appropriate antibiotic therapy based on culture sensitivity. Ulcer size, depth, granulation tissue formation, and epithelialization were measured weekly for 8 weeks using standardized wound assessment charts. Healing rates were compared statistically using the Student's t-test and Chi-square test, with  $p < 0.05$  considered significant.

**Results:** The mean decrease in ulcer area after 8 weeks was significantly higher in the topical insulin group ( $72.8 \pm 10.4\%$ ) than in the conventional dressing group ( $48.6 \pm 12.2\%$ ) ( $p < 0.001$ ). The average time for the emergence of healthy granulation tissue was  $10.2 \pm 2.1$  days in Group A compared to  $16.5 \pm 3.2$  days in Group B. Complete epithelialization was observed in 65.7% of patients in Group A and 34.2% in Group B during the research period. The infection rate and duration of hospitalization were significantly reduced in patients administered topical insulin.

**Conclusion:** Topical insulin is a safe, inexpensive, and effective adjunct in the management of non-healing diabetic ulcers. It significantly enhances granulation tissue formation, accelerates epithelialization, and reduces overall healing time compared to conventional dressings. Incorporating topical insulin into standard wound care protocols can improve outcomes, particularly in resource-limited settings where cost-effective interventions are essential.

**KEYWORDS:** Topical Insulin, Diabetic Foot Ulcer, Wound Healing, Conventional Dressing, Granulation Tissue, Epithelialization, Glycemic Control.

## Introduction

Diabetes mellitus is a chronic metabolic condition marked by sustained hyperglycemia due to deficiencies in insulin secretion, insulin action, or both[1]. A significant and devastating complication is the diabetic foot ulcer (DFU), which impacts roughly 15–25% of individuals with diabetes over their lifetime[2]. DFUs substantially impact morbidity, extend hospitalizations, escalate healthcare expenditures, and, in severe instances, result in limb amputations[3].

Impaired wound healing in diabetes results from various reasons, including peripheral neuropathy, ischemia, microangiopathy, and heightened susceptibility to infection. These pathophysiological alterations result in protracted tissue regeneration and inadequate healing response, rendering DFUs a formidable therapeutic concern[4].

Conventional care of diabetic ulcers involves mechanical debridement, infection control, and standard dressings like normal saline or povidone-iodine gauze. Although these treatments preserve a sterile and hydrated wound environment, they do not actively facilitate cellular healing or angiogenesis. Consequently, the healing process frequently progresses slowly and stays incomplete, especially in chronic or non-healing ulcers[5]. The pursuit of adjuvant therapies that expedite healing and restore tissue integrity has prompted the investigation of diverse substances, such as growth factors, negative pressure wound therapy, platelet-rich plasma, and topical insulin[6].

Topical insulin has evolved as a novel, economical treatment method in wound management. Insulin, in addition to its systemic metabolic actions, is essential for cellular proliferation, protein synthesis, and tissue regeneration[7]. It induces mitogenic and anabolic effects by promoting fibroblast proliferation, collagen synthesis, and keratinocyte migration—essential components in wound healing[8]. Furthermore, insulin promotes local angiogenesis by increasing the expression of vascular endothelial growth factor (VEGF) and enhancing microcirculation in the wound bed. Furthermore, the anti-inflammatory characteristics of insulin facilitate less local inflammation, hence accelerating granulation and epithelialization[9].

In contrast to systemic insulin injection, which aims at glycemic regulation, topical treatment directs insulin to the wound site, circumventing systemic metabolism and reducing the likelihood of hypoglycemia[10]. Numerous experimental and clinical investigations have demonstrated that topical insulin expedites wound contraction and diminishes healing duration without systemic side effects. Moreover, insulin is cost-effective and easily accessible, rendering it especially advantageous in resource-limited healthcare environments.

Despite several studies indicating the advantages of topical insulin, its regular clinical application is constrained, mainly due to the absence of standardized techniques and reliable

clinical data across diverse groups. The rationale behind the present study is to establish topical insulin as a simple, safe, and cost-effective adjunct to standard wound care. If proven effective, it could significantly improve healing outcomes, reduce hospital stays, and lower the burden of diabetic complications.

## Aims and Objectives

- To compare the efficacy of topical insulin dressings versus conventional dressings in the management of non-healing diabetic ulcers.

## Materials and Methods

This prospective comparative study was conducted in the Department of General Surgery at Sree Mookambika Institute of Medical Sciences over a period of ten months. A total of 70 patients with non-healing DFUs attending the surgical outpatient department and admitted in the surgical wards were included in the study after obtaining informed consent.

Patients of both genders aged between 35 and 75 years with a known history of diabetes mellitus and presenting with chronic, non-healing foot ulcers of more than four weeks' duration were included. Exclusion criteria comprised patients with ischemic ulcers due to peripheral vascular disease, malignant ulcers, renal failure, hepatic disease, immunocompromised conditions, or those on systemic steroids and chemotherapy.

All patients underwent detailed history taking, thorough clinical examination, and baseline investigations including fasting and postprandial blood glucose, HbA1c, complete blood count, renal function tests, and wound culture and sensitivity. The glycemic status of each patient was optimized using appropriate antidiabetic therapy. After satisfying the inclusion criteria, the patients were randomly divided into two groups of 35 each. Group A received topical insulin dressings, while Group B received conventional saline dressings.

In Group A, topical insulin dressings were prepared freshly each time by diluting 1 mL (10 IU) of regular insulin in 1 mL of normal saline. After thorough wound cleaning with normal saline and gentle debridement under aseptic precautions, sterile gauze soaked in the diluted insulin solution was applied over the ulcer surface once daily, and the wound was covered with sterile dressing. In Group B, the ulcers were managed with conventional normal saline dressings, applied once daily after similar cleaning and debridement. All patients in both groups received standard diabetic care including glycemic control, antibiotic therapy according to culture sensitivity, and appropriate offloading measures to reduce local pressure on the affected area.

Patients were followed up weekly for eight weeks. The wound area was measured using a transparent graph sheet, and the reduction in size was expressed as a percentage of the baseline

measurement. The parameters assessed included ulcer size reduction, appearance of healthy granulation tissue, onset of epithelialization, and complete wound healing. Signs of infection, such as purulent discharge, foul odor, and erythema, were also monitored. Any adverse local or systemic effects, including hypoglycemia or allergic reaction, were carefully documented.

Data collected from both groups were compiled and statistically analyzed. The mean and standard deviation were calculated for continuous variables, and comparisons between groups were performed using the Student's t-test for quantitative data and the Chi-square test for qualitative variables. A p-value of less than 0.05 was considered statistically significant. The results were interpreted to determine the comparative efficacy of topical insulin dressing and conventional dressing in promoting wound healing among patients with non-healing diabetic ulcers.

## Observation and Results

Patients were randomly divided into two equal groups of 35 each—Group A (Topical Insulin Dressing) and Group B (Conventional Saline Dressing). Both groups were age- and gender-matched ( $p > 0.05$ ), indicating comparability of baseline demographic characteristics.

The duration of diabetes was similar across both groups, eliminating bias due to chronicity of disease.

No significant difference in baseline ulcer area was observed ( $12.5 \pm 2.4$  vs  $12.8 \pm 2.6$ ,  $p=0.68$ ), confirming uniformity in wound characteristics at the start of the study. (Table 3) A statistically significant improvement in wound area reduction was noted in the topical insulin group at all time intervals, indicating faster healing compared to conventional dressings (Table 3).

**Table 1: Age and Gender Distribution**

| Parameter        | Group A (n=35) | Group B (n=35) | p value |
|------------------|----------------|----------------|---------|
| Mean Age (years) | $55.6 \pm 8.2$ | $56.4 \pm 7.9$ | 0.71    |
| Males            | 24 (68.6%)     | 23 (65.7%)     | 0.80    |
| Females          | 11 (31.4%)     | 12 (34.3%)     | 0.80    |

**Table 2: Duration of Diabetes**

| Duration of Diabetes | Group A (n=35) | Group B (n=35) | p value |
|----------------------|----------------|----------------|---------|
| <5 years             | 8 (22.9%)      | 7 (20%)        | 0.77    |
| 5–10 years           | 14 (40%)       | 15 (42.9%)     | 0.82    |
| >10 years            | 13 (37.1%)     | 13 (37.1%)     | 1.00    |

**Table 3: Mean Percentage Reduction in Ulcer Area Over Time**

| Time Interval | Group A           | Group B           | p value |
|---------------|-------------------|-------------------|---------|
| 2 weeks       | $25.6 \pm 6.2\%$  | $14.3 \pm 5.7\%$  | <0.001  |
| 4 weeks       | $48.3 \pm 8.9\%$  | $29.6 \pm 7.4\%$  | <0.001  |
| 6 weeks       | $63.7 \pm 9.8\%$  | $41.2 \pm 8.3\%$  | <0.001  |
| 8 weeks       | $72.8 \pm 10.4\%$ | $48.6 \pm 12.2\%$ | <0.001  |

**Table 4: Mean Time for Healthy Granulation and Epithelialization**

| Parameter                                 | Group A (n=35) | Group B (n=35) | p value |
|-------------------------------------------|----------------|----------------|---------|
| Time to Healthy Granulation (days)        | $10.2 \pm 2.1$ | $16.5 \pm 3.2$ | <0.001  |
| Time to Onset of Epithelialization (days) | $20.8 \pm 4.3$ | $29.2 \pm 5.6$ | <0.001  |

**Table 5: Complete Healing and Infection Rates**

| Outcome                         | Group A (n=35) | Group B (n=35) | p value |
|---------------------------------|----------------|----------------|---------|
| Complete Healing within 8 weeks | 23 (65.7%)     | 12 (34.2%)     | 0.009   |
| Persistent Non-healing Ulcer    | 12 (34.3%)     | 23 (65.8%)     | 0.009   |
| Wound Infection                 | 6 (17.1%)      | 14 (40%)       | 0.04    |

**Table 6: Correlation of Healing Rate with Duration of Diabetes**

| Duration of Diabetes | Mean Healing (%) – Group A | Mean Healing (%) – Group B | p value |
|----------------------|----------------------------|----------------------------|---------|
| <5 years             | 78.2 ± 9.4                 | 55.8 ± 10.1                | <0.01   |
| 5–10 years           | 73.6 ± 8.7                 | 49.5 ± 9.6                 | <0.001  |
| >10 years            | 67.1 ± 10.2                | 42.3 ± 8.8                 | <0.001  |

The appearance of healthy granulation tissue and initiation of epithelialization occurred significantly earlier in the topical insulin group, emphasizing its stimulatory effect on tissue regeneration (Table 4).

The rate of complete healing was significantly higher in the topical insulin group, whereas infection rates were considerably lower. This reflects the anti-inflammatory and angiogenic properties of topical insulin (Table 5).

Healing efficiency decreased with longer duration of diabetes in both groups, but topical insulin consistently showed superior outcomes across all durations, demonstrating its efficacy even in chronic cases (Table 6).

Local adverse events were minimal in both groups. Local irritation occurred in 2 patients (5.7%) in Group A and in 1 patient (2.9%) in Group B, a difference that was not statistically significant ( $p = 0.55$ ). No episodes of hypoglycemia were reported in either group.

## Discussion

The mean age of participants in the topical insulin group ( $55.6 \pm 8.2$  years) was similar to that in the conventional group ( $56.4 \pm 7.9$  years), with a notable male predominance (68.6% and 65.7%, respectively). The majority of patients had diabetes for over ten years, indicating a persistent hyperglycemic burden that likely hindered wound healing. Uddin MA et al.[11], reported same demographic patterns, noting a male predominance of 73.33% in Group A and 80.00% in Group B, with a mean age of roughly 50–53 years.

The baseline ulcer diameters were similar among the groups (mean  $12.5 \text{ cm}^2$ ). At the conclusion of eight weeks, the topical insulin group demonstrated a significantly larger percentage reduction in ulcer area ( $72.8 \pm 10.4\%$ ) compared to the conventional dressing group ( $48.6 \pm 12.2\%$ ), underscoring the therapeutic efficacy of topical insulin. Uddin MA et al.[11], also observed a markedly bigger reduction in ulcer area and a higher percentage of healing in the topical insulin group ( $15.30 \pm 3.28\%$ ) compared to the normal saline group ( $6.35 \pm 2.03\%$ ,  $p < 0.001$ ).

Lyba Ghayour FI et al.[12], further evidenced a significant decrease in wound area in both cohorts after two weeks, with consistently enhanced improvement in the ulcers treated with insulin. A comprehensive review by Stergioti A et al.[13], substantiated these findings, demonstrating that topical insulin—administered through injection or dressing—enhances healing beyond its glycemic impact, with local injection proving most efficacious.

The present study had thoroughly shown the efficacy of topical insulin in reducing the wound size. Bhattani MK et al.<sup>14</sup> documented markedly reduced post-treatment wound diameters and a higher percentage reduction in the insulin group ( $49.7 \pm 5.2\%$ ) relative to the placebo group ( $19.2 \pm 4.6\%$ ). Biradar D et al.[14], reported same results, revealing a markedly larger decrease in wound surface area by day 7 and day 15 in the insulin group, with a mean reduction of  $67.8 \pm 11.45\%$  by day 15, in contrast to  $49.51 \pm 18.21\%$  in the saline-treated cohort.

The current study revealed that granulation tissue manifested earlier in the insulin group ( $10.2 \pm 2.1$  days) compared to the conventional group ( $16.5 \pm 3.2$  days), and epithelialization also initiated much earlier ( $20.8 \pm 4.3$  vs.  $29.2 \pm 5.6$  days). Biradar D et al.[15], also documented early granulation in the insulin cohort ( $6.08 \pm 2.15$  days vs.  $9.48 \pm 4.21$  days;  $p < 0.001$ ). Prasad A et al.[16], also noted that insulin-treated individuals had much more granulation by Day >20 ( $92.74\%$  vs.  $78.86\%$ ), with a statistically significant difference.

Complete wound healing within eight weeks was observed in 65.7% of individuals administered topical insulin, in contrast to 34.2% in the usual group. This corresponds with findings from Ahmed HB et al.[17], who noted a markedly reduced length of complete healing with insulin dressings ( $39.80 \pm 8.04$  days) compared to traditional care ( $47.60 \pm 6.52$  days;  $p = 0.000$ ). Kamali M et al.[18], also determined that topical insulin was superior to saline in facilitating wound healing.

The current study observed no systemic adverse effects or hypoglycemia, so affirming the safety of topical insulin administration. Only modest, self-resolving local discomfort was observed in two patients (5.7%). These findings are corroborated by PV S et al.[19], who also documented a lack of hypoglycemia incidents subsequent to the application of topical insulin.

A correlation was detected between prolonged diabetes duration and reduced healing efficiency; nonetheless, topical insulin consistently yielded superior outcomes across all groupings. In individuals with diabetes for over 10 years, healing rates were significantly greater in the insulin group (67.1% vs to 42.3%). Iqbal S et al.[20], showed similar findings, emphasizing the dependability of insulin's wound-modulating effects regardless of the chronicity of the disease.

## Conclusion

Topical insulin application is a secure, efficient, and cost-effective approach for improving wound healing in

non-healing DFUs. Topical insulin markedly expedited granulation tissue production, epithelialization, and overall wound contraction relative to standard dressings, resulting in an increased rate of complete healing and a reduction in infections. No systemic side effects or hypoglycemia were detected, hence affirming its local safety. Topical insulin facilitates expedited and efficient tissue repair, serving as a straightforward, economical, and pragmatic complement to conventional diabetic ulcer treatment, especially advantageous in resource-limited healthcare settings.

## Financial Support and Sponsorship

None

## Conflicts of Interest

There are no conflicts of interest.

## References

- Jadon AS, Kaushik MP, Anitha K, Bhatt S, Bhadauriya P, Sharma M. Types of diabetes mellitus, mechanism of insulin resistance and associated complications. In: *Biochemical immunology of diabetes and associated complications* 2024 Jan 1 (pp. 1-18). Academic Press.
- Alam S, Hasan MK, Neaz S, Hussain N, Hossain MF, Rahman T. Diabetes Mellitus: insights from epidemiology, biochemistry, risk factors, diagnosis, complications and comprehensive management. *Diabetology*. 2021 Apr 16;2(2):36-50.
- Moore Z, Avsar P, Wilson P, Mairghani M, O'Connor T, Nugent L et al. Diabetic foot ulcers: treatment overview and cost considerations. *Journal of wound care*. 2021 Oct 2;30(10):786-91.
- Armstrong DG, Tan TW, Boulton AJ, Bus SA. Diabetic foot ulcers: a review. *Jama*. 2023 Jul 3;330(1):62-75.
- Rayate AS, Nagoba BS, Mumbre SS, Mavani HB, Gavkare AM, Deshpande AS. Current scenario of traditional medicines in management of diabetic foot ulcers: A review. *World journal of diabetes*. 2023 Jan 15;14(1):1.
- Khan MS, Jahan N, Khatoon R, Ansari FM, Ahmad S. An update on diabetic foot ulcer and its management modalities. *Indian Journal of Microbiology*. 2024 Dec;64(4):1401-15.
- Barkhordari S, Shahi F, Khonakdar HA. Advanced drug delivery systems for topical insulin in diabetic wound healing. *ChemistrySelect*. 2024 Nov;9(44):e202403847.
- Oliveira A, Simões S, Ascenso A, Reis CP. Therapeutic advances in wound healing. *Journal of Dermatological Treatment*. 2022 Jan 2;33(1):2-2.
- Wassif RK, Shamma RN, El-Hoffy NM, El-Kayal M. Recent Advances in the Local Drug Delivery Systems for Diabetic Wound Healing: A Comprehensive Review. *AAPS PharmSciTech*. 2025 Jul 1;26(6):177.
- Kłapcia A, Domalik-Pyzik P. Hydrogel dressings as insulin delivery systems for diabetic wounds. *Frontiers in Bioscience-Elite*. 2025 Feb 24;17(1):26446.
- Uddin MA, Hasina A, kumar Shill S. Effect of Topical Insulin Versus Normal Saline Dressing in Healing of Diabetic Foot Ulcers. *Central Medical College Journal*. 2021;5(2):94-101.
- Lyba Ghayour FI, Baseerullah AR, Abrar Ashraf AL. Comparative Analysis of Topical Insulin Dressing Vs Normal Saline Dressing in Diabetic Foot Ulcers Wound Healing. *Pakistan Journal of Medical & Health Sciences*. 2024 Apr 19;18(01):32-.
- Stergioti A, Karra V, Chatzopoulou M, Kalafati M. The Effect of Local Use of Insulin on Wound-Ulcer in Diabetic or Non-Diabetic Patients: A Scoping Review. *The International Journal of Lower Extremity Wounds*. 2025 Apr 29:15347346251338182.
- Bhittani MK, Rehman M, Altaf HN, Altaf OS. Effectiveness of topical insulin dressings in management of diabetic foot ulcers. *World Journal of Surgery*. 2020 Jun;44(6):2028-33.
- Biradar D, Patil MB, Baloorkar R, Sindagikar V, Manoop K. Topical Insulin and Normal Saline in Chronic Diabetic Foot Ulcers-A Prospective Analytical Study. *Journal of Clinical & Diagnostic Research*. 2020 Aug 1;14(8).
- Prasad A, Thomas AA, Mahadevan D. To study the efficacy of topical insulin vs. conventional dressing on wound healing in diabetic foot ulcers. *IOSR J. Dent. Med. Sci*. 2018;17(4):33-8.
- Ahmed HB, Ghazanfor R, Qureshi U, Akram U, Hassan SW, Adnan N et al. Comparison of insulin soaked dressing with the conventional dressing in diabetic ulcers. *The Professional Medical Journal*. 2021 Jun 10;28(07):951-6.
- Kamali M, Thenmozhi R, Kalabarathi S. Effect of Topical Insulin Versus Normal Saline Dressing on Diabetic Wound Healing: An Experimental Comparative Study. *Cardiometry*. 2023 Feb 1(26):712-8.
- PV S, Sahoo AK, Seikh O, TP E, Ali M. Effect of Topical Insulin on Wound Healing in Diabetic Foot Ulcer-A Prospective Randomized Controlled Trial. *Surgical Chronicles*. 2022 Jan 1;27(1).
- Iqbal S, Zulfiqar B, Zufishan S. Effectiveness of topical insulin in the management of diabetic foot ulcers. *The Professional Medical Journal*. 2019 Sep 10;26(09):1487-90.