

**DRESSINGS FOR TREATING FOOT ULCERS IN PEOPLE WITH DIABETES - A SYSTEMATIC REVIEW**S. Subramanian<sup>1</sup><sup>1</sup>Assistant Professor, Department of General Surgery, Palakkad Institute of Medical Sciences, Palakkad, India

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**Abstract**

**Background:** If left untreated, diabetes mellitus leads to an increase in the levels of sugar (glucose) in the bloodstream. It is a significant health concern that affects millions of people worldwide. Dressings of wounds play a crucial role in the management of these ulcers. This systematic review aimed to assess the effectiveness of different dressings in managing foot ulcers in patients with diabetes. **Materials and Methods:** A systematic search of PubMed and Google Scholar databases from January 2012 to March 2024 was conducted. Inclusion criteria involved Studies investigating the efficacy of various dressings in the treatment of foot ulcers among individuals with diabetes were included. Data synthesis included a narrative summary of the study characteristics, methodologies, and key findings, emphasising the unique contributions of each study. **Result:** This review included eight studies, revealing comparable efficacy among various dressings for managing foot ulcers in patients with diabetes. Basic wound contact dressings remain pivotal in diabetic foot ulcer (DFU) management, with no compelling evidence supporting the superiority of advanced alternatives. **Conclusion:** Addressing foot ulcers in patients with diabetes is crucial for well-being and health care. Our review underscores the importance of dressings in managing these ulcers, noting that basic wound contact dressings are still foundational, with no clear advantage observed for advanced options.

**INTRODUCTION**

Diabetes mellitus (DM) encompasses various metabolic disorders resulting from irregularities in insulin secretion, insulin function, or both, resulting in sustained elevation of blood glucose levels, termed hyperglycaemia.<sup>[1]</sup> It affects an estimated 1.8 million people in the UK (about 3% of the population) and 24 million individuals in the USA. Global forecasts suggest that the global prevalence of DM could increase to 4.4% by 2030, potentially affecting approximately 366 million individuals.<sup>[2]</sup>

Diabetes mellitus is recognised for its diverse complications, and foot ulceration, which frequently leads to lower extremity amputations, is a common complication. The occurrence of foot ulcers varies between 4% and 10% among individuals diagnosed with diabetes mellitus.<sup>[3]</sup> Diabetic foot ulcers commonly become infected and constitute a significant reason for hospital admission. In addition, they represent more than half of non-traumatic lower limb amputations among individuals with this medical condition. Ulceration plays a crucial role in limb loss for two reasons. They provide a pathway for infection and can lead to gradual tissue death and

inadequate wound healing in the presence of severe ischemia.<sup>[4]</sup>

Preventive measures and proactive foot care are recommended to reduce patient suffering, use costly resources, and increase the likelihood of amputation. There has been a growing recognition of how reimbursement systems can impact the prevention, treatment, and results of diabetic foot wounds in recent times.<sup>[5]</sup> Annual foot examinations are advised for all diabetic individuals to detect high-risk foot conditions such as peripheral vascular insufficiency, structural foot abnormalities, and diminished protective sensation, for which targeted interventions have proven effective in mitigating the risk of amputation.<sup>[6]</sup>

Dressings are essential in the treatment of persistent wounds, especially diabetic foot ulcers (DFUs), as they reduce exudate, control infection, and promote wound healing. A variety of advanced dressings have been newly introduced, such as gel dressings, enzymatic debridement dressings, silver ion dressings, iodine-infused dressings, platelet-rich plasma dressings, and epidermal growth factor dressings. Collagen dressings have been used to manage foot ulcers associated with diabetes (DFU). Collagen elements, such as fibroblasts and

keratinocytes are significant components of skin formation.<sup>[7]</sup>

There is a vast choice of dressings available to treat chronic wounds, such as foot ulcers, in people with DM, categorised based on their primary material [Table 1]. In this systematic review, we aimed to analyse the available literature and evaluate the efficacy of various dressings for treating foot ulcers in individuals with diabetes.

## MATERIALS AND METHODS

The overall quality of evidence for each outcome was assessed using the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) methodology. We systematically searched multiple online databases, including PubMed and Google Scholar, to identify all randomised clinical trials that investigated the efficacy of various dressings for treating foot ulcers in individuals with diabetes. This report conforms to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

### Literature Search Strategy

A systematic and comprehensive search was conducted across major scientific databases, including PubMed and Google Scholar, to identify relevant studies on the effectiveness of various dressings for the treatment of foot ulcers in individuals with diabetes. The search spanned from January 2012 to March 2024 and encompassed studies published within this timeframe. Keywords utilized in the search strategy comprised variations of "foot ulcers," "diabetes," and "dressings," combined with terms like "treatment outcome," "efficacy," and "wound healing." Boolean operators (AND, OR) were employed to refine the search and ensure retrieval of pertinent literature.

### Inclusion and Exclusion Criteria

Studies were included if they met the following criteria.

- Individuals diagnosed with diabetes mellitus.
- Studies investigating the use of dressings to treat foot ulcers in patients with diabetes
- Randomised controlled trials (RCTs), observational studies, and systematic reviews.
- Studies published from January 2013 to March 2024
- Studies published in peer-reviewed journals.
- Included Human Subjects.
- Available in English.

Studies were excluded if they met the following criteria.

- Studies published before January 2012.
- Studies not involving the use of dressings to treat foot ulcers in patients with diabetes
- Studies with insufficient data or unclear methodology.
- Studies published in languages other than English.

**Synthesis of Findings:** The data synthesis encompassed a narrative overview of essential study attributes, methodologies utilised, and significant outcomes concerning the effectiveness of various dressings in managing foot ulcers among individuals with diabetes. Considering the expected diversity in study designs, a qualitative methodology was employed to highlight the distinct contributions of each study towards comprehending the relative efficacy of different dressings for treating foot ulcers in the diabetic population.

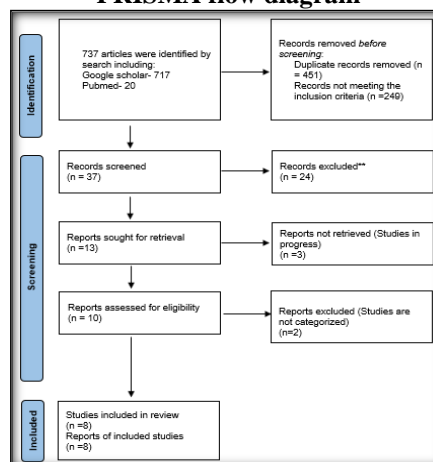
**Ethical Considerations:** As this review was based on an analysis of previously published studies, ethical approval was not required. All the included studies adhered to ethical standards, as outlined in their respective publications.

## RESULTS

We included Cochrane systematic reviews of randomised controlled trials (RCTs) that investigated dressing types for treating foot ulcers in individuals with diabetes mellitus (DM). Furthermore, non-Cochrane systematic reviews of RCTs, systematic reviews, and meta-analyses examining different dressing options for foot ulcers in patients with DM were integrated, provided that they exhibited a systematic methodology, including a thorough search strategy, inclusion of only RCTs, clear and relevant criteria for study selection, evaluation of the methodological aspects of the included studies, and synthesis of evidence. Mixed treatment comparison meta-analyses were considered for inclusion if they were conducted as part of or as a result of a systematic review of RCTs.

A thorough search of Google Scholar and PubMed identified 737 articles related to the selected topic. After removing 451 duplicate records, 249 articles were excluded as they did not meet the inclusion criteria. Subsequently, 37 records were screened and 24 studies were excluded. Further evaluation categorised two studies as in progress and two as pending. Ultimately, eight studies were found to be eligible and included in the review, aligned with the specified inclusion criteria [Table 2].

### PRISMA flow diagram



**Table 1: Types of dressings for DFU with examples.**

Dressing Type	Description	Example
Basic Wound Contact Dressings	Typically consists of non-medicated or medicated cotton pads placed directly on the wound.	Paraffin gauze dressing, Xeroform®, Primapore®, Mepore®, absorbent cotton gauze.8
Advanced Wound Dressings	Offer advanced options with various functionalities for wound management.	Alginate dressings, hydrogel dressings, films, soft polymer dressings, hydrocolloid dressings, foam dressings, capillary-action dressings, and odour-absorbent dressings. 8
Anti-Microbial Dressings	Contains antimicrobial agents to prevent or treat infection.	Honey-impregnated dressings, iodine-impregnated dressings, silver-impregnated dressings, and other antimicrobial dressings. 8
Specialist Dressings	Specialized dressings targeting specific wound characteristics or functions.	Protease-modulating matrix dressings. 8

**Table 2: Characteristics of Included Studies**

Authors and year	Study Type	Participants (n)	Outcomes
Donaghue et al, <sup>[9]</sup> (2015)	A systematic review (Overview)	13 eligible systematic reviews	They documented the healing of wounds during their follow-up periods of six and four weeks. Altogether, 51% (36 out of 70) of ulcers in the alginate group healed, while 53% (23 out of 44) of ulcers in the basic wound contact dressing group healed. The relative risk (RR) was calculated as 1.09 with a 95% confidence interval (CI) ranging from 0.66 to 1.80, using a fixed-effect model; the inconsistency index (I <sup>2</sup> ) was 27%. Two reviews compiled data from a solitary trial. Data of moderate quality indicate a lack of significant difference in the number of healed ulcers between the basic wound contact dressing and the iodine-impregnated dressing groups. However, the estimates are uncertain, and the comparison may lack sufficient statistical power. There was no evidence of a difference in the number of adverse events, including secondary infections, between groups.
Yang et al, <sup>[10]</sup> (2024)	Meta-analysis	601	Sixteen randomized controlled trials (RCTs) provided data on the overall efficacy rate, encompassing 601 patients in the group using Chinese herbal compound dressings, with 564 demonstrating effective treatment, and 600 patients in the control group, with 425 showing effective treatment. There was no notable heterogeneity observed (I <sup>2</sup> = 0.0%, p = 1.000), and a fixed-effects model was utilized.
Moura et al, <sup>[11]</sup> (2013)	Review	-	The research examined recent progressions in wound coverings for diabetic foot ulcers (DFUs). The findings underscored the significance of maintaining a moist wound environment, preventing infections, controlling wound excretion, and encouraging tissue renewal in DFU management. Current dressings were noted to incompletely fulfil all the prerequisites for DFU care. The results emphasized the necessity for ongoing exploration and creativity to formulate more efficient wound dressings customized to the distinct requirements of DFU patients.
Jan et al, <sup>[12]</sup> (2012)	Systematic review	100	In this study, participants are evenly distributed between Group A (conventional Pyodine dressing) and Group B (honey dressing), aiming to compare their effectiveness in treating diabetic foot ulcers (DFUs). Results revealed that Group B exhibited a significantly quicker recovery time (p < 0.0001) compared to Group A, with healing rates of 72% and 66%, respectively, and amputation rates of 28% and 34%, respectively. While no statistical significance was found in amputation rates between the groups (p = 0.6658), the discussion highlights the importance of this faster recovery time in Group B and its potential implications for patient outcomes.
Holmes et al, <sup>[13]</sup> (2013)	Systematic review	2386	There is insufficient evidence to advocate for the replacement of the established standard for managing diabetic wounds, which involves identifying the root cause, addressing infections, ensuring adequate blood supply, regular removal of dead tissue, and providing appropriate pressure relief. However, despite the scarcity of comprehensive studies and the necessity for enhanced research methodologies and increased randomized controlled trials, wound dressings containing collagen do offer some advantages in treating diabetic foot ulcers, warranting careful consideration by wound management clinicians. The evidence thus far fails to establish the superiority of any specific source or combination of collagen biological materials.
Tallis et al, <sup>[14]</sup> (2013)	Randomized Controlled trials (RCTs)	48	The study compared the use of clostridial collagenase ointment (CCO) debridement to saline-moistened gauze (SMG) in treating diabetic foot ulcers. The results indicated that CCO treatment was more effective in improving wound assessment scores, reducing wound area, and achieving better response rates compared to SMG treatment. Additionally, the economic analysis suggested that the direct mean costs per responder were lower in the CCO group compared to the SMG group, both in a physician office setting and a hospital outpatient department setting.
Dumville et al, <sup>[15]</sup> (2012)	Systematic review	15 eligible systematic reviews	The study found that hydrogel and foam dressings outperformed basic wound contact materials in healing rates, based on data from small-scale studies with unclear or high risk of bias. Additionally, hydrocolloid-matrix dressings showed higher odds of ulcer healing compared to other types, but with uncertain estimates of very low quality. Overall, evidence supporting the superiority of more expensive 'advanced' dressings over cheaper options was lacking, with low or very low-quality evidence.
Gottrup et al, <sup>[16]</sup> (2013)	48	Randomised Controlled study	In this study, the patients were split into two groups, both showed notable improvement in wound assessment scores by week 12, with substantial reductions in total score. No significant discrepancies were observed in demographic variables

			or wound characteristics between the groups. The findings suggest that both dressings, CCO and SMG, effectively reduced wound assessment scores, indicating their potential efficacy in foot ulcer management. Additionally, no significant differences were detected in wound environment moisture between the two treatments.
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## DISCUSSION

Diabetic foot ulcer (DFU) is a prevalent and severe complication associated with diabetes mellitus (DM), posing a risk of up to 25% for DFU development in DM patients, and an amputation rate 10 to 20 times greater than that of non-diabetic individuals.<sup>[17]</sup> Diabetic foot ulcers (DFUs) have a profound impact on patient well-being and can pose life-threatening risks, imposing significant economic burdens on patients, families, and society.<sup>[18,19]</sup> Hence, improving the clinical success rate and advancing wound healing in DFU are focal points in diabetes mellitus (DM) clinical research. In addition to fundamental treatments such as debridement, anti-infection measures, blood sugar regulation, and foot care, topical dressings play a pivotal role in DFU management.<sup>[20]</sup> These dressings act as protective barriers for DFU wounds, and some newer types also expedite vascular and tissue regeneration while eliminating bacteria, thereby facilitating wound healing. The appropriate selection of dressings is vital for achieving optimal treatment outcomes in DFU.

All reviews, rated as moderate to high quality, found no clear differentiation among the various dressings regarding wound healing in foot ulcers. At present, there is insufficient evidence to suggest that any "advanced" dressing surpasses basic wound contact dressings in terms of efficacy in healing foot ulcers in individuals with diabetes mellitus (DM). Chen et al,<sup>[21]</sup> studied that, a perfect dressing should provide moisture balance, sequester proteases, stimulate growth factors, exhibit antimicrobial properties, allow oxygen to permeate, and possess the ability to facilitate autolytic debridement, thereby promoting granulation tissue production and re-epithelialisation. Furthermore, it should offer an extended duration of effectiveness, high efficacy, and enhanced sustained drug release in medical systems.

This comprehensive review assessed various dressing varieties, including basic wound contact, hydrogels, hydrocolloids, foams, alginate, protease modulators, and antimicrobials (iodine and silver). Suggestions have been made that different dressings could be tailored to address specific wound conditions or phases of recovery, indicating that achieving complete healing may not be the appropriate treatment goal for all interventions.

For instance, foam and alginate items can be used to address periods of excessive exudation, whereas antimicrobial dressings can be administered to address infections. The inference is that these products are formulated to establish an ideal setting for the trajectory of wound healing, although direct

healing may not be their primary anticipated outcome- A study done by Shu et al.<sup>[22]</sup>

Yang et al,<sup>[23]</sup> reported that compound dressings derived from traditional Chinese medicine have gained widespread utilization in the management and treatment of DFU, supported by numerous studies affirming their efficacy and safety. These dressings are recognised for their ability to clear heat, detoxify, activate blood circulation, dispel stasis, and promote tissue regeneration. They are commonly administered in diverse formats such as ointments, oil dressings, powder dressings, and wet dressings.

Dwivedi,<sup>[24]</sup> studied the emergence of novel and recent alternatives to traditional dressings, which involved blending various polymers and employing more effective crosslinking techniques to produce enhanced materials to ensure an optimal wound environment. Natural (chitosan, hyaluronic acid, cellulose, alginate, collagen, and fibrin) and synthetic (polyvinyl alcohol [PVA], polyethylene glycol [PEG], polyvinylpyrrolidone [PVP], polyurethane [PU], poly (2-hydroxyethyl methacrylate) [PHEMA], and polyesters) polymers have been combined or cross-linked (e.g. with genipin, oxidised dextran, or glutaraldehyde) for this purpose. Additionally, medicated dressings have been explored as a means of efficiently delivering drugs or other bioactive substances, which has been previously demonstrated to enhance DFU treatment.

Studies investigating the integration of natural extracts have demonstrated significant potential for DFU treatment. Consequently, in the foreseeable future, research will undoubtedly prioritise the creation of more effective and cost-effective biocompatible and biodegradable medicated dressings capable of delivering crucial DFU healing agents to the wound site to enhance patient care and quality of life.

## CONCLUSION

In conclusion, addressing foot ulcers in individuals with diabetes mellitus (DM) is of immense significance because of its substantial repercussions on patient welfare and healthcare provisions. This systematic review highlights the crucial role of dressings in managing diabetic foot ulcers (DFUs). Although various dressing options exist, ranging from traditional to advanced formulations, our analysis suggests that there is no clear difference in efficacy between them. Basic wound contact dressings remain the cornerstone of DFU management, with no strong evidence supporting the superiority of advanced dressings.

However, the expanding scope of wound management offers promising avenues,

encompassing the integration of botanical extracts, innovative polymer combinations, and pharmaceutical dressings to enhance healing outcomes and patient well-being while optimising healthcare utilisation. Future studies should focus on formulating dressings that are more effective, economically viable, and compatible with biological systems tailored to meet the unique requirements of individuals with diabetes. This endeavour ultimately aims to alleviate the burden of foot ulcers and enhance the overall quality of life of affected individuals.

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