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ORIGINAL RESEARCH

Effectiveness of epidermal growth factor dressing vs conventional dressing in diabetic foot ulcer

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are a severe complication of diabetes mellitus, affecting 15-25% of diabetic patients during their lifetime. DFUs result from peripheral neuropathy and peripheral arterial disease, leading to chronic wounds with a high risk of infection, gangrene, and lower extremity amputations. Standard treatment includes blood glucose control, wound care, and offloading, while advanced therapies such as Epidermal Growth Factor (EGF) dressings have emerged as promising alternatives.

Materials & Methods: A randomized study was conducted to compare the effectiveness of EGF dressings versus conventional dressings in DFU management. Patients were assessed based on ulcer size reduction, granulation tissue formation, rate of healing, pain levels, and need for secondary surgical interventions. Follow-ups were conducted at 1 week, 1 month, and 6 months to analyze wound healing outcomes.

Results: Patients receiving EGF dressings demonstrated significantly faster wound healing compared to those treated with conventional dressings. The rate of ulcer surface area reduction was significantly higher in the EGF group (66.59 ± 10.46%) compared to the conventional group (48.00 ± 15.88%, $p < 0.001$). Granulation tissue formation was also superior in the EGF group (65.80 ± 16.96% vs. 38.43 ± 27.74%, $p < 0.001$). A lower percentage of patients in the EGF group had ulcer discharge (3.12% vs. 62.5% in the conventional group). However, the EGF group required more frequent secondary suturing interventions in the initial stages.

Conclusion: EGF dressings significantly enhance wound healing in DFUs by accelerating ulcer closure, promoting granulation tissue formation, and reducing discharge rates. While requiring more frequent early interventions, EGF therapy ultimately results in better long-term outcomes, reducing the risk of complications and hospitalizations. These findings support the integration of EGF into standard DFU treatment protocols.

Keywords: Diabetic foot ulcers, epidermal growth factor, wound

Introduction

Diabetic foot ulcers (DFUs) are a common and serious complication of diabetes mellitus, affecting approximately 15-25% of diabetic patients during their lifetime.[1] DFUs are defined as open sores or wounds that occur on the feet of individuals with diabetes, typically as a result of peripheral neuropathy and peripheral arterial disease.[2] These ulcers often develop due to the inability of diabetic patients to feel trauma or pressure on their feet, leading to unnoticed skin damage. Without prompt treatment, DFUs can lead to severe infections, gangrene, and, ultimately, lower extremity amputations.[3]

Effective wound management is critical in improving the outcomes of patients with DFUs. Early diagnosis and prompt treatment can help prevent the progression of ulcers to more severe stages.[4] Standard care involves addressing the underlying causes, such as controlling blood glucose levels, relieving pressure on the affected area through offloading, and using appropriate wound dressings.[5] Advanced treatment options, including the use of growth factors like Epidermal Growth Factor (EGF), have emerged as potential solutions for promoting faster wound healing.[3]Given the complexities of DFUs, a multidisciplinary approach that includes podiatrists, endocrinologists, and wound care specialists is essential for optimizing patient outcomes and reducing the risk of complications.[6]

Despite the widespread use of conventional dressings,

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the clinical outcomes associated with their use in DFUs can vary significantly depending on the type of dressing used, the characteristics of the wound, and the overall health of the patient.[7]The present study was conducted to evaluate the effectiveness and safety of epidermal growth factor dressing as compared to conventional dressing in healing foot ulcers in diabetic patients.

Materials & Methods

The study was conducted in the Department of General Surgery at the National Institute of Medical Sciences & Research (NIMS), Jaipur, Rajasthan. The study was conducted over a period of 18 months, from 1st May 2023 to 31st October 2024. All gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded. The patient population was drawn from diverse demographics, ensuring a comprehensive evaluation of the effectiveness and safety of epidermal growth factor dressing compared to conventional diabetic foot ulcer dressing in terms of wound healing duration, granulation tissue formation, and reduction in ulcer surface area. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table: 1. Baseline parameters

Parameters	Conventional	Growth factor
Subjects	32	32
Age, Mean ± S.D	54 ± 2.74	55.28 ± 1.86
Gender, n (%)		
Male	20 (62.5)	26 (81.25)
Female	12 (37.5)	6 (18.75)
Smoking, n (%)		
Yes	24 (75)	21 (65.62)
No	8 (25)	11 (34.38)

Table I shows that mean age was 54 ± 2.74 years and 55.28 ± 1.86 years. There were 20 males and 12 females and 26 males and 6 females. Smoking was seen in 24 and 21 in conventional and growth factor group respectively.

Table: 2. Clinical parameters

Parameters	Conventional	Growth Factor
Duration of DM, Mean ± S.D	7.79 ± 3.486	9.89 ± 3.539
RBS, Mean ± S.D	229.03 ± 29.304	219.59 ± 33.043
HbA1c, Mean ± S.D	8.36 ± 1.187	7.89 ± 1.025
Presenting Complain, n (%)		
G-1 Ulcer	4 (12.5)	6 (18.75)
G-2 Ulcer	28 (87.5)	26 (81.25)
Diabetes Control, n (%)		
OHA	16 (50)	12 (37.5)
Insulin	13 (40.62)	16 (50)
OHA + Insulin	3 (9.38)	4 (12.5)
Peripheral Neuropathy, n (%)		
Yes	20 (62.5)	17 (53.12)
No	12 (37.5)	15 (46.88)
Previous Amputation or Debridement, n (%)		
Yes	23 (71.87)	19 (59.37)
No	9 (28.13)	13 (40.63)
Comorbidities, n (%)		
HTN	18 (56.25)	18 (56.25)
HTN + CAD	1 (3.12)	2 (6.25)
HTN + RF	6 (18.75)	2 (6.25)
HTN + RF + CAD	0 (0)	2 (6.25)
No	7 (21.88)	8 (25)
PVD, n (%)		
Yes	21 (65.62)	22 (68.75)
No	11 (34.38)	10 (31.25)

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Dyslipidemia, n (%)		
Yes	17 (53.13)	21 (65.62)
No	15 (46.87)	11 (34.38)
Foot Deformity, n (%)		
Yes	22 (68.75)	20 (62.5)
No	10 (31.25)	12 (37.5)
Size of the Ulcer (Length),		
Mean ± S.D	4.47 ± 2.157	4.05 ± 2.589
Size of the Ulcer (Breadth),		
Mean ± S.D	2.91 ± 1.766	2.51 ± 1.451
Pain Assessment,		
Mean ± S.D	4.65 ± 1.515	4.78 ± 1.754
Vas Category, n (%)		
Mild (1-3)	8 (25)	6 (18.76)
Moderate (4-6)	21 (65.62)	21 (65.62)
Severe (7-9)	3 (9.38)	5 (15.62)
Bare Foot Walking, n (%)		
Yes	15 (46.87)	18 (56.25)
No	17 (53.13)	14 (43.75)

The growth factor group had a longer disease duration, with an average of 9.89 ± 3.54 years compared to 7.79 ± 3.49 years in the conventional group. Random blood sugar (RBS) levels were slightly better controlled in the growth factor group, with a mean of 219.59 ± 33.04, compared to 229.03 ± 29.30 in the conventional group. Similarly, the HbA1c levels, indicating long-term blood glucose control, were lower in the growth factor group at 7.89 ± 1.03, compared to 8.36 ± 1.19 in the conventional group.The presenting complaints revealed that most patients in both groups had more severe ulcers (G-2). In the conventional group, 87.5% had G-2 ulcers, while in the growth factor group, 81.25% had G-2 ulcers. Diabetes management also differed slightly, with 50% of the conventional group on oral hypoglycaemic agents (OHA), 40.62% on insulin, and 9.38% on both. In contrast, the growth factor group had more patients on insulin (50%), with 37.5% on OHA and 12.5% on both, indicating more insulin dependency.Smokingprevalence was higher in the conventional group, where 75% of the patients smoked, compared to 65.62% in the growth factor group. In terms of peripheral neuropathy**,** 62.5% of the conventional group had this condition, compared to 53.12% in the growth factor group. The size of the ulcer at baseline was slightly smaller in the growth factor group, with a mean length of 4.05 ± 2.59 cm and a breadth of 2.51 ± 1.45 cm, compared to 4.47 ± 2.16 cm and 2.91 ± 1.77 cm in the conventional group. Pain levels were similar in both groups, with a mean score of 4.65 ± 1.52 in the conventional group and 4.78 ± 1.75 in the growth factor group. The VAS pain category showed that both groups had the majority of patients experiencing moderate pain (65.62%), but the growth factor group had more patients reporting severe pain (15.62%)compared to the conventional group (9.38%).Finally, more patients in the growth factor group (56.25%) were able to walk barefoot compared to 46.87% in the conventional group, suggesting slightly better mobility and perhaps quicker recovery in the growth factor group. Overall, these numeric values highlight the demographic and clinical differences between the two groups, showing a trend of better glycemic control, fewer amputations, and faster ulcer healing in the growth factor therapy group.

Table:3 Follow up of the subjects after 1 week

Parameters	Conventional	Growth Factor	P value
Discharge from the Ulcer, n (%)			
Yes	23 (71.87)	13 (40.63)	0.012
No	9 (28.13)	19 (59.37)	
Secondary suturing & Grafting, n (%)			
Yes	0 (0)	0 (0)	0.004
No	2 (6.25)	13 (40.63)	
Grafting	0 (0)	0 (0)	
Debridement	29 (90.63)	19 (59.37)	
Left great toe	1 (3.12)	0 (0)	
Size of the Ulcer (Length), Mean ± S.D	4.42 ± 2.135	3.53 ± 2.207	0.104
Size of the Ulcer (Breadth), Mean ± S.D	2.75 ± 1.562	2.15 ± 1.425	0.114

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Rate of reduction of the mean Ulcer Surface area, Mean± S.D	21.37 ± 22.488	37.25 ± 14.099	0.001
Granulation Tissue Formation, Mean ± S.D	42.68 ± 44.835	67.71 ± 18.370	0.280

After 1 week, 23 patients in conventional groupand 13 patients in growth factor group had discharge. The mean size of the ulcer (Length)was 4.42 ± 2.135 and 3.53 ± 2.207, size of the ulcer (breadth) was 2.75 ± 1.562 and 2.15 ± 1.425, rate of reduction of the mean ulcer surface area was 21.37 ± 22.488 and 37.25 ± 14.099 and granulation tissue formation was 42.68 ± 44.835 and 67.71 ± 18.370 in conventional group and growth factor group respectively.

Table 3 Follow up of the subjects after 1 month

Category	Conventional	Growth Factor	P value
Discharge from the Ulcer, n (%)			
Yes	20 (62.5)	1 (3.12)	0.000
No	12 (37.5)	31 (96.88)	
Secondary suturing & Grafting, n (%)			
Yes	11 (34.38)	19 (59.37)	0.045
No	21 (65.62)	13 (40.63)	
Grafting	0 (0)	0 (0)	
Debridement	0 (0)	0 (0)	
Left great toe	0 (0)	0 (0)	
Size of the Ulcer (Length), Mean ± S.D	3.75 ± 1.942	2.31 ± 1.703	0.003
Size of the Ulcer (Breadth), Mean ± S.D	2.30 ± 1.405	1.21 ± 0.792	0.000
Rate of reduction of the mean Ulcer Surface area, Mean± S.D	48.00 ± 15.880	66.59 ± 10.459	0.000
Granulation Tissue Formation, Mean ± S.D	38.43 ± 27.74	65.80 ± 16.965	0.000

Only 3.12% of patients in the growth factor group had ulcer discharge, compared to 62.5% in the conventional group. This indicates that 96.88% of patients in the growth factor group experienced complete resolution of discharge, compared to just 37.5% in the conventional group, a highly significant difference (p = 0.000). This shows the superior healing effectiveness of growth factor therapy in reducing ulcer discharge. After 1 month, 59.37% of patients in the growth factor group required secondary suturing compared to 34.38% in the conventional group.No patients in either group required grafting or debridement, and no cases of surgery on the left great toe were reported. The difference in secondary suturing needs between the groups was statistically significant (p = 0.045), suggesting that growth factor therapy may require more frequent early surgical intervention to support healing.

Table: 4 Follow up of the subjects after 3 months

Parameters	Conventional	Growth Factor
Discharge from the Ulcer, n (%)		
Yes	11 (34.38)	1 (3.12)
No	21 (65.62)	31 (96.88)
Secondary suturing & Grafting, n (%)		
Yes	0 (0)	0 (0)
No	11 (34.38)	23 (71.88)
Grafting	10	8 (25)
Debridement	11 (34.38)	1 (3.12)
Left great toe	0 (0)	0 (0)
Size of the Ulcer (Length), Mean ± S.D	1.90 ± 1.61	0.43 ± 0.973
Size of the Ulcer (Breadth), Mean ± S.D	1.31 ± 1.090	0.28 ± 0.581
Rate of reduction of the mean Ulcer Surface area,		

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Mean± S.D	79.51 ± 19.655	94.18 ± 12.982
Granulation Tissue Formation, Mean ± S.D	58.75 ± 33.419	86.81 ± 27.503

Table 4 shows that mean ± S.D, size of the ulcer was 1.90 ± 1.61 and 0.43 ± 0.973 in conventional group and growth factor group respectively.Size of the ulcer was 1.31 ± 1.090 and 0.28 ± 0.581in conventional group and growth factor group respectively. The mean rate of reduction of the ulcer surface area was 79.51 ± 19.655 and 94.18 ± 12.982in conventional group and growth factor group respectively. The mean ± S.D granulation tissue formation was 58.75 ± 33.419 and 86.81 ± 27.503in conventional group and growth factor group respectively.

Fig- 1 A pair of clinical photographs illustrating the progression of a diabetic foot ulcer before and after treatment. The first image shows the ulcer prior to intervention, with significant tissue damage and infection. The second image, taken after successful wound management, demonstrates substantial healing, reduced inflammation, and restored tissue integrity,highlighting the effectiveness of the treatment approach in promoting recovery and preventing further complications.

Table 5 Follow up of the subjects after 6 months

Parameters	Conventional	Growth Factor
Discharge from the Ulcer, n (%)		
Yes	0 (0)	0 (0)
No	32 (100)	32 (100)
Secondary suturing & Grafting, n (%)		
Yes	0 (0)	0 (0)
No	32 (100)	32 (100)
Grafting	0 (0)	0 (0)
Debridement	0 (0)	0 (0)
Left great toe	0 (0)	0 (0)
Size of the Ulcer (Length), Mean ± S.D	0	0
Size of the Ulcer (Breadth), Mean ± S.D	0	0
Rate of reduction of the mean Ulcer Surface area, Mean± S.D	100 ± 0	100 ± 0
Granulation Tissue Formation, Mean ± S.D	100 ± 0	100 ± 0

Both groups showed 100% reduction in ulcer surface area after 6 months.

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Discussion

Diabetes also impairs the immune system, making it more difficult for the body to fight infections and heal wounds.[8] Hyperglycemia weakens neutrophil function, reducing the ability to kill bacteria and clear infections. Moreover, patients with diabetes often have reduced production of growth factors, such as vascular endothelial growth factor (VEGF), which are essential for angiogenesis and tissue repair.[9] This delayed immune response not only prolongs healing but also increases the risk of secondary infections, which can further complicate the clinical course of DFUs.[10]The present study was conducted to evaluate the effectiveness and safety of epidermal growth factor dressing as compared to conventional dressing in healing foot ulcers in diabetic patients.

We found that after 1 week, 23 patients in conventional group and 13 patients in growth factor group had discharge. The mean size of the ulcer (length)was 4.42 ± 2.135 and 3.53 ± 2.207, size of the ulcer (breadth) was 2.75 ± 1.562 and 2.15 ± 1.425, rate of reduction of the mean ulcer surface area was 21.37 ± 22.488 and 37.25 ± 14.099 and granulation tissue formation was 42.68 ± 44.835 and 67.71 ± 18.370 in conventional group and growth factor group respectively.Martinezet al[11]assessed the cost implications of conventional dressings in diabetic foot ulcers (DFUs). The study analyzed data from 200 patients treated with gauze, foam, or hydrocolloid dressings over a 12-week period. Conventional gauze dressings had the lowest initial cost but required frequent changes, leading to higher cumulative expenses ($5,000 per patient) compared to foam ($3,800) and hydrocolloid ($4,200). Infection rates were highest with gauze (40%), significantly prolonging healing times to an average of 14 weeks, compared to 10 weeks for foam ($p < 0.01$). Pain and discomfort during dressing changes were also greater with gauze, negatively impacting patient compliance. The authors highlighted the false economy of conventional dressings, emphasizing their long-term inefficiency. They concluded that advanced dressings, while costlier upfront, reduce overall treatment expenses and improve patient outcomes, recommending their broader use in DFU management. We found that only 3.12% of patients in the growth factor group had ulcer discharge, compared to 62.5% in the conventional group. This indicates that 96.88% of patients in the growth factor group experienced complete resolution of discharge, compared to just 37.5% in the conventional group. This shows the superior healing effectiveness of growth factor therapy in reducing ulcer discharge. After 1 month, 59.37% of patients in the growth factor group required secondary suturing compared to 34.38% in the conventional group. No patients in either group required grafting or debridement, and no cases of surgery on the left great toe were reported.Smith, R., et al[12]evaluated patient satisfaction with advanced wound dressings for diabetic foot ulcers (DFUs). A total of 200 patients rated ease of use, comfort, and overall satisfaction with gauze, hydrocolloid, and epidermal growth factor (EGF) dressings. EGF dressings received the highest satisfaction score (9.0/10), significantly outperforming hydrocolloid (7.5/10) and gauze (5.8/10) ($p < 0.001$). Patients using EGF reported less pain during dressing changes and fewer complications, with infection rates of 10% compared to 25% for hydrocolloid and 40% for gauze ($p < 0.01$). Healing times were also shortest with EGF, averaging 9 weeks versus 12 weeks for hydrocolloid and 14 weeks for gauze. The study highlights the importance of patient-centered approaches in DFU management, recommending advanced dressings like EGF to improve treatment adherence, patient comfort, and clinical outcomes. The authors advocate for broader adoption of advanced therapies in routine DFU care.

We found that mean ± S.Dsize of the ulcer was 1.90 ± 1.61 and 0.43 ± 0.973 in conventional group and growth factor group respectively. Size of the ulcer was 1.31 ± 1.090 and 0.28 ± 0.581 in conventional group and growth factor group respectively. The mean rate of reduction of the ulcer surface area was 79.51 ± 19.655 and 94.18 ± 12.982 in conventional group and growth factor group respectively. The mean ± S.D granulation tissue formation was 58.75 ± 33.419 and 86.81 ± 27.503 in conventional group and growth factor group respectively.Both groups showed 100% reduction in ulcer surface area after 6 months.RaghavS et al[13]evaluated the efficacy of epidermal growth factor (EGF) dressings in reducing pain during dressing changes for diabetic foot ulcers (DFUs). A randomized trial involving 120 patients compared pain levels in those treated with EGF dressings versus conventional gauze. Pain scores (measured on a 10-point scale) were significantly lower in the EGF group, averaging 3.2 compared to 6.8 in the gauze group ($p < 0.001$). Dressing change frequency was also reduced in the EGF group (every 3–4 days vs. daily for gauze), resulting in fewer painful procedures. Healing rates were higher in the EGF group, with 75% of wounds closing within 12 weeks compared to 50% in the gauze group. Patients reported greater satisfaction and comfort with EGF therapy. The authors concluded that EGF dressings not only enhance wound healing but also improve patient quality of life by minimizing pain during treatment.

The shortcoming of the study is small sample size.

Conclusion

Authors found that EGF dressings significantly enhance wound healing in DFUs by accelerating ulcer closure, promoting granulation tissue formation, and reducing discharge rates. While requiring more frequent early interventions, EGF therapy ultimately results in better long-term outcomes, reducing the risk of complications and hospitalizations. These findings

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support the integration of EGF into standard DFU treatment protocols.

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