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Clinical Study of Effect of Collagen Dressing Versus Conventional Dressing in Partial Thickness Burns

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Abstract

Introduction: Burn injuries remain among the most traumatic and challenging forms of skin injury, particularly in pediatric and resource-limited settings. They lead to substantial morbidity and mortality, with a high burden of infection, delayed healing, and potential long-term disability due to scarring.

Aims and Objectives

Aim: To evaluate the clinical effectiveness of collagen dressing compared to conventional dressing in patients with partial-thickness burns.

Primary Objective: To compare the time required for complete wound healing in patients treated with collagen versus conventional dressings.

Secondary Objectives

1. To compare infection rates, pain scores, and dressing change frequency between the two treatment groups.
2. To evaluate scar quality and incidence of contractures at 3-month follow-up.
3. To assess patient satisfaction, compliance, and willingness to use the same dressing in future.

Material and Method:

Study Design: A Prospective, quasi-experimental study.

Study Period: 18 Months

Place of study: Department of Surgery at a tertiary care centre, Dr. S.C.G.M.C, Nanded, Maharashtra

Sample Size: A total of 100 patients were enrolled using purposive sampling, and they were equally divided into two groups of 50 patients each.

Result: The mean age of participants in Group A was 21.4 ± 3.2 years, while that of Group B was 22.1 ± 2.8 years. In terms of gender distribution, Group A comprised 33 males (66%) and 17 females (34%), whereas Group B included 31 males (62%) and 19 females (38%).

Discussion: This study was undertaken to evaluate and compare the clinical efficacy, patient outcomes, and cost-effectiveness of collagen dressings versus conventional dressings in the management of partial-thickness burns. A total of 100 patients with partial thickness burns were included in the study, with 50 patients allocated to Group A (collagen dressing) and 50 patients to Group B (conventional dressing).

Keywords: Burn Injuries, Burn Depth, Biodegradable, Collagen Dressings, Infection Rates, Morbidity.

Introduction

Burn injuries remain among the most traumatic and challenging forms of skin injury, particularly in pediatric and resource-limited settings. They lead to substantial morbidity and mortality, with a high burden of infection, delayed healing, and potential long-term disability due to scarring. Among the myriad treatment modalities developed to address this global concern, biological dressings—particularly collagen-based—have gained prominence for their physiological compatibility, reduced pain, and accelerated healing times. This thesis explores the therapeutic potential of collagen dressings in the management of partial-thickness burns, drawing upon both clinical evidence and biochemical rationale.

Partial-thickness burns, which involve the epidermis and part of the dermis, are further categorized as superficial or deep depending on the extent of dermal penetration. Superficial partial-thickness burns exhibit erythema, blistering, and pain, with brisk capillary refill and a relatively rapid healing course if properly managed.

In partial-thickness burns, viable skin appendages such as hair follicles and sweat glands often remain intact. These structures serve as reservoirs for keratinocyte migration and epithelial regeneration. However, for this process to proceed effectively, a moist, infection-free environment is essential. Wound dressings, therefore, play a critical role in creating a microenvironment that fosters cellular activity, reduces microbial load, and minimizes desiccation and pain.

Wound healing is a multistage process comprising hemostasis, inflammation, proliferation, and remodeling. Collagen, particularly Type I, is the most abundant protein in the extracellular matrix and plays a critical role in providing structural integrity to granulation tissue. It supports fibroblast adhesion, promotes angiogenesis, and forms a scaffold for keratinocyte migration[6,7].

Collagen dressings are designed to mimic the natural dermal matrix, thus facilitating these biological

functions. They can absorb exudates, bind matrix metalloproteinases (MMPs), and reduce proteolytic degradation of newly formed tissue. Moreover, being biocompatible, non-immunogenic, and biodegradable, collagen dressings do not provoke inflammatory responses that could impede healing.

Aims and Objectives

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2. To evaluate scar quality and incidence of contractures at 3-month follow-up.
3. To assess patient satisfaction, compliance, and willingness to use the same dressing in future.

Materials and Methods

This quasi-experimental study was conducted over a period of 18 months in the Department of Surgery at a tertiary care centre. The study included both inpatients and outpatients who presented with partial-thickness (first and second- degree) thermal burns and fulfilled the specified inclusion criteria. A total of 100 patients were enrolled using purposive sampling, and they were equally divided into two groups of 50 patients each. Group A received collagen dressings, while Group B received conventional dressings (e.g., silver sulfadiazine, paraffin gauze).

Study Design and Population

This was a prospective, quasi-experimental study aimed at comparing the clinical outcomes of collagen dressing versus conventional dressing in patients with partial-thickness burns. All patients were admitted through the outpatient department or the emergency unit of the tertiary care centre.

Inclusion Criteria

- Patients aged less than 25 years
- Patients presenting with partial-thickness (1st and 2nd degree) burns
- Burn wounds covering <40% of the Total Body Surface Area (TBSA)
- Burn injuries not older than 24 hours
- Patients with facial burns
- Patients who provided written informed consent after stabilization

Exclusion Criteria

- Patients with full-thickness (third-degree) burns
- Patients with >40% TBSA involvement
- Electrical or chemical (non-thermal) burns
- Burn wounds older than 24 hours
- Patients who refused consent or were medically unfit for follow-up

Sample Size and Statistical Justification

The sample size was calculated using the formula:

$$n = \frac{2S^2(z_1 + z_2)^2}{(M_1 - M_2)^2}$$

Where:

- **n** = required sample size
- **S** = standard deviation
- z_1, z_2 = standard normal variates corresponding to desired power and confidence level
- $M_1 - M_2$ = minimum detectable difference between

the two group means A total of 100 patients were selected (50 in each group), based on anticipated dropout rates and data variability.

Data Management and Statistical Analysis

Data from all participants were entered into a pre-designed case record form, compiled using Microsoft Excel 2018, and analysed with GraphPad Prism version 3.06. Statistical analysis included:

- Descriptive statistics: Mean ± standard deviation for quantitative variables.
- Frequency and percentage distributions: For categorical data (e.g., gender, infection status).
- Inferential statistics: t-test, chi-square test, or Mann-Whitney U test applied where appropriate.
- Significance threshold: A p-value < 0.05 was considered statistically significant.
- Graphical representation: Bar charts, box plots, and line graphs were used where applicable.

Result

Table 1: Age and Gender Distribution of Study Population

Group	Mean Age (years) ± SD	Male (n, %)	Female (n, %)	Total (n)
Group A (Collagen)	21.4 ± 3.2	33 (66%)	17 (34%)	50
Group B (Conventional)	22.1 ± 2.8	31 (62%)	19 (38%)	50
p-value	0.278 (NS)	-	-	-

A total of 100 patients with partial thickness burns were included in the study, with 50 patients allocated to Group A (collagen dressing) and 50 patients to Group B (conventional dressing). The mean age of participants in Group A was 21.4 ± 3.2 years, while that of Group B was 22.1 ± 2.8 years. The age range in both groups fell within the inclusion criterion of patients under 25 years of age.

In terms of gender distribution, Group A comprised 33 males (66%) and 17 females (34%), whereas Group B included 31 males (62%) and 19 females (38%). There was no significant difference in age or gender distribution between the two groups, indicating that both cohorts were comparable in demographic characteristics

Figure 1: Bar diagram showing gender distribution by group

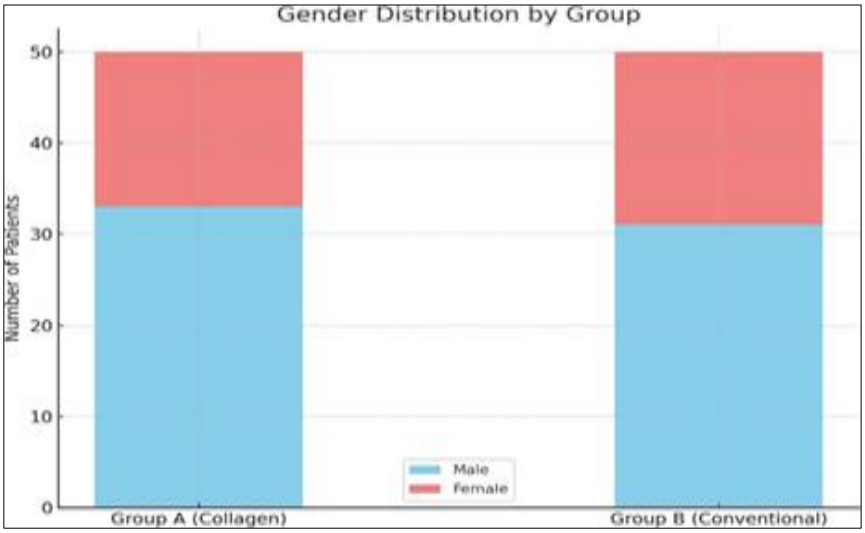


Figure 2: Box and whisker plot showing age distribution by group

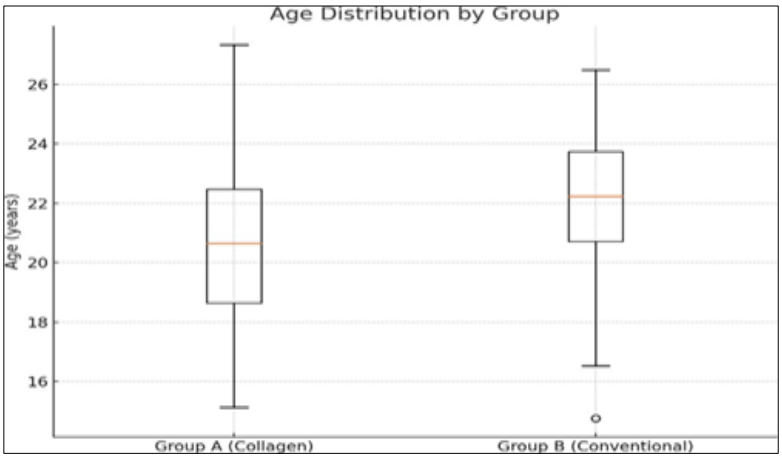


Table 2: Burn Characteristics at Presentation

Characteristic	Group A (Collagen)	Group B (Conventional)	p-value
Burn Depth			
Superficial partial thickness	32 (64%)	30 (60%)	0.684
Deep partial thickness	18 (36%)	20 (40%)	
Mean %TBSA ± SD	17.6 ± 6.2	18.1 ± 5.9	0.612
Time Since Injury (hours)	7.3 ± 4.1	6.9 ± 3.8	0.713
Anatomical Sites Involved			
Upper limbs	28 (56%)	27 (54%)	
Lower limbs	18 (36%)	20 (40%)	
Trunk	9 (18%)	7 (14%)	0.838
Face	10 (20%)	11 (22%)	
Mode of Burn			
Scald	24 (48%)	25 (50%)	
Flame	19 (38%)	17 (34%)	0.925
Contact	7 (14%)	8 (16%)	

Burn depth was assessed clinically upon admission. In Group A, 32 patients (64%) had superficial partial thickness burns, while 18 patients (36%) had deep partial thickness burns. In Group B, 30 patients (60%) had superficial partial thickness burns and 20 patients (40%) had deep partial thickness burns. The mean total body surface area (TBSA) affected was 17.6 ± 6.2% in Group A and 18.1 ± 5.9% in Group B. The average time from injury to hospital presentation was 7.3 ± 4.1 hours in Group A and 6.9 ± 3.8 hours in Group B. Anatomically, the upper limbs were the most frequently affected site in both groups (56% in Group A and 54% in Group B), followed by the lower limbs (36% in Group A and 40% in Group B). Involvement of the trunk and face was also documented, with facial burns present in 10 patients (20%) in Group A and 11 patients (22%) in Group B.

With respect to the mode of burn injury, scald burns were most common in both groups (48% in Group A and 50% in Group B), followed by flame burns (38% in Group A and 34% in Group B), and contact burns (14% in Group A and 16% in Group B).

Figure 3: Clustered bar diagram showing burn depth distribution between groups

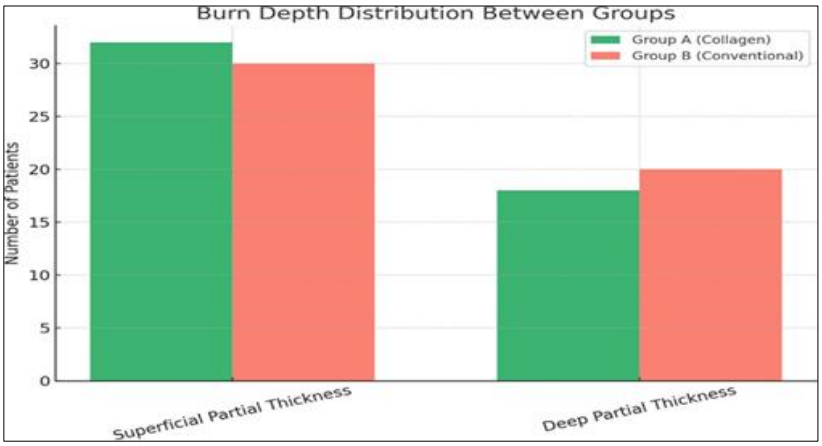


Figure 4: Clustered bar diagram showing anatomical site involvement by group

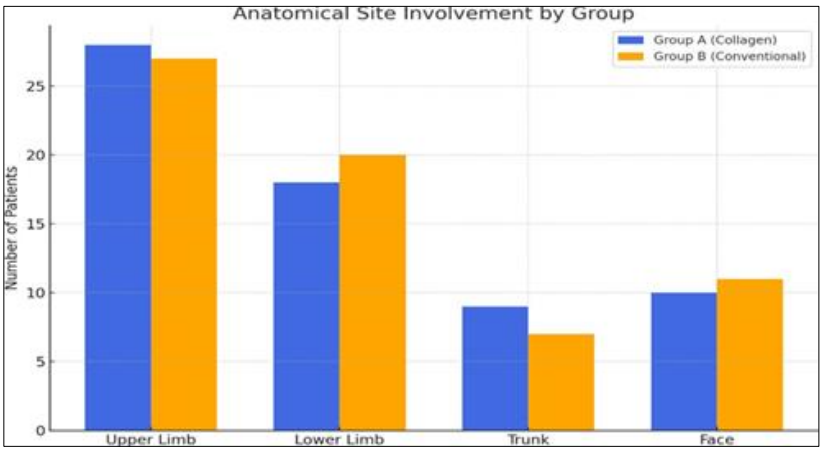


Figure 5: Clustered bar diagram showing mode of burn injury by group

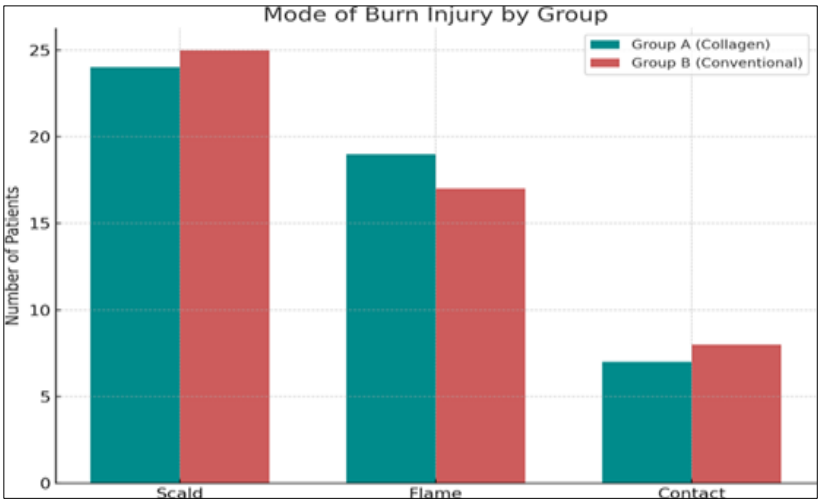


Table 3: Pre- and Post-Dressing Wound Culture Results

Time Point	Group A (Collagen) – Positive Cultures (n, %)	Group B (Conventional) – Positive Cultures (n, %)	p- value
Day 0 (Pre- dressing)	0 (0%)	0 (0%)	—
Day 3	3 (6%) – S. aureus (2), P. aeruginosa (1)	9 (18%) – S. aureus (5), P. aeruginosa (3), E. coli (1)	0.048
Day 5	4 (8%) – S. aureus (2), K. pneumoniae (2)	14 (28%) – S. aureus (6), P. aeruginosa (4), K. pneumoniae (4)	0.009
Day 7	4 (8%) – same as Day 5	17 (34%) – increase in P. aeruginosa & K. pneumoniae	0.004

Wound cultures were taken from all patients at predetermined intervals—prior to the application of dressing (Day 0), and subsequently on Day 3, Day 5, and Day 7. At baseline (Day 0), all patients in both groups had sterile cultures, as collagen dressing was only applied after ensuring no microbial growth.

On Day 3, positive cultures were observed in 3 patients (6%) in Group A and 9 patients (18%) in Group B. The organisms isolated in Group A Included Staphylococcus aureus (2 cases) and Pseudomonas aeruginosa (1 case), while those in Group B included S. aureus (5 cases), P. aeruginosa (3 cases), and Escherichia coli (1 case).

By Day 5, 4 patients (8%) in Group A and 14 patients (28%) in Group B showed positive cultures. The isolates from Group A included S. aureus (2 cases) and Klebsiella pneumoniae (2 cases). Group B cultures yielded S. aureus (6 cases), P. aeruginosa (4 cases), and K. pneumoniae (4 cases). On Day 7, the number of positive cultures remained at 4 (8%) in Group A and increased to 17 (34%) in Group B. The microbial profile in Group B showed a relative rise in P. aeruginosa and K. pneumoniae isolates.

Figure 6: Clustered bar diagram showing wound culture positivity by time

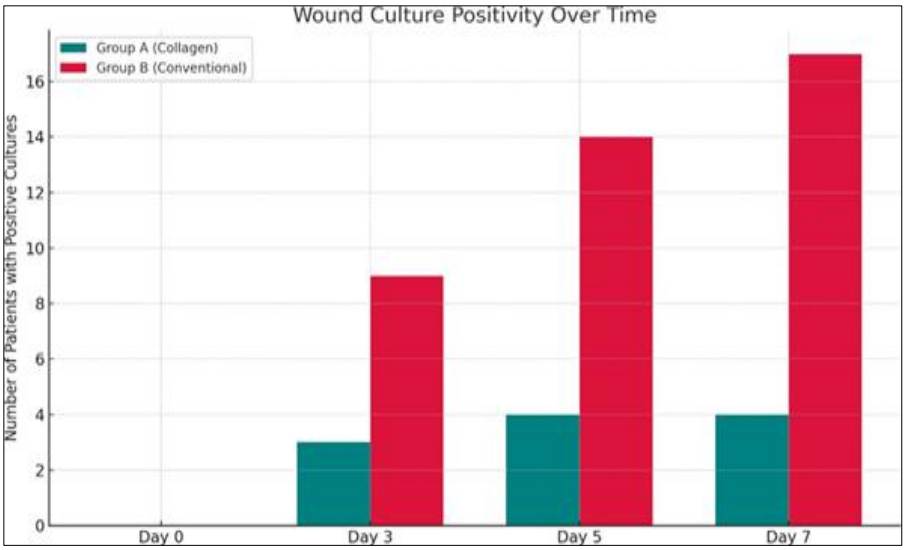


Table 4: Mean Healing Time (Days) in Both Groups

Group	Mean Healing Time (days) ± SD	Median (IQR)	Range (Min–Max)	p- value
Group A (Collagen)	9.2 ± 2.1	9 (8–10)	6–14	0.001
Group B (Conventional)	13.6 ± 2.8	13 (12–15)	9–18	

The healing time, defined as the number of days required for complete epithelialization of the burn wound, was recorded for all patients in both groups.

In Group A (collagen dressing), the mean healing time was 9.2 ± 2.1 days, with a median of 9 days (interquartile range: 8–10 days). The range of healing time in this group extended from a minimum of 6 days to a maximum of 14 days. In contrast, Group B (conventional dressing) had a mean healing time of 13.6 ± 2.8 days, with a median of 13 days (interquartile range: 12–15 days). The healing duration in this group ranged from 9 to 18 days.

Figure 7: Bar diagram showing comparison of mean healing time between groups

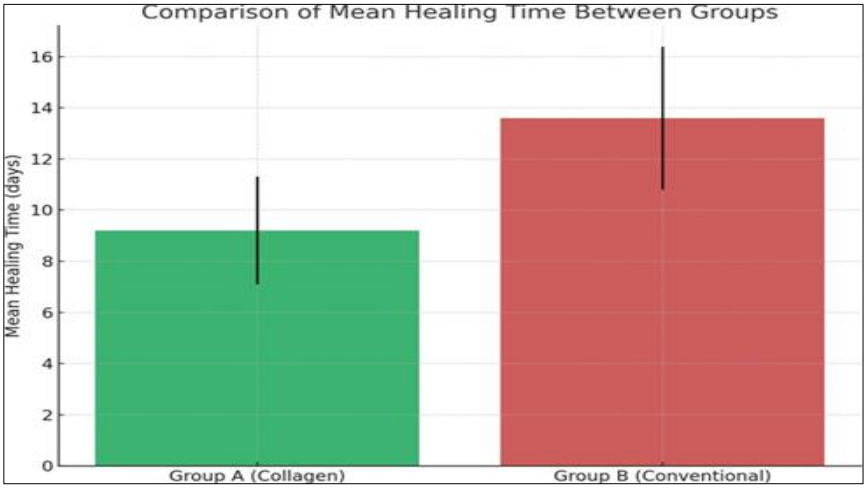


Table 5: Infection Rate Comparison between Groups

Infection Parameter	Group A (Collagen)	Group B (Conventional)	p- value
Total patients with any positive culture	6 (12%)	20 (40%)	0.001
Patients with signs of sepsis	1 (2%)	5 (10%)	0.091
Purulent discharge under dressing (n, %)	2 (4%)	9 (18%)	0.026
Need for systemic antibiotics beyond routine	3 (6%)	11 (22%)	0.014

Infection parameters were monitored clinically and microbiologically throughout the treatment period.

A total of 6 patients (12%) in Group A developed positive wound cultures at any point during follow-up, compared to 20 patients (40%) in Group B.

Clinical signs of sepsis—including tachycardia, fever, hypotension, and altered sensorium—were observed in 1 patient (2%) in Group A and 5 patients (10%) in Group B. Purulent discharge under or around the dressing was noted in 2 patients (4%) in Group A and in 9 patients (18%) in Group B.

Additionally, 3 patients (6%) in Group A required systemic antibiotics beyond the standard prophylactic regimen, whereas 11 patients (22%) in Group B required escalation of antibiotic therapy due to wound infection.

Figure 8: Clustered bar diagram showing infection parameters comparison between groups

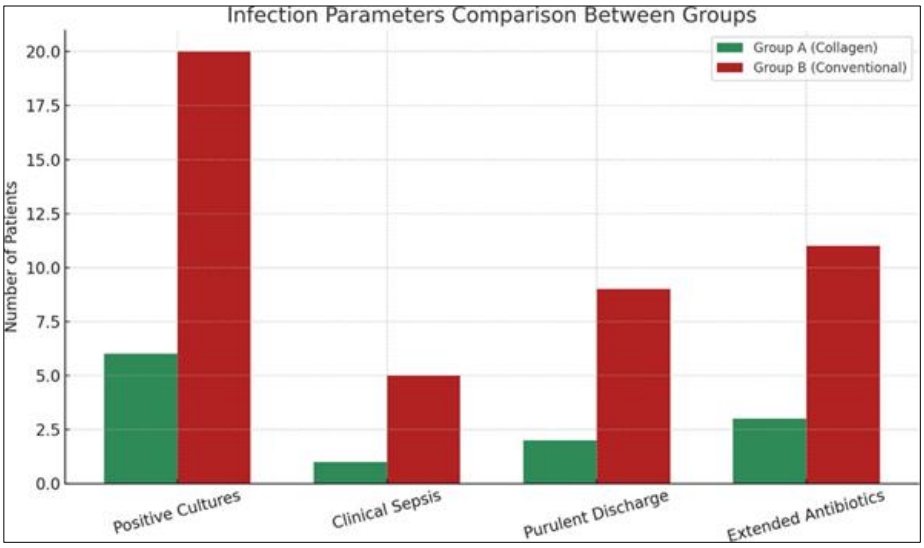


Table 6: Dressing Change Frequency & Duration of Hospital Stay

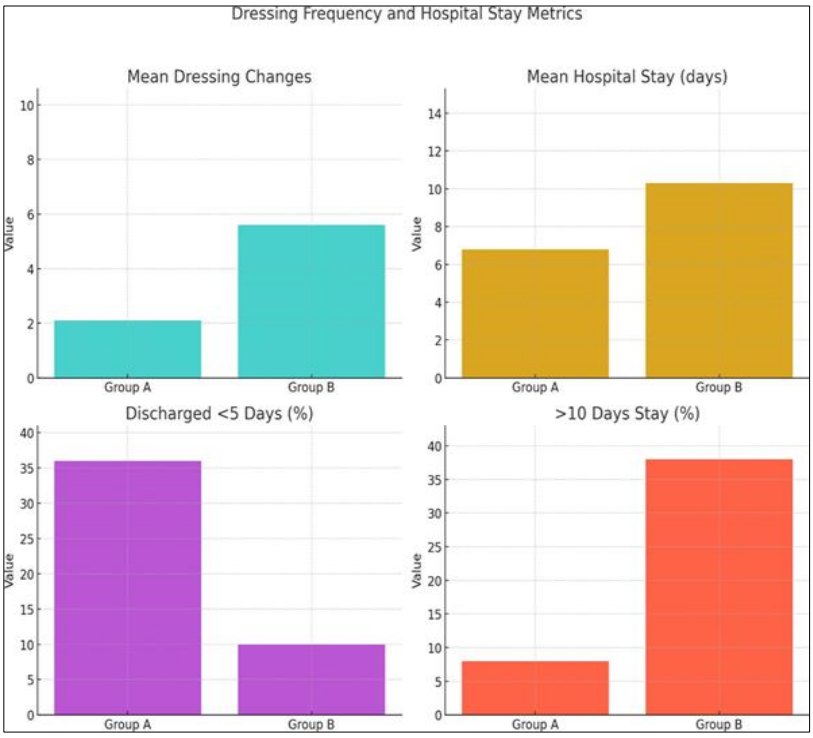
Parameter	Group A (Collagen)	Group B (Conventional)	p- value
Mean no. of dressing changes ± SD	2.1 ± 0.6	5.6 ± 1.2	<0.001
Range of dressing changes	1–3	3–8	
Mean hospital stay (days) ± SD	6.8 ± 2.2	10.3 ± 2.9	<0.001
Patients discharged within 5 days	18 (36%)	5 (10%)	0.002
Patients requiring >10 days stay	4 (8%)	19 (38%)	<0.001

The number of dressing changes required per patient and the length of hospital stay were recorded and analyzed.

In Group A (collagen dressing), patients underwent an average of 2.1 ± 0.6 dressing changes during their treatment period. The number of changes ranged from 1 to 3 per patient. In contrast, Group B (conventional dressing) required significantly more frequent changes, with an average of 5.6 ± 1.2 dressing changes (range: 3 to 8).

Hospital stay duration also differed notably between groups. The mean hospital stay in Group A was 6.8 ± 2.2 days, whereas in Group B it was 10.3 ± 2.9 days. Among Group A patients, 18 (36%) were discharged within 5 days, compared to only 5 patients (10%) in Group B. Conversely, 4 patients (8%) in Group A required hospitalization for more than 10 days, while 19 patients (38%) in Group B had extended hospital stays.

Figure 9: Bar diagrams showing dressing frequency and hospital stay metrics



Discussion

This study was undertaken to evaluate and compare the clinical efficacy, patient outcomes, and cost-effectiveness of collagen dressings versus conventional dressings in the management of partial-thickness burns. Conducted as a quasi- experimental clinical study in a tertiary care center over a period of 18 months, it enrolled 100 patients meeting defined inclusion criteria, who were equally divided into two groups. Group A received collagen-based biological dressings, while Group B was treated with standard conventional dressings such as silver sulfadiazine and paraffin gauze. The demographic profile of the patients reflected the typical epidemiology of burns in young adults, with a male predominance and mean age in the early twenties, and both groups were comparable in baseline characteristics, burn depth, extent, anatomical site, mode of injury, vital signs, comorbidities, and time since injury. This ensured homogeneity and minimized confounding factors.

The findings of this study strongly support the use of collagen dressings over conventional modalities across multiple key clinical parameters. Collagen-treated wounds demonstrated significantly faster epithelialization, with a mean healing time of just over 9 days, compared to nearly 14 days in the conventional group. The reduced healing time facilitated earlier discharge and improved long-term outcomes, such as reduced incidence of hypertrophic scars and contractures.

The findings of this study corroborate and build upon a robust body of literature demonstrating that collagen dressings not only accelerate wound healing but also improve long-term functional and cosmetic outcomes, reduce the incidence of complications, and enhance the overall quality of burn care.

In this study provides strong evidence that collagen dressings are a superior alternative to conventional dressings in the management of partial-thickness burns. They offer a comprehensive solution that addresses biological healing, patient comfort, infection control, and logistical efficiency.

Conclusion

This study are consistent with and reinforce the growing body of evidence supporting collagen as a bioactive, biocompatible, and patient- preferred dressing for partial-thickness burns. The clinical advantages observed here can be attributed to collagen's unique biological properties: its ability to act as a physiological scaffold for cellular regeneration, its moisture-retentive and semi- permeable nature that preserves the wound microenvironment, and its ability to reduce matrix-degrading enzymes while protecting against microbial invasion.

Moreover, the improved scar quality and reduced incidence of contractures observed in the collagen group underscore its long-term benefits beyond the immediate healing phase.

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