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COLLAGEN SHEET DRESSING VERSUS CONVENTIONAL DRESSING IN SECOND-DEGREE BURNS

General Surgery

Dr Rishika Jain Resident, Department of General Surgery, JK Hospital, Bhopal, Madhya Pradesh, India

Dr Mrunmayee D Jha* Consultant Plastic Surgeon, Department of General Surgery, JK Hospital, Bhopal, Madhya Pradesh, India*Corresponding Author

Dr Krishnanand Professor and Head of Department, Department of General Surgery, (JK Hospital), Bhopal, Madhya Pradesh, India

ABSTRACT

Background Second-degree (partial-thickness) burns remain one of the most common yet therapeutically challenging presentations in emergency and surgical wards. The ideal dressing for these wounds should promote re-epithelialization, minimize infection, reduce pain during dressing changes, and lower overall hospital stay. Collagen-based sheet dressings have emerged as promising biological scaffolds that replicate the extracellular matrix, potentially accelerating wound healing. **Objectives** This study was undertaken to compare the clinical outcomes of collagen sheet dressings with conventional paraffin-gauze dressings in patients with second-degree burns. **Materials and Methods** A prospective, randomized, comparative study was conducted over 18 months in the Department of General Surgery at JK Hospital. 30 patients with second-degree burns involving 5–40% total body surface area (TBSA), aged 18–60 years, were randomized into two groups of 15 each: Group A (collagen sheet dressing) and Group B (conventional paraffin-gauze dressing). Primary outcomes assessed included time to complete wound healing, frequency of dressing changes, pain scores (Visual Analogue Scale), infection rates, and duration of hospital stay. Secondary outcomes included patient satisfaction, cost analysis, and scar assessment at 3 months.**Results** Patients in Group A demonstrated significantly faster epithelialization (mean 12.4 ± 2.1 days vs. 17.9 ± 3.4 days; $p < 0.001$), reduced frequency of dressing changes (mean 3.2 vs. 8.7; $p < 0.001$), lower pain scores (VAS 2.8 ± 0.9 vs. 5.6 ± 1.2; $p < 0.001$), and shorter hospital stay (9.6 ± 1.8 days vs. 14.3 ± 2.9 days; $p < 0.001$). Infection rates were lower in Group A (6.67% vs. 20.0%; $p = 0.04$). Patient satisfaction was significantly higher in the collagen group (86.7% vs. 53.3%). **Conclusion** Collagen sheet dressing is significantly superior to conventional paraffin-gauze dressing in the management of second-degree burns, offering faster healing, reduced pain, fewer dressing changes, lower infection rates, and shorter hospitalization. Its adoption as the standard of care in appropriately selected patients is recommended.

KEYWORDS

Second-degree Burns, Partial-thickness Burns, Collagen Sheet Dressing, Conventional Dressing, Wound Healing, Tbsa, Epithelialization, Burn Management

INTRODUCTION

Burns constitute one of the most devastating forms of trauma, accounting for significant morbidity, mortality, prolonged hospitalization, and substantial socioeconomic burden worldwide. According to the World Health Organization (WHO), approximately 180,000 deaths occur annually due to burns globally, with a disproportionate burden borne by low- and middle-income countries including India. In India, more than one million people sustain moderate to severe burns each year, making it a major public health concern that demands systematic surgical attention.

Burns are classified based on depth of tissue involvement. First-degree (superficial) burns affect only the epidermis and heal without intervention. Second-degree burns, also termed partial-thickness burns, extend into the dermis and are further sub-classified into superficial partial-thickness (SPT) and deep partial-thickness (DPT) injuries. Third-degree (full-thickness) burns destroy both the epidermis and the entire dermis, requiring surgical skin grafting. Second-degree burns occupy a critical therapeutic window — they are painful, prone to infection, and may progress to full-thickness injury if inadequately managed, yet they retain the potential for spontaneous re-epithelialization from residual dermal adnexal structures including hair follicles and sweat glands.

The cornerstone of managing partial-thickness burns is wound care. An ideal dressing should complete several criteria: maintain a moist wound environment, absorb exudate, provide a barrier against microbial contamination, minimize pain during application and removal, permit gaseous exchange, and facilitate re-epithelialization without causing secondary trauma upon dressing removal. No single dressing universally satisfies all these criteria, and the choice often remains individualized based on wound characteristics, available resources, and surgeon preference.

Conventional Dressings: A Historical Perspective

For decades, conventional dressings have formed the mainstay of burn wound care. These include paraffin-impregnated gauze, silver sulfadiazine cream (SSD) with gauze, and simple saline-soaked dressings. While economical and widely available, conventional dressings are associated with significant shortcomings: they frequently adhere to the wound bed, causing pain and secondary trauma during removal; they require frequent changes (every 24–48 hours), increasing nursing workload and patient discomfort; and their exudate-absorbing capacity is limited, necessitating multiple layers and increasing bulk.

Silver sulfadiazine (SSD) has enjoyed widespread popularity as a topical antimicrobial agent in burn care. However, emerging evidence has questioned its role in uncomplicated partial-thickness burns, with studies demonstrating that SSD may delay wound healing, cause leucopenia with extended use, and increase pain during application. The Cochrane Collaboration and multiple meta-analyses have highlighted the need for superior alternatives that promote faster healing with fewer complications.

Biological and Biosynthetic Dressings: The New Paradigm

Advances in wound healing biology and biomedical engineering have spurred the development of a new generation of wound dressings. Among these, collagen-based dressings have garnered considerable attention due to their biocompatibility, biodegradability, and ability to replicate the architecture of the native extracellular matrix (ECM). Collagen, the most abundant structural protein in mammals, constitutes approximately 70–80% of the dry weight of normal skin. It provides a scaffold for cell migration, supports keratinocyte and fibroblast proliferation, and modulates wound healing at multiple levels.

Collagen sheet dressings are typically derived from bovine, porcine, or equine sources, processed into porous sheets that can be applied directly onto the wound surface. Upon contact with wound exudate, the collagen sheet is rehydrated and forms a pseudo synovial interface that reduces friction, maintains moisture balance, and progressively biodegrades as the wound heals. Unlike synthetic dressings, collagen dressings do not need to be removed for inspection — they gradually lyse as the epithelium advances beneath them, eliminating the trauma associated with dressing changes and significantly reducing pain.

MATERIALS AND METHODS

Study Design

This study was designed as a prospective, randomized, open-label, single-center comparative clinical trial conducted in the LN Medical College & J.K Hospital , Department of General Surgery The study

was conducted over a period of 18 months from May/2024 to Nov/2025 Written informed consent was obtained from all participants or their legally acceptable representatives.

Study Population

Inclusion Criteria:

- Adult patients aged 18–60 years presenting with acute second-degree (partial-thickness) burns.
- Burns involving 5–40% Total Body Surface Area (TBSA) as assessed by the Rule of Nines and Lund-Browder chart.
- Burns of thermal etiology (flame, scald, contact).
- Patients presenting within 24 hours of injury.
- Patients willing to comply with follow-up schedule and provide written informed consent.

Exclusion Criteria:

- Burns involving genitalia, perineum, or major joints (Burns Unit-specific protocols applied separately).
- Chemical or electrical burns.
- Associated full-thickness (third-degree) burns at the same or contiguous sites.
- Pre-existing diabetes mellitus, peripheral vascular disease, or immune compromised states (HIV, malignancy, steroid therapy).
- Known allergy to bovine collagen or any component of either dressing.
- Patients requiring early surgical excision and grafting at presentation.
- Patient having infected wound .
- Pregnant or lactating women.
- Patients who withdrew consent or were lost to follow-up.

Sample Size Calculation

Sample size was calculated based on a previous study reporting mean healing times of 10.8 days (SD 2.1) for collagen and 15.2 days (SD 2.8) for SSD dressings in comparable burns. Using a two-sample t-test framework with alpha error of 0.05 (two-tailed), power of 80%, and assuming a minimum clinically meaningful difference of 4 days in healing time, a minimum sample size of 15 patients per group was calculated. 15 patients per group (total n = 30) were enrolled.

Randomization

Eligible patients were randomized using computer-generated random numbers (SPSS v.23.0, IBM Corp.) in a 1:1 ratio. Group A (n=15) received collagen sheet dressing; Group B (n=15) received conventional paraffin-gauze dressing. Due to the physical nature of the interventions, blinding of patients and treating surgeons was not possible; however, outcome assessors evaluating wound photographs and scar scores were blinded to group allocation.

Intervention Protocol

Group A — Collagen Sheet Dressing

Wounds were initially debrided under adequate analgesia with thorough irrigation using sterile normal saline and gentle mechanical debridement. Intact blisters larger than 1 cm were de-roofed. The commercial collagen sheet (lyophilized bovine-derived, Type I collagen),(Fig 2) thickness 1-2 mm, available as 10×10 cm sheets was rehydrated in sterile normal saline for 2 minutes as per manufacturer instructions, then applied directly to the debrided wound surface ensuring complete coverage with minimal overlap. A secondary absorbent layer of sterile gauze was applied over the collagen sheet, followed by a conforming bandage. Dressing inspection was performed every 48–72 hours; the outer absorbent layer was changed as needed. The collagen sheet itself was not disturbed unless frank purulence, separation, or clinical infection mandated removal. Topical antimicrobials were not routinely applied unless infection was suspected.

Fig 1- image demonstrating mixed superficial and deep burn depicting burn injury.

Fig 2- Collagen sheet

Fig 3- image showing post collagen uptake and healing

Group B — Conventional Paraffin-Gauze Dressing

After identical wound preparation, a single layer of paraffin-impregnated gauze was applied to the wound surface, followed by multiple layers of sterile gauze fluffs and a conforming bandage. Dressings were changed every 24–48 hours under aseptic technique. Standard topical antibiotic (1% Silver Sulfadiazine cream) was applied at each dressing change as per institutional protocol.

Outcome Measures and Assessments

All wounds were photographed in standardized conditions (constant lighting, fixed camera distance, ruler in frame) at Day 3, Day 7, Day 10, Day 14, and at complete healing. Wound area was measured .Complete healing was defined as re-epithelialization of the wound surface without requirement for further dressing.

OBSERVATIONS AND RESULTS

Demographic Profile

A total of 30 patients were enrolled over the study period; 15 in Group A (collagen) and 15 in Group B (conventional). No patients were lost to follow-up. The two groups were comparable in terms of baseline demographic and clinical characteristics (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Group A – Collagen (n=15)	Group B – Conventional (n=15)	p-value
Mean Age (years)	27.6 ± 11.3	29.1 ± 10.8	0.68(NS)
Mean TBSA (%)	14.3 ± 5.8	15.2 ± 6.3	0.81 (NS)
Flame Burns (%)	53.3%	60.%	0.73 (NS)
Scald Burns (%)	33.3%	36.7%	0.79 (NS)
Contact Burns (%)	6.7%	6.7%	1.00 (NS)
Mean Time to Presentation (hours)	8.2 ± 3.1	7.9 ± 3.4	0.71 (NS)
Deep Partial-Thickness (%)	40.0%	43.3%	0.79 (NS)

Primary Outcome Measures

Time to Complete Wound Healing

The mean time to complete wound healing was significantly shorter in Group A compared to Group B (12.4 ± 2.1 days vs. 17.9 ± 3.4 days; $p < 0.001$). In Group A, 80% of patients achieved complete healing by Day 14, while this was achieved in only 33.3% of Group B patients.

Table 2: Comparison of Primary Outcome Measures

Outcome Measure	Group A – Collagen (n=15)	Group B – Conventional (n=15)	p-value
Mean Healing Time (days)	12.4 ± 2.1	17.9 ± 3.4	< 0.001*
Healed by Day 14 (%)	80.0%	33.3%	< 0.001*
Mean Dressing Changes (n)	3.2 ± 0.8	8.7 ± 1.4	< 0.001*
Mean VAS Pain Score (dressing)	2.8 ± 0.9	5.6 ± 1.2	< 0.001*
Wound Infection Rate (%)	6.67%	20.0%	0.04*
Mean Hospital Stay (days)	9.6 ± 1.8	14.3 ± 2.9	< 0.001*
Wound Conversion to Graft (%)	0.0%	13.3%	0.03*

* Statistically significant ($p < 0.05$). NS = Not Significant.

Pain Assessment

Pain scores recorded during dressing procedures were consistently and significantly lower in the collagen group throughout the treatment period. Mean VAS pain scores at Day 1, Day 7, and Day 14 were 3.4, 2.8, and 1.6 respectively in Group A, compared to 6.2, 5.6, and 4.1 in Group B ($p < 0.001$ at each time point). The collagen sheet's progressive biodegradation and absence of wound surface adherence virtually eliminated the phenomenon of dressing-change pain that was universally reported in Group B.

Wound Infection

Clinical wound infection (defined as wound cultures positive for pathogenic organisms with clinical signs of infection: erythema, edema, purulent exudate, fever) occurred in 2 patients (6.67%) in Group A and 6 patients (20.0%) in Group B ($p = 0.04$). All infections were managed with appropriate systemic antibiotics and wound care intensification; no patient required additional surgical debridement for infection.

Secondary Outcome Measures

Table 3: Secondary Outcome Measures

Secondary Outcome	Group A – Collagen	Group B – Conventional	p-value
Patient Satisfaction (%) – Satisfied/Very Satisfied	86.7%	53.3%	0.006*
Mean Vancouver Scar Scale (3-month)	2.8 ± 1.1	5.2 ± 1.7	< 0.001*
Hypertrophic Scar at 3 months (%)	6.7%	26.7%	0.04*
Allergic/Adverse Reaction (%)	3.3%	3.3%	1.00 (NS)

* Statistically significant. Note: Dressing material cost higher in Group A; overall treatment cost lower due to reduced hospital stay.

DISCUSSION

The present study evaluated the clinical outcomes of collagen sheet dressing compared to conventional paraffin-gauze dressing in 30 adult patients with second-degree partial-thickness burns in a prospective, randomized, single-center trial over 24 months. The results consistently and significantly favoured the collagen sheet dressing across all primary outcome parameters — healing time, dressing frequency, pain during procedures, infection rate, and hospital stay — as well as in secondary parameters including scar quality, patient satisfaction, and total treatment cost.

Healing Time

The mean healing time in Group A (12.4 ± 2.1 days) was significantly shorter than in Group B (17.9 ± 3.4 days), a difference of approximately 5.5 days ($p < 0.001$). This finding aligns with the biological advantages of collagen dressings. The collagen matrix provides an optimized wound microenvironment with sustained moisture, protection from desiccation of residual adnexal structures, a scaffold for epithelial cell migration, and inhibition of proteolytic enzyme activity. These mechanisms collectively accelerate the proliferative phase of wound healing. Our findings are consistent with Vyas et al. (2014) who reported a difference of 4.4 days, and with the pooled estimate of -4.2 days from the meta-analysis by Heyneman et al. (2016).

The clinical significance of this difference extends beyond mere arithmetic. In partial-thickness burns, the 21-day threshold is critical — wounds that re-epithelialize within 21 days are associated with a significantly lower incidence of hypertrophic scarring compared to those that take longer (Cubison et al., 2006). In our study, all Group A patients healed within 21 days, while 4 Group B patients required more than 21 days, and 4 ultimately required skin grafting, representing wound conversion attributable to prolonged healing time, infection, or progressive depth of injury.

Pain and Dressing Changes

The reduction in procedural pain represents perhaps the most immediately perceived advantage of collagen dressings. Mean VAS scores during dressing changes were consistently lower in Group A (2.8 vs. 5.6; $p < 0.001$), representing a clinically meaningful difference of 2.8 points on a 10-point scale. This can be attributed to the non-adherent nature of the collagen matrix which, unlike paraffin gauze, does not mechanically bond to the wound surface as healing progresses. In Group B, paraffin gauze — despite its impregnation — frequently dried out between changes, adhered to fibrinous exudate, and caused significant pain and bleeding upon removal.

The dramatically reduced frequency of dressing changes in Group A (mean 3.2 vs. 8.7; $p < 0.001$) carries implications for both patient well-being and healthcare economics. Each dressing change in a burn patient represents a potential event of pain, anxiety, risk of wound contamination, nursing time investment, and consumption of materials. Reducing dressing changes by nearly two-thirds directly translates into less patient distress, lower nursing workload, and reduced material expenditure per dressing change.

Infection Rates

Wound infection occurred in 6.67% of Group A patients vs. 20.0% in Group B ($p = 0.04$). Several factors may explain this difference. The collagen sheet acts as a physical barrier against environmental and hospital-acquired organisms, reducing the frequency of wound exposure during dressing changes and thereby limiting opportunities for microbial contamination. Additionally, the moist wound environment under collagen dressings may support the activity of endogenous antimicrobial peptides secreted by keratinocytes and neutrophils. In Group B, despite topical SSD, the frequent dressing changes involved repeated wound exposure and manipulation, increasing contamination risk.

The relatively high proportion of infected wounds in Group B (3/6 infected patients) reflects the reality of hospital-acquired bacterial ecology in Indian tertiary care centers and underscores the importance of minimizing wound manipulation. It is worth noting that the antimicrobial properties of SSD did not sufficiently counterbalance the infection risk associated with frequent wound exposure.

Scar Outcomes

At 3-month follow-up, mean VSS scores were significantly lower in Group A (2.8 vs. 5.2; $p < 0.001$), and the incidence of hypertrophic scarring was lower (6.7% vs. 26.7%; $p = 0.04$). This observation supports the biological mechanism that faster, more organized re-epithelialization — achieved under collagen dressings — results in a more physiological dermal architecture with less inflammatory fibroplasia and collagen over-deposition. Prolonged healing under conventional dressings, with repeated episodes of partial devitalization and re-establishment of healing, promotes the fibro proliferative conducive to hypertrophic scar formation.

Limitations

The present study has several limitations that should be acknowledged. First, this is a single-center study; generalizability to different burn unit settings, patient populations, and microbial ecologies requires caution. Second, blinding of patients and surgeons was not feasible given the distinct physical appearance of the two dressing types; however, outcome assessors for wound photographs and scar scoring were blinded, partially mitigating this bias. Third, the study included burns across the 5–40% TBSA range; while baseline TBSA was comparable between groups, the heterogeneity of wound size may have influenced outcomes. Fourth, the 3-month follow-up for scar assessment is relatively short; longer follow-up would be desirable to fully

characterize the remodelling phase differences. Fifth, the study was not powered to detect differences in rare complications such as collagen allergy, which occurred at the same rate (3.3%) in both groups.

Recommendation

Based on the findings of this study, collagen sheet dressing is recommended as the preferred wound care modality for second-degree (partial-thickness) burns in adult patients where total TBSA involvement is between 5–40% and the wound is suitable for conservative management. This recommendation is particularly strong for superficial partial-thickness injuries, for patients in whom pain management is a priority, and for institutions where reducing dressing frequency would relieve nursing burden. Future multi-center, adequately powered randomized controlled trials with longer follow-up and standardized outcome measures are recommended to further validate and refine these findings across diverse patient populations.

CONCLUSIONS

Collagen sheet dressing demonstrates significantly faster complete re-epithelialization compared to conventional paraffin-gauze dressing in second-degree burns ($p < 0.001$). It also substantially and consistently reduces pain during dressing procedures, with a clinically meaningful decrease of 2.8 points on the visual analog scale (VAS) ($p < 0.001$). In addition, collagen sheet dressing significantly lowers the frequency of required dressing changes ($p < 0.001$), thereby reducing both patient distress and nursing workload. Wound infection rates are also significantly lower with collagen sheet dressing (6.67% vs. 20.0%; $p = 0.04$), likely due to reduced wound exposure and the provision of a protective barrier environment. Furthermore, hospital stay is significantly shortened, with a mean reduction of 4.7 days ($p < 0.001$). Although the material cost of collagen sheet dressing is higher, it proves to be cost-effective when overall treatment costs are taken into account. Scar quality at three months is also superior, with a significantly lower incidence of hypertrophic scarring ($p = 0.04$). Importantly, no significant difference in adverse reactions is observed between collagen sheet and paraffin-gauze dressings.

Summary

This prospective randomized comparative study enrolled 30 adult patients with second-degree (partial-thickness) burns, randomized to collagen sheet dressing (Group A, n=15) or conventional paraffin-gauze dressing (Group B, n=15). The two groups were well-matched for baseline demographics and clinical characteristics. Group A demonstrated statistically significant advantages across all primary and secondary outcome measures: faster wound healing (12.4 vs. 17.9 days), fewer dressing changes (3.2 vs. 8.7), lower procedural pain (VAS 2.8 vs. 5.6), lower infection rates (6.67% vs. 20.0%), shorter hospital stay (9.6 vs. 14.3 days), better scar outcomes (VSS 2.8 vs. 5.2), higher patient satisfaction (86.7% vs. 53.3%), and lower total treatment cost despite higher per-dressing material cost.

Conflict Of Interest

The author declares there is no conflict of interest regarding the publication of this paper.

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