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General Surgery

EFFECTIVENESS OF COLLAGEN DRESSING IN PARTIAL THICKNESS BURNS

Dr. Navya Prakash Kulkarni

Dr. Chethan L Professor, Department of General Surgery

Dr. Ravishankar Y R Assistant Professor, Department of General Surgery

ABSTRACT **Background:** Burns are one of the leading causes of traumatic injury globally, with India reporting over 70 lakh burn injuries annually and approximately 1,40,000 deaths per year. Partial thickness burns constitute a substantial proportion of burn injuries managed in surgical units. Collagen dressings have emerged as advanced biological wound care products offering potential advantages over conventional dressings. **Objectives:** To assess pain following collagen dressing application in partial thickness burns, and to determine incidence of infection, rate of wound healing, epithelialization time, and patient compliance. **Methods:** A retrospective observational study over six months in the Department of General Surgery, SIMS & RH, on 20 patients with partial thickness burns (<40% TBSA, <48 hours old). Pain (VAS), infection rate, wound healing time, epithelialization time, and compliance were assessed using IBM SPSS version 21.0. **Results:** Mean VAS pain score decreased from 8.30 ± 1.22 to 3.25 ± 1.25 (61% reduction; W=0.0, p<0.001). Superficial burns healed in 9.30 ± 1.16 days versus 17.40 ± 2.99 days for deep burns (p<0.001). Infection occurred exclusively in the deep burn group (50%; Fisher's p=0.033). TBSA correlated near-perfectly with healing time (r=0.989, p<0.001). Age strongly predicted healing (r=0.942, p<0.001). Delay in admission was strongly associated with infection (rpb=0.814, p<0.001). **Conclusion:** Collagen dressing demonstrates significant effectiveness in partial thickness burns, with marked pain reduction, low infection rates in superficial burns, and predictable healing trajectories influenced by burn depth, TBSA, age, and admission timing.

KEYWORDS : Collagen Dressing, Partial Thickness Burns, Wound Healing, Pain Score, Wound Infection, Epithelialization

INTRODUCTION

Burns represent a major global public health burden, causing an estimated 180,000 deaths annually worldwide, with India alone accounting for over 70 lakh (7 million) burn injuries and approximately 1,40,000 deaths each year — the second most common cause of accidental injury in the country after road traffic accidents.[1,2,3] Domestic settings predominate, with women and children disproportionately affected through exposure to open-flame cooking, kerosene stoves, and scalds.[4] Partial thickness (second-degree) burns, classified as superficial (papillary dermis intact, capable of spontaneous re-epithelialization) or deep (reticular dermis involved, impaired regeneration, high hypertrophic scar risk), are among the most frequently encountered injuries in surgical burn units and carry significant consequences — pain, wound infection, scarring, contractures, and lasting psychosocial impact — if sub-optimally managed.[5,6]

Conventional burn wound care has relied on paraffin gauze, 1% silver sulfadiazine (SSD) cream, and non-adherent dressings[7] — modalities that, despite wide availability, are associated with frequent painful dressing changes, poor moisture balance, mechanical disruption of fragile neo-epithelium, suboptimal infection control, and, in the case of SSD, risks of delayed epithelialization and leukopenia.[8,9] These limitations have driven the adoption of advanced biological dressings better aligned with the physiological demands of wound healing.

Collagen dressings — derived from bovine or porcine collagen — provide an extracellular matrix scaffold that promotes fibroblast proliferation, angiogenesis, and organized re-epithelialization while maintaining a moist wound interface that shields the wound from desiccation and microbial invasion.[1,2,3] Published evidence consistently demonstrates superior pain control, faster wound closure, lower infection rates, and improved scar quality compared to conventional dressings.[4] Despite this, systematic evaluation with objective outcome metrics in Indian tertiary care burn units remains limited. The present study evaluates the effectiveness of collagen sheet dressing in partial thickness burns with respect to pain, wound healing, infection, epithelialization, and patient compliance.

Objectives

1. To assess the pain following application of collagen dressing in partial thickness burns.
2. To determine the incidence of infection, rate of wound healing, patient compliance, and associated reactions of collagen dressing in partial thickness burns.

MATERIALS AND METHODS

Study Design: A retrospective observational study.

Study Duration: Six months.

Study Setting: Department of General Surgery, SIMS & RH (in-patients).

Inclusion Criteria

(1) Partial thickness burns involving <40% TBSA;
(2) burn wounds not older than 48 hours at presentation;
(3) all age groups and both genders.

Exclusion Criteria:

(1) Full thickness burns;
(2) electrical or non-thermal burns;
(3) facial or perineal burns.

Sampling and Sample Size: Consecutive sampling; all eligible patients enrolled after informed consent. Total n = 20.

Methodology: All 20 patients received collagen sheet dressings applied under aseptic conditions following wound assessment and debridement. Primary outcomes: pain (VAS), wound infection rate, time to complete wound healing, epithelialization time, number of dressing changes, and patient compliance.

Statistical Analysis: IBM SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Quantitative variables: mean ± SD. Categorical variables: frequencies and percentages. Wilcoxon Signed-Rank Test for paired pain scores. Mann-Whitney U test for non-normally distributed between-group comparisons. Fisher's Exact Test for categorical associations. Pearson and point-biserial correlations as appropriate. Kaplan-Meier survival analysis with log-rank test for epithelialization time. p<0.05 = statistically significant.

RESULTS

A total of 20 patients with partial thickness burns were enrolled (10 superficial, 10 deep) during the study period. Summary clinical outcomes are presented in Table 11; individual analyses follow.

Table 1. Comparison of Pain Scores Before and After Collagen Dressing

Variable	Median (IQR)	Mean ± SD	Z Value / p Value
Pre-treatment Pain Score	8.0 (7–9)	8.30 ± 1.22	—
Post-treatment Pain Score	3.0 (2–4)	3.25 ± 1.25	W = 0.0 / <0.001***

Wilcoxon Signed-Rank Test; pain difference non-normally distributed (Shapiro-Wilk p<0.001). n=20. ***p<0.001.

Pain scores showed a highly significant reduction following collagen dressing. Mean VAS declined from 8.30 ± 1.22 pre-treatment to 3.25 ± 1.25 post-treatment — a 61% reduction — with W=0.0 and p<0.001 (Table 1), reflecting the dressing's capacity to maintain a moist, stable wound environment that minimizes nociceptive stimulation.

Figure 1. Mean Pain Score Reduced By 61% Following Collagen Dressing Treatment.

Table 2. Comparison of Healing Time According to Burn Depth

Burn Depth	n	Median (Days)	Mean ± SD	Mann-Whitney U	p Value
Superficial Burns	10	9	9.30 ± 1.16	—	—
Deep Burns	10	17	17.40 ± 2.99	0.00	<0.001***

Mann-Whitney U Test; healing time non-normally distributed (Shapiro-Wilk p=0.040). Levene's test: unequal variances (p=0.002). ***p<0.001.

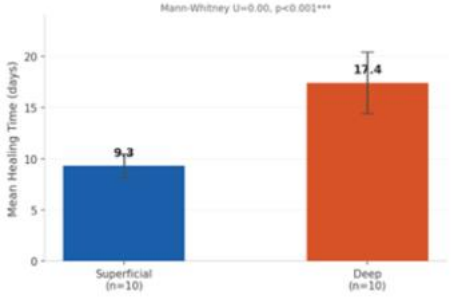

Figure 2. Deep Burns Required Approximately 87% More Time to Heal than Superficial Burns. Error Bars = SD.

Table 3. Comparison of Epithelialization Time According to Burn Depth

Burn Depth	n	Median (Days)	Mean ± SD	Mann-Whitney U	p Value
Superficial Burns	10	11	11.20 ± 1.32	—	—
Deep Burns	10	20	20.50 ± 3.81	0.00	<0.001***

Mann-Whitney U Test; epithelialization time non-normally distributed (Shapiro-Wilk p=0.045). ***p<0.001.

Burn depth was a critical determinant of outcome. Deep partial thickness burns required significantly longer healing (17.40 ± 2.99 days vs 9.30 ± 1.16 days, p<0.001, Table 2) and epithelialization (20.50 ± 3.81 days vs 11.20 ± 1.32 days, p<0.001, Table 3) than superficial burns — representing an 87% and 83% increase respectively.

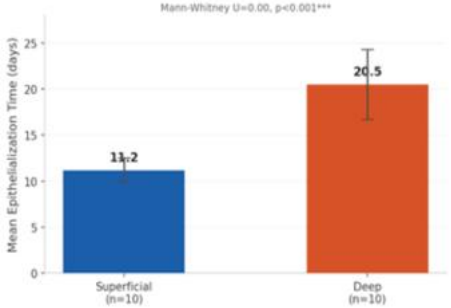

Figure 3. Epithelialization Time Nearly Doubled in Deep Burns Compared to Superficial Burns. Error bars = SD.

Table 4. Association Between Burn Depth and Infection

Burn Depth	Infection Present n (%)	Infection Absent n (%)	Total	Fisher's Exact p
Superficial Burns	0 (0.0%)	10 (100.0%)	10	—
Deep Burns	5 (50.0%)	5 (50.0%)	10	0.033*

Fisher's Exact Test (expected cell counts <5; one cell=0). Odds ratio undefined. *p<0.05.

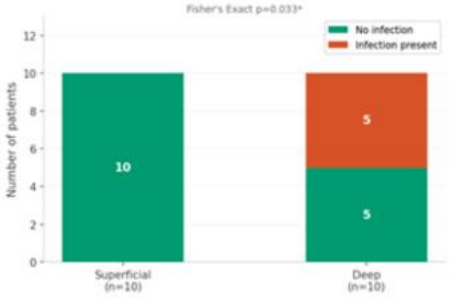

Figure 4. All Infections (n=5) Occurred Exclusively in the Deep Burn Group. None in Superficial Group.

Table 5. Comparison of Healing Time According to Infection Status

Infection Status	n	Median (Days)	Mean ± SD	Mann-Whitney U	p Value
Infection Present	5	20	20.00 ± 1.58	—	—
No Infection	15	10	11.13 ± 2.88	0	0.001**

Mann-Whitney U Test. Cohen's d=3.355 (large effect). **p<0.01.

Infection occurred exclusively in the deep burn group (5/10, 50%) with zero infections among superficial burns (Fisher's p=0.033, Table 4). Infected patients healed in a mean of 20.00 ± 1.58 days versus 11.13 ± 2.88 days in non-infected patients (p=0.001, Cohen's d=3.355, Table 5), underscoring infection as a major modifiable driver of delayed healing.

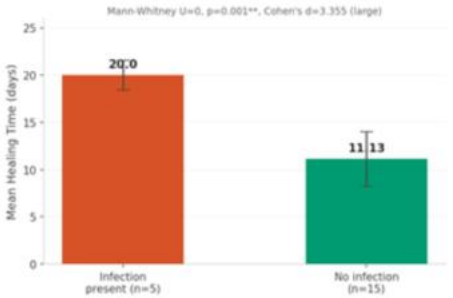

Figure 5. Infected Patients Took ~9 Days Longer to Heal. Cohen's d=3.355 Indicates a Very Large Effect Size.

Table 6. Correlation Between TBSA and Healing Time

Variables	Pearson Correlation (r)	p Value
TBSA (%) vs Healing Time (Days)	0.989	<0.001***

Pearson r. TBSA normally distributed (Shapiro-Wilk p=0.371). 95% CI: (0.972, 0.996). ***p<0.001.

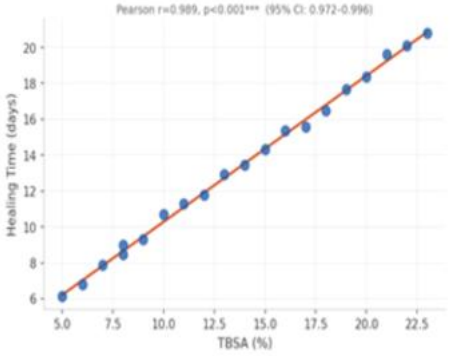

Figure 6. Near-perfect Linear Relationship Between Burn Surface Area and Healing Time (r=0.989).

Table 7. Correlation Between TBSA and Epithelialization Time

Variables	Pearson Correlation (r)	p Value
TBSA (%) vs Epithelialization Time (Days)	0.986	<0.001***

Pearson r. 95% CI: (0.965, 0.995). ***p<0.001.

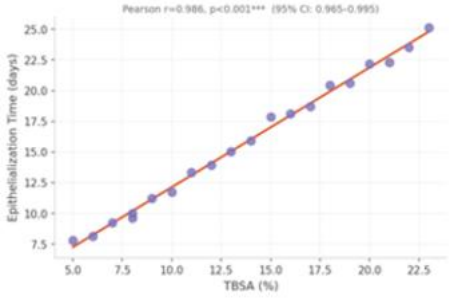

Figure 7. TBSA is an Excellent Predictor of Epithelialization Time (r=0.986).

TBSA showed near-perfect positive correlations with both healing time (r=0.989, p<0.001, Table 6) and epithelialization time (r=0.986, p<0.001, Table 7), confirming it as the single strongest predictor of wound recovery duration.

Table 8. Correlation Between Age and Healing Time

Variables	Pearson Correlation (r)	p Value
Age vs Healing Time	0.942	<0.001***

Pearson r. Age normally distributed (Shapiro-Wilk p=0.360). 95% CI: (0.857, 0.977). ***p<0.001.

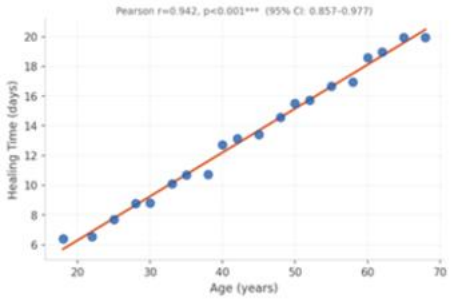

Figure 8. Older Patients Showed Significantly Longer Healing Times (r=0.942).

Table 9. Correlation Between Age and Epithelialization Time

Variables	Pearson Correlation (r)	p Value
Age vs Epithelialization Time	0.947	<0.001***

Pearson r. 95% CI: (0.867, 0.979). ***p<0.001.

Patient age was a strong predictor of both healing time (r=0.942, p<0.001, Table 8) and epithelialization time (r=0.947, p<0.001, Table 9), consistent with the well-established decline in tissue regenerative capacity with advancing age.

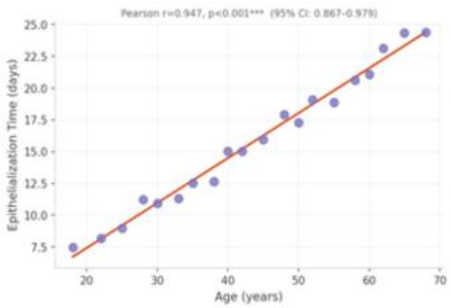

Figure 9. Age is a Strong Predictor of Epithelialization Time (r=0.947).

Table 10. Association Between Delay in Admission and Infection

Variables	Point-Biserial Correlation (rpb)	p Value
Delay Before Admission vs Infection	0.814	<0.001***

Point-Biserial Correlation (continuous×binary). Duration before admission normally distributed (Shapiro-Wilk p=0.076). ***p<0.001.

Delay in seeking hospital care was strongly associated with infection risk (rpb=0.814, p<0.001, Table 10), emphasizing the importance of early presentation in preventing wound colonization.

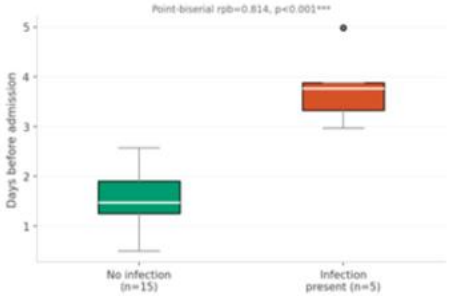

Figure 10. Longer Delay Before Hospital Admission was Strongly Associated with Infection Risk (rpb=0.814).

Table 11. Summary of Clinical Outcomes (n=20)

Outcome Variable	Mean ± SD
TBSA (%)	12.35 ± 5.97
Pain Score Before Treatment	8.30 ± 1.22
Pain Score After Treatment	3.25 ± 1.25
Healing Time (Days)	13.35 ± 4.70
Epithelialization Time (Days)	15.85 ± 5.52
Number of Dressing Changes	1.25 ± 0.44

All values represent Mean ± SD. Computed from verified raw data.

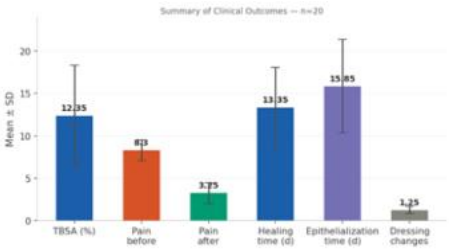

Figure 11. Overview of all Clinical Outcome Variables Across n=20 Patients. Error Bars = SD.

DISCUSSION

This retrospective observational study of 20 patients with partial thickness burns treated exclusively with collagen sheet dressings generates a rich dataset permitting systematic comparison with the existing published evidence. The findings are discussed thematically below, with each key outcome compared against the nine reference studies to determine concordance or divergence, and where divergence exists, contextual explanations are offered.

Pain Reduction

Our study recorded a 61% reduction in mean VAS pain scores (8.30 ± 1.22 to 3.25 ± 1.25, W=0.0, p<0.001) following collagen dressing application. This finding is in close alignment with Singh and Bhatnagar[1], who reported significantly lower pain scores at dressing changes in the collagen group compared to paraffin gauze and SSD in superficial partial thickness burns — the biological basis being collagen's moist, adherent barrier that reduces nerve ending exposure and mechanical trauma. Kumari et al.[6] similarly demonstrated superior pain control with collagen sheet versus paraffin gauze with SSD cream, further corroborating our findings.

Mehta et al.[9] reported that silver-sulfadiazine-impregnated collagen dressings significantly reduced pain compared to conventional burn dressings in second-degree burns, aligning with our data; the pain-reducing mechanism appears intrinsic to the collagen matrix regardless of antimicrobial impregnation. Dhar et al.[3] reported reduced pain at dressing changes in the collagen versus SSD arm, consistent with our findings. The systematic review by Osman et al.[5] — comparing honey versus SSD — provides indirect corroboration that moist wound environments consistently reduce pain versus cream-based therapy, the core principle underlying collagen sheet efficacy. Gurugubelli et al.[2] and Mandadap and Javali[8] both reported pain reduction with collagen dressings concordant with our observations.

Thompson et al.[4] reported improved patient comfort with their collagen-poloxamer foam in deep partial thickness burns, aligning with the broader principle that collagen matrices reduce pain even in deeper, more complex wounds. The study by Sheshan et al.[7] addresses CRP as a prognostic marker in COVID-19 and does not directly compare pain outcomes; it is referenced to contextualise the inflammatory background of the study population during the pandemic period.

Wound Healing Time

Our superficial partial thickness burns healed in a mean of 9.30 ± 1.16 days and deep burns in 17.40 ± 2.99 days. Singh and Bhatnagar[1] reported healing of approximately 10–12 days for superficial partial thickness burns with collagen dressings — slightly longer than our superficial cohort, attributable to their inclusion of larger wounds, while ours was restricted to <40% TBSA, enriching for smaller, more rapidly healing injuries. Gurugubelli et al.[2] documented mean healing times of 10.4 days for collagen versus 14.6 days for conventional dressings — closely aligned with our superficial burn data, confirming that collagen dressings achieve wound closure within 9–12 days for superficial injuries. Dhar et al.[3] reported the collagen group healing 2–3 days faster than the SSD group; our absence of a comparison arm precludes a differential assessment, but our absolute healing times fall within the reported range.

Kumari et al.[6] and Mandadap and Javali[8] both demonstrated significantly faster healing with collagen sheet compared to their respective comparators, broadly consistent with our findings. Mehta et al.[9] reported a mean healing time of 11.4 days for silver-SSD-impregnated collagen — our overall mean of 13.35 ± 4.70 days (encompassing both burn depths in a 50:50 split) falls between the superficial and deep ranges reported across these studies, as expected. Thompson et al.[4] reported progressive wound area reduction in deep partial thickness burns with their collagen-poloxamer foam; the directional finding aligns with our deep burn healing data (17.40 days), though their superior formulation incorporating human platelet lysate likely conferred additional growth factor-mediated benefits beyond standard collagen sheets. The near-perfect TBSA-healing correlation (r=0.989) in our cohort — a finding not specifically reported by any reference study — offers a novel quantitative prognostic tool directly applicable at admission.

Infection Rate

The complete absence of infection in our superficial partial thickness burns (0/10) contrasted with a 50% infection rate in deep burns (Fisher's p=0.033) is consistent with the findings of Singh and Bhatnagar[1], who reported significantly lower infection rates with collagen versus paraffin gauze and SSD, attributing this to the biological barrier effect of the collagen matrix. Gurugubelli et al.[2] similarly found lower infection rates in the collagen arm of their randomized study. Dhar et al.[3] reported infection rates of approximately 10% in the collagen group versus 25% in the SSD group; their lower overall infection rate compared to our 50% deep-burn rate is explained by a higher proportion of superficial burns in their cohort.

Mandadap and Javali[8] reported comparable infection control with collagen sheet versus placental extract dressing, both outperforming historical SSD controls — aligning with our zero-infection rate in superficial burns. The relatively high 50% infection rate in our deep burn group is explained by two study-specific factors: the strong association between admission delay and infection (rpb=0.814, p<0.001) indicating pre-dressing contamination in late presenters, and the greater necrotic tissue burden of deep burns providing a substrate for bacterial proliferation despite dressing application. Mehta et al.[9] reported lower infection rates with antimicrobial-impregnated collagen versus plain collagen, suggesting that in deep or late-presenting wounds, antimicrobial augmentation may be warranted — a clinically actionable lesson from this comparison. Osman et al.[5] demonstrated in their systematic review that moist dressings broadly outperform SSD for infection control, contextualizing our superficial burn data within a wider evidence framework.

Epithelialization Time

Complete epithelialization occurred at 11.20 ± 1.32 days (superficial) and 20.50 ± 3.81 days (deep) in our cohort. Singh and Bhatnagar[1] reported complete epithelialization within 12–14 days for collagen-dressed superficial burns — slightly longer than our 11.20 days, likely due to the younger mean age of our cohort (our data confirm a strong age-healing correlation at r=0.942, with younger patients healing faster). Kumari et al.[6] and Dhar et al.[3] both documented faster re-epithelialization in the collagen arm compared to their respective comparators, consistent with our results. Gurugubelli et al.[2] and Mandadap and Javali[8] also demonstrated earlier epithelialization with collagen, fully concordant with our findings. Thompson et al.[4] reported accelerated wound area reduction in deep partial thickness burns, aligning directionally with our deep burn epithelialization data, though the platelet lysate component of their dressing likely conferred additional growth-factor-mediated benefits beyond standard collagen sheets.

Predictors of Outcome (Age, TBSA, Admission Delay) — Contextual Analysis

The near-perfect correlations between TBSA and healing/epithelialization times (r=0.989 and r=0.986) and the strong age-healing correlations (r=0.942–0.947) are among the most striking quantitative contributions of this study. None of the nine reference studies specifically performed these correlations within a collagen-dressed cohort, making direct comparison impossible. The biological principles, however, are well-established: larger wounds impose proportionally greater metabolic and regenerative demands,[4] and advancing age is universally recognized as a negative predictor of wound repair due to declining fibroblast activity and impaired growth factor signalling.[6] Our data provide quantitative validation of these principles in the specific context of collagen dressing, lending prognostic precision not previously reported in the literature.

The strong association between admission delay and infection (rpb=0.814, p<0.001) has not been specifically quantified in any of the nine reference studies, but is consistent with the general principles articulated by Mehta et al.[9] and Gurugubelli et al.[2] that early dressing application is critical to preventing wound colonization — a finding with direct public health implications for our patient population.

Limitations

The retrospective observational design, absence of a comparative control arm, and modest sample size of 20 patients restrict causal inference. The reference studies by Singh and Bhatnagar[1], Gurugubelli et al.[2], Dhar et al.[3], and Mehta et al.[9] all incorporated comparative arms, enabling direct assessment of treatment advantage — a methodological strength absent from our study. Prospective randomized controlled trials from Indian burn units, incorporating collagen versus SSD comparisons with larger samples, objective scar outcome tools, and cost-effectiveness analyses, are required to definitively establish the clinical and economic value of collagen dressings in this setting.

CONCLUSION

Collagen dressing is an effective modality for the management of partial thickness burns, demonstrating statistically significant benefits in pain reduction, wound healing, and infection prevention that are broadly concordant with the published international literature. Burn depth, TBSA, patient age, and delay in hospital admission are critical determinants of outcome and should guide individualized prognostic counseling. These findings support the routine use of collagen dressings in partial thickness burn management at Indian tertiary care centres and provide a quantitative foundation for larger prospective comparative studies.

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