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COMPARISON OF EFFICACY OF DRY COLLAGEN VERSUS WET COLLAGEN IN BURN WOUND MANAGEMENT: A PROSPECTIVE COMPARATIVE STUDY IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background : Burn injuries remain a significant clinical challenge due to their associated morbidity, risk of infection, prolonged healing time, and extended hospital stay. Optimal wound management is essential to enhance healing, reduce complications, and improve patient outcomes. Collagen dressings have emerged as an effective biological dressing modality owing to their biocompatibility, ability to maintain a moist wound environment, and role in promoting tissue regeneration. However, limited comparative evidence exists regarding the clinical effectiveness of dry collagen versus wet collagen dressings in burn wound management. **Objectives :** To compare the efficacy of dry collagen and wet collagen dressings in promoting burn wound healing and to evaluate differences in pain, infection rates, progression to full-thickness burns, and duration of hospital stay between the two groups. **Methods :** This prospective comparative study was conducted at a tertiary care hospital over a period of 24 months and included a total of 52 patients with burn injuries. Patients were divided into two groups: 26 patients received dry collagen dressing and 26 patients received wet collagen dressing. Inclusion criteria comprised patients with superficial second-degree burns presenting within 72 hours of injury. Patients with third-degree burns, infected wounds, or delayed presentation were excluded. Clinical parameters assessed included time to presentation, time to collagen application, time for collagen separation, wound infection, progression to full-thickness burns, pain scores using the Visual Analogue Scale (VAS) and FLACC scale, and duration of hospital stay. Statistical analysis was performed using appropriate parametric and non-parametric tests, with a p-value of <0.05 considered statistically significant. **Results :** Baseline characteristics such as age, gender, burn degree, total body surface area, and cause of burn were comparable between the two groups ($p > 0.05$). Faster wound healing was observed in the dry collagen group, with 57.69% of patients achieving collagen separation within ≤7 days compared to 30.77% in the wet collagen group ($p < 0.05$). The incidence of wound infection (7.69% vs 15.38%) and progression to full-thickness burns (3.85% vs 15.38%) was lower in the dry collagen group, although these differences were not statistically significant. Pain scores were consistently lower in the dry collagen group across all time points. On Day 1, mean VAS scores were 6.38 ± 1.00 in the dry group versus 7.14 ± 1.08 in the wet group ($p < 0.05$). By Day 7, scores reduced to 1.90 ± 1.06 and 3.05 ± 1.05, respectively ($p < 0.01$). Similar trends were observed with FLACC scores, demonstrating significantly reduced pain in the dry collagen group ($p < 0.001$). The duration of hospital stay was significantly shorter in the dry collagen group, with 53.85% of patients discharged within ≤7 days compared to 26.92% in the wet collagen group. The mean hospital stay was 8.23 ± 3.48 days in the dry group versus 11.15 ± 4.40 days in the wet group ($p < 0.05$). **Conclusion :** Dry collagen dressing demonstrates superior clinical outcomes compared to wet collagen dressing in burn wound management. It is associated with faster wound healing, reduced pain, and shorter hospital stay, with a trend toward lower complication rates. These findings support the use of dry collagen as an effective and practical option in the management of superficial burn wounds.

KEYWORDS

Burn wound, Collagen dressing, Dry collagen, Wet collagen, Wound healing, Pain score, Burn management

INTRODUCTION

Burn injuries represent a significant global health problem, contributing to substantial morbidity, prolonged hospitalization, and long-term physical and psychological consequences. They affect individuals across all age groups, with a particularly high burden in low- and middle-income countries where access to specialized burn care is often limited. Even superficial burns, if not managed appropriately, can lead to complications such as delayed healing, infection, and progression to deeper tissue injury [1,2].

The primary goal in burn wound management is to achieve rapid and effective wound healing while minimizing pain, preventing infection, and reducing hospital stay. Conventional wound care methods, including gauze dressings and topical antimicrobial agents, primarily act as passive barriers and often require frequent and painful dressing changes. These limitations have driven the development of advanced and biological dressings that actively promote wound healing [3,4].

Collagen plays a crucial role in the wound healing process as it is the principal structural protein of the extracellular matrix. It provides a scaffold for cellular migration, supports angiogenesis, and facilitates tissue regeneration [5]. Collagen-based dressings have gained considerable importance in burn care due to their biocompatibility, biodegradability, low antigenicity, and ability to maintain a moist wound environment. These properties not only enhance epithelialization but also reduce pain and the frequency of dressing changes [6].

Collagen dressings can be broadly categorized into dry and wet forms based on their physical characteristics. Dry collagen is typically dehydrated and may be prepared through processes such as freeze-drying, allowing it to absorb wound exudate and gradually integrate with the wound bed [7]. Wet collagen, on the other hand, retains inherent moisture and mimics the natural hydrated state of collagen in tissues. Although both forms are widely used in clinical practice, there is limited comparative evidence regarding their relative effectiveness in burn wound management [8].

Previous studies have highlighted the advantages of collagen dressings over conventional methods, including faster wound healing, reduced infection rates, improved patient comfort, and shorter hospital stays. However, direct comparisons between dry and wet collagen dressings remain scarce, and clinical decision-making is often based on individual preference rather than strong evidence [9,10].

In this context, the present study was designed to compare the efficacy of dry collagen and wet collagen dressings in the management of burn wounds. The study evaluates key clinical outcomes such as wound healing time, pain levels, infection rates, progression to full-thickness burns, and duration of hospital stay. By providing a direct comparison between these two commonly used modalities, the study aims to contribute to evidence-based clinical practice and improve treatment outcomes in patients with burn injuries.

AIM AND OBJECTIVES

Aim

To compare the effectiveness of dry collagen and wet collagen dressings in the management of burn wounds.

Objectives

1. To compare the efficacy of dry collagen and wet collagen in promoting burn wound healing.
2. To evaluate and compare the time required for collagen separation from the wound in both groups.
3. To assess and compare the incidence of wound infection between patients treated with dry collagen and wet collagen.
4. To compare the progression of burn wounds to full-thickness injury in both groups.
5. To evaluate and compare pain levels in both groups using standardized pain assessment scales (VAS and FLACC).
6. To compare the duration of hospital stay between patients treated with dry collagen and those treated with wet collagen.

MATERIALS AND METHODS

Study Design

This study was conducted as a prospective comparative study.

Study Duration

The study was carried out over a period of 24 months.

Study Setting

The study was conducted at a tertiary care hospital, JSS Hospital, Mysore.

Study Population and Sample Size

A total of 52 patients presenting with burn wounds were included in the study. The participants were divided into two groups of 26 patients each.

The sample size was calculated using standard statistical formulae with a confidence level of 95% and power of 80%. Based on the calculation, 26 patients were required in each group, resulting in a total sample size of 52 patients.

Sampling Technique

Purposive sampling was used for participant selection, followed by allocation into two groups based on convenience.

Inclusion Criteria

- Patients of all age groups
- Either sex
- Superficial second-degree burns
- Presentation within 72 hours of injury
- Absence of signs of infection or inflammation

Exclusion Criteria

- Third-degree burns
- Patients with sensitivity to bovine, porcine, or avian products
- Wounds covered with dry eschar
- Delayed presentation (>72 hours)
- Perineal burns
- Electrical burns

Method of Data Collection

After obtaining ethical clearance and informed consent, patients fulfilling the inclusion criteria were enrolled in the study. For pediatric patients, consent was obtained from parents or guardians.

The total burn surface area (TBSA) was calculated using the Rule of Nines. Patients were then allocated into two groups:

- **Group 1 (Dry Collagen Group):** 26 patients received dry collagen dressing after thorough wound cleaning under anesthesia.
- **Group 2 (Wet Collagen Group):** 26 patients received wet collagen dressing following wound cleaning under anesthesia.

Method of application : under anaesthesia, burn wound was cleaned with normal saline and made dry. Dry wet collagen (according to the patient selection) was applied over the wound followed by one layer of cuticle, one layer of dry gauze and followed by application of pads and it was rolled using roller

All patients were monitored throughout their hospital stay, and relevant clinical parameters were recorded systematically.

OUTCOME MEASURES

The effectiveness of dry and wet collagen dressings was evaluated using the following parameters:

- **Wound healing:** Assessed by time taken for complete collagen separation from the wound (≤7 days, 7–14 days, 14–21 days)
- **Wound infection:** Evaluated based on clinical signs such as redness, swelling, warmth, and purulent discharge
- **Progression to full-thickness burns:** Monitored clinically during follow-up
- **Pain assessment:**

→ Visual Analogue Scale (VAS) for adults

→ FLACC scale for pediatric patients

- **Time to presentation and time to collagen application**
- **Duration of hospital stay**

PAIN ASSESSMENT TOOLS

Pain was assessed using standardized scales:

- **Visual Analogue Scale (VAS):** A 10-cm scale ranging from 0 (no pain) to 10 (worst imaginable pain), used for adult patients.
- **FLACC Scale (Face, Legs, Activity, Cry, Consolability):** A behavioral pain assessment tool used for pediatric patients, with scores ranging from 0 to 10.

Study Conduct

Patients meeting the inclusion criteria were enrolled after obtaining informed consent. Collagen dressings were applied according to group allocation. Post-treatment, patients were monitored for pain, infection, inflammation, and wound healing until discharge. All observations were recorded and compiled for analysis.

Data Analysis

Data were entered into a spreadsheet and analyzed using SPSS software (Version 29.0).

- Descriptive statistics included mean, standard deviation, frequency, and percentage.
- Inferential statistics included Chi-square test, independent t-test, paired t-test, and ANOVA where applicable.
- In case of non-normal distribution, appropriate non-parametric tests were used.

A p-value of <0.05 was considered statistically significant.

ETHICAL CONSIDERATIONS

Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was obtained from all participants or their guardians. No major ethical issues were encountered during the study.

Figure 1: Clinical application of wet collagen dressing over facial burn wounds.

Picture 1: Burns wound over the face after cleaning

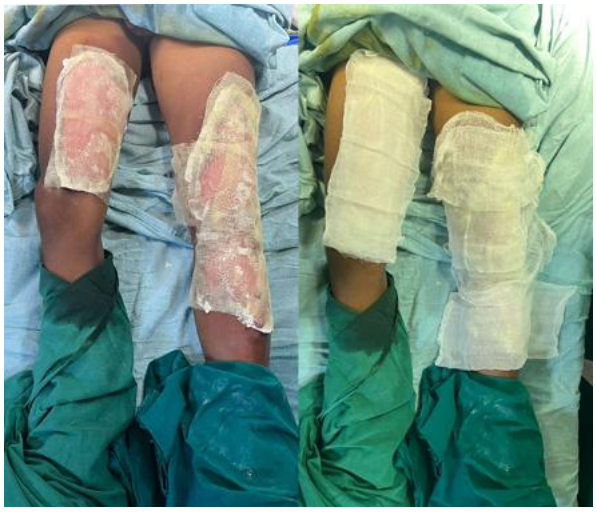
Picture 2: After application of wet collagen

Figure 1 demonstrates the stepwise management of superficial facial burn wounds using wet collagen dressing. The pre-application image shows erythematous superficial burn areas involving the cheeks, chin,

perioral region, and nasal area after thorough wound cleaning and removal of debris. Areas of partial epidermal loss with exposed viable dermis are visible, indicating superficial second-degree burns without evidence of deep necrosis.

Following wound bed preparation, wet collagen dressing was applied uniformly over the affected facial region. The collagen sheet appears well adherent to the wound surface, conforming closely to the facial contours and maintaining adequate wound coverage.

Figure 2: Clinical application of dry collagen dressing over lower limb burn wounds.



Picture 1: post application of dry collagen and cuticel over burn wound over both the thighs and left knee

Picture 2: next step of covering with dry gauze

Figure 2 demonstrates the application technique of dry collagen dressing in superficial burn wounds involving both thighs and the left knee region. The initial image shows dry collagen sheets combined with cuticel dressing placed directly over cleaned burn wound surfaces. The dressing adequately covers the raw erythematous areas and appears uniformly applied over the involved lower limb regions.

The subsequent image illustrates the secondary step of dressing reinforcement using sterile dry gauze coverage. This layered dressing technique helps secure the collagen sheet in position, protects the wound from mechanical trauma, and aids in absorption of wound exudate. The dry collagen dressing conforms well to the wound surface and provides a stable biological scaffold that facilitates epithelialization and tissue regeneration.

The figure also reflects the practical advantages of dry collagen dressing in larger extremity wounds, including ease of handling, effective wound coverage, and compatibility with secondary protective dressings. The maintained dressing integrity and complete wound coverage shown in the image support the clinical findings of faster collagen separation, reduced pain scores, and shorter hospital stay observed in the dry collagen group in the present study.

RESULTS

The present study included a total of 52 patients, equally divided into wet collagen and dry collagen groups (26 patients each). The overall demographic profile showed comparable baseline characteristics between the two groups, with no statistically significant differences in age distribution, gender distribution, degree of burn, total body surface area (TBSA), or cause of burn ($p > 0.05$). The mean age of patients was similar across groups, and both male and female participants were nearly equally represented.

The clinical profile of burn injuries was also comparable, with superficial burns forming the majority and hot water being the most common cause of injury in both groups. The distribution of burn sites showed some variation, with anterior trunk involvement being significantly higher in the dry collagen group.

However, the time interval between presentation and collagen application was similar in both groups.

Outcome measures demonstrated clear clinical advantages in the dry collagen group. The time for collagen separation was significantly shorter in the dry collagen group, indicating faster wound healing. Additionally, the incidence of wound infection and progression to full-thickness burns was lower in the dry collagen group, although these differences were not statistically significant.

Pain assessment revealed consistently lower pain scores in the dry collagen group across all time points (Day 1, Day 3, and Day 7), with statistically significant differences. Similar findings were observed using the FLACC scale in paediatric patients.

Furthermore, the duration of hospital stay was significantly shorter in the dry collagen group, with a higher proportion of patients discharged within 7 days. Overall, these findings suggest that dry collagen dressing is associated with faster healing, reduced pain, and shorter hospitalization compared to wet collagen dressing.

TABLE 1: AGE-WISE DISTRIBUTION OF PATIENTS IN WET AND DRY COLLAGEN GROUPS

Table 1 shows the age distribution of patients in both groups.

Age group (years)	Wet collagen group n (%)	Dry collagen group n (%)
<18	5 (19.23)	5 (19.23)
19–28	7 (26.92)	11 (42.31)
29–38	9 (34.62)	4 (15.38)
>38	5 (19.23)	6 (23.08)
Total	26	26
Mean ± SD	29.62 ± 12.12	27.54 ± 10.25
Total Mean ± SD	28.58 ± 11.18	
p-value	>0.05	

TABLE 2: GENDER DISTRIBUTION OF PATIENTS IN WET AND DRY COLLAGEN GROUPS

Table 2 shows the gender distribution in both groups.

Gender	Wet collagen group n (%)	Dry collagen group n (%)
Female	13 (50.00)	12 (46.15)
Male	13 (50.00)	14 (53.85)
Total	26	26

TABLE 3: DISTRIBUTION OF PATIENTS ACCORDING TO DEGREE OF BURN

Table 3 shows the distribution based on burn depth.

Degree of burn	Wet collagen group n (%)	Dry collagen group n (%)
Second degree	11 (42.31)	13 (50.00)
Total	26	26
p-value	>0.05	

TABLE 4: DISTRIBUTION OF PATIENTS ACCORDING TO PERCENTAGE OF TBSA

Table 4 shows burn surface area distribution.

TBSA (%)	Wet collagen group n (%)	Dry collagen group n (%)
<10%	8 (30.77)	9 (34.62)
11–20%	8 (30.77)	8 (30.77)
21–30%	3 (11.54)	6 (23.08)
31–40%	7 (26.92)	3 (11.54)
Total	26	26
p-value	>0.05	

TABLE 5: DISTRIBUTION OF PATIENTS ACCORDING TO CAUSE OF BURN

Cause of burn	Wet collagen group n (%)	Dry collagen group n (%)
Hot oil	3 (11.54)	4 (15.38)
Hot water	14 (53.85)	14 (53.85)
Soup	3 (11.54)	3 (11.54)
Tea	6 (23.08)	5 (19.23)
Total	26	26
p-value	>0.05	

TABLE 6: DISTRIBUTION OF PATIENTS ACCORDING TO SITE OF BURN

Site of burn	Wet n (%)	Dry n (%)	p-value
Head & neck	6 (23.08)	7 (26.92)	1

Arms	6 (23.08)	6 (23.08)	1
Forearms	12 (46.15)	7 (26.92)	0.249
Hand	7 (26.92)	4 (15.38)	0.499
Buttocks	6 (23.08)	6 (23.08)	1
Thighs	5 (19.23)	4 (15.38)	1
Legs	6 (23.08)	3 (11.54)	0.465
Anterior trunk	7 (26.92)	15 (57.69)	0.048
Posterior trunk	3 (11.54)	5 (19.23)	0.703

TABLE 7: TIME OF PRESENTATION AFTER BURN INJURY

Group	Mean ± SD (hours)	p-value
Wet	76.35 ± 31.99	<0.05
Dry	55.77 ± 17.94	

TABLE 8: TIME OF COLLAGEN APPLICATION

Group	Mean ± SD (hours)	p-value
Wet	81.12 ± 32.16	<0.05
Dry	60.62 ± 18.17	

TABLE 9: TIME DIFFERENCE BETWEEN PRESENTATION AND COLLAGEN APPLICATION

Time	Wet n (%)	Dry n (%)
4 hrs	6 (23.08)	4 (15.38)
5 hrs	20 (76.92)	22 (84.62)
p-value	>0.05	

TABLE 10: TIME FOR COLLAGEN SEPARATION

Time	Wet n (%)	Dry n (%)
≤7 days	8 (30.77)	15 (57.69)
7–14 days	12 (46.15)	8 (30.77)
14–21 days	6 (23.08)	3 (11.54)
p-value	<0.05	

TABLE 11: WOUND INFECTION

Outcome	Wet n (%)	Dry n (%)
Yes	4 (15.38)	2 (7.69)
No	22 (84.62)	24 (92.31)
p-value	>0.05	

TABLE 12: PROGRESSION TO FULL-THICKNESS BURN

Outcome	Wet n (%)	Dry n (%)
Yes	4 (15.38)	1 (3.85)
No	22 (84.62)	25 (96.15)
p-value	>0.05	

TABLE 13: DAY-WISE PAIN SCORES (VAS)

Day	Wet Mean ± SD	Dry Mean ± SD	p-value
Day 1	7.14 ± 1.08	6.38 ± 1.00	<0.05
Day 3	4.86 ± 1.32	3.19 ± 0.79	<0.001
Day 7	3.05 ± 1.05	1.90 ± 1.06	<0.01

TABLE 14: FLACC PAIN SCORES

Day	Wet Mean ± SD	Dry Mean ± SD	p-value
Day 1	6.8 ± 0.75	5.4 ± 0.49	<0.001
Day 3	4.2 ± 0.4	3.4 ± 0.49	<0.001
Day 7	2.6 ± 0.49	1.4 ± 0.49	<0.001

TABLE 15: DURATION OF HOSPITAL STAY

Duration	Wet n (%)	Dry n (%)
≤7 days	7 (26.92)	14 (53.85)
8–14 days	12 (46.15)	10 (38.46)
>14 days	7 (26.92)	2 (7.69)
Mean ± SD	11.15 ± 4.4	8.23 ± 3.48
p-value	<0.05	

Table 1 shows that the majority of patients were in the 29–38 years group in the wet collagen group (34.62%) and in the 19–28 years group in the dry collagen group (42.31%), with no significant difference ($p > 0.05$). Table 2 demonstrates an almost equal gender distribution in both groups. common in the wet group (57.69%), while the dry group had equal distribution of second-degree burns, with no statistical significance. Table 4 shows comparable TBSA distribution across groups, although higher TBSA (31–40%) was more frequent in the wet group (26.92%). Table 5 highlights hot water as the most common cause of burns in both groups (53.85%). Table 6 reveals significantly higher anterior trunk involvement in the dry collagen group (57.69%, p=0.048), while other sites were comparable. Table 7 and Table 8 show that patients in the dry collagen group presented earlier (55.77 hours) and received collagen application earlier (60.62 hours), both statistically significant ($p < 0.05$). Table 9 confirms no difference in treatment delay after presentation. Table 10 demonstrates faster collagen separation in the dry group, with 57.69% achieving ≤7 days compared to 30.77% in the wet group ($p < 0.05$), indicating faster healing. Table 11 and Table 12 show lower infection (7.69%) and progression to full-thickness burns (3.85%) in the dry group, though not statistically significant. Table 13 and Table 14 consistently show significantly lower pain scores in the dry collagen group across all days using both VAS and FLACC scales ($p < 0.05$ to < 0.001). Table 15 shows a shorter hospital stay in the dry group, with 53.85% discharged within ≤7 days compared to 26.92% in the wet group ($p < 0.05$), and a lower mean hospital stay (8.23 vs 11.15 days).

Overall, the compiled results clearly indicate superior clinical outcomes with dry collagen dressing in terms of faster healing, reduced pain, and shorter hospitalization.

DISCUSSION

The present prospective comparative study was conducted to evaluate and compare the clinical effectiveness of dry collagen and wet collagen dressings in the management of burn wounds. The findings of this study demonstrate that while both modalities are effective, dry collagen dressing shows superior outcomes in terms of wound healing, pain reduction, and duration of hospital stay [11].

Baseline characteristics including age distribution, gender, degree of burn, total body surface area (TBSA), and cause of burn were comparable between the two groups ($p > 0.05$), indicating that the study groups were well matched and suitable for comparison [12]. This comparability strengthens the internal validity of the study and ensures that the observed differences in outcomes are attributable to the intervention rather than confounding factors [13].

In the present study, the most common age group affected was 19–38 years, which is consistent with the active and working population being more exposed to burn injuries. Gender distribution was nearly equal in both groups, suggesting no gender predisposition in this cohort. The majority of burns were superficial in nature, aligning with the inclusion criteria of superficial second-degree burns [14,15].

Hot water emerged as the most common cause of burn injury in both groups, reflecting the predominance of scald injuries, which is in agreement with existing literature where domestic accidents, particularly involving hot liquids, are a leading cause of burns [16]. The anterior trunk was the most commonly involved site in the dry collagen group, with a statistically significant difference compared to the wet collagen group, although this variation is unlikely to have significantly influenced overall outcomes [17].

Early intervention is known to play a crucial role in burn wound management, potentially contributing to improved outcomes observed in this group [18].

Wound healing, as assessed by time for collagen separation, was significantly faster in the dry collagen group. A higher proportion of patients in this group achieved collagen separation within ≤7 days compared to the wet collagen group. This finding indicates more rapid epithelialization and tissue regeneration with dry collagen. The dehydrated nature of dry collagen may allow better absorption of wound exudate and closer adherence to the wound bed, thereby creating an optimal environment for healing [19].

The incidence of wound infection was lower in the dry collagen group compared to the wet collagen group, although the difference was not statistically significant. Similarly, progression to full-thickness burns was less frequent in the dry collagen group. These findings suggest a potential protective effect of dry collagen, possibly due to better barrier function and reduced moisture accumulation that may limit bacterial proliferation [20].

Pain assessment revealed significantly lower pain scores in the dry collagen group at all measured time points using both VAS and FLACC scales. Reduced pain may be attributed to fewer dressing changes, better wound coverage, and reduced exposure of nerve endings. This has important clinical implications, particularly in improving patient comfort and compliance with treatment.

Another key finding was the significantly shorter duration of hospital stay in the dry collagen group. A greater proportion of patients were

discharged within 7 days, and the mean hospital stay was notably lower compared to the wet collagen group. Shorter hospitalization not only reflects faster recovery but also reduces healthcare costs and resource utilization.

These findings are consistent with previous studies that have demonstrated the advantages of collagen dressings in burn management, including enhanced wound healing, reduced pain, and decreased hospital stay. However, direct comparisons between dry and wet collagen are limited in the literature, making this study a valuable contribution to evidence-based clinical practice.

Overall, the results of this study indicate that dry collagen dressing is more effective than wet collagen dressing in managing superficial burn wounds. Its advantages in promoting faster healing, reducing pain, and shortening hospital stay make it a preferable option in clinical settings.

LIMITATIONS

Despite the significant findings, certain limitations must be acknowledged. The sample size was relatively small, which may limit the generalizability of the results. The study was conducted at a single center, which may introduce institutional bias. Additionally, long-term outcomes such as scar quality and functional recovery were not assessed. Future studies with larger sample sizes, multicentric design, and long-term follow-up are recommended to validate these findings further.

CONCLUSION

Dry collagen dressing is a safe and effective modality for the management of superficial burn wounds. Compared to wet collagen, it offers significant advantages in terms of faster wound healing, reduced pain, and shorter duration of hospital stay, with a trend toward lower complication rates. These findings support the use of dry collagen as a preferred dressing option in clinical practice for burn wound management.

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