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''A COMPARATIVE STUDY BETWEEN COLLAGEN DRESSING AND AMORPHOUS HYDROGEL WITH COLLOIDAL SILVER DRESSING IN PARTIAL THICKNESS BURN''

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ABSTRACT

Introduction: Burn injury is one of the major global health problem. In many developed nations, burn incidence and death rates have been decreasing. Advances in the management of burn patients have contributed to significant improvements in morbidity and mortality over the last decade. However, the rate of child deaths from burns is still over 7 times in developing nations. This study was undertaken to compare the wound healing time, pain, complications and cost-effectiveness in partial thickness burns between collagen and amorphous hydrogel with colloidal silver dressings.

Materials and Methods: This was a prospective observational study over a period of one-year, conducted on 60 patients with partial thickness burn between 12 to 60 years of age. Patients were alternatively selected into two groups. One of which was treated with collagen dressings and the other was treated with amorphous hydrogel with colloidal silver dressing.

Results: Most of the patients were female (75%) and majority of patients (40 %) were in 21-30 years age group. Majority of the patients with collagen dressing needed only single dressing. Time taken for complete wound healing was 15.57 ± 6.79 Days in collagen dressing group, with rate of wound infection 16.7%, and mean cost of 4053.33 ± 2167.90 which was much lesser than the other group.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Conclusion: In this study, collagen dressing was found superior to amorphous hydrogel with colloidal silver dressing in partial thickness burn in terms of rate of wound healing, infection rate, pain and cost effectiveness.

Keywords: Burn, Partial thickness burn, Collagen dressing, Amorphous hydrogel with colloidal silver dressings

INTRODUCTION:

The WHO defines burn as an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals. Skin injuries due to ultraviolet radiation, radioactivity, electricity or chemicals, as well as respiratory damage resulting from smoke inhalation, are also considered to be burns.[1]

Burn profile closely follows the socioeconomic status of a country.[2] Developed nations with proper prevention policy, organized dwelling and safe kitchen technology and fuel have brought down burn incidence drastically. However, in developing nations, burn continues to be an endemic burden because of massive slum dwelling and large scale use of unsafe stoves and fuel.[3]

In India alone 60-70 lakhs people sustain burn injury annually, with mortality 1.4lakhs/year and an additional 2.4 lakh patients end up with severe deformities. Around 70% of all burn injuries occur in the age group of 15-40 years, the most productive age group.[4,5]

The common causes of burn injuries are thermal burns, scalding, electric or direct contact with hot surfaces3 that may be due to accidental, homicidal or suicidal. .

In India, accidental cases are most common, which may be during household works, principally cooking. Among homicidal burn, social conflict tops the list. In India, dowry deaths still poses a serious threat to our society and holds a ranks second among the causes of homicidal burns. Household quarrel is the most prevalent cause of suicidal burns followed by due to failure in examination or mental depression due to indebtness.[6]

Females have slightly higher rates of death from burns compared to males according to the

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

most recent data. The higher risk for females is associated with open fire cooking, or use of unsafecookstoves, which can ignite loose clothing. Along with adult women, children are particularly vulnerable to burns. Burns are the fifth most common cause of non-fatal childhood injuries.

The problems associated with burns management, treatment and healing have always been the main challenge. Therefore, problems of wound healing should be considered seriously in the management of burned patients and in the development and use of new wound repair materials.[3]

The ideal management of a burn is an economical, easy to apply, readily available dressings or method of coverage that will provide good pain relief, protect the wound from infection, promote healing, prevent heat and fluid loss, be elastic and non-antigenic and adhere well to the wound and waiting for spontaneous epithelization of superficial partial thickness burns.[7] During the last decade, various new dressing materials developed, however, only few of them fulfils the criteria for an ideal dressing material. Also most of them does not have antibacterial activities. Biological dressings like collagen on the other hand, create the most physiological interface between the wound surface and environment, and are impermeable to bacteria.[8] Collagen dressings have other advantages over conventional dressings in terms of ease of application and being natural, non-immunogenic, non-pyrogenic, hypo-allergenic, and pain-free.[9,10]

OBJECTIVE: To compare the wound healing time, pain, complications and cost-effectiveness in partial thickness burns between collagen and amorphous hydrogel with colloidal silver dressings.

METHODS:

After getting the ethical approval of the project, consent and agreement were obtained from all the patients. A total of 60 patients admitted in the Burn unit of Department of Surgery, Fakhruddin Ali Ahmed Medical College & Hospital between 1st September 2020 to 30th August 2021 and meeting the inclusion and exclusion criteria were included in this study.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

All patients were assessed clinically as to-

- % body surface area involvement – using Rule of Nine chart
- The degree of burns
- Mode of treatment – collagen dressings or amorphous hydrogel with colloidal silverdressing method

Inclusion criteria:

a. Patients with partial thickness burns irrespective of gender difference, of age

>12years and < 60 years

b. Burns with <60% TBSA (Total body surface area) and

c. Burn not older than 48hrs

Exclusion Criteria:

a. Patients with full thickness burn.

b. Patients with electrical or other non-thermal burn.

c. Patients with co-morbidities that could grossly affect the wound healing like

uncontrolled diabetes mellitus, chronic liver or renal disease, or major

nutritional deprivation.

d. Patient died in between the study.

Patients were alternatively selected into Group A and B.

Group A: Patients treated with collagen dressings.

Group B: Patients treated with amorphous hydrogel with colloidal silver dressing.

The data were collected in prescribed Proforma.

The patients were followed up on a daily basis in both groups until complete epithelization

occurs.

Materials used

1. Collagen sheets

2. Amorphous Hydrogel with Colloidal Silver Gel

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

3. Dressings with sterile cotton pads and roller gauze.

RESULTS:

Out of 60 patients 15 (25%) were male and 45 (75%) were female with a mean age of 33.2 ± 10.35 years in Group A and 34.8±9.79 years in Group B. Majority of patients (40 %) were in 21-30 years age group, out of which 43.3 % were included in Group A and 36.7 % were included in Group B. In this study, majority of the patients (45%) had≤20% BSA of burns.

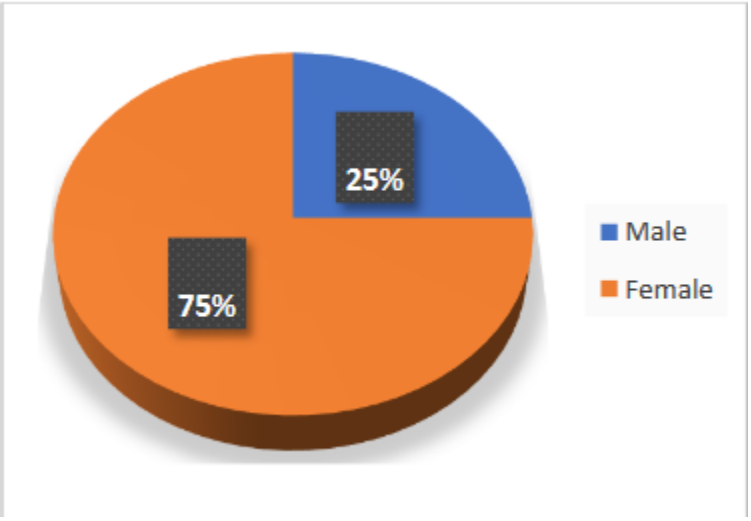

Figure 1: Pie diagram showing sex distribution of patients

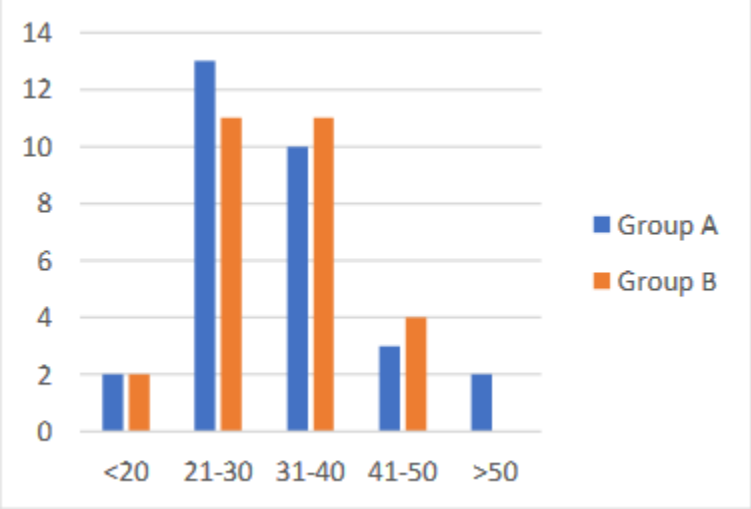

Figure 2: Distribution of patients in different age group

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Comparison of number of dressings: Majority of the patients (24) in Group A required only one dressing, while 6 patients required multiple dressings due to wound infection. In Group B, each patients required multiple number of dressings till complete epithelization, where maximum number of patients required more than 15 dressings.

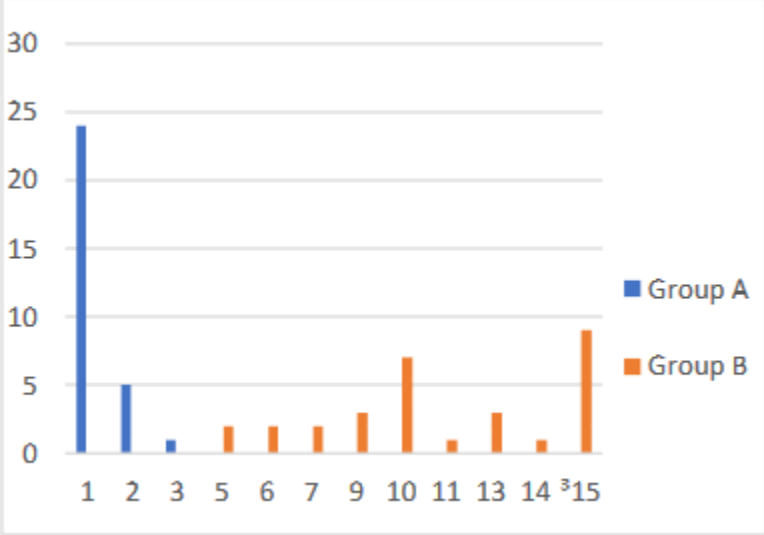

Figure 3: Comparison of number of dressings

Pain assessment on Day 1: After application of dressing on day 1, 63.3% of patients had pain score less than 5 in Group A, whereas in Group B, 36.7% of patients had pain less than 5. This comparison showed a significant difference with p value 0.007.

	N	Mean	Variance	T value	df	P- value
Group A	30	5.2	1.3	-2.788	56	0.007
Group B	30	5.9	0.9			

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

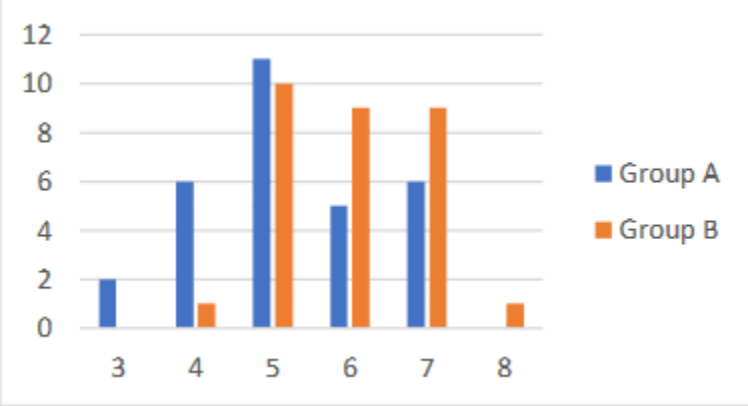

Figure 4: Pain assessment on Day 1

Pain assessment on Day 3: On day 3, in Group A, 93.3% of patients had pain score less than 5, whereas, in Group B, 76.7 % of patients had pain less than 5, which was significant statistically with p value 0.0004.

	N	Mean	Variance	T value	df	P- value
Group A	30	3.4	1.3	-3.705	54	0.0004
Group B	30	4.7	2.2			

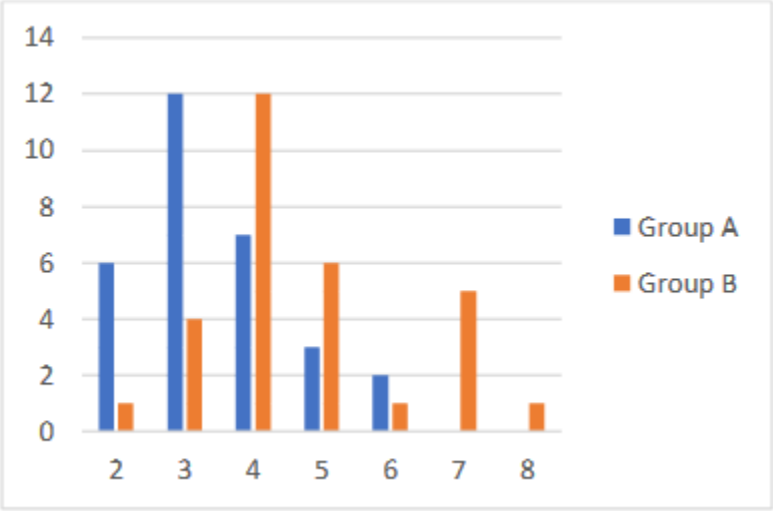

Figure 5: Pain assessment on Day 3

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Pain assessment on Day 7: 100% of the patients had score less than 5 in Group A, whereas in Group B, 96.7% had pain score less than 5 with p value 0.0002.

	N	Mean	Variance	T value	df	P- value
Group A	30	2	0.8	-3.91	55	0.0002
Group B	30	3.1	1.3			

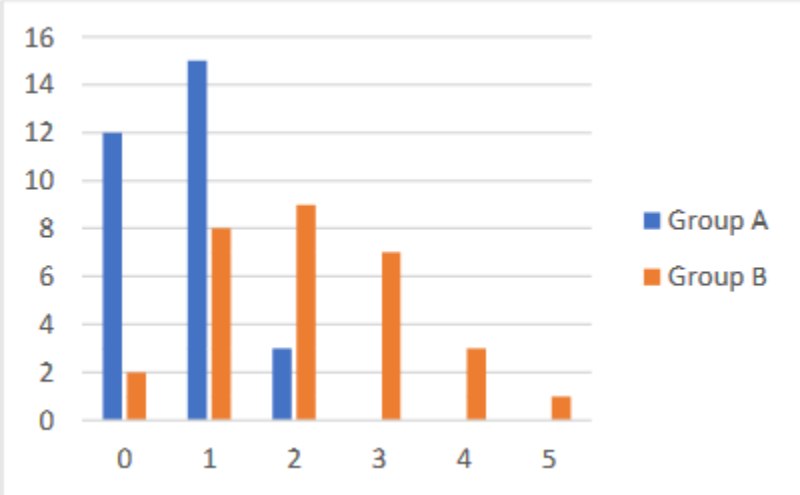

Figure 6: Pain assessment on Day 7

Pain assessment on Day 14: Comparison of pain in both the groups on day 14 showed a significant difference with p value 0.0003, where 100% of patients in Group A had pain score < 3.

	N	Mean	Variance	T value	df	P- value
Group A	30	1	0.8	-3.80	53	0.0003
Group B	30	2.1	1.7			

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

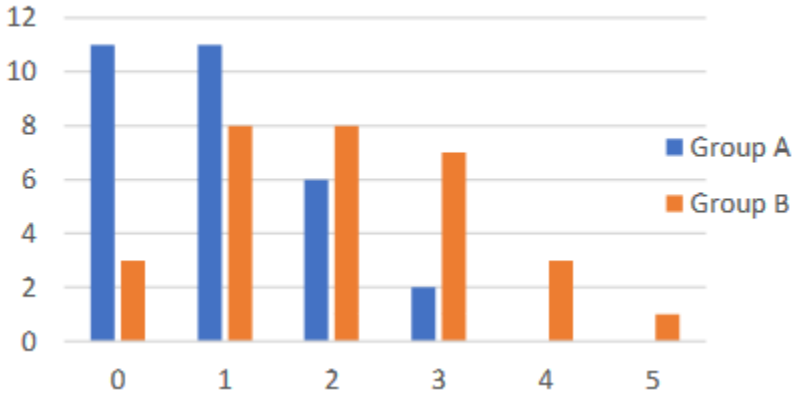

Figure 7: Pain assessment on Day 14

Time taken for complete wound healing: The Mean time taken for complete wound healing was 23.27 ± 8.74 days in Group B, whereas it was much lesser in Group A (15.57 ± 6.79 Days), with a significant difference of p value of 0.0004.

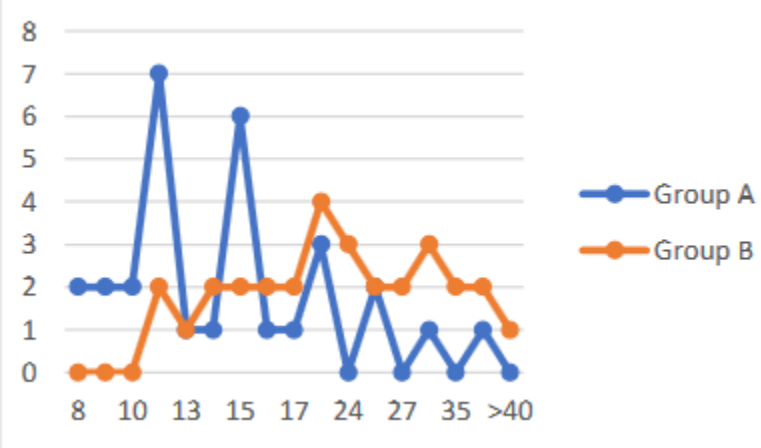

Figure 8: Time taken for complete wound healing

Comparison of rate of wound infection: Infection rate was much lower in Group A (16.7%) than Group B (40%). However there was no statistical significance.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

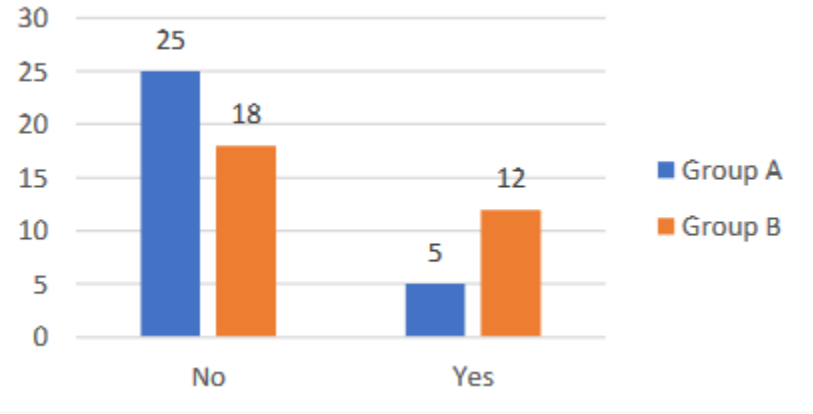

Figure 9: Comparison of rate of wound infection

Cost analysis:

The mean cost of collagen dressing was found less compared to the amorphous hydrogel with colloidal silver dressing. However, the result was not statistically significant (p-value >0.05).

	Mean Cost (Rupees)	T- value	P- Value
Group A	4053.33 ± 2167.90	-1.834	0.072
Group B	4999.33 ± 1782.47		

DISCUSSION:

The effective topical management of a burn wound is important to reduce the risk of infection and hence to improve the survival of the patient. Over the past decades, there has been a paradigm shift from the conventional silver dressing with a multitude of dressing materials available. However, a gold standard for use in partial- thickness burns is yet to be identified.[11] With the advancement of nanotechnology, Silver nanoparticles (AgNPs) were introduced as a novel dressing material. Later, studies reported higher synergistic activity of AgNPs when combined with hydrogel. AgNPs in combination with hydrogel made of

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

polyacrylamide/polyvinyl alcohol/-chitin reported higher bactericidal activity against E. coli, and S. aureus when compared to AgNPs alone.[12] Cell attachment studies using vero (epithelial) cells showed better adherence of the cells on the scaffolds made of AgNPs- hydrogel. [13]

Collagen sheet is noninflammatory, non-toxic, has low antigenicity, facilitates migration of fibroblasts and microvascular cells, and helps the synthesis of neo-dermal collagen matrices, thus minimizing scarring. It is elastic, soft and flexible, has good tear strength, impermeable to bacterial migration, modulates fluid flux from the wound, and has enough strength to be peeled off from the wound.[1]

The use of collagen dressing has been found to inhibit the action of metalloproteinase, an enzyme that increases proteolytic activity and inactivation of the growth factors involved in the wound-healing process.[14]

Collagen facilitates the migration of fibroblasts into the wound and enhances the metabolic activity of the granulation tissue.[2,3] Moreover, it also has hemostatic property forming hemostatic plug by interacting with platelets.[4]

In this study, the efficacy of collagen dressing was compared with amorphous hydrogel-colloidal silver dressing in terms of pain score, wound healing time, infection rate, and resultant scar, in a total of 60 patients with <60% BSA of burn, between 12-60 years of age group.

The mean healing time in Group A was found significantly less (15.6 6.79 days) compared to Group B (23.3 8.74 days) with a P- value of 0.0004 in patients <60% BSA of burn. This may be attributed to inhibition of the enzyme metalloproteinase by collagen. The study by **Harish Rao et al** (2012), reported a mean Healing time of 4.02 ± 0.59 days in collagen dressing, whereas 7.6 ±1.38 days in patients with silver sulfadiazine dressing in patients with foot ulcer, which was statistically significant with a p-value <0.0001.15 **A.Mohan Kumar et al** in 2018, reported mean time taken for healing 11.62 ± 3.58 days in patients with <40% of the total body surface area burn, who received collagen dressing.[16]

In this study, the infection rate was much lower in Group A (16.7%) than in Group B (40%). However, it was not statistically significant. A similar result was observed by **Ghule p. prasad et al** with less incidence of infection (14.3%) in the collagen group compared to (40%) silver sulfadiazine dressing.[17]

The common organisms isolated by culture sensitivity from infected burn wounds in this study

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

were Pseudomonas species (41.67%), Staphylococcus aureus (25%), and Klebsiella (16.67%). Among all these organisms Pseudomonas species was the most frequent organism isolated in both Groups. A similar result was reported by **P Prasad Ghule et al**, **Pune Patil P et al**, and **MeghaPriyadarshini et al**.[17,18,1] However, **S Rao et al** reported in their study that, the commonest bacteria involved in burn wound was Staphylococcus aureus, followed by Klebsiella species, Pseudomonas aeruginosa and others.[19]

80% of the patients in Group A had good scars in comparison to 66.7% in Group A. This result was also in accordance to **A. Mohan Kumar et al** who reported 100% of patients in collagen dressing with good scars.[20]

LIMITATIONS OF THE STUDY:

- The confounding factors affecting the healing rates could not be avoided in this study, as the two types of dressing methods were not used in the same patient.
- The small size of the sample.

Further studies are needed with accurately designed randomized control trials having a large number of patients, to corroborate the results of this study.

CONCLUSION:

The response to a burn injury is very complex, and so is the approach to its care. Burn wound management is a real challenging task for surgeons. Although we have passed important milestones in terms of survival following a burn injury, burn care needs to change over the next decades. New technologies need to be adopted to further improve burn outcomes.

The incidence of burn injury and it's wound management still possess a burden to health care system. During the last decades, various new dressing materials were developed for use in burn wound management, however, only a few of them fulfils the criteria for an ideal dressing material.

In this study, collagen dressing was found superior to amorphous hydrogel with colloidal silver dressing in partial thickness burn injury in terms of wound healing, infection rate, pain and cost effectiveness. As the resultant scar was better in majority of the patients using collagen, the

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

morbidity of the patients was also reduced to some extent.

Thus, it can be concluded that, collagen dressing may serve as an ideal dressing material in patients with partial thickness burns.

Author contribution

All authors have equal contribution.

Conflict of interest

The authors have no conflict of interest to declare.

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956

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