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THE EFFICACY OF COLLAGEN DRESSINGS IN THE MANAGEMENT OF PARTIAL THICKNESS BURNS

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Abstract

Background: Partial thickness burns are a prevalent form of burn injury that can be difficult to manage, typically necessitating regular dressing changes and leading to discomfort and scarring. The potential of collagen dressings as a treatment option has been suggested due to their capacity to enhance wound healing and mitigate inflammation. **Materials and Methods:** The retrospective study was conducted at the Department of General Surgery for three years in patients with fresh partial-thickness burns. Patients with a second degree partial burn were included in the study. Demographic details such as age, gender, history, and the subjective pain score after applying the dressing. Patients were assessed based on the number of dressings, texture, the contour of the scar, presentation timing, degree, and complications. **Results:** The study reports a male predominance (65%) for partial thickness burns, most prevalent in the age group of 21-30 (36.7%). Second-degree burns were most prevalent (56.7%), with <10% of affected surface area in 12 patients, 19 patients with 11-20% area, and 17 were affected with 31-40% of the affected area. Multiple dressing changes were required in 18.3% of patients, whereas 65% required normal dressing changes. The flushed scar was prevalent in 58.3% of the patients, and the mean pain score was 2.98 ± 1.24, with a mean duration stay of 14.11 ± 5.61 days. **Conclusions:** The use of collagen dressing has proven to be beneficial in patients with partial thickness burns, with better pain relief and reduced morbidity.

INTRODUCTION

Burns are a major morbid health issue affecting children and adults. The epidermal skin layer and the superficial layer of the dermis are both impacted by superficial burns. Damage to the deeper dermal tissues and structures like blood vessels and nerves may result from deep or full-thickness burns.[1] The most common causes of burn injuries are thermal burns, scalding, or direct contact with warm surfaces. Children frequently sustain burn injuries because their thinner skin can only withstand a certain amount of heat before being fully damaged.[2] To limit infection and promote healing with pleasing cosmetic outcomes, burn injury therapy is the goal. A wide range of wound care solutions are offered to meet these objectives.[3] Small-area burns are the most common type of burn suffered by children; hot spills cause 80% of burns in children under 5 years old.[4] One of the main problems with caring for burns is a bacterial infection that slows healing, increases discomfort, and raises the possibility of scarring.[5] Annually, 250,000 kids under 18 have severe burns that need medical treatment.[6]

Achieving physiological closure as quickly as possible is the ultimate objective in treating burn wounds. Cleaning, debridement, and maintaining a moist environment are all components of traditional burn wound treatment. To maintain a moist environment, operate as a bacterial barrier, and serve as a medium for the free movement of gases, an optimal dressing material must also provide a barrier against harmful pollutants.[7] Inflammatory mediators are released from burn wounds in large numbers in the wound and surrounding tissues. They frequently help restrict and prolong blood vesicles, considerably increasing capillary penetration and edema. Both damaged, and unburned skin develops widespread edema due to the changes in starling forces brought on by burns.[5] Collagen is the most important fibrous protein in extracellular connective tissue. The most prevalent and versatile protein in the animal world is collagen. Collagen makes approximately 25% of the total protein in the human body, and between 70 and 80 percent of that protein is found in the skin.[8]

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Data from low-quality, small trials show that silicon-coated nylon, silver-containing dressings, and biosynthetic dressings cure superficial and partial thickness burns faster than silver sulphadiazine cream. Burns treated with hydrogel dressings healed more quickly than those treated with standard treatment. To limit infection and promote healing with pleasing cosmetic outcomes, burn injury therapy is the goal. Presently, many different wound care solutions are available to help achieve these objectives.[3] Making the best treatment choice requires an accurate estimate of burn depth. Most substantial burns have a combination of depths, and burn depth can alter and deepen after the original injury.[9] Given its distinct structural and functional properties, creating collagen dressings makes perfect sense. The most prevalent and ubiquitous proteins in vertebrates are collagens. The collagens are a necessary foundation for cellular attachment and migration and mechanical support for the connective tissue.[7] The many types of dressings available can be classified according to the ingredients used in their production. Films, foams, composites, sprays, and gels are examples of subcategories.[3]

The most popular dressing material for treating partial-thickness burns is a mix of paraffin-impregnated gauze and an absorbent cotton wool layer.[10] Silver sulphadiazine cream may potentially slow wound healing due to a toxic impact on regenerated keratinocytes.[3] On the other hand, biological dressings like collagen provide a physiological contact between a wound surface and the environment and are resistant to germs.[5] Collagen promotes cellular development, is hemostatic, and has a low antigenicity. Collagen has been recognized for its role in the recovery of burn wounds for a very long time. Collagen may affect healing at the ultimate stage and in the very early stage of healing, as wound healing and regeneration entail cell proliferation, migration, cell differentiation, and interaction between the various components.[11] There are two basic techniques for preparing collagen for use as a biomaterial. One strategy involves treating biological structures in some way to eliminate non-collagenous elements and strengthen the remaining collagen while preserving the current structure and intermolecular cross-links. The collagen is solubilized in the second step, and attempts are made to rebuild and depolymerize the substance in the appropriate shape.[12]

Synthetic skin replacements are costly and may not be accessible in all burn clinics. Collagen sheets are widely accessible, less expensive, and may be utilized even in places without burn units, and they can be monitored by local healthcare personnel. Collagen sheets are made from cow tissues, primarily type l and ll collagen. They are packaged in a neutral glass vial containing a sterile preservative combination of isopropyl alcohol and water sterilized with ethylene oxide.[13] An ideal strategy for treating partial-thickness wounds in children would provide optimal wound protection and healing circumstances while minimizing the child's suffering. In the adult population, many collagen-based products, including Biobrane, Integra, and beta-glucan collagen matrix, have been created and utilized well in wound treatment (BGC).[14] India, newly released collagen-based dressings for acute burn wound treatment are widely used.[1] Collagen dressings may create an ideal habitat for bacterial colonization, resulting in exudation and delayed wound healing. In 19% of partial-thickness burn wounds, collagen dressing becomes infected, necessitating removal and redressing. This infection may cause scarring by increasing the production of inflammatory mediators such as prostaglandins and tumor necrosis factor-alpha at the site of infection. This infection causes wound dehiscence, low oxygen tension, and the breakdown of the existing cellular matrix.[15] This study aimed to look at the effects of collagen dressing on patients with partial-thickness burns.

MATERIALS AND METHODS

A retrospective study was conducted in the department of General Surgery on patients with fresh partial-thickness burns at a multispecialty hospital, for three years, from January 2020-2022.

Inclusion Criteria

All patients with partial burns of a partial burn of (second degree), in both male and female patients, < 40% of the body's surface area, not <24 h of wounds were charred were included.

Exclusion Criteria

Patients with full-thickness burns and any patient who had signs of wound infection or had previously received treatment at another center had a significant co-morbidity such as diabetes mellitus, hypertension, chronic renal disease, immunocompromised status, and so on, were excluded from the study. Individuals with a history of inhalation, electrical contact, or chemical burns were also excluded from participating.

Under strict aseptic conditions, the afflicted region was carefully cleaned to remove any external contamination. Before application, collagen sheets were thoroughly cleaned with normal saline to remove any lingering residues of preservation fluid. The sheet size will depend on the extent of the burn injury. It was taken care not to overstretch the sheets. All air bubbles between the wound and the collagen sheet were expelled using the forceps' back. Collagen sheet drying was verified to be adequate. A dressing was administered to prevent sheet displacements in younger children. Depending on the proportion of the body surface area affected, patients were treated with antibiotics, analgesics, and intravenous fluids. If provided, the dressing was replaced after 48 hours.

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Findings were based on the patient's self-reported subjective pain score, which is based on the pain score. The scale is represented graphically as 0–10, and the pain score is obtained 24 hours after dressing application. 0 denotes no discomfort, and 10 indicates the most agony the patient can tolerate. Once burn wounds were healed, patients were routinely followed up for clinical outcomes. Data were gathered and examined during the research period on the patient's age and sex, kind of burns, number of dressings, texture and contour of scar, the timing of presentation, degree and percentage of burns, and complications. Mean ± SD was used to represent data in tables and figures.

RESULTS

Out of the total 60 patients included in the study, 39 (65.0%) were found to be male patients, and 21 (35.0%) were female. The mean age in the current study was recorded to be between 21-30 years (36.7%) which was followed by <20 years (31.7%). 10 (16.7%) patients were 31 to 40 years of age, 7 (11.7%) were 41-50 years of age, and 2 (3.3%) were in the age group of >51 years. Out of the 60 patients majority of the patients were found with the second degree of burns in 34 (56.7%), and second-degree burns were seen in 26 (43.3%) patients. 12 patients had <10% of affected surface area, 19 (31.7%) had affected areas of 11-20%. 21-30% of affected areas were seen in 12 (20.0%), and 17 were affected by 31-40% of affected areas [Table 1].

Table 1: Table 1: Demographic details, distribution of degree of burn, and % of TBSA

		Frequency	Percentage
Age group	<20	19	31.7%
	21-30	22	36.7%
	31-40	10	16.7%
	41-50	7	11.7%
	>51	2	3.3%
Gender	Male	39	65.0%
	Female	21	35.0%
Degree of Burn	Second	60	100%
% of TBSA	<10%	12	20.0%
	11-20%	19	31.7%
	21-30%	12	20.0%
	31-40%	17	28.3%

49 (81.7%) of the patients required dressing changes less than three times, while 11 (18.3%) required multiple dressing changes. 39 (65.0%) patients had normally seen in the current study. Most patients were seen with a flushed scar in 35 (58.3%), followed by indented seen in 19 (31.7%). 56 (93.3%) of the patients were recorded with good compliance. 88.3 % of the infections were recorded in the study. 6.7% were seen with poor compliance, and 7% of the patients did not report any infection [Table 2].

Table 2: Distribution of various parameters

		Frequency	Percentage
No. of dressing	<3	49	81.7%
	>3	11	18.3%
Texture of scar	Normal	39	65.0%
	Hard	7	11.7%
	Palpable	14	23.3%
Contour of scar	Indented	19	31.7%
	Flushed	35	58.3%
	Hypertrophic	6	10.0%
Compliance	Good	56	93.3%
	Poor	4	6.7%
Infection	Yes	53	88.3%
	No	7	11.7%

The mean pain score recorded in the study was 2.98 ± 1.24. The mean duration stay was found to be 14.11±5.61 [Table 3].

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Table 3: Pain score and duration of stay

	Mean	SD
Pain score (VAS)	2.98	1.24

DISCUSSION

The primary cause of morbidity and death in children is burn-related injuries. 17–25% of all burn hospitalizations in India are for pediatric burns. Almost 90% of burn injuries are the result of home mishaps. Scald burns are more frequent in children under three years old. Due to overcrowding, dangerous cooking practices, and a lack of adult supervision for the kids, accidental burns are frequent in low socioeconomic level households. The majority of scald burns happen when kids unintentionally pull hot-liquid-carrying objects. Flame burns or firework injuries are more frequent in older kids.[16] The ultimate objective in treating burn wounds is to achieve full healing in the shortest time possible and to return the skin's texture and color to a state close to normal over the long term. Finding the best strategy for the proper patient might be difficult these days due to the introduction of many therapy and dressing methods. An optimal dressing material must preserve moisture, serve as a barrier against germs and other harmful substances, and allow for the free circulation of gases.[1] Partial-thickness wounds can be treated using a variety of techniques. Up until the development of artificial skin substitutes and contemporary topical agents, the gold standard of care consisted of thorough cleansing, wound debridement, and application of antimicrobial agents like mafenide acetate (Sulfamylon; UDL Laboratories), 1% silver sulfadiazine (Silvadene; Monarch Pharmaceuticals, Bristol, TN), or bacitracin.[17]

The creation and manufacture of biological dressings are the outcomes of research and development in wound dressing. Human amnion was often utilized until 1990 as a temporary biological cover for shallow and profound partial-thickness burns, promoting rapid healing and epithelialization.[18] Collagen-based dressings for burn wounds have evolved due to ongoing research into effective functional biological dressings, and they have shown to be superior and more beneficial. Given its distinct structural and functional properties, creating collagen dressings makes perfect sense. They are produced mainly using animal skin and Achilles tendons from cows. Collagen has been recognized for its role in the recovery of burn wounds for a very long time.[1] The collagens give the connective tissue mechanical support and serve as a crucial substrate for cellular adhesion and migration. Collagen is therefore viewed as being crucial to the process of regeneration.[19] One finding in research that stood out was that analgesia was required far less often in individuals who had collagen dressings. This is explained by the collagen group's quicker recovery and fewer dressing changes.[1] This observation is by our study, which also showed less number of dressings required in the patients. About 11 (18.3%) patients needed dressing more than three times. 49 (81.7%) of the patients required dressing only once or twice. Most cases in the collagen group received just one dressing after applying collagen sheets, and with epithelialization, any remaining collagen is naturally eliminated. Due to the ability to manage patients at home, hospital stays were also reduced. Collagen dressing was chosen by the majority of pediatric patients' parents (81% of group A kids under ten years). Fewer clothing changes and a shorter length of stay in the hospital for this group could explain this.[1]

Second-degree burns, whether superficial or deep dermis, take 2-4 weeks to heal and are excruciatingly painful. If second-degree burns are not treated immediately and correctly, they may get infected and progress to third-degree burns, which are deep burns that cause contracture and scarring. A biological dressing may hasten to heal and lessen the occurrence of a hypertrophic scar by defending the wound.[20] According to a study, the main benefits of collagen dressing over paraffin gauze and SSD include its ease of application and removal, faster healing, and shorter hospital stays. 90% of the instances only required one application of the collagen sheet.[1] The mean age group in our study was found to be between 21-30 years. Another study showed a mean age of 42.28 years.[5]

A special protein with a triple helical shape, collagen is a biological clothing that contains about 1000 amino acids in each of its three helices. Type I collagen is the most prevalent kind of collagen in the skin.[21] In second-degree burns, collagen sheets are beneficial. It becomes less expensive, and clothing discomfort may be avoided. It has been discovered that collagen dressing inhibits metalloproteinases from doing their job. By organizing and depositing newly produced fibers and granulation tissue in the wound bed, collagen is a biomaterial that promotes wound healing by providing a favourable environment.[1] In our study, 39 (65.0%) patients experienced normal scarring, followed by palpable scars in 14 patients. A study showed all collagen-dressing patients had scars that were in good health. As a result, collagen aids in tissue remodeling and creates a scar that is more durable than others.[5] This observation was by Demling et al. patient compliance with the collagen dressing was high (93%).[22] Collagen dressing exhibited a higher level of observed conformance as a result. This result was consistent with the Gerding RL study.[23] Our study showed compliance in 56 (93.3%) of the patients.

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In 17% of cases, when patients arrived at our facility after 72 hours, infection was evident as redness on the incision and purulent discharge under the adherent membrane. In 73% of patients, there was no infection after healing. The wounds were fully healed after 15 days, and epithelialization with pigmentation was finished after six weeks.[7] in the current study, 53 patients were observed to have an infection. Another study showed 95.45% of all patients recovered completely free of infection. No cultures were performed since all of the patients' wounds had fully recovered after 15 days and showed no symptoms of systemic sepsis.[1] 8% of the patients in a sample had an infection, indicating a decreased incidence of collagen dressing infection. Collagen was shown to be safe in all cases of the lack of any adverse effects.[5]

According to research by Singh et al., using collagen dressings speeds up the healing of various wounds, lessens the risk of scar contracture, and eliminates the necessity for skin transplantation.[24] Reconstituted collagen membranes are superior to amniotic or serosal membranes because they are easier to obtain in various sizes, remove easily, and are stable at room temperature for three years. In time, it will allow for the incorporation of drugs and growth factors that can be delivered in a controlled manner.[7] The epithelium needs a layer of collagen to act as the substrate. It develops, organizes, and aids in the orderly formation of the epithelium. Denuded regions cannot sufficiently support this, resulting in significant scarring and even keloids. Skinny nerves are shielded from injury by an intact epithelium; without it, the nerves are painfully exposed. Untended wounds are more likely to become infected and cause further health issues.[5] Collagen sheet covers were employed in 32 cases of recent burns and 26 cases of postburn contractures in research by Gupta et al. It protects against external infection, stops exudation from the raw regions, and promotes quick healing and epithelialization.[25]

In this study, partial thickness burns treated with collagen dressings had favourable outcomes regarding quick healing and reduced discomfort. The use of collagen had no adverse effects.

CONCLUSION

Collagen dressing has proven highly advantageous for burn patients, especially for small areas of superficial partial-thickness burns in all age groups. Patients with collagen dressing had better pain relief, so less analgesia was required. The scar that results in most collagen patients is reinforced, reducing the patient's morbidity. Since collagen is simple to apply and has strong membrane tolerance, it may be utilized as a temporary biological dressing during a partial thickness burn. Most of the time, no dressing changes were required before the wound healed completely. While traditional dressings tend to stick to the wound surface, the wound healing rate is faster, and scar quality is better. Reconstituted collagen membrane has shown to be quite beneficial for burn victims in underdeveloped nations. It is widely utilized in India due to its excellent capacity to adapt to hot and humid situations and its low cost.

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