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Original Research Article

Role of Early Excision and Grafting in Reducing Infection and Mortality in Burn Injuries

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Abstract:

Background: In impoverished countries, thermal burns continue to pose a serious threat to public health because they are often linked to severe morbidity and high death rates, which are mostly caused by burn wound infection. Longer hospital stays, higher metabolic demands, and an expanded window for invasive bacterial colonization are common outcomes of the conventional conservative care approach, which depends on the eschar's natural separation before grafting. In the treatment of deep partial-thickness and full-thickness burns, this study assesses the clinical effectiveness and safety of Early Excision and Grafting (EE&G) in comparison to the traditional delayed grafting method.

Methods: A prospective, randomized comparative study was carried out in the Department of Burns and Plastic Surgery in a government tertiary care hospital in India over a 18-month period (July 2024–December 2025). One hundred patients with 20–50% Total Body Surface Area (TBSA) thermal burns were included in the study. Patients were divided into two groups at random: Group A (n = 50) got split-thickness skin grafting and tangential excision within five days of the injury, while Group B (n = 50) received conservative dressing care until spontaneous eschar separation occurred (post-21 days), at which point grafting was performed.

Results: In comparison to Group B (64%, $p<0.05$), the study showed a statistically significant decrease in wound infection rates in Group A (22%). As a result, compared to the delayed group (24%), sepsis-related mortality was much lower in the early excision group (8%). In the early excision group, the mean length of hospital stay (LOS) was 26.3 days, compared to 42.5 days in the delayed group. The overall decrease in antibiotic use and critical care days indicates a favorable benefit-risk profile, even though the early excision group needed larger initial blood transfusion volumes.

Conclusion: In cases of severe burn injuries, early excision and grafting successfully eliminate the septic reservoir, improving survival rates and lowering hospital stays. In the Indian tertiary care context, blood products are a better therapeutic option than conservative therapy, notwithstanding the logistical challenges.

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Introduction

As one of the most serious types of trauma a human body may experience, burn injuries pose a serious threat to global health. The World Health Organization estimates that burns cause 180,000 deaths each year, with low- and middle-income nations accounting for the great majority of these deaths [1]. The epidemiology of burns in India is unique and concerning; it is frequently marked by industrial accidents, residential incidents involving kerosene stoves, and socioeconomic obstacles that impede access to high-quality care. Although the Parkland formula and other initial resuscitation methods have greatly decreased early mortality from hypovolemic shock, infection is nearly always the cause of late mortality in burn patients. Burn wound sepsis, which is made worse by the eschar, is the main offender [2].

Pathophysiology of Burn Wound Sepsis: The body's main physical and immunological defense against microbes is destroyed when a severe heat injury compromises the integrity of the skin. The ensuing eschar is an avascular necrotic substrate rich in proteins that is perfect for bacterial colonization. Systemic antibiotics and host immune cells are unable to effectively enter the eschar to stop

bacterial growth because it is avascular. The risk of invasive infection increases dramatically when the bacterial load surpasses 10^5 organisms per gram of tissue, which frequently results in bacteremia, Systemic Inflammatory Response Syndrome (SIRS), and ultimately Multiple Organ Dysfunction Syndrome (MODS) [2]. Additionally, new research indicates that the necrotic tissue emits harmful mediators that sustain immunosuppression and hypermetabolism, further impairing the host's defense against infection [3].

The Paradigm of Early Excision: In the past, conservative methods were preferred for managing burns in India and many other places. This required applying dressings every day and waiting for the eschar to slough—a natural separation caused by bacterial collagenase activity—before grafting the underlying granulating bed. Although viable tissue is preserved, the patient is left at risk for infection for several weeks. This assumption is challenged by the idea of Early Excision and Grafting (EE&G), which is defined as the surgical removal of necrotic tissue within the first 24 to 120 hours after damage. This aggressive technique, which was first made popular by Janzekovic in the 1970s [4] and later supported by Heimbach [5], attempts to transform an open, complicated, metabolic wound into a closed, clean surgical wound, potentially removing the source of infection before colonization becomes invasive.

Rationale for the Study: Although EE&G is widely recommended as the standard of care in Western literature [6], its application is uneven in developing nations. The lack of extensive skin banking facilities, the persistent overcrowding in intensive care units (ICUs), and the scarcity of blood bank resources are some of the particular challenges faced by Indian tertiary care facilities [7]. Additionally, compared to Western hospitals, the microbiological environment in Indian hospitals is different, with a greater frequency of organisms resistant to multiple drugs [8]. The purpose of this study is to measure the advantages of EE&G in this particular logistical and microbiological context, offering empirical evidence to support the allocation of resources required for aggressive surgical care.

Materials and Methods

Study Design and Setting: To guarantee high evidential value, this study was planned as a prospective, randomized comparative investigation. It was carried out at a government tertiary care teaching hospital in North India in the special Burn Unit of the Department of Plastic and Reconstructive Surgery. Because the study was conducted over a two-year period, seasonal differences in burn admissions could be taken into consideration. The Institutional Ethics Committee (IEC) granted complete ethical clearance before any participants were recruited, and the trial was registered in compliance with hospital policies. All patients or their legal guardians were required to provide written informed consent, which ensured they were aware of the advantages and disadvantages of the prescribed treatment plans.

Sample Size and Population: Based on the unit's past infection rates, a power analysis was carried out to attain statistical significance. The trial was then expanded to include 100 participants. To guarantee a uniform study population, a strict selection procedure was used. Adult patients with thermal burns (flame or scald) spanning a Total Body Surface Area (TBSA) of 20% to 50% between the ages of 18 and 60 were included in our study. The study's burns varied in depth from full-thickness (third degree) to deep partial-thickness (second degree). Hemodynamic stability was a crucial inclusion requirement; patients had to be stabilized following the initial resuscitation phase, usually following the Parkland formula recommendations.

On the other hand, because deep tissue damage from electrical or chemical burns is uncertain, we did not include these patients. Due to the fact that their mortality is frequently unrelated to wound care, patients with severe inhalation injuries who needed prolonged mechanical breathing were also not included. To further exclude confounding variables, people with pre-existing uncontrolled comorbidities including diabetes mellitus, chronic renal failure, or coagulopathies were excluded. Lastly, because delayed presentation hinders the "early" care mandated by the study protocol, patients who arrived at the facility more than 48 hours after their injury were excluded.

Methodology and Grouping: To avoid selection bias, patients were randomized using a computer-generated random number sequence upon admission and stabilization. They were split up into two different groups. Between Day 3 and Day 5 after the accident, Group A, also known as the Study Group (n=50), was supposed to have Early Excision and Grafting. Conservative Management was given Group B, the Control Group (n = 50). Split Skin Grafting (SSG) was carried out on the prepared granulating bed following daily dressing changes using topical antimicrobials such silver sulfadiazine or nanocrystalline silver until spontaneous eschar separation occurred, which usually took three to four weeks.

Surgical Protocol (Group A: Early Excision): The surgical operation was carried out under general anesthesia with stringent aseptic precautions for patients in Group A. Tangential excision using a Humby knife or dermatome was the method used. This required removing the necrotic eschar layer by layer until clear, punctate capillary bleeding was seen, indicating a healthy and viable dermal bed.1

To reduce blood loss, hemostasis was carefully attained by electrocautery and the use of gauze soaked in epinephrine (1:500,000 dilution). An autologous Split Thickness Skin Graft (STSG) obtained from healthy donor locations, usually the thighs, was used to patch the raw defect immediately after excision. To increase coverage and avoid fluid buildup beneath the graft, the grafts were meshed at a 1.5: 1 ratio.

Conservative Management Protocol (Group B: Delayed Grafting): In order to encourage the eschar's spontaneous separation (sloughing), patients in Group B received conservative treatment. Every day, wounds were cleaned with regular saline and treated with 1% Silver Sulfadiazine (SSD) cream, which is still the recommended topical antibacterial in this situation. throughout dressing changes, loose necrotic tissue was debrided at the bedside; however, throughout the acute period, no formal surgical excision was carried out. Until a healthy, vascularized granulation bed developed, which usually happened between Day 21 and Day 28 after the injury, this regimen was followed. Patients were brought to the operating room for delayed Split Thickness Skin Grafting (STSG) after the bed was judged receptive, which was indicated by brilliant red granulation tissue with little exudate.

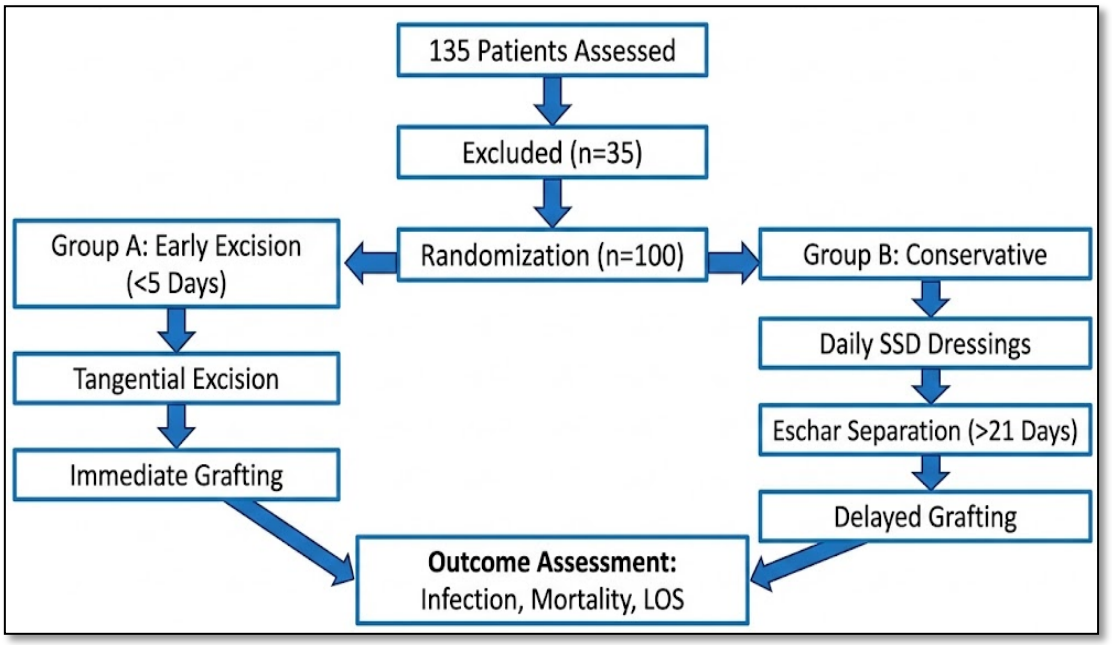

Figure 1: Flowchart of Patient Selection and Management Protocol

Data Collection and Statistical Analysis: The proportion of graft uptake, the incidence of positive wound cultures (defined as $>10^5$ CFU/g), and overall mortality rates were the main outcome metrics monitored. Secondary outcomes were on the use of resources, particularly the number of blood transfusions needed and the length of hospital stay (LOS). Every piece of information was painstakingly entered into a digital database. SPSS Version 25.0 was used for statistical analysis. The student's t-test was used to compare continuous variables, which were reported as mean ± standard deviation. The Chi-square test was used to assess categorical variables that were expressed as percentages. Statistical significance was defined as a p-value of less than 0.05.

Results

Demographic and Clinical Profile: The demographic distribution of the study population was balanced, preventing age or the severity of injuries from influencing the results. The mean age of patients in Group B was (36.5 ± 9.4) years, whereas in Group A it was (34.2 ± 8.1) years. Age, sex distribution, and the mean percentage of burns (32% vs. 34%) did not differ statistically significantly between the two groups. Seventy percent of the injuries were caused by flame burns, which is consistent with the epidemiological pattern of domestic kitchen mishaps in the area. Scald injuries accounted for the remaining 30%. A thorough analysis of these demographic traits is given in Table 1.

Table 1: **Demographic Characteristics of the Study Population**

Characteristic	Group A (Early Excision)	Group B (Delayed Grafting)	P-Value
Total Patients (n)	50	50	–
Mean Age (Years)	34.2 ± 8.1	36.5 ± 9.4	0.21 (NS)
Gender (Male/Female)	22 / 28	24 / 26	0.68 (NS)
Mean TBSA (%)	32.4 ± 4.5	34.1 ± 5.2	0.09 (NS)
Mode of Injury (Flame)	36 (72%)	34 (68%)	0.66 (NS)
Mode of Injury (Scald)	14 (28%)	16 (32%)	0.66 (NS)

(NS = Not Significant)

Bacteriological Profile and Infection Rates: To track colonization, wound swabs were taken on Days 3, 7, 14, and 21 at regular intervals. A notable disparity in infection rates was found by the investigation. Just 22% of individuals in Group A experienced an invasive wound infection. On the other hand, 64% of patients in Group B experienced clinical indications of infection ($p < 0.001$). Gram-negative species predominated in the microbial profile. The most commonly isolated pathogen was Pseudomonas aeruginosa, which was followed by Acinetobacter baumannii and Staphylococcus aureus. By Day 21, patients in Group B had a notably greater incidence of Multi-Drug Resistant (MDR) organisms, most likely as a result of extended antibiotic use and prolonged exposure to the hospital environment. The particular organisms that were isolated from wound cultures are listed in Table 2.

Table 2: Bacteriological Profile of Wound Cultures (Isolates from Infected Wounds)

Organism	Group A (n=11 infected)	Group B (n=32 infected)	Percentage (Overall)
Pseudomonas aeruginosa	5	14	44.1%
Staphylococcus aureus	3	10	30.2%
Acinetobacter baumannii	2	5	16.3%
Klebsiella pneumoniae	1	2	7.0%
E. coli	0	1	2.3%

Graft Take, Healing, and Resource Use: The early intervention group had better surgical results. In Group A, the average graft take was 88%, and only 6 patients (12%) needed re-grafting, primarily because of small hematomas or shear stresses. Group B, on the other hand, had a lower mean graft take of 72%. Due to graft lysis brought on by the underlying bacterial burden on the granulating bed, 18 patients (36%) in the delayed group required re-grafting.

The results emphasized the trade-offs associated with early excision when examining systemic effects. Group A needed more blood products, but they also had decreased mortality and much fewer positive blood cultures (sepsis). Patients in Group A received an average of 1.8 units of packed red blood cells, whereas those in Group B received an average of 0.6 units. However, a significant decrease in hospital stays was associated with this investment in blood products. Hospital beds were greatly freed up by Group A patients' average 16-day early release compared to Group B patients.

Table 3: **Comparative Clinical Outcomes between Early Excision (Group A) and Delayed Grafting (Group B)**

Parameter	Group A (Early Excision)	Group B (Delayed Grafting)	P-Value
N	50	50	–
Positive Blood Culture (Sepsis)	9 (18%)	28 (56%)	< 0.001
Mortality	4 (8%)	12 (24%)	0.02
Mean Hospital Stay (Days)	26.3 ± 5.2	42.5 ± 8.6	< 0.001
Blood Transfusion (Units/pt)	1.8 ± 0.6	0.6 ± 0.4	< 0.001
Contracture Formation	5 (10%)	18 (36%)	< 0.01

Mortality Analysis: The strongest evidence for early excision came from mortality rates. Two of the four deaths in Group A (8%) were linked to pulmonary embolism and two to refractory shock. Group B, on the other hand, reported 12 deaths (24%). Multi-organ failure and uncontrolled septicemia were directly responsible for ten of these deaths. The fatal risk of the retained eschar in the conservative management group is shown by this statistically significant difference.

Discussion

An important development in trauma medicine is the change in burn care from a passive, wait-and-see strategy to active surgical intervention. In the particular context of an Indian tertiary care system, this study validates the superiority of Early Excision and Grafting (EE&G), supporting international norms while highlighting the particular difficulties encountered in this area.

Reduction in Sepsis and Mortality: According to our findings, early excision results in a threefold decrease in mortality (8% vs. 24%). This result is consistent with Ong et al.'s meta-analysis, which found that early excision dramatically lowers mortality in burns without inhalation injury [9]. The process is simple: we are essentially carrying out a "mechanical antibiotic" intervention by surgically removing the eschar. Bacterial growth and biofilm formation, which are infamously challenging to treat with systemic antibiotics, are facilitated by the eschar [10]. Pseudomonas and Acinetobacter were among the virulent bacteria that proliferated unrestrained in Group B due to the extended presence of necrotic tissue. The quick closure of the burn wound is perhaps the best way to avoid deadly sepsis in the Indian setting, where hospital isolation facilities are frequently subpar and cross-infection rates are high [11].

Hemodynamic and Hematological Challenges: The substantial intraoperative blood loss associated with EE&G is a commonly mentioned critique. To guarantee a healthy graft bed, tangential excision necessitates cutting through dead tissue until viable, bleeding tissue is reached. This physiological cost was validated by our investigation, which showed that Group A needed substantially more blood transfusions (1.8 units mean) than Group B. This is consistent with research by Rodgers et al. [12], who found that the main factor limiting the amount of excision done in a single setting is blood loss. This reliance on blood banks creates a logistical challenge in a country with limited resources like India. However, the initial investment in blood products seems to be both clinically and financially reasonable when compared to the enormous expense of prolonged antibiotic therapy, extended ICU hospitalizations, and the management of sepsis in the delayed group [13].

Hospital Stay and Economic Implications: For Indian public hospitals, which are always running at or beyond capacity, the decrease in Length of Stay (LOS) from 42.5 days to 26.3 days is an important finding. More acute cases can be treated with faster patient turnover. Additionally, a higher prevalence of severe hypertrophic scarring and contractures (36%), requiring secondary reconstructive procedures, was linked to extended hospital stays in Group B. The patient, who is frequently the family's main provider, suffers a significant long-term financial and psychological burden as a result [14]. Monafo et al. found that early wound closure minimizes the inflammatory phase that causes excessive scar formation [15], which supports the decrease in contractures in the early excision group.

Technical Considerations in the Indian Setting: We noticed that in India, "early" excision is frequently postponed until Day 4 or 5 instead of Day 1 or 2. This is mostly because of the delayed referral system, which frequently results in patients arriving from outlying facilities with inadequate resuscitation. As a result, strict hemodynamic stabilization before to surgery was a key component of our procedure. The timing of "early" surgery must be physiological rather than merely chronological because doing major surgery on a hypovolemic patient may cause cardiac arrest or renal failure [16]. The case for early wound burden removal to reduce hospital exposure is further supported by the high prevalence of Acinetobacter baumannii in our control group, which reflects an increasing concern in Indian ICUs regarding nosocomial infections [8].

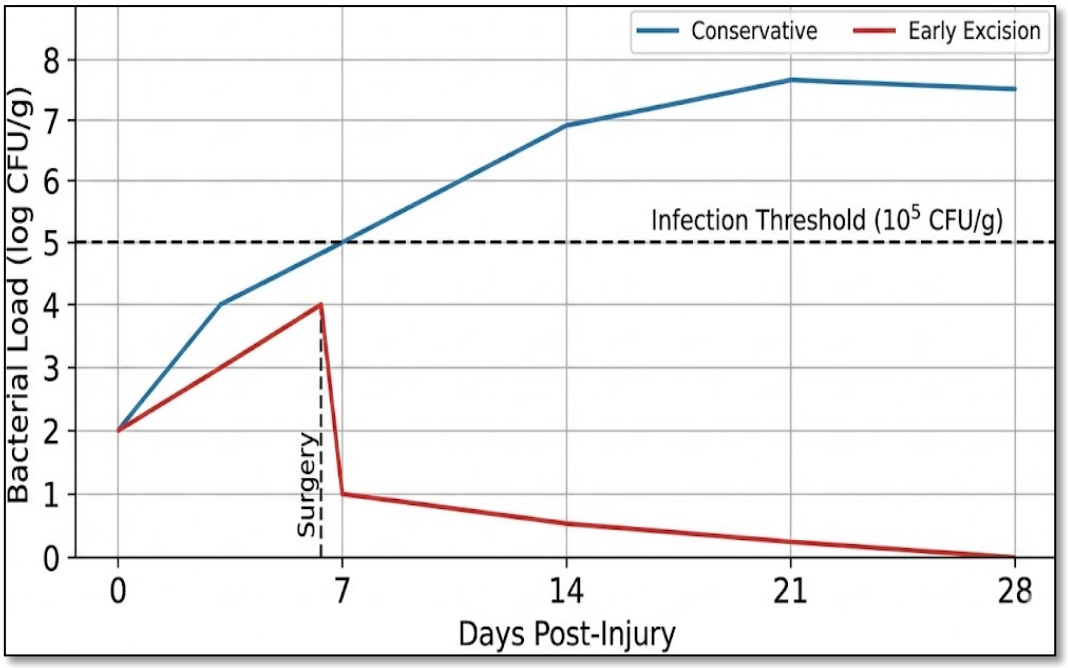

Figure 2: **Graphical Representation of Bacterial Load over Time**

Immunological Impact: According to recent studies, lymphocyte activity is inhibited by immunosuppressive substances released by the burn eschar [3]. We might be assisting in the restoration of the host's immunological capability by eliminating this tissue early. This theory is supported by our finding that Group A had decreased incidences of sepsis, indicating that the advantages of excision go beyond straightforward bacterial control to include systemic immunological regulation.

Limitations: There were certain restrictions on the study. Patients with less than 50% TBSA were the only ones eligible. Lack of autograft donor sites greatly complicates early excision in large burns (> 60%). Due to financial limitations, we did not use synthetic dermal matrices or cadaveric skin, which restricts the applicability of these findings to severe burns. This gap may be filled by upcoming skin banking research.

Conclusion

Even in the resource-constrained environments of a developing country, this study unequivocally shows that Early Excision and Grafting is the gold standard for treating full-thickness and deep partial-thickness burns. The advantages of the treatment greatly outweigh the higher immediate surgical skill, anesthesia support, and blood product supply requirements. EE&G minimizes long-term functional abnormalities, shortens hospital stays, lowers mortality rates, and dramatically lowers the incidence of burn wound infection.

It is highly advised that Indian tertiary care facilities implement an excision regimen within the first five days—post-stabilization. The vicious cycle of infection and inflammation is broken by this proactive, life-saving intervention. In order to ensure that the most severely injured patients can benefit from this surgical concept, future infrastructure upgrades must concentrate on creating regional skin banks to facilitate excision in major burns when autologous donor skin is limited.

References

1. Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. Burns. 2011 Nov 1;37(7):1087-100.
2. Church D, Elsayed S, Reid O, Winston B, Lindsay R. Burn wound infections. Clinical microbiology reviews. 2006 Apr;19(2):403-34.
3. Atiyeh BS, Gunn SW, Hayek SN. State of the art in burn treatment. World journal of surgery. 2005 Feb;29(2):131-48.
4. Janžekovic Z. A new concept in the early excision and immediate grafting of burns. Journal of Trauma and Acute Care Surgery. 1970 Dec 1;10(12):1103-8.
5. Heimbach DM. Early burn excision and grafting. Surgical Clinics of North America. 1987 Feb 1;67(1):93-107.
6. Herndon DN, Barrow RE, Rutan RL, Rutan TC, Desai MH, Abston S. A comparison of conservative versus early excision. Therapies in severely burned patients. Annals of surgery. 1989 May;209(5):547.
7. Gupta JL, Makhija LK, Bajaj SP. National programme for prevention of burn injuries. Indian journal of plastic surgery. 2010 Sep;43(S 01):S6-10.

8. Srinivasan S, Vartak AM, Patil A, Saldanha J. Bacteriology of the burn wound at the Bai Jerbai Wadia Hospital for children, Mumbai, India-A 13-year study, Part I-Bacteriological profile. Indian journal of plastic surgery. 2009 Jul;42(02):213-8.
9. Ong YS, Samuel M, Song C. Meta-analysis of early excision of burns. Burns. 2006 Mar 1;32(2):145-50.
10. Percival SL, Thomas JG, Williams DW. Biofilms and bacterial imbalances in chronic wounds: anti-Koch. International wound journal. 2010 Jun;7(3):169-75.
11. Sharma PN, Bang RL, Ghoneim IE, Bang S, Sharma P, Ebrahim MK. Predicting factors influencing the fatal outcome of burns in Kuwait. Burns. 2005 Mar 1;31(2):188-92.
12. Budny PG, Regan PJ, Roberts AH. The estimation of blood loss during burns surgery. Burns. 1993 Apr 1;19(2):134-7.
13. Saaiq M, Zaib S, Ahmad SH. Early excision and grafting versus delayed excision and grafting of deep thermal burns up to 40% total body surface area: a comparison of outcome. Annals of burns and fire disasters. 2012 Sep 30;25(3):143.
14. Ahuja RB, Bhattacharya S. Burns in the developing world and burn disasters. Bmj. 2004 Aug 19;329(7463):447-9.
15. Monafo WW, Bessey PQ. Benefits and limitations of burn wound excision. World journal of surgery. 1992 Jan;16(1):37-42.
16. Pruitt Jr BA, Foley FD, Moncrief JA. Curling's ulcer: a clinical-pathology study of 323 cases. Annals of surgery. 1970 Oct 1;172(4):523-39.