Journal of Medical and Health Studies (JMHS)
ISSN: 2710-1452
DOI: 10.32996/jmhs
Journal Homepage: www.al-kindipublisher.com/index.php/jmhs

JMHS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Early versus Delayed Excision and Grafting in Deep Burns: Impact on Healing Time and Hospital Stay

Rabab Abbas Hasan
Department of Surgery College of Medicine, University of Thi-Qar, Al-Nasiriyah, 64001, Iraq.
Corresponding Author: Rabab Abbas Hasan, **E-mail:** Rabab-s@utq.edu.iq

| ABSTRACT

Excision and grafting is the standard surgical treatment of deep burns, but the optimal timing remains debated. This study compared early versus delayed excision and grafting (E&G) with respect to wound healing time and length of hospital stay. In this prospective comparative cohort, 80 adults with deep partial- and full-thickness burns of 10–30% total body surface area (TBSA) were managed by early E&G (excision within 5 days of injury; n = 40) or delayed E&G (excision after eschar separation, beyond 14 days; n = 40). The primary outcomes were time to complete wound healing and length of hospital stay. Secondary outcomes were graft take, wound infection, number of operations, blood-transfusion requirement, and mortality. Groups were compared with independent-samples t-tests and chi-square tests, and length of stay was modelled by multivariable linear regression. The two groups were comparable at baseline (mean age 35.5 years; mean TBSA 18.4%). Early E&G was associated with shorter time to complete healing (24.3 ± 6.1 vs 38.7 ± 8.9 days; mean difference 14.4 days; 95% CI 11.0–17.8; $p < 0.001$) and shorter hospital stay (19.8 ± 5.7 vs 31.4 ± 8.2 days; mean difference 11.6 days; 95% CI 8.5–14.7; $p < 0.001$). Graft take was higher (92.4% vs 88.1%; $p = 0.03$) and wound infection lower (17.5% vs 37.5%; $p = 0.045$) in the early group. Early E&G required more blood transfusion (3.1 ± 1.4 vs 1.9 ± 1.1 units; $p < 0.001$). Mortality did not differ (5.0% vs 7.5%; $p = 0.64$). Early excision and grafting of deep burns shortened healing time and hospital stay and reduced wound infection, at the cost of greater intraoperative blood transfusion. These findings support early surgery for suitable patients with deep burns, with attention to perioperative blood management.

| KEYWORDS

deep burns; early excision; skin grafting; wound healing; length of stay; surgical timing

| ARTICLE INFORMATION

ACCEPTED: 21 April 2026 **PUBLISHED:** 28 May 2026 **DOI:** 10.32996/jmhs.2027.7.7.15

1. Introduction

For much of the twentieth century, deep burns were managed conservatively with dressings and topical antimicrobials until the eschar separated spontaneously, after which the granulating wound was grafted — a process that often took several weeks and was complicated by sepsis, prolonged hospitalisation, and disabling scarring.[1,2] The introduction of tangential excision by Janzeković in 1970 and of primary excision with immediate grafting by Burke and colleagues shifted practice toward earlier surgical removal of devitalised tissue.[3,4].

The rationale for early excision is that prompt removal of necrotic eschar reduces the burden of inflammatory mediators and the substrate for infection, thereby limiting the systemic response to injury and accelerating wound closure.[5,6] Comparative and randomised studies from the 1980s onward reported that early excision could reduce hospital stay, blood loss-adjusted morbidity, and — in selected patients without inhalation injury — mortality, although at the price of greater intraoperative blood loss.[7,8,9] A widely cited meta-analysis concluded that early excision shortens length of hospital stay and reduces mortality in

patients without inhalation injury, while increasing transfusion requirements.[10] Excision and grafting is now regarded as the standard surgical management of deep burns.[11,12].

Despite this evidence, the optimal timing of surgery is not settled, and practice varies with burn depth, total body surface area (TBSA), resource availability, and surgeon preference; delayed surgery remains common where demarcation of indeterminate-depth burns is awaited or where blood and theatre capacity are limited.[13,14] Robust local data comparing the two strategies remain valuable, particularly for the patient-centred outcomes of healing time and hospital stay. The aim of this study was to compare early versus delayed E&G of deep burns with respect to time to complete wound healing and length of hospital stay, together with graft take, infection, reoperation, transfusion, and mortality.

2. Materials and Methods

2.1 Study design and setting

This was a prospective comparative cohort study conducted in a tertiary burn unit over a 24-month period. The study was approved by the institutional research ethics committee, and written informed consent was obtained from all participants. Reporting follows the STROBE statement for cohort studies.

2.2 Participants and grouping

Adults aged 18–60 years with deep partial-thickness or full-thickness burns involving 10–30% TBSA, admitted within 48 hours of injury, were eligible. Patients with inhalation injury requiring mechanical ventilation, major comorbidity (significant cardiac, renal, or hepatic disease), electrical or chemical burns, or coagulopathy were excluded. Allocation to treatment reflected the admitting team's standard practice rather than randomisation: the **early E&G** group underwent tangential or fascial excision and split-thickness autografting within 5 days of injury, and the **delayed E&G** group underwent excision and grafting after spontaneous eschar separation, beyond 14 days post-burn. Eighty patients were enrolled, 40 per group.

2.3 Surgical management and outcomes

Excision was performed under tourniquet where feasible to limit blood loss, and wounds were resurfaced with meshed split-thickness autografts in accordance with contemporary burn-care guidelines.[15,16] The primary outcomes were (i) time to complete wound healing, defined as ≥ 95% re-epithelialisation of the grafted area, and (ii) length of hospital stay, both measured in days from injury. Secondary outcomes were graft take (percentage of viable graft at first dressing change), wound infection (clinical signs with positive quantitative culture), number of operations, blood-transfusion requirement (units of packed red cells), and in-hospital mortality. Scar-related morbidity was beyond the scope of this short audit and is addressed only in the discussion.[18].

2.4 Statistical analysis

Continuous variables are presented as mean ± standard deviation (SD) and categorical variables as counts and percentages. Between-group comparisons used the independent-samples t-test (or Mann–Whitney U test for non-normal data) for continuous variables and the chi-square or Fisher exact test for categorical variables. Mean differences are reported with 95% confidence intervals (CI). A multivariable linear regression was fitted for length of stay, adjusting for age, TBSA, and burn depth. A two-sided p-value < 0.05 was considered statistically significant.

3. Results

3.1 Baseline characteristics

The two groups were comparable in age, sex, TBSA, burn depth, and mechanism of injury (all $p > 0.05$), as shown in **Table 1**. The overall mean age was 35.5 years and mean TBSA 18.4%.

Table 1. Baseline characteristics by treatment group.

Characteristic	Early E&G (n=40)	Delayed E&G (n=40)	p-value
Age, years — mean ± SD	34.8 ± 11.2	36.1 ± 10.6	0.59
Male sex — n (%)	25 (62.5)	23 (57.5)	0.65
TBSA, % — mean ± SD	18.6 ± 5.4	18.1 ± 5.1	0.67
Full-thickness burn — n (%)	22 (55.0)	20 (50.0)	0.65
Flame mechanism — n (%)	27 (67.5)	25 (62.5)	0.64
Time to admission, h — mean ± SD	9.4 ± 6.1	10.2 ± 6.8	0.58

I. 3.2 Primary outcomes: healing time and hospital stay

Early E&G was associated with substantially shorter time to complete wound healing and shorter hospital stay (**Figure 1**; **Table 2**). Mean time to complete healing was 24.3 ± 6.1 days in the early group versus 38.7 ± 8.9 days in the delayed group (mean difference 14.4 days; 95% CI 11.0–17.8; $p < 0.001$). Mean length of hospital stay was 19.8 ± 5.7 versus 31.4 ± 8.2 days (mean difference 11.6 days; 95% CI 8.5–14.7; $p < 0.001$). The shorter stay with early surgery persisted after adjustment for age, TBSA, and burn depth in multivariable regression (adjusted $\beta = -10.3$ days; $p < 0.001$).

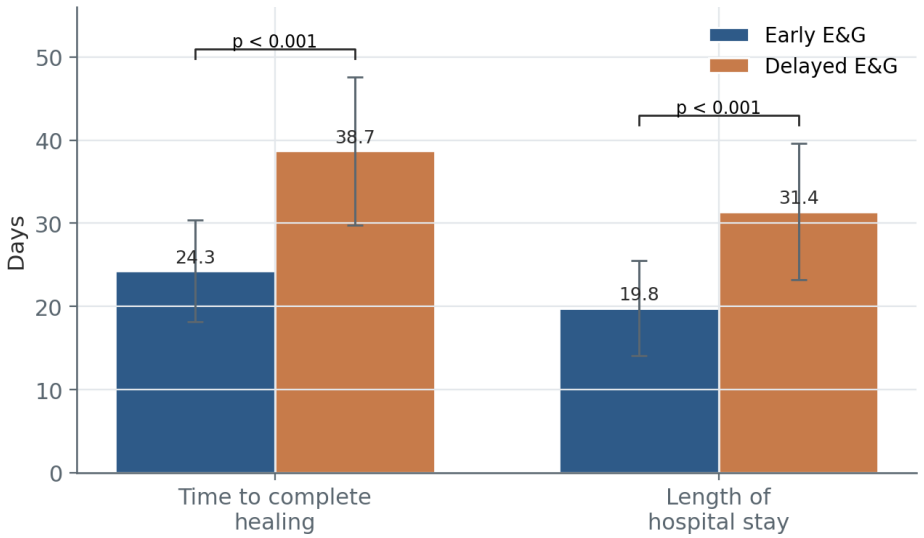

Figure 1. *Primary outcomes by group: time to complete healing and length of hospital stay (error bars = SD).*

Table 2. Primary outcomes by treatment group.

Outcome (days)	Early E&G	Delayed E&G	Mean diff.	p-value
Time to complete healing	24.3 ± 6.1	38.7 ± 8.9	14.4	< 0.001
Length of hospital stay	19.8 ± 5.7	31.4 ± 8.2	11.6	< 0.001

3.3 Secondary outcomes

Graft take was higher and wound infection lower in the early group (**Figure 2**). Mean graft take was 92.4% ± 6.8 versus 88.1% ± 9.2 ($p = 0.03$), and wound infection occurred in 7 (17.5%) versus 15 (37.5%) patients ($p = 0.045$). The principal trade-off favoured

the delayed group: early E&G required more blood transfusion (3.1 ± 1.4 vs 1.9 ± 1.1 units; p < 0.001), reflecting greater intraoperative blood loss during early excision (**Figure 3**). The delayed group, however, underwent more operations overall (2.3 ± 0.9 vs 1.8 ± 0.7; p = 0.01). In-hospital mortality did not differ between groups (**Table 3**).

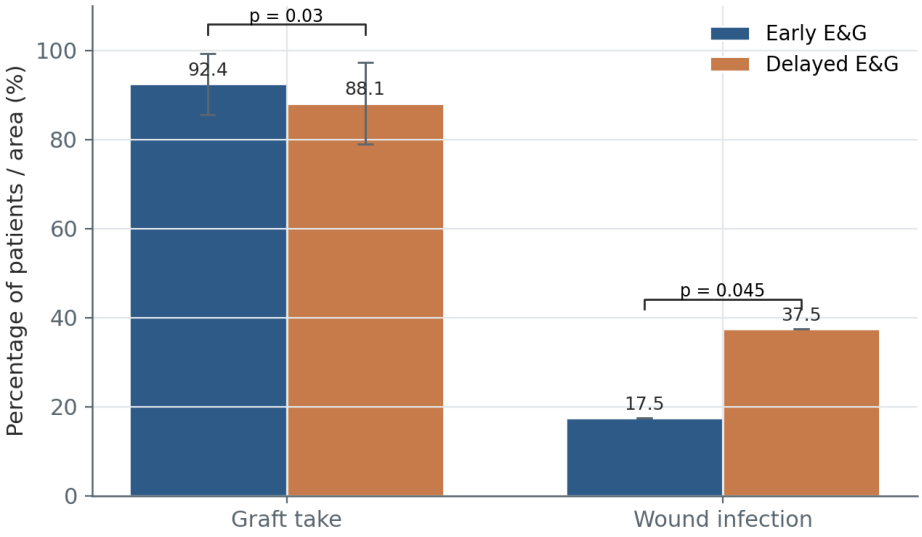

Figure 2. *Graft take and wound infection by group (error bars = SD where applicable).*

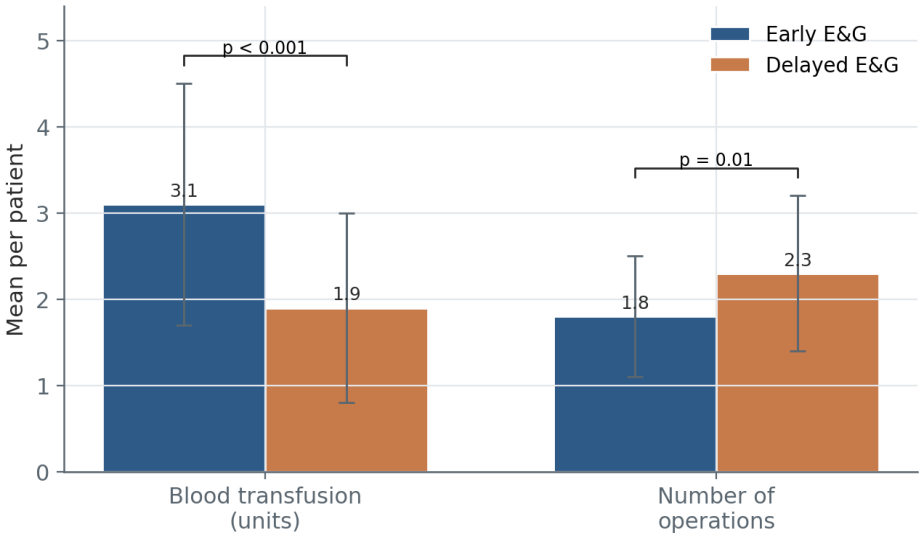

Figure 3. *Resource use by group: blood transfusion units and number of operations per patient (error bars = SD).*

Table 3. Secondary outcomes by treatment group.

Outcome	Early E&G	Delayed E&G	p-value
Graft take, % — mean ± SD	92.4 ± 6.8	88.1 ± 9.2	0.03
Wound infection — n (%)	7 (17.5)	15 (37.5)	0.045
Number of operations — mean ± SD	1.8 ± 0.7	2.3 ± 0.9	0.01
Blood transfusion, units — mean ± SD	3.1 ± 1.4	1.9 ± 1.1	< 0.001
In-hospital mortality — n (%)	2 (5.0)	3 (7.5)	0.64

4. Discussion

In this comparative cohort, early excision and grafting of deep burns was associated with markedly shorter wound healing and hospital stay, higher graft take, and lower wound infection, at the expense of greater blood-transfusion requirement. These findings are consistent with the prevailing literature, in which early excision reduces length of stay and infectious complications while increasing intraoperative blood loss.[7,9,10] The roughly two-week reduction in healing time aligns with the biological rationale for early eschar removal: eliminating necrotic tissue limits the inflammatory and infective stimulus and allows definitive wound closure to begin sooner rather than awaiting slow spontaneous separation.[5,1].

The shorter hospital stay with early surgery has important implications beyond patient comfort. Prolonged admission is a major driver of burn-care cost and of nosocomial infection risk, and earlier closure facilitates earlier rehabilitation, which is associated with better functional outcomes and lower rates of psychological morbidity such as depression after burn injury.[19,10] The higher graft take and lower infection rate in the early group are biologically coherent, since grafting onto a freshly excised, well-vascularised bed before bacterial colonisation establishes is more likely to succeed than grafting onto a granulating, contaminated wound.[20,6] Notably, this advantage reflects timely wound closure rather than antibiotic prophylaxis, which has not been shown to reliably prevent burn-wound infection.[21].

The principal disadvantage of early excision in this cohort was the greater transfusion requirement, a well-recognised trade-off attributable to brisk bleeding from early excision of vascular tissue before the relatively avascular phase of eschar separation.[9,4] This underscores the importance of perioperative blood-conservation measures — tourniquet use, tumescent infiltration, staged excision of very large burns, and meticulous haemostasis — when an early strategy is adopted; newer blood-sparing refinements such as hydrosurgical and tangential excision may further mitigate this disadvantage.[17] The comparable mortality between groups is in keeping with evidence that the survival benefit of early excision is most evident in specific subgroups (for example, younger patients without inhalation injury) rather than uniformly across all burns.[8,10].

4.1 Limitations

Several limitations temper these findings. Allocation was not randomised; although baseline characteristics were comparable, residual confounding by indication cannot be excluded, since clinical factors influencing the decision to operate early may independently affect outcomes. The single-centre design and modest sample limit generalisability and the power of subgroup analyses. Burns above 30% TBSA, inhalation injury, and paediatric patients were excluded, so the results do not extend to those populations. Finally, follow-up ended at wound healing, so longer-term outcomes such as hypertrophic scarring and contracture — important determinants of burn morbidity — were not captured and warrant dedicated study.[18].

5. Conclusion

Early excision and grafting of deep burns of 10–30% TBSA shortened wound healing time and hospital stay and reduced wound infection compared with delayed surgery, at the cost of increased intraoperative blood transfusion. For suitable patients without contraindications, an early surgical strategy — coupled with proactive perioperative blood management — offers meaningful benefit. Larger, randomised, multicentre studies incorporating long-term scar and functional outcomes are needed to refine the optimal timing of surgery.

Declarations

Ethics approval. Granted by the institutional research ethics committee; written informed consent was obtained from all participants.

Funding. None.

Conflicts of interest. The authors declare no conflicts of interest.

References

[1] Orgill DP. Excision and skin grafting of thermal burns. N Engl J Med. 2009;360(9):893–901. doi:10.1056/NEJMct0804451

[2] Jeschke MG, van Baar ME, Choudhry MA, Chung KK, Gibran NS, Logsetty S. Burn injury. Nat Rev Dis Primers. 2020;6(1):11. doi:10.1038/s41572-020-0145-5

[3] Janzeković Z. A new concept in the early excision and immediate grafting of burns. J Trauma. 1970;10(12):1103–1108. doi:10.1097/00005373-197012000-00001

[4] Burke JF, Bondoc CC, Quinby WC. Primary burn excision and immediate grafting: a method shortening illness. J Trauma. 1974;14(5):389–395. doi:10.1097/00005373-197405000-00005

[5] Heimbach DM. Early burn excision and grafting. Surg Clin North Am. 1987;67(1):93–107. doi:10.1016/s0039-6109(16)44135-6

[6] Ziegler B, Fischer S, Pieper D, Mathes T, Kneser U, Hirche C. Evidence and trends in burn wound debridement: an evidence map. Plast Surg (Oakv). 2020;28(4):232–242. doi:10.1177/2292550320928553

[7] Gray DT, Pine RW, Harnar TJ, Marvin JA, Engrav LH, Heimbach DM. Early surgical excision versus conventional therapy in patients with 20 to 40 percent burns: a comparative study. Am J Surg. 1982;144(1):76–80. doi:10.1016/0002-9610(82)90605-5

[8] Herndon DN, Barrow RE, Rutan RL, Rutan TC, Desai MH, Abston S. A comparison of conservative versus early excision: therapies in severely burned patients. Ann Surg. 1989;209(5):547–552. doi:10.1097/00000658-198905000-00006

[9] Budny PG, Regan PJ, Roberts AH. The estimation of blood loss during burns surgery. Burns. 1993;19(2):134–137. doi:10.1016/0305-4179(93)90036-8

[10] Ong YS, Samuel M, Song C. Meta-analysis of early excision of burns. Burns. 2006;32(2):145–150. doi:10.1016/j.burns.2005.09.005

[11] ISBI Practice Guidelines Committee. ISBI practice guidelines for burn care. Burns. 2016;42(5):953–1021. doi:10.1016/j.burns.2016.05.013

[12] Tompkins RG, Remensnyder JP, Burke JF, et al. Significant reductions in mortality for children with burn injuries through the use of prompt eschar excision. Ann Surg. 1988;208(5):577–585. doi:10.1097/00000658-198811000-00006

[13] Engrav LH, Heimbach DM, Reus JL, Harnar TJ, Marvin JA. Early excision and grafting vs. nonoperative treatment of burns of indeterminant depth: a randomized prospective study. J Trauma. 1983;23(11):1001–1004. doi:10.1097/00005373-198311000-00007

[14] Wong L, Rajandram R, Allorto N. Systematic review of excision and grafting in burns: comparing outcomes of early and late surgery in low and high-income countries. Burns. 2021;47(8):1705–1713. doi:10.1016/j.burns.2021.07.001

[15] ISBI Practice Guidelines Committee. ISBI practice guidelines for burn care, part 2. Burns. 2018;44(7):1617–1706. doi:10.1016/j.burns.2018.09.012

[16] Mohammadi AA, Bakhshaeekia AR, Marzban S, et al. Early excision and skin grafting versus delayed skin grafting in deep hand burns (a randomised clinical controlled trial). Burns. 2011;37(1):36–41. doi:10.1016/j.burns.2010.02.005

[17] Cao YL, Liu ZC, Chen XL. Efficacy of hydrosurgical excision combined with skin grafting in the treatment of deep partial-thickness and full-thickness burns: a two-year retrospective study. Burns. 2023;49(5):1087–1095. doi:10.1016/j.burns.2022.07.012

[18] Gauglitz GG, Korting HC, Pavicic T, Ruzicka T, Jeschke MG. Hypertrophic scarring and keloids: pathomechanisms and current and emerging treatment strategies. Mol Med. 2011;17(1–2):113–125. doi:10.2119/molmed.2009.00153

[19] Wiechman SA, Ptacek JT, Patterson DR, Gibran NS, Engrav LE, Heimbach DM. Rates, trends, and severity of depression after burn injuries. J Burn Care Rehabil. 2001;22(6):417–424. doi:10.1097/00004630-200111000-00012

[20] Enshaei A, Masoudi N. Survey of early complications of primary skin graft and secondary (delayed) skin graft surgery after burn wound resection in hospitalised burn patients. Glob J Health Sci. 2014;6(7):98–104. doi:10.5539/gjhs.v6n7p98

[21] Avni T, Levcovich A, Ad-El DD, Leibovici L, Paul M. Prophylactic antibiotics for burns patients: systematic review and meta-analysis. BMJ. 2010;340:c241. doi:10.1136/bmj.c241