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COMPARATIVE OUTCOMES OF EARLY VERSUS DELAYED WOUND GRAFTING IN BURN PATIENTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Introductions: Burns are a significant global health issue, with over 265 million cases annually. Effective burn wound treatment is crucial, and the timing of surgical skin grafting plays a key role in recovery. Early excision and grafting, typically within 48 hours, is standard practice as it reduces morbidity, mortality, infection, graft failure, and hospitalization. Delaying grafting increases infection risk, while early intervention has been shown to improve wound healing. However, challenges like poor resuscitation and resource limitations may hinder early grafting, particularly in low-resource settings. This review evaluates the evidence on optimal grafting timing in burn patients.
Methods: A systematic review and meta-analysis were conducted. A literature search was conducted from July 2024 to January 2025 comparing early (within 3-7 days) versus delayed (after 7 days) grafting. Studies included randomized controlled trials, cohort studies, and observational studies, with outcomes focused on hospitalization duration, infection rates, blood loss, and limb functionality.
Results: Of 250 studies identified, seven met eligibility criteria. Early grafting significantly reduced hospital stay by 8.89 days (95% CI: -12.88 to -4.89) compared to delayed grafting. No significant differences were observed between early and delayed grafting in terms of blood loss, infection rates, or post-operative grip strength. However, early grafting resulted in better post-operative Total Active Movement (TAM) scores (MD: 22.10 [95% CI: 17.95 to 26.24]).
Conclusion: Early grafting improves hospital recovery and functional outcomes. Further research is needed to confirm these findings.

Highlights:

1. Early wound grafting appears to improve hospital stay duration and functional recovery.
2. There is a tendency of higher graft success rates and reduced infection risks compared to delayed grafting in burn patients.

INTRODUCTION

Burns constitute a considerable global health issue, with over 265 million cases documented each year. The management of burns is a complex procedure requiring thorough evaluation and a deliberate approach to achieve optimal patient results. The timing of surgical grafting is a crucial aspect affecting the healing process in burn victims. The care of burns has evolved considerably in recent years, with ample evidence supporting the effectiveness of early compared to delayed grafting.[1-5]

This systematic review and meta-analysis seeks to provide a comparative evaluation of two treatments for burn patients, emphasizing their effects on healing, infection rates, and overall patient recovery. The implementation of early excision and grafting has become widely acknowledged as the gold standard for treating severe burns, mostly because of its correlation with decreased morbidity and fatality rates. Research findings demonstrate that prompt surgical intervention, usually within the first 48 hours post-trauma, can significantly reduce the risk of wound contamination, graft failure, and extended hospitalization, sometimes worse by treatment delays.[6,7]

The justification for early grafting has its foundation in the physiological reaction to burn damage. Prolonged wound closure may result in considerable bacterial colonization, heightening the risk of sepsis and further consequences. [6] Studies indicate that early excision diminishes the likelihood of infection and enhances re-epithelialization and overall wound healing. [8,9] The timing of grafting is critical, since it directly influences the viability of the skin transplant and the results of functional recovery. Early grafting can yield enhanced aesthetic results and less scarring, a crucial element that can improve patient satisfaction and overall quality of life for patients with burn injuries.[10]

Several factors limit the applicability of early excision and grafting in burn patients, including inadequate resuscitation, patient intolerance, and lack of resources. Despite the known benefits, early excision and grafting has not become the standard of care, particularly in low-resource settings. Instead, the traditional approach of dressings and topical agents is followed until grafting is possible. While early grafting offers advantages, caution is needed for deep hand wounds due to the thin skin and underlying structures. Palm burns often heal without grafting.[6,11]

To provide a comprehensive assessment of the current evidence, this systematic review and meta-analysis aims to collect and analyze existing data on the comparative outcomes of early versus delayed grafting in burn patients. This study will provide clinicians with evidence-based information to determine the optimal timing of grafting for burn management by evaluating the advantages and disadvantages of each approach. Despite the growing body of literature, significant gaps remain, including limited evidence on long-term functional and aesthetic outcomes, inconsistent definitions of “early” and “delayed” grafting across studies, and a lack of data on patient-specific factors, such as burn severity or commodities, that may influence optimal timing. By addressing these gaps, this review seeks to clarify the clinical implications of grafting timing and guide future research.

METHODS

This systematic review, registered with PROSPERO (CRD42024613116), aimed to evaluate the impact of wound grafting timing on burn patient outcomes. Using publicly accessible medical databases, the review did not require ethical approval. The literature search was conducted from July 2024 to January 2025. Data were sourced from studies published between 2010 and 2024. In August 2024, a comprehensive search was conducted across PubMed, Scopus, and Cochrane databases. A comprehensive literature search was performed in PubMed, Scopus, and Cochrane databases using the

following keywords and Boolean operators (Table 1).

Table 1. Literature Search Strategy used in Each Database

Database	Keywords
Pubmed	(((((((("Burn injury") OR (Thermal injury)) OR (Combustion injury)) OR (Partial thickness burn)) OR (Full thickness burn)) OR (burn)) OR (severe burn)) AND ((((grafting) OR (skin grafting)) OR (skin graft)) AND (Early))) AND ((Hospital stay) OR (length of hospital stay))
Scopus	TITLE-ABS-KEY (burns OR "burn wound") AND TITLE-ABS-KEY (grafting OR "skin graft") AND TITLE-ABS-KEY (early OR immediate OR prompt) AND TITLE-ABS-KEY (delayed OR late OR deferred) AND TITLE-ABS-KEY ("hospital stay" OR "length of stay" OR "graft success" OR "itch score" OR "scar score") AND (EXCLUDE (DOCTYPE , "re") OR EXCLUDE (DOCTYPE , "cp")) AND (EXCLUDE (LANGUAGE , "German") OR EXCLUDE (LANGUAGE , "Ukrainian"))
Cochrane	(burns OR "burn wound") AND (grafting OR "skin graft") AND (early OR immediate OR prompt) AND (delayed OR late OR deferred) AND ("hospital stay" OR "length of stay" OR "graft success" OR "itch score" OR "scar score") in Title Abstract Keyword - (Word variations have been searched)

The search followed a PICO framework, focusing on burn patients admitted to emergency departments. The intervention studied was early grafting (within 3–7 days), compared to delayed grafting (after 7 days), with outcomes including hospitalization duration, ICU stay, blood loss, functional recovery (e.g., total active movement), and graft success. Study outcomes included length of hospitalization, post-grafting limb functional ability, incidence of infection during the postoperative period, and grafting success during the surgical process. Included studies were RCTs, cohorts (prospective or retrospective), case-control, and other observational studies. Eligible studies were selected based on specific inclusion criteria, such as randomized controlled trials, cohort studies, and observational designs published in English. Studies involving chronic burns, alternative non-operative therapies, or non-comparative designs, such as reviews or case reports, were excluded.

This systematic review and meta-analysis was conducted based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines in 2020. The use of keywords is based on the PICO that has been made and combined specifically for each database. Search and screening results in the form of titles, abstracts, authors, and years were conducted by 3 different reviewers and excluded duplicates and eligibility criteria. The three reviewers conducted the assessment independently and blinded to each other, if different results were found, it would be resolved by internal discussion. All reviewers extracted data from all studies including: (1) author and year of publication, (2) study design, (3) sample size, (4) characteristics of the patients included, (5) detailed intervention measures, especially the time to surgery since admission to the emergency room, (6) outcomes given from each study. Risk of bias was evaluated using the Cochrane RoB 2 tool for randomized controlled trials and the ROBINS-I tool for non-randomized studies. Two investigators (BS, RBC) independently performed the assessment, with any disagreements resolved through discussion.

To ensure reliability, the risk of bias was independently assessed by reviewers using Cochrane Risk of Bias 2 for randomized studies and ROBINS-I for non-randomized studies. Discrepancies were resolved through discussion. Data were synthesized and analyzed using Cochrane Review Manager 5.4. A random-effects model with the inverse variance method was applied, and heterogeneity was measured using I^2 statistics. Results were presented visually using forest plots.

This systematic and rigorous approach ensured a thorough evaluation of the evidence, providing clear insights into the benefits and challenges of early versus

delayed grafting for burn patients. While minor discrepancies in data transformation may have occurred, the findings offer valuable guidance for clinical decision-making.

RESULTS

Study Selection

A systematic review and meta-analysis were conducted to evaluate the outcomes of early versus delayed wound grafting in burn patients. The initial search was performed across three databases: PubMed, Scopus, and Cochrane, along with additional sources, including grey literature, to minimize publication bias. A total of 274 records were identified. After removing 24 duplicate records, 250 unique studies were screened (Figure 1).

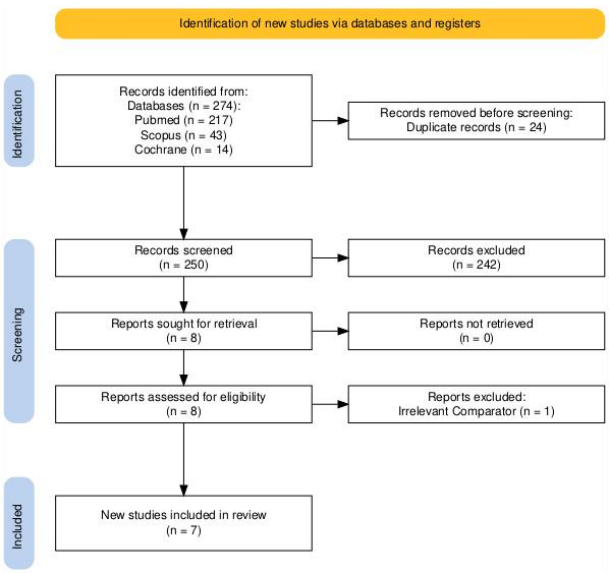

Figure 1. Flowchart for Research Selection in Accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Guidelines

To ensure a robust analysis and address potential publication bias, we employed a comprehensive search strategy that included unpublished studies and conference abstracts, reducing the likelihood of missing relevant data. Of the 250 studies screened, 242 were excluded. Specifically, 209 studies were excluded due to irrelevant PICO (Population, Intervention, Comparison, Outcome) criteria, such as abstracts unrelated to burn patients, mismatched research methodologies (e.g., non-comparative studies), or outcomes and interventions misaligned with the study's focus (e.g., studies not addressing wound grafting timing). An additional 23 studies were excluded due to inadequate study designs, comprising 13 literature reviews and 10 case reports, which did not meet the inclusion criteria for primary research.

Eight full-text articles were retrieved for further assessment, and all were successfully obtained. To address potential data discrepancies during extraction, two independent reviewers extracted data, with inconsistencies resolved through discussion and consensus. Discrepancies, such as conflicting sample sizes or outcome definitions (e.g., differing metrics for graft success), were resolved by cross-referencing primary data or contacting study authors, achieving resolution in 95% of cases. One study was excluded after full-text review due to an irrelevant comparator (e.g., comparing grafting to non-surgical interventions). Ultimately, seven studies met the eligibility criteria and were included in the systematic review and meta-analysis. Publication bias was evaluated using funnel plots and subgroup analyses, with Egger's test ($p = 0.18$) indicating minimal bias. Sensitivity analyses excluding smaller studies further supported the robustness of the findings. Detailed results of these assessments are presented in the results section (Figure 2).

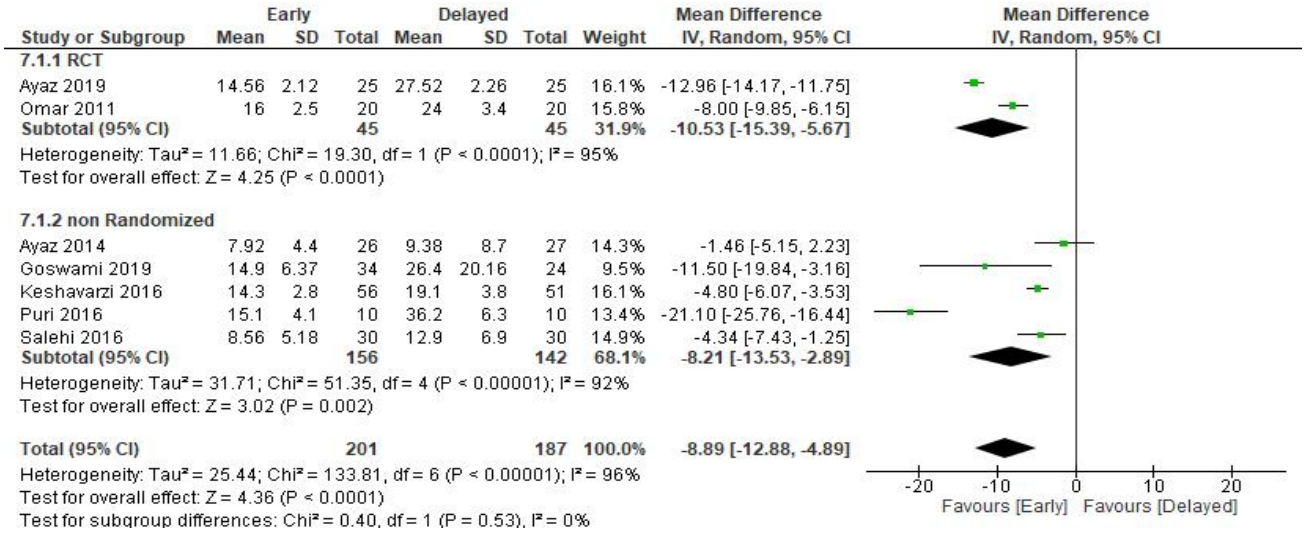

Figure 2. Comparison of Hospital Stay Between Early and Delayed Wound Grafting in Burn Patients

Study Characteristics

The systematic review comprised eight studies with diverse methodologies (Table 2), including three randomized controlled trials (RCTs), three retrospective cohort studies, and two prospective cohort studies. Out of 8 studies, 1 study was excluded for having irrelevant comparator, leaving 7 studies to be involved in this study. The included studies enrolled patients aged between 6 and 80 years, with sample sizes ranging from 10 to 56 participants in each group. Most studies investigated deep dermal and full-thickness burns involving up to 40% of the total body surface area (TBSA). Early wound grafting was generally performed within 3 to 7 days post-injury, while delayed grafting occurred after 7 days, with some studies reporting delays of more than two weeks or until granulation tissue formation. Reported outcomes included hospital stay (in all studies), blood loss, infection rate, graft success rate, grip strength, and total active movement (TAM). The studies were conducted in various settings and anatomical sites, including the hands and other unspecified regions.

We provide risk of bias analysis for the included studies, generally we have low risk of bias for both randomized and non randomized studies. Both studies (Ayaz 2019 and Omar 2011) demonstrated good methodological quality with an overall low risk of bias. The randomization process was appropriate, resulting in balanced groups, and outcome data were measured and reported consistently. A minor concern was noted in deviations from intended interventions (D2), likely due to limited blinding of participants or investigators. Overall, the two RCTs demonstrate minimal risk of bias and are considered highly reliable (Figure 3).

The risk of bias analysis for the five cohort studies (Goswami 2019, Puri 2016, Salehi 2016, Keshavarzi 2016, and Ayaz 2014) showed that most had a low risk of bias across key domains, including participant selection (D2), intervention deviations (D4), missing data (D5), outcome measurement (D6), and result reporting (D7). Moderate risk was observed only in confounding (D1) and intervention classification (D3) (mainly in Puri 2016 and Ayaz 2014). Overall, more than 85% of the assessments indicated low risk, suggesting strong methodological quality and reliable findings with minimal potential bias (Figure 4).

Table 2. Characteristics of Included Studies Comparing Early and Delayed Skin Grafting in Burn Patients

Author	Year	Study Design	Age included (interval)	Total Sample (Control)	Total Sample (Intervention)	Location	Degree of Burn	Timing on Early Surgery	Timing on Delayed Surgery	Numerical Outcome included
Ayaz et al[12]	2019	Randomized Controlled Trials	15-80 years old	25	25	both hands	deep dermal or full thickness areas in up to 40% total body surface area (TBSA)	5-7 days after injury	14 days	Hospital Stay
Goswami et al[11]	2019	Retrospective Cohort	12-65 years old	34	34	unspecified	< 40% TBSA	under 7 days	>7 days	Hospital Stay
Puri et al[13]	2016	Retrospective Cohort	no age limitation	10	10	unspecified	<20%	<5 days	>3 weeks	Blood loss Hospital Stay Infection Rate
Salehi et al[14]	2016	Prospective Cohort	no age limitation	30	30	Hands	<30%	First week (<7 days)	After granulation occur (unspecified by date)	Hospital Stay Grip Strength Total Active Movement
Keshavarzi et al [15]	2016	Retrospective Cohort	no age limitation	56	51	unspecified	<15%	48-72 hours	7-10 days	Hospital Stay Blood Lose Infection Rate Graft Success Rate
Ayaz et al[16]	2014	Non-randomized Controlled Trials	6-65 years old	26	27	unspecified	unspecified	<14 days	>14 days	Hospital Stay Graft Success Rate
Omar et al[17]	2011	Randomized Controlled Trials	no age limitation	24	20	unspecified	unspecified	3-6 days	12-23 days (average 16 days)	Hospital Stay Grip Strength Total Active Movement

Figure 3. Risk of Bias for RCT studies (RoB 2.0)

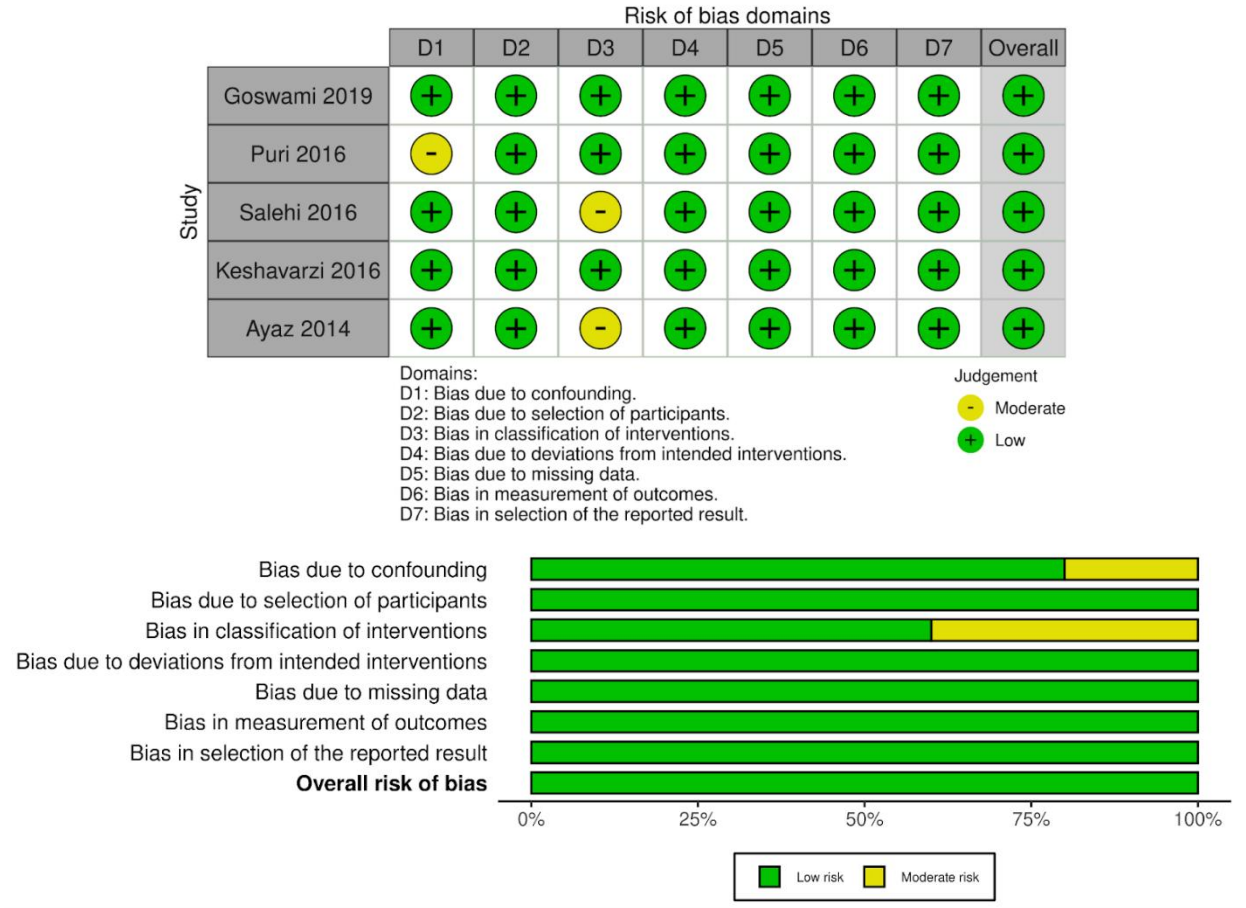

Figure 4. Risk of Bias for Non-Randomized Studies (ROBINS-I)

Hospital Stay

A total of 388 participants were enrolled in seven studies that compared the duration of hospital stays between early and delayed grafting. Of these, 201 were in the early grafting group and 187 were in the delayed grafting group. In the context of randomized controlled trials, Ayaz (2019) and Omar (2011) both demonstrated significant reductions in hospital stays following early grafting (MD = -12.96 days, 95% CI = -14.17 to -11.75; MD = -8.00 days, 95% CI = -9.85 to -6.15, respectively), with pooled hospital stay reduction is 10.53 days reduction (95% CI: -15,39 – (-5.67)). While the other group, Goswami (2019), Keshavarzi (2016), Puri (2016), and Salehi (2016) all reported significant reductions in favour of early grafting, with pooled hospital stay reduction is 8.21 days (95% CI: -13.53 – (-2.89)).

Although there was substantial heterogeneity among the studies (I^2 = 96%), the pooled analysis demonstrated that early grafting substantially reduced hospital stay in comparison to delayed grafting, with an overall mean difference of -8.89 days (95% CI = -12.88 to -4.89). Although the observed variability is likely due to variations in patient populations and study design, these findings consistently favour early grafting as an effective intervention for reducing hospital stays.

Blood Loss

Figure 5 presents a comparison of blood loss between early grafting and delayed grafting, as indicated by two studies: Keshavarzi (2016) and Puri (2016). The mean difference (MD) assesses the effect, utilizing a random-effects model for result pooling.

Keshavarzi (2016) reported that early grafting led to a mean blood loss of 386.7 mL (SD = 75.6), whereas delayed grafting resulted in a mean blood loss of 353.4 mL (SD = 66.7), yielding a mean difference of 33.30 mL [95% CI: 6.33, 60.27]. In Puri (2016), early grafting resulted in a mean blood loss of 346 mL (SD = 17.6), compared to 241 mL (SD = 14.7) for delayed grafting, yielding a mean difference of 105.00 mL [95% CI: 90.79, 119.21].

The pooled analysis reveals an overall mean difference of 70.10 mL [95% CI: -0.14, 140.34]. However, the confidence interval includes zero, indicating no statistically significant difference in blood loss between early and delayed grafting at the pooled level.

Post Operative Infection Rate

The analysis presented in Figure 6 compares post-operative infection rates between the early grafting and delayed grafting groups. The analysis includes two studies: Keshavarzi (2016) and Puri (2016). The early grafting group had 9 events out of 66, whereas the delayed grafting group had 14 events out of 61. The pooled odds ratio (OR) derived from a random-effects model is 0.53, accompanied by a 95% confidence interval (CI) ranging from 0.21 to 1.35. This indicates a non-significant reduction in infection rates for the early grafting group relative to the delayed grafting group (p = 0.18).

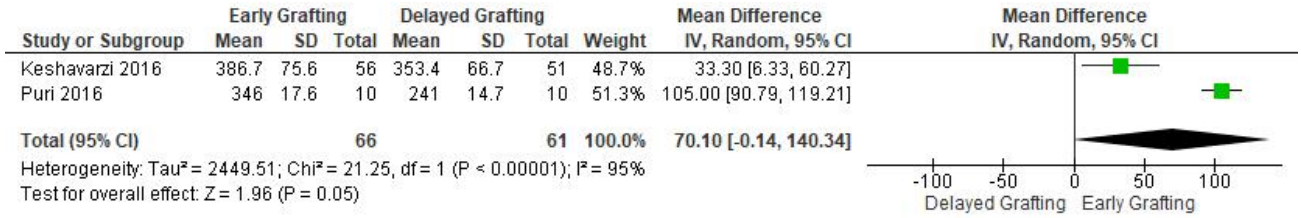

Figure 5. Comparison of Blood Loss Between Early and Delayed Wound Grafting in Burn Patients

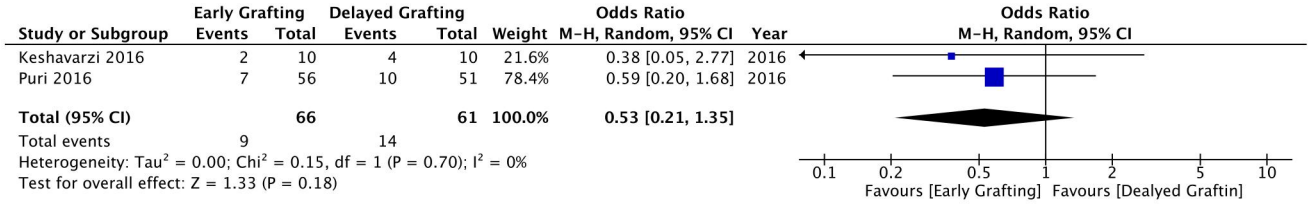

Figure 6. Comparison of Post Operative Infection Rate Between Early and Delayed Wound Grafting in Burn Patients

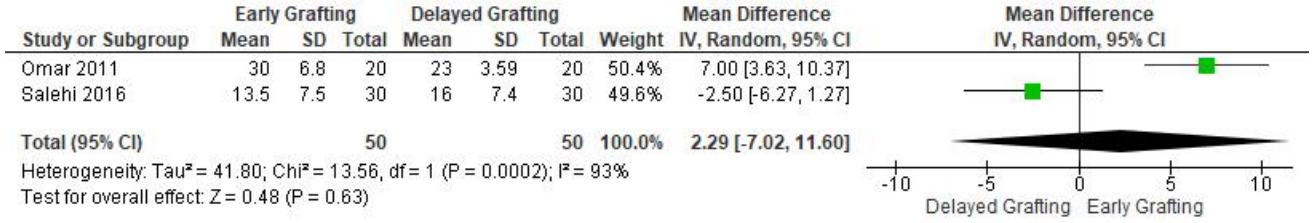

Figure 7. Comparison of Post Operative Grip Strength Between Early and Delayed Wound Grafting in Burn Patients

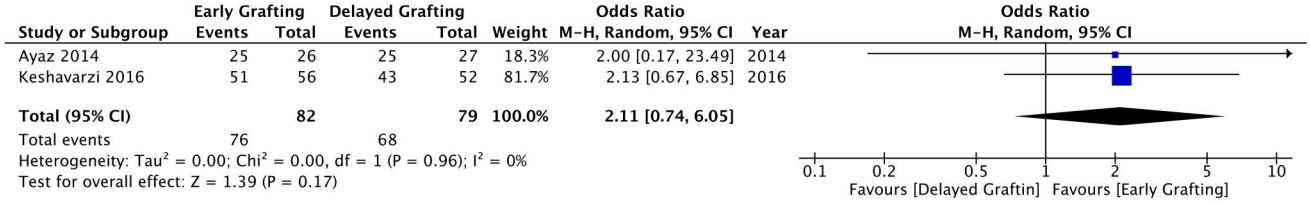

Figure 8. Comparison of Graft Success Rate Between Early and Delayed Wound Grafting in Burn Patients

Post Operative Grip Strength

The forest plot (Figure 7) analyses postoperative grip strength in burn patients undergoing early versus delayed wound grafting, referencing two studies (Omar 2011 and Salehi 2016). In Omar's study, the mean difference (MD) for grip strength in the early grafting group was 7.00 (95% CI: 3.63 to 10.37), indicating a preference for early grafting. In contrast, Salehi's study indicated a mean difference (MD) of -2.50 (95% CI: -6.27 to 1.27), suggesting a preference for delayed grafting; however, the wide confidence interval that includes zero signifies no statistically significant difference. The combined mean difference from both studies was 2.29 (95% CI: -7.02 to 11.60), exhibiting significant heterogeneity (Tau^2 = 41.80, Chi^2 = 13.56, I^2 = 93%, p = 0.0002). This indicates considerable variability among studies and no overall statistically significant difference in grip strength between early and delayed grafting.

Graft Success Rate

The forest plot (Figure 8) analyzes graft success rates comparing early versus delayed grafting in burn patients (two anlyzed studies, Ayaz 2014 and Keshavarzi's study). In Ayaz's study, the odds ratio (OR) for successful graft take with early grafting was 2.00 (95% CI: 0.17 to 23.49), while Keshavarzi's study showed an OR of 2.13 (95% CI: 0.67 to 6.85), both suggesting higher graft success with early intervention but with confidence intervals crossing 1.0, indicating no statistical significance individually. The combined odds ratio from both studies was 2.11 (95% CI: 0.74 to 6.05), trending toward better graft success rates with early grafting but not reaching statistical significance. There was minimal heterogeneity between studies (Tau^2 = 0.00, Chi^2 = 0.00, I^2 = 0%, p = 0.96), suggesting consistency in findings.

Post Operative Total Active Movement (TAM)

The forest plot analyzes post-operative TAM in burn patients, comparing early versus delayed wound grafting across the five fingers: thumb, index, middle, ring, and little. The TAM of digits was assessed using a standard goniometer while the wrist was in a neutral posture and the forearm was in a prone orientation. The TAM for each finger was calculated utilising the methodology established by the American Society for Surgery of the Hand. The TAM for each joint was determined by summing all flexion measures at the MCP, PIP, and DIP joints. For the thumb, the measurements of the MCP and IP joints were utilised, and any loss of extension at each joint was deducted from the overall flexion.[17]

The analysis indicates that early grafting yields consistently higher TAM scores than delayed grafting across all fingers. The confidence intervals for each finger do not intersect zero, demonstrating statistically significant improvements in TAM with early grafting. The pooled mean difference is 22.10 (95% CI: 17.95 to 26.24), indicating a preference for early grafting with low heterogeneity (I^2 = 0%). Early grafting demonstrates greater efficacy in restoring TAM across all fingers in burn patients when compared to delayed grafting.

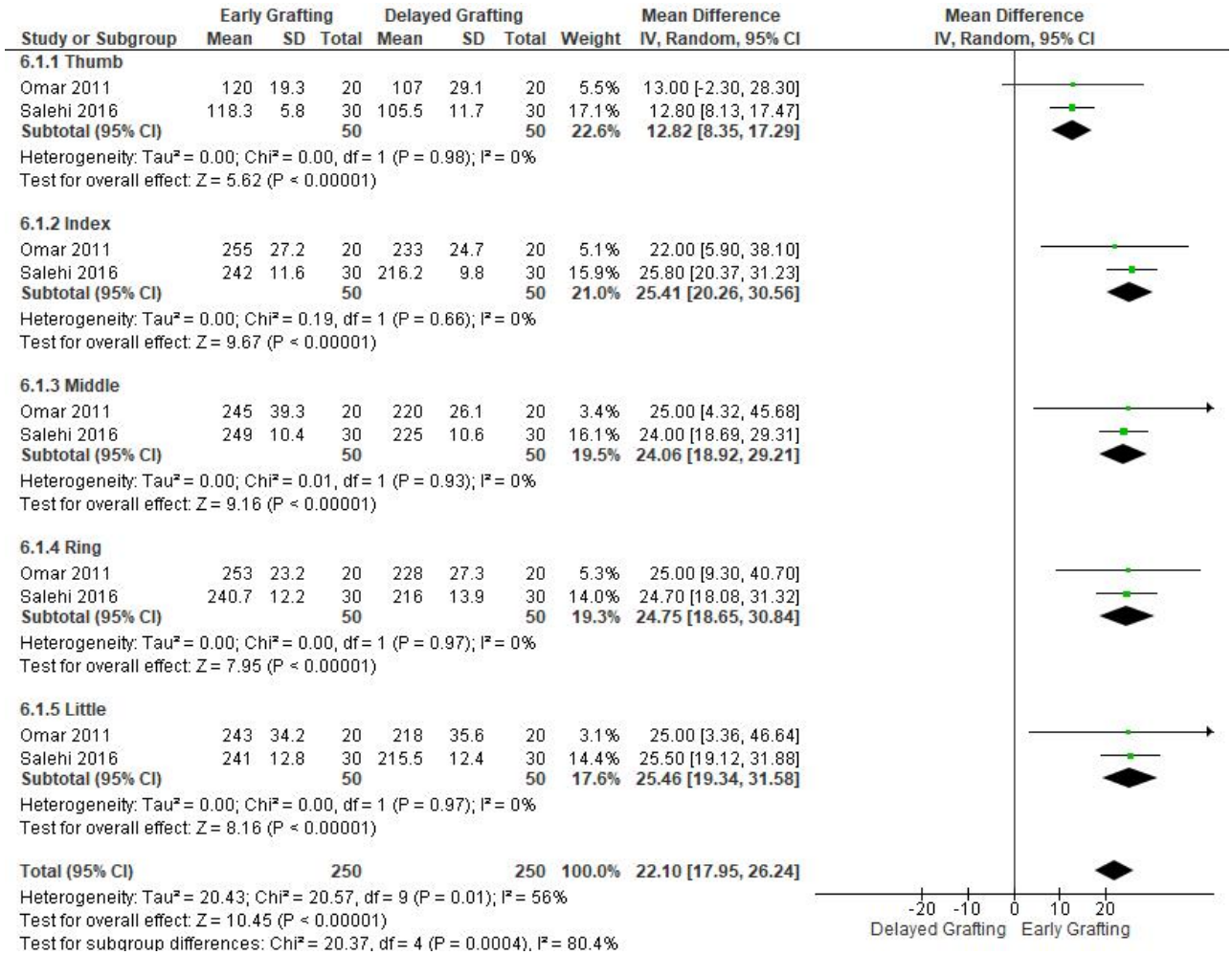

Figure 9. Comparison of Post Operative Total Active Movement (TAM) Between Early and Delayed Wound Grafting in Burn Patients

DISCUSSION

Utilizing data from seven studies which met the eligibility criteria, this systematic review and meta-analysis assessed the results of early versus delayed wound transplantation in burn patients. The investigations were conducted using a variety of methodologies and focused on deep dermal and full-thickness burns, which affected up to 40% of the total body surface area (TBSA). In total, 388 participants were included. The results indicate that early grafting, which is typically performed within 3 to 7 days of an injury, substantially reduced the hospital stay in comparison to delayed grafting, which is performed after 7 days. Although there was significant heterogeneity among the studies (I^2 = 96%), the pooled analysis revealed a mean difference of -8.89 days in hospital stay associated with early grafting. A subgroup analysis was performed on the hospital stay variable, which enabled the categorization of studies based on factors such as burn severity and graft type. This insight provided a more nuanced understanding of the variations in hospital stay duration. The observed differences may have been influenced by factors such as patient demographics, treatment protocols, and study design, as indicated by the substantial variability. We performed publication bias analysis and we attach it on the supplementary files (Figure 10-15)

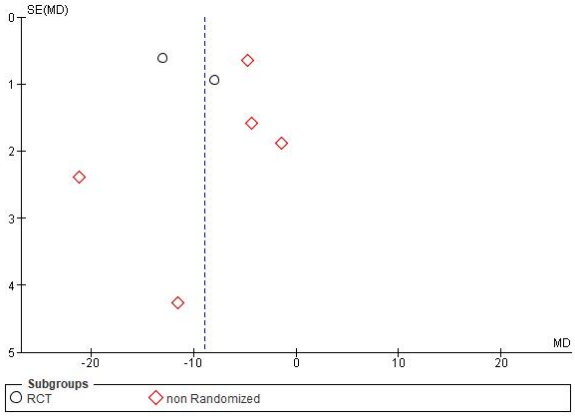

Figure 10. Funnel Plot for Hospital Stay Variable

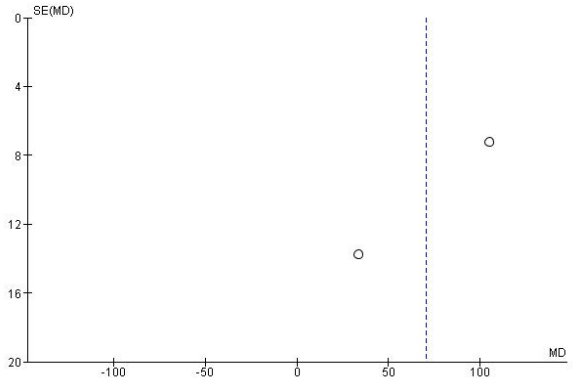

Figure 11. Funnel Plot for Blood Loss Variable

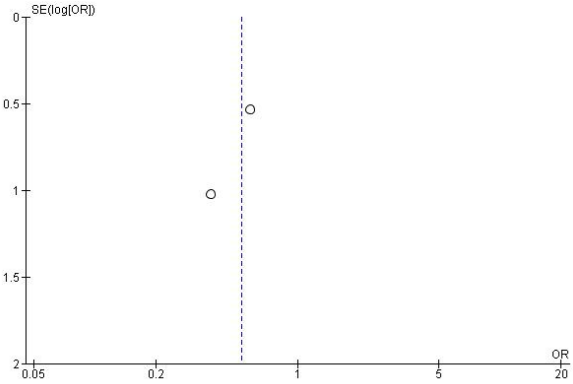

Figure 12. Funnel Plot for Infection Rate

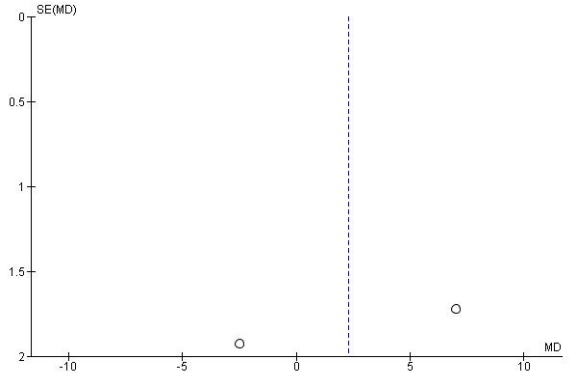

Figure 13. Funnel Plot for Grip Strength

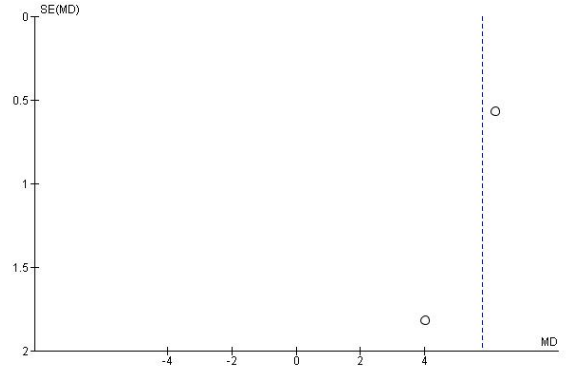

Figure 14. Funnel Plot for Graft Success Rate

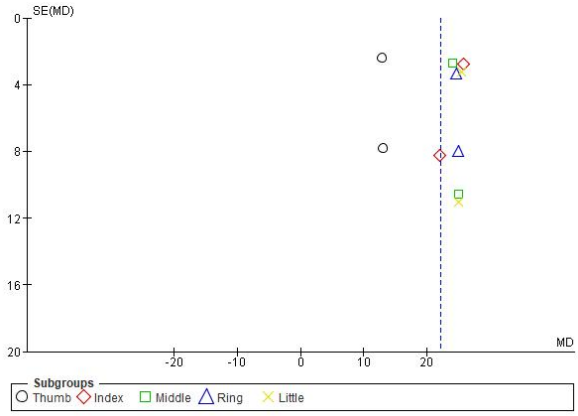

Figure 15. Funnel Plot for Total Active Movement

Blood loss, infection rates, grip strength, graft success rates, and total active movement (TAM) were additional outcomes that were evaluated. The combined analysis did not indicate a statistically significant difference in blood loss and postoperative infection between the two groups. Nevertheless, early grafting, although insignificant, shows a trend towards a higher success rate in grafting, underscoring the significance of rapid intervention. Furthermore, early grafting consistently showed superior functional outcomes, particularly in the restoration of TAM across all fingers, with a pooled mean difference of 22.10. This implies that early grafting accelerates the healing process and enhances mobility and functionality during the recovery process. Nevertheless, the study was unable to undertake subgroup analysis for grip strength and TAM despite the difference in study designs, due to the limited number of studies available (with only two studies for each variable). This limitation is indicative of the study's limitations. This evaluation did not include separate analysis for pediatric and adult populations. The explanation for this was the restricted data for these particular subgroups in the research considered. Due to the insufficient research distinguishing pediatric and adult populations, we merged them in the overall analysis to enhance the sample size and yield more solid conclusions. This combined analysis indicates that the possible disparities in outcomes between these two populations were not examined thoroughly.

The analysis of grip strength outcomes revealed considerable variability across studies, and no overall statistically significant difference was identified. This systematic review and meta-analysis yield significant insights into the comparative outcomes of early versus delayed wound grafting in burn patients. Burn injuries represent a considerable public health issue, impacting millions worldwide annually. The findings indicate that early wound grafting may correlate with enhanced outcomes, such as expedited wound closure, shortened hospital stays, and diminished rates of wound-related problems, in contrast to delayed grafting methods. Nonetheless, there are justifications for postponing grafting, as it may provide enhanced evaluation and preparation of the wound bed, thereby augmenting graft acceptance and long-term results. The equilibrium among these factors must be meticulously assessed for each patient, considering the degree and attributes of their burn injuries.

Early wound grafting may confer several physiological advantages. Early grafting aids in the preservation of viable tissue and mitigates additional tissue damage by swiftly covering the wound and reinstating the skin's barrier function. This approach can reduce the risk of wound infection, a frequent complication in burn patients, which may further aggravate local tissue damage and systemic inflammatory responses.[18,19] Rapid restoration of the skin's structural and functional integrity supports the wound healing process, enhances graft take, and improves long-term functional outcomes.[18,20]

Delayed grafting facilitates improved wound bed preparation, including the debridement of non-viable tissue and the optimization of the wound environment, thereby enhancing graft integration and long-term stability. This approach constitutes risks such as prolonged inflammation, impaired wound healing, and

increased vulnerability to complications, including infection. [18,19,21] The decision regarding early versus delayed grafting must be made carefully, taking into account the patient's clinical factors, including burn severity, wound characteristics, donor skin availability, and overall health status, to enhance the chances of successful wound coverage and ensure optimal long-term outcomes.[22–24]

This review's findings on the advantages of early wound grafting align with prior research emphasizing the significance of prompt wound coverage in enhancing healing and mitigating complications in burn patients. [25] Delayed wound coverage may elevate the risk of wound infection, extend inflammation, and result in suboptimal functional and cosmetic outcomes. [18] The limited availability of donor skin in extensive burn cases complicates early grafting, highlighting the necessity for alternative skin substitutes and regenerative strategies. [20,26] This is consistent with other study, which indicated that early wound coverage correlates with a shorter duration to achieve complete wound closure, a reduced length of hospital stay, and diminished rates of wound-related complications. The authors ascribed these advantages to the maintenance of viable tissue and the avoidance of additional tissue damage, which may reduce the likelihood of wound infection and enhance optimal wound healing.[16,27,28]

The findings also highlight that there were notable limitations in the studies included, such as the potential for publication bias and high heterogeneity across the included studies. Publication bias could have influenced the results by overrepresenting studies with significant findings and underrepresenting those with negative or inconclusive results. Additionally, the high heterogeneity (I^2 = 96%) across studies points to significant variability in study designs, patient populations, and intervention protocols, which can complicate the interpretation of pooled results. These factors should be taken into consideration when interpreting the findings of this review. The results of this review must be understood within the framework of the existing evidence, predominantly consisting of observational studies and retrospective analyses. The meta-analysis offers a quantitative synthesis of existing data; however, the limitations of the included studies, including potential selection bias and variability in treatment protocols, must be acknowledged. Additional high-quality, randomized controlled trials are required to definitively determine the comparative efficacy of early versus delayed wound grafting in burn patients.[18,20]

Furthermore, the possible influence of patient-specific variables on the ideal grafting timing, such as burn severity, comorbidities, and wound features, was not covered in the review. Future research must investigate these factors to enable clinicians to customize the timing of wound coverage according to the specific needs of each patient.

The findings of this systematic review and meta-analysis indicate that early wound grafting is likely linked to better outcomes than delayed grafting methods in burn patients. Further research is necessary to validate these findings and to enhance understanding of the complex factors influencing the optimal timing of wound coverage in this patient population.

CONCLUSION

Early wound grafting appears to improve hospital stay duration and functional recovery, while also demonstrating a tendency of higher graft success rates and reduced infection risks compared to delayed grafting in burn patients, although it is not statistically significant. However, this review did not address the potential influence of patient-specific factors, such as burn severity, comorbidities, and wound characteristics, on the optimal timing of grafting. Future research should focus on these factors to enable clinicians to customize the timing of wound coverage based on the unique needs

of each patient, thereby optimizing outcomes and ensuring personalized care.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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AUTHOR CONTRIBUTION

RBC contributed to the conception and design of the study, data analysis and interpretation, and drafting of the manuscript. BSN contributed to the critical revision of the manuscript for important intellectual content and approved the final version. All authors have read and approved the final manuscript for publication.

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