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Original Article

Comparative Outcomes of Delayed Exposed vs. Immediate Skin Grafting on Granulating Wounds

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ABSTRACT

Introduction: *Skin grafting is a critical procedure in the management of large or deep wounds, particularly those that are granulating. The timing of grafting, whether immediate or delayed, has long been a subject of debate among clinicians. This study aims to compare the outcomes of immediate versus delayed skin grafting in patients with granulating wounds.* ***Methods and materials:*** *This prospective, comparative, and purposive study was carried out in the Department of Plastic Surgery, Shaheed Suhrawardy Medical College Hospital, Dhaka, from 1st July 2023 to 30 June 2024. A total number of 66 patients were included consecutively in this study. Patients were divided into 2 groups.* ***Group I:*** *Spit thickness skin grafting on granulating wound by Delayed exposed method,* ***Group II****: Spit thickness skin grafting on granulating wound by immediate method. Statistical analysis of the results was done by computer software devised as the Statistical Package for Social Sciences (SPSS). Data were analyzed using Student's t-test, and Chi-squared (x2) Test. A 'p' value <0.05 was considered as significant.* ***Result:*** *The results of this study indicate that immediate skin grafting (Group I) led to significantly better outcomes compared to delayed grafting (Group II). Group I had a lower graft infection rate (17.1% vs. 41.9%, p=0.026) and fewer cases of graft loss (11.5% vs. 35.5%, p=0.048). Operation times were significantly shorter in Group I (48.0±3.8 minutes vs. 92.5±4.6 minutes, p<0.001), and postoperative hospital stays were also reduced (9.6±0.9 days vs. 16.7±1.1 days, p<0.001). Additionally, only 2.9% of Group I required subsequent grafts compared to 19.4% in Group II (p=0.036).* ***Conclusion:*** *Immediate skin grafting leads to better clinical outcomes compared to delayed grafting in the management of granulating wounds. Immediate grafting significantly reduces graft infection rates, graft loss, operation time, and postoperative hospital stays, while minimizing the need for subsequent grafting.*

Keywords: *Delayed skin grafting, Immediate skin grafting, Granulating wound, Infection*

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INTRODUCTION

Wound management is a cornerstone of surgical care, particularly for granulating wounds where timely and effective intervention is crucial to optimize healing outcomes. Granulating wounds are characterized by the formation of granulation tissue, a vascularized matrix that forms during the proliferative phase of wound healing, creating an ideal bed for skin grafting. Skin grafting accelerates wound closure, reduces complications, and improves functional and cosmetic results. However, the decision between immediate or delayed skin grafting for granulating wounds continues to challenge clinicians, with each approach offering distinct advantages and limitations [1]. Granulating wounds can result from various causes, including trauma, burns, infections, and debridement of necrotic tissue. These wounds demand meticulous care to prevent infection, promote vascularization, and prepare the wound bed for grafting. The choice of grafting timing significantly affects outcomes such as graft survival, infection rates, hospital stay duration, and patient satisfaction. Immediate skin grafting involves covering the wound with a graft shortly after preparation, while delayed grafting allows additional time for granulation tissue to stabilize before graft application [2,3]. Immediate skin grafting is often performed to minimize the time wounds are left exposed. This approach reduces the risk of secondary infections, shortens hospital stays, and expedites functional recovery. By providing an early

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protective cover, immediate grafting decreases wound desiccation and facilitates epithelialization [4]. Studies have demonstrated that early closure with grafts leads to favorable outcomes in wounds that are adequately debrided and free from infection [5]. However, if the wound bed is not well-prepared, immediate grafting may result in complications such as graft failure or partial loss, necessitating repeat interventions [6]. Despite its advantages, immediate grafting poses challenges in wounds with residual infection or poor vascularization, where graft failure rates can be higher. A study by Chen et al. emphasized that the success of immediate grafting hinges on a meticulous assessment of the wound bed to ensure optimal conditions for graft adherence [7]. Delayed grafting is often preferred for wounds requiring additional time to develop stable granulation tissue or for those with residual infection. This approach provides an opportunity for enhanced vascularity, reduced microbial burden, and better wound bed optimization, factors critical for successful graft adherence and integration [8]. Delayed grafting is particularly advantageous in managing large, contaminated, or complex wounds where immediate grafting poses a higher risk of failure [9]. However, delayed grafting is not without drawbacks. Prolonged wound exposure increases the risk of nosocomial infections and may extend hospital stays. It also imposes psychological and financial burdens on patients due to the need for frequent dressing changes and extended recovery periods [10]. Advances in wound care technologies, such as negative pressure wound therapy (NPWT), have further refined the delayed grafting approach by promoting rapid granulation and reducing bacterial load, thus enhancing graft success rates [11]. Immediate grafting was associated with shorter hospital stays but higher rates of partial graft loss compared to delayed grafting, which achieved superior graft take rates in complex wounds [9]. Emerging technologies, such as NPWT and biological dressings, have influenced this paradigm. NPWT, in particular, accelerates granulation tissue formation, creating a favorable environment for delayed grafting while reducing the treatment timeline [12]. However, its cost and resource requirements may limit its application in certain settings, emphasizing the need for cost-effectiveness analyses in the context of grafting strategies [13]. This study aims to provide a detailed comparative analysis of immediate and delayed skin grafting on granulating wounds.

METHODS & MATERIALS

This prospective, comparative, and purposive study was carried out in the Department of Plastic Surgery, Shaheed Suhrawardy Medical College Hospital, Dhaka, from 1st July 2023 to 30 June 2024. A total number of 66 patients were included consecutively in this study. Patients were divided into 2 groups. **Group I:** Spit thickness skin grafting on granulating wound by Delayed exposed method, **Group II**: Spit thickness skin grafting on granulating wound by immediate method. Each patient was evaluated by taking careful history, physical examination, and investigations. Preoperative management of the patients includes improvement of their general condition and preparation of the wound bed (Improvement of nutritional status, correction of anemia, control of infection of the wound by regular dressing and antibiotic as per culture and sensitivity of wound swab). Signs of graft infection were noted clinically by the color of the graft, odor, and amount of exudation/pus. Preoperative and postoperative findings were noted in both groups. Those patients who were discharged earlier were advised to come on the 14th postoperative day for the removal of the donor site dressing. Each patient was followed up for three weeks even if she/he was discharged earlier. Data were collected in a pre-designed structured data collection sheet. Percentages were calculated to find out the proportion of the findings. Further statistical analysis of the results was done by computer software devised as the Statistical Package for Social Sciences (SPSS). Data were analyzed using Student's t-test, and Chi-squared (x2) Test. A 'p' value <0.05 was considered as significant. Ethical clearance was taken from the ethics committee of Dhaka Medical College. Informed written consent was taken from all participants.

Inclusion Criteria:

- Granulating wounds at different sites of the body following burns, trauma or infection.

Exclusion Criteria:

- Circumferential lesions involving both surfaces of the limbs or trunks.
- Noncooperative patients.
- Wounds other than trauma or infection, e.g. following excision of cutaneous lesion or following release of post bum scar contracture.
- Wounds where the skin graft is not feasible like bare tendons, bones, cartilage, etc.
- Those who cannot follow the instructions of the doctor and keep immobilized the recipient site, especially in case of delayed exposed group.

RESULTS

Table – I: Comparison of age distribution between groups (*n*=66)

Age (year)	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
10-20	7(20.0%)	9(29.0%)	0.438
20-30	5(14.3%)	4(12.9%)	
30-40	10(28.6%)	10(32.3%)	
40-50	6(17.1%)	2(6.5%)	

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50-60	7(20.0%)	6(19.4%)	
Mean±SD	33.91±14.24	31.02±15.92	
Range	12-65	10-60	-

p >0.05 in unpaired 't' test (not significant)

Table I shows that around 30% of the subjects were between 30 - 40 years of age (28.6% in Group I and 32.3% in Group II). Twenty percent of Group-I were 50 years of age or above and another 20% below 20 years, 17.1% between 40 - 50 years, and 14.3% between 20 - 30 years. Twenty-nine percent of Group II was below 20 years of age, 19.4% 50 years or above, 12.9% between 20- 30, and 6.5% between 40- 50 years of age. No significant difference was observed between the mean ages of Group I and Group II (p = 0.438). The ages of Group-I ranged from 12- 65 years and those of Group - II from 10-60 years.

Table – II: Comparison of sex between groups (*n*=66)

Sex	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
Male	22(63.0)	23(74.0)	0.236
Female	13(37.0)	8(26.0)	

p>0.05 in Chi-squared (x2) Test (not significant)

Table II compares the distribution of sex between Group I (n=35) and Group II (n=31). In Group I, 63.0% of participants were male and 37.0% were female, while in Group II, 74.0% were male and 26.0% were female. The Chi-squared test showed no statistically significant difference in sex distribution between the two groups (p=0.236).

Table – III: Comparison of size of wound between groups

Size of wound (cm)	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
<50	3(8.6)	3(9.7)	0.926
50-100	8(22.9)	4(12.9)	
≥100	24(66.6)	24(77.4)	

p>0.05 (not significant)

Table III compares wound sizes between Group I (n=35) and Group II (n=31). In both groups, the majority of wounds were ≥100 cm (66.6% in Group I and 77.4% in Group II), followed by wounds measuring 50–100 cm (22.9% in Group I and 12.9% in Group II), and <50 cm (8.6% in Group I and 9.7% in Group II). The differences in wound size distribution between the groups were not statistically significant (p=0.926).

Table – IV: Comparison of operation time between groups (*n*=66)

Operation time (minutes)	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
≤30	11(31.4)	00	<0.001
31-60	17(48.6)	6(19.4)	
>60	7(20.0)	25(80.6)	

***p<0.001 with the help of Student's t-test (highly significant).

Table IV compares operation times between Group I (n=35) and Group II (n=31). In Group I, 31.4% of procedures took ≤30 minutes, 48.6% took 31–60 minutes, and 20.0% took >60 minutes. In Group II, none of the procedures took ≤30 minutes, 19.4% lasted 31–60 minutes, and 80.6% exceeded 60 minutes. The difference in operation times between the groups was highly significant (p<0.001) according to Student's t-test.

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Table – V: Comparison of Postoperative graft infection between groups (*n*=66)

Postoperative Graft Infection	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
Absent	29(82.9)	18(58.1)	0.026
Present	6(17.1)	13(41.9)	

* p<0.05 in Chi-square (x.2) Test (significant).

Table V compares postoperative graft infection rates between Group I (n=35) and Group II (n=31). In Group I, 82.9% of patients had no graft infection, while 17.1% experienced infections. In Group II, 58.1% had no infection, and 41.9% had infections. The difference in graft infection rates between the groups was statistically significant (p=0.026) according to the Chi-squared test.

Table – VI: Comparison of subsequent graft needed between groups (*n*=66)

Subsequent Graft Needed	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
Yes	1(2.9)	6(19.4)	0.036
No	34(97.1)	25(80.6)	

* p< 0.05 using Chi-square (x^2) Test (significant).

Table VI compares the need for subsequent grafting between Group I (n=35) and Group II (n=31). In Group I, only 2.9% of patients required additional grafting, while 97.1% did not. In Group II, 19.4% required subsequent grafting, and 80.6% did not. The difference in the need for subsequent grafts between the groups was statistically significant (p=0.036).

Table – VII: Comparison of postoperative hospital stays(day) between two groups (*n*=66)

Postoperative Hospital Stays(day)	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
≤7	17(48.6)	1(3.2)	<0.001
8-14	14(40.0)	11(35.5)	
>14	4(11.4)	19(61.3)	

*** p< 0.001 with the help Student;s t-Test(Highly significant).

Table VII compares postoperative hospital stays between Group I (n=35) and Group II (n=31). In Group I, 48.6% of patients stayed ≤7 days, 40.0% stayed 8–14 days, and 11.4% stayed >14 days. In Group II, only 3.2% stayed ≤7 days, 35.5% stayed 8–14 days, and 61.3% stayed >14 days. The difference in postoperative hospital stays between the groups was highly significant (p<0.001) as determined by Student's t-test.

Table – VIII: Comparison of outcome between two groups (*n*=66)

Outcome	Group		p-value
	Group-I(n=35)	Group-II(n=31)	
Graft infecton¶	6(17.9)	1(3.2)	0.026^{S}
Graft loss¶	4(11.5%)	11(35.5)	0.048^{S}
OT time required(minutes)#	48.0±3.8	92.5±4.6	<0.001
Hospital stay(days)(postoperative)#	9.6±0.9	16.7±1.1	<0.001
Subsequent graft needed¶	1(2.9%)	6(19.4)	0.036^{S}

#***p<0.001 with the help Students t-Test(Highly Significant)

¶ *p<0.05 with the help of Chi-square (x^2) Test (significant)

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Postoperative graft infection was significantly less in Group I (17.9%) than that in Group II (41.9%) (p = 0.026). Group I had significantly less postoperative graft loss compared to that of Group II (p = 0.048). The mean OT time involved in Group II was almost double (92.5 ± 4.6 minutes) than that required in Group I (48.0 ± 3.8 minutes) (p< 0.001). The postoperative hospital stay was significantly less in Group-I in comparison to that in group-II (p < 0.001). The subsequent graft needed was significantly higher (19.4%) in Group II than that in Group I (p = 0.036).

DISCUSSION

The present study found that postoperative graft infection rates were significantly lower in Group I (immediate skin grafting) at 17.9% compared to Group II (delayed skin grafting) at 41.9% (p=0.026). This finding is consistent with previous studies suggesting that immediate grafting helps minimize infection risks by providing early coverage over the granulating wound bed. Early grafting minimizes exposure to external contaminants, which is a major contributing factor to infection [14]. The rate of graft loss was significantly lower in Group I (11.5%) compared to Group II (35.5%, p = 0.048), indicating that immediate grafting improves graft survival. Graft loss can be attributed to several factors, including inadequate wound bed preparation, infection, and poor vascularization. In this study, the early application of grafts likely ensured better vascularization and reduced the exposure of granulating tissue to potential contaminants, which are critical in graft retention [15,16]. Previous studies similarly found that immediate skin grafting significantly reduced graft loss when compared to delayed approaches [17]. The operation time was significantly shorter in Group I (48.0 ± 3.8 minutes) compared to Group II (92.5 ± 4.6 minutes, p < 0.001), which is consistent with the inherent complexity of delayed grafting. Immediate grafting procedures are generally less complex, as they require fewer preparatory steps and less time for wound bed optimization. Delayed grafting often necessitates prolonged wound management, including additional debridement, microbial control, and sometimes the use of advanced wound care technologies such as negative pressure wound therapy (NPWT) [18]. Additionally, studies by Kumar et al. have noted that the added steps involved in delayed grafting significantly prolong the operation time [19]. The postoperative hospital stay was significantly shorter for Group I (9.6 ± 0.9 days) compared to Group II (16.7 ± 1.1 days, p < 0.001), which supports the notion that immediate grafting accelerates recovery. Shorter hospital stays reduce the risk of hospital-acquired infections and are associated with lower healthcare costs. The early closure of the wound in Group I allows for faster healing and fewer complications, including infections, which often lead to prolonged hospitalization [20]. The need for subsequent grafting was significantly higher in Group II (19.4%) than in Group I (2.9%, p = 0.036), further supporting the superiority of immediate grafting in achieving definitive wound closure. Delayed grafting is often associated with complications such as infection, graft failure, and inadequate wound healing, all of which contribute to the need for additional grafts [9]. In contrast, immediate grafting, by minimizing the time the wound is exposed, helps ensure better outcomes and reduces the need for subsequent surgeries. Our findings are in line with prior studies highlighting the benefits of immediate grafting in granulating wounds. Immediate grafting has been consistently shown to reduce complications such as infections and graft loss, shorten operation times, and decrease hospital stays compared to delayed grafting. While delayed grafting remains an option in certain circumstances, such as in cases where the wound bed is not adequately prepared or vascularized, it comes with a higher risk of complications.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights that immediate skin grafting leads to better clinical outcomes compared to delayed grafting in the management of granulating wounds. Immediate grafting significantly reduces graft infection rates, graft loss, operation time, and postoperative hospital stays, while minimizing the need for subsequent grafting. These findings support the superiority of immediate grafting in improving recovery and reducing complications, making it the preferred approach for granulating wounds when feasible.

RECOMMENDATION

Based on the findings of this study, it is recommended that immediate skin grafting be considered the preferred approach for granulating wounds, as it significantly improves clinical outcomes, reduces complications, and shortens hospital stays. However, patient-specific factors, including the wound's condition and overall health, should be carefully assessed to ensure the best treatment approach. Further research with larger sample sizes and long-term follow-up is suggested to reinforce these findings and guide clinical practice.

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