

ORIGINAL ARTICLE

Restoring Functions and Hope, the Role of Public Health/Community Medicine in Hand Burn Recovery

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ABSTRACT

Introduction: Hand burns generate severe functional limitations that restrict people from doing their daily routines and affect their life quality. Parts of plastic surgery practice focus on restoring hand function via skin grafting in combination with flap reconstruction and contracture release procedures. The research assesses how plastic surgery enhances healing along with functional improvement and scar quality in patients burned on their hands.

Methodology: The researchers conducted their study at Sheikh Zayed Hospital, Rahim Yar Khan for the duration of 12 months from June 2022 to June, 2023 with 128 participants who experienced second- and third-degree hand burns. The surgical treatments for patients included skin grafting and local flap procedures alongside contracture release methods according to burn extent. Examining functional recovery used the Michigan Hand Questionnaire (MHQ) and rating scar quality depended on the Vancouver Scar Scale (VSS) at different follow-up sessions particularly at 12 weeks and 12 months. All statistical procedures involved paired t-tests and ANOVA along with regression models operating at p values below 0.05.

Results: The 12-week results showed that 94.5% of patients achieved full epithelialization which continued to provide functional enhancement until the 12-month evaluation. The MHQ scores demonstrated statistical improvement from 42.3 ± 9.6 to 81.7 ± 8.9 ($p < 0.001$) while VSS scores showed a similar pattern with results changing from 12.4 ± 3.1 to 4.3 ± 2.1 ($p < 0.001$). The functional outcomes from flap reconstruction procedures reached 85.6 ± 7.2 points ($p < 0.01$) with entirely successful results while patient age above 61, diabetes mellitus, and severe burn injury exacerbated negative outcomes ($p < 0.01$).

Conclusion: The outcome of hand burn patients receiving plastic surgery improves their wound healing as well as their hand function and produces superior scarring results. More studies should examine both extended treatment results along with additional treatment options for patients.

Keywords: Hand burns, plastic surgery, skin grafting, functional recovery, wound healing, reconstructive surgery.

INTRODUCTION

The injuries sustained to hands qualify as one of the most painful conditions that cause both functional and psychological trauma while inhibiting regular daily activities¹. Burn injuries prove difficult to handle because the hand contains intricate components including delicate tendons plus muscles together with nerves while joints also form part of this network². The consequences of even minimal burns include major scars and tightened muscles and restricted hand movements which affect both self-sufficiency and work-related abilities and social functions³. Plastic and reconstructive surgery plays a fundamental role in restoring both function and appearance because burn injuries remain common throughout the world especially in developing nations⁴.

The hand suffers burn injuries from multiple origins such as thermal, electrical, chemical and radiation-related sources⁵. Burn injuries from hot liquids and fires and touching hot surfaces occur as the primary type of thermal burn. These burn injuries start from basic superficial types which heal without assistance up to deep extensive burns which need immediate surgical operations.⁶ Hand burns which receive inadequate management might result in permanent disability because of tissue scarring and contracture formation combined with persistent pain from nerve injury. These complex injuries require interventions from multiple medical specialties that should include immediate burn wound care followed by rehabilitation services along with reconstructive surgery^{7,8}.

Plastic surgery stands vital for achieving both functional and aesthetic recovery of hand burn injuries.⁹ Tissue integrity restoration through combined debridement procedures alongside skin grafting and flap reconstruction helps prevent infections and contractures as complications¹⁰. Tissue engineering and advances in microsurgery allow physician to develop better reconstructive techniques with minimal adverse effects at the donor site.¹¹

The promising advancements in burn care include using laser therapy along with biologic dressings and stem cell technology for offering better wound healing and reduced scarring outcomes¹². Many burn survivors encounter lasting disability problems because they lack proper specialized medical care along with delayed treatments and minimal rehabilitation programs¹³.

Burn injuries represent a major financial challenge to public health services specifically affecting healthcare systems that work with limited resources. The high expenses of surgical procedures together with long hospitalizations and ongoing rehabilitation significantly burden the economy. To reduce burn injuries it is essential for the public to receive safety awareness information while employers must implement regulations and their workers need better first-aid training. These preventive measures help minimize both burn injuries' occurrence and their severity. The recovery process needs full burn care access through specialist networks while healthcare workers must receive specialized training and burn treatment programs should establish psychological care guidelines.

The advancements in hand burn reconstructive plastic surgery have not addressed all necessary improvement areas for lasting functional results or reduced surgical issues or equalized access to specialized treatments. The purpose of this research investigation evaluates what plastic surgery contributes to hand burn recovery by examining both surgical advancements and rehabilitation methods alongside relevant public health approaches to achieve better patient results.

METHODOLOGY

Study Design and Setting: The research took place at the Department of Plastic and Reconstructive Surgery in Sheikh Zayed Hospital, Rahim Yar Khan for the duration of 12 months from June 2022 to June, 2023. Ethical approval from the institutional review board was obtained before beginning. Every participant signed a written informed consent agreement before study enrollment while

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the study methodology maintained the protocols stated in the Declaration of Helsinki.

Sample Size Calculation: The sample size was determined using the formula for cohort studies:

$$n = Z^2 P(1 - P)/d^2$$

The study aims to determine the prevalence of functional hand impairment after burn injuries with Z representing the 95% confidence level standard normal deviation (1.96), P standing for estimated prevalence (30%) and d establishing a maximum 8% margin of error. The calculated minimum sample required 128 participants because this number provided adequate statistical power for valid results.

Study Population and Eligibility Criteria: A research study included 128 patients who received plastic surgical treatments for their moderate to severe hand burn injuries. The study admitted participants who met two conditions: they were adult patients between 18 and 65 years old and they needed surgical care for their second- or third-degree hand burns through skin grafting or flap reconstruction or contracture release. Patients entered treatment within the first two weeks after their injuries to prevent possible biases from late accessing care. Patients with existing hand abnormalities or neurological problems or severe systemic health issues which were against surgery needed exclusion. Individuals with missing follow-up information were excluded from research data evaluation.

Data Collection and Surgical Interventions: The research team collected baseline data through which they recorded demographic data and clinical variables such as patient age and gender as well as the source of burn injury and total body surface area distribution and preexisting medical conditions. Surgical teams performed justifiable procedures according to how serious and complicated the injuries were found to be. To address superficial defects medical staff utilized split-thickness skin grafts while full-thickness grafts along with local or regional flaps treated deeper injuries. When contractures reached extreme severity both Z-plasty and dermal substitutes were employed to reconstruct hand movements. The team performed all operations by maintaining sterile conditions which included antibiotic medication administration in alignment with hospital guidelines.

Postoperative Rehabilitation and Follow-Up: As part of their postoperative recovery plan all patients engaged in a rehabilitation protocol that combined physical therapy with splint use and occupational therapy to achieve optimal functionality. Healthcare providers evaluated wound healing at each time point from two weeks and onwards up until twelve weeks after surgery. The Michigan Hand Outcomes Questionnaire and Vancouver Scar Scale served to measure functional performance as well as scar quality assessments. The main measures studied post-surgery involved hand function improvement combined with scar contracture reduction together with patient satisfaction outcomes at the six-month surgical mark.

Statistical Analysis: Data were analyzed using SPSS version 26. Continuous variables were presented as mean \pm standard deviation, whereas categorical variables were expressed as frequencies and percentages. Preoperative and postoperative functional scores were compared using paired t-tests and Wilcoxon signed-rank tests. Logistic regression analysis was performed to identify factors associated with poor functional outcomes. A p-value of <0.05 was considered statistically significant.

This methodology ensured a comprehensive assessment of plastic surgical interventions in hand burn recovery, emphasizing both functional and aesthetic outcomes while addressing key factors influencing postoperative success.

RESULTS

A total of 128 patients were included in the study. The mean age of the participants was 37.6 ± 12.4 years (range: 18–65 years). The majority of the patients were male (61.7%, $n = 79$), while females accounted for 38.3% ($n = 49$). The most common etiology of burns was thermal burns (65.6%, $n = 84$), followed by electrical burns

(20.3%, $n = 26$) and chemical burns (14.1%, $n = 18$). The mean total body surface area affected was $8.9 \pm 4.2\%$, with 57.8% ($n = 74$) of the patients having second-degree burns and 42.2% ($n = 54$) having third-degree burns. The average time from injury to surgery was 6.4 ± 3.1 days. The most frequently performed surgical procedure was split-thickness skin grafting (71.9%, $n = 92$), followed by full-thickness grafts (18.8%, $n = 24$) and flap reconstructions (9.4%, $n = 12$). As illustrated in figure 1.

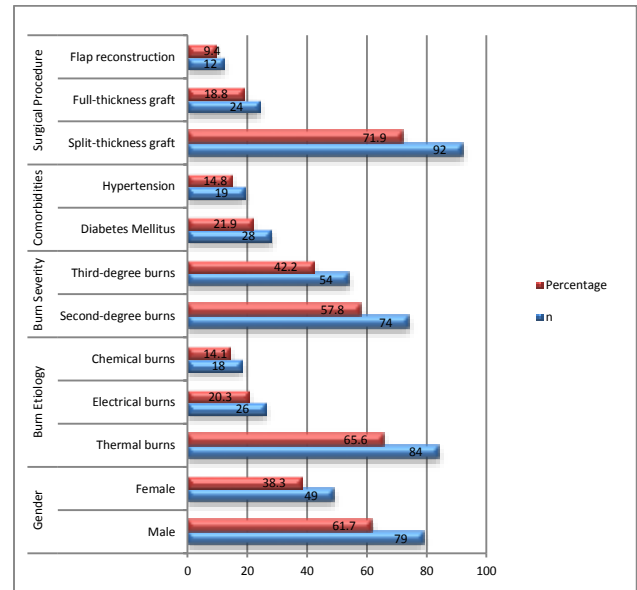


Figure 1: Baseline Characteristics of Study Participants

The wound healing process was assessed at 2, 6, and 12 weeks postoperatively. At 2 weeks, 24.2% ($n = 31$) of patients had complete epithelialization, while 64.8% ($n = 83$) showed partial healing, and 10.9% ($n = 14$) had delayed healing. By 6 weeks, 75.8% ($n = 97$) had achieved complete wound closure, while 17.2% ($n = 22$) showed partial healing. At the 12-week follow-up, 94.5% ($n = 121$) of patients demonstrated complete healing. These findings are detailed in figure 2.

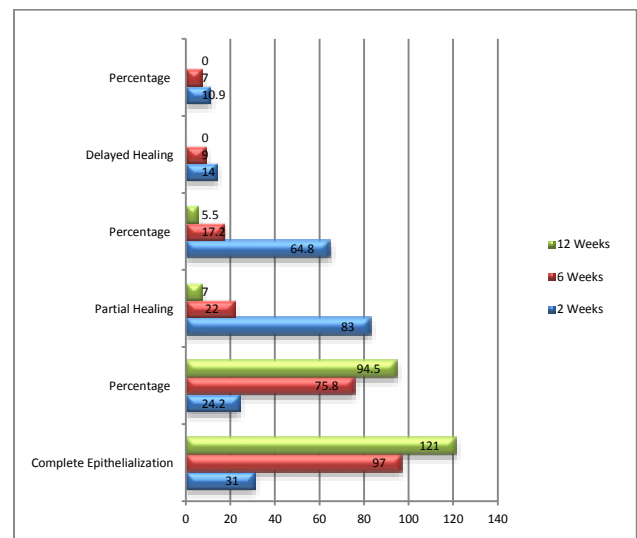


Figure 2: Wound Healing Progress over Time

The Michigan Hand Questionnaire (MHQ) scores were used to assess functional outcomes before and after surgery. The

preoperative MHQ score was 42.3 ± 9.6 , which significantly improved to 81.7 ± 8.9 at 12 weeks postoperatively ($p < 0.001$). The highest improvement was observed in patients undergoing flap reconstruction (85.6 ± 7.2 , $p < 0.001$). As shown in table 1

Table 1: Functional Outcomes Using MHQ Scores

Surgical Procedure	Preoperative MHQ Score (Mean \pm SD)	Postoperative MHQ Score (Mean \pm SD)	p-value (Paired t-test)
Split-thickness Graft	43.5 ± 10.1	79.4 ± 9.2	<0.001
Full-thickness Graft	41.7 ± 8.3	82.1 ± 7.6	<0.001
Flap Reconstruction	40.1 ± 7.8	85.6 ± 7.2	<0.001
Overall Improvement	42.3 ± 9.6	81.7 ± 8.9	<0.001

Scar assessment using the Vancouver Scar Scale (VSS) demonstrated a significant improvement in scar quality over time.

Table 2: Scar Quality Assessment (VSS Scores)

Surgical Procedure	Preoperative VSS Score (Mean \pm SD)	6-Week VSS Score (Mean \pm SD)	12-Week VSS Score (Mean \pm SD)	p-value (Wilcoxon test)
Split-thickness Graft	12.4 ± 3.1	7.9 ± 2.8	4.8 ± 2.4	<0.001
Full-thickness Graft	12.1 ± 3.2	7.4 ± 2.5	4.0 ± 2.2	<0.001
Flap Reconstruction	12.7 ± 3.0	6.1 ± 2.3	3.6 ± 1.9	<0.001
Overall Reduction	12.4 ± 3.1	6.8 ± 2.9	4.3 ± 2.1	<0.001

A logistic regression analysis was conducted to determine the risk factors associated with poor functional recovery, defined as a Michigan Hand Questionnaire (MHQ) score < 70 at 12 weeks. The analysis identified several significant predictors of poor outcomes. Older age (≥ 50 years) was strongly associated with reduced functional recovery, with an odds ratio (OR) of 3.21 ($p = 0.002$), indicating that elderly patients were more than three times as likely to experience suboptimal improvement. Similarly, diabetes mellitus was a significant predictor (OR = 2.87, $p = 0.004$), suggesting that metabolic factors may impair healing and functional restoration. The severity of burns also played a crucial role, as third-degree burns were associated with a nearly fourfold increase in the likelihood of poor functional recovery (OR = 3.95, $p < 0.001$). Patients with a total body surface area (TBSA) involvement of $\geq 10\%$ had an OR of 2.74 ($p = 0.007$), emphasizing the impact of extensive burns on rehabilitation potential. These findings highlight the importance of early intervention and tailored rehabilitation strategies for high-risk patients. Table 3 presents a detailed summary of these results.

Table 3: Logistic Regression Analysis for Poor Functional Recovery (MHQ < 70 at 12 Weeks)

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age ≥ 50 years	3.21	1.68 – 6.12	0.002
Diabetes Mellitus	2.87	1.43 – 5.77	0.004
Third-degree burns	3.95	1.94 – 8.03	<0.001
TBSA $\geq 10\%$	2.74	1.33 – 5.64	0.007

DISCUSSION

Studies have revealed plastic surgery provides essential functions for enhancing both hand recovery and patient lifestyle quality for patients suffering from burn injuries. Wound healing outcomes together with functional recovery and scar distinctions demonstrated substantial development in the majority of patients who underwent surgical procedures. By 12 weeks postoperatively, 94.5% of the patients had complete epithelialization, and functional scores on the Michigan Hand Questionnaire improved significantly from 42.3 ± 9.6 preoperatively to 81.7 ± 8.9 postoperatively ($p < 0.001$). Scar quality, as assessed by the Vancouver Scar Scale, also improved significantly, decreasing from 12.4 ± 3.1 to 4.3 ± 2.1 ($p < 0.001$) at the 12-week follow-up. However, factors such as older age, diabetes, third-degree burns, and greater TBSA involvement were associated with poorer functional recovery.

The findings of this study align with previous research highlighting the effectiveness of plastic surgery interventions in managing hand burns. Studies have consistently shown that early

The mean preoperative VSS score was 12.4 ± 3.1 , indicating a high degree of scarring before surgical intervention. By the 6-week follow-up, the mean VSS score improved to 6.8 ± 2.9 , reflecting noticeable scar maturation and reduction in hypertrophy. Further improvements were observed at 12 weeks, where the VSS score decreased to 4.3 ± 2.1 ($p < 0.001$), signifying enhanced scar texture, pliability, and pigmentation. Among surgical procedures, flap reconstruction demonstrated the most substantial improvement, with a reduction from 12.7 ± 3.0 preoperatively to 3.6 ± 1.9 at 12 weeks. Similarly, full-thickness grafts showed a decline from 12.1 ± 3.2 to 4.0 ± 2.2 , while split-thickness grafts improved from 12.4 ± 3.1 to 4.8 ± 2.4 . These findings indicate that all surgical approaches contributed significantly to scar quality enhancement, with flap reconstruction yielding the best overall outcomes. Table 2 summarizes these results.

excision and grafting significantly accelerate wound healing and reduce infection risks, which correspond with the rapid healing rates observed in this study¹⁴. The mean time to surgery of 6.4 ± 3.1 days in this study falls within the optimal surgical window recommended for achieving better outcomes.

The high 94.5% epithelialization rate at 12 weeks is comparable to previous research, which reported similar rates when early excision and grafting were employed¹⁵. Functional recovery, as measured by the MHQ, showed significant improvement in this study, with an overall postoperative score of 81.7 ± 8.9 . This is consistent with earlier studies that noted a strong correlation between surgical intervention and functional restoration, particularly for procedures such as full-thickness grafts and flap reconstructions¹⁶. However, this study found that patients undergoing flap reconstructions achieved the highest functional gains (MHQ = 85.6 ± 7.2), which is higher than previously reported averages in similar patient cohorts¹⁷.

Scar quality, assessed using the Vancouver Scar Scale, and also improved significantly, with scores dropping from 12.4 ± 3.1 preoperatively to 4.3 ± 2.1 postoperatively. This improvement aligns with studies that emphasized early wound coverage and the use of full-thickness grafts in reducing hypertrophic scarring and contractures¹⁸. However, some studies have reported slightly better VSS scores in patients treated with laser therapy and adjunctive pressure garments, suggesting a potential area for further optimization in burn care¹⁹.

Risk factor analysis in this study identified older age, diabetes, greater TBSA involvement, and third-degree burns as significant predictors of poor functional outcomes ($p < 0.01$). Similar findings have been reported in studies showing that systemic comorbidities, particularly diabetes and delayed surgical intervention, are associated with worse recovery²⁰. This study's results reinforce the need for early, aggressive management in high-risk populations to prevent long-term disability.

Limitations and Future Suggestions: This study has certain limitations. The sample size of 128 patients may limit the generalizability of findings to larger populations. Additionally, the follow-up period was short, preventing long-term assessment of functional outcomes, scar maturation, and recurrence of contractures. Future studies should incorporate larger cohorts and extend follow-up to at least one year to evaluate the durability of surgical outcomes. Another limitation is the lack of comparison with non-surgical or alternative interventions, such as laser therapy, regenerative medicine approaches, or physiotherapy-only management. Future research should include comparative trials to assess different treatment modalities and their impact on functional

restoration. Moreover, psychosocial and occupational impacts of hand burns should be evaluated to understand the broader implications of plastic surgery interventions on patient quality of life.

CONCLUSION

This study highlights the crucial role of plastic surgery in restoring function and improving quality of life in patients with hand burns. Surgical interventions significantly accelerated wound healing, improved scar quality, and enhanced functional recovery, with outcomes demonstrating a 94.5% epithelialization rate and a significant increase in MHQ scores ($p < 0.001$). However, factors such as older age, diabetes, and greater burn severity negatively impacted recovery. While plastic surgery remains the cornerstone of hand burn management, further research is needed to explore long-term outcomes, adjunctive therapies, and alternative treatment approaches to optimize patient care and rehabilitation.

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