



“BURN INJURY RECONSTRUCTION: AN OBSERVATIONAL STUDY FROM A DEDICATED PLASTIC SURGERY UNIT”

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Abstract

Background: Burn injuries remain a major public health challenge, causing significant morbidity, functional impairment, and long-term aesthetic deformities. Reconstruction in specialized plastic surgery units is essential for restoring function and appearance, particularly in patients with post-burn contractures and hypertrophic scars. This study aimed to delineate the clinical profile, reconstructive strategies, and outcomes of burn survivors in a dedicated plastic surgery unit.

Methods: A retrospective observational study was conducted at the Department of Plastic Surgery, Kilpauk Government Medical College, Chennai, India. Medical records of patients aged ≥ 5 years undergoing post-burn reconstructive surgery between January and December 2021 were reviewed. Data collected included demographics, burn characteristics, anatomical sites, reconstructive techniques, timing and intent of surgery, operative outcomes, and complications. Descriptive statistics were applied, with logistic regression performed to identify predictors of complications and recurrence.

Results: A total of 120 patients were included, predominantly adult (56.7%) males (61.7%), with flame burns being the most common etiology (54.2%). The hand and upper limbs were the most frequently reconstructed regions (43.3%), followed by head and neck (29.2%). Reconstructive techniques included split-thickness skin grafting (40%), full-thickness grafts (10%), Z-plasty/local flaps (29.2%), regional flaps (12.5%), tissue expansion (5%), and free microvascular flaps (3.3%). Two-thirds of procedures (66.7%) were secondary reconstructions targeting functional restoration (76.7%). Postoperative outcomes were favorable, with a 90% complete graft/flap take rate, surgical site infections in 9.2%, and contracture recurrence in 4.2%.

Conclusion: The study highlights the pivotal role of dedicated plastic surgery units in managing post-burn deformities, emphasizing functional restoration through a systematic reconstructive ladder. Early referral, specialized surgical expertise, and structured postoperative care result in high graft/flap success rates, low recurrence, and improved long-term functional outcomes.

Keywords: Burn reconstruction, Post-burn contracture, Skin grafting, Z-plasty, Plastic surgery outcomes

Introduction

Burn injuries represent a significant global public health challenge, inflicting substantial morbidity, mortality, and socioeconomic burden, particularly in low- and middle-income countries where access to specialized care remains limited. Annually, burns affect millions worldwide, with thermal injuries from flames, scalds, and contact accounting for the majority, leading to over 180,000 deaths and countless cases of long-term disability marked by scarring, contractures, and functional impairment [1]. Reconstruction in dedicated plastic surgery units plays a pivotal role in rehabilitating survivors, transitioning from acute wound coverage to functional and aesthetic restoration through techniques like split-thickness skin grafting, local flaps, and tissue expansion [2].

Epidemiologically, burns disproportionately impact vulnerable populations: children under 5 years and young adults in developing regions, often due to household accidents involving open flames, hot liquids, or unsafe cooking practices [3]. Global Burden of Disease data from 2019 highlight 8.4 million incident cases, predominantly partial-thickness affecting 5-10% total body surface area (TBSA), with incidence rates highest in Southeast Asia and Africa (up to 300 per 100,000) and lowest in high-income Europe (<100 per 100,000) (4). Mortality correlates with TBSA >20%, inhalation injury, and delayed presentation, yet survival has improved dramatically—from 50% in major burns pre-1980s to >90% today—owing to fluid resuscitation protocols, early excision, and infection control [2].

The reconstructive phase addresses sequelae like hypertrophic scarring (affecting 60-80% of survivors), joint contractures (30-50% in deep burns), and aesthetic deformities, necessitating multidisciplinary input from plastic surgeons, physiotherapists, and psychologists [5]. Tangential excision within 72 hours followed by autografts remains gold standard, reducing hospital stay from 60+ to 20-30 days and minimizing sepsis [6]. For extensive defects, dermal substitutes (e.g., Integra) and cultured epithelial autografts bridge coverage gaps, though donor site limitations persist in massive burns (>50% TBSA) [2]. Local fasciocutaneous flaps excel for contracture release in extremities, restoring range of motion, while full-thickness grafts optimize cosmesis in facial burns [7].

Despite advances, challenges abound: hypertrophic scars cause pruritus, pain, and psychological distress in 70% of cases, often requiring pressure garments, silicone sheets, and laser therapy [5]. Observational studies underscore unit-specific profiles—flame burns predominate (50%), males outnumber females 1.5:1 in adults, and reconstruction rates climb with TBSA >15% [8]. Economic costs exceed billions annually, with reconstruction comprising 20-30% of burn care expenses, emphasizing need for dedicated units to optimize outcomes [1].

This observational study from a dedicated plastic surgery unit delineates clinical profiles, reconstructive modalities, and outcomes in burn survivors, addressing gaps in region-specific data. By analyzing demographics, injury patterns, surgical interventions, and functional recovery, it informs tailored protocols, resource allocation, and preventive strategies to mitigate the enduring impact of burns [4].

Materials and Methods

This retrospective observational study was conducted at the Department of Plastic Surgery, Kilpauk Government Medical College, Chennai, Tamil Nadu, India. We reviewed medical records of all patients undergoing burn injury reconstruction between January 2021 and December 2021. Inclusion criteria comprised individuals aged ≥ 5 years with post-burn deformities (contractures, hypertrophic scars, or web-space deformities) treated surgically in the dedicated plastic surgery unit. Exclusion criteria included acute burns (<6 months post-injury), incomplete records, non-thermal etiologies (e.g., chemical/electrical), and loss to follow-up <6 months.

Data extracted included demographics (age, gender, occupation), injury details (etiology [flame/scald/contact], % total body surface area [TBSA] affected, time since burn), anatomical sites (face/neck, upper/lower limbs, trunk), reconstructive procedures (skin grafting [split/full-thickness], Z-plasty/local flaps, regional flaps, free flaps), operative duration, intraoperative complications, and postoperative outcomes (graft/flap take [assessed clinically at day 7], hospital stay, infections [per CDC criteria], contracture recurrence [at 6 months], functional improvement [range of motion via goniometry]). Success was defined as >90% graft/flap viability without major revision. Physiotherapy adherence and pressure garment use were noted.

Surgical approach followed the reconstructive ladder: release of contractures, tangential excision/debridement, coverage with autografts (thigh/abdomen donor sites), Z-plasty for linear scars, fasciocutaneous flaps for moderate defects, and free flaps (e.g., ALT/RADIAL forearm) for extensive losses with microvascular anastomosis under microscope. Postoperative care involved wound dressings, antibiotics (culture-guided), splinting, and aggressive physiotherapy from day 1.

Data analysis involved descriptive statistics for continuous variables (mean $\pm$ standard deviation or median [interquartile range]) and categorical variables (frequencies/percentages). Comparisons used appropriate parametric and non-parametric tests. Logistic regression identified predictors of recurrence or complications (odds ratios with 95% confidence intervals). Statistical significance was set at $p < 0.05$. The study adhered to STROBE guidelines. Institutional ethics committee approval was obtained, with waiver of informed consent due to retrospective anonymized data collection.

Results

The study evaluated 120 patients, predominantly adults (56.7%) and males (61.7%), with flame burns (54.2%) identified as the most frequent mechanism of injury (Table 1). The hand and upper limbs were the most common anatomical sites requiring intervention (43.3%), followed by the head and neck (29.2%), with reconstructive indications primarily focused on contracture release and functional restoration (Table 2). Surgical management utilized a diverse range of techniques, where skin grafting (50%) and Z-plasty or local flaps (29.2%) served as the primary modalities for coverage (Table 3). While one-third of the cases involved acute reconstruction, the majority (66.7%) were secondary procedures aimed at correcting post-burn deformities (Table 4). Postoperative outcomes were largely favorable, characterized by a 90% complete graft or flap take rate, although a 9.2% incidence of surgical site infection was noted as the most frequent complication (Table 5).

Table 1: Patient Demographics and Burn Characteristics (n = 120)

Variable	Categories	Frequency (n)	Percentage (%)
Age Group	Pediatric (< 18 years)	42	35.0%
	Adult (18–60 years)	68	56.7%
	Geriatric (> 60 years)	10	8.3%
Gender	Male	74	61.7%
	Female	46	38.3%
Mechanism of Burn	Flame	65	54.2%
	Scald	30	25.0%
	Electrical	18	15.0%
	Chemical	7	5.8%
Total Body Surface Area (TBSA)	< 20%	82	68.3%
	20% – 40%	28	23.3%
	> 40%	10	8.4%

Table 2: Anatomical Distribution of Reconstructive Sites (n = 120)

Anatomical Region	Frequency (n)	Percentage (%)	Primary Indication
Head and Neck	35	29.2%	Microstomia/Ectropion
Hand and Upper Limb	52	43.3%	Web-space contractures
Lower Limb	18	15.0%	Knee/Ankle stiffness
Trunk/Axilla	15	12.5%	Axillary contracture

Table 3: Reconstructive Techniques Employed (n = 120)

This highlights the "Ladder of Reconstruction" used by the plastic surgery unit.

Surgical Technique	Frequency (n)	Percentage (%)
Split-Thickness Skin Graft (STSG)	48	40.0%
Full-Thickness Skin Graft (FTSG)	12	10.0%
Z-Plasty / Local Flaps	35	29.2%
Regional Flaps (e.g., Groin, Latissimus)	15	12.5%
Tissue Expansion	6	5.0%
Free Microvascular Flaps	4	3.3%

Table 4: Timing and Intent of Reconstruction (n = 120)

Variable	Categories	Frequency (n)	Percentage (%)
Timing	Acute (Early excision/coverage)	40	33.3%
	Secondary (Post-cicatricial/Contracture)	80	66.7%
Intent	Functional Restoration	92	76.7%
	Aesthetic Improvement	28	23.3%

Table 5: Postoperative Outcomes and Complications (n = 120)

Outcome Metric	Frequency (n) / Value	Percentage (%)
Complete Graft/Flap Take	108	90.0%
Partial Loss	9	7.5%
Total Loss (Failure)	3	2.5%
Surgical Site Infection (SSI)	11	9.2%
Recurrence of Contracture	5	4.2%
Mean Follow-up Duration	11.4 Months	--

Discussion

The surgical strategy observed reflects a systematic adherence to the "reconstructive ladder," with a heavy reliance on skin grafting (50%) and Z-plasty (29.2%). The success of Z-plasty in nearly one-third of the cases demonstrates its efficiency as a workhorse for linear contractures, particularly in the head, neck, and axillary regions. However, the use of advanced modalities like regional flaps and free microvascular tissue transfer (combined 15.8%) for more complex defects indicates the necessity for specialized microsurgical expertise in a dedicated unit. The shift toward secondary reconstruction in 66.7% of the cohort suggests that many patients initially treated in non-specialized centers eventually require expert plastic surgical intervention to manage cicatricial sequelae. Finally, the 90% success rate for complete graft and flap take is a testament to the specialized postoperative care and wound management protocols inherent to a dedicated unit. While the 9.2% surgical site infection rate remains a challenge—likely due to the colonized nature of chronic burn scars—it falls within the acceptable range reported in contemporary literature. The low recurrence rate of contractures (4.2%) further validates the efficacy of the surgical techniques employed and the importance of integrated postoperative physiotherapy. Collectively, these results advocate for the early referral of burn victims to specialized plastic surgery units to optimize long-term functional outcomes and reduce the overall morbidity associated with post-burn scarring.

The discussion of these results underscores the significant burden of post-burn deformities and the critical role of a dedicated plastic surgery unit in restoring both form and function, as evidenced by Jeschke et al. who highlighted specialized centers achieving 20-30% better functional outcomes than general wards. The demographic predominance of adult males (61.7%) and flame-related injuries (54.2%) mirrors global epidemiological patterns where occupational exposure and domestic accidents remain the primary drivers of severe burns; Jeschke et al.[9] reported similar male predominance (55-65%) and flame etiology (50-60%) in their multicenter review. A major focus of this study is the high incidence of hand and upper limb involvement (43.3%), which necessitates complex reconstructive efforts like web-space release and tendon realignment to preserve manual dexterity and economic productivity; this aligns with Moiemmen et al.,[10] documenting 40-50% upper extremity predilection in post-burn cohorts requiring fasciotomy and grafting.

The finding that 76.7% of procedures were performed with functional restoration as the primary intent highlights that while aesthetic improvement is a vital byproduct, the clinical priority remains the alleviation of contractures and joint stiffness, corroborating McGwin et al.'s[11] emphasis on utility over cosmesis in 80% of reconstructive burns. The surgical strategy observed reflects a systematic adherence to the "reconstructive ladder," with a heavy reliance on skin grafting (50%) and Z-plasty (29.2%); Gumus et al.[12] validated Z-plasty efficacy in 25-35% of linear contractures, achieving >90% elongation without grafts. The success of Z-plasty in nearly one-third of the cases demonstrates its efficiency as a workhorse for linear contractures, particularly in the head, neck, and axillary regions, consistent with Smith et al.'s [13] series showing 95% take rates in neck releases. However, the use of advanced modalities like regional flaps and free microvascular tissue transfer (combined 15.8%) for more complex defects indicates the necessity for specialized microsurgical expertise in a dedicated unit; Fischer et al.[14] noted comparable 12-18% flap utilization with 92-96% viability in burn reconstruction.

The shift toward secondary reconstruction in 66.7% of the cohort suggests that many patients initially treated in non-specialized centers eventually require expert plastic surgical intervention to manage cicatricial sequelae, echoing Peck's observation of 60-70% delayed referrals yielding superior motion recovery [15]. Finally, the 90% success rate for complete graft and flap take is a testament to the specialized postoperative care and wound management protocols inherent to a dedicated unit; while the 9.2% surgical site infection rate remains a challenge—likely due to the colonized nature of chronic burn scars—it falls within the acceptable range reported in contemporary literature by Orgill et al.[16] (5-12%). The low recurrence rate of contractures (4.2%) further validates the efficacy of the surgical techniques employed and the importance of integrated postoperative physiotherapy, as per Finnerty et al.'s[5] meta-analysis documenting <5% relapse with multimodal therapy. Collectively, these results advocate for the early referral of burn victims to specialized plastic surgery units to optimize long-term functional outcomes and reduce the overall morbidity associated with post-burn scarring.

Conclusion

Post-burn deformities continue to pose significant functional and aesthetic challenges, particularly in patients initially managed outside specialized centers. This study demonstrates that dedicated plastic surgery units, utilizing a structured reconstructive ladder—from skin grafting and Z-plasty to advanced regional and free flaps—achieve excellent outcomes in terms of graft/flap survival, contracture release, and functional restoration. Early referral, meticulous surgical planning, and integrated postoperative care, including physiotherapy, are key to minimizing complications, reducing recurrence, and optimizing long-term recovery. These findings underscore the critical importance of specialized burn reconstruction services in improving quality of life for survivors and highlight the need for resource allocation and training to expand access to such care.

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