



Original Article

## Surgical Outcomes in Post-Burn Neck Contractures: A Prospective Study of 20 Patients in Ahmedabad

Priyankkumar Arvindbhai Tank<sup>1</sup>, Naim Satarbhai Sayra<sup>2</sup>, Piyush Malav<sup>3</sup>, Nimisha Arvindbhai Tank<sup>4</sup>

<sup>1</sup>Assistant Professor, Department of Plastic Surgery, Government Medical College, Surat, Gujarat, India

<sup>2</sup>Assistant Professor, Department of Plastic and Reconstructive Surgery, M.P. Shah Government Medical College, Jamnagar, Gujarat, India.

<sup>3</sup>Assistant Professor, Department of Burns and Plastic Surgery, B.J. Medical College, Ahmedabad, Gujarat, India

<sup>4</sup>Assistant Professor, Department of Anesthesiology, GCS Medical College, Hospital and Research Centre, Ahmedabad, Gujarat, India

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### Corresponding Author:

**Naim Satarbhai Sayra**

Assistant Professor, Department of Plastic and Reconstructive Surgery, M.P. Shah Government Medical College, Jamnagar, Gujarat, India.  
[naimsayra@gmail.com](mailto:naimsayra@gmail.com)

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### ABSTRACT

**Introduction:** Post-burn neck contracture is a common and disabling sequela of thermal injury, particularly in developing countries. The anterior cervical region is prone to severe contracture due to its thin skin, flexor surface, and constant mobility. This study aimed to evaluate the clinical presentation, surgical management, and functional outcome of post-burn neck contracture using objective measurement of the cervicomenal angle.

**Methods:** This prospective clinical study included 20 patients with established post burn neck contracture treated at a tertiary care center. Contractures were classified according to the Achauer classification. Preoperative and postoperative cervicomenal angles were measured using a goniometer. Surgical procedures included excisional or incisional release followed by split-thickness skin grafting, multiple Z plasty, or supraclavicular flap reconstruction. Patients were followed up for 3 months. The primary outcome was improvement in the cervicomenal angle. Secondary outcomes included graft take, hypertrophy, recurrence, and aesthetic contour.

**Results:** The mean age was 31.9 years, with female predominance (65%). Thermal burns were the leading cause (65%). Split-thickness skin grafting was performed in 65% of cases, Z-plasty in 20%, and supraclavicular flap in 15%. Functional and cosmetic outcomes were satisfactory in 86.4% patients. Complications occurred mainly in the graft group, including partial graft loss (30%), hypertrophic scarring (20%), and recurrence (15%). Flap reconstruction showed better aesthetic outcome and lower recurrence.

**Conclusion:** Surgical release with appropriate resurfacing significantly improves neck function and contour. Flap reconstruction provides superior outcomes with lower recurrence compared to skin grafting.

**Keywords:** Post-burn neck contracture, Split-thickness skin graft, STSG, Supraclavicular flap, Z-plasty, Burn reconstruction.

### INTRODUCTION

Burn injuries remain a major public health problem worldwide and are particularly common in developing countries such as India, where domestic and occupational exposure to open flames, kerosene stoves, and scald injuries are frequent.<sup>[1,2]</sup> Although advances in acute burn care have significantly reduced mortality, post-burn sequelae such as hypertrophic scarring and contracture formation continue to cause long-term functional and aesthetic disability.<sup>[3,4]</sup>

The neck is one of the most commonly affected regions in post burn contracture. The anatomical characteristics of the anterior cervical region, including thin and pliable skin, concave flexor surface, and constant multidirectional mobility,

predispose it to severe contracture formation.<sup>[5-7]</sup> Scar contractures in this region may result in restriction of neck extension, rotation, and lateral flexion, distortion of the lower face, lip incompetence, and impairment of activities of daily living.<sup>[3,5]</sup> In children, persistent cervical contracture may even affect mandibular growth and spinal alignment.<sup>[5]</sup>

Despite improvements in early excision and grafting techniques in acute burn management, many patients still present late with established mentosternal contractures requiring reconstructive intervention.<sup>[8]</sup> Several classification systems have been proposed to assess severity and guide management, including those by Achauer and later modifications by Remensnyder and Donelan.<sup>[5,9]</sup> The choice of reconstruction depends on the severity of the contracture, the availability of adjacent supple skin, patient compliance, and the surgeon's expertise.

Various surgical options have been described for the correction of post-burn neck contracture. These include split-thickness skin grafting (STSG), full-thickness grafting, multiple Z plasty for linear bands, supraclavicular fasciocutaneous flaps, regional myocutaneous flaps, and microvascular free tissue transfer.<sup>[3,10-14]</sup> While skin grafting remains a commonly used technique due to simplicity and ability to resurface large defects, recurrence and hypertrophic scarring are well-recognized limitations.<sup>[6,7]</sup> Regional flaps, such as the supraclavicular artery flap, provide thin, pliable tissue with a better colour and texture match, potentially reducing recurrence and improving aesthetic outcomes.<sup>[11,15]</sup>

An objective assessment of surgical outcome in neck contracture correction requires quantifiable measurement of functional improvement. The cervicomenal angle is an important parameter that reflects neck extension and aesthetic contour, and restoration of a near-normal cervicomenal angle is considered a key goal of reconstruction.<sup>[14]</sup>

In view of the functional, cosmetic, and psychosocial impact of post burn neck contracture and the variety of reconstructive options available, this prospective study was undertaken to assess the clinical presentation and etiological factors of post burn neck contracture, evaluate different surgical modalities used for its correction, and analyze postoperative functional improvement and complications using objective measurement of cervicomenal angle.

## **MATERIALS AND METHODS**

This prospective clinical study was conducted in the Department of Burns and Plastic Surgery at a tertiary care hospital. The study aimed to determine the degree of neck movement achieved after surgical release and resurfacing in patients with post burn neck contracture. The study protocol was approved by the Institutional Ethics Committee for Human Research. Written informed consent was obtained from all participants.

Twenty consecutive patients with established post-burn neck contracture were included in the study. Patients were selected based on predefined inclusion and exclusion criteria.

Inclusion criteria comprised proven cases of post burn neck contracture, both male and female patients, and patients of all age groups. Exclusion criteria included patients previously operated for neck contracture release presenting with recontracture at the same site, infected post burn neck contractures, presence of sinus or fistula formation over the neck, poor general condition, and unwillingness to undergo surgery.

All patients underwent a detailed local examination. Assessment included the extent of contracture, range of neck movements, nature of scar tissue, skin texture, colour match, and availability of adjacent supple skin. Contractures were classified according to the Achauer classification system.<sup>[5]</sup> They were further subcategorized into narrow band, broad band, and broad band with insufficient adjacent supple neck skin.

Functional assessment was performed by measuring the cervicomenal extension angle preoperatively and postoperatively, which is an accepted objective parameter for evaluating neck contour and functional restoration.<sup>[14]</sup> Patients were examined in an erect or sitting position, looking straight ahead. They were instructed to extend the neck, and extension was stopped when the downward pull of the lower lip became evident. A line was drawn along the central axis of the body, a second line along the visual axis, and a third line parallel to the visual axis passing across the mentum. The angle formed represented the cervicomenal angle. Measurements were recorded using a goniometer.

Preoperative surgical planning included marking the contracture bands and proposed incision lines. Bony landmarks such as the mental tubercle, sternal notch, midpoint of the clavicle, and mandibular angle were used as reference points. The vertical extent of deformity was assessed by measuring the mentosternal distance as described in standard reconstructive principles.<sup>[6,7]</sup> The anticipated raw area following release was estimated accordingly. The technically most feasible operation, providing optimal functional and aesthetic outcomes with minimal recurrence risk, was selected.<sup>[5,16]</sup>

All patients were operated under appropriate anesthesia planned preoperatively. Airway management in severe post burn neck contracture was approached cautiously due to anticipated difficulty, as described in previous literature.<sup>[17-19]</sup> Patients

were positioned supine with maximum possible neck extension within the limits of the contracture. Tumescence infiltration using normal saline with adrenaline was administered to facilitate dissection and minimize bleeding.

Complete excision of hypertrophic or hypopigmented scar tissue was performed to achieve full release. In selected cases, Z-plasties were incorporated to interrupt linear scar bands and improve lengthening, in accordance with established Z-plasty principles.<sup>[20]</sup> Fish mouth incisions were made where necessary to avoid straight-line scar formation.

Resurfacing was performed using STSG, multiple Z plasties, local advancement flaps, or a supraclavicular flap, depending on contracture type and adjacent skin availability. STSG remains a commonly used technique in post-burn neck reconstruction.<sup>[3,21]</sup> Supraclavicular flaps were raised based on perforators of the supraclavicular artery as originally described by Lamberty and later modified by Pallua.<sup>[11,15]</sup>

Skin grafts of adequate thickness were harvested and applied over the defect. Care was taken to avoid vertical graft junction lines to reduce the risk of recurrence, as emphasized in the classical reconstructive literature.<sup>[6,7]</sup> The graft was secured using tie over dressing technique.

Postoperatively, neck extension was maintained using Plaster of Paris splints, followed by custom-made splints and a cervical collar. Prolonged splinting and physiotherapy were advised to prevent recurrence, consistent with established management protocols.<sup>[3,10]</sup> Patients were followed up on the fifteenth postoperative day and at three months. Postoperative cervicomenal angles were recorded during follow-up visits.

The primary outcome measure was improvement in cervicomenal extension angle. Secondary outcomes included aesthetic contour, graft take, hypertrophic scar formation, and contracture recurrence.

## RESULTS

A total of 20 patients with established post-burn neck contracture were operated on during the study period.

### Demographic, Clinical, and Surgical Characteristics of Patients

A total of 20 patients with established post burn neck contracture underwent surgical correction during the study period. Most patients were adults, with the commonest age group being 31 to 40 years (25%). The mean age was 31.9 years. Females predominated (65%). Thermal burns were the leading cause (65%). Excisional release was performed in 60% cases. STSG was the most frequently used resurfacing method (65%), followed by multiple Z plasty (20%) and supraclavicular flap (15%). Most patients (85%) underwent contracture release within 1 year of burn injury (Table 1).

**Table 1: Demographic and surgical profile of study population (n = 20)**

Variable	Category	Number (n)	Percentage (%)
Age Group (years)	<10	1	5
	11–20	4	20
	21–30	4	20
	31–40	5	25
	41–50	4	20
	51–60	2	10
Sex	Male	7	35
	Female	13	65
Cause of Burn	Thermal	13	65
	Scald	7	35
Method of Release	Excisional	12	60
	Incisional	8	40
Resurfacing Modality	Split-thickness skin graft	13	65
	Multiple Z plasty	4	20
	Supraclavicular flap	3	15
Interval Between Burn and Surgery	Within 1 year	17	85
	After 1 year	3	15

### Complications

Postoperative complications were observed only in the skin-graft group. Partial graft loss occurred in 6 patients (30%). Scar hypertrophy was noted in 4 patients (20%). Re-contracture at the 3-month follow-up was observed in 3 patients (15%). (Figure 1)

Figure 1. Postoperative outcomes and complications (n = 20)

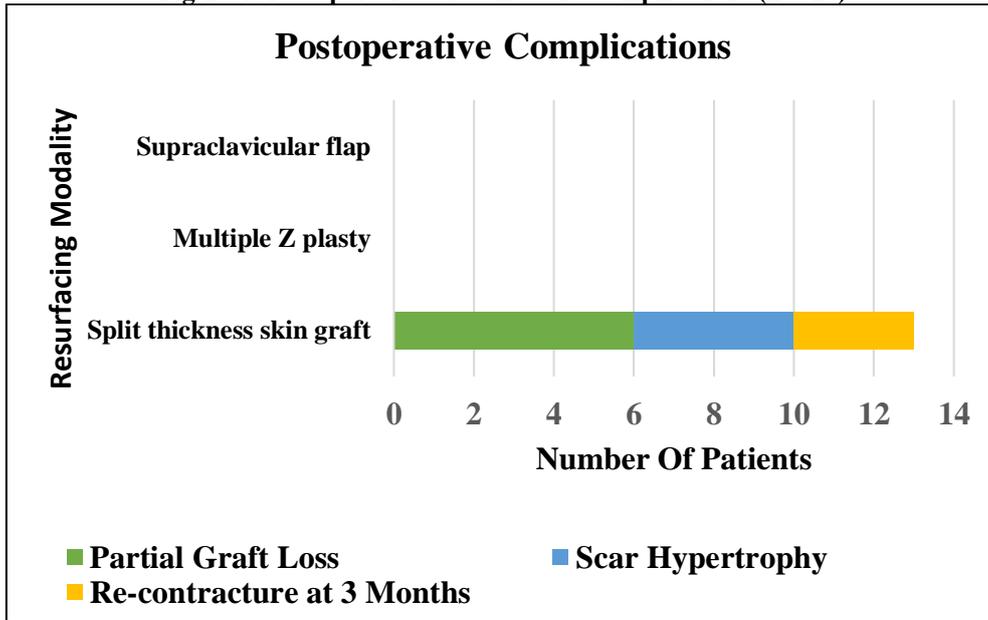


Figure 2. Release of post-burn neck contracture by excision of hypertrophic contracture scar followed by STSG



Figure 3: Release of post-burn neck contracture by excision of hypertrophic contracture scar followed by multiple Z plasty



**Figure 4: Release of post-burn neck contracture by excision of hypertrophic contracture scar and reconstruction with supraclavicular flap.**



## DISCUSSION

Post-burn neck contracture remains one of the most complex problems in reconstructive surgery. The anterior cervical region is highly prone to severe scarring because the skin is thin, loosely attached, and easily destroyed by thermal injury. In addition, the area from the chin to the sternum forms a concave flexor surface that favors flexion deformity during healing, and the constant neck mobility increases the risk of contracture formation.<sup>[5,22]</sup> Vertical scars in this region frequently mature into dense fibrous bands that significantly restrict extension.

The pathophysiology of burn wound healing involves inflammation, fibroblast proliferation, collagen deposition, and scar maturation, which together determine the severity of contracture formation.<sup>[23,24]</sup> Inadequate early burn care and delayed

intervention further aggravate deformity, particularly in developing countries.<sup>[1,2]</sup> Severe cervical contractures are more commonly reported in resource-limited settings due to the widespread use of open flames and limited access to specialized burn care.<sup>[1,25]</sup>

In the present study, 20 patients with post burn neck contracture were treated. The mean age was 31.9 years, with the majority in the third and fourth decades of life. Similar age distribution has been reported by Angrigiani et al., who observed a mean age of 28.3 years in 86 patients.<sup>[18]</sup> Saygin Abdul Kadir Mohammed reported a mean age of 23 years,<sup>[26]</sup> and Bhattacharya et al. documented an average age of 21.2 years.<sup>[3]</sup> These findings indicate that post-burn neck contracture predominantly affects young and economically productive individuals.

Females constituted 65% of patients in this series. Bhattacharya et al. reported 78.5% female patients,<sup>[3]</sup> while Moustafa et al. documented 66.3% female predominance.<sup>[27]</sup> Jain et al. also observed a higher proportion of females in their series.<sup>[10]</sup> This trend reflects domestic exposure to flame injuries in developing countries, especially during cooking activities.<sup>[1]</sup> Flame burns were the most common cause in our study, accounting for 65% of cases. Bhattacharya et al. similarly reported flame burns as the predominant cause.<sup>[3]</sup> Thermal burns remain the leading etiology in developing countries, whereas chemical or electrical burns are less frequent.<sup>[1]</sup>

Severity assessment is important for planning reconstruction. Mohamed Makkboul proposed classifying contractures as mild, moderate, or severe.<sup>[28]</sup> Onah introduced a numeric classification system based on position and severity.<sup>[29]</sup> Tsai et al. developed a zonal classification to guide microsurgical reconstruction.<sup>[30]</sup> In our study, 85% of patients had moderate-to-severe contractures, consistent with reports that advanced deformities are common in developing regions.<sup>[25]</sup>

Airway management in severe post burn neck contracture can be challenging. Benumof et al. emphasized the importance of preparation in difficult airway cases.<sup>[17]</sup> In one patient in our series, initial release under ketamine facilitated intubation, as described by Al Zacko et al.<sup>[31]</sup> and Agrawal et al.<sup>[32]</sup> Airtraq-assisted intubation has also been reported as a useful method in severe cases.<sup>[19]</sup>

The choice of surgical technique depends on the severity and available tissue. Achauer and Salisbury described principles of excision and resurfacing in neck reconstruction.<sup>[5,22]</sup> In mild cases, incisional release may suffice, whereas moderate and severe deformities often require excisional release with grafting or flap coverage. Nath et al. reported satisfactory outcomes with release and grafting.<sup>[21]</sup> Bhattacharya and Jain used split-thickness skin grafts with splintage in most patients.<sup>[3,10]</sup>

In the present study, split-thickness skin grafting was the most commonly employed method. However, grafting carries risks of hypertrophy and recurrence. Adant et al. demonstrated that recurrence rates are higher with grafts compared to flap reconstruction.<sup>[13]</sup> Cronin emphasized the importance of meticulous hemostasis to prevent graft loss,<sup>[6]</sup> and Feldman advised caution regarding immediate graft placement after excision.<sup>[7]</sup>

Flap reconstruction provides better contour and lower recurrence in selected cases. The supraclavicular artery flap, first described by Lamberty<sup>[11]</sup> and later popularized as an island flap by Pallua et al.<sup>[15]</sup> It offers reliable vascularity and a good color match. Laredo Ortiz also reported favorable outcomes with supraclavicular bilobed flaps.<sup>[33]</sup> Other options described in the literature include bilobed flaps,<sup>[34]</sup> bipedicle flaps,<sup>[35]</sup> trapezius fasciocutaneous flaps,<sup>[36]</sup> serratus anterior musculocutaneous flaps,<sup>[37]</sup> and free flaps such as the radial forearm flap.<sup>[38]</sup> Donelan and Remensnyder emphasized individualized reconstructive planning based on defect characteristics.<sup>[9,39]</sup>

In our study, the supraclavicular flap provided a superior aesthetic outcome compared to grafting alone. Functional and cosmetic results were satisfactory in 86.4% of patients. Evaluation was based on neck range of motion and aesthetic appearance, similar to the criteria used by Nath.<sup>[21]</sup>

Complications observed included partial graft loss, hypertrophic scarring, and recurrence in 15% of cases. Recurrence following release and grafting has been documented in previous series.<sup>[13]</sup> Prevention requires adequate release, proper splinting, and structured physiotherapy. Bhattacharya highlighted the role of dynamic extension splints in maintaining correction.<sup>[3]</sup>

Overall, the present study supports established reconstructive principles. Early release, appropriate resurfacing technique, meticulous surgical execution, and strict postoperative rehabilitation are essential to achieve durable functional and aesthetic outcomes. Improved primary burn care and public awareness remain critical in reducing the incidence of severe post-burn neck contractures in developing countries.<sup>[1,2]</sup>

This study provides a focused evaluation of post burn neck contractures managed at a tertiary care center, with uniform clinical assessment and systematic postoperative functional and cosmetic evaluation using neck range of motion, color match, and scar quality. Multiple reconstructive options (split-thickness skin grafting, Z-plasty, and supraclavicular flap)

were analyzed within the same cohort, enabling practical comparison in a similar etiological setting. A minimum follow-up of 3 months enabled early identification of graft loss, hypertrophy, and recurrence, reflecting real-world outcomes in a developing country where flame burns are common.

Limitations include a small sample size (n = 20), short follow-up duration, and lack of randomization, which may introduce selection bias and reduce generalizability. Standardized scar scoring systems and patient-reported outcome measures, including quality-of-life and psychosocial assessments, were not formally applied.

Future work should involve larger prospective comparative studies with longer follow-up, ideally using matched or randomized designs, and incorporating validated scar scales and quality-of-life tools alongside objective functional measurements. Evaluation of advanced reconstructive approaches (perforator-based flaps, expanded flaps, free tissue transfer) and newer modalities such as dermal substitutes may improve long-term outcomes. Strengthening primary burn care, early referral, public safety awareness, and structured splintage and physiotherapy programs will remain key to reducing the severity and recurrence of post-burn neck contractures.

## CONCLUSION

The choice of surgical procedure for the reconstruction of post-burn neck contractures can be made based on the pattern of scar contracture, the state of the surrounding skin, and the type of contracture. Post-burn neck contracture release with flaps or Z-plasty yields very good results, with fewer hospitalization days, a lower re-contracture rate, and good patient compliance, although it requires skill and knowledge to choose the right flap for each contracture type.

Although easy to execute and applicable to any type of neck contracture, contracture release with split skin grafting has a higher re-contracture rate and poor compliance due to long-term splinting. In our study, contracture release with a flap yielded good results, with no major complications, and did not require long-term splinting, compared with a split skin graft.

## Conflict of Interest

The authors declare that they have no conflicts of interest related to the publication of this study.

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