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Subcutaneous pedicled rhomboid flap technique in post burn contracture release

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Abstract

Post-burn contractures cause significant functional impairment and aesthetic deformity, especially when involving the neck, axilla, digits, and major joints. Traditional reconstructive options, including skin grafting and complex flaps, have limitations such as recurrence or high technical demand. The subcutaneous pedicled rhomboid flap is a reliable local flap technique that maximizes elongation while preserving vascularity. This study aimed to evaluate the effectiveness and versatility of the subcutaneous pedicled rhomboid flap in the surgical release of post-burn contractures. This prospective interventional study was conducted from September 2024 to August 2025 at Rizgary Teaching Hospital and Erbil Teaching Hospital. 24 patients (15males, 9 females; age range: (6–40 years) with mature post-burn linear contractures affecting various anatomical regions underwent contracture release using the subcutaneous pedicled rhomboid flap technique. Pre- and postoperative contracture lengths were measured between fixed reference points. Patients were followed up for 3 months to assess gain in length and postoperative outcomes. All patients showed functional improvement with postoperative length gains ranging from 1–5 cm, corresponding to percentage increases between 33.3% and 100%. The greatest improvement was observed in an axillary, elbow and neck contracture (100% gain), followed by neck and large joint contractures. No flap necrosis, wound dehiscence, or recurrence was noted during the follow-up period. Patients reported high satisfaction with both functional and aesthetic results. The subcutaneous pedicled rhomboid flap provides substantial functional gains, preserves tissue vascularity, and achieves satisfactory cosmetic outcomes without major complications.

Keywords: Post-Burn contracture, Rhomboid flap, Reconstructive surgery

Introduction

Post-burn contractures represent one of the most challenging sequelae in reconstructive plastic surgery, particularly when they involve functionally critical areas such as the neck, axilla, hands, and major joints. These deformities result from the abnormal shortening of scar tissue, often following healing by secondary intention, leading to significant restrictions in range of motion and aesthetic disfigurement if not managed appropriately.[1] The cornerstone of effective contracture management lies in achieving a tension-free release with restoration of both form and function. Traditional reconstructive options range along the ladder from skin grafts to complex free flaps. However, each approach carries limitations—skin grafts are associated with high rates of secondary contracture and suboptimal texture match, whereas free flaps demand advanced microsurgical expertise and resources.[2,15]

Among local flap techniques, Z-platy remains widely practiced due to its ability to realign scar orientation and provide modest elongation. Nevertheless, in cases involving wide, long, or multiple adjacent contracture bands, Z-platy can be limited by the need for extensive flap elevation and its dependence on vascular reliability.[3] An innovative alternative gaining recognition is the subcutaneous pedicled rhomboid flap which is geometrically designed to maximize scar lengthening through strategic Y-V and V-Y advancement techniques while preserving flap vascularity.[4] Originally introduced by Uzunismail et al. for digital burn contractures and later modified by Askar, this technique utilizes full-thickness rhomboid incisions with minimal dissection, allowing for effective release in poorly vascularized or previously grafted areas.[5,6]

Multiple studies have validated the efficacy of this method. They reported elongation gains ranging from 60% to over 300% depending on anatomical location and flap configuration (4,7).[7] Similarly, Mannan et al. demonstrated a mean gain of 77.28% in scar length across various anatomical regions, with most patients experiencing complication-free recovery.[8] The

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technique's subcutaneous pedicle design contributes to reliable perfusion, minimizing the risk of flap necrosis even in scarred or re-contracted tissue beds.[9]

Despite its proven advantages, the rhomboid flap remains underutilized in clinical practice.to my knowledge this study has not been done in our locality, the aim is to further evaluate the outcomes and versatility of the subcutaneous pedicled rhomboid flap in the surgical release of post-burn contractures.

Patients and Methods

Study design and setting

This prospective interventional study was conducted at Rizgary Teaching Hospital and Erbil Teaching Hospital over a one-year period, from September 2024 to August 2025. A total of 12 patients with linear post-burn contractures affecting various anatomical regions were included. Ethical approval was obtained before the initiation of the study, and informed consent was obtained from all participants.

Subjects

Patients were selected based on the following inclusion criteria: presence of mature post-burn linear contractures that caused functional limitation, medical fitness for general anesthesia, psychological stability, good compliance with postoperative care, and absence of active infection at the surgical site. Patients were excluded if they had diffused post burn contracture, unrealistic expectations, bleeding tendency, significant medical comorbidities that rendered them unfit for surgery, poor compliance with follow-up, or infection at the planned surgical site.

Preoperative assessment

Preoperatively, the contracture band length was measured between two fixed points (A–B). A rhomboid flap was then marked, with the 60° corner placed along the contracture line and the 120° corners positioned perpendicular to it. The side lengths of the rhomboid flap did not exceed the length of the contracture. From each 120° corner, two relaxation incisions were drawn laterally, with lengths not shorter than half and not longer than the side of the rhomboid.

Operative procedure

Full-thickness incisions were made around the flap and along the relaxation lines to create an island flap. The distal points of the relaxation incisions were advanced and sutured in a Y-V fashion, while the 60° angles along the contracture line were closed using a V-Y technique. This approach allowed effective elongation of the scar band while maintaining flap perfusion via a broad subcutaneous pedicle.

Postoperative assessment

Postoperative evaluation included three primary parameters: (1) the gain in length of the contracture band, measured as the difference between the preoperative (A–B) and postoperative (A2–B2) distances; Follow-up visits were conducted at 1 week (for dressing change), 2 weeks (for suture removal), 1 month (to initiate physiotherapy), 3 months (to assess scar maturation and mobility and gained length). Patients were asked to rate their functional and cosmetic satisfaction using the following options: very satisfied, satisfied, neutral, dissatisfied, or very dissatisfied. Visual Analogue scale (VAS 1-10) was used for the assessment of pain postoperatively

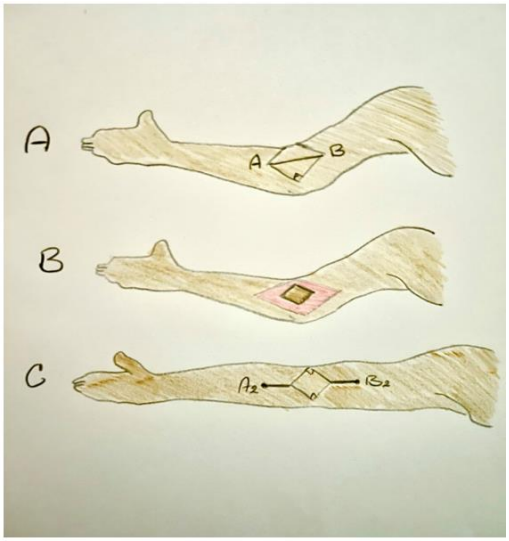

Figure (1): Preoperative marking of the post burn contracture

Figure (1) Shows Preoperative marking of the post burn contracture of antecubital fossa,

A, contracture band length measured between two fixed points (A–B). A rhomboid flap was then marked, with the 60° corner placed along the contracture line and the 120° corners positioned perpendicular to it. B, shows full thickness incision around the flap and relaxation lines creating an island flap. C, shows the wound after closure, the ends of the relaxation incisions is pulled toward the corner of the flap and sutured in a Y-V fashion. Proximal and distal corners along the contracture lines are closed in a V-Y fashion, A2–B2 which is the early postoperative length gained after the contracture released.

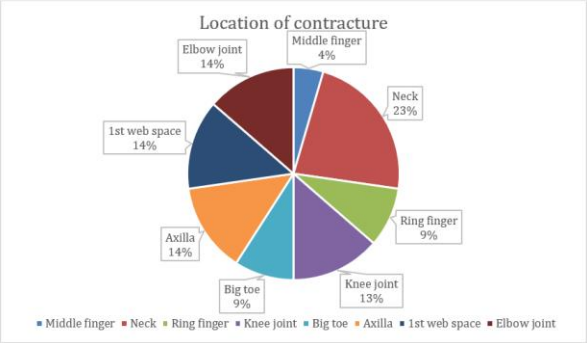

Figure (2): Graphic illustration of the locations of the contractures

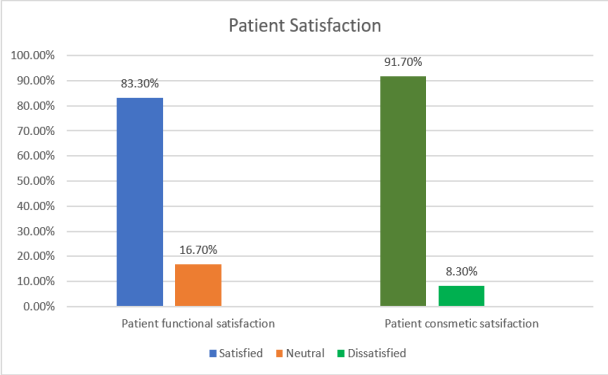

Figure (3): Graphic illustration of patient functional and cosmetic satisfaction

Ethical approval

Informed consent was obtained from all patients after providing thorough explanation of the aim and scope of the study. Permission was taken to share the photographs of the affected sites with reassuring patients that no identifiable information or photographs will be published. Written informed consent was obtained from all patients prior to their inclusion in the study. All participants were informed that clinical photographs taken during their management could be used for publication purposes, and consent was explicitly granted. Ethical approval for this study was obtained from the Research Ethics Committee of Hawler Medical University – College of Medicine, with meeting code 11, granted on August 6, 2025.

Data analysis

Data were analyzed using SPSS version [insert version]. Categorical variables were compared using the chi-square test or Fisher's exact test when expected frequencies were <5. Continuous variables were compared between groups using the independent samples t-test. A p-value <0.05 was considered statistically significant.

Results

In this study 24 patients who underwent post-burn contracture release using the subcutaneous pedicled rhomboid flap technique, assessed three months postoperatively. The study included 15 males and 9 females, aged between 6 and 40 years, with contractures affecting various anatomical sites including fingers, neck, knee joint, elbow joint, axilla, big toe, and the first web space Figure (2). As shown in Table (1) All patients demonstrated improvement in contracture length following surgery. The postoperative length gain ranged from 1 cm to 5 cm, with corresponding percentage increases ranging from 33.3% to 100%. The highest gain was observed in patient 8 (40 years old, male, with elbow joint contracture), and patient 14 (6-year-old male with axillary contracture), who achieved a 100% improvement (from 5 cm to 10 cm). Patients with neck contractures (Patients 20, 21, 22, 23 and 24) also showed substantial improvements, with gains ranging from 40% to 83.3%. The youngest patient (Patient 4, a 6-year-old female with a ring finger contracture) achieved a 50% gain, while the oldest patient (Patient 40, female with neck contracture) achieved a 71.4% gain.

Table (1): Outcome analysis of patients at 6 months postop

Patient	Gender	Age	Location of Contracture	Preoperative length	Postoperative length at 6 months	Postoperative length gain	% of gain
1	Female	24	Middle Finger	3 cm	4 cm	1 cm	33.30%
2	Male	38	Index finger	2cm	3cm	1cm	33.30%
3	Male	25	Ring finger	3 cm	4 cm	1 cm	33.30%
4	Female	6	Ring finger	4 cm	6 cm	2 cm	50%
5	Male	31	Little finger	3cm	5cm	2cm	66.6
6	Male	22	Elbow joint	7cm	11cm	4cm	57%
7	Female	15	Elbow joint	5cm	9 cm	4cm	80%
8	Male	40	Elbow joint	7cm	12cm	5cm	71%
9	Female	29	Knee joint	6cm	10cm	4cm	66.70%
10	Male	39	Knee joint	6.5cm	11cm	4.5cm	69%
11	Male	38	Knee joint	8cm	13cm	5cm	62.50%
12	Female	16	Big toe	4cm	7cm	3cm	75%
13	Male	18	Big toe	6cm	9cm	3cm	50%
14	Male	6	Axilla	5cm	10cm	5cm	100%
15	Female	23	Axilla	6cm	10cm	4cm	66.70%
16	Male	16	Axilla	4cm	8cm	4cm	100%
17	Male	15	1st web space	3cm	5cm	2cm	66.70%
18	Male	12	1st web space	4cm	6cm	2cm	50%
19	Female	28	1st web space	3.5cm	5cm	1.5cm	43%
20	Male	17	Neck	5cm	7cm	2cm	40%
21	Female	30	Neck	6cm	11cm	5cm	83.30%
22	Female	40	Neck	7cm	12cm	5cm	71.40%
23	Male	25	Neck	9cm	13cm	4cm	44.40%
24	Male	32	Neck	5cm	8cm	3cm	60%

Table (2): Association of patient overall satisfaction with clinical characteristics

		Satisfied n=20	Neutral N=4	p-value
Age		24.7±12.2	23±5.6	0.94
Gender	Male	14 (70%)	1 (25%)	1
	Female	6 (30%)	3 (75%)	
Duration of burn		6.3±2.9	6±5.6	0.909
Contracture severity	Mild	4 (20%)	3 (75%)	0.091
	Moderate	16 (80%)	0 (0%)	
	Severe	0 (0%)	1 (25%)	
Skin condition	Healthy	10 (50%)	2 (50%)	0.167
	Scarred but paliable	10 (50%)	0 (0%)	
	Rigid scar tissue	0(0%)	2 (1%)	
Flap size		2.3 ±1.1	2.5±2.1	0.843
VAS score, Mean±SD		2.7±1.1	4±1.4	0.198

Table (2) shows patient characteristics and associations with the clinical information of the patients. Among satisfied patients, the mean age was 24.7 ± 12.2 years, while in the neutral group it was 23.0 ± 5.6 years (p = 0.340). In terms of gender distribution, 14 males (70%) and 6 females (30%)

were satisfied, whereas 1 male (25%) and 3 female (75%) were neutral (p = 0.753). The mean duration of burn was 6.3 ± 2.9 years for satisfied patients and 6.0 ± 5.6 years for neutral patients (p = 0.909).

Regarding contracture severity, satisfied patients included 4 cases (20%) with mild and 16 cases (80%) with moderate severity, while neutral patients included 3 case (75%) with mild and 1 case (25%) with severe severity (p = 0.091). For skin condition, satisfied patients had 10 cases (50%) with healthy skin and 10 cases (50%) with scarred but pliable skin, while neutral patients had 2 case (50%) with healthy skin and 2 case (50%) with rigid scar tissue (p = 0.167).

The mean flap size was 2.3 ± 1.1 in the satisfied group and 2.5 ± 2.1 in the neutral group (p = 0.843). The mean VAS score was 2.7 ± 1.1 for satisfied patients and 4.0 ± 1.4 for neutral patients (p = 0.198).

Figure (4): Patient 11, a 38 years old male with post burn contracture of popliteal fossa

A preoperative lateral and posterior view. B Intraoperative marking. C after release and closure. D after 1 month. E after 6 months

Figure (5): Patient (1) 24 years old female with post burn contracture of middle finger A. Preoperative anterior and lateral view B. Intraoperative flap marking, dissection and closure C.1 month post op D. 3 months post op

Figure (4-5) shows 3 journeys from preoperative to posoperative outcomes of patients included in this study.

Figure (6): Patient 3, a 17 years old male with post burn contracture of neck A. Preoperative B. Intraoperative marking C. Flap dissection D. 1 month post op E. 6 months post op anterior and lateral view

Discussion

The findings of this study demonstrate that the subcutaneous pedicled rhomboid flap technique yields significant improvements in contracture length, with gains ranging from 33.3% to 100% at 3 months. These results are comparable to earlier clinical series by Koc et al. reporting elongation rates between 30% and 125%, depending on anatomical site and baseline severity.[4] In our series, the greatest gain (100%) was observed in an axillary contracture, aligning with previous reports indicating favorable outcomes in high-mobility regions.[4]

Recent clinical data continue to support the effectiveness of the rhomboid flap. A 2022 retrospective study by Ge et al., involving 48 patients treated with various scar-based local flaps, including rhomboid flaps, showed significant improvements in joint range of motion and a low recurrence rate of 10.4% over 6–24 months, with no flap necrosis reported.[10] like in my study gain in length and no flap necrosis observed. These findings reinforce the flap's safety profile and long-term durability, especially in functionally demanding regions like the axilla, neck, and web spaces.

In parallel, a 2023 review by Rehim et al. emphasized the value of flap-based reconstructions tailored to both functional and aesthetic needs, particularly in hand contractures. The authors noted that local flaps such as the rhomboid design offer optimal outcomes when adapted to the anatomical and biomechanical demands of the affected region.[11] Our findings align with this perspective, demonstrating reliable gains across diverse anatomical areas, from digital web spaces to large joints.

In our study, there were no statistically significant differences in patient satisfaction across age, gender, burn duration, contracture severity, skin condition, flap size, or VAS pain scores. This is consistent with the systematic review by Lastoria et al., which found that functional outcomes, rather than scar cosmesis, were stronger determinants of satisfaction following reconstructive burn surgery.[12] Reconstructive strategies that restore pliability and joint movement—such as local flap techniques—have been shown to enhance functional recovery even when satisfaction was not the primary endpoint.[13] Similarly, Dhua et al. reported significant functional improvement after neck contracture release with split-thickness skin grafting (mean cervicomental angle increase, $p < 0.001$), alongside high patient satisfaction rates.[14] These findings collectively suggest that, although demographic and aesthetic variables may influence satisfaction trends, functional restoration is the most consistent predictor of positive patient-reported outcomes following burn contracture release.

Conclusion

Subcutaneous pedicled rhomboid flap is a reliable and versatile option for post-burn contracture release. Our findings, supported by recent clinical and experimental studies, reinforce its role in restoring length and mobility across various contracture sites. Future research may explore long-term outcomes and the potential benefits of combining rhomboid flaps with adjunctive techniques in complex cases.

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Conflict of interest: The authors declare no conflict of interest

Data availability: The datasets generated and analyzed during the current study are available from the corresponding author, Dr. Huda Sarkawt Ibrahim, upon reasonable request.

Due to patient confidentiality and institutional regulations, the data are not publicly accessible, but anonymized data can be provided to qualified researchers upon request.

Funding: None

Ethical consideration: Written informed consent was obtained from all patients prior to their inclusion in the study. All participants were informed that clinical photographs taken during their management could be used for publication purposes, and consent

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