Pan-African Journal of Plastic, Reconstructive and Aesthetic Surgery Vol. 3 No. 2 June 2026
SQUARE FLAP FOR POST-BURN CONTRACTURE ELBOW RELEASE: CASE REPORT
S. Gichuru, MBChB, Plastic, Reconstructive and Aesthetic Surgery Resident, Department of Surgery, University of Nairobi Medical School, Nairobi, Kenya, **P. Sephekolo,** BDS, Oral Maxillofacial Surgery Resident, Department of Dental Sciences, University of Nairobi Medical School, Nairobi, Kenya, **A. A. Timothy**, Medical Student, Faculty of Health Sciences, University of Nairobi Medical School, Nairobi, Kenya and **F. Wanjiru**, MBChB, MMed, Consultant Plastic, Reconstructive and Aesthetic Surgeon, Kenyatta National Hospital, Nairobi, Kenya

SQUARE FLAP FOR POST-BURN CONTRACTURE ELBOW RELEASE: CASE REPORT

S. GICHURU, P. SEPHEKOLO, A. A. TIMOTHY and F. WANJIRU

SUMMARY

We report the case of a decade-old post-burn elbow flexion contracture successfully released with a square flap, achieving full extension and stable functional improvement. We share technical insights to inform practice and encourage consideration of this technique.

INTRODUCTION

There is no universally accepted method to release a post-burn contracture (PBC) (1).

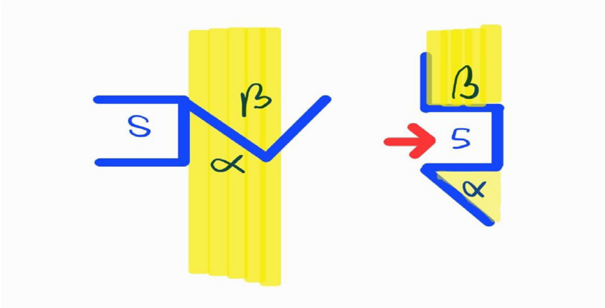
Ogawa and Pribaz outlined treatment strategies for elbow PBCs according to their classification. Linear contractures (Type I) should be excised completely and closed primarily with Z-plasties, W-plasties, or small-wave incisions to relieve tension. When linear scars involve both radial and ulnar surfaces (Type Ib), release can be achieved using propeller flaps designed on the cubital fossa. Broadband contractures confined to one surface (Type IIa) are best reconstructed with skin grafts or local flaps taken from intact adjacent tissue, while those spanning both radial and ulnar surfaces (Type IIb) can also be addressed with cubital fossa propeller flaps. Broadband contractures extending to adjacent surfaces (Type III) often require larger vascular pedicled flaps harvested from the upper arm or forearm. Finally, circumferential contractures (Type IV) demand robust coverage with vascular pedicled or free flaps to ensure complete release and prevent recurrence (2).

Complementing this, Terziqi offered a pragmatic treatment-oriented classification, stratifying elbow contractures by severity of motion loss: neglected cases with >10° loss (amenable to single or multiple Z-plasties), mild cases with 11–49° loss (managed with V-Y advancement or five-flap plasty), moderate cases with 50–89° loss (treated with multi-Z plasty and full-thickness skin grafts), and severe cases with >90° loss (requiring regional fasciocutaneous flaps such as the lateral arm flap) (3).

The square flap is a local flap used mainly to release linear PBC bands around joints (axilla, elbow, web spaces, fingers, cryptotia, etc.). It combines a central square advancement flap with two adjoining triangular transposition flaps respectively (4,1,5–9).

We design the square flap adjacent to the contracture line (Figure 1). Two triangular flaps could be: proximal (α) at a 45° angle and distal (β) at a 60-90° angle, with the flaps' lengths kept equal; the angles between 45° and 90° ensure adequate perfusion at the flap tip, effectively release contracture bands, and permit tension-free closure of the donor site (4–6,8).

Figure 1: Square flap design. ß angulated at a 60-90° angle; β angulated at a 45° angle; S flap is an advancement flap, red arrow indicates movement of the S flap; the yellow band in the linear contracture



Stereometric modelling shows that the standard square flap design (α = 45°, β = 90°) provides a larger flap area, improved length-to-width ratio, and greater postsurgical commissure length compared with conventional Z-plasties. Geometrically, it may achieve up to 180% lengthening, the highest among Z-plasty-derived techniques. Finite element analysis, accounting for tissue elasticity and 3-D deformation, estimates about 90% elongation, confirming the square flap's superiority in scar contracture release over high-powered Z-plasties such as the 90° and four-flap variants (6,7).

CASE PRESENTATION

We present the case of a 14-year-old female who developed a right elbow flexor contracture and a linear contracture across the dorsum of the hand (Figure 2). These deformities followed thermal burns sustained to the right upper limb and face during a house fire ten years earlier. Initial wound closure was achieved with split-thickness skin grafting, and the patient had not undergone any prior contracture-release procedures before presentation.

Figure 2: Right upper limb post-burn contractures – A: without surgical markings, B: with surgical markings

The general examination was unremarkable; local examination of the right upper limb was performed using Potokar's assessment tool (Table 1).

Table 1: Potokar's 5Ps Assessment

Assessment	Details
Problems (F2PIP)	• Form: extensive post-burn scars over the right upper limb extending from the forearm to the wrist (Figure 1); contractures noted:
	• Elbow: Extensive post-burn scarring involving the right upper limb with mixed hyper- and hypopigmentation and areas of mature grafted skin. A linear contracture band across the flexor aspect of the elbow with radiating scar bands is present, distorting the antecubital fossa. The elbow is fixed in approximately 20–30° of flexion due to the contracture.
	• Fifth digit: Additionally, there is a linear contracture along the ulnar aspect of the dorsum of the hand extending to the little finger, causing visible soft-tissue tethering.
	• Function: The flexed elbow restricted extension and impaired functional reach. Although shoulder and wrist range of motion are preserved, the patient reports difficulty writing in class due to discomfort, with mild pain elicited during elbow and wrist movements.
	• Pain: moderate pain.
	• Itch: No significant pruritus reported
	• Psychological issues: No overt psychological distress was reported during the interview.
Priorities	• Optimisation of functional outcomes and prevention of further contracture or impairment of the elbow
Possibilities	• Local flaps for surgical release of the elbow and hand contracture, with post-operative occupational and physiotherapy.
Perceptions	• The expectations were improved function and symptom control.
Plan	• MDT approach: plastic surgery, physiotherapy, and occupational therapy.
	• Surgical release of the elbow and hand in the same sitting: square flap for the elbow and a single z-plasty for the hand

For contracture release, we planned a square flap for the elbow PBC, following Hyakusoku's pearls (7): design triangular flaps with blunt angles to avoid tip necrosis, and elevate both square and triangular flaps to conventional skin-flap thickness for reliable perfusion and closure (Figure 3). We also planned a Z-plasty for the hand PBC. We acknowledge that in the schematic illustration, both triangular flaps were depicted at approximately 45°. However, intraoperatively, the β flap was modified and raised to a closer-to-standard 60° angle.

Figure 3: Square flap markings

The linear scar was incised along the flap markings, and the scar tissue was excised as the flaps were elevated together with the investing antebrachial fascia. During dissection, the lateral antebrachial cutaneous nerve was identified and preserved (Figure 4). The square flap was then advanced across the contracture site, while the adjacent triangular flaps were rotated and positioned proximally and distally on either side of the advanced flap.

Figure 4: Flaps raised. Advancement flap (right) and Z-plasties (left)

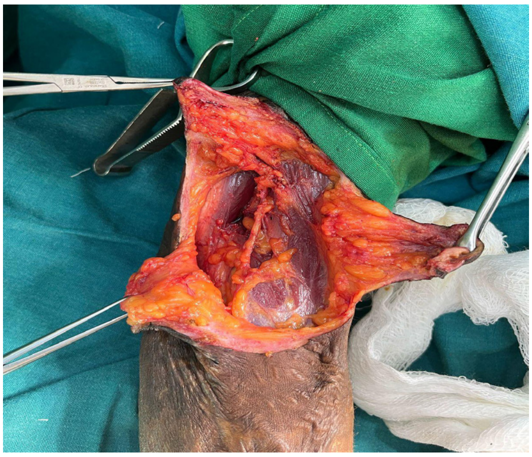


Figure 5: Advancement and Z-plasties secured

Fascial fixation was achieved using 4/0 polydioxanone round-body sutures, and flap corners were secured with 3/0 nylon reverse-cutting interrupted stitches (Figure 5).

Post-operative course was uneventful, with suture removal after 10 days. She started occupational therapy with an above-elbow extension splint immediately postoperatively and maintained it for about 6 months. After a week, we started passive range-of-motion exercises, then transitioned to active range-of-motion exercises after the 3rd week. During the 3rd month post-operative review, pressure garments were initiated, which she has yet to discontinue. She can achieve full elbow extension after 9 months (Figure 6).

Figure 6: 9th-month post-operative images showing full extension of the elbow

At her 9th-month post-operative review, the patient reported experiencing mild pain localised deep to the square flap, which was exacerbated by deep palpation. She described the discomfort as being partially relieved with gabapentin and noted intermittent numbness and tingling in the affected region. In response to these symptoms, she was prescribed silicone scar gel and triamcinolone injections for scar management, alongside pregabalin 75 mg twice daily for neuropathic pain control.

DISCUSSION

This case illustrates how a carefully planned square flap can convert a stiff, function-limiting elbow into a mobile, usable joint with minimal morbidity. In the patient presented, the square flap delivered predictable elongation of the contracted band, reliable vascularity, and a supple, well-contoured repair that permitted early mobilisation. The clinical result (measurable gains in range of motion, low immediate complication burden, and rapid return to activities of daily living) mirrors the pattern seen across contemporary series that favour local flaps for joint contractures (1,5,6,9). The primary objective was restoration of elbow extension and functional reach, which was achieved at 9-month follow-up.

The square flap's appeal lies in its geometric simplicity and functional payoff. Compared with traditional Z-plasty variants, the square flap can provide greater linear lengthening for band-like scars while preserving local tissue characteristics and colour match. In practice, this means less secondary contraction, a lower likelihood of reoperation or recurrence, and a reconstruction that ages with the patient's native skin (1,4–6,8,9). The technique is particularly well-suited for single linear contractures of the elbow where adjacent tissue is available, and the defect is amenable to local transposition; when defects are larger or tissue quality is poor, the square flap can be modified (for example, square-plus or combined perforator designs) (10) or supplemented by regional flaps (2,3).

Beyond the technical merits, this case underscores two pragmatic truths. First, surgical success is inseparable from rehabilitation: early, supervised mobilisation and a structured physical therapy plan are essential to preserve the length gained intraoperatively (5,11,12). Second, technique selection must be individualised—patient age, scar chronicity, compliance, and donor-site considerations should guide the choice between a square flap, Z-plasty, perforator flap, or graft (1–3,6). While skin grafting remains an option when local tissue is unavailable, its tendency toward secondary contraction and the need for prolonged immobilisation make it a less attractive first choice for most elbow contractures.

For clinical practice, the implications are immediate. Surgeons should consider the square flap as an option for linear elbow PBCs and reserve grafting for cases where flap coverage is not feasible. In this case, the square flap was chosen because the contracture was predominantly linear and accompanied by adequate adjacent supple tissue. Training programs should emphasise flap geometry and the small but important technical steps that reduce tip necrosis and optimise contour. At a research level, the field would benefit from standardised outcome metrics—degrees of motion, validated patient-reported outcome measures, and uniform follow-up intervals—to allow meaningful comparisons between flap types and to support prospective trials.

This case's strengths include a clear demonstration of functional restoration using a single-stage, reproducible technique and close integration with post-operative rehabilitation. Limitations are inherent in single-case reports: the follow-up period is limited, and outcomes from a single patient cannot capture the full spectrum of complications or the long-term recurrence risk. These limitations highlight the need for multicentre prospective cohorts and, where feasible, randomised comparisons. Potential risks of wider adoption—flap-tip compromise in poorly perfused tissue, donor-site tension, or inadequate release—can be mitigated by meticulous planning, conservative flap sizing, and readiness to convert to alternative strategies, including square flap modifications, when intraoperative findings demand it.

From the patient's perspective, the transformation is often profound (6). Regaining the ability to reach, dress, and perform self-care restores independence and confidence in ways that objective measures only partly capture. In this case, the patient described the outcome as "regaining independence," a succinct reminder that reconstructive surgery's ultimate metric is the restoration of meaningful function

CONCLUSION

In conclusion, the square flap demonstrates clear feasibility for postburn elbow contracture release, offering a geometrically simple, reproducible design that reliably achieves elongation with minimal morbidity, especially when integrated into standard rehabilitation protocols.

REFERENCES

1. Hifny MA, Abdelmegeed AG. Clinical comparison study of square flap method and five-flap Z-plasty technique for correction of post-burn axillary contractures: Analysis of length gain and evaluation of functional outcome. *Burns*. 2024 Dec 1;**50**(9):107246. doi:10.1016/j.burns.2024.08.012

2. Ogawa R, Pribaz JJ. Diagnosis, Assessment, and Classification of Scar Contractures. In: Hyakusoku H, Orgill DP, Teot L, Pribaz JJ, Ogawa R, editors. *Color Atlas of Burn Reconstructive Surgery.* Berlin, Heidelberg: Springer Berlin Heidelberg; 2010. p. 44–60. doi:10.1007/978-3-642-05070-1_8
3. Terziqi H, *et al*. Algorithms For Management Of Post-Burn Contracture In Upper Extremity In Children. *Ann Burns Fire Disasters.* 2021 Jun 30;**34**(2):192–8. *PubMed PMID*: 34584510; PubMed Central PMCID: PMC8396151.
4. Hyakusoku H, Akimoto M. The Square Flap Method. In: Hyakusoku H, Orgill DP, Teot L, Pribaz JJ, Ogawa R, editors. *Color Atlas of Burn Reconstructive Surgery.* Berlin, Heidelberg: Springer; 2010. p. 186–97. doi:10.1007/978-3-642-05070-1_23
5. Quong WL, Ogawa R. The Two Facing Square Flaps Method for Release of Anterior and Posterior Axillary Line Burn Contractures. *European Burn Journal.* 2023 Oct 4;**4**(4):529–36. doi:10.3390/ebj4040034
6. Dutta G, *et al*. Versatility Of Square Flaps In Post-Burn Contractures Involving Upper Limb. *Ann Burns Fire Disasters.* 2021 Sep 30;**34**(3):259–63. PubMed PMID: 34744542; PubMed Central PMCID: PMC8534307.
7. Kuwahara H, *et al*. A Comparative Finite Element Analysis of Two Surgical Methods for Cryptotia. *Plastic and Reconstructive Surgery – Global Open*. 2019 Jul;**7**(7):e2315. doi:10.1097/GOX.0000000000002315
8. Karki D, Narayan R. Role of Square Flap in Post Burn Axillary Contractures. *World Journal of Plastic Surgery.* 2017 Sep 1;**6:**285–91.
9. Huang C, Ogawa R. Three-dimensional Reconstruction of Scar Contracture-bearing Axilla and Digital Webs Using the Square Flap Method. *Plastic and Reconstructive Surgery – Global Open*. 2014 May;**2**(5):e149. doi:10.1097/GOX.0000000000000110
10. Hifny MA, Ogawa R. The Square-Plus Flap: A Modification to Release Long Postburn Scar Contractures. *Arch Plast Surg*. 2024 Jan;**51**(01):126–9. doi:10.1055/a-2189-9767
11. Dhakad V, *et al*. A Prospective Study on Management of Post Burn Contracture with Special Reference to Scar Scoring and Rehabilitation. *jemds*. 2019 Feb 4;**8**(5):321–5. doi:10.14260/jemds/2019/69
12. Fufa DT, *et al*. Prevention and Surgical Management of Postburn Contractures of the Hand. *Curr Rev Musculoskelet Med.* 2014 Mar 1;**7**(1):53–9. doi:10.1007/s12178-013-9192-9