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ABSTRACT

Severe contractures after snake bite envenomation pose significant functional challenges, particularly in low-resource settings. We report a 4-year-old with complex upper limb deformities successfully managed through single-stage multi-flap reconstruction. This novel approach restored mobility, reduced surgical burden, and highlights practical strategies for complex snakebite sequelae.

INTRODUCTION

Contracture following a snakebite results from local tissue necrosis (1), compartment syndrome with pressure-induced ischemia (2), and abnormal wound healing causing excessive fibrosis (3). The primary objective of reconstruction in the upper extremity is to restore functional motions, such as pinch, grasp, and hand opening, while also achieving soft tissue coverage that is both pliable and aesthetically pleasing. Careful assessment—including history, examination, and alignment with the patient's goals—is essential before planning surgery (4,5).

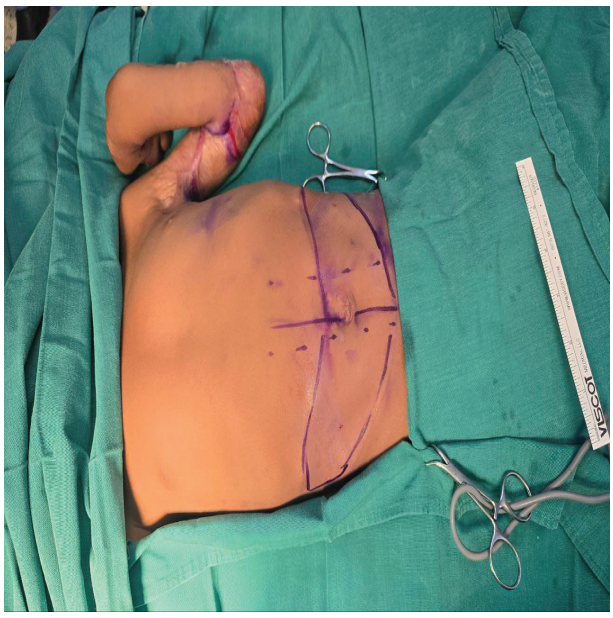
Treatment involves excision of fibrotic tissue, with reconstruction guided by the depth of involvement and exposure of underlying structures. Options range from skin grafts and local tissue rearrangements to regional pedicled flaps and free tissue transfer, chosen according to functional requirements and tissue availability. Postoperative care, including splinting, scar management, and structured rehabilitation, is critical to preserving motion and reducing recurrence (4,5).

The surgical literature on definitive reconstruction remains limited. Most severe contractures require staged releases (5,6), but this case demonstrates successful single-stage multi-flap reconstruction in a resource-limited Kenyan centre. Preserved adjacent tissues after cytotoxic envenomation allowed full correction and durable coverage in one sitting, highlighting the value of careful planning and flap selection to optimise functional recovery and minimise operative burden (5,7).

CASE PRESENTATION

A 4-year-old boy presented with severe left upper limb contractures involving the axilla, elbow, and wrist (Figure 1) one year after a snake bite, after conservative management.

Figure 1: Contractures



We assessed the patient using Potokar's method (8),

Table 1: Potokar's 5Ps Assessment

Assessment	Details

Problems (F2PIP)	• Form: Extensive mature scarring along the left upper limb (axilla, medial upper arm, elbow crease, volar wrist).
	• Contractures:
	  ◦ Shoulder: Adduction contracture; abduction only 10–20°.
	  ◦ Elbow: Flexion contracture; fixed at 140–150° flexion.
	  ◦ Wrist: Extension contracture; in 130–140°
	  ◦ Fingers: No fixed deformities at MCP (Metacarpophalangeal) or IP (Interphalangeal) joints; movements preserved with brisk capillary refill.
	• Function: Severe movement limitation at the shoulder, elbow, wrist □ impaired Activities of Daily Living (ADLs).
	• Pain: None at rest or passive movement.
	• Itch: Occasional mild pruritus; no medication needed.
	• Psychological Issues: Mild social withdrawal; reluctance to use limb in play, but no significant behavioural disturbance.

Priorities	• Primary: Restore functional ROM (Range of Motion), especially wrist and elbow, to improve independence. • Secondary: Cosmetic improvement for psychosocial well-being.
Possibilities	• Surgical release of contractures • Post-op rehab: physiotherapy + occupational therapy. • Scar management: pressure garments, silicone therapy.
Perceptions	Family expectations: focus on functional improvement to support regular play / school. Goals are realistic and aligned with achievable outcomes.
Plan	• MDT approach: plastic surgery, physiotherapy, occupational therapy, psychosocial support. • Surgical strategy: release all major contractures in one operative setting (not staged).

We released the elbow and wrist contractures through fish-mouth incisions, excising all scar tissue. For the flexor elbow defect, we reconstructed using a perforator-plus fasciocutaneous thoracoepigastric flap (Figure 2), which was designed from the lateral thoracic region and elevated medially. Perforators from the superior epigastric vessels were identified and preserved to ensure flap vascularity. The flap was then interpolated into the defect, and the donor site on the abdomen was closed primarily.

The wrist defect was reconstructed using a contralateral para-umbilical flap (Figure 2) based on perforators from the deep inferior epigastric artery. The flap was elevated laterally to medially in Camper's fascia, sparing Scarpa's fascia to protect the perforators. After raising the skin, subcutaneous tissue, and deep fascia, the flap was mobilised and inset into the wrist defect, with the donor site closed primarily.

Figure 2: Perforator-plus fasciocutaneous flaps (Left: Thoracoepigastric & Right: Paraumbilical)

For the axillary contracture, a Z-plasty was carried out with the central limb aligned along the posterior axillary fold (Figure 3). Full-thickness incisions were made through the skin and subcutaneous tissue to release the contracture, and the lateral flaps were mobilised while taking care to avoid injury to the axillary vessels and brachial plexus. The flaps were then transposed to achieve a tension-free closure.

Figure 3: Z-plasty

To stabilise the wrist after contracture release, two percutaneous K-wires were inserted across the carpal bones, one along the radial and one along the ulnar side, to maintain alignment during healing (Figure 4).

Figure 4: After flap inset

These were retained for four to six weeks until stability was achieved and subsequently removed. Postoperatively, the arm was supported in a sling or splint, and early physiotherapy was initiated to maintain the range of motion and minimise recurrence.

The flap was divided from its donor site and fully inset three weeks later, with some residual elbow flexure contracture noted (Figure 5).

Figure 5: After flap division

At the 6-month follow-up (Table 2), the donor site had healed; however, due to poor physiotherapy compliance resulting from financial constraints, an element of elbow flexion contracture persisted.

Table 2: Functional Outcomes Before and After Single-Stage Multi-Flap Reconstruction

Joint / Function	Preoperative Status	6-Month Postoperative Outcome
Shoulder	Adduction contracture; abduction limited to 10–20°	Abduction improved to ~100°, able to lift arm just above eye level
Elbow	Fixed flexion contracture at 60–70°	Residual flexion contracture with ~20–30° extension lag; flexion preserved
Forearm	Not assessed (restricted by proximal contractures)	Full pronation and supination restored
Wrist	Extension contracture; fixed in 130–140° extension (functionally ~30–40° flexion from neutral)	Resting posture at ~30–40° flexion from neutral, but with ~70° extension and ~70° flexion from this position (functional arc ~140°), enabling effective grasp and release
Fingers	No fixed deformities; MCP/IP motion preserved	Full motion maintained
ADLs	Severe limitation in feeding, dressing, and play	Independent feeding, able to manipulate toys/crayons, active play with peers, improved psychosocial confidence

DISCUSSION

This case contributes to the limited literature on multi-flap reconstruction for traumatic contractures, particularly those resulting from snakebites. The use of thoracoepigastric and paraumbilical flaps for such contractures is not widely described, with paraumbilical flaps being justifiably reserved for traumatic defects (9,10). By combining these perforator-plus fasciocutaneous flaps, we were able to restore both soft tissue coverage and functional mobility in the wrist and elbow joints.

This strategy offered several advantages. It reduced the need for multiple operations and grafts, thereby providing a cost-effective solution especially suited to resource-constrained settings. Physiotherapy for early mobilisation further enhanced recovery and highlighted the critical role of rehabilitation in maximising outcomes. The overall approach demonstrates that careful flap selection and postoperative planning can effectively address complex defects while minimising complications in challenging environments.

The staged "proximal-to-distal" release of upper limb contractures prioritises shoulder and elbow mobility before addressing the wrist and hand. This sequence optimised positioning, splinting (11); on the other hand, the rationale for single-stage reconstruction is coordinated joint recovery while reducing the burden of repeated anaesthesia and prolonged hospitalisation. Delivering transformative results in a single intervention boosted patient morale and conserved resources. Meticulous flap planning also ensured donor site preservation, reinforcing both functional and logistical efficiency.

The findings highlight the importance of early and aggressive intervention in snakebite-related contractures. Multi-flap reconstruction achieved robust coverage and restored function even within a resource-limited context. However, timely referral to specialised centres remains crucial. Chronic wounds and contractures often arise from delays or inadequate initial management. Strengthening wound care in peripheral hospitals through targeted training in debridement, infection control, and basic fasciocutaneous flap techniques could prevent progression to late-stage deformities.

This case, therefore, raises a broader public health question. Would short surgical skills courses for peripheral clinicians significantly reduce the burden of advanced contractures and the need for complex tertiary reconstructions? Research into this hypothesis, alongside comparative studies on multi-flap versus staged techniques, could inform strategies to optimise outcomes in snakebite injuries across low-resource regions.

The short-term success achieved here is attributed to timely surgical intervention, judicious flap design, appropriate wrist stabilisation, and postoperative rehabilitation. Long-term follow-up is necessary to assess durability; however, the combination of thoracoepigastric and paraumbilical flaps represents a promising reconstructive option for complex contractures. Ultimately, this case reinforces that early

intervention, careful flap planning, and rehabilitation are indispensable for successful outcomes in severe traumatic contractures.

CONCLUSION

Single-stage multi-flap reconstruction is a practical, resource-conscious strategy for severe upper limb contractures following cytotoxic snakebites. This approach can optimise outcomes in resource-limited environments, emphasising the value of early, aggressive reconstruction combined with rehabilitation.

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