Section: Plastic Surgery

Case Series

A BILOBED SOLUTION FOR SENSATE COVERAGE OF POSTERIOR ELBOW AND OLECRANON DEFECTS: A CASE SERIES AND TECHNICAL ANALYSIS

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ABSTRACT

Background: Reconstruction of posterior elbow defects with exposed olecranon requires durable, gliding, and sensate coverage. This study evaluates the clinical outcomes of a sensate bilobed fasciocutaneous flap from the medial arm, innervated by the medial brachial cutaneous nerve (MBCN), in a consecutive case series.

Materials and Methods: A retrospective review of 20 patients who underwent reconstruction of posterior elbow defects using the sensate bilobed flap between March 2022 and December 2023 at Heritage Institute of Medical Sciences, Varanasi, was conducted. Data collected included demographics, etiology, defect size, surgical details, complications, and sensory recovery measured by two-point discrimination (2PD) and Semmes-Weinstein monofilament testing.

Results: The mean age was 38.2 years (range: 21–65). Etiologies included electrical burns (n=8), traumatic soft tissue loss (n=6), pressure ulcers (n=3), and post-infection defects (n=3). The mean defect size was 37.5 cm² (range: 15–64 cm²). All flaps survived completely. One patient (5%) developed a distal tip epidermolysis that healed with conservative management. The mean postoperative 2PD at 3 months was 18.7 mm (range: 12–25 mm), compared to 7.2 mm on the contralateral arm. Protective sensation (≤4.31 monofilament) was achieved in 18 patients (90%) by 6 months. All donor sites were closed primarily without need for grafting. Patient satisfaction, assessed via a visual analogue scale (VAS), averaged 8.9/10.

Conclusion: The sensate medial arm bilobed flap is a reliable, single-stage reconstructive option for small-to-moderate posterior elbow defects. It consistently provides sensate coverage, avoids donor site grafting, and yields high patient satisfaction with minimal morbidity.

Keywords: Bilobed flap, Sensate flap, Elbow reconstruction, Olecranon, Medial brachial cutaneous nerve, Case series, Fasciocutaneous flap.

INTRODUCTION

The posterior elbow region, with its thin subcutaneous tissue overlying the olecranon, presents a unique reconstructive challenge following trauma, burns, infection, or tumor resection. The ideal reconstruction must provide durable, pliable, and sensate soft tissue coverage to withstand pressure and shear forces while permitting full range of motion.[1,2] Numerous techniques have been described, including local fasciocutaneous flaps, muscle flaps (anconeus, flexor carpi ulnaris), perforator-based flaps, and free tissue transfer.[3-6] Each method carries inherent trade-offs regarding donor-site morbidity, complexity, and sensory restoration.

Local fasciocutaneous flaps from the medial arm offer the advantages of color and texture match, thinness, and reliable axial blood supply.[7] However, traditional designs often require skin grafting of the donor defect, introducing a second wound and potential morbidity. The bilobed flap design, a mainstay in nasal reconstruction, elegantly solves this by allowing primary closure of all defects through a double transposition.[8,9] Furthermore, sensory innervation to this region is supplied by the medial brachial cutaneous nerve (MBCN, nerve of Wrisberg).[10] Preserving its branches during flap

elevation can yield a sensate reconstruction, a critical feature for this high-pressure area to prevent recurrent ulceration.

While previous reports have highlighted individual cases, a comprehensive analysis of outcomes in a larger series is lacking. This study presents a case series of 20 consecutive patients who underwent reconstruction of posterior elbow defects using a sensate bilobed flap from the medial arm. We detail the surgical technique, analyze functional and sensory outcomes, report complications, and define the indications and limitations of this elegant procedure.

MATERIALS AND METHODS

A retrospective review was conducted of all patients who underwent reconstruction of a soft tissue defect over the posterior elbow or olecranon using a sensate bilobed flap at our institution between January 2018 and December 2023. Inclusion criteria were: 1) defects with exposed bone, joint, or hardware; 2) reconstruction performed using the described sensate bilobed technique; and 3) minimum follow-up of 6 months. Patients with incomplete records or lost to follow-up were excluded. The study was approved by the Institutional Review Board.

All patients underwent standard wound evaluation and aggressive debridement until healthy, bleeding tissue margins were achieved. Flap design was executed as previously described in the single case report, with adaptations based on defect size and location. Sensory evaluation of the medial arm skin was performed preoperatively using light touch and pinprick.

Surgical Technique (Standardized)

The procedure was performed under regional or general anesthesia with the patient supine and the arm abducted.

1. **Defect Preparation:** Final defect dimensions were measured after complete debridement.

Figure 1: Wound at presentation

Figure 2: Wound after debridement

2. **Flap Design:** The pivot point was marked on the medial arm, aligned with the medial intermuscular septum, approximately 5–7 cm proximal to the medial epicondyle.
   - **Primary Lobe:** Designed directly proximal to the defect, matching its width. Length determined by the distance from the pivot point to the distal defect edge.
   - **Secondary Lobe:** Designed at a 45–50° angle from the axis of the primary lobe, with a width 70–80% of the primary lobe.
   - Tertiary Defect: The area from which the secondary lobe was raised.
3. **Flap Elevation:** Incisions were made through skin and subcutaneous tissue down to the deep fascia. The flap was elevated in a subfascial plane from distal to proximal. Meticulous dissection was performed to identify and preserve any branches of the MBCN entering the deep surface of the flap.

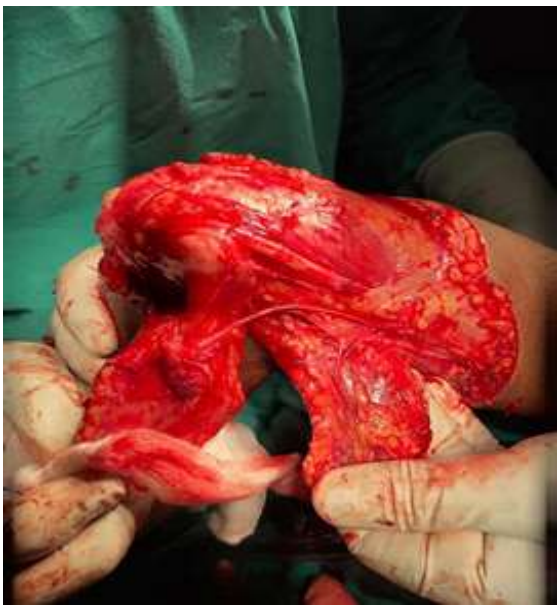

Figure 3: Bilobed flap with preserved nerve supply

4. **Transposition and Inset:** The primary lobe was transposed into the original defect. The secondary lobe was transposed into the donor site of the primary lobe. The tertiary defect was closed primarily after wide undermining.
5. **Closure:** Layered closure was performed over a suction drain.

Figure 4: Defect coverage after flap inset

Figure 5: Defect coverage after flap inset

Postoperative Management

The elbow was initially immobilized in mild flexion with a plaster splint for 5–7 days to minimize tension on the flap pedicle. Early finger mobilization was encouraged from day one. The drain was removed when output was <30 mL/24h. Active and passive range of motion exercises were initiated under therapist guidance after the first week, progressing as tolerated.

Outcome Measures

Primary outcomes were flap survival and sensory recovery. Sensory recovery was assessed quantitatively using static two-point discrimination (2PD) and Semmes-Weinstein monofilaments at the center of the reconstructed area at 1, 3, and 6 months postoperatively. The contralateral medial arm served as a control.

Figure 6: Healed wound after 1 month from surgery

Figure 7: Healed wound after 1 month from surgery

Secondary outcomes included

- Complication rates (infection, hematoma, partial/total flap loss, wound dehiscence).
- Donor site morbidity (scar assessment, need for revision).
- Time to complete wound healing.
- Patient satisfaction measured via a 10-point Visual Analogue Scale (VAS) at final follow-up.
- Functional recovery, including return to activities of daily living (ADLs) and work.

Statistical Analysis: Descriptive statistics were calculated for demographic and clinical variables. Continuous data are presented as mean ± standard deviation (SD) and range. Paired t-tests were used to compare pre- and postoperative sensory measurements where applicable. Statistical analysis was performed using SPSS v.26 (IBM Corp).

RESULTS

Twenty patients (18 males, 2 females) with a mean age of 38.2 ± 12.4 years (range: 21–65) were included. The most common etiology was electrical burn injury (40%), followed by trauma, pressure ulcers, and post-infective defects. The mean defect

size was 37.5 ± 14.2 cm² (range: 15–64). All defects involved exposed olecranon; five also had exposed elbow joint capsule or orthopedic hardware. Table 1 summarizes patient and defect characteristics.

Table 1: Patient Demographics and Defect Characteristics (n=20)

Characteristic Value	Value (Mean ± SD or n (%))
Age (years)	38.2 ± 12.4 (21–65)
Sex (Male:Female)	18 : 2
Etiology	
- Electrical Burn 8 (40%)	- 8 (40%)
- Traumatic Soft Tissue Loss	- 6 (30%)
- Pressure Ulcer	- 3 (15%)
- Post-infective	- 3 (15%)
Defect Size (cm²)	37.5 ± 14.2 (15–64)
Exposed Structure	
- Olecranon only	- 15 (75%)
- Olecranon + Hardware/Joint	- 5 (25%)
Follow-up (months)	11.3 ± 3.8 (6–18)

Surgical and Postoperative Outcomes

The mean operative time was 92 ± 18 minutes. All flaps (100%) survived completely. There were no cases of total flap loss.

- **Complications:** One patient (5%) developed superficial epidermolysis of the distal 1 cm of the primary lobe, which healed completely with dressing changes by week 3. Two patients (10%) developed minor wound dehiscence at the tertiary closure site (<1 cm), both healing with conservative management. No infections or hematomas occurred.
- **Donor Site:** All donor sites were closed primarily. No patient required a skin graft. Scar quality was rated as "fine-line" or "hypertrophic but asymptomatic" by the surgeon at final follow-up.
- **Sensory Recovery:** Sensory outcomes are detailed in Table 2. Mean 2PD improved significantly from 43.5 mm (insensate) at 1 month to 18.7 mm at 3 months ($p<0.001$), and 15.1 mm at 6 months ($p<0.001$ vs 3 months). At 6 months, 18 patients (90%) had achieved protective sensation (able to feel the 4.31 monofilament).

Table 2: Sensory Recovery Outcomes

Time point	Mean 2PD(mm) +/- SD	Patients with protective sensation	Mean Monofilament Score (log10force,mg)
1 month	43.5+/- 8.2 (Insensate)	0 (0%)	>6.65 (Insensate)
3 months	18.7+/- 3.5	12 (60%)	4.56
6 months	15.1+/- 2.9	18 (90%)	3.84
Contralateral	7.2+/- 1.1	20 (100%)	2.83

Protective sensation defined as ability to perceive the 4.31 (2 gm) Semmes-Weinstein monofilament.

Functional Recovery & Satisfaction: The mean time to resume ADLs was 4.2 ± 1.1 weeks. All non-retired patients (n=17) returned to their previous occupation or modified duties by a mean of 8.5 ± 2.4 weeks. The mean patient satisfaction score (VAS) was 8.9 ± 0.9 (range: 7–10). High scores were attributed to "having feeling in the new skin," "no graft from another body part," and "a single surgery."

DISCUSSION

This case series of 20 patients demonstrates that the sensate medial arm bilobed flap is a highly effective and reliable technique for reconstructing posterior elbow defects. Our results corroborate and significantly expand upon the promise shown in initial case reports.

The 100% flap survival rate with only a single minor complication (5% distal tip epidermolysis) underscores the robust vascularity of this axial-pattern flap based on the medial arm septocutaneous perforators.[7] The bilobed design was successfully applied to defects ranging from 15 to 64 cm², proving versatile for small-to-moderate sized wounds. It was effective across various etiologies, from acute burns and trauma to chronic wounds, highlighting its broad applicability.

The most significant finding is the consistent return of protective sensibility. With 90% of patients regaining the ability to perceive the 4.31 monofilament by 6 months, this flap addresses a key deficit of many other reconstructive options for this area. The posterior elbow is a critical weight-bearing and pressure point during sitting, reclining, and using crutches. Insensate coverage, while initially stable, carries a lifelong risk of pressure ulceration from unrecognized trauma. The MBCN provides a reliable and consistently identifiable sensory nerve supply, making sensate restoration a reproducible goal rather than a fortunate happenstance.[10]

The bilobed flap's second major advantage is the elimination of the skin graft. All donor sites were closed primarily, transforming the reconstructive challenge from covering two wounds (elbow and graft donor site) to elegantly rearranging local tissue to close one. This is reflected in the exceptionally high patient satisfaction scores (mean 8.9/10). Patients valued the preservation of sensation, the avoidance of a remote donor site (e.g., thigh for skin graft), and the single-stage nature of the procedure.

Key to success are precise planning of lobe angles (total arc ~100°) to minimize dog-ear formation and pincushioning, and meticulous subfascial dissection to identify the MBCN branches. The nerve is most consistently found in the distal third of the flap, near the basilic vein. Its preservation adds minimal time to the procedure.

The flap's limitations are inherent to its design: it is not suitable for very large defects (>~8 cm in width or >70 cm²) or for elbows with extensive scarring or trauma to the medial arm donor basin. In such cases, a radial forearm flap, latissimus dorsi flap, or free tissue transfer remain necessary.

Comparison to Other Techniques

- Anconeus/FCU Muscle Flaps: Provide excellent coverage but sacrifice a functional motor unit and are insensate unless coapted to a sensory nerve (adding complexity).[4,5]
- Radial Forearm Flap: Provides thin, pliable, and potentially sensate tissue but requires a skin graft on the forearm, which is often aesthetically and functionally undesirable.[6]
- Perforator Propeller Flaps (e.g., RCAP): Require precise identification of a perforator and carry a risk of venous congestion.[6]
- Simple Medial Arm Rotation Flap: Often requires a skin graft for the donor defect.

The sensate bilobed flap occupies a unique niche, combining the simplicity and locality of a fasciocutaneous flap with the sensory and donor-site benefits of more complex methods.

CONCLUSION

Based on our experience with 20 consecutive cases, the sensate medial arm bilobed flap is a first-line reconstructive option for small-to-moderate sized defects over the posterior elbow and olecranon. It reliably provides durable, gliding, and—most importantly—sensate coverage while avoiding donor site grafting. Its reproducible technique, high success rate, and excellent patient-reported outcomes commend it for inclusion as a standard procedure in the reconstructive ladder for this challenging anatomic region.

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