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Research Article

Revisiting Pedicled Medial Arm Flap for Soft Tissue Defects Around Elbow in Pediatric Patients

Muhammad Omar Afzal,[1] Aroobah Iqbal,[2] Javeria Khan,[3] Sadia Hussain,[4] Muhammad Ahsan Riaz,[5] Umar Asif[6]

[1-4,6]Department of Plastic Surgery, Mayo Hospital, Lahore, [5] Services Hospital, Lahore

Abstract

Elbow defects present intricate challenges in reconstructive surgery due to the joint's complex anatomy and functional requirements.

Objective: Objective of this study is to investigate the efficacy of perforator-based medial arm flap reconstruction for anterior elbow defects that circumvent the injury of the main source vessel in pediatric patients.

Methodology: This prospective study was done in Mayo Burn & Reconstructive Surgery department from November 2022 to November 2023. Pediatric patients requiring reconstruction of small to medium sized soft tissue defects around the elbow were included. The study describes the surgical technique, the anatomy of perforators, outcomes and challenges associated with this approach.

Results: 15 consecutive patients were treated with perforator based pedicled medial arm flap. Results showed a consistently located perforator near the medial epicondyle, enabling successful flap harvesting and viability. Post-operative outcomes revealed high flap survival rates with minimal complications.

Conclusion: The technique offers a reliable option for elbow defect coverage due to the consistent location of the perforator.

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Corresponding Author | Aroobah Iqbal, Post Graduate Trainee, Department of Plastic Surgery, Mayo Hospital, Lahore

Email: arubarana@yahoo.com

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Introduction

Elbow defects in pediatric patients pose a unique reconstructive challenge owing to its intricate anatomy and functional requirements. The reconstructive aim for coverage of soft tissue defects of anterior elbow is a pliable flap coverage that allows adequate coverage of neurovascular structures and passive range of motion.[1] Pediatric patients do not comply well with physiotherapy regimes, hence total coverage by a supple flap or interposition flap with split thickness skin graft to reconstruct the soft tissue defect is better.[2,3] Perforator flaps have gained popularity as they cause minimal donor site morbidity and allow easily elevation of the flaps for secondary bony or tendon work.[4,5]

The reverse medial arm flap can be based on the superior ulnar collateral artery or on the perforators from inferior ulnar collateral artery and brachial artery.[6,7] Reverse or distally based medial arm flap when based on ulnar recurrent arteries requires the division of the artery proximally which limits the usefulness of the flap if there is a distal injury around the origin of the pedicle.[3] The reverse flap's proximity to the defect site allows for a more anatomically congruent reconstruction, preserving joint function. However, due to its difficult dissection and dubious perfusion in distal trauma, it has not gained popularity.[8] The presence of a single, reliable perforator can potentially overcome this debacle, but existing literature only points to the presence of perforators in distal arm and does not identify presence and precise location of a single reliable perforator in this area. Perforators in this area are usually septo-cutaneous giving off muscular branches. We present our

study that explores the reconstruction of soft tissue defects around elbow with perforator based medial arm flap in pediatric patients, shedding light on our surgical technique and anatomy of the single consistent perforator closest to the elbow to allow large arc of rotation.

Methodology

After approval by ethical committee of the institution, this prospective study was done in Mayo Burn & Reconstructive Surgery Department from November 2022 to November 2023. We included patients between age 2 years to 12 years, both male and female, with small to medium soft tissue defects over anterior and posterior surfaces of the elbow amenable to closure with medial arm flap with or without the skin graft. We excluded patients with large defects, uncontrolled comorbidities and who had injury to the medial arm skin. Patients' demographics, surgical technique, perforator location and its origin, flap characteristics, flap survival and complications were assessed & recorded. Patients were followed up for up to 3 months.

Technique:

Patients were placed in supine position with shoulder abducted, externally rotated and elbow flexed at 90 degrees. An axis was marked extending from medial epicondyle along the posterior axillary fold till the axillary apex. An 8Hz hand-held Doppler Ultrasound probe was used to map the perforator(s) till the midpoint of this axis. After identification, an elliptical flap was marked based on the defect size. Posterior incision was given first and dissection was done till medial intermuscular septum of arm. Perforator was sought out over the preoperatively marked sites, and a single largest perforator with distinct artery and vein was selected. Flap was successfully harvested in a fasciocutaneous plane over a single perforator and rotated to cover the defect. Dressing and splintage was done post operatively. Figure 1 shows the diagrammatical depiction of the technique to raise the flap.

Figure1: *Diagrammatic depiction of surgical technique*

Results

15 consecutive patients with 9 males and 6 females were included in the study. The average age of patients was 8.5 ± 1.3 years. In 13 patients, soft tissue defects resulted after release of post burn elbow flexion contractures, while in 2 patient there was post traumatic soft tissue defect. table 1 shows the demographic and clinical details of the defect. In all cases, a consistent perforator was found within 3cm of the medial epicondyle. Figure 2 shows the distance at which dominant perforators were found from the medial epicondyle. The average distance was 2.62 ± 0.7cm as shown in figure 3. All the perforators arose from the superior ulnar collateral artery. In 14 patients the defect was anteriorly located over the cubital fossa and in 1 patient the defect was located posteriorly over the olecranon process. None of the flaps extended beyond the midpoint of the line between medial epicondyle and posterior axillary fold. All perforators have septocutaneous course Figure 4 shows a patient with high voltage electric injury resulting in elbow contracture. Release of contracture and coverage with medial arm flap was done. Figure 5 shows reconstruction of soft tissue defect after release of post burn contracture. There was complete flap survival in our case series and all the donor site defects were closed primarily.

Table 1: *patients demographic and defects details*

Characteristics		No. of patients	%
Gender	Male	9	60%
	Female	6	40%
Etiology	Post burn contracture	13	87%
	Post traumatic defec t	2	13%
Site	Anterior elbow	14	93%
	Posterior elbow	1	7%

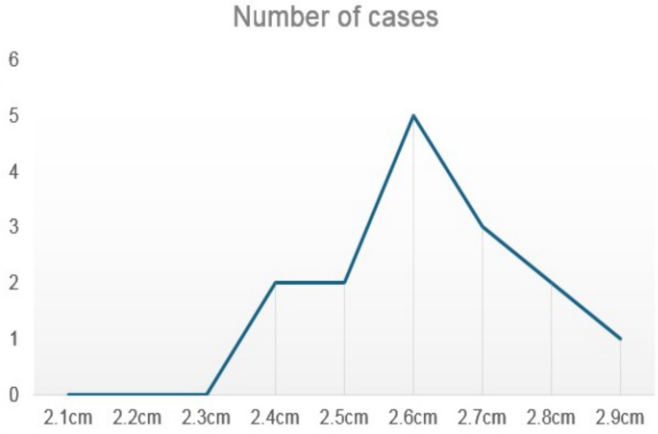

Figure 2: *Presence of dominant perforator at medial epicondyle in this cases series*

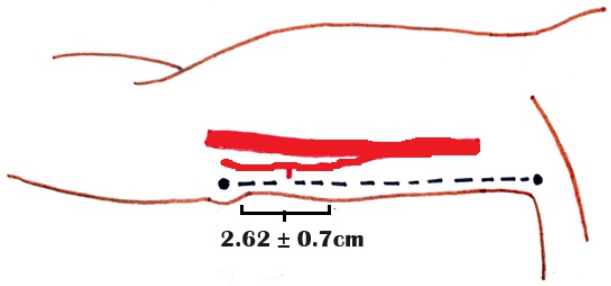

Figure 3: *Mean distance from the medial epicondyle at which the dominant perforator was located*

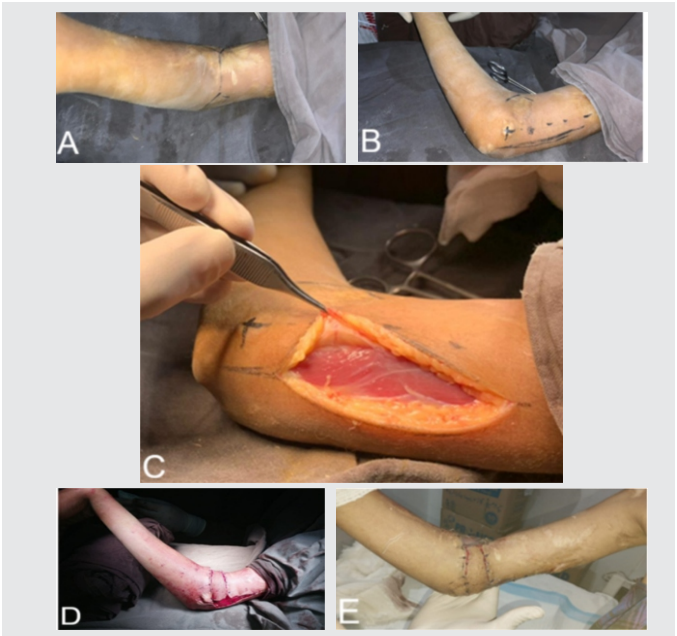

Figure 4: *Release of post electric burn elbow contracture and coverage with medial arm flap A. Preoperative marking of the perforator (B). Posterior incision and identification of the perforator (C). Coverage of the released surface with flap and split thickness skin graft (D). Complete flap survival on follow up after 1 week (E).*

Figure 5: *Release of post burn contracture and coverage with medial arm flap. Volar view after flap insetting (A). Dorsal view showing final flap insetting and STSG (B). Complete flap survival noted at 2 weeks of follow up (C).*

Discussion

Elbow defects are a unique reconstructive challenge, for which many strategies such as grafting, loco-regional, distant flaps and rarely free tissue transfer have been explored.[9] Grafts alone need prolong splintage and extensive physiotherapy to prevent recurrent contractures, which is difficult in pediatric age group.[10] On the contrary, free flaps require prolonge operative time and monitoring.[11] Localized fascio-cutaneous flaps, especially perforator-based flaps have been an area of interest for plastic surgeons owing to ease of dissection, reliable blood supply, good cosmetic result, and limited donor site morbidity.

Lateral Arm flap and Radial forearm flap have been described for elbow reconstruction but are limited due to obvious scar at lateral arm in cases of post burn contractures and sacrifice of a major vessel, respectively.[12] The medial arm flap, first described by Tagliacozzi, in 1597 has been utilized for resurfacing of head & neck, wrist and hand defects.[13] Cegarra-Escolano described the perforators of upper limb, the source vessels of which frequently accompanied the major nerves.[14] Coming out of the source vessels, the majority of perforators concentrated near the proximal and distal joints of a limb. Malzone G et al described the use of perforator-based propeller flaps for upper limb reconstruction, evading the need for mobilization of the source vessels.[15] Medial arm flap offers a convenient option for reconstruction of the defects around elbow and the skin is usually spared in majority of injuries at this region.

Cil Y et al describe a cadaveric study, describing a consistent perforator from brachial artery in distal forearm, suggesting flaps based on it to be a useful option for elbow reconstruction.[16] similarly, Gong et al performed a retrospective study on 8 patients for elbow reconstruction with perforator based medial arm flap, with complete survival of all flaps.[17] However they did study in adult patients and found a perforator in distal forearm arising from either brachial artery or superior ulnar collateral artery. Uslu et al presented a case report of medial elbow reconstruction with perforator based medial arm propeller flap, however, did not mention the precise location and origin of the perforator.[18] Medial arm flap provides thin, pliable, hairless skin which is in close proximity to elbow serving as a cosmetically superior reconstructive option for elbow defects. How-

ever, due to its anatomic variability, it had not become as popular.

Our study demonstrated a consistent perforator within 3cm of the medial epicondyle, and complete flap survival in all cases attesting to the reliability of the perforator. Although we were able to demonstrate the consistent presence of the perforator, but we only covered small to medium defects and didn't take tissue beyond the midpoint of arm, which necessitates further research to define safe limits of the flap. Similarly, the study was based on pediatric age group and in adults the perforator maybe located beyond the distance that we have found in our study.

Conclusion

Medial arm flap based on a consistent perforator near medial epicondyle, is a reliable reconstructive tool for coverage of elbow defects.

Ethical Approval

The Institutional Review Board (IRB), King Edward Medical University, Lahore approved this study vide letter #. 308/RC/KEMU dated 03-06-2022

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Author's Contribution:

Muhammad Omar Afzal: Data collection, Manuscript Revision, analysis and interpretation of data and final approval of the version.

Aroobah Iqbal: Conception and design of the study, data collection, analysis and interpretation, Drafting the work Final approval of the version to be published and accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Javeria Khan: Contribution to conception and design of study, Data Interpretation and Analysis and final approval of the version

Sadia Hussain: Data Collection, Data Analysis and final approval of the version

Muhammad Ahsan Riaz: Data collection, Manuscript Revision, analysis and interpretation of data and final approval of the version.

Umar Asif: Contribution to conception and design of study, Data Interpretation and Analysis and final approval of the version.

All authors meet the ICMJE authorship criteria and agree to be accountable for all aspects of the work, ensuring the accuracy and integrity of the research.

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