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Original Article

ALTERING THE MARKING OF THE REVERSE POSTERIOR INTEROSSEOUS ARTERY FLAP

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ABSTRACT

Background: Full-thickness defects on the dorsum of the hand requires thin, soft, and pliable skin for which there are limited locoregional flaps. The reverse posterior interosseous artery (PIA) flap based on the communicating artery fulfills all above requirements and can reach upto the fingers. However, there has been discrepancy in the surface marking of the flap and the anatomical position of the vessel pedicle. We share our alteration with the marking and ease of harvesting this flap.

Method and material: This is a prospective study conducted at a private teaching hospital in Karachi, over a period of 2 years from November 2017 to December 2019. After taking consent and ensuring confidentiality of all patients who had PIA flap reconstruction, we collected patient's demographic details, mode of injury, and flap surface area. We altered the described skin marking and took measures to prevent venous congestion and noted the outcomes in term of flap congestion and flap loss.

Results: Twenty-eight patients with a mode age of 32 years were operated during this period. The majority (64.2%) had a motor vehicle accident and machine injuries. The mean surface area of flaps was 6×10 cm^2, and 11 (39.2%) flaps had venous supercharging. All patients had a 10-20° wrist extension splint for 2 weeks. The mean follow-up of the patients was 14 ± 5 days, and 6 (21.4%) flaps de-

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veloped a minimal marginal flap loss, which was managed conservatively.

Conclusion: By minimally altering our surface marking, we experienced a easy and quick harvesting of this flap. However, one has to be vigilant and take all described precautions for venous congestion.

Introduction

A soft-tissue defect on the dorsum of the hand exposes underlying nerves, tendons, and bone. Although there are a number of local and regional flaps, the skin on the dorsal hand requires a soft, thin, and pliable skin coverage, for which there are limited local and regional options [1]. The posterior interosseous artery (PIA) flap not only fulfills these requirements but also it spares both major arteries of the forearm. It covers not only the dorsum of the hand but also can be extended to cover defects on fingers [2,3]. This extended PIA flap has made authors to probe into the main arterial basis of this reverse flow flap [4].

The PIA flap enters the posterior compartment of the forearm, as a branch from the common interosseous artery, at the inferior border of the supinator muscle. It lies in the septum, between extensor digiti minimi (EDM) and extensor carpi ulnaris (ECU) tendons, deep to muscles proximally and runs superficial in the distal half of the forearm [5]. It has a communicating branch with the anterior interosseous artery, which lies 2-3 cm proximal to the distal radioulnar joint (DRUJ). The traditional skin marking for the central axis of the flap marks the lateral humeral epicondyle and midpoint of the DRUJ [6], which shifts the distally based skin flap radial ward making the septum to lie off center.

We observed and have made some minor alteration in the markings of this flap, and thus, we share our experience of ease to harvest and minimize congestion rate with the reverse PIA flap.

Method and Material

This study was a prospective study conducted at a private teaching hospital in Karachi, over a period of 2 years (from November 2017 to December 2019). This hospital caters a number of patients not only from within the country but also from neighboring nations who had recently faced war conflicts. Thus, we treated many unique and complicated patients because of 24/7 hand and microvascular services offered by this institute.

After observing our previous results with the reverse PIA flap and its congestion rate in our department, we looked into the literature and performed a prospective study. We informed and took written consent from the patients for the procedure and confidentiality of data. A short proforma was filled to collect patient's demographic details, mode of injury, flap congestion, and superficial- or full-thickness loss. A good flap coverage was determined on the follow-up visit at 2 weeks with no signs of congestion or superficial loss requiring no surgical intervention. A statistical analysis was performed on SPSS version 21.0. The chi-square test was used for correlations, with a p-value ≤ 0.05 as significant.

FLAP MARKING AND DISSECTION

With the forearm in neutral position, we marked the lateral humeral epicondyle and midpoint of the DRUJ (Figure 1). A communicating branch is marked 2 cm proximal to the DRUJ. We marked a straight line from the lateral humeral epicondyle to ulnar head (Figure 1), indicating a intermuscular septum between EDM and ECU. The defect was mapped on the forearm centered on this line, sparing

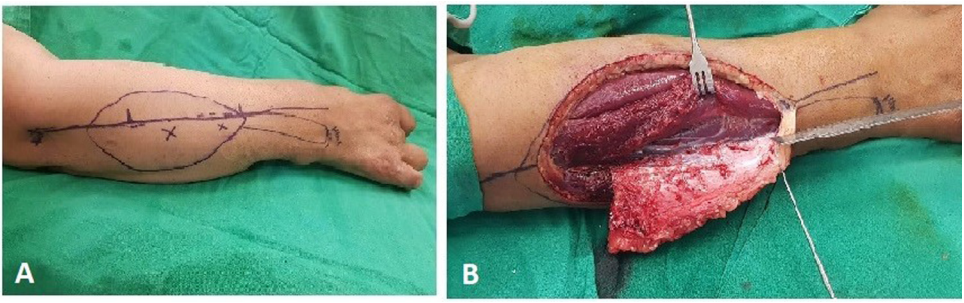

Figure 1. Preoperative marking from the lateral epicondyle of the humerus to ulnar head (A), with a straight line to the midpoint of the distal radioulnar joint. Pedicle identification between EDM (retracted) and ECU (B), with the scale pointing the direction of the pedicle distally.

Figure 2. Flap in-set after a week at the donor site (A) and with a skin paddle (B) covering the vessel. A well-taken split-thickness skin graft at the proximal donor site (C).

Table 1
Flaps on different regions of the hand.

Region		Number (%)
Hand	Volar	8 (28.6)
	Dorsum	11 (39.3)
	First web space	6 (21.4)
	Thumb	3 (10.7)

proximal 1/3rd of the forearm. We mark and harvest 1 cm of the distal skin pedicle, which keeps the vessels covered and prevents kinking, thus congestion (Figure 2).

The dissection is performed under torniquet control and starts from the proximal and radial border, identifying and preserving the posterior interosseous nerve. The septum is identified with a vessel just next to the interosseous membrane, entering a posterior compartment below the lower border of the supinator muscle. The dissection is completed from the ulnar border, the flap is rotated 180°, and the inset is performed. The donor site is covered with a meshed split-thickness skin graft, and the hand is splinted at 10–20° extension for 7 days.

Results

Twenty-eight patients underwent the PIA flap coverage on the hand with mode for age of 32 years (range: 16-52 years) and male-to-female ratio of 1.5:1. Eight (28.5%) patients had machine injury, 10 (35.7%) had a motor car accident, 4 (14.2%) had postburn contracture release, and 6 (21.4%) had a wound coverage after tumor ablation Table 1. shows the regions on the hand, which required the PIA flap coverage.

The mean area of the flap was 6×10 cm^2 (range: 4×6–8×10 cm^2), whereas the mean time to harvest the flap was 26 ± 8 minutes. Of 28 flaps, 11 (39.2%) flaps were supercharged to prevent venous congestion (the superficial vein of the flap was anastomosed with the superficial vein at a

Figure 3. Follow-up in a patient at 5 weeks postoperatively.

recipient site). This decision was taken by the surgeon if he found a good size of the superficial vein showing a good venous outflow after the flap harvest. All flaps had a distal skin paddle covering the distal vascular pedicle. The proximal donor site was covered with a split-thickness skin graft, and the distal donor site with a narrow skin pedicle was primarily closed (Figure 3).

Postoperatively, all patients had a wrist splint at 10-20°, elevation using sling, which was suspended to the bedside stand and intravenous antibiotics for 5 days.

Outcome

Flaps were monitored by a clinical examination for signs of venous congestion, color of the flap, skin turgor, and pin prick. At mean follow-up of 14 ± 5 days, all flaps survived and provided a durable and stable coverage. Mild congestion (dark blood on pin prick but no turgor or color change) was noted in 13 (46.4%) flaps; however, 6 (21.4%) had a minimal distal marginal flap loss, which required no further surgical intervention. These 6 (21.4%) flaps did not have venous supercharging. We correlated flap congestion with our maneuvers to prevent it and found statistically significant results with venous supercharging (p-value: 0.01) and distal skin paddle coverage (p-value: 0.04). All patients had a completely healed donor site, with a excellent graft take at 5th postoperative day. The wrist splint was removed at 2 weeks postoperatively. None of our patient had any functional weakness or loss.

Discussion

The defects on the hand can be covered using the principle of a reconstructive ladder; however, a pliable, durable, and well-vascularized tissue helps to preserve and regain hand function easily. These patients are good candidates for a free tissue transfer, which is the single sitting procedure and provides a tissue of choice. But, the availability of expertise and cost-effectiveness is always a barrier in decision-making. There are other locoregional flaps, abdominal or groin flaps, reverse radial or ulnar flaps, and perforator flaps [7], but these require a staged procedure or sacrifice a main supply to the hand.

The reverse PIA flap provides soft, versatile, and supple skin without disturbing the arterial supply of the hand. This flap receives its blood supply from a communicating branch of the anterior interosseous artery, which is located at 2-3cm from the midradioulnar joint; thus, this area should be spared from traumatic insult when planning this flap. The posterior interosseous artery has populated perforators in the middle third on the dorsum of the forearm [8] and has an unreliable perfusion in the proximal third of the forearm. Prasad R et al [9] described a technique for harvesting this flap by including more proximal skin territory.

Traditionally, the marking for the reverse PIA flap is from the lateral epicondyle to midpoint of the distal radioulnar joint [5]. The PIA flap runs in the septum between EDM and ECU muscle bellies, with a constant anatomical position proximally and distally communicated with the 5, 6 dorsal intercompartmental septal artery [3], which has a skin landmark from the lateral epicondyle to ulnar head. Thus, shifting our distal flap landmark to the ulnar head has made a flap elevation with a small distal skin paddle easy and quick. Preoperative hand-held Doppler examination is usually used to locate the vessel [10], but as practiced by Ashok G [11], we too dissect the flap from radial to ulnar and identify the posterior interosseous vessels.

As with all reverse flow flaps, postoperative venous congestion remains a common problem. The PIA flap congestion ranges from 8 to 25% in the literature [12]; however, we had a congestion rate of 21.4%, which can be due to vigilant maneuvers we opted to prevent this complication. There are a number of ways to prevent venous congestion, avoiding the dissection of the AIA and PIA communicating branch, venous supercharging [6,13] where deem indicated, creating a cutaneous handle which covers a distal flap pedicle, and avoiding the subcutaneous tunneling of the pedicle [14]. We practice harvesting, as previously described, racquet-shaped flap [15], which allows a easy flap inset and enhances a venous outflow as the skin bridge contains the subcutaneous venous plexus, but to include this distal skin paddle, we suggest to shift the distal marking to the ulnar head to reliably cover the vascular pedicle.

We did not have any patient who had a postoperative weakness or functional loss of extensors while elevating the reverse PIA flap; this may be better justified by Keogh A et al [16], who reported a detailed cadaveric study describing the anatomical relationship of PIA and posterior interosseous nerve (PIN) in the forearm. He too concluded that the antegrade PIA flap has more chances of damaging PIN, as compared to the minor or transient loss of PIN function when a retrograde flap is harvested.

Conclusion

We observed a easy and quick harvesting of this flap by minimally shifting the skin marking of the flap. We need to take all described precautions to prevent venous congestion.

Declaration of Competing Interest

All authors declare that they have no conflict of interests.

Ethical Statement

This study had been approved by the institute's ethical review board.

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Self.

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