

# The Posterior Interosseous Flap

Phairat Thuvasethakul, M.D., Somsak Leechavengvongs, M.D., Kiat Witoonchart, M.D.,  
and Chairaj Uerpairujkit, M.D.

*Institute of Orthopaedics, Lerdsin General Hospital, Bangkok, Thailand*

## ABSTRACT

**Twelve cases of distal based posterior interosseous flaps ( PIF ) were performed for skin coverage of soft tissue defects at the dorsums of hands, metacarpophalangeal joints of fingers, interphalangeal joint of thumb, and for reconstruction of the first web space. All but one (11 cases) of the flaps completely survived and achieved excellent results. The advantages of the flaps included : matching of skin color and texture to the defect, no need for immobilization, no need to perform microvascular anastomosis, and most importantly, the radial artery can be preserved. However, PIF was not easily harvested and, therefore, skillful surgical dissection was needed. Other important issues concerning PIF, such as, pivot point of the flap, the most important perforator branch, etc., were also discussed.**

The posterior interosseous flap (PIF) was first reported in 1986 by Zancolli and Angrigiani<sup>1</sup>. Later on in the same year, its anatomical study was reported by Penteado and Masquelet<sup>2</sup>. PIF is a fasciocutaneous flap type C located on the dorsal aspect of forearm. It is nourished by many septocutaneous perforators branched from the posterior interosseous artery (PIA).

Since the anastomosis between anterior and posterior interosseous artery occurs near the distal radioulnar joint (DRUJ), the PIF can be harvested and used as a distally based flap.<sup>3-6</sup> This flap can provide skin coverage to the soft tissue defect as distal as metacarpophalangeal joint of finger. The donor site was, then, simply covered by split thickness skin graft due to its excellent bed formed by muscle freshy fibers.

Nevertheless, there are other important issues regarding the use of PIF that needed to be considered, such as; what is the most important perforator branch, how many perforators are needed for flap survival, what to do

when extensor carpi ulnaris branch of posterior interosseous nerve cross the posterior interosseous artery and where is the pivot point of the flap.

The aim of this paper is to present the results of the flap and its indications. It also attempts to discuss some of the important issues outlined above.

## MATERIALS AND METHODS

From January 1992 - June 1995 PIF were performed in 12 patients (11 males and 1 female) admitted at the Institute of Orthopaedics, Lerdsin Hospital. The ages of patients ranged from 3 to 61 years (average = 27.3). The sizes of defects ranged from 2x4 cm<sup>2</sup> to 8x10 cm<sup>2</sup> (average 4.8x7.0 cm<sup>2</sup>). Almost all patients were traumatic cases except one, which was the youngest, was injured by electrical burn. Ten cases had tendons and bone exposed wounds at there different sites : on the dorsum of the hand ( 3 ), at the metacarpophalangeal joint of finger ( 5 ), and at the intephalangeal joint of thumb ( 2 ). In one case, the flap was used for reconstruction of the first web space after correction of contracture (see table 1).

## OPERATIVE TECHNIQUE

The operation was performed under pneumatic tourniquet. A line between the epicondyle of the distal humerus and DRUJ was drawn. After measuring the size of defect and the length of pedicle needed for rotation, the flap was designed on the dorsum of forearm.

Incision was done first at the distal forearm along the previously drawn line. The fascial septum between the 5<sup>th</sup> and 6<sup>th</sup> dorsal compartment was located. The fascia was, then, incised radially on EMD at 5 mm. away from septum to identify the PIA and its venae commitans within the septum. Distal dissection was performed to identify the anastomosis of anterior and posterior introsseous arteries, which was usually located about 2 cm proximal to DRUJ.

Table 1

Case	Sex/Age	Dx	Size(cm)	Distal border	Result
1	M/41	Ring avulsion of Rt. long finger	4x5	MP joint	Survived
2	M/20	Severe crush amputated 2 <sup>nd</sup> -5 <sup>th</sup> fingers Lt. hand	5x9	MP joint	Survived
3	M/23	Dorsal defect Lt. hand	5x7.5	Midproximal phalanx	Survived
4	M/19	Traumatic amputation of all fingers Lt. hand	5x7	Midproximal phalanx	Survived
5	F/61	Dorsal defect Lt. Hand	8x10	Midproximal phalanx	Survived
6	M/28	Traumatic amputation of Rt. ring & longfinger	2x4	MP joint	Complete Necrosis
7	M/14	1 <sup>st</sup> web space contracture	5x7	1 <sup>st</sup> web space	Survived
8	M/15	Crush amputation Lt. thumb	5x5	thumb IP joint	Survived
9	M/30	S/P replantation Lt. thumb	5x8	MP joint	Survived
10	M/40	Crush injury Rt. Hand	5x8	MP joint	Survived
11	M/34	Scar contracture of dorsal aspect of MP joints of 3 ulnar fingers	5x9	Midproximal phalanx	Survived
12	M/3	Electrical burn Rt. hand	4x5	Thumb MP joint	Survived

$$\bar{X}=4.8 \times 7.0$$

After finding the anastomosis, the radial side of the flap was elevated from underlying muscles, where many septocutaneous perforators could be found within septum.

At the most proximal border of the flap, the PIA was cut, ligated and dissected from PIN. Dissection was proceeded distally to the pedicle. The flap was raised with PIA and venae comitans and rotated to cover the defect.

The donor site was sutured primarily if the width of the flap was less than 5 cm. Otherwise, it was closed by split thickness skin graft. The vascularity of the flap could be checked by deflating the tourniquet after the dissection was completed. If bleeding from the flap occurred immediately, the vascular supply was sufficient and the flap usually survived.

## RESULTS

After the operation, all patients were closely observed for one day. Wound dressing was done daily and any clotted blood beneath the flap was evacuated to prevent infection. After one week, the patients were allowed to go home. They all were followed up for more than one month. It was found that, in almost all cases (11 cases), the flaps were completely survived, and achieved favorable results. Only in one case, the flap was completely necrosed. In this case, the flap was the smallest and bleeding from flap was delayed after tourniquet release.

## DISCUSSION

The results of this study clearly indicated that PIF is a favourable alternative in the treatment of deep wound on the hand, besides the conventional radial forearm flap.

Compared to the radial forearm flap, pedicle groin flap and free flap, PIF has many advantages. Firstly, it can preserve radial artery which is a major artery providing blood supply to forearm and hand. Secondly, it does not require any postoperative immobilization which cause inconvenience, discomfort, and stiffness of the upper extremity especially in elderly. Thirdly, using as rotation flap, microvascular anastomosis need not be performed, thus, makes PIF less difficult than free flap. Lastly, PIF provides a well matched skin texture and color to the recipient site<sup>5</sup> and good soft tissue coverage for further reconstructive procedures<sup>6</sup>.

Nonetheless, PIF has some disadvantages. Because PIF involves difficult and tedious dissection, skillful surgeon, meticulous dissection and knowledge about its anatomy are needed prior to perform this operation. The flap cannot be extended to cover PIP joint of finger and IP joint of thumb due to the limitation of flap length. Furthermore, partial necrosis of PIF has been reported.<sup>5</sup>

Many authors reported that the most important perforator branch providing flap survival was the first proximal perforator. Costa and Soutar<sup>3</sup> indicated that this branch was the first branch distal to supinator muscle. Buchler<sup>5</sup> later named this branch "the most proximal relevant perforator (MPRP)", which was located at 5-11.5 cm. distal to lateral epicondyle of the humerus.

Bayon and Pho<sup>4</sup> performed an anatomic study of Asian people and found that the first medium size perforator located at mid forearm level should be considered the most important to be included within the flap.

In 1992, Zancolli et al<sup>6</sup> reported "Choke Anastomosis" of the retrograde flow from anterior interosseous

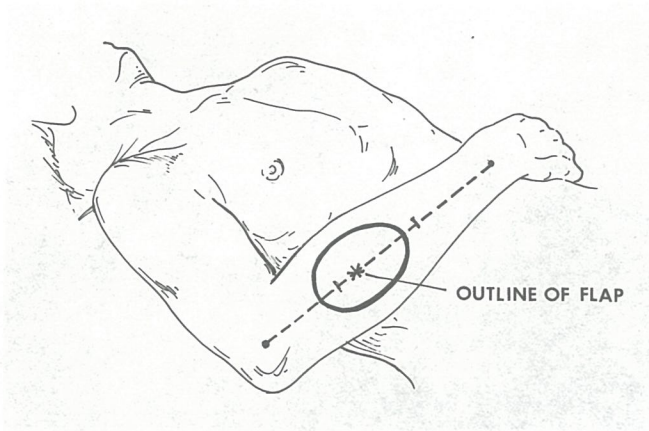


Fig. 1 Diagram showing outline of the flap.

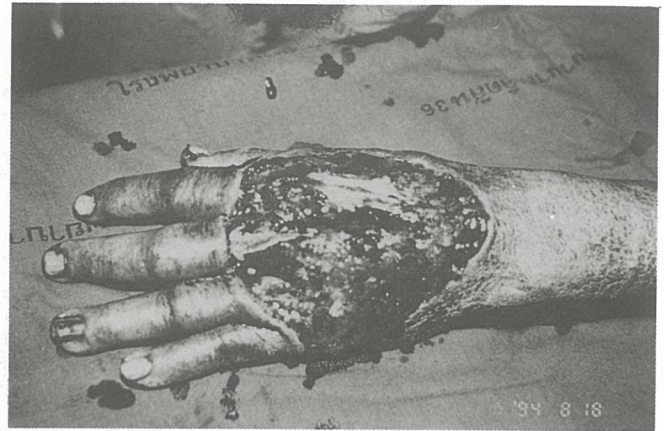


Fig. 2 patient 5, 2a Lesion of the dorsum of the left hand caused by farm equipment.



Fig. 2b Outline of the flap 8x10 cm<sup>2</sup>.



Fig. 2c The flap and donor site after 2 months.

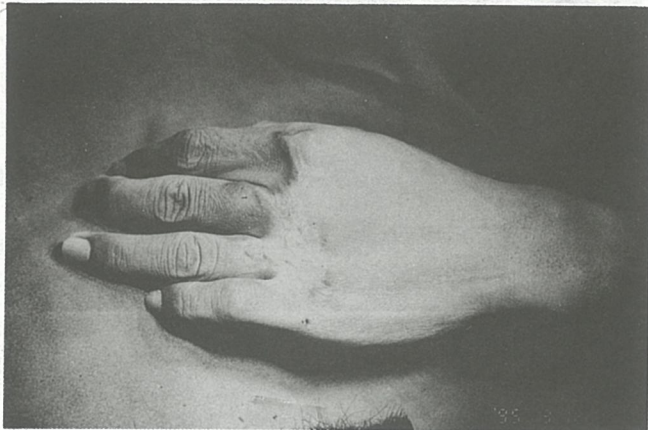


Fig. 3 patient 2, 3a Scar contracture at the MCP Jt. of the left hand



Fig. 3b After removal of the scar, extensor tendon and MCP Jt. were exposed

artery beyond the proximal third of posterior interosseous artery, which reduced the importance of the first proximal perforator. The authors suggested that "the medial cutaneous branch" which was located at mid forearm, was more important than other perforators.

We did not identify the above mentioned perforators before completing the dissection. However, our

experiences suggested that whenever a medium or large perforator was included in the flap, the flap was usually survived.

Buchler<sup>5</sup> had classified the relation of the ECU nerve branch to the descending branch of the PIA and its most proximal relevant septocutaneous perforator into 3 types: type A, B and C. The flap could be harvested without

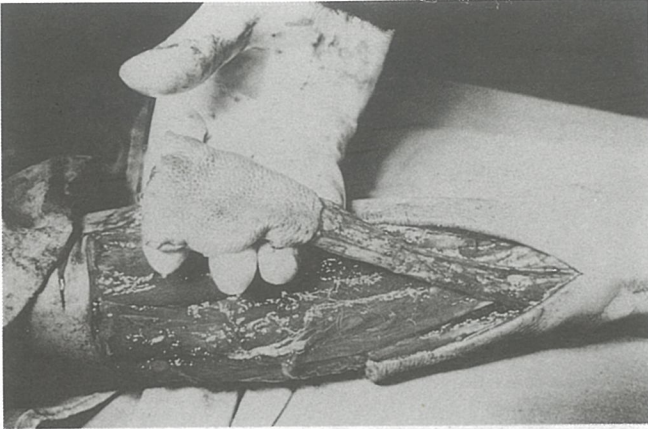


Fig. 3c Dissection of the posterior interosseous flap

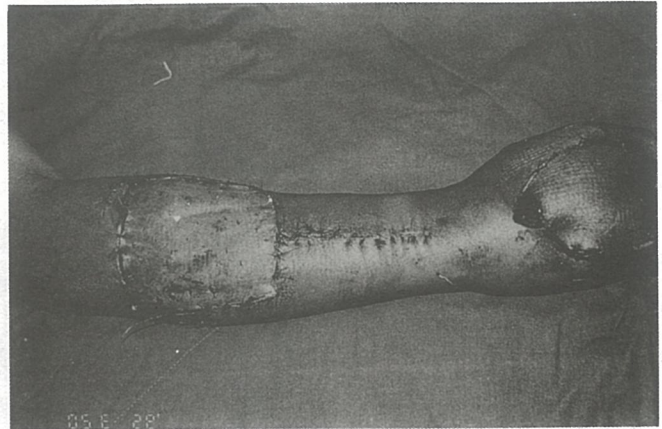


Fig. 3d The flap and donor site immediately post-operation

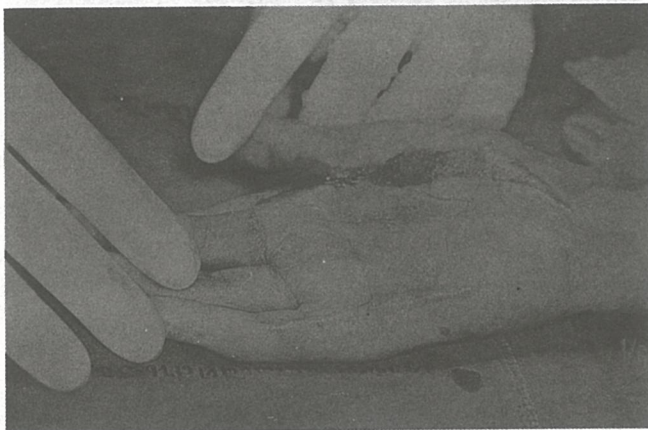


Fig. 4 patient 7, 4a Post-traumatic contracture of the first web space.



Fig. 4b Dissection of the posterior interosseous flap.



Fig. 4c The posterior interosseous flap was set after release the first web space contracture



Fig. 4d Results at 2 months.

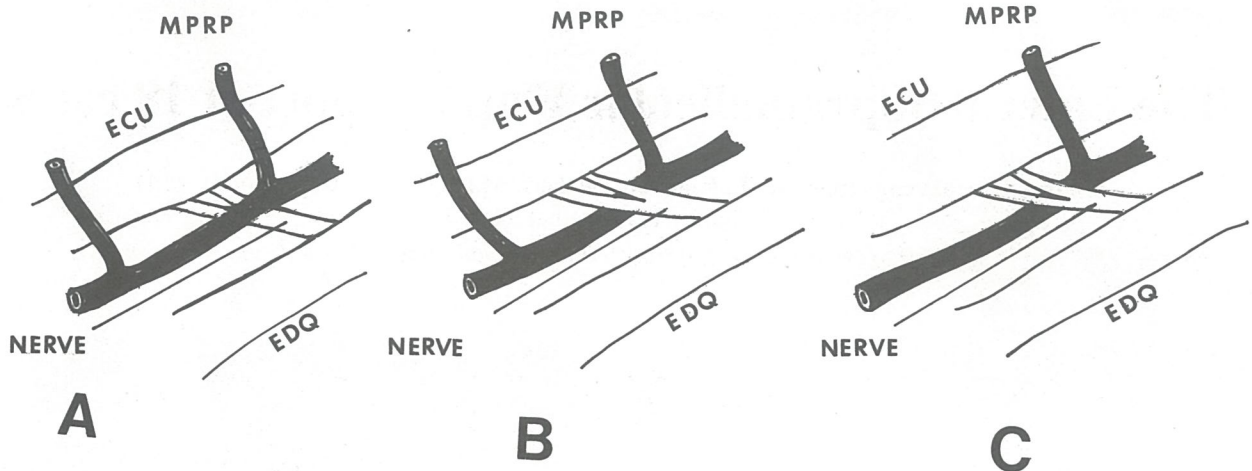


Fig. 5 Three types of relation of the extensor carpi ulnaris (ECU) nerve branch (nerve) to the descending branch of the posterior interosseous artery (PIA) and its most proximal relevant septocutaneous perforator (MPRP). While type A permits simple dissection, type B may require ligation of the MPRP use of the adjacent perforator and a fascial extension of the pedicle; in type C, neurotomy and repair of the ECU nerve branch are recommended right forearm dorsal view EDQ, extensor digiti quinti muscle.

neurotomy in type A and B. In type C, neurotomy and neurorrhaphy must be done prior to harvesting the flap. But Zancolli reported that the dissection to include the first proximal perforator within the flap was not necessary. In our dissection, we found only type A and did not encounter with this problem.

Pivot point is a determining factor of flap length. Its location depends on the anastomotic point. Buchler, Zancolli, and Merle believed this point to be at DRUJ, 2 cm. proximal to DRUJ, and 4 cm. proximal to DRUJ, respectively.

In our dissection, we followed Zancolli's, i.e., 2 cm. proximal to DRUJ, and we found that desired flap length was achieved in all case. The largest flap was 8x10 cm.<sup>2</sup>. The most distal site was at mid-shaft of proximal phalanx of middle finger. The flaps were survived in 11 cases and provided excellent soft tissue coverages. Only in one case (no. 6) the flap was completely necrosed. This might be due to its very small size (2x4 cm.<sup>2</sup>).

In summary, the distally based PIF can provide soft tissue coverage to various sites and sizes of defect in the

hand, such as, dorsum of hand, MP joint and proximal phalanx of finger, IP joint of the thumb and first web space. In addition, its color and texture is similar to the defect site and it has enough soft tissue for further reconstructive procedures.

PIF has many advantages over other flaps. It does not require any postoperative immobilization. Radial artery, which is a major and important artery of forearm and hand, can be preserved, and since no microvascular anastomosis is needed, the time, risk and difficulty of the operation were reduced.

Nevertheless, dissection of PIF is more tedious and difficult than radial forearm flap. Skillful microsurgical dissection and good knowledge of the vascular anatomy are needed prior to performing the operation. We recommend this flap in patient who has a small to medium size defect at dorsum of hand, IP joint of the thumb, MP joint of finger and first web space, especially the elderly who can not tolerate long operation and postoperative immobilization.

#### REFERENCES

1. Zancolli EA, Angrigriani C. Colgajo dorsal de antebrazo (en "isla" con pediculo de vasos interosseous posteriores) Rev Asoc Argent Orthop Traumatol 1986;51:161-8.
2. Penteado CV, Masquelet AC, Chevrel JP. The anatomical basis of the fascio-cutaneous flap of the posterior interosseous artery. Surg Radiol Anat 1986;8:209-15.
3. Costa H, Soutar DS. The distally based island posterior interosseous flap. Br J Plas Surg 1988;41:221-7.
4. Bayon P, Pho RWH. Anatomical basis of dorsal forearm flap: Base on posterior interosseous vessels. J Hand Surg(Br) 1988;13:435-39.
5. Buchler U, Frey HP. Retrograde posterior interosseous flap. J Hand Surg (A) 1991;16:283-92.
6. Angrigriani C, Zancolli EA. Posterior interosseous reverse forearm flap: Experience with 80 consecutive cases. Jor Plast Reconst Surg 1993;92:285-93.
7. Dap F, Dautel G, Voche P., Thomas C, Merle M. The posterior interosseous flap in primary repair of hand injuries: A review of 23 cases. J Hand Surg (Br) 1993;18:437-45.