Managing the soft tissue defects over the dorsum of hand: Our experience with Posterior Interosseous Artery (PIA) flap.

Khalid Masood,[1] Belal Saadat,[2] Khalid Zulfiqar Qureshi,[3] Karam Rasool Basra,[4] Hafiz Muhammad Kashif Shafi[5]

[1]Head of Department, Hand & Upper Limb Surgery department, CMH medical college and institute of dentistry Lahore
[2,3,4,5] Classified Surgeons, Hand & Upper Limb Surgery department, CMH medical college and institute of dentistry Lahore

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Corresponding Author:
Khalid Masood
E-Mail:
kmasoodsurg@hotmail.com

ABSTRACT

Objective: To determine the outcome of posterior interosseous artery (PIA) flap in terms of coverage of the defects and survival of the flap in patients with complex defects over the dorsum of hand and distal forearm.

Methods: This descriptive study was conducted in Hand and Upper Limb Surgery (HULS) CMH Lahore Medical College, Lahore, Pakistan from 15th July 2017 to 15th August 2019.All patients with complex defects of the dorsum of the hand and distal forearm were treated with posterior interosseous artery (PIA) flap. Post operatively the grafts were observed for coverage of the defects and graft survival.

Results: The total number of patients were 24 with 19(79.1%) males and 05(20.8%) females. The mean age was 37±7SD(range 21 to 56 years). Right hand was involved in 17(70.8%) patients and left in 7(29.1%) patients. Complete coverage of the defects were achieved in all cases. Successful graft survival and uptake was seen in 20(83.3%) flaps. Partial loss was seen in 03 (12.5%) flaps which required debridement and subsequent Split Thickness Skin Grafting. Complete graft loss was seen in 01 (4.1%) flap

Conclusion: Posterior interosseous artery flap (PIA) had higher survival rates and larger area of the dorsum of the hand and distal forearm were entirely covered with this graft. We recommend posterior interosseous artery flap as first line surgical technique to treat complex tissue defects of the dorsum of the hand and distal forearm.

Key words: Flap, Perforators, Posterior interosseous artery, skin graft, soft tissue defect of hand.

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INTRODUCTION

Muscle, tendon and bones are involved in the coverage over the dorsum of hand which make its reconstruction a difficult task. Exposed tendons and bone part cannot be covered by skin graft.[1] For this purpose, various flaps can be utilized to cover the dorsum of hand. These include reverse flow forearm flaps, flaps that are raised on local perforators, distant groin flaps, abdominal flaps and free flaps. Each of these flaps have merits and demerits. The reverse flow flaps are superior to other flaps as they are single stage flaps that are easily prepared and without any microvascular anastomosis.[2] The dorsal vascular arches and anterior interosseous artery makes anastomoses with posterior interosseous artery near wrist joint. The reverse flow through this anastomosis makes the anatomic basis of this PIA flap.[3] However, various anatomic variations are reported in the literature, hence, its reliability is very low when compared to the Radial Forearm Flap. But PIA has the advantage that it can cover larger soft

tissue defects extending up to metacarpophalangeal joint of the fingers and interphalangeal joint of the thumb.[3]

In 1986 Lu[4] was the first to describe reverse PIA flap in China, whereas Penteado[5] described it in English literature. Since then, the reverse Posterior Interosseous Artery (PIA) flap has been popular amongst the plastic surgeons and hand surgeons through the world. Currently PIA is used frequently and is second to radial forearm flap.[6,7] A distinct advantage of reverse PIA flap is that it does not compromise the major blood vessels of the forearm and hence has become a well-accepted alternative to radial forearm flap.[8]

The anatomical variations of PIA must be kept in mind because they are the major risk factor for flap necrosis. Although predominantly PIA arises from the common interosseous artery, it takes origin from ulnar artery in about 18% of patients.[9] The distal perforator is the usual source of supply to PIA flap, but it is recommended to include at least two perforators because if during dissection one perforator is inadvertently injured the second perforator will feed the flap.[10] The septocutaneous perforator located in the distal third forearm must also be included in the flap to reduce the chances of PIA flap necrosis.[11]

There are no standard guidelines to treat complex dorsal hand defects in our institution. The operating surgeons use techniques of their own choice to treat such injuries. Since PIA flap is a single stage procedure thus it has a higher patient acceptance and satisfaction ratio and has reduced patient hospital stay. Moreover microvascular anastomoses are not needed in this technique which makes this technique more feasible to the operating surgeon. The objective of our study was to determine the outcome of posterior interosseous artery(PIA) flap in terms of coverage of the defects and survival of the flap in patients with complex defects over the dorsum of hand and distal forearm. The results of our study will help us in formulating standard guidelines to treat patients with larger and complex defects of dorsum of the hand and distal forearm.

METHODS

This was a descriptive study of 24 cases managed using reverse PIA flap to cover different sorts of defects involving hand and distal forearm. The study was conducted in Hand and Upper Limb Surgery (HULS) center CMH Lahore Medical College Lahore, Pakistan from 15th July 2017 to 15th August 2019. All patients willing for surgery having skin loss on the dorsum of hand and distal forearm were included. Patient with malignant defects, multiple injuries and neurovascular injury involving upper limb were excluded. The Hospital Ethical Committee approved the study protocols. Informed consent was taken from patients.

Operative Procedure

The procedure was performed under general anesthesia and tourniquet control. Preoperative antibiotics (injection Cefuroxime 1.2 gm intravenously) was administered to all the patients. We ensured that the recipient site was clean, granulating and without any bacteria confirmed with negative microbiological swab for culture and sensitivity. The lateral humeral condyle and radial side of ulnar styloid process were taken as two reference points and the PIA flap is harvested along the long axis of these two reference points. The flap was dissected and raised from ulnar side. The posterior interosseous artery, cephalic vein and posterior cutaneous nerve of the forearm was protected. (Fig.I)

Fig. I: PIA Flap being raised keeping the interosseous artery intact in deep septum.

After dissecting the flap up to the distal forearm, the perforators were identified, separated up to the posterior interosseous artery and protected. The posterior interosseous nerve was also dissected and protected. (Fig: II)

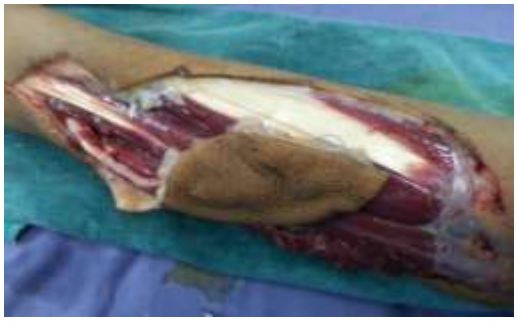

Fig II: Vessel pedicle separated and protected

The PIA flap was rotated to cover the defect at the distal forearm and wrist. (Fig III) The defect at the donor area was covered primarily or with skin grafting. Post operatively the wrist was kept in extension with a splint till flap healing. Intravenous antibiotics were continued for 7 days. The patients were reviewed fortnightly at follow up. All the patients were started supervised physiotherapy of hand, wrist and forearm after flap healing.

Fig III: Flap moved to fill the defect

We analysed our data with SPSS(version 20). All the important quantitative variables like age was represented as mean±SD and qualitative variables like gender was represented as frequency and percentages.

RESULTS

The total number of patients in our study was 24.Males were 17(70.8%) and females were 05(20.8%). The aetiology of soft tissue loss was trauma in 19(79.1%) cases, infective necrosis in 4(16.6%) and burn injury in 1(4.1%) patient. A total of 14(58.3%) patients were having soft tissue defects of various sizes over the dorsum of hand up to metacarpophalangeal joint(MPJ), 8(33.3%) were having defects over the dorsum of wrist and distal forearm while in 2(8.3%) patients had contractures of the first web space. The largest flap measured 12x8cm and the smallest flap measured 3x2cm. In 16(66.6%) cases the donor site was covered with split skin grafting while in 8(33.3%) cases the donor site was primarily closed. The entire soft tissue defects were covered with PIA flap in all cases. Complete survival and uptake was noted in 20(83.3%) flaps, whereas partial loss was seen in 03(12.5%) flaps which required debridement and subsequent Split Thickness Skin Grafting. Complete flap loss was seen in 01(4.1%) flap. No flap congestion was noted.

DISCUSSION

Soft tissue defects over the hand and wrist pose a great challenge to the hand surgeons and plastic surgeons.[3]Coverage of the vital structures with a well vascularized flap using a single stage or two stage procedure is essential for proper functioning of the hand. Split thickness skin grafting or full thickness skin grafting is usually not recommended to cover vital structures of the hand.[3]

The reverse posterior interosseous flap has the advantage of giving a good quality skin coverage to the dorsum of hand and thumb that exactly matches the volar aspect.[6] Another advantage of the PIA flap is that it can cover larger defects without any significant morbidity to the donor area.[8] Earlier PIA flaps were mainly used for contracted first web space but now it is successfully used to treat defects of the dorsum of hand including proximal parts of fingers and distal forearm.[9] Even the distal parts of the fingers can be covered with this flap but at the cost of less perforators, thereby risking necrosis of the flap. Coverage was extended up to the DIP level by Brunelli[12] in a two stage procedure and by making the wrist in extended position and exteriorizing the pedicle of flap. In our cases we were successful in extending the flap upto PIP joints but without exteriorizing the pedicle.

We recommend applying extension splint for a period of three weeks where distal reach is desirable. We followed the technique mentioned by Cheema[8] by not skeletonizing the feeding vessel including 5mm sleeve of deep fascia who managed 68 cases with impressive results. We lost one flap due to problem of anatomical variation that was based only on one perforator.

PIA flap is getting popularity because of having more benefits in terms of minimum donor site morbidity, excellent matching skin colour and texture and easy accessibility.[12] The flap can be neurotized by including posterior antebrachial cutaneous nerve and can be raised as an osteocutaneous flap by including a portion of ulna.[8] Franchi[13] used it as musculocutaneous flap and covered hand defects associated with osteomyelitis. It is a versatile flap, even damaged, burned or grafted skin over the flap area can successfully be transferred for covering defects on the dorsum of the hand.[14] Jakubeitz[15] successfully used only facial flap based on PIA to cover the defects. However, there are some pitfalls in this procedure as the posterior interosseous artery is very small in the distal forearm in about 6% of the cases.[8] Furthermore nerve crossing the artery will need repair to avoid losing normal muscle power.

The flaps can be extended distally up to the fingers without the risk of necrosis if the pedicle is exteriorized and wrist is kept in extension with the help of splint for three weeks.

The higher survival rates and low complication rates in our series was due to the fact that we carefully examined the preoperative anatomy of posterior interosseous artery. Distal pedicle was examined and confirmed before raising the flap. A sufficient amount of fascia and subcutaneous tissue was raised to make the flap bulky and vascular. No venous congestion was seen in our cases. The most probable reason for flap complications in our series was overstretching of the flap and those were our earlier cases. The results of Shahzad and his colleagues[16] were similar to our findings as all of their flaps survived. They had not documented any post-operative venous congestion in their 53 cases. The complications in their series were marginal flap loss in 1(1.8%) patient and donor site skin graft loss in 1(1.8%) patient.

However, Bilal and Ahmed[17] were of the opinion that that major complication of PIA flap was venous congestion as they noted this complication in 5(16.1%) of their patients. Other complications were partial necrosis (12.9%, n=4) and complete necrosis (3.2%, n=1). These authors concluded that venous congestion can be avoided by delaying PIA flap.

Our study had few limitations. The design of our study was descriptive. Our sample size was small. We could not evaluate the functional outcome of our patients. We recommend further well designed studies addressing all such limitations.

CONCLUSION

Posterior interosseous artery flap (PIA) had higher survival rates and larger area of the dorsum of the hand and distal forearm were entirely covered with this graft. We recommend posterior interosseous artery flap as first line surgical technique to treat complex tissue defects of the dorsum of the hand and distal forearm.

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