



A STUDY TO FIND THE FUNCTIONAL AND AESTHETIC OUTCOME OF POSTERIOR INTEROSSEOUS ARTERY FLAP IN PATIENTS WITH HAND DEFECTS

Plastic Surgery

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ABSTRACT

Aim: A retrospective study was carried out on patients who required PIA flap for reconstruction of their hand defects in tertiary health care center to study their functional and aesthetic outcome

Background: Soft Tissue Defects of the hand proximal to the MCP joints with exposed Joints Tendons, which requires secondary reconstruction needs flap cover. If a single stage reconstruction is possible, it could be chosen as a primary option and PIA flap is one such flap.

Materials and methods: A retrospective study was carried out from the year 2018 to 2019. All patients who underwent PIA flap during the above mentioned time period were included in this study. Data were collected about the patients regarding the donor site ,defect site ,size, depth and the tissue layers involved . The functional outcome was assessed using hand function scoring system.The aesthetic outcome was also assessed .

Result: A total of 15patients(11 males and 4 females)who required reconstruction for their hand defects were included. The mean defect size was 6*6.4cm . The defects were mainly due to trauma in 12 cases , Tumor in 1case and due to post burns in 2 cases. All our patients had PIA flap for coverage of defects. The donor site was covered by split skin graft(SSG) in most of the cases. 10 (67%) flaps survived completely and 2 (13%) flaps had superficial epidermal necrosis ,2 (13%) flaps had hematoma and 1 (7%) flap had wound infection all of which were managed conservatively . The patients regained their functions of hand and were pleased with the cosmetic appearance of donor and flap site.

Conclusion: The reverse-flow flap based on PIA is a reliable and versatile source of coverage of complex soft tissue defects in the hand. It gives excellent functional and aesthetic outcome with minimal or no donor site morbidity .

KEYWORDS

INTRODUCTION:

Soft tissue defects of the hand due to trauma are common in present day's high velocity trauma situations. High energy trauma and industrial and work place accidents are the common causes[1]. To minimize infection of soft-tissue defects, the hand requires early reconstruction and coverage procedures in addition to provide early mobilization by a single-stage procedure achieving a good functional result and decreasing hospital stay time. There is a need to apply regional flaps if local flaps are insufficient to the requirement. The use of radial and ulnar forearm flaps increases the safety and reliability of local flaps, but it damages a major artery of the hand. The dorso-ulnar flap has limited rotation because of its short pedicle.

The anterior interosseous artery flap has anatomically variable vessels and needs a tedious dissection involving the fragile pedicle.[2]. In recent times, the posterior interosseous artery flap described by Zancolli and Angrigiani [3] has gained widespread acceptance and popularity since there is no need for sacrificing a major vessel of the hand unlike the radial and ulnar artery flaps. Using a distally based pedicled PIA flap is a suitable means for providing vascularized skin for covering the dorsal region of the hand. The flap depends on the septocutaneous perforators from the PIA supplying the skin for its blood supply and can be used either proximally or distally [4]. The reverse posterior interosseous artery (PIA) flap is based on reverse flow through the PIA via anastomosis with the anterior interosseous artery near the wrist joint.[4]. PIA flap is indicated to cover defects with exposed bony and/or tendon tissues on the palmar and dorsal side of the wrist and the hand up to the metacarpophalangeal joint level and the whole thumb.It also helps in the coverage of defects on the palmar side of wrist and palm of the hand with exposed median and/or ulnar nerve and also in first webspace contracture release and coverage. The PIA flap affords a very durable and aesthetic option for soft-tissue coverage of the dorsum of the hand. Reconstruction of soft tissue seeks to restore both the function and aesthetic appearance of the hand. The flap donor site can usually be closed primarily with little to no

morbidity. In comparison with other local and distally based flaps such as the radial forearm flap, major blood vessels are spared.

With this background ,the study was done to evaluate the functional and aesthetic outcomes of the posterior interosseous artery flap in reconstruction of soft tissue defects of the hand .

MATERIALS AND METHODS:

The study included 15 patients(n=15) with hand defects resulting from various etiologies . A retrospective study was conducted for a duration of 2 years from January,2018 to December 2019 . The study included 11 (73%)Males and 4(27%) Females, with age ranging from 19 Years to 49 Years.

Data was collected about the patients regarding the donor site ,defect site, size, depth and the tissue layers involved . Right hand was reconstructed in 8(53%) patients and left hand was reconstructed in 7(47%) Patients . The cause of the defect were traumatic in 12 patients, due to burns in 3 case. 13 patients were operated electively and 2 patients were operated as emergency with immediate reconstruction . The donor site was examined to exclude any trauma or defect that may prevent the use of this flap. Posterior interosseous artery flap were given for all the patients for reconstruction of their hand defects .

Surgical procedure:

The patients were operated under regional anaesthesia with application of tourniquet without exsanguination. Wound debridement was done and measurements were taken for the dimension of the flap. Points were marked at lateral epicondyle and at distal radioulnar joint. A straight line joining these points was drawn with the hand in full pronation roughly representing the PIA course. The centre of the line is marked. Proximal limit of the flap in 3-4cm distal to lateral epicondyle.The point of rotation was marked 2.5cm proximal to radioulnar joint. Preoperative doppler marking of the perforator usually 1-2cm distal to the midpoint of the above drawn line. Skin is

incised in a lazy S or zigzag fashion along the central axis of proposed flap pedicle and flap carefully elevated down to deep fascia and the skin edges elevated from it until the fascia covering extensor digiti minimi and extensor carpi ulnaris muscle is seen, incising the fascia on both muscles, part of this fascia included with the flap pedicle and the dissection continue between the muscle and the fascia until the posterior interosseous artery become obvious. This is assisted by the septocutaneous perforators which guide the dissection down to its origin. Flap dissection starts with identification of vascular pedicle, including as many perforators as possible and proceeds from distal to proximal as the artery is superficial in the distal forearm but in the proximal half the vessels are deeply situated. The dissection proceed proximally on the radial side of the flap design with cauterization of all muscular branches until the dissection reach the proximal end of the flap, then continues along the ulnar side of the flap distally toward the wrist. The proximal end of the artery is clamped and the tourniquet is deflated; haemostasis is achieved, ensure adequate retrograde flow in the flap and give time for limb perfusion. Then the tourniquet is re-inflated and the proximal end of the artery is ligated and divided. The flap is then elevated carefully to avoid injury to the artery or the posterior interosseous nerve.

The harvested flap is now transposed to the recipient site either by tunneling or by opening up the intervening segment.

The donor site were closed directly if the flap size is less than 5cm or closed by split skin graft(SSG) from thigh when the flap width is more than 5cm

The post operative functional outcome was analysed using a hand function scoring system which include the type of deformities, method of reconstruction, preoperative and post operative scoring. Cosmetic outcome was assessed based on flap thickness, color match and appearance of donor site.

The following details were obtained for all the patients:

- operative details
- operative time
- operative complication(wound infection, hematoma, Seroma, functional loss, flap loss) with flap survival and graft take
- aesthetic outcome

Statistical analysis is done using MS excel



Fig 1: post chemo Extravasation injury of hand



Fig 2: flap design



Fig 3: an intraoperative picture



Fig 4: intraoperative photo showing reversal of flap to cover the defect



Fig 5: primary closure of donor site



fig 6 : Showing the final outcome

RESULT:

The study included 15 patients with hand defects of which 11 Males(73%) and 4 females (27%) with age ranging from 19 To 49 years were included with the mean age of 33 years. With Male:female ratio of 11:4. 13 (87%) patients were operated electively and 2 (13%) patients were operated as emergency with immediate reconstruction. There were 8(54%) first web space deformity and 5(33%) dorsal defects and 2(13%) with ulnar side defect; Of which 8 (53%) patients had right sided defect and 7(47%) patients had left sided defects. All defects were reconstructed by PIA flap (posterior interosseous artery flap).

The study period is for 2 years from 2018 January to 2019 December. The dimensions of flap used ranges from 6*4 cm to 11*7 cm (mean 6*6.4).

10(67%) survived completely, 2(13%) had superficial epidermal necrosis, 2(13%) had hematoma and 1(7%) had wound infection all of which were treated conservatively and managed well. All the flap survived completely and healing were uneventful. In 14(93%) cases the donor site was closed by split skin graft and primarily closed in 1(7%) case. All recipient and donor areas were healed uneventfully. The aesthetic outcome of the donor and recipient areas were satisfactory in 100% of the patients with no functional deformity.

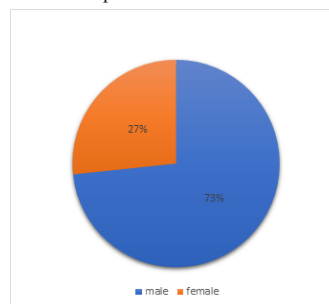


Fig a: showing the sex ratio

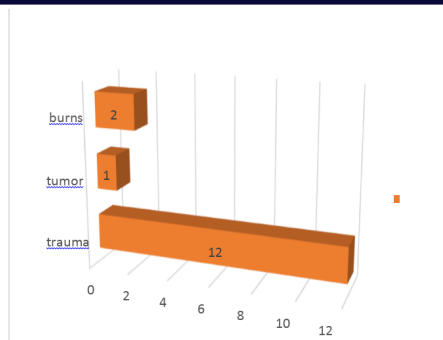


Fig b: showing the causes

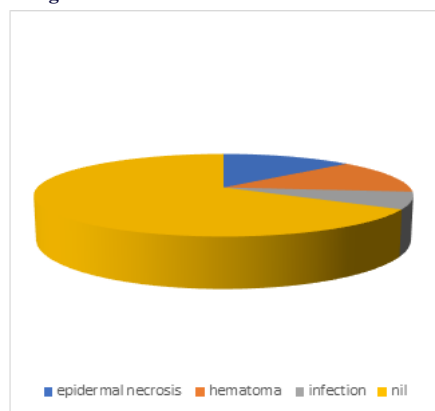


Fig c: showing the complications:

Table 1: demographic details & surgical data

no	Age/sex	Hand dominance	Defect size	Flap size (cm)	etiology	Donor site closure	
1	20/m	left	4*10	10*4	Crush injury	ssg	Primary
2	31/m	Right	6*5	8*4	Post traumatic raw area	+	
3	36/m	Right	5*5	7*8	Post traumatic defect	+	
4	27/m	Right	9*6	10*5	Blast injury Burns	+	
5	47/m	Left	6*9	11*5	Pi/*ps injury	+	
6	49/m	Left	7*5	9*8	Amputation	+	
7	19/m	Right	9*5	11*7	Traumatic amputation	+	
8	45/f	Left	6*6	9*7	Glomus tumor	+	
9	45/f	Left	4*10	6*4	Post chemo Extravasation injury	+	
10	25/m	Right	8*7	10*5	Crush injury	+	
11	24/m	right	6*5	8*10	Post blow sequale Z deformity	+	
12	28/m	Left	4*5	9*7	Post traumatic defect	+	
13	38/f	Right	5*8	7*4	Crush injury	+	
14	32/m	Left	4*5	6*4	Crush injury	+	
15	40/f	Right	7*5	9*7	Blast injury burns	+	

DISCUSSION:

Soft tissue defects of the hand with exposure of tendons, joints or bones

are common as a result of high velocity trauma injury. They often need local, regional, free flap for coverage. Regional flaps from the forearm like the radial forearm flap [12] and the ulnar artery flap were used for a long time. The use of radial and ulnar forearm flaps increased the safety and reliability of local flaps, but it damages a major artery of hand. The dorso ulnar flap has limited rotation because of its short pedicle. The anterior interosseous artery flap has anatomically variable vessels and needs a tedious dissection involving the fragile pedicle. The usage of these flaps has decreased considerably ever since the posterior interosseous flap gained popularity as there is no need for sacrificing a major vessel of hand unlike radial and ulnar artery flap. The things to be satisfied for best soft tissue reconstruction in the upper extremity are colour match, sensibility, durability and joint function. The PIA flap provides excellent color match for defects around the dorsal aspect of the wrist and the hand. In this series, males outnumbered the females in ratio of 11:4. There were similar male dominance found in series like zancolli & angriani [3], osam ahmed ibraheem [8], ashok s. Gavaskar [1] due to higher incidence of hand injuries in males. In this series the patients treated with PIA flap were in the age group ranging from 20 to 49 years. The largest flap used was 11*5cm and the smallest one was 6*4 cm with a mean range of 6*6.4cm. In a study by Ashok.s.gavaskar the skin flap size varies from 16*10cm to 5*4cm. The flaps are usually thin and pliable, unlike the bulky radial forearm flaps. The flaps raised in our series were quite thin in majority of the patients. The donor site is closed by primary closure or split skin graft depending upon the size of the defect. There were superficial epidermal flap necrosis in two of the patients which were treated conservatively and did not threaten the viability of the flap. There were no flap venous congestion in our series compared to the partial necrosis in seven of the 34 flaps by dap (1991) [9] which can be avoided by harvesting a wide pedicle and avoiding strangulation. Harvesting and flap insertion may be time consuming in case of free flaps and requires a lot of expertise and careful postoperative care.

To conclude, the posterior interosseous flap affords a very durable and aesthetic option for coverage of the dorsum of hand. Being a small less important vessel, it can be safely sacrificed leaving the major vessels untouched. It provides a good color match especially for dorsal defect

Table 2: pre-operative data of the patients (n=15)

Pre-operative	Nos. of patients (n%)
Trauma	12 (80)
Post tumor ablation	1 (7)
Post burn injury	2 (13)
Defect site	
1st. webspace	2
Dorsum aspect of hand	10
Ulnar side of hand	2 (13)
Volar aspect of hand	1
Size of defect	
Length (cm)	
Minimum – maximum	4cm-9cm
mean	6
Median	6
Sd	1.67
Breadth (cm)	
Minimum – maximum	5cm-10cm
mean	6.4
Median	6
Sd	1.85

Table 3 Post operative complications among the studied patients

Early post operative complication	No. of patients n%
Flap venous congestion	
Superficial epidermal necrosis	2 (13)
Complete flap necrosis	
Haematoma	2 (13)
Wound infection	1 (7)
Delayed graft take	
Graft rejection	
None (passed uneventfully)	10 (67)
Late complications	
Hypertrophic scar	
hyperkeratosis	
none	15 (100)

CONCLUSION

The distally placed PIA flap has proved to be reliable and useful for reconstruction of the first web space as well as the dorsum of the hand .It has low donor site morbidity and has good functional and aesthetic outcome.

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REFERENCE :

- [1]. Ashok S. Gavaskar .Posterior Interosseous Artery Flap for Resurfacing Posttraumatic Soft Tissue Defects of the Hand.2010;5:397–402
- [2]. Fouad M. Ghareeba, Mohamed A. Megaheda, Sherif M. El Kashtya, Alaa A. Labebb, Hesham K. H. Abd El Kadere .Functional and cosmetic outcomes of posterior interosseous artery flap in reconstructing hand defects.2019;31:1375–1379
- [3]. Zancolli EA, Angrigiani C. Colgajo dorsal de antebrazo (en isla) (pediculo de vasos interoseos posteriores). Rev Assoc Arg Ortop Traumatol. 1986;54:161e8.
- [4]. Ahmed Hassan El-Sabbagh,1 Ahmed Abd El-Moaty Zeina,2 Al-Moddather El-Hadidy,1 and Ahmed Bahaa El-Din1.Reversed Posterior Interosseous Flap: Safe and Easy Method for Hand Reconstruction. 2011 Dec; 3(2): 66–72. Other references
- [5]. Jia-Qiang Wang, MD, Qi-Qing Cai, MD, Wei-Tao Yao, MD, Song-Tao Gao, MD, Xin Wang, MD, Peng Zhang, MD Reverse Posterior Interosseous Artery Flap for Reconstruction of the Wrist and Hand after Sarcoma Resection.2013;250-254
- [6]. Tahseen A. Cheema,1 Shankar Lakshman,1 Mohammad Amin Cheema,2 and Shakeel Farrukh Durrani ,Reverse-Flow Posterior Interosseous Flap.2007 Sep;2(3): 112–116.
- [7]. CV Penteado, AC Masquelet & JP Chevreil .The anatomic basis of the fascio-cutaneous flap of the posterior interosseous artery , Les bases anatomiques du lambeau septo-cutané de l'artère interosseuse postérieure 8;209–215(1986
- [8]. Osam Ahmed Ibraheem, Mahdi Hameed Abood, Heider Hussein Tayah Sallomi. Evaluation of the Posterior Interosseous Artery Flap in Reconstructing Hand Defects,vol 7,NO 2;157-163(2008)
- [9]. Dap F, Dantel P, Voche P, Thomas C, and Merle S. The posterior interosseous flap in primary repair of hand injuries. A review of 23 cases. J Hand Surg (Br) 1993; 18B,437-44