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ORIGINAL ARTICLE

Reverse Posterior Interosseous Artery Flap for Hand Defects

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Abstract

Background: Soft tissue defects in hand needs an early reconstructive procedure that is single stage and well vascularized for best functional outcomes. Usually flap coverage is required for joints, exposed bones and long tendons. When local flaps are inadequate for the required defects, regional flaps are used.
Objective: The study was designed to evaluate the outcome of reverse posterior interosseous artery flap for hand soft tissue defects.
Material and Methods: This is a retrospective chart review of patients from 2013 to 2019 at National Orthopedic Hospital at Bahawalpur and was compiled at DHQTH, Bannu in 2023. During this time, 45 cases of posterior interosseous artery flap meeting the inclusion criteria were included in this study.
Results: In 34 cases the defect was due to crush, in 6 blast injury and in 5 thermal injury. Male to female ratio was 9:1. The defect was mostly on dorsum of hand and first web space. In all the cases, split thickness skin graft was used to cover the donor site. Three (7 %) patients had superficial flap necrosis at the distal most part, for which debridement and skin grafting was done.
Conclusion: Reverse posterior interosseous artery flap is an excellent source of skin coverage of dorsal hand and 1st web space.
Key Words: Soft tissue defect of hand, Reverse Posterior interosseous artery flap, sept cutaneous flap

Cite this article: Jan U A, Khan S, Khan A, Anwar J, tulmunataha S Reverse Posterior Interosseous Artery Flap for Hand Defects. BMC J Med Sci. 2024. 5(1):31-33

Introduction

Complex hand defects needs a single stage procedure for good functional outcomes. The aim in such cases is early recovery, early mobilization and to infection prevention. Loco-regional flaps are usually required to cover these types of defects. There are two main reverse forearm flaps which are commonly used for hand reconstruction. These are posterior interosseous reverse flow flap and radial forearm reverse flow flap. Ulnar reverse artery flap is seldom used, in desperate situations, as ulnar artery sacrifice can lead to dire consequences later on. As the ulnar artery bifurcates into anterior and posterior interosseous arteries, these arteries travel on each side of Interosseous membrane as the name suggests, there are several connections between these at several levels.

In general terms, the design of the flap should not extend beyond a certain point to prevent tissue necrosis. The length of the flap's pedicle is about 7 to 8 cm. The farthest point the flap can be harvested in the forearm is approximately 7.4 cm above the wrist joint. The upper limit of the flap should be about 7-8 cm below lateral epicondyle of the elbow.[1,2] Proximally, the posterior interosseous artery runs deep in the septum of extensor carpi ulnaris and extensor digiti minimi accompanied by the posterior interosseous nerve on its radial side.[3]The branches of posterior interosseous artery run perpendicularly to the skin and disperse in all directions.[4] There are three main perforators that can be identified in the mid-third of the forearm.These perforators make a communicating network above the

Authorship Contribution: [1-5]Substantial contributions to the conception or design of the work; or the acquisition, data analysis, drafting the work or revising it critically for important intellectual content, Final approval of the version to be published & supervision

Funding Source: none
Conflict of Interest: none

Received: March 29, 2024
Accepted: May 5, 2024
Published: July 2, 2024

fascia.[5]Posterior interosseous artery flap is a septocutaneous flap based on the reverse flow between the interosseous arteries (anterior and posterior) at the wrist level. In 1985, this was first described by Zancolli and Angrigiani.[6]

Since then it had a wide range of application in the reconstructive procedures of hand and wrist, andespecially 1st web space. This flap is more desirable, as sacrifices of essential vessel for hand perfusion is spared. Apart from the above advantages, this flap donor site can be primarily closed if the size is small.

Sometimes this flap can be made composite by adding tendons and bone graft from ulna when the need arises.[7]

Inclusion criteria:

- Age 15 to 60 years
- Both genders
- Complex defects over the dorsum of hand extending up to PIP joint.(>5cm)
- Operated by the same senior surgeon

Exclusion criteria:

- History of donor site infection
- Uncontrolled diabetes
- Absence of the distal communication between the anterior and posterior interosseous arteries at distal radio- ulnar joint level (5% of the cases).

Technique:
After placing the patient in supine position tourniquet was applied and the limb was not exanguated so that the vessels remain prominent. The forearm is fully pronated and placed beside the patient.

A straight line starting from lateral epicondyle to the distal radio-ulnar joint was drawn. The main anatomical land mark, is the septum between extensor digiti mini and extensor carpi ulnaris, in which the artery was lying sagittaly. In the proximal part the artery was relatively deep under the sheath of extensor digiti mini and in the distal part it was relatively superficial. So dissection should be done from distal to proximal, maintaining a soft tissue sleeve of 5mm on either side of the pedicle.

The pivot point is 1 inch proximal to radio-ulnar joint. We did not tunnel the flap and the donor site skin grafted in all cases.(Fig 1)

Fig 1: Pre-op and Post-op pictures of PIA flap

Data collection:
This is a retrospective chart review of patients from 2013 to 2019 at national orthopedic hospital at Bahawalpur. In the last six years, 45 cases of posterior interosseous artery flap, meeting the inclusion criteria were included in this study. Flaps were graded as good, partial necrosis and complete necrosis. The data was compiled and organized in DHQTH, 2023.

Results:

In 34 cases the defect was due to crush, in 6 blast injury and in 5 thermal injury. Male to female ratio was 9:1. The defect was mostly on dorsum of hand and first web space. In this study of 45 flaps, 42 (93%) were rated as good, 3 (7%) flaps had partial necrosis and no (0 %) flaps developed complete necrosis. In all the cases, split thickness skin graft was used to cover the donor area defect, which healed without any complications. The three patients having partial flap necrosis at the distal most part, were debrided and skin grafted

Discussion

Soft tissue defects of hand, needs an early reconstructive procedure that is single stage and well vascularized for best functional outcomes. Although, radial forearm flap was considered the flap of choice for hand defects, it is slowly going out of practice due to compromise of major arterial supply of already mutilated hand.[7,10,11] Similarly the ulnar artery reverse flow flap compromises a major arterial supply of the hand.[8]Additionally, a venous anastomoses is recommended to overcome edema and accelerate drainage of the hand, usually associated with volar forearm flaps. [7]

In posterior interosseous artery flap, the sacrifice of vessel does not affect hand blood supply adversely. If radial and ulnar artery along with palmer arches are damaged, this flap has the additional advantage that it can still be used for reconstruction, due to its retrograde flow.[4] This flap does not affecthandveno-lymphatic outflow as compared to other volar reverse flow fore arm flaps (radial and ulnar). It can has skin coverage capacity of dorsal hand defects up to PIP joint level and 1stweb.[7] It can be used as an osteofascio-cutaneous flap, including a vascularized ulna bone graft for reconstruction of the thumb.[9] This flap is extremely useful and dependable with constant anatomy as noted in previous studies.[7,8,15]Some authors were able to do coverage in a two stage procedure, up to the distal interphalangeal joints, by skeletonizing the pedicle and wrist extension.[16] But we covered in single stage up to proximal interphalangeal level, by extending the wrist only.

In our 68 flapspreviousseries,60 (88.24%) healed well, 4 (5.88%) flaps developed partial necrosis and 4 (5.88%) flaps developed complete necrosis.[17]In this study of 45 flaps, 42 (93%) were rated as good, 3 (7%) flaps had partial necrosis and no (0 %) flaps developed complete necrosis. In our experience, a steep learning curve is associated with PIA flap. All of our four complete failures occurred in our previous series. These may be caused by our initial attempts to isolate and skeletonize the pedicle. A 5 mm deep fascia sleeve was left on either side of the pedicle after recognizing our initial failures, in previous series. Fujiwara et al.also recommends a fascia sleeve in his study.[18]Venous return of PIA flap is dependent on venae comitantes in a retrograde fashion. In one study edema and congestion were observed in 34% of cases.[19] Chen et.al recommended that a venous anastomosis should be added when flap congestion occurs, turbo charging the flap.[20] We did not encounter these problems in our patients and consider the venae comitantes along PIA flap as enough for venous return even for a very large flap. We again put emphasis on preserving deep fascia sleeve surrounding the pedicle, to reduce these complications and to maintain the veno-arterial integrity of the flap.

Conclusion

Reverse posterior interosseous artery flap is an excellent source of skin coverage of dorsal hand and 1st web space.

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