

Posterior Interosseous Artery Flap in Acute Electrical Burns of The Hand

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Abstract : Posterior introsseous artery flap used to reconstruct defects of hand in our series of 20 cases. It is a single staged reliable procedure in preserving the vital structures of hand.

Keywords : Posterior Interosseous Artery Flap, Electrical burns of the hand, Versatility of flap.

I. Introduction

Electrical injuries around the wrist and hand create many problems for both patient and surgeon. The involvement of various anatomical structures and the depth of the lesions may jeopardize vascularisation and function to such extent as to whether to preserve the hand or not. When In consultations with patients and their families, we have noted that there is usually a strong desire to preserve the hand, even if only for external appearance. This logic seems to be justified, as nobody can readily accept the trauma of amputation of the hand, since it is natural to hope for functional improvement at a later stage. Even when both main arteries are damaged, vascularization of the hand was maintained within the normal range with the support of interosseous arterial system, as well as some aspects of surgical treatment like early cover of the wound and early mobilization.

Vascularised and supple hand gives us a scope for late reconstruction of damaged tendons and nerves. Reconstruction of soft tissue defects of the hand requires early cover by a single stage procedure to minimize infection, preserve function of the exposed vital structures, allow early mobilization and reduce hospital stay and thus achieve good functional result. A septocutaneous island flap based on posterior interosseous artery raised from posterior aspects of forearm has served well in our series. This is one of the largest series of reconstruction of electrical burns of the hand using posterior interosseous artery flap. Although the reverse flow posterior interosseous flap (RFPI) flap is not new, its use in acute post electrical burns is rarely reported.

II. Materials And Method

20 patients with hand defects of various sizes were treated following electrical burns from March 2014 to July 2015 . There were 17 males and 3 female patients. The age ranged between 14 and 46 years. Volar aspect of the wrist, followed by the proximal phalanx of the thumb was most common sites affected. The size varied from 3x3 cm to 11x7 cm. and the time interval between time of burns and flap cover varied from 5 to 45 days. All patients had functionally adequate hands with intact neurovascular system which were exposed.

VASCULAR ANATOMY:

The posterior interosseous artery is a division of common interosseous artery in majority of 90%. Occasionally it arises from ulnar artery (in 10%). It pierces the interosseous membrane and reaches posterior aspects of forearm at level of lower border of supinator muscle (union of proximal with the distal 2/3rd of dorsal forearm). It divides into two branches, ascending one (recurrent interosseous) that anastomoses at elbow with posterior branch of profunda brachii artery and a descending branch (proper interosseous artery) that courses between extensor digiti minimi and extensor carpi ulnaris to wrist joint. In proximal segment of posterior interosseous artery is placed deep above abductor pollicis longus muscle accompanied by posterior interosseous nerve and large venous plexus. Immediately after its origin the posterior interosseous artery gives off a large cutaneous branch (proximal cutaneous branch) that courses in intermuscular septum pierces deep fascia and distributes in subcutaneous tissue with 2 or 3 terminal branches. In proximal third posterior interosseous artery gives off a large branch to common extensor muscle which is a true division posterior interosseous artery narrows progressively and become superficial, lying immediately below deep fascia at middle of the forearm. A second cutaneous branch of posterior interosseous artery of large size is located at 1 to 2 cm distal to middle of forearm. At distal third of posterior forearm it gives 6 to 8 cutaneous branches of variable diameter. At level of wrist joint posterior interosseous artery anastomoses with anterior interosseous artery, this anastomosis is traditionally described as being located approximately 2 cm proximal to distal radioulnar joint.

POSTERIOR INTEROSSEOUS NERVE: Posterior interosseous artery is accompanied by posterior interosseous nerve, a motor deep branch of radial nerve, along its course over the abductor pollicis longus and extensor pollicis brevis. At lower part of forearm it runs forwards towards lower border of interosseous membrane to anastomose with the termination of anterior interosseous artery with dorsal carpal arterial network.

OPERATIVE TECHNIQUE

Pre operatively Doppler was done as mandatory to identify perforators of posterior interosseous artery flap and also to identify the distal anastomosis with anterior interosseous artery. Debridement is done till viable tissue is seen. In some cases a repeat debridement after 48 to 72 hours was necessitated.

PICTURE 2 - Surface marking of posterior interosseous artery lies on a line drawn from ulnar head with forearm in full pronation to lateral epicondyle of humerus which coincides the posterior interosseous artery. The line is divided in to three equal parts. Mostly the major perforators are located in the junction of middle and proximal third. Skin incision is started at level of distal anastomosis of posterior and anterior interosseous arteries. The dissection is continued-distal to proximal along the radial side of flap without opening deep fascia. Later fascia is opened longitudinally over extensor digitorum minimi and extensor carpi ulnaris after posterior interosseous artery is section at its proximal origin, ulnar side of flap is dissected with entire flap free as far as distal anastomoses.

We begin dissection at the ulnar border over proximal 2/3rd of flap. It is easy to identify the extensor carpi ulnaris muscle belly at this level. The deep fascia is divided longitudinally over extensor digiti minimi muscle belly with dissection continues radially until we are able to visualize the three to four constant muscle perforators from posterior interosseous artery. Because the artery and its venae comitantes are bigger in the proximal 2/3 of forearm, identification of the vessels is easier at this level. After this, the flap is elevated from the radial side until we see the numerous perforators to the extensor digiti minimi. At this stage both the lateral incisions are extended proximally and the vessel is divided at the proximal end of the flap. The flap is raised with the deep fascia and the inter muscular septum until the distal 1/3rd of the forearm. Now, the pedicle is gently dissected from between the tendinous portions of extensor digitorum minimi and extensor carpi ulnaris. The dissection is terminated when we see the fascial plexus with branch to distal end of ulna and use that as pivot point.

PEDICLE AND ROUTE OF TRANSPORTATION:

The pedicles were raised on a subcutaneous vascular pedicle and these were navigated to reach recipient site and the intervening skin bridge is incised and pedicle is placed in it and over which a split skin graft is applied. This step obviates compression of the pedicle and prevents damaging the posterior interosseous artery. After discharge, patient are followed up initially twice weekly for initial 15 days followed by once in a week for 1 month and once in a month there after.

III. Result And Observations

1. The total number of burns patients admitted in the above period were – 960 cases
2. Total number of patients admitted with electrical burns were – 115 cases.
3. Number of patients who sustained post electrical burns with hand defect were – 20 cases
4. Patients age in our study ranged from 14 years – 46 years with a mean age of 37. All patients were male patients except 3 female patients.
5. Accidental contact with electrical wires while working was the common cause.
6. Volar aspect is the most common region involving. 2nd most common is the dorsum of proximal phalynx of thumb.
7. The patients where there is full thickness defect over volar aspects of wrist, flexor tendons and median /ulnar nerve were also involved
8. In 20 cases 10 patients had associated injuries like gangrene of distal hand, fingers, toes, legs etc.
9. Size of the defect varied from 3x3 cm to biggest size of flap is 11x7 cm.
10. Earliest flap cover we could give is on 5th day and longest was 45th day.
11. The shortest hospital stay was 7 days and longest stay was 50 days.
12. Two island flaps had complete loss , three cases had marginal loss which healed with secondary intention.
13. One donor defect i.e 3x3 cm was closed primarily and other defects were covered with split skin graft.
14. One patient had dislocation of PIP Joint of right ring finger where it was fixed it with K- wire.

IV. Discussion

The posterior interosseous reverse forearm flap was originally described in 1985 by Zancolli and Angrigiani. Pentecost et al 1986 found anatomic basis of fasciocutaneous flap of posterior interosseous artery and absence of posterior interosseous artery in forearm in 4 of 70 specimens and distal anastomosis was absent in one case. Costa et al in 1987 found distal anastomosis constant in 22 used in cadaveric specimen. Bucher and Frey found PIA missing at middle forearm in 2 out of 36. Testut originally described distal anastomoses with anterior interosseous arteries. Cavadas PC in 2001 described posterior interosseous free flap with extended (PRS) pedicle for hand reconstruction.

Angrigiani C, Grilli D, Dominikow D, Zancolli EA 1993 studied 80 consecutive cases. Costa H, Smith R, McGrouther DA in 1988 reconstructed thumb by Posterior interosseous osteocutaneous Flap. Akin, Ozgenel U. reconstructed metacarpal bone and soft tissue defects in hand with posterior interosseous osteocutaneous flap. In the event of complete destruction of the radial and ulnar arteries in volar electrical trauma in the radiocarpal region, anatomical considerations suggest that it may be possible to vascularize the hand by means of the interosseous system, and in particular through the posterior interosseous artery. This artery is located in the posterior part of the forearm, and if not affected by the electric current it assumes great importance for the maintenance of vascularization of the hand through the dorsal carpal arch. It is an artery of considerable diameter (0.9-2.7 mm) and the blood flow through it is potent,

Absence of injury to both the interosseous arteries creates the possibility of uniform distribution of blood in the hand. In most cases the volar location of the trauma prevents the functioning of the anterior interosseous artery, leaving the hand dependent on the posterior interosseous artery.

Case Photos



Image-1 : Reconstruction of defect over dorsum of left hand



Image -2 : Reconstruction of extensor aspect of thumb



Image - 3 : Reconstruction of defect over wrist

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