

REVERSE HOMODIGITAL DORSORADIAL FLAP FOR THUMB SOFT TISSUE RECONSTRUCTION

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ABSTRACT

Primary and secondary reconstruction of the thumb is a common reconstructive challenge for the hand and plastic surgeons. Currently, The kite flap or the First dorsal metacarpal artery flap remains the regular choice and is believed to be the best for distal thumb defects, but it's the first time we have utilized a reverse homodigital dorsal radial flap for the thumb with an expected outcome. A 37 - year - old male patient suffered partially, obliquely, and radially necrotic thumb tip in the second week following conservation stitching of the wound due to a motorcycle accident. The necrotic tissues were desbrided and the residual defect was covered simultaneously by reverse homodigital dorsoradial flap. The Interphalange (IP) and Metacarpalphange (MCP) joints were flexible, and the active rang of motion (ROM) of the affected thumb was not limited at 3 months post - op. The reverse homodigital dorsoradial flap has become a useful and valuable material for thumb reconstruction. The flap provides acceptable aesthetic results with primary closure of the donor site and returns the essential functionality to the affected thumb.

Keywords: Thumb, reverse homodigital dorsoradial flap, case report.

I. INTRODUCTION

Hand function is very important in daily life, and work but it is also vulnerable to trauma, burn, or other injuries. The thumb plays the most important role in hand functionality. The pinch, grip, grasp, and precision handling are more easily accomplished with an opposable thumb. Soft tissue defects of the thumb, exposing tendons, nerves, arteries, or bone require a reliable vascularized flap reconstruction, preferably with a local or regional flap.

In the past, to resurface defects of the distal thumb, we have routinely selected the local vascularized flaps, of which the most popular has been the kite flap followed by the Brunelli flap. However, in this case, the palmar oblique defect radially to the distal thumb was well-suited to the utilization of a reverse homodigital dorsal radial flap, rather than a kite flap or a Brunelli flap.

The basic plastic surgery principle of altering “like with like” is still particularly true for thumb reconstruction. Soft tissue coverage of a thumb defect should be stable, pliable enough for easy

movement, preserve length, and ideally protect at the minimum sensation [1].

Many reconstructive options for soft tissue coverage of a distal dorsal thumb defect include the following: skin graft (though grafting over exposed bone commonly results in an unstable closure prone to failure and breakdown secondary to pressure), reverse cross-finger flap, modified Moberg (palmar advancement) flap, first dorsal metacarpal artery flap (kite flap, Foucher flap), and Brunelli flap, reverse homodigital dorsoradial flap, or free flap.

The commonly employed kite flap has become the workhorse for sensory distal thumb reconstruction [2 - 4]. However, in a complex hand trauma at the place opposite to the index, and in which the donor site of the kite flap is no longer available, the reverse homodigital dorsoradial flap becomes the most suitable choice.

The reverse homodigital dorsoradial flap is nourished by a constant vascular axis raising from the radial artery (dorsoradial digital artery) and connecting with the arterial palmar circuit at the level of the middle third of the proximal phalanx [4] (Figure 1).

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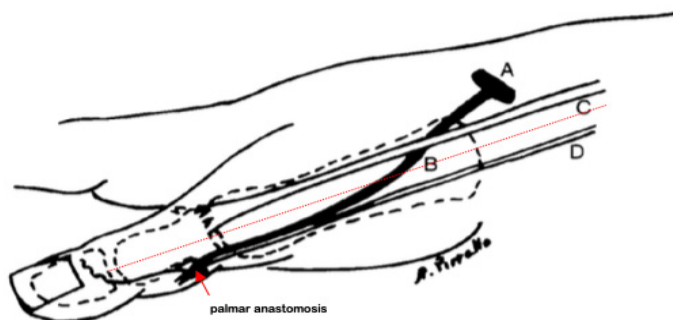


Figure 1: Anatomy of dosal radial collateral artery. A: radial artery; B: Dorsal radial branch; C: Extensor pollicis brevis tendon; D: sensory collateral branch of the radial nerve. The dorsal radial artery keeps an average distance from the median axis of the finger about 1 cm [5].

The digital dorsal radial artery divided by the radial artery at the grade of anatomical snuffbox ranging is measured from 0.6 mm to 0.8 mm in diameter and passes under the extensor pollicis brevis tendon. Then, it courses straight and regularly on a subcutaneous plane longitudinally on the radial side of the thumb toward the distal thumb and is far from the midline of the digit approximately 1 cm [5]. The artery constantly communicates with the palmar circuit at the level of the middle third of the proximal phalanx of the thumb. The pedicle involves the accompanying sensory branch of the superficial radial nerve running close to the artery, to provide a sensate flap. Care should be taken to a sufficiently wide dissection of subcutaneous tissue and to preserve visible larger veins to ensure adequate venous drainage of the flap, because no specific vein has been isolated or described as the main vessel for venous drainage, in the current literature [4, 6].

II. CASE PRESENTATION

2.1. Patient information

A 37 - year - old male patient was admitted to the hospital because of a wound to the left distal thumb a couple of hours after a motorcycle accident.

The patient had no history of smoking and no previous surgical intervention.

2.2. Clinical findings, diagnostic assessment

Recorded at clinical examination, the wound was in the crossed form on the pulp of the thumb, towards the radial side, contaminated by road dust, and poorly perfused at the peeled cutaneous island. The wound was shaped like a skin island. Flexor and extensor tendons were not damaged at the injured place. The x-ray images of the affected hand showed clearly that the bone was intact.

2.3. Interventions

In the first operation, he was made debridement to remove foreign bodies with intraoperative antibiotic therapy. We decided to stitch conservatively without revascularization after checking that the wound beds were still perfused and took him out of the hospital post - operation for 5 days. Unfortunately, he came back to us due to a partial necrosis of the remaining skin.

We planned to do a second debridement and reconstruct residual defects simultaneously. In the second operation, the necrotic tissues were excised and a defect was left on the radial side of the thumb exposing the bone of the distal phalanx (fig 2). Defect sizes were 3 cm and 2 cm in length and width, respectively. We decided to apply the reverse homodigital dorsoradial flap to resurface the defect.



Figure 2: The defect at the radial side of the distal thumb after the radical debridement

Techniques of flap dissections: It can be useful to identify the course of the dorsal radial digital artery from the snuffbox to the middle point of the proximal phalanx by a hand - held Doppler. This point which will be the pivot point of the flap, is marked. The skin island was drawn on the dorsal radial side of the first metacarpal of the affected thumb. Its size is determined by the size of the defect, approximately 5x3 cm running parallel to the line from the snuffbox to the pivot point. (fig 3)

The surgical procedures were performed under brachial plexus anesthesia to avoid vascular injury nourishing the flap and the tourniquet was set up at the level of distal arm. An incised line was made from the proximal cutaneous island designed previously. The flap was raised from proximal to distal part by blunt dissection to avoid damaging the pedicle which consists of an artery and a sensory collateral nerve being very near the artery. The extensor pollicis

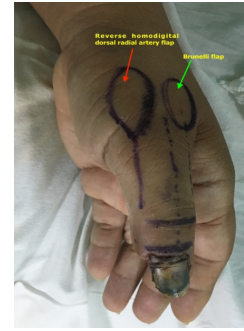


Figure 3: The designs of reverse dorsal radial artery flap (a red arrow) with its sizes were 5 cm and 3 cm in length and width, respectively.

brevis was determined and was gently spread apart (fig 4). The main artery and concomitant nerve were cut and coagulated, and then enclosed in the flap. The subcutaneous pedicle is taken and subdermal dissection is along the middle axis of the thumb toward the pivot point. It's not necessary to isolate the artery of the pedicle. We believe that the protection of adequate soft tissue around the pedicle allows a venous outflow though no real vein was identified. It is useful to include in the pedicle every venous skin branch seen near the pedicle to increase the venous flow. We didn't create a cutaneous tunnel to turn and transpose the flap to the receipt site to avoid the risk of venous congestion. A sufficiently wide strip of subcutaneous tissue has to be included to provide venous drainage and to avoid kinking of the pedicle. The proximal to distal dissection of the pedicle stopped at the midpoint of the proximal phalanx to protect the anastomosis with the palmar vascular network.



Figure 4: The dissection of the flap including a vascular and nervous pedicle, from proximal to distal, longitudinally the extensor pollicis brevis tendon (red arrow).



Figure 5: Image of flap at post - operative second week with a ruddy and elastic surface and tension - free edges.

After the flap is raised, the tourniquet is released to check adequate refills of the vascular pedicle and vascular flow to the flap and then rotated with an angle of 180 degrees and sutured with a few stitches. We cut the residual skin between the donor and the recipient site. Then the flap was stitched into the defect edges and the skin-skin closure between the cutaneous tail and the surrounding edges was performed, as well. The donor site then can be closed directly without a skin graft because of the small dimensions of the flap, and the skin elasticity.

2.4. Follow - up and outcomes

The thumb was immobilized with a short arm cast brace for 5 days. An IV cephalosporin 1st generation was prescribed 2 grams per day, every 6 hours. On the 10th day post - operation, the flap was still alive, ruddy, and had tension-free edges. After 2 weeks, the splint was removed and the patient was advised to move his thumb gently, and passively. Active exercises were allowed in the 4th week (fig 5). The patient had no numbness or paresthesia on the flap and could distinguish 2 points 5 mm apart. After two months, he could reach normal function of the thumb and come back his work after 3 months (fig 6).

He didn't complain about the scar created by the direct closures of the donor site.

III. DISCUSSIONS

Reconstruction of extensive defects of the thumb can be a difficult problem because immediate closure is of extreme importance for preserving function and avoiding complications. Many kinds of flaps have been described to recover these defects. The reverse homodigital dorsoradial flap is one such clever choice in this case with many dominant advantages. The flap transfer affects only one finger. The sensate recovery and the last scar are acceptable. In the dissection of the flap, the mobilization of its pedicle does not require the perishing of the most important artery. Moreover, reaching the dorsal or palmar distal thumb is the other favourableness of the flap with elastic, thin, and hairless texture on the surface. That good point creates a comfortable impression on the patient in the long term. Finally, postoperative care is simple and the mobilization of the unaffected fingers

is intact. However, because venous drainage of the flap is not created by any specific vein, a congestive complication of the flap may occur. Therefore, a wide dissection of subcutaneous tissue and aponeurosis included into the island and a cutaneous tail added are the methods to improve adequate venous drainage.

The skin graft is not suitable for this kind of defect because it lacks the thick tissues required to cover the exposed bone and it's probable to secondary injury in the future. The cross - finger flap requires a staged approach on two fingers and a period of immobilization causing the risk of subsequent joint stiffness [6]. Moberg flap which was first described in 1964 and then modified by O'Brien in 1967 can reach up the pulp defects of the thumb measuring even 4 cm in length but it presents some limitations including the mobility of this flap is quite limited, the requirement of skin graft at proximal palmar thumb and first web space may cause a volar contracture [7]. Another option is heterodigital neurovascular island flaps based on palmar digital arteries and nerves but it requires extensive digital and palmar dissection for the mobilization [6]. A kite flap from the dorsal surface of the adjacent index finger that was first described by Foucher and Braun in 1979, may be chosen for the distal thumb defects. The disadvantages of this flap include a skin graft for the donor site and the involvement of two fingers. Furthermore, the relatively darker dorsal skin consisting of hair follicles leads to less aesthetical pleasure despite the probable sensate skin zone [3, 8]. A type of flap that is taken from the ulnar side of the thumb and based on the dorsoulnar artery of the radial artery is a candidate for thumb defect with advantages such as only one affected finger and early mobilization of the thumb [1]. Free flaps can be used, but this technique requires microsurgical experience, prolonged operation, and a high risk of total flap loss.

The reverse homodigital dorsoradial flap was first described in 1996, based on the dorsal radial collateral artery originating from the radial artery. When the artery goes along the first metacarpal and proximal phalanx on the radial side, about 1 cm from the medial axis of the digit, it finishes at the

middle third of the proximal phalanx by connecting to the palmar circuit to the mobilization of the flap [5, 6]. Regarding the reinnervation on the flap, we didn't decide to coaptation between the branch of the superficial nerve included in the flap and the branch of the digital nerve on the other side. However, we recorded that two - point discrimination was 5 mm after 4 weeks. In the study of Moschella (2006), the author reported that the static two - point discrimination was evaluated only for palmar reconstruction with a mean value of 9.7 mm, which is not very different from the values obtained using techniques of nerve disconnection and reconnection [6].

We conclude that the defects of the hand are caused by traffic, labour, or daily living accidents, and reconstruction has still left the challenges to plastic and reconstructive surgeons to manage in the emergency room and to select suitable flap resurfacing. We used the reverse homodigital dorsoradial island flap for recovering the defects of the thumb and the result is acceptable as expected. However, the data and evidence limitations of the case report can't conclude that it's one of the most appropriate flaps to recover defects of the thumb.

IV. CONCLUSION

The reverse homodigital dorsoradial flap has become a useful and valuable material for thumb reconstruction. The flap provides acceptable aesthetic results with primary closure of the donor site and returns the essential functionality to the affected thumb.

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