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Reconstruction of a Wrist Defect with a Distally-Based Radial Artery Perforator Flap: A Case Report

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Abstract **Case Report**

Introduction: Because of the important anatomical structures situated superficially, reconstruction of wrist soft tissue defects is challenging for the plastic surgeon. Depending on the characteristics of the defect, various reconstruction methods are commonly performed. A pedicled perforator flap stands as a valuable option providing reliable coverage of the defect while preserving the vascularity. ***Case report*:** A 35-year-old male presented with a post traumatic wrist soft tissue defect with exposure of underlying structures. Surgical debridement was performed, and the resulting defect was reconstructed with a distally-based radial artery pedicled perforator flap. Postoperative recovery was uncomplicated. ***Conclusion*:** Radial artery perforator flap proved to be a workhorse flap for soft tissue reconstruction of the wrist. It has many of the benefits of the radial forearm flap but minimizes the disadvantages.

Keywords: Wrist defect; radial artery perforator flap; case report.

INTRODUCTION

Soft tissue defects in the forearm and wrist are commonly encountered issues, Yet they can occasionally present complex reconstructive challenges. Various types of injuries can result in the exposure of tendons, muscles, bones, and neurovascular structures. The management of such defects and the resurfacing of exposed critical structures typically require a systematic and staged approach. The options encompass local, regional, distant, and free flaps.

Advancements in the understanding of vascular anatomy have inevitably spurred innovations in flap design and its clinical application. Consequently, over the years, several surgical approaches have emerged as a result of the enhanced knowledge of the topographic anatomy of arterial perforators in the forearm and hand, enabling the versatile utilization of perforator flaps in reconstructive surgery. The present paper outlines a case of soft tissue defect in the wrist, effectively repaired using a distally based radial artery perforator flap.

CASE REPORT

A 35-year-old, right-handed male construction worker with no significant medical history, was promptly brought to the emergency department after being involved in a road traffic accident. The patient sustained a traumatic injury to his right wrist, leading to soft tissue loss and exposure of underlying structures. On examination, a soft tissue defect was noted on the dorsolateral aspect of the right wrist. No indications of neurovascular compromise were observed distal to the injury site, and the patient's motor functions remained unimpaired. A thorough trauma assessment revealed that the patient's injuries were restricted to the right upper extremity. The x rays images displayed no evidence of fractures, dislocations, or other abnormalities.

A staged approach was then chosen. The patient was promptly transferred to the operating room for a comprehensive assessment of the soft tissue defect, evaluating its size, depth, and adjacent structures. Surgical debridement was performed to excise any devitalized tissue and remove foreign material from the affected area. The structural integrity of the tendons was confirmed to be intact. However, attention was drawn to the condition of the peritendon, which was found to be damaged, exposing the underlying tendons. The examination unveiled a segment amenable to suturing, enabling a reduction in the overall size of the defect. Postoperatively, the patient was started on prophylactic antibiotics. He underwent serial wound assessments and wound care.

We decided to cover the defect with a distally based radial artery perforator flap. Doppler examination was employed to mark out the trajectory of the radial artery along the distal aspect of the volar forearm. After elevating the flap and visualizing the perforator vessels, a pedicled radial forearm flap based on a single perforator was dissected at a sub fascial level, The fasciocutaneous flap was then rotated 180° to cover the defect. One month later, the flap was detached and the donor site was covered with a split-thickness skin graft. Postoperatively, the patient had an uneventful recovery with no flap or donor site complications.

Figure 1: Soft tissue defect on the dorsolateral side of the right wrist

Figure 2: Post-debridement appearance of the soft tissue defect on the dorsolateral aspect of the right wrist

Figure 3: Harvesting of a distally based radial artery perforator flap, a meticulous dissection was performed from proximally to distally including the fascia within the flap

Figure 4: Flap turnover for defect coverage

Figure 5: Preoperative appearance prior to pedicle division and donor site closure

Figure 6: Closure of the donor site with split-thickness skin graft

Figure 7: Six-month follow-up evaluation post-reconstructive surgery

DISCUSSION

The reconstruction of dorsal hand soft tissue defects is critical for hand mobility and function, and still represents a challenge in everyday clinical practice. Several reconstruction methods have been described and are commonly performed to cover dorsal hand defects [1-3]. Skin grafts are not employed for defects involving exposed tendons or bones; yet, in cases where their application is considered suitable, secondary contraction poses a significant disadvantage [4].

The radial forearm flap, commonly referred to as the "Chinese flap," was first developed in 1978 and subsequently described as a free flap in the literature by Yang *et al*., in 1981.

In the same year, Song *et al*., popularized its use as a free flap for the reconstruction of the head and neck [5, 6]. Drawing inspiration from this type of free flap, a distally based pedicle flap that receives its blood supply reversibly from the ulnar artery through the palmar arch was presented in 1982 [7]. The routine use of the retrograde flow pedicled radial forearm flap has brought to light certain major drawbacks. the main disadvantages are the need to sacrifice the radial artery during the harvest of the flap, the donor site morbidities such as slight-to-moderate functional deficit, delayed wound healing, poor skin graft take, cold intolerance and in terms of esthetics as the donor skin of and fascia harvested from the volar forearm offer poor matches in color and contour to the more delicate and thinner tissue of the hand, especially the dorsum [8, 9]. These limitations, along with enhanced comprehension of the vascular anatomy of the forearm, have played a significant role in the development and utilization of perforator-based flaps, including the introduction of the distally based radial artery perforator flap (DBRAPF) into clinical practice [10].

As it courses through the forearm, The radial artery generates numerous musculocutaneous and septocutaneous arterial perforators. Towards the lower third of the forearm, it becomes superficial as it emerges in the septum located between the tendons of the brachioradialis and the flexor carpi radialis, emitting approximately ten small perforating vessels. The radial artery's most significant septocutaneous perforators originate within 2 cm proximal to the radial styloid [11, 12].

The DBRAPF have been used as adipofascial flaps [13, 14] and fasciocutaneous flaps [15, 16] for hand wound coverage. As the radial artery is preserved during the harvesting of this flap, a preoperative Allen's test is not required since flap circulation is independent of the ulnar-radial palmar vascular communication. However, patency of the main artery and its venae comitantes at the site of septocutaneous perforator branching is crucial for retrograde perfusion and flap survival.

The radial artery perforator flap allows the reconstruction of small- to moderate-sized defects in the distal forearm and hand. It offers volar coverage extending as distally as the base of the proximal phalanges. On the dorsal side, it provides coverage for defects proximal to the metacarpophalangeal joints and the radial two-thirds of the forearm. According to most authors, the flap's maximum size that ensures reliable planning falls within the range of 8 to 12cm in width and 15 to 20cm length. Limiting the localization of the top edge to the lower two-thirds of the forearm is important because of the perforator vascular cutaneous territory and extending the flap length beyond these dimensions would pose safety and reliability concerns [17, 18].

We believe that RAPF offers a versatile option in reconstructive surgery, with potential applications expanding beyond those previously demonstrated. This includes its use as a vascularized nerve flap.

CONCLUSION

The selection of the reconstructive method along the reconstructive ladder depends on the characteristics and localization of soft tissue defect and the general condition of the patient. The frequent and versatile clinical application of RAPF has demonstrated its effectiveness as a workhorse flap and an excellent functional reconstructive option for complex dorsal hand soft tissue defects, with minimal donor site morbidity.

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