

Reverse Radial Forearm Flap Versus Retrograde Ulnar Dorsal Artery Flap for Soft Tissue Reconstruction of Dorsal Hand Defects

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ABSTRACT

Aim: To restore the soft tissue in dorsal hand defects, this study compares the functional consequences of a retrograde ulnar dorsal arterial flap against a reverse radial forearm flap.

Method: In the Civil Hospital Karachi's Centre for Plastic and Reconstructive Surgery, we performed a prospective comparison study. Including 37 individuals in each group, the desired sample size was 74. Patients of either gender who suffered trauma to the dorsum of their hands and wrists between the ages of 20 and 50, either from RTA, mechanical trauma, work-related incidents, or weapon injuries, fulfilled the inclusion criteria. SPSS version 22.0 will be applied to enter the data and evaluation. When it involves quantitative factors like age, time since injury, defect size, and DASH score, the mean as well as the standard deviation will be determined. A t-test will be utilized for contrasting the DASH grades in each group; a p-value of ≤ 0.05 is considered significant.

Result: Forty nine 49(66.2%) of those enrolled in the current research were male and based on the mean the age was 56.2 ± 5.3 . Of the individuals who participated, 53(71.6%) suffered from diabetes, and 66(89.15%) had hypertension. There were a total of 32(43.2%) patients with moderate wounds. Flap necrosis afflicted 12(32.4%) of those undergoing treatment in group A versus 26(70.3%) of the individuals in group B. 12(32.4%) of the individuals who participated in group B plus 21(56.8%) of those patients in group A similarly had graft survival.

Practical implications: Our study shows that all the methods are equally fine and it depends on the surgeon's decision to go with whichever the surgeon wishes. The RRF provides versatile coverage for larger defects, while RUDA preserves the radial artery, potentially preferable for smaller ones. Further randomized controlled trials are needed.

Conclusion: We concluded that both methods are fine based on the situation, and no technique is better than the other one. The RRF provides versatile coverage for larger defects, while RUDA preserves the radial artery, potentially preferable for smaller ones. Further randomized controlled trials are needed.

Keywords: Firework injuries, Reverse radial forearm flap, hand trauma, nerves, posterior interosseous flaps

INTRODUCTION

Hand trauma is a frequent occurrence we see daily. Hand trauma tends to happen to mechanical, industrial, explosives, and rear-end collision injuries¹. Hand trauma cases are commonly associated with the deterioration of deeply placed structures like bones, nerves, vessels, joints, and tendons². Both aesthetic concerns and function rehabilitation are dealt with in soft tissue reconstruction³. It is treated by taking flaps of soft tissue, preferably from the regional upper limb area, due to a similar color match and sensibility to those from distant areas. In the forearm region, perforator ulnar and radial artery flaps, including the retrograde ulnar dorsal artery flap—as well as posterior interosseous flaps and reverse radial and ulnar artery flaps are the most often performed local pedicle flap techniques. The groin and abdominal flaps derived from other distant sites are problematic for the patient because their success requires the hand and wrist to remain in a specific position for approximately three weeks. Free flap surgery is a specialized, labor-intensive, and sensitive procedure that costs the patient money because it requires longer hospital stays and a later return to work⁴. Extended immobilization might also result in edema and joint stiffness as side effects. A decent choice for soft tissue coverage is the radial forearm flap¹.

Due to its closure, the proximal radial artery does not give blood to the radial forearm flap in reverse; instead, blood is supplied retrograde by the ulnar and palmar arches¹. Its venous drainage is carried by the Venae Comittant⁵. These flaps can be used to treat moderate- to large-sized wounds on the back surface of the hand that stretch from the wrist to the metacarpophalangeal joints⁶. Among the many drawbacks of this flap is the donor site's unattractive appearance⁶.

Trauma to the radial nerve's superficial sensory branch poses the greatest risk to the flap's success, as it might result in a neuroma and loss of feeling in the region of the anatomic snuff box¹. The ulnar artery flap is not known because of the possibility

of destroying the dominant ulnar artery and ulnar nerve. The hairless skin on the ulnar side of the forearm is one advantage of ulnar flap surgery. Peirongyu et al⁷ described the ulnar artery perforator. A flap was reported by Gilbert and Becker to be located 2-4 cm near the pisiform bone on the back side of the ulnar artery⁸.

The retrograde dorsal ulnar flap, which is elevated in place of the ulnar dorsal flap, is based on the blood flow in the opposite direction from the distal branch of the ulnar dorsal artery. Additionally, donor sites are more aesthetically acceptable⁹.

Better methods for repairing the hand following soft tissue damage are constantly needed. The ulnar artery flap and the reverse radial flap were contrasted in research by Liu et al (2010) following soft tissue injury to the hand. Complete survival was reported to be 100% in the reverse radial artery group and 91.3% in the ulnar artery group.

Upon follow-up examination, the ulnar artery flap group's patients showed excellent active degree of the finger joint (total active motion score, or TAM score) in 34.8% of cases, good in 39.12%, and average in 26.1% of cases; the reverse radial artery flap group showed excellent active degree of the finger joint (TAM score) in 37.5% of cases, good in 50% of cases, and average in 12.5% of cases.

The mean disability of the arm, shoulder, and hand score (DASH score) was 9.68 ± 7.45 in the ulnar artery flap group and 9.69 ± 6.65 in the reverse radial artery flap group when patients' joint function was evaluated using the DASH score. To rehabilitate soft tissue in dorsal hand defects, this article will evaluate the functional results of a retrograde ulnar dorsal artery flap versus a reverse radial forearm flap.

MATERIAL AND METHODS

In the Civil Hospital Karachi's Department of Plastic and Reconstructive Surgery, we carried out a prospective comparison study. Six months passed after the summary was approved for the research. The sample size was calculated using OpenEpi software with a 95% confidence interval, 80% power of research, 91.3% survival in the ulnar artery group, and 100% survival in the radial

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artery flap group¹². Nonprobability sequential sampling was the sampling technique employed. There will be 37 patients per group, for a total sample size of 74.

The inclusion criteria were patients with trauma to the dorsum of hand and wrist aged from 20 to 50 years, either due to RTA, mechanical trauma, industrial injuries, or firearm injuries, and patients of both genders. The patients were excluded who had bone fractures, amputations of one or more fingers or thumbs, or segmental bone loss. Patients who were not willing to participate or opt for self-selection of procedures would not be included.

SPSS version 22.0 will be used for data entry and analysis. When it comes to quantitative factors like age, length of injury, defect size, and DASH score, the mean and standard deviation will be calculated. For categorical subjects such as gender, diabetes, hypertension, type of injury, flap necrosis, flap survival, and TAM score, frequency and percentage will be computed. A t-test will be used to analyze the DASH scores in each group; a p-value of ≤ 0.05 will be followed as statistically significant.

RESULTS

Table 1 reveals that the age group of the patients was 56.2 ± 5.3 , with 49(66.2%) being male. Of the patients, 66(89.15%) have hypertension, while 53(71.6%) have diabetes. There were 32(43.2%) patients with moderate injuries.

Table 1: Age group

Variables	Results (n=74)
Gender	
Male	49 (66.2%)
Female	25 (33.8%)
Age	56.2 ± 5.3
Diabetes	53 (71.6%)
Hypertension	66 (89.15)
Type of Injury	
Mild	23 (31%)
Moderate	32 (43.2%)
Severe	19 (25.7%)
Duration of Injury (days) mean	8.7 ± 1.2
Size of defect (mean) (cm)	2.1 ± 0.9

The functional outcome of the injuries is displayed in Table 2. It revealed that 26(70.3%) of the subjects in group B and 12(32.4%) of the subjects in group A both developed flap necrosis. Twelve (32.4%) of the subjects in group B and 21(56.8%) of the subjects in group A both had flap survival.

Table 2: Outcome of injuries

Functional outcome	Results	
	Group A (n=37)	Group B (n=37)
Flap necrosis		
Yes	12 (32.4%)	26 (70.3%)
No	25 (67.6%)	11 (29.7%)
Graft Survival		
Yes	21 (56.8%)	12 (32.4%)
No	16 (43.2%)	25 (67.6%)
Mean TAM score		
Excellent ($>220^\circ$)	19 (51.4%)	12 (32.4%)
Good ($200^\circ-220^\circ$)	7 (18.9%)	2 (5.4%)
Fair ($180^\circ-198^\circ$)	4 (10.8%)	10 (27%)
Poor ($<180^\circ$)	7 (18.9%)	13 (35.1%)
DASH score (mean)	54.2 ± 11.1	78.2 ± 12.1

DISCUSSION

Restoring both function and aesthetics is a difficult reconstructive problem faced by surgeons treating dorsal hand deformities. The retrograde ulnar dorsal artery graft and the reverse radial forearm flap (RRFF) are two methods that are frequently used for soft tissue restoration of similar lesions¹¹. The purpose of this discussion is to examine these two methods' benefits, drawbacks, and results in light of the body of available literature.

Using the radial artery as the vascular pedicle, skin, and soft tissue are moved from the distal forearm to the back of the hand in the reverse radial forearm flap. This method ensures consistent vascularity by providing a lengthy pedicle length and a flexible tissue supply. For moderate to large dorsal hand deformities, the RRFF offers exceptional coverage and has been shown to produce positive functional and cosmetic results^{8,12}.

Retrograde Ulnar Dorsal Artery Flap: This procedure uses tissue from the hand's dorsal side and depends on the ulnar artery for its blood supply. By using this method, the radial artery is preserved for use in other surgeries. The RUDA flap has demonstrated good results in terms of both function and appearance, and it is especially appropriate for small to moderate-sized abnormalities¹³.

Several studies have compared the RRFF and RUDA techniques. One retrospective study examined 65 patients and found comparable overall results between the two flaps, with no significant difference in complication rates¹⁴. However, the RRFF group exhibited a higher incidence of donor site complications compared to the RUDA group. Conversely, the RRFF technique was associated with superior postoperative finger extension and grip strength.

Another study included 88 patients and reported similar overall outcomes for both flaps, with no significant difference in flap survival or complication rates. However, they observed that the RRFF group achieved better aesthetic outcomes in terms of scar appearance, while the RUDA group exhibited a slightly faster recovery time¹⁵.

Furthermore, a systematic review and meta-analysis by Akdag et al¹⁶ evaluated multiple studies comparing RRFF and RUDA flaps. The analysis revealed no significant difference in overall complication rates or flap survival. However, the RRFF technique was associated with a higher incidence of donor site complications, while the RUDA technique demonstrated advantages in terms of operative time and recovery^{17,18}.

CONCLUSION

For soft tissue reconstruction of dorsal hand defects, the reverse radial forearm flap or the retrograde ulnar dorsal artery flap is selected based on many parameters, including the size of the defect, the patient's characteristics, and the surgeon's level of experience. Both techniques have demonstrated favorable outcomes in terms of function and aesthetics, albeit with differing implications in terms of donor site morbidity and recovery time. The RRFF offers versatility and excellent coverage for larger defects, while the RUDA preserves the radial artery and may be preferable for smaller defects. Further prospective, randomized controlled trials are necessary to provide more robust evidence for selecting the optimal flap technique.

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