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Case report

## Application of Reversed Radial Forearm Flap for Reconstruction of a Dorsal Hand Soft Tissue Defect: A Clinical Case

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### Abstract

Worldwide, surgical techniques for soft-tissue hand defects have made use of the reversed radial forearm flap. Generally, has been used in dorsal hand defects.

**In this case report**, we showed the outcome of a case where the reversed radial forearm flap was applied to treat the dorsal hand defect. A 45-year-old patient who was injured in November 2020 as a result of stacking the right hand in the rotational mechanism. The injury was received 3 days before admission to the hospital. The first stage of surgical treatment was performed - necrectomy of the wound of the right hand. Afterwards, therapy using vacuum-assisted closure (V.A.C) was administered for 18 days. Once granulations had formed in the wound, the patient underwent the second phase of surgical intervention. The reversed radial forearm flap was turned and placed in order to close an opened, exposed bones and tendons in the dorsum of hand. There was no complication with flap viability in the postoperative period. Patient's joint range of motion and vital functions were acceptable. This case showed that the Reversed Radial Forearm Flap can also be used in dorsal hand defects.

**Keywords:** flap, pedicled flap, soft tissue injuries, hand injuries.

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## Introduction

The dorsum of the hand is a specialized region characterized by delicate and thin skin with limited subcutaneous tissue. This unique anatomical structure makes the dorsal hand particularly susceptible to various types of injuries such as crush injuries, degloving, thermal burns, and friction-related trauma [1]. These injuries often result in exposed tendons and bones, necessitating meticulous reconstruction techniques to restore both form and function to this crucial anatomical area. The treatment of cutaneous defects on the dorsal hand requires careful consideration of various factors, including the size of the defect, the available vascular supply, and the desired

aesthetic and functional outcomes. The estimated extent of the injury and the correct selection of adequate treatment are determined by the AO Soft Tissues Wound Classification [2]. Coverage possibilities using regional pedicle flaps consist of the radial forearm flap [3, 4], ulnar forearm flap [5,6], posterior interosseous artery flap [7-9], distal ulnar and radial artery perforator-based flaps [10-12].

**This case report** has demonstrated that, in addition to other reconstruction methods, the Reversed Radial Forearm Flap (RRFF) can also be used in dorsal hand defects.

## Description of the clinical case

Informed consent was obtained from the patient for inclusion in this case report.

The patient, a male, 45 years old, who was injured in November 2020 as a result of stacking the right hand in the rotational mechanism. The injury was received 3 days before admission to the hospital. Upon admission, the diagnosis was «Acute osteomyelitis of the bones of the right hand. Infected-scalped wound of the dorsal surface of

the right hand with damage to the extensor tendons, with a defect in soft tissues and skin IC3 IO3 MT1 NV1» was diagnosed.

During the initial examination, an extensive wound on the right hand of an irregular shape, 12.0x8.0 cm size, with multiple areas of necrosis and a fetid odor, was observed (Figure 1).



Figure 1 - Exterior view of the hand before the operation

After preliminary preparation, the first stage of surgical treatment was performed - necrectomy of the

wound of the right hand (Figure 2).



Figure 2 - Exterior view of the hand after the first stage of surgical treatment

Following this, therapy using vacuum-assisted closure (V.A.C) was administered for 18 days. Once granulations had formed in the wound, the patient

underwent the second phase of surgical intervention (Figure 3).



Figure 3 - Exterior view of the hand before the operation

**Surgical technique.** Before the surgical treatment, we used Allen’s test to assess the palmar arch and the length from the defect to the pivot point of the RA to determine the required pedicle length.

An S-shaped incision was made on the skin, and then the skin was carefully separated from the underlying adipofascial tissue while ensuring that an adequate amount of skin was retained in the donor area.



Figure 4 - Following the grafting of skin

Borders of the adipofascial flap, which included the forearm fascia, were cautiously cut, with special attention given to protecting the radial artery perforators and adipofascial tissue. In the proximal forearm, the radial

artery and accompanying veins were dissected and tied off. Great care was taken to preserve the lateral antebrachial cutaneous nerve.



Figure 5 - Following the grafting of skin and the primary closure of the donor site

The dissection of the flap proceeded from the proximal to the distal region, ending at a pivot point located 1 to 2 cm above the radial styloid. The RRF was then relocated to the intended area of defect either through a

subcutaneous tunnel, directly transposed and sutured in place. A skin graft was applied over the flap (Figure 4, 5). The patient came for the follow-up after 2 months (Figure 6).



Figure 6 - Post-op at 2 months showing good functional results and acceptable cosmetic appearance of the donor area

## Discussion

Restoring dorsal hand defects is crucial for preserving hand mobility and function. Various approaches for reconstruction have been outlined, ranging from employing skin grafts to utilizing free flaps. Skin grafts are unsuitable for addressing defects involving exposed tendons or bones due to their limitations, and their tendency to contract during healing poses a significant drawback in appropriate cases where they are employed [13-16].

In our case, we used an RRF flap, which requires sacrificing a major artery in the hand posing a risk to hand viability and leading to reduced blood supply.

While there are alternative flap techniques that aim to preserve the radial artery, each comes with significant drawbacks.

For instance, the flap described by Bertelli and Catarina [17] closely resembles the distally based RRFF flap but involves the dorsal superficial branch of the radial artery and is taken from the lateral dorsal forearm. This method involves more technical complexity and may produce less desirable cosmetic outcomes.

Another option is the dorsal ulnar artery fasciocutaneous flap described by Becker and Gilbert [18-19], which has limitations due to its short pedicle, limited rotation, and retrograde venous drainage. Both authors Becker and Gilbert have denoted that the dorsal ulnar artery fasciocutaneous flap has to be 10.0 x 5.0 cm.

The posterior interosseous artery flap (PIAF) [20-22] is another possibility. It does not sacrifice a major artery of the hand, but it demands a time-consuming and technically demanding microsurgical procedure because the PIAF is close to the posterior interosseous nerve and their separation is difficult to avoid injuries to the posterior interosseous nerve.

Also, we can use the pedicled groin flap (PGP) described by McGregor and Jackson [23-24]. The PGP is based on the superficial circumflex iliac arteriovenous system, which gives an optimal vascular supply that

enhances adjacent tissue in proximity to the flap, but when utilized, tends to hang in a lower position, often causing swelling within the flap.

Moreover, a pedicled abdominal flap remains a viable choice, although it has an above risk of stiffness [25] and a notable drawback in terms of lacking sensory function. In some cases, additional microsurgical interventions may be necessary, including wrapping flaps or transferring sensate skin from the plantar region.

The RRFF flap does have its disadvantages. It can result in a noticeable scar on the forearm and often necessitates skin grafting to close the recipient site, especially when dealing with larger flaps. In some cases, initial attempts at full-thickness skin grafting have been unsuccessful. To enhance the integration of the skin graft, techniques such as keeping the fascial flap moist or using a vacuum-assisted closure device directly on the flap have been employed. Skin grafting is then delayed until the flap has developed early granulation tissue, typically after at least 72 hours. This approach has successfully prevented further skin graft failures in this type of flap, which has a lower metabolic rate.

## Conclusions

We selected this particular flap for our patient due to its straightforward one-stage procedure and consistent anatomical characteristics, which simplify the surgical process and reduce operation time. An essential benefit of the Reversed Radial Forearm Flap is that it eliminates the need for intricate microsurgical techniques. Additionally, the flap offers thin, flexible tissue for the hand, providing excellent and inconspicuous coverage for exposed structures, along with a smooth surface that facilitates tendon gliding.

**Conflict of interest.** The authors declare that there is no conflict of interest.

**Contribution of the authors.** Performing surgery, conceptualization – S.B.; Performing surgery, methodology – Zh.R.; Performing surgery, writing (review and editing) – A.D.; Performing surgery, verification – R.A.; Performing surgery – A.M.; Writing (review and editing) – A.K.; Writing (original draft paper) – A.A.; Writing (original draft paper) – A.B.; Writing (original draft paper) – N.B.

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### Қолдың арқа жұмсақ тінінің ақауын қалпына келтіру үшін кері радиалды білек қақпағын қолдану: Клиникалық жағдай

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### Түйіндеме

Бүкіл әлемде жұмсақ тінің қол ақауларына арналған хирургиялық әдістер кері радиалды білек қақпағын қолданады. Әдетте қолдың арқа ақауларында қолданылады.

Бұл клиникалық есепте біз қолдың арқа ақауын емдеу үшін кері радиалды білек жапқышы қолданылған жағдайдың нәтижесін көрсеттік. 2020 жылдың қарашасында оң қолын айналу механизміне салу нәтижесінде жарақат алған 45 жастағы науқастың клиникалық жағдайы сипатталады. Жарақатты ауруханаға түскенге дейін 3 күн бұрын алған. Хирургиялық емдеудің бірінші кезеңі – оң қолдың жарасына некрэктомия жасалды. Одан кейін 18 күн бойы вакуумды жабуды (V.A.C) қолданатын терапия жүргізілді. Жарада түйіршіктер пайда болғаннан кейін науқасқа хирургиялық араласудың екінші кезеңі өтті. Қолдың артқы жағындағы ашылған сүйектер мен сіңірлерді жабу үшін кері радиалды білек қақпағы бұрылып, қойылды. Операциядан кейінгі кезеңде қақпақшаның өміршеңдігімен асқину болған жоқ. Науқастың бірлескен қозғалыс ауқымы және өмірлік функциялары қалпына келтірілді. Талқыланған клиникалық жағдай кері радиалды білек қақпағын қолдың арқа ақауларында да қолдануға болатынын көрсетті.

**Түйін сөздер:** қақпақша, педикулярлы қақпақ, жұмсақ тіндер жарақаты, білек жарақаты.

### Применение реверсионного лучевого лоскута предплечья для реконструкции дефекта мягких тканей тыльной стороны кисти: Клинический случай

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## Резюме

*Во всем мире в хирургических методах лечения дефектов мягких тканей кисти используется перевернутый лучевой лоскут предплечья, который используют при дефектах тыльной стороны кисти.*

*В данном клиническом отчете мы показали исход случая, когда для лечения дефекта тыльной стороны кисти был применен обратный лучевой лоскут предплечья. Больной, 45 лет, получил травму в ноябре 2020 года в результате зажатия правой руки во вращательном механизме. Травма получена за 3 дня до поступления в больницу. Выполнен первый этап хирургического лечения - некрэктомия раны правой руки. После этого в течение 18 дней проводилась терапия с использованием вакуумного закрытия (V.A.C). После формирования грануляций в ране больному был проведен второй этап хирургического вмешательства. Перевернутый радиальный лоскут предплечья был повернут и помещен для закрытия открытых, обнаженных костей и сухожилий тыльной поверхности кисти. Осложнений с жизнеспособностью лоскута в послеоперационном периоде не было. Объем движений и жизненные функции суставов пациента были приемлемы. Этот клинический случай показал, что перевернутый лучевой лоскут предплечья также можно использовать при дефектах тыльной стороны кисти.*

**Ключевые слова:** лоскут, лоскут на ножке, травма мягких тканей, травма кисти.