

# Limb Salvage Using Lateral Circumflex Femoral Artery Graft for a Hand Vibration Syndrome

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**Summary:** A 50-year-old man was admitted to the hospital with a chief complaint of long-standing cold-induced numbness in the fingers for more than a year, accompanied by persistent hand pain and fingertip ulceration for 3 months. On physical examination, radial and ulnar artery pulsation was absent in both limbs, and pale skin color, low skin temperature, and limited finger range of motion were noted. Gangrene was detected in the fingertips of the left index and middle fingers, and the right middle and ring fingers. The patient was diagnosed with bilateral arterial occlusion and vibration white finger. Upon admission, the patient underwent an intervention surgery on the right side. Subsequently, transplantation of the descending branches of the left and right lateral femoral circumflex arteries was performed to restore blood flow in the bilateral radial arteries. Additionally, debridement was conducted without shortening after the surgical procedure, the patient received anticoagulation, anti-inflammatory, and symptomatic treatment. The bilateral finger skin temperature increased by 3 °C postoperatively, and the accompanying pain and numbness were alleviated. The wound healed 1 month after surgery, and no recurrence of pain or ulcer was reported during the 1-year follow-up period. Eventually, his hand function recovered, without any impact on the vascular donor site. (*Plast Reconstr Surg Glob Open* 2024; 12:e5978; doi: 10.1097/GOX.0000000000005978; Published online 16 July 2024.)

**A**rterial occlusion refers to the pathological progression leading to stenosis or complete occlusion of the arterial lumen, often precipitated by arterial trauma, atherosclerosis, and thrombotic diseases. This condition manifests with symptoms such as pain, numbness, and impediments in limb functionality, significantly impacting patients' quality of life.<sup>1</sup> Bilateral arterial occlusion, though infrequent in clinical settings, typically

presents as digital pallor in Raynaud syndrome, alongside local pain, numbness, and chills, thereby potentially impairing manual dexterity.<sup>2</sup> Common etiologies of bilateral arterial occlusion encompass vibration white finger (VWF, also known as an occupational Raynaud phenomenon), thenar hammer syndrome, and Raynaud disease. VWF, characterized by profound vascular impairment and hand occlusion, can engender ischemia and nerve injury upon repetitive traumatic stimuli, often linked to prolonged usage of vibrating tools. Clinical features of VWF include intermittent finger blanching, pain at rest, and ischemic ulcer gangrene. As an occupational disease posing significant therapeutic challenges, VWF may be persistent post cessation of exposure and comprehensive treatment. In addition, exacerbating factors, such as smoking, alcohol consumption, and rest, may also contribute to disease onset. Patients whose occupational history of local vibration is more than 1 year and whose physical examination shows white fingers, ruling out peripheral vascular diseases such as Raynaud disease, can be diagnosed with this disease. Designated as a statutorily recognized occupational disease in China, VWF exhibits an escalating incidence and substantial disability rate, eliciting peripheral circulation disorders, neurological disorders, and skeletal muscle system dysfunction in the affected hands.<sup>3</sup> Traditionally, the management of bilateral arterial

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The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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DOI: 10.1097/GOX.0000000000005978

Disclosure statements are at the end of this article, following the correspondence information.



**Fig. 1.** Images of the hands. A, Preoperative view of the hands. Multiple ischemic ulcers in both hands before surgery. B, Postoperative image of the hands. There was no recurrence of pain or ulcers in either hand.

occlusion attributed to VWF primarily relied on conservative interventions, yielding suboptimal patient outcomes.

For patients with bilateral arterial occlusion who cannot obtain favorable outcomes through conservative treatment, it is necessary to seek other therapies.<sup>4</sup> Given the limitations of existing surgical procedures, alternative therapies become imperative for such patients. In this case, we conducted preoperative planning and performed transplantation of the descending branches of the lateral circumflex femoral artery to repair bilateral arterial occlusion caused by VWF. Eventually, this patient experienced favorable improvements. The case was reported as follows.

### CASE REPORT

A 50-year-old man was admitted to the hospital with a chief complaint of long-standing cold-induced numbness in the fingers for over a year, accompanied by persistent hand pain and fingertip ulceration for 3 months. The patient had a history of engaging in manual labor for a duration of 9 years and was a nonsmoker in the past. Previous attempts at anticoagulation and vasodilation at another medical facility yielded unsatisfactory results (lasting for 6 mo). Subsequently, the patient was recommended to undergo amputation at that hospital but declined the proposed treatment option. Upon admission to our hospital, the patient underwent a thorough physical examination. On physical examination, radial and ulnar artery pulsation was absent in both limbs, and pale skin color, low skin temperature, and restricted finger mobility were noted. Gangrene was detected in the fingertips of the left index and middle fingers, as well as the right middle and ring fingers (Fig. 1A). The B-ultrasound results indicated bilateral occlusion of bilateral radial and ulnar arteries at the wrist level. The computed tomography angiography (CTA) results revealed bilateral occlusion of the radial and ulnar arteries at the wrist level, as well as in the superficial and deep palmar arches. Besides, there was notable constriction and absence of blood flow

in all finger arteries. No abnormality was found in the blood vessels of both lower limbs. Based on these findings, the patient was diagnosed with bilateral arterial occlusion and VWF.

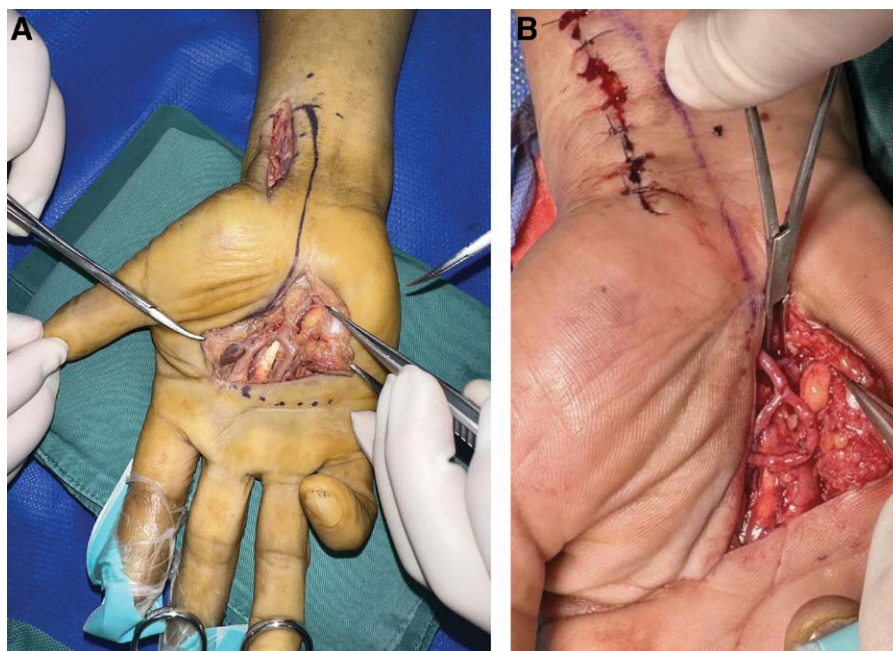
### TREATMENT PROCESS AND FOLLOW-UP

#### Treatment Process

The patient underwent balloon dilation surgery on the right hand. We attempted to perform balloon dilation with a guide wire inserted from the radial artery under local anesthesia through intracavitary digital subtraction angiography imaging, but the guide wire insertion failed. Postoperative pathology confirmed that the cavity was filled with scar tissue after vascular vibration injury. However, the surgical effect was not satisfactory (swelling and hematoma formation in the right hand after the intervention surgery), and hence, the intervention surgery was abandoned. Meanwhile, to avoid the acute onset of hematoma in the right hand, the vascular transplantation of the left hand was performed 1 week after the intervention surgery. Another week later, vascular transplantation was performed on the right hand.

#### Left Side

The left hand underwent vascular exploration, revealing complete occlusion of the radial artery at the transverse plane of the wrist and a narrow but not fully occluded lumen in the superficial palmar arch. Consequently, a decision was made to proceed with vascular transplantation. Specifically, the descending branches of the left lateral circumflex femoral artery were selected for the repair of the ipsilateral radial artery. A segment of the left lateral circumflex femoral artery descending branch, measuring 15 cm in length, was harvested and transplanted to the left upper limb. Subsequently, reconstruction of the radial artery in the wrist, between the fingers of the superficial palmar arch, was achieved



**Fig. 2.** Images of surgical process of the right hand. A, Exploring the radial artery, superficial arch of the palm, and various branches during surgery. B, After vascular transplantation.

through a subcutaneous tunneling approach. The proximal end of the lateral circumflex femoral artery was then anastomosed with the proximal end of the radial artery in the transverse plane of the wrist. After that, the distal end of the transverse plane of the palm was anastomosed with the ulnar end of the superficial palmar arch and the distal end of the lateral circumflex femoral artery. Meanwhile, debridement was performed on the necrotic part of the finger stump (without shortening), followed by postoperative anticoagulation, anti-inflammatory, and symptomatic treatment. Postoperatively, the skin temperature of the left finger was observed to rise by  $3^{\circ}\text{C}$  after surgery, and the pain and numbness in the fingers were eliminated.

#### *Right Side*

One week after surgery on the left hand, we performed surgery on the right side (Fig. 2A). Some of the surgical steps were similar to those on the left side. Only, we should note that when a descending branch (15 cm in length) of the right thigh lateral circumflex femoral artery was removed while preserving each perforating vessel, the descending branches of the right thigh lateral circumflex femoral artery and three vascular branches were removed, and the proximal end of the lateral circumflex femoral artery and the proximal end of the radial artery were anastomosed at the end of the transverse carpal plane. The distal end included the distal end of the lateral circumflex femoral artery and three branches, which were connected to the distal end of the superficial palmar arch, anastomosis of the distal end of the ulnar artery, the distal end of the deep palmar arch, and the ulnar end of the superficial palmar arch, respectively. Meanwhile,

debridement was performed on the necrotic part of the finger stump (without shortening), followed by postoperative anticoagulation, anti-inflammatory, and symptomatic treatment. The skin temperature of the right finger increased by  $3^{\circ}\text{C}$ , and the pain and numbness in the fingers were eliminated.

#### **Follow-up**

The wound on both fingers healed spontaneously 1 month after surgery, and no recurrence of pain or ulcers in either hand was reported within 1 year after treatment. Eventually, the patient's hand function recovered, and the function of the vascular donor area remained unaffected (Fig. 1B).

## **DISCUSSION**

Arterial and venous grafts are of great significance in the treatment of vascular occlusion,<sup>5</sup> and similar to the experience of coronary artery bypass grafting, radial artery grafts have a higher patency rate compared with saphenous vein grafts. Some scholars believe that lower abdominal artery grafts may have additional benefits than saphenous vein grafts.<sup>6</sup> Similar to our case, it is not common for both the radial and ulnar arteries to be affected simultaneously.

VWF requires conservative therapies, such as rest, avoidance of the work environment, smoking cessation, cold stimulation avoidance, and prevention of accidental injuries. Additionally, treatment necessitates the control of anticoagulation, vasodilation, blood pressure regulation, and management of blood sugar and lipid levels. Although these options are considered standard treatment



methods, they are only effective for patients with mild symptoms. Notably, conservative treatment often proves ineffective for individuals experiencing severe resting pain and gangrene.<sup>7</sup> Although amputation is a common treatment opinion, it results in the loss of limb functionality and a lack of improvement in blood circulation, resulting in an unfavorable prognosis.

In this case, conservative treatment proved to be ineffective for the patient who underwent a rapid progression of the condition within a span of 3 months. Nevertheless, the patient expressed a strong desire to retain limbs. Before the surgical procedure, a preoperative CTA examination was conducted, which revealed the presence of vascular occlusion in the wrist. Furthermore, our team possessed extensive clinical experience in the use of anterolateral femoral flaps and had developed a high level of proficiency in understanding the anatomy of the lateral femoral circumflex artery. Therefore, we decided to use the transplantation of the descending branches of the lateral femoral circumflex artery to repair the arterial occlusion. In the design of the surgical regimen, the proximal segment of vascular reconstruction was easily identified through CTA. However, the distal end of the vascular reconstruction posed a more complicated challenge. To address this, a wrist incision was performed to identify the occlusion of the radial artery in the transverse plane of the wrist, serving as the proximal end for the anastomosis of the radial artery. We explored the incision along the transverse line of the palm and identified the superficial palmar arch. Observations during the procedure revealed a narrow but not completely occluded lumen in the superficial palmar arch. Consequently, the blood supply to the superficial palmar arch was reconstructed via a vascular bypass, resulting in favorable surgical outcomes.

During the course of treating this patient, we gained valuable insights and experiences. It became evident that endovascular intervention technology had limited efficacy and potential harmful effects on small artery occlusion. Despite the patient undergoing intracavitary treatment on the right hand and attempts at balloon dilation, there was a poor response to these methods. Subsequently, a transplantation procedure involving the transplantation of the descending branch of the lateral circumflex femoral artery was performed. During vascular exploration and anastomosis, it was found that the intima of the blood vessels exhibited a rougher texture after endovascular surgery, and the occlusion of the lumen was aggravated. Besides, it was noted that endovascular surgery could potentially damage the blood vessel intima. In this special case, no intracavitary procedure was performed on the left side, and only the superficial palmar arch was anastomosed, resulting in normal blood vessel conditions. (If the superficial palmar arch was completely blocked, we would have needed to explore the blood vessels further away, such as performing vascular anastomosis at the level of the common digital artery or even the digital artery.) Meanwhile, the intracavitary procedure carried out on the right side involved distal anastomosis in four directions: the radial side of the superficial palmar arch, ulnar artery, deep palmar arch, and ulnar side of the superficial palmar arch. However, the damage to

the vascular membrane was more severe on the right side compared with the left side, despite no previous intervention history on the left hand. The postoperative follow-up also showed that the skin temperature on the right side was still slightly lower than that on the left side. Based on these observations, it can be concluded that caution should be exercised when considering endovascular intervention as a treatment modality for hand vascular occlusion.

To the best of our knowledge, this study represents the initial investigation into the utilization of the lateral femoral circumflex artery and perforator for the reconstruction of occluded blood vessels in both hands. Encouragingly, the posttreatment outcomes revealed favorable results, with no reported cases of recurrence within a 1-year follow-up period. Therefore, the transplantation of the lateral femoral circumflex artery and perforator could be considered a highly effective approach for the management of bilateral arterial occlusion.

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## DISCLOSURES

*The authors have read the CARE Checklist (2016), and the article was prepared and revised according to the CARE Checklist (2016). The authors have no financial interest to declare in relation to the content of this article. This research was supported by grants from the National Natural Science Foundation of China (Nos. 82172432 and 82102568), Shenzhen Key Medical Discipline Construction Fund (No. SZXK023), Shenzhen "San-Ming" Project of Medicine (No. SZSM202211038), Shenzhen Science and Technology Program (Nos. JCYJ20220818102815033, KCXFZ20201221173411031, and JCYJ20210324110214040), Guangdong Basic and Applied Basic Research Foundation (Nos. 2022B1515120046, 2022A1515220111, and 2021A1515012586), Guangdong Medical Science and Technology Research Funding (No. A2022390), and The Scientific Research Foundation of Peking University Shenzhen Hospital (No. KYQD2021099).*

## PATIENT CONSENT

*The patient provided written consent for the use of his image.*

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