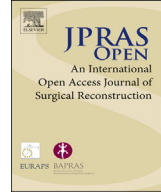




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## Case Report

# Successful hand salvage with free flap reconstruction in a limb with arteriovenous fistula

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## ABSTRACT

Free flap reconstruction of a defect on an extremity with an arteriovenous fistula is a surgical challenge due to the unique hemodynamic characteristics of an arteriovenous fistula and its potential complications. There is a paucity of evidence in the literature describing free flap reconstructions adjacent to arteriovenous fistulae. We present a successful case of an 86-year-old man with end-stage renal disease who underwent an anterolateral thigh free flap reconstruction of a hand defect immediately adjacent to his pre-existing radiocephalic fistula.

The free flap recipient vessels used were the dorsal branch of the ulnar artery, a tributary of the basilic vein and a vena comitans. Recipient veins were carefully chosen based on intra-operative barometry. The free flap reconstruction showed no signs of venous insufficiency or compromise at any stage. The radiocephalic fistula was never disrupted, nor was there any complication regarding the arteriovenous fistula. The patient maintained his regular hemodialysis throughout his care with routine arteriovenous fistula access.

The patient was reviewed six months post-op with no complications and he had returned to living independently in his own home. From our experience of this case, pre-existing arteriovenous

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fistulae should not preclude patients from undergoing free flap reconstructions if indicated.

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## Introduction

Arteriovenous fistula (AVF) is the preferred option for vascular access in hemodialysis patients due to its lower complication rate and long patency rate.<sup>1</sup> However, AVFs are associated with many complications: thrombosis, stenosis, ischemia, aneurysm and infection.<sup>2</sup> Therefore management of an extensive defect in the same limb as an AVF is a significant surgical challenge. Currently there is a lack of evidence regarding the treatment of choice for complex reconstructions on an extremity with pre-existing AVFs. We present a case of an 86-year-old man with end-stage renal disease with an extensive defect on his left hand distal to his radiocephalic fistula. Successful free flap reconstruction was achieved using an anterolateral thigh (ALT) free flap. Microscopic end-to-end anastomoses were performed between the flap's vessels and the dorsal branch of the ulnar artery, a tributary of the basilic vein and a vena comitans. To the best of the authors' knowledge, there is currently only one reported case that describes a successful free flap reconstruction with the sacrifice of the AVF to provide the recipient vessel for anastomosis.<sup>3</sup> This is the first case report in the literature that describes a successful free flap reconstruction with preservation of the ipsilateral AVF.

## Case report

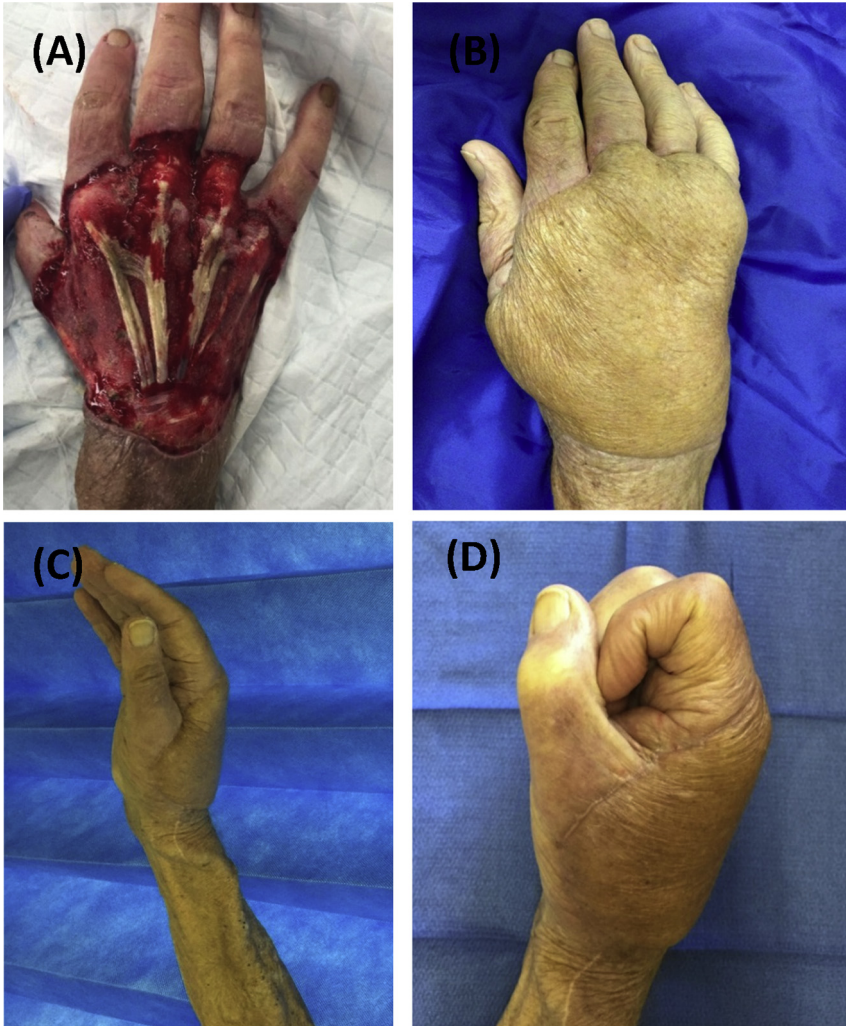
An 86-year-old man was diagnosed with *Mycobacterium ulcerans* following a two-week history of an expanding ulcer on the dorsum of his left hand. He was known to have end-stage renal disease secondary to right nephrectomy for renal cell carcinoma and was hemodialysis dependent for the previous 5 months. A radiocephalic fistula in his distal left forearm was utilized for his dialysis. *M. ulcerans* was confirmed as the offending organism with a positive acid-fast bacillus culture for *M. ulcerans* and a positive *M. ulcerans* polymerase chain reaction.

After multiple debridements, failed simple reconstructive efforts and a prolonged period of antibiotics the patient was left with a complex defect to the dorsal left hand and wrist encroaching on the tissues directly adjacent to the AVF site.

Regional flap and pedicled groin flap was considered as the potential reconstructive options. However, although regional flap can utilize alternate blood supply, sufficient tissue coverage would be difficult to achieve. On the other hand, a pedicled flap would bypass the AVF and another vascular access would need to be created for ongoing hemodialysis. In our case, a free flap was considered due to its good tissue coverage and the potential preservation of the AVF. Anterolateral thigh flap was thought to be the most appropriate option, as the contralateral radial forearm free flap would require incapacitation of both arms post-operatively.

Reconstruction was undertaken using an ALT free flap. Given the presence of the AVF, it is noted that no tourniquet was used in any procedures. At the time of free flap reconstruction, his defect measured approximately 15 cm × 20 cm with exposed extensor tendons, cutaneous nerve branches and extensor retinaculum (Figure 1A). The metacarpophalangeal joints (MCPJ) were open and further radical debridement and skin grafting was not a viable option. The extensor tendons were preserved during the procedure.

A risk of flap congestion due to high venous pressure in the efferent AVF venous system was a concern, so intra-operative venous pressure transduction was used prior to flap harvest and transfer. Pre-operatively a venous recipient pressure of less than 30 mmHg was determined as a requirement for safe free tissue transfer. In this case a normal caliber vein was selected and transduced intraoperatively,



**Figure 1.** (A) Pre-operative defect measured approximately 15 cm × 20 cm on the patient's left hand. (B) Reconstruction with an anterolateral thigh free flap (C) At six-month follow up radiocephalic fistula was successfully preserved (D) The free flap survived with an excellent functional and aesthetic outcome.

and a venous pressure of 16 mmHg was confirmed in the potential venous recipient. Harvest and transfer of the ALT free flap then proceeded.

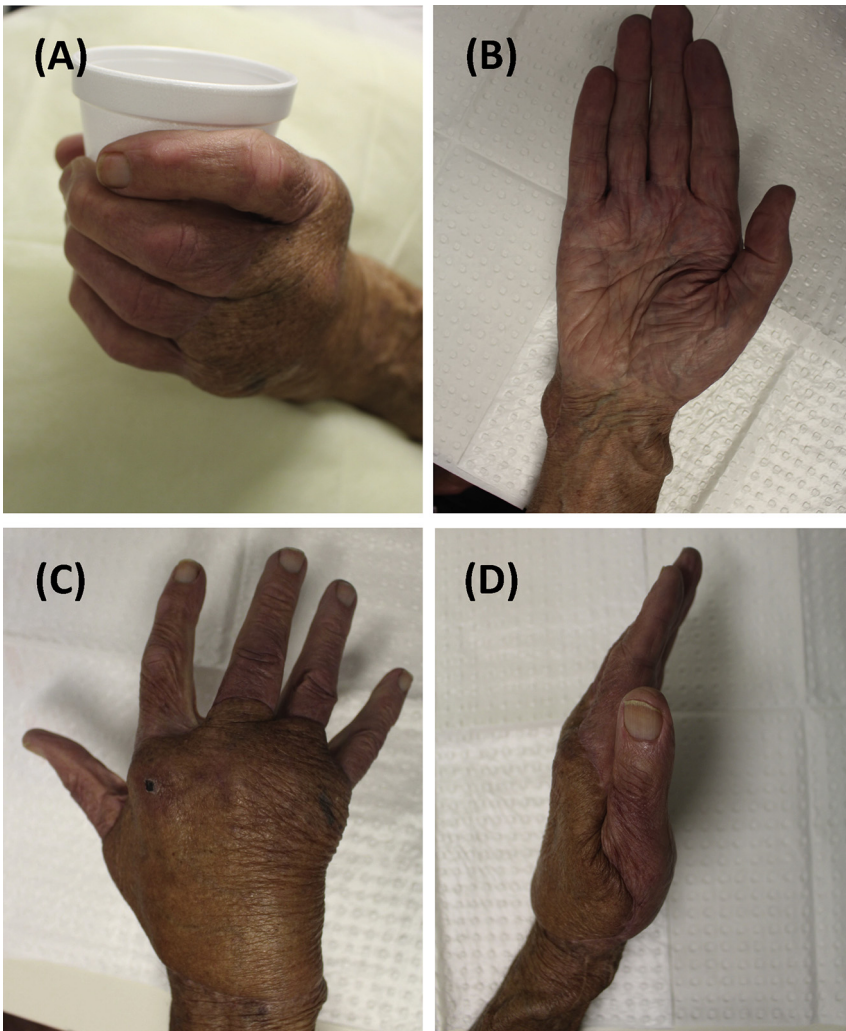
An anterolateral thigh free flap was harvested from the patient's right thigh (Figure 1B). A single end-to-end arterial anastomosis was performed using the dorsal branch of the ulnar artery, which was unusually large at approximately 4 mm in diameter, as the recipient vessel. Two venous end-to-end anastomoses were performed; the recipient veins utilised were a tributary of the basilic vein and a vena comitans. The radiocephalic fistula was preserved without complication. No post-operative complications were encountered.

Six months after surgery there were no flap complications and his AVF remained functional (Figure 1C). The patient had a good aesthetic and functional outcome (Figure 1D). He has subsequently undergone a further operation to debulk the flap. At twelve-month review, passive range of motion (ROM) of MCPJ extensions were  $-15^\circ$ ,  $-10^\circ$ ,  $-5^\circ$  and  $-10^\circ$  for the second, third, fourth and fifth digit

respectively. Passive ROM of MCPJ flexions were 75°, 85°, 85° and 90° for the second, third, fourth and fifth digit respectively. Passive ROM of thumb MCPJ hyperextension and flexion were 5° and 45° respectively. The patient currently continues regular hemodialysis through his pre-existing radio-cephalic fistula and has returned to full independence, living at home alone.

## Discussion

*M. ulcerans* cutaneous lesions are progressive, locally destructive and often difficult to treat.<sup>4</sup> Hence management of a *M. ulcerans* lesion distal to an AVF is even more challenging due to the unique hemodynamic effects and complications secondary to vascular access. Firstly, vascular access-induced ischemia, also known as steal syndrome, occurs when a developed AVF causes excessive flow



**Figure 2.** (A) At twelve-month review, patient had excellent functional outcomes and returned to full independence at home. (B) Palmar view of patient's left hand at twelve-month review (C) Dorsum of the patient's left hand at twelve-month review (D) Lateral view of patient's left hand at twelve-month review.

through the shunt and reduced blood flow distal to the AVF, which can cause hypoxia and ischemia.<sup>2,5</sup> In the setting of a dependent free flap reconstruction this can potentially lead to flap necrosis and flap loss as a result. Physiological steal is also a potent stimulus for collateral arterial development as a compensatory mechanism.<sup>6</sup> In our case, the large calibre of the dorsal branch of ulnar artery that was observed intra-operatively is possibly a result of this vasodilatory effect.

Similarly, another complication associated with AVF is arterial stenosis,<sup>7</sup> which can also reduce blood flow distal to AVF and cause ischemia.<sup>8</sup> Symptomatic ischemia is reported to occur more frequently with upper arm AVFs compared to forearm AVFs, with 10–20% of brachiocephalic and brachio basilic AVFs, 4.3–6% of forearm prosthetic implants and 1–1.8% of radiocephalic AVFs.<sup>5</sup> Impaired arterial supply may also compromise collateral blood supply across flap margins after reconstruction and impede longevity of the flap.

AVFs have the potential to cause venous hypertension and stasis distal to the fistula, resulting from either increased blood flow into a venous bed distal to AVF or proximal venous occlusion.<sup>9</sup> In addition, high venous volume secondary to an arteriovenous shunt can lead to valvular incompetence, retrograde venous blood flow and chronic venous varicosities.<sup>10</sup> Concerns regarding potential venous insufficiency of a free flap in this scenario are based on presumed elevated recipient venous pressure due to the AVF. The presence of an AVF proximal to a free flap reconstruction is perceived to reduce the success rate based on these unique hemodynamic properties and higher rates of thrombosis in such regions. AVF infection can also complicate reconstruction efforts.<sup>9</sup>

In our case, despite hemodynamic effect distal to an AVF and the complexity of the wound, successful reconstruction of the defect using an ALT flap was performed. At twelve-month follow-up, the patient had a good aesthetic and functional result without any compromise to his arteriovenous fistula, dialysis regimen or reconstruction (Figure 2A–D).

## Conclusion

We conclude that the presence of an arteriovenous fistula in a limb should not preclude a patient from having an adjacent free flap reconstruction where indicated. Our case demonstrates that with care and precise planning a complex reconstruction can be successfully performed in the same limb as an AVF.

## Conflicts of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

## Funding statement

There is no source of funding for this study.

## Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

## STROBE guideline

Our case report follows the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guidelines.

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