INTRODUCTION

This is the case of a traumatic arteriovenous fistula (AVF) with steal syndrome of the upper limb secondary to blunt trauma of the midbrachial artery. A useful technique is herein described involving complete ligation of the fistulous connection with a distal bypass procedure done using reversed Great Saphenous Reversed Vein (GSV) to salvage the upper limb.

Traumatic formation of an AVF is rare and is of relevance to Surgeons due to its complexity. This is the case of a construction worker who developed a traumatic AVF with steal syndrome of the upper limb secondary to blunt trauma of the midbrachial artery after a fall. A short literature review is included which highlights the rarity and the techniques utilized in the past. A unique and useful technique/approach is herein described involving complete ligation of the fistulous connection with a distal bypass procedure done using reversed GSV to salvage the upper limb with no complication.

CASE HISTORY

Whilst working on a scaffold, a thirty-two-year-old male construction worker fell resulting in trauma to the medial aspect of his arm involving the brachial artery and soft tissues. He was taken to a tertiary referral center where he was resuscitated via the advance trauma life support protocol. There were no other injuries of significance with the exception of an ischemic right upper limb with major injury to the brachial artery.

On exploration, the initial general surgeon found a partially avulsed brachial artery with no nerve or venous injury documented at that time. The vessel was repaired with a vein graft and the limb salvaged.

Postoperatively, there were no palpable distal pulses; however, the limb remained viable. Over the next 6 months, the limb became gradually swollen, painful, and darker in color, with many grossly distended veins. A thrill was present and the limb was mostly nonfunctional during this time. (Figure 1). A computed tomography angiogram with reconstruction showed massively dilated veins in a complex web affecting the entire right upper limb with a fistulous connection between the brachial artery and basilic vein in the midarm region. (Figure 2) The thrill disappeared upon digital pressure at that particular point, (Figure 3) as it was difficult to exactly detect where the connection was radiologically. Of note, there was no apparent nerve palsy; however, a chronic steal syndrome existed. Without interference of the nerve supply, careful control was obtained and a GSV bypass graft was done from the proximal brachial artery (Figure 4) to a point just proximal to the bifurcation of the brachial artery at the antecubital fossa. (Figure 5) A 6.0 double-armed polypropylene suture was used for the anastomosis. The GSV graft was harvested from the right lower limb. The fistulous connection was then oversewn with a 2.0 polypropylene
suture for the entire segment involved. (Figure 2) With the radial pulse restored, the patient made an uneventful recovery with soft tissue normalization over the next few weeks. (Figure 6).

3 | DISCUSSION

Traumatic arteriovenous fistula is of special interest because of its effects on the circulation and poses a challenge with surgical ingenuity and skill being a necessity to correct it.\(^1,2\) The first case of a traumatic arteriovenous fistula of the upper limb was described by Nurick in the Proceedings of the

**FIGURE 1** Photo of the upper limb demonstrating the diffuse, dilated, and tortuous veins

**FIGURE 2** CT angiography with reconstruction showing a complex network of massively dilated veins of the right upper limb with a fistulous connection at the upper to midbrachial artery and basilic vein

**FIGURE 3** Identification of the fistula between artery and vein in the arm

**FIGURE 4** Site of arteriovenous fistula identified and oversewn with the proximal anastomosis shown using a reversed great saphenous vein graft

**FIGURE 5** Distal anastomosis shown at the brachial artery in the antecubital fossa
Royal Society of Medicine in 1953 based on a case of a man shot through the axilla in 1917. Since then there have been sporadic reports on such cases affecting the upper limb. However, to the best of our knowledge there has been no case to rival the one herein described. The approach and technique to revascularize the upper limb is also detailed with a review of the literature.

Traumatic arteriovenous fistulae with steal syndrome are a rarity with few reports on the management of such. Traditional procedures would include proximal control, location, and disconnection of the fistula between artery and vein with an appropriate repair, which may include a vein or polytetrafluoroethylene patch or just primary repair. White et al described their experience with peripheral vascular injuries associated with falls from heights in 1987 in the Journal of Trauma. A 15-year experience with 10 injuries was described in 230 patients who jumped or fell from heights of at least three stories. These included four popliteal artery thromboses or disruptions, two popliteal vein disruptions, one traumatic tibial arteriovenous fistula, one subclavian artery pseudoaneurysm, one radial artery transection, and one lacerated medial circumflex artery. Although the mechanism of injury was multifactorial, all were associated with significant orthopedic trauma. Early recognition of vascular injuries, minimization of ischemic time, completion arteriography, venous repair, and liberal use of fasciotomy were emphasized to maximize limb salvage.

Loughlin et al described a case of penetrating metal fragment injury to the antecubital fossa with subsequent development of a false aneurysm of the brachial artery with a fistula to the vena comitans and median basilic vein. Surgical management involved aneurysmectomy, interposition cephalic vein grafting, and lateral repair of the vena comitans. Modern interventions include endovascular techniques to cover and control the injury site; however, in this particular case, it was difficult to localize the site and it was necessary to reconstruct the blood supply with a bypass due to the severe steal syndrome.

The technique used is a modification of standard distal revascularization interval ligation (DRIL) procedure as is done for steal syndrome in AVF creation for dialysis, which involves ligation of the brachial artery distal to the AVF inflow and revascularization of the distal arm with a bypass taken from a more proximal inflow source. In this case, a complete ligation of the fistulous connection between artery and vein was done instead with a distal bypass graft using reversed GSV in order to successfully revascularize the ischemic limb.

CONFLICT OF INTEREST
There are no conflicts of interest related to this manuscript.

AUTHOR CONTRIBUTIONS
Michael J. Ramdass is the author and Surgeon involved with this case. Developed the idea and wrote the manuscript.

PATIENT CONSENT
Written consent was obtained from the patient regarding the publication of this interesting case in a Scientific Journal.

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