

# The helix fistula

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The Society for Vascular Surgery clinical practice guidelines for hemodialysis access, in accordance with the National Kidney Foundation Kidney Disease Outcomes Quality Initiative guidelines and the Fistula First Breakthrough Initiative, recommend consideration of autogenous access over prosthetic conduits whenever possible. In a significant number of patients, however, upper extremity autogenous access is deemed unfeasible because of lack of a vein of suitable caliber (2 mm or less). This report describes the initial experience with a new class of autogenous hemodialysis access based on autogenous spiral vein grafts (helix fistulas). (*J Vasc Surg Cases* 2016;2:34-5.)

The Society for Vascular Surgery practice guidelines recommend consideration of autogenous access when possible.<sup>1</sup> Spiral vein grafts have a long history dating back to their initial use in 1976.<sup>2</sup> This series represents the first experience using spiral vein grafts for hemodialysis access, called helix fistulas. Patients were considered if they had functional veins that were unlikely to become viable traditional fistulas on the basis of small vein size (~2 mm) as assessed by ultrasound. Consent was obtained from surviving patients to be included in this report.

## CASE SERIES

**Patient 1.** The initial experience was in a 65-year-old woman with a dysfunctional left brachial-basilic fistula. This had been stented, and she developed recurrent edge stenoses requiring frequent angioplasty. She underwent resection of the stented segment and interposition with a 2.5-cm-diameter, 6-cm-long spiral vein graft using accessory saphenous vein tubularized over a 5-mL syringe. The fistula functioned well and remained patent with no additional need for dialysis-related interventions. She died 9 months later from a fall, resulting in a primary patency of 262 days.

**Patient 2.** A fit 87-year-old man was referred with end-stage renal disease. He had a palpable left radial pulse and normal Allen test result. Ultrasound showed 2-mm cephalic vein. He underwent radial-antecubital vein helix fistula; the cephalic vein was harvested through inversion venectomy<sup>3</sup> by exposing the vein at the wrist and passing a 4F KMP catheter antegrade to the shoulder. The vein was secured to the catheter and withdrawn retrograde. Side branches were identified by traction, exposed, and ligated. The vein was opened longitudinally and tubularized over a 3-mL syringe with 6-0 Prolene. The 15-mm-diameter, 18-cm-long spiral graft was tunneled superficially in the forearm. After systemic heparinization

(70 units/kg), the graft was anastomosed end to side to the radial artery through a generous arteriotomy and distally to the antecubital vein complex (Fig 1). The graft was cannulated at 52 days (Fig 2) and functioned well. He developed a venous outflow problem in the antecubital vein complex not amenable to angioplasty. The fistula thrombosed at 505 days.

**Patient 3.** A 52-year-old woman with end-stage renal disease was referred for access. Examination demonstrated a palpable radial pulse and normal Allen test result. Ultrasound demonstrated 2-mm forearm and upper arm cephalic vein in a noncontiguous layout. She underwent left radial artery to brachial vein helix fistula; the veins were harvested through inversion venectomy, connected end to end to create a single segment, and tubularized with 6-0 Prolene to create a 14-mm by 19-cm spiral graft that was tunneled in the forearm. After heparinization, the graft was anastomosed end to side to the radial artery and brachial vein. The graft was cannulated at 51 days and remains functional, but she developed an intimal hyperplastic response and has undergone percutaneous angioplasty approximately every 3 to 6 months. Primary patency was 98 days, with a primary assisted patency currently at 1254 days (3.4 years).

**Patient 4.** A 63-year-old morbidly obese woman presented with multiple prior prosthetic accesses and recent infected femoral loop prosthetic leg graft. Physical examination of the right upper extremity revealed a palpable brachial pulse but no palpable wrist pulses. The contralateral extremity had a known subclavian occlusion. As a final attempt for extremity access, the greater saphenous vein from the right leg was harvested endoscopically. The vein was tubularized over a 3-mL syringe with 6-0 Prolene to create the 15-mm by 20-cm spiral graft. The graft was tunneled superficially in the right upper arm. After heparinization, the graft was anastomosed to the brachial artery and axillary vein. At the postoperative visit, the graft was occluded. The patient remained catheter dependent and died 1 year later from catheter-related sepsis.

All patients underwent the procedure under general anesthesia. No perioperative morbidity or mortality was observed other than early graft failure in patient 4.

## DISCUSSION

The helix fistula represents a new class of autogenous access that offers some theoretical advantages: it uses vein that would otherwise remain unused; there is no maturation phase; cannulation is easy (having a large preformed diameter and superficial forearm location); and it is infection resistant. Theoretical disadvantages include

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Fig 1. Intraoperative photograph of the completed helix fistula.

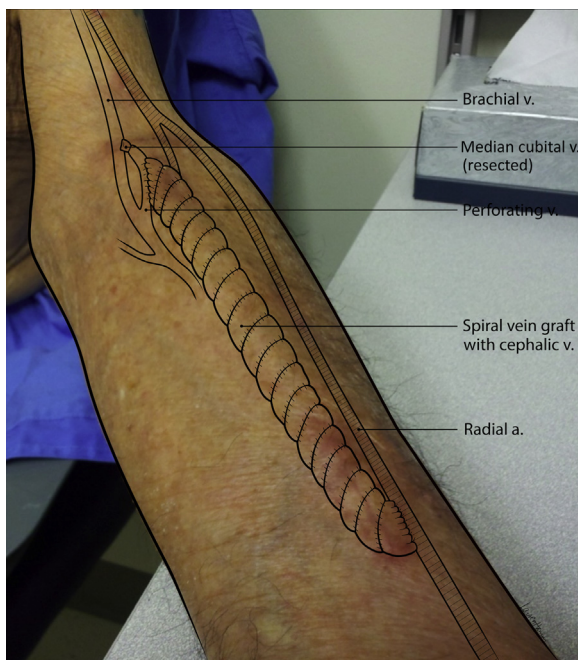


Fig 2. Photograph of the helix fistula 6 weeks postoperatively. Illustration of the underlying anatomy is overlaid on the photograph to highlight the structure and configuration of the fistula.

that it is labor and time intensive, with potentially increased exposure to anesthetic risk; the inability to positively remodel (spirally constrained by the suture line, it may not grow larger like a traditional fistula); and the possibility of pseudoaneurysmal degeneration with repeated use.

**Procedure length.** The case times for patients 1 to 4 were long at 4, 7, 8, and 6 hours, respectively. Inversion venectomy is slower but results in a smaller incision profile.

**Durability.** The chief concern was stability of the graft with repeated needle puncture, fearing suture failure and pseudoaneurysm formation. Additional observations are warranted, but no issues with durability were observed at 3.4 years.

**Intimal hyperplasia.** In patient 3, an early intimal hyperplastic response was observed, necessitating frequent angioplasty. Response to angioplasty has been favorable without need for high-pressure balloons. The other patients did not have this issue.

**Outflow.** In patient 2, the antecubital vein appeared to be a suitable outflow based on the redundancy of veins connected to this. This led to ultimate demise of the graft. In patient 3, brachial vein performed well.

**Tunneling.** In patient 4, it was challenging to tunnel the graft up to a superficial level and deep to the vessels in her obese upper arm; excessive angulation or tension likely caused failure. Straight forearm graft tunneling is favorable.

**Patient satisfaction.** Patients and providers were pleased with an autogenous conduit that was immediately mature and easily accessible by the dialysis technicians.

## CONCLUSIONS

The helix fistula represents a new class of autogenous hemodialysis access. Patients should be excluded if any other type of conventional autogenous access is available. Alternative bioprosthetic conduits should also be considered.<sup>4</sup> Patients with small veins and a desire to avoid prosthetic may be offered a helix fistula, taking into consideration the extra operative labor involved. The patient should possess a level of fitness suitable to endure a longer procedure and predicted life span long enough to benefit from autogenous access. If a helix fistula is to be constructed, it should be delayed until just before the need for dialysis. Forearm radial artery to brachial vein is an optimal configuration. The grafts in this limited experience were found to be safe and stable with no sign of pseudoaneurysmal degeneration but are subject to intimal hyperplasia that threatens their patency. The helix fistula may be a useful option whose optimal technical aspects remain to be fully explored. More experience is needed to assess objective advantages over prosthetic grafts.

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