# VASCULAR AND ENDOVASCULAR TECHNIQUES

**Thomas L. Forbes, MD, Section Editor**

# Superficialization of arteriovenous fistulae employing minimally invasive liposuction

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**Superficialization of arteriovenous fistulae allows for improved dialysis access allowing for prolonged utilization and more efficient dialysis treatment. Multiple methods are described for superficializing arteriovenous fistulae, and minimizing the surgical intervention is advantageous for patient recovery and potentially improved outcomes. We describe a novel technique of superficialization of an upper extremity arteriovenous fistula employing ultrasound-guided liposuction. This article describes the suction lipectomy technique and the tools necessary for superficialization of an upper extremity arteriovenous fistula. (J Vasc Surg 2010;52:1397-400.)**

Arteriovenous fistulae are commonly performed vascular access procedures for patients in need of current or future dialysis. Once the arteriovenous fistula is created, maturation is necessary prior to access attempts. In obese patients or those with deep veins, superficialization is often necessary to facilitate the repeated cannulation required for dialysis. Liposuction is one of the most promising techniques for superficialization of fistulae of the many that have been described, because it is minimally invasive and allows for shorter recovery with theoretically improved arteriovenous fistula patency rates secondary to decreased surgical intervention.[1] We present the case of a 61-year-old obese female with an upper extremity arteriovenous fistula that matured properly based on palpable thrill and ultrasound findings (increased diameter from 2.9 mm to 9.1 mm), however, the dialysis center staff were not comfortable accessing the vein, as it was believed to be too deep. We describe our liposuction technique, performed under ultrasound guidance in conjunction with our plastic surgeons, enabling superficialization of her arteriovenous fistula facilitating easier postoperative access. In this report, we describe various techniques of arteriovenous fistula superficialization, a review of the literature regarding minimally invasive superficialization, and a technical description of our technique.

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We describe the case of a 61-year-old woman with a history of a left upper extremity brachiocephalic fistula that had matured based on physical examination and ultrasound findings but was difficult to access secondary to its deep location and abundant overlying adipose tissue. A superficialization of the fistula was necessary for the dialysis center staff to adequately access the fistula. A plan for liposuction was employed for the superficialization. After intubation and preoperative prophylactic antibiotics, ultrasound was used to confirm the location and mark the overlying tissue above the arteriovenous fistula in the left upper extremity. Under ultrasound guidance, an 18-gauge needle was inserted into the subcutaneous tissues above the fistula and tumescent anesthesia was employed utilizing the Kline pump (HK Surgical, Inc, San Clemente, Calif) using 50 mL of 1% lidocaine with 1:100,000 units of epinephrine in a bag of 950 cc of normal saline. After infiltration of approximately 50 mL of anesthesia, a stab incision was made 1 cm above the anticubital fossa (Fig 1). A 2-mm Coleman Aspiration cannula (Byron Inc., Tucson, Ariz) attached to a 30-mL syringe was inserted and under ultrasound guidance, the overlying subcutaneous fat was aspirated in a radial fashion above the arteriovenous fistula. The subcutaneous adipose tissue was thinned so that the fistula was easily palpable and visible pulsations were noted after 50 mL of lipoaspirate. A completion ultrasound of the arteriovenous fistula was performed and no injury, pseudoaneurysm, or extravasation was noted. The puncture incision was closed with a single horizontal mattress suture, bandaged, and the arm wrapped in a 6-inch pressure bandage. At 1-week follow-up, the incision was healing appropriately and ultrasound was used to document a decreased fistula depth (Fig 2). Postprocedurally, the fistula had adequate superficialization at 4 weeks and was successfully accessed for dialysis at 3 months.

## DISCUSSION

Superficialization of arteriovenous fistulae is a well-described technique to facilitate cannulation of deep and

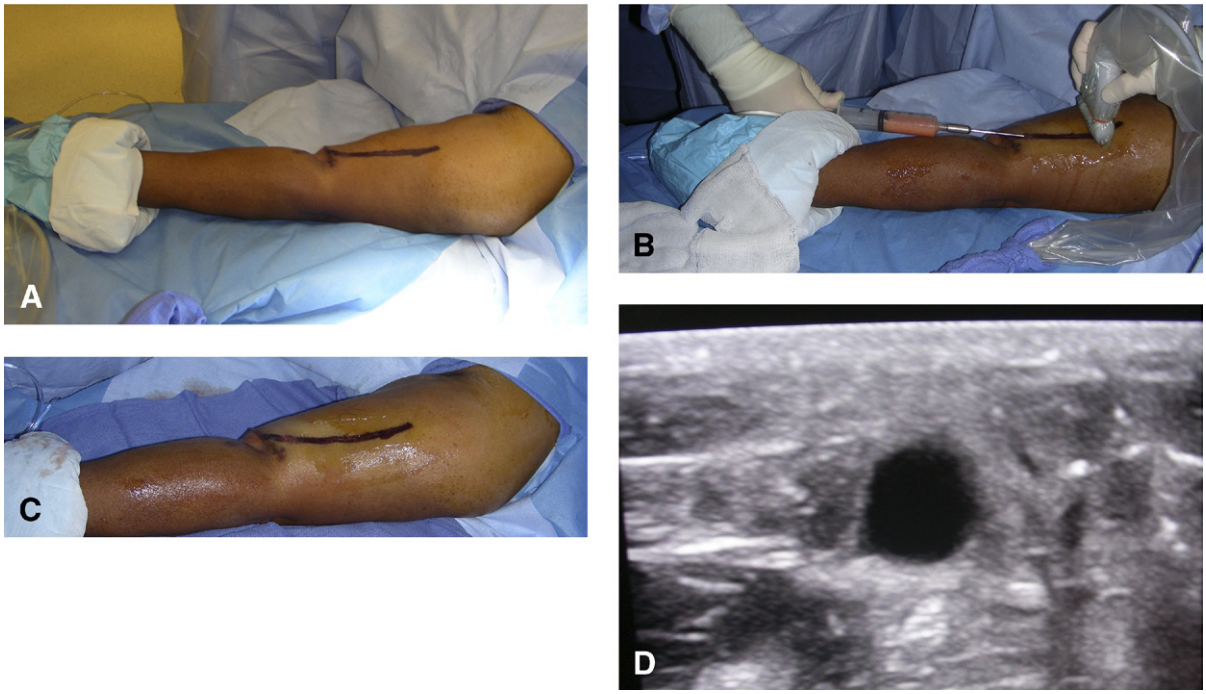


**Fig 1.** Technical description of upper extremity liposuction superficialization. Step 1 **(A)**: Identify the arteriovenous fistula using B mode duplex and mark the overlying skin. Step 2: Perform subcutaneous tumescence using 30-50 mL of 1% lidocaine with 1:100,000 units of epinephrine in a bag of lactated Ringer's solution (*to ensure 2-cm distance between the fistula and overlying skin*). After infiltration of appropriate tumescence, wait 5 minutes for epinephrine-induced vasoconstriction. Step 3: Create a stab incision 1 cm proximal to the anticubital fossa. Step 4 **(B)**: Insert the 2-mm adipose suction cannula under ultrasound guidance performing the suction lipectomy in a radial fashion above the arteriovenous fistula. Step 5 **(C)**: After thinning the tissue (*to the point where the fistula is easily palpable and visible pulsations are noted*), examine the fistula under ultrasound using B mode to ensure no injury, pseudoaneurysm, or extravasation and spectral duplex to ensure adequate flow through the fistula **(D)**. Step 6: Close the small incision and wrap the upper arm with a 6-inch pressure bandage, having the patient remove the bandage on postoperative day number 2 (**E**, *video*).

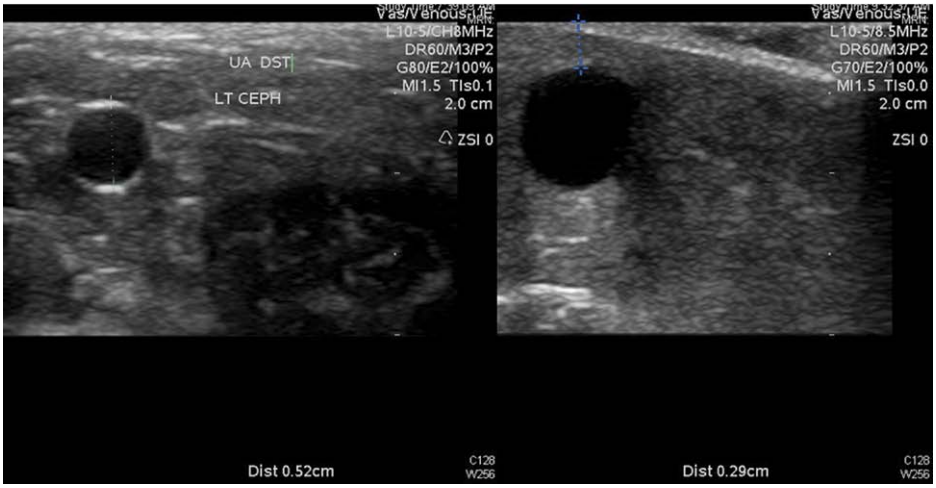


**Fig 2.** Differences in depth of arteriovenous fistula before and after suction lipectomy. Ultrasound images are before on the left and after on the right at the same level.

difficult-to-access fistulae. Superficialization typically requires dissection of the entire vein in order to allow for ready dialysis access and avoid fistula failure.[2,3] Over the past several years, procedures have been described that minimize the surgical intervention necessary for superficialization of arteriovenous fistulae and that speed recovery.[4,5] An example of currently described techniques for minimally superficializing fistulae is surgical lipectomy.[6,7]

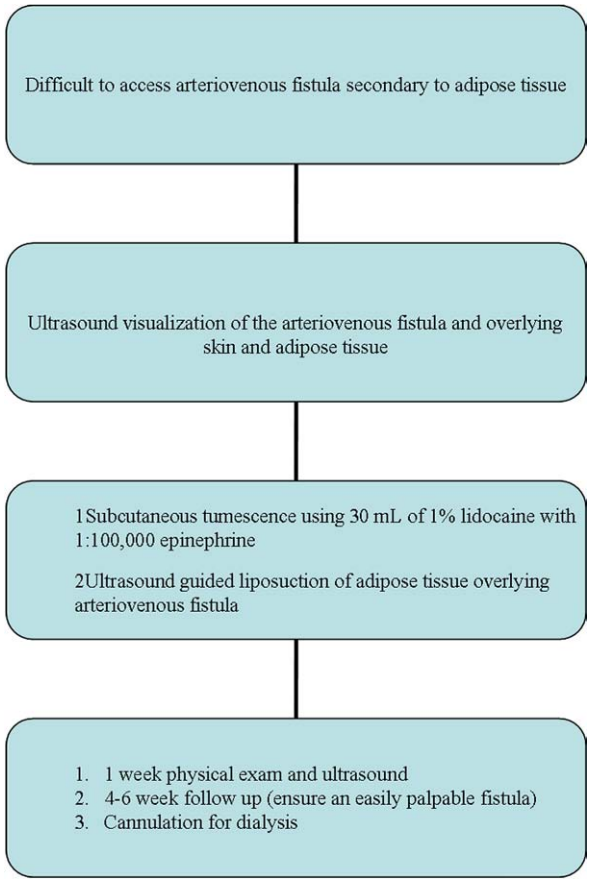


**Fig 3.** Algorithm for overall management of patients deemed candidates for liposuction superficialization of upper extremity arteriovenous fistulae.

Elevation and tunneled transposition is the most commonly used method of superficialization to allow for easier cannulation during dialysis. This technique may be associated with increased wound infection and fistula occlusion due to the length of the surgical incision and manipulation of the conduit. Other minimally invasive techniques such as lipectomy are being described in an effort to minimize these complications.[8] Open lipectomy is a recently described technique in forearm fistulae and a recent study of 49 consecutive patients who underwent second-stage lipectomy found a 96% success rate and 94% clinical utilization for dialysis.[8] In this group of patients, cannulation was first allowed 1 month following open lipectomy and the mean vein diameter increased from 6 to 8 mm, as measured using ultrasound. At 1 and 3 years, primary patency rates were 71% and 63% and a secondary patency rate of 98% and 88%.[8] Again, all patients required two incisions for this technique to be successful.

Open lipectomy of the forearm seems to have good patency rates, but suction lipectomy may have even more applicability in upper extremity fistulae, particularly in patients with deep veins and obese arms that make open superficialization a difficult operation. We describe a novel technique that can be performed under conscious sedation employing small incisions and continuous ultrasound monitoring for safety. The procedure is performed in conjunction with our plastic surgeons and a detailed technical description is shown in Fig 1. The first step in suction lipectomy superficialization is to identify the arteriovenous fistula using B mode duplex and to then mark the overlying skin. Tumescent anesthesia is then administered under ultrasound guidance (30-50 mL of 1% lidocaine with 1:100,000 units of epinephrine in a bag of lactated ringer's solution) between the fistula and overlying skin. Infiltration is complete after adequate turgor is achieved in the target tissue. A short period of time (5 minutes) is allowed for epinephrine induced vasoconstriction to occur and a 2 mm aspiration cannula is then inserted under ultrasound guidance. Continuous aspiration on the syringe is performed with the cannula in constant motion in a radial pattern above the arteriovenous fistula under direct ultrasound guidance. This direct ultrasound mapping and guidance minimizes potential complications, such as injury to the fistula or disruption of small tributary veins. This technique is performed on the overlying adipose tissue until the fistula is easily palpable and/or visible pulsations are noted underneath the skin. After thinning the tissue, the fistula is examined using B-mode duplex to ensure no injury, pseudoaneurysm, or extravasation and spectral duplex to confirm adequate flow through the fistula. A single subcutaneous mattress suture is used to close the incision. Follow-up is then performed routinely at 1 week for physical examination of the incision and fistula. At the same time period, ultrasound may be used for documentation of decreased depth. After 4 to 6 weeks, follow-up is necessary to ensure the fistula has adequate superficialization and is ready for dialysis access (Fig 3).

## CONCLUSION

Arteriovenous fistulae are commonly performed vascular procedures that may be complicated by difficult access secondary to overlying adipose tissue and a deep lying fistula. Liposuction of arm fistulae is a promising area for minimizing surgical intervention and the manipulation of arteriovenous fistulae as is often required with open superficialization. Careful patient selection and routine follow-up is necessary for success and this minimally invasive technique is promising for initial attempts at superficialization of upper arm arteriovenous fistulae.

## REFERENCES

1. Ochoa DA, Mitchell RE, Jennings WC. Liposuction over a shielded arteriovenous fistula for hemodialysis access maturation. J Vasc Access 2010;11:69-71.
2. Beathard GA, Arnold P, Jackson J, Litchfield T. Aggressive treatment of early fistula failure. Kidney Int 2003;64:1487-94.
3. Bhimani B, Asif A. Diagnosis and salvage of an immature fistula. Kidney Int 2007;72:126-30.
4. Collier PE, Saracco GM, Young JC, Fragola JA, Contractor FM, Diamond DL. Nonoperative salvage of subcutaneous hemodialysis fistulae. Am J Nephrol 1985;5:333-7.

5. Falk A. Maintenance and salvage of arteriovenous fistulas. J Vasc Interv Radiol 2006;17:807-13.
6. Roberts C. Saving a brachiocephalic fistula using lipectomy. Nephrol Nurs J 2005;32:331.
7. Beathard GA. Fistula salvage by endovascular therapy. Adv Chronic Kidney Dis 2009;16:339-51.
8. Bourquelot P, Tawakol JB, Gaudric J, Natario A, Franco G, Turmel-Rodrigues L, et al. Lipectomy as a new approach to secondary procedure superficialization of direct autogenous forearm radial-cephalic arteriovenous accesses for hemodialysis. J Vasc Surg 2009;50:369-74, e361.

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