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# Liposuction for Superficialization of Deep Hemodialysis Vascular Access: A Novel Application

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**Background:** More than 65% of patients with end-stage renal disease (ESRD) use arteriovenous fistulas (AVFs) for hemodialysis. The increasing incidence of comorbid ESRD and obesity (body mass index, >35 kg/m$^2$) precludes patients from kidney transplantation, resulting in a need for long-term, durable AVF access. Compared with traditional superficialization techniques for overlying adiposity, liposuction is minimally invasive and well-tolerated, allowing for earlier fistula use with lower complications. We present the detailed surgical technique for superficialization of AVFs using liposuction.

**Methods:** Fourteen patients with well-matured but difficult-access fistulas due to adiposity were selected. Preoperative ultrasound mapped depth of fistulas. Tumescent liposuction was completed in a cross-hatched manner. Intraoperative ultrasound confirmed cannula positioning and measured fistula depth. A palpable thrill remained throughout superficialization. Cannulation began 4 weeks postoperatively.

**Results:** Mean access depth preoperatively was 10.8 mm (8–15 mm), immediately postoperative was 7 mm (6–9 mm), and at 4 weeks was 5.3 mm (4–8 mm). The average usable access length was 12.7 cm (10–15 cm) after surgery. Thirteen fistulas were successfully accessed after liposuction superficialization. All patients were discharged home the same day. There were no postoperative infections or hemorrhage.

**Conclusions:** Early experience with liposuction for superficialization of deep hemodialysis access is promising. This innovative solution has the possibility to improve outcomes and quality of life for patients living with ESRD and obesity. Our experience shows that this is a safe and effective technique to increase patient eligibility, enable successful and early cannulation, and decrease recovery time.
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## INTRODUCTION

Obesity is becoming more prevalent in nearly every country. In the population with end-stage renal disease, the prevalence of obesity is higher than that in the general population, where a body mass index of greater than 35 kg/m$^2$ unfortunately precludes patients from renal transplantation.[1–4] Disqualification from transplantation, combined with the fact that patients with obesity have an increased survival on hemodialysis, results in a growing population that requires long-term hemodialysis, and ultimately, functional vascular access. It is common in patients with obesity for an arteriovenous fistula (AVF) or arteriovenous graft to develop well after its creation, which is unable to be cannulated because it is too deep from the surface due to a thick layer of overlying adipose tissue. To address this, the access can be rendered functional by a superficialization procedure that brings the vessel closer to the skin, which is defined by less than 6 mm from the surface according to

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the guidelines.[5] There are 3 types of superficialization procedures: surgical elevation with or without transposition of the vein, lipectomy, and liposuction.

Of these 3 techniques, liposuction seems to be the least invasive. Liposuction does not require the long incisions that the other 2 techniques demand, nor does it manipulate the vessel, thus limiting the risk of developing new stenoses that later might threaten access and cannulation. Liposuction is well-tolerated, safe, and effective.[6–11] This is, however, a new technique, and the combined literature published includes fewer than 100 patients, including journal articles, abstracts, and conference presentations.[6–11] At the University of Nebraska Medical Center, we have performed liposuction to superficialize 14 deep, properly developed AVFs and arteriovenous grafts. To the best of our knowledge, our cohort is the largest cohort to date presented in a peer-reviewed article. All the procedures were performed in a hospital-based operation room by 2 attending plastic surgeons (D.A.R. and S.C.F.).

There is a lack of medical literature describing in detail the surgical technique of liposuction for superficialization of deep vascular access, and thus, this article is intended to fill that void. In addition to the surgical technique, we will describe the surgical instruments needed, vacuum used, pressures needed for liposuction, and billing suggestions, as well as the collaboration between interventional nephrology and plastic surgery in patient selection, presurgical vascular access evaluation, planning of the procedure, and postsurgical follow-up.

The outcomes of our cohort have been presented in a separate article and will not be repeated here.[12] This study was approved by the University of Nebraska Medical Center institutional review board, and the authors complied with all the current requirements for ethical conduct.

## MATERIALS AND METHODS

### Patient Selection and Indications

All included patients were referred to plastic surgery after demonstrating failure of access secondary to depth. We consider that liposuction is indicated only in deep, well-developed accesses that have a reasonably good chance of functioning properly for a significant duration of time after superficialization. All accesses should be evaluated with a 2-dimensional ultrasound to document the access depth. To obtain an accurate depth, the ultrasound probe should just touch the patient's skin. By applying excessive pressure to the skin, the access depth can be artificially less than its true depth.

To ensure that the vascular access is well developed, we suggest performing angiograms in all patients before planning liposuction. In our experience, the angiogram uncovered vessel abnormalities that were not detected on ultrasound. Angiograms have the added advantage of mapping possible collaterals that are to be treated before and/or avoided during liposuction. We feel that the patient's life expectancy should be more than 1 year to qualify for liposuction. Finally, to ensure proper access maturation before surgery, liposuction should not be performed sooner than 6 weeks after access creation.

### Takeaways

**Question:** Current arteriovenous fistula superficialization procedures are invasive and risk fistula injury. Is it possible to apply minimally invasive surgical techniques to safely superficialize fistulas and improve hemodialysis access?

**Findings:** Patients with functional, difficult-access fistulas due to adiposity underwent liposuction superficialization. Angiography, ultrasound, and digital pressure mapped fistula anatomy, identified abnormalities, and guided liposuction cannulas. Fistula depth decreased from 10.9 to 5.3 mm and usable length increased from 5 to 12.7 cm.

**Meaning:** Liposuction can safely and effectively extend the usable length of arteriovenous fistulas for a growing patient population in need of long-term, durable dialysis access.

### Surgical Technique

The patient was first anesthetized using different anesthetic techniques including general endotracheal anesthesia, brachial block, and local anesthesia combined with monitored anesthesia care. Five of our patients received perioperative antibiotics within 1 hour of incision time. However, with the current data available, we cannot make a clear indication for the use of prophylactic antibiotics for this procedure. All patients received bilateral sequential compression devices both before and after surgery.

The patient was placed in supine position. The access arm was prepared circumferentially with chlorhexidine and draped in the usual sterile manner. The arm was placed on a padded arm board or on the operative table, depending upon the access location. All arms were preoperatively mapped, and the depth of the vessel was measured using ultrasound in 2-cm intervals (Fig. 1A). Intraoperative ultrasound was also used to measure interval depths.

Collaborative decision-making between the plastic surgeon and the nephrologist is paramount for successful liposuction superficialization of the dialysis access. Physical examination and ultrasound identify which parts of the fistula will require superficialization. Ideally, in a healthy, accessible fistula, the depth will be less than 6 mm from the skin. It is imperative that minimal pressure be placed on the skin when mapping depth, so as to not falsely depreciate the depth of the fistula. A rectangle is marked 2.5 cm to either side of the fistula (Fig. 1A) and will be the zone of liposuction. The fat directly superficial and lateral to the fistula is to be removed (Fig. 1B).

After mapping is completed, the target zone is infiltrated with Klein tumescent solution (1 L normal saline, 1 mg epinephrine, and 50 mL 1% lidocaine).[13] Hand infiltration with an 18-G spinal needle was used to infiltrate the subcutaneous fat in the target zone. This was allowed to instill for 15 minutes.

Stab incisions were made on opposite corners of the target zone to allow for cross-hatching of the liposuction cannulas (Fig. 2A). Pretunneling of the subcutaneous fat was performed with cannulas off suction. Mercedes and spatula-tipped liposuction cannulas were used for liposuction (Fig. 2B, C). Ultrasound was used to ensure that the

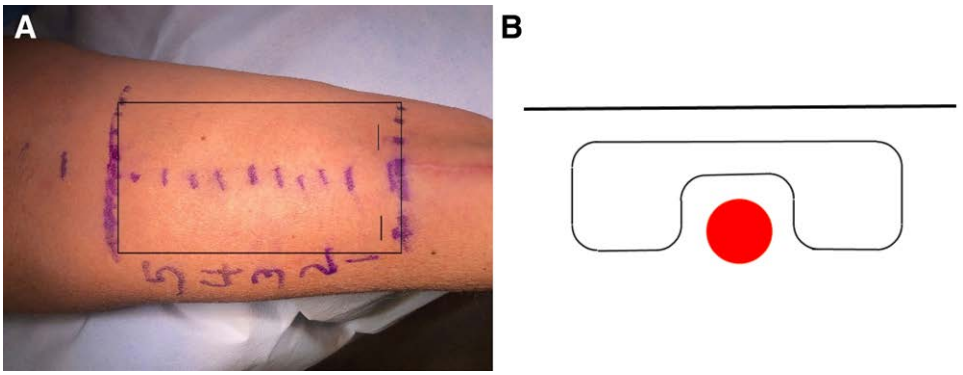


**Fig. 1.** Surgical technique. A, Preoperative ultrasound marking of the fistula in 2-cm intervals with areas 2.5 cm lateral to the fistula marked for treatment. B, Schematic representing the targeted adipose tissue lateral and superficial to the fistula.

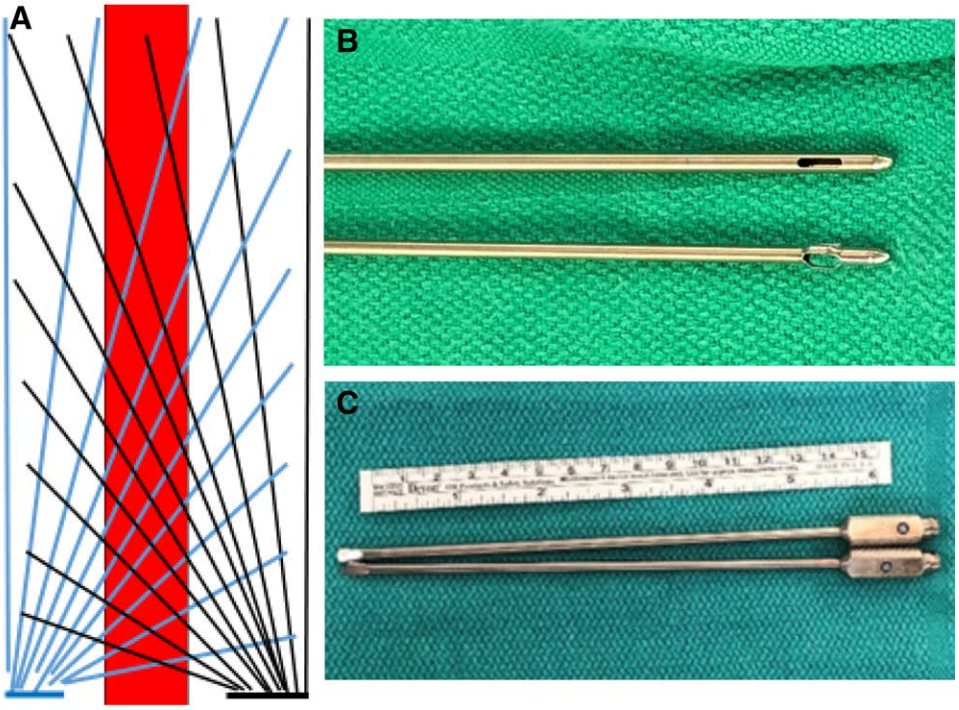


**Fig. 2.** Surgical technique. A, Schematic representing the cross-hatch pattern for liposuction. B, C, Examples of the Mercedes and spatula-tipped cannulas used for liposuction.

liposuction cannula remained above and to the sides of the fistula. The spatula tip was preferred as the suction port could reliably be directed away from the fistula. To further avoid trauma to the access, we suggest maintaining the tip of the cannulas close to the skin. By exerting digital compression on the skin and guiding the direction and passes of the cannulas, we ensure we aspirated the fat above the access but also lateral to the access (Fig. 3).

Frequent ultrasound use was used to measure fistula depth from the skin. Surgery was concluded when the depth of the fistula was less than 8 mm, which we found correlated to a postoperative depth of 6 mm after resorption of tumescent fluid and resolution of postoperative edema and inflammation.

## RESULTS

In our cohort, the mean access depth was 10.8 mm (range, 8–15 mm) preoperatively. Immediate postoperative depth was 7 mm (range, 6–9 mm). Four weeks postoperatively, the mean access depth was 5.3 mm (range, 4–8 mm). A thrill was palpable before and after surgery. Gentle compression was then applied using an elastic bandage wrap to limit edema postoperatively for the first 2 weeks after surgery. Fistulas were allowed to be accessed at 4 weeks postoperatively. The patients were followed up in the clinic by the plastic surgeon to ensure proper healing, as well as at their hemodialysis center by the nephrologist and interventional nephrologist to decide the timing of cannulation.


**Fig. 3.** Liposuction of the target area with digital compression of the overlying skin to ensure proper cannula positioning and directionality, and precise movements. A, Guided liposuction of the target area. B, Preoperative pinch test. C, Postoperative pinch test.

## DISCUSSION

The detailed outcomes of our cohort are presented in a different publication[12]; we summarize our results here to highlight the most common clinical scenarios we encountered. Using our above-mentioned technique, we were successful in 13 of 14 cases. In 11 cases, the primary reason for superficialization was inadequate cannulation length (<5 cm). The remaining cases required superficialization secondary to excessive depth along the entire length of the fistula. Excessive use of short segments of a fistula led to premature fistula failure. Liposuction for superficialization was also able to increase useable length from an average of 5 cm to 12.7 cm (range, 10–15 cm). In short-segment superficialization cases, the short segment still was able to be used throughout the healing process, which prevented the need for placement of temporary hemodialysis catheters. In excessive depth superficialization cases, tunneled dialysis catheters were required for interim access. In 2 cases, the tunneled catheter was able to be successfully removed and dialysis transitioned to the newly superficialized fistula. In the remaining case, the resulting fistula remained too deep for use after liposuction and was also the deepest one in the cohort at 15 mm. This patient continued dialysis through their existing tunneled line.

There were no infections, hemorrhages, or hematomas postoperatively. All patients were discharged home the same day. Only 1 complication occurred, which involved bleeding during surgery, and this was easily controlled with external digital pressure. This patient was still discharged home the same day and gained 6 cm of usable length. In our experience, postoperative pain was moderate and well-controlled with as-needed oxycodone and acetaminophen (billing suggestions: 15878 liposuction upper extremity).

## CONCLUSIONS

Early experience with liposuction for superficialization for deep hemodialysis vascular access is promising. Our preliminary experience indicates that this is a safe and effective technique in select patients. We present our technique for liposuction for superficialization of deep hemodialysis vascular access with the hope it will benefit future patients and extend the life of AVFs.

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## DISCLOSURE

*The authors have no financial interest to declare in relation to the content of this article.*

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