

Fistulas in Challenging Patients: Central Vein Obstruction and Obesity

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Department of Surgery

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Central vein occlusion/stenosis

- 1) Patients with an ***existing AVF*** and ***symptomatic*** CVO/stenosis
- 2) Patients with known CVO/stenosis in ***need of new vascular access*** for dialysis

- Central venous stenosis and occlusion are common problems facing hemodialysis patients.
- These lesions are generally associated with hemodialysis catheters and are more commonly found in patients with multiple catheters, a history of catheter infections, or long-term catheter use.

MacRae JM, Ahmed A, Johnson N, Levin A, Kiaii M. Central vein stenosis: a common problem in patients on hemodialysis. ASAIO J. 2005 Jan-Feb;51(1):77-81.

Agarwal AK, Patel BM, Haddad NJ. Central vein stenosis: a nephrologist's perspective. Semin Dial. 2007 Jan-Feb;20(1):53-62.

- Individuals with central venous occlusive disease with ***a functional AVF may be asymptomatic*** and successfully undergo dialysis on a routine basis with venous outflow provided by multiple collateral vessels.
- Levit, et al. found ***better outcomes*** in those ***asymptomatic*** individuals followed by ***observation*** than those treated by intervention with angioplasty.

Levit RD, Cohen RM, Kwak A, et al. Asymptomatic central venous stenosis in hemodialysis patients. Radiology. 2006 Mar;238(3):1051-6. Epub 2006 Jan 19.

Limited AVF outflow should be matched with limited inflow

- When the **total cross sectional area of draining venous collaterals is insufficient** to handle AVF flow, patients may have **significant symptoms** with swelling and pain in the affected extremity that may extend to the head, neck, and chest wall or breast.
- Stenotic or occluded central veins and ensuing symptoms may lead to ligation of an otherwise well functioning access for some patients.

Symptomatic patients are often treated successfully by central venous angioplasty with or without stent placement..... however the lesions ***tend to recur***, often within a short period, requiring additional procedures.

Stent grafts may occlude important collateral flow, worsening symptoms if the stent fails.

-Agarwal AK. Endovascular interventions for central vein stenosis. Kidney Res Clin Pract. 2015 Dec; 34(4):228-232.

-Oderich GS, Treiman GS, Schneider P, Bhirangi K. Stent placement for treatment of central and peripheral venous obstruction: a long-term multi-institutional experience. J Vasc Surg. 2000 Oct;32(4):760-9.

-Agarwal AK. Central vein stenosis: current concepts. Adv Chronic Kidney Dis. 2009 Sep;16(5): 360-70.

Surgical bypass for a ***symptomatic*** vascular access patient with central venous obstruction is less commonly utilized
..... a ***major*** procedure in these ESRD individuals.

-Suliman A, Greenburg JI, Angle N. Surgical bypass of symptomatic central venous obstruction for arteriovenous fistula salvage in hemodialysis patients. Ann Vasc Surg. 2008 Mar;22(2):203-9.

-Kalra M, Gloviczki P, Andrews JC, et al. Open surgical and endovascular treatment of superior vena cava syndrome caused by nonmalignant disease. J Vasc Surg. 2003 Aug;38(2):215-23.

-Glass C, Maevsky V, Massey T, Illiq K. Subclavian vein to right atrial appendage bypass without sternotomy to maintain arteriovenous access in patients with complete central vein occlusion, a new approach. Ann Vasc Surg. 2009 Jul-Aug;23(4):465-8.

Flow reduction is a simple, minimally invasive option

- **Inflow AVF banding** lowers pressure in the access outflow, restoring or improving inflow-outflow balance while maintaining adequate blood flow for dialysis.... Many techniques...
- Measuring **access flow volume during flow restriction procedures** predicts a successful outcome. In general, the minimum post banding access flow for AVFs should be 400-500 ml/min.

Jennings WC, Miller GA, Coburn MZ, Howard CA, Lawless MA. Vascular access flow reduction for arteriovenous fistula salvage in symptomatic patients with central venous occlusion. J Vasc Access 2012;13(2):157-162.

AVF flow reduction for symptomatic CVO:

- N=22, Ages 22-72 years (mean=43years).
- Nine patients(40.9%) were female
- 8(36.4%) obese.
- Mean access **flow of 1640ml/minute before banding decreased to 820ml/minute after banding** ($p < 0.01$).
- All patients had access salvage.
- Swelling resolved promptly in 20 patients and was markedly improved in two individuals.
- Three patients had aneurysm repair with simultaneous inflow banding and decreased intra-access pressure after flow restriction.
- Two fistulas failed at eight and 13 months.

Jennings WC, Miller GA, Coburn MZ, Howard CA, Lawless MA. Vascular access flow reduction for arteriovenous fistula salvage in symptomatic patients with central venous occlusion. J Vasc Access 2012;13(2):157-162.

Precision banding with operative US access flow measurements

AVF outflow →

Operative access flow measurements with restriction in ½ mm increments is key.

AVF →

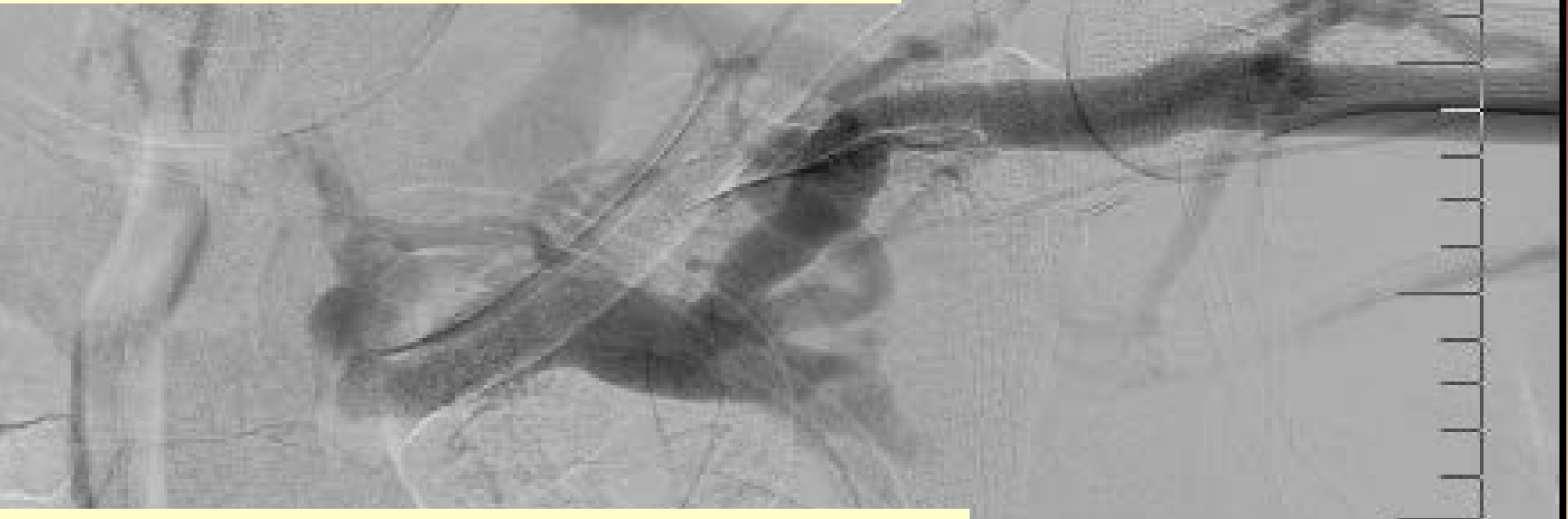
Gkotsis G, Jennings WC, Malik J, Mallios A, Taubman K. Treatment of high flow arteriovenous fistulas after successful renal transplant using a simple precision banding technique. Ann Vas Surg. 2015.

Central vein occlusion/stenosis

- 1) Patients with an ***existing AVF*** and ***symptomatic*** CVO/stenosis
- 2) Patients with known CVO/stenosis in ***need of new vascular access*** for dialysis

Patients with CVO in need of a new access

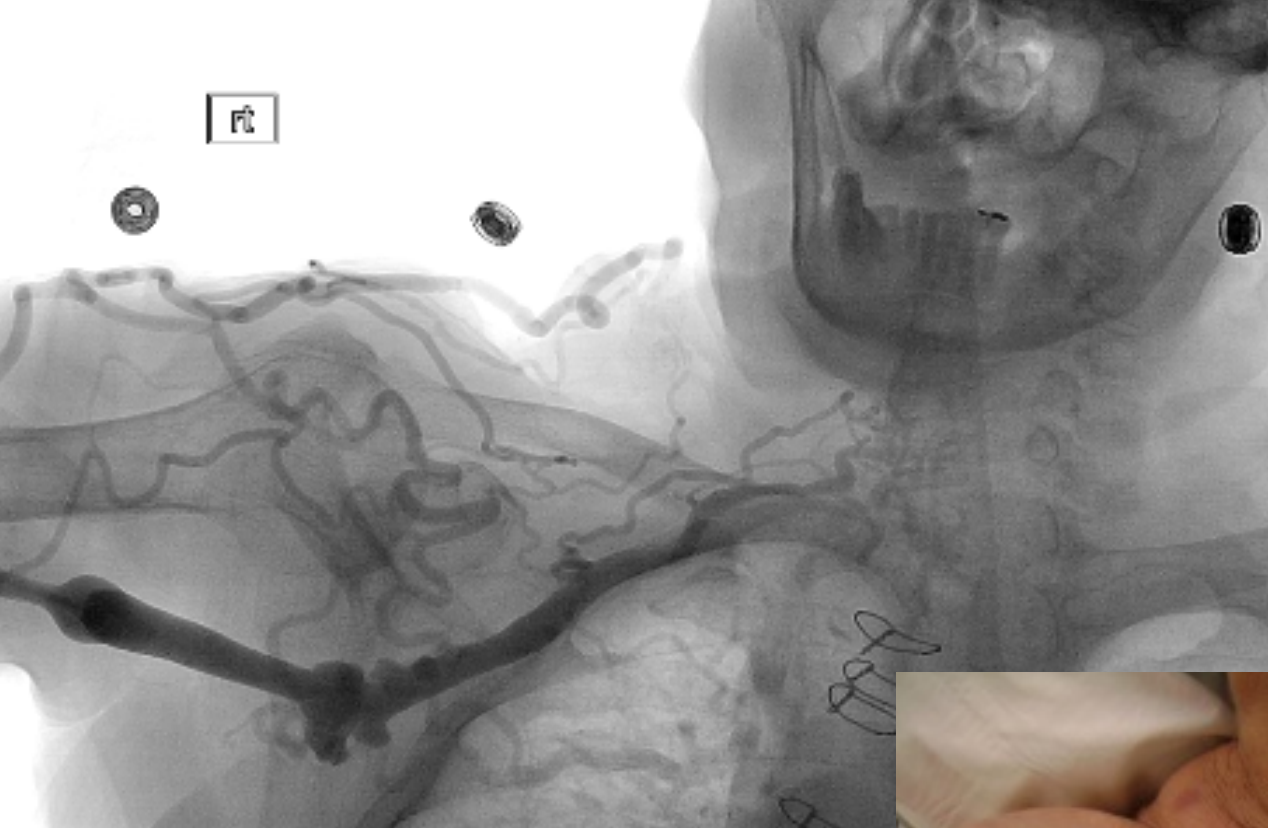
t brachiocephalic vein occlusion



Central venous obstruction(CVO) has been considered a contraindication for creating a vascular access due to fear of developing a swollen extremity.

However, many of these individuals develop large collateral veins and are asymptomatic.





Femoral AVF access?

Thigh AVG?

HeRO catheter?

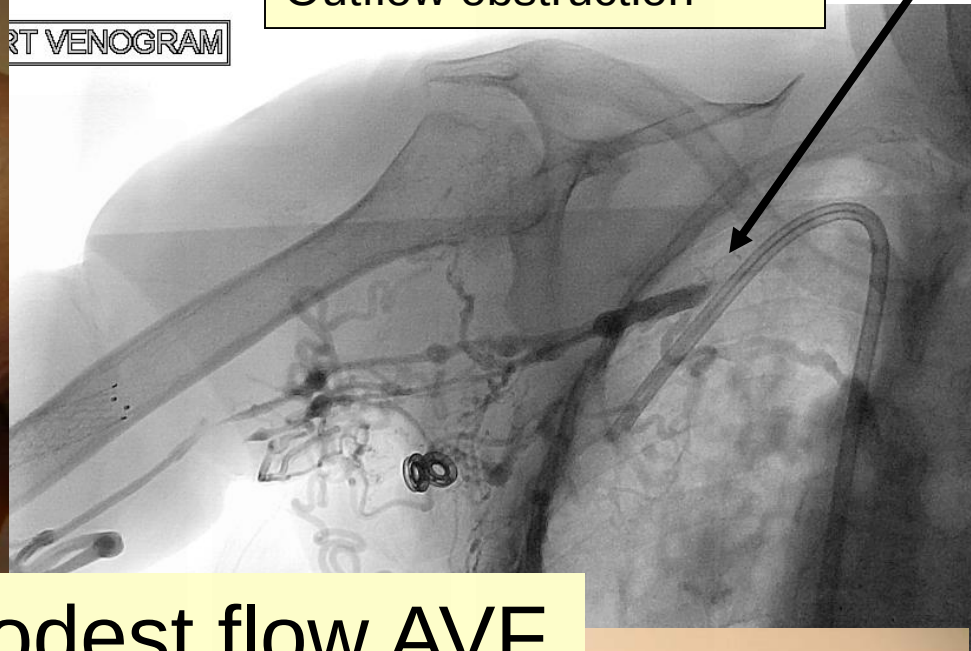
**Is an upper extremity
AVF possible?**





PORT VENOGRAM

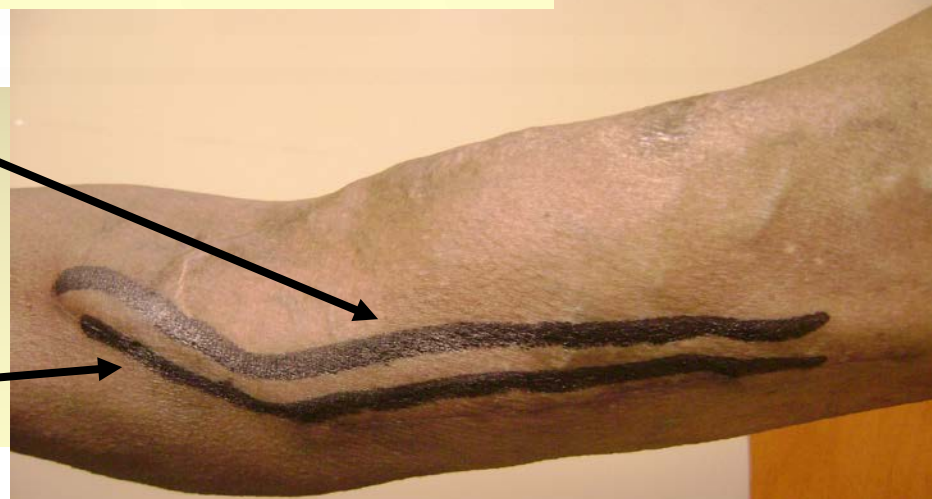
Outflow obstruction



Create a modest flow AVF

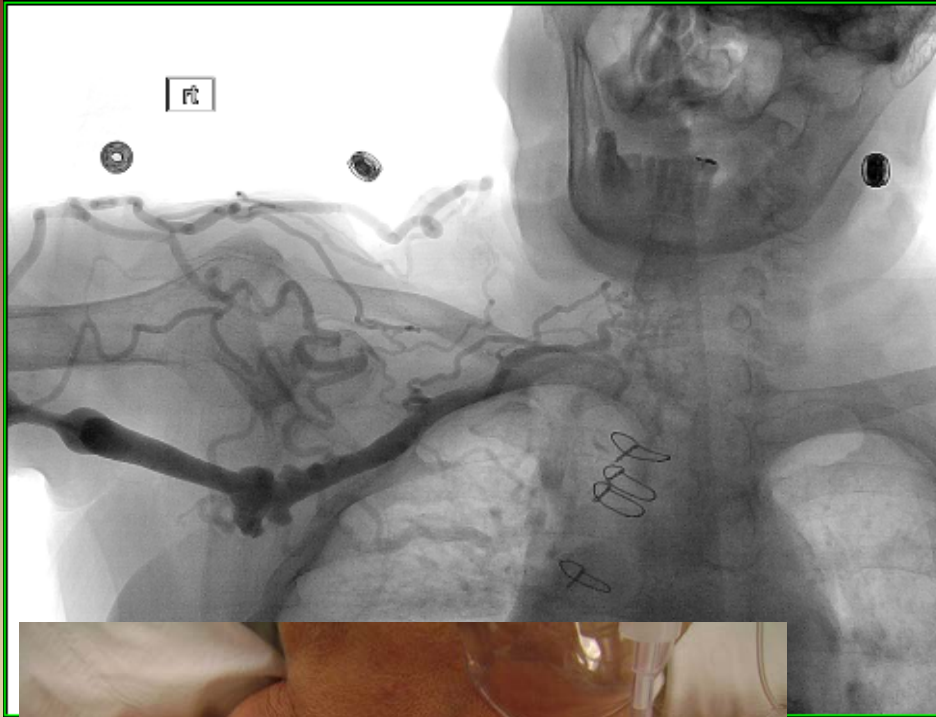
Second stage brachial vein transposition AVF

First stage radial artery-radial vein AVF

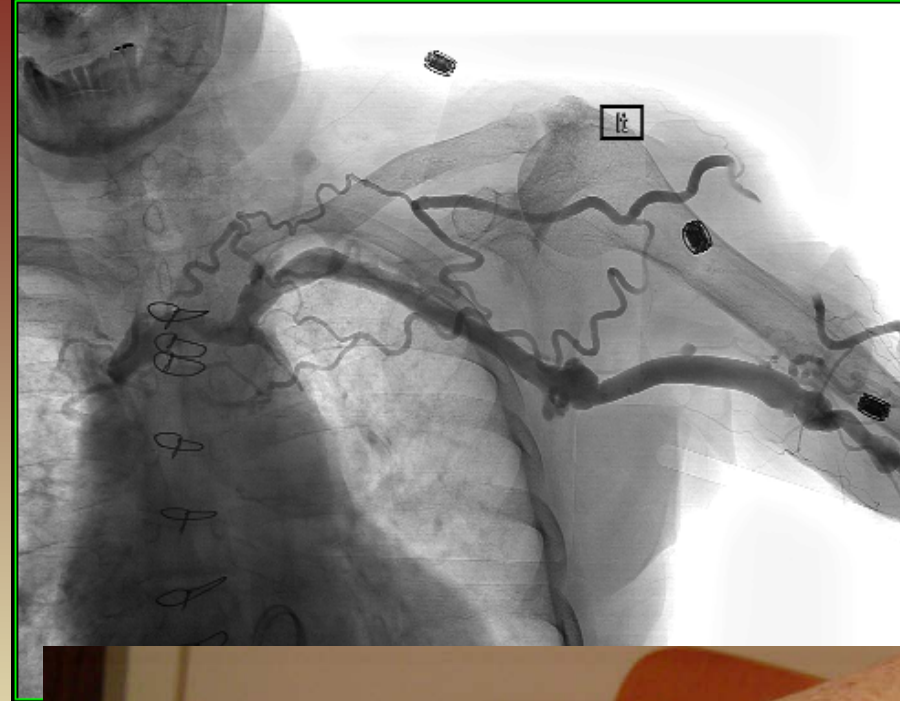


Jennings WC, Taubman KE. Semin Vasc Surg. 2011 Jun;24(2):72-81. Alternative autogenous arteriovenous hemodialysis access options.

Right venogram



Left venogram



PRA-AVF, marked for use

Jennings WC, Maliska III CM, Blebea J, Taubman KE. Creating Arteriovenous Fistulas in Patients with Chronic Central Venous Obstruction. J Vas Access 2016 May 7;17(3):239-42.

Creating Arteriovenous Fistulas in Patients with Chronic Central Venous Obstruction.

Methods:

- Venous imaging **confirmed central obstruction and extensive collateral venous return.**
- The AVF was constructed in the extremity with the most favorable ultrasound vessel mapping and collateral central venous outflow.
- Arterial **inflow via the radial artery** was utilized when possible, creating a **lower flow access.**

Results:

19 patients during an eight year time period.

- Mean age 53 years, 63% were female, and 58% diabetic.
- Arterial inflow was from the radial artery in 15 patients and the brachial or axillary artery in 5 individuals.
- Post-operative AVF flow volumes were 415-910 ml/min (mean=640ml/min).
- Three individuals had previous Hemodialysis Reliable Outflow (HeRO) catheters placed elsewhere. Each had a successful AVF created.

Results:

Eight patients(42%) developed some degree of arm edema. Two resolved without intervention. The others required inflow banding(2), deep outflow branch coiling(1), and recannalization with angioplasty(4) of the CVO. Each resolved.

No AVFs were lost due to arm edema.

Mean follow-up was 14 months.

Two AVFs failed at 8 and 16 months. Primary and cumulative patency rates were 49% and 100% at 12 months and 39% and 80% at 24 months, respectively.

Conclusions: Central venous occlusion need not preclude access loss or the creation of a successful new AVF.

Extensive venous collaterals and avoiding high flow AVFs are important elements for success.

Fistulas in obese patients



- Over 100 million adults in the United States are estimated to have a body mass index (BMI) $> 30 \text{ kg/m}^2$ 35% of the United States' adult population.
- Obesity in the incident ESRD population has also increasedat a rate roughly twice that seen in the total United States population.

<http://www.cdc.gov/obesity/data/adult.html>

Kramer HJ, et al. Increasing body mass index and obesity in the incident ESRD population. J Am Soc Nephrol. 2006 May;17(5):1453-9.

Obesity in the United States

- By 2030 - Total health-care costs attributable to obesity/overweight would double every decade up to \$ 956.9 billion
- At the current rate of increase: By 2048 - all American adults would be overweight or obese

- Wang Y. et al. Will All Americans Become Overweight or Obese? Estimating the Progression and Cost of the US Obesity Epidemic. *Obesity* (2008) 16 10, 2323–2330. doi:10.1038/oby.2008.351

- Hedley AA et al. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA*. 2004 Jun 16;291(23):2847-50.

Obesity makes vascular access more challenging.....

- Fewer AVFs created
- Likely more interventions required
- More complex operations for functional access
- However, ***an autogenous access remains a practical and preferred option when possible.***

-Allon M et al. Factors associated with the prevalence of arteriovenous fistulas in hemodialysis patients in the HEMO Study. *Kidney International* (2000) 58, 2178–2185.

-Kats M. Impact of obesity on arteriovenous fistula outcomes in dialysis patients. *Kidney Int.* 2007 Jan;71(1):39-43.

-Weyed W, et al. Obesity is not an obstacle for successful autogenous arteriovenous fistula creation in haemodialysis. *Nephrol Dial Transplant.* 2008 Apr; 23(4):1318-22. Epub 2007 Oct 23.

- Ironically, the ***common outflow vein*** options in overweight individuals have ***frequently been spared*** repeated vein punctures and intravenous cannulations due to the patient's obesity.
- Although obesity in the USA is associated with worse all cause mortality, Kalantar-Zadeh et al found ***obese dialysis patients had a longer survival rate*** than non-obese dialysis patients.

Kalantar-Zadeh K, Abbott KC, Salahudeen AK, Kilpatrick RD, Horwich TB. Survival advantages of obesity in dialysis patients. Am J Clin Nutr. 2005;81(3):543-554.

Access options in obese patients

- Lipectomy
- Superficialization
- Transposition / Translocation
- Liposuction
- Buttonhole cannulation of short available segments (ultrasound if needed?)
- AV Graft placement

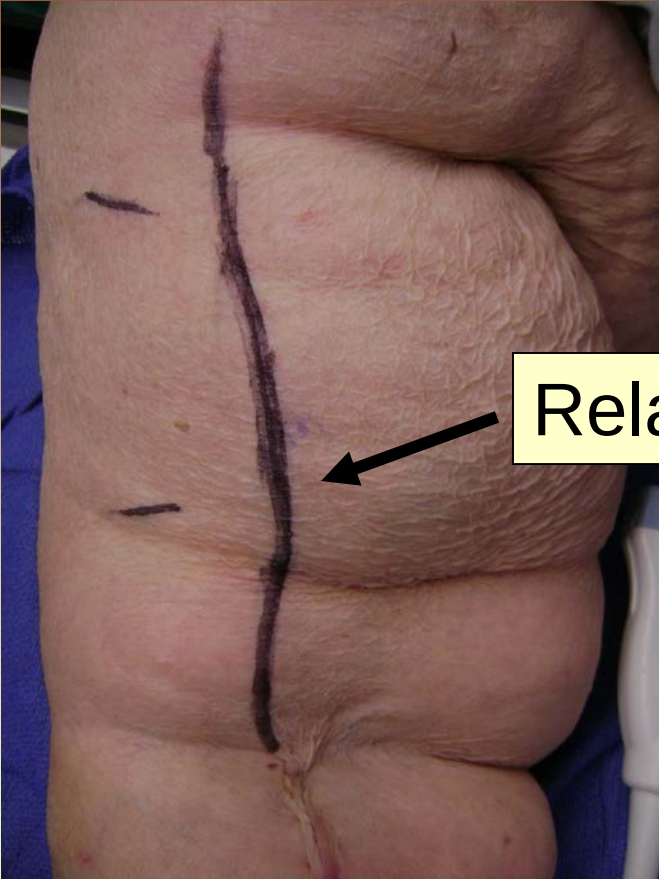
Lipectomy vs Elevation procedures

- *Lipectomy* is preferred when the cephalic vein is a relatively straight conduit.
- *Elevation* is preferred when the outflow vein has not only increased in diameter but has also elongated and become tortuous.

These procedures are most often completed in two stages, approximately 4-6 weeks following primary AVF construction.

Lipectomy in the arm

Barnard KJ, Taubman KE, Jennings WC. Accessible autogenous vascular access for hemodialysis in obese individuals using lipectomy. Am J Surg. 2010 Dec;2010(6):798-802.



Relatively straight, simply too deep

Forearm lipectomy

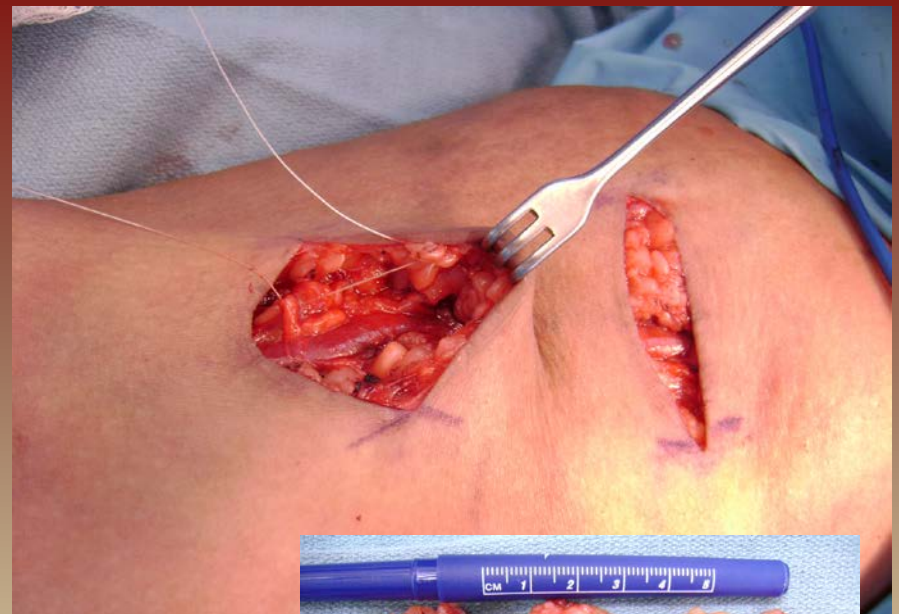
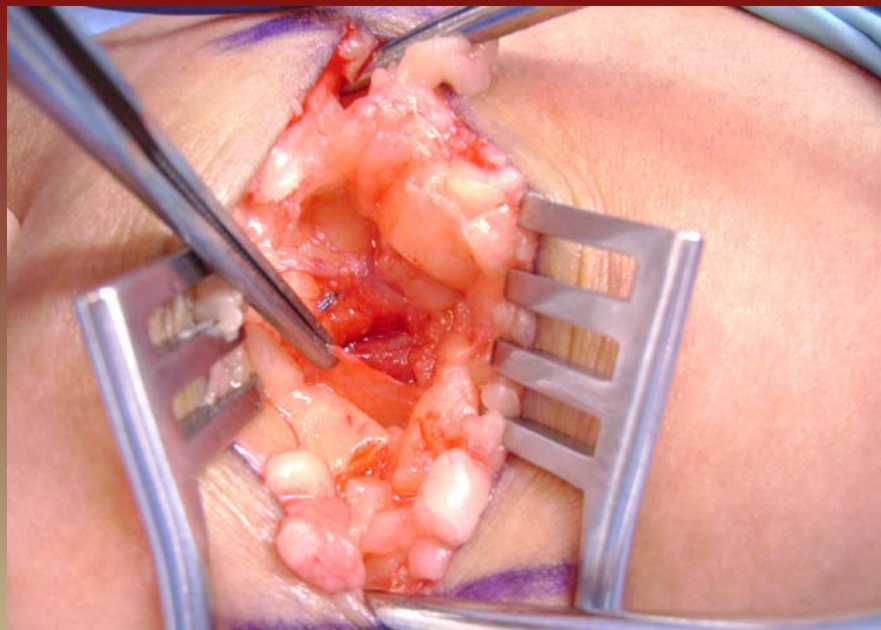
Bourquelot, J. et al. Lipectomy as a new approach to secondary procedure superficialization of direct autogenous forearm radial-cephalic arteriovenous accesses for hemodialysis. Journal of Vascular Surgery. 2009 Aug;50(1):369-74.

Lipectomy

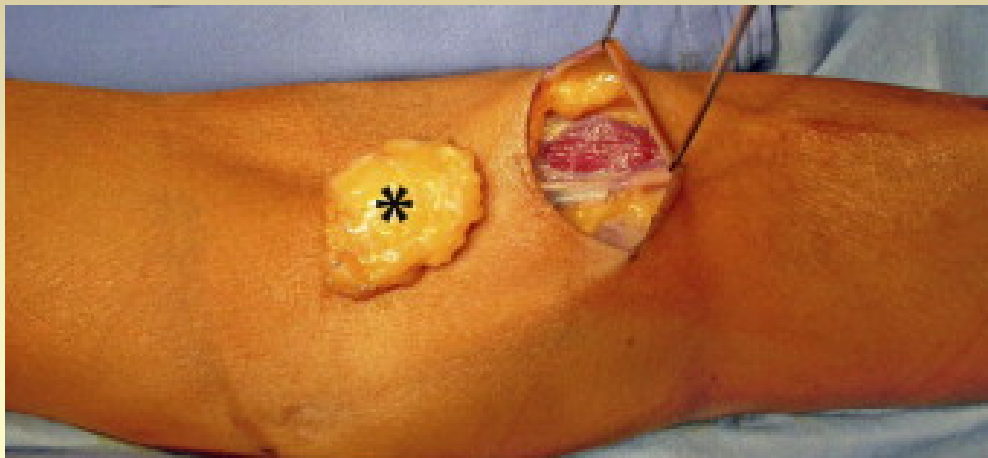
Lipectomy

First stage AVF

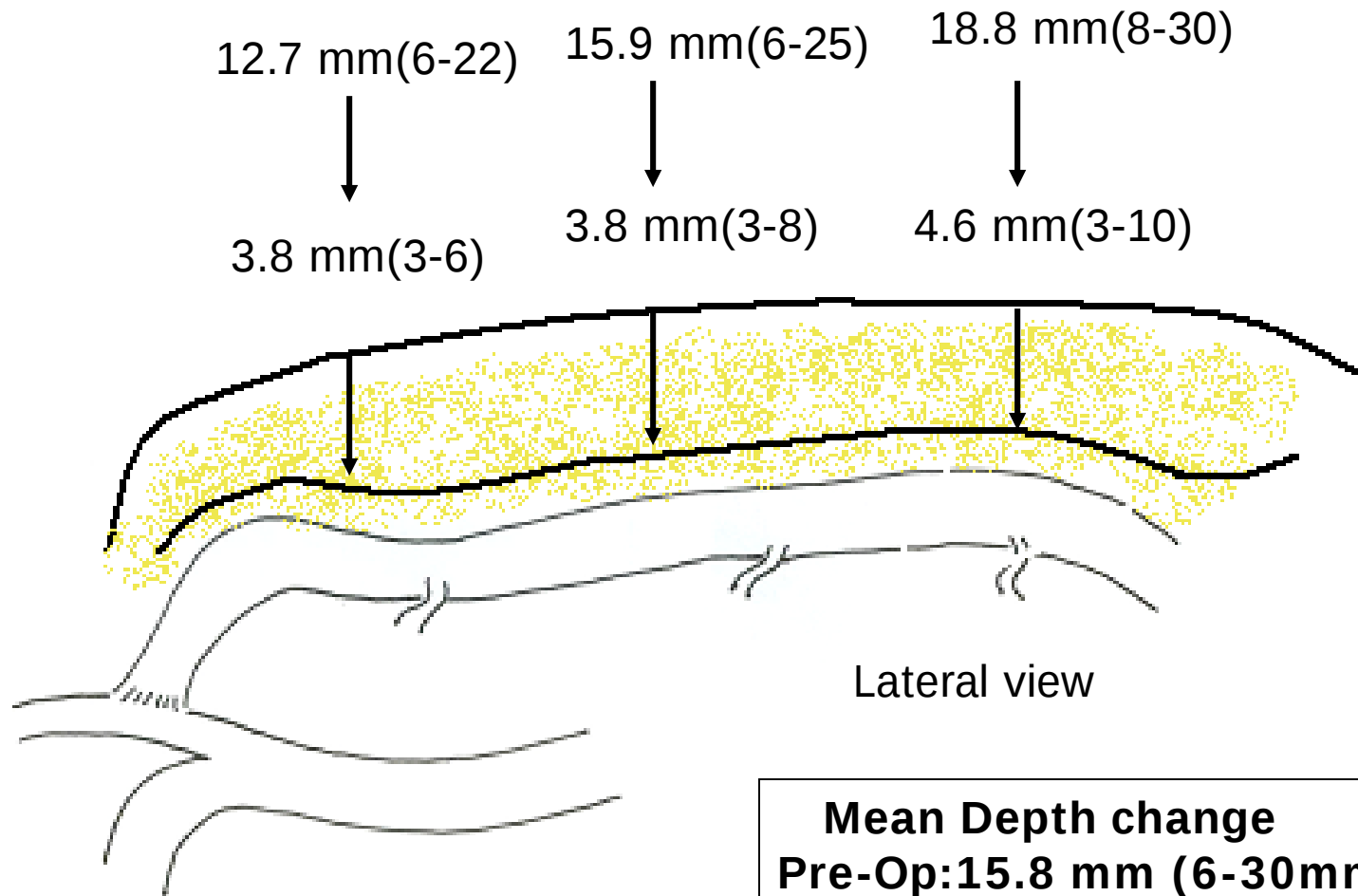
Jennings WC, Mallios A, Blebea J. Upper Extremity Permanent Hemodialysis Access Placement. Darling RC, Ozaki CK. Master Techniques in Surgery: Vascular Surgery: Hybrid, Venous, Dialysis Access, Thoracic Outlet, and Lower Extremity Procedures. Ch.16, p.151-163. Philadelphia: Wolters Kluwer; 2016.



Barnard KJ, Taubman KE, Jennings WC. Accessible autogenous vascular access for hemodialysis in obese individuals using lipectomy. Am J Surg. 2010 Dec;2010(6):798-802.



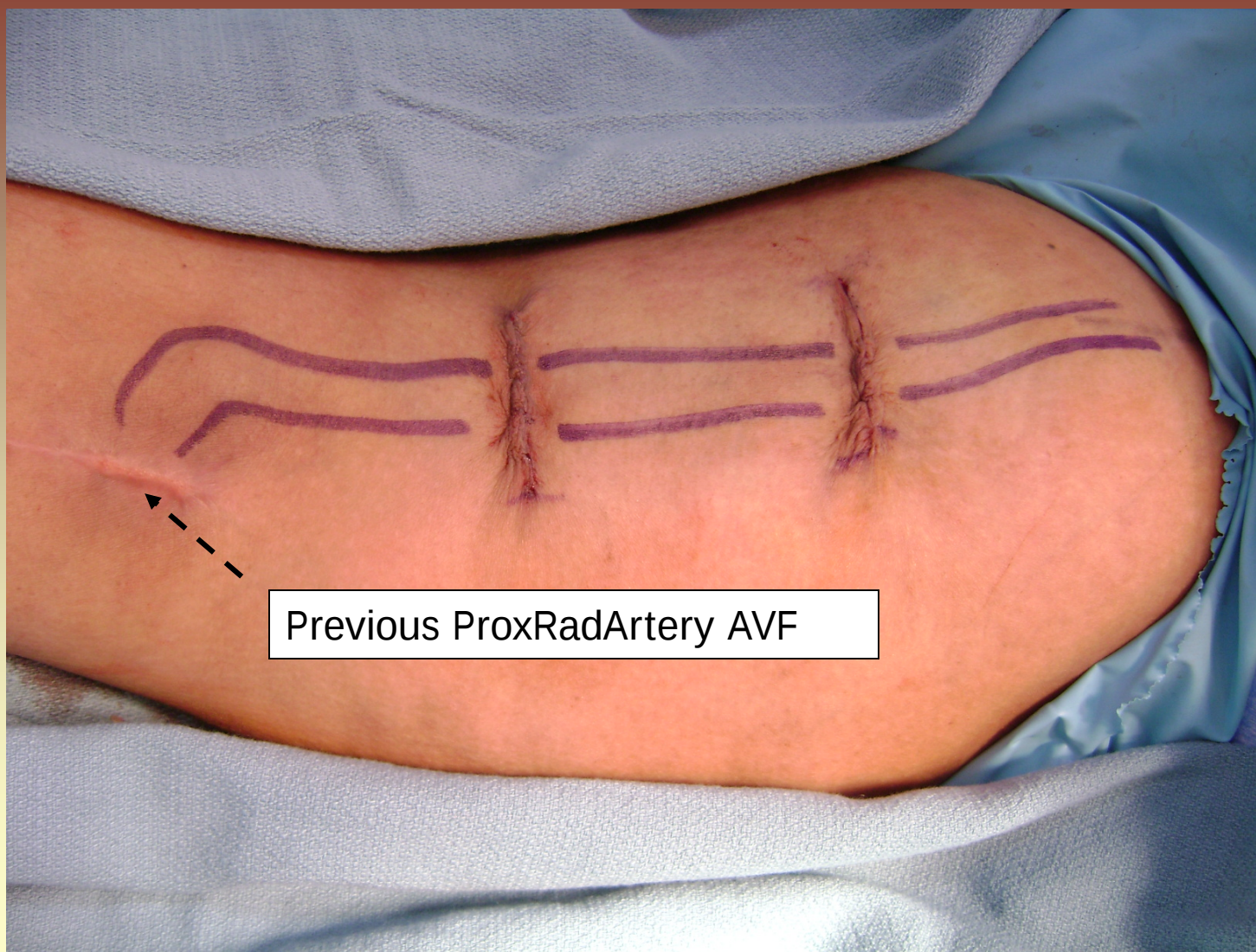
Bourquelot, J. et al. Lipectomy as a new approach to secondary procedure superficialization of direct autogenous forearm radial-cephalic arteriovenous accesses for hemodialysis. Journal of Vascular Surgery. 2009 Aug;50(1):369-74.



Lateral view

Mean Depth change
Pre-Op: 15.8 mm (6-30mm)
Pos-Op: 4.1 mm (3-8 mm)
(P ≤ 0.01)

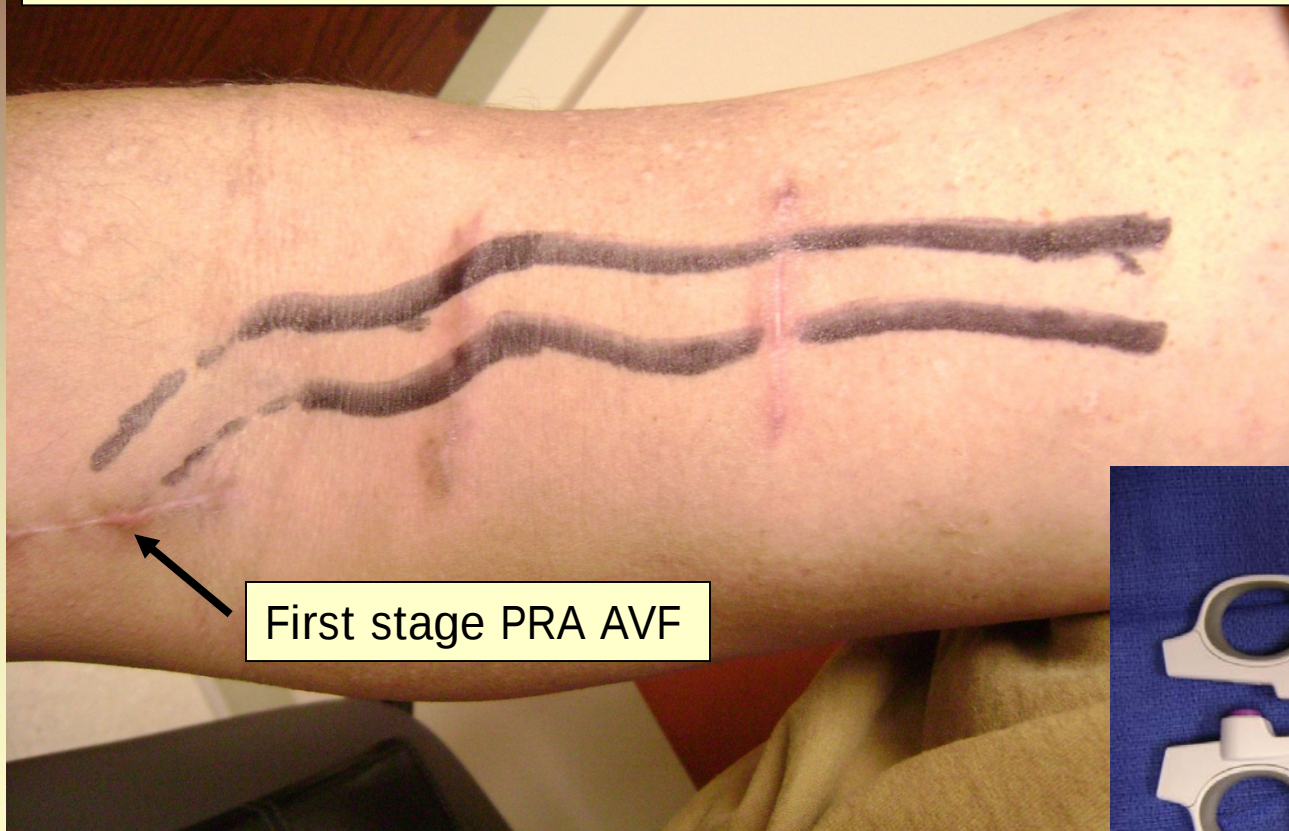
Barnard KJ, Taubman KE, Jennings WC. Accessible autogenous vascular access for hemodialysis in obese individuals using lipectomy. Am J Surg. 2010 Dec;2010(6):798-802.



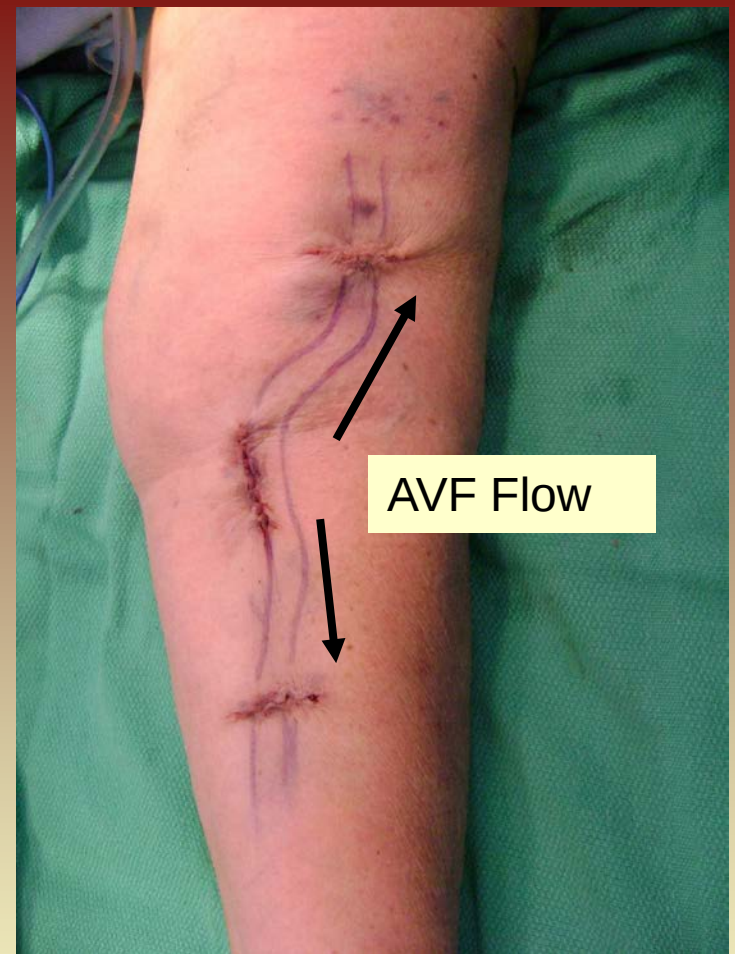
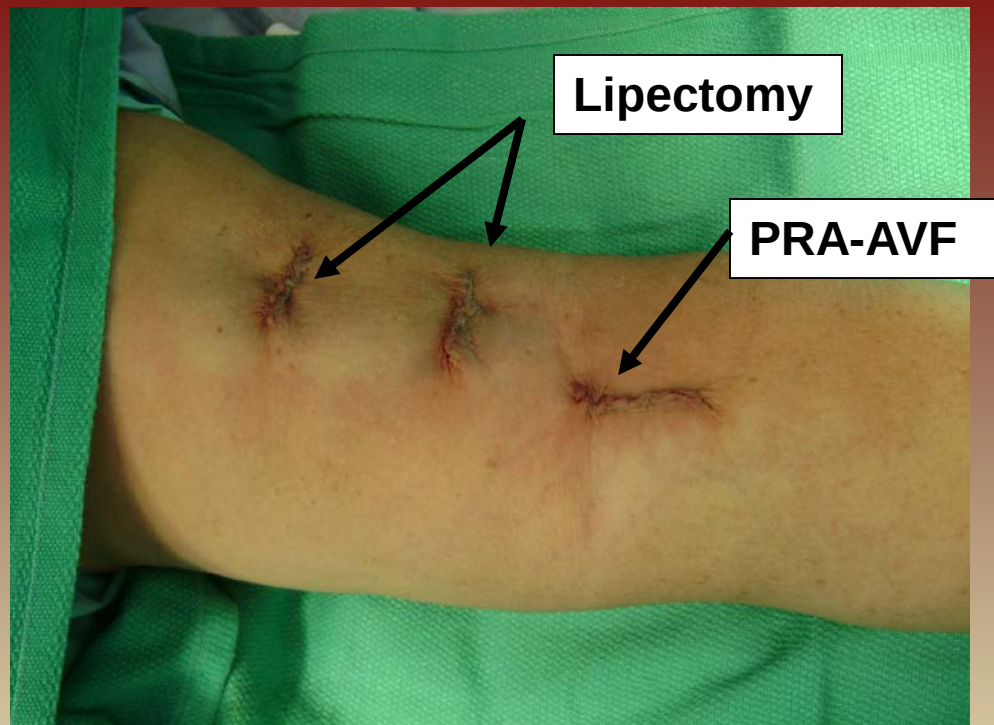
Previous ProxRadArtery AVF

Mature AVF after lipectomy and prior
to first dialysis.

Marked for initial cannulation



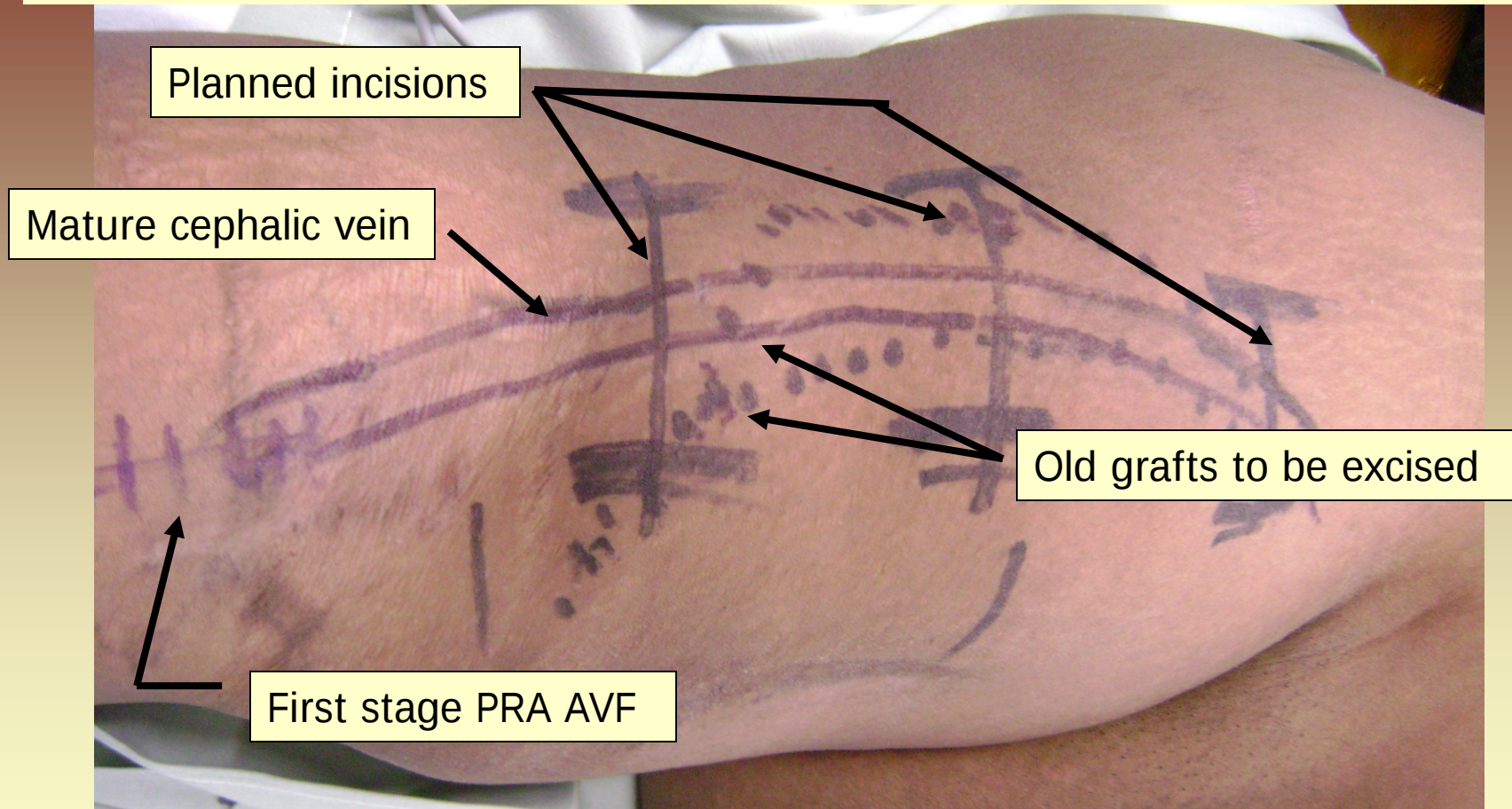
Covidien



Lipectomy with PRA-AVFs as a single stage procedure..... uncommon!

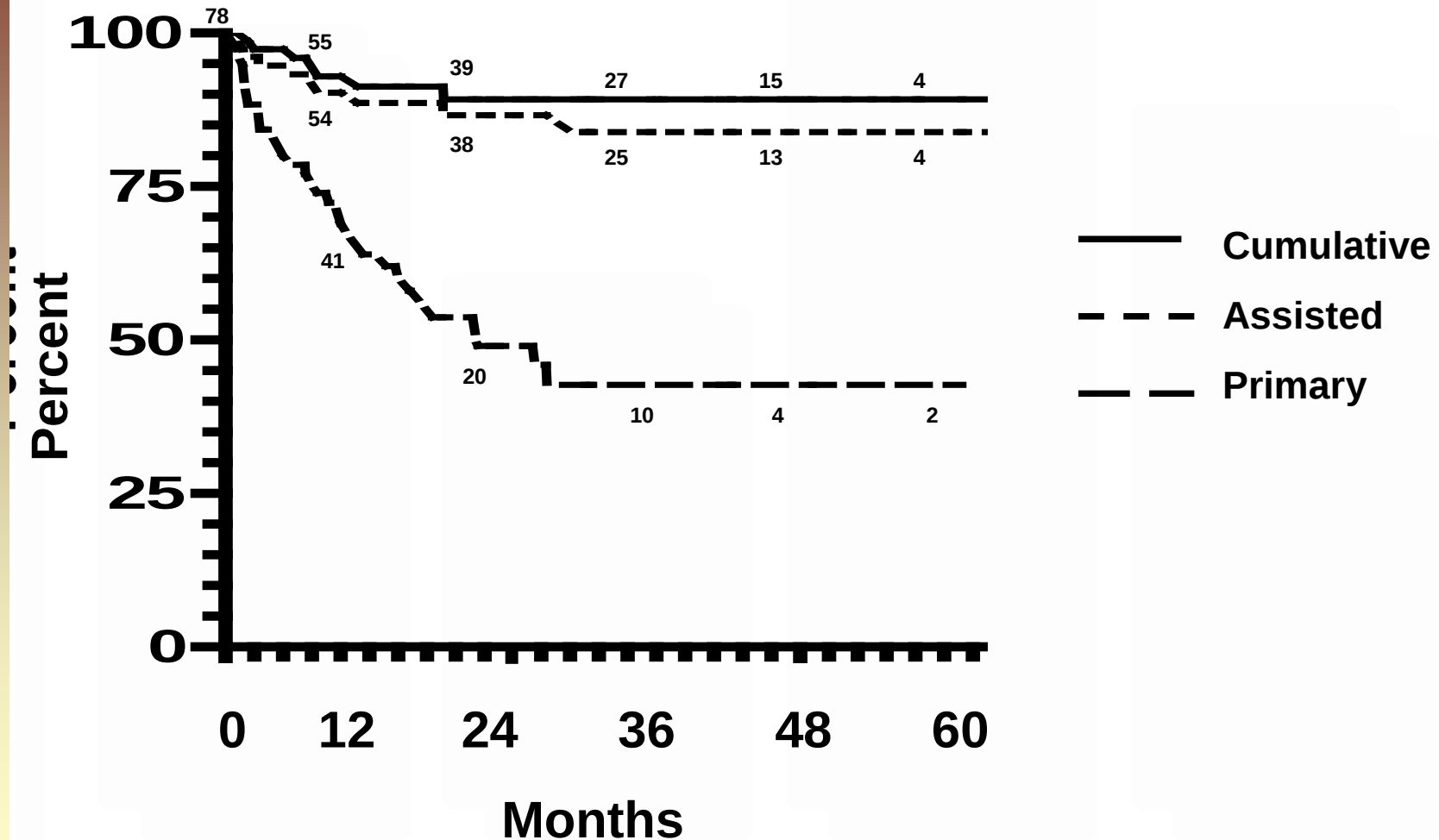
When the cephalic vein is $\geq 6\text{mm}$.

Failed AVGs with new deep AVF: Excision grafts + lipectomy



(Your US exam shows these options!)

AVF Lipectomy Patency



Maliska III CM, Jennings WC, Mallios A. When Arteriovenous Fistulas are Too Deep: Options in Obese Individuals. 2015 JAmCollSurg 2015. Dec;221(6):1067-72.



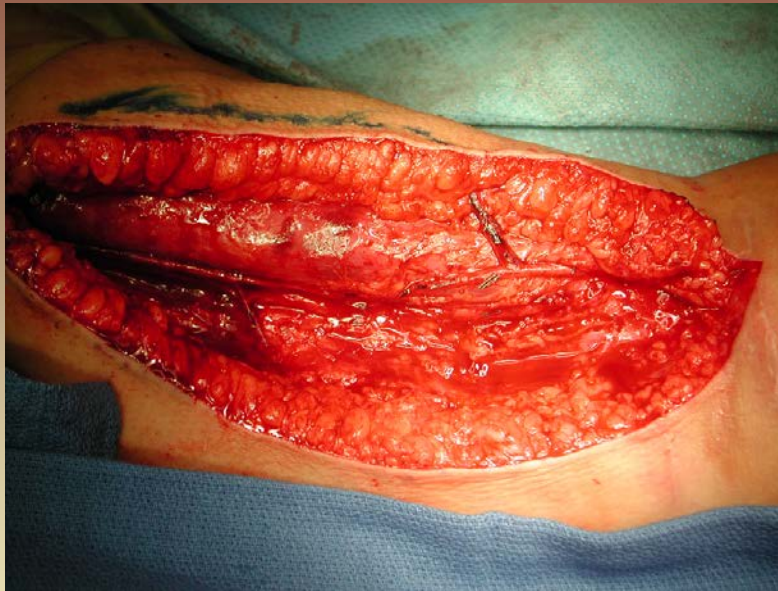
Elongated and tortuous



Elevation

Fistula Elevation Procedure: Experience with 295 Consecutive Cases During a 7-Year Period Bronder CM, Cull DL, Kuper SG, et al. J Am Coll Surg 2008;206:1069–1075.

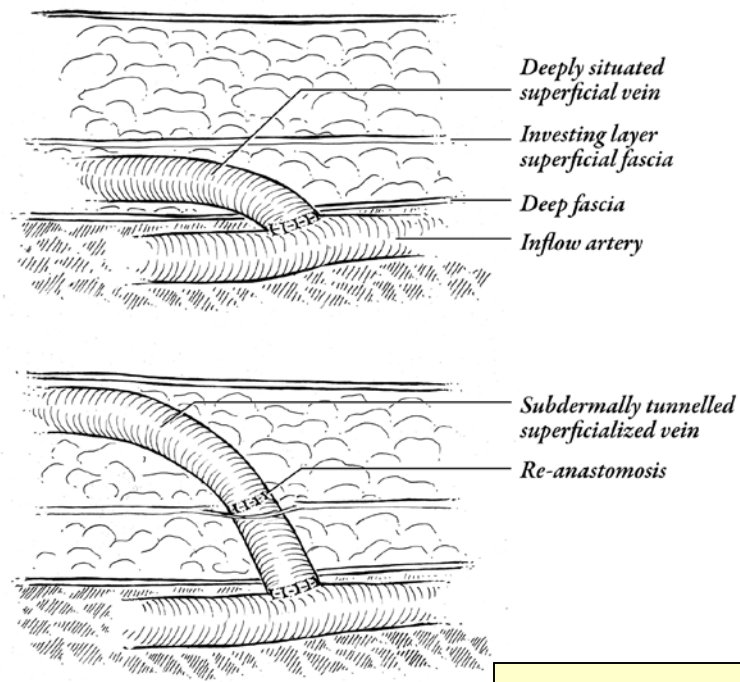
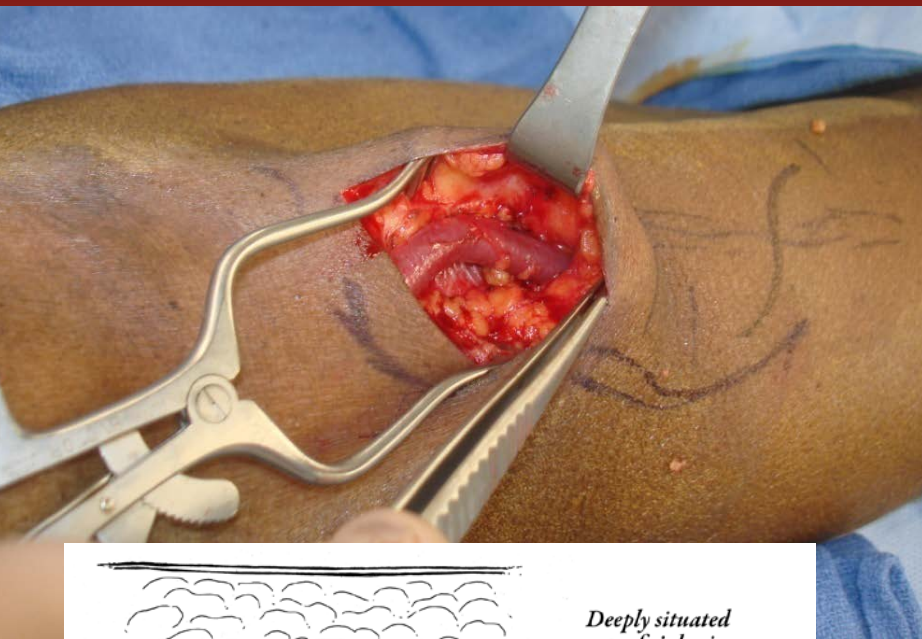
Basilic and Brachial Vein Transposition and Elevation



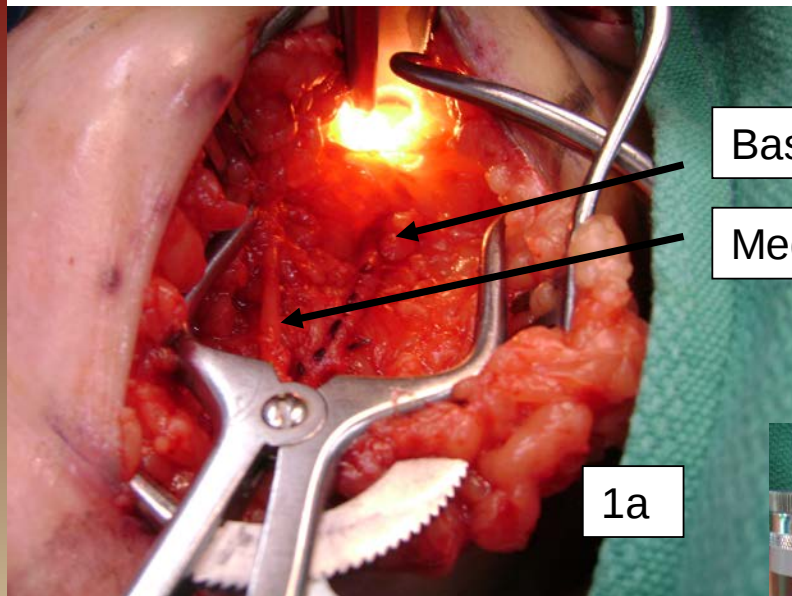
Consider minimal invasive transposition techniques in obese individuals

Paul EM, Sideman MJ, Rhoden DH, Jennings WC. Endoscopic basilic vein transposition for hemodialysis access. J Vasc Surg. 2010;51(6):1451-56.

Arroyo MR, Sideman MJ, Spergel L, Jennings WC. Primary and Staged Transposition Arteriovenous Fistulas Using the Basilic and Brachial Veins, J Vasc Surg. 2008 Jun;47(6):1279-83.



Minimally Invasive Superficialization Technique (MIST)....Shenoy, et al. JVascSurg. Ap 2016.



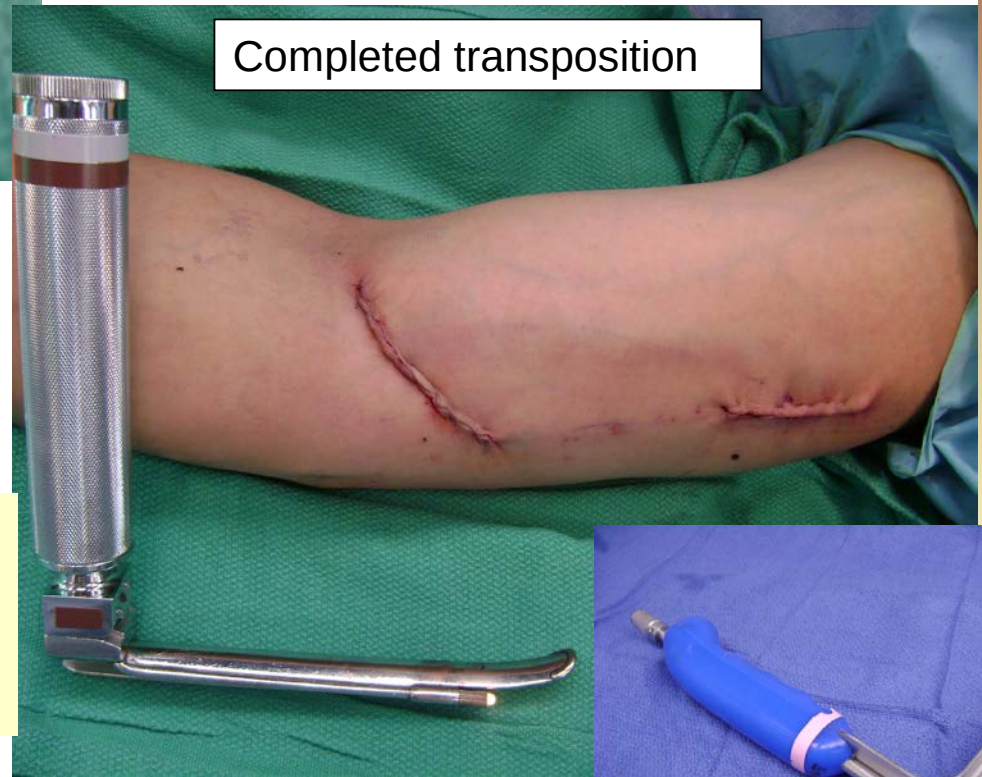
Basilic vein marked for orientation prior to harvest

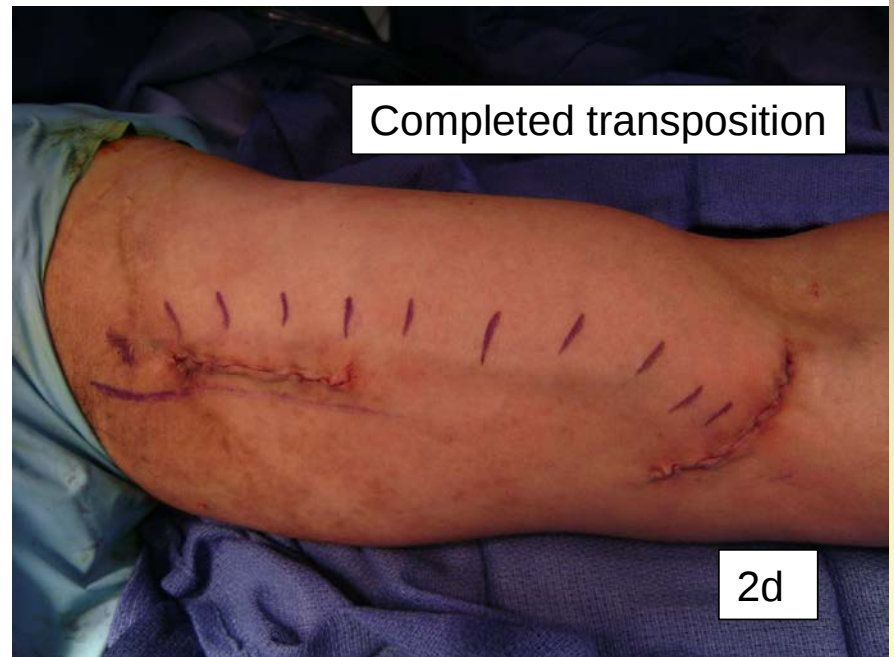
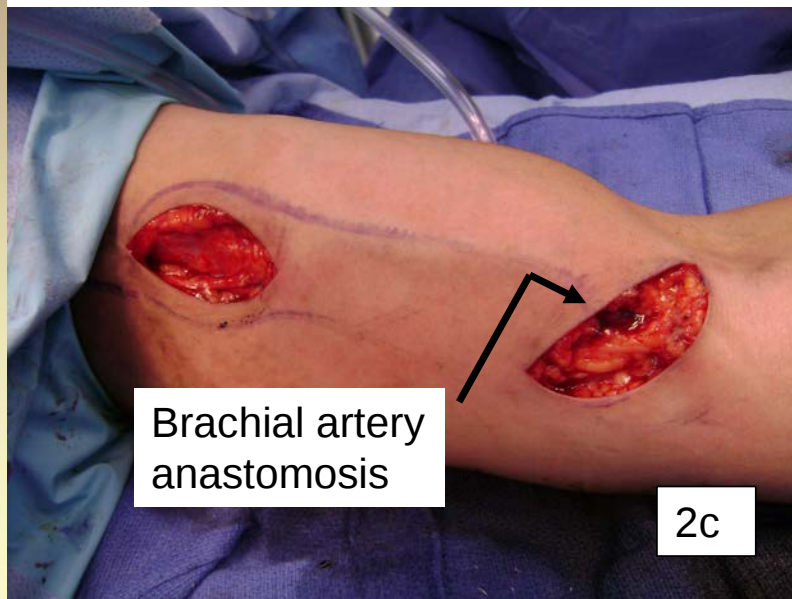
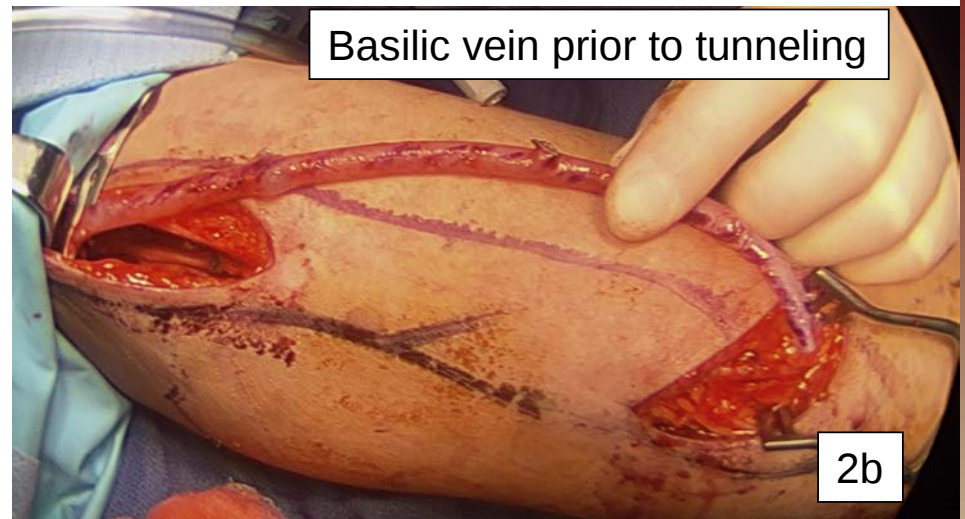
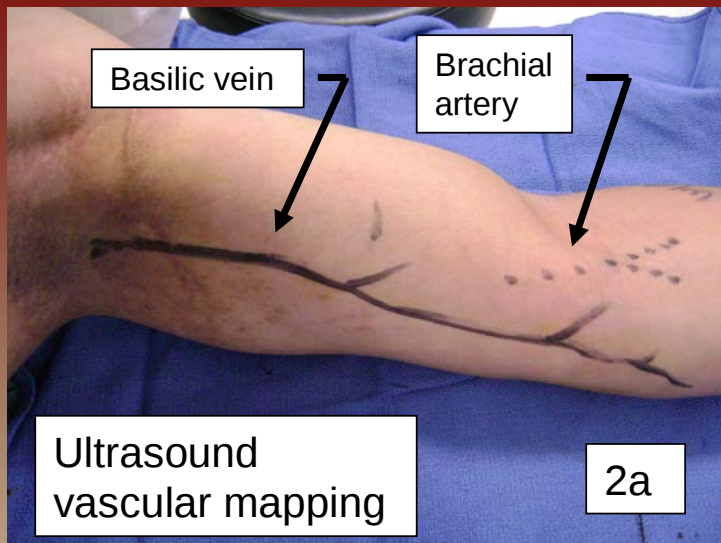
Median antebrachial nerve

1a

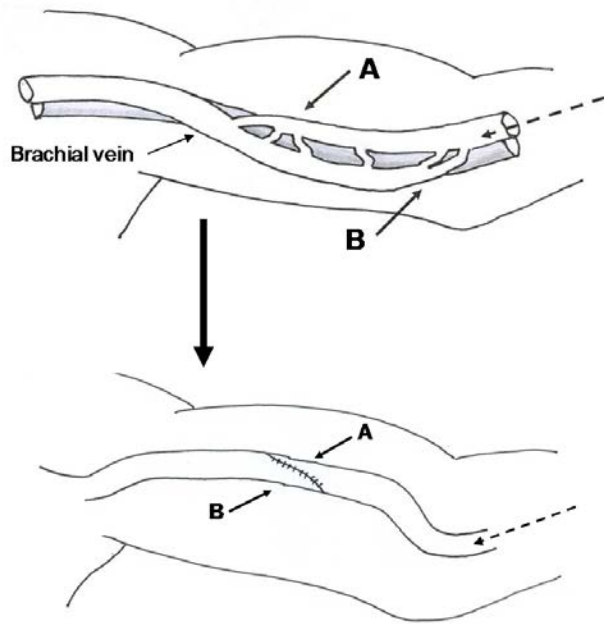
Off label use of
laryngoscope

Basilic vein harvest with laryngoscope
Minimally Invasive Basilic Vein Harvest for
Arteriovenous Fistula Transposition Using a
Laryngoscope. Jennings WC, Blebea J, Arcos
VK, et al. J Vasc Access. 2012 Jul

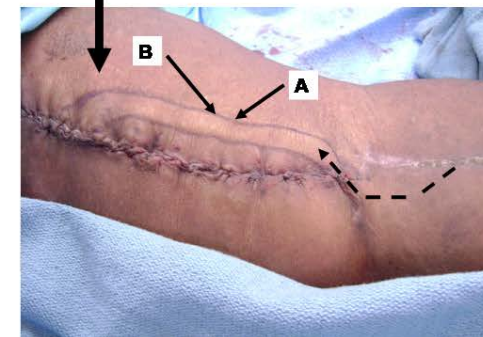
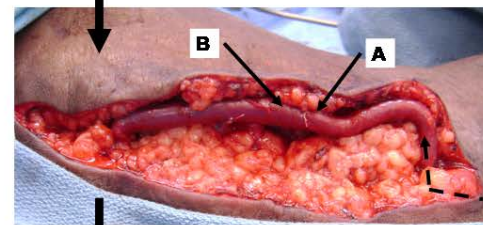
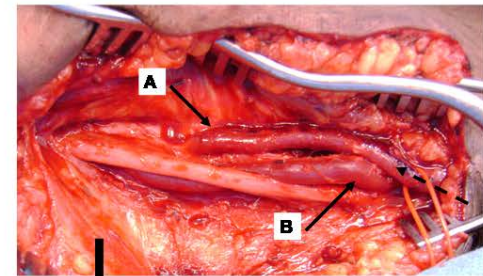




Vascular Surgery: Minimally Invasive Basilic Vein Arteriovenous Fistula Transposition for Hemodialysis Vascular Access. 2011.



Even brachial veins may be used in obese patients



Jennings WC, Howard CA, Lee FS, McMurray D. Extending outflow brachial vein length for transposition arteriovenous fistulas. J Vasc Access 2011 Oct-Dec;12(4):377-80

Liposuction



Targeted area for liposuction.

Previous (first stage) AVF



Vein harvest device as shield

Liposuction over a Shielded Arteriovenous Fistula for Hemodialysis Access Maturation. Daniela A. Ochoa, MD, Robert E. Mitchell, MD, William C. Jennings, MD. Journal of Vascular Access, 2010.



Lateral arm view post-liposuction. Arrows indicate site of mature cephalic vein, now just 2-4 mm deep.

Liposuction

- Rebecca A, Krochmol D, Chapital A, et al. Arteriovenous Fistula/Graft Salvage Using Suction Assisted Lipectomy. http://www.scvs.vascularweb.org/SCVS_Contribution_Pages/Abstracts/2009/p23.html
 - Krochmal DJ, Rebecca AM, Chapital AB, et al. Superficialization of arteriovenous fistulas using suction assisted lipectomy. Southwestern Surgical Congress, poster March 2009. <http://www.swscongress.org/meetings/PosterAbstracts.pdf>
 - Liposuction over a Shielded Arteriovenous Fistula for Hemodialysis Access Maturation. Daniela A. Ochoa, MD, Robert E. Mitchell, MD, William C. Jennings, MD. Journal of Vascular Access, 2010.
 - McMillan W, Hile C. Liposuction Assisted Brachio-Cephalic Fistula in the Morbidly Obese: Functional Patency and Reimbursement. Midwestern Vascular Surgical, 2013
 - Ladenheim ED, Krauthammer JP, Burnett J, et al. Liposuction for superficialization of deep veins after creation of arteriovenous fistulas. J Vas Access. April, 2014.
 - Miller G. Liposuction of Deep Arm Fistulas. VASA 2014, J Vasc Access
- Abstract, n = 3
 - Abstract n = 3
 - Case report
 - Abstract n= 30
 - J Vas Access n = 14
 - Abstract n = 30

When Arteriovenous Fistulas are Too Deep: Options in Obese Individuals

Study Design:

Consecutive vascular access patients where the planned venous outflow cannulation segments were too deep, requiring an additional surgical procedures to establish functional access.

These additional procedures included lipectomy, outflow elevation, cephalic transposition, liposuction, or an implantable cannulation guide.

Maliska III CM, Jennings WC, Mallios A. When Arteriovenous Fistulas are Too Deep: Options in Obese Individuals. 2015 JAmCollSurg 2015. Dec;221(6):1067-72.

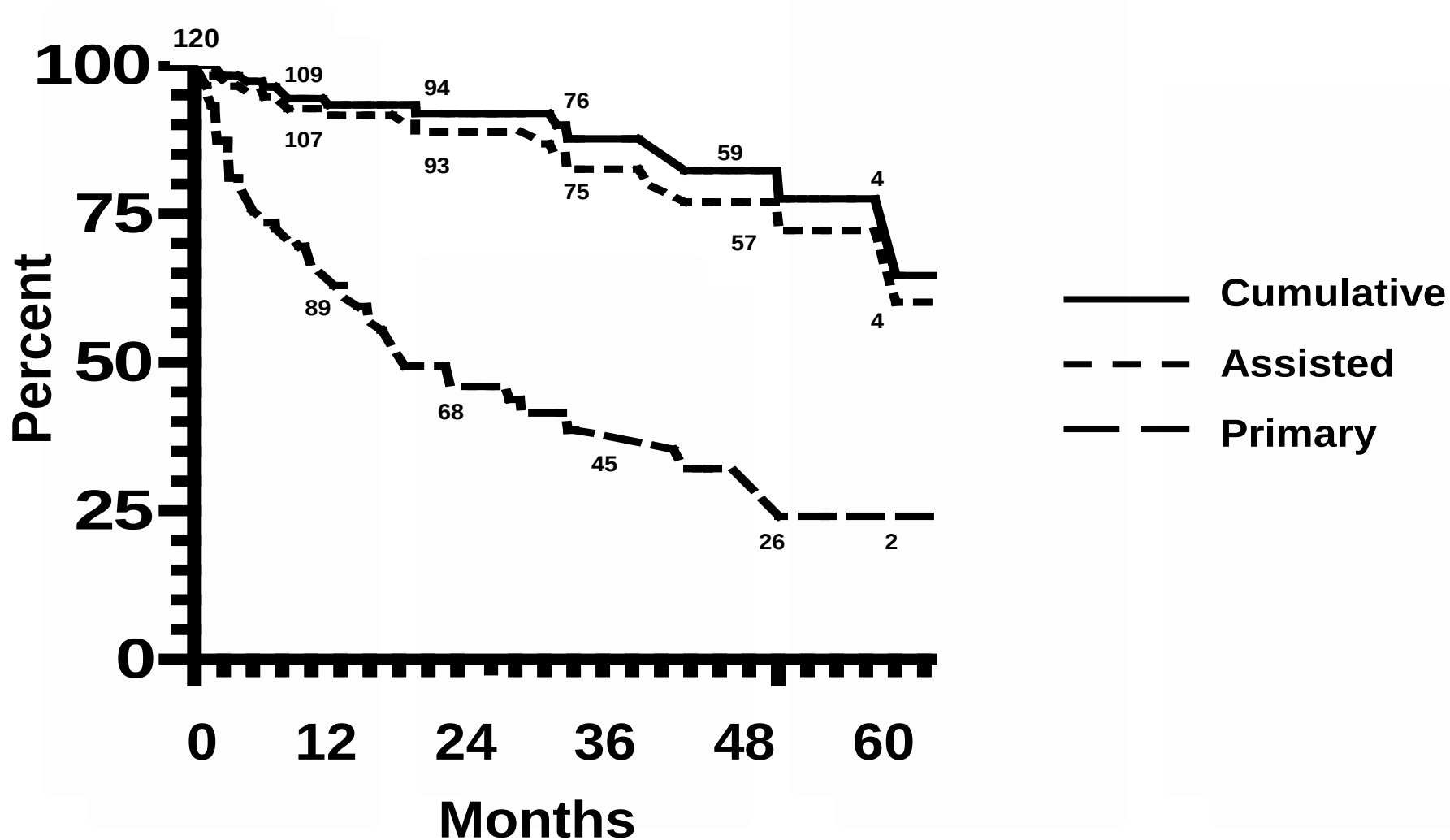
Results:

- 120 patients required an additional procedure due to the depth of cannulation sites.
- Ninety-nine (83%) were females, 85 (71%) were diabetic, and 53 (45%) had previous access operations.
- BMI: 25.4-62.8 kg/m² (mean 40.8 kg/m²)
- Age range: 27-81 years (mean 54 years)
- Follow-up: 1-101 months (mean=25 months).

Results:

- The most common additional procedure performed was a lipectomy (n=78) with one year primary and cumulative patency rates of 78% and 97% and two year rates of 69% and 91%, respectively.
- Primary and cumulative patency rates for all patients were 63% and 93% at one year and 46% and 91% after two years, respectively.

Deep AVF Patency



Maliska III CM, Jennings WC, Mallios A. When Arteriovenous Fistulas are Too Deep: Options in Obese Individuals. 2015 JAmCollSurg 2015. Dec;221(6):1067-72.

Conclusions:

- A variety of surgical options were found to be successful in establishing a functional autogenous vascular access for individuals where cannulation sites were simply too deep.
- Obesity did not preclude the construction of an autogenous access, although a planned second-stage procedure was often required.

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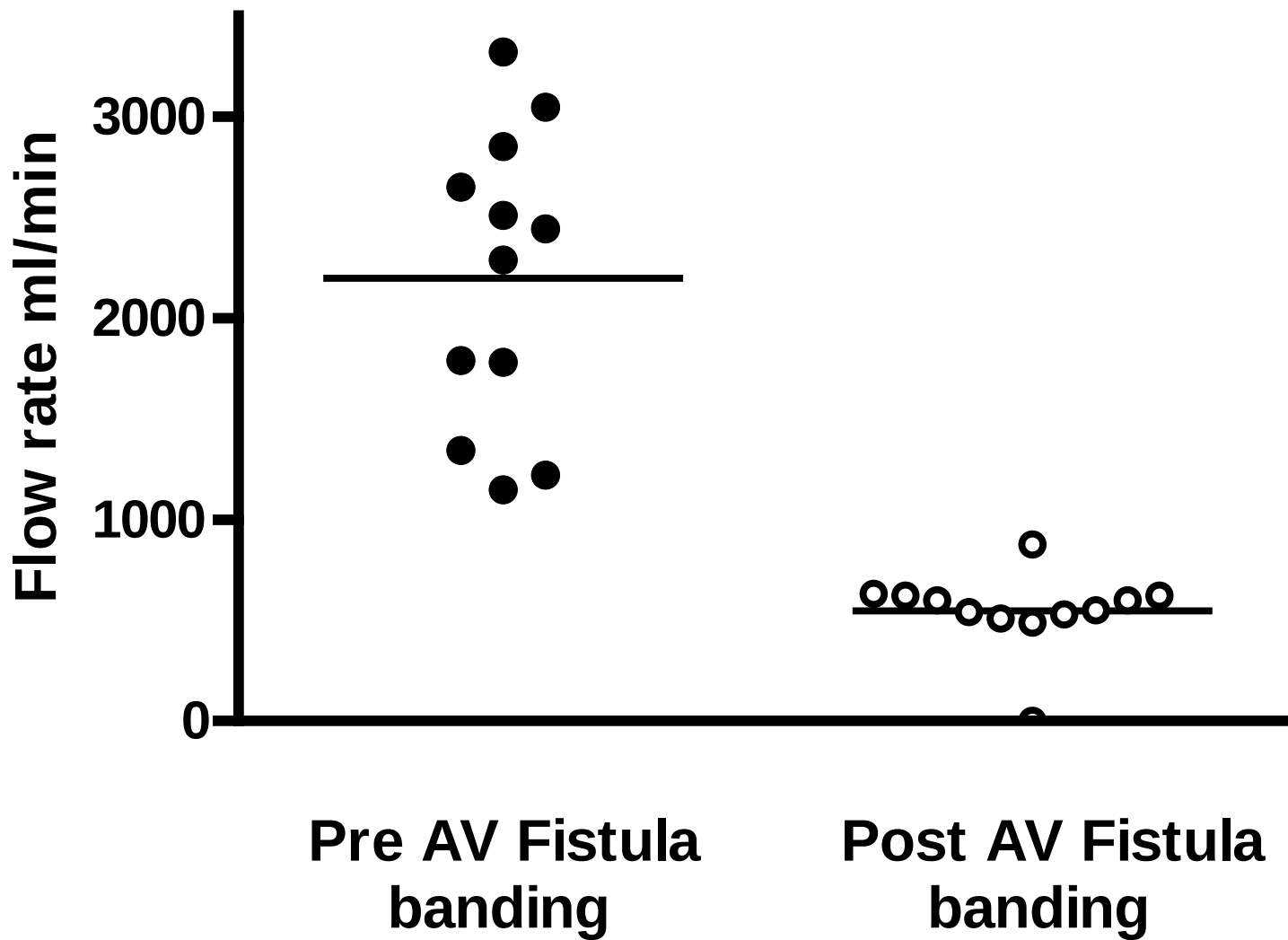
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www.ivas2018.com



Gkotsis G, Jennings WC, Malik J, Mallios A, Taubman K. Treatment of high flow arteriovenous fistulas after successful renal transplant using a simple precision banding technique. Ann Vas Surg. 2015.

Ultrasound: A Critical Role in **ALL** aspects of Vascular Access

- Prior to fistula creation
- Follow-up before initial access cannulation.
- Evaluating access problems



-Parmley M, Broughan TA, Jennings WC. Vascular Ultrasonography Prior to Dialysis Access Surgery. Am Journal of Surg. 184(6), December 2002, 568-572.
-Clinically Immature Arteriovenous Fistulas: Effect of US on Salvage. Singh P, Robbin ML, Lockhart ME, Allon M. Radiology. 246(1), Jan 2008. 299-305
Jennings WC, Parker DE. Creating arteriovenous fistulas using surgeon-performed ultrasound. J Vasc Access. Jul 12;17(4):333-9.