

Editorial

Femoral Artery Cutdowns: Tips & Tricks for Cardiac Surgeons

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Submitted: 4 August 2024 Revised: 27 August 2024 Accepted: 2 September 2024 Published: 24 October 2024

Introduction

Every cardiac surgeon needs to be facile with femoral artery access for a wide array of reasons, ranging from the placement of femoral arterial lines for monitoring (such as when a radial line is inaccessible or unreliable) to the use of a femoral artery for insertion of an intra-aortic balloon pump or for insertion of an arterial cannula for cardiopulmonary bypass (CPB) or for an extracorporeal oxygenator circuit (ECMO).

In an earlier era, I was, like many cardiovascular trainees of my generation, trained in ‘all things thoracic & cardiovascular’ during my seven years of surgical residency. And, in the years that followed that training, I and my colleagues performed the full range of thoracic, cardiac, and vascular surgical procedures. Many of these various cardiovascular procedures involved exposing one or both femoral arteries. As the disciplines of Cardiac Surgery and Vascular Surgery evolved and diverged, those training in Cardiac Surgery were less likely to need to access and utilize the femoral arteries and, therefore, became somewhat less facile with accessing them and with managing the wounds resulting from this exposure. Therefore, a brief review of the techniques for exposing the femoral arteries and for managing the resulting surgical wounds seems worthwhile. Let’s get started...

Mark the Anatomical Landmarks after Positioning the Patient

The first step for most surgical incisions is to identify and mark the pertinent anatomy with a felt tipped pen. The need for this marking is greater in a training environment, of course. When planning access to the femoral vessels, you should identify and mark the following landmarks before prepping the operative area, which will ensure that the subsequent draping is optimal for exposure of this area:

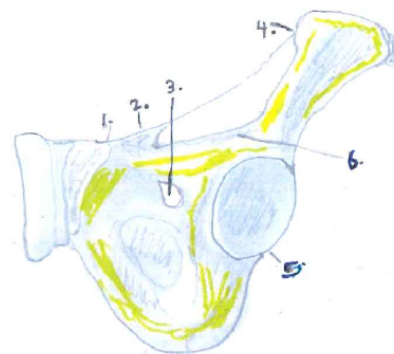
- The anterior superior iliac crest or spine (ASIS)
- The pubic tubercle

(Mark the ASIS and pubic tubercle with circles.)

- The anatomical midline of the lower abdomen
- The inguinal ligament, from the iliac crest to the pubic tubercle

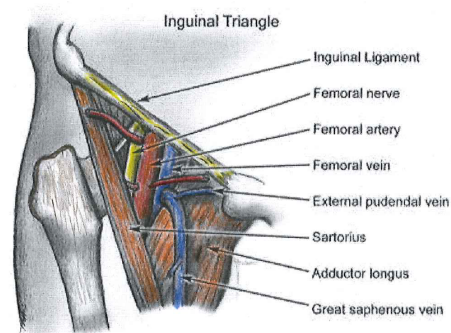
(Mark the ligament with a line between the marked circles.)

Here is a diagram with these landmarks labeled on a left hemi-pelvis:



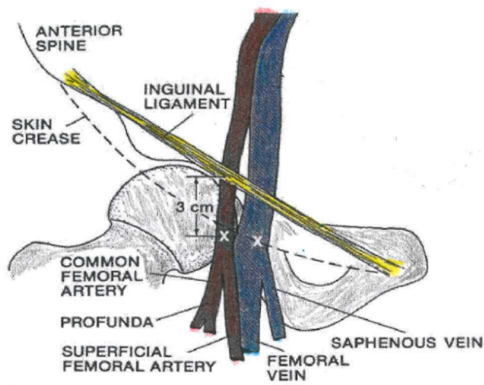
1. Pubic tubercle. 2. Lacunar ligament. 3. Obturator canal. 4. Anterior superior iliac spine (ASIS). 5. Transverse acetabular ligament. 6. Ligament of Cooper.

The femoral artery is halfway between the ASIS and the midline:

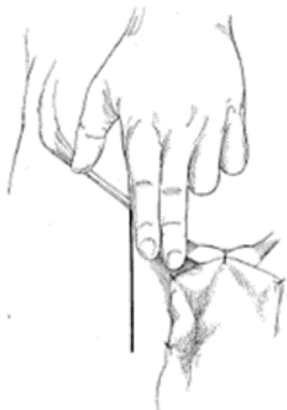


(It is helpful to recall the mnemonic, NAVEL, for visualizing the anatomy of the femoral triangle. NAVEL stands for: nerve, artery, vein, empty space, & ligament.)

The great trochanter of the hip can also be used as a landmark to help locate the femoral artery, if the femoral arterial pulse is not easily palpable, since the top of the great trochanter of the hip is usually aligned with the optimal area to access the artery percutaneously, as shown here:



The greater trochanter is usually palpable through the drapes on most patients, even those who are somewhat heavy. It may be also useful to remember that the femoral artery is usually about two fingerbreadths lateral to the pubic tubercle, while the femoral vein is one fingerbreadth lateral to the pubic tubercle. This diagram shows the location of the femoral artery, which is delineated by the straight line, lateral to the index finger in this figure:



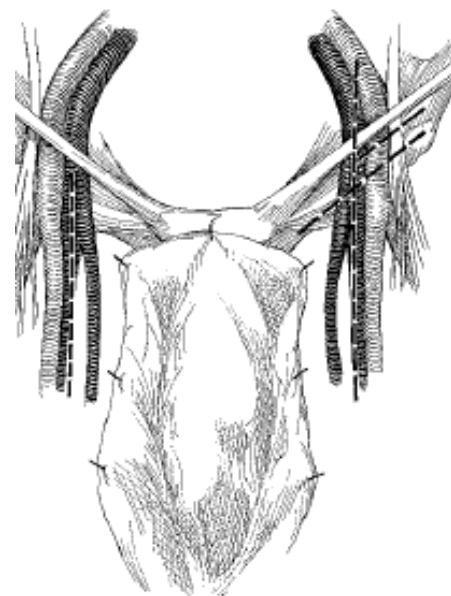
It is important to realize that the inguinal crease (of the skin) is often well below the inguinal ligament, especially in obese patients. So, the common femoral artery may be underneath this adipose tissue. There are several considerations when a significant amount of abdominal adipose tissue is in your way when attempting to access the femoral vessels. First of all, it can be worthwhile to attempt to pull this tissue superiorly. One way to do this is to use tape to retract it, though one must be thoughtful about the possibility of tape injury to the skin. If you are going to use tape in this way, you should do it prior to prepping the area. Another way to gain exposure in this circumstance is to have an assistant hold the panniculus up by hand, but that assignment can be a challenging one, especially given that the traction may have to be maintained for quite a while. For really large folks, a self-retaining retractor like a Bookwalter or Omni-Track abdominal retractor can be used to maintain this retraction, especially once the initial incision in the groin has

been made. Another important consideration is that the incision for exposure of the femoral artery should not cross the inguinal crease perpendicularly (as doing so may significantly impair subsequent healing of the skin incision).

Though uncommon, there are some anatomical variants of the femoral artery, particularly the deep femoral branch of that artery. A comprehensive review of these variants can be found in the article by Tzouma *et al.* [1] included in the references.

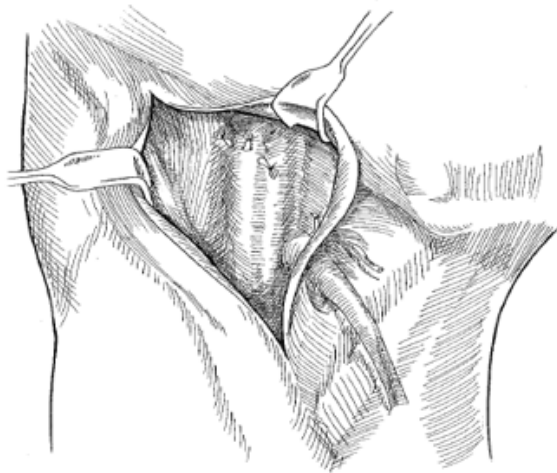
Drape to Keep Area of the Femoral Artery in View

Once you have sorted out and marked the anatomy, you can prep and drape. After prepping, the first step in draping is to fold a sterile towel length-wise to cover the 'mid-groin' (an area you would like to avoid during an operation in this region). The width of the towel, as it comes out of the pack, is usually too wide for this purpose. So, the towel should be opened and then refolded so that it is narrower. The towel is then placed over the 'mid-groin area' and tucked down so that there is plenty of room between the edge of the towel and the area you plan to incise. Many surgeons do not like putting adhesive drapes on the groin when working there. (These adhesive drapes will make it harder to use a Doppler, and they often do not stay stuck down optimally anyway.) After draping, you should change your gloves (or have an extra pair on while draping so that you can then take off the outermost one when the drapes have been positioned). It may be worthwhile to staple the towel in place, as illustrated here:



Re-mark the Anatomy

You may need to re-mark the anatomy and your intended incision site after prepping and draping, as the marks placed earlier are often obscured by the prep solution. The incision should, ideally, start 3 to 5 cm lateral to where you think the femoral artery is located and curve downwards in a gentle curve into the axis of the leg and over the expected location of the femoral artery. You should avoid having the incision cross the inguinal crease perpendicularly. In fact, an old surgical adage is to avoid having incisions cross sites in the body that bend, like the elbow or the groin, in a perpendicular manner. Here's a diagram that demonstrates these principles:



The incision in the skin (with the upper lateral aspect somewhat aligned with the inguinal ligament) can then be retracted, with the subsequent deeper dissection more and more aligned with the long axis of the leg and the expected location of the femoral artery [2].

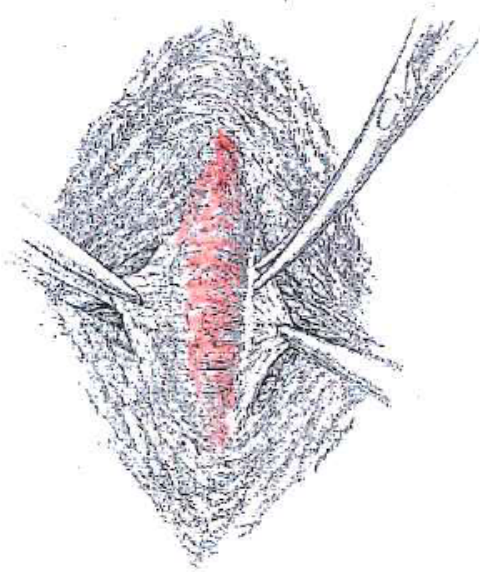
Sometimes the femoral pulse will be palpable. If you cannot feel that pulse, consider using a Doppler to help locate the artery. The artery itself is also sometimes palpable, even without a pulse, especially if it is thickened or scarred. If you see vein branches, as you deepen the dissection, you are likely to be more medial than is optimal for exposing the femoral artery.

Sometimes, though not always, you will encounter the layers of thin fascia between the skin and the femoral sheath, which are the lower extremity equivalents of Camper's Fascia (more superficial) and Scarpa's Fascia (deeper). These layers can sometimes be used to aid in the subsequent closure of this wound. You will need at least one, and often several, Weitlaner retractors to hold the edges of the incision out of the way. As you continue the dissection down to the femoral artery, you will incise the slightly more substantial tissue of the femoral triangle, though this tissue is fairly variable in how substantial it ac-

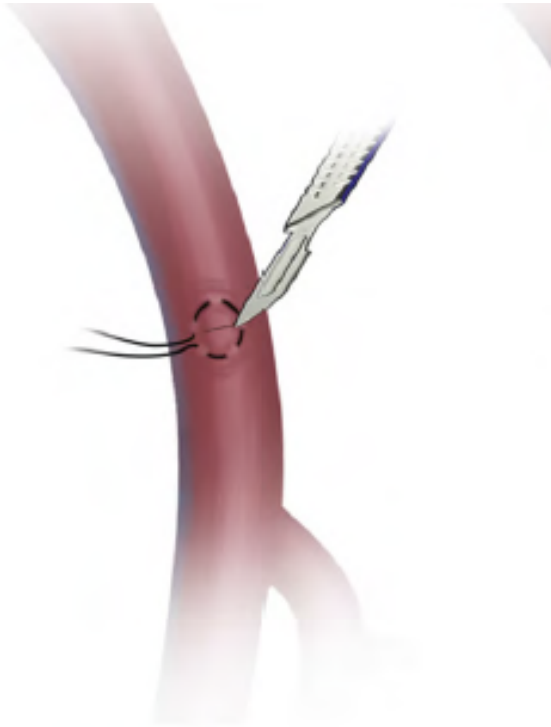
tually is. Again, the deeper you continue into your dissection, the more likely it will be that you can feel the femoral arterial pulse or at least the thickened femoral artery, if it is somewhat diseased. Again, a Doppler probe can sometimes be helpful in locating the femoral artery.

Dissecting around the Artery

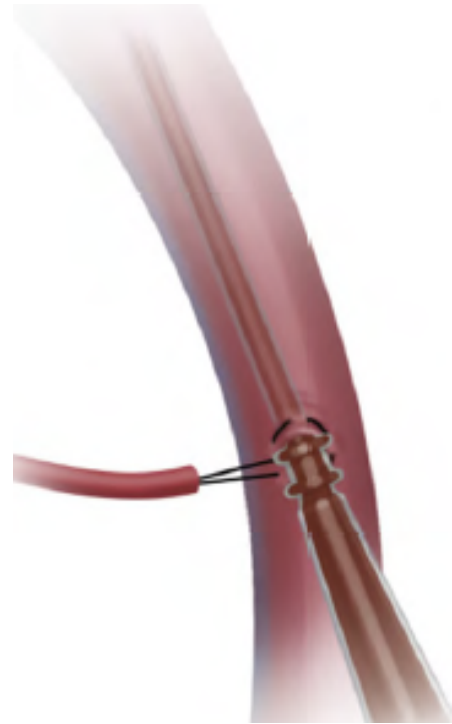
Once you have found the artery, you will begin to dissect around it, as shown below, trying to stay in what anatomists call 'The Plane of Leriche'. This plane may seem closer to the artery than you might expect.



You can then decide how much of the artery you will need to dissect out to control it. To cannulate the femoral artery for a transarterial aortic valve replacement (TAVR), a thoracic endovascular aortic repair (TEVAR), or an endovascular aneurysm repair (EVAR), you may not need to dissect out all the branches of this artery. However, you must assure yourself that you have the common femoral artery itself in your sights. It is not unusual to end up encountering the superficial femoral artery before you identify the common femoral artery. One way to assure yourself that you are really looking at the common femoral is to dissect superiorly until you can see, or at least feel, the inguinal ligament. There is often only 5 to 10 centimeters of common femoral artery inferior to the inguinal ligament, prior to its branching into its superficial and deep branches. Once you have the common femoral artery in view, you can usually clean it off just enough to put a purse string in the adventitia. Your cannulation sutures do not need to be full thickness. These sutures should look somewhat like this:

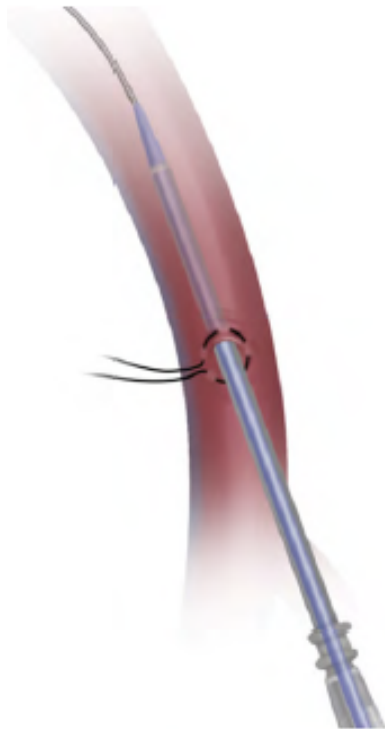


The pursestring can be tightened down onto the cannula with a Rummel tourniquet to maintain hemostasis, as shown here:



It may be advantageous to make a small incision with a knife in the adventitia, which can allow the unimpeded passage of an introducer or cannula into the lumen of the artery with the Seldinger technique, which will look like this:

If a nick has been placed in the adventitia to facilitate passage of dilators and introducers, it should be reapproximated after removal of the introducer and tying the pursestring at the end of the procedure, like this:



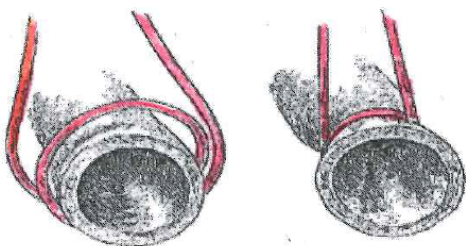
Consider Cannulating the Artery Prior to Placing a Pursestring

It is worth considering placing your pursestring around the cannula that will be used to deploy a stent graft (or a perfusion cannula, especially if femoral artery cannulation has been done for institution CPB or ECMO), when it is time to remove that cannula (rather than at the time of cannulating the artery). This strategy is more attractive when the artery is relatively small, as the purse string, when tied, will almost certainly narrow the vessel less than might a pursestring placed prior to cannulation. This approach may be appropriate for cannulating for TAVR's as well. That is, the introducer can be placed first, and the pursestring placed later.

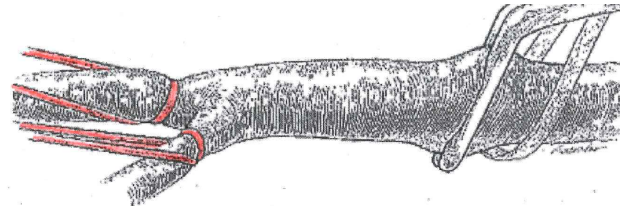
One can also consider putting 5-0 Prolene stitches immediately adjacent to the cannula, emulating the way the Perclose device stitches are aligned. This strategy may be more attractive if the vessel is small or if the entry site of the cannula is near a plaque. If this strategy is employed, the cannula is removed, and the adjacent stitches are pulled up to control bleeding. Then, a subsequent 5-0 Prolene stitch can be placed, inside out both proximally and distally (i.e., with two 'bites'). These 3 stitches could be supplemented, if necessary, with additional stitches placed in a similar manner. The need for additional stitches should be determined prior to tying the previously placed stitches, so that such an additional stitch can be placed inside out in both directions. Another strategy that some prefer is to take advantage of the Perclose technique, even in these cutdown situations. To use this strategy, one would puncture with the micropuncture technique, get a guidewire into the delivery vessel, position (but not tie) the Perclose type sutures on either side of the site, and then use these sutures to achieve initial control once the delivery sheath is removed.

In all cases of a femoral artery cutdown, it is prudent to get a vessel loop around the femoral artery proximal to the initial puncture of the vessel to be cannulated, which can facilitate gaining temporary control of the vessel when the cannula or sheath is removed. If you need to ensure more control the artery and its branches, you can use a combination of vessel loops and clamps.

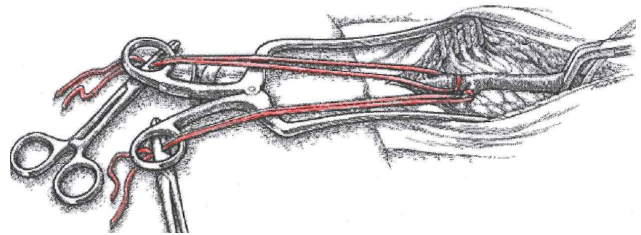
Here's a sketch of how to use the Potts technique of controlling the vessels with vessel loops:



Here's a sketch of the use of a clamp on the proximal femoral artery and vessel loops placed around the more distal branches:



Here's how the vessel loops can be secured using a Weitlaner retractor:



The exposure of the femoral artery for cannulation is usually different than exposing it for a vascular operation, such as an aorto-bifemoral bypass. Specifically, in most vascular operations, the deep and superficial femoral arteries need to be exposed and controlled, as shown in the figures above. This more extensive exposure may require dividing some veins that are often in the bifurcation of the common femoral artery into the deep and superficial femoral arteries. That dissection may also result in the division of lymphatics, which can be problematic postoperatively by causing lymph leaks from the wound. Though often hard to see, any visible lymphatics should be clipped.

Closing the Wound

The decision that should be made before closing the wound, after the procedure has been completed, is whether or not to leave a closed suction drain in the wound. Such a drain, if placed, should be led out of a separate stab wound and not through the incision itself. The deeper the groin and the more extensive the dissection has been, the more you should consider leaving a small drain in the wound. If it does not drain much, you can pull it out soon after the operation. If it does drain a lot, you will be glad that you placed that drain. And, you should never remove that drain until the output into the drain is minimal or until the skin has healed.

After placing the drain (if one is used), you need to close the layers of the wound precisely. The first layer to close is the femoral sheath. You can start a 3-0 absorbable

suture at the superior aspect of this sheath and tie it. Then, you can run it inferiorly until the sheath is closed. You can, without stopping or starting a new stitch, ‘reverse field’ and suture superiorly, with the hope of re-approximating the thinner, more superficial fascial layers. More often than not, you can get three layers of tissue closed in this way. Then, you should close the skin with a 4-0 absorbable subcuticular suture. You can consider putting Dermabond skin sealant or antibiotic ointment on the incision to seal it even further. This type of precise, ‘water-tight’ closure is especially important if there is any prosthetic material in the groin, such as when there is a vascular graft, like the femoral limb of an aorto-bifemoral bypass, the proximal end of a femoral to popliteal bypass, or a vascular patch.

Here is a picture of what you do NOT want a groin wound to look like postoperatively (which is more common than it should be):



Note that the incision in this picture crossed the inguinal crease perpendicularly, which will often result in the patient’s wound looking like this one. You should try to avoid orienting such an incision in this manner, as described above.

Some practitioners suggest the use of a negative pressure device to aid in healing in groin wounds created for vascular access operations, noting that groin wound complications after vascular access occur in 20 to 40% of these operations [3].

If a drain was not placed during the initial operation and lymphatic fluid is leaking out of the wound postoperatively, the situation is, at best, challenging. And, if there is any prosthetic material in the wound, that material is very likely to become infected. Furthermore, infected patches or grafts, if not removed, will eventually form a pseudoa-

neurysm and possibly ‘blow out’, often with disastrous results. Therefore, if there is a lot drainage, or if there is a moderate amount of drainage and prosthetic material is present, the groin site should be re-explored, cleaned up, drained, and re-closed. Many surgeons will consider placing a sartorius muscle flap over the graft prior to closing such a wound for the second time [4].

Step by Step Review for a Groin Cutdown

- Review all preop information on the patency and quality of the femoral and iliac arteries
- Feel for pulses (and compare sides)
- Mark the landmarks prior to prepping & draping
- Drape the ‘mid-groin’ with narrow towel, stapled in place
- Re-mark the landmarks with a sterile marking pen after prepping
- Make a curved incision starting a bit lateral to the femoral artery
- Carry it inferiorly, aligning the lower half over the femoral artery
- Dissect out only as much of the femoral artery as will be needed
- Consider placing the pursestring in the artery after cannulating it
- Leave a drain in the wound if the dissection was extensive
- Close the wound in layers
- Consider applying Dermabond or antibiotic ointment to the skin closure to help seal it as quickly as possible
- Dress the wound with a small dressing that is likely to stay in place

Summary

Every cardiac surgeon will, from time to time, need to utilize the femoral vessels for a variety of procedures. There are a number of anatomical and technical issues that need to be understood and taken into account when working with these vessels. This review provides some tips and tricks for working with these vessels and for dealing with the opening and closing of the wounds required for their exposure.

Author Contributions

This manuscript was completed by CT, alone.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The author declares no conflict of interest. CT serves as associate editor of this journal. CT declares that he was not involved in the processing of this article and has no access to information regarding its processing.

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