COMMON FEMORAL ENDARTERECTOMY

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The common femoral artery (CFA) is the gateway to the aortoiliac arteries, as well as the gatekeeper for distal limb perfusion. Moreover, it is the most common access site for peripheral endovascular procedures. Therefore, it is frequently encountered by vascular surgeons.

The common femoral endarterectomy (CFE) was first described by Dos Santos in 1947. Until then, it was assumed that intima removal would result in thrombosis. With extraordinary primary patency of 80% after seven years, it has been the standard technique for treatment of peripheral arterial obstructive disease in this anatomical region ever since. It can be performed as a stand-alone intervention, or, increasingly, in conjunction with endovascular surgery to simultaneously correct inflow or outflow disease.

Currently, endovascular techniques are explored, which may serve as an alternative for open repair of the CFA; e.g., for patients or groins unsuitable for surgery. Percutaneous transluminal angioplasty (PTA) complimented with adjuncts as stenting, atherectomy, and drug-coated devices are still under investigation; however, long-term results are not available yet.

ANATOMY

The CFA is a continuation of the external iliac artery. It passes beneath the inguinal ligament and after branching of the inferior epigastric and superficial iliac circumflex arteries, called the CFA.

The groin can be seen as a triangle, in which the CFA travels down, bordered by the sartorius muscle laterally, the adductor longus muscle medially and the inguinal ligament cranially. The floor of the triangle is formed by the iliopsoas muscle laterally, and the pectineus muscle on the medial side. After a variable length of approximately 4 cm, the CFA bifurcates in the superficial and deep (profundal) femoral artery. The superficial femoral artery (SFA) continues along the anteromedial side of the upper leg, between the sartorius muscle laterally and the adductor longus muscle on the medial side. The profunda femoral artery (PFA) artery mostly lies posterolateral of the SFA and traverses over the pectineus and adductor brevis muscles. The CFA is aligned with the femoral nerve laterally and the common femoral vein medially (Figure 18.1). Moreover, on the medial and proximal side, an extensive lymphatic network is present.

The arterial wall includes three layers, namely the intima, media, and adventitia. The intima consists of endothelium and the internal elastic lamina. The endothelium ensures smooth surface and has antithrombotic properties. Next, the media is composed by layers of smooth muscle cells, surrounded by basal lamina, collagen and elastin fibers. Its main function is to regulate flow resistance by vasoconstriction and vasodilation. Lastly, the adventitia contains the vasa vasorum, which provide blood supply to the arterial wall. In addition, it has a collagenous matrix providing tensile strength.

SURGICAL TECHNIQUE

Exposure

The patient is placed in the supine position on the operating table. In particular, while performing a hybrid intervention, it is convenient to pack the

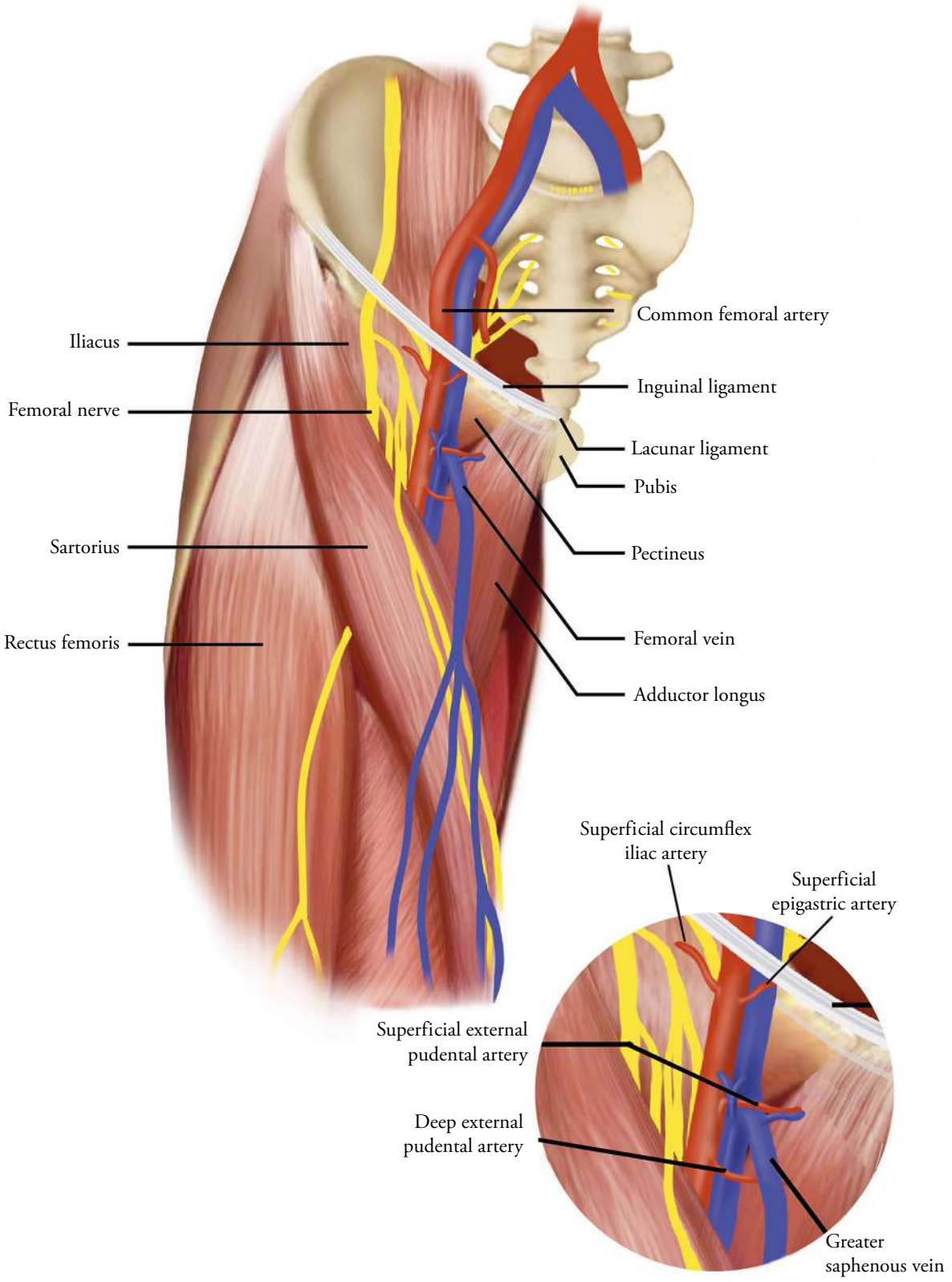

Figure 18.1. Anatomy of the groin.

arms alongside the abdomen. The procedure can be performed under general or regional anesthesia, or local anesthesia with sedation.

A variety of incisions can be used to expose the CFA. When only limited exposure is needed, for instance for cardiac cannulation, a small transverse incision can be made. The incision is placed just distally of the inguinal ligament. To perform an endarterectomy, usually more exposure is needed and a longitudinal incision is preferred. The length of the incision depends on the extend and location of the atherosclerotic burden, mostly in such a way that it originates a few centimeters above the inguinal ligament and extended distally as far as needed. The incision can be guided by anatomical landmarks and placed straight over the femoral pulse. Often the femoral pulse is not palpable due to the nature of the disease. Sometimes, the calcification is prominent and may serve as an alternative marker. When neither a pulse nor a calcified tube is palpable, one may place the incision just medially of the midline between the lateral border of the os pubis and the spina iliaca anterior superior (SIAS) (Figure 18.2a). As a "golden ratio", for the right leg, the operator may put his/her left hand thumb on the lateral border of the pubic bone and the index finger on the SIAS (for the left leg, right hand thumb on lateral border pubic bone and index finger on the SIAS). The femoral artery is located in the V-shaped crease between the thumb and index finger (Figure 18.2b).

After incision, the dissection is continued into the subcutis using electrocautery. To prevent wound dehiscence, seroma and infection, the dissection and soft tissue handling should be done delicately. Care must be taken to progress to the artery in a straight and smooth fashion and not to wonder off. Once the great saphenous vein is encountered, the incision is too far medially, and one should progress more laterally. Efforts should be made to preserve the great saphenous vein for future use of patch or bypass

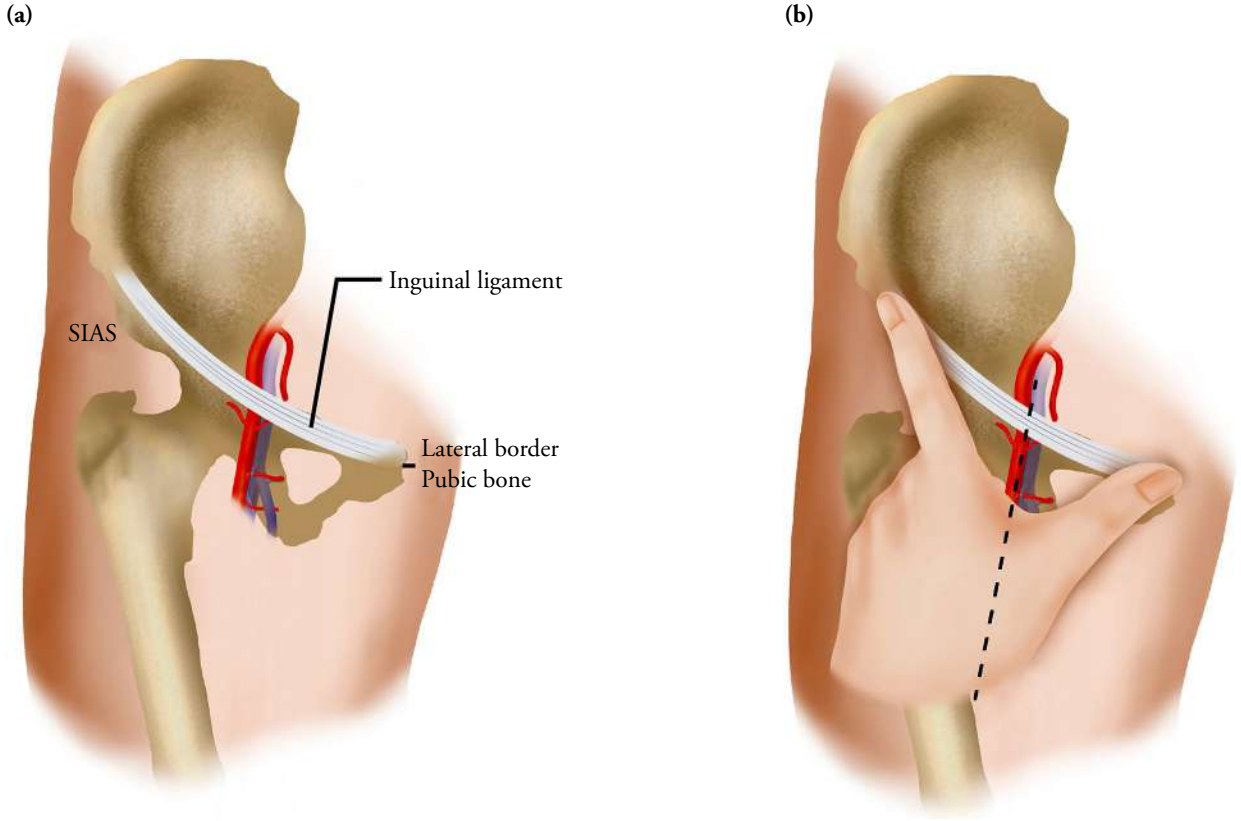

Figure 18.2. **(a)** Location of CFA (red) in the midline between SIAS and the lateral border of the pubic bone. **(b)** Positioning of left hand as "golden ratio" maneuver to locate CFA.
CFA: Common femoral artery; SIAS: Spina iliaca anterior superior.

conduit. Lymph nodes that may be encountered should be passed on either side instead of crossing straight through and lymphatic channels may be ligated to avoid postoperative seroma formation.

In particular, in patients with obesity or in redo surgery cases, it may be helpful to first identify the inguinal ligament and subsequently further dissect distally from there; the femoral sheath composing the CFA will appear from underneath the inguinal ligament and is easily identified at this location. After identification of the femoral sheath, further dissection is mainly done by sharp dissection using Metzenbaum scissors. The femoral sheath is cut in a longitudinal fashion. With cephalad retraction of the inguinal ligament, further proximal exposure can be assured. Be aware that the inferior epigastric and deep circumflex iliac veins cross anteriorly over the distal external iliac artery. Injury and subsequent retraction of these veins in the retroperitoneal space may cause difficult controllable bleeding. This can be prevented by ligation of the vein before dissecting toward the distal external iliac artery. The artery is exposed as far proximal until a healthy segment is identified where a vascular clamp can be put safely. Often, it is needed to dissect beyond the level of the inferior epigastric artery and circumflex artery.

Traversing distally, a change in vessel caliber marks the branching off the PFA and continuation of the SFA. The SFA can be further exposed by

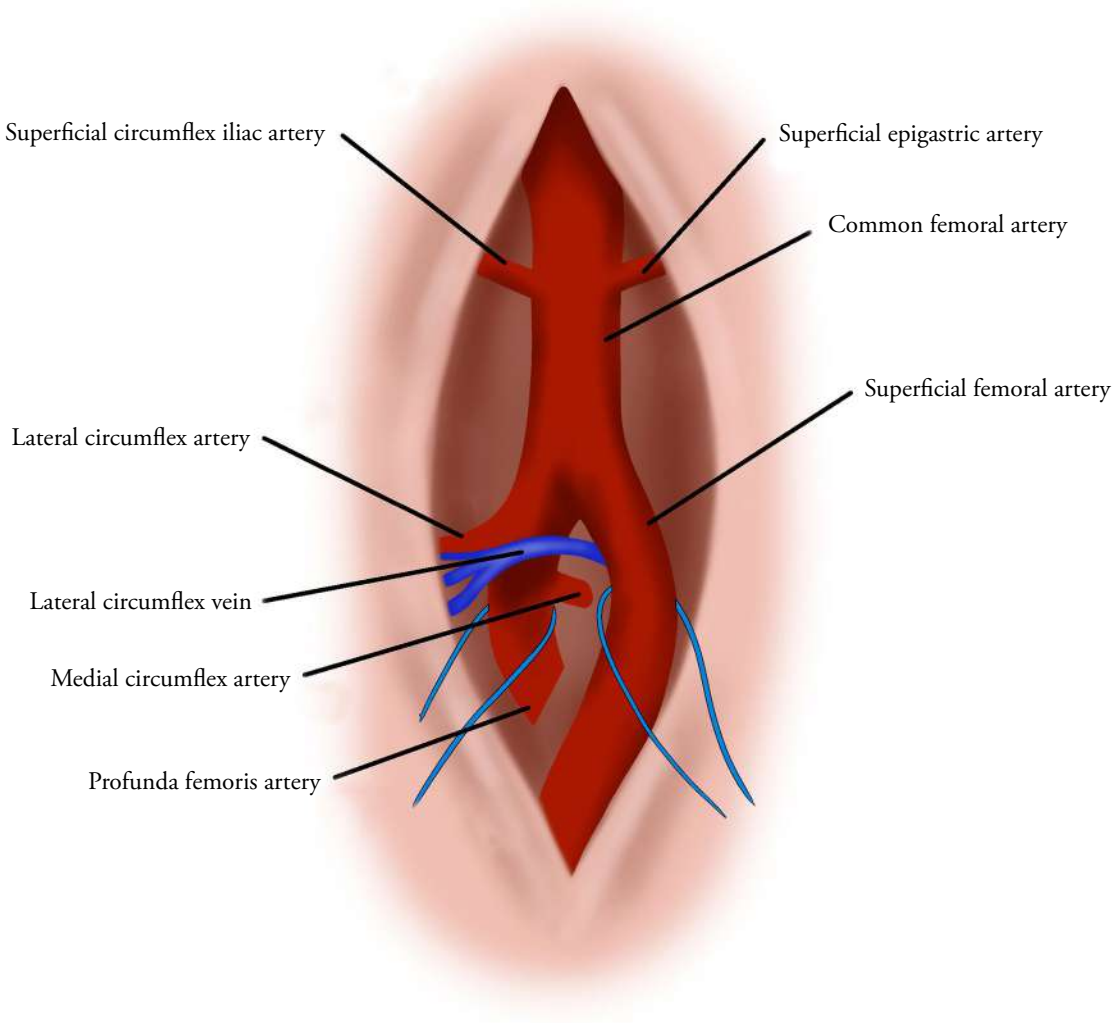

Figure 18.3. Exposure of (right) common femoral artery and bifurcation.

extending the incision distally, if needed. The PFA may be exposed to the level where it is healthy and non-diseased. Be aware that the lateral femoral circumflex vein traverses across the origin of the PFA and needs to be identified to prevent injury while dissecting the origin of the artery. It may be ligated before silastic looping or to extend exposure more distally (Figure 18.3).

Silastic vessel loops are often used to control inflow and outflow, and they may facilitate exposure by gentle traction. A vessel loop can be particularly helpful to control the PFA without the need to dissect it circumferentially; for this purpose, after dissection of the CFA and SFA, the vessel loop is passed underneath the common and subsequently under the SFA.

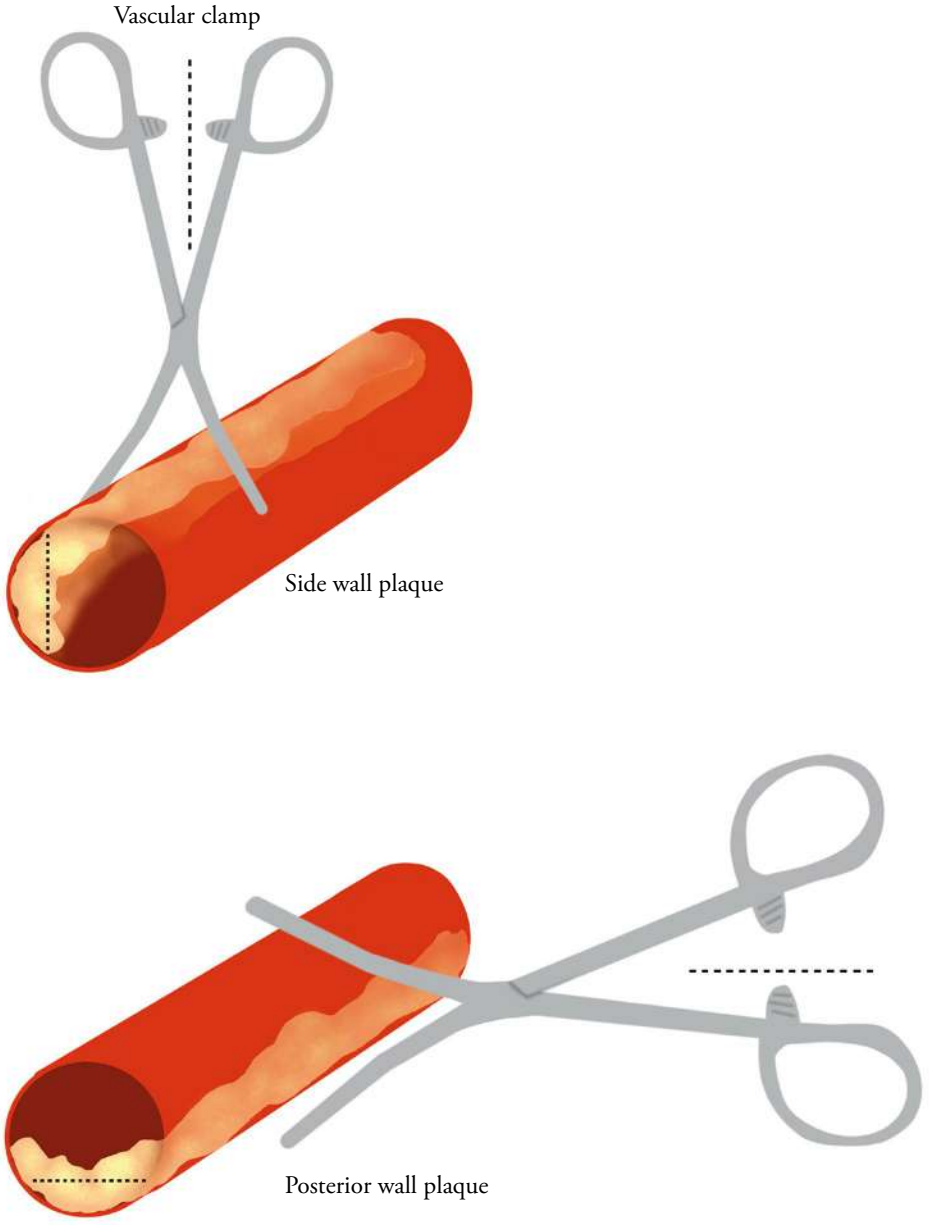

Figure 18.4. Example of anterior-posterior clamping (left) in presence of posterior plaque or lateral-medial clamping (right) in presence of side wall plaque.

Endarterectomy

After intravenous (IV) administration of heparin (70-100IU/kg), inflow and outflow are interrupted by either a (padded) vascular clamp or tightening of the vessel loops. Make sure to place a vascular clamp in such a fashion that the plaque does not rupture or damage the vessel wall; in the presence of posterior plaque, place the clamp in an anterior-posterior fashion, with a Cooley or spoon-shaped vascular clamp. In case of lateral plaque, the clamp can be placed in a lateral-medial fashion (Figure 18.4). While using vessel loops, excessive tension may injure the arterial wall; therefore, the least amount of tension resulting in flow interruption should be applied. In rare cases, heavy calcification impedes safe clamping. In this case, one may use intravascular control by using balloon occlusion.

An arteriotomy is performed over the CFA with a No. 11 scalpel, directing the blade upwards. The arteriotomy is extended proximally and distally using Potts scissors and can be, then, extended as far

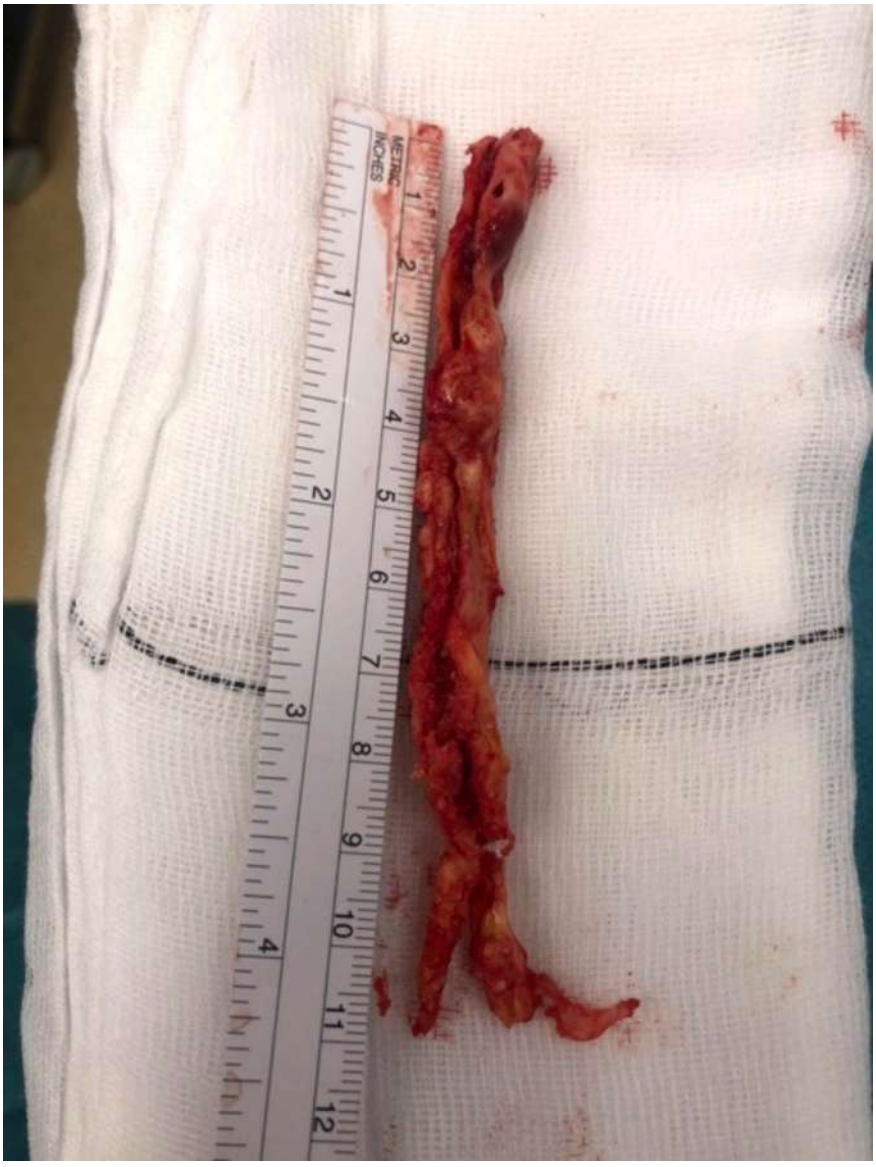

Figure 18.5. Result of a plaque removal by common femoral endarterectomy including femoral bifurcation.

as needed to end in a healthy segment. When the SFA is occluded, one may opt to direct the arteriotomy into the PFA to ensure sufficient outflow to the leg.

The main goal of an endarterectomy is to restore unrestricted blood flow by removing the atherosclerotic plaque. The plane can be between the intima and the media, but mostly results in removing both the intima as well as the inner media. To end up in the right plane, use the forceps to elevate the plaque away from the adventitia. If needed, apply some countertraction on the adventitia; however, be careful not to compress the arterial wall with the forceps. After developing the initial plane, further separate the plaque from the media or adventitia using the Watson-Cheyne elevator, pushing it away from the plaque while holding gentle traction on the plaque simultaneously.

At the proximal end, a physiological termination of the plaque usually occurs, resulting in a smooth endpoint. If not, the plaque may be cut or retracted with an artery forceps. Thereafter, it is good practice to flush the proximal side, to check whether inflow in the CFA is unrestricted. At the distal side, the endarterectomy can be continued into the SFA, the PFA, or both. An effort is made to superficialize the endarterectomy plane to ensure a smooth endpoint, to prevent a significant intimal flap, which may result in dissection or arterial occlusion. It may be needed to terminate the endarterectomy by sharp dissection using an eye blade or scissors. Several separate Kunlin sutures (prolene 6/0 or 7/0) can be placed to tack the distal intima to the media and adventitia. These sutures should be placed from the inside to the outside to prevent dissection of the intima. Moreover, do not put excessive tension while tying the sutures, as this may tear the intima and media. Using heparinized saline, one may test that the intima is well adhered to the vessel wall. Finally, remaining fibers of the media can be gently peeled off the endarterectomy plane (Figure 18.5).

Concomitant obstructive iliac disease

When the inflow is compromised due to obstructive disease extending into the iliac artery, ensure that the endarterectomy is extended up to the level of the epigastric artery and underneath the inguinal ligament; this will ensure safe and durable iliac angioplasty and stent placement if needed.

In case of concomitant femoral and external iliac occlusion, a ring stripper or plaque stripper can be used to extend the endarterectomy up to the level of the iliac bifurcation (Figure 18.6). To do so, the calcified tube is transected at the level of the common femoral arteriotomy. Then, the ring stripper is sized to closely encircle the calcified tube. With gentle traction on the calcified tube, the ring stripper is pushed proximally in a twisting and turning manner. Once resistance occurs, slightly retract the ring stripper and make sure that the tube is detached from the adventitia circumferentially. At the end of the calcification, or when no progress is made, slightly turn and tilt the ring stripper to terminate and remove the plaque (Figure 18.7).

In case of a hybrid intervention, combining a CFE with proximal endovascular treatment, it is of utmost importance to carefully plan the endovascular approach beforehand. One may complete the endarterectomy first. Thereafter, the patch is punctured and a retrograde sheath inserted, to proceed with the endovascular treatment of the iliac trajectory. However, in case of obstructive disease in the groin extending into the external iliac artery, the endarterectomy may impede navigation of the wire in the external iliac artery. Alternatively,

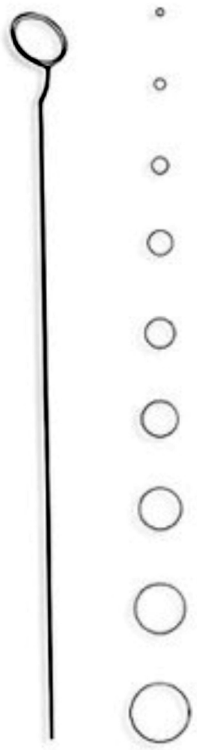

Figure 18.6. Ring stripper in different sizes.

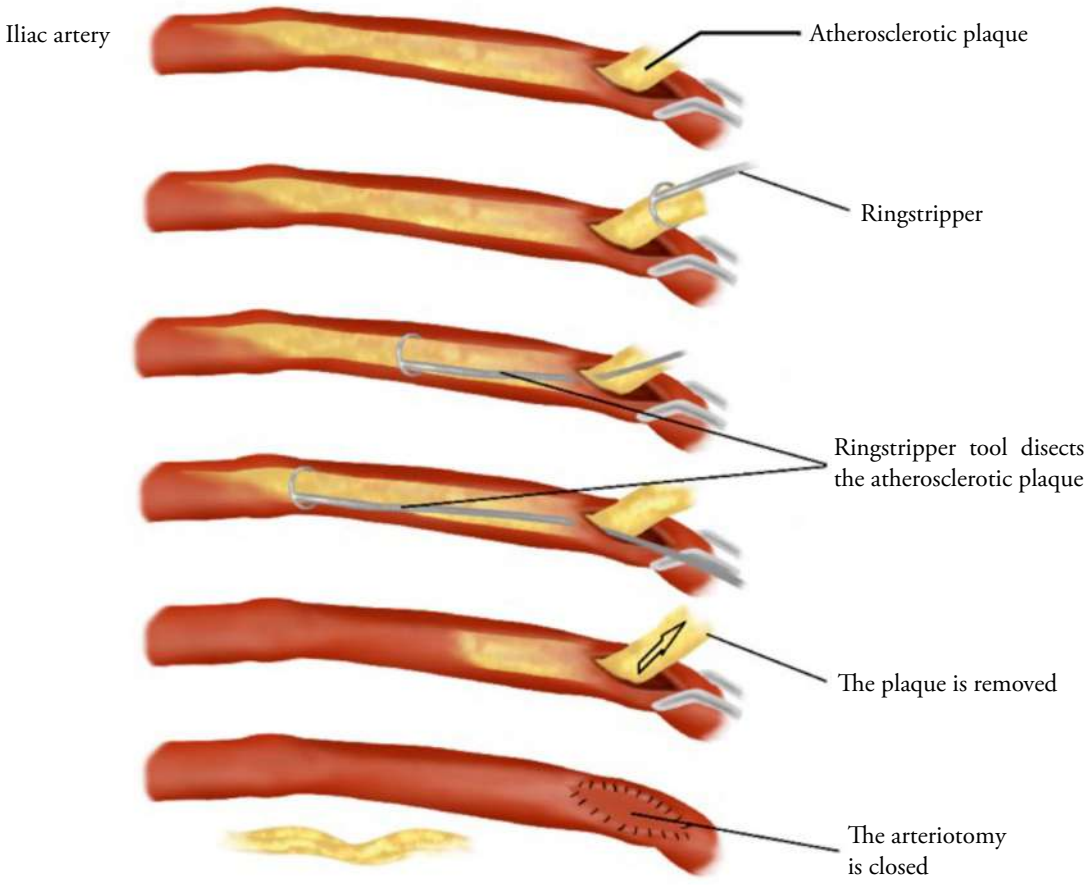

Figure 18.7. The procedural steps for the use of ring stripper tool.

one may puncture the contralateral CFA and cross the iliac lesions in a crossover, antegrade fashion before surgical incision of the diseased side. The wire is left in place in the femoral artery awaiting endarterectomy. With this technique, the guidewire can be picked up after arteriotomy and led outside via puncture of the patch with an 18-gauge needle. After completion of the patch plasty and restoration of flow, the wire can be used to proceed with iliac angioplasty and/or stenting.

Patch plasty

The arteriotomy is closed using an autologous patch from great saphenous vein or a synthetic patch from bovine pericardium, Dacron® or polytetrafluoroethylene (PTFE). Usually, a running non-absorbable prolene suture 5/0 or 6/0 is used, depending on the thickness of the endarterectomized vessel wall. Different techniques can be used, such as the parachuting technique, or starting with a knot in the outmost corner to fixate the patch. Before complete closure, the inflow and outflow need to be flushed, and the artery must be rinsed with heparinized saline. Flow is restored to the PFA first to prevent distal embolization to the foot. Next, the SFA flow is restored.

Closure

Hemostasis is thoroughly checked and, if satisfactory, the femoral sheath is closed with Vicryl running sutures. Several closure techniques are described to prevent postoperative wound complications. It is advisable to close in multiple layers to minimize dead space that may facilitate formation of a hematoma or a lymphocele. The skin should be closed with subcuticular resorbing

monofilament sutures. Evidence suggests that negative pressure wound therapy on the closed skin for several days may further decrease the risk of postoperative wound infection.

TIPS & PITFALLS

- Thoroughly assess the preoperative imaging for dorsal side branches in the CFA, as well as PFA branches.
- Prep and drape wide for extension of incision or to allow for retroperitoneal exposure for adequate proximal control.
- Tissue handling is important in prevention of seroma, wound dehiscence and postoperative wound infection. Marking your incision based on anatomical landmarks and maintaining a straight dissection will improve tissue handling.
- Encircle the CFA proximally of the epigastric and circumflex artery; it prevents the vessel loop from slipping caudally, into your operating field.
- In case of concomitant iliac disease in a hybrid procedure, make sure to extend the endarterectomy cranially to Poupart ligament. In this way, PTA/stenting beyond the ligament is avoided.
- A Y-patch can be created in case both the SFA and the PFA need an arteriotomy to obtain an adequate endarterectomy.
- Do not injure the great saphenous vein; you may need it for a later bypass.

TROUBLESHOOTING

- There is bleeding from the suture lines of the patch. First tamponade the bleeding, but if not sufficient use a 6-0 prolene to oversew leakages, and do this always with the vascular clamps back on, to prevent tearing the thin endarterectomized wall.
- There is bleeding from the endarterectomized vessel wall. Use a piece of muscle or remaining patch to stitch tears in the vessel wall, while the vascular clamps are back on.
- There is inadequate pulsation distally from the endarterectomy. This is probably caused by a dissection flap at the endpoint of the endarterectomy. Reopen the patch and correct using Kunlin stitches.

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