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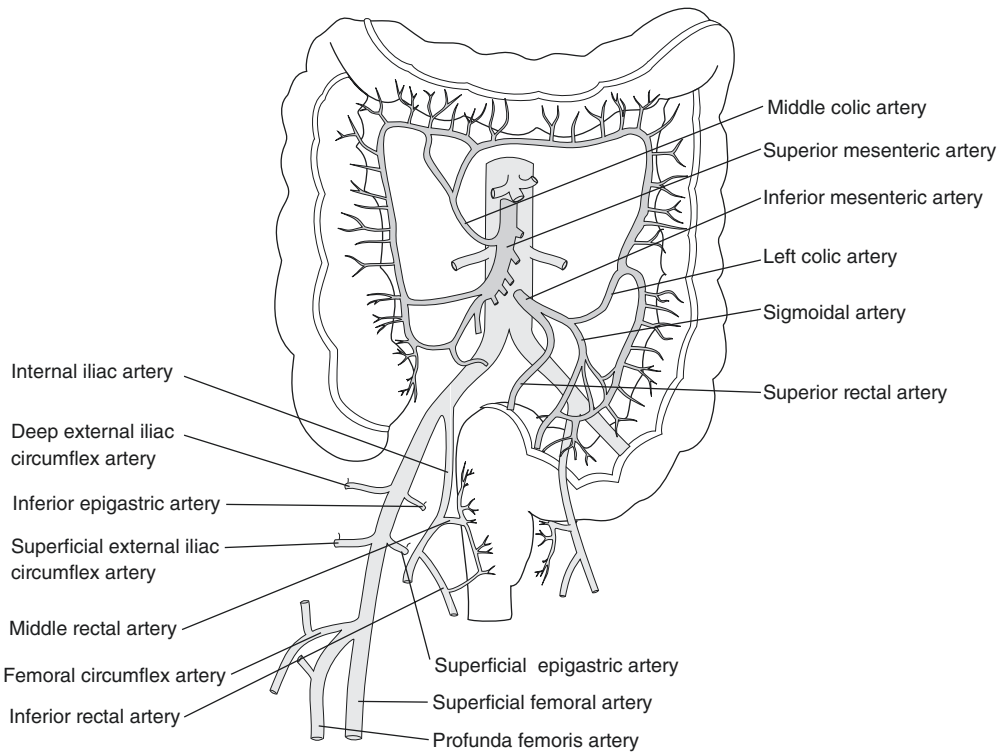
Pelvic Revascularization During Aortic Reconstruction

Jamal J. Hoballah

Preservation of pelvic perfusion should be an integral part of any aortic reconstructive procedure. Pelvic ischemia is an important complication that may, on occasion, be fatal. The clinical manifestations of pelvic ischemia include buttock claudication, buttock necrosis, rectosigmoidal ischemia, cord ischemia resulting in urinary and fecal incontinence, and sexual dysfunction. A knowledge of the pelvic blood supply is essential to understanding and planning the preservation of pelvic perfusion during aortic reconstruction.



J. J. Hoballah (✉)
Department of Surgery, American University of Beirut Medical Center, Beirut, Lebanon
e-mail: jh34@aub.edu.lb

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The pelvic blood supply is derived from several sources. The right and left internal iliac arteries provide the major blood supply to the pelvis. In addition, the pelvis receives some blood supply from branches of the external iliac artery. These branches include the inferior epigastric and the deep external iliac circumflex arteries. The inferior mesenteric artery (IMA) can also contribute to the pelvic blood supply. The inferior mesenteric artery divides into three main branches: the left colic artery, the sigmoidal artery, and the superior rectal artery. The contribution of the IMA to the pelvic blood supply is usually through the superior rectal artery, which communicates with the middle and inferior rectal arteries. The pelvis can also receive some blood supply from the superior mesenteric artery through its middle colic artery branch. The middle colic artery communicates with the left colic artery, which in turn connects with the superior rectal artery. The pelvis may also acquire further blood supply from the common femoral arteries through the superficial epigastric and superficial iliac circumflex arteries. In addition, the profunda femoris artery through its femoral circumflex branches can also contribute to the pelvic blood supply. Thus, the collateral blood flow to the internal iliac artery may originate from the contralateral internal iliac, the ipsilateral external iliac, the inferior mesenteric, the superior mesenteric, the common femoral, and the profunda femoris arteries.

An important principle of aortic reconstruction is to maintain the perfusion of at least one internal iliac artery to avoid the possible complication of pelvic ischemia [1, 4]. However, the perfusion of both internal iliac arteries is desirable if it can be safely accomplished without excessive prolongation of the duration of the procedure.

AORTOILIAC OCCLUSIVE DISEASE

In a patient with aortoiliac occlusive disease, the proposed reconstruction is usually an aortobifemoral bypass. The proximal anastomosis can be carried out in an end-to-end (section "Distal Anastomosis to the External Iliac Artery with a Bypass to the Internal Iliac Artery") or end-to-side configuration (section "End-to-End Aortobifemoral Bypass"). Pelvic perfusion may be maintained by constructing the proximal aortic anastomosis in an end-to-side fashion. This type of anastomosis is especially necessary when the external iliac arteries are heavily involved with occlusive disease. In this situation, an end-to-end aortofemoral bypass cannot provide retrograde perfusion to the internal iliac arteries due to the disease in the external iliac arteries. If an end-to-side aortobifemoral bypass cannot be performed, pelvic revascularization may still be achieved by constructing a side-to-side anastomosis between the graft limb and the common iliac artery bifurcation (section "End-to-End Aortobifemoral Bypass") [2]. It is important to perfuse the profunda and preserve its branches during the aortobifemoral bypass procedure. A profundaplasty should be performed if necessary.

AORTOILIAC ANEURYSMAL DISEASE

In aortic aneurysmal disease, the extent of replacement is usually governed by the extent of the aneurysmal disease and the anatomy of the pelvic circulation. If the aneurysmal disease is limited to the infrarenal aorta, a tube graft replacement is usually performed (section "Distal Anastomosis to the Aortic Bifurcation"). The perfusion of the internal iliac arteries is then restored to the preoperative status. Similarly, if the aneurysmal disease extends into the common iliac arteries but does not involve the iliac bifurcation, the preoperative internal iliac perfusion can be maintained by the placement of an aortobiiliac bypass graft.

When the aneurysmal disease extends to the level of the iliac bifurcation, several options may be available. One option is to transect the common iliac

artery approximately 1.5 cm proximal to the bifurcation. An arteriotomy is created into the origin of the external iliac artery for 1–1.5 cm. The limb of the graft is transected in a beveled fashion and sutured in an end-to-end manner to the transected common iliac artery (section "Distal Anastomosis to the Common Iliac Artery"). When constructing the posterior part of the anastomosis, the needles usually are introduced close to the orifices of the internal iliac and external iliac arteries, which are not involved in the aneurysmal pathology. The advantage of this technique is that it provides direct antegrade flow into the internal and external iliac arteries. In addition, it involves performing a single anastomosis. However, if the iliac arteries are heavily calcified, this anastomosis may be quite challenging. A localized endarterectomy may need to be performed with tacking of the endarterectomy endpoint.

Another option to preserve internal iliac artery flow is to transect the common iliac artery approximately 1.5 cm from the iliac bifurcation. The transected common iliac artery is oversewn without obliterating the orifices of the external and internal iliac arteries. The arteriotomy is then created in the external iliac artery. A limb of the aortobiiliac graft is sutured in an end-to-side manner to the external iliac artery. The perfusion into the internal iliac artery is provided by retrograde flow from the external iliac artery. This technique may be ideal when the iliac bifurcation is calcified and the plaque extends into the proximal part of the external iliac artery. In this situation, the distal external iliac artery is mobilized and the arteriotomy is created in the disease-free distal segment of the external iliac artery.

The aneurysmal disease may extend beyond the iliac bifurcation into the internal iliac artery with sparing of the external iliac artery. If the disease is limited to the proximal part of the internal iliac artery, one possible technique involves suturing the limb of the graft to the internal iliac artery in an end-to-end manner [3]. The external iliac artery is then reimplanted into the limb of the graft (section "Distal Anastomosis to the Internal Iliac Artery with Reimplantation of the External Iliac Artery"). If the aneurysmal disease extends into the proximal part of the external iliac artery, the limb of the graft can be connected to the external iliac artery in an end-to-end fashion. A separate graft is then sutured to the internal iliac artery (section "Distal Anastomosis to the External Iliac Artery with a Bypass to the Internal Iliac Artery"). This graft may originate from the body or limb of the aortic graft. If the aneurysmal disease extends into the distal part of the internal iliac artery, an anastomosis may not be technically possible. In this situation, ligation of the internal iliac artery becomes necessary.

Infrequently, perfusion of at least one internal iliac artery is not possible because of extensive involvement by aneurysmal or occlusive disease. In this situation, the pelvic blood supply may be maintained by preserving the collateral blood supply of the internal iliac artery. This can be accomplished by reimplanting the inferior mesenteric artery. In addition, the blood flow into the external iliac artery and the profunda femoris artery and their branches should be maintained [4].

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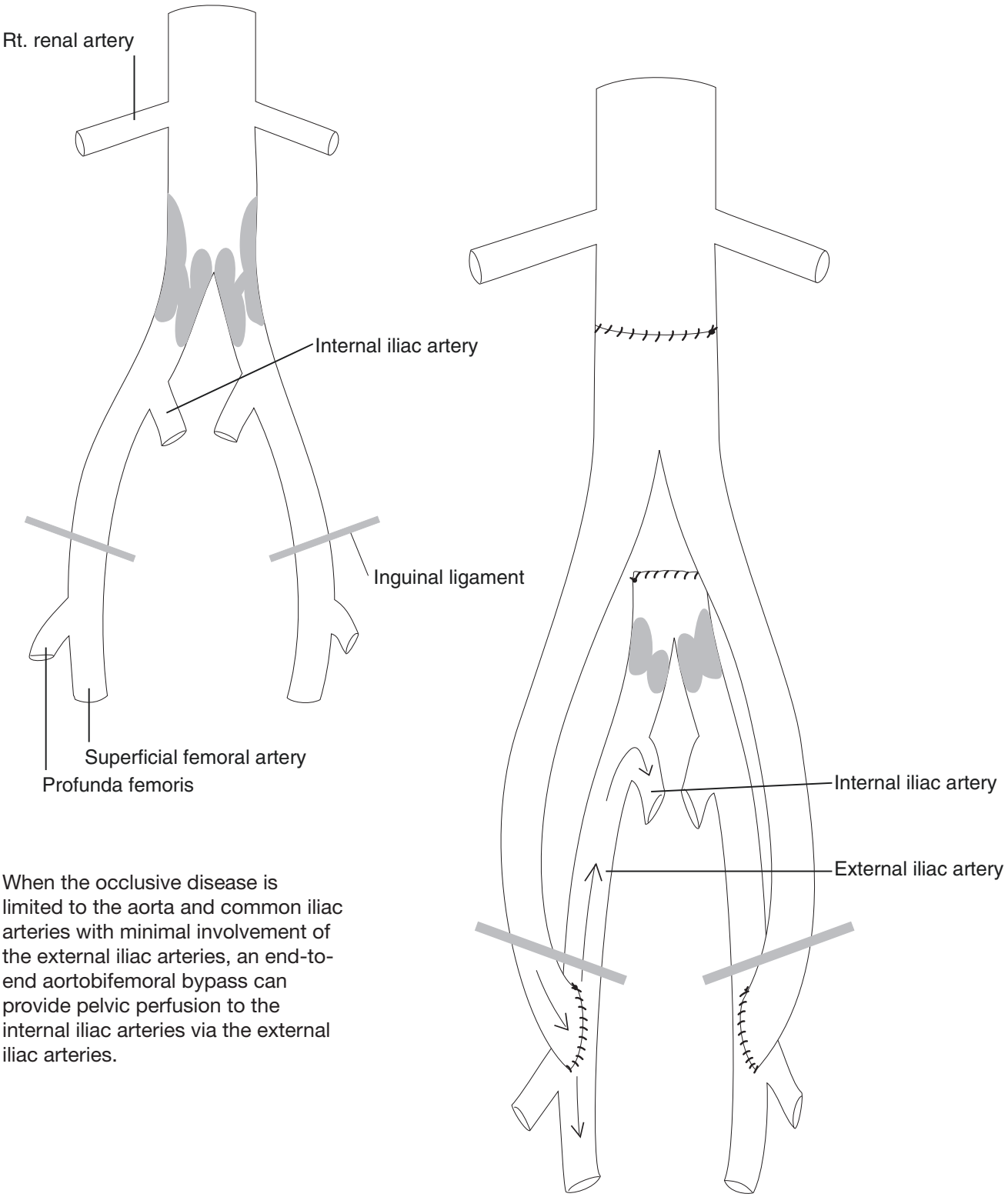
1. Connolly JE, Ingegno M, Wilson SE. Preservation of the pelvic circulation during infrarenal aortic surgery. Cardiovasc Surg. 1996;4:65–70.
2. Cronenwett JL, Gooch JB, Garrett E. Internal iliac artery revascularization during aortofemoral bypass. Arch Surg. 1982;117:838–9.
3. Hoballah JJ, Chalmers RTA, Nazzal MM, Mohan CR, Corson JD. Internal iliac revascularization during aortic aneurysm replacement: a review and description of a useful technique. Am Surg. 1997;63:970–4.
4. Iliopoulos JI, Hermreck AS, Thomas JH, Pierce GE. Hemodynamics of the hypogastric arterial circulation. J Vasc Surg. 1989;9:637–42.

Aortoiliac Occlusive Disease

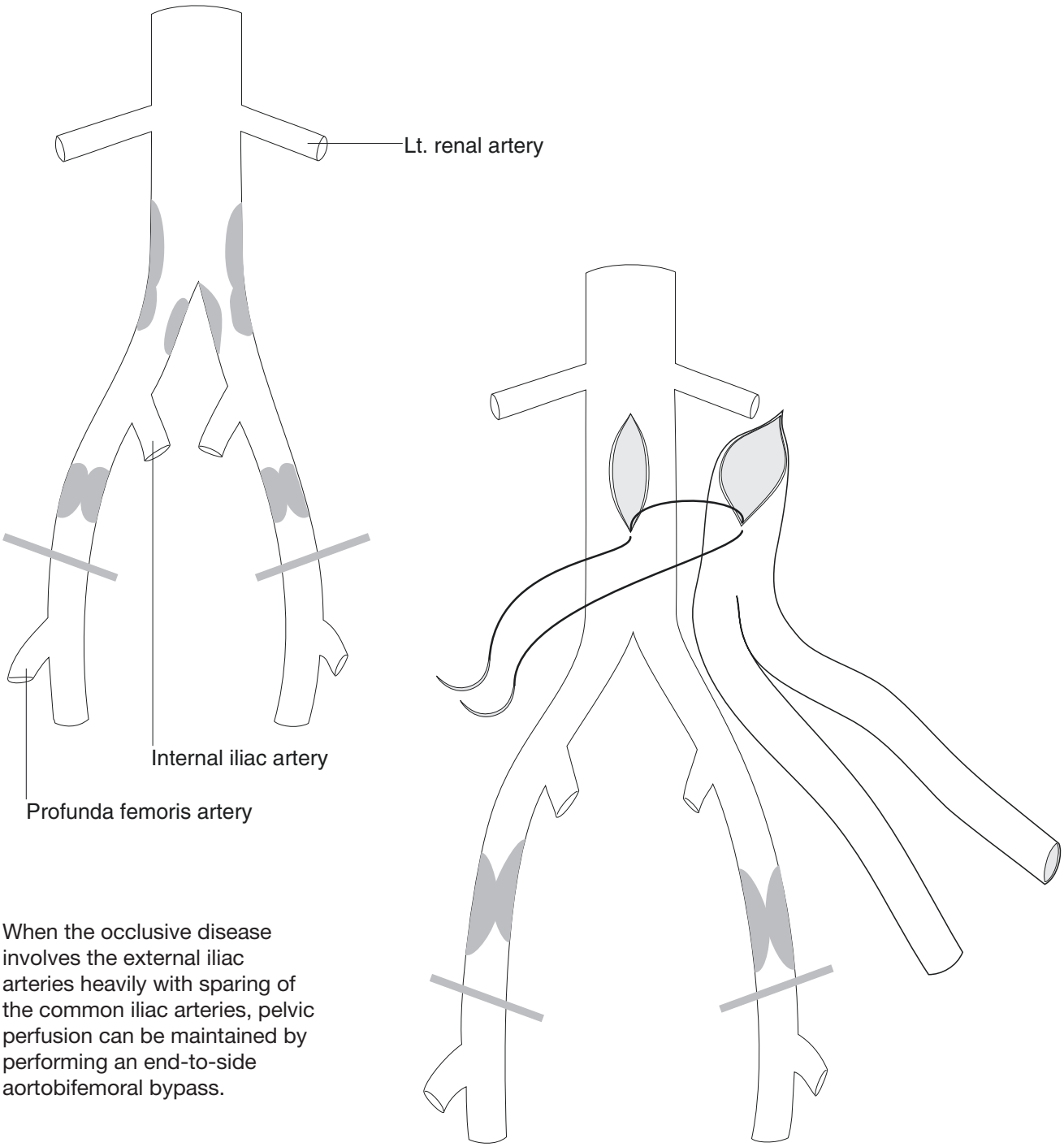
End-to-End Aortobifemoral Bypass



When the occlusive disease is limited to the aorta and common iliac arteries with minimal involvement of the external iliac arteries, an end-to-end aortobifemoral bypass can provide pelvic perfusion to the internal iliac arteries via the external iliac arteries.

Aortoiliac Occlusive Disease

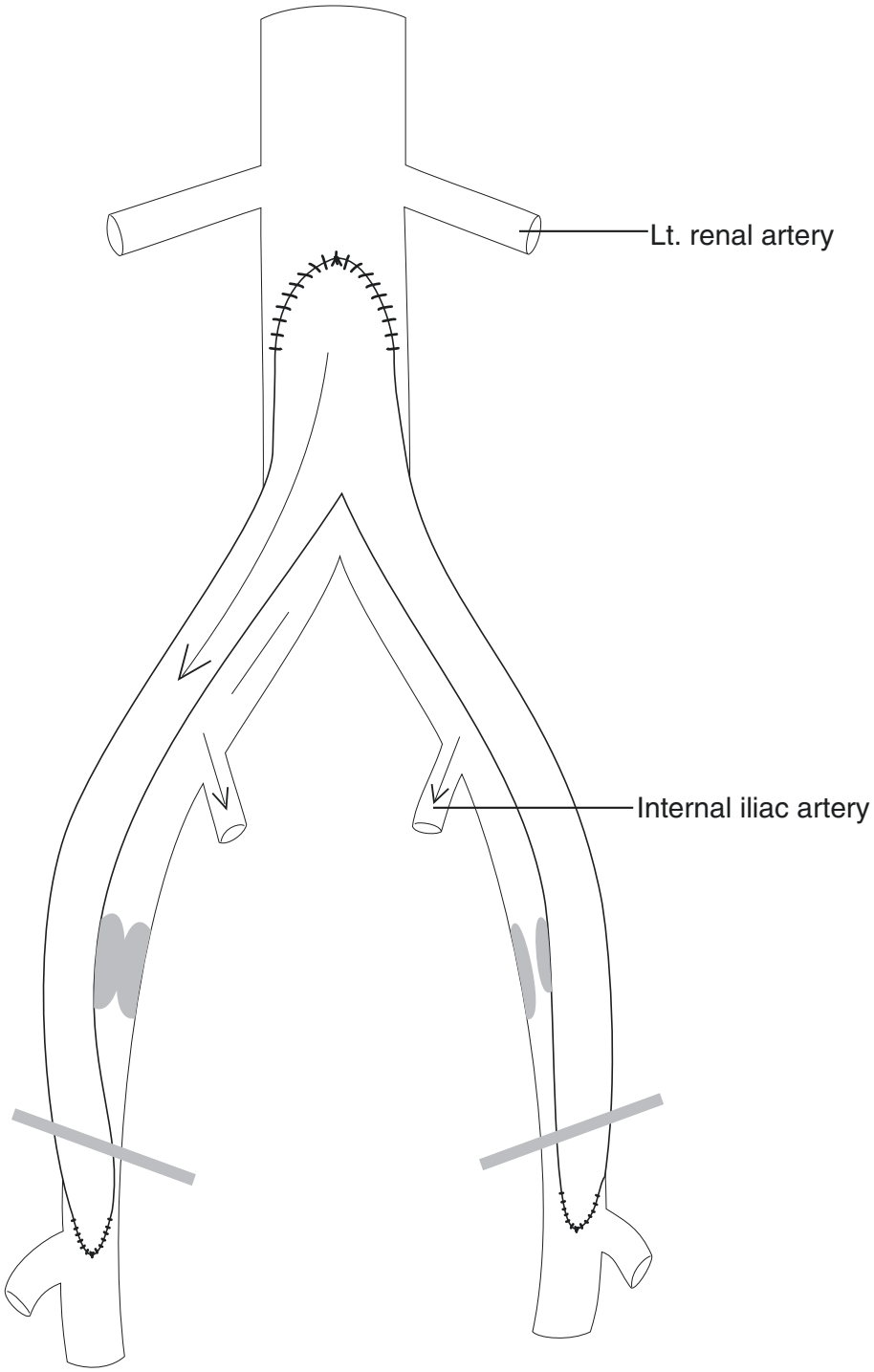
End-to-End Aortobifemoral Bypass



When the occlusive disease involves the external iliac arteries heavily with sparing of the common iliac arteries, pelvic perfusion can be maintained by performing an end-to-side aortobifemoral bypass.

Aortoiliac Occlusive Disease

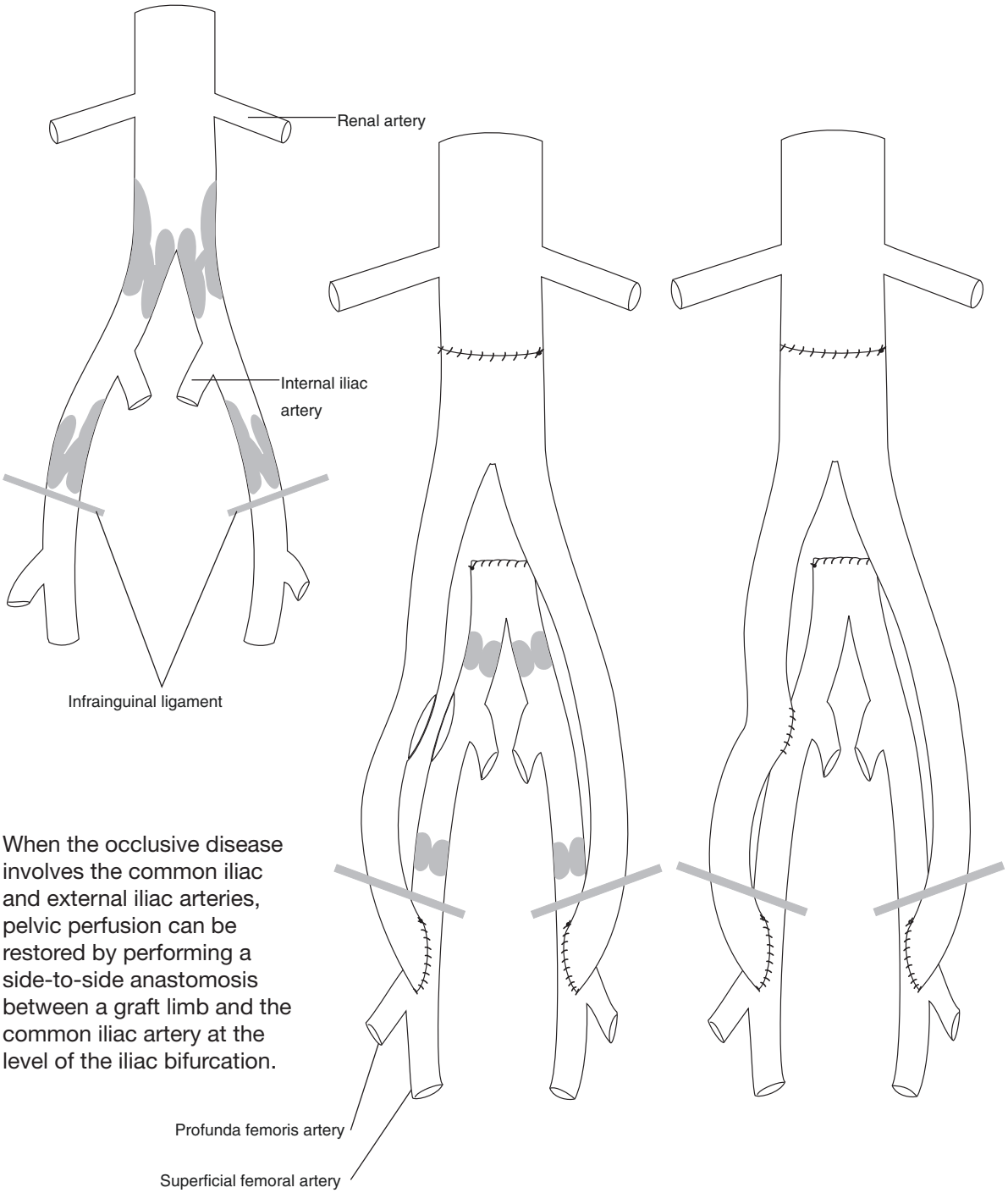
End-to-End Aortobifemoral Bypass



In the end-to-side reconstruction, the native circulation is usually left undisturbed.

Aortoiliac Occlusive Disease

End-to-End Aortobifemoral Bypass



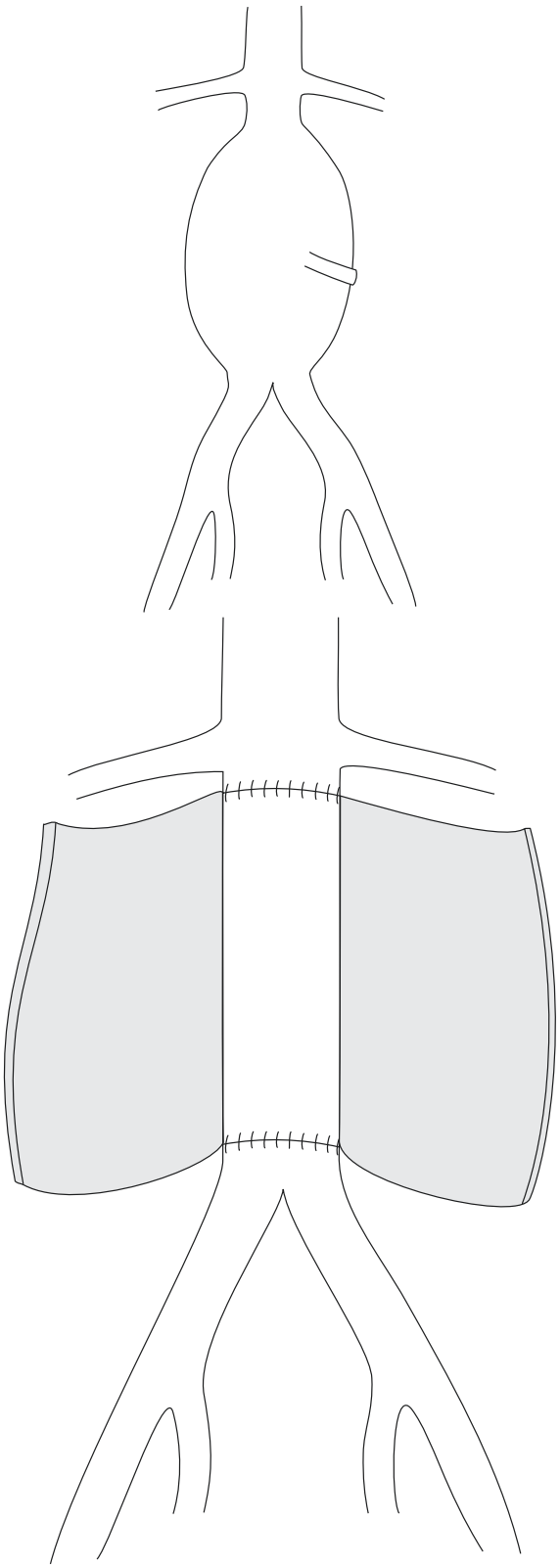
When the occlusive disease involves the common iliac and external iliac arteries, pelvic perfusion can be restored by performing a side-to-side anastomosis between a graft limb and the common iliac artery at the level of the iliac bifurcation.

Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Aortic Bifurcation

When the aneurysmal pathology is limited to the aorta and does not involve the common iliac arteries, a tube graft replacement is performed.

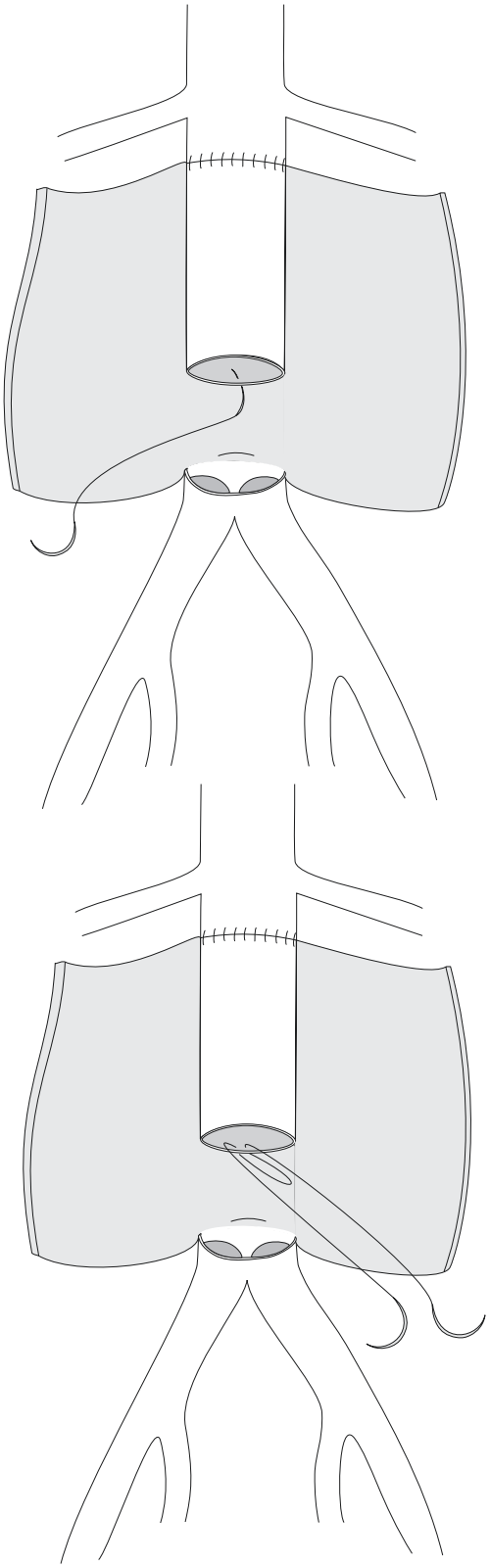
When performing a tube graft replacement, the distal anastomosis can be very challenging because of calcifications or the absence of a well-defined neck at the level of the aortic bifurcation.



Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Aortic Bifurcation

The same principles discussed in the construction of the proximal aortic bifurcation apply here as well. The suture can be started at the center of the posterior suture line or on either side. However, when the neck is ill defined, starting at the center of the posterior wall can help to establish even progression on either side, as shown here.

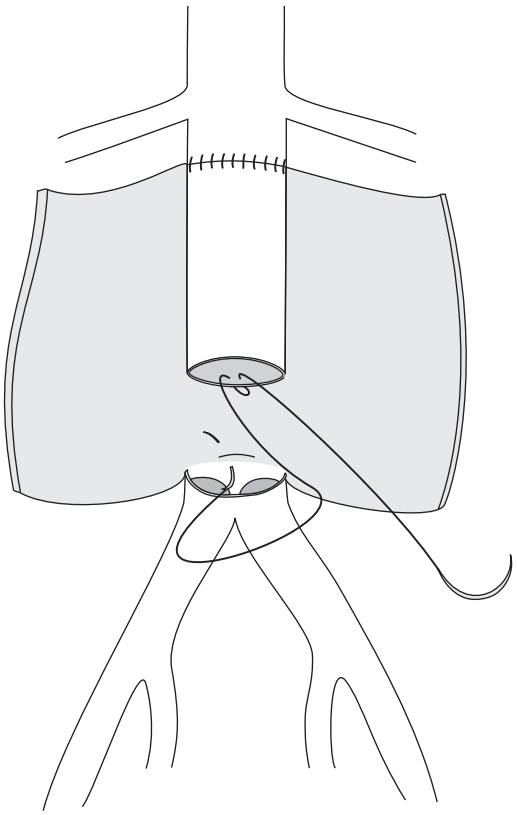


Start by placing a horizontal mattress suture in the center of the posterior wall of the graft.

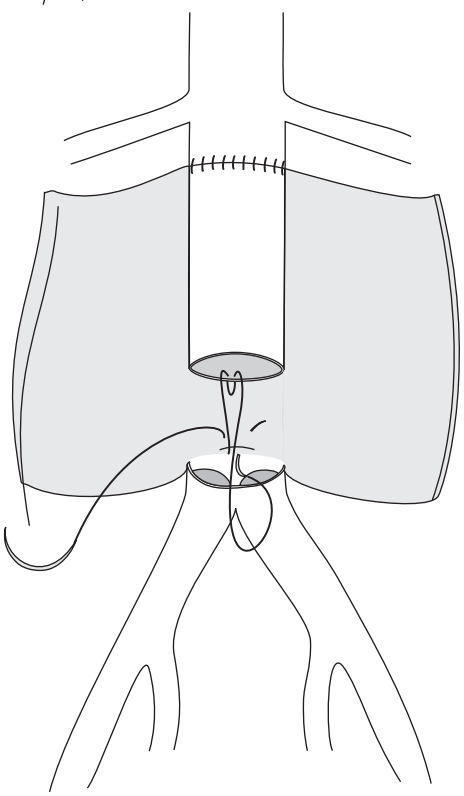
AORTOILIAC ANEURYSMAL DISEASE

Distal Anastomosis to the Aortic Bifurcation

Introduce the needle in the center of the posterior aortic wall. The site of introduction of the needle should be free of aneurysmal disease. The needle can be introduced very close to the orifices of the common iliac arteries. It is preferable to avoid excessive advancement when constructing the posterior wall because of the difficulty in controlling bleeding from the posterior suture line.



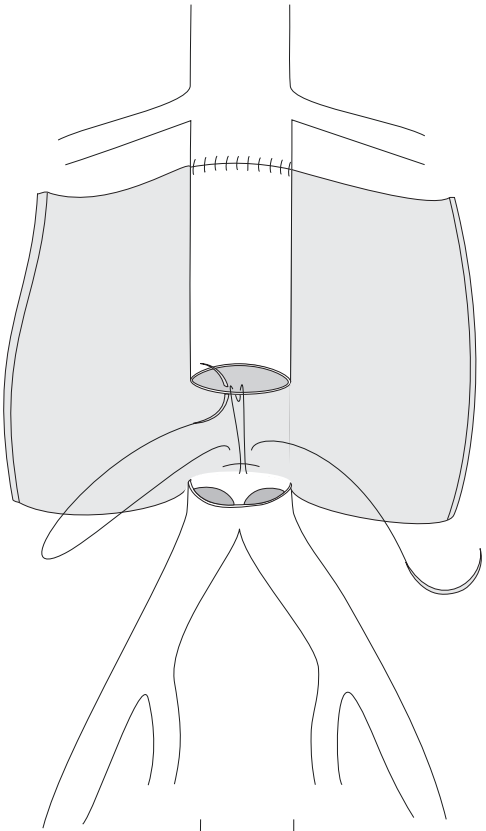
Place a matching horizontal mattress suture in the center of the posterior aortic wall.



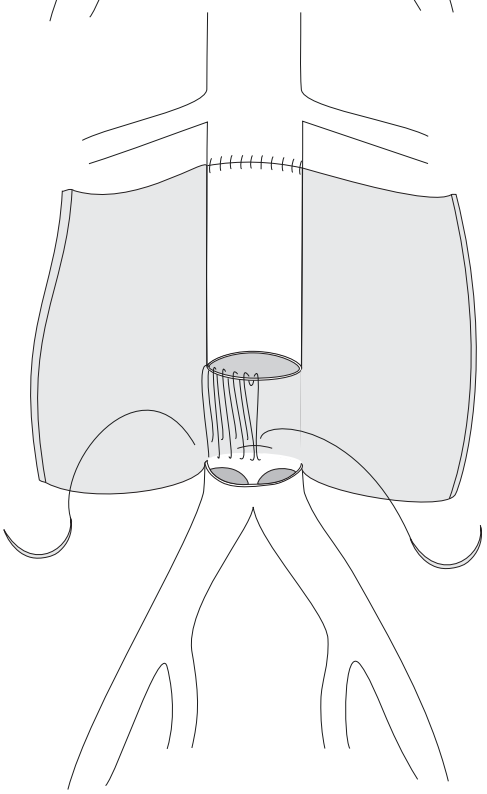
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Aortic Bifurcation

Introduce the needle in the graft.



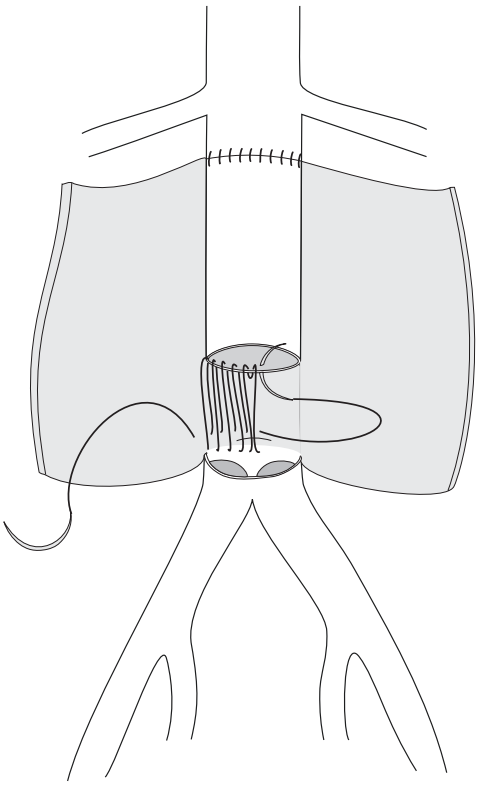
Complete suturing the posterior part of the suture line on one side.



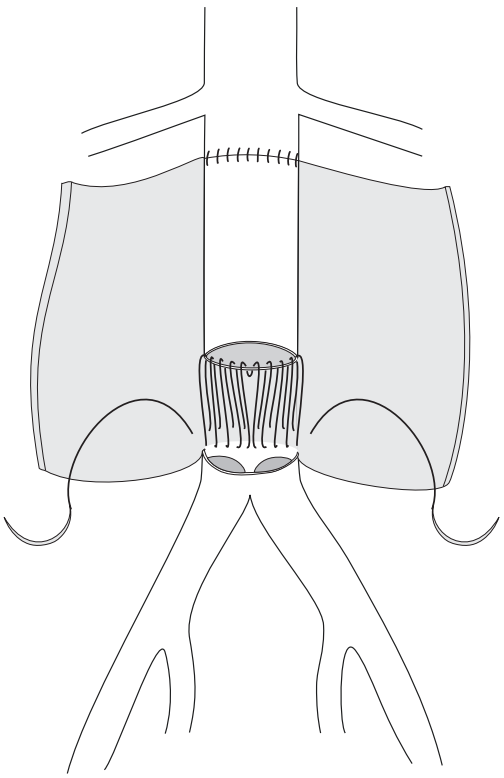
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Aortic Bifurcation

Do the same on the other side. Introduce the needle in the graft, outside-in.



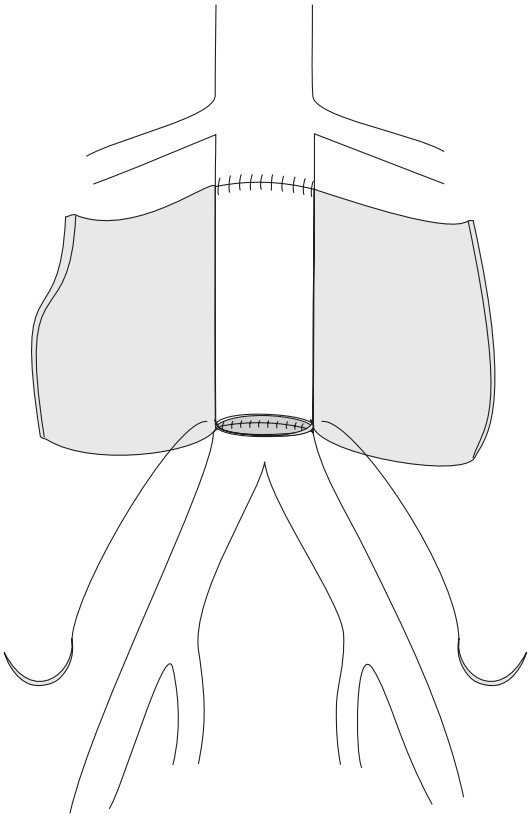
Complete the posterior suture line on the other side.



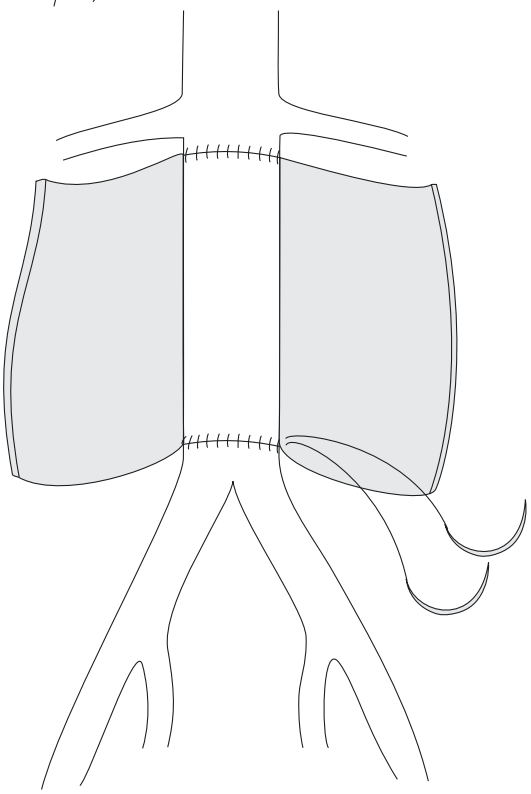
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Aortic Bifurcation

Pull and tighten the suture line. Use a nerve hook to ensure that the suture line is not loose.



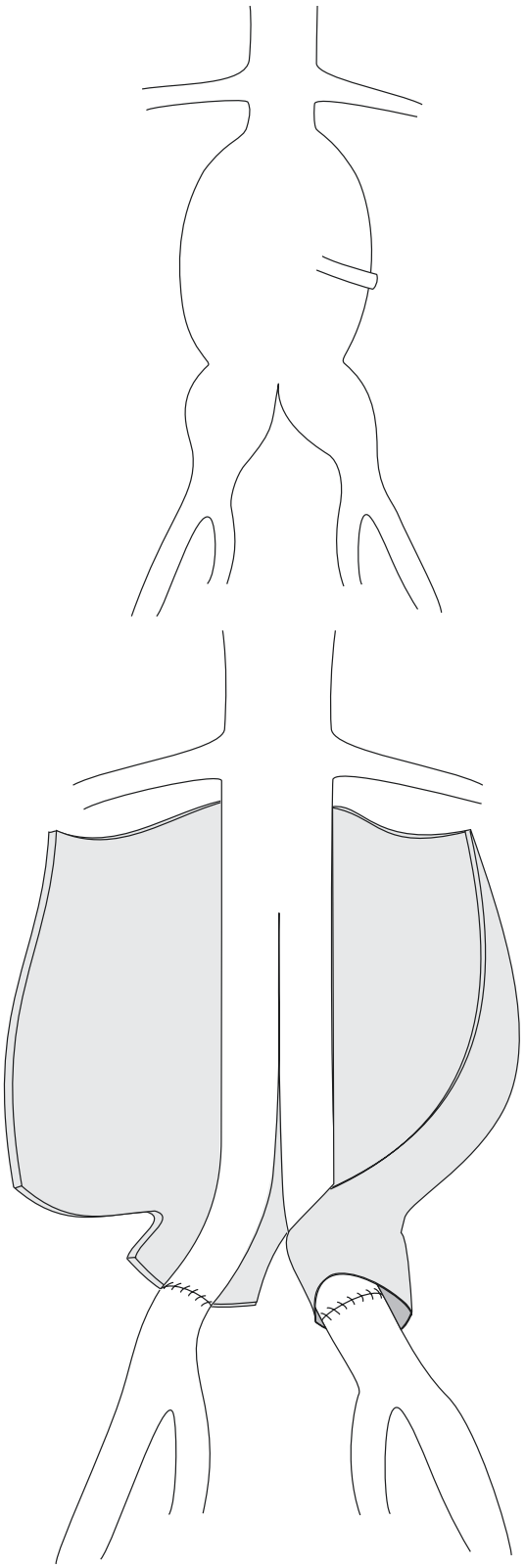
You may start another suture for the anterior part of the anastomosis. Alternatively, you may continue with the same suture to complete the anastomosis as shown here.



Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Common Iliac Artery

When the aneurysmal pathology extends to the proximal portion of the common iliac arteries, a bifurcated graft replacement to the level of the distal common iliac arteries is performed.

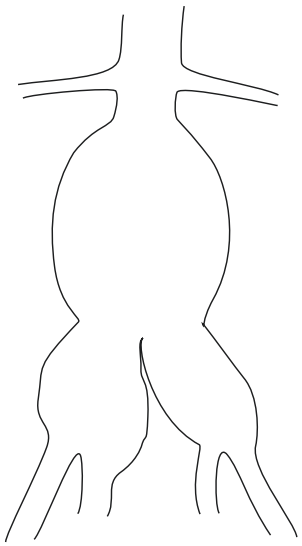


The posterior wall of the common iliac artery may be transected or left intact. Be careful to avoid injury to the iliac veins, which could occur during the transection of the common iliac arteries. In addition, make sure that the bites in the transected iliac artery include the adventitia. On the left side, the graft can be tunneled through the aneurysmal iliac artery.

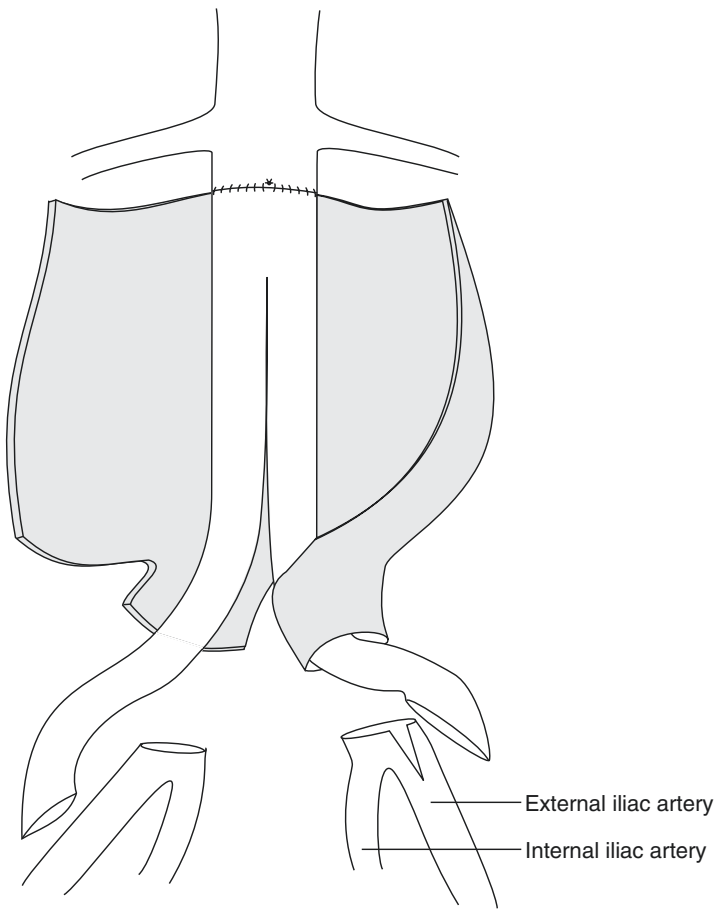
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Common Iliac Artery

When the aneurysmal disease extends to the iliac bifurcation, several options are available depending on the quality of the common iliac artery at the bifurcation.



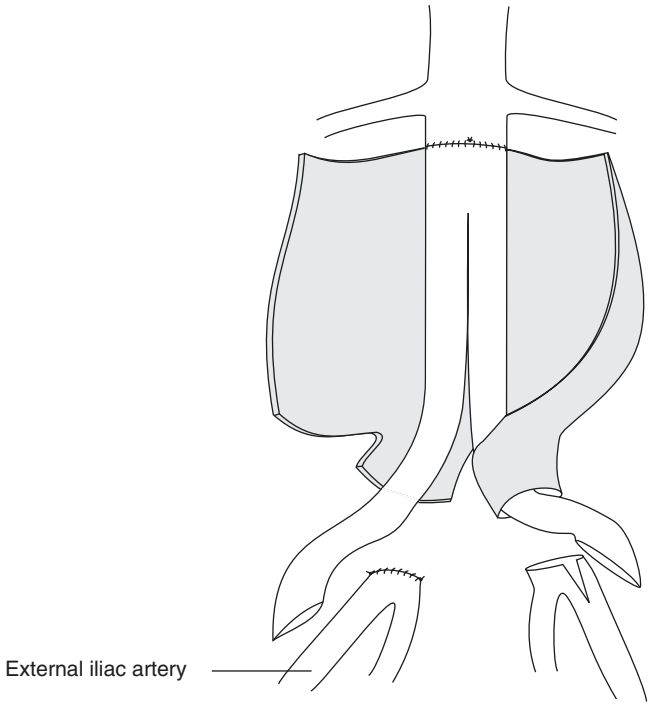
If the iliac bifurcation is not heavily calcified, the arteriotomy can be extended into the orifice of the external iliac artery as shown on the left side.



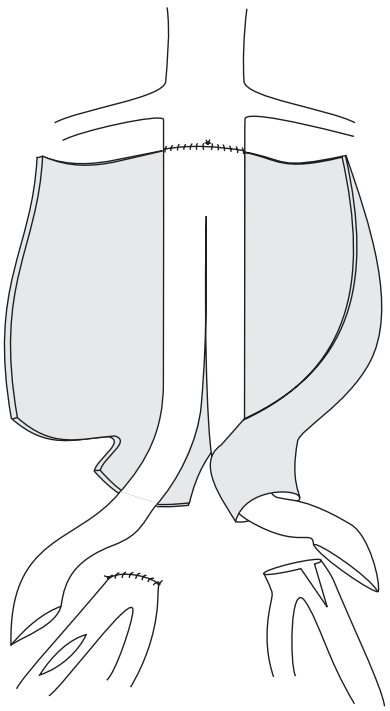
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Common Iliac Artery

If the iliac bifurcation is heavily calcified, or if the first part of the external iliac artery is involved with occlusive pathology, the transected common iliac artery is oversewn as shown on the right side.



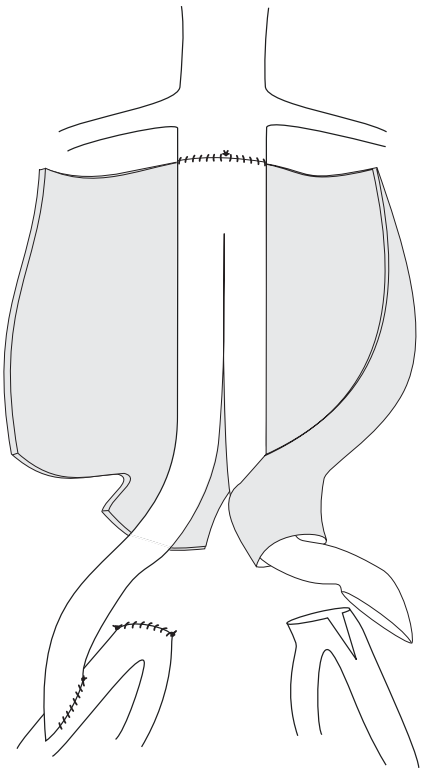
A soft area is then chosen in the external iliac artery for constructing the distal anastomosis.



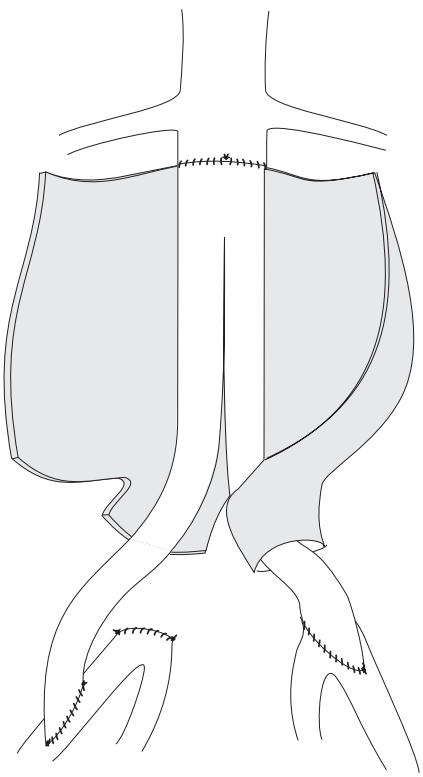
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Common Iliac Artery

An end-to-side anastomosis is then constructed to the external iliac artery, which will also provide retrograde flow into the internal iliac artery as shown on the right side.



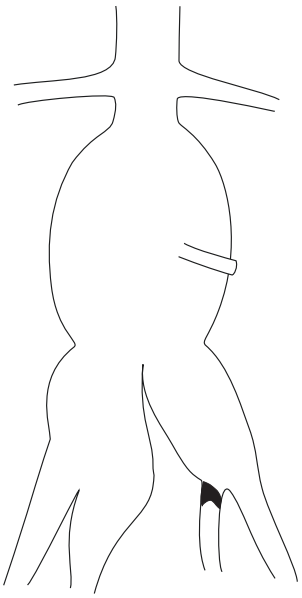
The reconstruction on the left side provides antegrade perfusion into the external and internal iliac arteries. If a localized endarterectomy is performed, tacking of the endarterectomy endpoint should be considered.



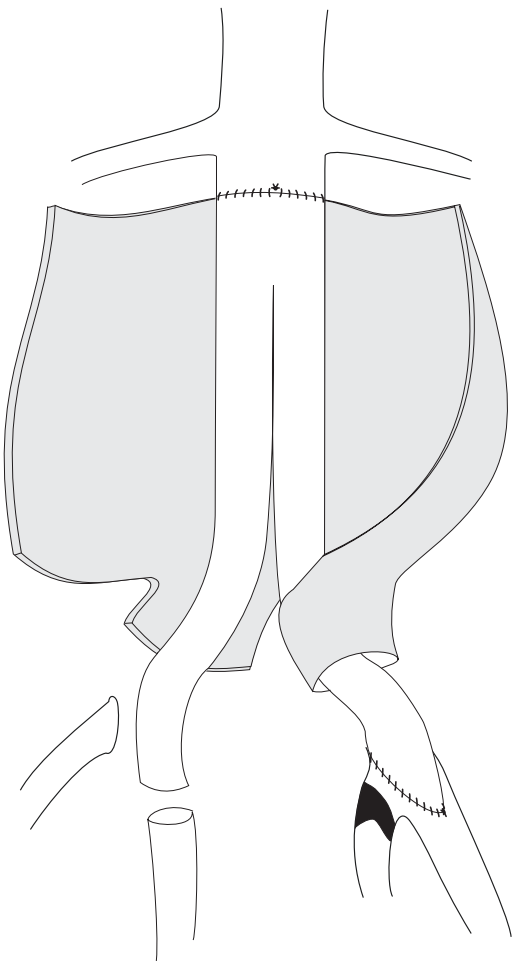
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Common Iliac Artery

When the aneurysmal disease extends beyond the iliac bifurcation into the proximal part of the internal iliac artery, revascularization of at least one internal iliac artery should be attempted.



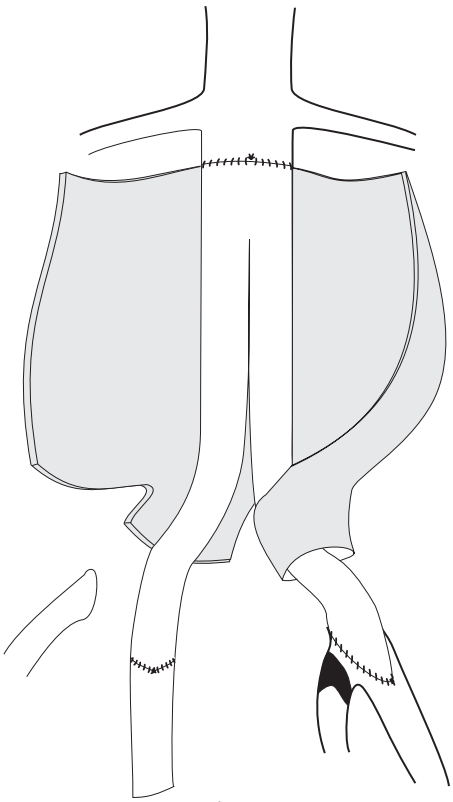
If the aneurysmal disease is limited to the very proximal part of the internal iliac artery, one option is to transect the external iliac artery at the level of the iliac bifurcation. The graft is anastomosed to the internal iliac artery using an end-to-end configuration as shown on the right side.The external iliac artery is then reimplanted into the limb of the graft.



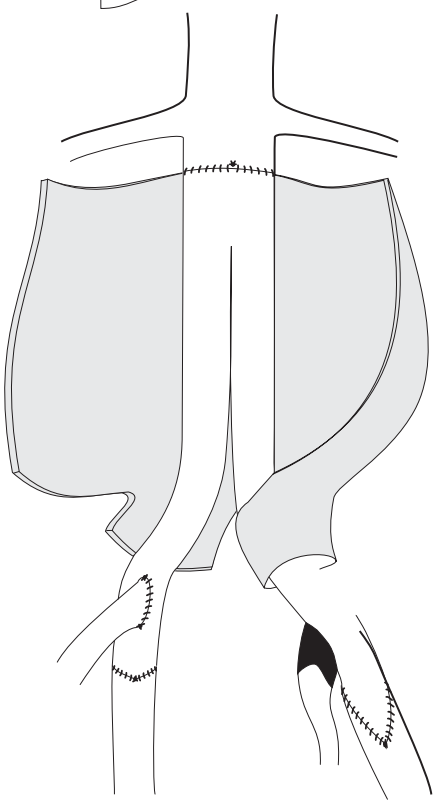
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Internal Iliac Artery with Reimplantation of the External Iliac Artery

The graft is anastomosed to the internal iliac artery using an end-to-end configuration as shown on the right side.



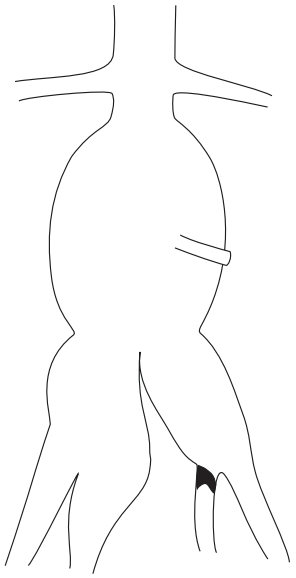
The external iliac artery is then reimplanted into the limb of the graft.



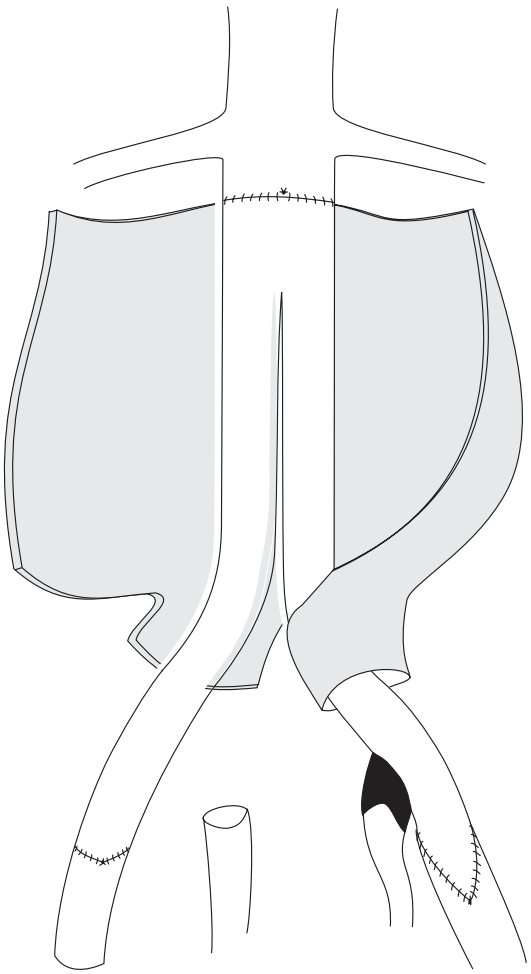
Aortoiliac Aneurysmal Disease

Distal Anastomosis to the Internal Iliac Artery with Reimplantation of the External Iliac Artery

Another option to revascularize the pelvis in the situation shown on the right side involves constructing a separate bypass to the internal iliac artery.



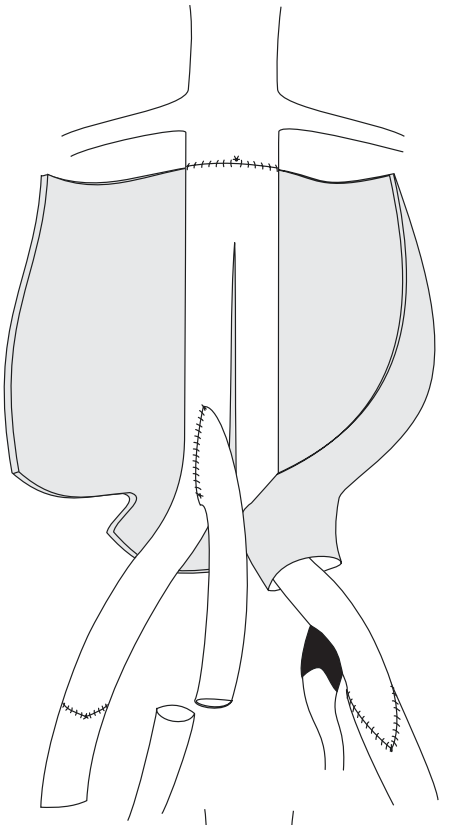
The graft limb is first anastomosed to the external iliac artery.



Aortoiliac Aneurysmal Disease

Distal Anastomosis to the External Iliac Artery with a Bypass to the Internal Iliac Artery

A separate graft is then sutured to the body of the graft or to one of its limbs as shown here.



The bypass is then anastomosed to the internal iliac artery.