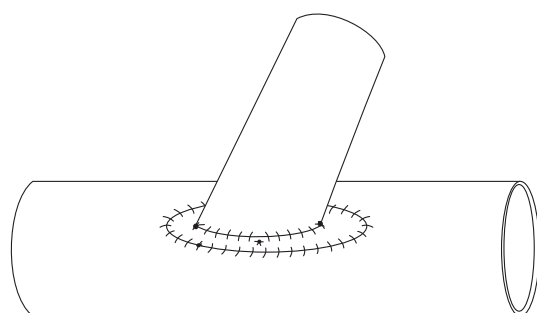


Adjunctive Techniques: Distal Anastomosis of an Infrainguinal Prosthetic Bypass

Jamal J. Hoballah

VEIN PATCHES AND CUFFS

Neointimal hyperplasia is a leading cause of bypass failure in the intermediate postoperative period (2–24 months). In prosthetic bypasses, neointimal hyperplasia is most likely to develop at the level of the distal anastomosis. Several techniques have been developed in an attempt to improve the patency of infrainguinal prosthetic bypasses [1, 2, 5, 6, 7, 8, 9, 10]. These techniques involve incorporating a segment of vein between the prosthetic bypass and the recipient artery. The theory behind these techniques is that the interposition of the vein segment may ameliorate the future development of neointimal hyperplasia at the level of the distal anastomosis. In addition, incorporating the vein segment could facilitate the construction of the distal anastomosis and improve bypass patency in the immediate postoperative period. Although these techniques were often used, there are very few prospective randomized trials to date that show their efficacy [1, 2, 3]. Furthermore, there are no prospective randomized trials that compare these various techniques in an attempt to identify which technique is best. With the advancement of endovascular technology and the availability of aggressive infrainguinal and infrapopliteal revascularization options, including retrograde pedal and popliteal access, tibial prosthetic bypasses are rarely performed nowadays. Nevertheless, when used as a last resort prior to an amputation, adjunctive techniques may be useful.



Linton's Patch

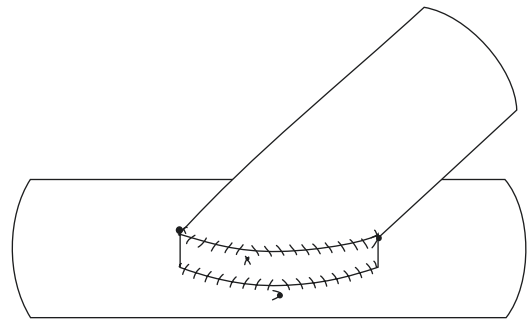
LINTON PATCH

In one technique (section “Linton Patch”), a vein patch angioplasty is initially performed at the site selected for the distal anastomosis. An incision is created in the patch and used as the new site for constructing the anastomosis. The graft is then sutured to the vein patch. This technique is often referred to as the “Linton patch” technique [1, 3, 4]. It is relatively simple to perform and can facilitate the construction of the anastomosis, especially in a heavily calcified vessel.

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MILLER CUFF

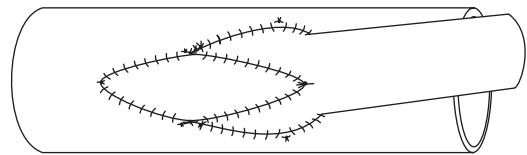
Another technique involves suturing a segment of vein to the arteriotomy at the site selected for the distal anastomosis as a collar or a cuff. The graft is then sutured to the vein cuff. This technique originally described by Siegman is usually referred to as the "Miller cuff technique" [5, 7]. Several modifications of this technique have been described. The simplest method to perform is illustrated in section "Miller Cuff." St. Mary's boot, another modification of the Miller cuff, is also described in section "Miller Cuff" [5].



Miller's Cuff

TAYLOR PATCH

Another technique involves constructing the distal anastomosis directly between the graft and the artery. An incision is then created in the graft at the level of the distal anastomosis and extended through the apex for 1–2 cm into the outflow artery. A vein patch angioplasty of the incision is then performed. This method is referred to as the "Taylor patch" (section "Taylor Patch") [9]. This technique can be technically demanding and requires mobilization of a long segment of artery in order to construct the anastomosis.



Taylor's Patch

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Vein Patches and Cuffs
Linton Patch

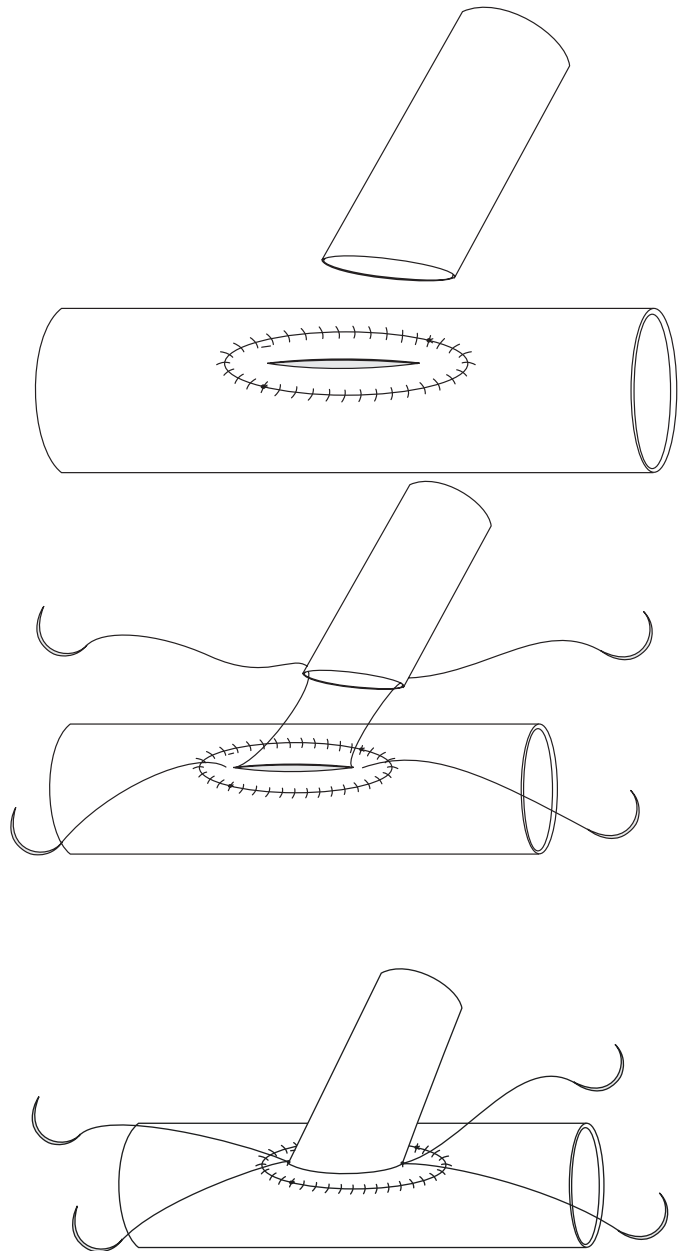
Create an arteriotomy measuring 1.5–2.0 cm. Suture a vein patch to the arteriotomy as shown in Chap. 8.

Perform an incision in the center of the patch.

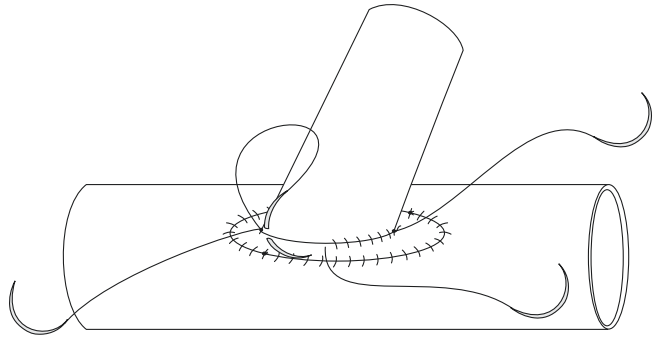
Transect the prosthetic graft in a beveled manner to match the incision in the vein patch.

Start one suture at the heel the graft (outside-inside), and then through the intimal part of the vein patch. place a similar suture at the apex.

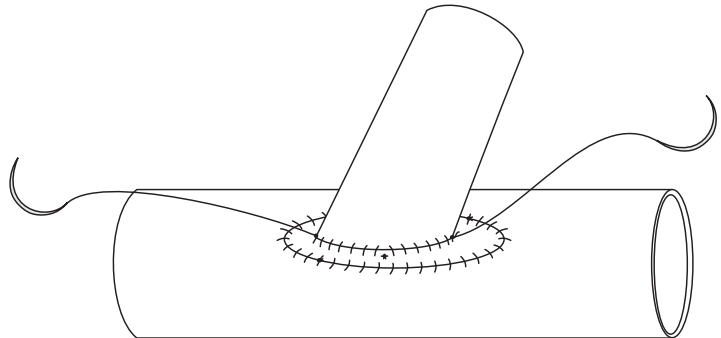
Tie both sutures.



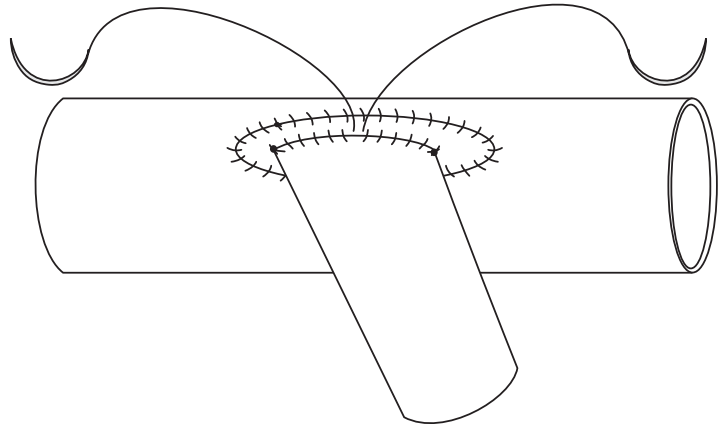
Start suturing with the heel suture. Introduce the needle outside-inside in the graft and inside-outside in the vein patch. Do the same with the apical suture.



Tie the sutures.



Flip the graft and replicate the suturing process on this side.

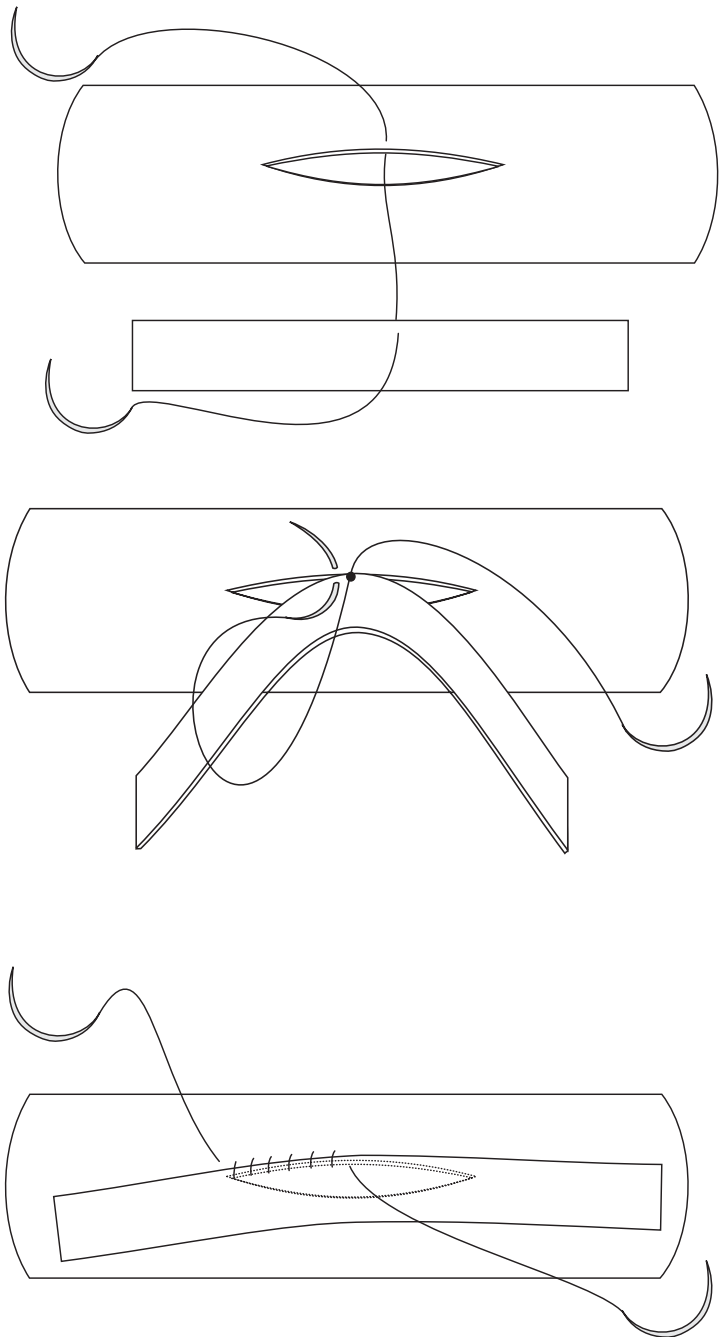


Create an arteriotomy measuring 1.5–2.0 cm. Harvest a 4-cm segment of vein and slit the vein to create a patch.

The suture is first started in the center of the vein patch. The needle is introduced from the adventitial side of the vein.

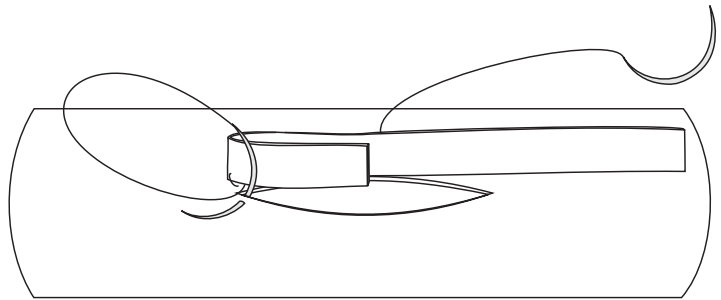
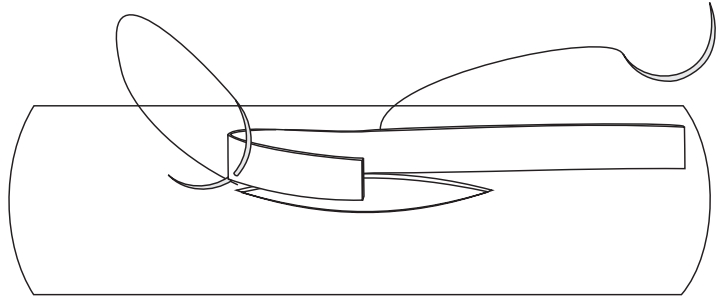
The needle is then introduced from the intimal side of the artery in the middle of the arteriotomy.

Tie the suture and start suturing by introducing the needle outside-inside in the vein patch and inside-outside in the artery.

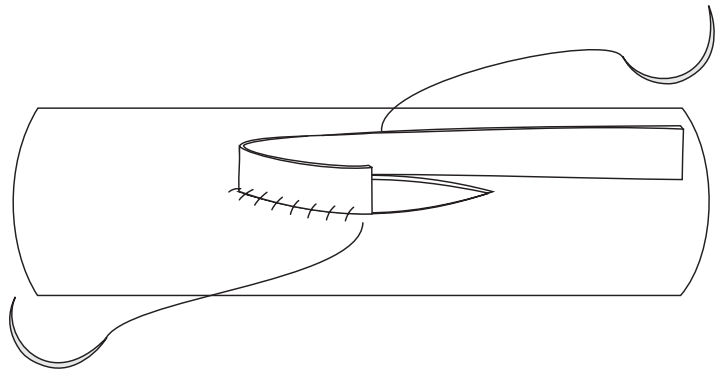


Vein Patches and Cuffs
Miller Cuff

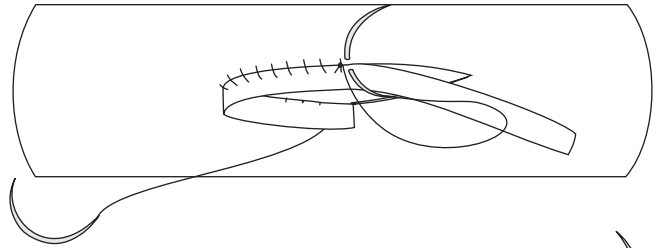
Place several sutures until the apex is reached. Fold the vein cuff and place an apical bite in the vein.



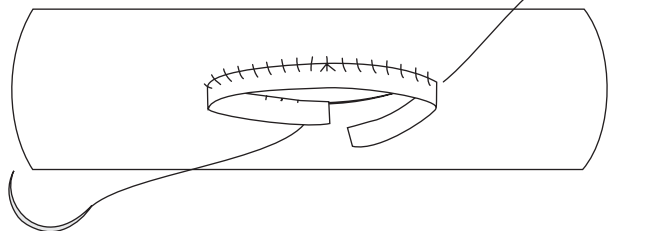
Introduce the needle through the apex of artery. Continue suturing until you reach one end of the patch.



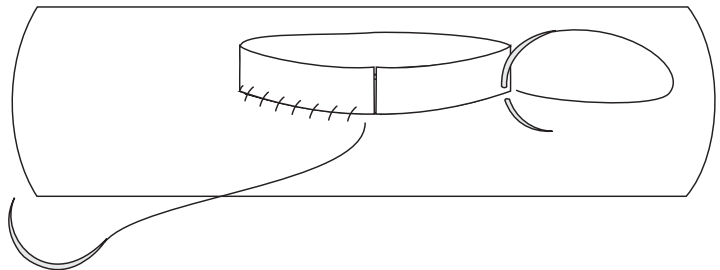
Flip the patch.



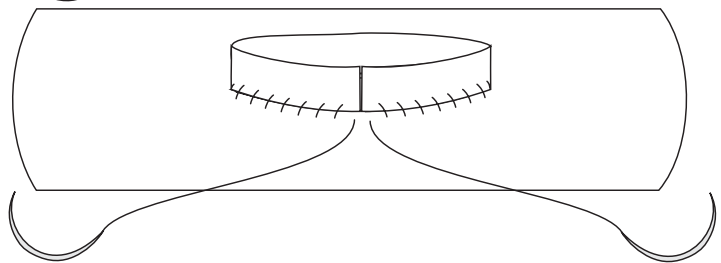
Again, introduce the needle from the adventitial side of the vein patch and then from the intimal side of the artery.



Continue suturing until the heel of the arteriotomy is reached.

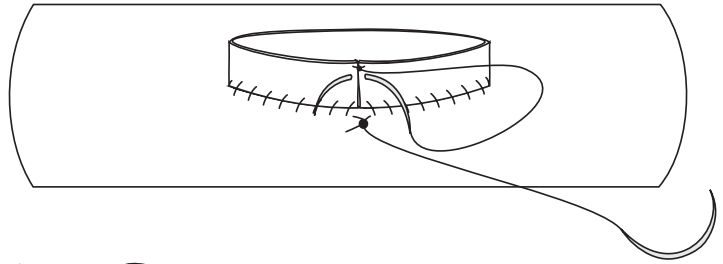


Fold the vein.

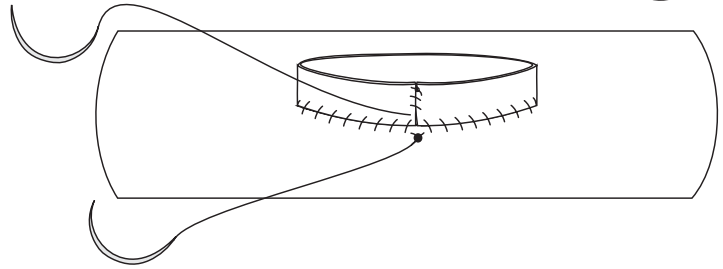


Vein Patches and Cuffs Miller Cuff

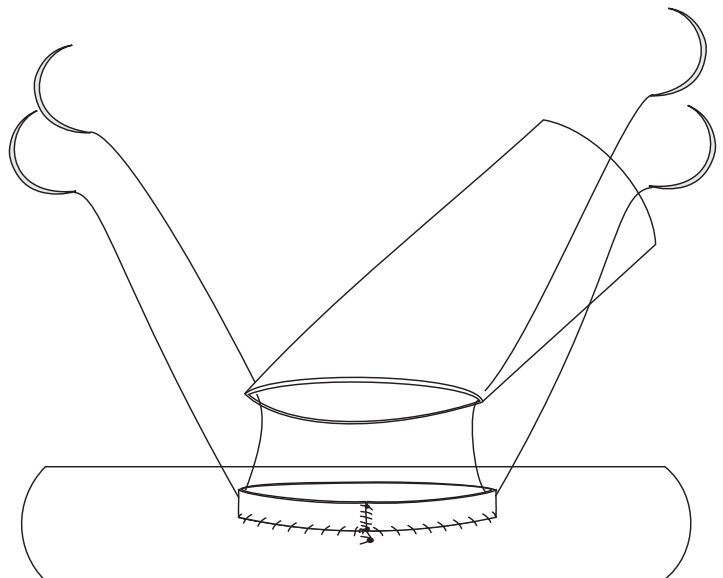
Place the heel sutures. (Again, outside-inside in the vein, inside-outside in the artery.) Continue suturing until both ends of the vein patch meet. Tie the sutures and cut one end.



Tie the sutures and cut one end. Start another suture at the apex to join the edges of the vein patch. Continue suturing toward the arterial suture line. Tie the sutures together.

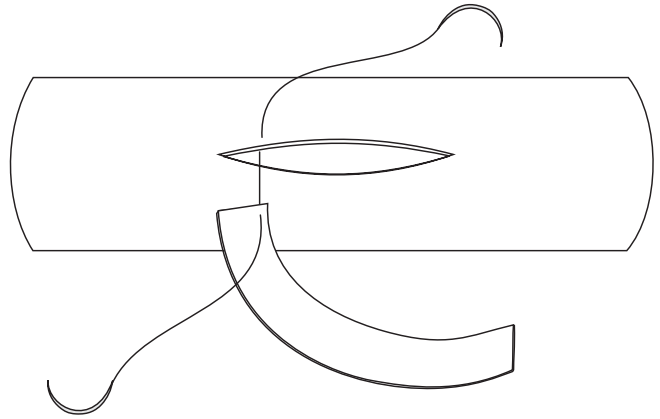


Transect the prosthetic graft in a beveled manner to match the vein cuff. Construct the anastomosis between the graft and the cuff as described in Chap. 9.

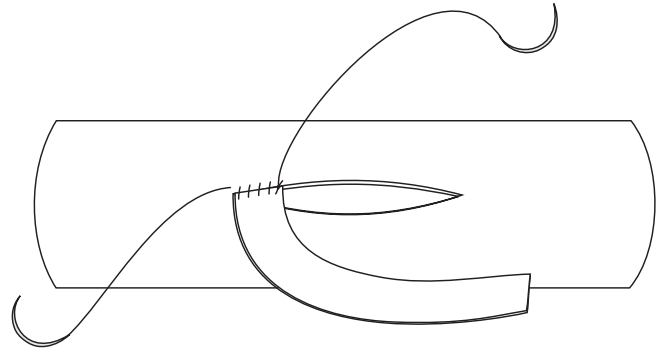


Vein Patches and Cuffs
Miller Cuff Modification
St. Mary's Boot

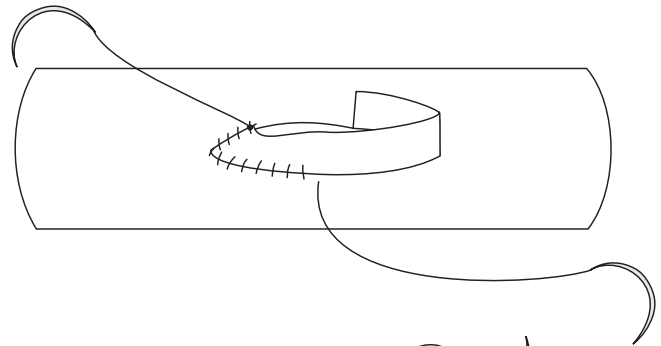
Start suturing from one corner of the vein patch.



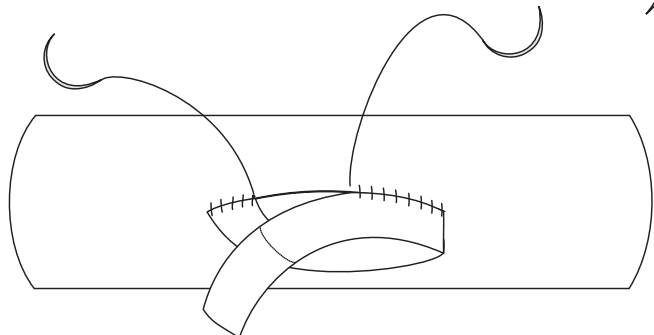
Tie the suture. Run one end toward the apex of the arteriotomy.



Fold the vein and continue running the suture toward the heel.

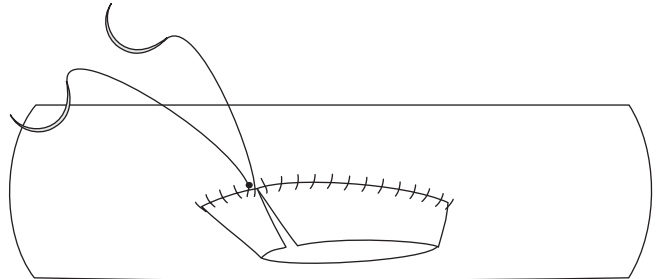


Fold the vein around the heel and continue running the suture toward the apex.

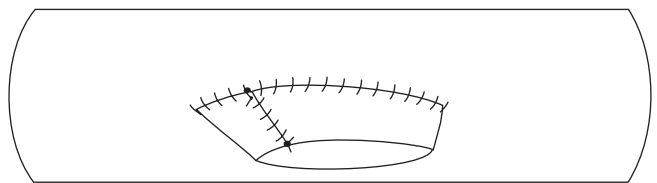


Vein Patches and Cuffs
Miller Cuff Modification
St. Mary's Boot

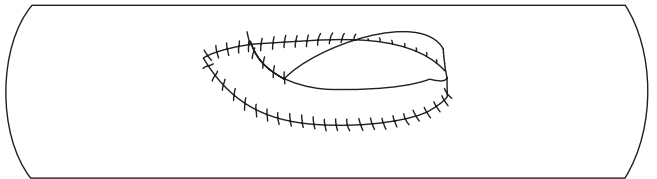
Trim the vein to the appropriate length.



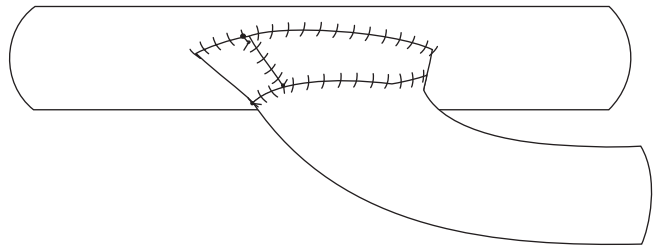
Suture the edges of the vein patch.



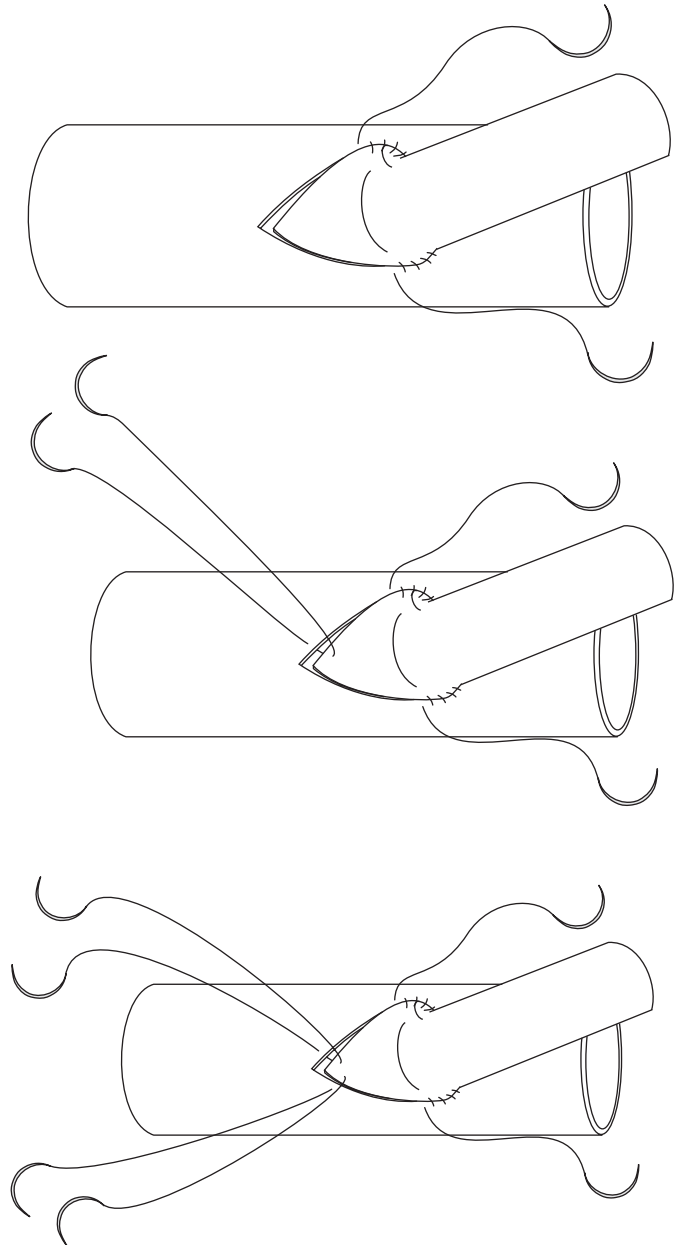
Excise a small wedge of the vein cuff at the heel.



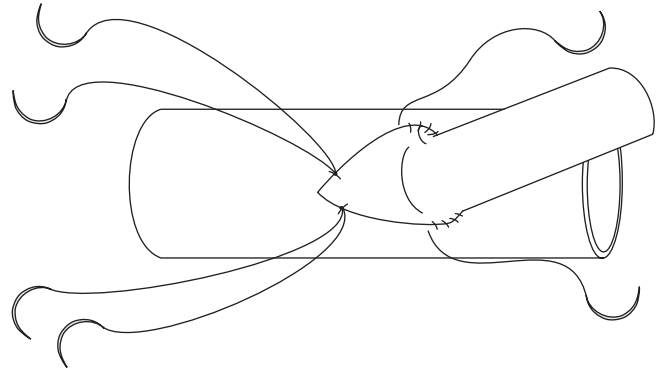
Suture the graft to the vein cuff.



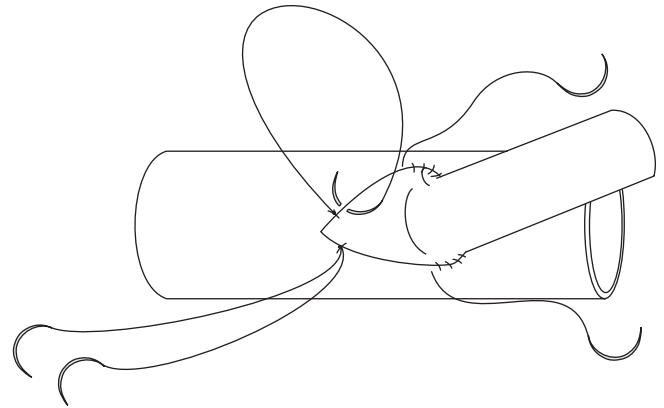
Construct the heel portion of the anastomosis using a parachute or tie-down technique. Place one suture on one side of the center of the apex. Introduce the needle outside-inside in the graft, inside-outside in the artery.



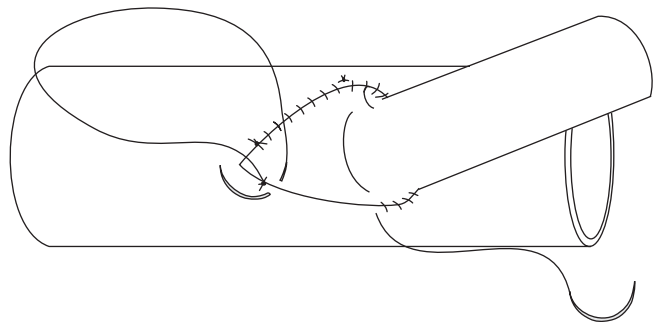
Vein Patches and Cuffs
Taylor Patch



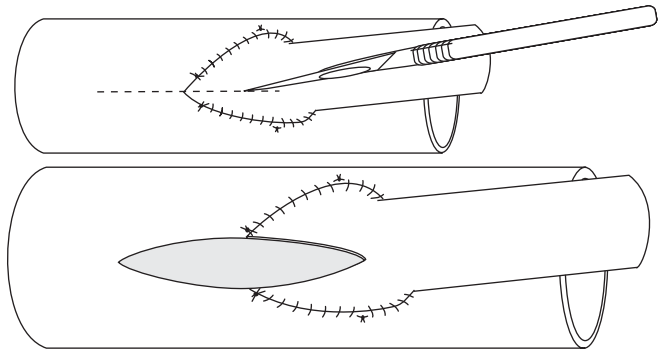
Place an identical suture on the other side of the apex. Tie both sutures.



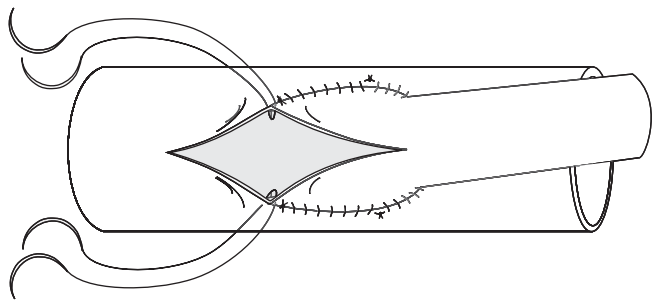
Run one end toward the heel suture. Run the other end toward the heel suture.



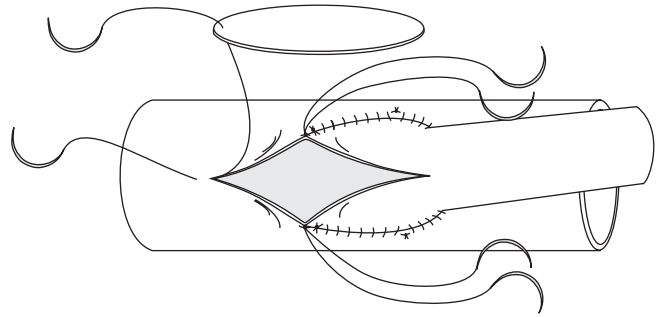
Incise the graft anteriorly and extend the incision across the center of the apex.



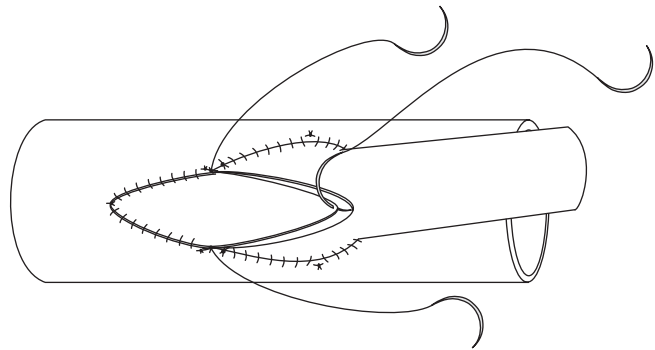
Place two stay sutures between the incised apices of the graft and artery. Suture the vein patch



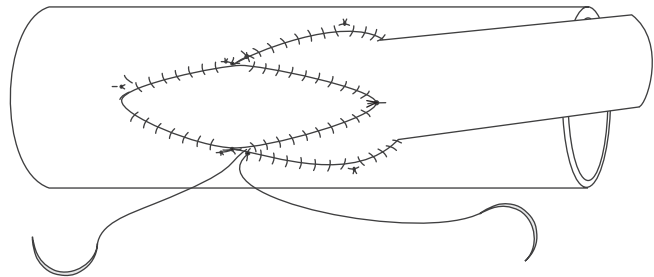
Vein Patches and Cuffs
Taylor Patch

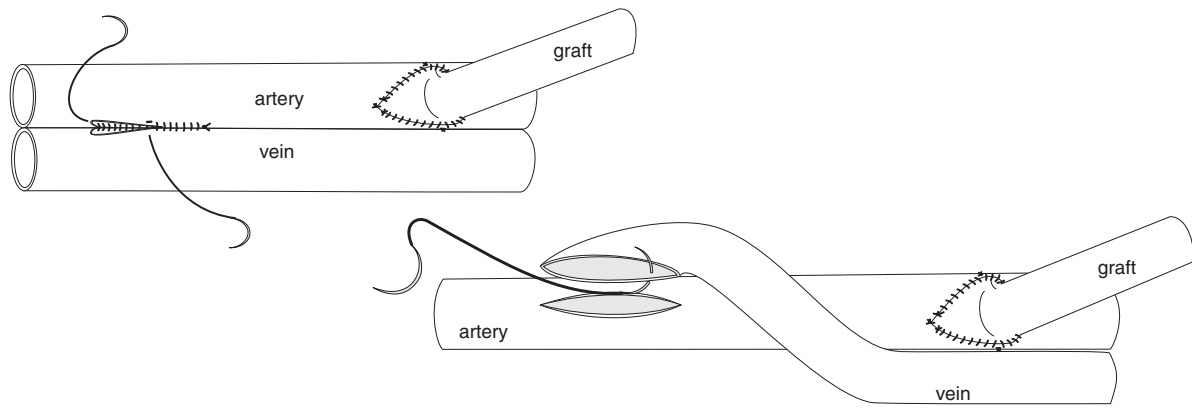


starting at the apex. You may use a parachute technique or an anchor technique as shown here. Run each end toward the stay sutures and tie them together.



Start another suture in the center of the heel. Run each end toward the remaining stay sutures and tie them together.





ARTERIOVENOUS FISTULAE

Poor distal runoff is often cited as a cause of infrainguinal prosthetic bypass failure. Several techniques have been developed in an attempt to improve the patency of prosthetic bypasses with disadvantaged outflow tracts. The main concept of these techniques is the creation of an arteriovenous (AV) fistula to improve the outflow and decrease the distal vascular resistance [12].

In one technique, after constructing the distal anastomosis between the prosthetic graft and the recipient artery, an arteriovenous fistula is constructed a few centimeters distal to the anastomosis [14]. This arteriovenous (AV) fistula can be constructed in a side-to-side fashion (Figure 13.1A) as described in Chap. 11.

The arteriovenous fistula can also be constructed by dividing the vein and joining its proximal end to the artery, a few centimeters distal to the anastomosis using an end-to-side configuration (Figure 13.1B).

In other techniques, the arteriovenous fistula is incorporated in the construction of the distal anastomosis (Figure 13.2) [12, 13]. In one variation, the arteriovenous fistula is constructed in a side-to-side fashion (section “[Vein Patches and Cuffs](#)”). An incision is created in the artery at the site selected for the distal anastomosis. A matching incision is created in the vein accompanying the artery. The adjacent walls of the artery and the vein are sutured together, resulting in a combined opening into the artery and the vein. The graft is then sutured to this newly created opening, allowing the blood to flow into the artery and the vein simultaneously. The size of the fistula can be theoretically controlled by changing the length of the venotomy. The longer the size of the venotomy, the larger is the fistula. One advantage of this technique is that it involves adding only one additional suture line between the adjacent walls of the artery and the vein. The disadvantage of this technique is that the prosthetic bypass is connected directly to the artery without the potential theoretical benefit of an interposed vein segment.

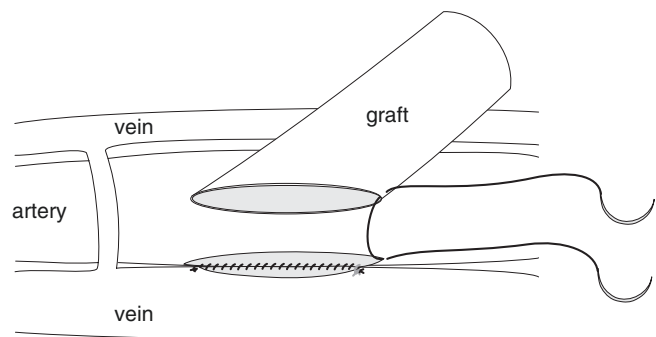


Figure 13.2 AV fistula incorporated in the anastomosis

Another variation described by Ascer involves incorporating the concept of vein cuff and the concept of arteriovenous fistula together (section “Arteriovenous Fistulae”) [11]. In this method, one of the veins accompanying the artery is mobilized for several centimeters. An arteriotomy is created in the artery at the site selected for the distal anastomosis. The vein is transected and sutured to the artery in an end-to-side manner. It is important to mobilize the vein for a long segment to allow for a gentle curve of the vein over the artery. A venotomy is created in the hood of the vein and will serve as the new site for constructing the anastomosis with the prosthetic graft (Figure 13.3a). The graft is then sutured to the venotomy. Although this technique involves creating an additional anastomosis, it has several attractive features. The anastomosis between the vein and the artery and the anastomosis between the bypass and the vein are conducted by following the same principles of any end-to-side anastomosis. Surgeons are familiar with this type of reconstruction, which can be carried out even in heavily calcified vessels. The anastomosis between the graft and the vein can be accomplished with relative ease and expediency. At the completion of the anastomoses, the flow and the magnitude of the fistula can be controlled by banding of the fistula. The pressure in the graft is measured and compared to the radial artery pressure. Banding is considered unnecessary if the gradient is less than 30 mmHg, or if the pressure in the graft is greater than 100 mmHg. Banding can be accomplished by placing a 4-mm polytetrafluoroethylene cuff (PTFE) ring around the vein (Figure 13.3b).

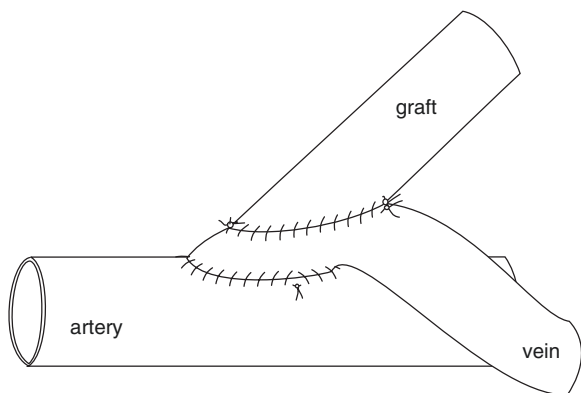


Figure 13.3 (a) End-to-side AV fistula incorporated in the distal anastomosis.

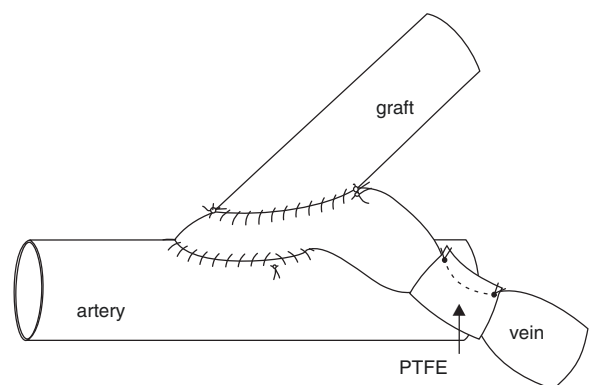


Figure 13.3 (b) Banding of the AV fistula using a PTFE ring.

REFERENCES

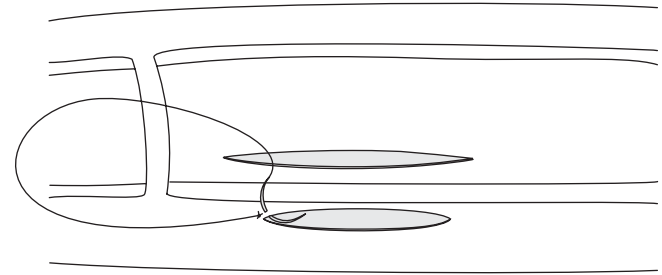
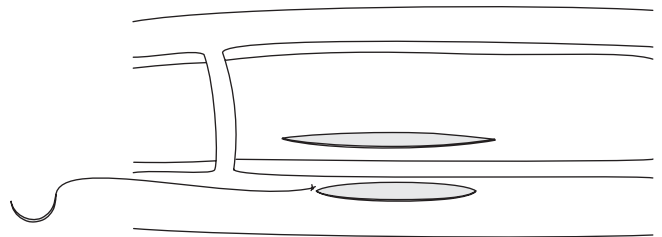
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Arteriovenous Fistulae
Side-to-Side

Expose the infrapopliteal vessels. Select the larger accompanying vein for creating the AV fistula.

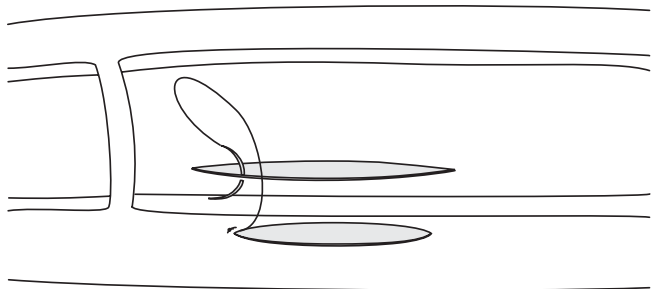
Create an arteriotomy in the anteroinferior aspect of the artery, close to the selected vein.

Create a venotomy in the selected vein, adjacent to the created arteriotomy. The size of the venotomy can vary according to the surgeon's preference.



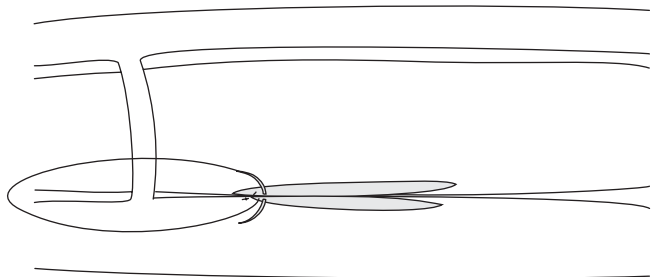
Start a horizontal mattress suture at the apex of the venotomy. Tie the suture and cut one end.

Introduce the needle outside-inside in the vein, close to the start of the suture.



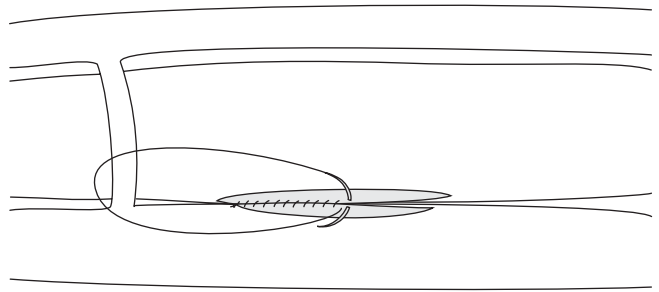
Introduce the needle in a corresponding site in the artery (inside-outside).

Pull the suture. Start suturing the adjacent arterial and venous walls together.

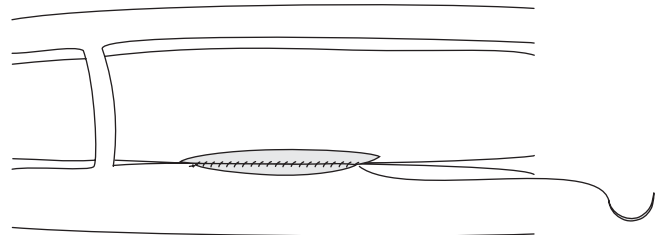


The needle is introduced from the intimal side of the artery and then from the adventitial side of the vein.

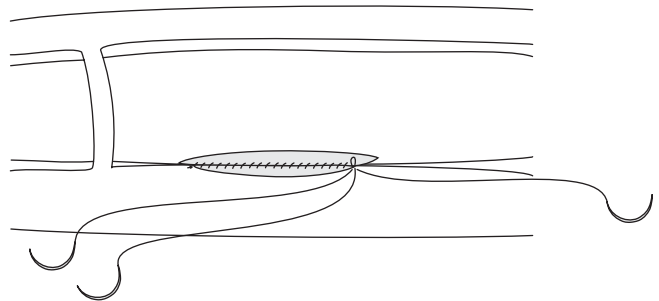
**Arteriovenous Fistulae
Side-to-Side**



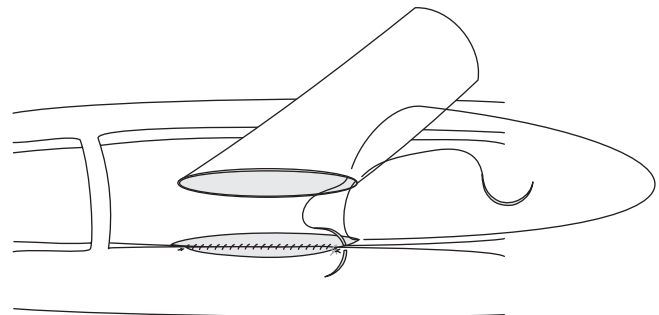
Continue suturing until the adjacent venous and arterial walls are fully approximated.



Start another stay suture at the apex of the venotomy and tie the sutures together. Transect the graft to match the size of the arteriotomy.

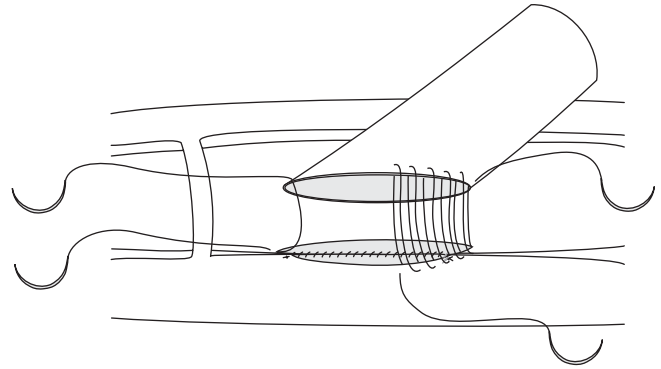


Start one suture at the center of the heel, outside-inside in the graft, inside-outside in the artery. You may tie the suture or use a parachute technique as shown here.

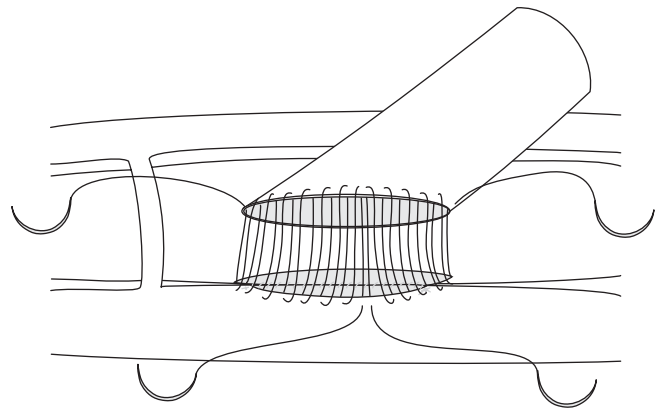


Arteriovenous Fistulae
Side-to-Side

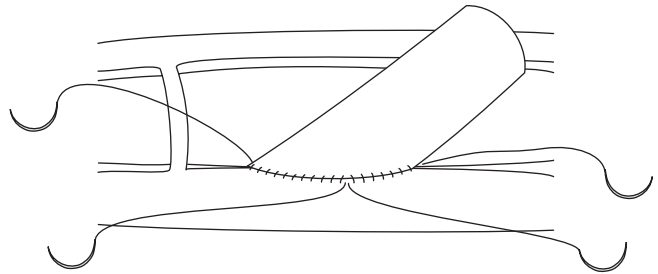
Start another suture at the apex.
(Outside-inside in the graft and inside-
outside in the artery.)



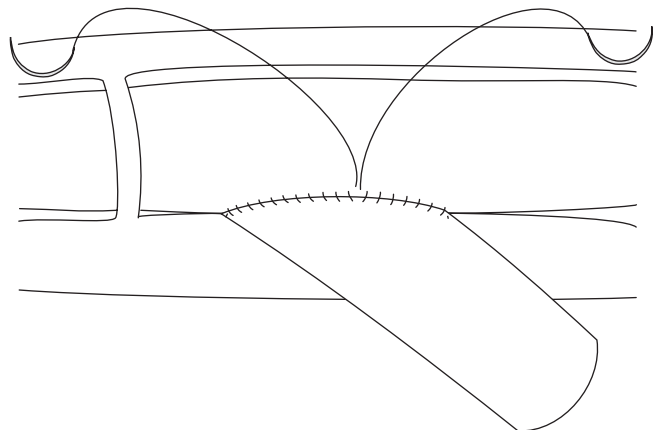
Continue until you reach the other suture.



Pull and tighten the sutures.



Flip the graft and replicate the suturing on
this side.



**Arteriovenous Fistulae
Side-to-Side**

Expose the tibial vessels and divide the venae comitantes.

Dissect a 5-cm segment of the larger accompanying tibial vein.

Ligate and transect the vein as distally as possible.

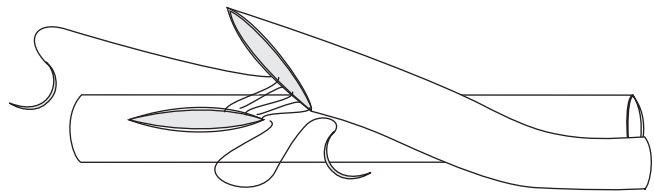
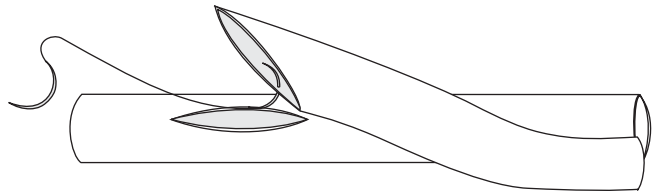
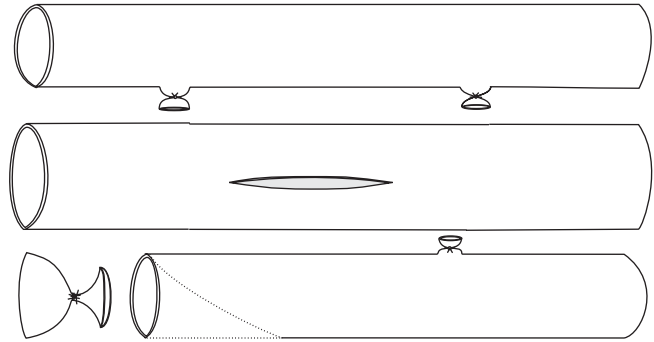
Perform an arteriotomy in the tibial artery.

Incise the posterior wall of the transected vein to match the size of the arteriotomy.

Make sure to place the vein on the arteriotomy to accurately place the incision in the posterior wall of the vein.

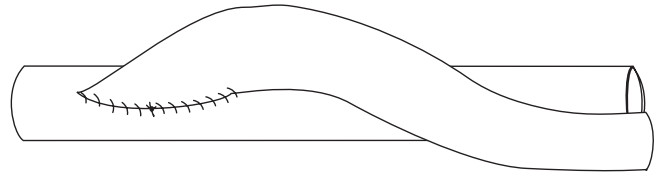
You may perform the anastomosis using an anchor technique or a parachute technique as shown here. Start suturing in the vein a few bites away from the center of the heel (outside-inside in the vein, inside-outside in the artery).

Continue suturing until you are a few bites beyond the center of the heel.



Arteriovenous Fistulae
Side-to-Side

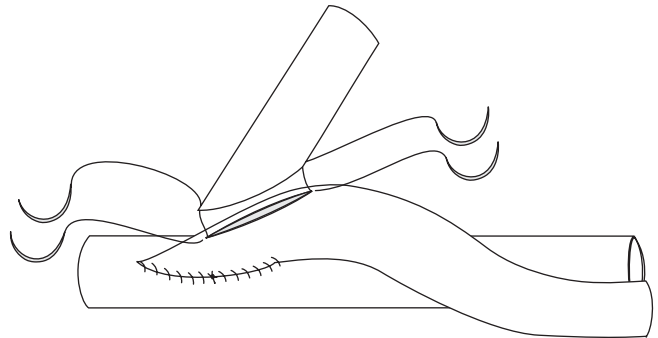
The anastomosis is completed and checked for hemostasis.



Create a 1–1.5-cm venotomy.

Transect the prosthetic graft in a beveled fashion to match the size of the venotomy.

Construct an end-to-side anastomosis between the graft and the vein as described in Chap. 9.



Check the suture lines for hemostasis.

