

PERFORMING THE PROXIMAL ANASTOMOSIS

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Proximal graft anastomoses can be performed under a cross-clamp or, after the removal of the cross-clamp, by placing a side clamp, depending on the surgeon's preference and the ongoing practice of the clinic.

1. PROXIMAL ANASTOMOSIS WITH A SIDE CLAMP

After lifting the cross-clamp and initiating heart perfusion, an appropriate vascular clamp is partially placed on the ascending aorta. It is crucial to position the clamp on the anterior surface of the ascending aorta in a way that an adequate amount of aortic tissue remains, depending on the number of proximal anastomoses to be performed (Figure 5.1). After adjusting the length of the graft, an aortotomy is made in the designated area. A full-thickness opening is created in the aorta with an aortic punch of the appropriate size (Photos 5.1, 5.2 and 5.3). Aortic punches are available in different sizes (2.5 mm, 2.8 mm, 3.0 mm, 4.0 mm), and usually, a minimum of a 2.8 or 3-mm punch is used to ensure sufficient inflow (Figure 5.2).

Once the aortotomy is performed, the anastomosis is completed with 5/0 or 6/0 polypropylene sutures, going from the outer layer of the graft to the inner layer of the aorta and ensuring the sutures pass through the entire thickness of the aorta (Figure 5.3). The heel of the graft is appropriately positioned according to the surgeon's

preference for the obtuse margin or intermediate coronary artery (usually at 11 or 12 o'clock), the diagonal artery (between 9 and 11 o'clock), the right coronary artery (at 3 or 4 o'clock), or the posterior descending artery (between 5 and 6 o'clock) (Figure 5.4, Photo 5.4).

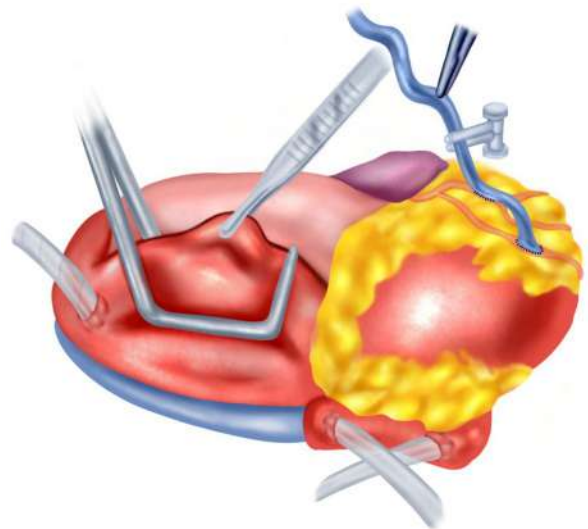


Figure 5.1. Placing a side clamp on the ascending aorta and gently pulling it with an atraumatic forceps facilitates the preservation of sufficient tissue for the proximal anastomosis. During this process, slightly reducing systemic blood pressure helps to minimize potential damage to the aortic wall. Care should also be taken not to completely occlude the aortic lumen while applying the side clamp.

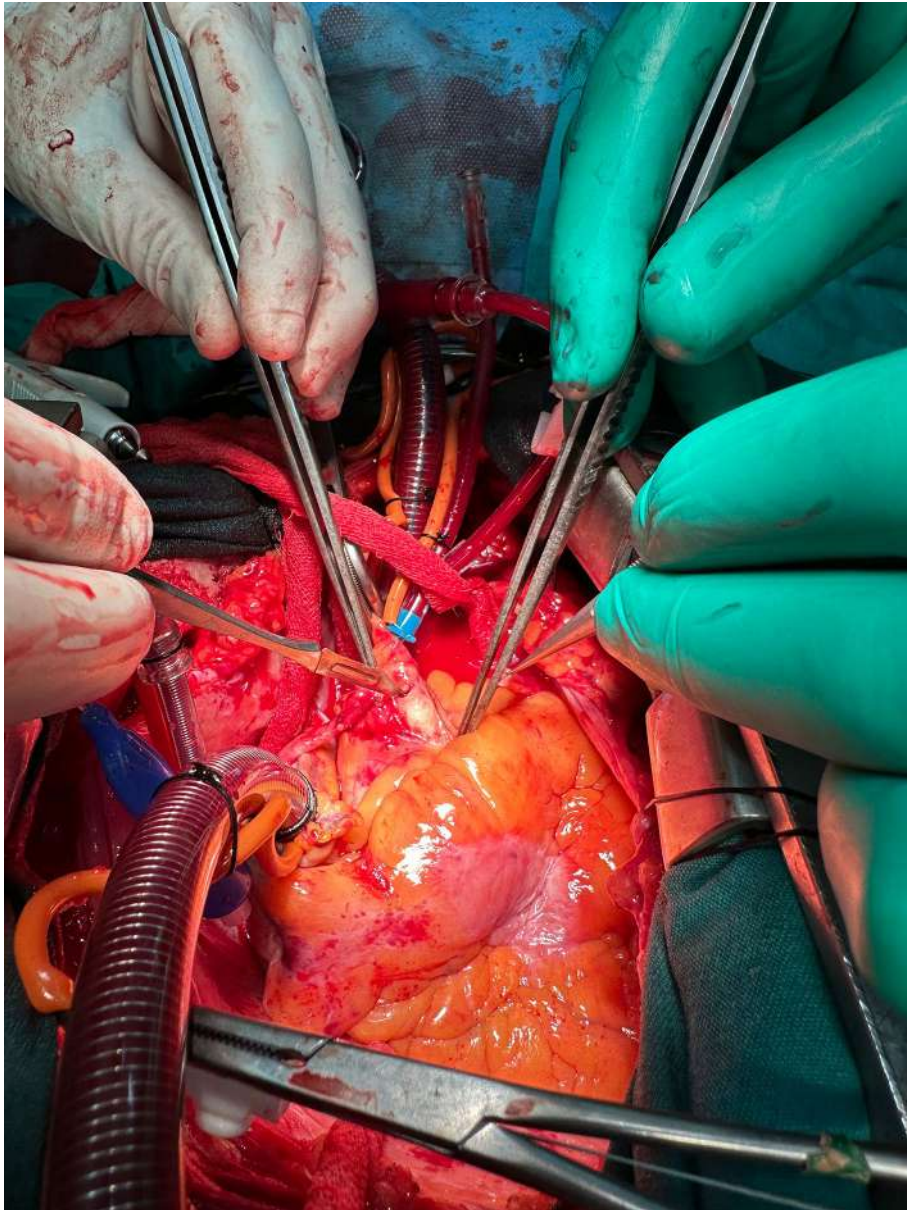


Photo 5.1. An incision is made in the ascending aorta using a No. 11 scalpel, creating a full-thickness cut. Some surgeons may prefer making the incision in the shape of a cross or a plus sign.

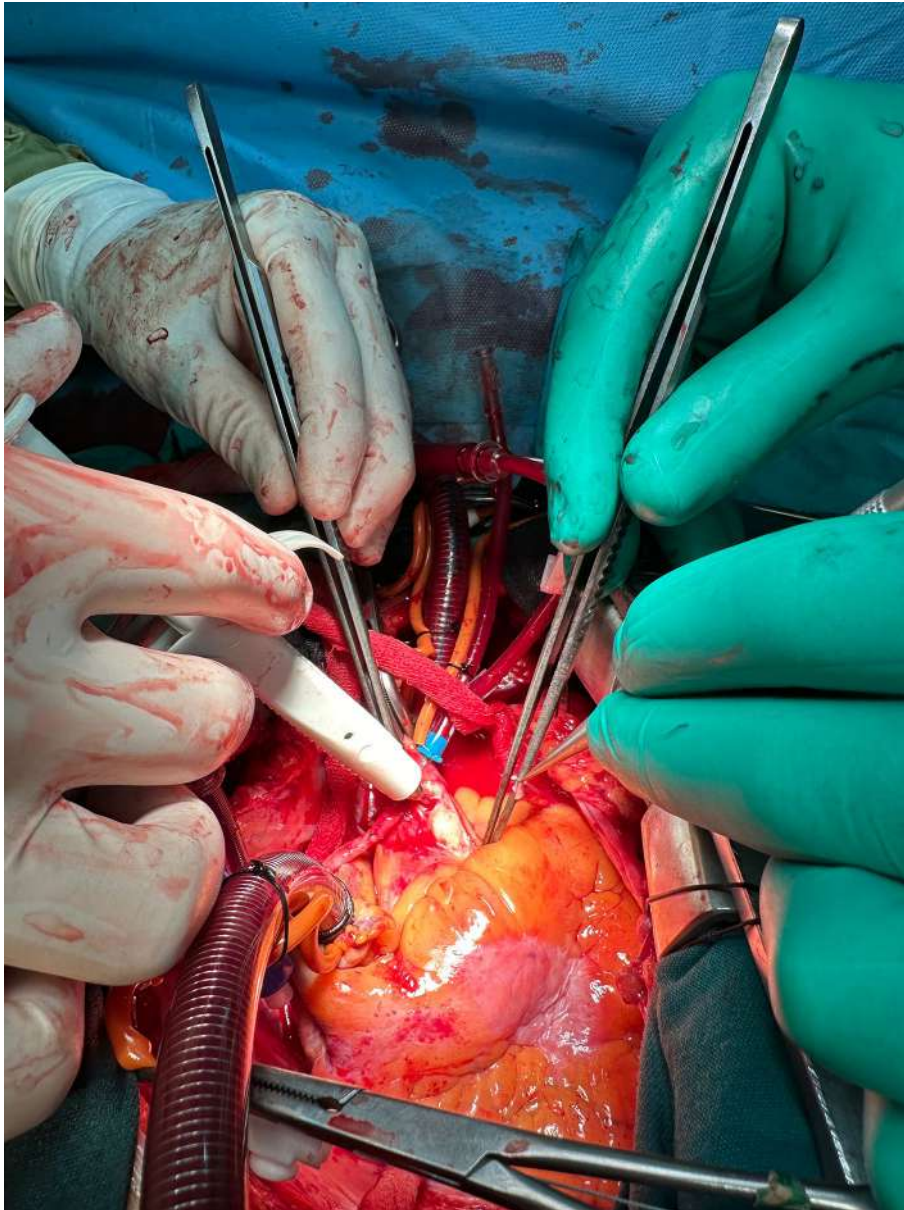


Photo 5.2. Subsequently, a punch tool of appropriate diameter is inserted into the hole created in the aorta at a right angle, ensuring that the hole is opened to the desired size.

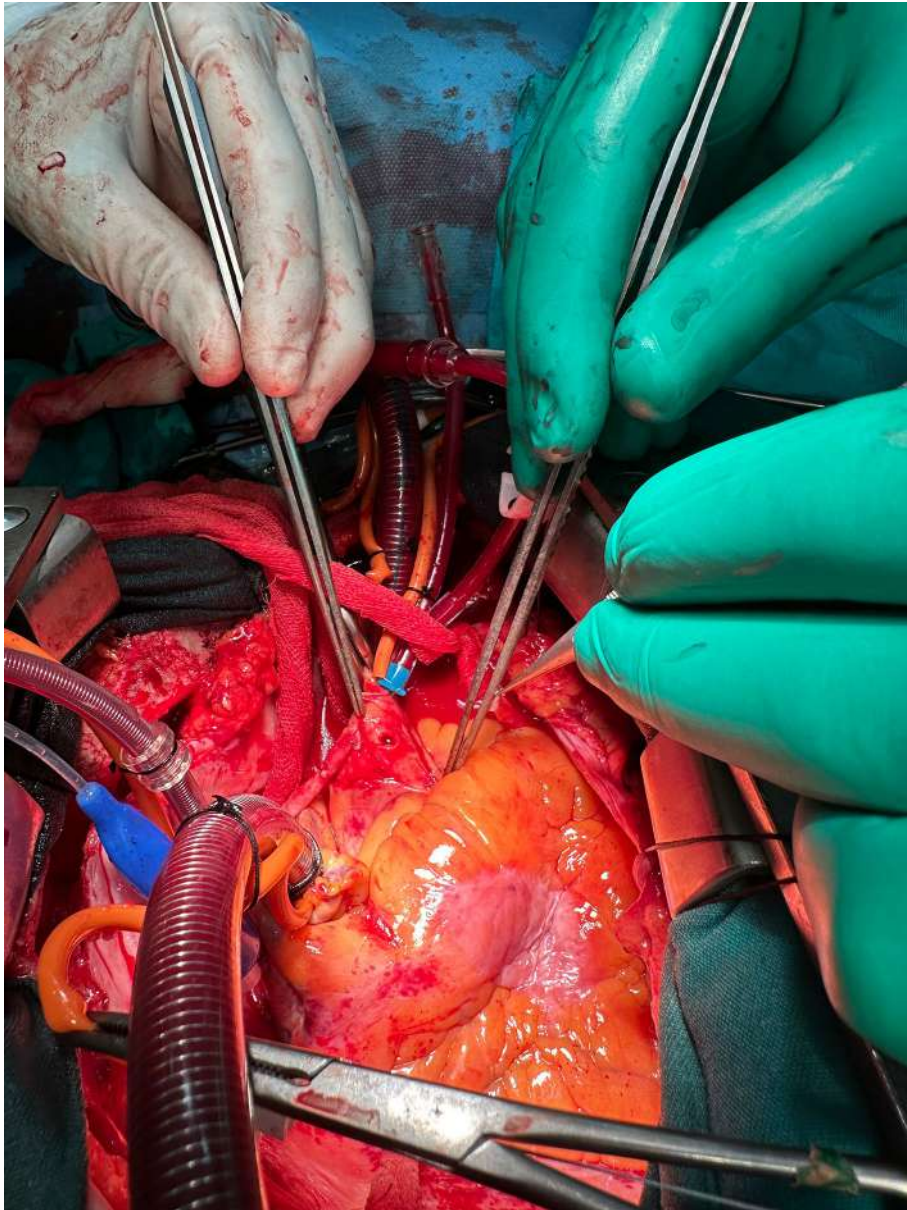


Photo 5.3. It is important for the edges of the opened hole to be smooth and free from deep grooves.

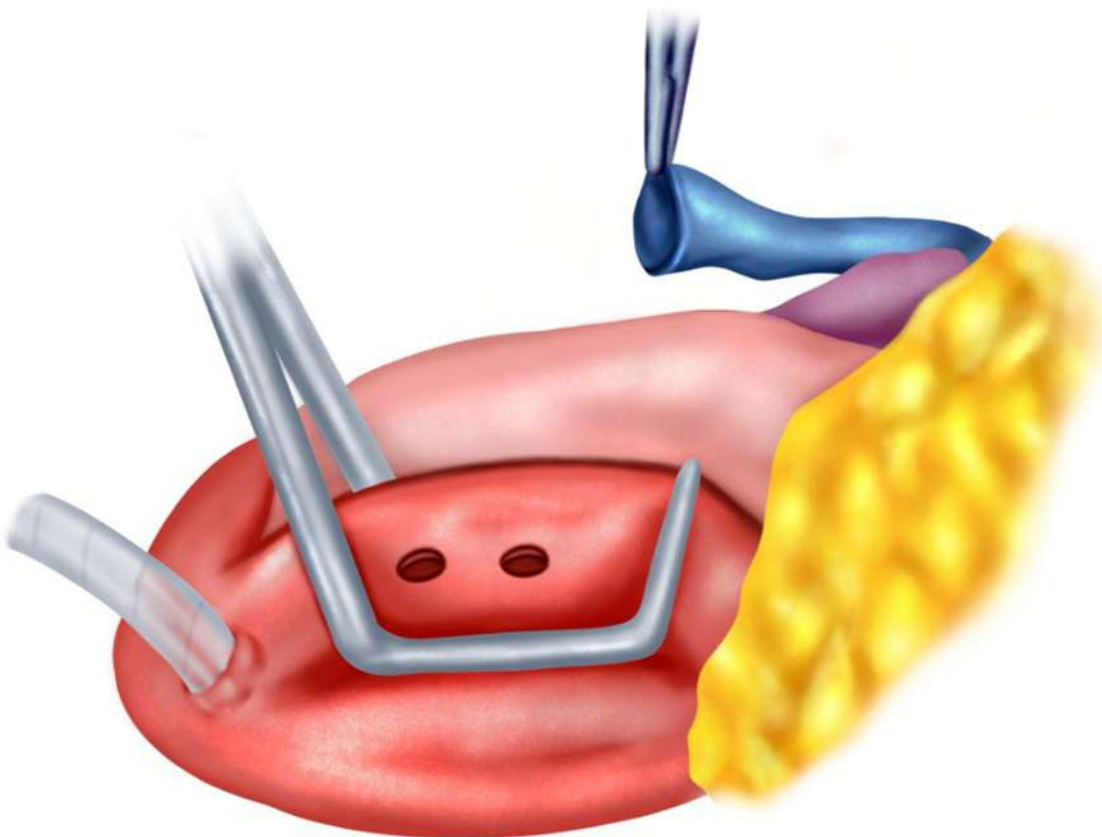


Figure 5.2 Creating an adequate ostium using an aortic punch tool is crucial. A small ostium can both restrict blood flow and lead to asymmetrical configuration during graft anastomosis, potentially causing bleeding.

Proximal Anastomosis Solutions in Calcified Aorta

Care should be taken to ensure the absence of atheromatous plaques in the aortotomy area. If there are plaques in the anastomosis area or if the aortic wall is thick, the aortotomy should be closed with 4/0 or 5/0 polypropylene, and another anastomosis site should be chosen if possible. In cases where the ascending aorta is severely calcified, a side clamp cannot be applied, and the heart needs to be operated on without touching the aorta; ready-made anastomosis systems can be used. Devices such as Heartstring III Proximal Seal System (Getinge Ltd., Stockholm, Sweden), Enclose II Anastomosis Assist Device (Novare Surgical Systems, Inc., CA, USA), Viola Proximal Anastomosis Sealing System (VGS Ltd, Tel Aviv, Israel), and Pas-Port Proximal Anastomosis System (Cardica, Inc., Redwood City, CA, USA) can be utilized for this purpose. In cases

where these devices are not available, a simple anastomosis can be performed using an appropriately sized Hegar dilator (Figure 5.5).

2. PROXIMAL ANASTOMOSIS UNDER CROSS-CLAMP

Depending on the surgeon's preference, proximal anastomoses can also be performed under a cross-clamp. This offers the advantage of better visualization of the aortotomy and ease of performing the anastomosis. After filling the heart, it is essential to determine the length of the graft and the location of the aortotomy. The graft anastomosis and positioning are as described earlier.

While performing a proximal anastomosis, it is crucial to ensure not only the determination of the length of the graft, but also to check for any rotation

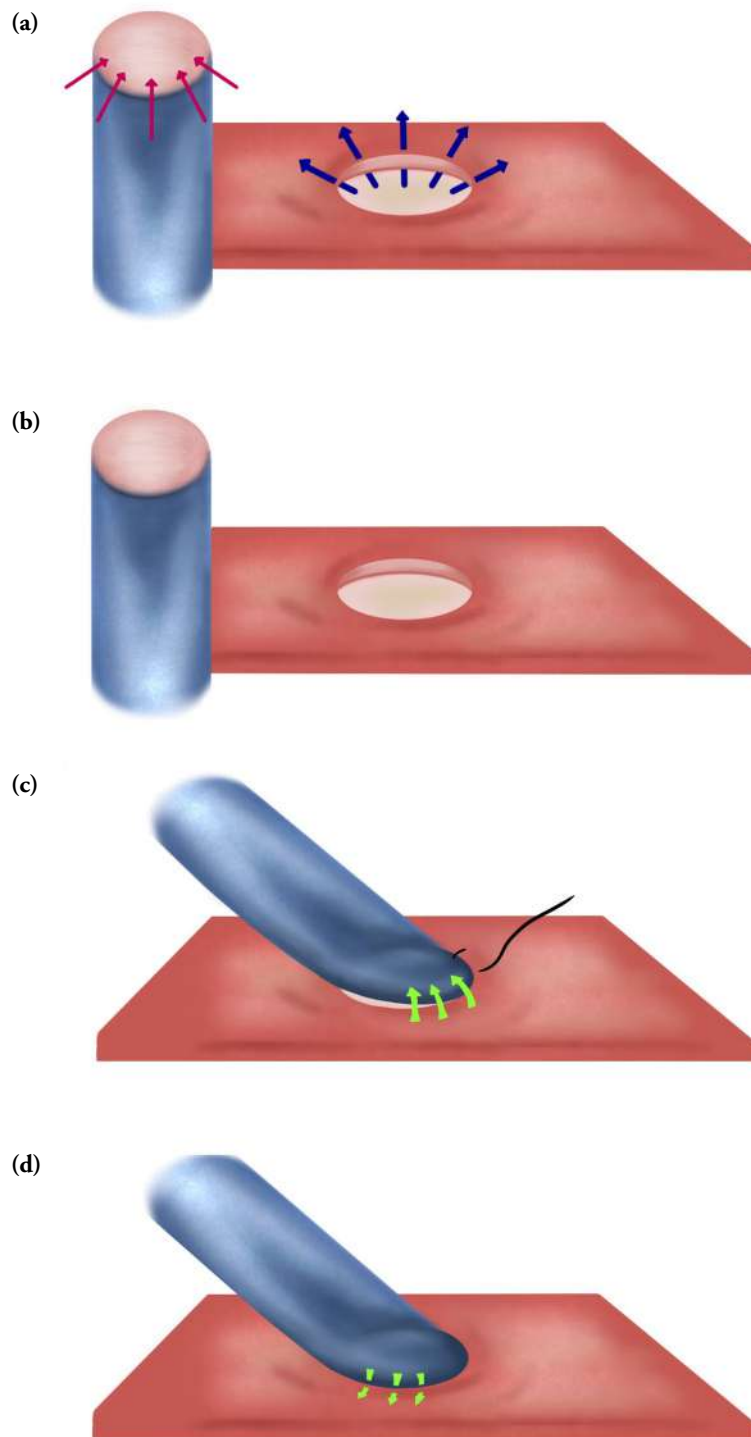


Figure 5.3. Before initiating the proximal anastomosis of the aortocoronary graft, attention should be given to two key aspects: the angle at which the graft will be given relative to the aorta and the positioning of sutures accordingly. Subsequently, sutures are passed through both the graft and the aorta, traversing full thickness, ensuring proper seating of the graft. The remaining part of the anastomosis is, then, completed.

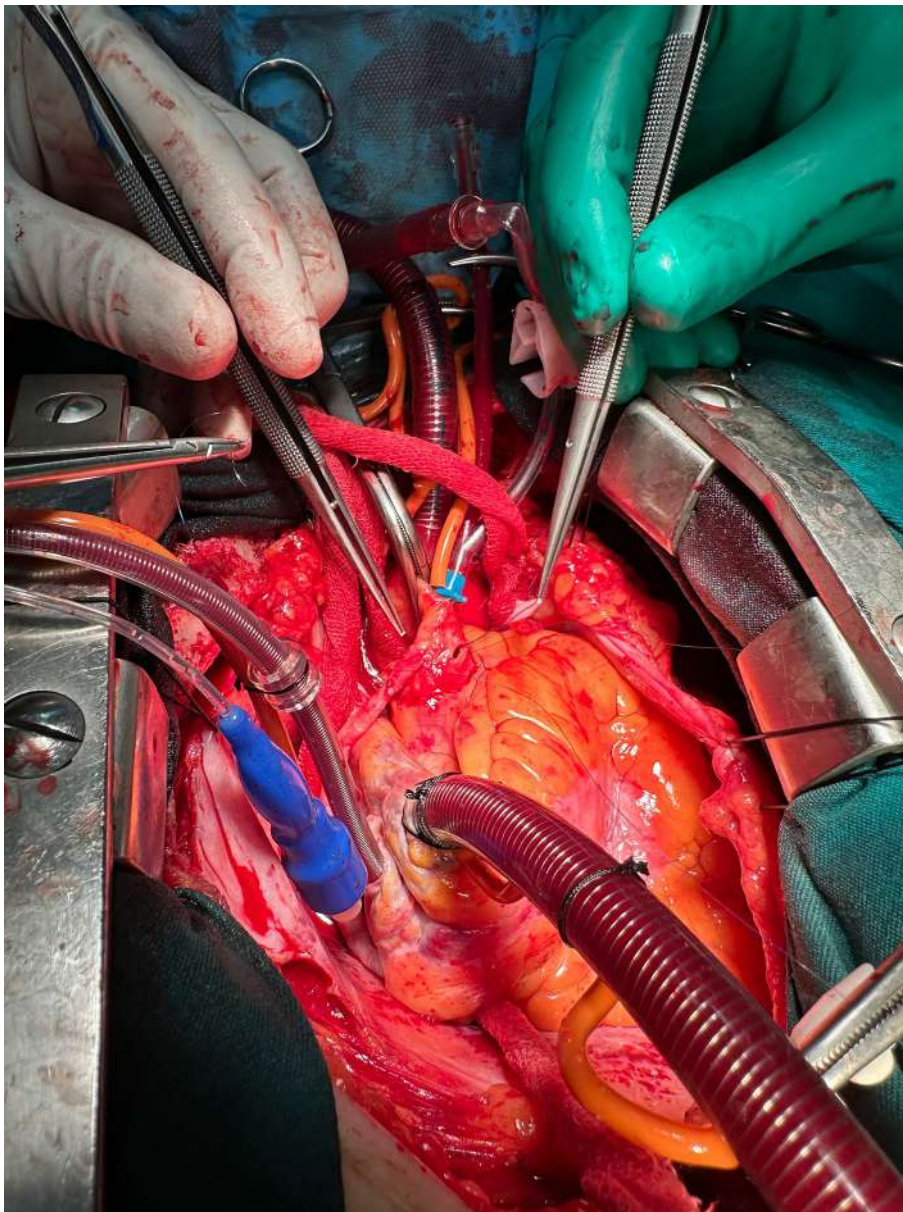


Photo 5.4. While passing sutures, attention should be given to orienting the graft. As one moves caudally in the aorta, particularly with saphenous vein grafts, the graft should be angled more upwards rather than transversely. This helps to reduce the likelihood of kinking due to the height of the pulmonary artery.

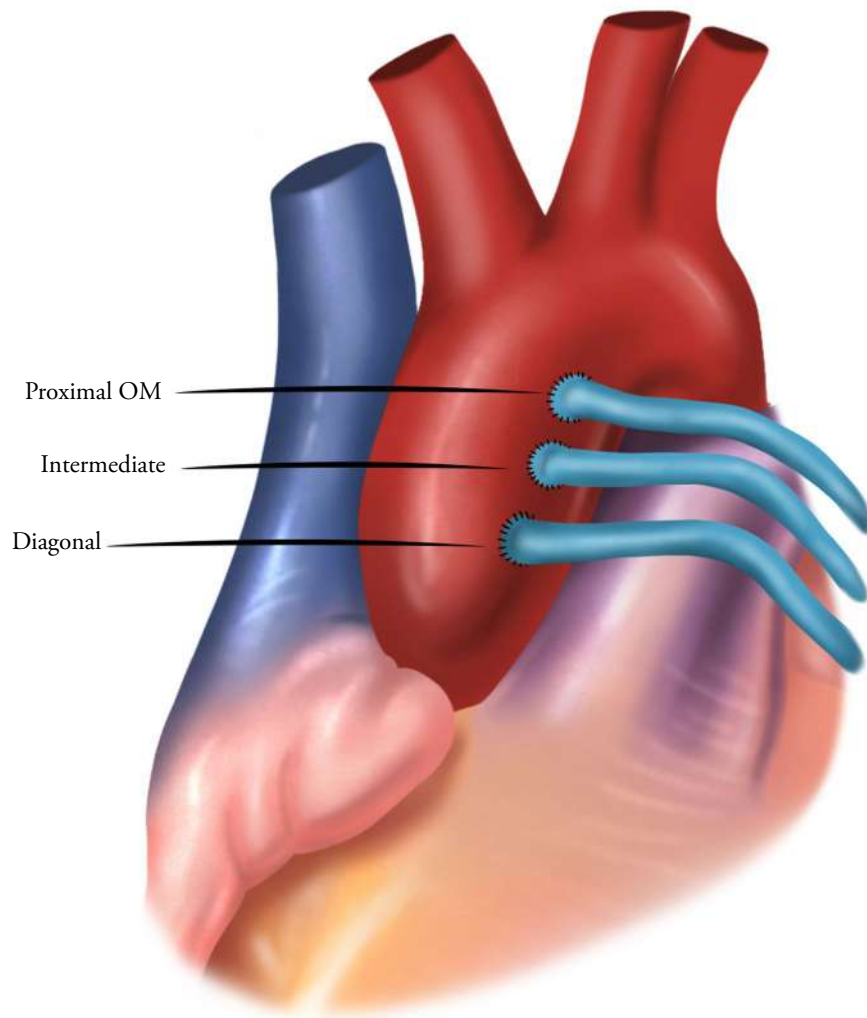


Figure 5.4. The angulation of grafts in the ascending aorta, based on their sequence from top to bottom, also varies. The proximal anastomosis, which is positioned at the lowest point due to the higher and wider diameter of the proximal part of the pulmonary artery, should be angled slightly more caudally. Otherwise, there is an increased risk of kinking in the proximal part of the graft. As one moves upward in the ascending aorta, a more horizontal anastomotic angle can be given.
OM: Obtuse marginal.

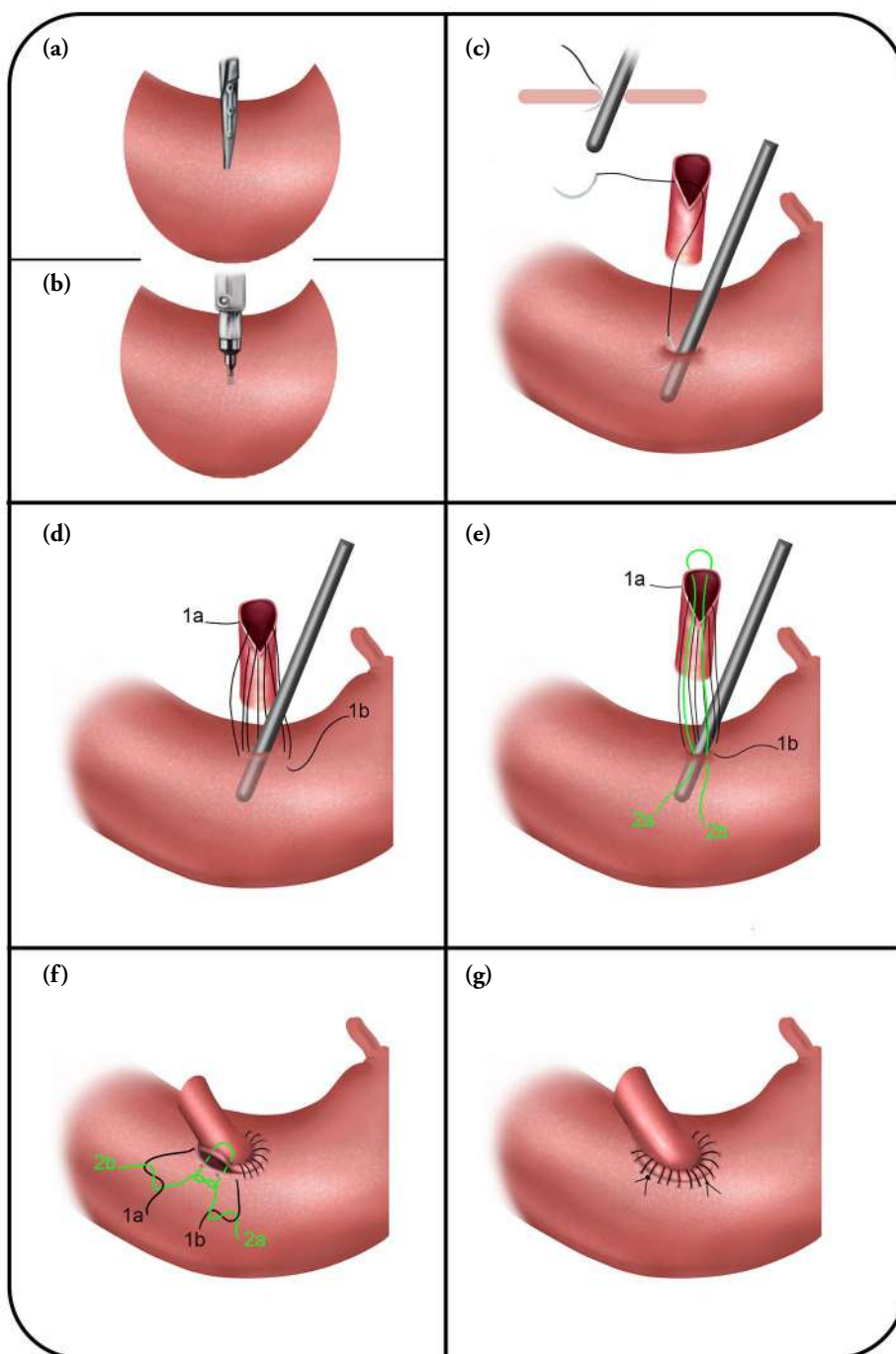


Figure 5.5. Due to calcification preventing the placement of a side clamp in the ascending aorta, a practical technique for performing anastomosis is as follows: **(a)** A hole is created in the ascending aorta using a punch, large enough for the dilator to pass through, and bleeding is controlled with a finger. **(b)** A Hegar dilator, 5 mm in size (or suitable for the graft diameter), is inserted through the hole created with a punch. **(c)** Sutures are passed through while aligning with the flat part of the Hegar dilator. **(d)** The first suture is continued until the last 2 to 3 sutures. When the last 2 to 3 sutures remain, a second suture is passed in a U-shape through the graft. **(e, f)** The Hegar dilator is quickly removed, and all sutures are tightened. Subsequently, the two sutures are tied together.

of the graft around its axis. If rotation is present, the graft may become occluded early. Marking the graft along its length with a sterile pen before anastomosis can be helpful in preventing potential twist errors during the configuration phase.

TIPS & PITFALLS

- Plaques in the proximal anastomosis area can be damaged during clamp placement, and atheromatous particles can cause embolism, leading to strokes. Evaluating the ascending aorta with preoperative computed tomography or intraoperative epiaortic ultrasound is crucial to determine the correct anastomosis site and prevent complications.
- Creating an opening based on the diameter of the graft is essential. For smaller-diameter grafts such as radial artery or free internal thoracic artery (ITA) grafts, a smaller punch should be used to ensure a secure anastomosis configuration.
- Sutures should pass through the full thickness of the aorta during anastomosis. This is necessary for both fixing possible aortic plaques and preventing intimal separations, which can lead to life-threatening aortic dissections.
- Properly positioning the grafts at the correct angles is critical to provide a more homogeneous and uninterrupted flow. Grafts which are not properly positioned may experience bending and kinking, particularly after the heart resumes working and assumes a neutral position. This directly affects graft patency.
- The size of the pulmonary artery or right atrium should be carefully assessed beforehand and considered while performing proximal anastomoses. In patients with a

large right atrium, making the anastomosis too proximal on the ascending aorta when the heart assumes a neutral position can cause the graft to kink. Similarly, in patients with an enlarged pulmonary artery, making the anastomosis lower on the inside curvature of the ascending aorta can lead to kinking.

- Adequately filling the heart while performing proximal anastomosis under cross-clamp is crucial. When the heart assumes a neutral position, insufficient filling may cause the graft to be too short and stretched, while excessive filling may cause the graft to be too long and lead to bending. Therefore, evaluating the neutral state of the heart before entering cardiopulmonary bypass is essential and should be considered during proximal anastomoses.
- Rotation of the graft around its axis can lead to early graft occlusion. To prevent this, one face of the graft can be drawn with a surgical pen. Infusing the graft with heparinized saline to check for rotation and ensure smooth flow is essential.

TROUBLESHOOTING

- If the graft is long and kinking, it should be shortened, and an end-to-end anastomosis should be performed again.
- In case of rotation, the graft is cut, the rotation is corrected, and an end-to-end anastomosis is performed again.
- If the graft is short, it can be lengthened by making an interposition with an appropriately sized graft. If there is a kink near the aortotomy site, the proximal anastomosis should be repositioned by correctly placing the heel of the graft.