

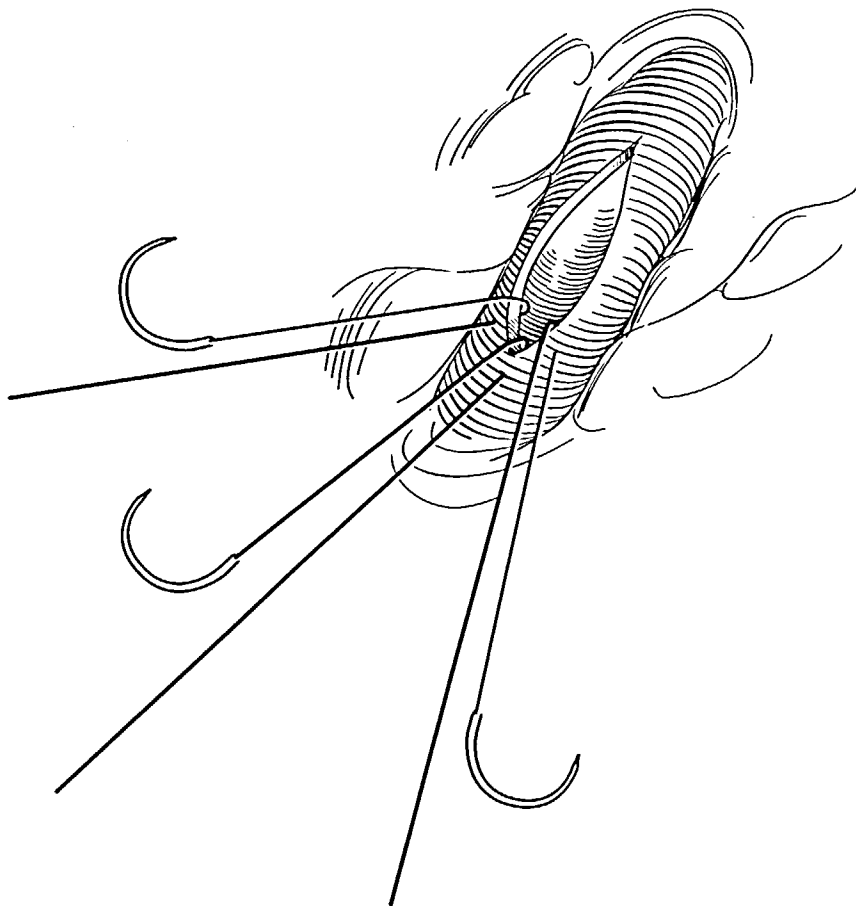
Anastomotic Techniques

Bruce W. Lytle, MD

For most graft to coronary artery anastomoses, I use an interrupted technique with 7-0 silk suture. This type of technique is not common, and many surgeons have documented good outcomes using some variety of a continuous suture technique. However, the interrupted technique has been used by many Cleveland Clinic Foundation staff surgeons and residents, and its effectiveness has been documented with angiograms of tens of thousands of vein and arterial anastomoses.

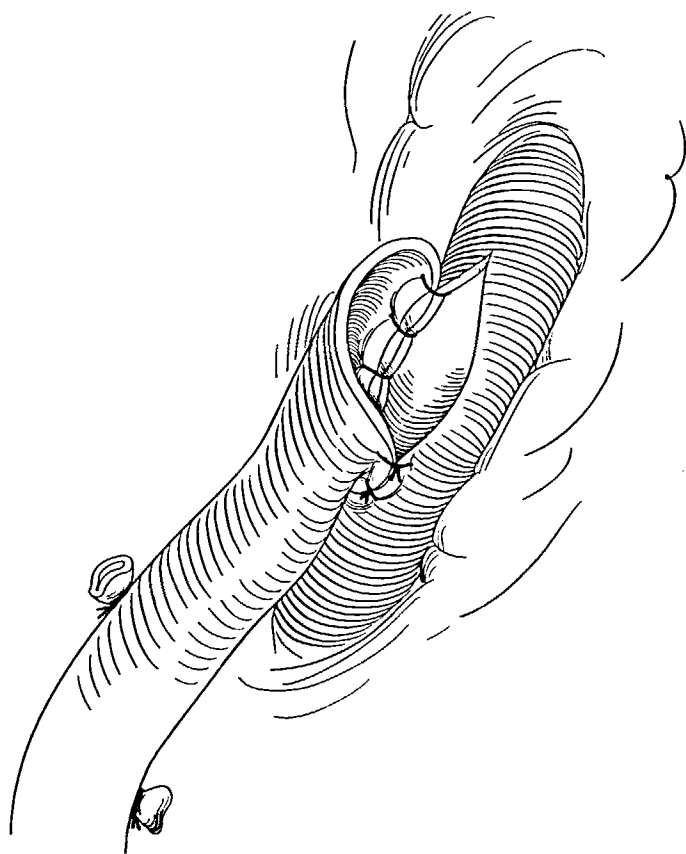
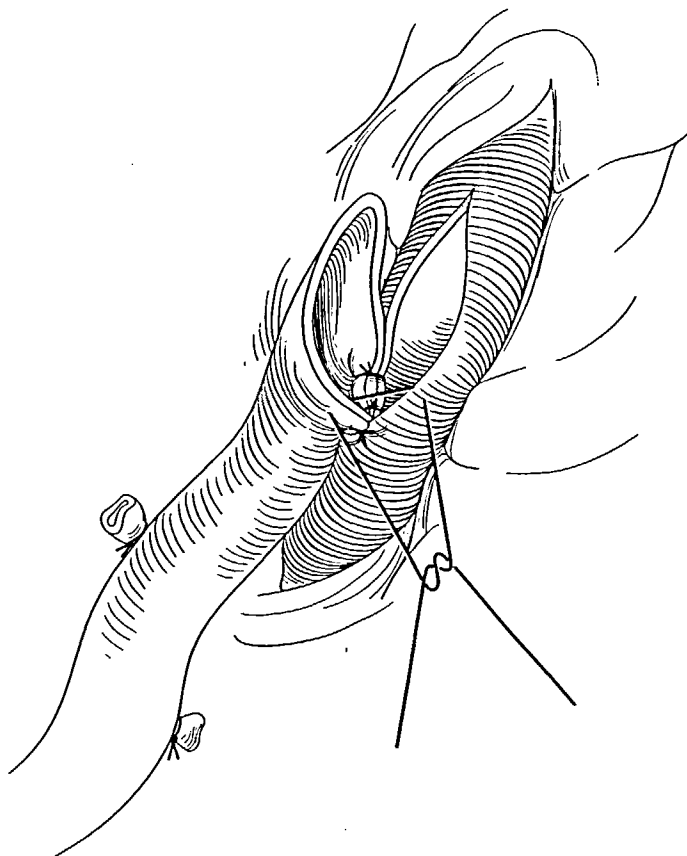
The general advantages of the interrupted technique are perfect visualization of the anastomotic field without the need to put traction on the graft and the anastomosis (as tends to be the case with most continuous suture strategies) and avoidance of the pursestring effect of a continuous anastomosis. The disadvantages of the interrupted technique include the need for repetitive tension-less tying of fine sutures and the danger of tangling sutures.

SURGICAL TECHNIQUE

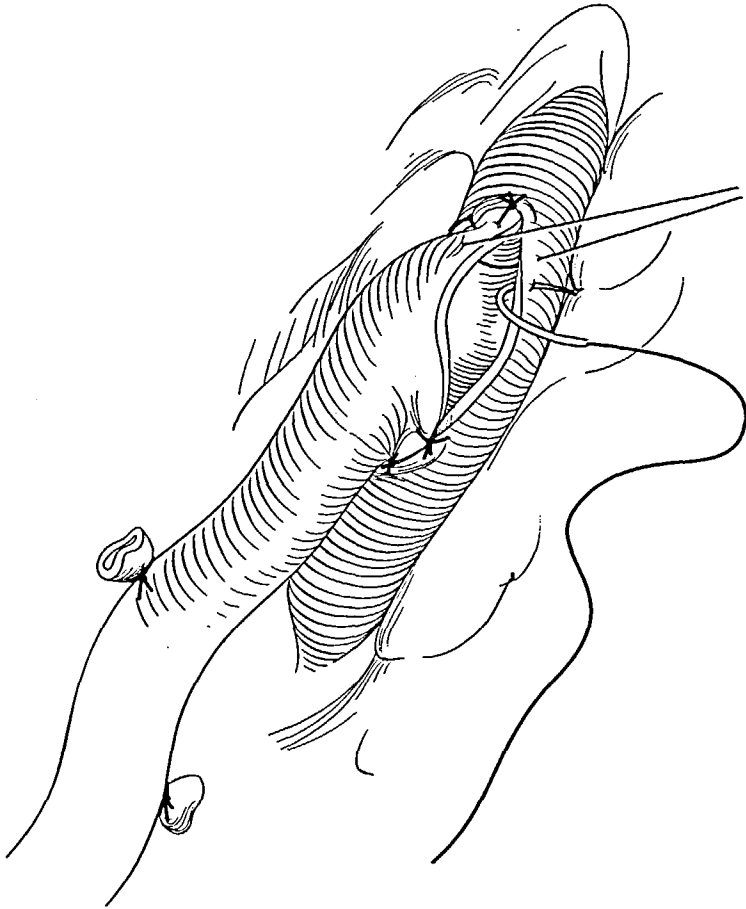


I During a standard vein-to-coronary artery end-to-side distal anastomosis, a 1-cm coronary arteriotomy is made, and 3 double-ended 7-0 silk sutures are placed through the coronary artery at the most dependent portion of the anastomosis. If the main right coronary artery (RCA) or a septal perforating vessel is being grafted, the most dependent portion will be the toe of the graft. For all other vessels, the most dependent portion will be the heel. (Courtesy Cleveland Clinic Foundation.)

2 The three sutures are then placed through the graft, and the graft is tied into place. Any discrepancy between the graft size and the coronary anastomosis is corrected by opening the coronary artery to match the graft. The hood of the graft is always left a little bit longer than the coronary arteriotomy. Most vein grafts are constructed to vessels on the posterior or lateral wall, so the axis of the anastomosis is vertical. (Courtesy Cleveland Clinic Foundation.)

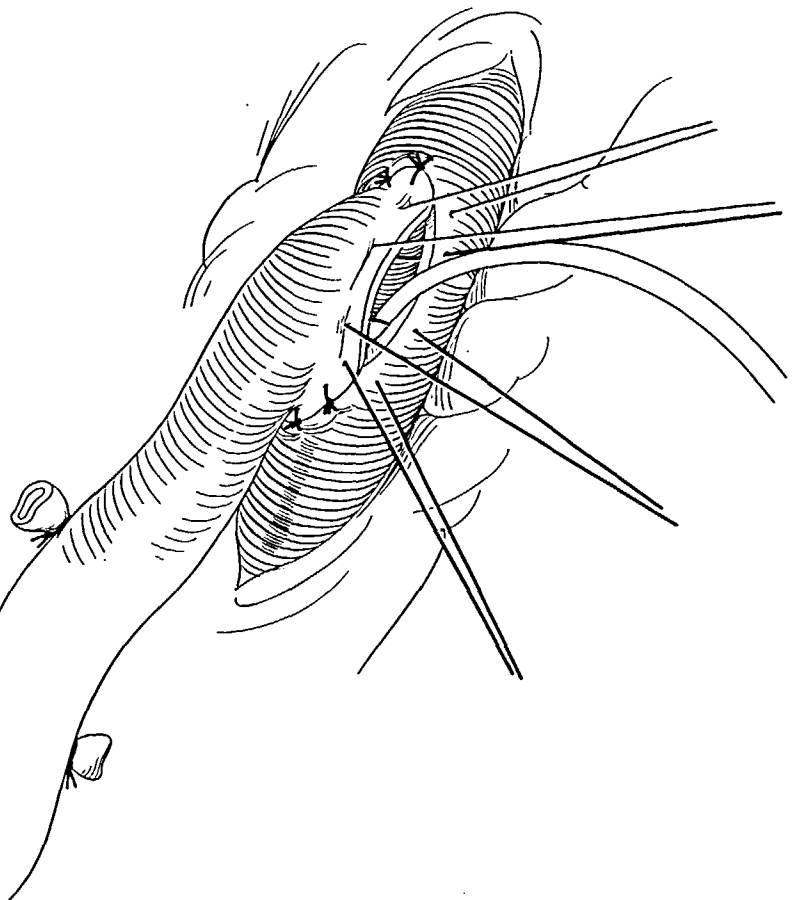


3 Forehand sutures (for a right-handed surgeon) are placed in the left-hand side of the coronary artery 2 to 3 mm apart, then placed through the vein graft and tied into place. These sutures are continued up to the "shoulder" of the anastomosis, the suture next to the tip of the anastomosis with 3 or 4 sutures used for each side. (Courtesy Cleveland Clinic Foundation.)

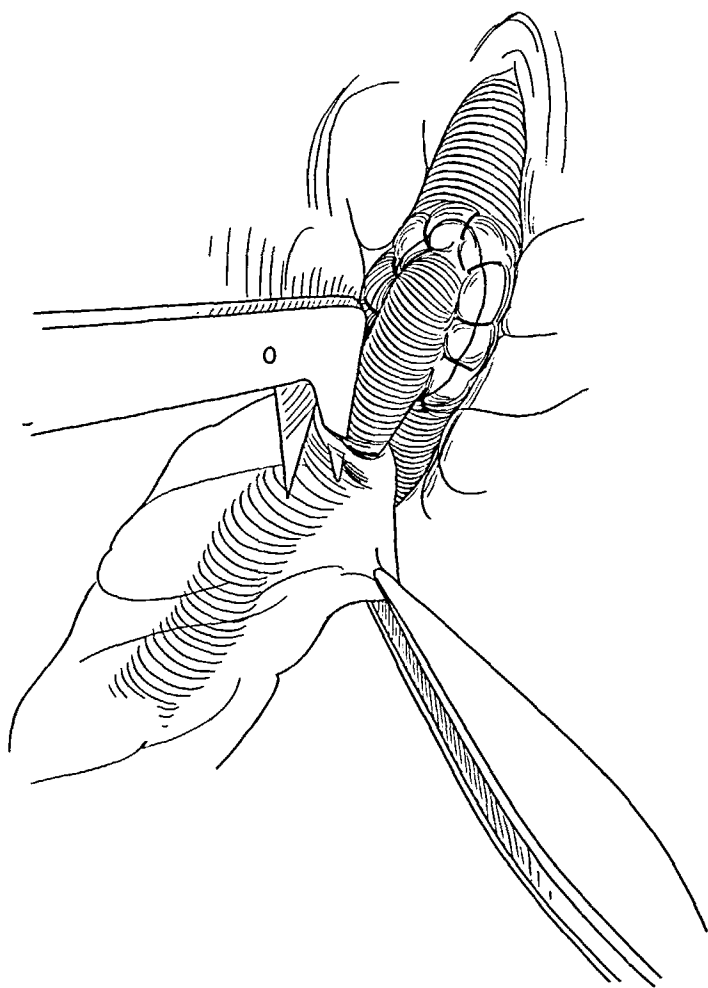
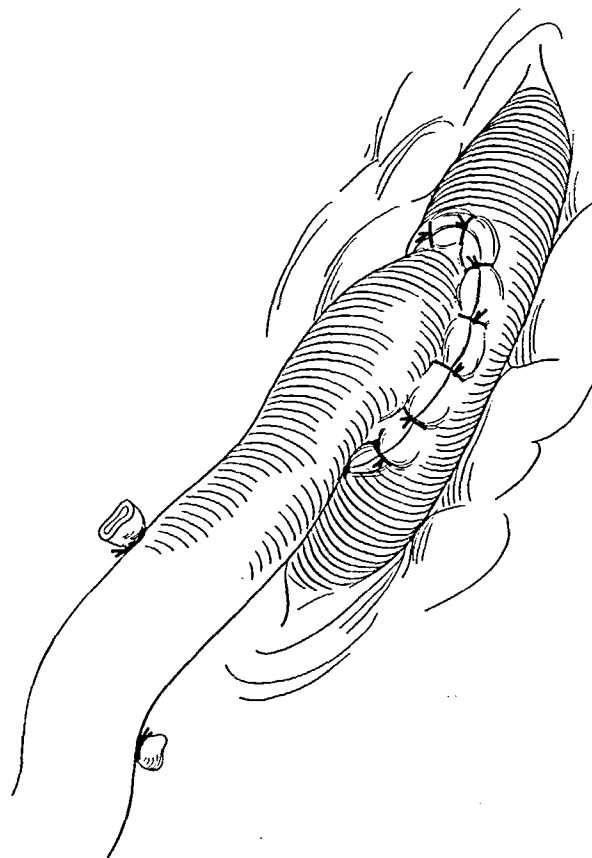


4 The 3 sutures in the tip are placed in the coronary artery, then through the graft, and are left untied until all have been placed. Then the left shoulder suture is tied, but the right shoulder suture and sometimes the tip suture are left untied while further sutures are placed in the right side of the anastomosis. This allows good exposure of the “backhand” side of the anastomosis. (Courtesy Cleveland Clinic Foundation.)

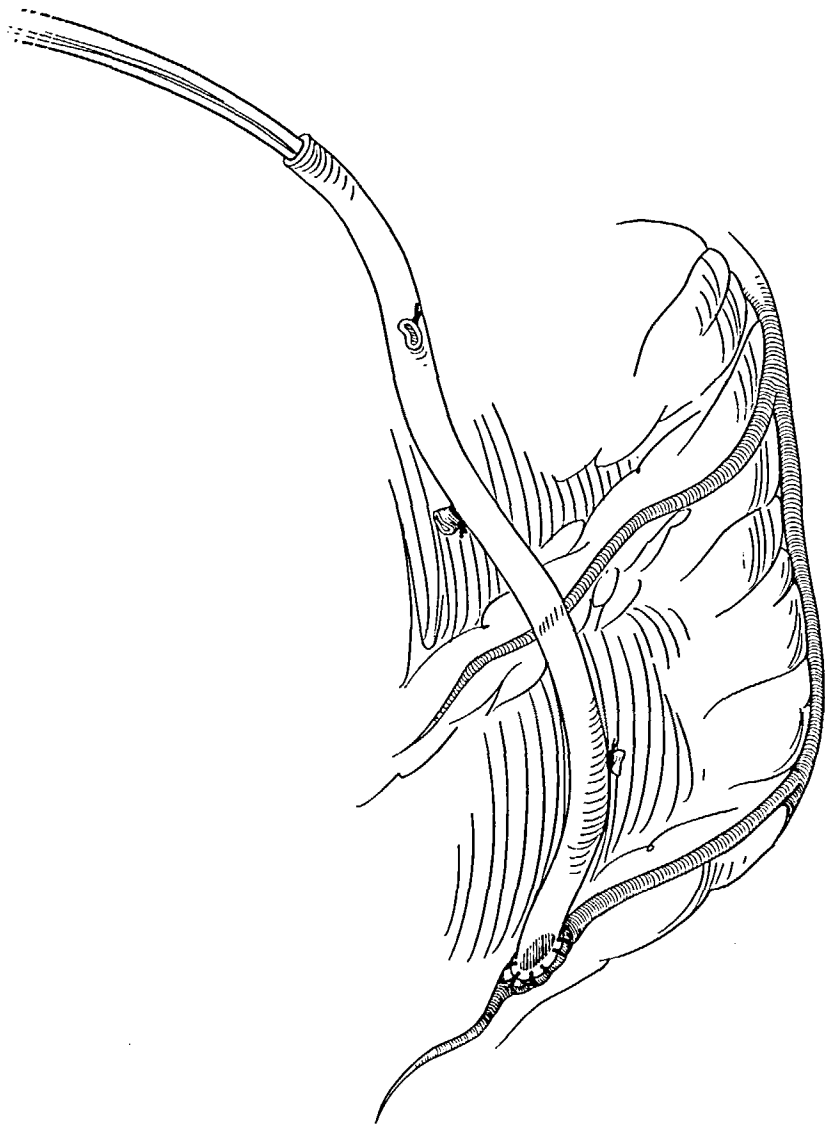
5 Once the right “side” sutures are placed, the tip and shoulder are tied, the anastomosis is probed with a 1-mm probe proximally and distally. (Courtesy Cleveland Clinic Foundation.)



6 The remaining sutures are then tied. There are usually typically 12 sutures in this type of anastomosis, but the number varies with vessel size. (Courtesy Cleveland Clinic Foundation.)

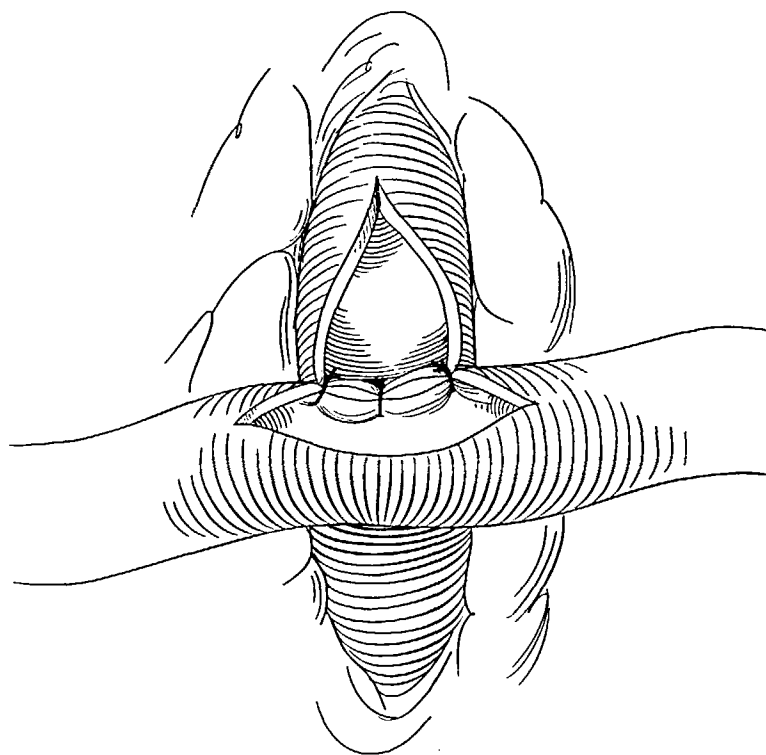


7 Artery-to-coronary end-to-side grafts are constructed in a similar fashion. Particular care must be taken at the heel portion of the anastomosis of internal thoracic artery (ITA) or gastroepiploic artery (GEA) grafts to avoid constriction of these relatively small and fragile grafts. If the artery being used as a graft is extremely small, then 8-0 monofilament suture with a fine needle is used for the 3 heel stitches of the anastomosis. The hood of ITA or GEA grafts should be 1 to 2 mm longer than the coronary arteriotomy, because these arterial grafts will not safely stretch over an arteriotomy that is longer than the graft opening. When the anastomosis is completed, a fine scissors is used to divide adventitial bands on the head of the arterial graft. (Courtesy Cleveland Clinic Foundation.)

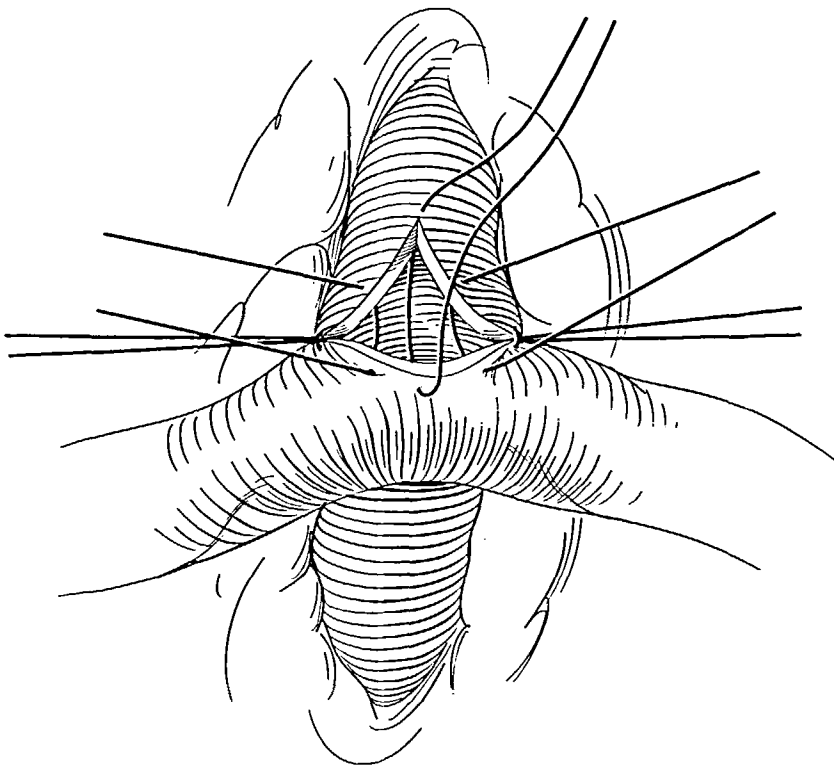
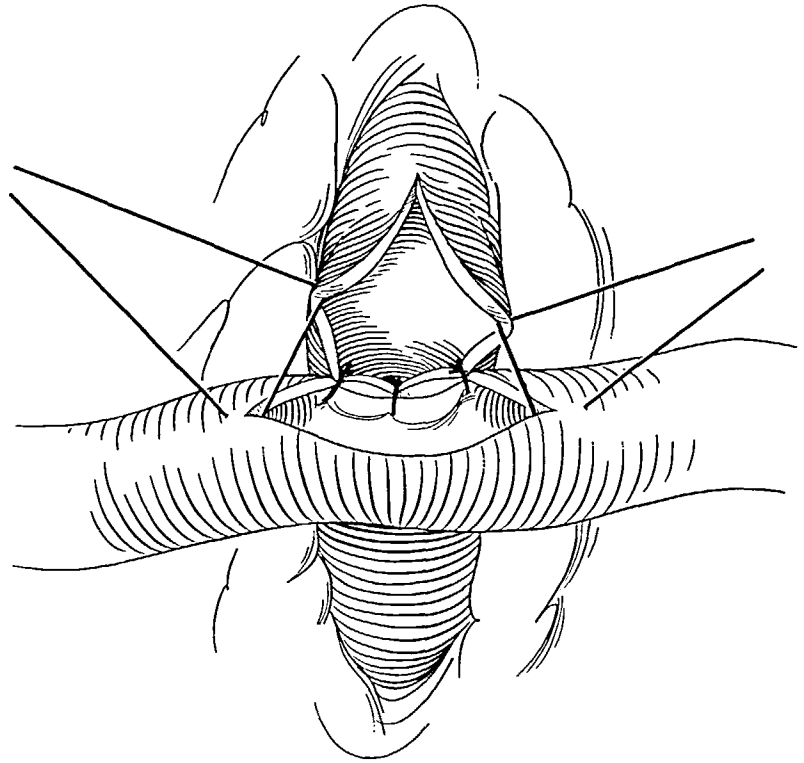


8 Sequential vein-to-coronary grafts usually involve the right coronary and/or circumflex system distal to the atrioventricular groove. The distalmost end-to-side anastomosis is constructed first, as detailed in 1 to 6. After that anastomosis is completed, cardioplegic solution may be run through the graft to aid in orientation of the conduit and in measuring the length between anastomoses. I usually use a diamond-type vein-to-coronary side-to-side anastomosis with the axis of the vein at a right angle to the axis of the coronary artery. This makes things pretty simple and geometrical. The coronary arteriotomy is shorter than that used in an end-to-side anastomosis but is at least twice the diameter of the coronary artery. The venotomy is usually 3 to 5 mm long and parallel to the long axis of the vein. (Courtesy Cleveland Clinic Foundation.)

9 Again, the three dependent (heel) sutures are placed in the coronary artery, through the vein, and tied into place. At this point the relative length of the vein and artery openings are inspected and corrected if necessary. The initial three sutures are spaced along the vein such that the next stitch on each side is placed in the angle of the venotomy and the middle part of the coronary arteriotomy. This is an 8-stitch anastomosis with 3 sutures at the heel, 3 at the toe, and a single suture along each side placed in the angle of the vein, thus creating a perpendicular diamond anastomosis. (Courtesy Cleveland Clinic Foundation.)



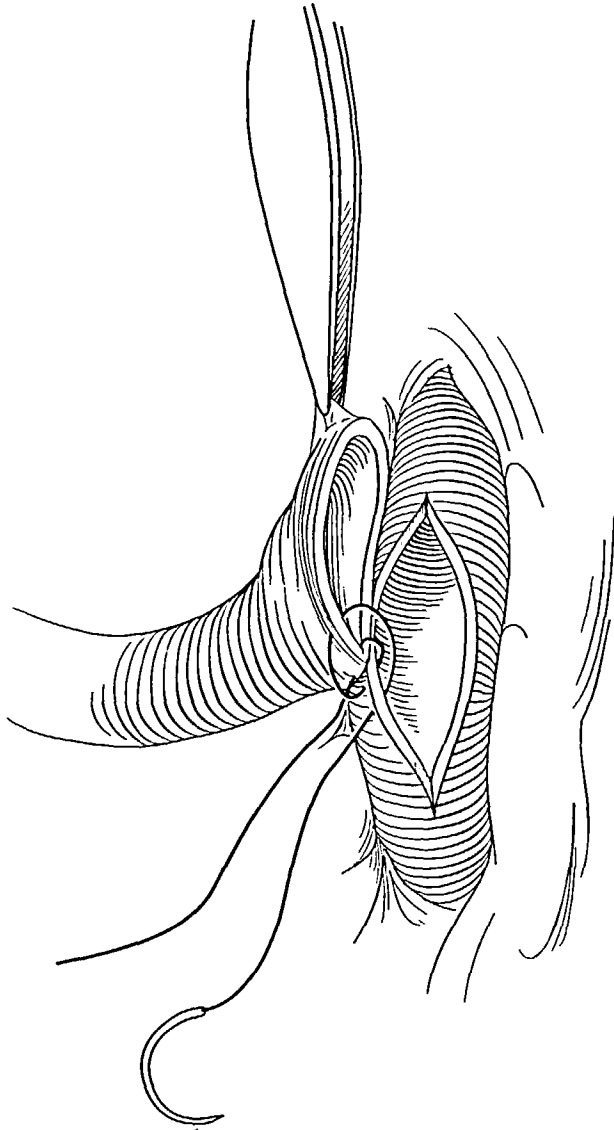
10 Sutures are placed in the middle of the side of the coronary arteriotomy and through the angle of the venotomy on each side of the anastomosis, but are left untied. (Courtesy Cleveland Clinic Foundation.)



11 Three sutures are placed at the shoulders and tip of the coronary arteriotomy, then evenly spaced along the side of the vein graft before any are tied. Then all of the sutures except 1 side suture are tied, the anastomosis is probed, and the final side suture is tied down.

This type of sequential anastomosis is extremely effective for grafting very small coronary arteries. It is safe because it allows shaping of the vein to the much smaller coronary artery and is one situation for which the interrupted strategy is truly superior.

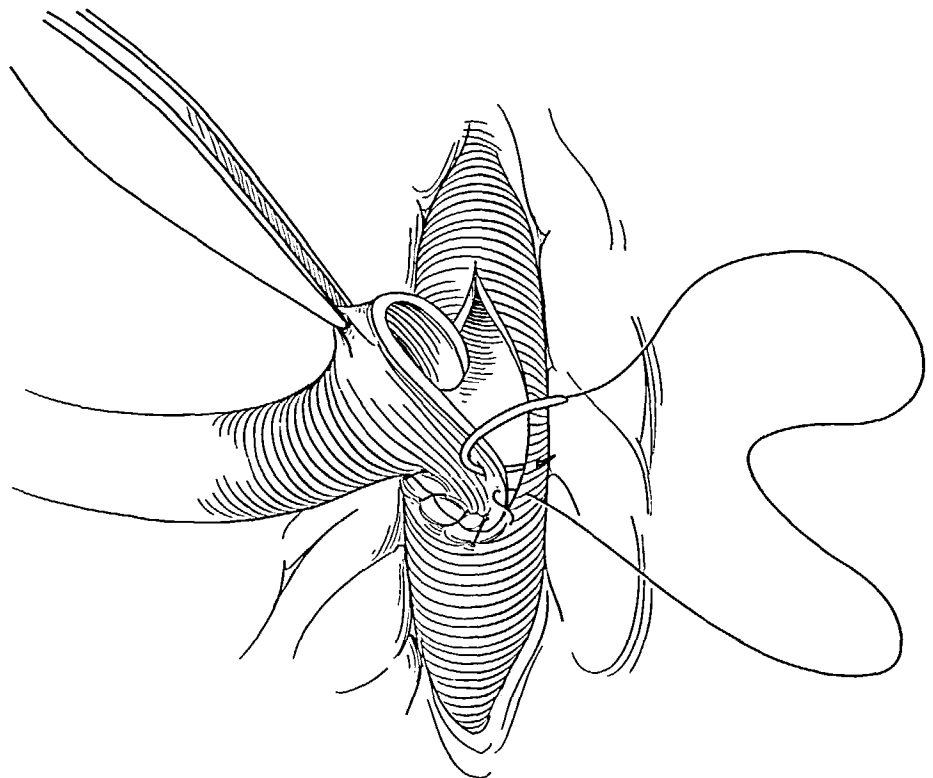
The radial artery often is of similar size and elasticity as vein grafts, and I use a similar sequential anastomotic technique for radial artery grafts. ITA and GEA sequential grafts are constructed differently, because those grafts are smaller and less elastic. (Courtesy Cleveland Clinic Foundation.)



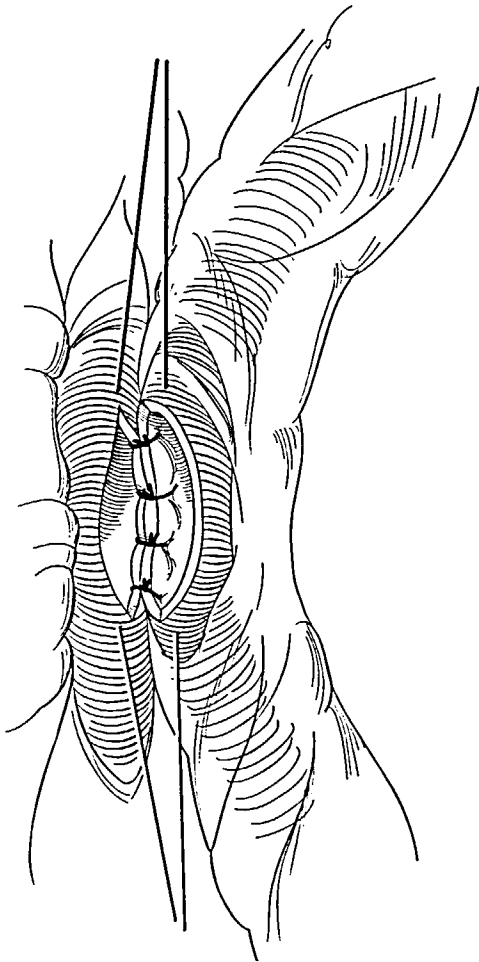
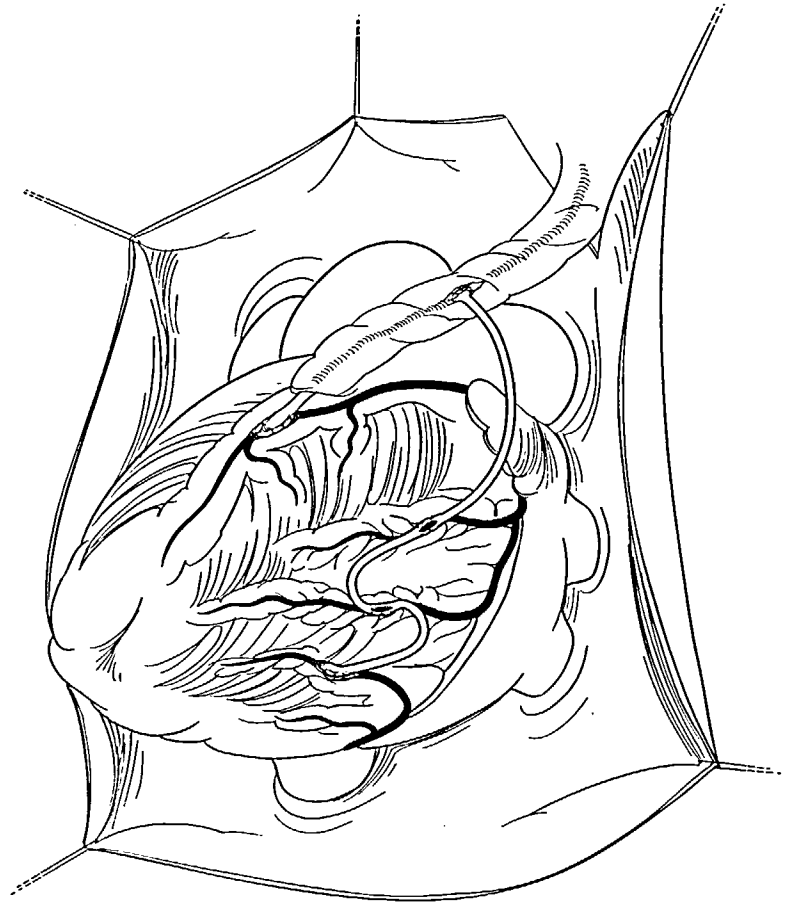
12 A common strategy is to use composite ("T" or "Y") ITA grafts with an anastomosis of the right ITA to the left ITA. This approach usually provides a good proximal anastomosis for the right ITA, makes it easier to use the right ITA to graft posterior vessels, and prevents the future problem of performing a repeat median sternotomy with the right ITA graft crossing the midline. It does mean that inflow into this system is based entirely on the left ITA, making preoperative evaluation of the left ITA important.

The right ITA-to-left ITA "T" anastomosis is usually done before cardiopulmonary bypass is initiated. The anastomosis is constructed with the left ITA held against the chest wall in a vertical position away from the beating heart, and 7-0 traction sutures are used on the adventitia of the left ITA to open the anastomosis. The left ITA arteriotomy is 1 cm long and 45° off the top of the left ITA toward the left side. An 8-0 Prolene suture is used because of the small, relatively atraumatic 8-0 needle and the observation that the continuous tension of a continuous suture technique avoids tears in vessels that may be very fragile. A continuous 8-0 suture is begun at the left aspect of the left ITA arteriotomy. (Courtesy Cleveland Clinic Foundation.)

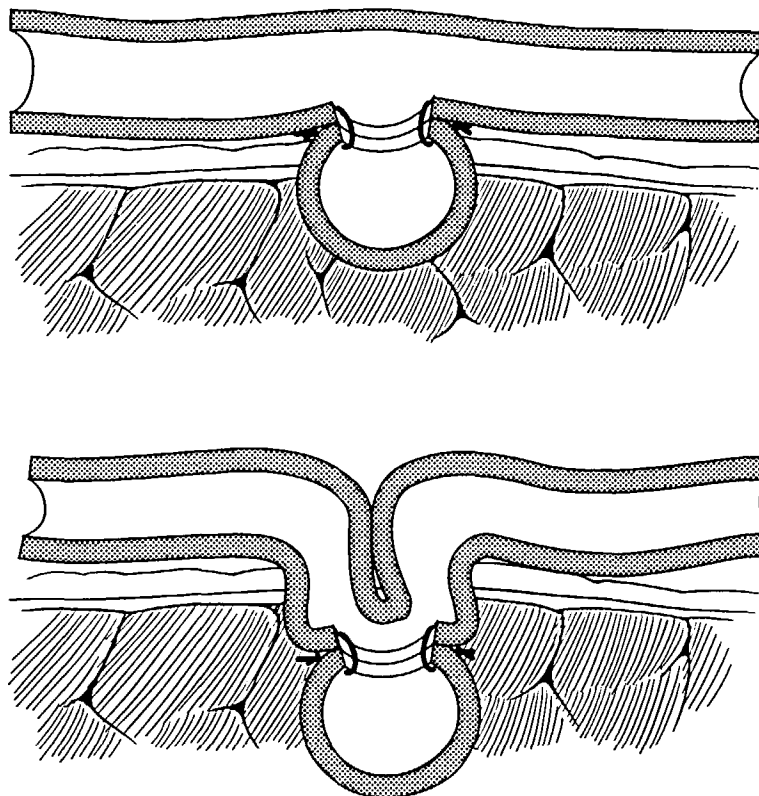
13 The continuous 8-0 suture is continued $\frac{3}{4}$ of the way around the arteriotomy, with the other limb of the 8-0 suture then used to join it. Obviously, this is a critical anastomosis. (Courtesy Cleveland Clinic Foundation.)



14 With a composite bilateral ITA graft, the right ITA is often used for multiple anastomoses to the circumflex or right coronary systems. These side-to-side anastomoses are constructed differently than vein graft sequential anastomoses. The more proximal side-to-side anastomoses are constructed first, allowing accurate measurement of the distance between anastomoses with the graft distended by arterial blood from the *in situ* arterial graft. Also, the side-to-side anastomoses are not constructed in a diamond pattern because of the danger of flattening the anastomosis of a small ITA with a diamond anastomosis. Sequential ITA anastomoses are constructed with the long axes of the ITA and the coronary artery parallel to one another. This also allows the ITA to enter the anastomosis without being kinked by epicardial fat or muscle. This strategy means, however, that quite a bit of right ITA length is used if multiple anastomoses are required. (Courtesy Cleveland Clinic Foundation.)



15 First, the heel and the forehead side of the side-to-side anastomosis are constructed, then the opposite side of the anastomosis is filled in with interrupted sutures. (Courtesy Cleveland Clinic Foundation.)



16 Great care must be taken at the heel and the toe of the side-to-side anastomosis, as kinking can occur there not only from suture misadventure, but also because of the angle at which the graft takes off from the coronary artery. This is a particular danger when a coronary artery is in a hole created by epicardial fat, muscle, or scarring from a previous operation.

When the coronary artery is intramyocardial or deep in fat, it may not be wise to perform sequential ITA grafts, and a short “Y” graft may be helpful. For example, when grafting both the LAD and diagonal, it is often possible to divide the left ITA at the correct length and have a 2- to 4-mm segment of distal ITA remaining. That ITA segment may be anastomosed to the more proximal left ITA and used as a short graft to a diagonal. Despite the fact that this requires another anastomosis, it is a safe way to avoid kinking of a sequential graft by an unfavorable angle or a vessel lying deep in myocardium or fat. (Courtesy Cleveland Clinic Foundation.)

From the Department of Thoracic and Cardiovascular Surgery, The Cleveland Clinic Foundation, Cleveland, OH.

Address reprint requests to Bruce W. Lytle, MD, Department of Thoracic and Cardiovascular Surgery, The Cleveland Clinic Foundation, 9500 Euclid Avenue F25, Cleveland, OH 44195.

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