

The Role of Vascular Clips in Vascular Access Surgery

Use of this new technology improves the long-term patency of autogenous and graft arteriovenous fistula for hemodialysis, with significant reduction in patient hospitalization, morbidity, and healthcare cost.

BY ARNOLD MILLER, MD, AND WOLFF M. KIRSCH, MD

Maintaining vascular access and treating the related complications in patients with end-stage renal disease (ESRD) remains the leading cause of hospitalization and morbidity in this group of patients.¹ It also accounts for the largest portion of the healthcare dollars designated to the treatment of the patient with ESRD.² The routine use of autogenous arteriovenous fistula (AVF) rather than synthetic graft fistula (AVG) improves long-term patency and reduces the number of required revisions to maintain patency, but the underlying problems of access failure remain.³ Although these problems are multifactorial, such as repeated needle-sticks, hemorrhage with tissue infiltration, peridialysis hypotension, and local compression, the problem of perianastomotic neointimal hyperplasia with stenosis and eventual access occlusion remains the leading cause of access failure.^{4,5} All modifications of anastomotic hemodynamics, such as patches, cuffs, and varying the anastomotic angle, based on conventional suturing techniques have failed to improve long-term patency.

The nonpenetrating, acute-legged clips (AnastoClip VCS, LeMaitre Vascular, Burlington, MA) have been shown to allow an interrupted everted, elastomeric, flanged "blood tight" anastomosis with streamlined flow and improved hemodynamics.⁶ We have previously shown that use of the AnastoClip in both autogenous AVF and synthetic bridge-graft fistulas (AVG) have a beneficial effect on fistula patency compared with conventional sutures (Figure 1).⁷ Such a benefit in patency translates into significant cost savings and a reduction in patient morbidity.

THE ANASTOCLIP DEVICE

The device is a flanged titanium clip of various sizes, which allows the application of a constant pressure despite tissues of varying thickness (Figure 2), so that the clip is able to self-regulate the final pressure between the tips. The clips are nonpenetrating and, when properly applied, provide an everted, intima-to-intima interrupted anastomosis. Healing of the vessel wall occurs with minimal distortion of the vessel structure (Figure 3A,B), thus minimizing the neointimal hyperplasia so consistently seen with conventional suturing techniques (Figure 3C).

TECHNIQUE

The clip may be used for either end-to-side or end-to-end anastomoses, patch angioplasty for stenotic vessels (Figure 4A-E), or as an alternative closure method of a simple arteriotomy or venotomy. Although the basic anastomotic technique is similar whether sutured or clipped, there are certain specific technical details that may optimize the effectiveness of the clip.

A specially designed everting forceps (Figure 5A) allows easy eversion of the "lips" of the anastomosis, ensuring intima-to-intima apposition. It is important to be sure that when the clip is applied, it encompasses both the lip of the artery and the vein, or prosthetic graft and blood vessel (no lips, no clips). For the end-to-side anastomosis, the quadrant technique is used, with holding sutures placed at the heel, the toe, and in the center of the anastomosis (Figure 5B). A U-stitch is usually placed at the heel and toe of the anastomosis. Where the vessels are small, to minimize narrowing of the artery and compromise of the inflow, three simple interrupted sutures may be placed at the heel of the anastomo-

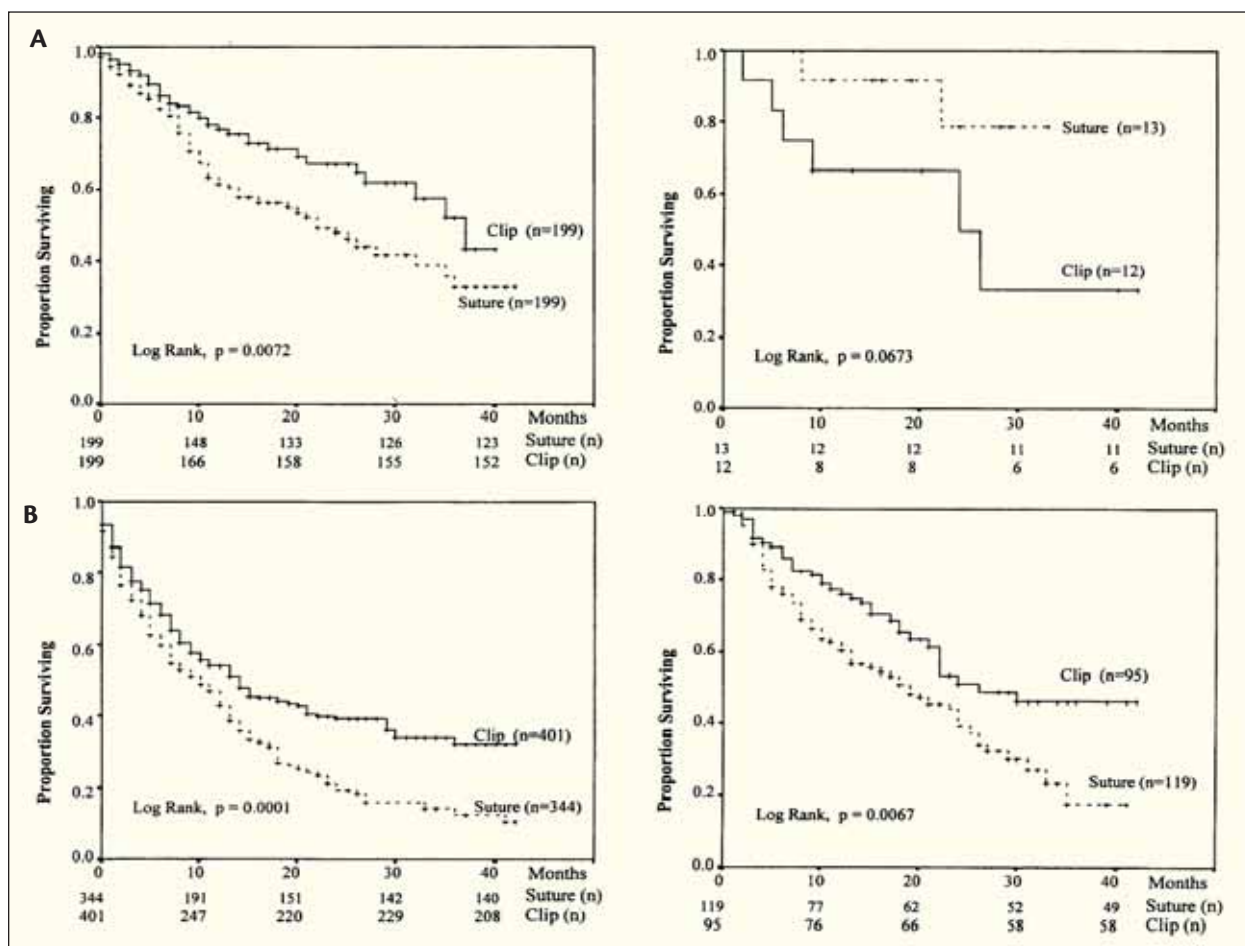


Figure 1. Kaplan-Meier analysis of primary patency for AVF (n=398) (A) and AVG (n=745) (B). In the AVF group, the primary patency was significantly improved and the secondary patency was marginally better for the sutured anastomosis ($P=.067$). In the AVG group, the primary and secondary patency were significantly improved over the sutured group. (Modified with permission.⁷)

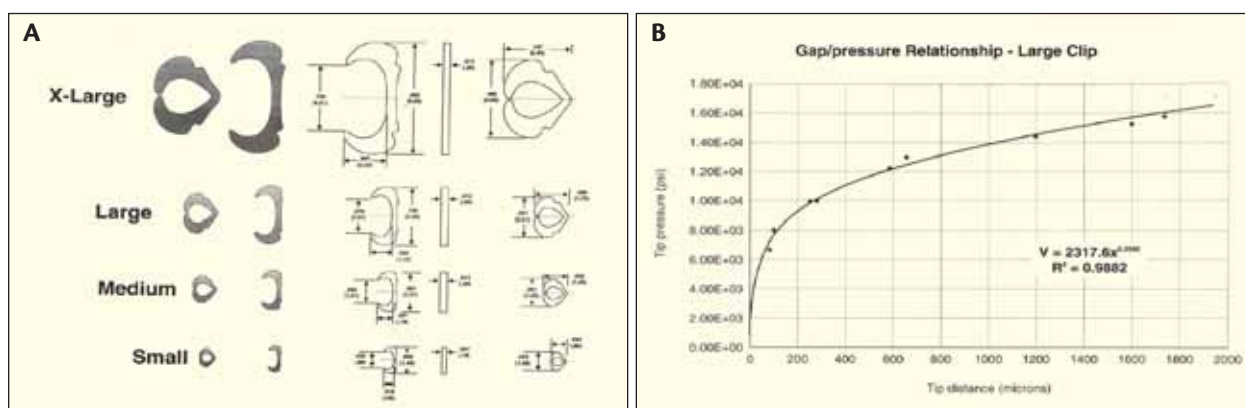


Figure 2. Various sizes of the clip are available for different procedures and vessel sizes. The small clips are used for microsurgery, medium clips are used for AVF at the wrist, large clips are used for upper arm AVF or synthetic grafts, and the extra-large clips are used for the femoral and other large arteries (A). Regression line for the relationship between the final tip gap and the pressure for the large VCS clip (B). A function has been calculated to describe this regression. Note the unique, self-adjusting property of the acute-legged clip.

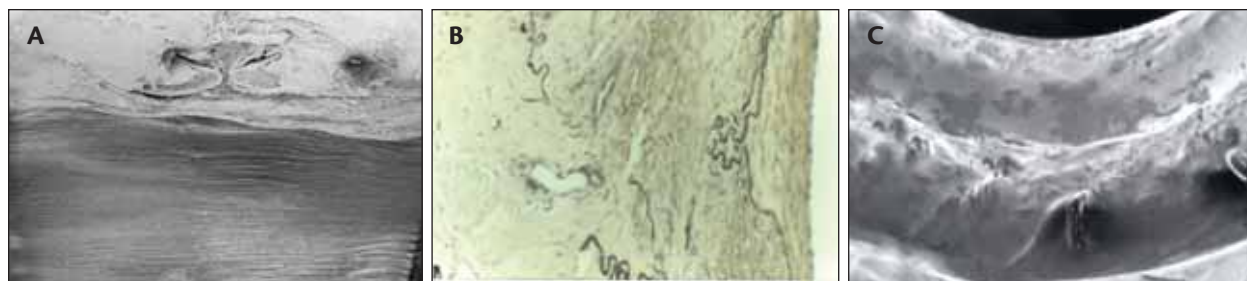


Figure 3. Scanning electron microscopic view of end-to-end bovine common carotid artery reconstruction (anastomotic line) at 1 year after placement. Note the large Anasto-VCS clip tips in place with underlying compressed arterial wall matrix between the clip tips, and the complete intimal resurfacing. Note the lack of intimal hyperplasia at the anastomotic line (A). Light microscopic view (van Gieson's stain for elastin) of healed arterial wall of bovine carotid end-to-end clipped anastomoses 1 year after placement showing reconstruction of the internal elastic lamina and smooth endothelial surface without smooth muscle cell migration (B). Scanning electron microscopic view of a Dacron interposition graft into bovine common carotid 1 year after placement. Note the intimal neoplasia at the anastomotic line and foreign-body polypropylene suture within the arterial lumen (C).

sis. The clips should be evenly spaced approximately 2 mm to 3 mm apart. The hood of the anastomosis at the "toe" should be more generous than for sutured anastomosis to prevent narrowing of the toe of the anastomosis with the application of clips.

For the end-to-end anastomosis, holding sutures are placed at opposite ends of the anastomosis and, where needed, an additional holding suture is placed in the middle of the suture line dividing the anastomosis into quadrants. Unlike sutures, the clips are easily removed after application without damage to the underlying vessels. A special remov-

ing forceps, which opens the clips, is used and should be available whenever the clips are used (Figure 5C).

The ability to remove and reapply the clips to the anastomosis without damage to the underlying vessels is a distinct advantage over the sutured anastomosis in which the penetrating needle often causes damage and requires debridement of the edges prior to redoing the anastomosis. If a flap or thrombus or other technical deficit in the anastomosis is noted and needs correction, removing one or two or more clips allows easy access to the anastomosis without the necessity of an arteriotomy in the hood of the graft.

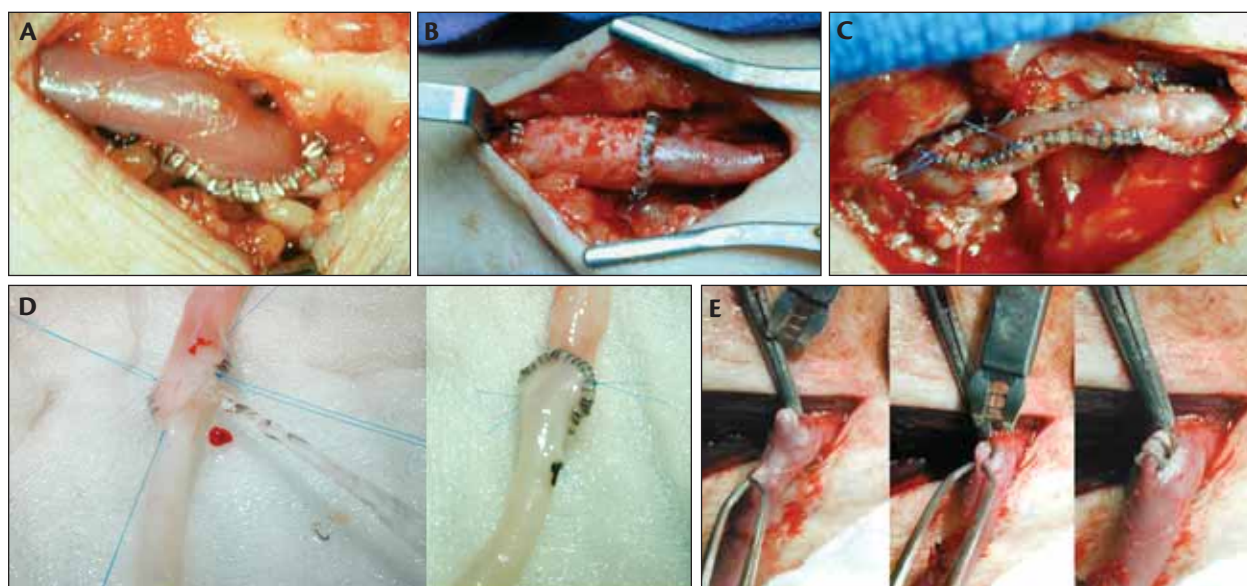


Figure 4. Operative photographs of applications of the AnastoClip. End-to-side cephaloradial AVF at the wrist (A). Interposition PTFE graft with end-to-end anastomosis for stenotic upper arm transposed basilic vein AVF (B). Vein patch-angioplasty for stenotic "runoff" cephalic forearm vein at the needle-stick site from cephaloradial AVF at the wrist (C). End-to-end anastomosis of two segments of arm vein for distal lower-extremity bypass (D). Exclusion of a small varicosity in a saphenous vein bypass conduit in the lower extremity (E).

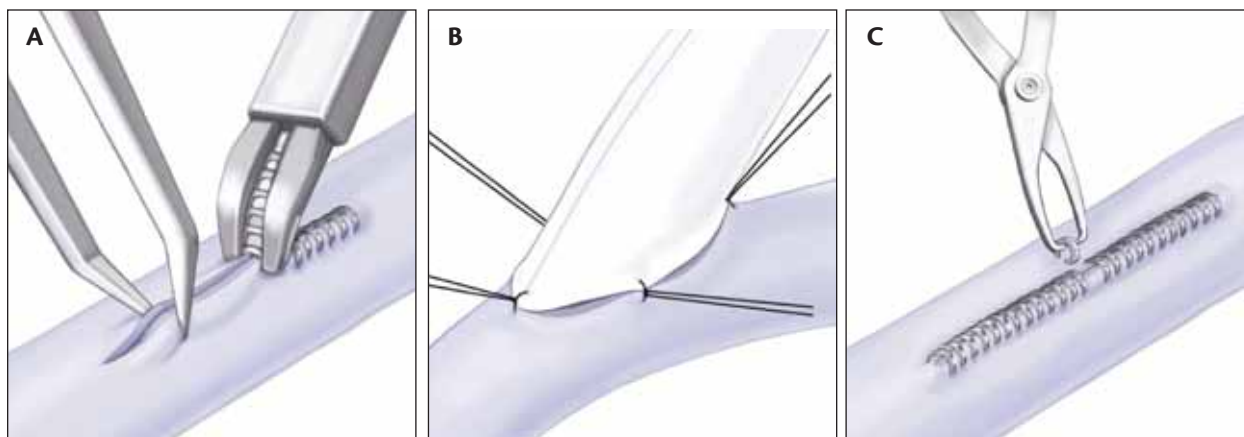


Figure 5. Special everting forceps ensuring equal lips for clip application (A). Holding sutures for end-to-side anastomosis (B). Clip removal instrument removes clips without injuring the graft or blood vessel (C).

DISCUSSION

Although the unique properties of the nonpenetrating clip and an everted intima-to-intima anastomosis without distortion of the vessel wall are critical to the reduction of neointimal hyperplasia and the improved results compared with standard continuous suture technique, it appears that creating an interrupted anastomosis may be just as important. The interrupted anastomosis reduces the compliance-mismatch between the vein or graft and the artery at the anastomosis.⁸ Even the nitinol self-tying surgical suture (Coalescent Surgical, Sunnyvale, CA), which penetrates through the vessel wall and remains within the blood vessel lumen similar to the standard vascular suture, but allows an expeditious interrupted anastomosis to be performed, has shown an improved early patency in access surgery.⁹

CONCLUSION

The AnastoClip is a simple device that allows for the rapid creation of an interrupted anastomosis without penetration of the vessel wall. Our multicenter study showed a statistically significant improved primary (AVF, $P=.007$; AVG, $P=.0001$) and secondary patency (AVG, $P=.007$), as well as a reduction of the number of revisions required to maintain patency per unit time for both the AVF and AVG.⁷ If the savings in patient care with this improved patency and fewer revision surgeries shown in this study were extrapolated to estimate the reduction in cost of maintaining the vascular access in all ESRD patients nationally, by the simple use of the clipped anastomosis for all AVF and AVG, millions of healthcare dollars could be saved, with a significant reduction in patient hospitalization and morbidity (unpublished data).

Finally, the use of the interrupted anastomosis for all vas-

cular anastomoses is now feasible, and studies are being conducted to examine the efficacy of the clipped anastomosis in all areas of vascular surgery. ■

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