

Polypropylene suture—Is it safe?

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Polypropylene suture has steadily gained popularity for use in vascular and cardiac surgical procedures because of its long-term tensile strength and minimal tissue trauma. However, recently some questions have arisen concerning its safety. We recently had two cases of polypropylene fracture, one occurring early and the other late after operation. Comparison and collation of these two cases with other reports leads to the conclusion that polypropylene suture is safe in most situations, but care must be taken to avoid instrumentation trauma and kinking stresses at knots, which probably explain most of the reported cases of polypropylene failure. In addition, polypropylene probably should not be used in graft-to-graft anastomoses in which the continual sawing stresses of two rigid structures appears to lead to an excessive incidence of late suture fracture with resultant false aneurysm formation. (*J VASC SURG* 1986; 4:98-100.)

Because tissue-to-graft ingrowth at synthetic anastomoses does not yield adequate tensile strength to withstand arterial pressure, all synthetic vascular graft anastomoses as well as patch closures and valve implantations depend on suture line integrity for the lifetime of the patient. Because silk, nylon, and polyethylene sutures lose tensile strength with time, their use in synthetic anastomoses has been abandoned by most surgeons.¹ Braided Dacron polyester sutures and monofilament polypropylene sutures maintain tensile strength and are commonly used for synthetic graft anastomoses. However, several recent reports have questioned the safety of polypropylene in some cases.¹⁻⁹ These reports have been sporadic and present a variety of circumstances with no clear pattern of failure that emerges. We have recently had two cases that, when considered together along with the literature reports, may help clarify the problem.

CASE REPORTS

Case 1. A 70-year-old diabetic man was admitted for evaluation of a transient ischemic attack associated with bilateral high-pitched carotid bruits. Arteriograms revealed critical bilateral carotid bifurcation stenoses. A left carotid endarterectomy was done May 21, 1984, followed by a right carotid endarterectomy on May 24. Postoperative recovery was unremarkable until the evening of May 27 when after a coughing episode, massive swelling of the right side of the neck developed associated with acute respiratory compromise followed by respiratory arrest. An emergency tracheostomy was done in the patient's room, and, once stabilized, he was returned to the operating room

where exploration of the right carotid artery revealed dehiscence of the 5-0 polypropylene arteriotomy closure resulting from a fracture of the suture some distance from the knot. The artery was repaired, and the patient awoke with left hemiplegia. He was eventually discharged from the hospital 3 months later after a complicated course with some neurologic improvement but with a residual marked left-sided hemiparesis and severe dysarthria.

Case 2. A 55-year-old man was admitted after the sudden onset of pain in his left leg. He had undergone an aortobifemoral knitted Dacron bypass in 1977 for an aortic aneurysm followed by bilateral femoral-proximal popliteal bypasses with 8 mm knitted Dacron in 1979 to relieve claudication. Physical examination showed a cool left leg and foot with a 6 cm false aneurysm in the left femoral area and a 2 cm false aneurysm in the right femoral area. Pulses were absent bilaterally distal to the femoral aneurysms, and ankle pressures were 30 mm Hg on the left and 65 mm Hg on the right with a brachial pressure of 110 mm Hg. Arteriograms showed an occluded femoropopliteal graft on the left side along with probable embolic thrombus in the left popliteal artery. The right femoropopliteal graft was also occluded.

Operation on May 18, 1983 disclosed fracture of the 5-0 polypropylene suture with total dehiscence and 1.5 cm separation of the Dacron graft-to-Dacron graft anastomosis. The aortofemoral graft-to-femoral artery anastomosis done with braided polyester suture was intact. A femoral-to-distal popliteal bypass of 6 mm polytetrafluoroethylene along with distal embolectomies established satisfactory distal flow. One week later operation on the right side again showed fracture of the 5-0 polypropylene suture with complete dehiscence of the Dacron graft-to-Dacron graft anastomosis. A similar procedure to that done on the left gave satisfactory results.

DISCUSSION

Monofilament polypropylene suture has been commercially available since 1969 and has steadily

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gained popularity among cardiac and vascular surgeons for tissue-to-tissue suture lines as well as prosthetic-to-tissue suture lines. Advantages of polypropylene include excellent maintenance of tensile strength with no biodegradation, a low coefficient of friction giving less tissue trauma in suturing, low tissue reactivity, low thrombogenicity, less chance of infection, and some evidence of less intraoperative blood loss.¹⁰⁻¹² However, when a running suture technique is used (as it is in most vascular anastomoses), use of the monofilament suture with a low coefficient of friction and no tissue ingrowth may result in complete anastomotic dehiscence with any suture fracture either early or late after operation. Conversely, a braided Dacron polyester suture with some tissue ingrowth and fixation would be less likely to result in total anastomotic dehiscence with suture disruption.

A review of the literature yielded only several isolated cases of polypropylene failure, but no study has been done to indicate the incidence or cause of the problem, and no large series showed more than an occasional case. Cornel² reported a pericardial patch dehiscence from polypropylene suture failure 1 month after closure of a primum atrial septal defect. Myhre³ reported three cases including failure of a proximal aortocoronary 5-0 polypropylene anastomosis intraoperatively, dehiscence of the 5-0 polypropylene aortic closure of a patent ductus arteriosus in a 21-year-old man resulting in death, and dehiscence of a 5-0 polypropylene anastomosis 2 days after a femoropopliteal bypass. All three cases resulted from suture fracture at the base of a knot. Szarnicki⁴ found fragmented polypropylene in a recurrent secundum atrial septal defect 3 years after the initial repair. Aldrete⁵ found a fracture below an intact knot in a partially dehiscd prosthetic mitral valve sewn with continuous 2-0 polypropylene suture. Alajmo and Vaccari⁹ reported dehiscence of a left atriotomy closure resulting in death; polypropylene fracture was at a distance from the knot. Our first case involved 5-0 polypropylene fracture at a distance from the knot.

Recently attention has been focused by several authors and a suture manufacturer on instrumentation of polypropylene sutures with forceps or clamps.^{8,12-14} Certainly any monofilament suture, particularly small ones, will be more likely to be weakened by instrument handling than will a braided suture because its integrity depends on a single strand. The suture in our first patient was probably grasped with a forceps during shunt removal.

Care must also be taken to avoid kinking at a knot because such stress may result in suture fracture.

Tying a single strand to a looped double strand at the end of a suture line automatically creates a kink and should be avoided. When tying two single sutures, care must be taken to square the knot to avoid a kink. Other possibly helpful measures may include use of larger polypropylene sutures, use of double-layer running closures of cardiectomy sites, use of interrupted suture technique when applicable, and use of an alternate (braided polyester) suture where appropriate.

Late vascular anastomotic failure results in false aneurysm formation with multiple etiologic factors proposed.* However, most authors implicate arterial wall degeneration or weakness as the dominant factor with intact suture lines found pulled from the artery in most cases. Pathologic studies tend to support such a tenet although no comparative studies have been done. Silk, nylon, and polyethylene sutures degenerated and were associated with many false aneurysms. However, polypropylene and Dacron polyester sutures appear to give satisfactory results with only occasional cases of suture failure reported in synthetic graft-to-tissue anastomoses. No prospective, randomized study has yet been done comparing the two.

Although there has been no indication of frequent polypropylene suture fracture in synthetic graft-to-tissue anastomoses resulting in false aneurysms, there does seem to be a pattern emerging of false aneurysms from polypropylene fracture in graft-to-graft anastomoses as occurred bilaterally in our second case. Although such anastomoses are not common, several authors reported similar cases.^{7,8,11} The mechanism of suture fracture in such cases is probably a sawing effect of the two rigid structures on the suture line occurring with each arterial pulsation. If so, similar stresses would be expected to occur between a synthetic graft and a heavily calcified large artery. In these instances braided polyester suture is probably safer, and an interrupted technique might be considered in some.

CONCLUSION

Monofilament polypropylene suture is probably safe for synthetic graft-to-tissue as well as tissue-to-tissue anastomoses, and it offers the advantage of less drag and tissue trauma during suture placement. There is no biodegradation, and tensile strength is maintained. However, extreme care must be taken to avoid instrumentation of the suture with clamps or forceps because such trauma may lead to later suture fracture with disastrous results in the early postop-

*References 1, 6-8, 11, 14-22.

erative period and failed repairs, valve dehiscences, or false aneurysms later.

Some reports raise a question of fracture at knots. Care should be taken to square knots and to avoid tying a single strand to a looped double strand at the end of a suture line since either may increase the stress at the base of a knot, making suture fracture more likely.

Synthetic graft-to-synthetic graft anastomoses should probably not be done with polypropylene because several cases of polypropylene fracture with resulting false aneurysms have occurred in such instances. The mechanism of suture fracture is thought to be the continued sawing effect at the interface of the two rigid synthetic grafts. If so, caution should probably be exercised in the use of polypropylene suture at a synthetic graft to calcified artery or valve annulus interface in which similar sawing stresses may occur.

REFERENCES

1. Starr DS, Weatherford SC, Lawrie GM, Morris GC. Suture material as a factor in the occurrence of anastomotic false aneurysms. *Arch Surg* 1979; 114:412-5.
2. Cornel G. Fracture of polypropylene suture (letter). *Ann Thorac Surg* 1982; 33:641.
3. Myhre OA. Breakage of Prolene suture (letter). *Ann Thorac Surg* 1983; 36:121.
4. Szarnicki RJ. Polypropylene suture fracture (letter). *Ann Thorac Surg* 1983; 35:333.
5. Aldrete V. Polypropylene suture fracture (letter). *Ann Thorac Surg* 1984; 37:264.
6. Carson SN, Hunter GC, Palmaz J, Guernsey JM. Recurrence of femoral anastomotic aneurysms. *Am J Surg* 1983; 146:774-8.
7. Hollier LH, Batson RC, Cohn I. Femoral anastomotic aneurysms. *Ann Surg* 1980; 191:715-20.
8. Satiani B, Kazmers M, Evans WE. Anastomotic arterial aneurysms. *Ann Surg* 1980; 192:674-82.
9. Alajmo F, Vaccari M. Polypropylene suture fracture (letter). *Ann Thorac Surg* 1985; 39:400.
10. Dean RH, Pinkerton JA, Foster JH. The use of monofilament suture in vascular surgery. *Surgery* 1975; 78:165-8.
11. Gaspar MR, Movius HJ, Rosental JJ, Bell DD, Lemire GG, Odou M. Prolene sutures are not a significant factor in anastomotic false aneurysms. *Am J Surg* 1983; 146:216-9.
12. Reul GJ. The role of sutures in complications in vascular surgery and their relationship to pseudoaneurysm formation. In: Bernhard VM, Towne JB, eds. *Complications in vascular surgery*. New York: Grune & Stratton, Inc, 1980:615-38.
13. Marshall DC. Personal letter. Somerville, NJ: Ethicon Inc, 1983.
14. Nichols WK, Stanton M, Silver D, Keitzer WF. Anastomotic aneurysms following lower extremity revascularization. *Surgery* 1980; 88:366-74.
15. Kassem AE, Hallman GL. False iliac aneurysms. *Tex Heart Inst J* 1984; 11:334-7.
16. Brandt B, Groeger EC, Lambeth WC. Anastomotic false aneurysms—A comparison of braided Dacron and polypropylene sutures. *Am Surg* 1982; 48:255-7.
17. Szilagyi DE, Smith RF, Elliott JP, Hageman JH, Dall'Omo CA. Anastomotic aneurysms after vascular reconstruction: Problems of incidence, etiology, and treatment. *Surgery* 1975; 78:800-16.
18. Gaylis H. Pathogenesis of anastomotic aneurysms. *Surgery* 1981; 90:509-15.
19. Thompson BW, Read RC, Campbell GS. Uninfected false aneurysms after arterial reconstruction with prosthetic grafts. *Am J Surg* 1979; 138:920-3.
20. Knox WG. Peripheral vascular anastomotic aneurysms. *Ann Surg* 1976; 183:120-3.
21. Richardson JV, McDowell HA. Anastomotic aneurysms following arterial grafting. *Ann Surg* 1976; 184:179-82.
22. Nunn DB, Rao N, Renard A. Anastomotic aneurysms. *Am Surg* 1975; 41:281-8.