Brief Communications

Mechanical properties and microscopic findings of a Dacron graft explanted 27 years after coarctation repair

Naoko Nagano, MD,[a] Raymond Cartier, MD,[a] Tiffany Zigras, MEng,[b] Rosaire Mongrain, PhD,[b,d] and Richard L. Leask, PhD,[c,d] Montreal, Quebec, Canada

Dr Cartier

Dacron grafts are effective and useful conduits for large-caliber arteries. There are very few reports of long-term (>15 years) changes of implanted Dacron grafts in human subjects. In the short term, dilatation after implantation is often observed at follow-up echocardiographic and computed tomographic imaging. Although the unused mechanical properties of the Dacron grafts have been reported,[1,2] there has been no report of the changes after clinical use in human subjects.

We present a case of a Dacron graft explanted after 27 years. We evaluated the mechanical properties by means of biaxial tensile tensing and compared the result with an unused version of the Dacron graft.

Clinical Summary

A 48-year-old man was evaluated for persistent left shoulder pain after commencing regular exercise. Radiographic analysis showed a dilated mediastinal shadow. He had previously undergone surgical intervention to repair a coarctation of the aorta at the age of 21 years. At that time, a 14-mm double-velour woven Dacron graft (4 cm in length) was used to replace the narrowed aorta. A detailed investigation revealed that there was an 8-cm pseudoaneurysm at the site of the coarctation repair involving both the proximal and distal anastomoses. The graft and the pseudoaneurysm were removed after achievement of deep hypothermic circulatory arrest, and a new 26-mm woven Dacron graft was implanted. The old anastomoses \were completely dehiscent. His postoperative course was uneventful, and he was discharged from our institute after 6 postoperative days.

An anterior part of the Dacron graft was obtained from the operative field. The lumen of the graft appeared shiny and white, showing significant host tissue overgrowth (Figure 1, *A*). Immunohistochemical analysis confirmed the presence of endothelial cells on the luminal surface and a few macrophages within the graft. There was no obvious calcification within the Dacron mesh or tissue overgrowth; however, there was significant collagen and glycoaminoglycan deposits both in the graft and host tissue overgrowth (Figure 1, *B* and *C*). Two samples (1.5 cm × 1.5 cm of size) were prepared for mechanical testing, one with the host tissue overgrowth (tissue positive) and the other stripped of tissue (tissue negative). The tissue was easily peeled off the Dacron graft. The averaged thickness of the tissue overgrowth was 0.25 mm, and the Dacron graft was 0.64 mm. There was no obvious disruption of the Dacron structure; however, there was significant cellular infiltration and matrix deposition between the Dacron fibers (Figure 1, *B* and *C*). An unused, woven, double-velour vascular graft (Boston Scientific Medi-tech) was obtained and tested with the same protocol for comparison ($n = 5$). The average thickness of the unused Dacron graft was 0.66 mm. Tensile testing was performed by using the EnduraTEC elf 3200 biaxial tensile tester system supplied with Win

From the Department of Cardiac Surgery[a] and Research Center,[d] Montreal Heart Institute and Université de Montréal, Montreal, Quebec, Canada; and the Departments of Mechanical Engineering[b] and Chemical Engineering,[c] McGill University, Montreal, Quebec, Canada.

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Address for reprints: Raymond Cartier, MD, Department of Cardiac Surgery, Montreal Heart Institute, 5000 Belanger Street, Montreal, Quebec H1T 1C8, Canada (E-mail: rc2910@aol.com).

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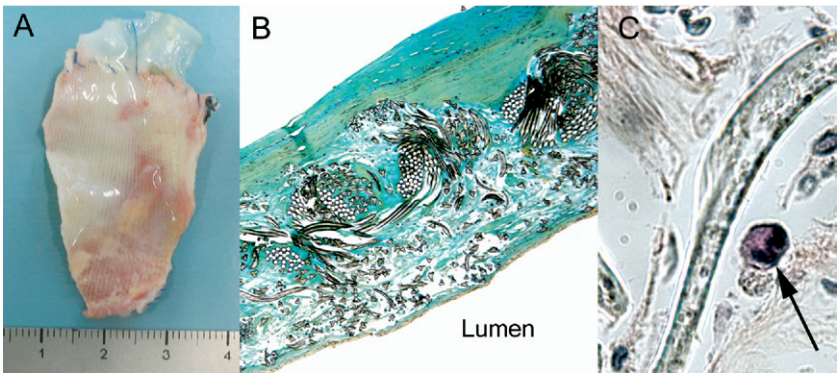

Figure 1. The Dacron graft explanted after 27 years. A, The explanted anterior part of the Dacron graft, luminal side up. Host tissue overgrowth is clearly seen on the lumen. B, Movat pentachrome-stained section of the graft, which clearly shows the infiltration of tissue into the graft. C, Hematoxylin and eosin–stained section showing the presence of an infiltrated macrophage.

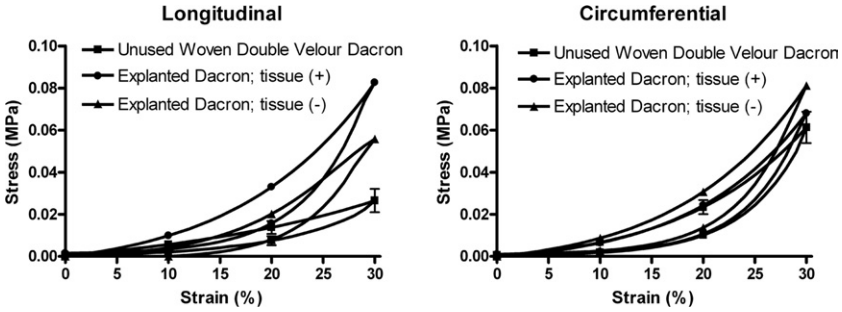

Figure 2. The final stress–strain curves from the biaxial mechanical testing. The excised graft was tested with *(+)* and without *(−)* host tissue overgrowth. All configurations were compared with the mechanical properties of an unused Dacron graft.

Test software. The samples were subjected to 13 loading and unloading cycles with a displacement of 30% of an averaged distance and at a constant strain rate of 0.1 mm/s. The first 10 cycles were used for preconditioning, and the last 3 cycles were considered the experimental stretching (Figure 2).

Mechanical testing showed that the unused Dacron graft had directional dependency in its mechanical properties, with the circumferential direction stiffer than the longitudinal direction. In the circumferential direction there was no significant difference in the response of the unused excised portion with and without tissue ($P > .05$, 1-way analysis of variance). In the longitudinal direction there was a noticeable difference in the mechanical response. The presence of host tissue overgrowth significantly stiffened the graft ($P = .0002$, 1-way analysis of variance). At low strain, the unused and excised grafts without tissue were similar.

Discussion

The long-term fate of Dacron grafts, especially woven large-caliber grafts, has not been well documented. The durability of Dacron grafts has been well established, although there are some reports of complications caused by degeneration of the Dacron.[3] It has been suggested that after initial dilatation, the Dacron graft slowly continues to increase its diameter in vivo.[4] Mechanical property changes in the graft might contribute to aneurysm formation and disruption of the Dacron graft. In the present study we had a rare opportunity to test a Dacron graft explanted 27 years after implantation. When we compared the mechanical properties of the excised graft to an unused graft, we found no significant difference in the circumferential mechanical properties. Tissue infiltration and overgrowth did have an effect on the longitudinal stretch, reducing the directional dependency of the material over time. In spite of 27 years of clinical use, there was no real evidence of necrosis, and there was evidence of endothelialization. This has been previously reported in medium-caliber Dacron grafts[5] but not in large-caliber thoracic aorta grafts. This case reemphasizes the utility and durability of woven double-velour Dacron grafts.

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