Comparison of axillofemoral and aortofemoral bypass for aortoiliac occlusive disease

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Purpose: A comparison of aortofemoral bypass grafting (AOFBG) and axillofemoral bypass grafting (AXFBG) for occlusive disease performed by the same surgeons during a defined interval forms the basis for this report.

Methods: Data regarding all patients who underwent AOFBG or AXFBG for lower-extremity ischemia caused by aortoiliac occlusive disease were prospectively entered into a computerized vascular registry. The decision to perform AOFBG rather than AXFBG was based on assessment of surgical risk and the surgeon's preference. This report describes results for surgical morbidity, mortality, patency, limb salvage, and patient survival for procedures performed from January 1988 through December 1993.

Results: We performed 108 AXFBGs and 139 AOFBGs. AXFBG patients were older (mean age, 68 years compared with 58 years for AOFBG, $p < 0.001$), more often had heart disease (84% compared with 38%, $p < 0.001$), and more often underwent surgery for limb-salvage indications (80% compared with 42%, $p < 0.001$). No significant differences were found in operative mortality (AXFBG, 3.4%; AOFBG, < 1.0%, p = NS), but major postoperative complications occurred more frequently after AOFBG (AXFBG, 9.2%; AOFBG, 19.4%; $p < 0.05$). Follow-up ranged from 1 to 83 months (mean, 27 months). Five-year life-table primary patency, limb salvage, and survival rates were 74%, 89%, and 45% for AXFBG and 80%, 79%, and 72% for AOFBG, respectively. Although the patient survival rate was statistically lower with AXFBG, primary patency and limb salvage rates did not differ when compared with AOFBG.

Conclusion: When reserved for high-risk patients with limited life expectancy, the patency and limb salvage results of AXFBG are equivalent to those of AOFBG. (J VASC SURG 1996;23:263-71.)

Aortofemoral bypass grafting (AOFBG) is the standard surgical treatment for aortoiliac occlusive disease, partly because of a 5-year patency rate that exceeds 80% in many reports.[1-6] With the nearly simultaneous reports of Blaisdell and Hall[7] and Louw[8] in 1963, axillofemoral bypass grafting (AXFBG) was introduced as an alternative technique for lower-extremity inflow revascularization. Widespread use of AXFBG for treatment of aortoiliac occlusive disease was limited in the past because long-term patency rates were inferior to those reported for AOFBG.[9-14]

Patency results achieved with AXFBG have improved recently, which is temporally related to the introduction of externally supported prostheses. Primary patency rates of >70% at 5 years have been reported by several investigators.[15-18] These results of AXFBG are noteworthy for superiority over previous AXFBG series and for a striking similarity to patency results from AOFBG series. Although few studies have compared AXFBG and AOFBG,[13,19-22] none were prospective. No reports have been published about concurrent AXFBG and AOFBG procedures performed by the same surgeons at a single institution. A comparison of prospectively collected results of all AXFBG and AOFBG procedures performed for occlusive disease by the vascular surgery service at the

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Oregon Health Sciences University during a single time period forms the basis for this report.

METHODS

Data about all patients who underwent AXFBG or AOFBG at the Oregon Health Sciences University Hospital and Portland Veterans Affairs Hospital from January 1, 1988, to December 31, 1993, for lower-extremity ischemia caused by aortoiliac occlusive disease were entered prospectively into a computerized vascular registry. Excluded from this study were procedures performed for abdominal aortic aneurysm, trauma, aortoenteric fistula, aortic graft infection, or any indication except ischemia caused by atherosclerotic occlusive disease. Repeat AXFBG performed to treat failure of an initial AXFBG were also excluded (n = 9) to preserve the independence of the observations compared (i.e., to avoid counting individual patient data twice). The results with respect to all parameters evaluated were not altered by this exclusion.

Before surgery, patient demographic data and associated medical conditions were recorded. Noninvasive vascular laboratory evaluation of the lower extremities with methods previously described was obtained.[23] Complete arteriography of the aorta and lower extremities was performed before elective surgery. Patients who underwent AXFBG had noninvasive preoperative testing to assess axillary artery inflow. Upper-extremity arteriography was performed in patients with abnormal study results, as previously described.[17]

Choice of AOFBG or AXFBG for each patient was not randomized, but was made by each operating surgeon on the basis of an assessment of surgical risk. AXFBG was selected when AOFBG was relatively contraindicated by operative technical factors such as multiple previous abdominal or aortic surgeries, radiation, or stoma, or by systemic factors such as advanced age, severe cardiac or pulmonary disease, or other severe medical illness. No specific criteria were used for the choice of AXFBG or AOFBG; the decision was made on an individual basis for each patient by each attending surgeon. Concomitant infrainguinal bypass was performed in patients with multilevel disease in whom an inflow procedure alone would have been insufficient for complete revascularization, as we have previously described.[24]

The operative technique for AXFBG has been described previously.[17,18,25] All grafts were constructed of 8-mm externally supported polytetrafluoroethylene. The axillofemoral component of the graft was tunnelled subcutaneously from the axilla in the midaxillary line, medial to the anterior superior iliac spine, to the ipsilateral femoral artery. Proximal anastomosis was performed in an end-to-side fashion to a longitudinal arteriotomy in the first portion of the axillary artery, followed by distal anastomosis to the femoral artery for axillounifemoral bypass or to the ipsilateral anastomotic "hood" of a previously placed femorofemoral bypass for axillobifemoral bypass.

AOFBG was performed by retroperitoneal or transperitoneal exposure according to the preference of the operating surgeons. All AOFBGs were performed with woven Dacron grafts. Distal anastomoses were to the common femoral, superficial femoral, or deep femoral arteries depending on the pattern of occlusive disease at the femoral level. Femoral endarterectomy and profundaplasty were performed when appropriate as previously described.[26] All operations were performed by one or more of the authors acting as teaching assistant to vascular surgery and general surgery residents.

After surgery, patients were seen by one of the authors for follow-up visits every 3 months for the first year and every 6 months thereafter. Graft patency was assessed at each visit by clinical examination and by noninvasive vascular laboratory examination. Suspected graft occlusions were confirmed by arteriography. Long-term primary patency, secondary patency, limb salvage, and survival rates were determined with standard life-table analysis as defined by published reporting standards.[27] Limb salvage was defined as rest pain, the presence of ischemic ulceration with ankle-brachial index of ≥ 0.40, or both. For AXFBG, failure of the axillofemoral or femorofemoral component or of both components was regarded as failure of the entire graft. For AOFBG, failure of either limb was regarded as failure of the graft. Patency rates were calculated on the basis of the number of grafts, limb salvage rates were calculated from the number of limbs at risk, and survival rates were calculated from the number of patients. Comparisons among the groups were tested with χ^2 analysis for conditional variables and the log-rank test for life-table results.

PATIENTS

Demographics. During the study period, 108 AXFBG were performed in 108 patients and 139 AOFBG were performed in 139 patients. The age range for the entire study population was 35 years to 90 years. Patients who underwent AXBFG tended to be older than patients who underwent AOFBG (mean age of 68.12 ± 11.42 years compared with

Table I. Associated medical conditions in patients who underwent axillofemoral and aortofemoral bypass

Condition	*Axillofemoral bypass (n = 108)*	*Aortofemoral bypass (n = 139)*	*p**
Age >80 years	10 (9%)	0 (0%)	<0.001
Tobacco use	93 (86%)	114 (82%)	NS
Heart disease	91 (84%)	52 (38%)	<0.001
Chronic pulmonary disease	14 (13%)	17 (12%)	NS
Diabetes mellitus	31 (29%)	27 (19%)	NS
Chronic renal failure	12 (11%)	3 (2%)	<0.01
Prior intraabdominal surgery	48 (44%)	42 (30%)	<0.05
Prior aortic surgery	17 (16%)	8 (6%)	<0.05

*χ^2 analysis.

Table II. Indication for axillofemoral and aortofemoral bypass

Indication	*Axillofemoral bypass (n = 108)*	*Aortofemoral bypass (n = 139)*	*p**
Claudication	22 (20%)	81 (58%)	<0.001
Rest pain	53 (49%)	44 (32%)	<0.001
Ischemic ulcer or gangrene	33 (31%)	14 (10%)	<0.001

*χ^2 analysis.

58.71 ± 10.21 years; $p < 0.001$ by t test comparison of means). Seventy-two patients who underwent AXFBG (67%) and 107 patients who underwent AOFBG (77%) were male (p = NS).

Clinical presentation. Associated medical conditions are summarized in Table I. Patients who underwent AXBFG were significantly more likely to have heart disease ($p < 0.001$), chronic renal failure ($p < 0.01$), and previous intraabdominal or aortic surgery ($p < 0.05$). Incidence of diabetes mellitus, chronic pulmonary disease, and tobacco use did not differ.

Indications for surgery are shown in Table II. Limb salvage was the indication for surgery in 86 patients with AXBFG (80%), as compared with 58 patients with AOFBG (42%) ($p < 0.001$). Claudication was a more frequent indication for AOFBG, representing 81 procedures (58%) as compared with 22 (20%) for AXFBG ($p < 0.001$).

Types of surgical procedures. Of the 108 AXFBGs, 99 were of an axillobifemoral configuration (92%) and 9 were axillounifemoral (8%). Of the 139 AOFBGs, 76 were performed with a transperitoneal approach (55%) and 63 with a retroperitoneal approach (45%; p = NS).

Superficial femoral artery occlusion occurred more frequently in patients who underwent AXFBG than in those in the AOFBG group, as demonstrated in Table III ($p < 0.001$). One or both superficial femoral arteries were occluded before 81 AXFBG (75%), as compared with 79 AOFBG procedures (57%) ($p < 0.005$). Concurrent infrainguinal bypass was also performed more frequently with AXBFG (33 of 108, 31%) than with AOFBG (22 of 139, 15%; $p < 0.05$).

Perioperative morbidity and mortality rates. Four perioperative deaths occurred after AXBFG and one after AOFBG, which yields 30-day operative mortality rates of 3.4% and <1.0%, respectively (p = NS). After AXBFG two patients died of myocardial infarction, one of cardiac arrhythmia, and one of stroke; after AOFBG one patient died of stroke.

Major postoperative complications occurred less frequently after AXFBG (9.2%) than after AOFBG (19.4%) ($p < 0.05$). Myocardial infarction, graft occlusion, and bleeding that required reoperation occurred with similar frequency for both procedures (data not shown). Pulmonary failure, acute renal failure, and stroke occurred more frequently in patients undergoing AOFBG. Ten wound complications (including superficial infection, hematoma, or lymphocele) occurred after AXFBG (9.2%) and 18 after AOFBG (12.4%) (p = NS).

Patency. Follow-up ranged from 1 to 83 months (mean, 27 months). Mean follow-up for AXFBG was significantly shorter than for AOFBG (AXFBG, 18 months; AOFBG, 28 months; $p < 0.05$), which reflects the shortened survival time of AXFBG patients, as described below. Seventeen AXBFGs (15.7%) became occluded, including six in the axillofemoral segment alone, five in the femorofemoral segment alone, and six in both segments. Primary patency was lost in 16 AOFBGs (11.5%) because of

Table III. Patency of superficial femoral artery and use of concominant infrainguinal bypass at the time of axillofemoral or aortofemoral bypass

	Axillofemoral bypass (n = 108)	*Aortofemoral bypass (n = 139)*	*p**
Superficial femoral artery patency			
None	66 (61%)	28 (20%)	<0.001
One	15 (14%)	51 (37%)	<0.001
Both	27 (25%)	60 (43%)	<0.01
Infrainguinal bypass			
Unilateral	27 (25%)	20 (14%)	NS
Bilateral	3 (3%)	2 (1%)	NS
Total number of limbs†	33 (31%)	22 (15%)	<0.05

*χ^2 analysis.
†Refers to the total number of concominant infrainguinal bypass procedures performed.

Table IV. Life-table primary patency of axillofemoral bypass (n = 108)

Period (mo)	*At risk (no.)*	*Occluded (no.)*	*Withdrawn (no.)*	*Interval patency rate*	*Cumulative patency rate*	*SE*
0-1	108	1	7	0.99	0.99	0.01
2-6	100	6	21	0.93	0.92	0.03
7-12	73	2	11	0.97	0.9	0.03
13-24	60	7	20	0.86	0.77	0.05
25-36	33	1	17	0.96	0.74	0.07
37-48	15	0	6	1	0.74	0.1
49-60	9	0	8	1	0.74	0.13

10 single-limb occlusions, 3 complete graft occlusions, repair of 2 distal graft pseudoaneurysms, and removal of 1 infected graft. Life-table primary patency rates at 5 years for AXFBG and AOFBG were 74% and 80%, respectively (p = NS), as shown in Tables IV and V. Primary patency of both procedures was not significantly affected by the indication for surgery, the patency of the superficial femoral arteries, or the need for concomitant infrainguinal bypass (data not shown). For AOFBG, patency rates did not differ on the basis of surgical exposure, with 5-year primary patency rates of 83% for the transperitoneal approach and 77% for the retroperitoneal approach (p = NS).

All graft occlusions were accompanied by recurrent symptoms of lower-extremity ischemia. Seventeen secondary procedures were performed to treat AXBFG occlusions. Ten of these were placement of a new AXFBG or femorofemoral bypass, and seven were revisions with or without thrombectomy. Fifteen secondary procedures were performed to treat AOFBG occlusions: one graft replacement, eight thrombectomies or revisions, and six AXFBG or femorofemoral bypasses. The secondary patency rate at 5 years for AXFBG (81%) was significantly lower than that of AOFBG (92%) ($p < 0.025$; log rank test). This difference between secondary and primary patency rates reflects the authors' preference for thrombectomy/revision to treat AOFBG limb occlusion rather than repeat bypass grafting to treat AXFBG occlusion.

Limb salvage. Eighty-six patients (114 limbs) underwent AXFBG and 58 patients (71 limbs) underwent AOFBG for limb-salvage indications. During follow-up, seven limbs were amputated from seven patients who had undergone AXFBG, and seven limbs were amputated from six patients after AOFBG. All amputations occurred after progression of inoperable infrainguinal disease, failure of infrainguinal revascularization, or both. No amputations resulted directly from failure of AXFBG or AOFBG alone. All patients who required amputation originally underwent surgery for limb-salvage indications. No amputations were performed in patients who underwent surgery for claudication. After 5 years, life-table limb salvage rates were 89% for AXFBG and 78% for AOFBG (p = NS).

Late mortality. Five-year survival rates by life-table analysis were 45% after AXBFG and 72% after AOFBG ($p < 0.01$) (Tables VI and VII). Including the immediate postoperative deaths, 28 deaths occurred during follow-up after AXBFG and 25 occurred after AOFBG. The most frequent cause of death after AXBFG was cardiac disease (13 patients, 46%), followed by cancer (5 patients, 18%), stroke (2 patients, 7%), and unknown causes (8

Table V. Life-table primary patency of aortofemoral bypass (n = 139)

Period (mo)	*At risk (no.)*	*Occluded (no.)*	*Withdrawn (no.)*	*Interval patency rate*	*Cumulative patency rate*	*SE*
0-1	139	2	5	0.99	0.99	0.01
2-6	132	3	11	0.98	0.96	0.02
7-12	118	3	14	0.97	0.94	0.02
13-24	101	3	29	0.97	0.9	0.03
25-36	69	3	23	0.95	0.86	0.04
37-48	43	1	10	0.97	0.83	0.05
49-60	32	1	19	0.96	0.8	0.06

Table VI. Life-table survival for axillofemoral bypass (n = 108)

Period (mo)	*At risk (no.)*	*Death (no.)*	*Withdrawn (no.)*	*Interval survival rate*	*Cumulative survival rate*	*SE*
0-1	108	4	3	0.96	0.96	0.02
2-6	101	5	17	0.95	0.91	0.03
7-12	79	4	10	0.95	0.86	0.04
13-24	65	6	20	0.89	0.77	0.05
25-36	39	8	17	0.74	0.57	0.06
37-48	14	0	7	1	0.57	0.1
49-60	7	1	4	0.8	0.45	0.13

patients, 29%). After AOFBG, 9 deaths (36%) resulted from cardiac disease, 6 (24%) from cancer, 1 (4%) from stroke, and 9 (36%) from unknown causes.

DISCUSSION

Patients with symptomatic aortoiliac occlusive disease sufficiently severe to warrant interventional treatment can be treated by percutaneous techniques, including balloon angioplasty and stenting, or by operative techniques. Although minimally invasive, percutaneous techniques are limited in application by a therapeutic paradox. The more extensive the disease and the more severe the patient's symptoms, the less likely percutaneous therapy will be successful or even feasible. AOFBG and AXFBG can be performed in patients with the most severe occlusive disease. Although reported 5-year patency rates after AOFBG have consistently exceeded 80%,[1-6] long-term results with AXFBG have varied from 10% to >70% at 5 years.[11,13,28,29] This variation has led to a perception of AXFBG as a "compromised" procedure with a limited clinical role.[10,30] After the introduction of externally supported prostheses by Sauvage et al.[31] in 1978, however, patency rates of AXFBG have dramatically improved. Several papers, including a previously published series from our institution, have demonstrated patency rates after AXFBG that approach those from the historic AOFBG series.[15-18] This contemporary trend justifies reevaluation of the roles of AXFBG and AOFBG in the treatment of aortoiliac occlusive disease.

Despite numerous AXFBG and AOFBG series in the literature, no prospective, randomized series has compared both procedures. In retrospective comparisons, Ray et al.,[13] Bunt,[20] and Schneider et al.[22] found inferior patency rates with AXFBG, whereas Johnson et al.[19] and Mason et al.[21] demonstrated excellent results with no significant difference in long-term patency rates. These series, however, all included small numbers of patients in both AXFBG and AOFBG groups, which makes valid comparison difficult. Also, externally supported grafts were only used in the report of Schneider et al.[22] The present study, which compares a large concurrently performed series of AOFBG and externally supported AXFBG, shows no difference in long-term patency rates. The primary patency rate at 5 years was 74% for AXFBG and 80% for AOFBG (p = NS).

Significant differences were found between patient groups that underwent AOFBG and AXFBG. AXFBG was the preferred procedure for patients with increased operative risk. The patients who underwent AXFBG in our study were on average a decade older and a greater number had heart disease, renal failure, and previous intraabdominal or aortic surgery than those who underwent AOFBG. In the past, most AOFBG series have also included a large proportion of patients with claudication, ranging from 40% in Malone et al.[1] to 76% in Crawford et al.[5]

Table VII. Life-table survival for aortofemoral bypass (n = 139)

Period (mo)	*At risk (no.)*	*Death (no.)*	*Withdrawn (no.)*	*Interval survival rate*	*Cummulative survival rate*	*SE*
0-1	139	1	3	0.99	0.99	0.01
2-6	135	2	10	0.98	0.98	0.01
7-12	123	3	9	0.97	0.95	0.02
13-24	111	9	27	0.91	0.86	0.03
25-36	75	4	20	0.94	0.81	0.04
37-48	51	2	10	0.96	0.78	0.05
49-60	39	2	18	0.93	0.72	0.06

In contrast, previously published series on AXFBG have varied widely in the severity of ischemic symptoms, ranging from 12% with claudication in Eugene et al.[12] to 59% reported by Ray et al.[13] In the current study, only 20% of AXFBG were placed for claudication compared with 58% of AOFBG ($p < 0.001$). Despite these major differences in patient populations, no difference was found in operative mortality, patency, or limb salvage rates between AOFBG and AXFBG groups. Patients who underwent AXFBG had fewer major complications, which perhaps reflects the operative procedure of decreased magnitude.

The higher incidence of comorbid risk factors and the higher percentage of operations for limb salvage in patients who underwent AXFBG has been associated with a shorter life expectancy than that found in patients who underwent AOFBG. The 5-year survival rate after AXFBG has ranged from 26% reported by Eugene et al.[12] to 67% reported by Johnson et al.[19] In contrast, the 5-year survival rate for AOFBG has ranged from 59% reported by Szilagyi et al.[6] to 87% reported by Poulias et al.[32] Survival of patients who required AOFBG has been estimated to be 10 years less than the "normal," nonatherosclerotic, age-adjusted male population.[33] In this study, although the operative mortality rates did not differ, the long-term survival rates were significantly lower in patients who underwent AXFBG. Our reported 5-year survival rate of 45% after AXFBG and 72% after AOFBG is consistent with previously published reports. In the setting of this major difference in life expectancy, no difference is detectable in patency rates as calculated by life-table methods.

It is not the purpose of this paper to suggest that AXFBG and AOFBG are equivalent procedures, a conclusion that could only result from a randomized trial. Rather, it seems reasonable to regard AXFBG as a useful treatment in a spectrum of options. These options include nonoperative treatment for patients with mild to moderate symptoms; percutaneous techniques for patients with minimal lesions; AOFBG, which has excellent results when applied to good-risk patients; and AXFBG, which, when reserved for high-risk patients with limited life expectancy, produces equivalent results for patency and limb salvage.

CONCLUSION

Performance of AXFBG in high-risk patients with aortoiliac occlusive disease is a safe practice that does not produce patency results inferior to those achieved with AOFBG. There appears to be no reason to avoid AXFBG in such patients because of concerns about patency or limb-salvage results.

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DISCUSSION

Dr. Frank W. LoGerfo (Boston, Mass.). Dr. Passman and his colleagues from Oregon have demonstrated commendable results in the modern treatment of aortoiliac occlusive disease and in their emphasis on the role of AXFBG. Without question, their patients who undergo the AXFBG procedure were at higher risk for death, as confirmed by age, previous cardiac disease, renal failure, and other factors. Furthermore, they were, by traditional measures, at higher risk for graft occlusion based on a higher incidence of limb salvage procedures, occlusion of the superficial femoral artery, and the need for simultaneous distal bypass.

On the basis of this experience, they raise a legitimate question. Should the indications for AXFBG be extended to include more patients who currently undergo AOFBG?

In turn, I pose to them a question. If all of your patients had undergone AXFBG, what would have been achieved? At best, one death would have been eliminated. But because that patient died of a stroke, even that is unlikely. If all had undergone AXFBG, could you have really maintained a primary patency rate of > 80%, equivalent to AOFBG? Perhaps you can provide a different perspective on this matter, but as I see it, expanding the indications for AXFBG could be justified only if you had achieved a 0% mortality rate and a patency rate equivalent to AOFBG. I submit that the simultaneous attainment of those two goals is sufficiently unlikely as to temper any enthusiasm that we abandon AOFBG as the gold standard.

What fraction of patients who currently have aortoiliac occlusive disease should undergo AXFBG? At our hospital, of 313 aortoiliofemoral reconstructions over the past 4 years, the breakdown was 60% AOFBG, 18% iliofemoral

bypass, 14% femorofemoral bypass, and only 8.7% AXFBG. The mortality rate for patients who underwent AOFBG was 1.1%.

On the basis of the existing literature and our own experience, why should we not favor an alternative interpretation of your own data? Because your mortality rate for patients who underwent AOFBG is low and the patency is well-established, why not extend your indications for AOFBG? This would avoid the concerns about disruption of the axillary anastomosis about which you have written: external pressure on the graft and the risk of warfarin anticoagulation before or after graft thrombectomy.

Dr. Passman and his colleagues have advanced the art of arterial reconstruction by identifying and solving technical problems associated with AXFBG. They have made it clear that this is an operation that vascular surgeons can turn to with confidence in the management of aortoiliac occlusive disease.

Dr. Lloyd M. Taylor, Jr. Dr. LoGerfo asked why not perform only AXFBG, and to be certain to cover both sides of the waterfront, he also asked why we should not do all AOFBG. It is important to understand that the purpose of this paper is not to suggest that either should be done to the exclusion of the other, but rather that AXFBG and AOFBG are techniques that produce equivalent results when applied appropriately to properly selected patients. It is not our intention to suggest that AXFBG should replace AOFBG, but rather that it can be selected with confidence in older, higher-risk patients without concern that in so doing the surgeon is condemning the patient to inferior patency results.

Dr. Joseph R. Schneider (Evanston, Ill.). Your group's results with AXFBG are truly remarkable. I believe your success may be due in large measure to liberal selection criteria. As you know, we previously performed a similar analysis and found that AXFBG performed poorly as measured by patency rate when compared with AOFBG. I take issue with your statement that the concurrent comparison of AXFBG and AOFBG is unknown—at least three previous concurrent comparisons have been published.

We were criticized by Dr. Willard Johnson for performing AXFBG in 25% of our patients. Your group performed AXFBG in nearly half of your patients. Our subsequent report noted that characteristics of patients who underwent AXFBG were dramatically different in reports from different institutions and that patency was highly dependent on indications and patient characteristics.

We also pointed out that the inclusion of even a small number of patients with claudication may have a dramatic effect on patency calculations because these patients enjoy better patency, live longer, and thus have a disproportionate effect on the life-table patency calculations. Twenty percent of your patients had claudication, which is a relatively high number when compared with most previous reports of AXFBG. Although your patients' average age was 68 years, several previous reports, including ours, have presented series of patients with mean ages of >70 years.

Finally, one half of your AXFBG patients survived 5 years, whereas only one third of ours survived even 3 years. I don't think we're operating on the same kind of patients.

Why not perform the lower-risk AXFBG in a young patient with claudication who can expect prolonged patency? Even if we and others could achieve your phenomenal success in terms of patency, as Dr. Rutherford, we, and others have shown, AXFBG is a poor hemodynamic performer that achieves a predicted resting ankle-brachial index of less than 0.7 with completely normal outflow.

Although AXFBG may augment perfusion enough to salvage the limb, it does not provide the hemodynamic normalization that AOFBG does, and it would likely provide incomplete relief of claudication even with normal outflow.

Given your success, what criteria do you now use to choose AXFBG over AOFBG for chronic occlusive arterial disease? Have you compared AXFBG and AOFBG when restricted to patients with limb-threatening ischemia? Have you measured the hemodynamic results of AXFBG in your patients? Have you been forced to convert any AXFBG to AOFBG because of thrombosis or inadequate relief of symptoms?

Dr. Taylor. As emphasized in the presentation, we had no fixed criteria for the choice of AXFBG versus AOFBG. The choice was individualized by the surgeons who cared for the patients. AXFBG was chosen in patients who were believed to be at higher operative risk with shorter anticipated survival times.

Your question about patency results as a function of the indication for surgery is an important one. In this study, no difference in patency was found in AXFBG that were performed for claudication as compared with those performed for limb-salvage indications. But the numbers are small, and the power to detect a difference may not be very great.

You asked whether we have hemodynamic data that compare the results of AXFBG with those of AOFBG. We do, but we have not compared them because the patients were not randomized.

Finally, were any AXFBG converted to AOFBG for thrombosis? The answer is no. But as pointed out in the manuscript, we performed multiple conversions in the opposite direction. When AOFBG failed, the follow-up procedure frequently was AXFBG.

Dr. G. Patrick Clagett (Dallas, Tex.). What antithrombotic therapy do you use and what do you recommend?

Dr Taylor. We use aspirin therapy in all our patients except those who have an identified disorder of coagulation. All of our patients are screened for hypercoagulable disorders, and if one is identified, he or she is treated with warfarin.

Dr. John A. Mannick (Boston, Mass.). I believe that in discussing these two operations we sometimes forget that the technique of performing the AXFBG is very

important if good long-term results are to be achieved. Many surgeons have focused on doing an adequate technical AOFBG and pay little attention to the technical details that the Oregon group has quickly outlined in their presentation. I commend them for the analysis of how to do the procedure correctly and emphasize the fact that putting the anastomosis far proximal on the axillary artery, so that when the patient moves the arm the anastomosis isn't disrupted, is very important.

Secondly, a smooth curve for the graft with no intermediate incision that the graft can get hung up on is very important. Finally, that they allow the full flow rate to both limbs to go down the entire axillary limb all the way to the distal anastomosis, thereby doubling that flow rate for the axillary limb through its entire course, is also very important. I think that many surgeons who criticize this operation haven't learned how to do it correctly; the Oregon group obviously has.

Dr. David C. Brewster (Boston, Mass.). I congratulate the Portland group. As is their style and as they have often done in the past, they have presented us with some provocative material and conclusions. I have several points of concern or caution.

First, as pointed out in the presentation, this is not a randomized study, so is it possible that the degree or pattern of proximal occlusive disease was not equivalent in these patients and that it allowed AXFBG to be performed in patients with higher perceived risk but actually more favorable proximal inflow patterns of disease? Perhaps their more advanced ischemic symptoms were caused by more extensive infrainguinal occlusive disease.

Second, I think it is important to recognize that your results of 75% primary patency with AXFBG are really extraordinary. Although Sauvage's group has presented somewhat similar data, I think it contradicts much of the acquired experience reported over the last 3 decades about the primary patency rates of extraanatomic grafts such as AXFBG. Do you believe that this contradiction is due to the use of externally supported grafts, or do you have any other postulates why your results are so much better than other reported experiences?

Dr. Taylor. You are correct that it is not a randomized study. The pattern of occlusive disease may differ between the two groups. We emphasized in the presentation that patients who underwent AXFBG had more extensive occlusive disease, a higher incidence of limb-salvage indications, and lower aggregate ankle-brachial pressure indices. The intriguing theory that perhaps they didn't have very severe inflow disease was not examined by our study, but it certainly will be in the future.

The second question is why these results are better than they have been in the past. It's tempting to attribute the improvement to the externally supported prosthesis, and the results from Seattle, which are comparable with our own, using externally supported Dacron, would lend credence to that idea. I can only tell you that the results of AXFBG performed at our institution in the past decade are markedly improved compared with those that had been previously experienced, and I suspect that Dr. Mannick has touched on the reason for that, which is that the technical details have been worked out.

Dr. Enrico Ascer (Brooklyn, N.Y.). Dr. Mannick commented that your excellent results can be attributed to the technique. I must tell you that all the techniques that you discuss have been previously published in a chapter in Haimovici's book by Frank Veith and I about the long proximal anastomosis, the redundancy of the proximal graft, and putting the graft on top of distal anastomosis on the femorofemoral graft. So all of this has been published before.

Despite all these techniques, our results are basically 55% to 60% patency at 5 years, so I would therefore submit to you that the reason for your better results is not necessarily the technique, but rather because you're operating on more patients with claudication, and we have limited our cases to limb-salvage situations.