Peroneal artery bypass: A reappraisal of its value in limb salvage

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In general the surgical literature has expressed pessimism about the value of bypass to the peroneal artery for limb salvage. The combination of greater technical difficulty, low patency rates, and hemodynamic failures have led to the establishment of this prejudice. In a review of 284 arteriograms in limbs with infrapopliteal arterial occlusion, the peroneal artery was the least diseased in 40% and was the only available vessel in 37% of instances. One hundred fifty-two peroneal bypasses have been performed in a 7-year period, 116 by the in situ method, 23 with excised vein, and 13 by nonautogenous conduits. During the same period 125 anterior tibial and 114 posterior tibial bypasses were also done. The mean preoperative ankle/brachial indices were 0.27 for peroneal, 0.25 for anterior tibial, and 0.29 for posterior tibial bypasses. These were converted to mean postoperative indices of 0.84, 0.86, and 0.92, respectively. Corresponding transmetatarsal/brachial indices were 0.72, 0.75, and 0.90. Rest pain was relieved in all these patients, and in 94 patients with tissue loss, there were 11 major amputations, nine healed forefoot amputations, and 20 healed digital ray amputations. Hemodynamic failures were two in the peroneal, two in the anterior tibial, and three in the posterior tibial group with one perioperative amputation in each. The cumulative limb salvage rate at 3 years for the peroneal group was 81%. This experience has shown that the patency and limb salvage rates obtained are comparable to those for the anterior and posterior tibial arteries and that hemodynamic failure is an uncommon occurrence. The influence of the presence of the pedal arch on both patency and limb salvage also shows that although poorer results are obtained when the pedal arch is absent, this should not be a deterrent to performing a peroneal bypass. (J VASC SURG 1984; 1:809-816.)

Since Dale's initial report[1] of success with the reversed saphenous vein tibial bypasses, many series of such operations have testified to their value when used for salvage of the profoundly ischemic lower limb.[2-7] In most of these studies, however, the authors have expressed a strong preference for the anterior and posterior tibial arteries as the site of distal anastomoses as opposed to the peroneal artery, which has been employed much less often or not at all.[2,8] The reasons most commonly advanced for this choice are decreased accessibility,[2] lower patency rates,[9] and hemodynamic failures,[8] which have resulted in reduced limb salvage rates compared with other tibial artery bypasses.[9] Consequently, a strong and almost traditional prejudice has emerged that has resulted in many vascular surgeons regarding bypass to the peroneal artery as an operation of last resort, whereas others have openly condemned its use altogether.[10,11]

Based on our experience with 152 bypasses to the peroneal artery as the single outflow tract carried out over the last 7 years, we wish to redress this generally unfavorable balance of opinion and to confer some measure of respectability on this much reviled procedure. Because of the nature of infrapopliteal reconstructive procedures and the association of their failure with high amputation rates, these operations were confined only to those limbs that as a result of severe ischemia were at higher risk of limb loss.[12] This article addresses this subject particularly by comparing the results obtained over an identical period of time with those anterior and posterior tibial bypasses performed for similar conditions of critical limb ischemia.

MATERIAL AND METHODS

Between 1977 and 1984, 391 bypasses were performed to single infrapopliteal arterial outflow tracts. One hundred fifty-two bypasses were inserted into the peroneal artery, 125 to the anterior tibial,

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Table I. Infrapopliteal bypasses (1977-1984); frequency of conduit use

Artery	*In situ vein*	*Excised vein*	*Nonautogenous conduit*	*Total*
Peroneal	116	23	13	152
Anterior tibial	88	22	15	125
Posterior tibial	85	18	11	114

Table II. Indications for surgery with and without pedal arch visualization

	Plantar arch elements	
Indications	*Present*	*Absent*
Rest pain	53	9
Nonhealing ulcer	41	6
Gangrene	23	20

and 114 into the posterior tibial. Three types of conduits were used for these bypasses: in situ saphenous vein, excised autogenous vein, and nonautogenous conduits. The frequency of use of these conduits with respect to the individual arteries is shown in Table I. The indications for surgery were rest pain, nonhealing ulcers and gangrenous tissue loss and had a similar distribution in each group. In the peroneal bypasses there were 62 limbs with rest pain (41%), 47 limbs with nonhealing ulcers (31%), and 43 limbs with gangrenous tissue loss (28%). Eighty-five (56%) of these patients were diabetic and 91 (60%) were male. Visualization of definitive segments of the pedal artery anatomy, that is, primary or secondary pedal arches,[13] was obtained in 117 instances (77%) either on preoperative or on subsequent operative angiography. In the 35 remaining bypasses only small unnamed collaterals could be recognized in the foot itself (Table II). Preoperatively, the mean ankle systolic pressure for the peroneal group measured 42 mm Hg and the ankle/brachial index (ABI) 0.27; for the anterior tibial group, systolic pressure was 30 mm Hg and ABI 0.25; and for the posterior tibial systolic group, pressure was 44 mm Hg and ABI 0.29 (Table III).

OPERATIVE DETAILS

In this series all exposures of the peroneal artery were carried out through the medial route. By posterior displacement of the gastrocnemius muscle and separation of the soleus muscle from its tibial origin, the plane containing the posterior tibial neurovascular bundle was entered. Initially the peroneal artery was located by division of the numerous arterial and corresponding venous tributaries of the posterior vessels to the tibialis posterior muscle with displacement of the neurovascular bundle posteriorly. The peroneal artery, which lies in the same anatomic plane, could thus be reached.[1,14] However, it was soon realized that by developing a dissection plane posterior to the posterior tibial vessels, these tributaries were not encountered, the peroneal nerve was readily identified, and the peroneal artery between its parent veins was immediately adjacent. This approach has saved much operative dissection. In the distal half of the leg, in many instances, the peroneal artery was covered by a musculotendonous sheath of the flexor digitorum longus, thus obscuring immediate visualization of the artery. However, recognition of this anatomic variant has led to rapid identification of this artery even at the most distal levels of its approach.

The character of the arterial wall was considered to be normal in 83 instances (55%), to be of moderate stiffness in 45 (30%), and to be of poorer, that is, stiff and calcified, consistency in 24 (15%). These latter difficulties occurred almost exclusively in the diabetic patients. In all instances the artery was handled with a philosophy of minimal dissection, that is, strenuous attempts were made to keep it in its bed as far as possible, to use only softly sprung (25 gm tension) microvascular clamps, and to carry out a scrupulously careful anastomosis under magnification (up to ×6) and with the use of monofilament suture material (7 or preferably 8-0 polypropylene).[15] When the pathologic changes in the arterial wall did not allow employment of these techniques, the use of internal occlusion balloons and the tourniquet technique described by Bernhard et al.[16] invariably allowed these anastomoses to be carried out. The distal insertion of the bypass was placed in the proximal half of the peroneal artery in 118 instances (78%), in the distal half of the artery in 32 instances (21%), and in the terminal posterior perforating branch of the artery in two instances. The immediate technical reconstructive adequacy and pedal communications were determined in each instance by intraoperative angiography (referred to previously) and, more recently, its physiologic effects by direct intraoperative Doppler ultrasound and immediate postoperative waveform analysis and segmental pressures.

RESULTS

In the postoperative period each patient has been seen and examined by one or more of the authors at specific predetermined intervals (monthly for the first 6 months, three times per month for 1 year, and

Table III. Pre- and postoperative ankle and postoperative mean pressures and branchial indices

	Preoperative mean		*Postoperative mean*			
Outflow	*ASP*	*ABI*	*ASP*	*ABI*	*TMSP*	*TMBI*
Peroneal artery	42	0.27	111	0.84	95	0.72
Anterior tibial artery	30	0.25	107	0.86	93	0.75
Posterior tibial artery	44	0.29	122	0.92	121	0.90

ASP = ankle systolic pressure (mm Hg); ABI = ankle/branchial index; TMSP = transmetatarsal systolic pressure (mm Hg); TMBI = transmetatarsal/branchial index.

Table IV. Cumulative patency rates for anterior tibial, posterior tibial, and peroneal bypasses

Months	*No. at risk*	*Failures*	*Interval patency (%)*	*Cumulative patency (%)*
Anterior tibial bypass				
0-1	125	5	95.5	95.5
2-12	92	3	95.6	91.3
13-24	40	4	87.7	80.7
25-36	21	2	86.7	69.4
37-48	7	0	100.0	69.4
Posterior tibial bypass				
0-1	114	7	93.2	93.2
2-12	85	5	92.8	86.4
13-24	48	5	85.7	74.1
25-36	17	1	93.3	69.2
37-48	12	0	100.0	69.2
Peroneal bypass				
0-1	152	5	96.4	96.4
2-12	121	6	93.6	90.2
13-24	60	5	87.7	79.1
25-36	16	2	81.0	64.0
37-48	4	0	100.0	64.0

every 6 months thereafter). In addition to clinical examination, pulse volume recordings, Doppler ultrasound examination, systolic blood pressures, and relevant brachial indices were also recorded at each visit.[17] Data have thus been accumulated prospectively, stored, and analyzed by a specific computer program.[18] In the perioperative (30 day) period there were seven deaths (4%) and nine bypass occlusions (6%). Three occlusions were successfully revised with continued patency, and five of the remaining six required major amputation. The patency data and life-table analysis for all three groups of infrapopliteal bypasses are shown in Table IV. For the peroneal bypasses, cumulative patency was 96% at 1 month and 64% at 4 years. During the same interval the cumulative patency of both anterior and posterior tibial bypasses was 69%.

In patients with patent bypasses, the mean postoperative ankle pressures were 111 mm Hg and ABI 0.84 (peroneal), 107 mm Hg and ABI 0.86 (anterior tibial), and 122 mm Hg and ABI 0.92 (posterior tibial). The corresponding ankle pressures and transmetatarsal/brachial indices (TMBI) were peroneal, 95 mm Hg and TMBI 0.72; anterior tibial, 93 mm Hg and TMBI 0.75; and posterior tibial, 121 mm Hg and TMBI 0.90 (Table III). In the peroneal group there were 11 major amputations, (nine forefoot amputations defined as any amputation in which the oscalcis with an intact ankle joint and heel pad was retained) and 20 digital or metatarsal ray amputations.

We have defined hemodynamic failure as any event in which, despite a patent bypass with demonstrated prograde flow, tissue loss was progressive and a major amputation was required or as failure to heal an ulcerated or amputated area of the foot within a period of 12 weeks even if healing subsequently took place without the necessity for further amputation. In the peroneal group there were two such instances of hemodynamic failure; one resulted in major amputation. There was a similar experience in the anterior tibial group, whereas in the posterior tibial group there were three such instances of which one subsequently required major amputation.

The peroneal bypass cumulative limb salvage by life-table analysis is shown in Table V. In this table only the major amputations, defined as below knee

Table V. Cumulative limb salvage after peroneal bypass

Months	*No. at risk*	*Failures*	*Interval patency (%)*	*Cumulative patency (%)*
0-1	152	5	96.4	96.4
2-12	121	4	95.7	92.2
13-24	60	1	97.4	89.8
25-36	16	1	90.5	81.2
37-48	4	0	100.0	81.2

Table VI. Angiographic survey of infrapopliteal outflow tracts (289 limbs)

	Best	*Only*	*Totals*
Peroneal bypass	66	45	111
Anterior tibial bypass	52	35	87
Posterior tibial bypass	50	41	91

or above knee, are shown since retention of the ankle joint with the heel-walking surface is considered to be functional foot salvage. This table conforms to the patterns seen in other series in which limb salvage generally exceeds bypass patency to a small degree since failure of a bypass after a period of relatively slow occlusion does not inevitably lead to limb loss.

DISCUSSION

Dible[19] should be credited with the recognition that the peroneal artery is often spared the ravages of atherosclerosis and is frequently patent and minimally diseased even when the adjacent tibial arteries are occluded. He observed this so frequently in his dissection of legs amputated for end-stage ischemia that he used the term "peroneal leg" to describe it. To test this contention in the present-day setting, we have examined 289 lower limb arteriograms of patients with total occlusion of the popliteal artery. The results shown in Table VI indicate that when only one infrapopliteal artery was present, it was predominantly the peroneal artery (39%); and when other tibial arteries were also visualized, the peroneal artery was angiographically demonstrated to be more frequently healthy (38%) than either the anterior or posterior tibial arteries. In addition, in this clinical experience the peroneal artery was the outflow tract of choice for necessity in over one third (39%) of the infrapopliteal bypasses, a proportion rarely appearing in the surgical literature.

The reasons most commonly advanced for this prejudice against the peroneal artery are its inaccessibility compared with the posterior tibial artery, the lower patency rates, and the higher incidence of hemodynamic failures, the interaction of all these factors leading to reduced limb salvage compared with anterior and posterior tibial bypasses. However, since it has been confirmed statistically that in advanced popliteal and infrapopliteal atherosclerosis, the peroneal is frequently the best and often the only preserved infrapopliteal outflow tract in the lower limb with profound ischemia, we have consequently used this artery more often than either the anterior or posterior tibial arteries in infrapopliteal bypasses. Graham and Hannel[20] have also had a similar experience. Although its relative sparing by atherosclerosis has been likened to that of the profunda femoris in the thigh,[21] its behavior is more akin to that of its homologue in the arm, the anterior interosseous artery, which, after the loss of the radial and ulnar arteries by dialytic access, is generally capable of adequate palmar perfusion.

Absence of any direct communication with the pedal arch has been one of the reasons frequently cited as a deterrent to utilization of the peroneal artery. It has been suggested that this contributes to bypass failure or to the ultimate frustration of patent but hemodynamically inadequate bypasses in which limb loss is inevitable. However, we have found that a patent, minimally diseased peroneal artery will provide adequate perfusion for the ischemic foot as evidenced by the bypass patency and limb salvage rates of 64% and 81% at the 4-year interval. These figures conform to the pattern seen in other series in which limb salvage generally exceeds bypass patency since failure of a bypass after a period of relatively slow occlusion does not inevitably lead to limb loss.

Reluctance to perform these bypasses in part stems from previous reports of low patency and limb salvage rates with reversed vein grafts and nonautogenous conduits. It may be argued that extensive use of the saphenous vein in situ is predominantly responsible for these results. Although we believe this to be true,[22] comparison of the cumulative patency rates of bypasses with all three infrapopliteal arteries carry particular significance because of their close similarities. Although the best hemodynamic results at the most distal level of perfusion measured (transmetatarsal) were achieved by the posterior tibial bypasses (TMBI 0.90), the performance of the peroneal artery was at least respectable enough to show complete relief of rest pain and lesion healing in most instances.[23] Hence we are strongly convinced that if the peroneal artery is the best vessel angiographically, it should be used in preference to more diseased tibial arteries. In addition, since it is often the last remaining infrapopliteal

vessel, failure or reluctance to use this artery as an outflow tract will both decrease the operability rate and hence increase the frequency of major amputations.

Hemodynamic failure, as already defined, is one of the most frustrating occurrences in the practice of vascular surgery. Not only does the patient eventually lose the limb in the presence of a patent bypass but the surgeon is haunted by the specter of having performed an essentially useless reconstructive procedure. Parenthetically, we regard a bypass kept patent by retrograde flow only as being a technical but not hemodynamic failure. In the patients with peroneal bypass, there were two such incidents, one of which resulted in major amputation. However, in the anterior and posterior tibial bypass groups, such incidents occurred with similar frequency. Therefore, although hemodynamic failure was experienced in the peroneal bypass group as previously reported, similar failures also occurred in other tibial bypasses, an observation not previously considered in other reports on this subject.

In this group of patients who have undergone peroneal bypass, Table VII shows the indications for surgery categorized for limbs with and without elements of plantar arch arterial anatomy. Of the 62 patients with rest pain, no major amputations were required, although nine patients had no recognizable arch anatomy. However, in the 64 patients with plantar arch who presented with nonhealing ulcers or gangrene, there were four amputations (7%). In the 26 patients in whom tissue loss was the initial presentation, there were seven (27%) eventual major amputations. These figures show what has been described previously,[21] that is, the increment of flow required for the management of rest pain is relatively small compared with that flow required for eventual healing when tissue loss has occurred. It is evident from these figures that the presence of a recognizable plantar arch is an anatomically favorable situation, but it is also clear that absence of the plantar arch does not inevitably lead to major amputation or even hemodynamic failure.[24,25]

Statements that the peroneal artery is the least accessible of the infrapopliteal arteries are generally true. For this reason many surgeons have avoided its use and turned to the more readily exposed tibial vessels for limb revascularization[7] even though they may be more diseased angiographically. However, as a result of our relatively extensive use of the peroneal artery, the technical problems of access, exposure, and anastomosis have been identified and thus simplified. Although we have routinely used the medial approach to the artery at all levels, we agree with Dardik et al.[26] that at least the distal half of the artery may be equally readily exposed after fibular resection. In addition, consideration of a possible future amputation should not prejudice the choice of vessel or level of infrapopliteal reconstruction.[2] When peroneal revascularization is performed with strict attention to the described technical details, the results appear to be worthwhile.

Table VII. Effect of recognizable plantar arch on major amputation

Amputation	*Arch (N = 64)*	*No arch (N = 26)*	*Total*
Perioperative	2	3	5
Late	2	4	6
	4 (7%)	7 (27%)	

Reichle et al.[27] have reported that late occlusion occurs less frequently in the femorotibial than femoropopliteal bypass. They have explained that this may be due to less severe atherosclerosis in the tibial vessels compared with the popliteal artery. By the same reasoning, sparing of the peroneal artery by atherosclerosis should result in better patency rates since the intrinsically better preservation of the vessel will provide a superior outflow tract. The value of the peroneal artery may therefore lie not only in its better equality at the time of operation but also in its slower rate of atherosclerotic deterioration.

In conclusion, we believe that the peroneal artery is both the least and the last diseased of the infrapopliteal arteries. When it is the only infrapopliteal vessel, it should be used without inordinate fear of hemodynamic failure. When it is the best of infrapopliteal vessels, it should be used preferentially in expectation of results comparable with those of the anterior and posterior tibial bypasses. Finally, in the vast majority of instances the communication between the peroneal artery and organized pedal arterial anatomy (plantar arch) are both well defined and competent. In the small group of patients in which there is absence of recognizable elements of the pedal arterial anatomy, results of bypasses are poorer but not of such disastrous significance that the surgeon should despair of the ultimate performance.

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DISCUSSION

Dr. John L. Ochsner (New Orleans, La.). It has always been our policy at the Ochsner Clinic to use whatever vessel in the lower leg appears to be the most ideal. Consequently, we have utilized the peroneal artery more frequently than either the anterior or posterior tibial in salvage procedures. As the authors have stated, often it is the only demonstrable vessel.

In our experience with 122 bypasses to the tibial and peroneal vessels, the best results occurred in the anterior tibial and secondarily the peroneal. The reason the anterior tibial gives the best results is not because it is an anterior tibial; it is the fact that in this group of bypasses there were less composites and homografts used. Eighty percent of the bypasses to the anterior tibial had pure autogenous veins as the conduit, whereas in both the peroneal and the posterior tibial there was a high percentage of either composite grafts or homografts. There were more of the less than ideal conduits in the posterior tibial; therefore, the worst and the mediocre conduits were in the peroneal.

Thus it appeared to us that it doesn't matter which vessel is used. One needs to pick the vessel that is the largest and has the best runoff. We agree with the authors. We think the peroneal is as good as the tibial vessels.

Dr. Herbert Dardik (Englewood, N.J.). In our peroneal series we found that these patients do not have the life expectancy of those with popliteal and tibial reconstructions. Fifty percent of the patients with peroneal bypasses had died within 4 years of reconstruction compared to 7 years for those with tibial and popliteal reconstructions. This half-life concept for graft, limb, and survival cumulative functions is, incidentally, exceedingly useful and facilitates the comparison of data.

Despite this gloomy outlook for survival, we agree with the authors that the limb salvage rate is certainly respectable and approaches that achieved for the tibial arteries. Similarly, the patency rates of the peroneal bypasses are also comparable to the tibial arteries, but popliteal reconstructions show obvious superiority.

In the absence of an adequate saphenous vein, we have explored the use of the adjunctive distal arteriovenous

fistula to maintain prosthetic graft patency by keeping the velocity above the critical thrombotic threshold level with the aid of this fistula. Our data suggest that this is a useful technique to maintain graft patency and also obviates the otherwise frequent need for thrombectomy and revision of the standard peroneal reconstruction.

My question to the authors of this important article is: In the absence of autogenous tissue, and discounting my own data, do you still believe that peroneal bypass is worth the effort, or would you proceed directly to amputation and thereby avoid potential loss of the knee joint?

Dr. Sushil Gupta (New York, N.Y.). I wish to congratulate Dr. Karmody on his clear-cut evidence showing that one set of circumstances believed to preclude successful limb salvage does not do so. We at Montefiore Hospital and Albert Einstein College of Medicine in New York have also challenged a number of presumed contraindications to limb salvage. These include a blind or isolated popliteal artery segment when no usable saphenous vein is available; absence of a plantar arch; only an isolated segment of distal artery available for bypass; heavily calcified tibial arteries; and the need for a distal bypass when no saphenous vein is available.

Our 5-year limb salvage results for bypasses done in the presence of these presumed contraindications range from 67% for isolated popliteal bypasses with polytetrafluoroethylene (PTFE) to 60% for distal bypasses with PTFE and 67% for peroneal bypasses. However, these limb salvage results are about 15% to 20% higher than the cumulative patency results.

Thus, as you can see, in situations previously thought to be hopeless, arterial reconstructions can work and can save limbs. Such operations can provide important palliation for a substantial number of patients. We urge that the aggressive approach like ours and Dr. Karmody's be widely adopted and used by those surgeons committed to these sometimes taxing operations.

Dr. Dieter Raithel (Spardorf, West Germany). At the Surgical Clinic at the University of Erlangen we have obtained similar results. In 414 tibial reconstructions from 1965 until 1982, distal anastomosis was done in 242 cases, to the posterior tibial and the anterior tibial artery in 112 cases and in 60 cases to the peroneal artery.

The patency rate in a mean follow-up of 43 months was 73% in the posterior position and 58.8% in the anterior position. In the same follow-up period, 72.2% of the peroneal reconstructions were patent.

I agree with the authors that the peroneal artery is often a less diseased artery and very suitable for bypass with excellent long-term results. My question to the authors is: What is the postoperative treatment? Do you put them on anticoagulants or antiplatelet inhibitors?

Dr. Anton N. Sidawy (Boston, Mass.). We recently looked at our results with tibioperoneal reversed autogenous vein grafts. We had 25 grafts to the anterior tibial, 32 to the posterior tibial, and 21 to the peroneal artery. The incidence of diabetes in each group was about 49%. At 6 years, patency rates were 63%, 77%, and 80% and limb salvage rates 78%, 81%, and 80% to the anterior tibial, posterior tibial, and peroneal arteries, respectively. None of these grafts failed beyond 1 year of placement, for an overall patency rate of 71% and limb salvage of 80% at 6 years.

Thus our results agree with the results reported in this article by Drs. Karmody, Leather, and colleagues. We think that the peroneal artery is as good as any other tibial vessel to receive the bypass graft. I wish to emphasize the importance of operative arteriography and the use of papaverine solution to prevent spasm and to preserve endothelium when preparing either a reversed or an in situ vein graft. In our opinion these are important factors leading to improved results in extreme tibioperoneal reconstructions.

I have one question for Dr. Karmody. Some patients are diabetics; they have noncompressible vessels. How reliable is the index measurement in these patients? Do you think that occasionally palpation of these grafts, especially if they are in situ, as in most of your patients, is a better method to determine graft patency?

Dr. Arthur I. Auer (St. Louis, Mo.). We agree with Drs. Karmody and Leather completely! In addition, we want to thank them for their help in getting us started with the in situ technique and showing our fellows the pathway to good patency rates.

At St. John's Mercy Hospital in St. Louis County we have obtained a 5-year cumulative patency rate of 64% for peroneal bypasses. The limb salvage rate for all distal bypasses is roughly the same, 73% for peroneal, 81% for posterior tibial, 75% for dorsalis pedis, 69% for anterior tibial, and 75% for plantar arteries.

Forty-nine peroneal artery bypasses have been performed. All were veins except five composites, one sequential and three Gore-Tex, one of which is still patent at 4½ years. The 49 cases represent 23% of all of our distal bypass procedures. Patency average is 29 months. All patients had either rest pain, ischemic ulcers, or gangrene. One half were diabetic.

Initially we had 39 patients alive with patent grafts. There were four in-hospital deaths, three of which had patent grafts. There were only six immediate occlusions. Only the last seven cases of the 49 were in situ grafts. Ulcers in 22 patients healed, and in seven patients, toe amputation sites healed. It is interesting, as pointed out by one of the other discussants, that 47% of the total group is already dead, but 74% of these had their boots on.

We have two questions: Have the authors compared their results of in situ vs. reversed saphenous vein grafts? Is there any anatomic physiologic reason for the sparing of the peroneal artery as the only outflow in so many patients?

Dr. Anthony M. Imparato (New York, N.Y.). Dr. Leather, what is the minimal angiographic appearance that you require before you will operate and expect the peroneal bypass to work?

Dr. Leather (closing). I would like to thank the discussants for their agreement with the value of the peroneal

artery in limb salvage and to compliment them on their excellent results.

In answer to Dr. Dardik's question, what do we use when saphenous vein is not available, I frankly do not know the answer to that question. I look to him and others who work in this area. I think that the arteriovenous fistula may have found a place in keeping the relatively thrombogenic synthetic conduit open. We think bypass with conduits other than vein is worth doing but approach it with much less enthusiasm because the results when one switches from in situ to synthetic conduits are dramatically different.

I can only say to Dr. Gupta that we look forward to his presentation on peripheral resistance as a prognostic guide to the success of distal bypass.

Dr. Raithel, fortunately, we have not given any of these patients antiplatelet agents or aspirin. I say fortunately because that might have clouded the issue even more than it is at the moment.

Dr. Sidawy, our incidence of diabetes is in the same range. The longevity of these patients is an index of the terminal stage of their disease and is amazingly constant from one series to another.

Dr. Auer, to answer your question of comparing saphenous vs. in situ vein grafts in this group of patients: the inclusion of reversed vein grafts did pull down the cumulative patency rate to 64%, which for the in situ alone is 75% at 4 years. But again, the numbers are quite small and it would be difficult to draw any significant conclusions. Analyzed on their own, reversed vein graft patencies fall into the range of results that are generally reported for bypasses to vessels at these levels, namely, a 40% to 50% patency rate at 4 years.

Dr. Imparato, in all the work with the in situ bypass, we have attempted to identify what the limits are, and I must say that we have not as yet achieved that end. Every time you think you have succeeded, there is a little posterior branch of a peroneal or a similar runoff that disproves one's pessimism. I would say in general, however, the vessel that is heavily calcified at the ankle level extending into the foot generally has not fared as well as the others. Beyond that we have not been able to identify any contraindication to proceeding with an in situ bypass.