Meta-analysis of popliteal-to-distal vein bypass grafts for critical ischemia

Maximiano Albers, MD, PhD,[a] **Marcello Romiti, MD, PhD,**[a] **Francisco Cardoso Brochado-Neto, MD, PhD,**[a] **Nelson De Luccia, MD, PhD,**[a] and **Carlos Alberto Bragança Pereira, PhD,**[b] *Santos and São Paulo, São Paulo, Brazil*

Background: **Several studies have described the use of popliteal-to-distal bypass grafts, mostly in patients with diabetes mellitus who show tissue loss and represent a high-risk population. The study objective was to conduct meta-analysis to assess the long-term primary and secondary patency and foot preservation after popliteal-to-distal bypass grafts.**

Methods: **Data was retrieved from studies published from 1981 through 2004 that were identified from an electronic database. Thirty-one series that used survival analysis reported a 1-year graft patency rate and included at least 15 bypasses. Data from life tables, survival curves, and texts were used to calculate an interval success rate for each month in each series of grafts. Monthly success rates were combined across series to obtain a pooled estimate of success for each month, according to a random-effects protocol for meta-analysis. Pooled survival curves were then constructed for graft patency and foot preservation.**

Results: **The 5-year pooled estimate ± standard error was 63.1% ± 4.3% for primary patency, 70.7% ± 4.6% for secondary patency, and 77.7% ± 4.3% for foot preservation. There was a superiority trend favoring reversed vein grafts and tibial bypasses that became more apparent in sensitivity analysis. No publication bias was detected.**

Conclusion: **The popliteal-to-distal vein bypass is a tool of high efficiency in the treatment of severe, chronic critical ischemia in the lower extremity. (J Vasc Surg 2006;43:498-503.)**

The tradition of placing the proximal anastomosis of infrainguinal bypasses in the common femoral artery prevailed until 1981, when Veith et al[1] proposed the short bypass principle. This principle involves the use of more distal sites for the origin of the bypass and combines the advantages of avoiding groin dissection, requiring less graft material, using shorter incisions, and reducing operative time. The popliteal-to-distal (PD) bypass graft often uses the great saphenous vein (GSV), has evolved as the most typical short bypass, but is applicable to only a small fraction of patients who have a nearly normal popliteal pulse and absent pedal pulses. Despite concern over the progression of disease in the superficial femoral artery (SFA), the few reports that have addressed this problem have shown low rates of progression.[2-7]

With the use of percutaneous transluminal angioplasty for short lesions in the SFA, there has been a slight increase in the applicability of PD bypasses.[4,8] On the other hand, angioplasty of infrapopliteal arteries has become a viable alternative to PD bypass.[9] Because diabetic patients are particularly prone to develop tibioperoneal occlusion with minimal disease in the SFA, these patients represent the main target for PD bypass grafting when critical ischemia develops. Furthermore, the ischemic diabetic foot with superimposed infection often creates an urgent need for a PD bypass to salvage the limb. The increasing prevalence of diabetes mellitus in the ageing world population and the competing interests in endovascular procedures justify a reassessment of all types of bypass grafting. The current meta-analysis assessed long-term outcomes after PD bypass grafting.

METHODS

Study identification. The senior author (M. A.) searched articles published from January 1981 through December 2004 in the databases of MEDLINE, EMBASE, and LILACS. The descriptors *popliteal to distal bypass* and *pedal bypass* listed 1113 and 637 titles, respectively. Several words were searched in these titles, including *pedal, dorsalis, dorsal, plantar, distal, inframalleolar, foot, popliteal, tibial,* and *peroneal.* After reading the abstracts online, 79 articles were printed for complete reading. Articles referenced were read selectively, but the final meta-analysis included 31 articles,[2-32] all of which were identified from the databases (Appendix A, online only).

Criteria for inclusion. The articles included satisfied the following criteria: (1) a minimum of 15 PD grafts, (2) a greater number of PD grafts than femoral-to-distal grafts, when these procedures had not been described separately, (3) use of survival analysis to describe outcomes, and (4) a minimum follow-up of a year, at least for some grafts. If six articles[5,6,21,26,28,31] that contained 112 femoral-to-distal bypasses were excluded, then 243 PD bypasses would also be excluded. Although a single center has reported more than one study on the subject,[15,16,31] no bypass was included more than once.

From Vascular Surgery Section, Department of Surgery, Health and Medical Sciences Sector, Lusiada Foundation,[a] and Institute for Mathematics and Statistics.[b]

Competition of interest: none.

Additional material for this article may be found online at www.mosby.com/jvs.

Correspondence: Maximiano Albers, Rua Ministro Godói, 1584, AP 74, 05015-001 São Paulo, SP, Brazil (e-mail: albersm@uol.com.br).

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Table I. Demographic and surgical variables for 29 popliteal-to-distal vein bypass graft series

	Original series	*Studies with no data*
Grafts	1 2320	0
Mean age	66.0 (60.0, 72.0)	6
Male sex	72.4 (50.0, 92.3)	8
Hypertension	55.2 (16.2, 82.4)	14
Diabetes mellitus	86.3 (40, 100)	5
Smoking	40.7 (11.0, 90.2)	11
Heart disease	51.3 (21.9, 70.0)	12
Second bypass	10.0 (0.0, 28.6)	21
Tissue loss	87.9 (53.8, 100)	7
Renal failure	19.3 (2.4, 65.3)	15
GSV	87.5 (0.00, 100)	6
Proximal anastomosis AK	28.1 (0.00, 70.6)	6
Pedal bypass	62.0 (0.00, 100)	1
Censored within one year	37.0 (6.7, 52.4)	0

GSV, Great saphenous vein; *AK,* above-knee.
Values are weighted means (range).

Outcomes. The outcomes selected for meta-analysis included primary patency (PP), secondary patency (SP), and foot preservation (FP), which have mostly been reported as recommended.[33] Although PP and SP reflect the fate of arterial reconstructions better, FP describes the fate of revascularized limbs, which also depends on other factors such as vascular disease in the foot, diabetic neuropathy, and ongoing pedal sepsis. The survival data were described in the original studies by using life tables of different structures, survival curves, and texts (Appendix B, online only).

Data extraction. Two authors (M. R. and F. C. B. N.) retrieved the data from life tables and from survival curves that showed the number of units (bypasses or limbs) at risk for all intervals, and the senior author (M. A.) retrieved the data from less complete survival curves and from texts. Occasionally, data from a text combined with a life table or survival curve were used to generate data for a different outcome.[4,9,15,25,26] The data extracted from each study were confirmed by a second observer. The articles included usually reported on the sites of proximal and distal anastomoses and on the graft materials used but often omitted the rates of secondary bypasses (Appendix A, online only). The mean age and the rates of male gender, hypertension, diabetes, and smokers were also occasionally omitted (Table I).

Meta-analysis of subgroups. Despite the missing data in some articles, the PD graft series were classified according to the predominant outflow artery, whether a tibial bypass (n = 17) or a pedal bypass (n = 15). The tibial bypass series contained 637 tibial or peroneal bypasses, 314 pedal bypasses, and 11 other procedures. The pedal bypass series contained 227 tibial or peroneal bypasses, 1147 pedal bypasses, and 1 femoropopliteal bypass. The PD graft series was also classified according to the predominant graft configuration, whether reversed GSV (n = 14) or nonreversed GSV (n = 13). In situ GSV series and translocated GSV series were studied together.

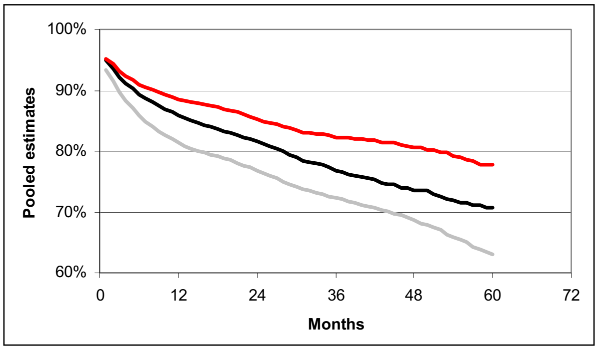

Fig 1. Random-effects meta-analysis of popliteal-to-distal bypass grafts for primary patency *(gray line),* secondary patency *(black line),* and foot preservation *(red line).*

Study quality. An ideal study should contain the rate of patients requiring PD grafts, life tables rather than graphs, the 1-month follow-up interval, an account for loss to follow-up, and the use of PP, SP, and FP. Of particular relevance is a link between predictive variables and each life table. Other relevant items are the rates of primary bypasses and tissue loss, regimens of postoperative antithrombotic therapy, the number of patent grafts that did not avoid a major amputation, the number of limbs with disease progression in the SFA, data on further bypasses, and the absence of a flat tail in the survival curve. Hence, a perfect study would score 15, with a decrease of one point for each unmet requirement. No blinding process was used.

Statistical methods. Random-effects meta-analysis implies that the studies combined are a random sample of a universe of studies. On the other hand, fixed-effects meta-analysis estimates a single common effect for all studies. The former was preferred because patients, surgeons, and quality of care differ worldwide. Random-effects meta-analysis combined monthly hazard rates from single series to yield a pooled estimate of success for each month of follow-up (Fig 1). The product of successive, monthly pooled estimates of success then yielded a pooled measure of success for each group or subgroup. Between-study and between-interval variances were calculated as previously reported to reduce the influence of study size on the pooled estimates.[34] This was done separately for PP, SP, and FP, and a standard error was calculated for each pooled estimate at each yearly interval.[34] The differences between subgroups were measured at yearly intervals and assessed statistically according to Schenker and Gentleman.[35] This method judges the significance of differences by examining the overlap between confidence intervals and does not calculate *P* values.

Sensitivity analysis. First, fixed-effects modelling, which differs from random effects by assuming null between-study variances, was used to obtain decreased standard errors and be less conservative in the comparison of subgroup meta-analyses.

Second, bias was present in the original studies, which assumed independence between events and losses to

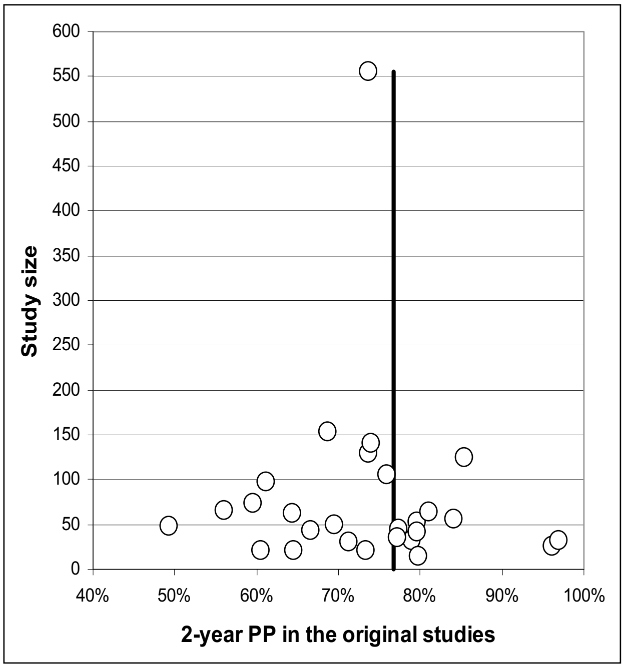

Fig 2. Funnel plots of study size vs 2-year primary patency *(PP)* in the original studies. Symmetry around the 2-year pooled PP *(vertical bar)* does not indicate publication bias.

follow-up. To deal with such bias, the following adjustments were done in the original data: (1) a percentage of censored units representing losses to follow-up of 10% in each month within the first year of follow-up, and (2) 60% of units considered as lost represented additional failures. The rate of 10% was obtained from articles that described withdrawals in detail,[3,11,24,26] and the rate of 60% was an extreme assumption used in a similar meta-analysis.[34]

Third, selective exclusion was applied to the largest study,[16] which contained only bypasses to the dorsal pedis artery; five studies[4,17,26,28,30] that used plain curves or texts to describe graft survival, five studies[5,6,21,26,28] that contained femoral-to-distal bypasses, five studies[12,14,25,27,30] that scored <8 for quality, and the flat tails of 20 studies.[2,4,6-15,18,21,22,24,26,29,30,32]

Finally, publication bias was investigated by using funnel plots (Fig 2).

RESULTS

Characteristics of the original studies. The country of origin was the United States for 21 studies, Germany for three studies, Italy for two studies, Brazil for two studies, and Spain, Belgium, and Finland for one study each. The 31 studies were scored for quality from 3 to 12 (median, 9) (Appendix A, online only). The median was 1995 for the year of publication and 48 subjects for study size. There was a wide predominance of diabetes mellitus, tissue loss, and use of GSV grafts (Table I). Eight prosthetic grafts were used, but excluding the corresponding studies would also exclude 836 PD vein grafts. Only two bypasses were done in patients with claudication. Survival analysis used mainly life tables (PP, n = 10; SP, n = 9; FP, n = 8) and survival curves that showed the number at risk for all intervals (PP, n = 10; SP, n = 11; FP, n = 9) or for some intervals (PP, n = 5; SP, n = 6; FP, n = 3). A few articles showed survival curves that omitted the number at risk (PP, n = 1; SP, n = 2; FP, n = 2) or used texts alone or combined with another tool (PP, n = 2; SP, n = 4; FP, n = 6). All articles showed a life table or a survival curve for at least one main outcome.

Table II. Meta-analysis estimates for the main outcomes

Month	*PP(%)*	*SP(%)*	*FP(%)*
	93.3 (1.1)	94.9 (1.0)	95.1 (1.2)
3	89.7 (1.5)	92.2 (1.4)	93.0 (1.6)
6	85.8 (2.1)	89.3 (1.6)	90.9 (1.9)
12	81.5 (2.0)	85.9 (1.9)	88.5 (2.2)
24	76.8 (2.3)	81.6 (2.3)	85.2 (2.5)
36	72.3 (2.7)	76.7 (2.9)	82.3 (3.0)
48	68.6 (3.3)	73.6 (3.5)	80.7 (3.6)
60	63.1 (4.3)	70.7 (4.6)	77.7 (4.3)

PP, Primary patency; *SP,* secondary patency; *FP,* foot preservation.
Values are pooled estimates (standard-errors).

The early mortality rate described in 30 articles was 0% to 11.5% (weighted average, 2.3%) and was slightly smaller for tibial graft series (2.0%) than for pedal graft series (2.6%) (χ^2 test = 0.136; degrees of freedom = 1; $P = 0.71$). The 1-year cumulative death rate calculated for 22 articles was 5.6% to 27.0% (weighted average, 13.1%). Twenty-one articles described the percentage of patent grafts that did not avoid a major amputation, which was 0% to 11.6% (weighted average, 4.3%). Seven articles described disease progression in the SFA or proximal to this artery that was 1.8% to 5.9% (weighted average, 4.3%).

Graft patency and limb salvage. The pooled estimate of success was 93.3% ± 1.1% for PP, 94.9% ± 1.0% for SP, and 95.1% ±1.2% for FP at 1 month, and 63.1% ± 4.3%, 70.7% ± 4.6%, and 77.7% ± 4.3%, respectively, at 5 years (Table II). The monthly pooled failure rate decreased progressively for all three outcomes to <1% at 8 months and remained below this level thereafter. The differences in the subgroup meta-analysis were not significant at yearly intervals (Table III).

A complete transmetatarsal amputation was required for nearly 15% of the patients in some original PD graft studies,[2,15,19,22,26] but in one study,[17] this procedure was done in 31%. Toe and ray amputation were done even more frequently.

Sensitivity analysis. The fixed-effects model produced small increases in the 5-year pooled estimates (Table IV) but revealed a significant difference at 1 and 2 years in the comparison of nonreversed vs reversed GSV grafts for both PP and SP, as well as in the comparison of tibial graft series with pedal graft series for SP. Adjustments for lost follow-up and the selective exclusion of studies changed the 5-year pooled estimates by <4% (Table IV), with no alteration in the statistical significance. When the flat tails from

Table III. Meta-analysis of graft patency and foot salvage for subgroups

	Studies/grafts	*1 yr (%)*	*2 yr (%)*	*3 yr (%)*	*4 yr (%)*	*5 yr (%)*
PP						
Reversed GSV	13/90	83.1 (2.7)	79.1 (3.1)	74.4 (3.9)	68.9 (5.2)	65.9 (6.6)
NR GSV	10/1024	77.7 (3.8)	73.2 (4.3)	69.0 (5.1)	66.7 (6.8)	58.5 (7.8)
PP						
Pedal bypass	11/1266	77.4 (3.5)	72.4 (3.7)	68.3 (4.4)	65.6 (4.9)	56.6 (5.6)
Tibial bypass	16/871	84.7 (2.5)	80.3 (2.9)	75.4 (3.5)	70.0 (4.8)	68.6 (5.6)
SP						
Reversed GSV	14/911	87.5 (2.7)	84.5 (3.1)	78.9 (4.0)	74.0 (4.8)	73.2 (6.3)
NR GSV	13/1186	84.1 (3.3)	78.9 (3.9)	74.0 (4.8)	71.9 (6.0)	66.5 (7.7)
SP						
Pedal bypass	14/1361	81.1 (3.1)	76.8 (3.6)	72.1 (4.6)	69.8 (5.2)	65.4 (6.3)
Tibial bypass	16/918	89.8 (2.3)	85.6 (2.8)	80.4 (3.4)	75.9 (4.7)	75.5 (6.1)
FP						
Reversed GSV	13/889	87.7 (2.7)	85.6 (3.2)	82.9 (3.5)	81.1 (4.3)	79.7 (5.4)
NR GSV	10/1019	87.5 (4.3)	84.4 (4.6)	81.2 (6.1)	79.8 (7.3)	75.3 (8.4)
FP						
Pedal bypass	11/1261	88.4 (4.2)	84.5 (4.4)	81.4 (5.3)	79.6 (6.8)	75.7 (7.3)
Tibial bypass	16/900	87.5 (2.4)	85.5 (2.9)	82.9 (3.4)	81.2 (4.0)	79.8 (5.0)

PP, Primary patency; *GSV,* great saphenous vein; *NR,* nonreversed; *SP,* secondary patency; *FP,* foot preservation.

Table IV. Sensitivity analysis of graft patency and foot salvage

Procedure	*PP (%)*	*SP (%)*	*FP (%)*
Fixed-effects modelling	2.0	1.4	3.2
Adjustments for loss to follow-up	−1.4	−2.3	−3.7
Exclusions			
Largest study	2.6	2.0	1.3
Plain curves and texts	−0.8	1.2	0.6
Femoral-to-distal bypasses	1.4	2.7	2.3
Quality score <8	3.4	−1.0	0.8
Flat tails	−4.4	−4.0	−2.3

PP, Primary patency; *SP,* secondary patency; *FP,* foot preservation.
Values are changes in the 5-year pooled estimates.

original studies were excluded, there was a decrease of 1.8% and 4.4% for PP, 1.6% and 4.1% for SP, and 1.1% and 2.2% for FP at 4 and 5 years, respectively.

For a study size of <50 grafts, the 2-year estimate was higher than the 2-year pooled estimate in five of 14 series for PP and in six of 16 series for SP. Consequently, small series that showed better results were not published selectively.

DISCUSSION

Meta-analysis of uncontrolled surgical series represents the best source of evidence when randomized trials do not exist and when the available studies are reasonably homogenous, as is the case for PD bypass grafts. Clearly, the current meta-analysis included studies that described comparable patients and used similar methods of analysis. All but two patients had critical ischemia, most patients had diabetes, and vein grafts were used wherever possible. Only five studies failed to describe all three main outcomes, and only two studies did not present a survival curve of good quality or a life table. Not surprisingly, 21 studies cited the recommendations of Rutherford et al[33] or a previous version.

A flat segment in a survival curve conveyed biased information on the risk of failure within the corresponding interval. Meta-analysis of PD grafts eliminated the problem of long flat tails seen in most original studies, thereby avoiding the overestimation of graft patency and limb salvage >2 years. The current study also showed that PD grafts were technically highly successful and remarkably stable >8 months, even when the flat tails were eliminated.

A major advantage of PD bypass grafts is the possibility of frequently using the GSV, although the choice of graft configuration remains a matter of preference. In situ vein grafting may not allow use of the best portion of available vein and often implies using parallel incisions at the ankle, whereas excised veins obviate these problems and allow the use of a tapered conduit. The nonreversed translocated GSV is therefore particularly suitable for infrapopliteal revascularization.[12,16,18]

In a flexible approach to pedal revascularization, surgeons from a prestigious center used this configuration in 15% of the cases until 1989 and in 31% thereafter.[15,16] In contrast, most studies on PD grafts have shown a preference for the reversed configuration, perhaps because PD grafts are essentially short grafts and because reversed GSVs may also have a natural tapering.[16] Such a preference seems justified because the differences in pooled patencies favored the reversed GSV, although not significantly. The alternative use of fixed-effects modelling yielded significant differences in the pooled patencies at 1 and 2 years, however. This statistical procedure was easily justifiable because the patients sampled were homogenous and the corresponding changes in the pooled estimates were small. Other procedures in the sensitivity analysis had little impact on the outcomes and did not reveal any statistical significance.

When a dorsal pedal bypass and a peroneal bypass are both applicable, some surgeons prefer the dorsal pedal bypass to obtain more complete foot revascularization and avoid major amputation in the presence of a patent graft.[16] Obviously, this choice negates the short-graft principle. The comparison of tibial graft series and pedal graft series was thus of some practical importance. Random-effects modelling revealed no significant difference favoring the former series, but fixed-effects modelling yielded a significant difference at 1 and 2 years. Despite the superiority trend of tibial graft series, the pooled FP differed by <1% at these two times. A properly indicated tibial or peroneal bypass is possibly as effective as a longer pedal bypass for limb salvage.[36]

Because patients undergoing PD bypass grafting generally have chronic critical limb ischemia, FP becomes an outcome of particular interest. Unfortunately, FP does not provide information of the effects on rest pain nor does it measure the incidence of complete ulcer healing and minor amputation, all of which limit walking ability and quality of life. Walking ability and quality of life are better after revascularization, even with a moderate foot salvage rate, than after primary below-knee amputation.[37] In diabetic patients, however, the well-known complications in target organs may further reduce the quality of life.[38]

The present meta-analysis provided a basis against which infrapopliteal angioplasty should be compared. An early mortality rate averaging 2.3% in PD graft series may compare unfavorably with angioplasty, whereas a pooled FP of 88.5% at 1 year and the remarkable stability of PD grafts >7 months represent a major challenge to interventionalists.

Bias was small in this meta-analysis. The adjustments for incomplete follow-up showed only small decreases in the pooled patencies, and the inflating effect of flat tails from the original studies was corrected. Clinical symptoms, graft material, and level of proximal anastomosis were mostly restricted by design, whereas subgroup meta-analysis partly assessed the influence of graft configuration and outflow artery. Except for runoff, no other predictor of graft patency is well recognized.

CONCLUSION

The internal and external validity of inferences from this meta-analysis were strongly supported. The studies reviewed adopted similar outcomes, provided data of high quality, and described high response rates. In addition, the study design, particularly the criteria for inclusion, was compatible with real life and allowed an adequate sampling of a hypothetic population of studies. Finally, random-effects modelling avoided undue precision, and sensitivity analysis clarified several points. In the absence of bias and study invalidity, we conclude that PD vein grafts for critical ischemia provide excellent outcomes and should be used confidently in suitable patients.

AUTHOR CONTRIBUTIONS

Conception and design: M.A, N.D.L, C.A.P
Analysis and interpretation: M.A, C.A.P
Data collection: M.A, M.R, F.C.B
Writing the article: M.A
Critical revision of the article: M.R, F.C.B, N.D.L, C.A.P
Final approval of the article: M.A, M.R, F.C.B, N.D.L, C.A.P
Statistical analysis: M.A, C.A.P
Overall responsibility: M.A

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Appendix A (online only). Main features of popliteal-to-distal vein grafts in 31 studies

First author	*Size*	*DM (%)*	*Tissue loss (%)*	*Pedal bypass (%)*	*GSV (%)*	*Flat tail*	*Early deaths (%)*
Andros	88	76.1	85.2	38.6	85.2		2.3
Ballard	43	87.5	67.4	16.3	100	+	2.3
Biancari	66	78.8	100	72.7	93.9	+	6.1
Brothers	62	40	71	61.3	Unk	+	1
Brown	52	88.2	69.2	21.2	94.2		1.9
Cantelmo	32	71.9	Unk	25	93.8	+	0
Cavallini	15	100	100	86.7	86.7		0
Davidson	31	Unk	100	Unk	Unk	+	0
Eckstein	21	Unk	Unk	61.9	Unk	+	4.8
Frankini	43	78	93	62.8	95.3		4.7
Gloviczki	48	Unk	Unk	100	Unk	+	0
Goyal	21	81	76.2	0	0	+	4.8
Grego	71	77.5	69	9.9	57.7		2.8
Harrington	73	78	79	100	97.3	+	1.4
Hughes	98	83.7	94.9	100	68.4		1
Marks	32	65.5	Unk	34.4	100		6.3
Mills	56	86.8	98.1	39.3	96.4	+	5.4
Mohan	35	100	94.3	28.6	85.7	+	0
Monux Ducaju	30	70	70	46.7	93.3	+	3.3
Ouriel	21	81	66.7	0	0		4.8
Pereira	20	65	100	65	85	+	5
Pomposelli	556	91.9	74.8	100	80		1
Rhodes	26	96.2	53.8	15.4	100	+	11.5
Rosenbloom	49	76	85.7	36.7	93.9		0
Schmiedt	140	100	96	50	Unk	+	1.4
Schneider	64	100	100	66.9	100	+	1.6
Shah	106	78.3	Unk	38.7	63.2	+	2.8
Stonebridge	124	100	83.9	61.3	89.5	+	0.8
Verhelst	44	91.7	88.6	44.2	95.5	+	0
Wengerter	153	87	92.2	24.2	94.1	+	3.9
Wölfle	130	100	97.7	48.5	96.9	+	2.3

DM, Diabates mellitus; *GSV,* great saphenous vein; *Unk,* unknown.

Appendix B (online only). Assessment of survival analysis and attributed quality score

First author	*Life table*	*1-month interval*	*Description of losses*	*Censored 1-yr (%)*	*Outcome measures*	*Risk-set*	*Quality score*
Andros		+		43.2	SP		5
Ballard	+	+		44.2	All 3	+	11
Biancari	+	+		21.2	All 3	+	8
Brothers		+		41.9	All 3	+	9
Brown	+	+		17.3	All 3	+	12
Cantelmo		+		28.1	All 3	+	9
Cavallini			+	6.7	All 3	+	8
Davidson	+	+	+	35.5	SP		8
Eckstein		+		42.9	SP		3
Frankini		+	+	16.3	SP FP	+	9
Gloviczki		+		25	PP SP		5
Goyal			+	42.9	All 3	+	9
Grego		+		14.1	All 3	+	10
Harrington	+	+	+	23.3	All 3		9
Hughes		+	+	27.6	All 3	+	11
Marks	+	+		46.9	All 3	+	10
Mills	+	+		50	All 3	+	11
Mohan		+		22.9	All 3	+	9
Monux Ducaju	+	+		33.3	All 3	+	11
Ouriel		+		42.9	All 3	+	10
Pereira		+	+	10	All 3	+	11
Pomposelli		+		50.4	All 3	+	8
Rhodes		+		23.1	All 3	+	6
Rosenbloom		+	+	44.9	All 3	+	10
Schmiedt		+		18.6	All 3	+	6
Schneider		+		32.8	All 3	+	9
Shah	+	+		49.1	All 3	+	11
Stonebridge		+		52.4	All 3	+	8
Verhelst		+		22.7	All 3	+	9
Wengerter	+			31.4	All 3	+	9
Wölfle	+	+	+	30	All 3	+	11

SP, Secondary patency; *FP,* foot preservation; *PP,* primary patency.