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Stent placement compared with balloon angioplasty for obstructed coronary bypass grafts. Saphenous Vein De Novo Trial Investigators.

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STENT PLACEMENT COMPARED WITH BALLOON ANGIOPLASTY FOR OBSTRUCTED CORONARY BYPASS GRAFTS

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ABSTRACT

Background Treatment of stenosis in saphenous-vein grafts after coronary-artery bypass surgery is a difficult challenge. The purpose of this study was to compare the effects of stent placement with those of balloon angioplasty on clinical and angiographic outcomes in patients with obstructive disease of saphenous-vein grafts.

Methods A total of 220 patients with new lesions in aortocoronary–venous bypass grafts were randomly assigned to placement of Palmaz–Schatz stents or standard balloon angioplasty. Coronary angiography was performed during the index procedure and six months later.

Results As compared with the patients assigned to angioplasty, those assigned to stenting had a higher rate of procedural efficacy, defined as a reduction in stenosis to less than 50 percent of the vessel diameter without a major cardiac complication (92 percent vs. 69 percent, $P<0.001$), but they had more frequent hemorrhagic complications (17 percent vs. 5 percent, $P<0.01$). Patients in the stent group had a larger mean ($\pm$SD) increase in luminal diameter immediately after the procedure (1.92 ± 0.30 mm, as compared with 1.21 ± 0.37 mm in the angioplasty group; $P<0.001$) and a greater mean net gain in luminal diameter at six months (0.85 ± 0.96 vs. 0.54 ± 0.91 mm, $P=0.002$). Restenosis occurred in 37 percent of the patients in the stent group and in 46 percent of the patients in the angioplasty group ($P=0.24$). The outcome in terms of freedom from death, myocardial infarction, repeated bypass surgery, or revascularization of the target lesion was significantly better in the stent group (73 percent vs. 58 percent, $P=0.03$).

Conclusions As compared with balloon angioplasty, stenting of selected venous bypass-graft lesions resulted in superior procedural outcomes, a larger gain in luminal diameter, and a reduction in major cardiac events. However, there was no significant benefit in the rate of angiographic restenosis, which was the primary end point of the study. (N Engl J Med 1997;337:740-7.)

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THE treatment of patients with obstructive disease of coronary-artery bypass grafts poses a challenge of increasing magnitude as the population of patients who have undergone bypass surgery continues to grow. Within a decade after surgery, half of all saphenous-vein bypass grafts have severe atherosclerotic disease.[1-7] Management of graft disease is problematic, since repeated surgery entails substantial risk and the results of conventional angioplasty have been disappointing.[8-12] As compared with angioplasty in native coronary arteries, balloon dilation of vein grafts is associated with increased rates of procedural complications and restenosis.[12-16] Previous randomized trials of stent implantation, as compared with balloon angioplasty, have shown superior outcomes in native vessels, and observational reports have suggested favorable results in diseased vein grafts.[17-22] Accordingly, we conducted a prospective, randomized trial to compare stent implantation with balloon angioplasty for the treatment of obstructive disease of venous bypass grafts.

METHODS

Twelve clinical centers with experience with the implantation of Palmaz–Schatz stents participated in the trial (see the Appendix). The study protocol was approved by the institutional review board at each site.

Selection of Patients

The study population consisted of patients with new lesions in aortocoronary venous bypass grafts who had angina pectoris, ob-

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*Institutions and additional investigators participating in the Saphenous Vein De Novo (SAVED) trial are listed in the Appendix.

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jective evidence of myocardial ischemia, or both. Angiographic entry criteria included stenosis of 60 percent or more of the luminal diameter in vessels from 3.0 to 5.0 mm in diameter. Exclusion criteria were myocardial infarction within the previous seven days; a contraindication to therapy with aspirin, dipyridamole, or warfarin; an ejection fraction of less than 25 percent; diffuse disease that would require more than two stents; evidence of thrombus; and outflow obstruction of the graft due to distal anastomotic stenosis or poor runoff in the recipient native vessel. After giving informed consent, patients were randomly assigned to either angioplasty or stent placement.

Protocols

The stent used in this trial was the 15-mm-long Palmaz–Schatz coronary stent (Johnson & Johnson Interventional Systems, Warren, N.J.).[23-25] Patients assigned to stent placement received aspirin (325 mg daily) and dipyridamole (75 mg three times per day), beginning at least 24 hours before the procedure. During the procedure, patients received intravenous dextran 40 and heparin to maintain an activated clotting time of more than 300 seconds. Warfarin therapy was begun on the day of the procedure, and heparin therapy was continued until a therapeutic prothrombin time (international normalized ratio, 2.0 to 3.5) was achieved. Dipyridamole and warfarin were continued for one month, and aspirin indefinitely.

Angioplasty was performed with use of conventional balloon catheters. Patients in whom angioplasty was successful received aspirin (325 mg daily) indefinitely. Crossover to stent placement was permitted as a bailout procedure in the event of abrupt or threatened vessel closure. Patients assigned to the angioplasty group who required stent placement as a bailout procedure received warfarin and dipyridamole for one month in addition to aspirin.

Follow-up

Patients were evaluated clinically one, three, and six months after the procedure. Coronary angiography was repeated at six months. Angiography was performed earlier if there were recurrent symptoms. However, if restenosis was not found during repeated angiography performed within four months of the procedure, angiography was repeated at six months.

Angiographic Analysis

Angiography was performed in orthogonal views at base line, after the intervention, and at six months. Quantitative coronary analysis was performed at the core angiographic laboratory at Jefferson Medical College with use of a validated edge-detection algorithm.[18,24-28] The diameters of the normal-appearing segments proximal and distal to the lesion were averaged to determine the reference vessel diameter. The minimal luminal diameter, reference diameter, and degree of stenosis as a percentage of the vessel diameter were calculated as mean values from orthogonal projections.

End Points

The primary angiographic end point was restenosis, defined as stenosis of 50 percent or more of the luminal diameter at follow-up. When multiple lesions were treated, restenosis was considered present in a patient if any lesion had restenosis. Secondary angiographic end points included the rate of procedural success and the change in the minimal luminal diameter from the base-line value immediately after the procedure and at six months. Procedural success was defined as a reduction in the degree of stenosis to less than 50 percent, as assessed by quantitative angiography. Procedural efficacy was also assessed as an initial outcome; this combined angiographic and clinical end point was intended to reflect the overall predictability of the planned intervention. Procedural efficacy was defined as angiographic success with the assigned therapy, without crossover to the alternative therapy, and the absence of in-hospital complications.

The principal clinical end point was a composite outcome defined as the occurrence of death, myocardial infarction, repeated bypass surgery, or revascularization of the target lesion. Myocardial infarction was defined as the presence of new Q waves lasting 0.04 second or more or an elevation of the serum creatine kinase level to three times the upper limit of normal with an elevated MB fraction (measured 6, 12, and 24 hours after the procedure). Secondary clinical outcomes included the duration of hospitalization and the frequency of bleeding and peripheral vascular complications.

Statistical Analysis

The target sample size of 210 patients was based on the assumption that the rate of restenosis in vein-graft lesions in the angioplasty group would be 50 percent or more and that the rate of restenosis in stented vessels would be less than 25 percent.[20-22] Allowing for a procedural failure rate of 10 percent and an angiographic-restudy rate of 80 percent, the enrollment of 210 patients would yield more than 150 patients with angiographic follow-up and give the study a statistical power of 0.90 and an alpha level of 0.05.

Data were recorded prospectively and forwarded to the data-coordinating center. Case-report forms and charts were independently audited by research monitors. Adverse events were reviewed in blinded fashion by the steering committee.

Outcomes were analyzed according to the intention-to-treat principle. Categorical data were assessed by the chi-square or Fisher's exact test. Rates of clinical events in the treatment groups at 6 months (follow-up window, 120 to 240 days) were compared with use of the log-rank test. Two-tailed P values were calculated, with values below 0.05 considered to indicate statistical significance.

The quantitative angiographic results for 122 lesions treated with stenting and 120 treated with angioplasty were analyzed by multivariate analysis of variance with use of the BMDP program 4V.[29] The results for individual lesions were not entirely independent, since 18 percent of patients had multiple lesions. We therefore used a linear-structure model of vessel measurements that included a patient factor, which was tested under a second "between" (or grouping) factor, treatment assignment (stenting vs. angioplasty). In addition, the model contained a "within" (or repeated-measures) factor, time (base line, immediately after the procedure, or follow-up). The three dependent variables in the multivariate model were the diameter of the reference vessel, the minimal luminal diameter, and the percentage of stenosis. Because the term for the interaction of time and treatment assignment in the model was significant for all three variables ($P<0.002$), the multiple analysis of variance was performed for each level of the time factor separately. Protection against the detection of spurious differences due to multiple comparisons was afforded by the "protected F-tests" concept — that is, the principle of not interpreting effects further when the overall F tests failed to reject the null hypothesis.[30]

RESULTS

Between January 1993 and June 1995, 220 patients were enrolled; 110 patients were assigned to stent placement and 110 patients to angioplasty. After randomization, five patients (two in the stent group and three in the angioplasty group) were excluded because of violations of the protocol with respect to enrollment criteria. The base-line clinical and angiographic characteristics of the groups are shown in Tables 1 and 2, respectively. The treated grafts were relatively old: on average, 10.1 years in the stent group and 9.4 years in the angioplasty group. The groups were well matched except for a slightly higher prevalence of diabetes in the angioplasty group.

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TABLE 1. BASE-LINE CLINICAL CHARACTERISTICS OF THE PATIENTS.*

CHARACTERISTIC	STENT GROUP (N=108)	ANGIOPLASTY GROUP (N=107)
Age (yr)	66±9	66±9
Male sex (%)	82	79
Hyperlipidemia (%)	65	64
Hypertension (%)	61	55
Diabetes mellitus (%)	23	36†
Current smoking (%)	17	15
Prior myocardial infarction (%)	68	70
Myocardial infarction within previous 6 wk (%)	18	19
Unstable angina (%)	82	77
Ejection fraction	0.53±0.14	0.52±0.14

*Plus–minus values are means ±SD. Five of the 220 patients originally enrolled were excluded because of protocol violations.

†P=0.05 for the comparison between the groups.

TABLE 2. BASE-LINE ANATOMICAL CHARACTERISTICS OF THE PATIENTS.*

CHARACTERISTIC	STENT GROUP (N=108)	ANGIOPLASTY GROUP (N=107)
Age of graft (yr)	10.1±4.2	9.4±4.3
Recipient native vessel (%)		
Left anterior descending artery	33	36
Left circumflex artery	31	29
Right coronary artery	28	27
Multiple	8	8
Distal anastomosis (%)		
Single	84	82
Multiple	16	18
Location of target lesion (%)		
Aortic anastomosis	7	9
Proximal third	43	29
Middle third	29	36
Distal third	19	21
Coronary anastomosis	2	5
No. of lesions treated (%)		
1	82	83
2	14	10
⩾3	4	7
Length of lesion (mm)	9.6±5.4	9.8±5.2
Degree of stenosis (% of diameter)	72±12	71±12
Eccentricity (%)	73	82
Ulceration (%)	35	39
Thrombus (%)		
Definite	6	8
Possible	18	22
Lesion on bend >45 degrees (%)	11	10
Tortuous graft (%)	39	39

*Plus–minus values are means ±SD. There were no significant differences between the groups. Five of the 220 patients originally enrolled were excluded because of protocol violations.

Procedural Outcomes

Stents were placed in 105 of 108 patients assigned to this therapy (97 percent). Two patients assigned to the stent group were treated with angioplasty because the characteristics of the lesions were deemed unfavorable for stent placement at the time of the procedure, and one patient underwent bypass surgery. Balloon angioplasty was performed in 103 of 107 patients assigned to this therapy (96 percent). Of the four patients assigned to angioplasty who did not undergo the procedure, two were treated medically and two underwent bypass surgery. Seven patients in the angioplasty group (7 percent) required bailout stent placement.

Rates of procedural success and early clinical outcomes are shown in Table 3. Angiographic procedural success was achieved in 97 percent of the patients assigned to stent placement and 86 percent of those assigned to angioplasty ($P<0.01$). The rate of procedural efficacy was also significantly higher in the stent group than in the angioplasty group (92 percent vs. 69 percent, $P<0.001$). Thus, 31 percent of patients assigned to angioplasty had an unsuccessful angiographic result, had a major complication, or required unplanned revascularization. In contrast, only 8 percent of the stent group had an unsuccessful angiographic result, a complication, or a need for alternative therapy.

There were no significant differences between the groups in terms of major in-hospital cardiac complications. However, there was a trend toward fewer non–Q-wave myocardial infarctions in the stent group (2 percent, as compared with 7 percent in the angioplasty group; $P=0.10$). Abrupt reclosure of the vessel occurred in one patient in each group; the incidence of thrombosis in the stented vessel within one month was 0.9 percent. Bleeding and vascular complications were significantly more common in the stent group (17 percent vs. 5 percent, $P<0.01$).

Angiographic Results

Coronary angiography was repeated a mean (±SD) of 6±2 months after the initial procedure in 166 of 193 patients eligible for angiographic follow-up (86 percent). The follow-up rate was similar for the stent and angioplasty groups (88 percent and 84 percent, respectively; P not significant). The quantitative angiographic results are shown in Table 4. Immediately after the intervention, a larger mean gain in luminal diameter was achieved in the patients assigned to stent placement (1.92±0.30 mm vs. 1.21±0.37 mm, $P<0.001$). Although the late loss of luminal diameter was higher after stenting, there was a significantly greater mean net gain in luminal diameter at six months with stenting (0.85±0.96 mm vs. 0.54±0.91 mm, $P=0.002$). The minimal luminal diameter at six months was 1.73±1.02 mm

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TABLE 3. PROCEDURAL OUTCOMES AND EARLY CLINICAL EVENTS.*

VARIABLE	STENT GROUP (N=108)	ANGIOPLASTY GROUP (N=107)	P VALUE
Procedural outcome†			
Angiographic success (%)	97	86	<0.01
Procedural efficacy (%)	92	69	<0.001
Crossover to stenting (%)	—	7	—
Hospital stay (days)	7±6	4±7	<0.001
In-hospital events (%)			
Death	2	2	0.79
Q-wave myocardial infarction	2	1	0.99
Non–Q-wave myocardial infarction	2	7	0.10
CABG	2	4	0.45
Abrupt vessel closure	1	1	0.99
Repeated PTCA	1	1	0.99
Any event	6	11	0.13
Bleeding and vascular complications at 0–30 days (%)			
Stroke	0	0	0.99
Vascular surgery	5	3	0.72
Transfusion	15	3	<0.01
Any event	17	5	<0.01

*Plus–minus values are means ±SD. CABG denotes coronary-artery bypass graft surgery, and PTCA percutaneous transluminal coronary angioplasty. Five of the 220 patients originally enrolled were excluded because of protocol violations.

†Angiographic success was defined as residual stenosis of less than 50 percent of the vessel diameter immediately after the procedure. Efficacy was defined as angiographic success achieved with the assigned therapy and the absence of a major in-hospital complication.

TABLE 4. CHARACTERISTICS OF LESIONS AT BASE LINE AND ANGIOGRAPHIC RESULTS IMMEDIATELY AFTER THE PROCEDURE AND AT SIX MONTHS.*

VARIABLE	STENT GROUP	ANGIOPLASTY GROUP	P VALUE
At base line			
Diameter of reference vessel — mm	3.18±0.56	3.19±0.61	0.36
Minimal luminal diameter — mm	0.90±0.42	0.94±0.44	0.34
Degree of stenosis — % of diameter	72±12	71±12	0.47
After procedure			
Diameter of reference vessel — mm	3.19±0.55	3.19±0.61	0.55
Minimal luminal diameter — mm	2.81±0.49	2.16±0.57	<0.001
Degree of stenosis — % of diameter	12±13	32±17	<0.001
Elastic recoil — %	13±9	30±16	<0.001
Dissection — % of lesions	7	29	<0.001
At 6 mo			
Diameter of reference vessel — mm	3.14±0.54	3.11±0.57	0.95
Minimal luminal diameter — mm	1.73±1.02	1.49±0.88	0.01
Degree of stenosis — % of diameter	46±30	51±26	0.02
Restenosis in lesion — no./total no. (%)	35/98 (36)	43/91 (47)	0.11
Restenosis in patient — no./total no. (%)	32/86 (37)	37/80 (46)	0.24
Change in minimal luminal diameter — mm			
Immediate gain	1.92±0.30	1.21±0.37	<0.001
Late loss	1.06±0.92	0.66±0.87	<0.001
Net gain	0.85±0.96	0.54±0.91	0.002

*Plus–minus values are means ±SD. The results are means for all lesions, unless otherwise specified. In the stent group, 122 lesions were treated in 108 patients; in the angioplasty group, 120 lesions in 107 patients.

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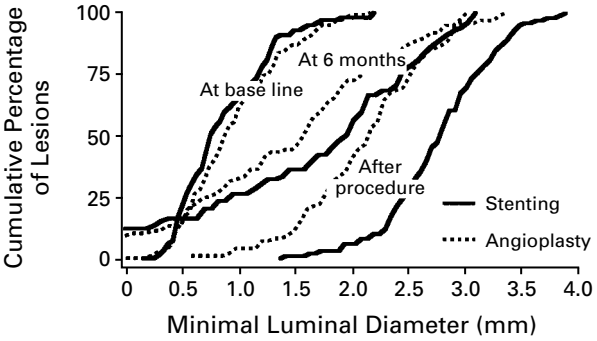

Figure 1. Cumulative Distribution of Minimal Luminal Diameters in the Treatment Groups at Base Line, Immediately after the Procedure, and at Six Months.

The degree of initial luminal narrowing was similar in the two treatment groups, as demonstrated by the near-superimposition of the curves at base line. The curves separate after the procedure and at follow-up, indicating the larger luminal diameter achieved by stent placement.

in the stent group and 1.49±0.88 mm in the angioplasty group (P=0.01). Cumulative frequency distributions of minimal luminal diameters in the two groups are shown in Figure 1.

When the results were analyzed according to intention-to-treat principles, restenosis was found in 37 percent of the patients in the stent group and in 46 percent of the patients in the angioplasty group (P=0.24). The relative risk of restenosis in a patient after stenting was 0.84 (95 percent confidence interval, 0.64 to 1.11); after adjustment for diabetes mellitus, the relative risk was 0.83 (95 percent confidence interval, 0.63 to 1.08). Restenosis was observed in 36 percent of the lesions in the stent group and in 47 percent of the lesions in the angioplasty group (P=0.11). The relative risk of restenosis in a lesion after stenting was 0.82 (95 percent confidence interval, 0.64 to 1.05); after adjustment for diabetes, the relative risk was 0.83 (95 percent confidence interval, 0.64 to 1.06). When only patients who received the assigned therapy according to the protocol were analyzed, the differences in the rates of restenosis were statistically significant: 34 percent for the patients treated with stenting as compared with 48 percent for those treated with angioplasty (P<0.05). The relative risk of restenosis was 0.77 (95 percent confidence interval, 0.60 to 0.99) for the stent group as compared with the angioplasty group; after adjustment for diabetes, the relative risk was 0.78 (95 percent confidence interval, 0.60 to 1.01).

Late Clinical Events

The cumulative incidence of major cardiac events at follow-up is shown in Table 5. The rate of event-free survival (freedom from death, myocardial infarction, repeated bypass surgery, and revascularization of the target lesion) was significantly greater for patients assigned to stenting than for patients assigned to balloon angioplasty (Fig. 2). At 240 days, the rate of event-free survival by Kaplan–Meier analysis was 73 percent in the stent group as compared with 58 percent in the angioplasty group (P=0.03). The relative risk of a major cardiac event associated with stenting was 0.82 (95 percent confidence interval, 0.68 to 0.98); after adjustment for diabetes, the relative risk was 0.82 (95 percent confidence interval, 0.68 to 0.99).

DISCUSSION

Recurrent myocardial ischemia after coronary-artery bypass surgery is a common clinical problem because of the large number of patients with bypass grafts implanted many years earlier. Angiographic studies have found that within 10 years after the operation, half of all vein grafts are totally occluded or have severe atherosclerotic disease.[1-7] Repeated bypass surgery is more technically challenging than a first operation, is associated with higher morbidity and mortality, and provides less symptomatic relief.[8-11] Angioplasty is therefore often attempted in lieu of reoperation. However, the results of balloon angioplasty in saphenous-vein bypass grafts are less favor-

Table 5. Major Cardiac Events up to 240 Days after the Procedure.

Event	Stent Group (N=108)	Angioplasty Group (N=107)	P Value
	percent		
Death	7	9	0.44
Q-wave myocardial infarction	5	4	0.99
Non–Q-wave myocardial infarction	6	11	0.13
Coronary bypass surgery	7	12	0.24
Repeated angioplasty	13	16	0.54
Target-lesion revascularization	17	26	0.09
Any event	26	39	0.04

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able than those in native vessels, with rates of restenosis exceeding 50 percent.[12-16] Furthermore, the rates of complications and restenosis increase once the age of a graft exceeds three to five years.[13,15,16] Given the limitations of these therapies, stent implantation has been suggested as an alternative therapeutic approach. Observational studies of patients who have received the Palmaz–Schatz stent have reported relatively low rates of restenosis.[19-22] However, there have been no direct comparisons of angioplasty and stent implantation for the treatment of disease in saphenous-vein grafts.

The results of our randomized trial demonstrate that elective stent placement produces better angiographic and clinical outcomes than balloon angioplasty in the treatment of new lesions in aortocoronary venous bypass grafts. Stenting was associated with superior initial angiographic results, higher rates of procedural success, and a trend toward fewer periprocedural non–Q-wave myocardial infarctions. Although the rates of restenosis were not significantly different with the two treatment strategies, at six months the luminal diameter was significantly larger in the stent group. Most important, clinical outcome was improved by stenting. The proportion of patients who were free from death, myocardial infarction, repeated bypass surgery, and revascularization of the target lesion was significantly greater in the stent group.

The findings of this study are concordant with those of the Stent Restenosis Study (STRESS) and the Belgium–Netherlands Stent (Benestent) trial, which found superior outcomes with stenting in native coronary arteries.[17,18] On the other hand, our findings contrast with data on directional atherectomy in bypass-graft lesions reported by the second Coronary Angioplasty versus Excisional Atherectomy Trial (CAVEAT II).[31,32] Although both stenting and atherectomy produced better initial angiographic results in vein grafts than angioplasty, atherectomy was associated with more procedural complications, particularly distal embolization.[31,32] The trend toward more non–Q-wave infarctions in patients treated with atherectomy contrasts with the trend toward fewer non–Q-wave infarctions in patients treated with stenting in our trial. Possibly the screen-like configuration of the stent may entrap friable graft atheroma, thereby reducing the likelihood of dislodgement and embolization of larger debris.

Several limitations of stenting should be emphasized. The intense anticoagulation protocol used in this trial resulted in a significant increase in hemorrhagic complications. Similar findings were observed in the Benestent and STRESS trials, which used similar anticoagulant regimens.[17,18] Although this protocol was standard therapy when the trial was performed, subsequent studies have shown the superior safety and efficacy of aspirin and ticlopidine in conjunction with high-pressure stent deployment.[33-35] A reduction in the rate of hemorrhagic complications after vein-graft stenting has also been reported with antiplatelet therapy alone.[36]

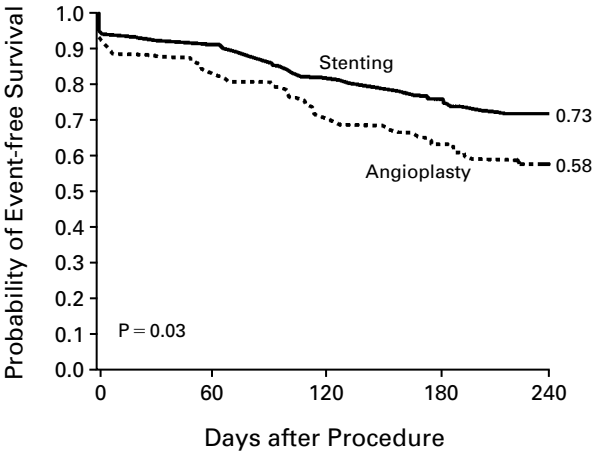

Figure 2. Kaplan–Meier Survival Curves for Freedom from Major Cardiac Events.

The rate of event-free survival was significantly higher among patients assigned to stenting than among those assigned to angioplasty. The relative risk of a major cardiac event after stenting was 0.82 (95 percent confidence interval, 0.68 to 0.98); after adjustment for diabetes, the relative risk was 0.82 (95 percent confidence interval, 0.68 to 0.99).

The results of this study cannot be extrapolated to populations excluded from the trial, such as patients with restenotic or diffusely diseased grafts. In a prospective study of Palmaz–Schatz stents in vein-graft disease, we found a significantly higher rate of restenosis of single stents placed in recurrent lesions than of those placed in new lesions (51 percent vs. 22 percent).[20]

It is important to emphasize limitations due to the open nature of this trial, since patients and operators were not blinded to the treatment. Thus, the possibility of bias cannot be excluded despite the prospective, randomized trial design. This caveat is pertinent not only to the angiographic results but also to clinical end points, since the decision to perform additional procedures could have been influenced by the knowledge that the stent was present. On the other hand, several factors support our findings. First, quantitative measurements of the severity of stenosis were performed by a core laboratory using a validated computerized program that automatically determined the luminal dimensions. Second, the results of this trial of stenting in vein grafts closely corroborate the findings of the two landmark trials of stents in native vessels.[17,18] In all three studies, stent placement was associated with a larger gain in minimal luminal diameter, a reduction of 25 to 30 percent in the risk of restenosis, and fewer cardiac events. Finally, in this trial knowledge of the patients' treatment assignment did not appear to influence the use of further procedures

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to treat restenosis. In patients with angiographic evidence of restenosis, the proportion of patients undergoing revascularization of the target lesion was virtually identical in the two study groups: 59 percent after stenting and 58 percent after angioplasty.

A final limitation of this study is that stenting was less effective in reducing the rate of restenosis than we anticipated. With respect to a priori assumptions, the rate of restenosis in the balloon angioplasty group was lower than expected, whereas the rate of restenosis in the stent group was higher than expected.[12-16,22,31] According to quantitative coronary analysis by the same core angiographic laboratory used in this study, restenosis in the multicenter registry of vein-graft stenting was only 22 percent,[20] a rate substantially lower than that in the current trial. A similar phenomenon was observed in the STRESS trial, in which there was a significant discordance in rates of restenosis between the registry and randomized studies. The rate of restenosis of stented vessels in native coronary arteries was 32 percent in the prospective randomized trial, as compared with only 14 percent in the registry, despite similar inclusion criteria and analysis by the same core laboratory.[18,28] These results suggest a bias toward favorable outcomes in observational registries of the use of interventional devices. As a result, the use of the intention-to-treat principle in a prospective, randomized trial may yield results that are less favorable than expected.

As compared with conventional angioplasty, stent placement in new vein-graft lesions was associated with better initial angiographic results and higher rates of procedural success. Although the luminal diameter at six months was larger in the stent group, there was no significant difference in the rate of restenosis, the primary angiographic end point. However, major cardiac events occurred less frequently in the stent group. Continued follow-up is planned to assess longer-term clinical outcomes.

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APPENDIX

The following institutions and investigators, in addition to the authors, participated in the Saphenous Vein De Novo (SAVED) trial: Arizona Heart Institute, Phoenix; Emory University Hospital, Atlanta; Johns Hopkins Hospital, Baltimore; Methodist Hospital, Lubbock, Tex.; the Heart Group, Bellevue, Wash.; Thomas Jefferson University Hospital, Philadelphia — A. Zalewski and P. Walinsky; University of California, San Diego, La Jolla; University of Florida, Gainesville — R. Kerensky and T. Wargovich; University of Texas, Houston; University of Texas, San Antonio — S.R. Kiesz; William Beaumont Hospital, Royal Oak, Mich.; Yale University, New Haven, Conn. — H. Cabin; Beth Israel Deaconess Medical Center, Boston — D. Baim; Core Angiographic Laboratory, Thomas Jefferson University Hospital, Philadelphia — D. Rehmann; and Data Coordinating Center, Johnson & Johnson Interventional Systems, Warren, N.J. — J. Gwo, J. Lind, and C. Ray.

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