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Restenosis, Reocclusion and Adverse Cardiovascular Events After Successful Balloon Angioplasty of Occluded Versus Nonoccluded Coronary Arteries

Results From the Multicenter American Research Trial With Cilazapril After Angioplasty to Prevent Transluminal Coronary Obstruction and Restenosis (MARCATOR)

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Objectives. **This study sought to compare the frequency of restenosis, reocclusion and adverse cardiovascular events after angioplasty of occluded versus nonoccluded coronary arteries.**

Background. **Angioplasty of chronically occluded coronary arteries is believed to be associated with a higher frequency of restenosis and reocclusion than angioplasty of subtotal stenoses. Whether this leads to adverse cardiovascular events is unknown.**

Methods. **The Multicenter American Research Trial With Cilazapril After Angioplasty to Prevent Restenosis (MARCATOR) was a placebo-controlled trial with angiographic follow-up to determine the effect of the angiotensin-converting enzyme inhibitor cilazapril on the frequency of restenosis. In this trial, restenosis was defined as 1) angiographic reduction of minimal lumen diameter ≥0.72 mm between angioplasty and the follow-up visit; and 2) >50% diameter stenosis on the follow-up angiogram. We identified 139 patients with successful angioplasty of a coronary occlusion (Group 1) and compared the frequency of restenosis, reocclusion and adverse cardiovascular events with that in 1,295 patients with successful angioplasty of a subtotal stenosis (Group 2).**

Results. **Restenosis occurred in 36 patients with occluded arteries (29%) versus 264 with nonoccluded arteries (23%, p = 0.177) by definition 1 and in 62 patients with occluded arteries (49%) versus 478 with nonoccluded arteries (42%, p = 0.119) by definition 2. Occlusion was present in 24 Group 1 patients (19%) compared with 74 Group 2 patients (7%) (p < 0.001). During the 6 month follow-up period, two Group 1 patients (1.4%) and six Group 2 patients (0.5%) died; no Group 1 patients and 10 Group 2 patients (0.8%) developed severe congestive heart failure; nonfatal myocardial infarction occurred in 4 Group 1 patients (2.9%) and 31 Group 2 patients (2.4%); repeat coronary angioplasty or bypass surgery was performed in 29 Group 1 patients (21%) and 232 Group 2 patients (18%); and angina was present in 18 Group 1 and 163 Group 2 patients (13% for both). Eighty-six Group 1 patients (62%) and 853 Group 2 patients (66%) remained free of these adverse events during the 6-month follow-up period (p = 0.513).**

Conclusions. **The frequency of restenosis was slightly but not significantly greater after successful angioplasty of an occluded artery than after angioplasty of a subtotal stenosis. Although reocclusion was more frequent, occurring in 19% of patients, the net clinical benefit of angioplasty in such patients was similar to that in patients with subtotal stenoses over the 6-month follow-up period.**

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Percutaneous transluminal coronary angioplasty of chronically occluded arteries is associated with a lower initial success rate than angioplasty of arteries that are stenotic but not occluded (1–9). In addition, when angioplasty is successful, the frequency of restenosis and reocclusion has been reported to be considerably higher than that after angioplasty of subtotal stenoses (2,10,11). In view of these reports, it has been suggested that angioplasty of chronically occluded arteries not be performed (12), despite evidence that such patients have a significant reduction in angina and need for coronary artery bypass surgery in the years after the procedure (1,11).

However, the true restenosis and reocclusion rates after angioplasty of an occluded artery is unknown because of the small numbers of patients in previous studies and incomplete angiographic follow-up (2,10,11). One recent large study (13) with a high rate of angiographic follow-up reported a reocclu-

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sion rate of 19% for patients undergoing angioplasty of a coronary occlusion; however, whether restenosis and reocclusion lead to adverse cardiovascular events in such patients remains unclear.

The Multicenter American Research Trial With Cilazapril After Angioplasty to Prevent Restenosis (MARCATOR) (14) was a prospective, randomized trial in which 1,436 patients were enrolled after successful coronary angioplasty to determine whether treatment with the angiotensin-converting enzyme inhibitor cilazapril reduced the frequency of restenosis on follow-up coronary angiography 6 months after angioplasty. The results of the study revealed that therapy with cilazapril did not prevent restenosis and did not favorably influence the overall clinical outcome after coronary angioplasty. In the trial, 139 patients underwent successful coronary angioplasty of an occluded coronary artery, and 1,295 underwent angioplasty of a subtotal coronary stenosis.

We performed a data bank study of the MARCATOR trial to determine the frequency of restenosis, reocclusion and adverse cardiovascular events at 6-month follow-up angiography in patients with successful coronary angioplasty of a coronary occlusion versus those with successful angioplasty of a subtotal stenosis.

Methods

Study patients. The MARCATOR study was a prospective, randomized trial in which 1,436 patients at 41 participating centers were enrolled after successful coronary angioplasty and randomly assigned to one of three dosages of the angiotensin-converting enzyme inhibitor cilazapril (1, 5 or 10 mg orally twice a day) or matching placebo. The inclusion criteria for MARCATOR were age 25 to 80 years, no myocardial infarction within the preceding 5 days and no severe valvular disease, severe hypertension, previous revascularization procedure or recent treatment with an angiotensin-converting enzyme inhibitor. The primary aim of the study was to determine whether treatment with cilazapril reduced the frequency of restenosis on routine follow-up coronary angiogram 6 months after the initial angioplasty procedure. In the study, 139 patients underwent coronary angioplasty of an occluded coronary artery, and 1,295 underwent angioplasty of a subtotal stenosis. Two patients with missing data were excluded from analysis. Because the results of MARCATOR revealed no difference in frequency of restenosis between the patients assigned to cilazapril and placebo, all patients were included for analysis in the current study, regardless of which treatment arm they were assigned to.

Medical therapy. In addition to the assigned study medication, all patients received 325 mg of aspirin before the angioplasty procedure and daily throughout the 6-month follow-up period. A calcium channel blocking agent was given before and for at least 24 h after the angioplasty procedure. All other medical therapy was at the discretion of the treating physician.

Definitions. *Occlusion* = complete absence of anterograde flow beyond a coronary stenosis; *single-vessel disease* = ≥50% narrowing of a major coronary artery or one of its major branches; *multivessel disease* = presence of a second lesion ≥50% diameter stenosis in a major coronary or in one of its major branches; *successful angioplasty* = residual diameter stenosis <50% by visual assessment of the immediate postangioplasty angiogram at the clinical site.

Immediate outcome. Angioplasty success was determined immediately after completion of the angioplasty procedure at the clinical site at which it was performed. The adverse event committee of MARCATOR considered periprocedural myocardial infarction after the initially successful angioplasty procedure to have occurred in patients with prolonged chest pain suggestive of myocardial ischemia, electrocardiograms (ECGs) revealing ischemic changes and elevation of creatine phosphokinase levels to greater than two times the upper limit of normal. Myocardial infarction was considered to have occurred whether or not Q waves developed on ECG. Patients in whom angiographic success was achieved were still eligible for inclusion in the trial, even if a periprocedural myocardial infarction was believed to have occurred.

Quantitative angiography. Coronary angiograms were obtained before, immediately after and 6 months after angioplasty. A standardized method of data acquisition was used to ensure accurate reproducibility of the angiograms, as previously described (15,16). All cineangiograms were analyzed using the Cardiovascular Angiographic Analysis System (CAAS), as previously described in the MERCATOR trial (17). The absolute values for minimal lumen diameter, as well as reference diameter, were measured by computer using the catheter diameter without contrast medium as a scaling device. Coronary occlusions were assigned a value of 0 mm for minimal lumen diameter and 100% for percent diameter stenosis. In these cases, the postangioplasty reference diameter was used as the reference diameter at follow-up. If repeat angioplasty was required for clinical indications before the routine 6-month follow-up angiogram, measurements of the dilated arterial segment were obtained from the angiogram immediately before the second angioplasty procedure regardless of when in the follow-up period it was performed. Patients who did not undergo follow-up angiography were excluded from this analysis; imputation of angiographic data was not performed. For patients with more than one dilated vessel, only the most severe stenosis was analyzed.

Definition of restenosis. In MARCATOR and the present analysis, restenosis was prospectively defined in two ways: 1) loss in minimal lumen diameter ≥0.72 mm between postangioplasty and follow-up angiography; and 2) diameter stenosis >50% at follow-up angiography. In MARCATOR, treatment effects of cilazapril were tested by the chi-square test, and no difference in frequency of restenosis between patients assigned to cilazapril and those assigned to placebo was found using either definition of restenosis ($p = 0.83$ for definition 1; $p = 0.41$ for definition 2).

Follow-up. All patients underwent outpatient evaluation 1, 4, 12, 16 and 24 weeks after angioplasty; no patient was lost to follow-up. Follow-up angiography was performed 6 months after angioplasty. Adverse events included as end points in this analysis were 1) death, 2) New York Heart Association class III or IV congestive heart failure, 3) nonfatal myocardial infarction, 4) repeat coronary angioplasty or coronary artery bypass surgery, and 5) recurrent angina (Canadian Cardiovascular Society class II or higher) requiring initiation or an increase in medical therapy compared with that at 1 week after coronary angioplasty. Patients with more than one adverse event were assigned the highest ranked event that occurred, according to the previous list of end points. Myocardial infarction was considered to have occurred in patients with chest pain thought to represent myocardial ischemia, ECG changes and elevation of serum creatine phosphokinase to levels greater than or equal to two times normal. All myocardial infarctions were adjudicated by an adverse outcome committee.

An analysis was performed to determine whether there had been clinical benefit from the angioplasty procedure. At the 24-week visit before repeat coronary angiography, patients who were free of the aforementioned adverse events were said to have derived clinical benefit from angioplasty.

Statistical methods. The present analysis is based on one lesion per patient. For patients undergoing dilation of more than one lesion, the "worst" lesion was used. The worst lesion was considered to be a total occlusion, if one was present, or the lesion with the largest change in stenosis from postangioplasty to follow-up angiography.

Continuous variables are presented as medians (25th, 75th percentiles). Discrete variables are expressed as frequencies (percentages).

Differences in continuous variables between Groups 1 and 2 were tested using the Wilcoxon rank-sum test. Differences in discrete variables were tested by the chi-square test. Results were interpreted as statistically significant at $p < 0.05$.

Results

Baseline characteristics. Analysis of the baseline clinical characteristics of the study revealed that their median age was 59 years; 80% were male (Table 1). Patients who underwent angioplasty of a coronary occlusion were more likely to have a history of myocardial infarction (55% vs. 45% for patients with nonoccluded arteries, $p = 0.018$). Myocardial infarction occurred a median of 71 days before the angioplasty procedure in patients with an occlusion. Single-vessel disease was present in 58% of all patients. The median duration of angina was 120 days.

Angiographic and procedural characteristics. The proportion of patients who underwent angioplasty of the left anterior descending, circumflex and right coronary arteries was similar in both groups (Table 2). Patients who underwent angioplasty of a coronary occlusion tended to have undergone angioplasty of a second coronary lesion more frequently than patients undergoing angioplasty of a subtotal stenosis (39% vs. 24%, $p < 0.001$). More balloon inflations were performed, and total inflation time and duration of the procedure were longer in patients with coronary occlusions as well.

Table 1. Baseline Clinical Characteristics of Study Patients

	Occlusion (n = 139)	Subtotal Stenosis (n = 1,295)
Age (yr)	54 (47, 62)	59 (51, 66)
Male	122 (88%)	1,029 (79%)
Prior MI	77 (55%)*	581 (45%)
Days since prior MI	71 (24, 222)	58 (11, 1002)
Prior MI within 2 wk	15 (11%)	176 (14%)
Prior MI >2 wk earlier	59 (43%)	396 (31%)
Single-vessel disease	85 (61%)	753 (58%)
Multivessel disease	54 (39%)	542 (42%)
CCS angina class		
I	10 (8%)	95 (8%)
II	45 (35%)	374 (31%)
III	38 (29%)	332 (27%)
IV	36 (28%)	409 (34%)
Angina at rest	52 (37%)	600 (47%)
Duration of angina (d)	104 (37, 377)	121 (22, 971)
History of diabetes	18 (13%)	181 (14%)
Current smoker	22 (20%)	272 (27%)

*$p = 0.018$. Data presented are medians (25th, 75th percentiles) or number (percent) of patients. CCS = Canadian Cardiovascular Society; d = days; MI = myocardial infarction.

After angioplasty, patients with a coronary occlusion had had a significantly smaller reference vessel diameter (2.5 vs. 2.7 mm, $p < 0.0001$), smaller minimal lumen diameter (1.5 vs. 1.7 mm, $p = 0.0001$) and greater residual diameter stenosis (37% vs. 34%, $p = 0.0004$) than patients with subtotal stenosis. However, although these differences were statistically significant, the absolute differences were very small.

The cumulative distribution curve of the reference vessel size immediately after coronary angioplasty is presented in Figure 1. Fifty percent of the occluded vessels had a reference vessel size ≤2.45 mm. Figure 2 shows the cumulative distribution of the minimal lumen diameter immediately after coronary angioplasty. Figure 3 shows the cumulative distribution of the lumen diameter stenosis immediately after coronary angioplasty.

In-hospital complications. After successful angioplasty, adverse events during the remainder of the hospital period were infrequent in both groups. There were no deaths. Myocardial infarction occurred in 2 patients in Group 1 (1.4%) and 20 in Group 2 (1.5%). Repeat coronary angioplasty was performed in 4 Group 1 (2.9%) and 25 Group 2 patients (1.9%); bypass surgery was not performed in any Group 1 versus 4 Group 2 patients (0.3%). Angiographic evidence of thrombus was present in 13 Group 1 (9%) versus 49 Group 2 patients (3.8%, $p = 0.002$); coronary embolization was diagnosed in 0% of Group 1 versus 0.2% of Group 2 patients.

Results of follow-up angiography. A similar proportion of patients in both groups underwent follow-up angiography, and

Table 2. Baseline Angiographic and Procedural Characteristics of Study Patients

	Occlusion (n = 139)	Subtotal Stenosis (n = 1,295)
Artery dilated		
LAD	44 (32%)	517 (40%)
RCA	52 (37%)	458 (35%)
Cx	43 (31%)	320 (25%)
No. of lesions dilated		
1	86 (62%)*	981 (76%)
2	41 (30%)	247 (19%)
≥3	12 (9%)	67 (5%)
Balloon/artery ratio	NA	1.1 (1.0, 1.2)
No. of inflations	5 (3, 7)	3 (2, 5)
Total inflation time (s)	375 (250, 690)	295 (194, 450)
Reference diameter (mm)		
Pre-PTCA	NA	2.6 (2.3, 3.0)
Post-PTCA	2.5 (2.1, 2.8)†	2.7 (2.3, 3.1)
Stenosis		
Pre-PTCA	100 (100, 100)	60 (53, 66)
Post-PTCA	37 (31, 44)‡	34 (29, 40)
MLD (mm)		
Pre-PTCA	0 (0, 0)	1.0 (0.9, 1.2)
Post-PTCA	1.5 (1.3, 1.8)†	1.7 (1.5, 2.0)

*p = 0.001. †p = 0.0001. ‡p = 0.0004. Data presented are medians (25th, 75th percentiles) or number (%) of patients. LAD = left anterior descending coronary artery; Cx = circumflex coronary artery; MLD = minimal lumen diameter; NA = not applicable; PTCA = percutaneous transluminal coronary angioplasty; RCA = right coronary artery.

the duration of time to follow-up angiography was also similar between the two groups (Table 3). The median lumen diameter stenosis in Group 1 patients was more severe (50% vs. 47%, p = 0.0068), and minimal lumen diameter was narrower in Group 1 patients as well (1.2 vs. 1.4 mm, p = 0.0027). Restenosis tended to occur more frequently in Group 1 than Group 2 patients. Restenosis occurred in 29% of Group 1 patients versus 23% of Group 2 patients when defined as a loss in minimal lumen diameter ≥0.72 mm between postangioplasty and follow-up angiography (p = 0.177) and in 49% of

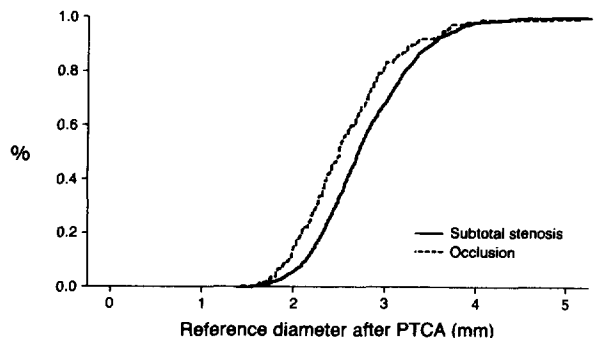


Figure 1. Cumulative distribution curve of reference vessel size immediately after percutaneous transluminal coronary angioplasty (PTCA). Fifty percent of occluded vessels had a reference vessel size ≤2.45 mm.

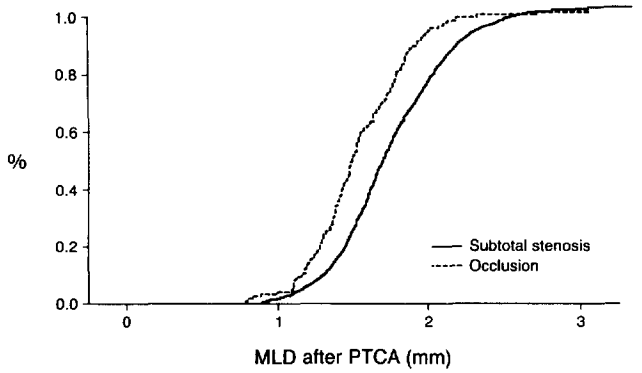


Figure 2. Cumulative distribution of minimal lumen diameter (MLD) immediately after coronary angioplasty (PTCA).

Group 1 patients versus 42% of group 2 patients (p = 0.119) when defined as a lesion >50% on follow-up angiography. Occlusion was more likely to be present in Group 1 patients (19% vs. 7% in Group 2 patients, p = 0.001).

Figure 4 reveals the cumulative distribution of minimal lumen diameter at 6-month follow-up angiography. The cumulative distribution curve of lumen diameter stenosis at 6-month follow-up angiography is presented in Figure 5; 19% of Group 1 patients had recurrent occlusion at follow-up angiography. Figure 6 reveals the cumulative distribution curve of the change in lumen diameter stenosis between the immediate postangioplasty and the 6-month follow-up angiogram. Approximately 20% of patients had either no loss or an increase in lumen diameter between the two angiograms.

Adverse events during follow-up. There was no difference in the frequency of adverse cardiovascular events between the two groups of patients 6 months after the angioplasty procedure (Table 4). Two Group 1 (1.4%) and 6 Group 2 patients (0.5%) died during the follow-up period. A similar proportion of patients in Groups 1 and 2 developed functional class III or IV congestive heart failure (0% vs. 1%), had a myocardial infarction (3% vs. 2%), required repeat coronary angioplasty or bypass surgery (21% vs. 18%) or developed Canadian Cardiovascular Society class II angina or higher (13% vs. 13%)

Figure 3. Cumulative distribution of lumen diameter stenosis immediately after coronary angioplasty (PTCA).

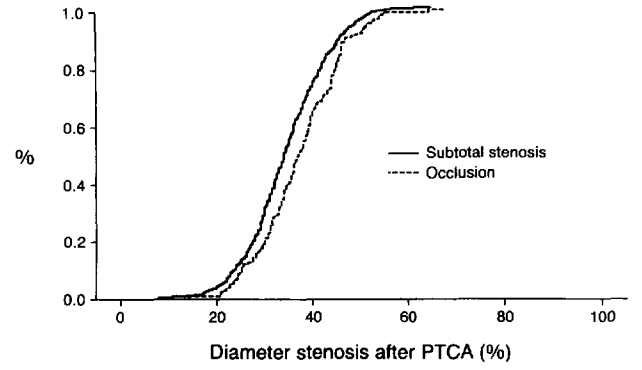


Table 3. Frequency, Timing and Results of Follow-Up Angiography

	Occlusion (n = 139)	Subtotal Stenosis (n = 1,295)	p Value
Pts with follow-up angiography	126 (91%)	1,138 (88%)	
Days to follow-up angiography	170 (147, 176)	169 (147, 182)	
Reference vessel diameter (mm)	2.6 (2.3, 2.9)	2.7 (2.3, 3.1)	
Mean stenosis (%)	50 (39, 67)	47 (37, 59)	0.0068
Post–follow-up stenosis loss	12 (1, 33)	13 (2, 24)	0.304
MLD	1.2 (0.9, 1.6)	1.4 (1.0, 1.7)	0.0027
Post–follow-up MLD loss	0.31 (−0.04, 0.89)	0.34 (0.07, 0.70)	0.561
Restenosis			
≥0.72-mm loss in MLD	36 (29%)	264 (23%)	0.177
>50% stenosis	62 (49%)	478 (42%)	0.119
Occlusion present (%)	24 (19%)	74 (7%)	0.001

Data presented are medians (25th, 75th percentiles) or number (%) of patients (Pts). MLD = minimal luminal diameter.

during the follow-up period. Sixty-two percent of Group 1 patients and 66% of Group 2 patients were free of all adverse cardiovascular end points (p = 0.513). Patients with more than one adverse event were assigned the highest ranked event, according to the previously listed study end points.

Discussion

The results of the present study reveal that the frequency of angiographic restenosis at 6 months tends to be greater in patients with successful coronary angioplasty of a total occlusion than in those with successful angioplasty of subtotal stenoses and that the frequency of occlusion is significantly greater (19% vs. 7%, p = 0.001). However, despite the greater reocclusion rate, adverse cardiovascular events are no more frequent in such patients, and the proportion of patients that derive clinical benefit from a successful angioplasty procedure is similar in both groups of patients.

Risks and benefits of dilation of occluded arteries. Angioplasty of chronically occluded arteries is associated with a lower initial success rate than angioplasty of subtotal occlusions (1–9). In patients with successful angioplasty, restenosis rates are high, averaging 46% in several previously reported series, with reocclusion in 17% of patients (1,2,4,7). In view of the lower primary success rate, the higher restenosis rate and the increased time, expense and radiation exposure to both patients and physicians associated with angioplasty of occluded coronary arteries (18), some have questioned whether angioplasty of occluded coronary arteries should be performed (12). Conversely, several results of angioplasty of occluded coronary arteries must be emphasized.

1. The complication rate is lower than that for angioplasty of subtotal occlusions (1–9). The average mortality rate associated with attempted angioplasty of occluded arteries is <1% (1–9), and the frequency of emergency bypass surgery is also low, averaging 2% (1,3,5–9). In many cases, the mortality rate and frequency of emergency bypass surgery resulting from angioplasty of occluded arteries is actually the result of complications of angioplasty of subtotally occluded arteries performed during the same procedure (1).

2. The previously reported high restenosis rates after angioplasty of occluded coronary arteries may be inaccurate because follow-up angiography rates were low in these studies, ranging between 27% and 71% (1,2,4,5,8,10). This biases those

Figure 4. Cumulative distribution curve of minimal lumen diameter (MLD) on 6-month follow-up angiography.

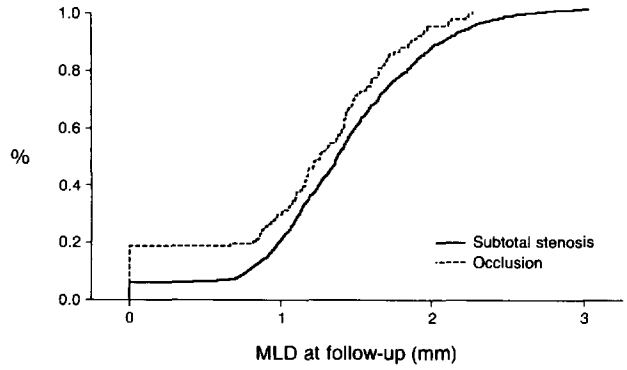
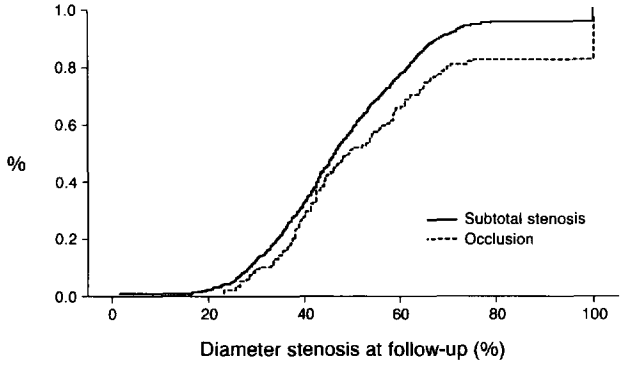


Figure 5. Cumulative distribution curve of lumen diameter stenosis on 6-month follow-up angiography; 19% of Group 1 patients had recurrent occlusion on follow-up angiography.



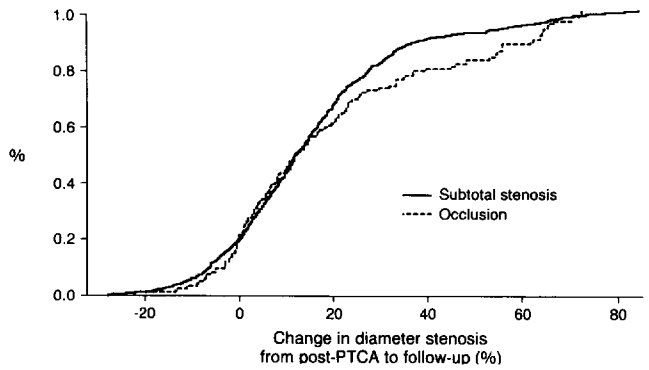


Figure 6. Cumulative distribution curve of change in diameter stenosis between immediate postangioplasty and 6-month follow-up angiography. Approximately 20% of patients had either no loss or an increase in lumen diameter between the two angiograms. PTCA = percutaneous transluminal coronary angioplasty.

Table 4. Adverse Cardiovascular Events (in order of rank) During Follow-Up Period*

	Occlusion (n = 139) [no. (%) of pts]	Subtotal Stenosis (n = 1,295) [no. (%) of pts]
Death	2 (1.4)	6 (0.5)
Congestive heart failure	0 (0)	10 (0.8)
Myocardial infarction	4 (2.9)	31 (2.4)
PTCA/CABG	29 (21)	232 (18)
Recurrent angina	18 (13)	163 (13)
Event free	86 (62)	853 (66)

*Patients (pts) with more than one adverse event were assigned the highest ranked event that occurred. p = 0.513 for entire six-level composite end point. CABG = coronary artery bypass graft surgery; PTCA = percutaneous transluminal coronary angioplasty.

studies toward higher restenosis rates than actually exist because patients with recurrent symptoms are more likely to undergo follow-up angiography, and most will have restenosis. Most asymptomatic patients who do not undergo coronary angiography do not have restenosis or reocclusion. In the current trial, most patients (91%) underwent follow-up angiography, and quantitative angiographic analysis was performed. Restenosis occurred only slightly more frequently in patients with coronary occlusion than in those with subtotal stenoses, and the difference did not reach statistical significance. Reocclusion occurred in 19% of such patients; occlusion occurred in only 7% of patients who had subtotal stenoses initially. Nonetheless, the most important finding of the current study is that despite the higher reocclusion rate in patients undergoing angioplasty of a chronic coronary occlusion, the frequency of adverse cardiovascular events was no greater than that in patients with subtotal stenoses, and a similar proportion of patients in both groups were found to have derived clinical benefit from the angioplasty procedure.

Intracoronary stents. Recent studies have indicated that reocclusion and restenosis of chronic coronary occlusions may be reduced by the use of intracoronary stents. Preliminary data from two recent retrospective studies (19,20) reveal that in 69 patients with chronic coronary occlusions and stent placement, the 6-month reocclusion rate was 5%, and restenosis occurred in 23% compared with a reocclusion rate of 28% and restenosis rate of 65% in 399 patients treated with balloon angioplasty alone. Prospective, randomized studies are needed to determine whether stents should be routinely used in this setting.

Clinical benefit despite restenosis. It should be emphasized that in patients with successful dilation of an occluded coronary artery, substantial clinical benefit may result and persist, even if restenosis develops. Restenotic lesions that reduce the lumen diameter between 50% and 90% do not generally reduce coronary blood flow until heart rate and blood pressure significantly increase, as occurs with exercise. Indeed, the analysis of clinical benefit in the present trial indicates that 62% of patients had sustained clinical benefit 6 months after the angioplasty procedure, although restenosis developed in many of them, regardless of which definition of restenosis is used.

Duration of occlusion. In the present trial, data were not collected on the estimated duration of coronary artery occlusion. Most patients who underwent angioplasty of a coronary occlusion had a history of myocardial infarction (55%) and single-vessel disease (61%). Prior infarction in these patients had occurred a median of 59 days before the angioplasty procedure; patients with a myocardial infarction in the preceding 5 days were not eligible for inclusion in the trial. Therefore, the duration of the coronary occlusion is likely to be long term in most Group 1 patients; accordingly, the results of the present study data should not be applied to patients with less chronic coronary occlusions whose outcome may differ from patients in the present study.

Limitations of the study. Because data were not collected on the duration of coronary occlusion in the trial, analysis of a possible relation between the duration of occlusion and the frequency of restenosis could not be performed. The 139 patients with a total occlusion are too small a group to conclusively evaluate factors that influence the risk of restenosis after coronary angioplasty of coronary occlusions.

Conclusions. After successful angioplasty of a chronically occluded artery, restenosis within 6 months occurred in 29% or 49% of patients, depending on the definition of restenosis used, and reocclusion occurred in 19%. However, the majority of such patients (62%) appear to have derived clinical benefit from the procedure, and the frequency of adverse cardiovascular events during the following 6 months was similar to that in patients with subtotal stenoses.

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