Rotational atherectomy in the distal left anterior descending coronary artery through an internal mammary artery graft

Gennaro Sardella, Leonardo De Luca, Angelo Di Roma and Francesco Fedele

We report the case of a 53-year-old white man who began complaining of dyspnoea and angina 19 months after coronary artery bypass graft surgery. Coronary angiography revealed the presence of a long and critical stenosis in the native left anterior descending coronary artery, shortly after distal anastomosis of the left internal mammary artery. After failed predilatations with standard or cutting balloons, we successfully used the rotablator system, which allowed us to implant a bare-metal stent in the native left anterior descending coronary artery. However, stent deployment caused long linear graft dissection, which was reduced by drug-eluting stent implantation in the proximal and distal segments of the left internal mammary artery. *J Cardiovasc Med* **7:368–372 © 2006 Italian Federation of Cardiology.**

Journal of Cardiovascular Medicine 2006, **7**:368–372

Keywords: dissection, coronary artery bypass grafting, internal mammary artery, rotational atherectomy

Department of Cardiovascular and Respiratory Sciences, ''La Sapienza'' University, Rome, Italy

Correspondence and request for reprints to Dr Gennaro Sardella, Dipartimento di Scienze Cardiovascolari e Respiratorie, Università degli Studi ''La Sapienza'', Policlinico Umberto I, Viale del Policlinico 155, 00161 Roma, Italy
e-mail: rino.sardella@uniroma1.it

Received 16 May 2005 **Revised** 12 September 2005
Accepted 14 September 2005

Introduction

The use of coronary rotational atherectomy (CRA) in addition to standard percutaneous coronary intervention (PCI) remains a useful tool for the treatment of selected complex coronary lesions [1]. Over the past years, CRA has mainly been used to improve procedural outcomes and to expand the indications for PCI in uncrossable and long lesions. In fact, in cases of heavily calcified de-novo coronary lesions, stent implantation is sometimes challenging even after preballoon dilatation and it may become easier with pretreatment using rotational atherectomy by improving stent expansion and apposition [2].

Lesions at distal coronary artery bypass graft anastomoses have been notoriously difficult to reach and treat with standard angioplasty techniques. Previous reports described a successful use of CRA in the saphenous vein graft [3] or left internal mammary artery (LIMA) [4], but never in native coronary artery segments crossing coronary artery bypass grafts.

We describe the use of rotational atherectomy in a LIMA graft to the native left anterior descending coronary artery (LAD).

Case report

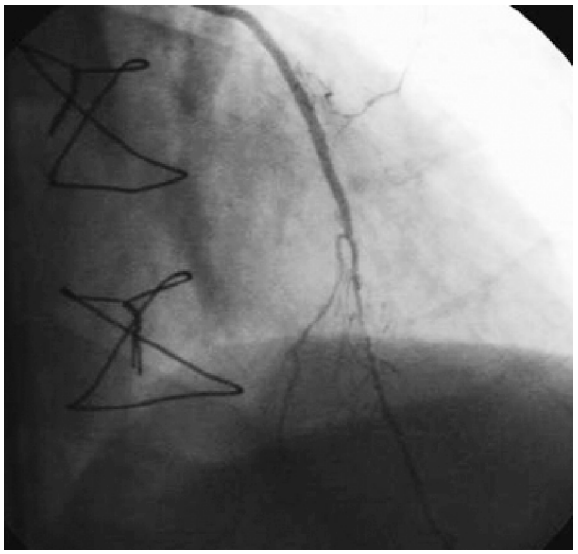
A 53-year-old white male with systemic hypertension, mild dyslipidaemia and a history of non-Q-wave myocardial infarction began complaining of new-onset dyspnoea and angina 19 months after coronary artery bypass graft surgery (LIMA to LAD, saphenous vein graft to the marginal branch). He was referred to our department for coronary angiography, which revealed the presence of a nonstenotic dominant right coronary artery, 50% stenosis of the proximal left main, total occlusion of the LAD proximal to the insertion of a patent LIMA, and a long critical stenosis in the native LAD shortly after distal anastomosis of the LIMA (Fig. 1). No lesions were observed in the saphenous vein graft.

We planned to perform a conventional PCI in the native LAD through the LIMA and a JR 4.0 8 Fr guide catheter was used to engage the LIMA ostium. A 0.014″ guidewire (BMW; Guidant, Indianapolis, Indiana, USA) was advanced into the LAD, but both a noncompliant balloon (2.5 × 13 mm, Power-Sail; Guidant) and a cutting balloon (2.5 × 10 mm, Ultra; Boston Scientific, Natick, Massachusetts, USA) were ineffective in achieving stenosis dilatation (Fig. 2). At the angiographic control, no dissection was observed. Therefore, we decided to switch to the rotablator system (Boston Scientific), the previous guidewire was removed and a 0.009″ extrasupport guidewire was placed in the distal LAD. A 1.5 mm burr was easily introduced through the LIMA and rotational ablation was repeated four times at 150 000 rpm (Fig. 3). Afterwards, dilatation of the stenosis was achieved using a 2.5 × 8 mm noncompliant balloon (Power-Sail; Guidant) and a very low-profile bare-metal stent 2.5 × 20 mm (Tsunami; Terumo, Tokyo, Japan) was implanted.

This paper has been partially presented on the web site www.tctmd.com

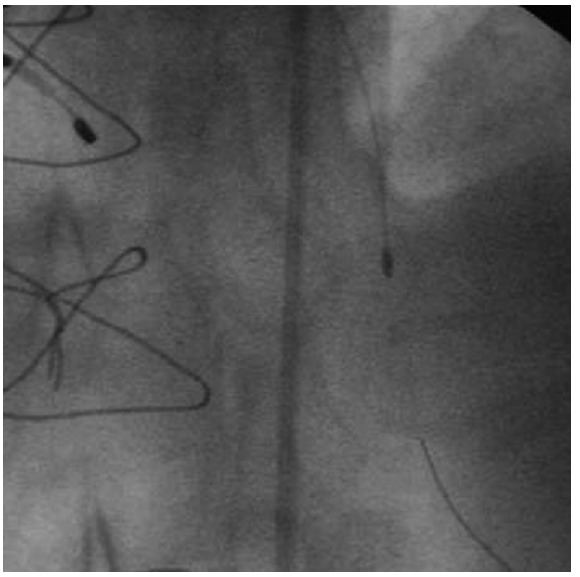
1558-2027

Fig. 1



Long critical stenosis in the native left anterior descending coronary artery shortly after distal anastomosis of the left internal mammary artery.

Fig. 3

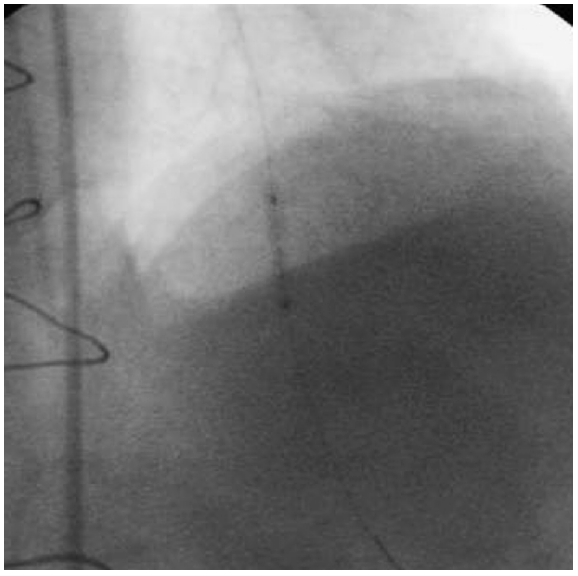


Passage of the 1.5 mm burr through the left internal mammary artery.

The angiographic examination showed no residual stenosis of the LAD lesion (Fig. 4), but a long linear dissection of the proximal (Fig. 5a) and distal (Fig. 5b) segments of the LIMA. Two Taxus stents (Boston Scientific, 3.0×28 and 3.0×32 mm, respectively) were implanted in the LIMA, covering the proximal and distal dissections with an optimal final result (Fig. 6) (Thrombolysis in Myocardial Infarction flow and myocardial blush grade 3).

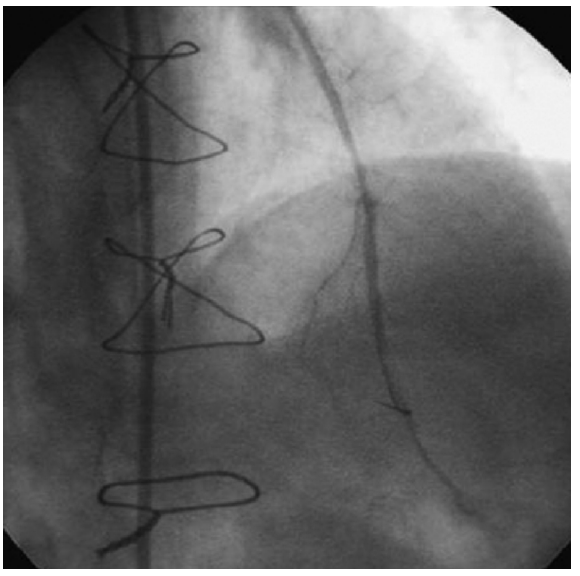
The patient was treated with aspirin 300 mg orally, β-blockers and heparin (8000 IU) intravenously before the procedure, with abciximab (0.25 mg/kg bolus and 0.125 μg/kg per min intravenously) immediately before

Fig. 2



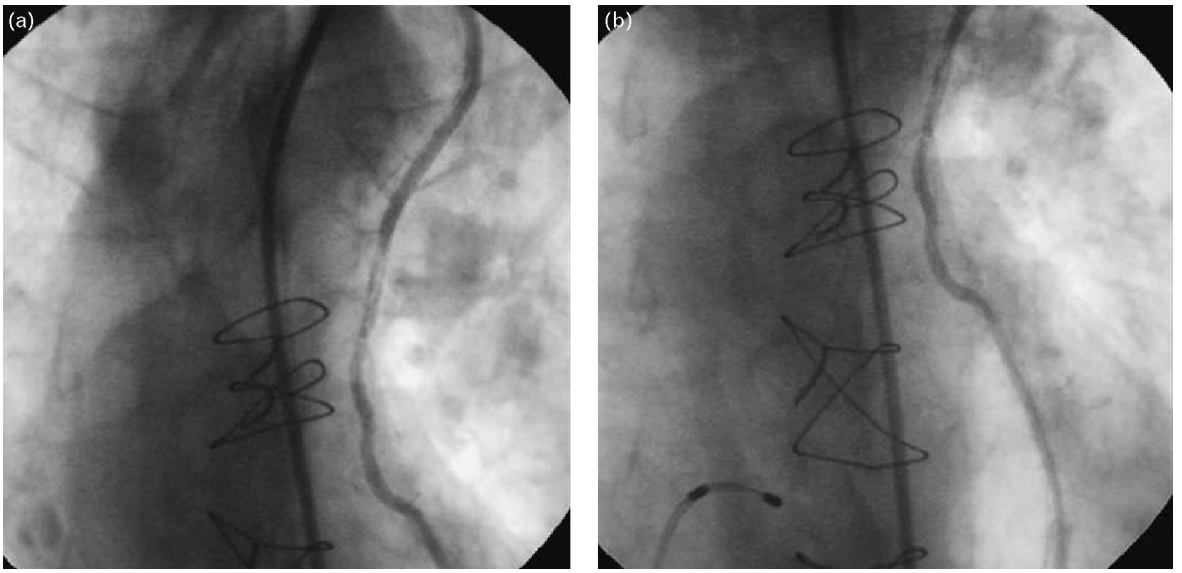
Failed predilation of the critical stenosis in the native left anterior descending coronary artery with conventional or cutting balloons.

Fig. 4



Postprocedural native left anterior descending coronary artery without residual stenosis.

Fig. 5



Long linear dissection in the proximal (panel a) and distal segments (panel b) of the left internal mammary artery.

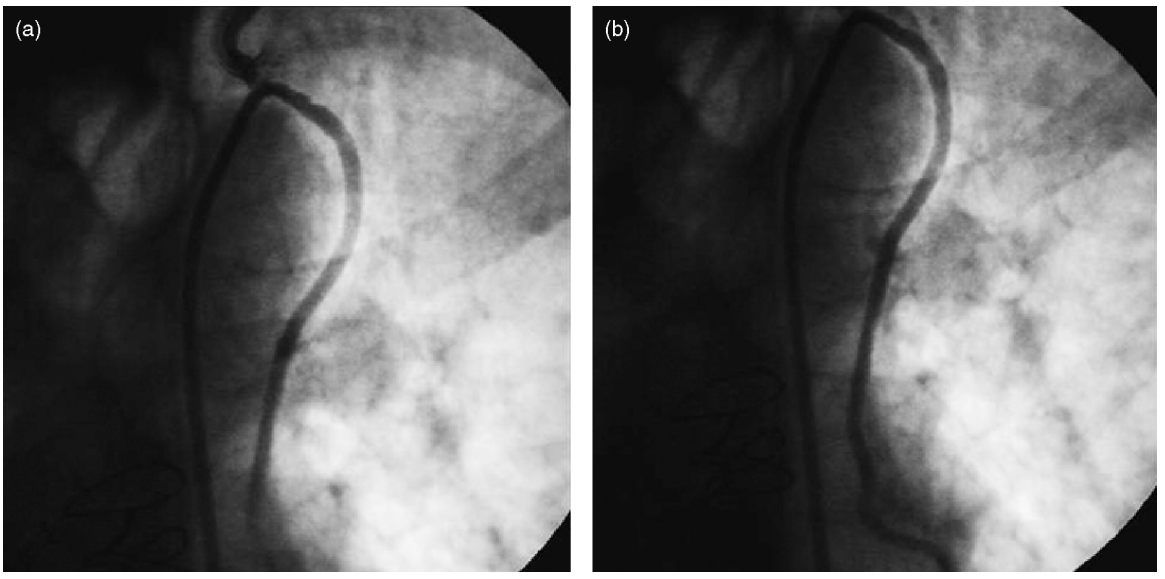
revascularization and for 12 h thereafter. Subsequently, he received heparin for 48 h, aspirin 100 mg daily, and clopidogrel (loading dose of 300 mg, followed by 75 mg daily for 9 months).

No periprocedural clinical complications occurred and only a mild elevation of cardiac troponin I levels (1.4 ng/ml) was observed during hospitalization. Nine months after the index intervention, the patient was in stable clinical conditions and the angiographic follow-up showed maintenance of the final result.

Discussion

Despite the increasing use of PCI and intracoronary stent placement for the treatment of obstructive coronary artery disease, a large subset of coronary lesions cannot be adequately treated with balloon angioplasty and/or intracoronary stenting alone. Such lesions are often

Fig. 6



Final angiographic result after Taxus stent implantation in the proximal (panel a) and distal (panel b) segments of the left internal mammary artery.

heavily calcified or fibrotic and undilatable with the present balloon technology and attempts to treat them with conventional PCI often lead to vessel dissection or incomplete stent deployment with resultant adverse outcomes.

Rotational atherectomy remains a useful device for debulking calcified or complex coronary stenoses [1,5], usually as an adjunct to subsequent balloon angioplasty or stenting. In contrast to balloon angioplasty or stent placement that widen the coronary lumen by displacing atherosclerotic plaque, high-speed rotational atherectomy removes plaque by ablating the atherosclerotic material, which is dispersed into the distal coronary circulation and washed away across the capillary bed. Experimental [6] and clinical [7–10] studies reported no significant impact on resting wall motion, coronary blood flow velocities, myocardial perfusion, or other clinical markers of myocardial ischaemia after uncomplicated rotablator atherectomy.

In the mid-1990s, this technique became widely used in several centres and then its use declined [11]. In fact, CRA is generally considered a complex technique that should be performed by skilled operators. In a prospective observational study, evaluating the indications, technique and results of consecutive patients treated with CRA in 12 Italian centres during 1 year, the centre CRA volume was not associated with in-hospital or 9-month outcomes [12]. Therefore, the authors concluded that CRA, even when used sporadically in selected complex lesions, could provide good immediate and mid-term results [12].

Traditionally, PCI has been the standard approach for treating coronary artery bypass graft lesions, technically approachable, with high procedural success and excellent short- and long-term results [13]. However, this technique suffers from certain shortcomings, namely its inadequacy in treating distal lesions in native coronary vessels and adverse lesion morphologies. Newer, second-generation intravascular techniques, such as rotational atherectomy, have been introduced with the aim of overcoming these problems [3,4].

The ideal burr-to-artery ratio of CRA for optimizing acute luminal results and minimizing coronary dissection and restenosis is unknown. The STRATAS study [14] demonstrated that an aggressive rotational atherectomy strategy offers no advantage over more routine burr sizing plus routine angioplasty. A previous study [15], which evaluated at 6 months if the procedural results or technique were related to the need for target vessel revascularization in 311 patients treated with CRA at different burr-to-artery ratios, determined that the need for revascularization was the lowest for a burr-to-artery ratio between 0.6 to 0.85 compared to a burr-to-artery ratio < 0.6 or > 0.85 ($P < 0.04$). Therefore, despite improvement in acute luminal results with an increased burr-to-artery ratio, the use of a moderate burr-to-artery ratio correlated with the lowest revascularization rates. All this suggests the use of CRA with an undersized burr-to-artery ratio, followed by adjunctive PCI procedures, in order to reduce vessel trauma and global risk and to achieve an effective debulking, without causing any no-reflow phenomenon [16]. Even in our case, showing a burr-to-artery ratio of 0.625, we noticed only a mild elevation of cardiac troponin I levels with an optimal myocardial blush grade after the procedure.

Importantly, the procedural outcome of CRA is highly correlated with stenosis morphology and location [17]. In different series reported in the literature [18–22], although types of treated lesions were different, the overall success rate ranged between 88 and 99% with a mortality rate of 0 to 3%. Also in our case, we obtained an optimal angiographic success without any major complications, with the exception of LIMA dissection that might have been caused by the passage of the burr from the catheter to the LIMA graft. Unfortunately, an intravascular ultrasound control, which could better reveal the post-procedural result, was not performed.

In conclusion, the rotablator system could be suitable for treating complex calcified lesions of a distal native LAD through the LIMA, provided that the burr size and the passage into the graft are carefully evaluated.

References

1 Cavusoglu E, Kini AS, Marmur JD, Sharma SK. Current status of rotational atherectomy. *Catheter Cardiovasc Interv* 2004; **62**:485–498.
2 Moussa I, Di Mario C, Moses J, Reimers B, Di Francesco L, Martini G, *et al.* Coronary stenting after rotational atherectomy in calcified and complex lesions. Angiographic and clinical follow-up results. *Circulation* 1997; **96**:128–136.
3 Cardenas JR, Strumpf RK, Heuser RR. Rotational atherectomy in restenotic lesions at the distal saphenous vein graft anastomosis. *Cathet Cardiovasc Diagn* 1995; **36**:53–57.
4 Thomas WJ, Cowley MJ, Vetrovec GW, Malloy W, Goudreau E. Effectiveness of rotational atherectomy in narrowed left internal mammary artery grafts to the left anterior descending coronary artery. *Am J Cardiol* 2000; **86**:86–88.
5 MacIsaac AI, Bass TA, Buchbinder M, Cowley MJ, Leon MB, Warth DC, Whitlow PL. High speed rotational atherectomy: outcome in calcified and noncalcified coronary artery lesions. *J Am Coll Cardiol* 1995; **26**:731–736.
6 Friedman HZ, Elliott MA, Gottlieb GJ, O'Neill WW. Mechanical rotary atherectomy: the effects of microparticle embolization on myocardial blood flow and function. *J Interv Cardiol* 1989; **2**:77–83.
7 Zotz RJ, Erbel R, Philipp A, Judt A, Wagner H, Lauterborn W, Meyer J. High-speed rotational angioplasty-induced echo contrast in vivo and in vitro optical analysis. *Cathet Cardiovasc Diagn* 1992; **26**:98–109.
8 Fourrier JL, Bertrand ME, Auth DC, Lablanche JM, Gommeaux A, Brunetaud JM. Percutaneous coronary rotational angioplasty in humans: preliminary report. *J Am Coll Cardiol* 1989; **14**:1278–1282.
9 Laarman GJ, Serruys PW. Percutaneous coronary rotational angioplasty: preliminary clinical and quantitative imaging results. *Int J Card Imaging* 1991; **7**:47–54.
10 Bowers TR, Stewart RE, O'Neill WW, Reddy VM, Safian RD. Effect of Rotablator atherectomy and adjunctive balloon angioplasty on coronary blood flow. *Circulation* 1997; **95**:1157–1164.
11 Ramsdale DR, Morris JL. If Rotablator is useful, why don't we use it? *Heart* 1997; **78 (Suppl 2)**:36–37.

12 Rubartelli P, Niccoli L, Alberti A, Giachero C, Ettori F, Missiroli B, *et al.* Coronary rotational atherectomy in current practice: acute and mid-term results in high- and low-volume centers. *Catheter Cardiovasc Interv* 2004; **61**:463–471.
13 Sharma AK, McGlynn S, Apple S, Pinnow E, Canos DA, Gevorkian N, *et al.* Clinical outcomes following stent implantation in internal mammary artery grafts. *Catheter Cardiovasc Interv* 2003; **59**:436–441.
14 Whitlow PL, Bass TA, Kipperman RM, Sharaf BL, Ho KK, Cutlip DE, *et al.* Results of the study to determine rotablator and transluminal angioplasty strategy (STRATAS). *Am J Cardiol* 2001; **87**:699–705.
15 Kaplan BM, Safian RD, Mojares JJ, Reddy VM, Gangadharan V, Schreiber TL, *et al.* Optimal burr and adjunctive balloon sizing reduces the need for target artery revascularization after coronary mechanical rotational atherectomy. *Am J Cardiol* 1996; **78**:1224–1229.
16 Sardella G, De Luca L, Adorisio R, Di Russo C, Fedele F. Effects of rotational atherectomy with a reduced burr-to-artery ratio on coronary no-reflow. *Minerva Cardioangiol* 2004; **52**:209–217.
17 Ellis SG, Popma JJ, Buchbinder M, Franco I, Leon MB, Kent KM, *et al.* Relation of clinical presentation, stenosis morphology, and operator technique to the procedural results of rotational atherectomy and rotational atherectomy-facilitated angioplasty. *Circulation* 1994; **89**:882–892.
18 Reifart N, Vandormael M, Krajcar M, Gohring S, Preusler W, Schwarz F, *et al.* Randomized comparison of angioplasty of complex coronary lesions at a single center. Excimer Laser, Rotational Atherectomy, and Balloon Angioplasty Comparison (ERBAC) Study. *Circulation* 1997; **96**:91–98.
19 Kiesz RS, Rozek MM, Ebersole DG, Mergo DM, Chang CW, Chilton RL. Novel approach to rotational atherectomy results in low restenosis rates in long, calcified lesions: long-term results of the San Antonio Rotablator Study (SARS). *Catheter Cardiovasc Interv* 1999; **48**:48–53.
20 Reisman M, Buchbinder M, Sharma S. A multicenter randomized trial of rotational atherectomy vs. PTCA: DART [abstract]. *Circulation* 1997; **96**:I–467.
21 Reisman M, Harms V, Whitlow P, Feldman T, Fortuna R, Buchbinder M. Comparison of early and recent results with rotational atherectomy. *J Am Coll Cardiol* 1997; **29**:353–357.
22 Bersin RM, Cedarholm JC, Kowalchuk GJ, Fitzgerald PJ. Long-term clinical follow-up of patients treated with the coronary rotablator: a single-center experience. *Catheter Cardiovasc Interv* 1999; **46**:399–405.