Angioplasty and Stenting of Distal Anastomotic Stenosis of Femoropopliteal Bypass Graft Using Helical Interwoven Nitinol Stents

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Abstract

Keywords

- ▶ femoropopliteal bypass grafts
- ▶ anastomotic stenosis
- ▶ nitinol helical interwoven Supera stents

Minimally invasive endovascular options of angioplasty and stenting can be used to treat distal anastomotic stenoses in lower limb bypass grafts, but stents near the knee joint may fracture. The nitinol helical interwoven structure of the Supera stents (IDEV Technologies Inc., Houston, TX) has improved flexibility and kink resistance. We report a patient who received salvage angioplasty and Supera stenting of the distal anastomosis of femoropopliteal bypass grafts with good mid-term results. Considering the high radial strength and fracture resistance, these Supera stents may be a good treatment option in salvaging failing bypass grafts.

Anastomotic restenoses after lower limb bypasses predispose to graft failure, and considerable uncertainty still exists about the optimal management of these threatened bypass grafts. Conventional open surgical revision includes inflow procedures, patch angioplasties, interposition vein grafts, and vein graft extensions.¹ However, with the advent and development of minimally invasive endovascular options, balloon angioplasty and stents can be used to treat anastomotic strictures of threatened lower limb bypass grafts.²

The Supera stent (IDEV Technologies Inc., Houston, TX) is a relatively new stent which consists of six pairs of closed end interwoven nitinol wires and is delivered via a coaxial catheter-based delivery handle. The helical structure has been shown to improve radial strength, flexibility, and kink resistance, and is designed to adapt to the arterial anatomy. It was formally launched in Leipzig, Germany, in 2010 with a full launch in Europe in summer of 2010, and the first case in Asia was performed at our institution in October 2011. We have to date performed more than 100 cases of lower limb revascularization using Supera stents, and our previous experience of 78 cases has been published.³

The aim of this study is to report our experience in using the Supera stents treating a patient with distal anastomotic strictures of femoropopliteal bypass grafts.

Case

A 34-year-old man presented with history of more than 1 year progressively worsening short distance left calf intermittent claudication, and he could manage less than 100 yards. Risk factors included heavy tobacco smoking. Arterial duplex and computed tomography (CT) angiogram showed significant stenosis at the distal left external iliac artery and long > 20 cm occlusion of the superficial femoral artery with collaterals reconstituting the above knee popliteal artery. He underwent a left distal external iliac artery and common femoral artery endarterectomy and bypass to above knee popliteal artery using a ringed 6 mm ePTFE bypass graft (GORE Vascular Graft, Dundee, Scotland). He recovered well and has no symptoms on walking postoperatively. However, on surveillance duplex 24 months later was found that both proximal and distal anastomoses were stenosed to 70%, confirmed by on-table angiogram (▶Fig. 1A). He underwent open proximal anastomotic patching with Hemashield Dacron patch (Maquet, Rastatt, Germany), and distal anastomotic angioplasty with a 7 mm × 40 mm balloon (Advance™ 18LP, COOK Medical, Bjæverskov, Denmark) followed by placement of a 7 mm × 40 mm Supera stent (IDEV Technologies Inc.) (▶Fig. 1B, C). The stenoses were corrected, and

Fig. 1 (A) On-table angiogram showing 70% stenosis in the distal anastomosis. (B) Postangioplasty and Supera stenting of the distal anastomosis. (C) Plain radiograph of the Supera stent at the distal anastomosis.

patient remained asymptomatic. Follow-up duplex and CT angiogram 5 months postoperatively did not show any restenosis and radiograph of the stent did not show any fractures (→Fig. 2A–C). Follow-up duplex at 9 months postoperatively did not show any graft or proximal and distal anastomotic restenosis (→Fig. 3A, B).

Discussion

Assisted patency with primary angioplasty and stent placement in distal anastomotic stenoses of lower limb bypass grafts is not a new concept, but this is the first article in the world literature on the use of Supera stents for this treatment, with good short- and mid-term results. What this article adds is that the flexibility and strength of the Supera stent could be used effectively in buttressing the distal anastomotic stenoses. This may be useful in addition to the

other endovascular techniques described in the published literature.

Cotroneo et al reported implantation of 24 stents in 21 clinically significant > 50% distal anastomotic stenoses in 22 infragenicular grafts with a mean stenosis length of 1.4 cm, and the cumulative primary, primary assisted, and secondary patency rates for the treated graft stenoses were, respectively, 95, 95, and 100% at 6 months and 71, 81, and 86% at 1 year.⁴ The authors concluded that stent placement was a feasible and effective tool in the endovascular treatment of distal anastomotic infragenicular bypass graft stenoses. Engelke et al used cutting balloon angioplasty in 16 anastomotic stenoses, and reported 2 local restenoses and 1 graft occlusion at 5 and 7 months, therefore, with a cumulative 6-month primary and secondary graft patency rates of 84 and 92%, respectively.⁵ Basile et al reported the use of cutting balloon angioplasty in 17 patients with

Fig. 2 (A) Postoperative CT angiogram follow-up showing patent anastomosis. (B) Magnified view of the Supera stent CT angiogram. CT, computed tomography.

Fig. 3 (A) Follow-up duplex at 9 months postoperatively did not show any graft or proximal and (B) distal anastomotic restenosis.

stenosis or occlusion at the proximal or distal anastomoses of peripheral bypass grafts, with no complications and a cumulative primary patency at 18 months of 82.35%, but two cases had restenoses necessitating further cutting balloon angioplasty treatments at 10 and 7 months, respectively.⁶ Stents placement at the femoropopliteal junction and proximal/mid-popliteal artery has been a concern for many vascular specialists because the biomechanical forces over the knee joint can predispose to stent fracture and restenosis.^{7–9} The femoropopliteal arterial segment, especially the part behind the knee joint, is known to be exposed to many mechanical influences crossing flexion points as well as interaction with the surrounding musculature, and the artery is constantly exposed to relevant external forces, including compression, torsion, and elongation during locomotion. According to the manufacturers' information, the Supera stent shows increased flexibility, duration, and radial force as a result of the helical interwoven design. According to this information, the radial force of the Supera stent at a diameter of 4 to 5 mm is 18 pounds (in comparison, radial force of Astron Pulsar is 3 pounds, common self-expanding nitinol stents 3–4 pounds, and common balloon-expandable stents up to 0.6 pounds).^{10,11}

Many authors have taken advantage of the flexibility of the Supera stent behind the knee. Goltz et al used it as a bail-out option in an occluded popliteal segment with a fractured stent in situ.¹² After thrombolysis, a catheter-based transluminal passage beside the fragmented stent was created, and a reentry distal to the fragmented stent was gained. With the guidewire in situ, the popliteal artery was dilated with increasing sizes of balloon catheters to crush the fragmented stent totally, and thereafter to reinsert a Supera stent. Vogel et al used the Supera nitinol stent in a claudicant, where recanalization attempt of a heavily calcified, occluded superficial femoral artery was complicated by a previously implanted, fractured standard stent. Using the subintimal space, a reentry device was used to allow distal wire entry into the true lumen at the level of the popliteal artery, and after crushing of the fractured stent with a series of increasingly sized standard balloons, a

Supera stent was deployed to secure patency of the femoropopliteal artery.¹³

This case showed that the Supera stent is flexible and conforms to the distal anastomosis of the femoropopliteal bypass grafts, and as such has been effective in managing distal anastomotic strictures.

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