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EDITORIAL COMMENT

# Focal Stenting Versus "Metal Jacket" for Long Subintimal Recanalization of the Femoropopliteal Artery*

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Long chronic total occlusions are a formidable challenge for endovascular recanalization. Patients with critical limb ischemia are at a greater risk of developing advanced disease along with chronic total occlusions requiring revascularization to avoid amputation (1). Over the years, different endovascular techniques have been used to cross long chronic total occlusions. Subintimal recanalization was serendipitously discovered and first reported by Bolia et al. (2) in 1989, when the atherosclerotic plaque, occluding the lumen, was crossed by circumventing the plaque via the subintimal space using a wire and catheter. This technique is also known as percutaneous intentional extraluminal recanalization (PIER) (3). Histological analysis of vessels that had undergone subintimal recanalization demonstrated that the dissection plane was between the internal elastic lamina and the occlusive plaque (4). The space is dilated with a balloon that communicates with the true lumen distal to the occlusion, thereby establishing flow. Despite establishing flow and high limb salvage rates, the nemesis has been the high rate of restenosis with subintimal recanalization. Primary patencies ranging from 45% to 70% at 1 year, with further decrements over time (5,6). The availability of nitinol stents, in conjunction with this new channel technique created by subintimal recanalization, has improved long-term patency.

The excitement of the first-generation nitinol stents quickly waned when data showed poor long-term patency, especially when multiple stents were used to treat long lesions or when stent fractures happened (7). Second-generation stents became available in longer lengths to reduce the use of multiple stents. Stent design has evolved to reduce the incidence of fractures but has not completely prevented them (8). These stents have demonstrated superiority in long-term patency when compared with balloon angioplasty in complex long lesions (9). The endovascular approach has to overcome 3 main challenges when confronting chronic total occlusions: 1) crossing the lesion; 2) establishing a lumen; and 3) long-term patency.

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In this issue of *JACC: Cardiovascular Interventions*, Hong et al. (10) have retrospectively evaluated patency, utilizing spot stenting versus long stenting, after an intentional subintimal approach for long chronic total occlusions of the femoropopliteal arteries. Of 163 patients with chronic total occlusions, 196 limbs were recanalized successfully. Of these, 129 limbs (66%) with spot stenting were compared with 67 limbs (34%) with long stenting. Restenosis of 29% in the spot-stenting group and 45% in the long-stenting group ($p = 0.001$) with a median follow-up of 1.7 years was noted. Multivariate analysis showed long stenting, nonuse of clopidogrel or of cilostazol, distal runoff vessels ≤1, small stent diameter, lower post-procedural ankle-brachial index, and stent coverage of the popliteal artery (especially when extending to the tibial plateau or below) increased the risk of restenosis. Because this was a retrospective study, the choice of long- versus spot-stent strategy was not randomized but was at the discretion of the operator, creating selection bias. In the long-stent group, the vessel diameter (5.8 ± 0.9 mm and 6.2 ± 1.0 mm, $p \leq 0.01$) and stent size (6.5 ± 0.5 mm and

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7.3 ± 0.7 mm, p ≤ 0.001) were smaller than in the spot-stent group.

Also, it is possible that the long-stenting strategy was opted for when the subintimal track was more diffusely diseased. Similar to Hong et al. (10), others have shown that patency is related to the length of the stent used (11,12). They report the subintimal recanalization was "intentional," but this was not confirmed with intravascular ultrasound. The complexity of these long lesions mixed with varying degrees of calcification and shrinkage of the chronically occluded vessel (13) may cause the crossing wire/catheter to travel back and forth from "true" lumen to subintima without the operator knowing. This has been shown to impact long-term patency (14). There have been no comparison studies assessing patency utilizing subintimal recanalization versus "true" lumen recanalization. Finally, only 39% of the limbs were evaluated for stent fracture, and in the ones evaluated, long stenting had 9 of 27 (33%) fractures as compared with spot stenting (11 of 49 [22%]). Will these data of long stenting versus spot stenting hold true for the newer generation of stents, which are longer and have been shown to be less prone to fractures? In conclusion, Hong and his team (10) should be congratulated for bringing forth an important practical challenge faced in clinical practice for the treatment of long lesions (25 ± 8 cm) and complex lesions (94% were in TransAtlantic Inter-Societal Consensus TASC II C/D). This is a population that is excluded from many trials. Prospective randomized studies are warranted for complex chronic total occlusions to compare subintimal recanalization to "true" lumen recanalization and to identify factors favoring long-term patency. Acute patency is being achieved with balloons, stents and atherectomy, but how these devices impact long-term results needs to be identified. Finally, the efficacy of drug-eluting balloons added to the use of these devices needs further study (15-18).

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## REFERENCES

**1.** Norgren L, Hiatt WR, Dormandy JA, Nehler MR, Harris KA, Fowkes FG. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). J Vasc Surg 2007;45 Suppl S:S5-67.

**2.** Bolia A, Brennan J, Bell PR. Recanalisation of femoro-popliteal occlusions: improving success rate by subintimal recanalisation. Clin Radiol 1989; 40:325.

**3.** Reekers JA, Kromhout JG, Jacobs MJ. Percutaneous intentional extraluminal recanalisation of the femoropopliteal artery. Eur J Vasc Surg 1994; 8:723-8.

**4.** Scholtes VPW, de Borst GJ, de Vries J-PPM, et al. Subintimal angioplasty track of the superficial femoral artery: a histological analysis. Circ Cardiovasc Interv 2012;5:e6-8.

**5.** Met R, Van Lienden KP, Koelemay MJ, Bipat S, Legemate DA, Reekers JA. Subintimal angioplasty for peripheral arterial occlusive disease: a systematic review. Cardiovasc Intervent Radiol 2008;31:687-97.

**6.** Bown MJ, Bolia A, Sutton AJ. Subintimal angioplasty: meta-analytical evidence of clinical utility. Eur J Vasc Endovasc Surg 2009;38:323-37.

**7.** Scheinert D, Scheinert S, Sax J, et al. Prevalence and clinical impact of stent fractures after femoropopliteal stenting. J Am Coll Cardiol 2005;45: 312-5.

**8.** Laird JR, Katzen BT, Scheinert D, et al. Nitinol stent implantation versus balloon angioplasty for lesions in the superficial femoral artery and proximal popliteal artery: twelve-month results from the RESILIENT randomized trial. Circ Cardiovasc Interv 2010;3:267-76.

**9.** Matsumura JS, Yamanouchi D, Goldstein JA, et al. The United States StuDy for EvalUating EndovasculaR TreAtments of Lesions in the Superficial Femoral Artery and Proximal Popliteal By usIng the Protege EverfLex NitInol STent SYstem II (DURABILITY II). J Vasc Surg 2013;58: 73-83.e1.

**10.** Hong S-J, Ko Y-G, Shin D-H, et al. Outcomes of spot stenting versus long stenting after intentional subintimal approach for long chronic total occlusions of the femoropopliteal artery. J Am Coll Cardiol Intv 2015;8:472-80.

**11.** Laird JR, Katzen BT, Scheinert D, et al. Nitinol stent implantation vs. balloon angioplasty for lesions in the superficial femoral and proximal popliteal arteries of patients with claudication: three-year follow-up from the RESILIENT randomized trial. J Endovasc Ther 2012;19:1-9.

**12.** Geraghty PJ, Mewissen MW, Jaff MR, Ansel GM. Three-year results of the VIBRANT trial of VIABAHN endoprosthesis versus bare nitinol stent implantation for complex superficial femoral artery occlusive disease. J Vasc Surg 2013;58: 386-95.e4.

**13.** Ohana M, El Ghannudi S, Girsowicz E, et al. Detailed cross-sectional study of 60 superficial femoral artery occlusions: morphological quantitative analysis can lead to a new classification. Cardiovasc Diagn Ther 2014;4:71-9.

**14.** Bosiers M, Deloose K, Callaert J, et al. In lower extremity PTAs intraluminal is better than subintimal. J Cardiovasc Surg (Torino) 2012; 53:223-7.

**15.** Yang X, Lu X, Li W, et al. Endovascular treatment for symptomatic stent failures in long-segment chronic total occlusion of femoropopliteal arteries. J Vasc Surg 2014;60:362-8.

**16.** Lichtenberg M, Kolks O, Hailer B, et al. PEACE I all-comers registry: patency evaluation after implantation of the 4-French Pulsar-18 self-expanding nitinol stent in femoropopliteal lesions. J Endovasc Ther 2014;21:373-80.

**17.** Scheinert D, Werner M, Scheinert S, et al. Treatment of complex atherosclerotic popliteal artery disease with a new self-expanding interwoven nitinol stent: 12-month results of the Leipzig SUPERA popliteal artery stent registry. J Am Coll Cardiol Intv 2013;6:65-71.

**18.** Simpson EL, Michaels JA, Thomas SM, Cantrell AJ. Systematic review and meta-analysis of additional technologies to enhance angioplasty for infrainguinal peripheral arterial occlusive disease. Brit J Surg 2013;100:1128-37.

**KEY WORDS** occlusion, stent, subintimal dissection