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The Emerging Role of Atherectomy in the Era of Drug-Elution

The potential impact of debulking prior to utilizing DCBs.

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Femoropopliteal (FP) arterial disease accounts for approximately 40% of all peripheral arterial interventions.[1] Several technologies have been used to treat the FP artery including plain old balloon angioplasty (POBA), nitinol self-expanding bare-metal stents, covered stents, atherectomy, drug-coated balloons (DCB), and drug-coated stents (DCS). Although a higher patency rate in the FP artery is achievable with bare-metal stents when compared to POBA, reduction in target lesion revascularization (TLR) has not been predictably demonstrated in these studies.[2-6] In addition, stents are associated with several challenges, including stent fractures[7,8] (though less likely with contemporary designs and interwoven self-expanding nitinol stents[9]), in-stent restenosis, and continued low patency rates on long-term follow-up, particularly in long lesions. More importantly, stent evaluation has generally been limited to 3 years of follow-up and therefore, the longer-term impact of these implants on the integrity of the stent, overall patency, and TLR have not been well defined. Furthermore, it is uncertain how stents interact with the delivery of antiproliferative drugs in restenotic lesions and whether this reduces the drug's effectiveness. Finally, the need for restenting a restenotic FP lesion remains in about 5% to 10%[10,11] of cases despite the use of debulking technology. The outcome of several layers of stents within a highly mobile FP artery subjected to multiple forces remains unknown.

Unquestionably, stents are easy to deploy in the FP arteries and require significantly less time and likely less radiation exposure to the operator and patient, which are highly desirable features to the endovascular specialist. In addition, economic factors play a significant role in stent use. The current reimbursement to hospitals and physicians is the same as atherectomy and more than POBA, and the cost associated with the use of stents is less to the hospitals, particularly when lesions are treatable with one stent (which can now be accomplished in most patients with stents available as long as 20 cm). Finally, acute procedural results with stenting are excellent and operators are generally instantly rewarded with stent-like results by simply stenting the vessel. With all these positive factors, stents have continued to

CASE STUDY: SEVERE CALCIFICATION IN THE CFA

A case of severe calcification (Figure 1) treated with the JETSTREAM™ Atherectomy System and adjunctive DCB with excellent angiographic results and no dissection. Pre- and post-intravascular ultrasound (IVUS) images (Figure 2) show a clear increase in minimal luminal area after use of the JETSTREAM™ Atherectomy System.

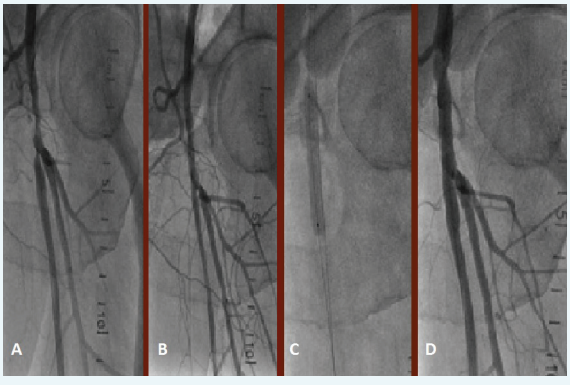
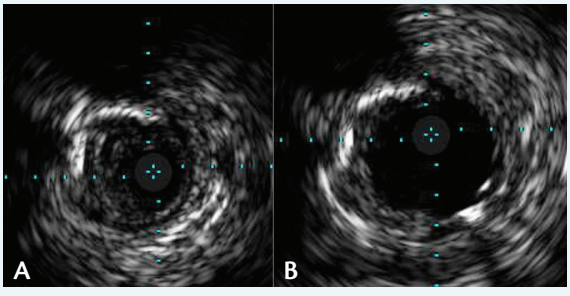


Figure 1. Common femoral artery with moderate calcification (A) treated with the JETSTREAM™ Atherectomy System (B) and adjunctive DCB (C) with excellent angiographic results (D) and no dissection.*



Boston Scientific images on file.

Figure 2. Pre (A) and post (B) atherectomy images from the Jetstream Calcium Study show a clear increase in minimal luminal area after treatment with the JETSTREAM™ Atherectomy System.*

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lead the US market in over 60% of FP de novo or non-stent restenotic cases.[12]

ATHERECTOMY AS A FIRST-LINE TREATMENT

In this article we describe our current approach in treating de novo FP arterial disease and the rationale of using atherectomy as a first-line treatment followed by DCB. The use of stenting in our laboratory has been mostly for bailout purposes and is generally used in < 10% to 15% of our cases. It is clear at this time that devices that carry and effectively deliver antiproliferative drugs to the FP arterial wall will likely become the standard to treat FP disease. In the Zilver PTX randomized trial, the Zilver PTX stent (Cook Medical) had a superior 12-month event-free survival rate (90.4% vs 82.6%; $P = .004$) and primary patency rate (83.1% vs 32.8%; $P < .001$) when compared with POBA.[13] In addition, data presented this spring from the MAJESTIC trial demonstrated 9-month primary patency results of 94.4% with the ELUVIA™ Drug-Eluting Vascular Stent System (Boston Scientific Corporation).[14]

DCBs have been consistent in showing that patency is markedly improved compared to POBA in treating FP arterial disease and most of these trials reduced TLR significantly.[15-19] The data, however, have mostly been limited to short and intermediate lesion lengths. Another recent analysis showed no real significant differences in the current Zilver PTX stent and available DCBs in reducing TLR.[20,21] Why do we really need atherectomy if one can get an effective treatment with a DCS or a DCB? In fact, why do we even need a DCS if the DCBs suffice, particularly with all the potential problems that may occur with stenting as described above? We'll spend the next portion of the article answering those very questions.

AN ATHERECTOMY + DCB ALGORITHM IN ONE MODERN-DAY ENDOVASCULAR PRACTICE

Adhering to a goal of achieving stent-like outcomes but with fewer stents left behind, our algorithm has been simple. Short lesions (< 10 cm) that are not calcified, not totally occluded, and not located in "no-stent" zones are approached with balloon angioplasty, at the lowest pressure possible to achieve full balloon expansion, followed by a DCB sized 1:1 to the vessel wall and inflated only to nominal pressure. Stenting these lesions is then generally done on a provisional basis and only if a flow-limiting dissection occurs (D and higher) or > 30% residual narrowing persists despite prolonged balloon inflation (≥ 3 minutes). The presence of a non–flow-limiting dissection is left alone after a DCB and is not treated with stenting. In general, these less complex lesions appear to respond well to prolonged balloon inflation and the need for stenting is minimal. However, these lesions are infrequent in our experience and the real challenge in treating the FP artery is in addressing complex disease such as long lesions, total occlusions, and calcified vessels. In lesions such as these, we employ a strategy of vessel prep with atherectomy first, prior to utilizing DCB.

> "…the real challenge in treating the FP artery is in addressing complex disease such as long lesions, total occlusions, and calcified vessels. In lesions such as these, we employ a strategy of vessel prep with atherectomy first, prior to utilizing DCB."

Complex FP lesions are at the highest risk for bailout stenting with balloon angioplasty. In fact, studies have demonstrated that the predictors of stenting of FP lesions are longer lesions, calcified disease, total occlusions, and TASC C/D lesions.[22] Irrespective of lesion morphology, however, the pretreatment of FP lesions with atherectomy remains an independent predictor of reducing the odds for bailout stenting.[22]

Small randomized trials have shown that atherectomy in general improves vessel compliance and reduces the need for bailout stenting in infrainguinal interventions.[23-25] Following atherectomy, a lower balloon inflation pressure is needed for full balloon expansion leading to less barotrauma and dissections and therefore less bailout stenting. Directional atherectomy of FP de novo lesions was shown to improve vessel compliance and reduce dissections and bailout stenting compared to PTA alone.[23] In the COMPLIANCE 360 trial,[24] differential sanding with orbital atherectomy of calcified FP lesions improved lesion compliance and resulted in reduction in bailout stenting. In addition, in a small study by Cioppa et al,[26] directional atherectomy in severely calcified FP lesions resulted in bailout stenting in only 6.5% of cases. Furthermore, in the large prospective multicenter DEFINITIVE LE study,[27] bailout stenting was 3.2% in all comers with a mean lesion length of 8.1 cm. Finally, rotational and aspiration devices have shown a low rate of stenting in short to intermediate lesion lengths (11.9% with the JETSTREAM™ Atherectomy System [Boston Scientific Corporation, Figure 4]).[28]

Despite these highly encouraging acute procedural results for atherectomy as a first-line non-stent strategy in FP disease, there has been no conclusive randomized data to demonstrate that clinically driven outcomes (particularly TLR) are reduced when compared to POBA, and there has been no adequately powered randomized trials of atherectomy against stenting. Due in part to these reasons, atherectomy has not gained greater acceptance and has continued to lag behind stenting in the treatment of de novo FP disease.

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CASE STUDY: CALCIFIED SFA

A long chronic total occlusion with calcification was successfully crossed intraluminally and treated with the JETSTREAM™ Atherectomy System, followed by adjunctive balloon angioplasty. This lesion had all unfavorable predictors for bailout stenting, but the no-stent strategy with the JETSTREAM™ Atherectomy System and low-pressure adjunctive balloon was successful in obtaining good angiographic results.

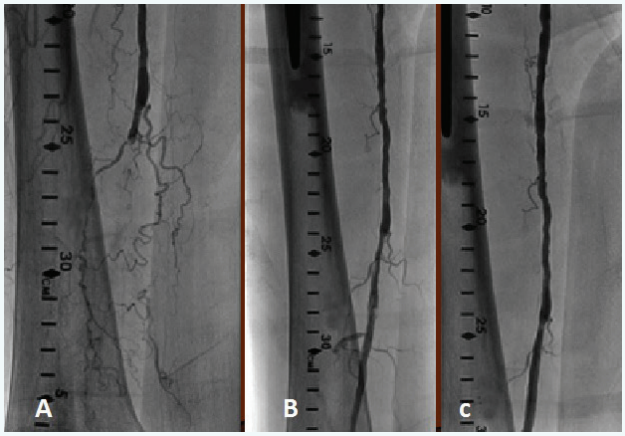

Figure 3. Chronic calcified total occlusion (A) successfully treated with the JETSTREAM™ Atherectomy System (B) followed by adjunctive balloon angioplasty (C).*

ATHERECTOMY IN THE DCB ERA

Recent positive data from DCB trials have renewed excitement in atherectomy. Theoretically, high acute procedural success with atherectomy coupled with very effective antiproliferative therapy using DCBs may emerge as an important strategy in treating FP disease. In a small nonrandomized study, 30 patients (claudicants, n = 18; limb ischemia, n = 12) underwent treatment of FP heavy calcified lesions with intravascular ultrasound guided directional atherectomy and DCB. The bailout stenting rate was 6.5%. The TLR rate was 10% and the reinterventions occurred in three insulin-dependent patients who received stents during the procedure.[26] In addition, DCB use with rotational atherothrombectomy was used in 29 patients with occlusions of the FP arteries. At 6 months, restenosis was only 6.9% by duplex ultrasound.[29]

Finally, the DEFINITIVE AR study randomized patients with FP disease to directional atherectomy with DCB (DAART) versus DCB alone.[30] A higher technical success rate and lower incidence of flow-limiting dissections was seen in the DAART arm. Primary patency for long (≥ 10 cm) lesions at 1-year follow-up was 96.8% in patients treated with DAART compared to 85.9% of patients treated with DCB alone (in severely calcified lesions it was 70.4% and 62.5%, respectively). Adequately powered trials are needed to address this fundamental question of whether atherectomy plus DCB will provide an added advantage over DCB alone in providing an optimal non-stent strategy in the treatment of FP arterial disease.

THE JETSTREAM™ ATHERECTOMY SYSTEM CHOICE

The JETSTREAM™ Atherectomy System is a rotational device with active aspiration, and is frequently used in our laboratory. The JETSTREAM™ Atherectomy System uses a front-cutting tip and expandable proximal blades that allow a larger radius of debulking.[31] The current system has been modified from its predecessor, the original Pathway Medical Technologies device. Iterations of the device include an increase in the differential cutting efficiency and the aspiration efficiency, which potentially reduces the risk of distal embolization. The device is designed for ease of use, requiring no removal and reinsertion during the procedure due to the active aspiration component. Also, it is well suited for a variety of lesions such as those that are soft, fibrotic, calcified, and thrombotic. Early data from the xl-PAD registry[32] was recently reported on 68 patients treated with the JETSTREAM™ Atherectomy System. Mean lesion length was 133.9 mm ± 106.8 mm with a high rate of chronic total occlusions (22.1%) and heavy calcification (27.9%). Procedural success was 94.1%. At 12-months post-procedure, TLR was 20.6%. Preliminary results from the first 155 patients enrolled in the JET registry[33] with lesion length 220 mm ± 290 mm, distal embolization requiring treatment occurred in 2% of patients. There were no other complications. Pretreatment stenosis was 91% ± 10%; after treatment with the JETSTREAM™ Atherectomy System, residual stenosis was 47% ± 21%, and after JETSTREAM™ Atherectomy System and adjunctive treatment, residual stenosis was 9% ± 8%. Long-term data are not available yet from this registry.

Figure 4. Jetstream SC catheters with Single Cutters (top two; tibial sizes) and Jetstream XC catheters with eXpandable Cutters (bottom two; SFA and popliteal sizes).

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Finally, the JETSTREAM Calcium Study,[34] a prospective, single-arm, multicenter study to evaluate the JETSTREAM™ Atherectomy System in severely calcified FP lesions as determined by intravascular ultrasound, showed a reduction in visual diameter stenosis from a baseline of 86% ± 9% pretreatment, to 37% ± 13% after atherectomy, and 10% ± 6% after adjunctive treatment. IVUS showed that lumen area increased from 6.6 mm^2 ± 3.7 mm^2 to 10 mm^2 ± 3.6 mm^2 (P = .001), with calcium reduction responsible for 86% ± 23% of the lumen increase. The role of vessel debulking with the JETSTREAM™ Atherectomy System before DCB use remains unclear. It is anticipated, however, that this device may increase drug delivery into the vessel wall in lesions that may traditionally represent a barrier for drug transport, such as severely calcified disease, and potentially positively alter TLR on follow up, a concept that will need validation.

CONCLUSION

We conclude that a strategy of improving vessel compliance with debulking and less bailout stenting coupled with adjunctive DCB is likely to emerge as an effective alternative strategy in treating FP arterial disease, a concept that requires future validation with well-powered and randomized trials. ■

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**Results from case studies are not necessarily indicative of results in other cases. Results in other cases may vary.*

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