Chapter 7
The Role of Atherectomy in Vessel Prepping During Infrainguinal Arterial Interventions

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Vessel prepping (VP) is a strategy utilized during infrainguinal arterial endovascular interventions with several key benefits when used prior to definitive treatment. VP results in a reduction in vessel barotrauma, increases vessel compliance, allows optimal luminal gain, and decreases dissection rate. There are various options for VP including balloon angioplasty, atherectomy, lithotripsy (Shockwave Medical), specialty balloons, and the FLEX VP system (VentureMed). Quite often, the device selection appears to depend on operator comfort, training, availability, cost, reimbursement, and lesion morphology.

Atherectomy has been shown to be an effective VP device with multiple systems available to the operator (Fig. 7.1). Atherectomy utilizes debulking as a way to change vessel compliance. Although there is no well-powered randomized comparative data among various atherectomy devices, operators' preference and lesion characteristics seem to play a significant role in the choice of the device. Over the past several years, we have used a softer debulking strategy in less bulky or less calcified lesions. For instance, fatty, fibrofatty, and mild to moderately calcified lesions can be modified with a gentler debulking approach just enough to alter compliance and reduce subsequent barotrauma and deeper dissections. Another alternative to prepping these lesions would be the FLEX VP device or specialized balloons. We find a more aggressive debulking methods are more likely to be needed in complex disease such as chronic total occlusions (CTO), in-stent restenosis (ISR), and severely calcified lesions. In an aggressive debulking approach, a *residual narrowing* of about 30–40% lesion severity is targeted. On the other hand, we target a *reduction in lesion severity* by about 30% when using a softer debulking approach (for instance, a 90% lesion can be targeted to be about 60%). One advantage of a softer debulking strategy is less distal embolization and less dissections. An

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N. W. Shammas (ed.), *Peripheral Arterial Interventions*, Contemporary Cardiology, https://doi.org/10.1007/978-3-031-09741-6_7

aggressive debulking strategy can be associated with distal embolization, dissections, and need for bailout stenting although the latter is likely to be less than no debulking. Intravascular ultrasound (IVUS) can be very useful to guide therapy as this helps in determining lesion morphology and residual narrowing more accurately as well as helps in better sizing of the reference vessel diameter (Fig. 7.2).

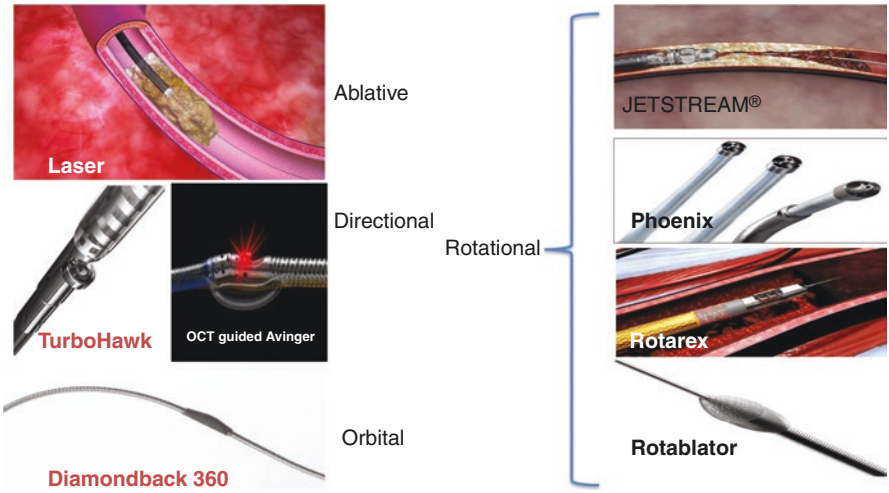

Fig. 7.1 Atherectomy devices

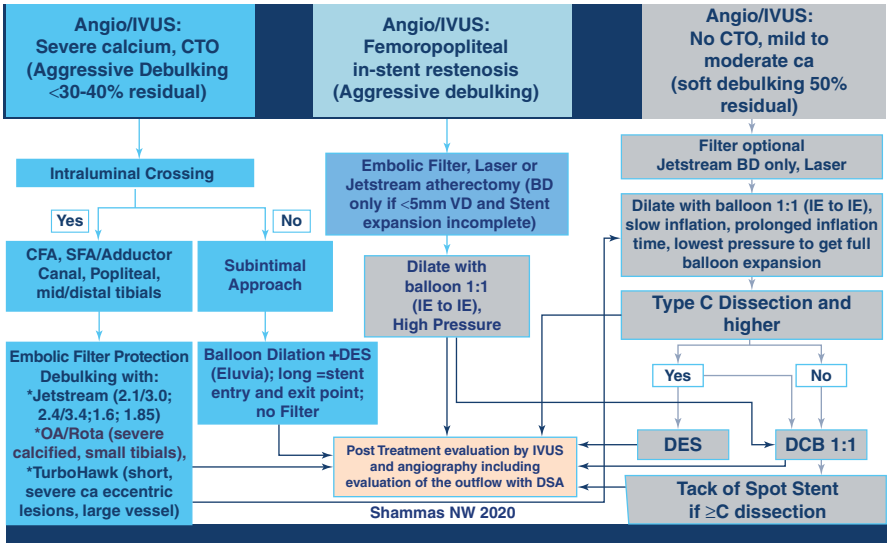

Fig. 7.2 Algorithm using intravascular ultrasound and atherectomy in approaching various lesion morphologies during infrainguinal arterial endovascular interventions (Reprinted with permission from HMP communications)

In general, atherectomy for vessel prepping includes laser, orbital, directional, and rotational devices. Below, we discuss how various atherectomy methods can achieve the debulking strategies described above. Table 7.1 illustrates a summary on how various atherectomy devices are likely to be more effective in specific lesion morphologies (Fig. 7.3).

Table 7.1 Suggested atherectomy device choices in different lesion subsets

☺ = on label ☺ = off label ☺ = Do not use X = Effective XX = Very Effective

Atherectomy Type	Directional	Rotational	Laser Ablative		Orbital
Atherectomy Device	TurboHawk	Jetstream XC	Excimer	Auryon	Diamondback 360
Short Eccentric	XX ☺	X ☺	X ☺	X ☺	X ☺
Thrombus	- ☹	XX ☺	XX ☺	XX ☺	- ☹
Below the knee	X ☺	X* ☺	XX ☺	X* ☺	XX ☺
Long calcified disease	XX ☺	XX ☺	X ☺	XX ☺	XX ☺
In-stent restenosis	- ☹	XX ☹	XX ☺	X* ☺	- ☹
Chronic total occlusion	XX ☺	XX ☺	XX ☺	XX ☺	XX ☺

* More data needed

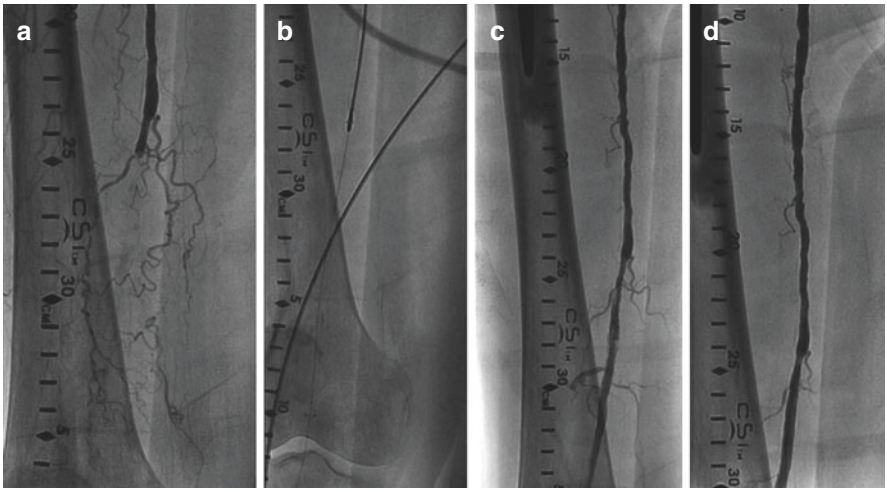

Fig. 7.3 (**a**) Chronic total occlusion of the superficial femoral artery. (**b**) Jetstream atherectomy catheter. (**c**) Post-atherectomy with the Jetstream rotational and aspiration device. (**d**) Final outcome post-PTA. No dissections or need for bailout stenting

Laser Atherectomy

Laser-based devices include the excimer laser (Philips) and the Auryon™ laser (AngioDynamics).

The CVX-300 excimer laser system (Philips) is indicated in fibrotic, calcific, and thrombotic infrainguinal lesions. Excimer or excited dimer is a form of ultraviolet light. The CVX-300 excimer uses xenon and chloride (XeCl) which under high pressure and electrical stimulation generates laser light in the ultraviolet range. The wavelength of the XeCl is 308 nm. Several studies have shown the effects of the excimer laser-based system on 1-year patency including the CELLO trial [1] which included 65 patients with moderate to severe calcified lesions of the femoropopliteal arteries. The percent diameter stenosis was reduced to 34.7 ± 17.8% from 77 ± 15%. This was further reduced to 21 ± 14.5% after balloon angioplasty (PTA) in 42 subjects and PTA plus stenting in 15 patients. The 12-month patency rate was 54%, and the freedom from TLR was 76.9%. Based on this study, the laser-based system appeared to be an effective plaque removal device, with no adverse events noted in this study. With adjunct therapy with PTA and stenting, procedural and long-term outcomes at 1 year appear reasonable but numerically suboptimal to the application of drug elution devices such as drug-coated balloons (DCB) or drug-eluting stents (DES).

The use of the excimer laser prior to PTA versus PTA alone was analyzed in the EXCITE ISR trial [2]. Patients with femoropopliteal in-stent restenosis (ISR) treated with laser and PTA had a greater freedom from TLR at 6 months when compared to PTA alone (61.8% vs 73.5% $p = 0.05$). The study also showed less residual stenosis in the laser plus PTA arm compared to the PTA arm alone (4.7% vs 13.6%, $p = 0.02$). The goal of VP in ISR is not to alter vessel compliance (as the vessel is confined within a stent) but to debulk excessive restenotic tissue particularly in chronic total occlusions (CTO). The Photoablation Using the Turbo-Booster and Excimer Laser for In-Stent Restenosis Treatment (PATENT) study [3], a European multicenter prospective study, evaluated the Turbo-Elite laser atherectomy catheter. Of the 90 ISR lesions, procedural success was 96.7% with percent stenosis reduced to 32.3% from 87.0%. Percent stenosis further reduced to 7.4% following adjunctive PTA which was performed in 79 of the lesions. Target lesion revascularization (TLR) at 6 and 12 months were 87.8% and 64.4%, respectively. The 30-day major adverse event (MAE) was 2.2%. Another important finding is the reduction of bail-out stenting in the laser and PTA arm.

The Auryon™ is hybrid technology with a laser and a blunt blade. The blade creates a slit that enables deeper catheter penetration into the tissue. The laser is a solid-state third harmonic Nd:YAG (neodymium-doped yttrium aluminum garnet) with a wavelength of 355 nm and a pulse duration less than 25 ns. The Auryon™ system has single-use catheters, with diameters ranging from 0.9 to 2.35 mm (4–7 French). The smaller catheters can be used for below-the-knee applications. The larger catheters (2 and 2.35 mm) have an aspiration system that seems to reduce distal embolization as was shown in the pivotal Investigation Device Exemption

(IDE) trial EX-PAD-03 study [4]. Having a solid-state medium, the Auryon™ system has a 15-s warm-up time, and no catheter calibration is required. Furthermore, the longer wavelength of 355 nm does not require saline flush since there is no interaction with contrast media. In the EX-PAD-03 trial, symptomatic (Rutherford 2–4) infrainguinal peripheral arterial disease patients were enrolled in a prospective, single-arm, international, multicenter, open-label trial at 8 US and 3 European sites. A total of 97 patients were enrolled and treated. Severe calcification was seen in 26.2% of patients. CTO was present in 21.5, and 20.6% were restenotic (of which 15.9% were ISR). The average reduction in residual stenosis post-laser alone prior to any adjunctive therapy was 33.6% and was not affected by lesion morphology. Patency by duplex evaluation at 30 days and 6 months was 96.8% and 85.6%, respectively, and was similar between those treated with drug-coated balloons and not [5]. Clinically driven target lesion revascularization (TLR) occurred in 3% of lesions, and no distal embolization was reported although only two patients had an embolic filter production. These results were encouraging and demonstrated that a soft ablation is effective in generating low bailout stenting and promising patency and TLR. It is speculated that these results are likely due to less damage to the deeper layers of the vessel wall given the short penetration distance of this laser and the softer debulking that seems to occur in all lesion subtypes treated.

Orbital Atherectomy

The orbital atherectomy (OA) system (Cardiovascular Systems, Inc.) utilizes a crown coated with diamond dust (Diamondback 360™) to sand moderate to severely calcified lesions. The benefits of the OA system in calcified lesions are the reduction of intimal calcium, as well as fracture of the deeper calcium layers due to transmission of mechanical rotational energy into the vessel wall [6]. The outcomes of this vessel preparation are the reduction of angiographic dissections due to the reduction in intimal calcium and improvement in vessel compliance.

The COMPLIANCE 360 study [7] was a randomized, prospective, and multicenter trial which evaluated the outcomes of OA plus PTA vs PTA alone. The study showed similar freedom from TLR when comparing OA plus PTA vs PTA alone at 81.2% and 78.3%, respectively. PTA alone showed significantly lower number of lesions being stented in the OA plus PTA arm vs PTA arm alone (5.3% vs 77.8%, $p < 0.001$). The OA plus PTA group also utilized a lower maximal balloon pressure when compared to the PTA alone (4.0 atm vs 9.1 atm, $p < 0.001$). At 12 months, freedom from TLR was similar between the two groups, 81.2% for OA plus PTA vs 78.3% for PTA alone ($p > 0.99$). While not significantly different, the PTA group had a significantly higher stenting rate which could have favored a lower long-term TLR in the PTA group. The study also suggested that OA was an effective vessel prep device in calcified femoropopliteal lesions. The overall results showed better luminal gain and less stenting.

The use of OA in vessel prepping was also evaluated in the CALCIUM 360 trial [8]. This randomized multicenter study evaluated the 1-year outcome in treating calcified lesions. The study utilized the Diamondback 360 Orbital atherectomy system followed by adjunct PTA versus PTA alone. A total of 50 patients were enrolled. The primary endpoint was defined as residual stenosis of ≤30% without bailout stenting type C through F dissection. OA plus PTA when compared to PTA alone had a numerically higher procedural success rate (93.1% vs 82.4%, $p = 0.27$) as well as lower use of bailout stenting (6.9% vs 14.3%, $p = 0.44$). At 1 year, there was an increased rate of freedom from TLR at 93.3% for OA plus PTA and 80% for the PTA group. There was a significant difference in freedom from all-cause mortality in the OA plus PTA groups vs PTA alone, at 100% and 68.4%, respectively, $p = 0.01$. While procedural success, rate of bailout stenting, and freedom of TLR were not statistically significant, the data suggest that OA when used for vessel preparation prior to definitive PTA in calcified infrapopliteal lesions may improve outcomes and reduce bailout stenting.

Rotational Atherectomy

The Jetstream atherectomy device (Boston Scientific) utilizes a combination of rotational cutting and aspiration. It is approved for infrainguinal peripheral arterial disease as well as thrombectomy. The Jetstream was evaluated in moderate and severely calcified vessel in the Jetstream Calcium study [9], which utilized intravascular ultrasound (IVUS) to evaluate the effectiveness of the device in calcified lesions. Study size included 55 patients. The study showed Jetstream use increased luminal area from 6.6 ± 3.7 to 10.00 ± 3.6 mm^2 ($p = 0.001$) where calcium removal was responsible for 86 ± 23% of the change. Patients who underwent PTA post-Jetstream saw a further increase from 7.1 to 11.9 mm^2 ($p = 0.001$). From this study, it was shown in moderate and severely calcified lesions, the Jetstream was effective at enhancing luminal area with further improvement post-PTA. It should be noted there were no flow-limiting dissection or adverse events 30-day post-procedure. This indicated that Jetstream could be an effective prepping device before PTA with excellent procedural outcomes.

The JET Registry study evaluated de novo and non-stent restenotic lesions in the femoropopliteal arteries [10]. Lesion length was 16.4 ± 13.6 mm, and pretreatment stenosis was 92.7% for patient who received a stent and 90.2% for non-stented lesions. Of 241 patients, 224 underwent PTA, and 84 of those received additional stenting. Post-Jetstream stenosis was 54.8 ± 22.0%. For those who underwent stenting, final stenosis was 6.6 ± 10.2% compared to 11.6 ± 11.7% in the adjunctive PTA group. Procedural success rate was 98.3%. At 30 days, MAE was 2%. At 12 months, TLR rate was 18.3%. Distal embolization occurred in three patients. This data suggest Jetstream atherectomy is an effective and safe treatment modality in de novo and non-stent restenosis lesions.

The JET-ISR study [11] evaluated Jetstream atherectomy in the setting of femoropopliteal ISR. In this multicenter prospective registry, the freedom from TLR at

6 months was 79.3% (95% CI 68.9–89.8%) and at 1 year 60.7% (95% CI 47.8–73.6%). No drug-coated balloons were used. Bailout stenting was seen in 6/60 (10%) lesions. Lesion length was 19.9 ± 13.5 cm, and 33/60 (55%) lesions were CTO. This suggests that for complex ISR and CTO lesions, vessel prepping with Jetstream produces good outcomes at 1 year with a reduced need for bailout stenting. Jetstream atherectomy in ISR remains off-label in the United States.

The Phoenix atherectomy system (Philips) is another rotational device that uses a front cutting device and internal helix screw designed to remove debulked material while cutting. The device is indicated in femoropopliteal and below-the-knee lesions. The EASE study [12] evaluated the safety and effectiveness of the device in de novo and restenotic infrainguinal arterial lesions. The study was a prospective, multicenter, nonrandomized investigational trial with sites located in the United States and Germany. 105 patients and 123 lesions were included in the primary analysis with a primary efficacy endpoint of post-atherectomy residual stenosis of ≤50%. Technical success was achieved in 95.1% of lesions with further reduction to ≤30% in 99.2%. There were a 5.7% major adverse event rate through 30 days and 16.8% through 6 months including arterial restenosis in seven cases, four type A and B dissections, three with intermittent claudication, two vessel perforations, one type C dissection, one in-stent restenosis, one stent occlusion, and one skin ulcer. TLR was 88% and TVR 86.1% at 6 months. Based on this data, the Phoenix system appears to be an effective debulking device when followed with adjunctive therapy. More comparative trials should be performed to fully assess the device as a debulking option prior to adjunctive therapy.

The Rotarex Rotational Excisional Atherectomy System (BD) also utilizes a rotating catheter and internal helix screw that removes debulked material simultaneously. The system utilizes blunt facets, as well as side windows to further remove debulked material. The device is approved in the United States and European markets. Bérczi et al. [13] evaluated the device in 18 patients and 19 limbs with acute or subacute occlusion of the femoropopliteal artery. Technical success was achieved in 15/19 vessel, with 17 of limbs utilizing adjunctive therapy with angioplasty or stent. The study reported two perforations in heavily calcified plaques, one arteriovenous fistula, and three distal embolizations. Wissgott et al. [14] evaluated the device in 40 patients with chronic occlusion of the iliac (n = 4) and femoropopliteal arteries (n = 36). In this study, technical success was 100% with 27/40 patients receiving adjunctive balloon and 7/40 requiring stenting. There was a 22.5% restenosis rate at 12 months. There was no distal embolization, amputations, or death. Two dissections were seen after balloon dilation.

Directional Atherectomy

There are multiple directional atherectomy (DA) devices that utilize a direct cutting method for plaque removal in the infrainguinal arteries. Devices including the SilverHawk, TurboHawk, and HawkOne (Medtronic) as well as newer devices such

as the Pantheris (Avinger), which utilizes built-in optical coherence tomography (OCT), are available to operators.

The SilverHawk was evaluated in the DEFINITIVE LE trial [15], an 800-patient multicenter single-arm study. Technical success was 89% with 3.8% distal embolization, 2.3% dissection, 5.3% perforation, and 2.0% acute vessel occlusion. Bailout stenting was seen in 3.2% of lesions. At 1 year, primary patency was 84% with freedom from amputation at 97.1% [16].

The DEFINITIVE AR trial [17] investigated how directional atherectomy and anti-restenotic therapy (DAART), a combination of DA and drug-coated balloon therapy, performed when compared to DCB alone. Technical success was 89.6% for DAART therapy when compared to DCB alone at 64.2% ($p = 0.004$). The trial also showed lower rates of flow-limiting dissections in favor of DARRT at 2% vs DCB at 19% ($p = 0.01$). One-year data showed TLR of DAART at 7.3% and 8.0% for DCB ($p = 0.90$). The combination of DCB and DA delivered excellent technical success and reduced dissections, though 1-year data showed no significant difference in TLR. Following the DEFINITIVE AR trial, the ISAR-STATH study [18] evaluated the difference between DCB plus stenting and PTA plus stenting vs DA plus bailout stenting in superficial femoral lesions. This randomized trial included 155 patients with de novo lesions and showed that paclitaxel-based DCB and stenting had a 6-month angiographic diameter stenosis of 34 ± 31%, compared to PTA and stenting at 56 ± 29% ($p = 0.009$) and DA and bailout stenting at 55 ± 29% ($p = 0.007$). At 24 months, the DCB group had a decreased risk of TLR as well as no difference in target lesion thrombosis, mortality, or amputation. Angiographically, the ISAR-STATH study showed DCB and stenting were superior to DA and bailout stenting and BA with stenting.

The randomized trial of SilverHawk atherectomy and PTA versus PTA alone was the first trial that evaluated the added benefit of atherectomy when compared to PTA alone [19]. In this prospective, two-center randomized trial of PTA versus SilverHawk and PTA of infrainguinal arteries, 58 patients were included. Of these, 29 (36 vessels) were randomized to the atherectomy arm and 29 (48 vessels) to the PTA arm. There was no statistical difference in TLR (16.7% vs 11.1%) or TVR (21.4% vs 11.1%) or major adverse events between the PTA and atherectomy groups, respectively. Bailout stent placement was performed in 18 of 29 patients (62.1%) in the PTA arm and 8 of 29 patients (27.6%) in the atherectomy arm ($p = 0.017$). Distal embolization was more frequently seen in the atherectomy arm. This study was the first randomized study to show that atherectomy as a technique has a major impact on VP by reducing bailout stenting but did not affect the long-term outcome of the procedure.

The Pantheris OCT atherectomy device was evaluated in the VISION study [20], a single-arm, multicenter study with 158 subjects and 198 lesions. After use of the Pantheris device, the mean diameter stenosis decreased to 30.3 ± 11.8% from 78.7 ± 15.1%, $p < 0.001$. Further reduction to 22.4 ± 9.9% was seen after adjunctive therapy with PTA of 84 lesions and stenting in 10 lesions. At 6 months, a TLR rate of 6.4% was noted. The use of OCT appears to be key in the low adverse events. There were no significant perforations, a 0.5% catheter-related dissection rate, and

a 2% rate of embolic events. Histological analysis showed less than 1% involvement of the adventitia in 82.1% of samples. The use of the OCT-guided device appears to be an effective plaque removal device with excellent procedural results. The device has the advantage of limiting adventitial damage, which is a key predictor in loss of patency post-intervention.

Atherectomy and Drug-Coated Balloons

Preclinical studies have shown that atherectomy enhances drug elution into the vessel wall which in return may improve the long-term outcomes of a procedure when compared to DCB alone. The dual advantage of improving acute procedural results and optimizing long-term outcome is a viable concept that was seen in some observational studies and small randomized trials, but more definitive large-scale trials are lacking. The JET-RANGER (NCT03206762) was designed to test this hypothesis with the Jetstream atherectomy and DCB vs DCB alone, but terminated early because of poor enrolment resulting from the DCB and mortality debate fueled by the Katsanos et al. meta-analysis [21] as well as the COVID-19 pandemic.

Severe calcium is a barrier to drug elution. Fanelli et al. [22] have shown that severe calcium has a negative impact on patency and TLR. In 60 patients with de novo lesions of the superficial femoral artery treated with DCB, dissections were more prevalent in patients with severe calcium. Higher circumferential degree of calcium (>270° vs <90°) resulted in more late lumen loss (0.75 ± 0.21 vs 0.45 ± 0.1) and loss of patency (50% vs 100%). Furthermore, TLR was higher in patients with severe calcium (TLR 25% vs 0%). In the Directional Atherectomy Followed by a Paclitaxel-Coated Balloon to Inhibit Restenosis and Maintain Vessel Patency—A Pilot Study of Anti-Restenosis Treatment (DEFINITIVE AR study) [17], a total of 19 patients with severely calcified lesions were treated with DA + DCB. Less rate of flow-limiting dissections was seen with DA + DCB (19% for DCB and 2% for DA + DCB ($p = 0.01$)). Patency by duplex ultrasound was 84.6% for DA + DCB, 81.3% for DCB ($p = 0.78$), and 68.8% for calcified lesions. In addition, Gandini et al. [23] randomized 48 patients with chronic superficial femoral artery in-stent occlusion to laser atherectomy + DCB ($n = 24$) versus DCB only ($n = 24$). Patency at 6 and 12 months (91.7% and 66.7%, respectively) were significantly higher than in the DCB group (58.3% and 37.5%, respectively) ($p = 0.01$). Also, TLR at 12 months was 16.7% in the laser + DCB group and 50% in the DCB only group ($p = 0.01$). Furthermore, observational data suggest a sustained long-term benefit of the combination of atherectomy and DCB when compared to atherectomy only. In 75 patients with de novo or restenotic femoropopliteal lesions, adjunctive PTA was performed on 50 patients (26 de novo, 13 in-stent restenosis, 3 non-stent restenosis, 8 mixed lesions) and adjunctive DCB (Lutonix® 24 (Bard/BD), IN.PACT® 1 (Medtronic)) on 25 patients (21 de novo, 1 in-stent restenosis, 2 non-stent restenosis, 1 mixed lesion). Freedom from TLR was significantly higher with atherectomy and adjunctive DCB compared to atherectomy with adjunctive PTA at 12 months

(94.7% vs 68.0%, $p = 0.002$) and 16 months (94.4% vs 54%; $p = 0.002$) [24]. Finally, in a single-center cohort, 89 patients (139 lesions) were treated with DCB, of whom 40 (29%) were treated with orbital atherectomy (OA) + DCB. Less bailout stenting was seen in those with OA + DCB (18% vs 39%, $p = 0.01$), but freedom from TLR (82% in both groups ($p = 0.6$)) and patency (81% DCB and 77% DCB + OA ($p = 0.8$)) were similar at 1 year [25]. One could conclude that OA + DCB with less bailout stenting yielded similar outcome to DCB with a higher rate of stenting.

Conclusion

The use of atherectomy as a plaque removal device appears to be an effective method prior to definitive treatment with PTA or drug-coated balloons in reducing angiographic dissections and bailout stenting. Atherectomy, however, does not appear to impact the long-term outcome of the procedure with the exception of in-stent restenosis when compared to PTA. Recently, Shammas et al. [26] showed that IVUS-based dissections can be significant with certain atherectomy devices, such as Jetstream atherectomy, in the femoropopliteal arteries. These dissections are not identified on angiography, which may partially explain the loss of patency in these vessels on long-term follow-up without the adjunctive treatment with a mitigating factor such as drug-coated balloons or stents. Other atherectomy devices have also been evaluated and have shown various degrees of dissection not visible on angiography [27]. Recently, the Auryon laser with its softer debulking capacity was shown to have a very low number of adventitial dissections which may partly explain the excellent intermediate-term patency and TLR on follow-up [28]. Finally, in the VISION study [20] where the adventitia has been mostly spared, the TLR rate was only 6.4% at 6 months. This certainly poses the important question whether too much of an aggressive debulking strategy is always needed and whether the choice of the atherectomy device can make a difference in the long-term outcome. Further studies are needed to prove this hypothesis.

VP using atherectomy requires that devices are tailored to certain lesion subsets as indicated in Table 7.1. Excimer laser atherectomy as a VP device appears to have success with limited adverse events in ISR lesions, in fatty and fibrofatty lesions, and in mild to moderate calcium. The Auryon laser appears to be quite effective in severe calcium and can also be used in other lesion subtypes including ISR. OA is an excellent device for severe calcium and particularly in below-the-knee lesions. Rotational atherectomy with the Jetstream device has been shown to yield good results in de novo and non-stent restenosis lesions as well as calcified lesions particularly in the femoropopliteal segments. It has also been shown to be safe in ISR although remains off-label in the United States for this application. Directional atherectomy is also effective for many lesions, but preferred overall for short and eccentric lesions [29] when compared to the laser, as it requires frequent removal and emptying of the nosecone and has a higher rate of distal embolization [30]. The

Pantheris OCT system appears to spare the adventitia because of OCT-guided debulking and performs well in multiple lesion subtypes at the expense of longer procedure time. It also requires an understanding of OCT imaging.

VP remains critical to the success of infrainguinal arterial endovascular treatment. Atherectomy is an important modality to VP, and devices are best tailored to lesion morphology. Other emerging technologies besides atherectomy are likely to play a significant role in VP without debulking such as the FLEX VP longitudinal microincision system (VentureMed Group), Shockwave lithoplasty (Shockwave Medical), or other specialty balloons. A common denominator among all vessel prepping devices is the ability to obtain excellent acute procedural results leaving the least metal behind. This is achieved by limiting dissections while maximizing luminal gain. Optimal imaging needs to play a critical role in understanding the best mechanism of VP devices in various lesion morphologies.

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