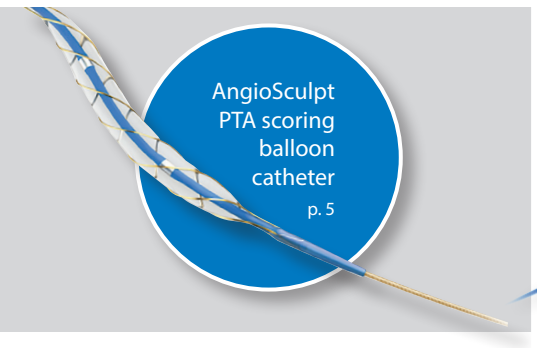
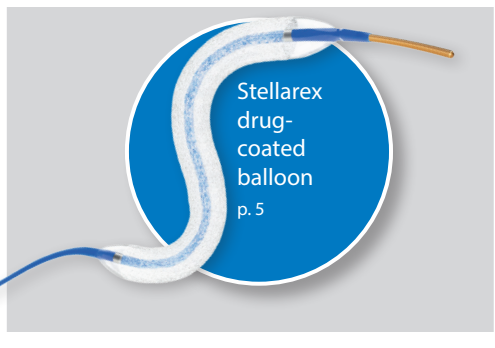
June 2018

vascularnews

EDUCATIONAL SUPPLEMENT





This educational supplement has been sponsored by Philips

Introduction to Philips Vascular suite

Over 200 million people worldwide are living with peripheral arterial disease. Today, 387 million people globally are living with diabetes, and they are at higher risk for developing peripheral arterial disease (PAD), critical limb ischaemia (CLI) and severe diabetic foot complications.

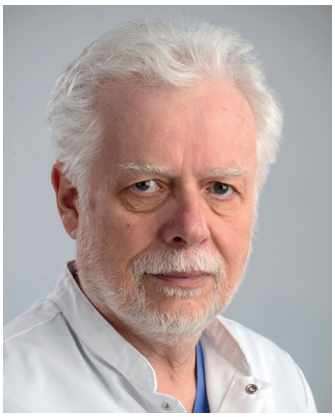
The number of people living with diabetes continues to climb, bringing PAD and CLI interventions to epidemic levels. Today these patients have more options, including endovascular interventions like below-the-knee procedures. This is in part due to new devices designed to make treatment more durable and facilitate retreatment—aspiring to leave nothing behind. To standardise this fast-evolving landscape, the medical community is working towards the creation of evidence to answer clinical dilemmas and define novel guidelines.

Meeting clinical demands in this area and others, Philips provides a range of clinical suites—including the Vascular suite. As a flexible portfolio of integrated interventional technologies and services for particular clinical areas including PAD procedures, the Vascular suite can be tailored to specific needs. Offering workflow options, dedicated interventional tools and relevant vascular devices to support high levels of standardisation and redefine outcomes for vascular patients, the Vascular suite supports each step of the procedure: From decision to guidance, treatment, and confirmation.

Assessing the needs of peripheral arterial disease and critical limb ischaemia

Patients suffering from claudication and non-healing wounds from arterial vascular compromise are increasing. This increase parallels the global epidemics of increasing population age, diabetes and renal insufficiency.

The main challenges encountered in treatment of these diseases, Dr George Adams (Rex Hospital and UNC School of Medicine, Raleigh, USA) explains, include patient noncompliance in the treatment of comorbidities such as hypertension, diabetes, hyperlipidemia and smoking cessation, which predispose patients to vascular disease. Further challenges are presented in the lack of recognition of peripheral arterial disease (PAD) by physicians when patients present with leg pain. Finally, Dr Adams says, the problem lies in cost, as patients with critical limb ischaemia (CLI) require costly procedures to salvage limbs and many re-present over time due to restenosis.

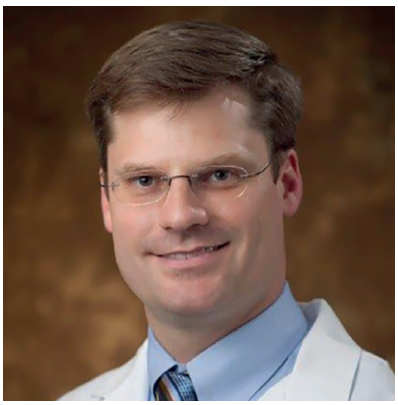


Prof Jim Reekers

Prof Jim Reekers (University of Amsterdam, Amsterdam, the Netherlands) further suggests that a key issue in tackling critical limb ischaemia lies in understanding the pathophysiology behind it. “We still see around 10–20% of the patients being amputated despite a successful endovascular procedure. This figure has not changed much over the years and seems to be unrelated to the new developed technologies. That is why we have developed a new definition of CLI. We can distinguish, based on this clinical observation, two types of CLI: The first type is flow dependent CLI and the second is flow independent CLI. By making this difference we can start to understand what physiological and functional parameters determine the success of an intervention, independent of a successful intervention.”

Prof Reekers commented, “it is interesting to see that IVUS controlled angioplasty can lead to better long-term results” in his opinion and experience, “due to the recognition of angiographic underestimated reststenosis. We are still in a flow of development.”

To tackle the growing issue of PAD, some key improvements are needed. These include new tools, technology and therapy to treat chronic occlusions, calcium and small vessels. Formal rehabilitation programmes post endovascular or surgical intervention for PAD should be set up, and awareness should be raised among the public as well as healthcare providers.



Dr George Adams

Fortunately, Dr Adams suggests that tools and technologies are currently evolving to meet these treatment needs. “Imaging is evolving such that safer and easier access to arterial vessels can be obtained with ultrasound, while intravascular imaging (IVUS, OCT) can be used to cross complex lesions, evaluate their morphology and size to personalise care, and evaluate complications. Perfusion software can inform the operator if the percutaneous intervention is enough to heal the wound or if additional intervention is warranted,” he says. “Tools to prep the vessel, such as focal force balloons, lithoplasty balloons, and atherectomy, are evolving to treat all plaque morphologies while reducing the need to place a scaffold and prevent recoil. Finally, intravascular biologic therapies are evolving to prevent restenosis (i.e. drug-coated balloons, direct drug delivery, and drug-eluting stents).”

Meanwhile, workflow continues to evolve to optimise new clinical methods. “For example,” Dr Adams says, “many technicians and nurses are learning to prep and position patients differently depending on access. These procedures are long, so staging initial diagnostic angiography and interventional procedure are becoming commonplace. Also, having a multitude of devices available to treat different vascular lesions is warranted. Therefore, allocated easily accessible space for these devices is needed for efficient workflow.”

The role of Philips solutions in solving needs: Highlighting tools and devices

Azurion System

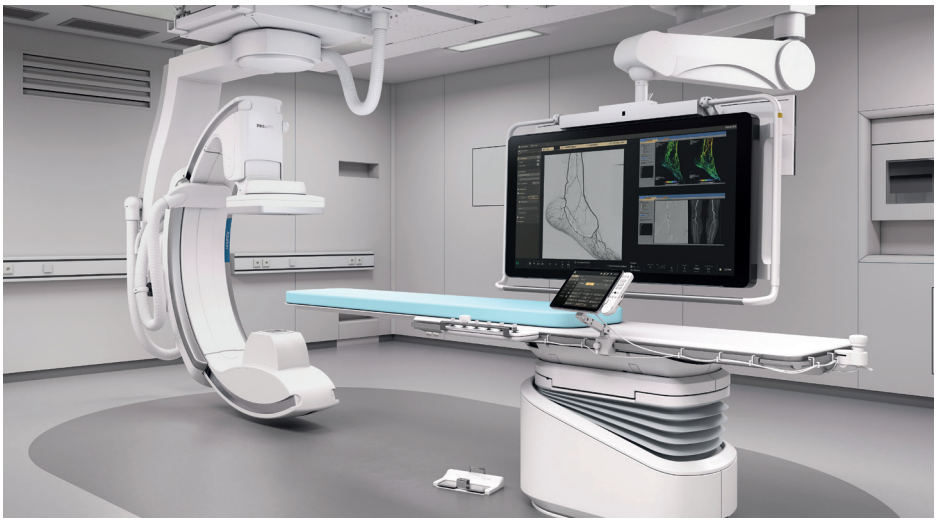
A part of the Vascular suite, the Azurion system works to help you manage and optimise procedures, providing the tools for a better and faster workflow. This is possible due to compatible functionalities including Zero Dose Positioning, FlexVision Pro, ClarityIQ and Roadmap Pro.

Dr Richard Harris (Sydney Adventist Hospital, Hornsby, Australia) has been using the Azurion Hybrid OR for over six months for a "broad range of endovascular interventions", from atherectomy and drug-coated balloon angioplasty to endovascular aneurysm repair (EVAR), coil embolisations, and catheter-directed thrombolysis.

For Dr Harris, one of the features of Azurion particularly useful for peripheral procedures is the Zero Dose positioning: Being able to move the system without having to re-irradiate the patient. The Smart Mask feature uses the previous image for the next area without having to do new runs, enabling shortening of the procedure time and managing exposure. The good image quality "allows us to be sure that we are seeing what we need to see the first time around—without having to do multiple runs," Dr Harris says, adding that the ease of gantry movement around the entire length of the patient anatomy is very helpful.

"The Azurion system has enabled all of our vascular cases to be performed in one place," Dr Harris says, smoothing the admission process and workflow. "In terms of floor space," he adds, "the anaesthetic bay is spacious," allowing "plenty of workspace" for all members of the team.

The system has provided Dr Harris with "a whole new level of confidence that we are providing the best technology to deliver endovascular surgery for patients. Better accuracy, clearer pictures, more confidence in placing devices, much improved workflow, managed radiation risk, allows all kinds of hybrid procedures."

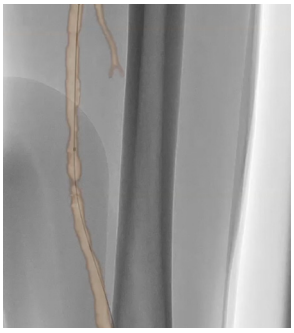


The VesselNavigator: Roadmapping the future of endovascular procedures

By Dr Yann Gouëffic

Endovascular treatment has become a first-line treatment for peripheral arterial disease (PAD) procedures and peripheral interventionalists are pushing the limits by performing more and more complex and long endovascular procedures. Dr Yann Gouëffic writes here about his experience of using the VesselNavigator to improve planning and execution of such procedures, managing radiation exposure.

In routine practice, interventionalists navigate into the vasculature using flat images (2D view) and 2D-roadmapping to visualise the guidewire or the catheter with respect to the vasculature. However, 2D-roadmapping is a two-dimensional X-ray image guidance that increases the amount of contrast product during the procedure and is a temporary imaging. Moreover, the effect of X-ray exposure during peripheral endovascular procedures should be taken into consideration. Indeed, endovascular procedures for below-the-knee disease are accompanied by a higher radiation exposure of the operator than with coronary procedures. Lastly, the need of repeated iodinated contrast injection is also a limiting factor for patients with diabetes and/or renal failure, which are common comorbidities for PAD patients.



Fusion imaging guidance during aortic endovascular repair helps reduce contrast and manage radiation dose, especially if the registration protocol is contrast- and almost radiation-free. The VesselNavigator fuses live interventional X-ray images with pre-acquired 3D MRI or CT images of the patient's vascular structures and allows live 3D catheter navigation for endovascular and hybrid procedures.

Dr Yann Gouëffic

In our department, PAD procedures are performed under local anaesthesia and sedation, and general anaesthesia is not mandatory to use fusion guided navigation. A main limitation is related to the patient positioning which can be different for the CT scan and the procedure. Indeed, the lower limbs' position could be different in terms of rotation, potentially causing some mismatch between the 3D vascular mask and the live X-ray. This drawback can be solved by similar installation between the CT scan and the procedure.

Despite it having been proven that using fusion imaging guidance during aortic aneurysm endovascular repair helps to reduce contrast and manage radiation dose, evidence is still lacking for PAD procedures. For this reason, the SOFT trial from the Department of Vascular Surgery of Nantes is assessing the clinical benefits of advanced imaging application allowing 3D overlay guidance during PAD endovascular revascularisation.

Dr Yann Gouëffic is professor and head of the Department of Vascular Surgery at Centre Hospitalier Universitaire (CHU) in Nantes, France.

Perfusion angiography with the 2D Perfusion software

2D Perfusion is a software product that calculates the change in density per pixel over time after local injection of contrast. Perfusion angiography, using this software, gives a colour coded and graphic representation of the change in Volume (density) over Time, which indicates Flow characteristics. Perfusion angiography therefore visualises flow in a 2D (per pixel) Region of Interest (ROI). This imaging modality helps in visualisation of total flow in an organ. It does not measure absolute flow, but this technique can be used to visualise comparative flow, pre-and post-intervention. Because perfusion angiography is a real-time technique, it can also be used to visualise increase in foot flow during intervention. Using real-time perfusion angiography, it instantly adds insight and objectivity to decision making about the endpoint of an intervention. The technology particularly benefits the millions of patients globally who suffer from peripheral arterial disease (PAD), as perfusion angiography is designed to help interventionalists dealing with PAD patients and critical limb ischaemia (CLI) to get better procedural results and to minimise risks of severe foot complications and limb loss.

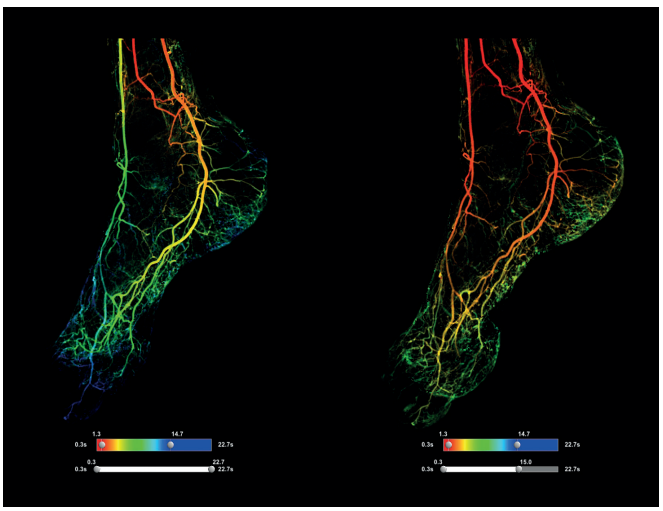
The 2D Perfusion software generates a colour coded representation of contrast with high detail and precision, but the actual information comes from the graphic representation of the perfusion in the ROI. With pharmacological challenging of the functionality of the vascular system, using pre- and post-intervention perfusion images, the information acquired can help shed light on the extent and severity of a patient's condition as well as understand the impact of an intervention. The instant imaging allows for next steps to be envisioned as an intervention is ongoing, and could give operators immediate feedback on the procedure, its effectiveness and the likelihood of reintervention.

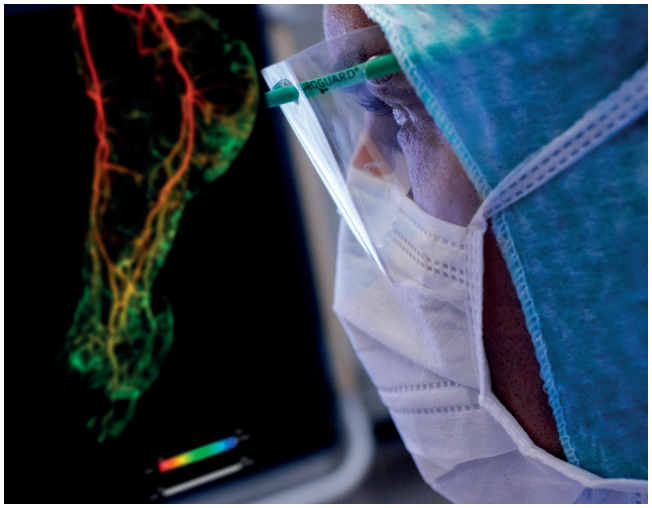
Perfusion angiography typically requires no more than one injection of contrast media and a single DSA run to visualise perfusion in the affected region. A drawback for perfusion angiography is that this technique demands a very meticulous acquisition of the perfusion data. The foot should not be moved during acquisition. For this, a dedicated footrest has been developed. A low volume (9ml in 3 seconds with a contrast injector) with high density (320) should be used. Only high density contrast will give reliable perfusion images. Contrast should also not be painful to avoid movement. Contrast administration should be close the ROI, to avoid contrast dilution, preferable with the catheter tip at the mid poplitea.

By providing flow data of revascularisation procedures such as percutaneous transluminal angioplasty (PTA), perfusion angiography makes it possible to assess effect of treatment—while the patient is still on the table.

This perfusion angiography software meets real and pressing clinical needs. Prof Jim Reekers (University of Amsterdam, Amsterdam, the Netherlands) hopes that the technology's ability to visualise the change in blood flow pre- and post-intervention in the foot of a CLI patient presents one of the parameters to define a successful CLI intervention. "We have already seen that the angiographic images are completely unreliable in this perspective," Prof Reekers says. "I think this is a revolution and opens doors to new research."

Dr George Adams (Rex Hospital and UNC School of Medicine, Raleigh, USA) is similarly optimistic: "The hope is that perfusion angiography (2D Perfusion, Philips) will assist the interventionalist during the procedure if the endovascular treatment is enough to heal the wound or should more work be done."





A feasibility study with 132 patients indicates that perfusion angiography might be used as a new endpoint for lower limb revascularisation. Early ongoing research looks into the possibilities to test the functionality of the microcirculation to identify sub-types of patients with CLI.[1] A non-functional microcirculation is the same as a flow-independent ischaemia, Prof Reekers says. "This might completely change our treatment strategies and triggers new research to treat microangiopathy." Another study found that with perfusion angiography of the foot it is possible to obtain stabile, reliable and instant information of foot perfusion, pre- and post-intervention.[2]

Dr Adams shared his hope that his most recent research can be published as soon as possible. The urgency may be due to the benefits seen in 2D Perfusion, but also highlights the current lack of consensus on certain aspects of CLI procedures. There are currently no guidelines for interventionalists performing PTA or other techniques to suggest an optimal treatment approach, and as Prof Reekers suggests, there is a lack of certainty as to which parameters are most likely to predict successful outcome. As a result, many interventionalists face a difficult and often frustrating lack of objective, quantifiable outcome measures as well as a struggle to accurately predict risk of amputation. For these reasons, perfusion angiography and the 2D perfusion technology behind it can provide a necessary guidance through clear and objective perfusion imaging.

References

1 Reekers J *et al.* Functional Imaging of the Foot with Perfusion Angiography in Critical Limb Ischemia. *Cardiovasc Intervent Radiol.* 2015 DOI 10.1007/s00270-015-1253-6.

Disclaimer: The data used to test the feasability of PA were obtained from a consecutive group of 89 patients with CLI who were treated with standard below-the-knee angioplasty and 12 separate patients who were not suitable for endovascular revascularisation. The conclusion of the study also states that "clinical evaluation and standardisation of PA is mandatory before introduction in daily practice".

2 Jens S *et al.* Perfusion Angiography of the Foot in Patients with Critical Limb Ischemia: Description of the Technique. *Cardiovasc Intervent Radiol.* 2014 DOI 10.1007/s00270-014-1036-5.

AngioSculpt PTA scoring balloon catheter

The AngioSculpt scoring balloon catheter for percutaneous transluminal angioplasty (PTA) provides effective plaque scoring for enhanced luminal gain. Its technology features locking in plaque edges with precision and exerting around 15–25 times enhanced scoring force dilation power, followed by a safe and effective dilation power post-scoring.

For Dr George Adams (Rex Hospital and UNC School of Medicine, Raleigh, USA), the AngioSculpt scoring balloon is a "very effective focal force balloon that adequately preps the vessel". The scoring element of the device is created with smooth electropolished nitinol struts, leading to a uniform scoring that results in low dissection rates and no significant device slippage.

"This balloon," Dr Adams explains, "causes microfractures in the plaque to reduce the risk of spiral dissection and recoil. The balloon has a low profile and can be used to treat both below- and above-the-knee lesions. The diameter of the balloon ranges from 2–8mm. Additionally, it can treat long lesions—the longest treatment length being 100mm. The patients that benefit the most are those with harder plaque; heterogeneous and/or calcific lesions."

References

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MASCOT Presented at Veith 2009 (NYC, NY) and CRT 2010 (Washington, DC).

Quick-Cross support catheters

Quick-Cross was developed to give wire support for crossing occlusions, providing assistance in handling any lesion. Dr Martyn Knowles (UNC Rex Hospital, Raleigh, USA) explains how the device is used and what makes it an ideal tool with multiple applications for an interventionalist.

Discussing his experience with the device, Dr Knowles says: "The Quick-Cross support catheter is a versatile catheter for use in a wide variety of interventional cases."

"Whether these catheters are being used during complex aortic cases, such as fenestrated aortic grafts, or wire and catheter exchanges in tibial revascularisations," Dr Knowles explains, "they provide excellent support and trackability. Furthermore, the markers make the catheter easy to identify."

There is a range of support tools for interventionalists to choose from. However, Dr Knowles maintains, "In my practice and experience, the Quick-Cross support catheter exceeds similar devices in terms of support, trackability, and pushability", adding: "The price of the catheter is excellent, which makes it a go-to tool for everything from catheter exchanges to complex interventions. The 0.014 catheter is unmatched in its ability to cross significant lesions in the periphery."

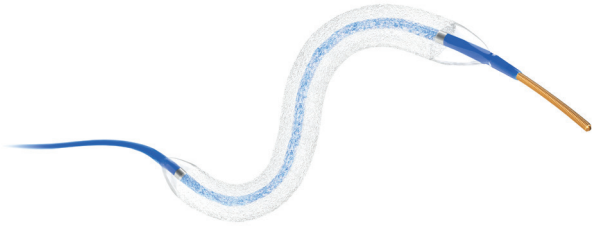
Stellarex drug-coated balloon illuminated by prominent trials

Stellarex is a drug-coated balloon (DCB) for above- and below-the-knee treatment. The DCB has been extensively studied in the ILLUMENATE trials. The trials, which consisted of four studies and included 1,046 patients, were designed as rigorous multicentre studies and included independent adjudication of imaging and adverse events.

All the ILLUMENATE trials met their primary safety endpoints with significantly lower major adverse event rates—individual as well as composite composite—compared to either the performance goal or non-DCB angioplasty control arm. Two of the trials were randomised controlled trials (European RCT and US Pivotal RCT). The European trial demonstrated durability in both safety and efficacy out to two-year follow-up, while the US pivotal trial demonstrated safety and efficacy out to one year, with long-term follow-up currently underway.

"The collective takeaway from the ILLUMENATE trial," Dr George Adams (Rex Hospital and UNC School of Medicine, Raleigh, USA) said, "was to demonstrate a durable effect for a lower dose (2ug per mm^2) drug-coated balloon. Additionally, the studies demonstrated consistency of treatment effect across multiple trials in diverse patient populations." Dr Adams commented the support for Stellarex comes from the two randomised trials "showing a durable treatment effect, with no indication of late catch-up at two years."

"What is unique about Stellarex is that this treatment effect has been observed across multiple randomised controlled trials with different patient populations," Dr Adams said. "In the European RCT, the patient population was very similar to the IN.PACT SFA and LEVANT 2 trials (Admiral and Lutonix DCBs, respectively).



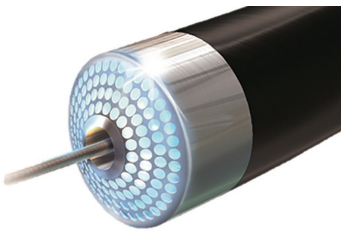
However, in the US pivotal RCT, the patient population was more complex, with a higher incidence of diabetics and calcification."

"The European RCT results support Stellarex DCB as a low-dose DCB with proven efficacy. When seen in context with other DCB trials of similar design; ILLUMENATE European RCT results display high efficacy without any safety trade-off and carrying up to 75% less drug."

"The US pivotal RCT further supports the high primary patency and low restenotic rates; one-year primary patency 82.3% and target lesion revascularisation rate of 7.9%. The patient population studied was challenging, with over 40% of the target lesions being severely calcific and half of them being diabetic."

TurboElite Laser Atherectomy

The TurboElite atherectomy device is a laser-based atherectomy catheter well-equipped to treat challenging cases of in-stent restenosis as well as calcification.



"With recent changes to the catheter, eccentric or focal plaque is treated with the ability to create a directional treatment zone. The ability of laser to treat severe in-stent restenosis is unmatched and allows for successful treatment without compromise," says Dr Martyn Knowles (UNC Rex Hospital, Raleigh, USA).

"The TurboElite Atherectomy device is my go-to device for soft or mixed plaque, in-stent restenosis, and mild to moderate calcification cases. The device allows for a large amount of luminal gain with minimal risk of embolisation," he explains. "In fact, the majority of my experience with the device does not include the use of a filter."

Knowles argues that the TurboElite "far exceeds other similar devices" in terms of ease of use, patient outcomes and cost, offering a wider application. "The device is well suited for a variety of pathology. Laser atherectomy is clearly the industry leader in the treatment of in-stent restenosis that allows for successful luminal gain, which then allows for successful treatment of the underlying lesions. Furthermore, with the information received from IVUS, any soft or mixed plaque lesions are best treated with laser atherectomy."

Phoenix Atherectomy

For Dr Theodosios Bisdas (Universitätsklinikum Münster, Münster, Germany), the Phoenix atherectomy device is a "unique tool" in the endovascular armamentarium.

The device is based on a simple, front-cutting technology that continuously cuts, captures and clears debulked material with just one catheter insertion and reduces potential trauma to the vessel. The internal Archimedes screw allows plaque clearance without the need of a distal protection device and without having to remove the catheter and clean out the debris, decreasing cost and procedure time.

One of the benefits Dr Bisdas sees in Phoenix, as compared to other atherectomy devices, is its ease of use. "Moreover," he says, "the shielded cutter increases the safety of debulking and the 5F profile for below-the-knee arteries is advantageous. Noteworthy is also that there is no risk of vessel collapse due to the absence of any high vacuum pressure. Finally, no capital equipment or infusion pump is required and there is no limited range for vessel treatment."

The Phoenix device is a versatile tool, which according to Dr Bisdas can provide a particularly broad service range "for those interventionalists who support the concept of 'leave nothing behind' in the femoropopliteal artery". The key to achieving technical success with the device, Dr Bisdas says, is by advancing slowly on challenging lesions, paying particular attention to the system lubrication and, crucially, choosing the appropriate guidewire based on the treatment location.

The improved decision-making, outcome assessment and workflow of IVUS clinics

Intravascular ultrasound (IVUS) works to visualise blood vessels from the inside out to help determine which vessels to treat. It is a catheter-based imaging technology that allows physicians to use cross-sectional images, in order to assess presence and extent of disease, plaque geometry and morphology, guidewire position during lesion crossing, and stent position post-treatment.

IVUS allows assessment of stenosis percentage and length, calcium and thrombus, real-time vessel diameters, dissection, position of wire in true or false lumen, location of side branches without using contrast and finally helps to assess the completeness of treatment.

Dr Bibombe Patrice Mwipatayi, (University of Western Australia and director of Perth Institute of Vascular Research in Perth, Australia) sees IVUS as a "crucial and important" tool for management of a wide range of cases. With IVUS, patient anatomy is "clearly determined", Dr Mwipatayi says. He adds that IVUS is important in venous patients "where the decision to stent and to determine adequately which stent size is required. In conditions like May-Thurner syndrome, IVUS should always be used if treatment is required".

Dr Martyn Knowles (UNC Rex Hospital, Raleigh, USA) similarly describes a broad group when it comes to patients that are well-suited for IVUS. "Intravascular ultrasound has proved itself useful in essentially all of my aortic, arterial, venous, and dialysis access cases," Dr Knowles says. "Angiography is limited in its abilities, and misses a large amount of pathology while also possibly over- or underestimating the extent of disease. Furthermore, assessment of an intervention after either atherectomy or angioplasty is necessary to ensure excellent results. Additionally, intravascular ultrasound is an excellent adjunct for anatomical identification and often helps provide precise device placement."

The higher success-rates of IVUS in aiding diagnoses and pathology assessment is accompanied by its avoidance of contrast—a feature which Dr Knowles describes as a "key benefit" of the technology, along with the large amount of information that can be gained from the use of IVUS, such as anatomical identification, location and severity of disease, and confirmation of successful treatment. "Angiography is limited in the ability to completely diagnose or rule out pathology," Dr Knowles adds, "but IVUS augments the findings on angiography for more successful results."

Dr Mwipatayi adds that the multiple projections create clarity of anatomy visualisation, as well the simplifying of endovascular procedures "by providing information that conventional angiogram or venogram cannot provide".

Following implementation of IVUS, improvements in workflow has also been observed. "IVUS has led to many improvements in my workflow and is part of my daily routine in interventional cases," Dr Knowles says. "Through IVUS, I gain a better understanding of the severity of disease and the best device for successful treatment. These choices streamline my overall case flow and decreases procedure time. Furthermore, the successful treatment affords the best ability to avoid early reintervention."

IVUS is compatible with a full line of catheters designed to help guide treatment strategies, including the Pioneer Plus re-entry catheter, Quick-Cross support catheters, the Stellarex and AngioSculpt balloon catheters, and the Phoenix, Turbo-Elite and Turbo-Tandem atherectomy catheters.

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CASE 1

2D Perfusion

Patient

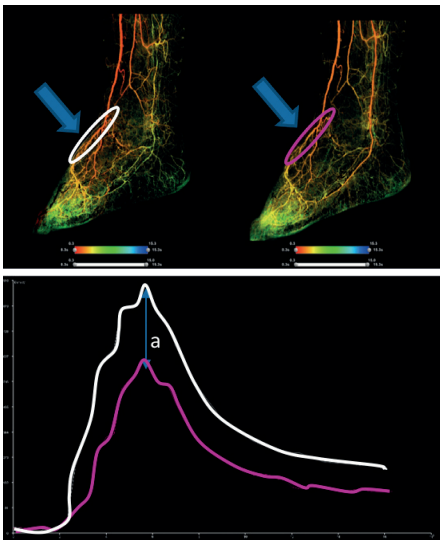
- 55-year old male
- Diabetic
- Critical limb ischaemia
- Recent amputation of the third toe and bad healing of the wound
- Posterior tibial artery occluded and fibular (peroneal) artery fragile, but without significant stenosis

Treatment

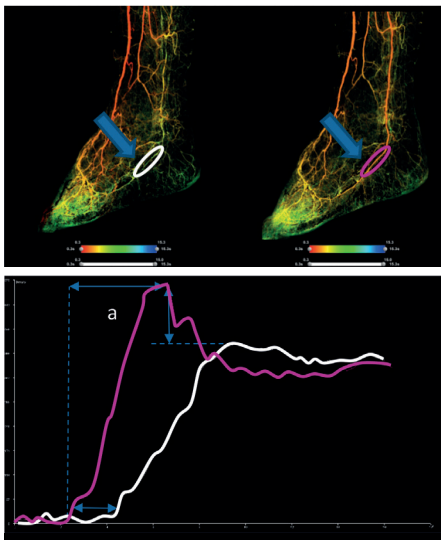
- Balloon angioplasty of the distal part of the posterior tibial artery
- Peroneal artery too fragile to treat

Dr D.A.F. van den Heuvel, Antonius Hospital at Nieuwegein, the Netherlands

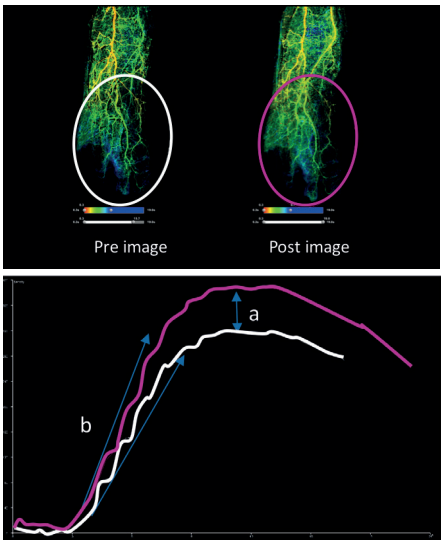
In this case, a 55-year old male patient with diabetes, critical limb ischaemia and recent amputation of the third toe and bad healing of the wound, presented with the posterior tibial artery occluded and the fibular (peroneal) fragile, but without significant stenosis. The distal part of the posterior tibial artery was treated using balloon angioplasty. The peroneal artery was too fragile to treat. 2D Perfusion was used to evaluate the perfusion in the foot before and after treatment. In addition a stealing effect was detected in the dorsalis pedis artery.



Top: Stealing effect in dorsalis pedis artery (DPA), based on pre and post comparison
Bottom: Peak density drops after treatment in the DPA. Area under curve is reduced after treatment, indicating less blood to flow through the region of interest. This suggests a stealing effect due to opening of the PTA.



Top: Posterior Tibial Artery (PTA) shows more and faster flow after treatment
Bottom: Conversely to the effect in the DPA, the PTA perfusion has increased.



Top: The forefoot is supplied with more blood after treatment
Bottom: Considering the whole forefoot, the perfusion characteristics have improved.

CASE 2

PAD treatment algorithm and the value of IVUS

Patient

- 52-year old male with acute chronic occlusion of the left popliteal artery

Tools

- 8F x 65cm Pinnicle Destination guiding sheath
- 6000 units (total) heparin
- Penumbra Cat 8F, 115cm catheter
- Philips PV .035 IVUS catheter
- Boston Scientific Mustang dilation balloon, 5cm x 120mm
- Philips Stellarex DCB, 6cm x 120mm

Treatment

- Post-overnight thrombolysis protocol
- Angiography
- PTA
- Thrombectomy
- IVUS
- Stellarex DCB

Dr Frank Arko, Sanger Heart and Vascular Institute, Charlotte, USA

The patient presented with acute chronic occlusion of the left popliteal artery. Intravascular ultrasound (IVUS) was used to determine the size of the vessel proximal and distal to the affected segment, and plaque morphology in terms of whether there was calcium present and where it was located, whether it was mixed morphology comprised mostly of fibrotic or fibro-fatty material, and whether there was thrombus and how organised it was. Further, IVUS was used to determine the orientation of the wire prior to therapy being performed, to establish whether the wire was sub-optimal or not. Finally, IVUS was used for plaque geometry to determine whether it was concentric or eccentric.

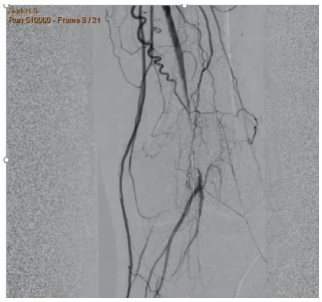


Figure 1: Initial angiogram of the left popliteal artery

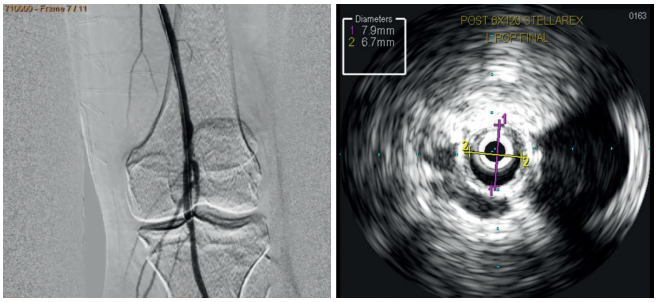


Figure 2 and 3: Final results

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