Supplement to

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Endovascular TODAY

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STRIKING A NEW CHORD IN

VESSEL DILATATION

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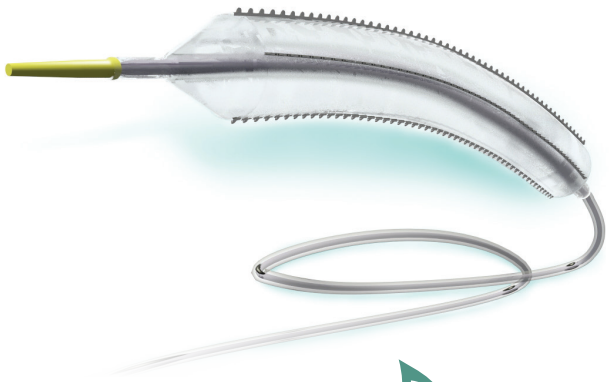
INTRODUCING SERRATION TECHNOLOGY

By Peter A. Schneider, MD

We have had 40 years to perfect balloon angioplasty. Considering its simplicity and low cost, it is an incredible tool for dilatation. In many different procedures over multiple decades, balloon angioplasty has served as definitive therapy. As endovascular approaches and techniques have been applied to more complex lesion morphology, multiple, more advanced definitive therapies have been developed, including drug-coated balloons, drug-eluting stents, stent grafts, bare-metal stents, and woven nitinol stents. All these technologies depend, to some degree, on vessel dilatation. Clinical experience and data are accumulating that demonstrate a need for reliable lumen gain and arterial expansion as part of the endovascular armamentarium for dilatation of lesions.

Drug-coated balloons in particular present a conundrum. Drug uptake may depend on the angioplasty mechanism creating dissection. Aggressive percutaneous transluminal angioplasty with slight oversizing, full expansion, and inflation within 30 seconds of entering the bloodstream are all desirable to promote drug transfer and good results. At the same time, interventionists are attempting to limit dissection by careful balloon technique so that the arterial surface will be smooth.

This is where the value of obstructive lesion treatment with a product like the *Serranator*® (Cagent Vascular) could make a difference in ensuring optimum lumen gain. Serrations in particular may be a good way to dilate a vessel. By creating microchannels, the *Serranator*® provides a line along which the serration balloon energy will dissipate, creating more predictability and control of the lumen expansion. The concept of creating serrations is new to angioplasty; however, it is widely used across multiple industries.



Serranator®
The Virtuoso of Vessel Dilatation

I believe this new technology will offer the same simple, familiar, versatile, easy-to-use features we all know well of standard angioplasty. ■

FUN FACT

The name *Serranator*® is a combination of the words "serrate" and "serenade."

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The *Serranator*® Alto PTA Serration Balloon Catheter

The *Serranator*® Alto PTA Serration Balloon Catheter (Figure 1) is an over-the-wire balloon dilatation catheter designed to perform percutaneous transluminal angioplasty for peripheral vasculature as described in the indications for use statement. The *Serranator*® Alto has a nylon semicompliant balloon with four embedded external serrated metal strips. The serrated strips are designed to create linear, interrupted scoring (Figure 2) along the endoluminal surface during balloon angioplasty.

INDICATIONS FOR USE

The ***Serranator*® Alto** PTA Serration Balloon Catheter is intended for dilatation of lesions in the iliac, femoral, iliofemoral, and popliteal arteries and for the treatment of obstructive lesions of native or synthetic arteriovenous dialysis fistulae. Not for use in the coronary or neuro-vasculature. The *Serranator*® Alto received 510(k) clearance from the US Food and Drug Administration in February 2017.

The ***Serranator*® Bass**, currently in development, will be intended for below-the-knee arteries.

PRODUCT SPECIFICATIONS

- 0.018" guidewire compatible
- 6 F sheath compatible
- Semicompliant balloon
- 150 cm catheter length
- 4.0, 5.0, and 6.0 mm balloon diameters
- 40, 80, and 120 mm balloon lengths

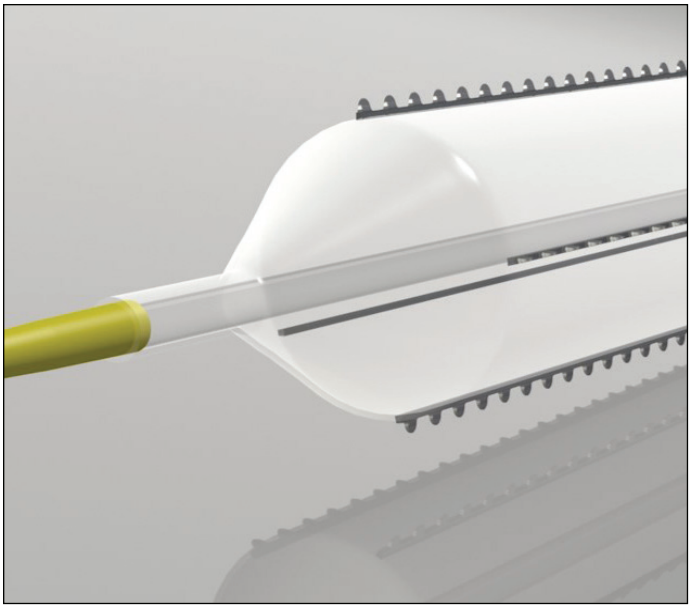

Figure 1. Close-up of the *Serranator*® Alto balloon and its four embedded external metal serrated strips.

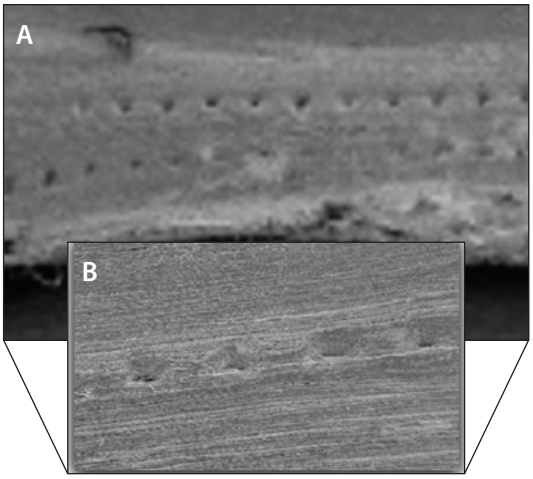

Figure 2. Scanning electron microscopy (SEM) images approximately 5X (A) and 10X (B) of porcine femoral artery surface 7 days after *Serranator*®. Linear, interrupted serrations demonstrate controlled media exposure, circumferential expansion (between each serration), and neointimal healing.

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ASK THE EXPERTS

What Is Your Approach to Vessel Prep?

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What role has device innovation played in your ability to treat more complex lesions?

Innovation has allowed us to treat longer and more complex lesions that otherwise were deemed not treatable. Ten years ago, it would have been a big deal to open a superficial femoral artery chronic total occlusion (CTO) and merely treat it with plain old balloon angioplasty (POBA). If there was no significant dissection, it would have been considered an optimal result. If there was a dissection, we used self-expanding bare-metal stents. Long CTOs were left alone and sent to surgery for bypass. Infrapopliteal lesions were not treated.

Today's innovations allow operators to perform procedures in complex lesions with better devices that prepare the vessel for optimal lumen gain without the added complications that we have seen in the past. The change is unbelievable. The abundance of new technologies has enabled us to treat a full spectrum of disease both above and below the knee due to the availability of debulking devices such as atherectomy, plaque modification devices, specialty balloons, CTO crossing wires, and CTO crossing devices, to name a few.

> All subsequent treatments perform best if the vessel is well prepped.

What devices are still needed today?

We are always going to need a new device of some sort because we continue to push the limit of what we can treat. We still need better vessel prep devices that allow us to gain lumen without risk of dissection or perforation. Additionally, we need devices that provide long-term patency, especially in infrapopliteal lesions.

What balloon dilatation techniques do you use before drug-coated balloons (DCBs)?

As we have learned from the IN.PACT and LEVANT trials, well-prepped vessels respond best to DCB. Therefore, we initially do a 1:1 ratio POBA. If we can achieve proper luminal gain that can be deemed a suitable vessel prep, we proceed to DCB. In settings where POBA isn't sufficient, we escalate our therapy to use specialty balloons (such as high-pressure balloons and scoring balloons) and/or atherectomy.

How important is vessel preparation?

I cannot emphasize enough the value of vessel prep—not just for use before DCBs, but also for acute luminal gain and stenting. Our vision toward vessel prep has become a primary element in the process of peripheral vascular intervention.

In my opinion, a good vessel prep is equivalent to reducing the lesion to < 20% residual stenosis with no flow-limiting dissections and no residual waist on the prepping balloon. Vessel preparation should be optimal despite the final therapy to be delivered. All subsequent treatments perform best if the vessel is well prepped.

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Disclosures: Principal Investigator of the PRELUDE Study.

What role has device innovation played in your ability to treat more complex lesions?

Our traditional approach to complex femoropopliteal lesions has been POBA and bare-metal stents, usually with nitinol self-expanding stents. This strategy produced suboptimal acute results in a significant number of complex lesions and suboptimal midterm results due to restenosis.

Device innovation has allowed improved vessel preparation with technologies including high-pressure balloons, scoring, and cutting balloons, as well as debulking strategies such as atherectomy. We have also used more novel technologies such as the Lithoplasty balloon (Shockwave Medical, Inc.) and angioplasty with the Chocolate balloon (Cordis Corporation).

Device innovation has also resulted in improved mid-term durability, primarily around anti-restenosis strategies with drug-eluting stents and balloons.

What devices are still needed today?

We still need improved vessel preparation devices for complex lesions—devices that are simple to use. Before I think vessel prep was focused mainly on luminal gain. But today we are looking for devices that will give you luminal gain, minimize the severity of dissection, change vessel compliance, and prepare for drug delivery. I think these are the four essentials to help eliminate restenosis. Given the need for durability of drug administration in the femoropopliteal segment, this is becoming more meaningful. Changing vessel compliance is something we should think about, and new technologies are starting to do this. The vessel prep concept has become more sophisticated. We want to be able to achieve all of these things with our prep devices. If a device is able to do all of this at low pressure, then clearly there will be an even greater advantage.

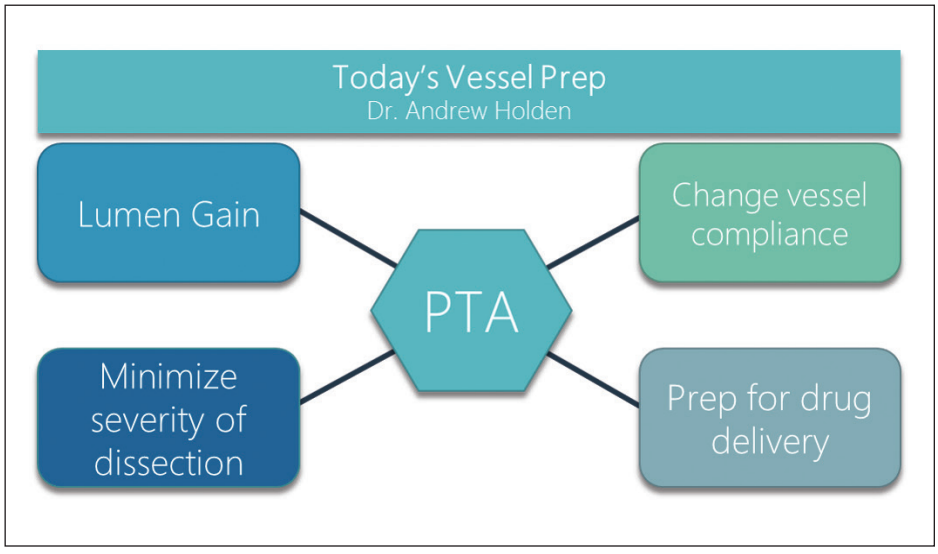
What balloon dilatation techniques do you use before DCB?

I use high-pressure, scoring, and cutting balloons, as well as atherectomy and devices still being studied. Based on what we know, drug delivery is about the depth of penetration and particularly in allowing penetration past the calcium and into the media and adventitia. We know that calcification limits drug absorption. In the days before DCBs, vessel preparation wasn't a concept we had at all. But now it certainly is.

How important is vessel preparation?

With the success of DCBs in vessels that respond well to angioplasty, more focus has gone on to adequate vessel preparation. We now focus on achieving technical success (minimal residual stenosis and dissection) in all patients before treatment with drug-eluting technologies.

Good vessel preparation constitutes achieving significant luminal gain with a residual stenosis ≤ 30% (preferably less than this) and freedom from significant dissection (grade D or worse). In the era of drug-eluting technologies, this should also include techniques to improve drug delivery to the media and adventitia. ■



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The PRELUDE Study

The PRELUDE Study (PRospective Study for the TrEatment of Atherosclerotic Lesions in the Superficial Femoral Artery and/or Popliteal Artery Using the Serranator DevicE) is a single-arm, prospective, multicenter feasibility study enrolling up to 30 subjects with superficial femoral or popliteal lesions. The first case was performed in February 2017. The primary objectives are to collect safety and efficacy data, and to perform 30-day and 6-month follow-up. A secondary objective is to assess the feasibility of using OCT and/or IVUS in a subset of 10 patients to evaluate the presence of serrations. Dr. Andrew Holden (Auckland, New Zealand) is the Principal Investigator of the study, and the coinvestigators are Drs. Marianne Brodmann (Graz, Austria), Marek Krzanowski (Krakow, Poland), and Przemyslaw Nowakowski (Chrzanow, Poland).

PRELUDE STUDY: KEY INCLUSION/EXCLUSION CRITERIA

Inclusion	Exclusion
Resting ABI ≤ 0.9	Previously implanted stent
Rutherford 2, 3, or 4	Rutherford 1, 5, or 6
Lesions within the SFA or popliteal	CTO > 6 cm
Stenosis ≥ 70%	Acute total occlusions; evidence of acute thrombus
One long lesion or multiple lesions up to 10 cm	Severe calcification
De-novo, or non-stented restenotic lesions	Atherectomy

CASE PRESENTATIONS

The cases presented here are five of the subjects enrolled in the PRELUDE study to date. The SFA and popliteal lesions (Cases 1, 2, and 3) ranged from mild to severe calcification. Each case demonstrates effective lumen gain with minimal injury and no flow-limiting dissections after the use of *Serranator*® Alto.

The IVUS and OCT images (Cases 4 and 5) demonstrate clear evidence of serration, disruption of intimal calcification, and acute lumen expansion.

Angiography core lab adjudication was performed at Yale Cardiovascular Research Group under the direction of Alexandra Lansky, MD, and OCT/IVUS core lab adjudication was completed by University Hospitals, Harrington Heart and Vascular Institute under the direction of Hiram Bezzera, MD.

These early clinical results indicate that the effect of *Serranator*® Alto on atherosclerotic and calcified lesions, previously seen in preclinical bench, animal, and cadaver studies, is confirmed.

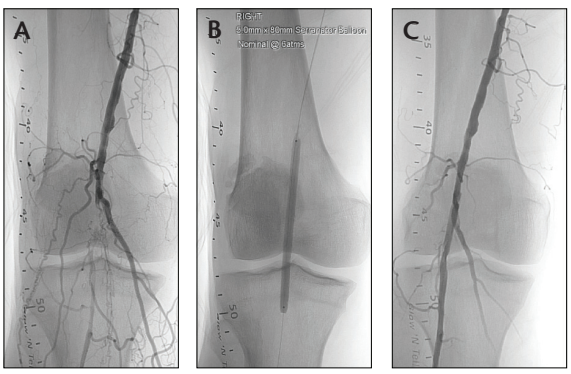
Enrollment in the PRELUDE study is ongoing. Six-month follow-up on all subjects is expected to be completed in Q4 2017. ■

CASE STUDY #1

Right Proximal Popliteal With Total Occlusion

Performed by Dr. Andrew Holden

PRETREATMENT | *SERRANATOR*® INFLATION | POST-TREATMENT



The reference vessel diameter was 4.19 mm; lesion length was 54.28 mm; percent stenosis was 100% (A).
A 5 mm X 80 mm *Serranator*® Alto was inflated to 6 atm (B).
After treatment, residual stenosis was 20.23% (C).

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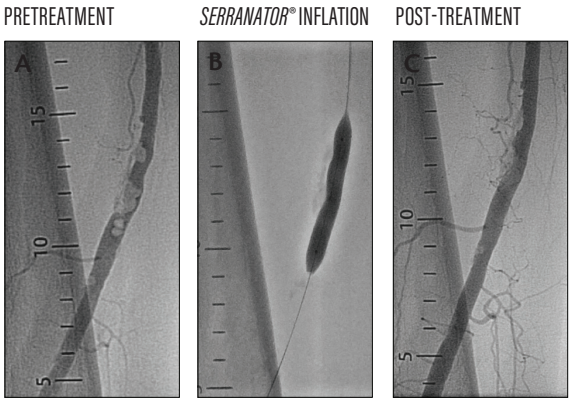
CASE STUDY #2

Right Distal SFA With Severe Calcification

Performed by Dr. Marek Krzanowski

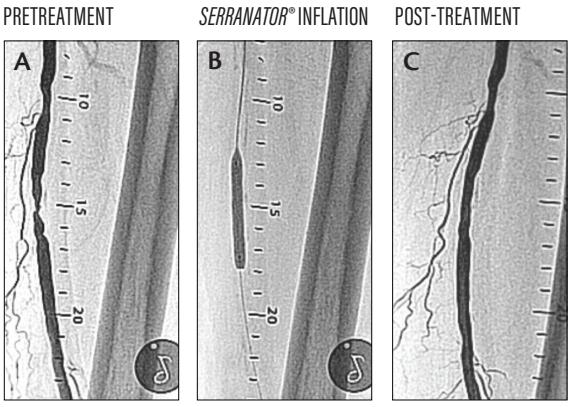


The reference vessel diameter was 6.12 mm; lesion length was 30.04 mm; percent stenosis was 94.59% (A). A 6 mm X 40 mm *Serranator*® Alto was inflated to 11 atm (B). After treatment, residual stenosis was 24.07% (C).

CASE STUDY #3

Left Mid SFA

Performed by Dr. Przemyslaw Nowakowski

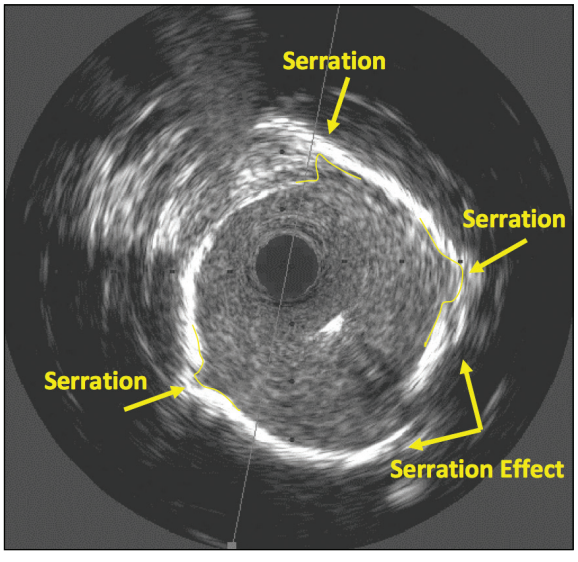


The reference vessel diameter was 5.15 mm; lesion length was 28.42 mm; percent stenosis was 77.02% (A). A 5 mm X 40 mm *Serranator*® Alto was inflated to 6 atm (B). After treatment, residual stenosis was 12.84% (C).

CASE STUDY #4

IVUS of Serration Effect in Mid-SFA Lesion

Performed by Dr. Przemyslaw Nowakowski



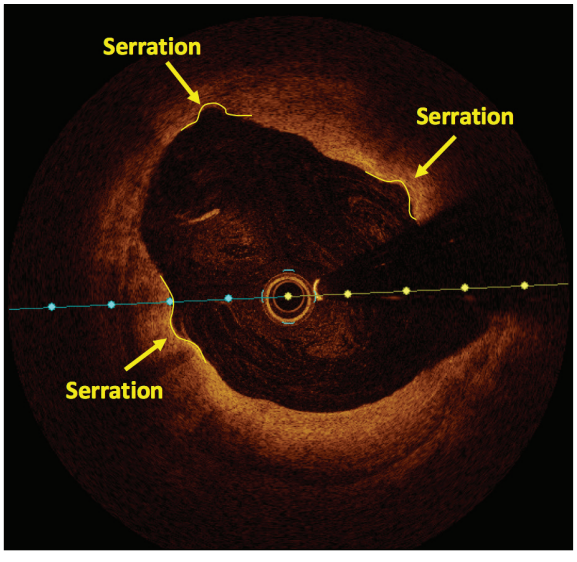
Controlled modification of severe intimal calcification by the *Serranator*® Alto. Note the controlled acute luminal gain of the impacted calcified intimal layer.

—J. Mustapha, MD

CASE STUDY #5

OCT of Serration Effect

Performed by Dr. Andrew Holden



The OCT image shows clear evidence of serration caused by the *Serranator*® Alto device.

—A. Holden, MBChB, FRANZCR, EBIR

Angiography by A. Lansky, MD, at Yale Cardiovascular Research Group.
OCT/IVUS by H. Bezzera, MD, at University Hospitals, Harrington Heart and Vascular Institute.

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