



Balloon Angioplasty of Infrapopliteal Arteries: A Proposed Algorithm for Optimal Endovascular Treatment

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Disclosure

Speaker name: Ehrin Armstrong

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I have the following potential conflicts of interest to report:

Consulting: Abbott Vascular, Boston Scientific, Cardiovascular Systems, Gore, Medtronic, Philips, PQ Bypass, Shockwave

Employment in industry

Stockholder of a healthcare company

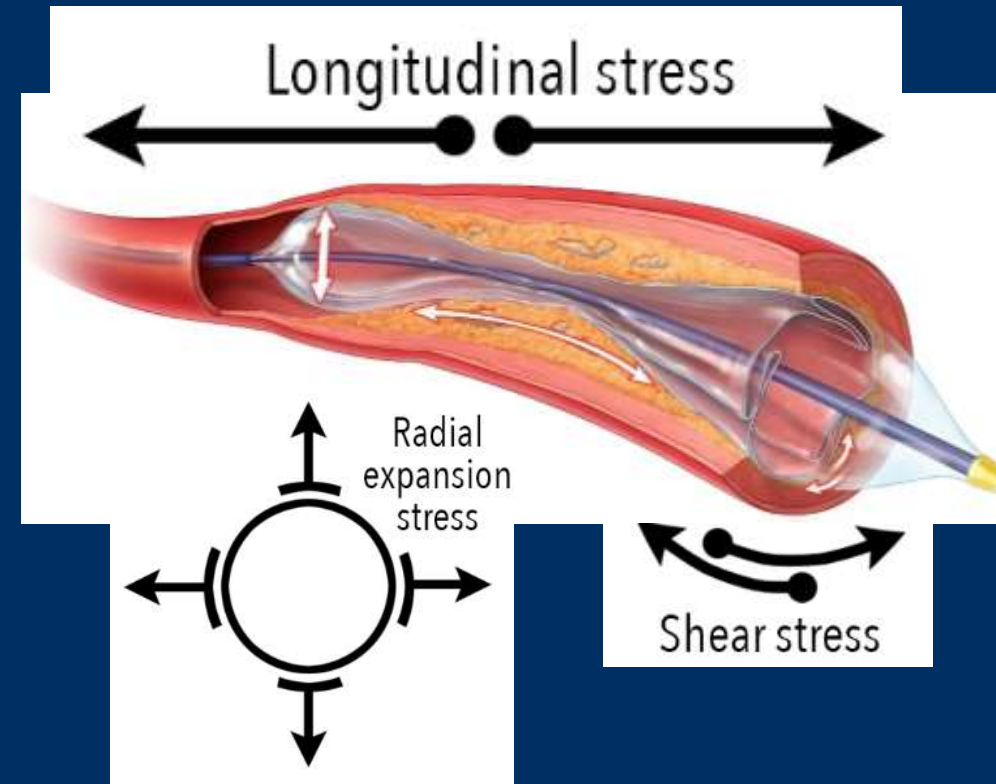
Owner of a healthcare company

Other(s)

I do not have any potential conflict of interest

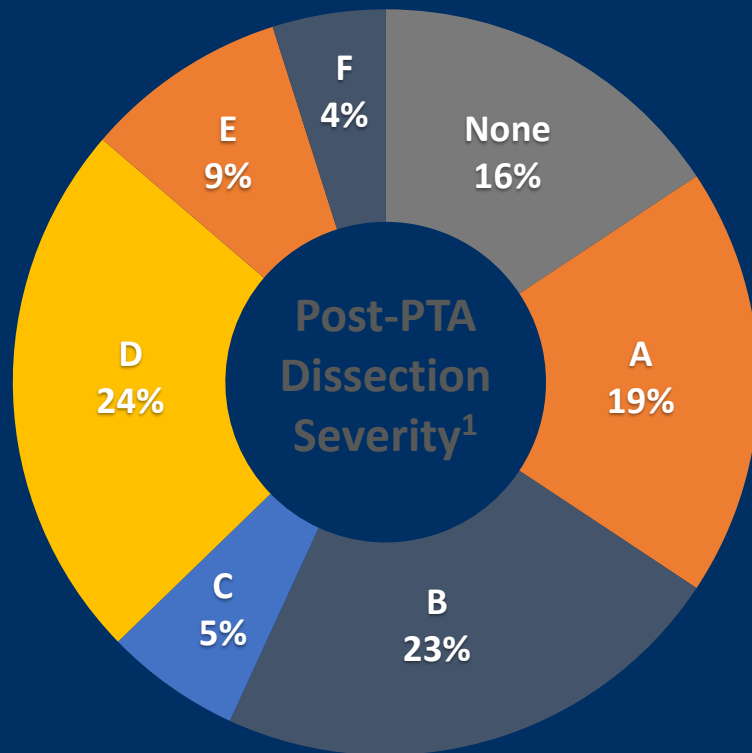
Limitations of Balloon Angioplasty

- Balloon angioplasty is foundation of infrapopliteal endovascular intervention.
- Mechanism of balloon angioplasty is:
 - Subtotal rupture of artery to adventitial layer
 - Dissection of plaque off medial/adventitial interface
 - NOT compression of plaque (impossible)



Dissections Are Common and Are Often Severe

Up to 42% of PTA (POBA or DCB) results in a dissection \geq Grade C^{1,2}



Real World Registry

Stent Rate

Lutonix[®] Registry³

25.2% All Patients

35.7% Lesions 140-500mm

IN.PACT[®] Admiral[®] Registry⁴

24.7% All Patients

40.4% Lesions \geq 150mm

46.8% Total Occlusions

¹Fujihara, *J Endovasc Ther* 2017

²Kobayashi, *Circ Cardiovasc Interv* 2016

³Thieme, *J Am Coll Cardio Interv*, 2017

⁴Micari, *J Am Coll Cardio Interv*, 2018

Early Recoil After Balloon Angioplasty of Tibial Artery Obstructions in Patients With Critical Limb Ischemia

Frederic Baumann, MD^{1,2}; Jacqueline Fust³; Rolf Peter Engelberger, MD¹; Ulrike Hugel, MD¹; Do-Dai Do, MD¹; Torsten Willenberg, MD¹; Iris Baumgartner, MD¹; and Nicolas Diehm, MD¹

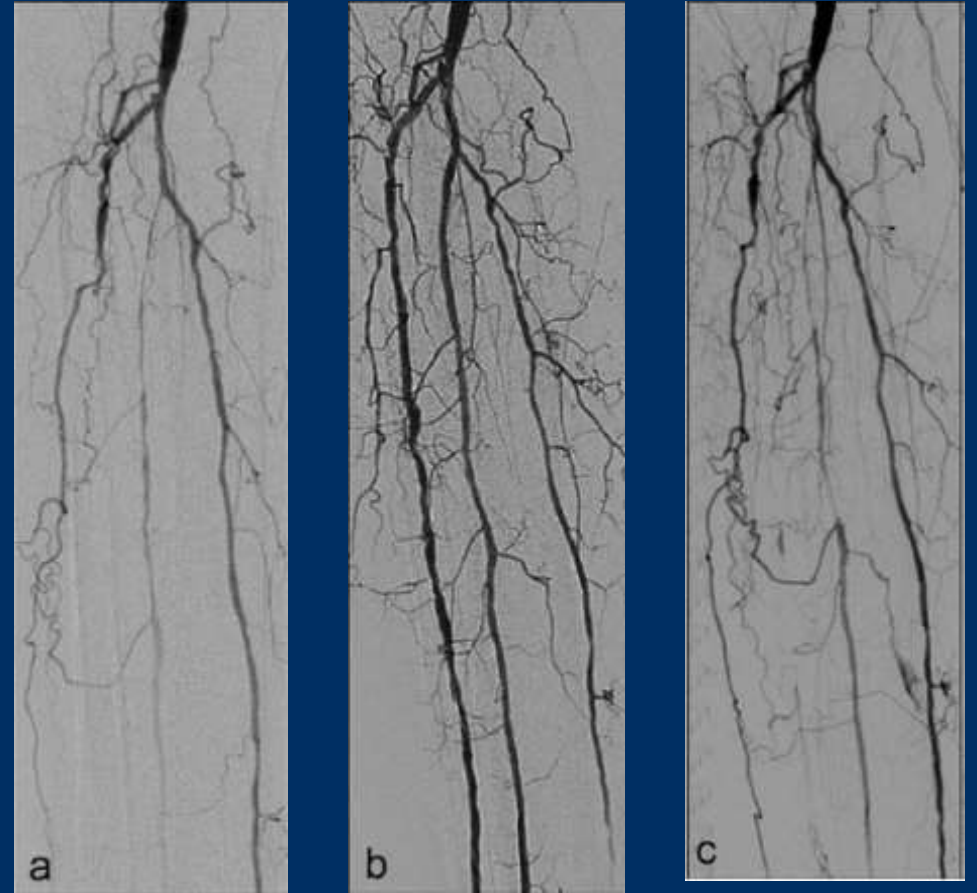
- 30 patients undergoing infrapopliteal balloon angioplasty.
- Angiograms obtained immediately and 15 minutes later.
- 97% had elastic recoil, with mean recoil 29%.
 - More pronounced effect in diabetics.

Elastic Recoil



What are the Patency Rates After Tibial Artery Angioplasty?

- Angioplasty in 77 tibial arteries.
 - Average lesion length 184 mm
 - 65% occlusions
- At 3 months, clinical improvement in 76% of patients.
- Angiographic follow-up
 - Reocclusion in 38%
 - Stenosis > 50% in 31%



Proposed Algorithm for Infrapopliteal Balloon Angioplasty

Step 1: Assess Lesion Calcification

- Consider using IVUS or EVUS to determine calcification extent and location
- If moderate/severe calcium, consider use of adjunctive atherectomy, intravascular lithotripsy, or specialty balloons



Step 2: Select Balloon Diameter and Length

- Size balloon 1:1 or 1.1:1 to reference vessel (typically 3.0-4.5 mm)
- Size balloon 0.5-1.0 mm larger diameter than visual estimate
- Strongly consider IVUS or EVUS for optimal diameter measurement
- Use tapered balloon for long (eg, >200 mm) lesions



Step 3: Optimize Balloon Inflation Technique

- Slow balloon inflation (1 atm every 5-10 seconds)
- Inflate balloon to nominal pressure (4-8 atm)
- Inflate balloon for at least 3 minutes

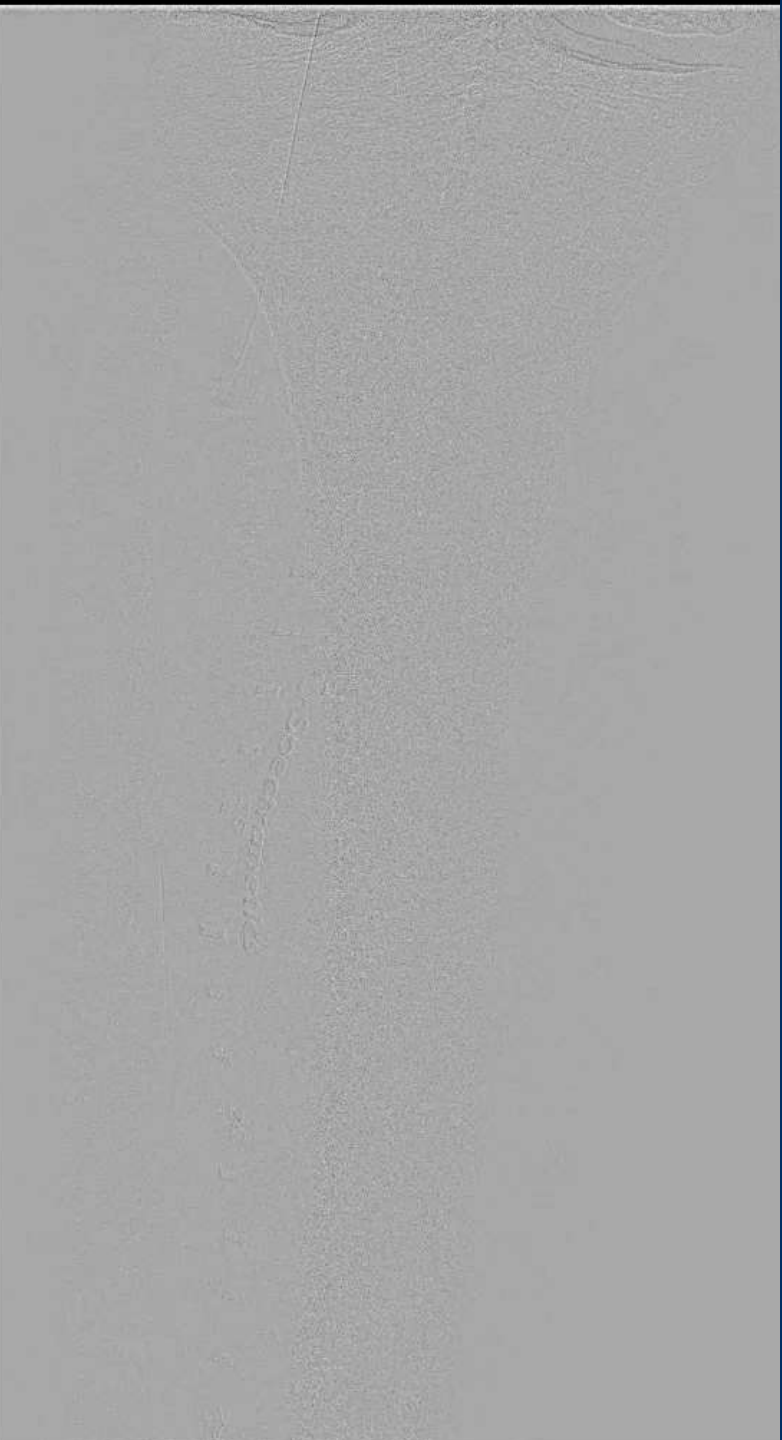
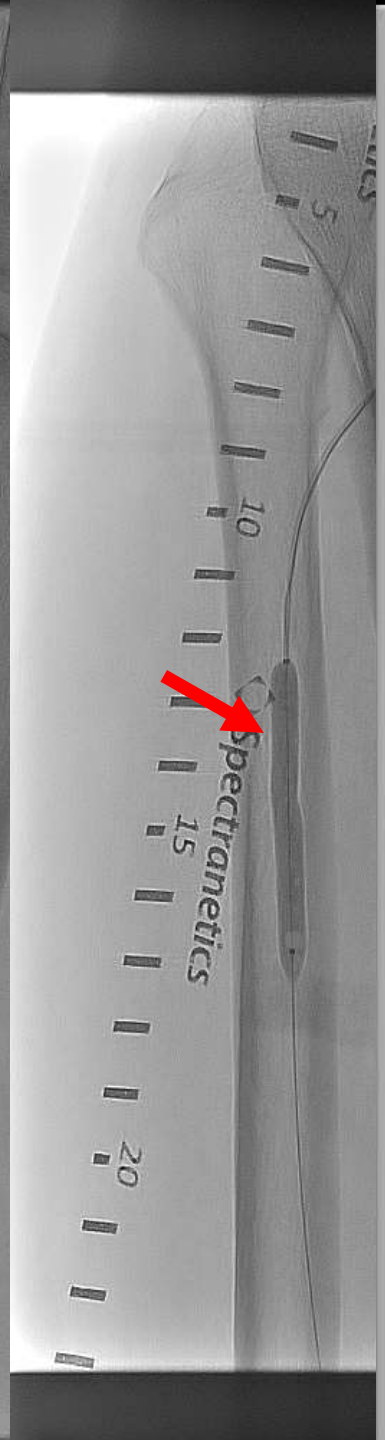
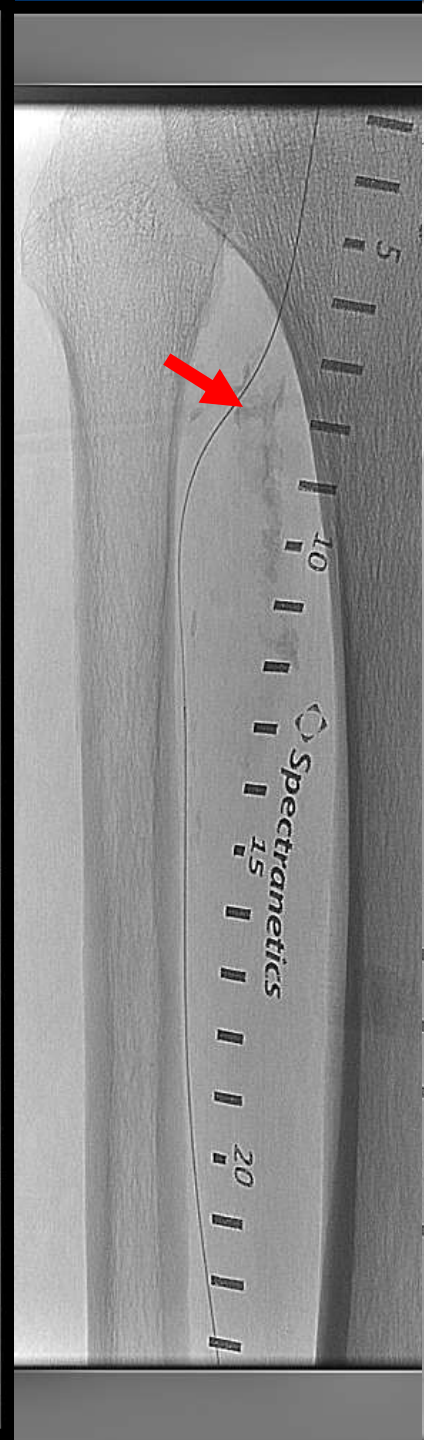
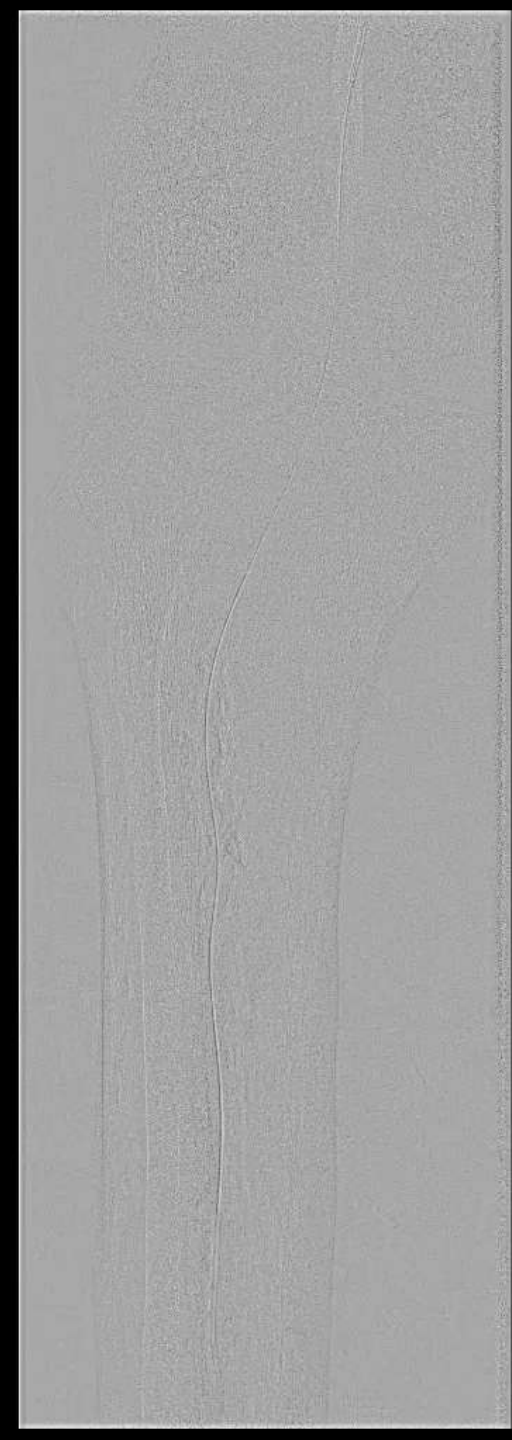


Step 4: Assess Dissection and Recoil

- Utilize multiple angiographic views
- Repeat angioplasty in cases of severe dissection or recoil >30%
- Implant bailout scaffolds for continued dissection

Step 1: Lesion Calcification

- Angiography underestimates the severity and extent of lesion calcification.
 - IVUS is a useful adjunct for determining calcification severity
- Calcification is more common in the infrapopliteal arteries.
- Atherectomy or intravascular lithotripsy may help minimize dissections and need for bail-out stenting.



Step 2: Balloon Diameter and Length

- Select a balloon diameter sized 1:1 or 1.1:1 relative to the vessel diameter.
- IVUS optimizes sizing – consistently 0.5-1.0 larger diameter than angiographic visual estimate.
- Use a long balloon – consider tapered balloons for very long lesions.

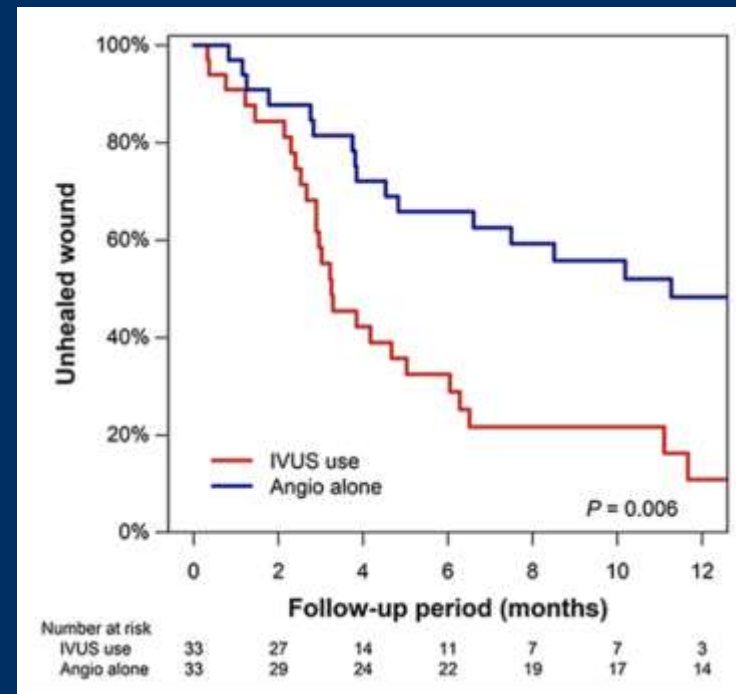
Intravascular Ultrasound–Guided Interventions for Below-the-Knee Disease in Patients With Chronic Limb-Threatening Ischemia

Masahiko Fujihara, MD^{1,2} , Yuko Yazu, CE³,
and Mitsuyoshi Takahara, MD, PhD⁴

88 vessels treated with IVUS vs. 242 vessels treated with angiography alone

Mean balloon size with IVUS was 0.3-0.5 mm larger on average.

No difference in TLR, but improved rate of wound healing with IVUS guidance



Step 3: Balloon Inflation Duration

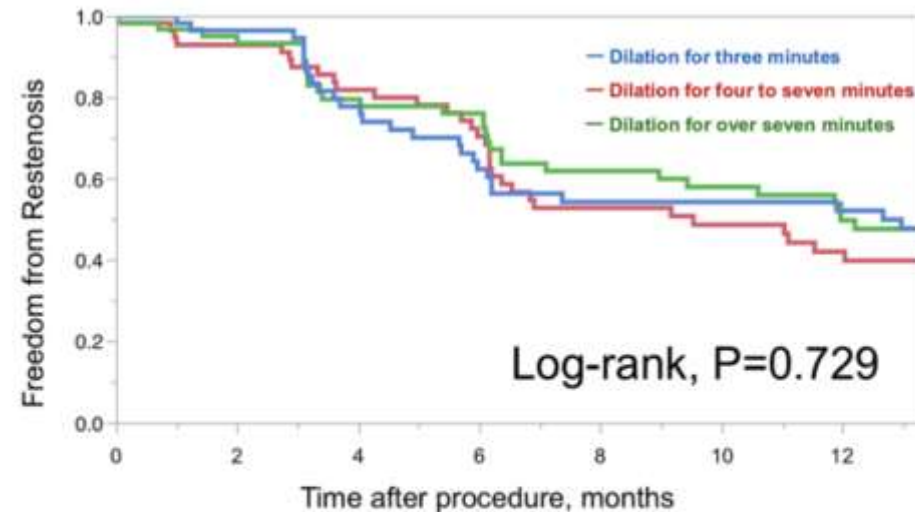
- Inflate balloon slowly.
- Goal is minimal pressure that optimizes balloon expansion.
- Inflate balloon for at least 3 minutes.

Impact of Prolonged Inflation Times During Plain Balloon Angioplasty on Angiographic Dissection in Femoropopliteal Lesions

Kazunori Horie, MD¹ , Akiko Tanaka, MD¹, Masataka Taguri, PhD², Shigeaki Kato, PhD¹, and Naoto Inoue, MD¹

Prolonged balloon dilation >3 minutes associated with lower rates of severe dissection

Additional balloon dilation was more often required if initial dilation was for shorter duration



Months		0	3	6	12
At risk	Three minutes	55	42	28	22
	Four to seven minutes	56	45	29	20
	Over seven minutes	60	47	33	22
Rate (%)	Three minutes	100.0	79.2	54.9	44.9
	Four to seven minutes	100.0	84.9	55.8	39.2
	Over seven minutes	100.0	81.0	61.1	46.8

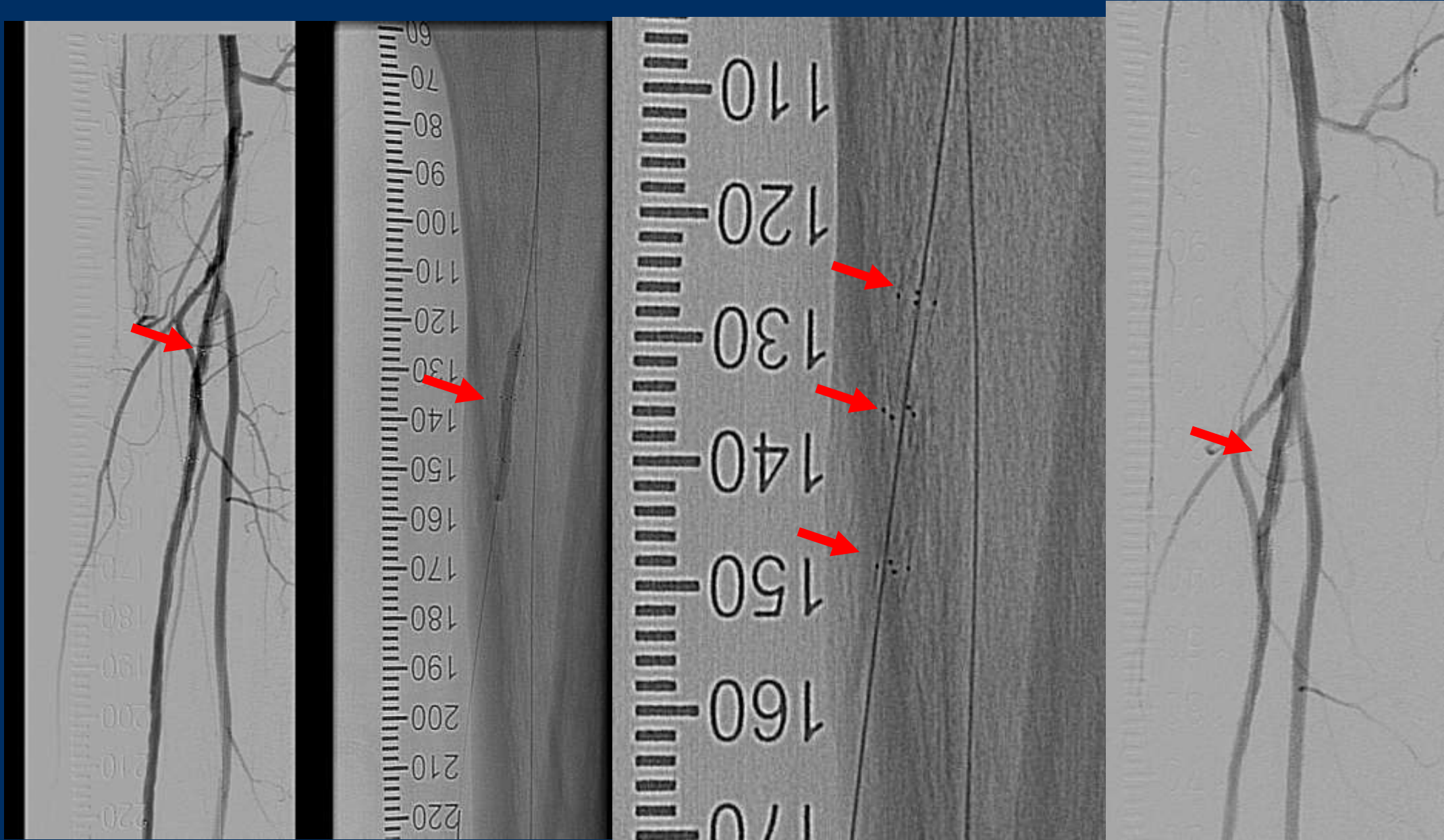
Step 4: Assess Dissection and Recoil

- Utilize multiple angiographic views.
- In cases of dissection or residual stenosis, consider repeat balloon angioplasty.
- In cases of continued dissection, place a tack or stent.

Tack Device For Severe Dissection



Tack Device For Severe Dissection



Summary and Conclusions

- Balloon angioplasty remains the mainstay of therapy for infrapopliteal lesions but has important limitations.
- Careful attention to technique has the potential to improve acute outcomes and potentially long-term patency.
- New purpose-built implants will help improve outcomes.