

***FOLLOW-UP  
after  
PERIPHERAL ARTERY  
ANGIOPLASTY AND STENTING***

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# DISCLOSURE

**R. Eugene Zierler, MD, RPVI**

**No Relevant Financial  
Relationship Reported**



# FOLLOW-UP AFTER ANGIOPLASTY AND STENTING

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## Rationale

- All vascular procedures have modes of failure that must be identified and managed appropriately in order to provide the best possible long-term results
- Follow-up testing is justified only if consequences of failure are severe and early re-intervention improves outcome
- The primary goal of follow-up is to detect clinically significant problems at an early stage when they can be managed most safely and effectively - *even before clinical signs and symptoms are evident*

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## Key Questions

1. What is the role of vascular laboratory “surveillance” after peripheral artery endovascular interventions?
2. How often should we test?
3. Do we need to develop specific duplex criteria for use after endovascular interventions?
4. What are the indications for re-intervention?

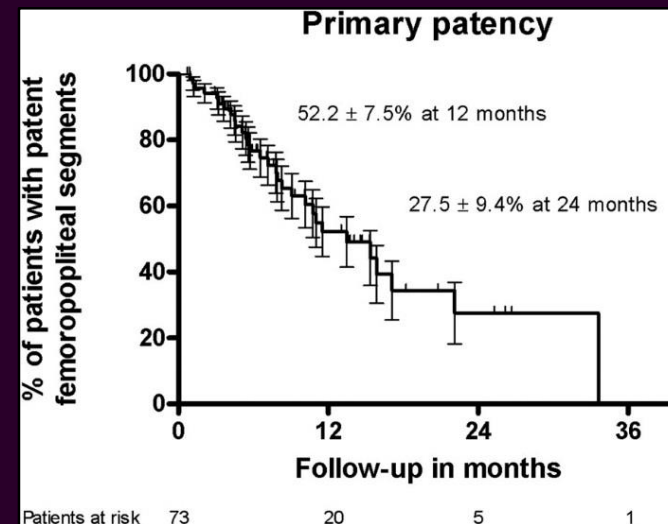
# FOLLOW-UP AFTER ANGIOPLASTY AND STENTING

## Does Surveillance Improve Outcome?

### Endovascular interventions for TASC II D femoropopliteal lesions

Donald T. Baril, MD, Rabih A. Chaer, MD, Robert Y. Rhee, MD, Michel S. Makaroun, MD, and Luke K. Marone, MD, *Pittsburgh, Penn*

- 79 limbs (74 patients) treated (71% CLI)
- Mean follow-up 11 months
- Duplex testing identified
  - 21 re-stenosis
  - 9 occlusions
- 29 re-interventions
- Restenosis and occlusion are relatively common in these complex, long lesions and follow-up utilizing noninvasive testing is required



	<b>1° Patency</b>	<b>1°- Assisted</b>	<b>2° Patency</b>
12 Months	52.2 ± 7.5%	88.4 ± 4.2%	92.6 ± 3.8%
24 Months	27.5 ± 9.4%	74.2 ± 10.9%	88.9 ± 5.1%

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## SVS 2018 Guidelines

1. Extracranial Carotid Artery
2. Thoracic and Abdominal Aorta
3. Mesenteric Arteries
4. Renal Arteries
5. Open Lower Extremity Arterial Revascularization
6. Endovascular Lower Extremity Arterial Revascularization

### SOCIETY FOR VASCULAR SURGERY<sup>®</sup> DOCUMENT

#### Editors' Choice

#### The Society for Vascular Surgery practice guidelines on follow-up after vascular surgery arterial procedures



R. Eugene Zierler, MD,<sup>a</sup> William D. Jordan, MD,<sup>b</sup> Brajesh K. Lal, MD,<sup>c</sup> Firas Mussa, MD,<sup>d</sup> Steven Leers, MD,<sup>e</sup> Joseph Fulton, MD,<sup>f</sup> William Pevec, MD,<sup>g</sup> Andrew Hill, MD,<sup>h</sup> and M. Hassan Murad, MD, MPH,<sup>i</sup> *Seattle, Wash; Atlanta, Ga; Baltimore, Md; Columbia, SC; Pittsburgh, Pa; Poughkeepsie, NY; Sacramento, Calif; Ottawa, Ontario, Canada and Rochester, Minn*

#### ABSTRACT

Although follow-up after open surgical and endovascular procedures is generally regarded as an important part of the care provided by vascular surgeons, there are no detailed or comprehensive guidelines that specify the optimal approaches with regard to testing methods, indications for reintervention, and follow-up intervals. To provide guidance to the vascular surgeon, the Clinical Practice Council of the Society for Vascular Surgery appointed an expert panel and a methodologist to review the current clinical evidence and to develop recommendations for follow-up after vascular surgery procedures. For those procedures for which high-quality evidence was not available, recommendations were based on observational studies, committee consensus, and indirect evidence. Recognizing that there are numerous published reports on the role of duplex ultrasound for surveillance of infrainguinal vein bypass grafts, the Society commissioned a systematic review and meta-analysis on this topic.

The panel classified the strength of each recommendation and the corresponding quality of evidence on the basis of the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system: recommendations were graded either *strong* or *weak*, and the quality of evidence was graded *high*, *moderate*, or *low*. The resulting recommendations represent a wide variety of open surgical and endovascular procedures involving the extracranial carotid artery, thoracic and abdominal aorta, mesenteric and renal arteries, and lower extremity arterial revascularization. The panel also identified many areas in which there was a lack of high-quality evidence to support their recommendations. This suggests that there are opportunities for further clinical research on testing methods, threshold criteria, and the role of surveillance as well as on the modes of failure and indications for reintervention after vascular surgery procedures. (*J Vasc Surg* 2018;68:256-84.)

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## General Considerations

- Clinical assessment: Focused history, examination of pulses, wounds, arterial access sites, and ABIs
- Optimal medical management
- Re-intervention is typically more expensive than the initial procedure and patency rates may be lower
- A baseline duplex within the first month is recommended to serve as a post-intervention baseline and identify residual stenosis



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## Aortoiliac Endovascular Intervention

- Primary patency of aortoiliac stenting:

1 Year	3 Years	5 Years
93%	83%	78%

- Duplex threshold for restenosis: Vr >2.5 or PSV >300 cm/s
- Results of re-intervention are generally good
- No strong evidence that duplex surveillance is beneficial



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## Aortoiliac Endovascular Intervention

1. We recommend clinical examination, ABI, and DUS within the first month after aortoiliac segment EVT to provide a post-treatment baseline and to evaluate for residual stenosis. Clinical examination and ABI, with or without the addition of DUS, should be performed at 6 and 12 months and then annually as long as there are no new signs or symptoms.

Strength of Recommendation: 1 (Strong)

Quality of Evidence: C (Low)

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## Femoropopliteal Endovascular Intervention

- Most commonly treated arterial segment
- Variety of devices and techniques makes follow-up difficult:  
Angioplasty, bare-metal stents, stent grafts, atherectomy
- Assisted primary patency rates are good, but it is not clear if re-intervention in the absence of symptoms is beneficial
- Special consideration may be given to follow-up for complex interventions – since they have the highest risk for restenosis

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## Duplex Criteria for Femoropopliteal PTA/Stent Sites

Study	Stenosis	PSV	Velocity Ratio (Vr)	EDV
Tinder 2008	<50%	<180 cm/s	<2	--
	>50%	180-300cm/s	2-3.5	>0 cm/s
	>70%	>300 cm/s	>3.5	>45 cm/s
Baril 2009	<50%	<190 cm/s	<1.5	
	>50%	190-275 cm/s	1.5-3.5	
	>80%	>275 cm/s	>3.5	
Bui 2012	Normal	<200 cm/s	<2.0	
	Moderate	200-300-cm/s	2.0-3.0	
	Severe	>300 cm/s	>3.0	
Shrikhande 2011	>70%	>223 cm/s	>2.5	

**PSV >300 cm/s or Vr >3.5 are indicators of severe re-stenosis**

*PSV, Peak systolic velocity, EDV, End-diastolic velocity,  
Vr, PSV at site of stenosis/PSV in normal proximal vessel*

# FOLLOW-UP AFTER ANGIOPLASTY AND STENTING

The natural history of duplex-detected stenosis after femoropopliteal endovascular therapy suggests questionable clinical utility of routine duplex surveillance

Trung D. Bui, MD, Joseph L. Mills, Sr, MD, Daniel M. Ihnat, MD, Angelika C. Gruessner, PhD, Kaoru R. Goshima, MD, and John D. Hughes, MD, *Tucson, Ariz*

85 patients, 94 limbs with femoropopliteal endovascular procedures

- Duplex done at  $\leq 1$  week, 3, 6, 12 months, and annually
  - Normal PSV  $< 200$  cm/s and VR  $< 2$
  - Moderate stenosis PSV 200-300 cm/s or VR 2-3
  - Severe stenosis PSV  $> 300$  cm/s or VR  $> 3$
- Initial procedures
  - 44 PTA alone
  - 27 PTA and stenting
  - 23 atherectomy

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85 patients, 94 limbs  
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endovascular  
procedures

- Endovascular procedures vs. vein grafts:
  - ✓ Tendency to develop re-stenosis is greater, but lesions may stabilize or regress over time
  - ✓ Symptomatic patients after endovascular procedures tend to present with re-stenosis
  - ✓ Symptomatic patients after vein grafts are more likely to present with thrombosis
  - ✓ Duplex parameters do not reliably predict occlusion after endovascular procedures

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## Femoropopliteal Endovascular Intervention

2. We suggest clinical examination, ABI, and DUS within the first month after femoropopliteal artery EVT to provide a post-treatment baseline and to evaluate for residual stenosis. Continued surveillance at 3 months and then every 6 months is indicated for the following:

- A. Patients with interventions using stents because of the potential increased difficulty of treating an occlusive vs stenotic in-stent lesion.
- B. Patients undergoing angioplasty or atherectomy for critical limb ischemia because of increased risk of recurrent critical limb ischemia should the intervention fail.

Strength of Recommendation: 2 (Weak)

Quality of Evidence: C (Low)

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## Tibial Artery Endovascular Intervention

- Tibial artery interventions are associated with low patency and high restenosis rates
- Usually done for critical limb ischemia
- Value of adding duplex surveillance to the routine clinical assessment has not been established



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## Tibial Artery Endovascular Intervention

3. We suggest clinical examination, ABI, and DUS within the first month after tibial artery EVT to provide a post-treatment baseline and to evaluate for residual stenosis. Continued surveillance at 3 months and then every 6 months should be considered. Those patients with a deteriorating clinical vascular examination, return of rest pain, nonhealing wounds, or new tissue loss should undergo repeated DUS.

Strength of Recommendation: 2 (Weak)

Quality of Evidence: C (Low)

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## Conclusions

- The role of duplex surveillance after lower extremity endovascular interventions is not well established
- SVS guidelines recommend a baseline duplex within the first month to serve as a post-intervention baseline
- Velocity criteria for severe restenosis have been published
  - ✓ **PSV >300 cm/s or Vr >3.5 for femoropopliteal lesions**
- The guidelines clearly show that there is a need for better clinical evidence on follow-up after arterial interventions (testing methods, threshold criteria, and surveillance protocols)

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Final Thought

Zierler's Law

$$\text{Optimal frequency of vascular lab surveillance} \propto \frac{1}{\text{Durability of the intervention}}$$

*Higher re-stenosis and failure rates require more frequent follow-up testing...*

