

# Popliteal Artery Lesions: Atherectomy, Stenting or Bypass?

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## Disclosure

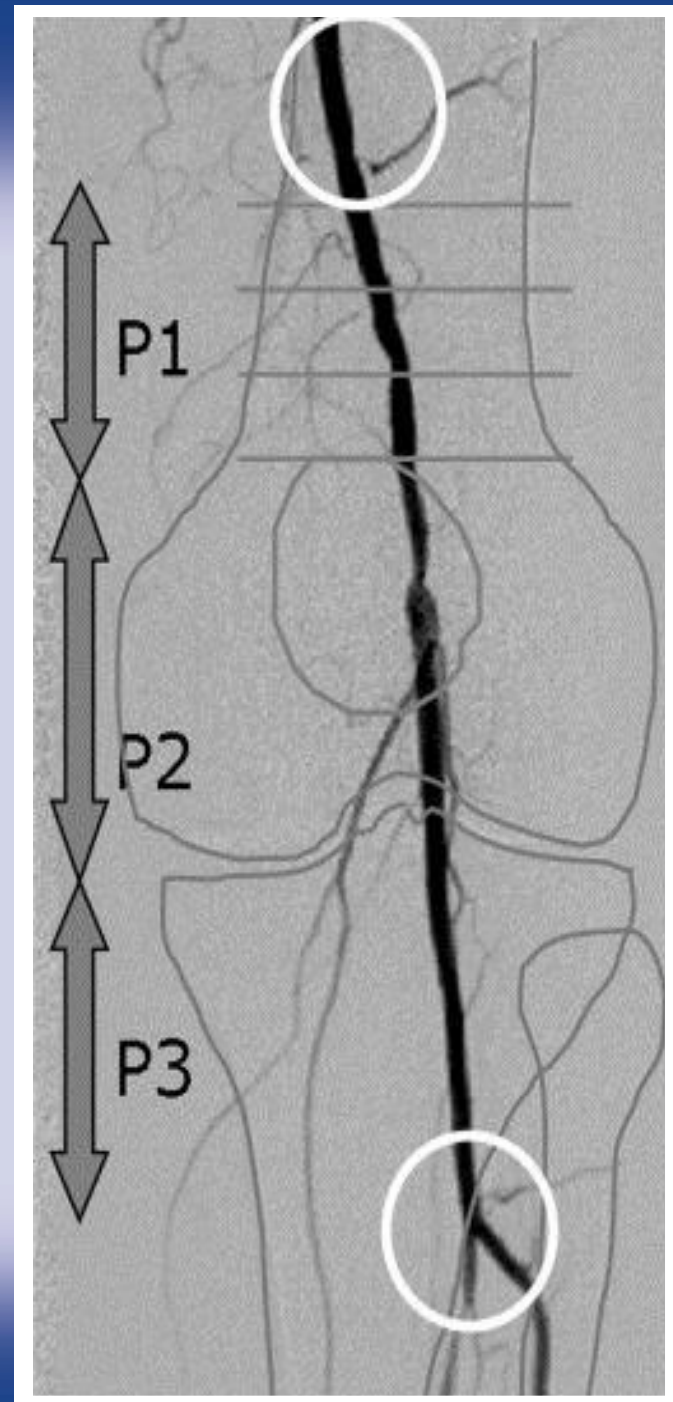
Peter A. Schneider, MD

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I have the following potential conflicts of interest to report:

- Modest royalty from Cook
- Chief Medical Officer: Intact Vascular and Cagent
- Scientific Advisory Board: Medtronic, Cardinal Abbott  
(not compensated)

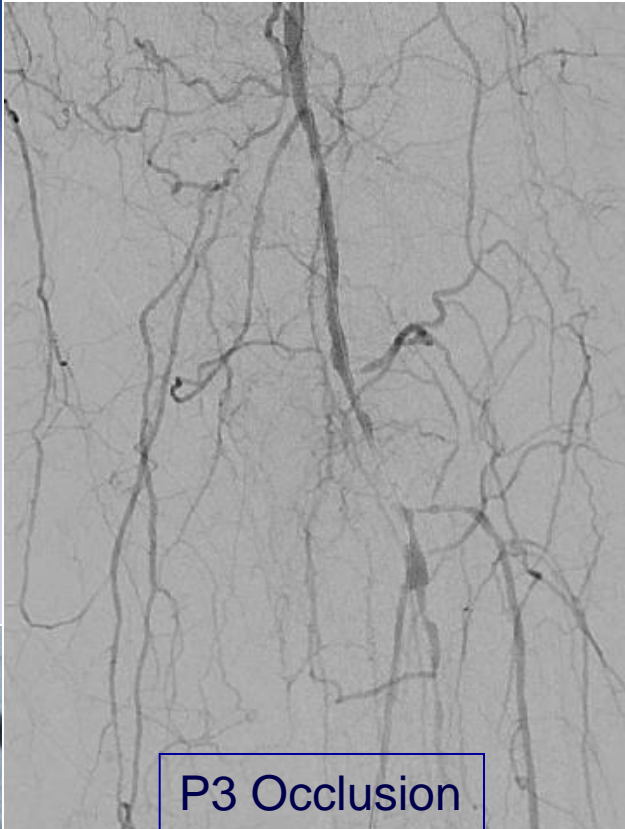
# Popliteal Artery Anatomy



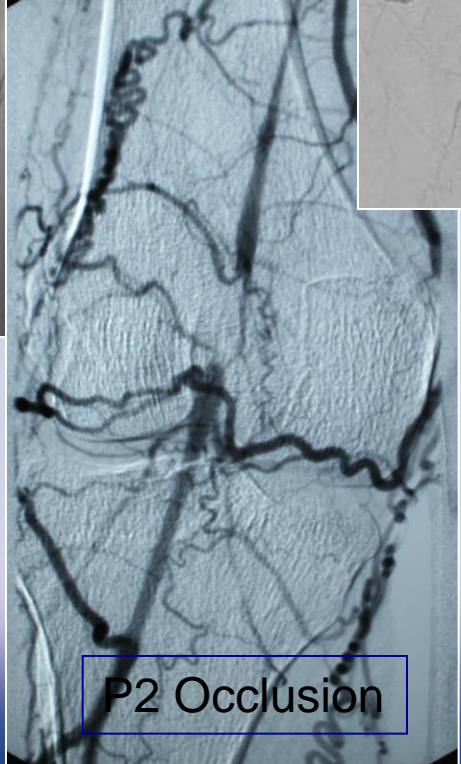
Combined occlusion  
of SFA and P1 with  
reconstitution of  
distal P2



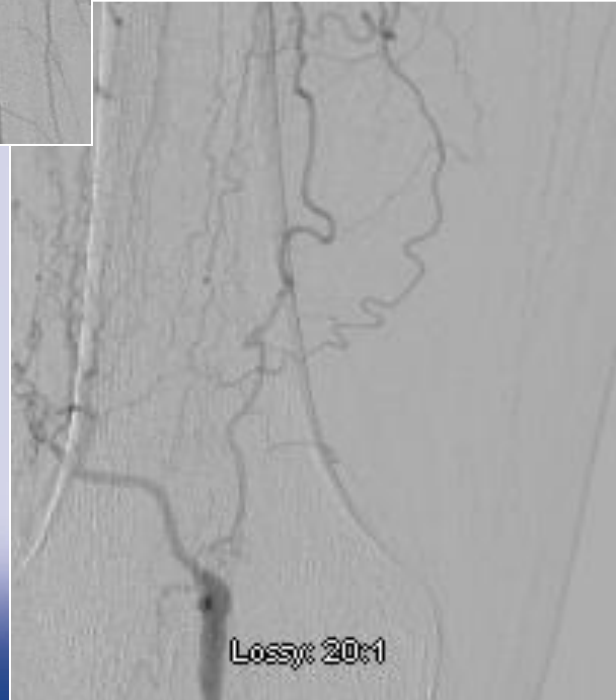
P1 Occlusion



P3 Occlusion



P2 Occlusion



Lossy: 20x1

# Popliteal Artery Length Changes With Position

Conformational Change in the Femoropopliteal Artery With Leg Movement

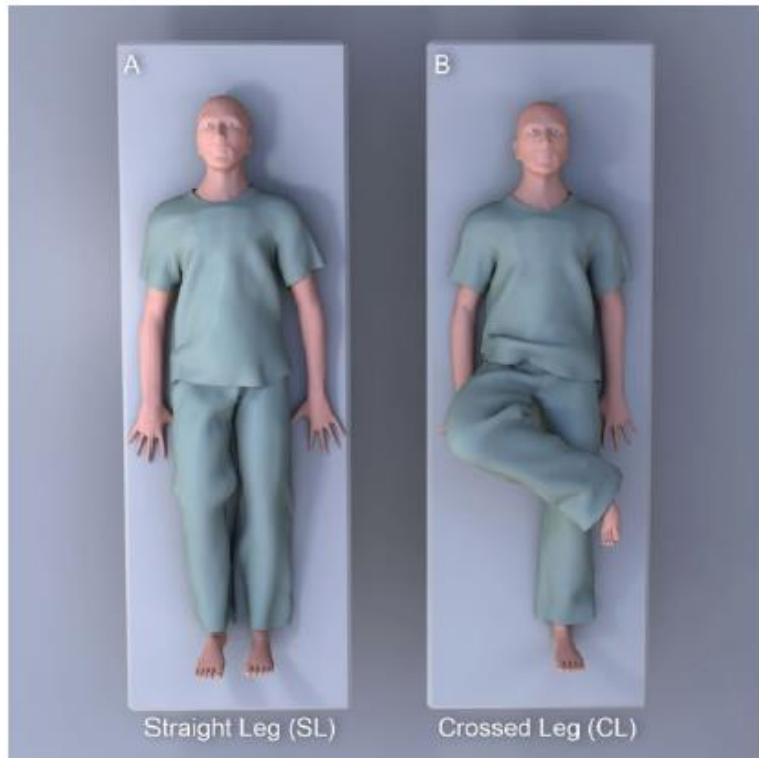


Fig. 2. Demonstration of the straight-leg (SL) and crossed-leg (CL) positions. [Color figure can be viewed in the online issue, which is available at [www.interscience.wiley.com](http://www.interscience.wiley.com).]

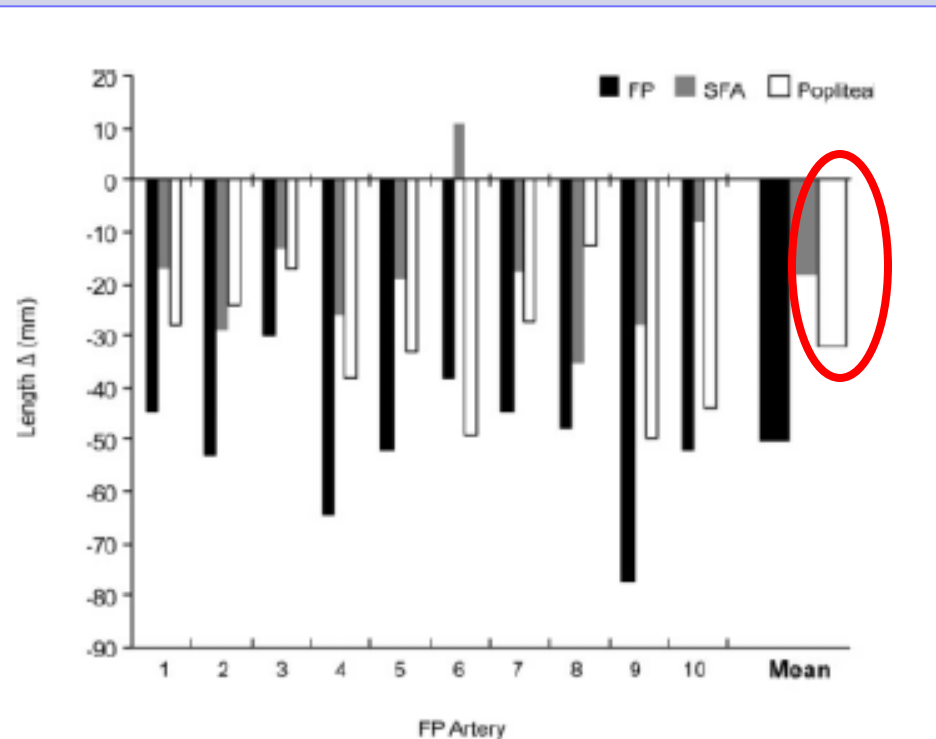


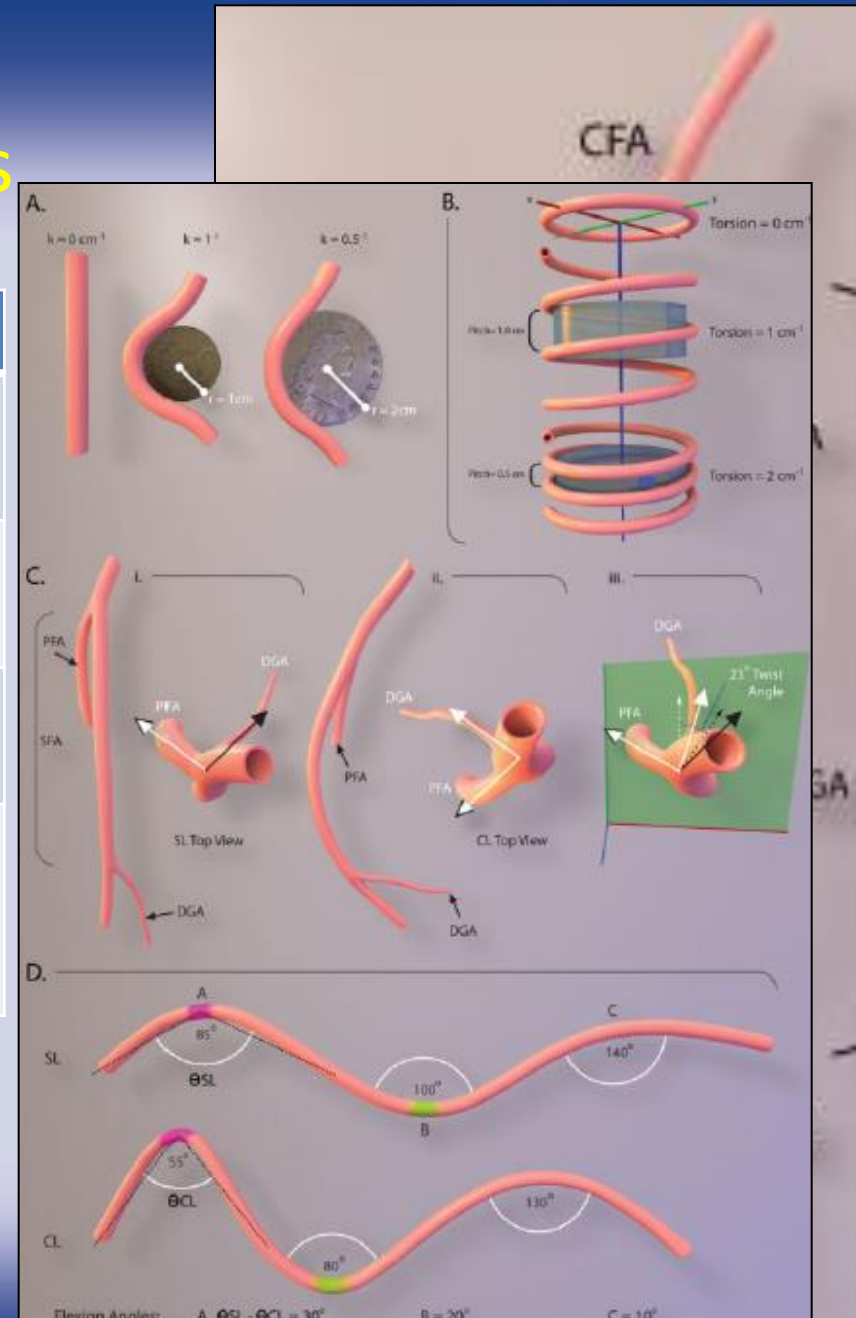
Fig. 6. Absolute change in the length of the SFA, PA, and FP artery between the SL and CL positions for each individual patient.



# Popliteal Artery

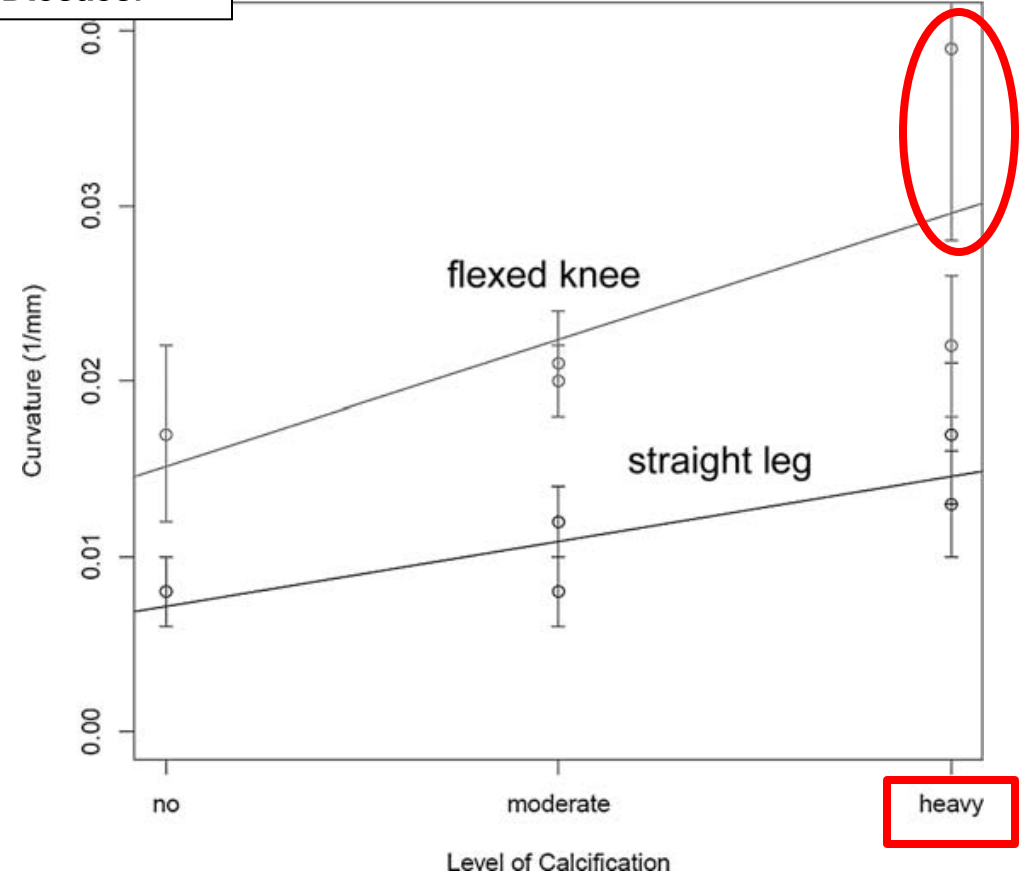
## Conformational Changes

	SFA	Popliteal
Shorten	18mm	32mm
Increased curvature	0.04cm	0.20cm
Twist	46 degrees	61 degrees
Flexion points (>15degrees)	2 of 10	10/10 Avg 2.4 per artery



## Quantification of Popliteal Artery Deformation During Leg Flexion in Subjects With Peripheral Artery Disease:

Spearman coeff.=0.97 (straight)  
and 0.98 (flexed)



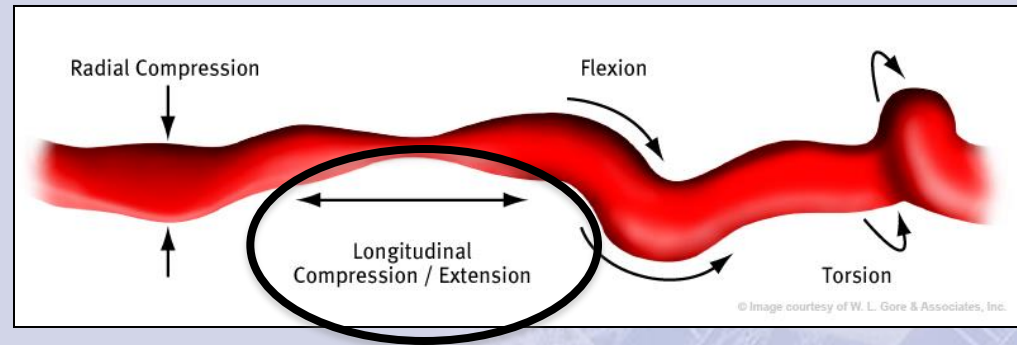
More curvature in the popliteal artery with the knee flexed.

In the more heavily calcified popliteal artery, curvature is more acute.

**Figure 4** ♦ Deformation behaviors of the popliteal arteries of 5 patients with respect to different calcification levels for a maximal curvature ( $\text{cm}^{-1}$ ) in straight and flexed legs. Vascular calcification was assessed using a semi-quantitative scoring system: no (0), moderate (1), and heavy (2) calcification.

# Affect of Stenting the Popliteal Artery

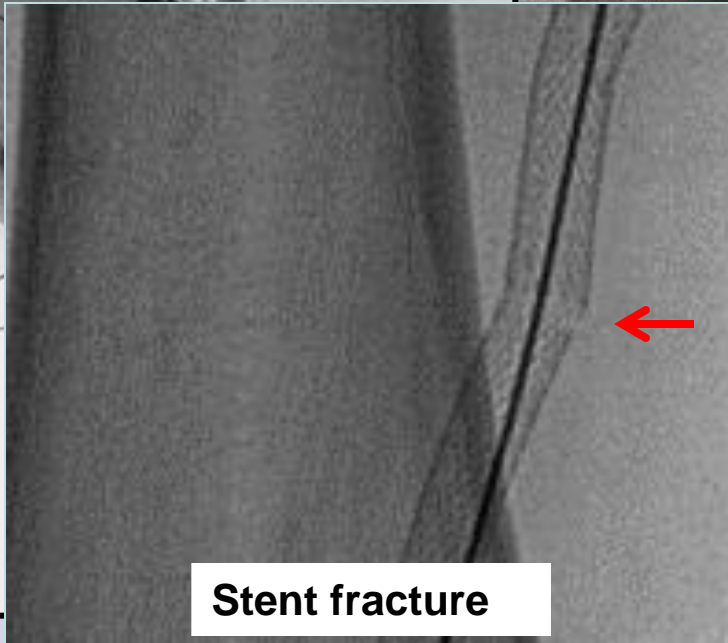
Longitudinal Compression  
90 degrees flexion of knee  
and hip



Location	Native	Stented
Middle SFA	9%	3%
Distal SFA/P1	23%	6%
Popliteal (P2/P3)	14%	11%



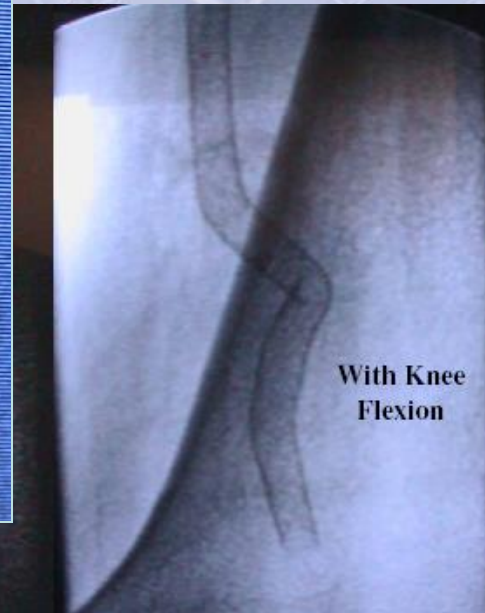
**Kink at end of the stent.**



**Stent fracture**



**at proximal popliteal.**



**With Knee  
Flexion**

The artery is somewhat fixed at the adductor and also by perigenicular collaterals.

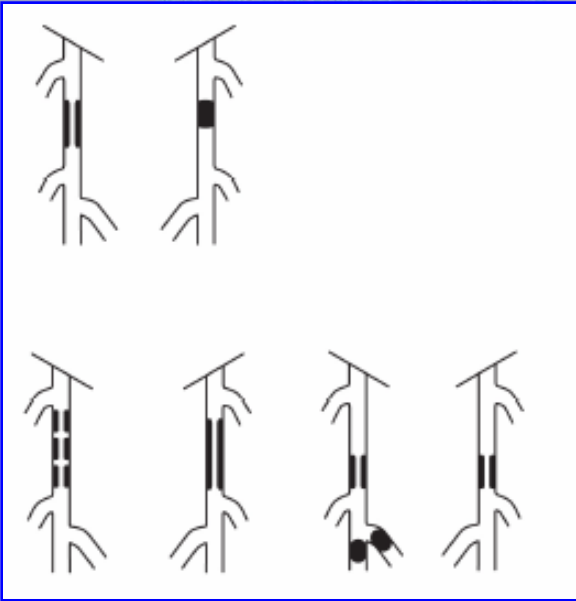
Iida et al. Am J Cardiol 2006;98:272.  
Sirocco J Endovasc Ther 2006;13:701.  
Scheinert et al. JACC 2005;45.

# TASC II

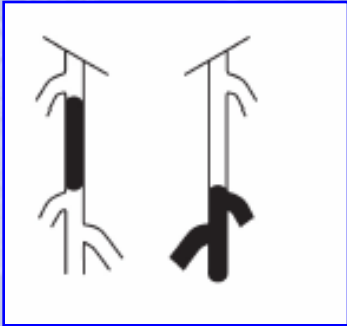
## Table F2 TASC classification of femoral popliteal lesions

MARITTI RIVE GAUCHI & CONFERENCE CENTER PARIS, FRANCE

<b>Type B lesions</b>	<ul style="list-style-type: none"><li>Multiple lesions (stenoses or occlusions), each <math>\leq 5</math> cm</li><li>Single stenosis or occlusion <math>\leq 15</math> cm not involving the infra geniculate popliteal artery</li><li>Single or multiple lesions in the absence of continuous tibial vessels to improve inflow for a distal bypass</li></ul>
	<ul style="list-style-type: none"><li>Heavily calcified occlusion <math>\leq 5</math> cm in length</li><li>Single popliteal stenosis</li></ul>



<b>Type D lesions</b>	<ul style="list-style-type: none"><li>Chronic total occlusions of CFA or SFA (<math>&gt;20</math> cm, involving the popliteal artery)</li><li>Chronic total occlusion of popliteal artery and proximal trifurcation vessels</li></ul>
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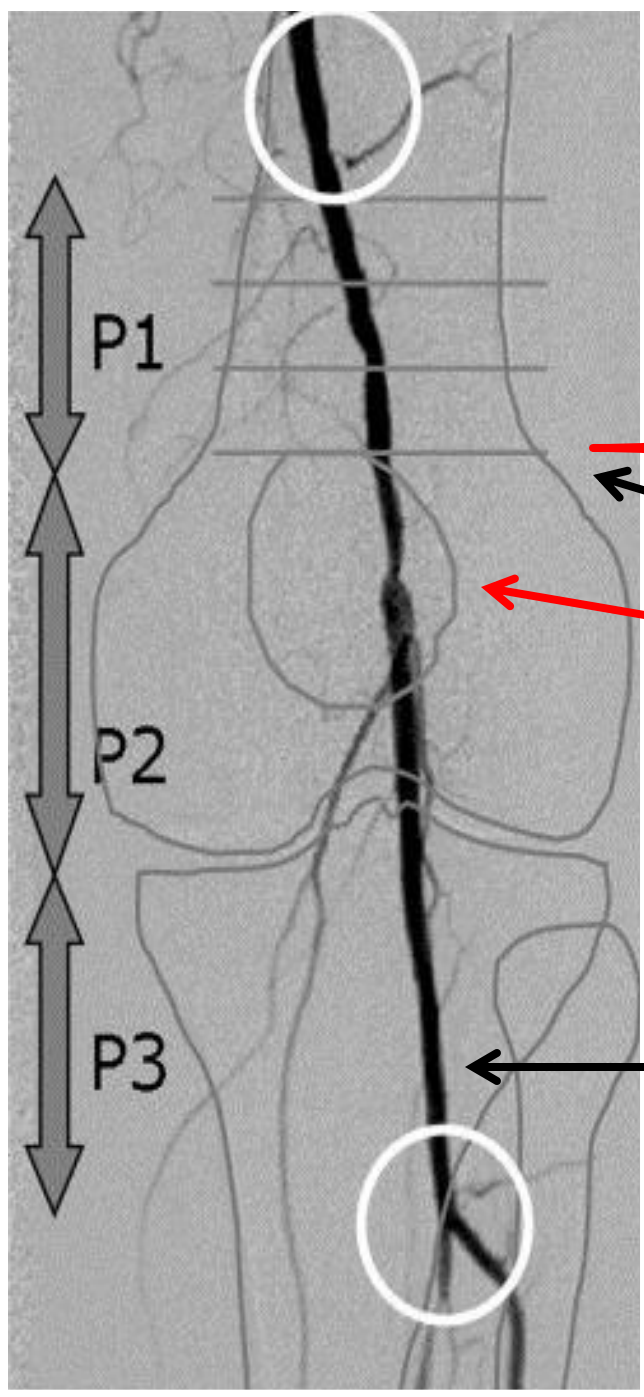


# Major Stent Studies

Parameter (study start)	LifeStent* Resilient (July 04)	Everflex* Durability II (August 07)	Smart* Stroll (August 08)	Complete SE Vascular	Zilver PTX* (March 05)	SUPERA Superb
<b>FDA Approval</b>	Feb 2009	Mar 2012	Nov 2012	no	Nov 2012	March 2014
<b>Subjects</b>	<b>206</b> (72 PTA)	<b>287</b>	<b>250</b>	<b>196</b>	<b>479</b> (241 ZS / 238 PTA)	<b>264</b>
<b>Lesion Length (Min, Max)</b>	<b>61.85</b> 57.2 PTA	<b>109.6</b> (10.0, 180.0)	<b>77.31</b> (15.73, 200.10)	<b>61</b>	<b>54.6 / 53.2</b> PTA	<b>78</b>
<b>12 m Primary</b>	<b>81.5%</b>	<b>67.7%</b>	<b>66.5%</b>	<b>72.6</b>	<b>82.7%</b>	<b>86%</b>
<b>Patency &lt;2.0</b>	36.7% PTA		71.2% (<2.5)		32.7% PTA	
<b>Design</b>	<b>2:1 RCT</b> PTA	<b>OPC *</b>	<b>OPC</b>	<b>OPC</b>	<b>1:1 RCT</b> PTA	<b>OPC</b>

**67-86% one year patency**

# Studies Including Popliteal Artery



Durability Study-Everflex 2.1%

Stroll Trial-SMART 15.6%

Zilver Trial-Zilver PTX 7.2%

Superb Trial-Supera

SFA Trial-In.PACT DCB

Resilient Study-Lifestent 4.6%

Levant 2 Trial-Moxy DCB

Inferior extent of  
angiographic inclusion criteria



***Endovascular Treatment of Atherosclerotic Popliteal Artery Lesions –  
Balloon Angioplasty versus primary Stenting:  
A prospective, multi-centre, randomised study***

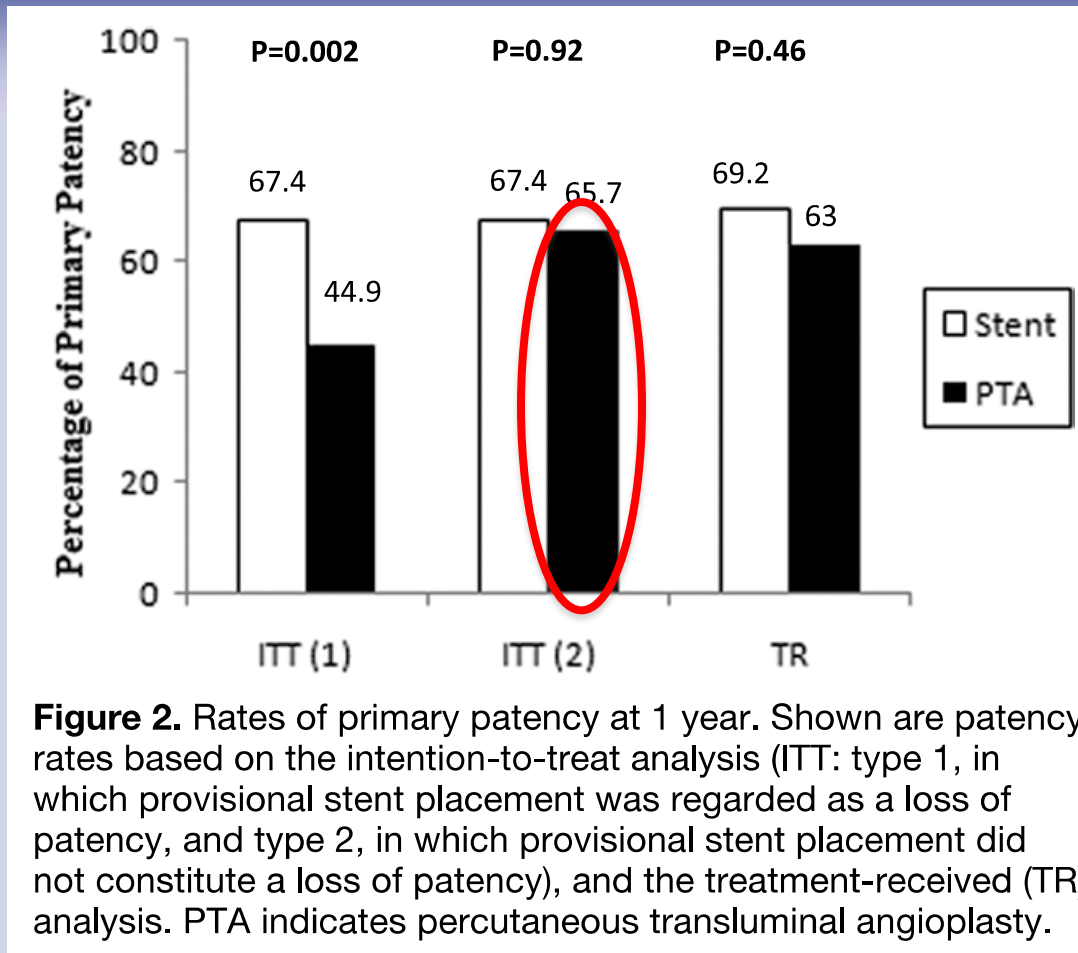
***ETAP***

	<b>PTA N=127</b>	<b>Stent N=119</b>
<b>Lesion length [mm]</b>	43.2±28.1	41.3±31.3
<b>CTO</b>	33% (42)	33% (39)

	<b>All Patients (N=246)</b>	<b>PTA (N=127)</b>	<b>Stent (N=119)</b>
<b>Popliteal I+II</b>	46.7	47.2	46.2
<b>Popliteal II+III</b>	46.7	47.2	46.2
<b>Popliteal I+II+III</b>	6.6	5.6	7.6



# ETAP-Primary Patency at 12 months



**Figure 2.** Rates of primary patency at 1 year. Shown are patency rates based on the intention-to-treat analysis (ITT: type 1, in which provisional stent placement was regarded as a loss of patency, and type 2, in which provisional stent placement did not constitute a loss of patency), and the treatment-received (TR) analysis. PTA indicates percutaneous transluminal angioplasty.

Patency in group with PTA and provisional stent is very similar to results of primary stenting.

# Supera Popliteal Registry

Stented arterial segment	
P1	39 (38.4)
P2	48 (47.5)
P3	14 (13.9)
Total occlusion	48 (47.5)
Stenosis	53 (52.5)
Calcifications	
None	20 (19.8)
Mild	29 (28.7)
Moderate	21 (20.8)
Severe	31 (30.7)
Vessel run-off	
0 or 1 vessel	41 (40.6)
2 or 3 vessels	60 (59.4)
Lesion length, mm*	58.4 ± 34.3 (10–200)
Stent length, mm	84.3 ± 45.1 (40–240)



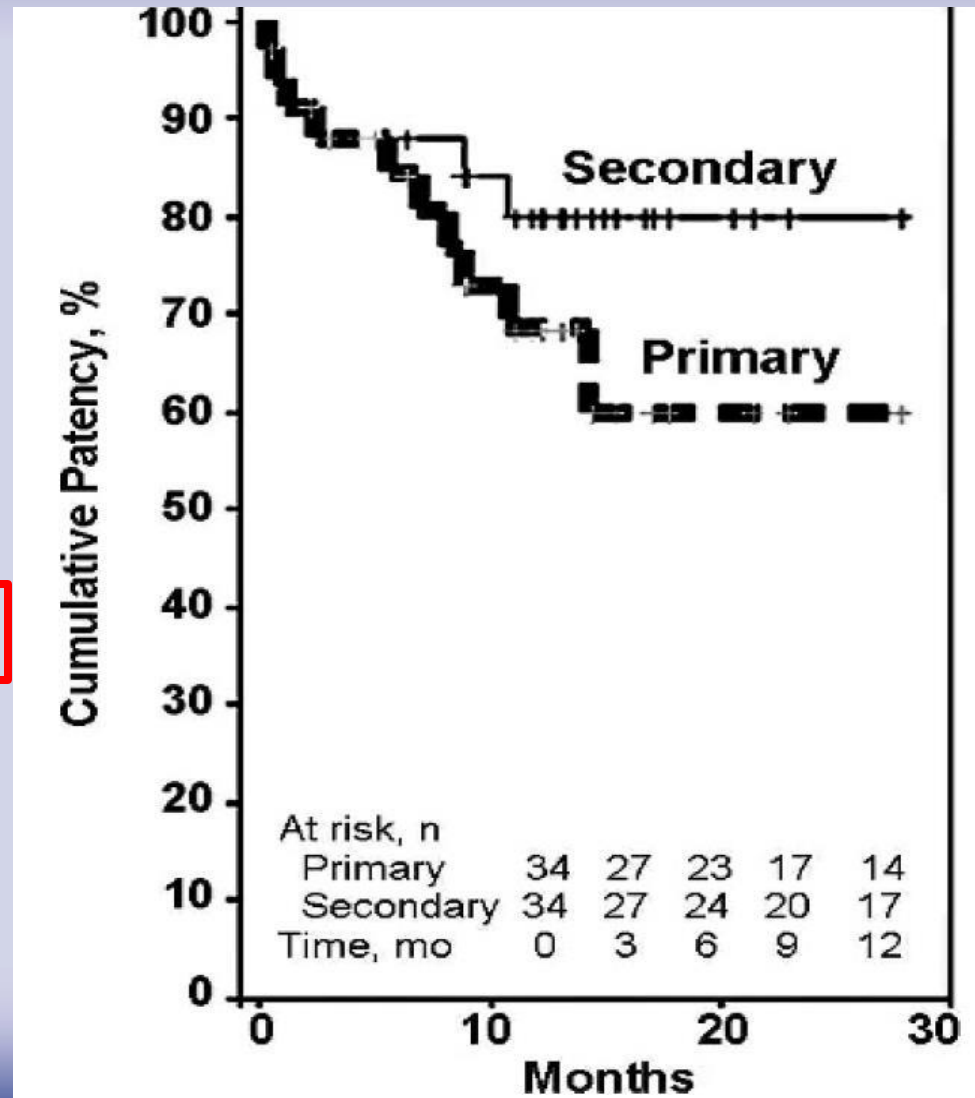
# Supera Popliteal Registry

**Table 3. Stent Patency Rates, ABI, and Cumulative Numbers of Adverse Events at 6 and 12 Months of Follow-Up**

	Baseline	Follow-Up (Months)	
		6	12
Stent patency, %			
Primary	—	94.6 ± 2.3	87.7 ± 3.7
Secondary	—	97.9 ± 1.5	96.5 ± 2.0
Ankle-brachial index	0.58 ± 0.15	0.93 ± 0.19*	0.97 ± 0.18*
Cumulative adverse events			
Death	—	5	10
In-stent occlusion	—	3	4
>50% In-stent restenosis	—	3	6
Amputation	—	0	1
Repeat percutaneous recanalization	—	3	7

# Popliteal Stent for CLI

40 patients with CLI  
Lesions of P1 and P2  
Occlusions: 88%  
Lesion length: 74mm  
12 month patency: 68%



# Popliteal Artery 12 Month Results

## PTA and Selective Stent

Study	Patients	Length	Occl	Bailout stent	Patency of PTA/stent
ETAP	124	43mm	33%	25%	65%
BU	38	46mm	34%	45%	73%

## Atherectomy

Study	Patients	Length	Occl	Patency
Columbia	110	38mm	30%	69%
BU	18	34mm	33%	73%
Columbia P3	100	100mm	45%	65%
U of Michigan	67	82mm	all	55%
Columbia (multilevel)	49	10-18cm	90%	51%

Zeller et al. LINC 2014  
 Semaan et al. Vasc Endovasc Surg 2010;44:25  
 McKinsey et al. Ann Surg 2008  
 Gallagher et al. J Endovasc Ther 2011;18:624  
 Siracuse et al. J Vasc Surg 2014 March 17.

Embolization 1-22%  
 Bailout stent 6-10%



# Primary Stent of Popliteal Artery 12 Month Results

Study	Stent	# pts	Length	Occl	Fracture	Patency
ETAP	Lifestent	119	41mm	33%	4%	67.4%
Melopre	Lifestent	67	63mm	48%	10%	70.2%
Durability	Everflex	60	71mm	45%	0%	70.3%
Popliteal registry	Supera	125	58mm	48%	0%	87.7%
1 <sup>st</sup> US	Supera	34	N/A	44%	0%	79.2%

One year patency 67-87%

Zeller et al. LINC 2014  
Peeters, Bosiers. MEET 2008  
Durability LINC 2014  
Scheinert et al. JACC Interv 2013;6:65  
Leon et al J Vasc Surg 2013;57:1014

# Popliteal Lesions

## This is what I do

	Indication	Comment
Bypass	<ol style="list-style-type: none"> <li>1. Whole popliteal</li> <li>2. Early endo failure (&lt;6 mos) or multiple failures</li> </ol>	Lengthy lesions, esp. if involving whole popliteal artery, esp. with reconstitution in tibials or associated with long SFA occlusion.
PTA/selective stent	<ol style="list-style-type: none"> <li>1. Isolated popliteal lesions</li> <li>2. Associated with SFA or tibial disease that is not contiguous</li> </ol>	Avoid stent when possible. Scoring balloon. Don't stent bypass target site. Favor Supera if stent required
Atherectomy	<ol style="list-style-type: none"> <li>1. Focal, highly calcified stenoses, ledge-like lesions</li> </ol>	DCB may alter use of atherectomy
Other	<ol style="list-style-type: none"> <li>1. Stent-grafts</li> <li>2. DCB</li> </ol>	-Avoid covering pergenicular collaterals -Studies include popliteal