

# Current treatment methods for long occlusions of the femoropopliteal segment in patients with intermittent claudication: Minireview

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**Background.** Intermittent claudication is a classic symptom of peripheral arterial disease. It is mainly treated conservatively but if this fails, a form of revascularization is indicated. The revascularization in chronic occlusion of femoropopliteal region is currently performed by two basic methods: the standard method of surgical bypass and the newer miniinvasive alternative represented by the endovascular method. The treatment of patients with solely claudication and long occlusion of femoropopliteal region remains controversial. The aim of this minireview was to determine whether surgical bypass is still the best method of choice in a time of endovascular techniques.

**Methods.** A MEDLINE search for original and review articles using key terms, intermittent claudication and long femoropopliteal occlusion.

**Results and Conclusion.** No ideal treatment for long occlusions of the femoropopliteal segment has been established to date. It is clear that the role of endovascular techniques in the treatment of SFA occlusions is increasing. It remains that, lower risk patients with claudication should be examined to assess the quality of veins suitable for revascularization and bypass should be selected as the first method of choice.

**Key words:** occlusion of femoropopliteal region, intermittent claudication, femoropopliteal bypass, percutaneous transluminal angioplasty, subintimal angioplasty

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## INTRODUCTION

Peripheral arterial disease (PAD) is a systemic response to atherosclerosis. In Europe and North America, PAD affects approximately 16% of the population over 55 years of age. In patients over 70 years of age, various symptoms of PAD are seen in 20% of the population<sup>1</sup>. Intermittent claudication is a classic symptom of ischemic disease of the lower limbs. Slight to medium claudication affects 2-6% of males and 1-2% of females aged over 60 years<sup>1</sup>. The femoropopliteal region is affected in 30% of patients with PAD. The superficial femoral artery (SFA) is atherosclerotically changed in the form of stenosis and/or occlusions. Stenosis are typically short, less than 5 cm in length, as opposed to occlusions, which are often diffuse, severely calcified and longer than 5 cm (ref.<sup>2</sup>).

Diagnosis is based on physical examination, which includes measuring the ankle-brachial index, objectifying the claudication interval using the treadmill tester, examination by duplex sonography, and imaging methods (CT angiography, MR angiography, and digital subtraction angiography). The various imaging methods have their advantages and disadvantages and their indication often relies on the equipment and practice of the given institution. MR angiography is currently preferred, primarily due to the absence of risks associated with exposition to ionizing radiation, minimization of risks associated with administration of contrast agent, precise imaging and

quantification of calcified stenosis, which CT angiography significantly overestimates.

Intermittent claudications are treated mainly conservatively. Conservative therapy includes an aggressive effort to decrease the risk factors for atherosclerosis, antiaggregation and vasoactive therapy and rehabilitation. A necessary requirement for a good result is cooperation of the patient during exercise aimed at prolonging the claudication interval. Maximum effect to prolong the claudication interval is achieved only when exercising under the supervision of a physiotherapist<sup>3</sup>.

If following conservative treatment the patient feels significantly restricted on walking, a form of revascularization is indicated. Revascularization in chronic occlusions of the femoropopliteal (FP) area is currently performed by two basic methods. A classical method is surgical revascularization using bypass technique with natural or artificial artery replacement - FP bypass. Another newer minimally-invasive method is endovascular treatment - percutaneous transluminal angioplasty without stenting or with the implantation of stentgraft, and subintimal recanalization. Each of these revascularization methods and techniques has its advantages and disadvantages and thus limitations in their use. Knowledge and accessibility of all methods allows us to correctly indicate the proper type of procedure. Revascularization success, both surgical and endovascular, depends on the quality of the inflow and outflow tract. In patients with claudication, revasculariza-

tion of the FP segment should not be indicated if there is a poor outflow tract, which requires placing the distal anastomosis of the bypass or terminating the endovascular recanalization on the III. segment of the popliteal artery (PA). Patients with claudication and poor outflow tract necessitating distal anastomosis of the bypass or termination of the endovascular recanalization to be placed on the III. segment of the popliteal artery should not be indicated for revascularization of the FP segment.

A case in point in the treatment PAD is patients with claudication with solely long occlusion of the SFA without affected AP or leg arteries. In simple terms a long occlusion of SFA is an occlusion longer than 10 cm. These days with the expansion of the endovascular methods, is a relevant question to ask if surgical revascularization using bypass is still the best choice for treatment this specific group of patients.

The results of various types of treatment are evaluated according to technical success, primary patency, primary assisted patency and secondary patency<sup>4</sup>. The most used classification arising from recommendations of Trans-Atlantic Consensus is TASC (Inter-Society Consensus for the Management of Peripheral Arterial Disease), it was published in 2000 and revised in 2007 (ref.<sup>1</sup>).

## METHODS OF REVASCULARIZATION AND THEIR RESULTS

### Surgical treatment

A classical surgical method of revascularization of a long occlusion of the SFA is femoropopliteal bypass extending from the CFA to the first segment of the PA. The affected segment is bypassed with a vascular graft, which may be an autologous vein- most often the great saphenous vein (GSV), an artificial vascular prosthesis or, in special cases, the umbilical vein or a cryopreserved vein is used<sup>5</sup>. An artificial vascular prosthesis is indicated in cases where the vein has an unacceptable diameter (less than 3-4 mm), varicose or postphlebotic changes. These changes are present in up to 30% of patients. The golden standard for vascular prostheses is a prosthesis from expanded polytetrafluorethylene - ePTFE. Utilization of prosthesis for revascularization is supported by a good outflow tract, a preserved plantar arc supplied by two lower leg arteries and/or patients with a short life expectancy<sup>5</sup>. Opinions regarding the recommended use of prosthesis in order to preserve the saphenous vein in patients with claudica-

tions are arguable. On one hand they are supported by a shorter operation time, lower morbidity associated with a smaller operation wound and most importantly the GSV is preserved if needed for coronary bypass or a more distal reconstruction. A clear disadvantage of ePTFE prosthesis is the creation of a neointima, especially on the distal anastomosis. On the other hand quality reconstruction using autologous saphena vein has the lowest number of complications. Only a very small percentage of patients with intermittent claudication require the saphenous vein for coronary bypass<sup>6</sup>.

Femoropopliteal bypass with autologous vein has had the best revascularization results for decades and a metaanalysis of studies, performed by Pereira, confirms this fact<sup>7</sup>. Primary patency when using the saphena vein after five years ranges between 75-84% (ref.<sup>6,9</sup>). Eugster evaluated the results of only patients with intermittent claudication and presented an excellent primary patency after 10 years of 63.5% and primary assisted patency up to 87.3% (ref.<sup>10</sup>).

Femoropopliteal bypass using ePTFE prosthesis is among the most commonly used alternatives to autologous vein. Early results of revascularization (up to two years after bypass) using prosthesis with distal anastomosis above the knee (proximal bypass) are comparable to results using autologous vein, after five years the results are significantly better in favor of the vein (49% vs. 69%) and results of studies after 10 years are lacking, with one exception<sup>11</sup>. Another alternative to using autologous vein is a Dacron prosthesis. Results of studies comparing the results of Dacron and ePTFE prostheses for proximal bypass are contradictory. While Aune presents comparable results with primary patency of 58% after 5 years<sup>12</sup>, another multicentric study by Jensen showed a difference after 2 years favoring Dacron (76% vs. 65%) (ref.<sup>14</sup>). Results of individual studies based on the type of prosthesis used are shown in Tables 1-2.

A comparison between bypass using autologous vein and ePTFE prosthesis in patients with claudication under comparable conditions was performed by AbuRahma and Ballotta. The main part of their method included performing the revascularization on one limb using autologous saphena vein and on the other limb using ePTFE prosthesis. After 5 and 6 years of follow-up the results of these revascularizations were comparable<sup>15,16</sup>.

Most authors showed that a predictive factor affecting the results of FP bypass is the quality of the outflow tract or the number of patent lower leg arteries and filling of

**Table 1.** Results of FP bypass – comparison between autologous vein (VSM) and ePTFE prosthesis.

Author	AbuRahma		Burger		Klinkert		Sala		Ballotta		Pereira	
Year of publication	1999		2000		2003		2003		2003		2006	
Follow-up	6 years		2 years		5 years		4 years		5 years		5 years	
Number of patients	43		136		151		75		51		–	
Replacement used	VSM	ePTFE	VSM	ePTFE	VSM	ePTFE	VSM	ePTFE	VSM	ePTFE	VSM	ePTFE
Primary patency in %	76	68	83	67	75.6	51.9	82.8	84	94	84	77.2	57.4
Secondary patency in %	85	77	83	77	79.7	57.2	80.6	79.5				
Cummulative patency in %	74	39					62	44				

**Table 2.** Results of FP bypass – comparison of results based on type of prosthesis used.

Author	Aune		Jensen	
Year of publication	2000		2007	
Follow-up	5 years		2 years	
Number of patients	103		427	
Material	Dacron	ePTFE	Dacron	ePTFE
Primary patency in %	58	58	70	57
Secondary patency in %			76	65

**Table 3.** Results of endovascular methods.

Author	London	Saxon	Köcher	Scott	Kougias
Year of publication	1994	2007	2008	2008	2009
Follow-up	3 years	4 years	3 years	3 years	1 year
Method	SIR	Viabahn	SIR	SIR	SIR+Viabahn
Follow-up	3 years	4 years	3 years	3 years	1 year
Number of patients	200	76	123	472	57
Primary patency in %		55	48.4	25	75
Primary assisted in %	56	67		50	84
Secondary patency in %		79			

the plantar arc. When evaluating the results of patients with intermittent claudication, most authors agree that it has not been established that they are influenced by the number of patent arteries<sup>14,16,17</sup>. Despite the good results of FP bypass mentioned above, the authors caution to carefully indicate these revascularizations in patients with intermittent claudication. They advise to maximize the utilization of conservative therapy possibilities. At the same time, Pereira in his meta-analysis discovered that in cases of bypass revascularization in patients with claudication, there is no reason to save the autologous saphena<sup>7</sup>.

#### Endovascular methods for treating long occlusions of the SFA

Endovascular treatment is based on percutaneous transluminal angioplasty (PTA). The goal of PTA is to dilate the pathologically changed arterial wall together with the atherosclerotic plaque. The main mechanism of angioplasty is the insertion of a lead wire into the narrowed or occluded arterial segment followed by dilation using balloon catheter of the entire media and part of the adventitia so that even the external diameter of the artery is extended. In cases of persisting stenosis after dilation, a stent/stentgraft may be applied. In the treatment of short stenosis or occlusions of the SFA, the best results are achieved with PTA. However, the technical success and results of this method in treating occlusions longer than 10 cm are not as convincing. One way of improving these results and maintaining long-term patency is stenting. Indications for primary stenting of the SFA and its results are often the subject of studies. Three randomized studies using PTA and nitinol stents were performed in patients with claudication<sup>18-20</sup>. Better results of primary stenting were achieved in patients with longer lesions. Primary stenting of lesions with an average occlusion length of 130 mm in a study by Schillinger was better than secondary stenting<sup>18</sup>.

PTA alone for long occlusions of the femoropopliteal segment has low primary technical success and poor long-term results with a high rate of restenosis. Another method improving the results of angioplasties in this area is subintimal recanalization (SIR). Its goal is to bypass the long occlusion of the artery through the subintimal space with subsequent dilation of this space. Dilation of the subintimal space and its patency may, in certain indicated cases, be supported by stent. The author of the SIR technique, A. Bolia reports a primary patency after SIR without stent of 71% after 12 months and 58% after 3 years<sup>21</sup>. Studies which include only patients with claudications after SIR present a clinical success rate of 58-90%, a primary patency of 56% after one year, and primary assisted patency of 52-56% after 3 years<sup>22-25</sup>. Bolia reports that SIR is a treatment alternative in patients with claudication, who have a longer claudication interval and where the risks associated with bypass are too high<sup>21</sup>.

Dosluoglu reports that primary patency after SIR with selective stenting after one year increases to 50-85% (ref.<sup>2</sup>). The frequency of selectively used stents in the femoropopliteal area is increasing. Nonetheless a retrospective study by Schmieder 12 months after SIR did not show a significant difference between patients with and without selective stent application<sup>26</sup>. In this study, however, the SIR group with stent had to undergo bypass more often than the SIR group without stent. This result may be due to the use of stent in cases of suboptimal results of SIR caused, for example, by calcifications or multiple lesions of the SFA. It has already been determined, that failure of SIR does not worsen the results of subsequent bypasses. The time period after SIR, which does not require further intervention ranges between 7,8 months to 3 years<sup>23,24</sup>.

Stentgraft implantation into a stenotic SFA is among the newer endovascular techniques. Advantages of a stentgraft include its ability to act against negative remodeling and minimize fractures and mechanical failure. A

sufficient stentgraft diameter, the absence of massive calcifications in the artery, antiaggregation treatment and at least one patent lower leg artery are necessary to maintain patency<sup>27,28</sup>. Results of stentgraft implantation by Saxon after 4 years showed a 55% primary patency and 79% secondary patency; the results were not significantly affected by the length of the occlusion but by the diameter of the intervened artery<sup>28</sup>. In cases of long occlusions longer than 15 cm where SIR was combined with stentgraft, primary patency was 75% after one year as compared to 28% in patients with SIR alone<sup>29</sup>.

Results of individual endovascular methods are presented in Table 3.

### Results of studies comparing surgical and endovascular methods

There are few studies which directly compare endovascular and surgical methods, especially longterm results are lacking. Comparison of studies is difficult due to differing study designs and study end-points, methods of follow-up and possibly the use of different types of stents.

Dosluoglu published a study, unfortunately which included patients with claudication as well as critical limb ischemia (CLI), which compared bypass with ePTFE prosthesis and PTA with stenting in patients with TASC C and D lesions. Despite the high percentage of patients with CLI in the bypass group, the primary patency of this group was 75% after two years. The PTA group with stents classified TASC C had significantly better patency (primary 80%, secondary 98%) than the PTA group TASC D (primary 36%, secondary 60%). The best results when compared to bypass was achieved by PTA group TASC C. Dosluoglu thus recommends that group TASC C receives initial treatment in the form of PTA with stent rather than revascularization using ePTFE prosthesis. Contrarily in patients with TASC D, PTA with stent should only be used in high-risk patients<sup>2</sup>.

Kedora published a study comparing patients who underwent FP bypass using ePTFE prosthesis or endovascular treatment by stentgraft (Viabahn). After 12 months, both groups had a comparable primary patency of 74%, after two years 63%. Not surprisingly, patency differed in patients classified TASC A/B, where patency was 64% after 2 years, and TASC C/D where patency was only 47%. Even after 4 years both groups showed very comparable results<sup>30</sup>.

### CONCLUSION

Ideal treatment of long occlusions of the femoropopliteal segment has not been established to date. In summation, it is apparent that the role of endovascular techniques used in the treatment of SFA occlusions is increasing. It is clear that PTA in combination with selective stent implantation is the method of choice in short SFA lesions. Primary stenting using self-expanding stents or stentgraft implantation into long SFA lesions shows good short-term results, which must, however, be con-

firmed in long-term follow-up, especially in patients with intermittent claudication. Nonetheless, the premise still stands that lower risk patients with claudication should be examined to assess the quality of veins suitable for revascularization and bypass should be selected as the first method of choice.

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