

# Ringed Reinforced Polytetrafluoroethylene Sheltered Saphenous Vein Graft for Femorofemoral Bypass in Critical Leg Ischemia with Limited Distal Run Off

## Sınırlı Distal Run-Off'a Sahip Kritik Bacak İskemisi Olan Hastalarda Ringli Politetrafloroetilen ile Desteklenen Safen Ven Greftinin Femoro-Femoral Bypass'da Kullanımı

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**ABSTRACT** Femorofemoral bypass is an appropriate alternative method of treatment in patients with unilateral iliac arterial occlusive lesions when catheter-based intervention is not feasible and aorta-femoral bypass is contraindicated because of medical risk factors or previous surgical procedures. We aimed to demonstrate an alternative solution for femorofemoral bypass procedure by using an externally ringed polytetrafluoroethylene-sheltered saphenous vein graft in three patients in whom the small calibrated deep femoral arteries were their only chance for revascularization. This alternative technique could be performed in extremity salvaging operations in critical leg ischemia with limited distal run-off.

**Key Words:** Femoral artery; limb salvage; polytetrafluoroethylene

**ÖZET** Femorofemoral bypass, unilateral iliak arter tıkaıcı lezyonu olan ve katater ile müdahale veya aortofemoral bypassın tıbbi risk faktörleri veya önceki cerrahi işlemler nedeniyle uygun olmadığı hastalarda uygun alternatif tedavi metodudur. Biz, tek şansı ince kalibrasyonlu derin femoral arter revaskülarizasyonu olan üç hastada, femorofemoral bypass işlemi sırasında dışarıdan ringli politetrafloroetilen ile desteklenen safen ven greftinin kullanımını alternatif çözüm olarak sunmayı amaçladık. Bu alternatif teknik, sınırlı distal dolaşımı olan kritik bacak iskemisinde uygulanabilir.

**Anahtar Kelimeler:** Femoral arter; ekstremitte kurtarılması; politetrafloroetilen

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Femorofemoral bypass (FFB) is an appropriate alternative treatment method in patients with unilateral iliac arterial occlusive lesions when aorta-femoral bypass is not feasible. Dacron or ringed polytetrafluoroethylene (PTFE) vascular grafts are usually preferred in FFB, however in patients with infection risk or for replacement of priorly inserted thrombosed or infected grafts, saphenous vein (SV) grafts are also used.<sup>1-4</sup> Nevertheless, saphenous vein can be considered as a suitable alternative in terms of vascular diameter in patients where deep femoral arterial or lateral circumflex arterial bypass is necessary due to diffuse atherosclerosis. However, patency rates were found to be smaller in the SV grafts when compared to the fabric grafts. External compression, small caliber and complicated indi-

cations are all blamed factors for this outcome.<sup>1</sup> This technique provides a solution with the use of an external sheltered SV graft for patients who do not have any other chance for bypass surgery apart from a small calibrated deep or lateral circumflex femoral artery.

After written informed consent was obtained from the patients, three cases of critical limb ischemia undergoing femoro-femoral bypass by using an alternative technique were presented.

## CASE REPORTS

### CASE 1

The age of our first case was 66 years, and he was hospitalized with the complaint of right leg ischemic rest pain. Neither the right femoral nor the more distal pulses were palpable. The right foot was cold and pale. The ankle/brachial index (ABI) was measured to be 0.36. Computerized tomography (CT) angiography revealed an occlusion starting from the right main iliac artery and ending at the right common femoral artery. Patient was discharged from the hospital on the 6<sup>th</sup> postoperative day. On his control on the 4<sup>th</sup> month after the surgery, he was observed to have no specific complaints concerning his leg. ABI was calculated as 0.67. His control magnetic resonance (MR) angiography showed a functioning FFB graft.

### CASE 2

Our second case was a 70-year-old male patient applied with the complaint of right foot pain. His history revealed complete amputation of the left arm due to atherosclerosis, chronic renal failure treated with hemodialysis 3 times a week, coronary artery bypass grafting operation 5 years ago, and a stent implantation in his left main iliac artery a week ago. In his physical examination, he had necrosis at the tip of the second toe of his right foot, pallor and coldness. ABI for this extremity was calculated as 0.22. His femoral artery pulse was faint, and CT angiography displayed an occlusion from the right main iliac artery to the common femoral artery and the deep femoral artery, and its branches were hardly visualized with poor collateral circulation. Patient was discharged from the hospital on the

postoperative 5<sup>th</sup> day. The patient was followed up regularly, and on the 6<sup>th</sup> postoperative month he had no complaints and the ABI was calculated as 0.63.

### CASE 3

Our third patient was a 76-year-old male patient who applied with the complaint of pain in his right lower extremity. His history revealed an aorto-bifemoral Y graft interposition operation and right femoro-popliteal xenograft interposition 5 years ago. His cardiac ejection fraction was 30%. An angiogram taken after one year showed a functioning Y graft but an occluded xenograft, and hence a stent was placed to the right superficial femoral artery. He then applied in 2012 with leg pain at rest, and angiography showed an occluded stent. He underwent another operation, and the right leg of the Y graft was detached, and an end-to-end anastomosis was done with a tubular dacrone which was placed to the superficial femoral artery with a side-to-side fashion and to the popliteal artery with an end-to-side fashion. The angiography showed an occlusion in this graft as well, and a femorofemoral bypass to the deep femoral artery was performed. Patient was discharged from the hospital on the 7<sup>th</sup> postoperative day. On his control at the first month, clinical outcome was good with a warm feet free from ischemic pain, and a patent bypass.

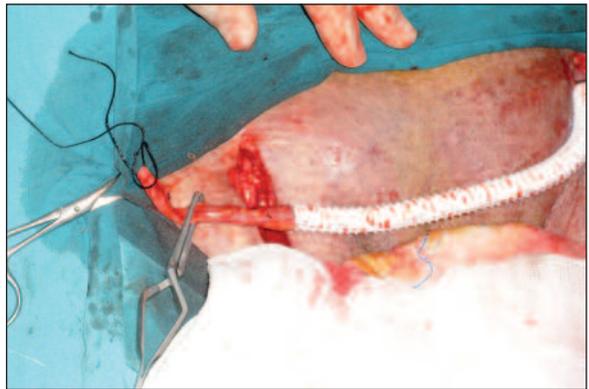
## TECHNIQUE

In addition to aorta-iliac disease, superficial femoral arteries of all patients were occluded and distal vascular structures were not visible on angiographic imaging.

We preferred FFB bypass rather than an anatomic bypass for extremity salvage because of the decreased patency rates in patients with limited distal run-off, therefore we aimed to minimize the preoperative and postoperative life threatening complications without opening the abdominal cavity.

In our technique, a traditional femoro-femoral bypass approach is used in all our patients first. This procedure can be performed under local or general anesthesia if the clinical condition of the

patient is suitable, but we preferred general anesthesia in all patients because all patients were on antiagregant and vasodilator treatment which are the contraindications for regional anesthesia, and exploration of the deep femoral artery under local anesthesia causes more pain.<sup>5</sup> Vertical incisions were made over the femoral area, and femoral arteries and its branches were dissected and turned with rubber bands. All significant collateral branches were protected as possible to increase distal run-off. Lymphatic tissues were carefully controlled by ligation and electrocautery to avoid postoperative collection. Great saphenous vein was dissected from unischemic leg (Donor leg) to prevent delay of skin healing. A suprapubic tunnel was made subcutaneously before systemic heparinization. We passed a 7-mm ring reinforced PTFE graft from subrapubic tunnel providing a smooth femoro-femoral curve to prevent kinking, then SV was introduced through the PTFE graft in order to prevent compression of surrounding tissues onto the vein graft (Figure 1). First, end-to-side anastomosis of the donor side of the SV graft was performed to the common femoral artery. After anastomosis is completed, the bulldog clamp was removed from the SV, and it was filled with blood for adjusting the length and preventing torsion of the SV graft. The free end of the SV graft was anastomosed to deep femoral arteries in two patients and to the lateral circumflex femoral artery in one patient in an end-to-end fashion at the recipient legs, and the latter was extended onto the deep femoral artery to ensure good outflow. If there had been a significant obstruction in the orifice of the deep femoral artery, an endarterectomy or patch angioplasty was performed. If both the common femoral and the superficial femoral arteries were heavily atherosclerotic and deep or lateral circumflex femoral arteries were the only outflow tracts for the graft, an end-to-end anastomosis to this vessel was made, and we found out that there was no diameter variance between the SV and the recipient arteries for a bypass. We preferred to use 6/0 polypropylene sutures for the anastomoses. Closure of the subcutaneous tissues and skin is important to avoid a dead space and minimize wound sepsis



**FIGURE 1:** Saphenous vein was inserted through a 7-mm PTFE graft in order to prevent compression of surrounding tissues on the vein graft.

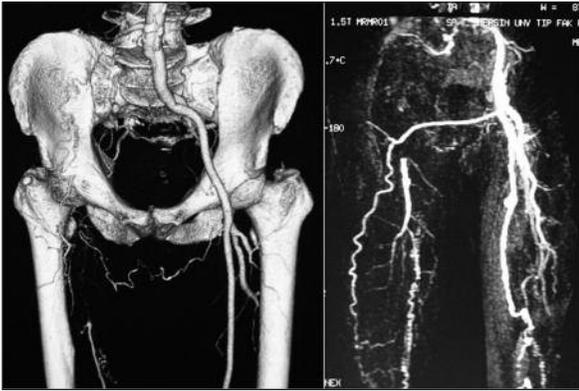
and local compression over SV anastomosis, therefore drain and vacuum blood drainage system was applied to all patients' femoral area until postoperative first day. Pulse of the graft may not be palpable because of sheltering ringed enforced PTFE graft, in this condition, graft patency can be examined by direct Doppler examination. Antiplatelet regime was started to all patients.

All femoro-femoral bypass grafts were followed-up clinically and with Doppler examination. MR angiography was performed preoperatively and postoperatively to demonstrate collateral improvement and graft patency (Figure 2a-b).

## DISCUSSION

Currently, a significant number of patients with unilateral occlusive iliac arterial lesions are treated with percutaneous transluminal angioplasty (PTA) procedures. Patients with relatively good general condition who are not candidates for PTA usually undergo a surgical aortic-femoral bypass operation. However a FFB procedure is a treatment option in patients with limited life expectancy and/or high operative risk factors.<sup>1,2</sup>

The long term results of direct bypass grafting in comparison to FFB have been demonstrated, however some authors like Rutherford and Fahal have performed FFB in low risk-patients without critical limb ischemia and reported better results with 5-year patency rates ranging from 82% to 90%.<sup>3</sup>



**FIGURE 2:** a) Preoperative magnetic resonance (MR) angiography of the patient. b) Postoperative MR angiography demonstrates collateral improvement and graft patency.

<sup>6</sup> Dacron or PTFE grafts have been used for this purpose, and SV grafts have only been recommended in infected patients, or in patients susceptible to infection.<sup>1,2</sup> On the other hand, when the anastomosis must be performed to the deep femoral arteries or to its branches such as lateral circumflex artery due to extensive atherosclerosis, as was the case in our three patients, saphenous vein may be required for a better diameter consistency. The lateral and medial circumflex arteries have collateral circulation with the popliteal arteries, thus even when these arteries are used as well as the deep femoral arteries for the revascularization of the lower extremities, the femoral area receives sufficient blood sharing it with the crural area, and the limbs can be salvaged in the presence of critical extremity ischemia.<sup>7</sup>

Mingoli et al. reported poor results with the SV grafts with patency rates of 34.3% for 5 years, and 21.8% for 10 years.<sup>1</sup> However, attention should be paid to the reality that the use of SV grafts for this purpose is limited, and might have affected the reported patency rates.<sup>1-3</sup> On the other hand, Pai and coworkers reported SV patency rates as 89.3% by the end of one year.<sup>2</sup> The absence of long term results of Pai et al.'s study regarding the SV grafts gives rise to a difficulty in graft selection for FFB surgeries.

Although external compression is blamed as the most important factor for the poor results of the SV in FFB, freeing the graft from compression by passing it through a ring reinforced graft is noteworthy. Moreover, it is very well known that ring reinforced grafts have better long term outcomes in comparison to other fabricated grafts.<sup>1</sup> However in a multicenter study conducted in France, Ricco et al. reported that the outcomes were not affected by the diameter and type of the grafts used.<sup>4</sup> Some experimental studies described a beneficial effect of an external support on the reduction of neointimal hyperplasia and neovascularization in the adventitial tissue, thus purporting the beneficial potential on the long term patency rates for the saphenous vein grafts.<sup>8</sup>

Despite saphenous vein grafts are recommended to be used for FFB only in patients undergoing redo operations or in operations with high anticipation of infection, we used this vein in these patients as the diameters of the recipient arteries were relatively small.

The results of our three cases indicate that deep femoral artery and its branch, the lateral circumflex femoral artery can be used in critical leg ischemia for a FFB with the SV being sheltered with an external support to prevent compression in an extremity salvaging operation, and there will be no inconsistencies between the lumen sizes. A solution for the patient in short term with anticipated fair patency rates can be attained with this method. The effect of sheltering the saphenous vein in a piece of ring reinforced PTFE graft in terms of long term results will only be available only when this technique is used more frequently for FFB.

### ***Conflict of Interest***

*Authors declared no conflict of interest or financial support.*

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