Technique and results of femoral bifurcation endarterectomy by eversion

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Objective: **This study evaluated, in a contemporary prospective series, the safety and efficacy of femoral endarterectomy using the eversion technique and compared our results with results obtained in the literature for the standard endarterectomy with patch closure.**

Methods: **Between 2010 and 2012, 121 patients (76% male; mean age, 68.7 years; diabetes, 28%; renal insufficiency, 20%) underwent 147 consecutive femoral bifurcation endarterectomies using the eversion technique, associating or not inflow or outflow concomitant revascularization. The indications were claudication in 89 procedures (60%) and critical limb ischemia in 58 (40%). Primary, primary assisted, and secondary patency of the femoral bifurcation, clinical improvement, limb salvage, and survival were assessed using Kaplan-Meier life-table analysis. Factors associated with those primary endpoints were evaluated with univariate analysis.**

Results: **The technical success of eversion was of 93.2%. The 30-day mortality was 0%, and the complication rate was 8.2%; of which, half were local and benign. Median follow-up was 16 months (range, 1.6-31.2 months). Primary, primary assisted, and secondary patencies were, respectively, 93.2%, 97.2%, and 98.6% at 2 years. Primary, primary assisted, and secondary maintenance of clinical improvement were, respectively, 79.9%, 94.6%, and 98.6% at 2 years. The predictive factors for clinical degradation were clinical stage (Rutherford category 5 or 6, $P = .024$), platelet aggregation inhibitor treatment other than clopidogrel ($P = .005$), malnutrition ($P = .025$), and bad tibial runoff ($P = .0016$). A reintervention was necessary in 18.3% of limbs at 2 years: 2% involving femoral bifurcation, 6.1% inflow improvement, and 9.5% outflow improvement. The risk factors of reintervention were platelet aggregation inhibitor (other than clopidogrel, $P = .049$) and cancer ($P = .011$). Limb preservation at 2 years was 100% in the claudicant population. Limb salvage was 88.6% in the critical limb ischemia population, with a statistically higher rate for patients with malnutrition ($P = .029$), preoperative platelet count >450 $\times 10^9$/L ($P = .0071$), platelet aggregation inhibitor treatment other than clopidogrel ($P = .022$), preoperative deep femoral artery occlusion or stenosis >75% ($P = .0064$), and poor tibial runoff ($P = .00042$).**

Conclusions: **Eversion femoral bifurcation endarterectomy is a safe, efficient, and reproducible technique for the treatment of atherosclerotic femoral lesions. Advantages are notable, especially the lack of need for prosthetic angioplasty, eliminating the risk of patch infection or pseudoaneurysms and permitting direct puncture if endovascular procedures are needed for assisted patency. (J Vasc Surg 2015;61:728-33.)**

Surgical endarterectomy has been the standard treatment for atherosclerotic lesions of the femoral bifurcation for >50 years.[1-10] Patency, clinical results, limb salvage, morbidity, and mortality of femoral bifurcation endarterectomy (FBE) have been well established and confirm the good results of this procedure.[2-10]

In an attempt to reduce at minimum the rate of complications, surgeons use some variants of the technique: incision, surgical approach, direct closure of the arteriotomy, or the use of venous or prosthetic patch. For many years, we have performed a modified technique of the FBE: the eversion, using as the departure point the technique of carotid endarterectomy. Because this technique is well known and has proven good results on the carotid bifurcation, we decided to adapt it for the femoral bifurcation. The transection is made at the level of the common femoral artery (CFA), which avoids patch closure and its potential complications. This study examined the safety and efficacy of FBE using the eversion technique in a contemporary prospective series.

METHODS

The hospital's Institutional Review Board approved the study. All patients in the study were completely informed regarding the procedure and the study and gave their consent.

Patients and data collection. Between November 2010 and November 2012, we enrolled 121 consecutive symptomatic patients (147 limbs) on which we performed FBE using the eversion technique. Of these, 76% (92 of 121) were men, 28% had diabetes, and 20% had chronic renal failure. All patients were receiving statin and platelet aggregation inhibitor treatment. The femoral bifurcation lesions were diagnosed on duplex ultrasound (DUS) imaging or computed tomography angiography (CTA), or both. The demographic and clinical features of the study group are reported in Table I.

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Table I. Population characteristics and clinical presentation according the Rutherford classification[12]

Variables	*Mean (range) or No. (%)*
Age, years	68.7 (44-92)
Gender	
Male	92 (76)
Female	29 (24)
Body mass index, kg/m^2	26.5 (15.2-44.9)
Smoking	
Current	34 (28)
Weaned	58 (48)
None	29 (24)
Hypertension	100 (82.6)
Diabetes	34 (28)
Dyslipidemia	98 (81)
Medical treatment	
Optimal	57 (47)
Suboptimal	60 (50)
Untreated	4 (3)
Thrombophilia	3 (2.5)
Cancer	25 (20)
Immunosuppression	8 (6.6)
Renal insufficiency	24 (20)
Minor	22
Moderate	1
Severe	1
Heart disease	54 (45)
ASA score, mean	2.77
1	0
2	35 (29)
3	76 (63)
4	8 (6)
No result	3 (2)
Rutherford clinical stage	
Claudication	89 (60.6)
1—Mild	1 (0.7)
2—Moderate	11 (7.5)
3—Severe	77 (52.4)
CLI	58 (39.4)
4—Ischemic rest pain	29 (19.7)
5—Minor tissue loss	16 (10.9)
6—Major tissue loss	13 (8.8)

ASA, American Society of Anesthesiologists; *CLI,* critical limb ischemia.

Table II. Preoperative limb vascularization

Preoperative limb vascularization	*No. (%)*
Iliac lesions	
Healthy or <50% stenosis	66 (44.9)
50%-75% stenosis	39 (26.6)
>75% stenosis	23 (15.6)
Preocclusive stenosis	8 (5.4)
Occlusion	10 (6.8)
Dissection	1 (0.7)
Femoral tripod lesions	
CFA lesion only	10 (6.8)
CFA + proximal SFA lesion (DFA healthy)	29 (19.7)
CFA + proximal DFA lesion (proximal SFA healthy)	2 (1.4)
All femoral tripod lesions	106 (72.1)
Femoral/popliteal lesions[a]	
Healthy or <50% stenosis	42 (28.6)
TASC II A	23 (15.6)
TASC II B	18 (12.2)
TASC II C	9 (6.1)
TASC II D	55 (37.5)
Runoff vessels	
3 vessels	82 (55.8)
2 vessels	39 (26.5)
1 vessel	17 (11.5)
0 vessel	5 (3.4)
No result	4 (2.7)

CFA, Common femoral artery; *DFA,* deep femoral artery; *SFA,* superficial femoral artery; *TASC II,* TransAtlantic Inter-Society Consensus for the Management of Peripheral Arterial Disease.
[a]According TASC II classification.[11]

FBE was used exclusively in 27 procedures (18.4%), and we performed 105 hybrid procedures (71.4%) consisting of FBE with concurrent endovascular interventions on the ipsilateral limb (64 on inflow, 35 on outflow, and six on both). Fifteen FBEs (10.2%) were associated with surgical treatment of other lesions on the ipsilateral limb: thrombectomy or remote endarterectomy using Vollmar rings on iliac artery in five procedures or the superficial femoral artery (SFA) in two procedures. All procedures were performed under general anesthesia.

Only the patients who needed concurrent bypass grafts using the CFA for the proximal or distal anastomosis were excluded. The eversion technique was not feasible in those cases, and the endarterectomy was performed using longitudinal arteriotomy, and closure was realized by patched anastomosis with the graft.

Prospective inclusion consisted in marking the medical history, physical examination, operative notes, laboratory data, and radiologic studies. The patient's clinical category at presentation was determined according to the Rutherford classification as specified by the Society for Vascular Surgery/American Association for Vascular Surgery reporting standards.[11] All patients underwent preoperative DUS imaging or CTA, or both. Bifurcation lesions and limb vascularization are summarized in Table II.

Eversion technique for FBE. The dissection of the femoral bifurcation is performed through a classic groin incision. After general heparinization and arterial clamping, we proceed to CFA transection at 1 to 2 cm above its bifurcation. The endarterectomy is begun at the CFA by the standard technique, using a spatula. The eversion progresses proximally, and the plaque is removed. Hydrodissection may be used to obtain a nontraumatic detachment of the atherosclerotic plaque. Gentle traction is used to completely remove the core, leaving a thin, tapering end point. While the plaque is removed, the luminal surface and the transition between the endarterectomized and the nonendarterectomized segments of the CFA are carefully assessed.

For the distal segment of the CFA, we proceed in the same way, but once arrived at its bifurcation, the closed jaws of a dissector are used to mobilize the plaque circumferentially. The plaque is divided using classical scissors. After distal division of the plaque, the endarterectomy is carried out into the SFA and, respectively, deep femoral artery (DFA) orifices, as distally as possible. The end point