

# What Classification of the Extent of Atheromatous Lesions on the Femoral Arterial Bifurcation for a Good Endovascular Therapeutic Indication?

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## Abstract

The evaluation of the extension of the atheromatous lesion is essential for the planning of the endovascular technique at the level of the femoral arterial bifurcation. Therefore, we changed the classification of Azema and applied it to a series of patients who had undergone open surgery of the femoral arterial bifurcation. This evaluation made it possible to have an idea of the distribution of atheromatous lesions in this region and to compare the efficiency of this modified classification of Azéma with others used in the literature. This modified classification of Azema is relevant and constitutes a decision-making tool for the endovascular therapeutic indications of femoral arterial bifurcation.

## Keywords

Classification, Extension, Athéromatous, Endovascular, Azema

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## 1. Introduction

The postoperative morbidity and mortality of the open surgery on the femoral arterial bifurcation (femoral tripod), on the one hand, and the minimally invasive character of endovascular treatment, on the other hand, have led some authors to seek an alternative to open surgery. They report the result of their endovascular approach experiments at the level of the femoral tripod. Actually, the respective place of endovascular treatment and the open surgery, in the management of occlusive lesions of the femoral tripod, remains controversial be-

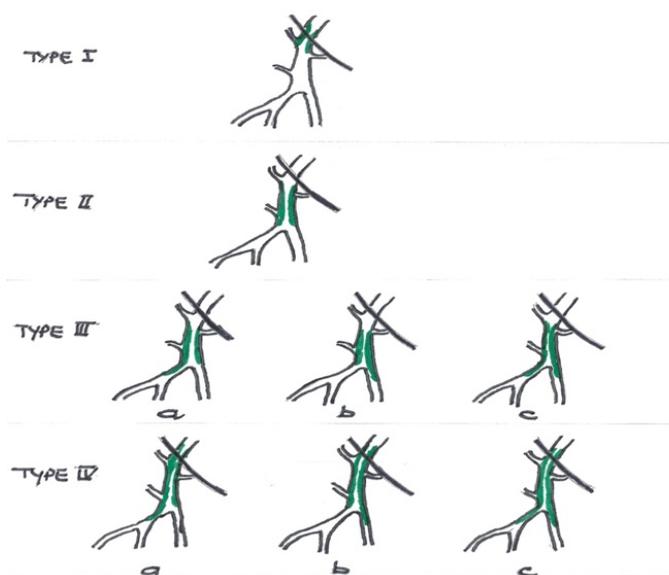
tween the proponents of open surgery who argue for a better long-term permeability (primary and primary patency assisted at 5 years of age respectively by 91% and 100%) [1]; and the advocates of endovascular treatment who emphasize the reduction of mortality, morbidity and length of stay [2]. Different endovascular approaches (simple angioplasty, cutting balloon, atherectomy, stenting) have been proposed but no consensus exists on the optimal technique. Moreover, while in the field of endovascular therapeutics the anatomy of lesions, especially their extensions, remains the most important decision-making element. There are several proposals in the literature for classifying atherosclerotic lesions according to their extensions on the femoral tripod [3]. On the other hand, with our experience of endovascular practice, we consider these last insufficient because not taking into account all the possible therapeutic aspects. Therefore, we propose the modification of one of the classifications in order to apply it to a population with atheromatous lesions of the femoral tripod before discussing its efficiency.

## 2. Materials and Methods

This is a retrospective study from January 2015 to July 2017 involving 65 patients (70 sides) who were hospitalized, in the Department of Vascular Surgery of the North Hospital of Marseille, for the surgical management of arterial disease of the lower extremities related to atheromatous lesions of the femoral tripod.

Inclusion criteria are for patients with 1) significant lesions of the femoral tripod isolated or associated with other lesions, 2) treated by conventional surgery isolated or associated with endovascular staging of upstream or downstream lesions, and 3) having angioTDM imaging. The exclusion criteria are the absence of angioTDM of the arteries of the lower limbs of good quality allowing the extraction of a central line.

In addition to the clinical data, morphological data at the femoral tripod are collected from the angioTDM analysis using the EndoSize image processing software. The images are transferred in DICOM format to a console with this software. After the determination of a proximal point at the level of the birth of the common femoral artery (CFA) taking as a reference the birth of the inferior epigastric artery, and a distal point located 5 cm downstream of the birth of the superficial femoral artery (SFA) an automatic segmentation is performed followed by the extraction of a primary 3D central line. A second central line is then created that begins at the femoral bifurcation and ends 5 cm downstream of the birth of the deep femoral artery (DFA). This process allows us to extract a 3D image of the femoral tripod. From the latter, we evaluate the extent of atheromatous lesions on the femoral tripod using the classification of Azema *et al.* modified by ourselves to have more readability on the anatomical lesions encountered (**Figure 1**).



**Figure 1.** Extension of lesions at the level of the femoral tripod according to the modified classification of Azéma *et al.* Type I: Lesions limited to the external iliac and common femoral arteries, without involvement of the femoral tripod, Type II: lesions limited to the common femoral artery, without involvement of the femoral tripod, Type III: Lesions of the common femoral artery extended on the femoral tripod; a-, interesting the deep femoral artery, b-, interesting the superficial femoral artery; c-, interesting the deep and superficial femoral arteries, Type IV: Lesions of the external iliac and common femoral arteries extended on the femoral tripod; a-, interesting the deep femoral artery, b-, interesting the superficial femoral artery; c-interesting the deep and superficial femoral arteries.

### 3. Results

#### Demographic and Clinical Characteristics

The average age was 69.4 years old. There was a male predominance. The sex ratio was 4:1. The average body mass index was 25.

In terms of antecedents and cardiovascular risk factors, smoking was found in 75.7% of patients, diabetes in 27.1% of patients, hypertension in 61.4% of patients, dyslipidemia in 21.4% of patients; % of patients and cannabis use in 2.9% of patients. In addition, in 8.6% of patients, no cardiovascular risk factors were found.

Two patients (2.9%) were renally impaired at the dialysis stage

Clinically, 27% of patients were at stage 3 of the Rutherford classification. The systolic pressure index averaged 0.41 (**Table 1**).

The arterial lesions were in 57.1% on the right. In four patients the lesions were bilateral. According to the modified classification of Azéma, types I and II were respectively 2.8%, type III was 31.4% (a = 4.2%, b = 20%, c = 7.2% and Type IV was 23% (a = 3%, b = 14.3%, c = 5.7%).

### 4. Discussion

The extent of the lesions to be treated is an important morphological criterion to

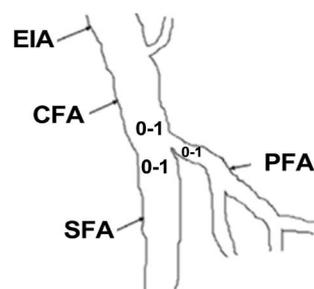
**Table 1.** Demographic and Clinical Characteristics Morphological data.

<i>Age</i>	69.63 ans Extrêmes (année) : 44-95
<i>Gender</i>	H: 81.4% (n = 57) F: 18.6% (n = 13) Sex Ratio 4:1
<i>BMI</i>	24.63
<i>Tabacco</i>	75.7% (n = 53)
<i>Diabetes</i>	27.1% (n = 19)
<i>Hypertension</i>	61.4% (n = 43)
<i>Dyslipidemia</i>	21.4% (n = 15)
<i>Cannabis</i>	2.9% (n = 2)
<i>Dialysis</i>	2.9% (n = 2)
<i>Rutherford classification</i>	
0	1.4% (n = 1)
1	8.6% (n = 6)
2	25.7% (n = 18)
3	38.6% (n = 27)
4	4.3% (n = 3)
5	18.6% (n = 13)
6	2.9% (n = 2)
<i>ABI</i>	0.41

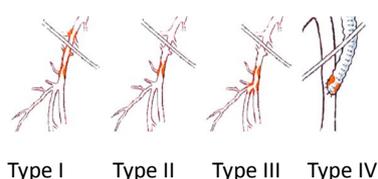
be analyzed pre-operatively for the choice of the endovascular technique. Three types of classifications were reported in the literature.

Bonvini [4] adapted for the calcium lesions of the common femoral artery and its terminal branches, the Medina classification [5] which was intended for coronary calcium lesions and their bifurcations (Figure 2). It is a binary classification (0 = absence of lesions and 1 = presence of lesions) which makes it possible to have, through a schema, a global vision of calcium lesions in this region. This classification of Medina consists of three figures: the first number represents the common femoral artery, the second number ranks the superficial femoral artery and the third number is for the deep femoral artery. This classification is complete and perfectly transferable to the lesions of the femoral bifurcation, however it lacks simplicity and clarity.

Moreover, the classification of Azema is based on the work of Lopez *et al.* [6] on the mobility of the common femoral artery according to flexion or extension of the hip. Two points of flexion and torsion of the common femoral artery during the movements were authenticated by the authors: the segment of the artery at the level of the lower part of the inguinal ligament and that located at the upper part of the sartorius muscle. Thus this classification distinguishes four types of lesions (Figure 3). Types I and III are considered to be areas at risk of fracture or stent crushing:



**Figure 2.** Medina Classification. EIA: external iliac artery, CFA: common femoral artery, SFA: superficial femoral artery, PFA: deep femoral artery. 1st number: common femoral artery. 2nd number: superficial femoral artery. 3rd number: deep femoral artery.



**Figure 3.** Topographic classification of ilio-femoral lesions according to Azema and al. Type I: localized calcium lesions on the external iliac artery and extending over the common femoral artery. Type II: limited calcium lesions on the common femoral artery. Type III: localized calcium lesions on the common femoral artery and its terminating branches. Type IV: calcium lesions on a proximal or distal anastomosis on the common femoral artery.

The classification of Azema and al. does not seem to us exhaustive because it does not take into account the extensive lesions of the iliac artery external to the bifurcation, hence the decision to adopt a modification of this classification by deleting the corresponding type IV for anastomotic stenosis and replace it with extensive lesions in both junctional territories. If we follow the reasoning of Azema et al, in this modified classification, type I and II lesions appear to be the most eligible lesions for endovascular treatment. Indeed, coronary work has shown that lesions extended to bifurcations (types III and IV) are associated with a low success rate, a high rate of acute complications and follow-up course [7]. The causes evoked at these high complication rates are directly related to the close relationship between anatomy, flow and distribution of atherosclerotic lesions. Hence the development of stents specifically dedicated to bifurcations. Some coronary bifurcated stents have recently been used to treat complex lesions of the popliteal trunk [8]. Stenting indications for these type III and IV lesions should take into account the diameters of the target bifurcation. The work of Mishra *et al.* [9] illustrates the importance of respecting the rule of the three diameters of the main artery and its distal branches. This rule is governed by Murray's law and that of Finet which states that the diameter of the main artery is equal to  $2/3$  of the sum of the diameters of the distal branches [9]. Indeed, the

use of two stents may compromise this law. Our work provided information on the average measurements of the femoral tripod in terms of length, diameters and angulations that can be used for the design of a bifurcated stent dedicated to the femoral tripod.

## 5. Conclusions

The modified Azema classification is an alternative to other means of assessing the extent of atheromatous lesions of the femoral arterial bifurcation.

It allows having a global vision and all possible topographical combinations of atheromatous lesions of the femoral arterial bifurcation in order to choose the appropriate endovascular technique.

## Conflicts of Interest

The authors of this article declare that there is no conflict of interest.

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