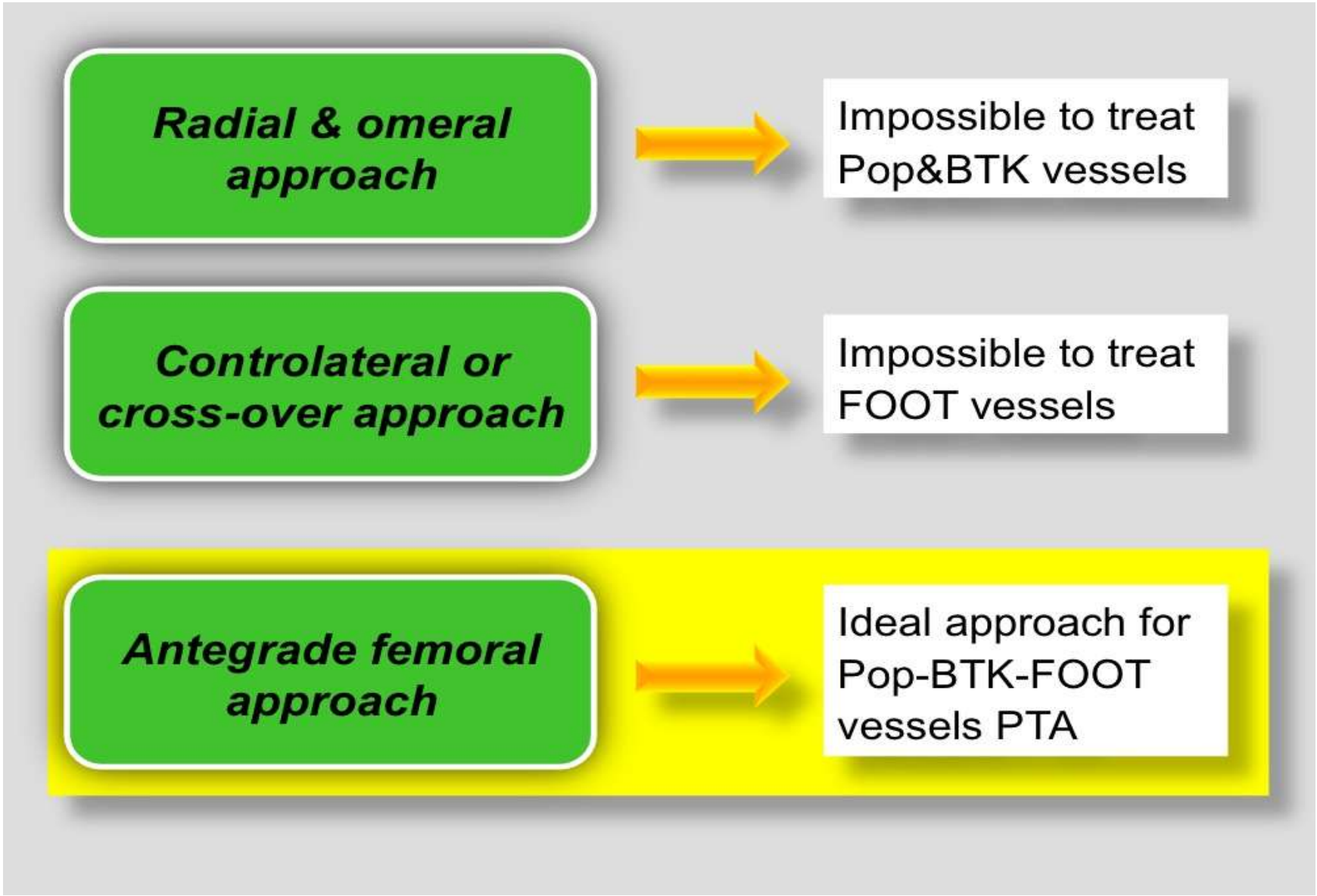
CARDIOVASCULAR SUMMIT
TCTAP 2015

Endovascular Intervention

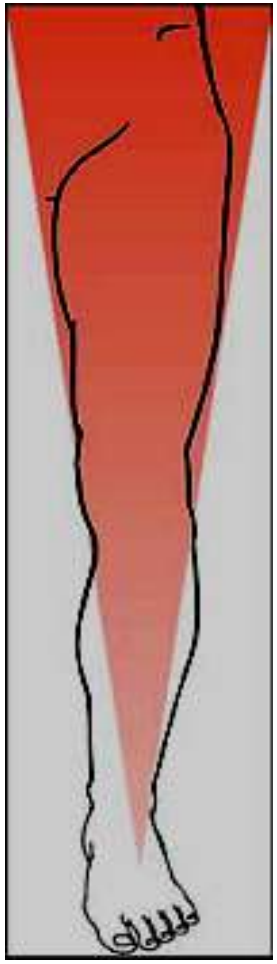
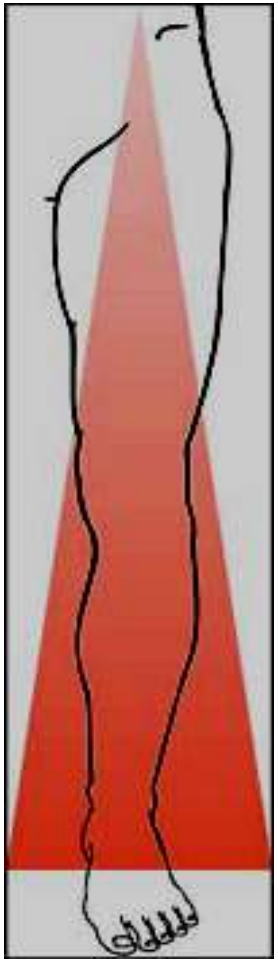
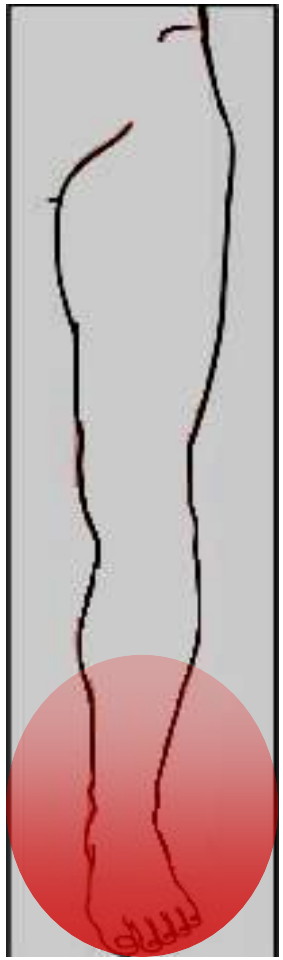
Lower Extremity Intervention - Technical Evolution from Puncture to Closure

GB Danzi, MD
Italy

Lower Extremity Intervention

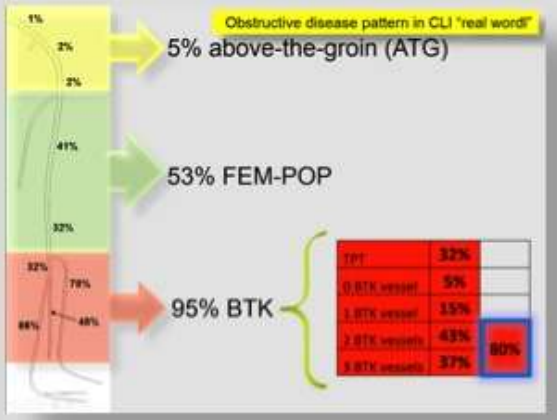


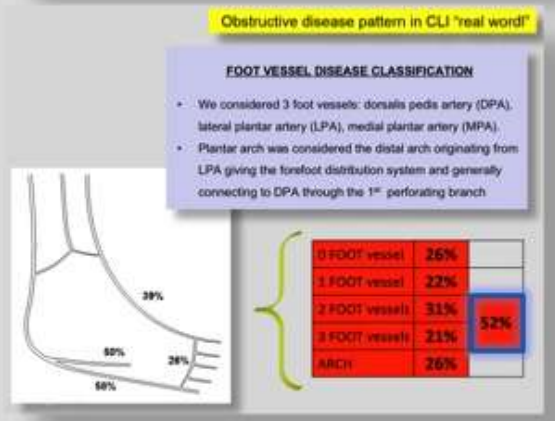
Disease Pattern in PAD

	Hypercholesterolemia Current smoking	Age Diabetes mellitus	ESRD Diabetes mellitus
Iliac			
Femoro-popliteal			
BtK			

Antegrade femoral approach

- In the majority of diabetic patients with CLI, the obstructive disease involves BTG vessels, sparing the iliac and the common femoral artery, and enabling the antegrade femoral approach.
- In diabetic CLI this is the favored approach because it provides adequate device control, maximizes angiographic resolution, and enables access to foot vessels to achieve complete and WRA revascularization.
- Despite these positive characteristics of the antegrade access, the controlateral approach is still considered by many Authors the standard approach, because antegrade access is more technically demanding, fraught by increased risk of access-site failure or complications and requires an adequate learning curve.



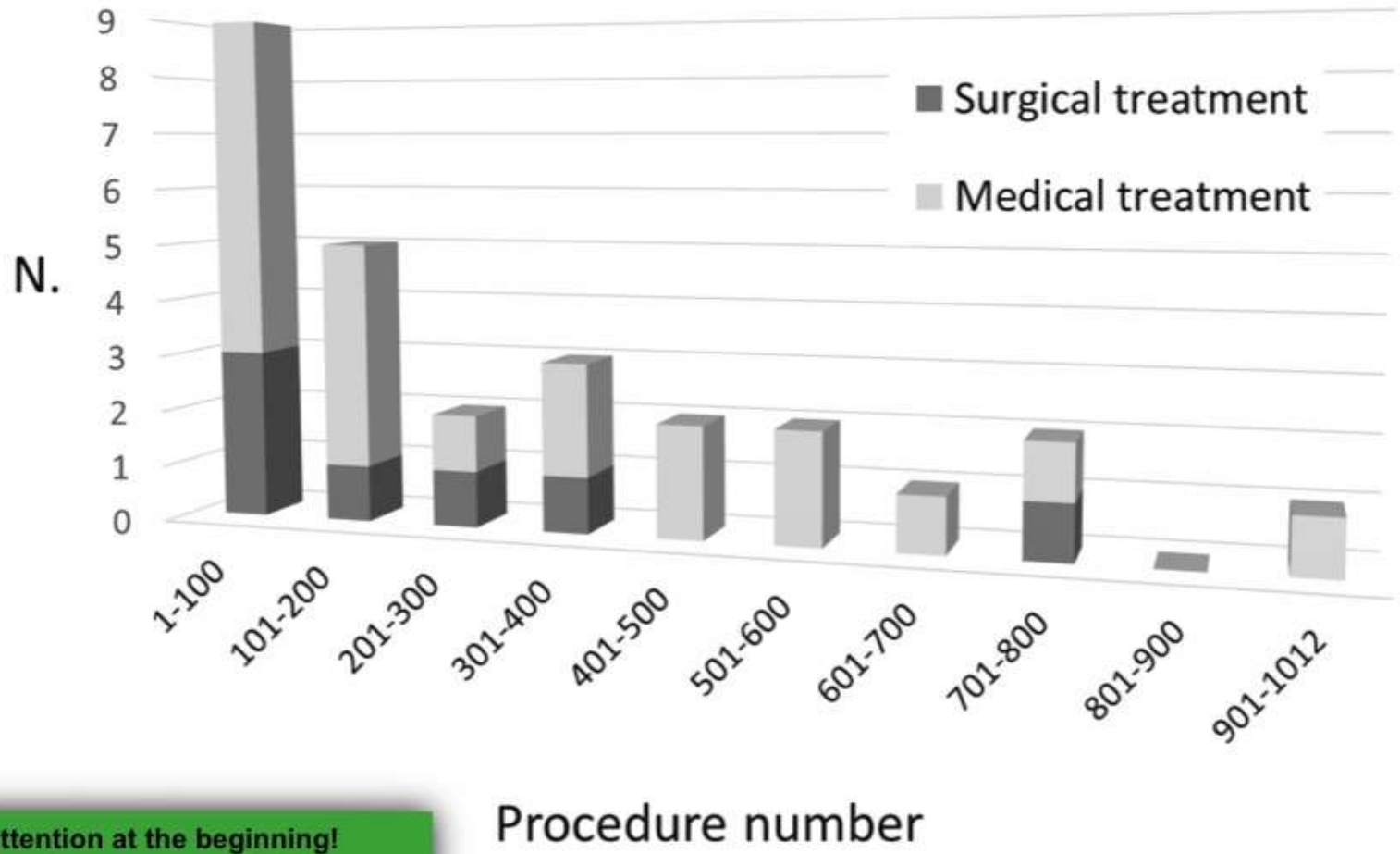


Antegrade femoral approach

Our experience with the antegrade femoral puncture as first choice approach in below-the-groin vessel disease started in 2000. In the very first 1012 cases performed in the period 2000-2008, we had 27 major complications (2.77%)

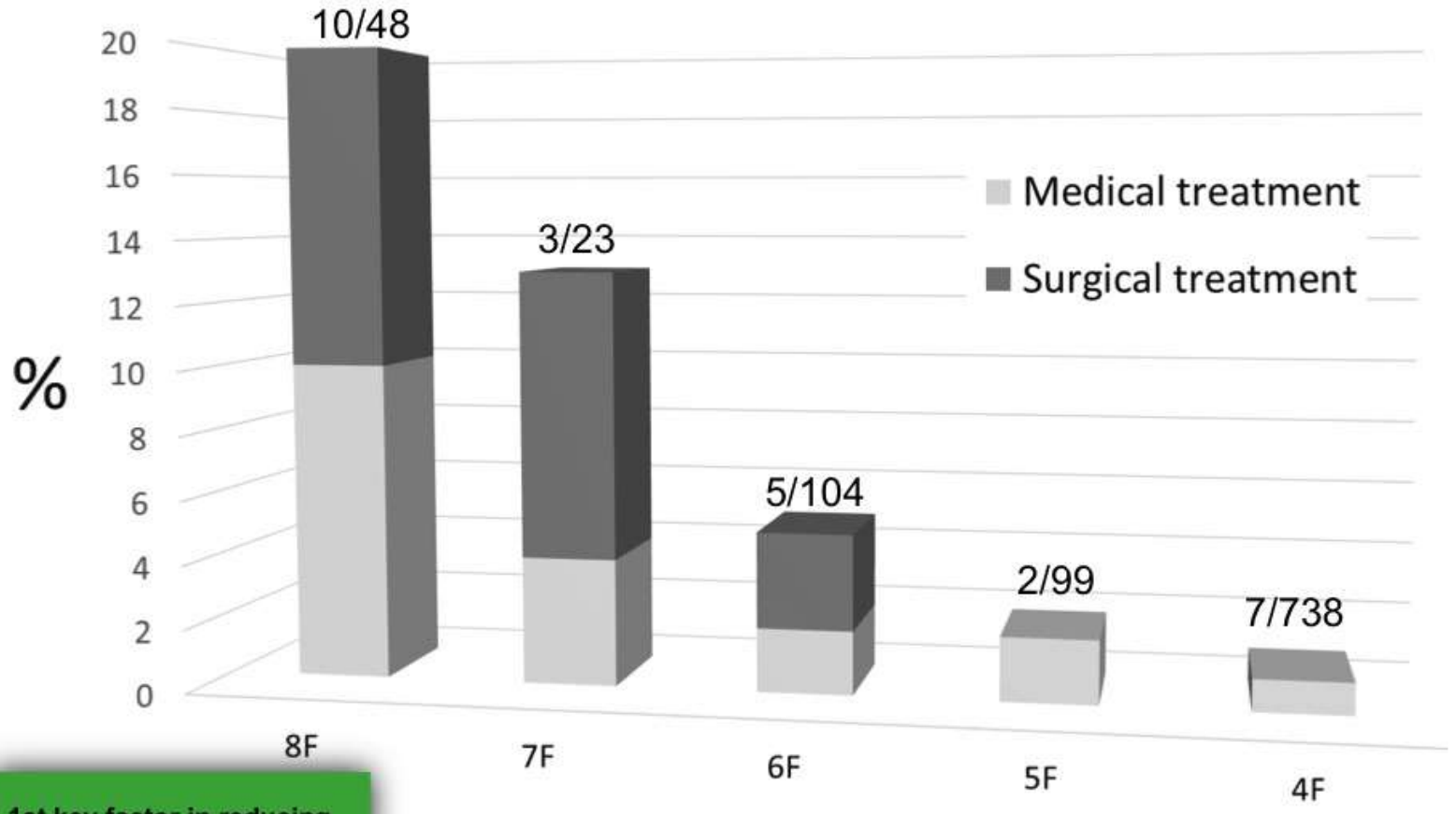
	Medical treatment	Surgical treatment	Puncture above half line of the femoral head	Puncture below half line of the femoral head
Groin hematoma	14	3	4	13
Abdominal wall hematoma	1	-	1	-
Scrotal hematoma	-	1	1	-
Pseudoaneurism	-	1	-	1
Retroperitoneal hematoma	5	1	6	-
Acute femoral thrombosis	-	1	-	1
Total	20	7		

Antegrade femoral approach complications (2000-2008; 1,012 procedures)

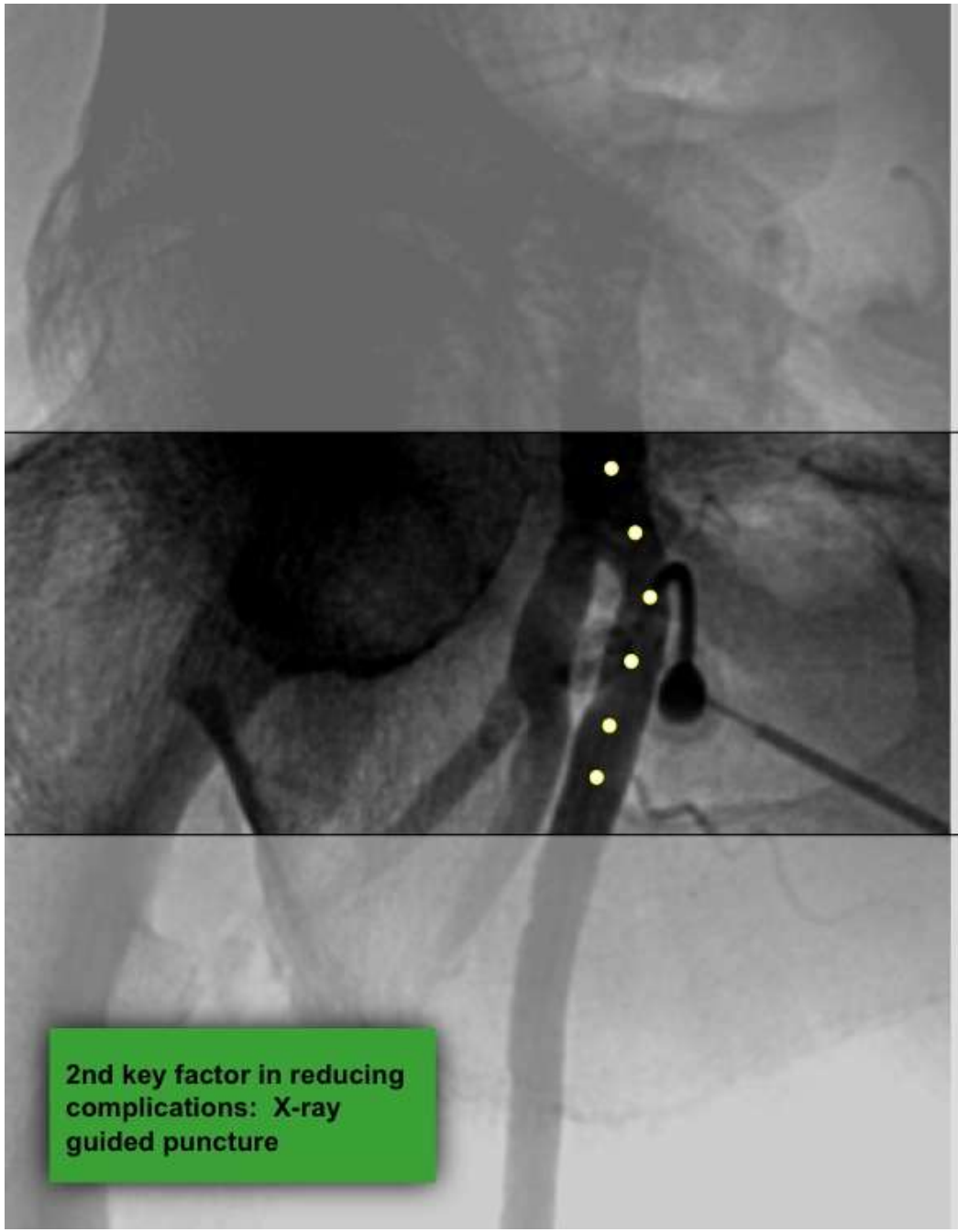


Pay attention at the beginning! The learning curve needs 200 procedures to stabilize to standard value

Antegrade femoral approach complications according to sheath size (2000-2008; 1,012 procedures)



1st key factor in reducing complications: standard use of 4-5 Fr sheaths



A too high puncture is highly problematic for manual compression hemostasis because the common femoral artery (CFA) is going deeply into the external iliac artery and the puncture may be above the inguinal ligament, which represents the best barrier against retroperitoneal bleeding.

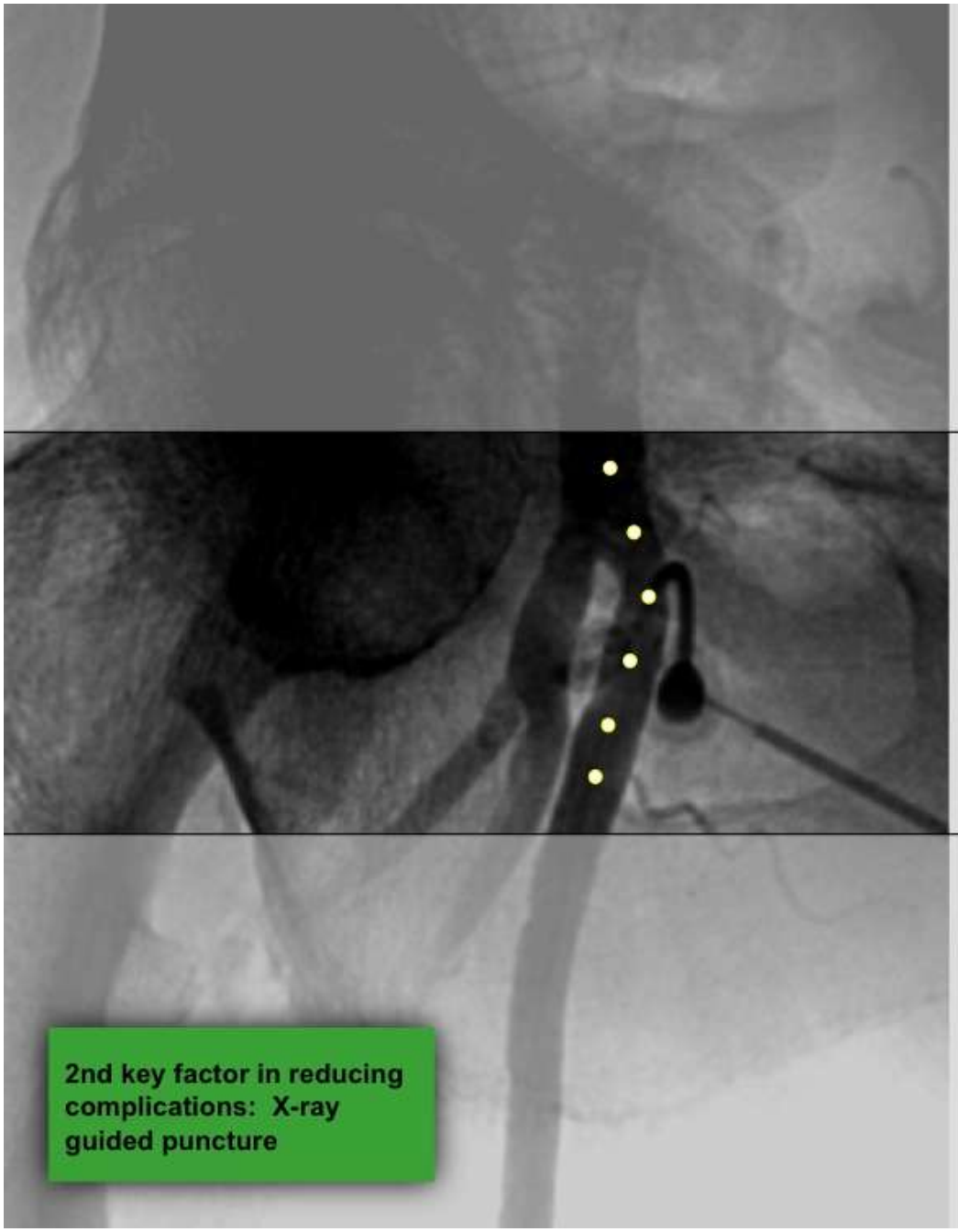
Irani F et Al. Common femoral artery access techniques: a review. J Cardiovasc Med 2009;10:517–22

This is the correct puncture region: below the inguinal ligament, not too distal from the inferior edge of the femoral head

A too low puncture into the superficial femoral artery (SFA) can impair manual compression hemostasis because the artery is going deeply into the muscle and is not surrounded by the connective groin tissue that is the best environment for a fast and sure hemostasis.

Gabriel M et Al. Location of femoral artery puncture site and the risk of postcatheterization pseudoaneurysm formation. Int J Cardiol 2007;120:167–71

2nd key factor in reducing complications: X-ray guided puncture



Danger of retroperitoneal, abdominal wall and external genital bleeding

The antegrade femoral puncture can be in the CFA or in the proximal SFA without an increase in morbidity.

Kweon M et Al. Antegrade Superficial Femoral Artery versus Common Femoral Artery Punctures for Infrainguinal Occlusive Disease. J Vasc Interv Radiol 2012;23:1160–4

Danger of thigh ematoma or pseudoaneurysm

2nd key factor in reducing complications: X-ray guided puncture

Antegrade femoral approach technique

1) Groin evaluation & anesthesia

Accurate palpation of the groin in order to identify the inguinal ligament and the best femoral pulse.

- Take time to examine the groin of the patient: identify the best target
- Move the skin under your fingers: try to avoid too much tissue between your needle entry point and the artery
- Do local anesthesia exactly where you want to do the antegrade puncture: begin at the distal edge of the inguinal ligament in direction of the distal region
- Leave the needle in place as a marker for X-ray evaluation

Antegrade femoral approach technique

1) Groin evaluation & anesthesia

2) X-ray evaluation

Check with X-Ray the needle position in relation with the femoral head.

- Use an antero-posterior projection
- Your target is near the inferior edge of the femoral head
- The artery is often visible due to calcification and the procedure can be done under fluoroscopy
- Take care to avoid exposition of your fingers under the direct X-ray beam

Antegrade femoral approach technique

1) Groin evaluation & anesthesia

2) X-ray evaluation

3) Needle puncture

Use a 19-gauge angiographic needle

- Make a little skin cut using a lancet where you want to insert the needle, to keep the needle movements free
- Remember that when the needle is >3 cm deep you probably have crossed by side the SFA and are going into the deep femoral artery

Antegrade femoral approach technique

1) **Groin evaluation & anesthesia**

2) **X-ray evaluation**

3) **Needle puncture**

4) **Wire advancement**

Use a 0.035" wire with a 45° angulated soft tip

- Do not use a straight or a U shaped wire
- Check the wire movements using an ***omolateral oblique view 25°-30°***: this projection opens the CFA bifurcation
- ***Be delicate and careful: try to engage the SFA ostium using a combination of needle angulation (upward, downward, left, right) and wire manipulation***
- In case of doubt take a ***bare needle angiogram*** of the femoral bifurcation slowly injecting few mL of diluted contrast dye; avoid strong injection!
- The puncture can be into the common femoral artery or the superficial femoral artery: in this case it is important not to have disease immediately above the entry point

Antegrade femoral approach technique

1) **Groin evaluation & anesthesia**

2) **X-ray evaluation**

3) **Needle puncture**

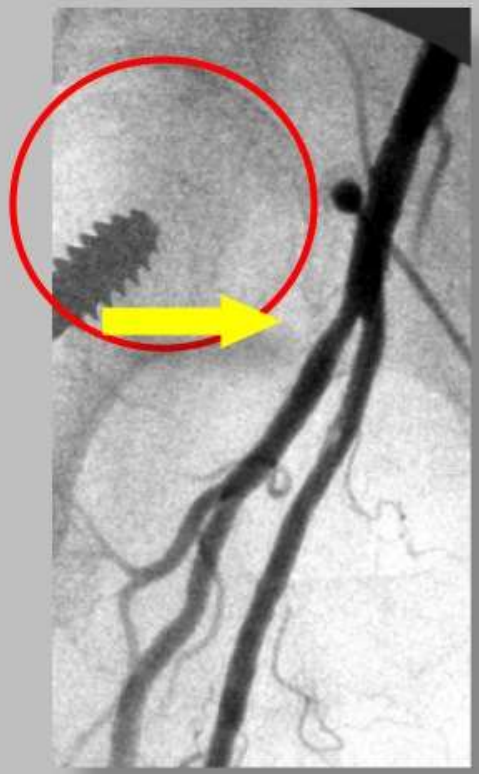
4) **Wire advancement**

5) **Sheath positioning**

When the wire is into the superficial femoral artery advance a 4 French sheath

- Use a ***very flexible sheath*** because the sheath often undertakes a "U" shape position and most of the sheaths kink.
- Inject slowly one mL of contrast dye to check your position: in case of proximal SFA disease, the sheath could be entrapped into a closed endoluminal space. If so, leave the wire inside the sheath to maintain position, withdraw the sheath to the CFA bifurcation, and take a picture of the vascular anatomy
- Remember that you are injecting contrast dye into the SFA: in case of distal obstruction the injection must be more proximal and stronger in order to give contrast dye backward into the deep femoral and internal iliac arteries, because collaterals to the distal vessels could come from these arteries

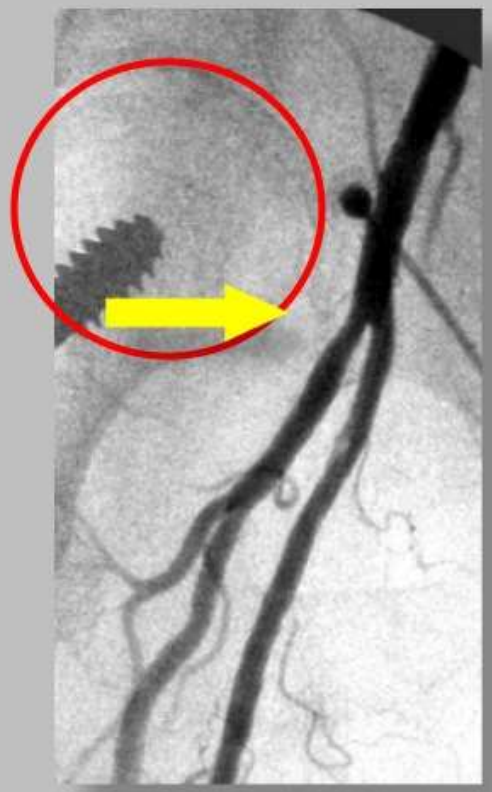
Antegrade femoral approach



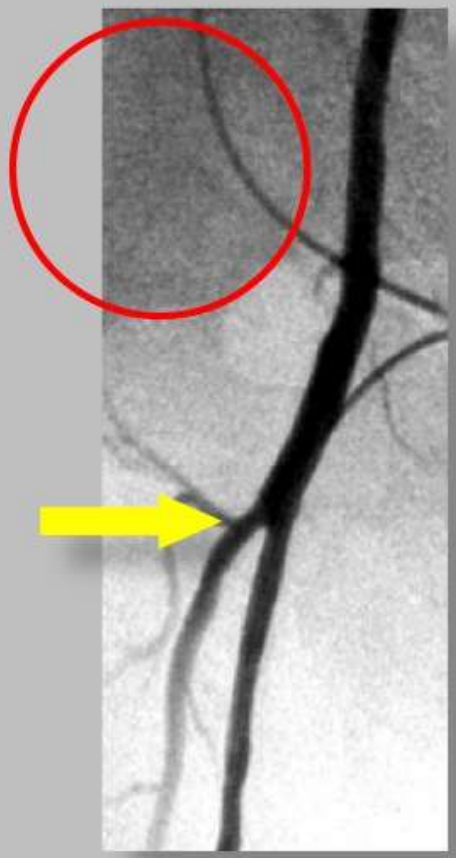
Standard bifurcation

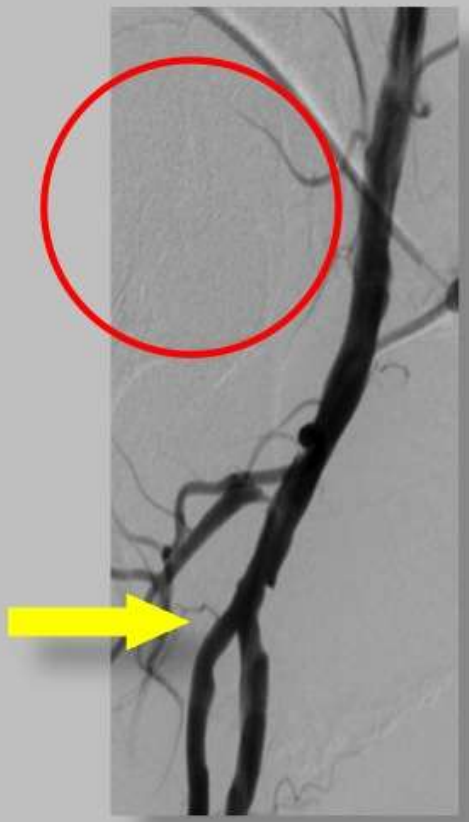
High bifurcation

Antegrade femoral approach



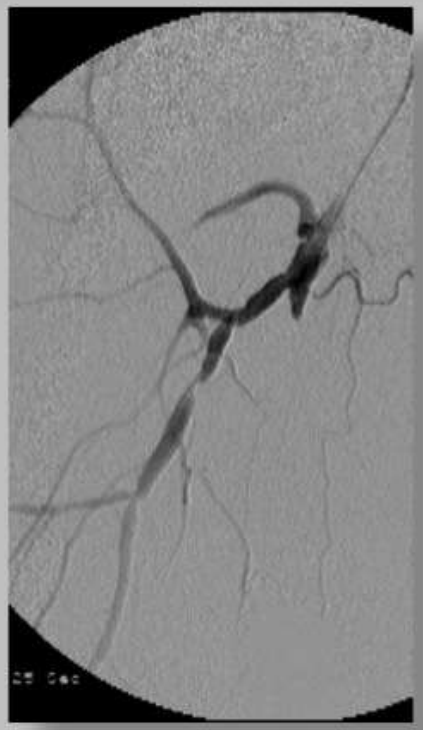
Standard bifurcation





Low bifurcation

Antegrade femoral approach



Diseased bifurcation

1. Shift to controlateral approach
2. Maintain antegrade approach if you are at least 2 cm above the disease

"In cases of antegrade approach, a bare needle angiogram of the femoral bifurcation was performed in order to have an adequate distance (>2 cm) from the target lesion"

Airoldi F et al. Antegrade approach for percutaneous interventions of ostial SFA: outcomes from a prospective series of diabetic patients presenting with critical limb ischemia. Cardiovasc Rev Med 2012;13:20–4

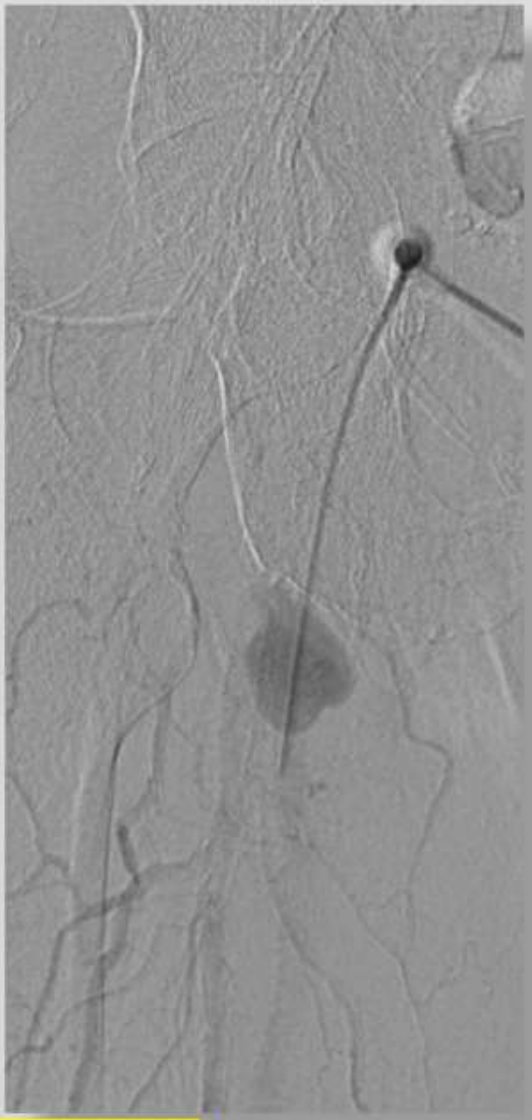
PATIENT DATA

- 40-year-old female
- Type 1 DM
- ESRD → hemodialysis
- CLI

- Puncture above the half line of the femoral head
- 6 Fr sheath

- 2 days after the procedure, during hemodialysis, sudden pain in the groin
- Huge abdominal wall hematoma

Example of a very low puncture into SFA
High risk of local hematoma



Superficial pseudo-aneurysm due to a previous low antegrade puncture

Retrograde approach: rationale

The antegrade approach of a CTO can be unsuccessful due to many reasons:

1. **Loss or rupture of the antegrade vessel pathway**
2. **Inability to re-enter into the true distal patent lumen due to limited distal “landing” zone or vessel calcification**
3. **Inability to correctly identify the origin of an occluded tibial artery**
4. **High risk to damage, continuing the antegrade subintimal dissection, the distal target vessel which could be the only landing zone of a distal bypass**

The Retrograde Puncture

- This strategy consists in a direct retrograde puncture of a distal patent vessel, followed by the insertion of wires and catheters with the aim to achieve the proximal open lumen were the antegrade approach failed.

- When antegrade and retrograde devices are connected, the procedure can continue with a standard antegrade angioplasty and hemostasis of the distal puncture site.

- A retrograde puncture can be done in every segment of the below-the-groin vessel, from the SFA to the foot vessels, providing good technical and clinical results.

Key points in retrograde puncture (1)

1. **Choice of the puncture site.** Accurate angiographic evaluation using different oblique views is necessary to identify the best target vessel.

2. **Vasodilators.** Especially for the distal vessels, the use of vasodilator (nitroglycerine, verapamil) is essential in avoiding spasm of the vessel. Vasodilators can be administered intra-arterially, as close as possible to the puncture site, and subcutaneously around the needle entry point.

3. **Puncture technique.**
   - The puncture is performed with a *21 Gauge needle*, under fluoroscopic guidance with contrast medium injection and at the maximum magnification. The length of the needle must be chosen according to the depth of the target vessel.
   - The operator must keep in mind the concept of *parallax technique*: the needle should be advanced by maintaining a perfect overlap with the target vessel.
   - Once chosen the correct projection for the puncture, a 90° angulated projection can be useful to check the distance of the needle to the target vessel.

Key points in retrograde puncture (2)

4. **Sheath.** In SFA and popliteal artery a 4F sheath is sometimes necessary to permit retrograde approach with the support of a 4 French catheter. In BTK vessels we avoid standard sheaths and prefer to use a sheathless approach or a micro sheath.

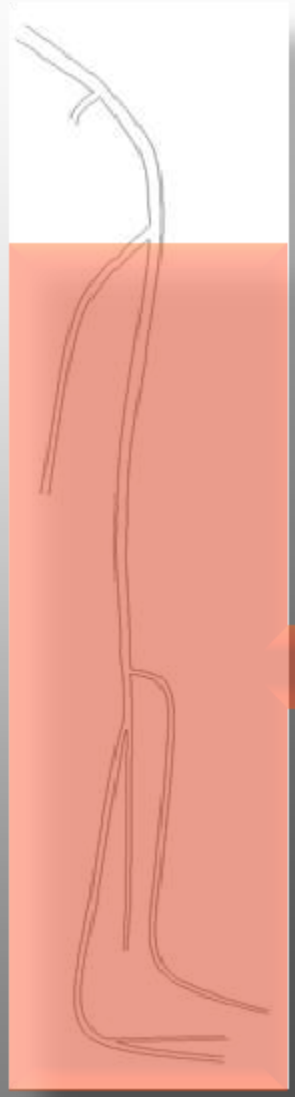
4. **Retrograde crossing strategy.** Every 0.014” and 0.018” wire can be used for retrograde crossing of the CTO. We generally prefer to start with a 0.018” wire, because of the enhanced support. Low profile, support catheters are very useful for wire support, orientation and exchange.

Key points in retrograde puncture (3)

Artery	Preferred oblique view	Preferred segment	Skin puncture site	Needle length
SFA	Controlateral, 30-45°	Distal	Medial aspect of the thigh at the level of the superior edge of the rotula	9-15 cm
Popliteal	Antero-posterior Maintain the supine position with the knee gently flexed and rotated	Medium-distal	Posterior aspect of the knee	7-9 cm
Anterior tibial	Omolateral 20-40°	Every segment	Antero-lateral aspect of the leg	4-7 cm
Posterior tibial	Lateral	Distal, retromalleolar segment, proximal plantar arteries	Medial aspect of the ankle	4-7 cm
Peroneal	Omolateral 20-40°	Every segment	Antero-lateral aspect of the leg; the needle crosses the interosseus membrane	7 cm
Dorsalis pedis	Antero-posterior	Every segment	Dorsum of the foot	4 cm
Foot arteries	Antero-posterior	– First metatarsal artery – Tarsal arteries – Collaterals	Dorsum of the foot Plantar access is not practical because of skin thickness	4 cm

Retrograde approach in 1402 CTOs

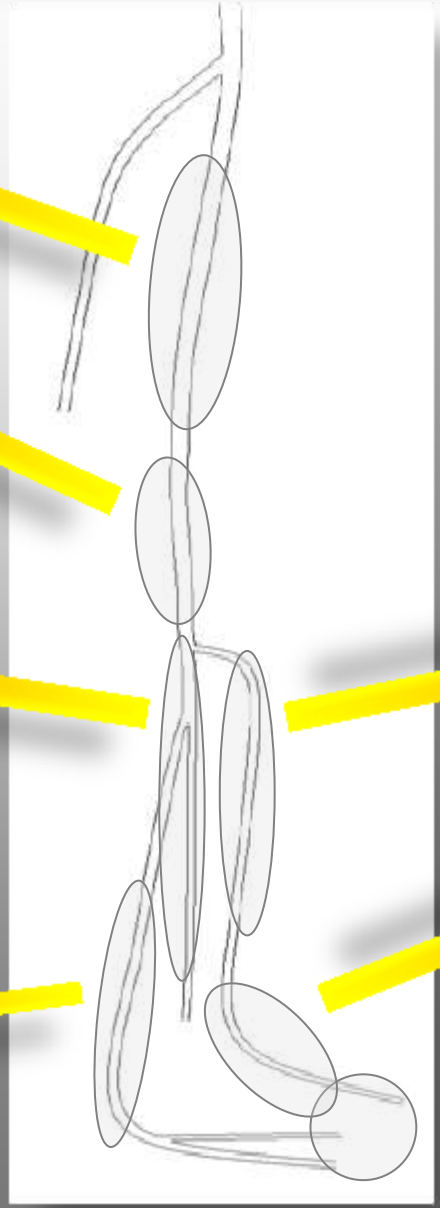
Milan experience 2010-2013



- **Retrograde puncture**
- **Transcollateral**
  1. Pedal-plantar loop technique
  2. Peroneal artery branches PTA

Successful RETRO 147 (10%)

Retrograde approach: Milan experience 2010-2013



SFA 8%

POP 5%

TTP-PER 3%

PT 15%

OTHER 5%

AT 13%

PED 35%

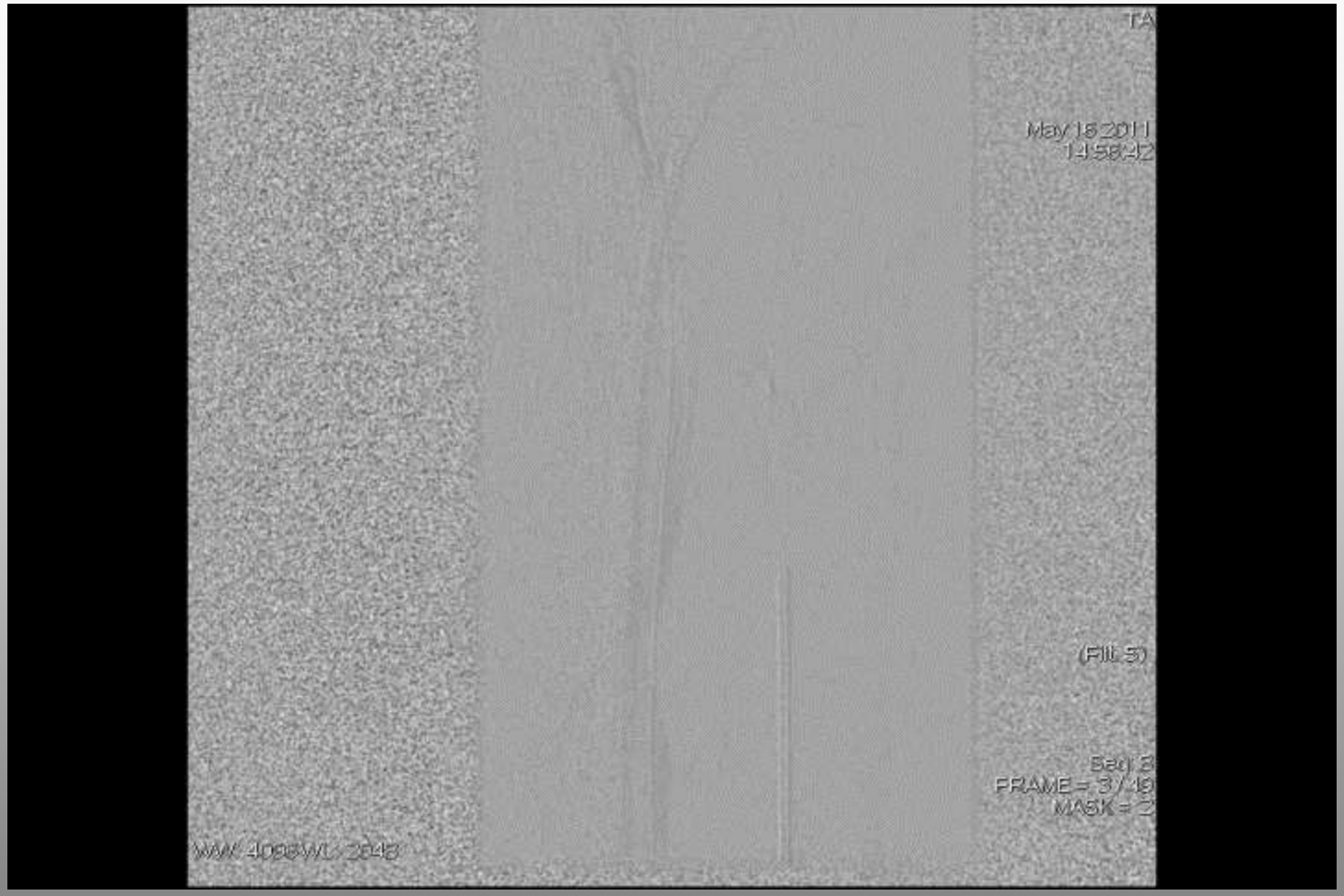
CASE RETRO 1

Failure of antegrade approach due to unfavorable ATA take off

Baseline angio

Failure to enter the ATA ostium

Retrograde ATA puncture



Kissing balloons

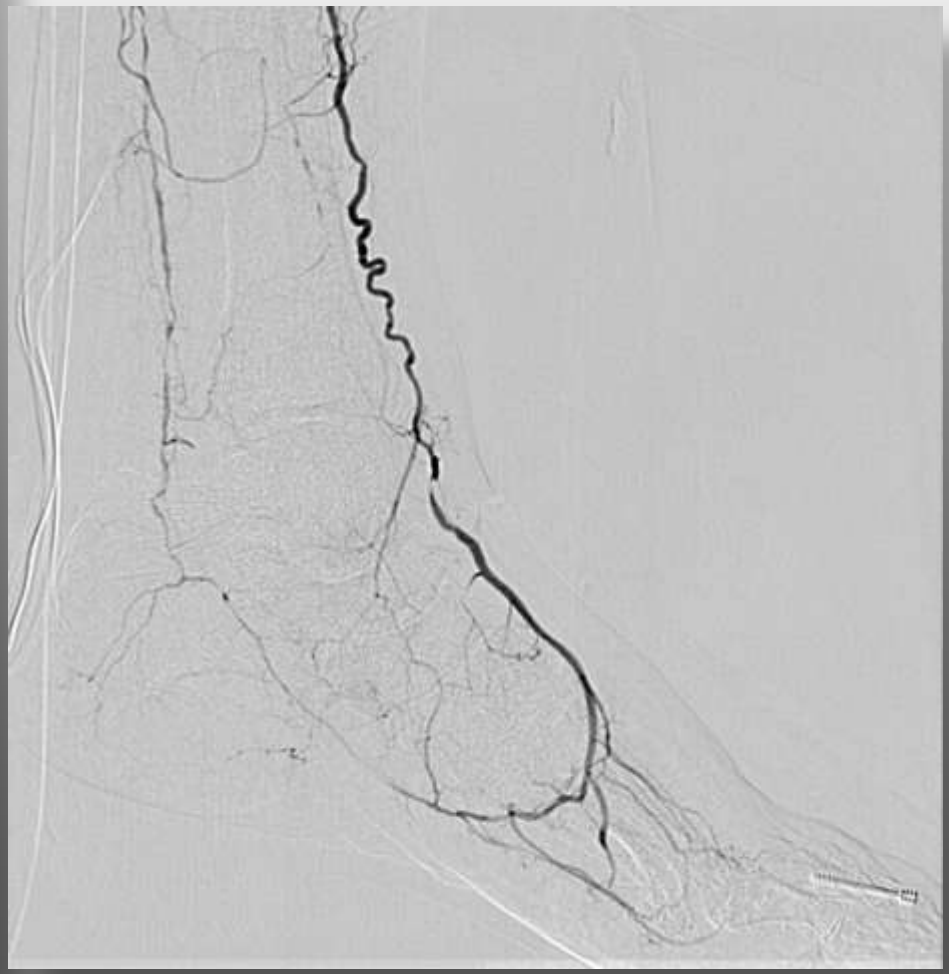
Baseline angio

Final result

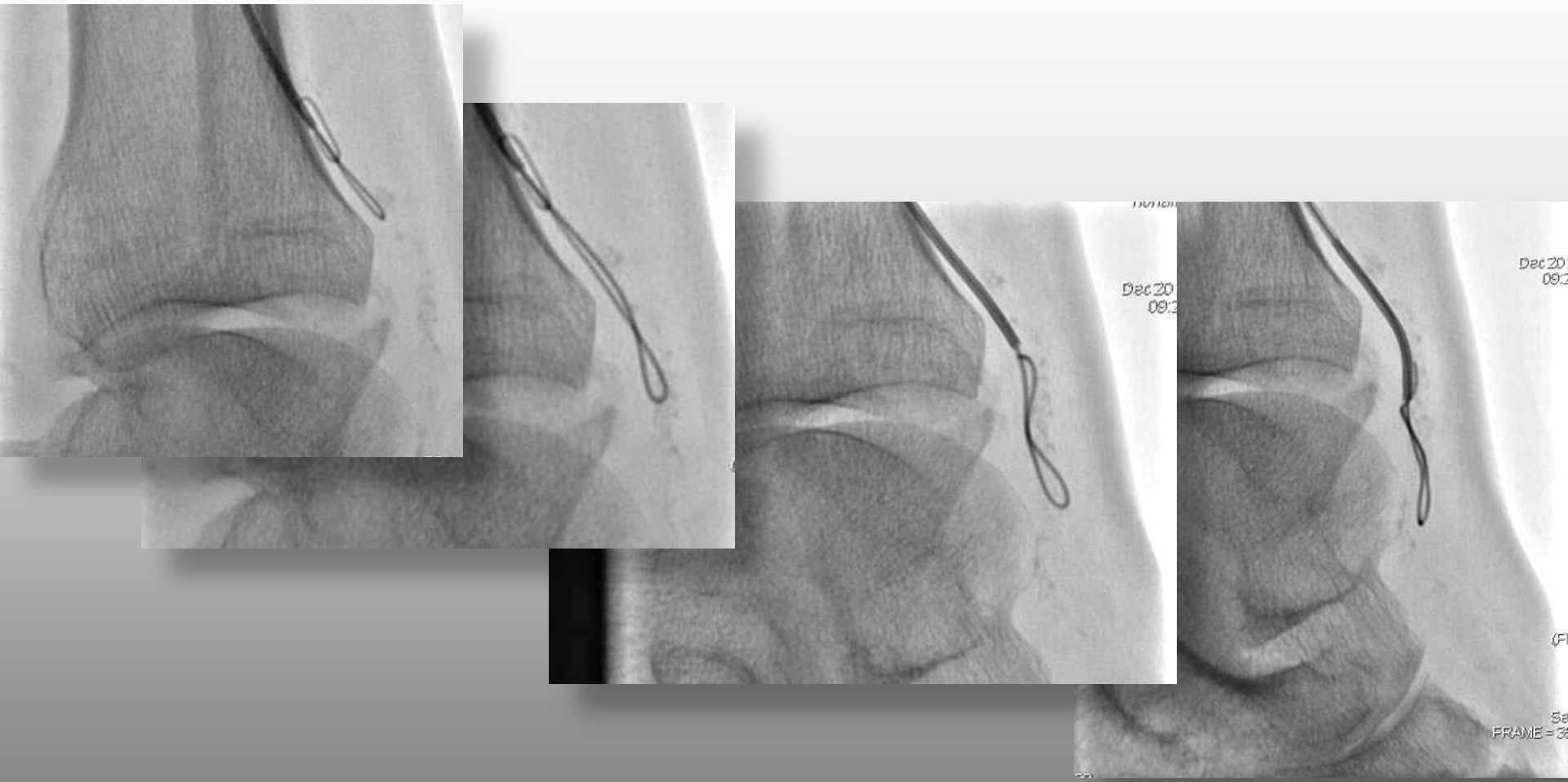
CASE RETRO 2

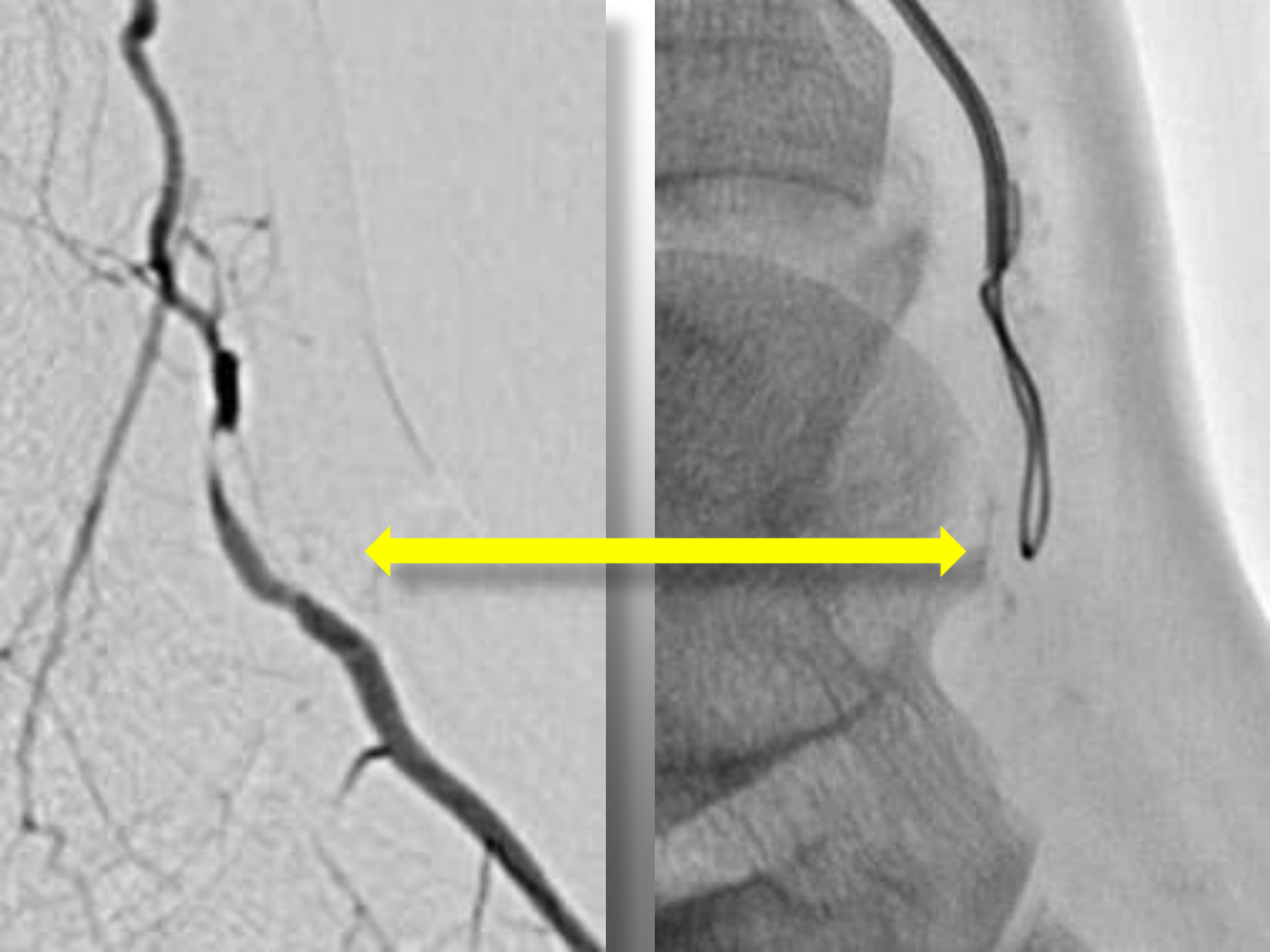
Failure of subintimal approach in a very calcified dorsalis pedis

- Hypoplasic ATA
- Occluded Peroneal artery
- Big and healthy dorsalis pedis



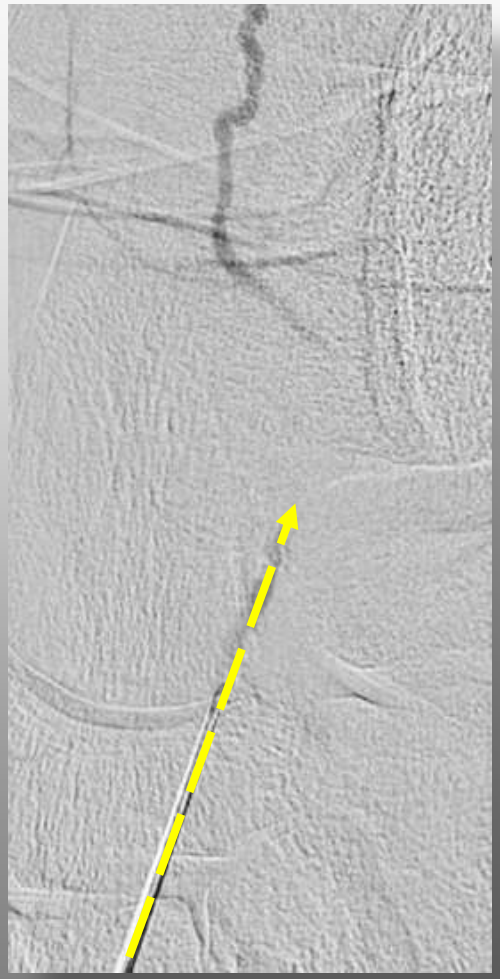
Subintimal approach in peroneal artery





Retrograde dorsalis pedis puncture

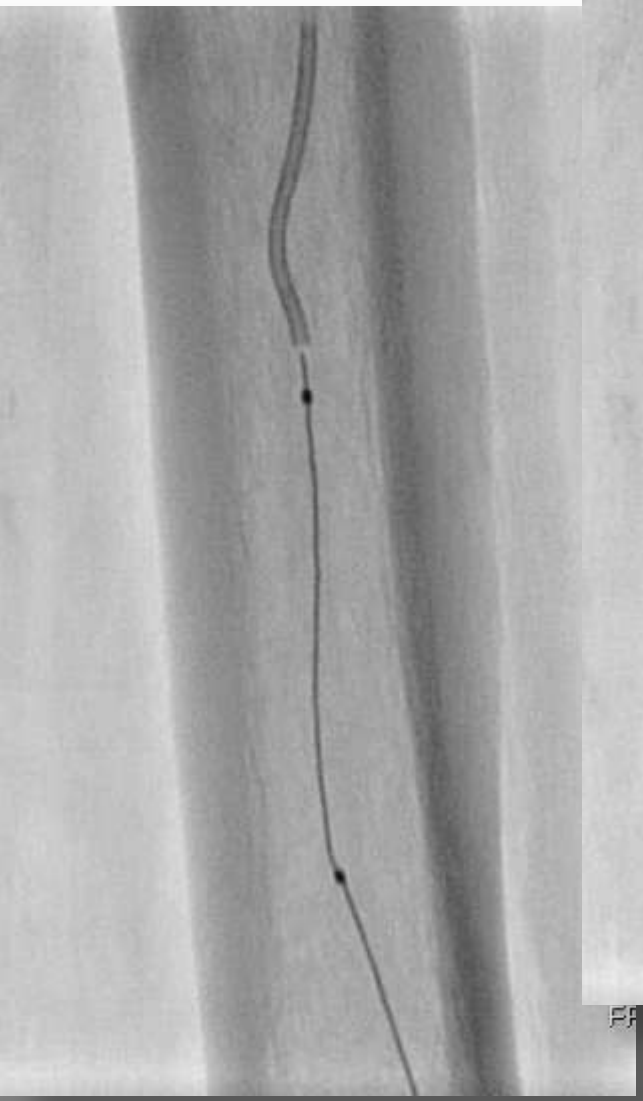
Retrograde dorsalis pedis puncture

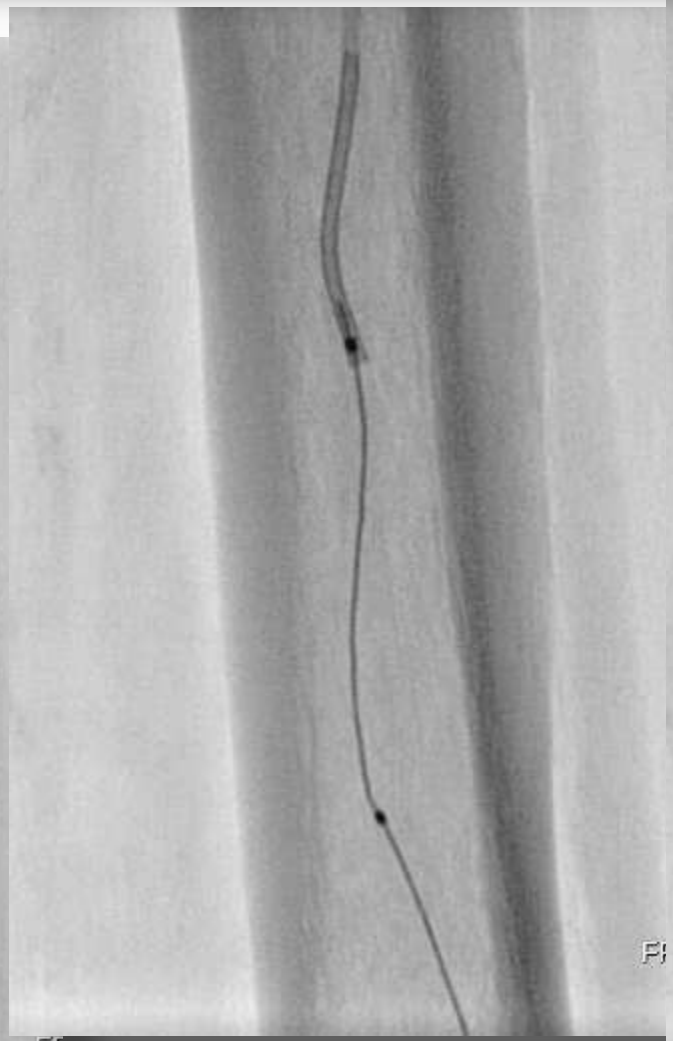


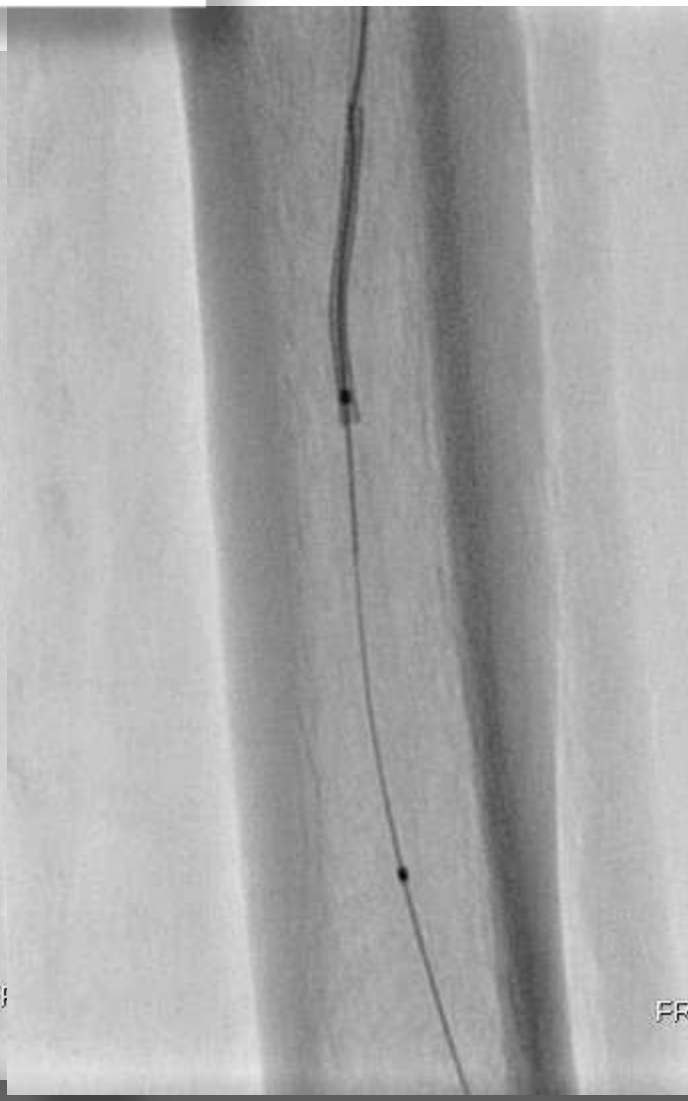
Parallax technique: the needle and the artery are (perfectly) aligned

Retrograde dorsalis pedis puncture

Retrograde dorsalis pedis puncture







Shift to antegrade approach

Final result

Lower Extremity Intervention

Technical Evolution from Puncture to Closure

Thank You !