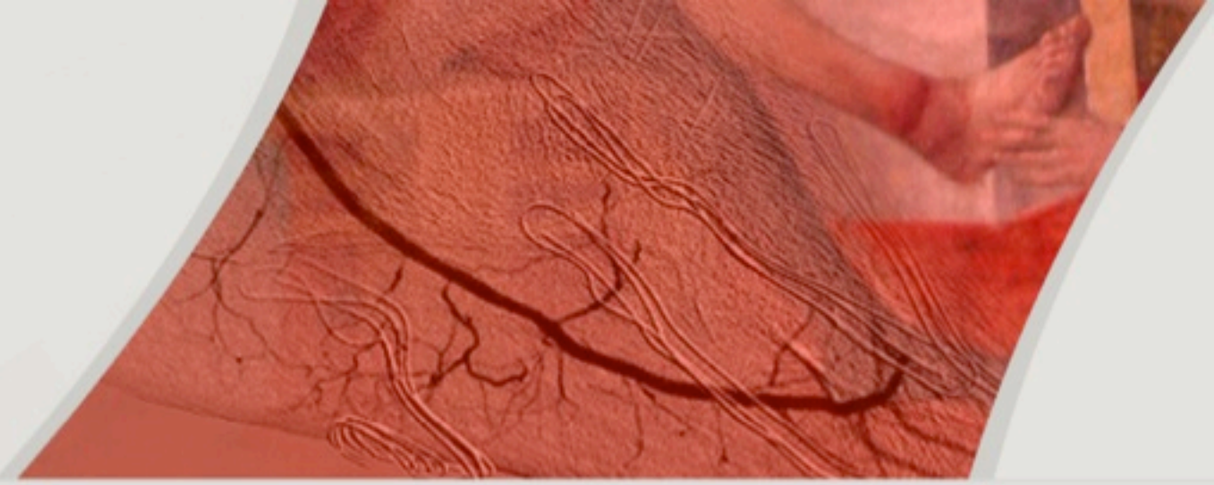
Targets in CLI revascularization

Roberto Ferraresi
Peripheral Interventional Unit
www.robertoferraresi.it

HUMANITAS GAVAZZENI
Bergamo
Italy

Targets in CLI revascularization



Main Principles

- Complete Revascularization
- Wound-related Artery Revascularization
- Wound Blush

Conclusions

Targets in CLI revascularization

The first imperative of revascularization is to tailor the procedure to the patient, balancing between two sometimes conflicting principles:

on one hand revascularization must be as complete as possible, using all the techniques and devices able to guarantee the best and durable blood supply to the wounds;

on the other hand the procedure must be as “soft” as possible, reducing to the minimum the patient’ stress, contrast dye administration, fluid infusion, and respecting the extreme fragility typical of CLI diabetic patients.

Targets in CLI revascularization

1. Complete revascularization

DIABETICMedicine
DOI: 10.1111/j.1464-5491.2007.02167.x

When is a technically successful peripheral angioplasty effective in preventing above-the-ankle amputation in diabetic patients with critical limb ischaemia?

Cardiovasc Intervent Radiol (2010) 33:720–725
DOI 10.1007/s00270-010-9881-3

CLINICAL INVESTIGATION

PTA of Infrapopliteal Arteries: Long-term Clinical Follow-up and Analysis of Factors Influencing Clinical Outcome

Jan H. Peregrin · Boris Kožnar · Josef Kováč · Jarmila Laštovičková · Jiří Novotný · Daniel Vedlich · Jelena Skibová

Targets in CLI revascularization

1. Complete revascularization

Peregrin: limb salvage rate at one year increased from 56% without direct blood flow to the foot (0 BTK vessels open), to, respectively, 73%, 80% and 83% with 1, 2 or 3 BTK vessels open.

Faglia: PTA of tibial arteries had a better outcome than PTA of the peroneal artery alone.

Targets in CLI revascularization

1. Complete revascularization

- 1 vessel better than 0
- 2-3 vessels better than 1
- Tibials better than peroneal

Healing is a blood flow-dependent phenomenon and the first principle guiding our revascularization strategy must be giving the best possible blood supply to the foot.

Complete revascularization

CASE 1

CASE 1

FR


CASE 1

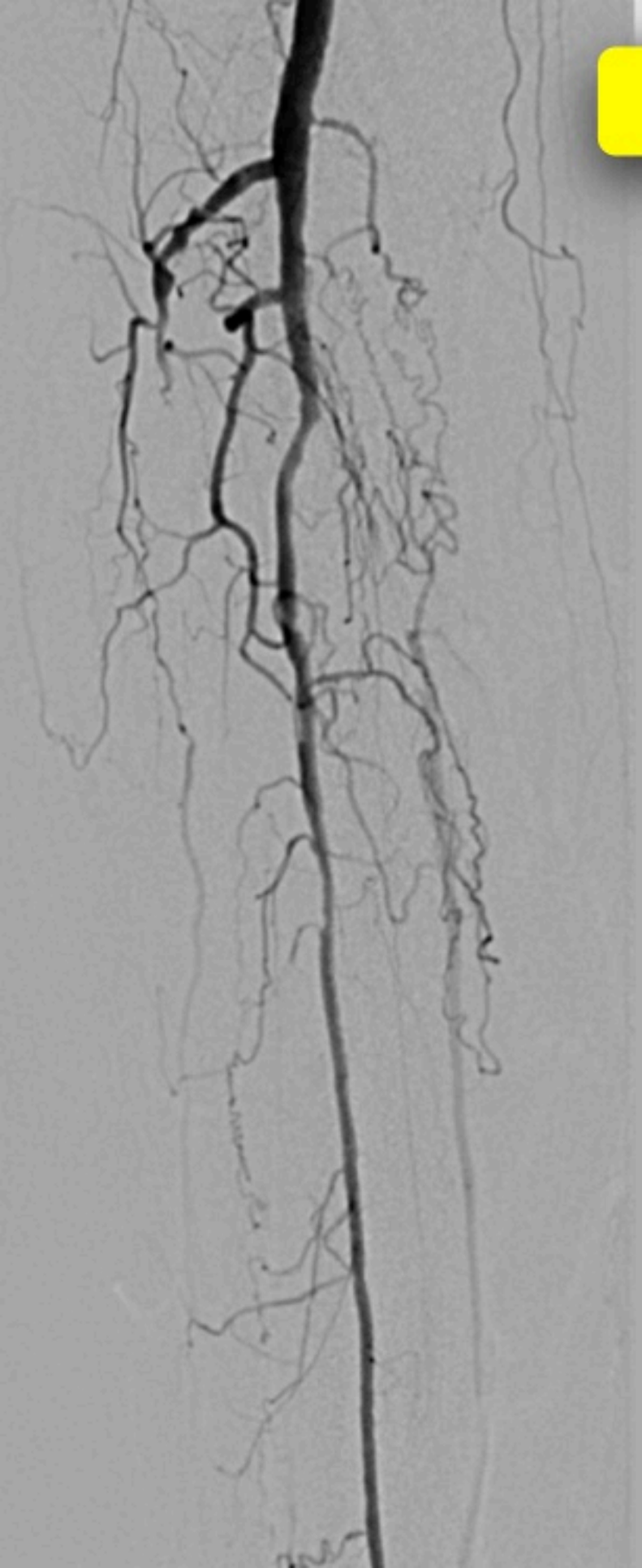
Complete revascularization

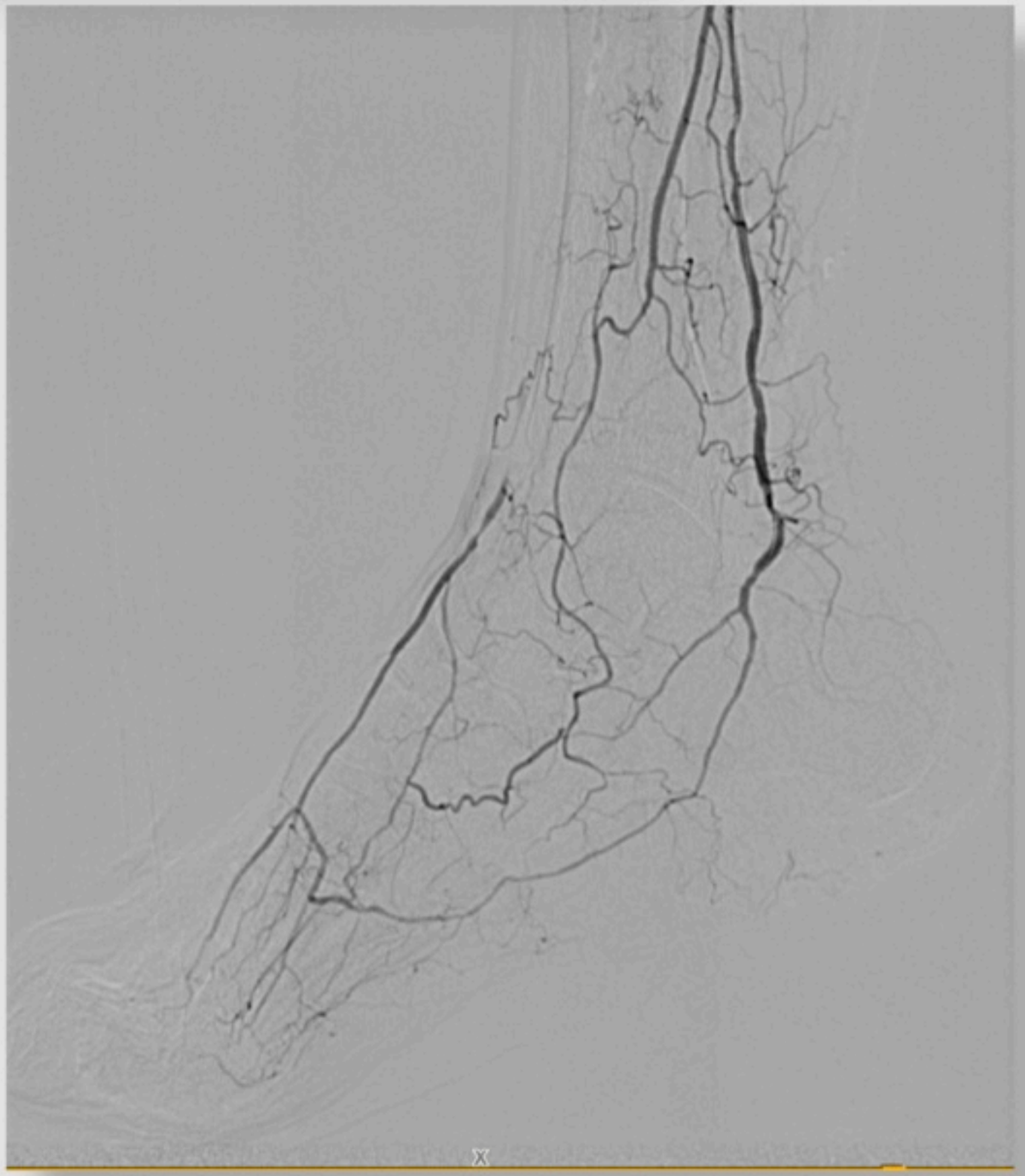
CASE 1

CASE 1

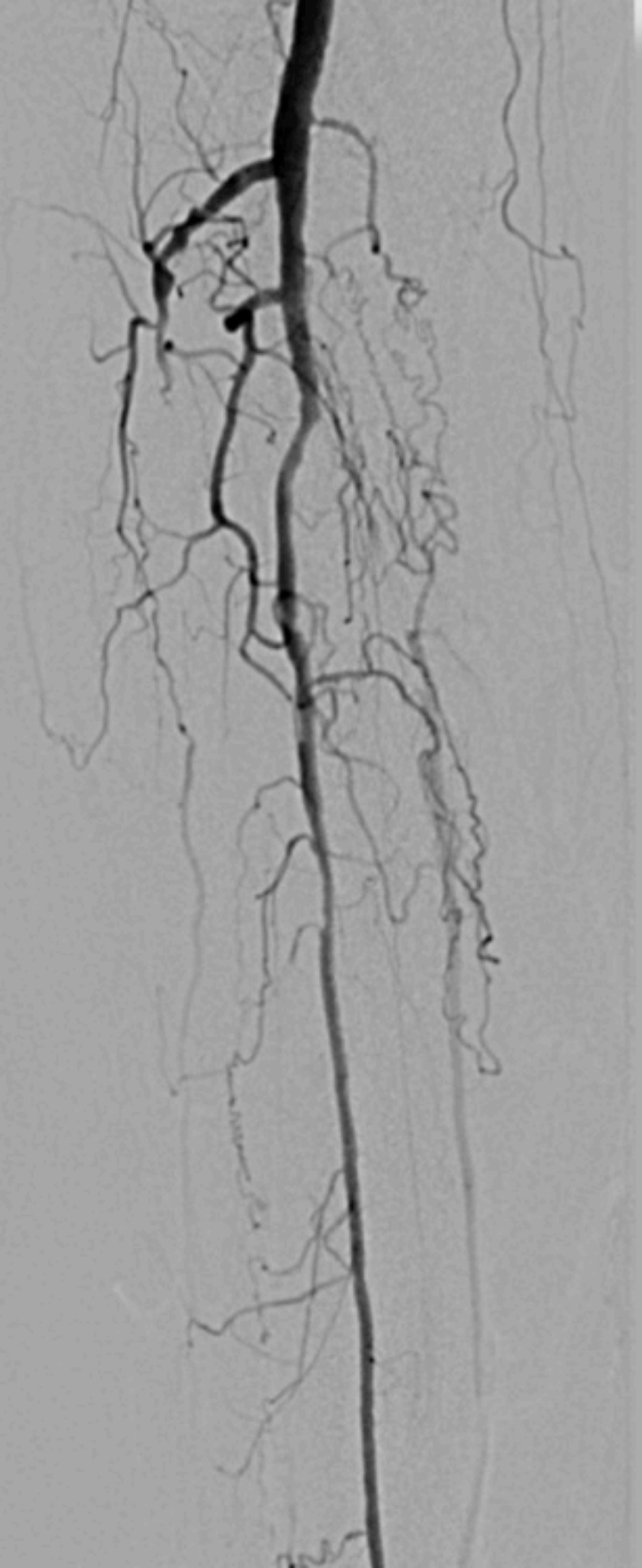
Complete revascularization

CASE 2

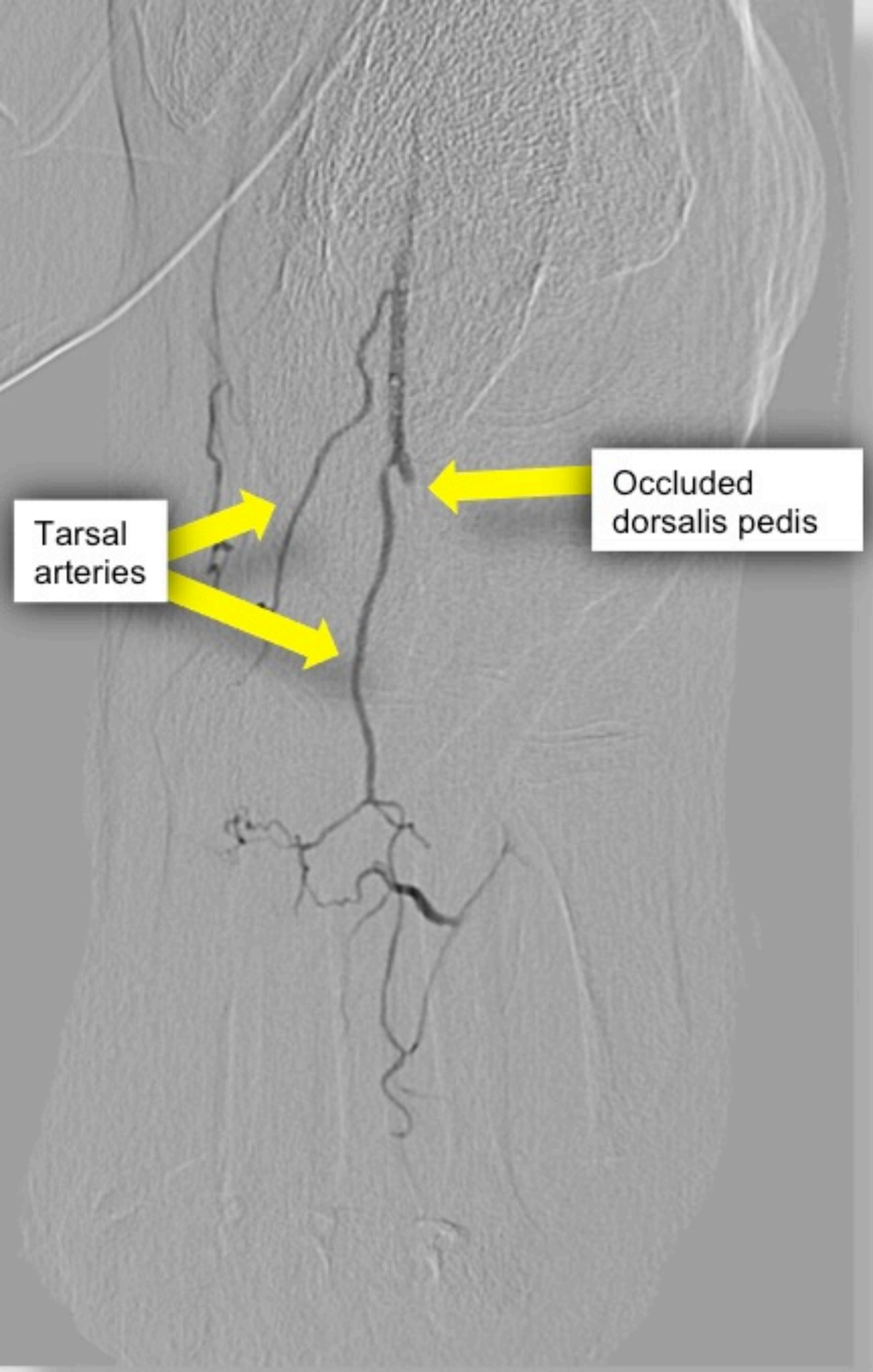


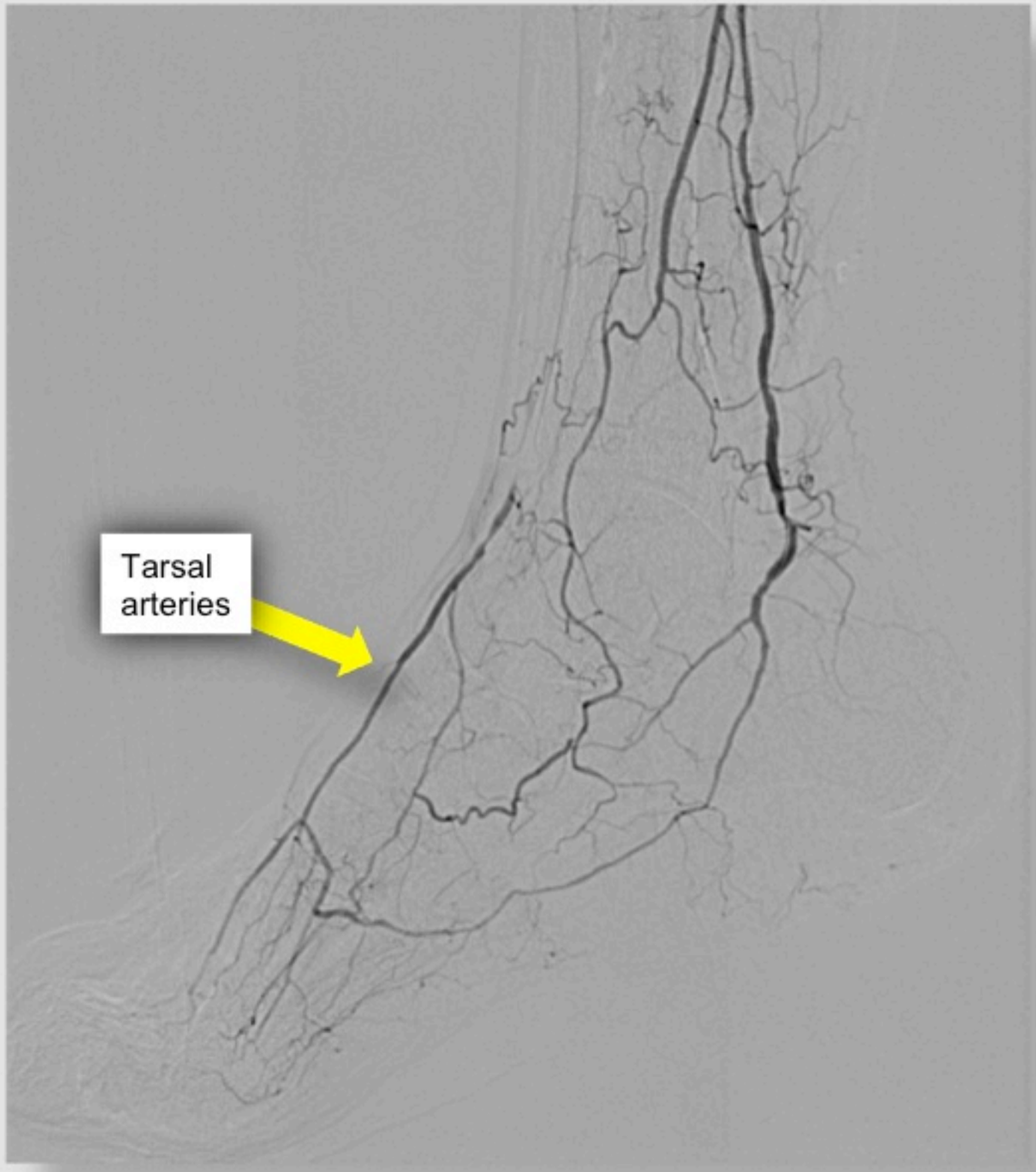


CASE 2

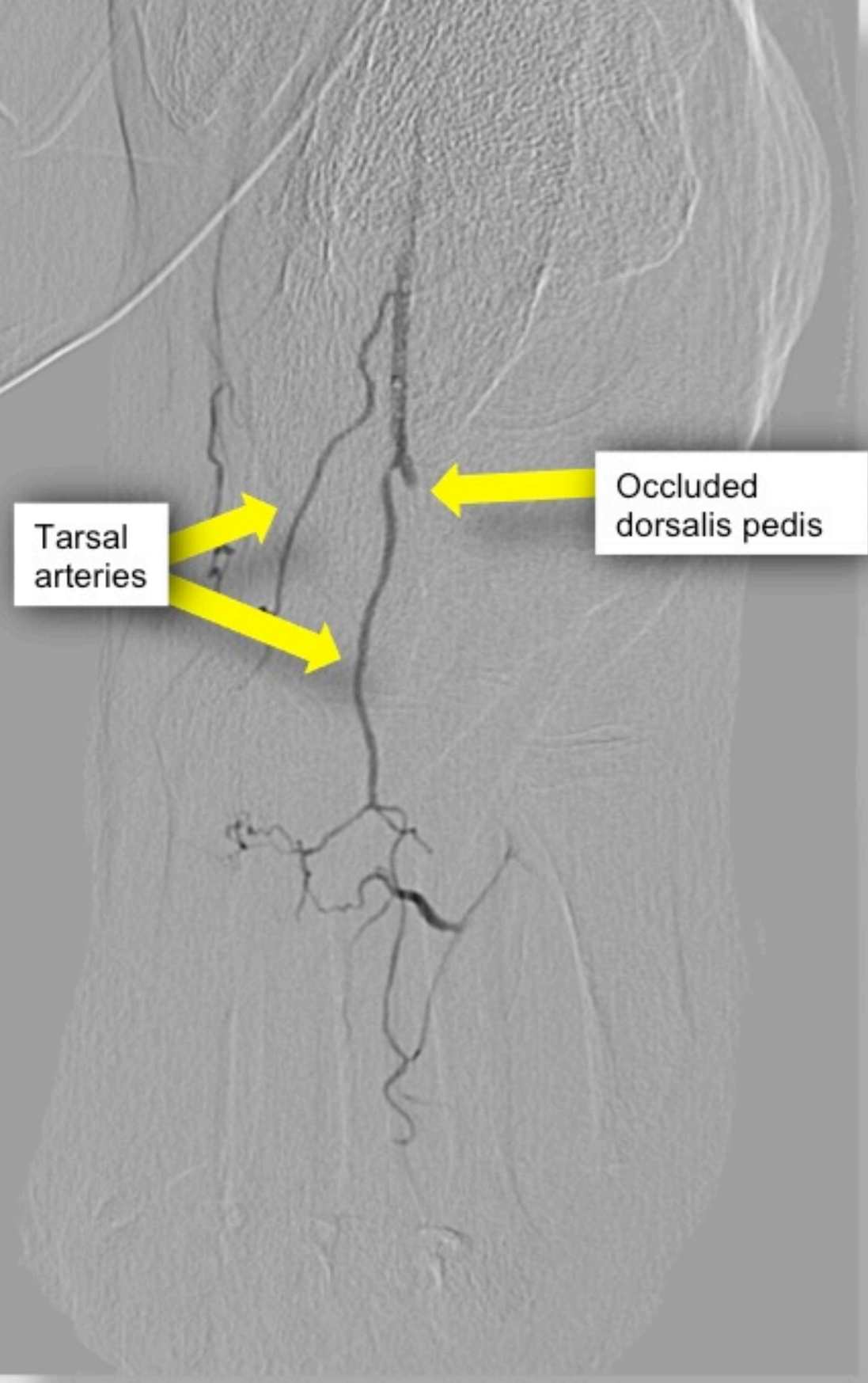


CASE 2





CASE 2



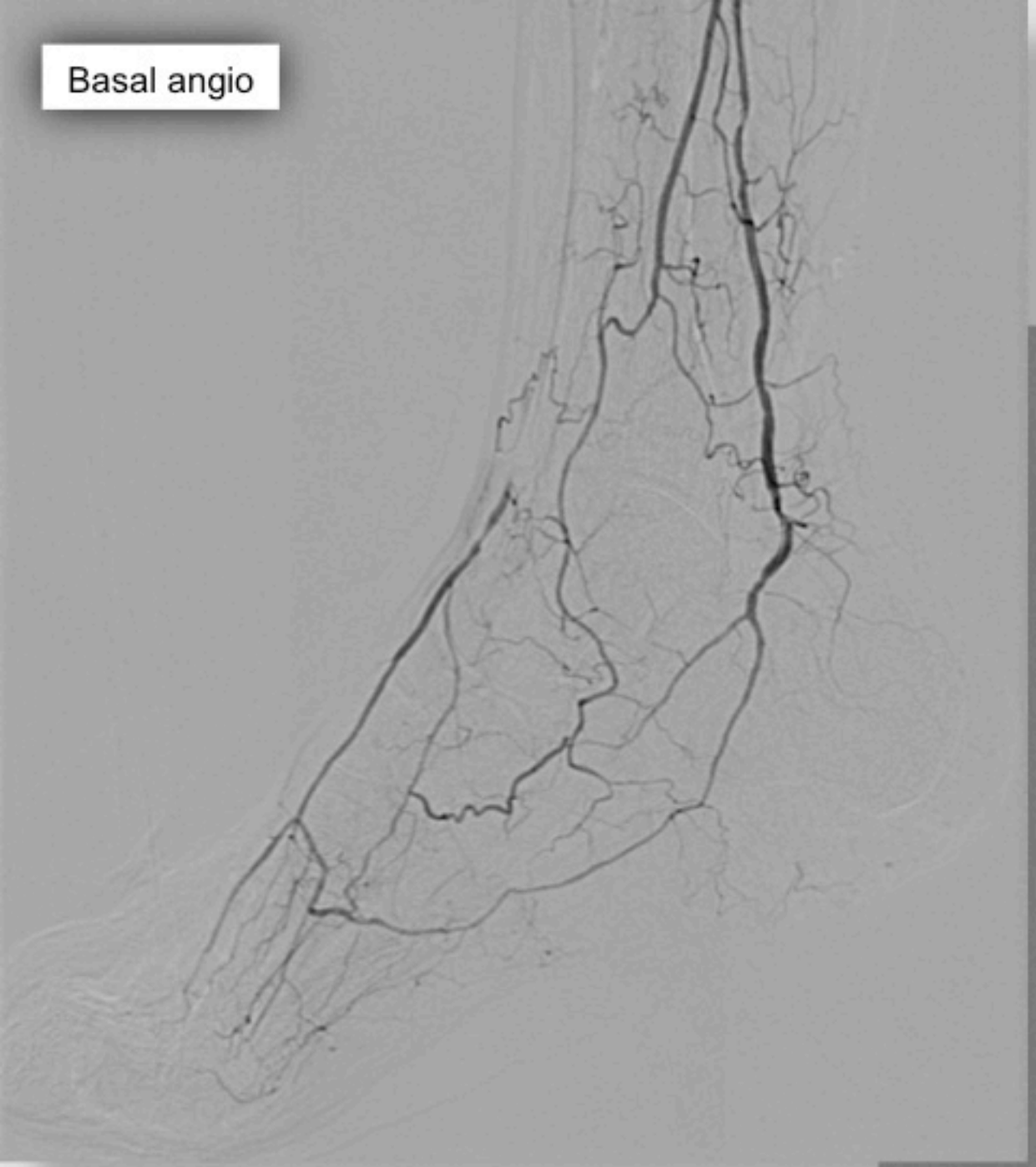
CASE 2

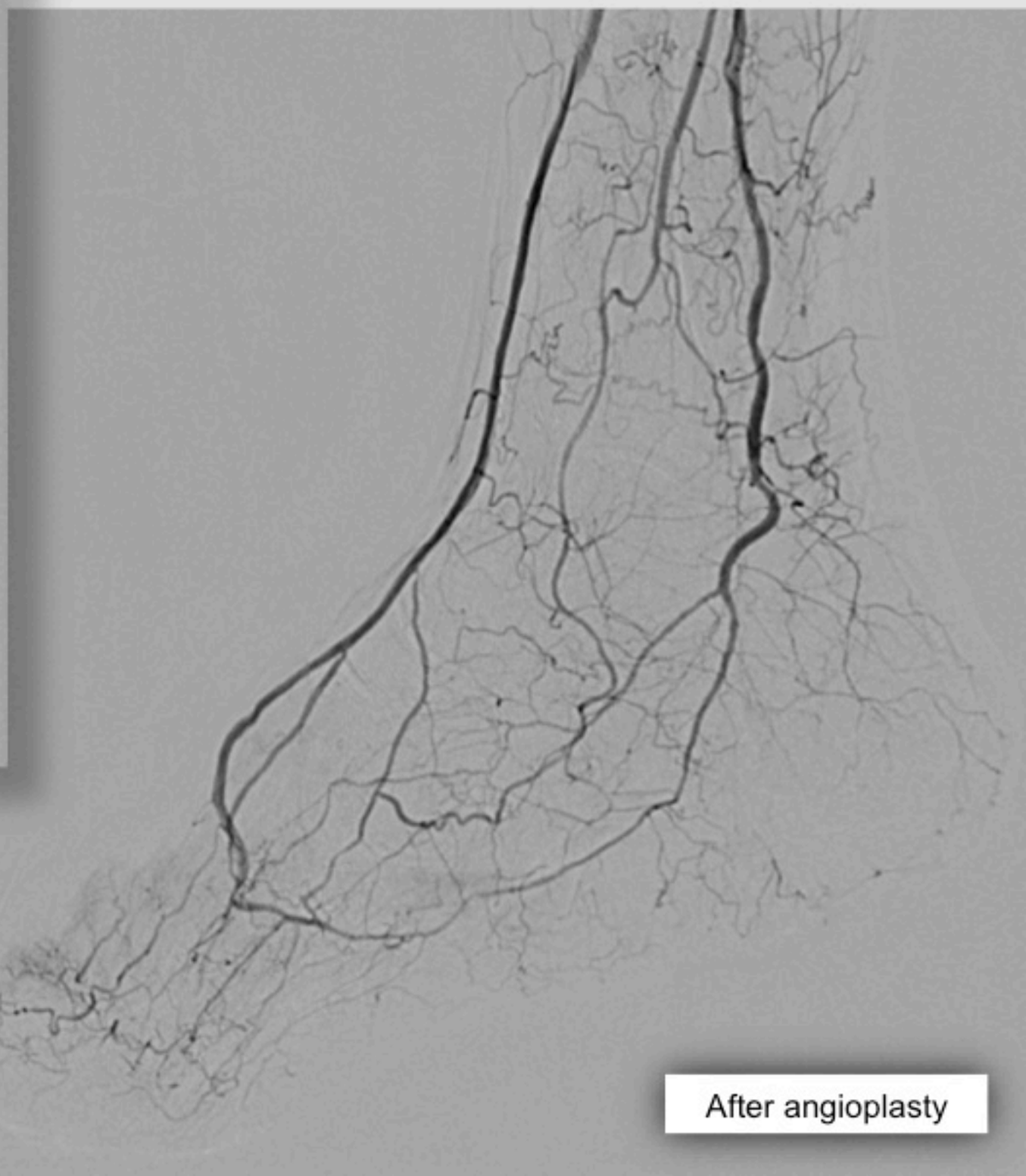
Plantar arch

CASE 2

Dorsalis pedis
after angioplasty

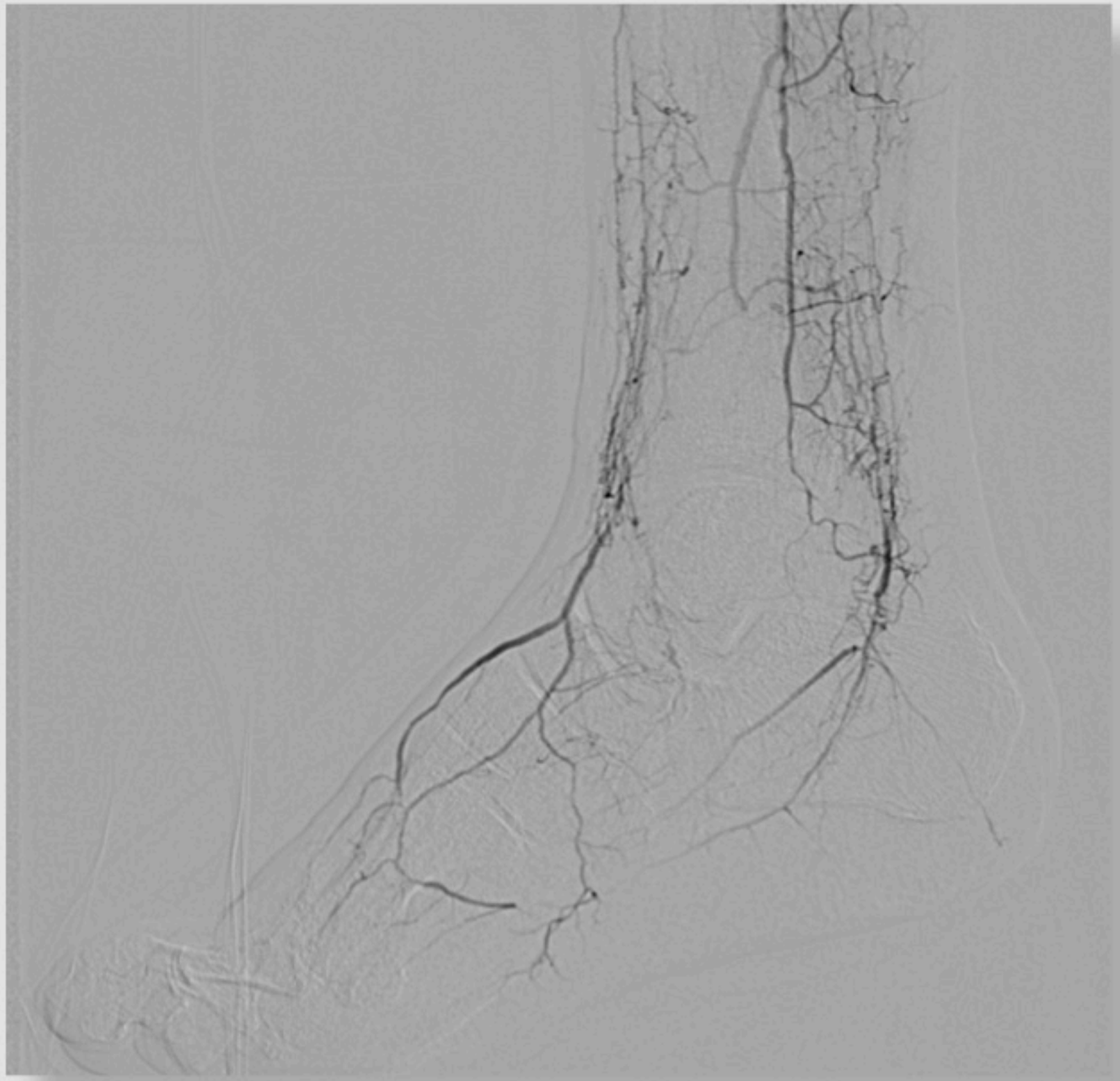
CASE 2





Complete revascularization

CASE 3



Complete revascularization

CASE 3

Targets in CLI revascularization

1. Complete revascularization

Failure!

2. Wound-related Artery Rev.

Complete revascularization could not be achieved in many cases, due to different reasons:

- Technical failure
- Time failure (patient stress, contrast dye amount etc.)

Targets in CLI revascularization

1. Complete revascularization

Failure!

2. Wound-related Artery Rev.

Revascularization of a Specific Angiosome for Limb Salvage: Does the Target Artery Matter?

Richard F. Neville,[1] Christopher E. Attinger,[2] Erwin
Michael Thomassen,[2] and Anton N. Sidawy,[3] Washi

Importance of the Angiosome Concept for Endovascular Therapy in Patients with Critical Limb Is

Osamu Iida,[1] MD, Shinsuke Nanto,[2*] MD, PhD
Kuniyasu Ikeoka,[1] MD, Shin Okamoto,[1]
Masashi Fujita,[1] MD, PhD, Hiroto
and Seiki Nagata,[1]

A reliable approach to diabetic neuroischemic foot wounds: below-the-knee angiosome-oriented angioplasty.

Alexandrescu V, Vincent G, Azdad K, Hubermont G, Ledent G, Ngongang G, Filimon AM

Targets in CLI revascularization

1. Complete revascularization

- 1 vessel better than 0
- 2-3 vessels better than 1
- Tibials better than peroneal

2. Wound-related Artery Rev.

- Direct revascularization (bypass or PTA) better than indirect revascularization

Wound-related artery concept

Following the angiosome concept, a successful revascularization (PTA or bypass) of the artery directly feeding the wound region (Wound related artery, WRA) leads to higher rate of limb salvage and wound healing.

1. Taylor GI et Al. The vascular territories (angiosomes) of the body: Experimental study and clinical implication. Br J Plast Surg 1987;40:113-41
2. Taylor GI et Al. Angiosomes of the leg: anatomic study and clinical implications. Plast Reconstr Surg 1998;102:599-616
3. Attinger CE et Al. Angiosomes of the foot and ankle and clinical implications for limb salvage: reconstruction, incisions, and revascularization. Plast Reconstr Surg 2006;117:261S-293S
4. Iida O et Al. Importance of the angiosome concept for endovascular therapy in patients with critical limb ischemia. Catheter Cardiovasc Interv 2010;75:830-6
5. Iida O et Al. Long term reults of direct and indirect endovascular revascularization based on the angiosome concept in patients with critical limb ischemia presenting with isolated below-the knee lesions. J Vasc surg 2012;55:363-70
6. Alexandrescu V et Al. Selective primary angioplasty following an angiosome model of reperfusion in the treatment of Wagner 1-4 diabetic foot lesions: practice in a multidisciplinary diabetic limb service. J Endovasc Ther 2008;15:580-93
7. Alexandrescu V et Al. The challenging topic of diabetic foot revascularization: does the angiosome-guided angioplasty may improve outcome. Journal of Cardiovascular Surgery 2012;53:3-12
8. Alexandrescu V et Al. A reliable approach to diabetic neuroischemic foot wounds: below-the-knee angiosome-oriented angioplasty. J Endovasc Ther 2011;18:376-87
9. Alexandrescu V et Al. Angiosome theory: Fact or fiction? Scand J Surg 2012;101:125-31
10. Neville RF et Al. Revascularization of a specific angiosome for limb salvage: does the target artery matter? Ann Vasc Surg 2009;23:367-73
11. Houlind K et Al. The Role of The Angiosome Model in Treatment of Critical Limb Ischemia. Chapter 24, “Artery Bypass” 2013, WS Aronow editor, Publisher: InTech

Wound-related artery concept 1

All of the studies comparing direct and indirect revascularization are retrospective; we can assume that the operators focused on traditional optimal technical targets rather than the WRA, but we don't know if the same patients would have been technically revascularizable following an angiosome-oriented approach. It is possible that in the "indirect revascularization" groups there was a propensity to collect patients with the most technically challenging disease and the differences in the outcomes may simply reveal basal differences in the extend and type of obstructive disease.

Try to do what is possible and don't lose time on unrealistic targets!

Wound related artery concept 2

Direct revascularization could have a different value depending on the presence or not of a good distal distribution network:

Good distal distribution system

Varela et al. demonstrated that the restoration of blood flow to the ulcer through collateral vessels (pedal and distal peroneal branches) provided similar results to those obtained through its specific source artery in terms of healing and limb salvage.

- Varela C et Al. The role of foot collateral vessels on ulcer healing and limb salvage after successful endovascular and surgical distal procedures according to an angiosome model. Vasc Endovascular Surg 2010;44:654-60

Inadequate distal distribution system

In diabetic patients and ESRD patients in hemodialysis collateral vessels formation is reduced or absent. Foot circulation becomes functionally terminal because of lack of collaterals. This is the reason why we need to improve the most direct blood flow to the wounded area.

- Circulation, 1999;99:2239-2242;
- Cardiovasc Res. 2001 Feb 16;49(3):554-60;
- Circulation, 2004;2343-2348;
- Azuma N et Al. Factors influencing wound healing of critical ischaemic foot after bypass surgery: Is the angiosome important in selecting bypass target artery? Eur J Vasc Endovasc Surg 2012;43:322-28

WRA rev. in a “desert foot”

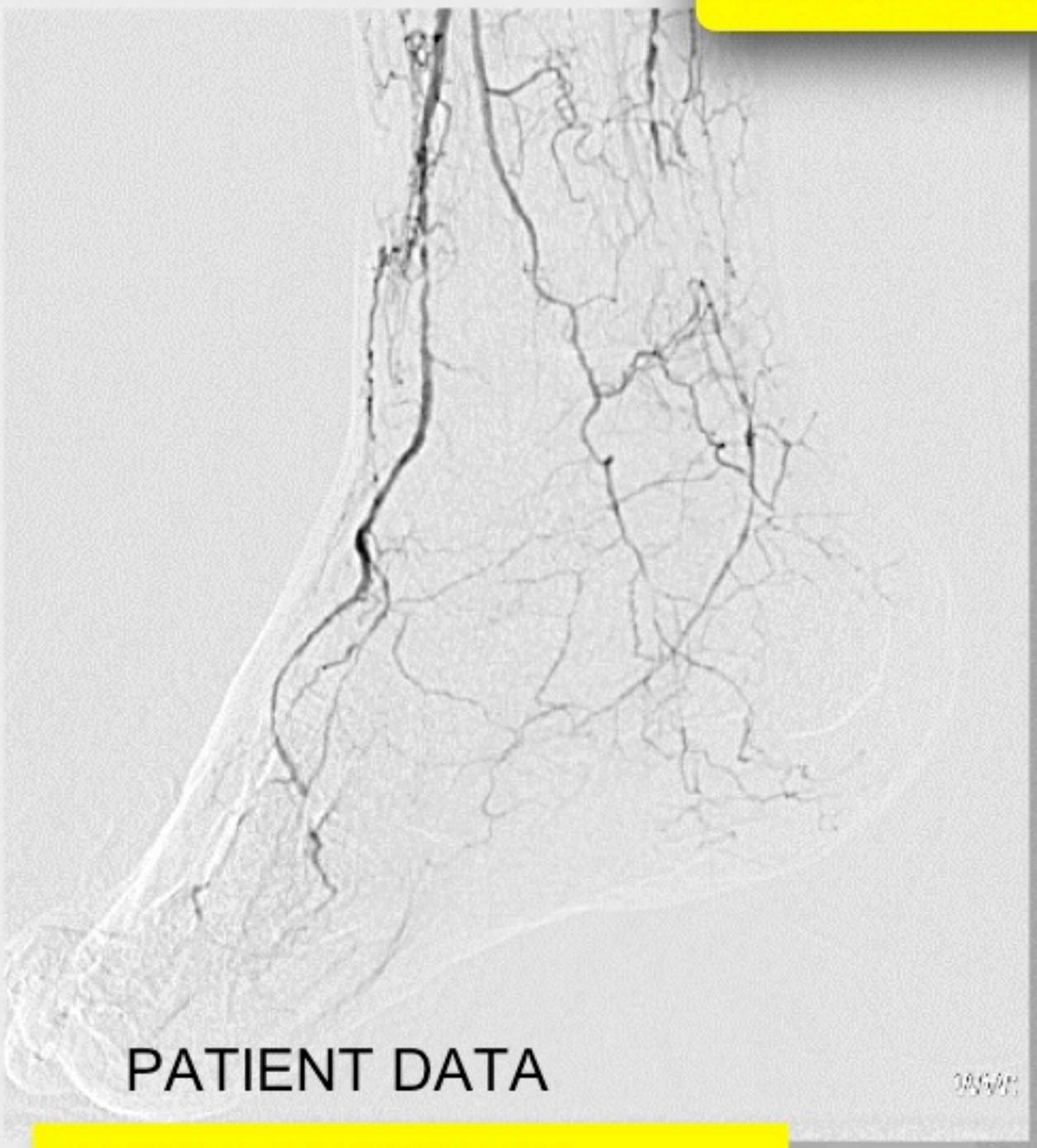
CASE 4

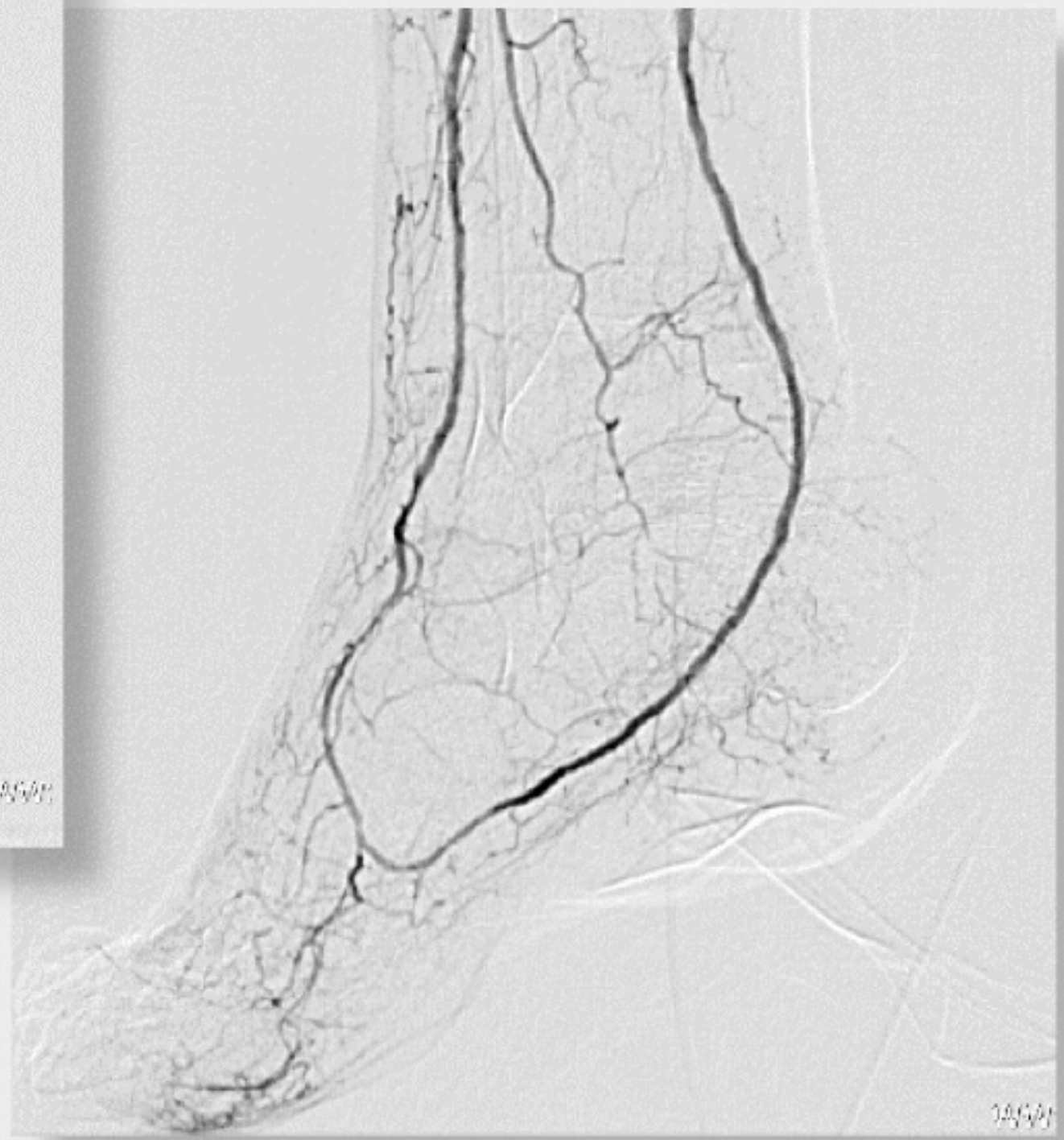
PATIENT DATA

- 69-year-old male
- Type 2 DM
- ESRD in hemodialysis
- Forefoot plantar ulcer

WRA rev. in a “desert foot”

CASE 5





PATIENT DATA

- 64-year-old male
- ESRD in hemodialysis
- Heel ulcer

Wound related artery concept 3

CASE 6

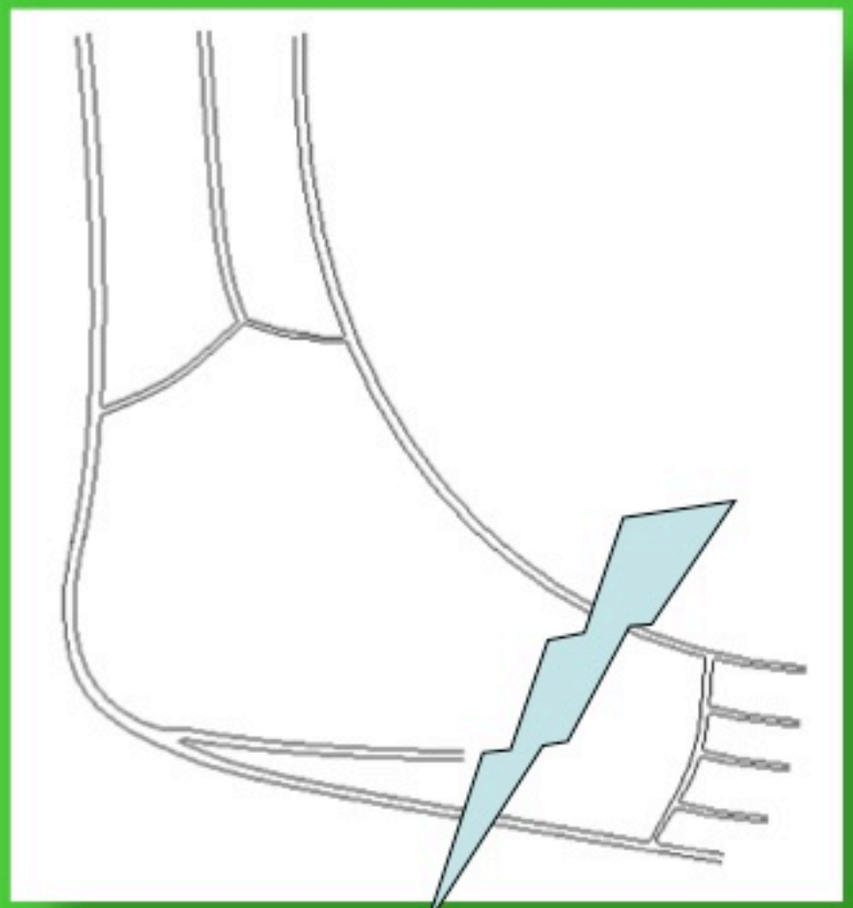
Not every wound, especially in case of deep infection, is confined into a single angiosome space; patients with extensive tissue damage cannot be classified on the basis of an angiosome-oriented revascularization.

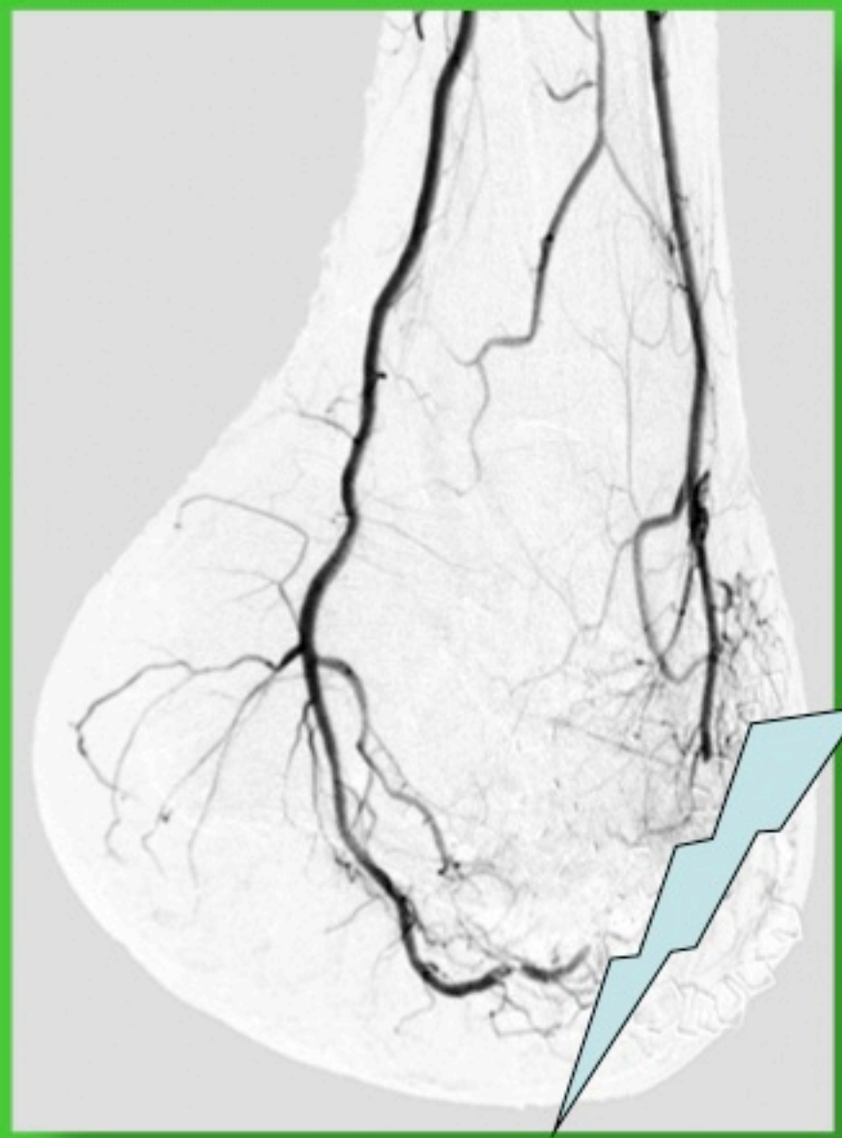
Match your revascularization strategy with the surgical care of the wounds!

Wound related artery concept 3

Forefoot amputations (rays, trans-metatarsal, Lisfranc, Chopart) are a common cause of foot circle interruption

“Willis like” foot circle





CASE 7

Example of “surgical WRA” revascularization

PATIENT DATA

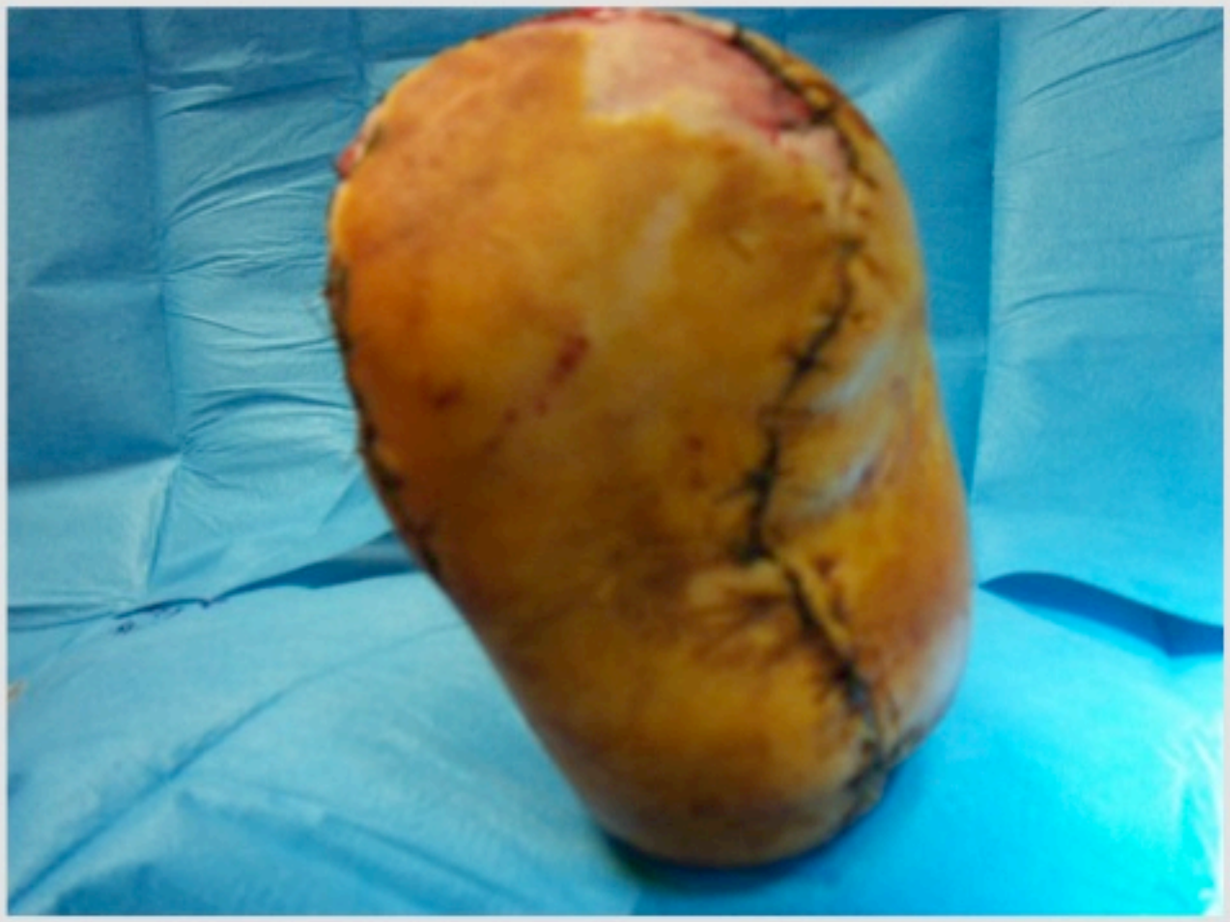
CASE 7

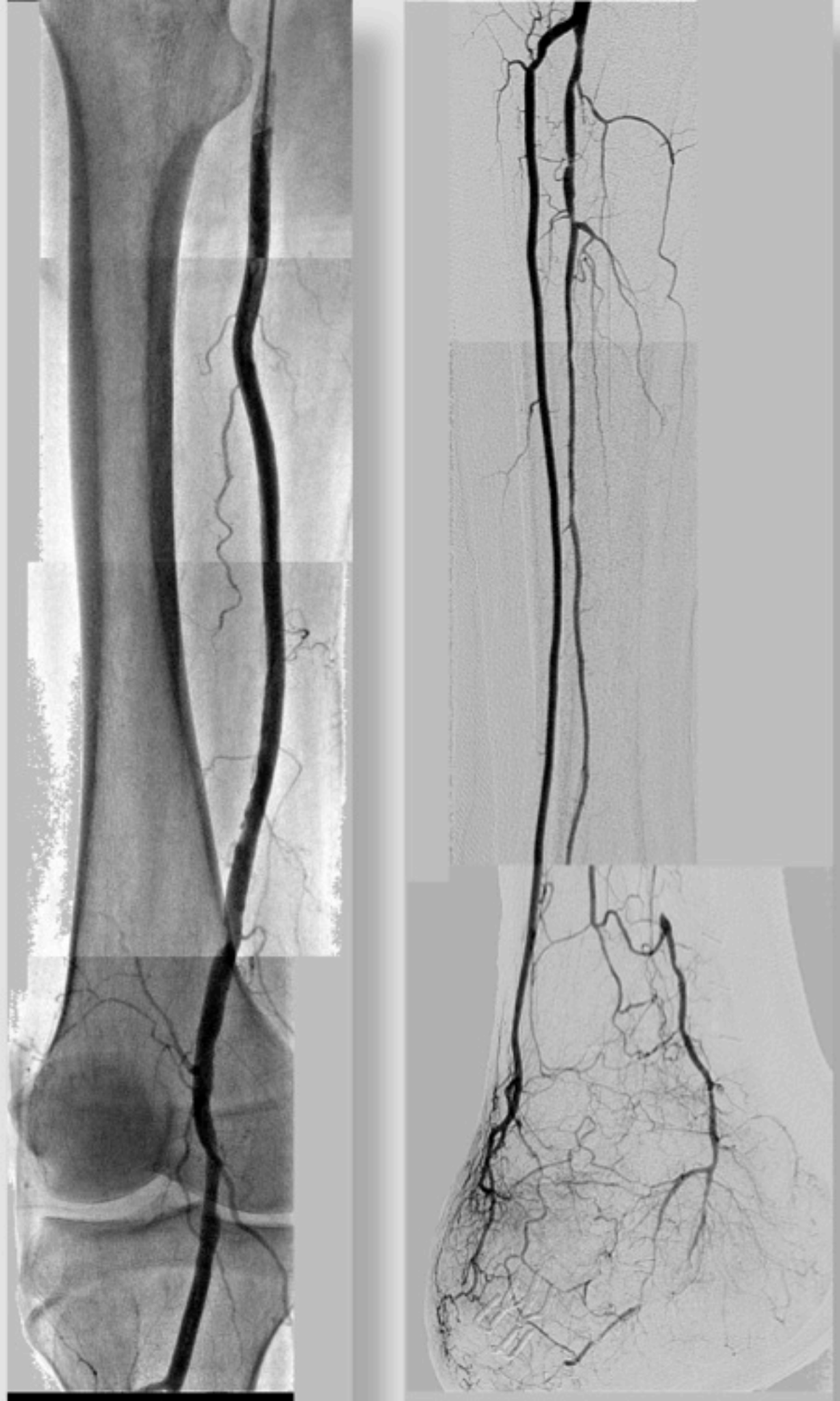
- 64-year-old male
- Type 2 DM
- Neuropathy, bones deformity
- Chronic plantar ulcer
- Forefoot infection with deep phlegmon

PATIENT DATA

CASE 7

- TMT amputation





CASE 7

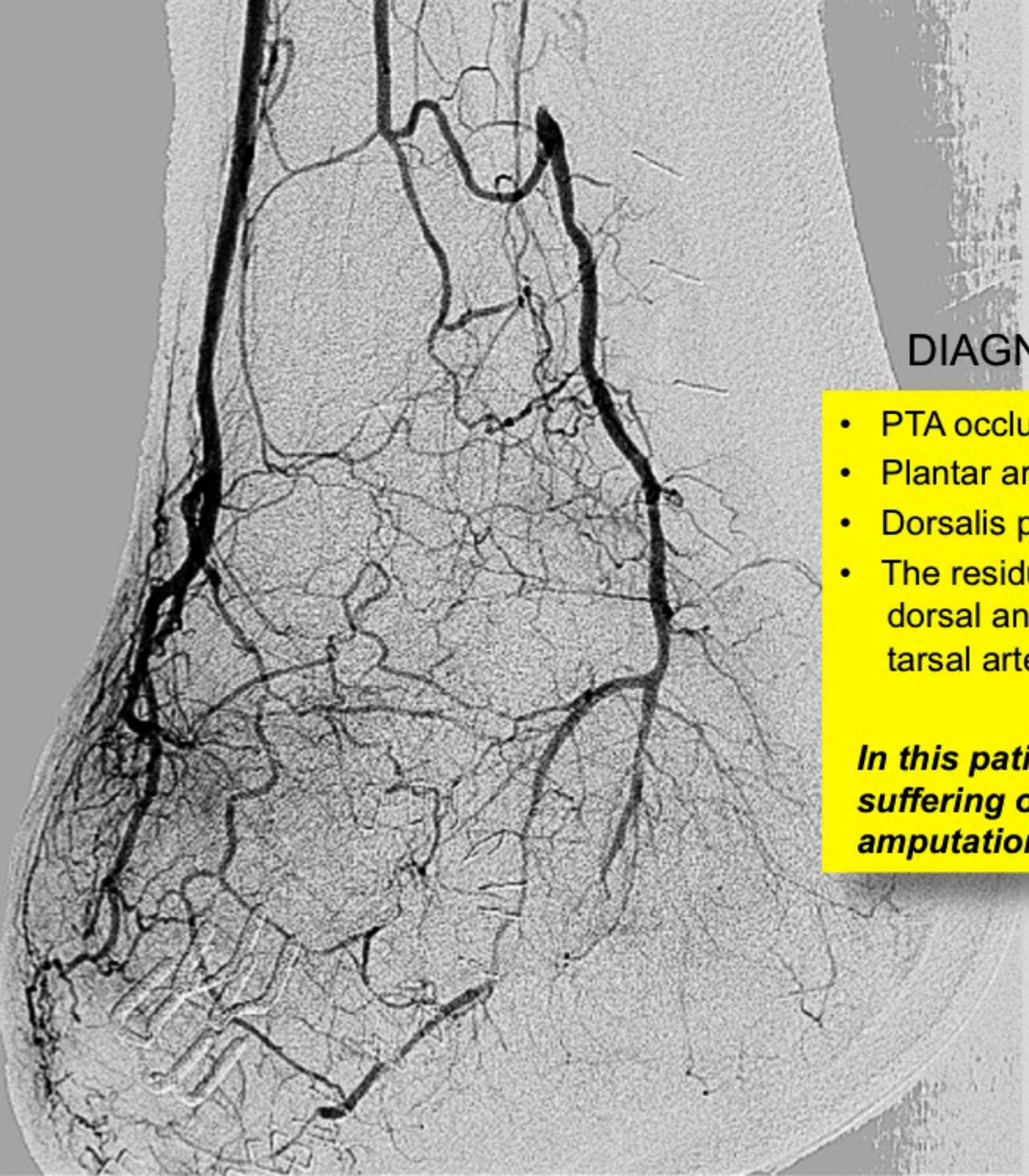
DIAGNOSIS

- Good FEM-POP patency
- Good ATA with present dorsalis pedis pulse
- Occlusion of PTA with good collateralization by peroneal posterior perforating branch

This patient has a pure neuropathic history; the arteriopathy was mild and was not responsible of the plantar lesion and of the catastrophic evolution in forefoot amputation.

Why has the plantar edge of the amputation experienced ischemia?

CASE 7

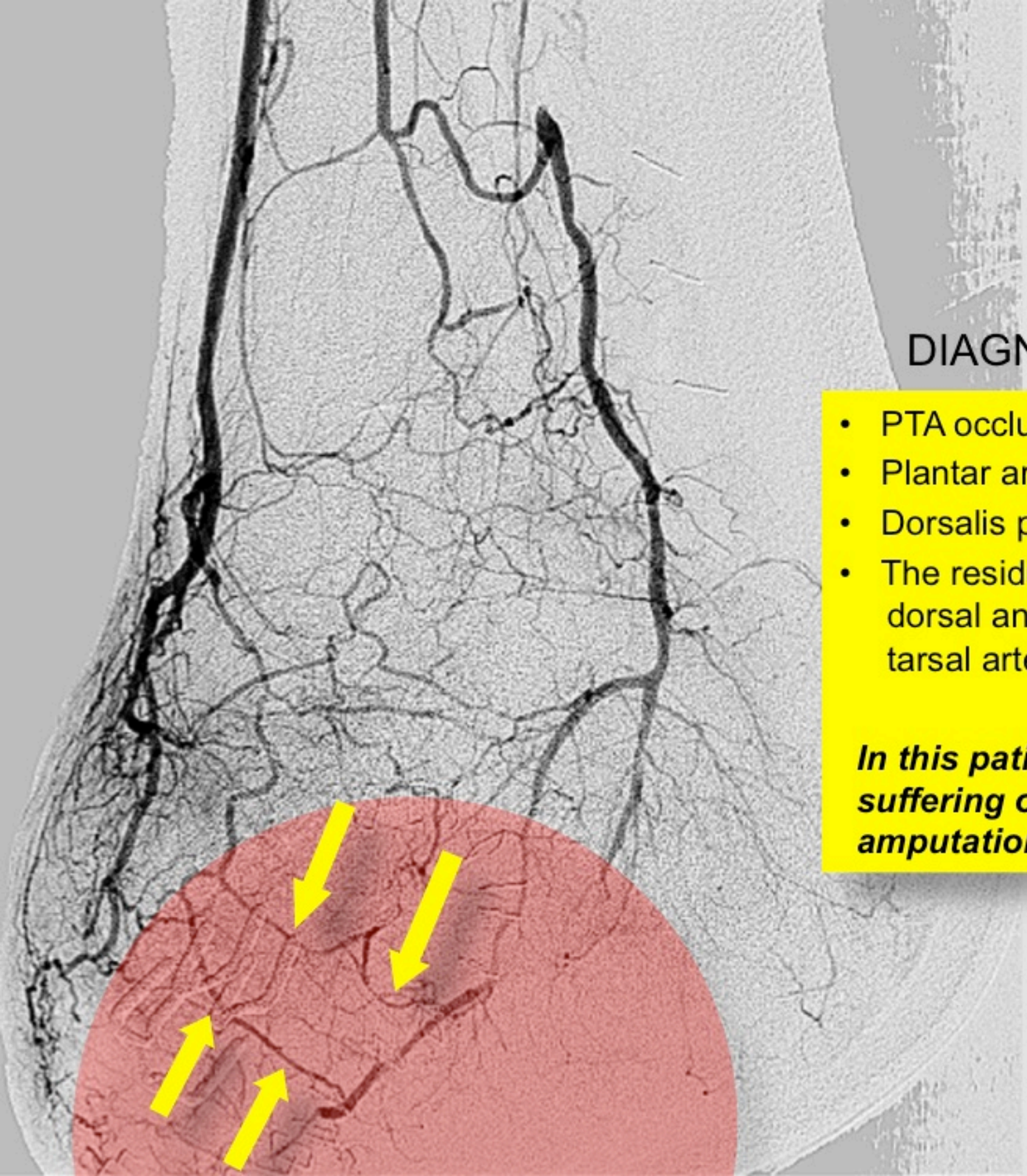


DIAGNOSIS

- PTA occlusion
- Plantar arteries occlusion
- Dorsalis pedis tied by the surgeon
- The residual connection between dorsal and plantar region are 2 thin tarsal arteries

In this patient there is an ischemic suffering of the plantar edge of the amputation without healing.

CASE 7



DIAGNOSIS

- PTA occlusion
- Plantar arteries occlusion
- Dorsalis pedis tied by the surgeon
- The residual connection between dorsal and plantar region are 2 thin tarsal arteries

In this patient there is an ischemic suffering of the plantar edge of the amputation without healing.

CASE 7

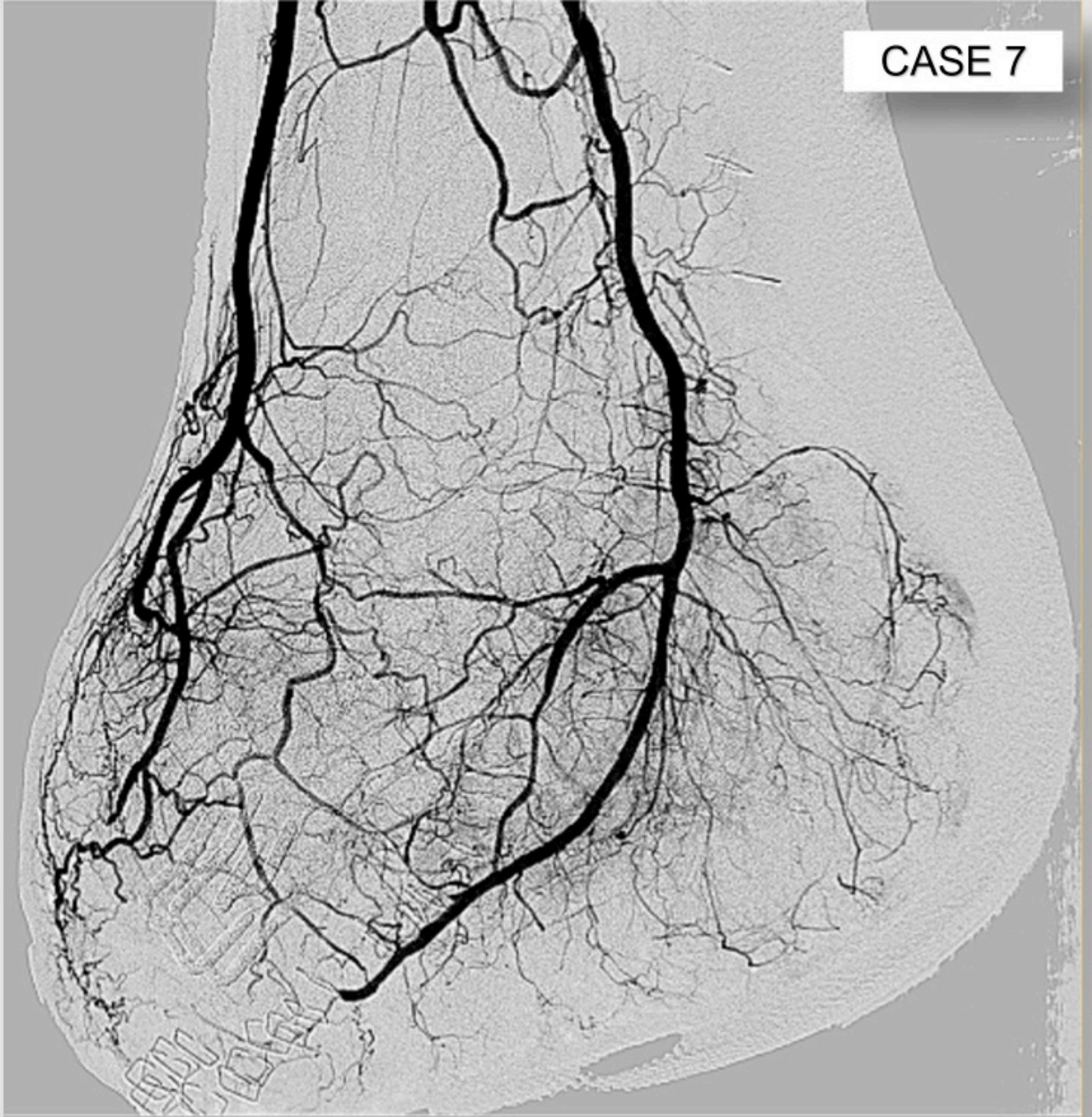
Forefoot amputations can remove the main pedal-plantar connection, the pedal-plantar loop, separating the dorsal and plantar edges of the surgical wound

CASE 7

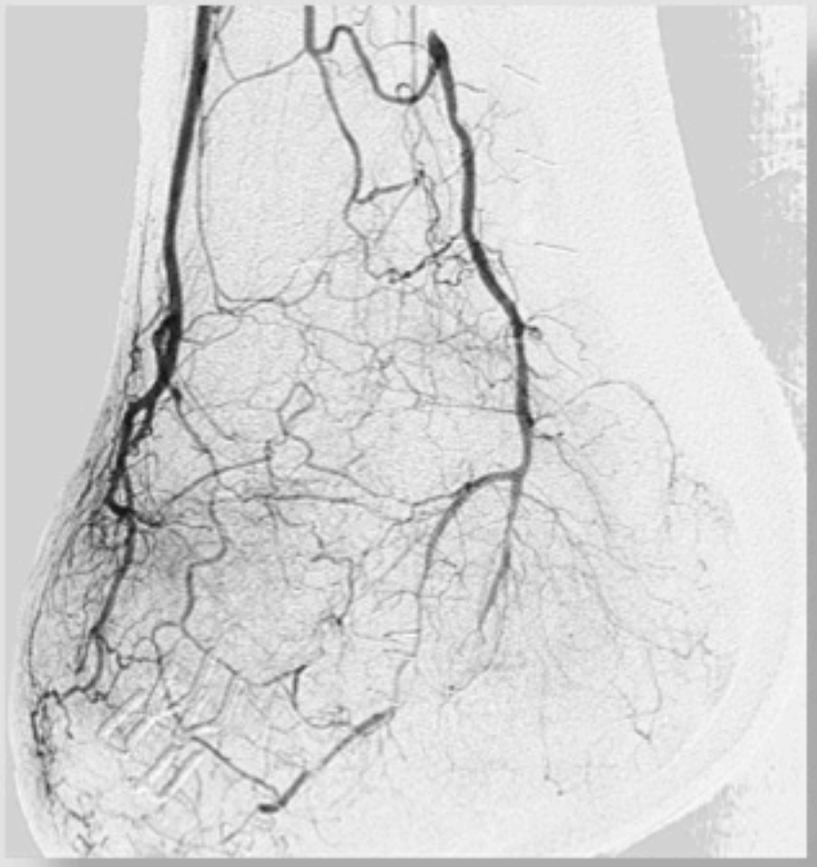
Forefoot amputations can remove the main pedal-plantar connection, the pedal-plantar loop, separating the dorsal and plantar edges of the surgical wound

CASE 7

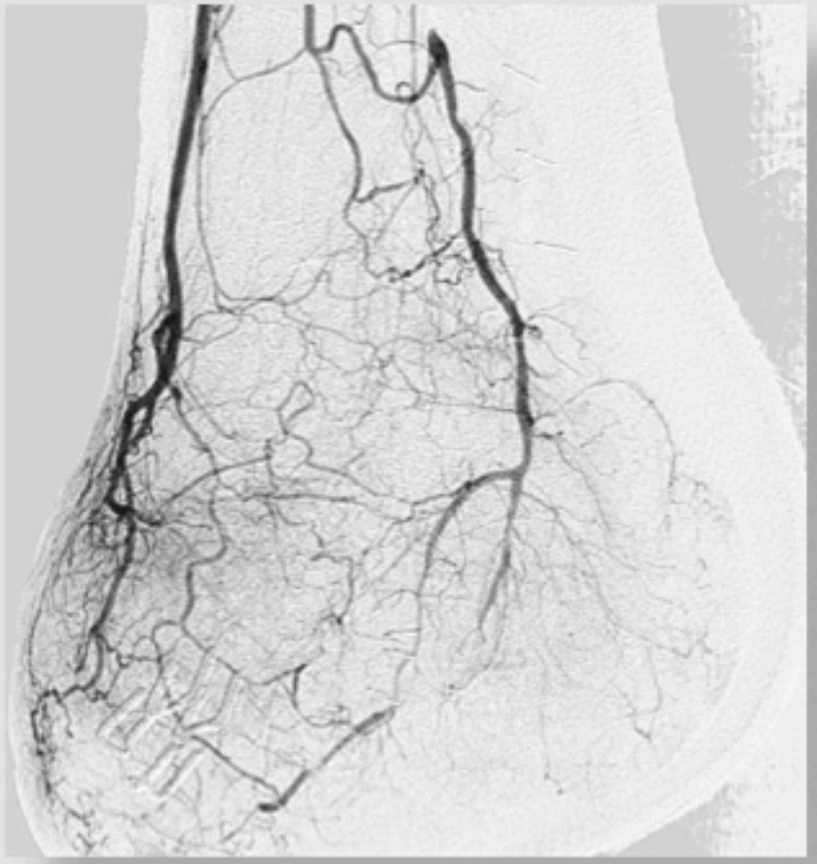
Angioplasty of PTA and lateral plantar artery


CASE 7

CASE 7



CASE 7



CASE 8

Example of “surgical WRA” revascularization

CASE 8

CASE 8

PATIENT DATA

- 82-year-old male
- Type 2 DM
- Chopart amputation

In this patient there is ischemic suffering of the plantar edge of the amputation without healing.

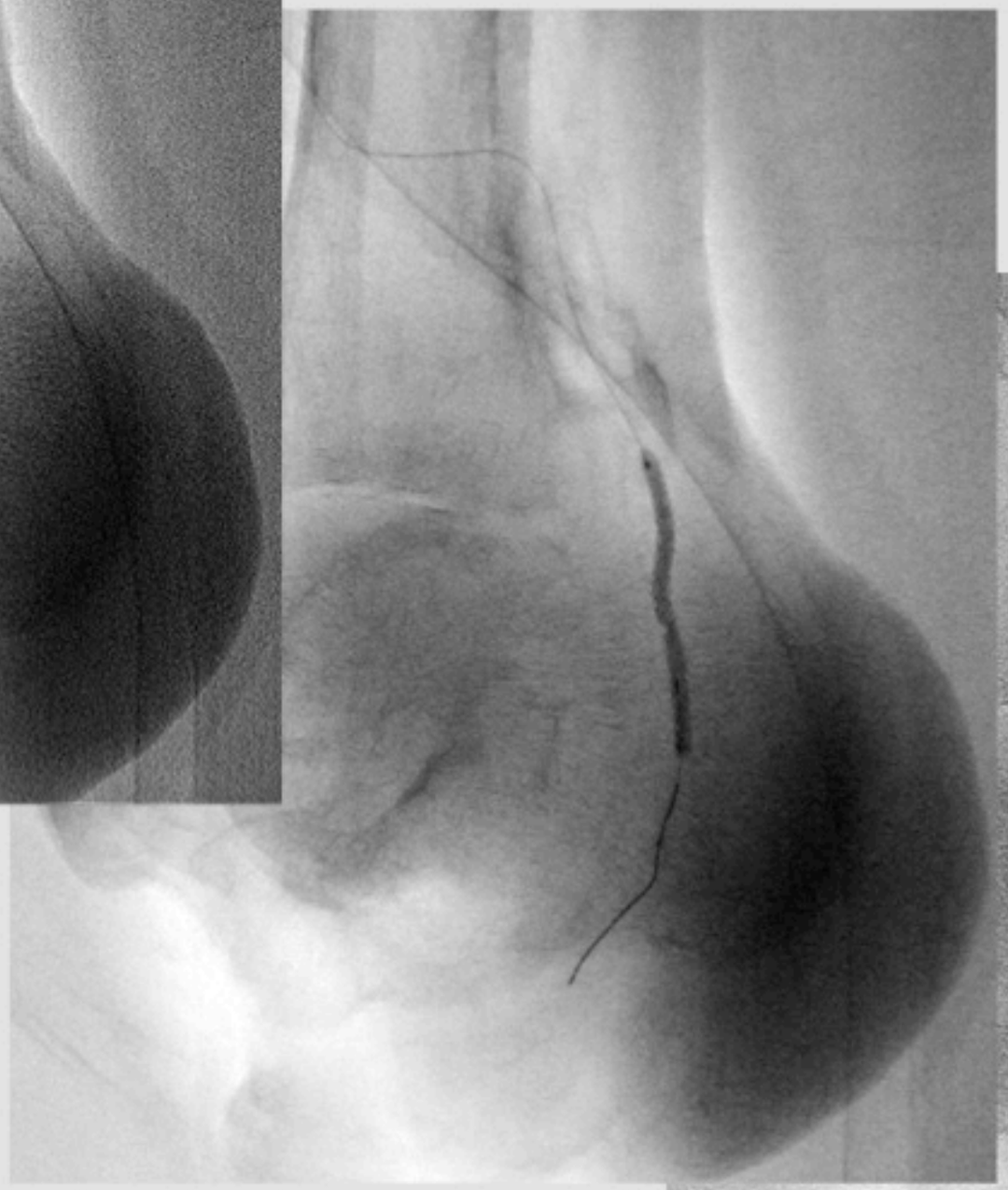
CASE 8

PATIENT DATA

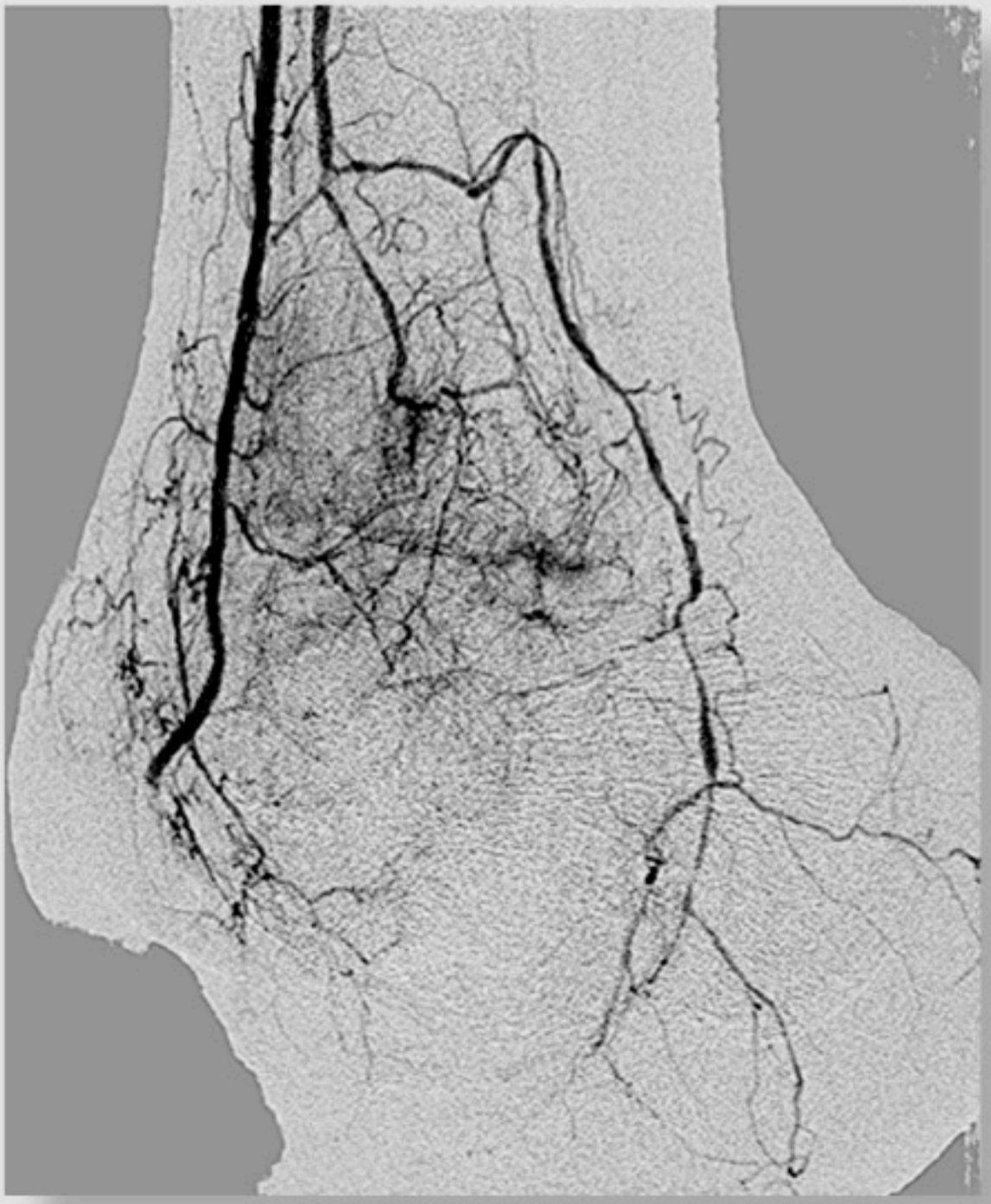
- 82-year-old male
- Type 2 DM
- Chopart amputation

In this patient there is ischemic suffering of the plantar edge of the amputation without healing.

CASE 8



CASE 8

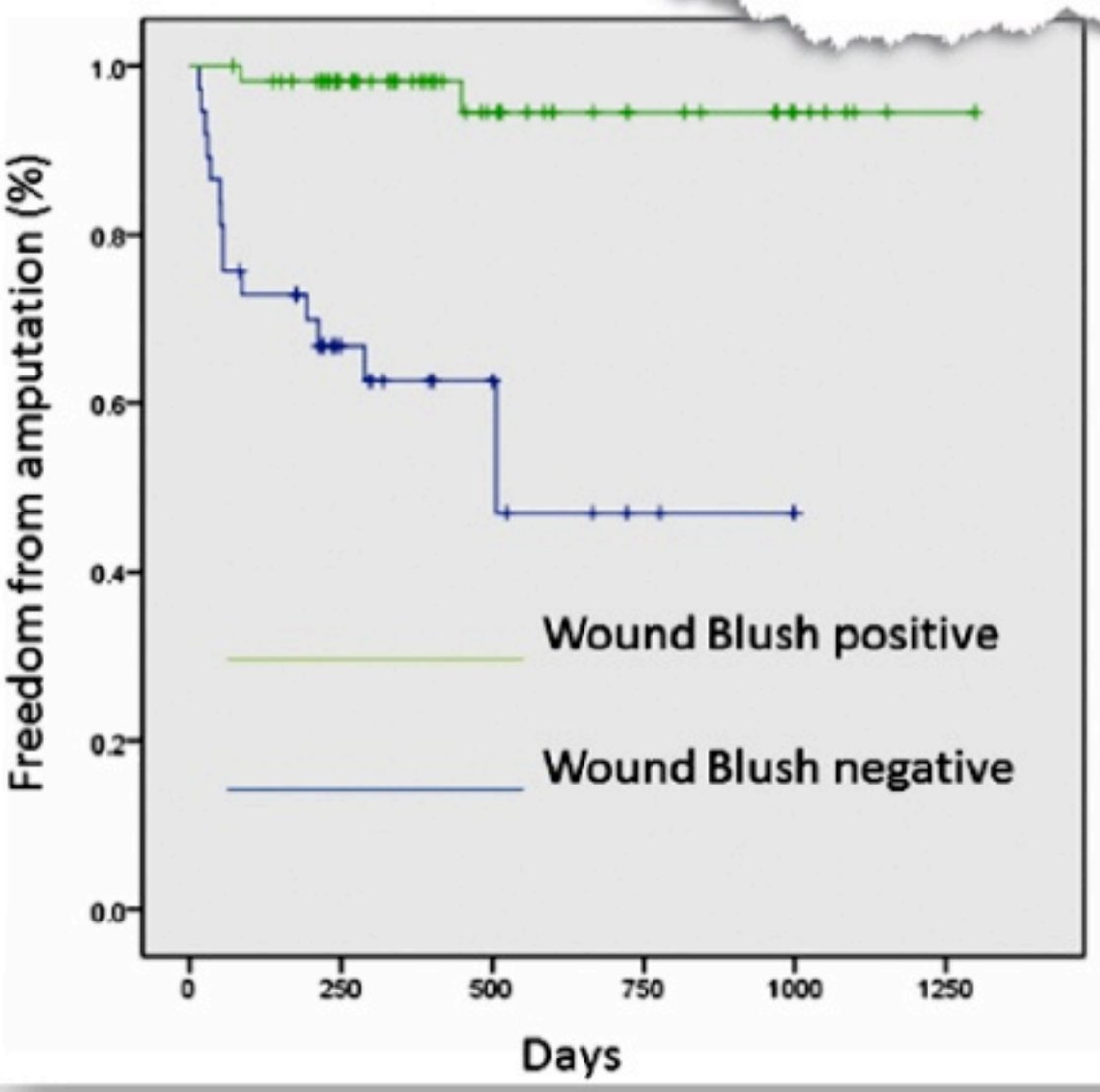


Wound blush concept

Impact of wound blush as an angiographic end point of endovascular therapy for patients with critical limb ischemia

Makoto Utsunomiya, MD,[a] Masato Nakamura, MD,[a] Mami Nakanishi, MD,[a] Takurou Takagi, MD,[a] Hidehiko Hara, MD,[a] Kiyoshi Onishi, MD,[b] Tetsuro Yamada, MD,[b] and Kaoru Sugi, MD,[a] *Tokyo, Japan*

J Vasc Surg 2012;55:113-21



Wound blush as an angiographic end point in PTA may be a novel predictor of limb salvage in patients with CLI.

CASE 9

Example of wound blush after PTA

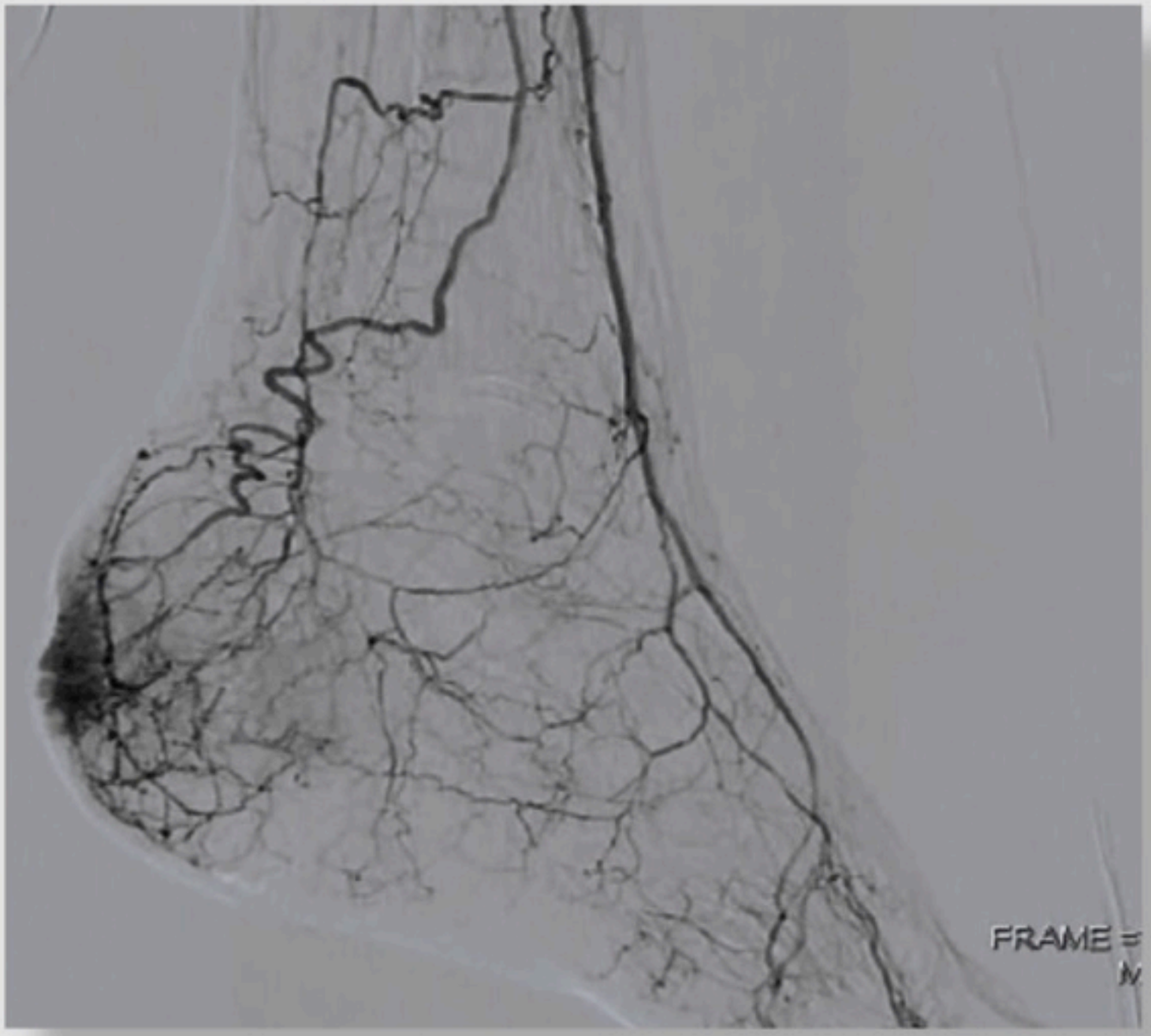
CASE 9

PATIENT DATA

- 72-year-old
- Type 2 DM
- Heel ulcer

CASE 9

CASE 9



DIAGNOSIS

Wound blush in the heel ulcer: a good prognostic factor for healing.

Wound blush concept

Impact of wound blush as an angiographic end point of endovascular therapy for patients with critical limb ischemia

Makoto Utsunomiya, MD,[a] Masato Nakamura, MD,[a] Mami Nakanishi, MD,[a] Takurou Takagi, MD,[a] Hidehiko Hara, MD,[a] Kiyoshi Onishi, MD,[b] Tetsuro Yamada, MD,[b] and Kaoru Sugi, MD,[a] *Tokyo, Japan*

J Vasc Surg 2012;55:113-21

In our experience wound blush is not always a reliable sign:

- A positive wound blush is a very good prognostic sign for healing
- A negative wound blush does not have a negative prognostic value because, especially after subintimal treatment of very long vessel segment, a diffuse distal vessel spasm with slow flow is frequent, inhibiting tissue blush.

Targets in CLI revascularization

1. Complete revascularization

- 1 vessel better than 0
- 2-3 vessels better than 1
- Tibials better than peroneal

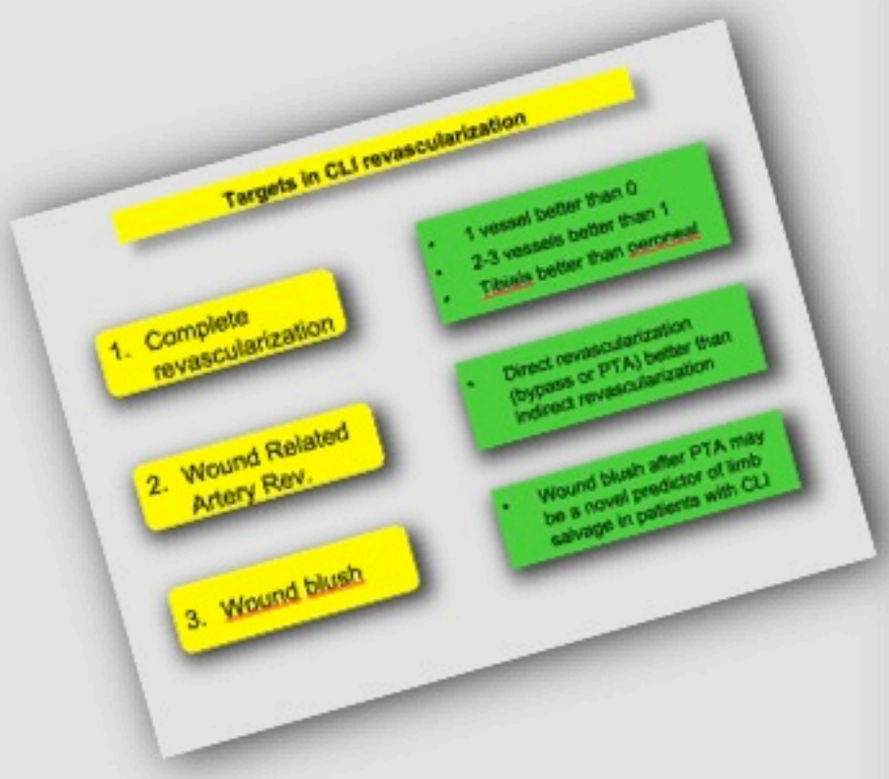
2. Wound-related Artery Rev.

- Direct revascularization (bypass or PTA) better than indirect revascularization

3. Wound blush

- Wound blush after PTA may be a novel predictor of limb salvage in patients with CLI

Targets in CLI revascularization



Complete WRA/WB must not be uncritically pursued: the procedure must be tailored to technically realistic strategies and to the general patient status. Consider patient/foot/technique and the possibility to check the clinical result on the wound in the next days and, in case of persistent ischemia, to improve the result in another procedure.

PATIENT

- Procedure time
- Volume infused
- Contrast dye amount
- Double antiplatelet therapy
- Procedure stress

FOOT

- Type/site of lesion
- Presence or not of infection
- Scheduled surgical procedure
- Ability to walk

TECHNIQUE

- Treatable vessels
- Technical options
- Material costs (balloons, atherectomy, stent, DES, DEB, laser etc.)
- Late patency