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**CONTROVERSIES & UPDATES** 

IN VASCULAR SURGERY

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## WHEN AND HOW TO NAVIGATE FROM OR TOWARD THE ARTERIES OF THE FOOT?



2018

#### WHEN TO NAVIGATE TOWARDS FOOT VESSELS?

- Below-the-ankle vessel disease is a key factor in CLI
- Angioplasty is usually possible
  - but when is it really useful and not harmful?
    - Clear clinical indication is mandatory\*
      - Rutherford 5-6 patients
    - Clear pathophysiology is mandatory\*
      - Failure of the foot distribution system
  - → To obtain direct-flow into the wound
  - → To improve the « outflow » and foot perfusion
    - And limit the slow-flow phenomenon
  - → To create an AVF (Limflow)
- Never touch what is more or less functionning!

<sup>\*</sup>Ferraresi et al. Linc 2017

## WHEN TO NAVIGATE TOWARDS FOOT VESSELS?

#### **Obtain direct-flow into the wound**

ACC Cardiovasc Interv 2017 Jan 23;10(2):188-194. doi: 10.1016/j.jcin.2016.10.026.

Wound Blush Optainment Is the Most Important Angiographic Endpoint for Wound Healing.

Utsunomiya M<sup>1</sup>, Takabara M<sup>2</sup>, Iida O<sup>3</sup>, Yamauchi Y<sup>4</sup>, Kawasaki D<sup>5</sup>, Yokoi Y<sup>6</sup>, Soga Y<sup>7</sup>, Ohura

TABLE 4	Multivariate Analy	is for Predictor of	Wound Healing	(Angiographic	Variables)
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	Total We (N = 185)	ound Blush Positive (n = 142)	Wound Blush Negative (n = 43)	p Value	
Number of pat	ent BK vessels				
0	15 (8)	9 (6)	6 (14)		
1	72 (39)	49 (35)	23 (54)		
2	70 (38)	60 (42)	10 (23)		
3	28 (15)	24 (17)	4 (9)	0.020	
Number of patent BA vessels					
0	17 (9)	5 (4)	12 (28)		
1	104 (56)	80 (56)	24 (56)		
2	64 (35)	57 (40)	7 (16)	< 0.001	
Pedal arch	147 (80)	97 (68)	7 (16)	< 0.001	
Angiosome dire	ect 104 (56)	86 (61)	18 (42)	0.036	

	Unadjusted HR (95% CI)	Adjusted HR (95% CI)
Number of patent BK vessels (0-3)	$0.96 \ (0.77\text{-}1.78) \ (p=0.667)$	$0.85 \ (0.66\text{-}1.10) \ (p=0.226)$
Number of patent BA vessels (0-2)	1.23 (0.93-1.63) (p = 0.141)	1.24 (0.88-1.75) (p = 0.225)
Pedal arch	1.12 (0.79-1.59) (p = 0.524)	0.90 (0.61-1.33) (p = 0.597)
Direct flow	1.06 (0.75-1.50) (p = 0.736)	1.10 (0.743-1.63) (p = 0.629)
Wound blush	1.85 (1.15-2.98) (p = 0.012)	1.84 (1.11-3.05) (p = 0.019)

In the multivariate Cox model, all the variables listed in the table were entered to obtain adjusted hazard ratios. CI = confidence interval; HR = hazard ratio; other abbreviations as in Table 3.



#### WHEN TO NAVIGATE TOWARDS FOOT VESSELS?







Guidewire alone / if the extremity does not cross the lesion and turns into a loop...



Not always feasible in long /calcified lesions (CTOs >6 months)

## HOW TO NAVIGATE TOWARDS FOOT VESSELS?

1/ Antegrade approach

Guidewire alone / if the extremity does not cross the lesion and turns into a loop...



## WHEN TO NAVIGATE FROM FOOT VESSELS?

2/ Retrograde approach

First series by Spinosa et al. JVIR 2005

- High risk to damage distal target vessel by continuing antegrade approach
  - while it might be the only landing zone for bypass
- Inability to re-enter into the true lumen
- Rupture or loss of the antegrade vessel pathway
- Inability to correctly identify the origin of peroneal of tibial artery

Failure to cross antegrade 18% Success with retrograde approach 86% Pedal access site occlusion 2% Other local complications 8% Montero-Baker et al. J Endovasc Ther 2008;15:594

#### PROS

- Small diameter vessels : increased pushability
- Less likelihood of entering sidebranches
- Distal cap often softer
  - $\rightarrow$  Easier re-entry
- Limits the extension of dissection
  - $\rightarrow$  Shorter arterial segment to treat

#### **CONS**

- Challenging
- Small diameter vessels prone to spasm and dissection
- Often calcified
- Sharp angulation near the ankle
- Long procedure time





## **HOW TO NAVIGATE FROM FOOT VESSELS?**

2/ Retrograde approach

First series by Spinosa et al. JVIR 2005





#### Optimal installation is key

Sterile preparation of both groins + entire leg



#### Simple scopy if calcified

If not proximal injection + road-mapping

#### Parallax adjustment +++

Needle and artery must be perfectly aligned

#### R. Ferraresi, CACVS 2014

Artery	Preferred oblique view	Preferred segment	Skin puncture site	Needle length
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	<ul> <li>First metatarsal artery</li> <li>Tarsal arteries</li> <li>Collaterals</li> </ul>	Dorsum of the foot Plantar access is not practical because of skin thickness	4 cm







#### Fluoroscopy guided puncture

## **HOW TO NAVIGATE FROM FOOT VESSELS?**

2/ Retrograde approach

First series by Spinosa et al. JVIR 2005

#### **Dedicated material**

- 16-G needle or 21-G micropuncture kit
- Antispasm Cocktail

Wires

- 0.018" guidewires / 0.014" guidewires
- Wire excalation strategy (stiffer wire)
- Support catheters or OTW balloon catheters

500 mL heparinized normal saline

- 3,000 µg nitroglycerin
- 2.5–5 mg verapamil





Endoluminal Approach

Subintimal Approach



Catheter Cardiovasc Interv. 2014 May 1;83(6):987-94. doi: 10.1002/ccd.25227. Epub 2013 Nov 9.

Tibio-pedal arterial minimally invasive retrograde revascularization in patients with advanced peripheral vascular disease: the TAMI technique, original case series.

Mustapha JA1, Saab F, McGoff T, Heaney C, Diaz-Sandoval L, Sevensma M, Karenko B.



Cardiovasc Intervent Radiol. 2013 Apr;36(2):554-7. doi: 10.1007/s00270-012-0391-3. Epub 2012 Apr 25.

Retrograde percutaneous transmetatarsal artery access: new approach for extreme revascularization in challenging cases of critical limb ischemia.

Manzi M, Palena LM.



- reserved for extremely challenging cases

new technical strategy

feasible and safe







#### 3/ Transcollateral approach



#### Pedal-plantar loop technique for reconstruction of plantar arch

- Low-profile balloons
  - Dedicated diameter 1.5 to 4 mm
  - Dedicated length : Avoid long balloons
    - High early restenosis rates (< 2 years)</li>
    - Not compliant enough → arterial stress → hyperplasia





First picture from Ferraresi et al. LINC 2014, Second picture from Lee et al. EVT Last pictures From Manzi et al.



#### 3/ Transcollateral approach



#### 2) Through « collaterals » that are not systematized



"Trans-collateral" angioplasty for a challenging chronic total occlusion of the tibial vessels: a novel approach to percutaneous revascularization in critical lower limb ischemia.

Fusaro M<sup>1</sup>, Agostoni P, Biondi-Zoccai G.



3/ Transcollateral approach



# 2)

Through « collaterals » that are not systematized

Catheter Cardiovasc Interv. 2008 Feb 1;71(2):268-72. doi: 10.1002/ccd.21332.

"Trans-collateral" angioplasty for a challenging chronic total occlusion of the tibial vessels: a novel approach to percutaneous revascularization in critical lower limb ischemia.

Fusaro M<sup>1</sup>, Agostoni P, Biondi-Zoccai G.



#### **Create an AVF fistula**

J Endovasc Ther, 2017 Oct;24(5):619-626. doi: 10.1177/1526602817719283. Epub 2017 Jul 12.

Midterm Outcomes From a Pilot Study of Percutaneous Deep Vein Arterialization for the Treatment of No-Option Critical Limb Ischemia.

Kurn S<sup>1</sup>, Tan YK<sup>1</sup>, Schreve MA<sup>2</sup>, Ferraresi R<sup>3</sup>, Varcoe RL<sup>4,5</sup>, Schmidt A<sup>6</sup>, Scheinert D<sup>6</sup>, Mustapha JA<sup>7</sup>, Lim DM<sup>1</sup>, Ho D<sup>1</sup>, Tang TY<sup>1</sup>, Alexandrescu VA<sup>8</sup>, Mutrangura P<sup>6</sup>.

- LimFlow
  - 7F arterial catheter
  - 5F venous catheter
  - console to facilitate crossing with needle
- 0.014" driven across crossover point into retrograde sheath
- 3 x 40mm balloon to predilate arteriovenous fistula
- 0.014" exchanged for 0.018" over support catheter
- reversed valvulotome to disrupt the valves
- covered stent from posterior tibial vein up to patent posterior tibial artery to cover venous collaterals





Figure 1. Overview of the LimFlow approach to percutaneous deep venous arterialization.



Figure 2. Arterial "send" catholor."

Figure 3. Venous "receive" celheter

#### **Create an AVF fistula**

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## 7 "end stage" CLI patients with no remaining open or endovascular options

- No 30-day MAEs
- 6-month results
  - Skin temperature
    - improved on FLIR thermography
  - Complete wound healing in 4
  - Immediate 
     Rest pain in 1
  - Increased transcutaneous oximetry levels in 4
  - Major amputation in 1
- CE Mark study underway
- Pre-investigational device exemption application accepted by FDA







## **PERONEAL ACCESS (1)**

 Antegrade failure of peroneal recanalization with 0.018" guidewire and Trailblazer





## **PERONEAL ACCESS (2)**

#### Retrograde peroneal puncture

- Proximal 1/3 of the leg
- Cook<sup>®</sup> micropuncture kit or 16 to 21 Gauge needle (64 mm long)
- Vasodilators (papaverine) in case of spasm
- Fluoroscopy-guided under road-mapping





## **PERONEAL ACCESS (3)**

- Sheathless approach +++
- Trailblazer 0.018" x 90cm



## **PERONEAL ACCESS (4)**

- Catheterization of proximal long 4F sheath
- Procedure resumed by antegrade way





## **PERONEAL ACCESS (5)**

Balloon angioplasty by Savvy<sup>®</sup> 2.5mm x 100mm (SAFARI)





## **PERONEAL ACCESS (6)**

#### Distal hemostasis

- Appropriately sized balloon inflation from antegrade access
- In the meantime, manual compression at the retrograde puncture site
- Angiographic control
- Closure device : FémoSeal<sup>®</sup>

## **TAKE HOME MESSAGE**

#### Consider to go Below-the-ankle whenever clinically indicated

- Rutherford 5-6 patients
- Failure of the foot distribution system
  - $\rightarrow$  To obtain direct-flow into the wound
  - → To improve the « outflow » and foot perfusion
    - And limit the slow-flow phenomenon
  - $\rightarrow$  To create an AVF (Limflow)
    - Technically feasible and safe
    - Appears to provide positive clinical results in terms of
      - limb salvage
      - wound healing
    - But expect high restenosis rates
- Antegrade-Retrograde techniques improve success rates
- New extreme approaches are under development
- IMPORTANTLY : Never touch what is more or less functionning!



