



VIII CONGRESSO
NAZIONALE
PIEDE DIABETICO
INTERASSOCIATIVO SID-AMD

*Focus sul piede nella
gestione del diabete*



ROMA, 18-20 GIUGNO 2026
HOTEL NH VILLA CARPEGNA

SAD e MAC guidano la scelta terapeutica?

Mauro Gargiulo



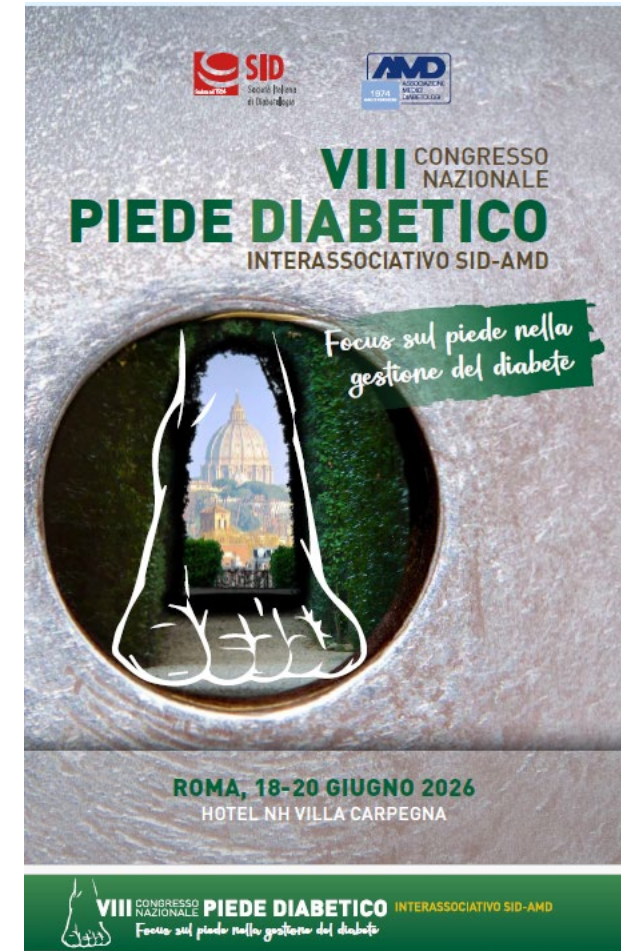
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mauro.gargiulo2@unibo.it

SAD e MAC guidano la scelta terapeutica?

Disclosure

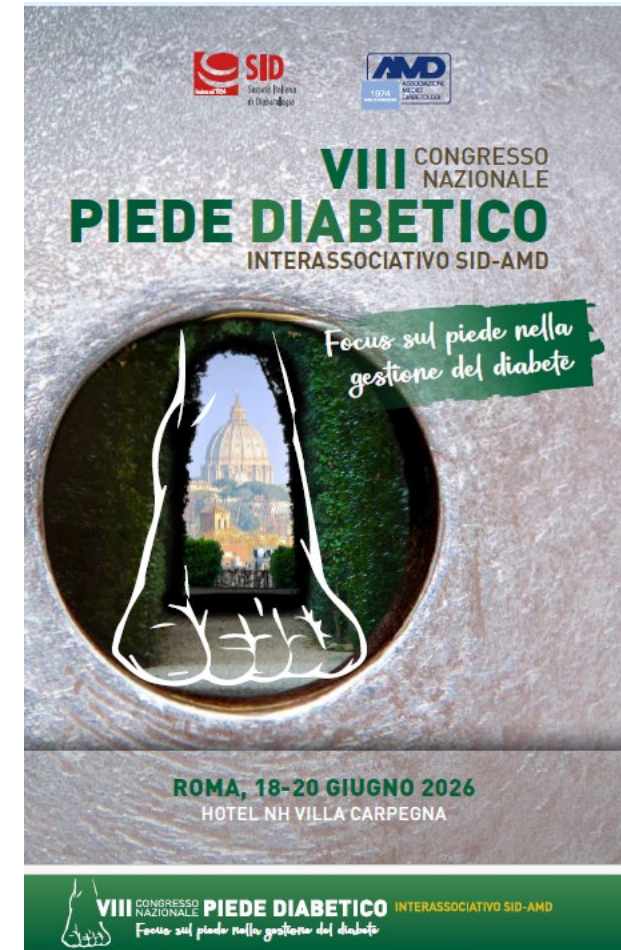
Speaker name: **Prof Mauro Gargiulo**

I have **no** potential conflicts of interest to report



SAD e MAC guidano la scelta terapeutica?

10.10 SAD e MAC: guidano la scelta terapeutica?
Si: Roberto Ferraresi
No: Mauro Gargiulo



SAD e MAC guidano la scelta terapeutica?

Disclosure

Speaker name: **Prof Mauro Gargiulo**

I have potential conflicts of interest to report





BAD, SAD, MAC

Pedal Medial Arterial Calcification (pMAC) Score

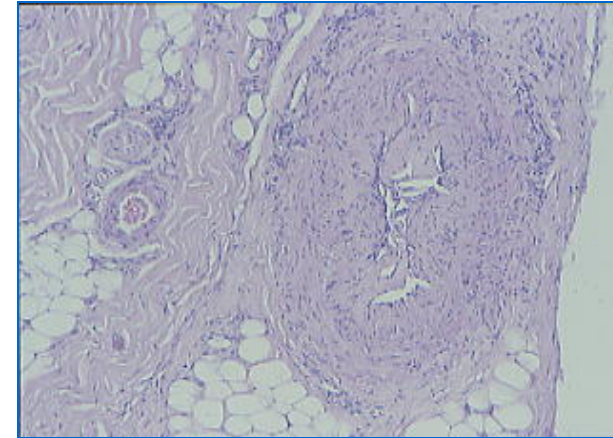
- Range: 0 to 5
- 1 point per arterial segment with specified length of "tram track" calcification
- Foot x-ray:
 - Minimum two-view: antero-posterior, lateral
 - Three-view: + oblique



Non atheromatous peripheral vascular disease of the lower extremity in diabetes mellitus

Goldenberg SG et al Diabetes 1959

Diabete = micro-angiopatia ostruttiva arti inferiori



Diabete +



= AMPUTAZIONE MAGGIORE

Combined clinical and pathologic study of diabetic and non-diabetic peripheral disease

Strandness DE et al Diabetes 1964

Large and small artery occlusion in diabetics and non-diabetics with severe vascular disease

Conrad MG Circulation 1967

Diabete = a) micro-angiopatia - inspessimento membrana basale capillari
 - maggior permeabilità capillare
 - incremento degli shunt a-v

b) macro-angiopatia - arteriopatia ostruttiva infrapoplitea



Limb salvage in diabetic patient with tibial arteries disease

Boston's experience

- LoGerfo FW et al.

Current concepts. Vascular and microvascular disease of the foot in diabetes. Implications for foot care.

N Engl J Med. 1984 Dec 20;311(25):1615-9. Review.

- LoGerfo FW.

Vascular disease, matrix abnormalities, and neuropathy: implications for limb salvage in diabetes mellitus.

J Vasc Surg. 1987 May;5(5):793-6. Review.

Diabetic vascular disease - PAOD

1. Macroangiopathy is most often seen in popliteal and tibial arteries

2. The lesions tend to be more extensive

3. Histopathological lesions

- Macroangiopathy

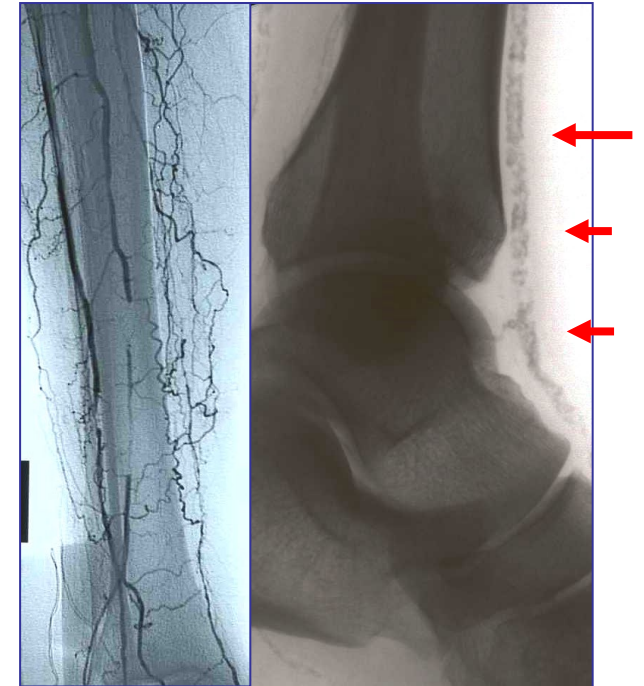
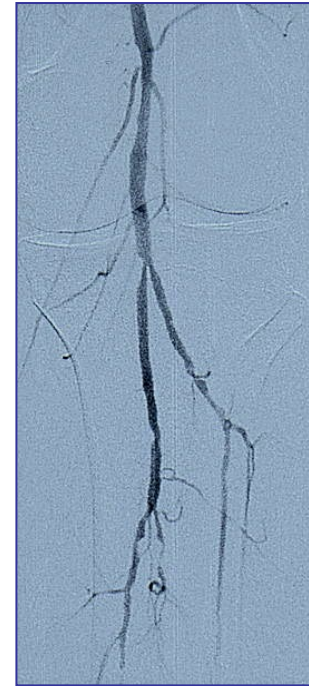
atherosclerosis

diffuse intimal fibrosis

medial calcific sclerosis

- Microangiopathy

no small artery or arteriolar occlusive lesion



4. Patency of the ankle and foot arteries

LoGerfo FW

J Vasc Surg 1987; 5: 793-6

Diabetic vascular disease - PAOD

1. Macroangiopathy is most often seen in popliteal and tibial arteries

2. The lesions tend to be more extensive

3. Histopathological lesions

- Macroangiopathy

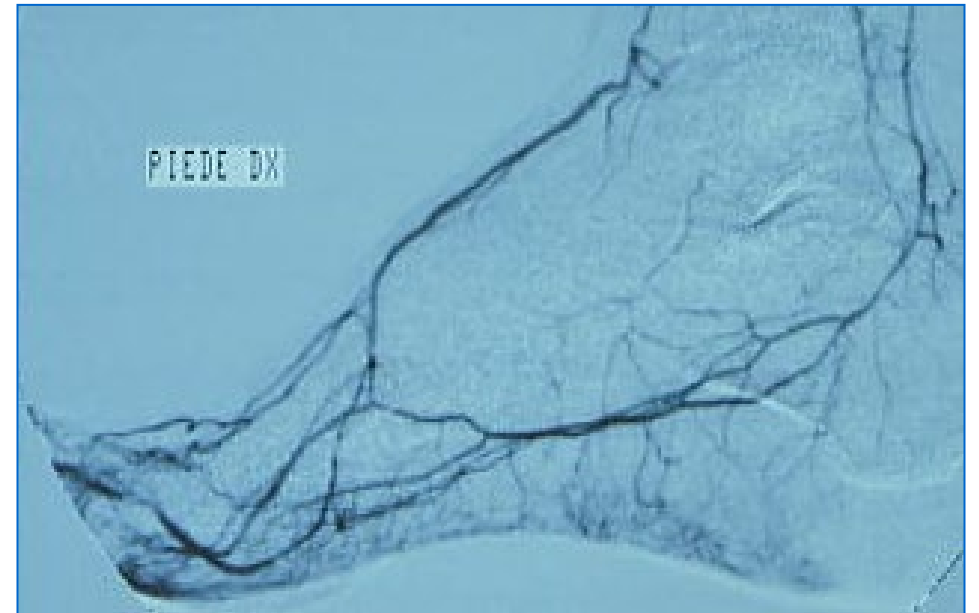
 - atherosclerosis

 - diffuse intimal fibrosis

 - medial calcific sclerosis

- Microangiopathy

 - no small artery or arteriolar occlusive lesion



4. Patency of the ankle and foot arteries

LoGerfo FW

J Vasc Surg 1987; 5: 793-6

Diabetic vascular disease - PAOD



Bypass to the ankle

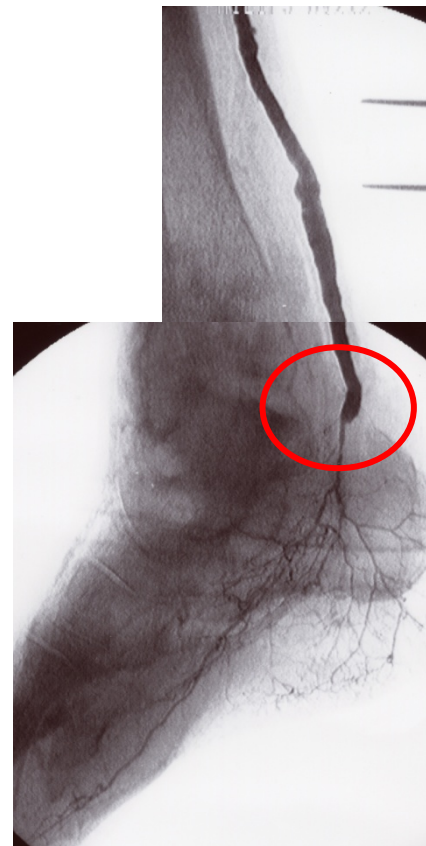


Posterior Tibial A.



Anterior Tibial A.

Bypass to the foot



Common Plantar A.



Dorsalis pedis A.



Limb salvage in diabetic patient with **tibial arteries disease**

Boston's experience

- Pomposelli FB Jr et al.

Efficacy of the **dorsal pedal bypass** for limb salvage in diabetic patients: short-term observations.

J Vasc Surg. 1990 Jun;11(6):745-51; discussion 751-2.

- Pomposelli FB Jr et al.

A **flexible approach** to infrapopliteal vein grafts in patients with diabetes mellitus.

Arch Surg. 1991 Jun;126(6):724-7; discussion 727-9.

- Stonebridge PA et al.

Popliteal-to-distal bypass grafts for limb salvage in diabetics.

Eur J Vasc Surg. 1991 Jun;5(3):265-9

- Kwolek CJ et al

Peripheral vascular **bypass in juvenile-onset diabetes mellitus**: are aggressive revascularization attempts justified?

J Vasc Surg. 1992 Feb;15(2):394-400; discussion 400-1.

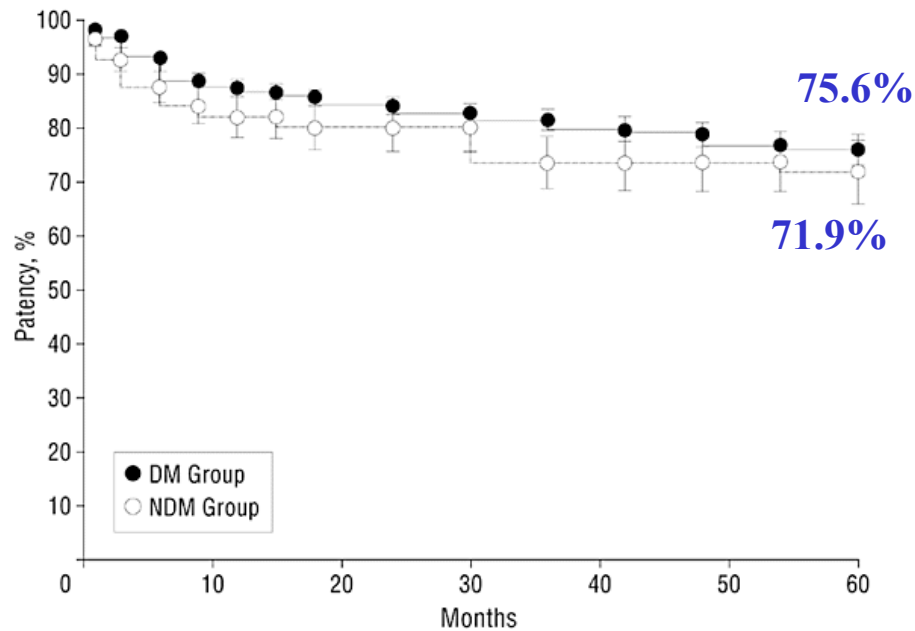
- Holzenbein TJ et al.

Results of a policy with **arm veins** used as the first alternative to an unavailable ipsilateral greater saphenous vein for infrainguinal bypass.

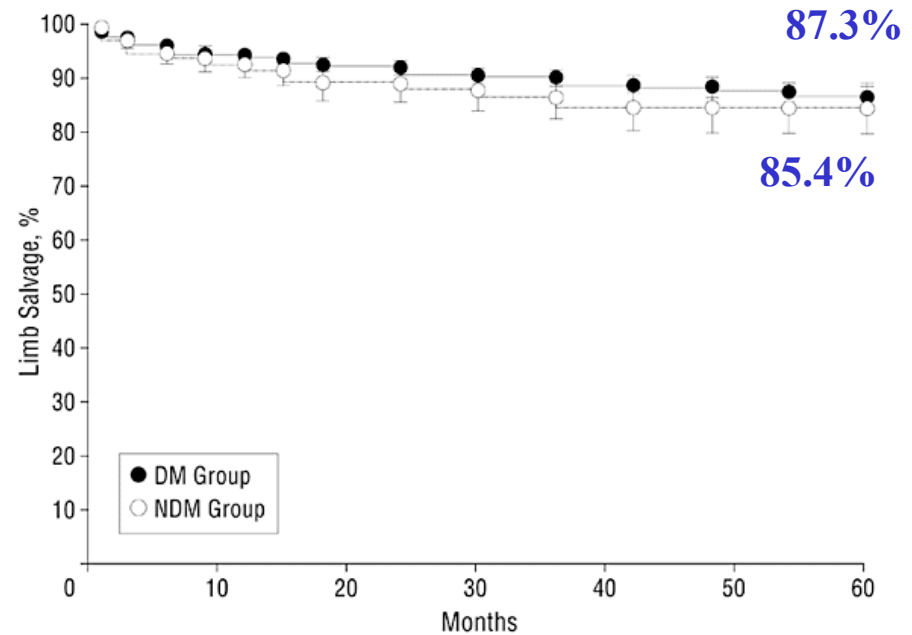
J Vasc Surg. 1996 Jan;23(1):130-40.

Lower Extremity Revascularization in Diabetes : Late Observations

*Akbari CM et al.
Arch Surg. 2000;135:452-456*



Cumulative Primary Patency



Limb Salvage

**Peripheral Angioplasty as the First-choice
Revascularization Procedure in Diabetic Patients with
Critical Limb Ischemia: Prospective Study of 993
Consecutive Patients Hospitalized and Followed Between
1999 and 2003**

E. Faglia,^{1*} L. Dalla Paola,² G. Clerici,¹ J. Clerissi,³ L. Graziani,⁴ M. Fusaro,⁴
L. Gabrielli,⁵ S. Losa,⁵ A. Stella,⁶ M. Gargiulo,⁶ M. Mantero,¹ M. Caminiti,¹ S. Ninkovic,²
V. Curci¹ and A. Morabito⁷

Eur J Vasc Endovasc Surg 29, 620–627 (2005)

Table 2. Stenoses (number of, > 4 cm of length or multiple) and occlusions (number of, > 2 cm of length or multiple) in every artery of the ischemic limb and number of successful PTA procedures performed

Artery	Stenoses	Multiple or length > 4 cm	Successful PTA	Occlusions	Multiple or length > 2 cm	Successful PTA
Iliac trunk	65	29 (44.6%)	65 (100%)	6	3 (50.0%)	6 (100%)
Profunda femoral	31	16 (51.6%)	25 (80.6%)	6	1 (16.7%)	5 (83.3%)
Superficial femoral	343	266 (77.6%)	341 (99.4%)	185	123 (66.5%)	142 (76.8%)
Popliteal	221	92 (41.6%)	215 (97.3%)	86	47 (54.7%)	77 (89.5%)
Anterior tibial	235	188 (80.0%)	215 (91.5%)	589	530 (90.0%)	142 (24.1%)
Posterior tibial	218	164 (75.2)	185 (84.7%)	725	679 (93.7%)	83 (11.4%)
Peroneal	337	241 (71.5%)	284 (84.3%)	342	257 (75.1%)	88 (25.7%)

CASE REPORT

Combined Retrograde–Antegrade Arterial Recanalization Through Collateral Vessels: Redefinition of the Technique for Below-the-Knee Arteries

L. Graziani · L. G. Morelli

Cardiovasc Intervent Radiol (2008) 31:49–55
DOI 10.1007/s00270-007-9214-3

CLINICAL INVESTIGATION

Transluminal Angioplasty of Peroneal Artery Branches in Diabetics: Initial Technical Experience

Lanfroi Graziani · Antonio Silvestro · Luca Monge · Gian Mario Boffano ·
Francesco Kokaly · Ilaria Casadidio · Francesco Giannini

Crossing the Rubicon: A Closer Look at the Pedal Loop Technique

Lanfroi Graziani, Brescia, Italy

Cardiovasc Intervent Radiol (2013) 36:75–83
DOI 10.1007/s00270-012-0344-x

CLINICAL INVESTIGATION

ARTERIAL INTERVENTIONS

Alternative Techniques for Treatment of Complex Below-the-Knee Arterial Occlusions in Diabetic Patients With Critical Limb Ischemia

Roberto Gandini · Luigi Uccioli · Alessio Spinelli ·
Costantino Del Giudice · Valerio Da Ros ·
Tommaso Volpi · Marco Meloni · Giovanni Simonetti

J ENDOVASC THER
2014;21:775–778

775

◆ TECHNICAL NOTE

Antegrade Pedal Approach for Recanalizing Occlusions in the Opposing Circulatory Pathway of the Foot When a Retrograde Puncture Is Not Possible

Luis Mariano Palena, MD, and Marco Manzi, MD

The Clinical Utility of Below-the-Ankle Angioplasty using “Transmetatarsal Artery Access” in Complex Cases of CLI

Luis Mariano Palena,^{1*} MD, Enrico Brocco,² MD, and Marco Manzi,¹ MD

Catheterization and Cardiovascular Interventions 83:123–129 (2014)

Cardiovasc Intervent Radiol (2013) 36:554–557
DOI 10.1007/s00270-012-0391-3

LETTER

Retrograde Percutaneous Transmetatarsal Artery Access: New Approach for Extreme Revascularization in Challenging Cases of Critical Limb Ischemia

Marco Manzi · Luis Mariano Palena



BAD, SAD, MAC

Pedal Medial Arterial Calcification (pMAC) Score

- Range: 0 to 5
- 1 point per arterial segment with specified length of "tram track" calcification
- Foot x-ray:
 - Minimum two-view: antero-posterior, lateral
 - Three-view: + oblique



ORIGINAL ARTICLE

RECENT DEVELOPMENTS IN THE MANAGEMENT OF THE DIABETIC FOOT

BAD transmission and SAD distribution: a new scenario for critical limb ischemia

Roberto FERRARESI ^{1 *}, Giovanni MAURI ², Fabrizio LOSURDO ³, Nicola TROISI ⁴,
Diego BRANCACCIO ⁵, Carlo CARAVAGGI ⁶, Luca NERI ⁷



Figure 1.—Example of BAD without SAD. Tibial arteries are occluded. At the ankle level the distal anterior tibial artery and the plantar arteries receive collateral vessels from the distal peroneal artery. The arch is patent, tarsal, metatarsal, digital and calcaneal branches are well represented.

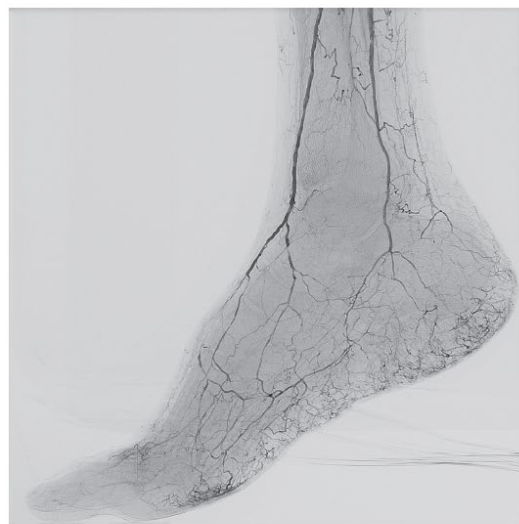


Figure 2.—Example of mild SAD. Tibial arteries are patent. The dorsalis pedis and the plantar arteries are obstructed. The arch and the tarsal, metatarsal and calcaneal branches are patent but show diffuse disease; digital arteries are not visualized.

TABLE III.—Prevalence of lesions and lesion severity across arterial districts in 1915 limbs.

Parameter	Stenosis	Occlusion	Any disease
ATG			187 (9.8%)
Common iliac	27 (1.4%)	23 (1.2%)	50 (2.6%)
External iliac	61 (3.2%)	37 (1.9%)	98 (5.1%)
Common femoral artery	61 (3.2%)	24 (1.2%)	85 (4.4%)
SFA			871 (45.5%)
Proximal	204 (10.7%)	322 (16.9%)	526 (27.5%)
Medial	233 (12.2%)	424 (22.2%)	657 (34.3%)
Distal	228 (11.9%)	353 (18.5%)	581 (30.3%)
P-TPT			886 (46.3%)
Proximal	148 (7.7%)	198 (10.4%)	346 (18.1%)
Mid	223 (11.7%)	184 (9.6%)	407 (21.3%)
Distal	171 (8.9%)	197 (10.3%)	368 (19.2%)
Tibial-peroneal trunk	291 (15.2%)	313 (16.4%)	604 (31.5%)
Anterior tibial			1398 (73.0%)
Proximal	430 (22.5%)	811 (42.4%)	1241 (64.8%)
Distal	281 (14.9%)	901 (47.7%)	1182 (61.72%)
Posterior tibial			1549 (80.9%)
Proximal	364 (19.1%)	989 (51.9%)	1353 (70.65%)
Distal	275 (14.7%)	1020 (54.7%)	1295 (69.4%)
Infra-malleolar	272 (14.8%)	965 (52.5%)	1237 (67.2%)
Peroneal			845 (44.1%)
Proximal	302 (15.8%)	376 (19.6%)	678 (35.4%)
Distal	199 (10.5%)	341 (18%)	540 (28.2%)
Dorsalis pedis*	262 (15.3%)	381 (22.3%)	643 (37.6%)
Lateral plantar*	329 (19.2%)	663 (38.8%)	992 (58.0%)
Medial plantar*	269 (15.7%)	567 (33.2%)	836 (48.9%)
Small foot arteries**	271 (16.5%)	143 (8.7%)	414 (25.2%)

Data are presented as number of cases (percentage).

*Base, N.=1711 legs with the study of big foot arteries; **base, N.=1640 legs with the study of small foot arteries.

ORIGINAL ARTICLE

RECENT DEVELOPMENTS IN THE MANAGEMENT OF THE DIABETIC FOOT

BAD transmission and SAD distribution: a new scenario for critical limb ischemia

Roberto FERRARESI ^{1 *}, Giovanni MAURI ², Fabrizio LOSURDO ³, Nicola TROISI ⁴,
Diego BRANCACCIO ⁵, Carlo CARAVAGGI ⁶, Luca NERI ⁷

Medial Arterial Calcification

JACC State-of-the-Art Review

Peter Lanzer, MD,^a Fadil M. Hannan, DPHIL,^b Jan D. Lanzer, MD,^{c,d,e} Jan Janzen, MD,^f Paolo Raggi, MD,^g
Dominic Furniss, DM, MBBCH,^h Mirjam Schuchardt, PhD,ⁱ Rajesh Thakker, ScD,^j Pak-Wing Fok, PhD,^k
Julio Saez-Rodriguez, PhD,^c Angel Millan, PhD,^l Yu Sato, MD,^m Roberto Ferraresi, MD,ⁿ Renu Virmani, MD,^m
Cynthia St. Hilaire, PhD^{o,p,q}

Original Article

VASCULAR
MEDICINE

Association of infrapopliteal medial arterial calcification with lower-limb amputations in high-risk patients: A systematic review and meta-analysis

Fabrizio Losurdo ^{1,2} , Roberto Ferraresi³, Alessandro Ucci⁴,
Anna Zanetti¹, Giacomo Clerici³ and Antonella Zamboni^{1,5}

Vascular Medicine
2021, Vol. 26(2) 164–173
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DOI: 10.1177/1358863X20979738
journals.sagepub.com/home/vmj


Clinical Investigation

A Novel Scoring System for Small Artery Disease and Medial Arterial Calcification Is Strongly Associated With Major Adverse Limb Events in Patients With Chronic Limb-Threatening Ischemia

Roberto Ferraresi, MD¹, Alessandro Ucci, MD² , Alessandra Pizzuto, MD³,
Fabrizio Losurdo, MD⁴, Maurizio Caminiti, MD⁴, Daniela Minnella, MD⁴,
Andrea Casini, MD⁵, Giacomo Clerici, MD⁴, Miguel Montero-Baker, MD⁶,
and Joseph Mills, MD⁶

Pedal arterial calcification score is associated with hemodynamic change and major amputation after infrainguinal revascularization for chronic limb-threatening ischemia

Iris H. Liu, MD,^a Bian Wu, MD,^a Viktoriya Krepiy, DPM,^a Rym El Khoury, MD,^a Roberto Ferraresi, MD,^b
Alexander M. Reyzelman, DPM,^a Jade S. Hiramoto, MD, MAS,^a Peter A. Schneider, MD,^a
Michael S. Conte, MD,^a and Shant M. Vartanian, MD,^a San Francisco, CA; and Milan, Italy

(J Vasc Surg 2022;76:1688-97.)

The Impact of Small Artery Disease (SAD) and Medial Arterial Calcification (MAC) Scores on Chronic Wound and Amputation Healing: Can It Tell Us More?

Saranya Sundaram,¹ Christian Barksdale,² Stephanie Rodriguez,¹ and Mathew D. Wooster,¹
Charleston, South Carolina

Global Vascular Guidelines on the Management of Chronic Limb-Threatening Ischemia

5. The Global Limb Anatomic Staging System (GLASS)

Table 5.3. Assignment of Global Limb Anatomic Staging System (GLASS) Stage					
FP Grade	IP Grade				
	0	1	2	3	4
4	III	III	III	III	III
3	II	II	II	III	III
2	I	II	II	II	III
1	I	I	II	II	III
0	NA	I	I	II	III

NA = Not applicable.
After selection of the target arterial path (TAP), the segmental femoropopliteal (FP) and infrapopliteal (IP) grades are determined from high-quality angiographic images. Using the table, the combination of FP and IP grades is assigned to GLASS stages I to III, which correlate with technical complexity (low, intermediate, and high) of revascularization.

GLASS (Global Limb Anatomic Staging System): a critical appraisal

R. Ferraresi et al.; J Cardiovasc Surg 2021

Conclusions: The distribution of the FP, IP and final GLASS grading was mainly grouped at the two extremes, letting the intermediate grades rather scarce. The majority of patients present with an absent or severely diseased pedal arch, **stressing the need to incorporate infra-malleolar disease into the GLASS.**

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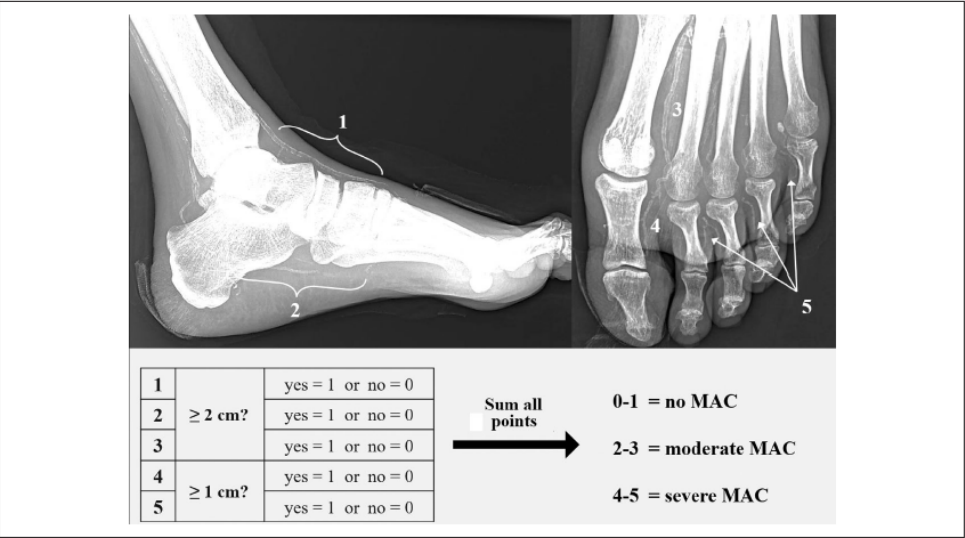


Figure 2. Laterolateral and anteroposterior radiographic projections of the foot indicating the 5 predefined vascular sites for evaluation to determine the medial arterial calcification (MAC) score: (1) the dorsalis pedis artery from the ankle joint to its disappearance inside the metatarsal bones; (2) the lateral plantar artery from the bifurcation of the posterior tibial artery to the visible

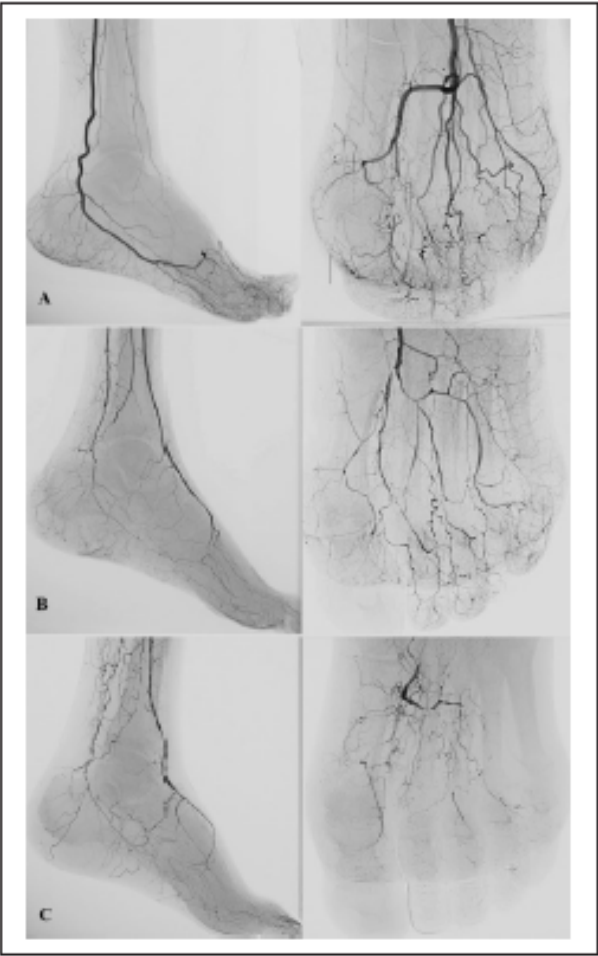


Figure 1. Laterolateral (left) and anteroposterior forefoot (right) radiographic projections. (A) An example of small artery disease (SAD) score 0: all the small arteries originating from a dominant lateral plantar artery are well visualized. Calcaneal, tarsal, metatarsal, and digital arteries are patent without any signs of obstruction. (B) An example of SAD score 1 (moderate disease): the plantar arteries and all the small calcaneal, tarsal, metatarsal, and digital arteries are patent but diffusely diseased and narrowed; only the first toe is really desert. (C) An example of SAD score 2 (severe disease): the plantar system is occluded, the plantar arch is isolated and diseased, the heel and forefoot present residual and isolated segments of small arteries, and the toes are completely desert.

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Table 4. Multivariable Cox Regression Analysis^{a,b}

	Complete Healing	FF Unscheduled Podiatric Surgical Reintervention	FF Re-do Revascularization	Major Amputation	Survival	FF MALE
Diabetes	1.05 (0.64 to 1.72) p=0.84	0.58 (0.29 to 1.16) p=0.12	1.43 (0.83 to 2.47) p=0.19	0.89 (0.34 to 2.32) p=0.82	1.85 (0.95 to 3.58) p=0.06	0.74 (0.44 to 1.23) p=0.24
Dialysis	1.34 (0.87 to 2.05) p=0.17	1.42 (0.9 to 2.23) p=0.12	1.48 (0.91 to 2.41) p=0.11	2.56 (1.23 to 5.33) p=0.012	1.68 (0.89 to 3.17) p=0.1	1.65 (1.11 to 2.46) p=0.013
WIFI wound 1	Reference	Reference	Reference	Reference	Reference	Reference
WIFI wound 2	0.98 (0.58 to 1.65) p=0.94	1.09 (0.62 to 1.93) p=0.7	0.6 (0.36 to 1.01) p=0.051	1.77 (0.53 to 5.84) p=0.34	1.23 (0.53 to 2.82) p=0.62	0.93 (0.59 to 1.44) p=0.73
WIFI wound 3	1.72 (0.84 to 3.53) p=0.14	2.24 (1.01 to 5.04) p=0.04	0.66 (0.28 to 1.54) p=0.34	1.75 (0.34 to 8.67) p=0.5	2.2 (0.78 to 6.8) p=0.12	1.26 (0.64 to 2.48) p=0.5
MAC score 0	Reference	Reference	Reference	Reference	Reference	Reference
MAC score 1	1.36 (0.75 to 2.45) p=0.3	1.82 (0.93 to 3.53) p=0.07	2.78 (1.47 to 5.25) p=0.002	3.03 (0.86 to 10.63) p=0.08	0.94 (0.4 to 2.22) p=0.89	1.87 (1.14 to 3.09) p=0.014
MAC score 2	1.64 (0.9 to 3.0) p=0.1	2.96 (1.53 to 5.73) p=0.001	2.57 (1.33 to 4.97) p=0.005	2.68 (0.75 to 9.65) p=0.13	1.73 (0.77 to 3.88) p=0.18	2.23 (1.33 to 3.74) p=0.002

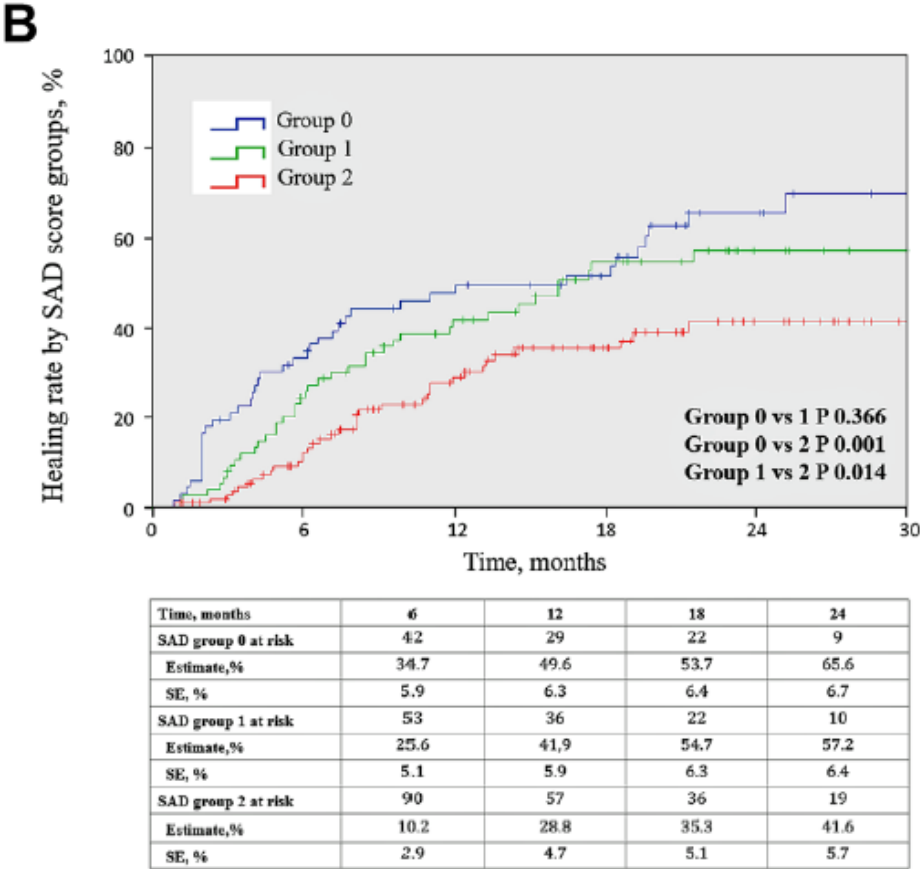
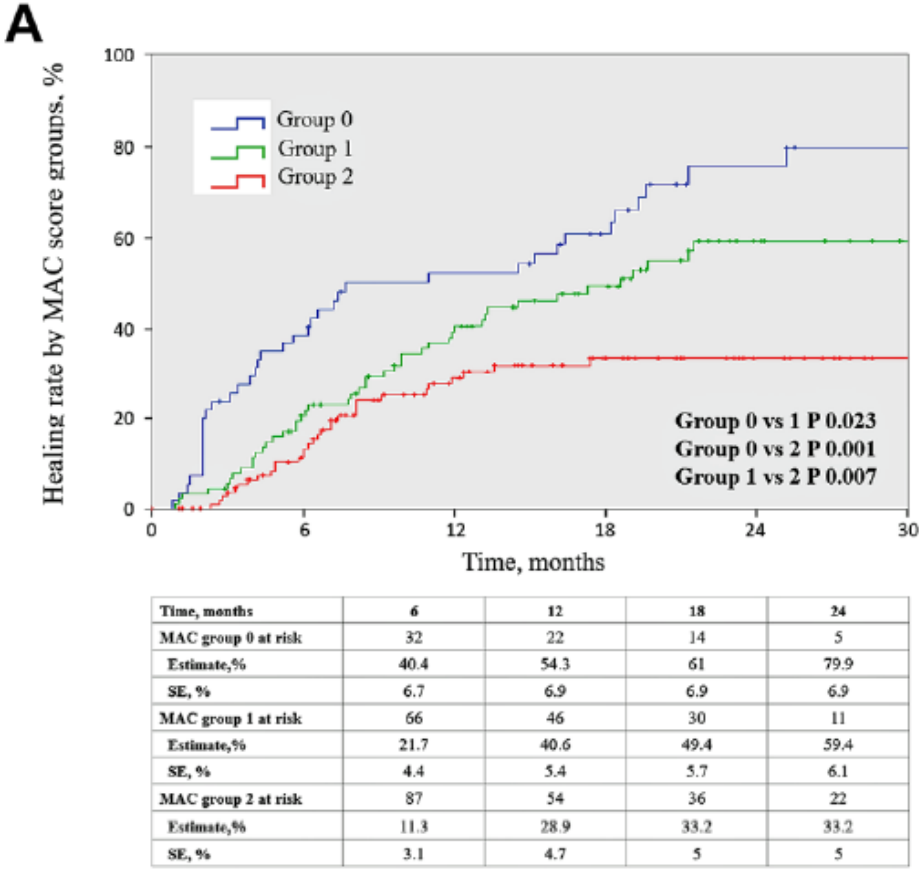
Abbreviations: FF, freedom from; MAC, medial arterial calcification; MALE, major adverse limb events; WIFI, Wound, Ischemia, foot Infection classification.

^aData are presented as the odds ratio (95% confidence interval).

^bSignificant associations are marked in boldface.

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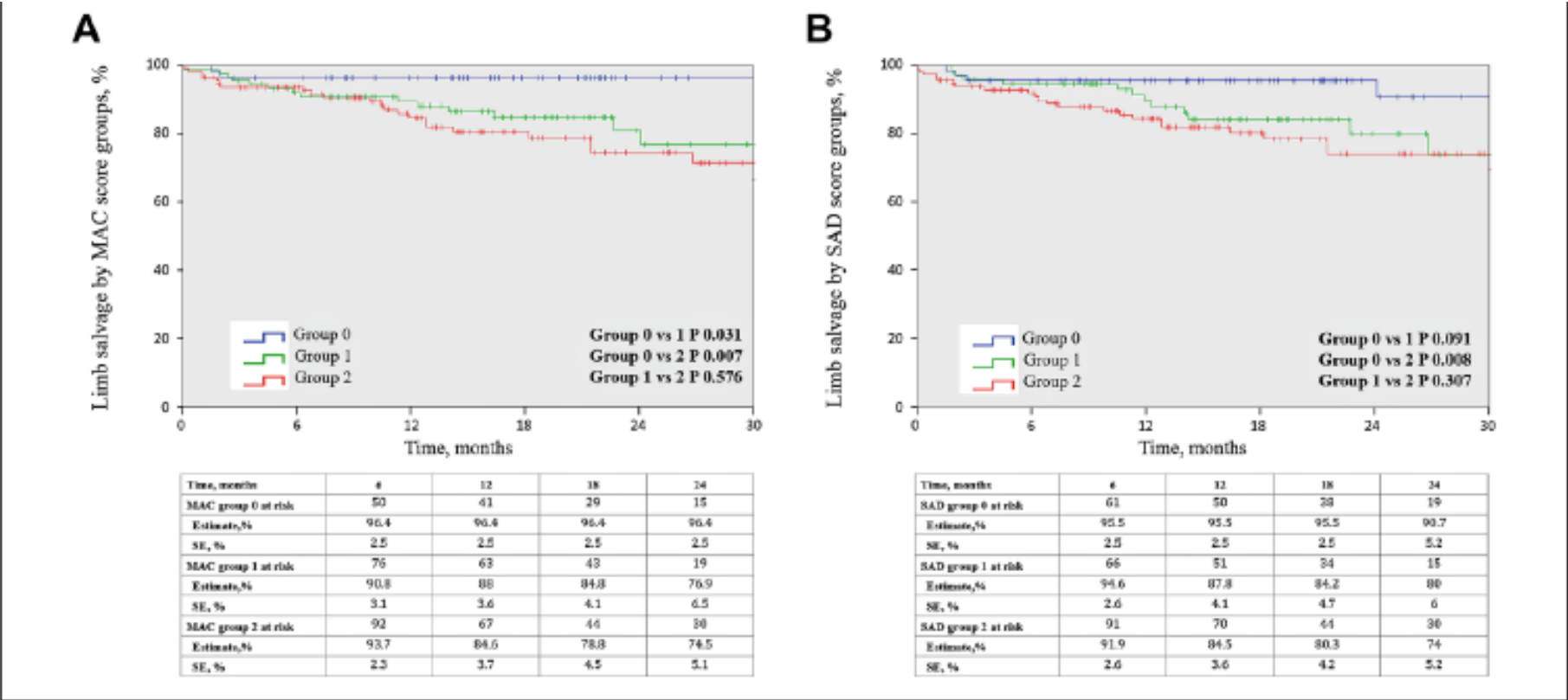


Figure 7. Limb salvage estimates for the (A) medial arterial calcification (MAC) groups and the (B) small artery disease (SAD) groups. SE, standard error.

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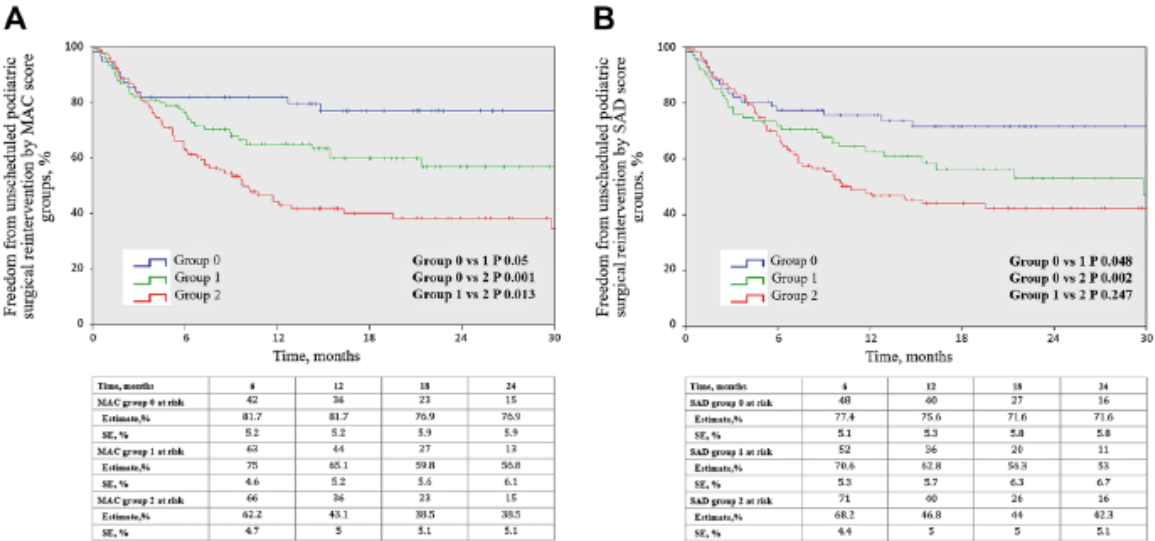


Figure 5. Freedom from unscheduled podiatric surgical reintervention estimates for the (A) medial arterial calcification (MAC) groups and the (B) small artery disease (SAD) groups. SE, standard error.

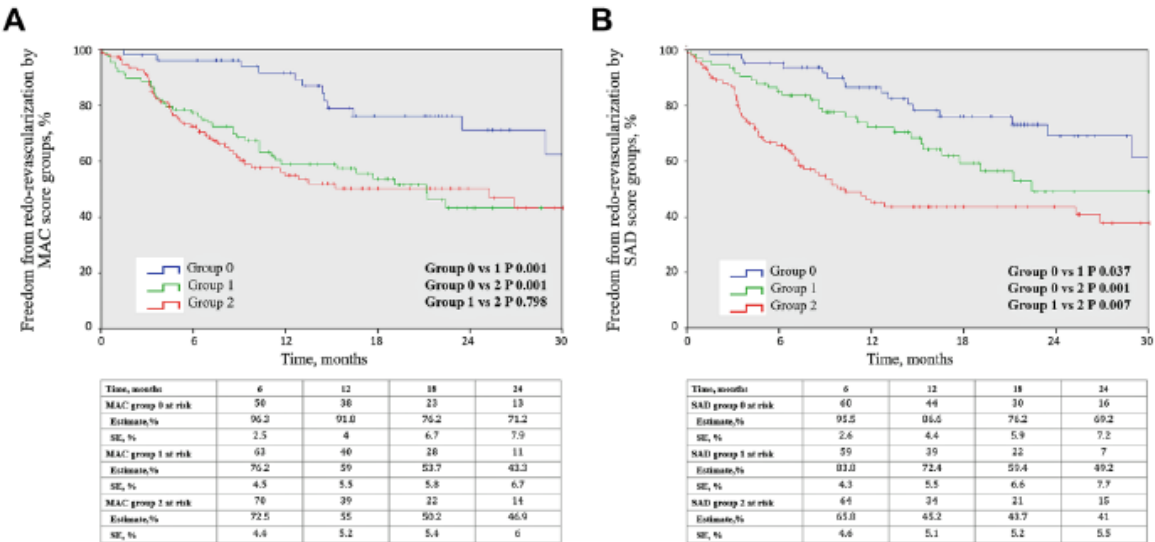


Figure 6. Freedom from redo revascularization estimates for the (A) medial arterial calcification (MAC) groups and the (B) small artery disease (SAD) groups. SE, standard error.

A Novel Scoring System for Small Artery Disease and Medial Arterial Calcification Is Strongly Associated With Major Adverse Limb Events in Patients With Chronic Limb-Threatening Ischemia

Roberto Ferraresi, MD¹, Alessandro Ucci, MD², Alessandra Pizzuto, MD³, Fabrizio Losurdo, MD⁴, Maurizio Caminiti, MD⁴, Daniela Minnella, MD⁴, Andrea Casini, MD⁵, Giacomo Clerici, MD⁴, Miguel Montero-Baker, MD⁶, and Joseph Mills, MD⁶

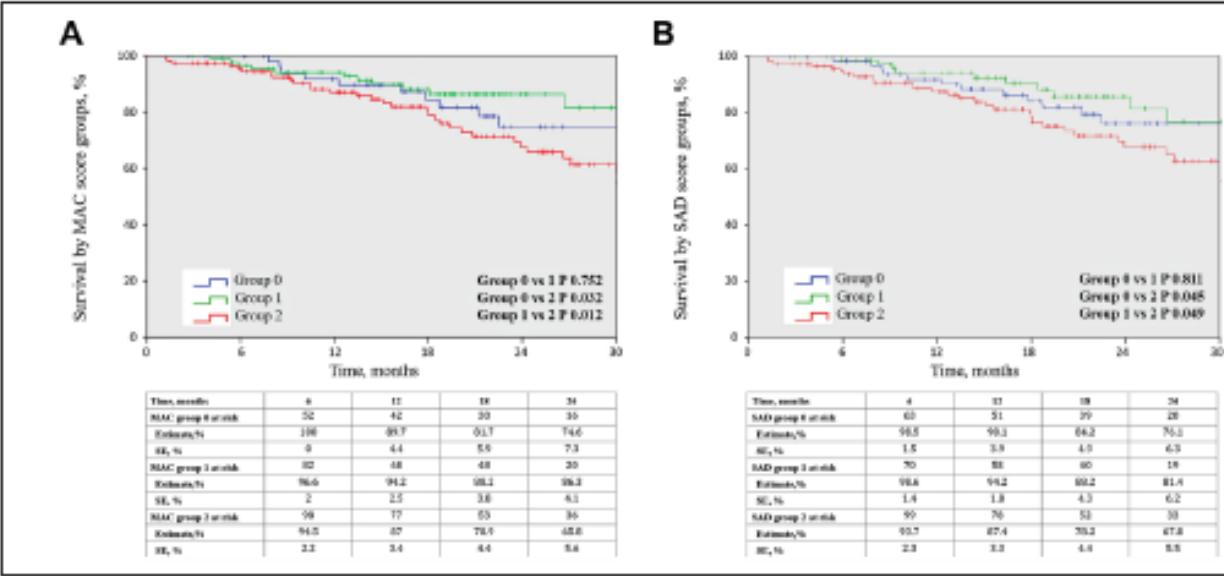


Figure 8. Survival estimates for the (A) medial arterial calcification (MAC) groups and the (B) small artery disease (SAD) groups. SE, standard error.

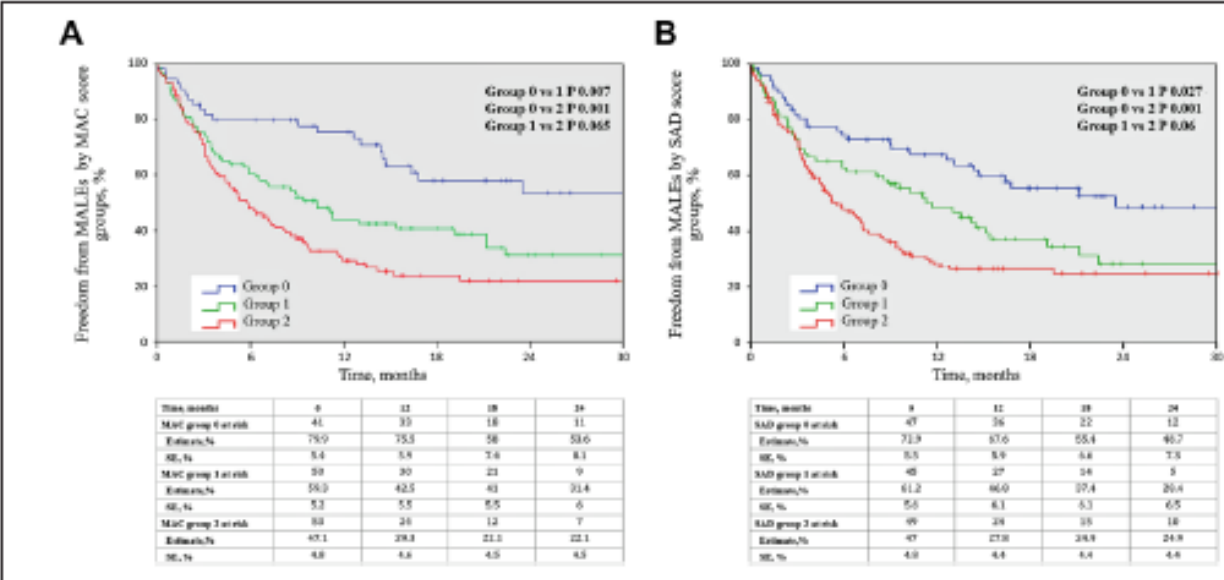


Figure 9. Freedom from major adverse limb events (MALE) estimates for the (A) medial arterial calcification (MAC) groups and the (B) small artery disease (SAD) groups. SE, standard error.

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Materials and Methods

SAD According to the LL and AP DSA projections of the foot, all the small arteries arising from the 3 BTA arteries (the tarsal, metatarsal, digital, and calcaneal branches) were evaluated. SAD was scored as

- 0 [no or mild disease with a well-represented network of forefoot and calcaneal arteries (Figure 1A)];
- 1 [moderate: diffuse disease/stenoses with narrow but patent arch, metatarsal, digital, and calcaneal arteries (Figure 1B)];
- 2 [severe: occlusion or extreme poverty of the arch, metatarsal, digital, and calcaneal arteries (Figure 1C)].

The SAD score was defined for each patient by 2 blinded evaluators (R.F. and A.U.). Limbs were stratified into groups 0, 1, or 2 corresponding to the SAD score.

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Materials and Methods

To determine the **MAC score**, 3 authors (R.F., A.U., and A.P.) independently evaluated the LL and AP radiographic projections of the foot at 5 vascular sites; in case of doubt, the oblique view was also considered. The 5 sites were (1) the dorsalis pedis artery from the ankle joint to its disappearance inside the metatarsal bones; (2) the lateral plantar artery from the bifurcation of the posterior tibial artery to the visible part of the distal plantar arch; (3) the first metatarsal artery from its proximal origin to the metatarsalphalangeal joint line; (4) the first toe artery medial or lateral; and (5) other toe arteries from the metatarsal-phalangeal joint line to the tiptoes.

At each of these areas, the evaluators determined the presence or absence of vessel calcification, its length, and whether there was the *typical rail-tracking pattern consistent with MAC*. In the dorsalis, lateral plantar, and first metatarsal arteries, a positive finding was indicated by a ≥ 2 -cm-long rail-tracking calcification. In the toe arteries, a positive score was given for a ≥ 1 -cm-long rail-tracking calcification (Figure 2). Every vascular site was scored as 0 or 1 point, and the MAC score was the sum of the points at each of the 5 sites, ranging in a 6-level scale from 0 to 5. However, after initial MAC evaluation, *the MAC score was refined to a 3-level scale for limb categorization: group 0, no MAC (0 or 1 positive site); group 1, moderate MAC (2 or 3 positive sites); or 2 group, severe MAC (4 or 5 positive sites).*

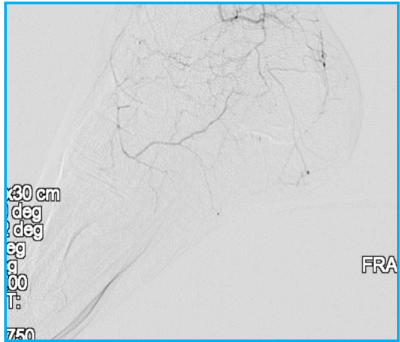
**A Review and Proposed Classification
System for the No-Option Patient With
Chronic Limb-Threatening Ischemia**

Journal of Endovascular Therapy
2021, Vol. 28(2) 183–193
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DOI: 10.1177/1526602820963911
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SAGE

Tanner I. Kim, MD¹, Shant S. Vartanian, MD², and Peter A. Schneider, MD²

Table 3. Classification of the No-Option and Poor-Option Patient.

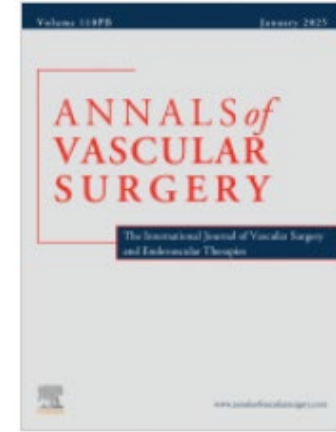
Type	Description
I: Desert foot pedal anatomy	No patent pedal vessels or desert foot anatomy



The Impact of Small Artery Disease (SAD) and Medial Arterial Calcification (MAC) Scores on Chronic Wound and Amputation Healing: Can It Tell Us More?

[Saranya Sundaram](#) ¹  · [Christian Barksdale](#)² · [Stephanie Rodriguez](#)¹ · [Mathew D. Wooster](#)¹

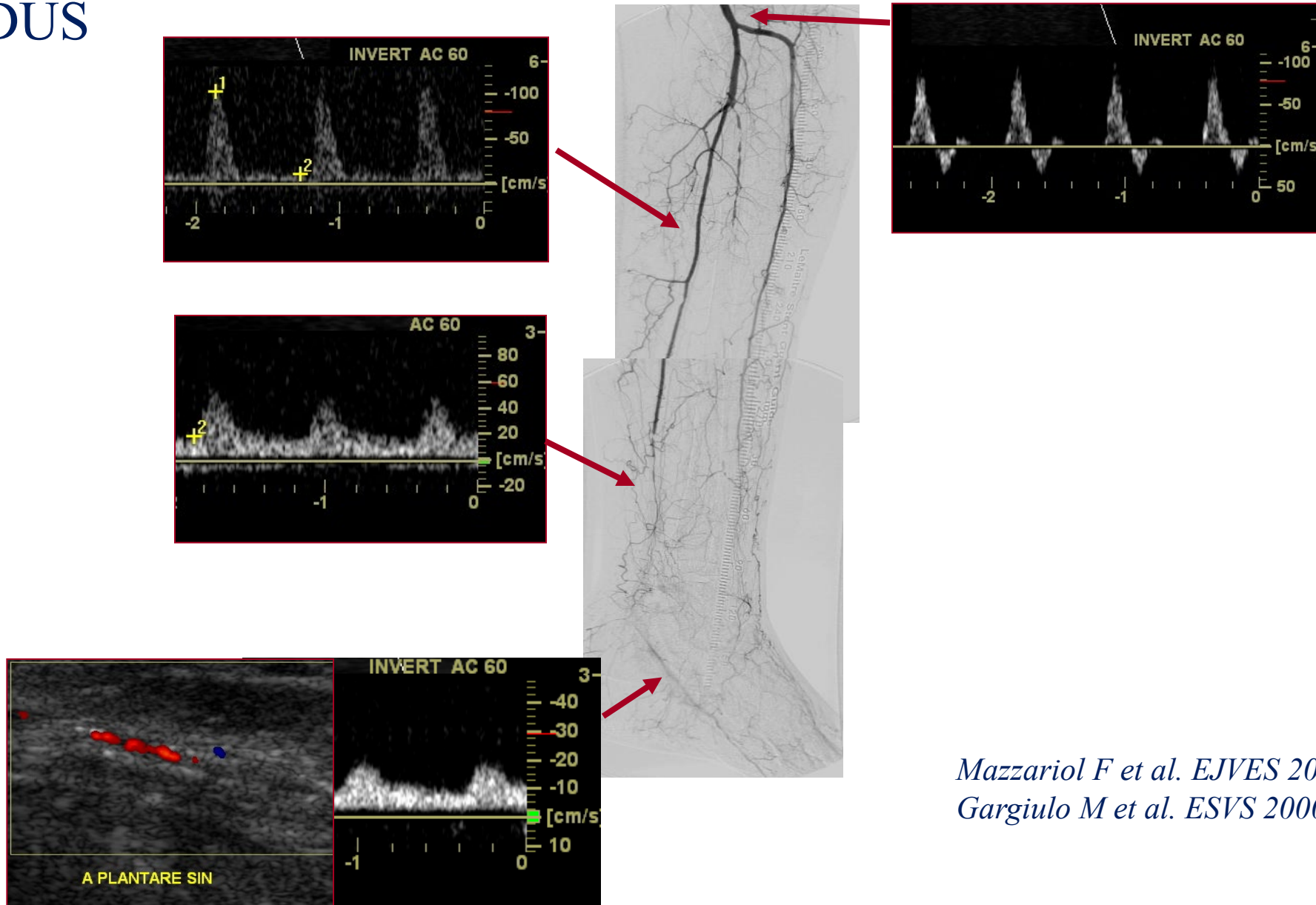
Ann Vasc Surg 2025



Background

In 2021, Ferraresi et al. created a novel scoring system based on the impact of small artery disease (SAD) and medial arterial calcification (MAC) on wound healing. SAD and MAC scores functioned similar to Wound, Ischemia, and foot Infection (WIfI) but with minimal resource expenditure. **Despite its potential, few studies have expanded on the original dataset**

PAD and DUS



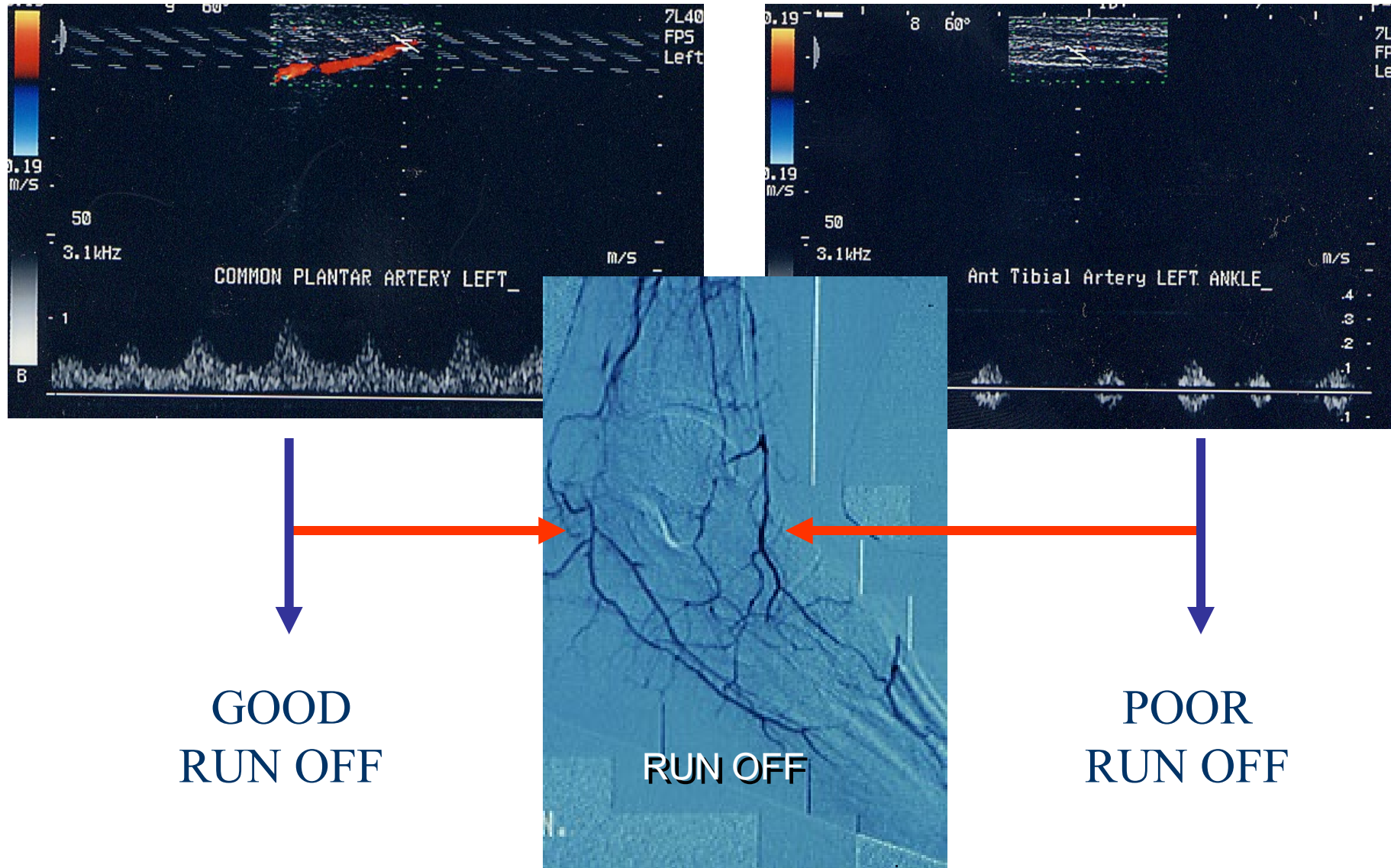
Mazzariol F et al. EJVES 2000; 19:509-515
Gargiulo M et al. ESVS 2000



Tibial arteries disease in diabetic patients:

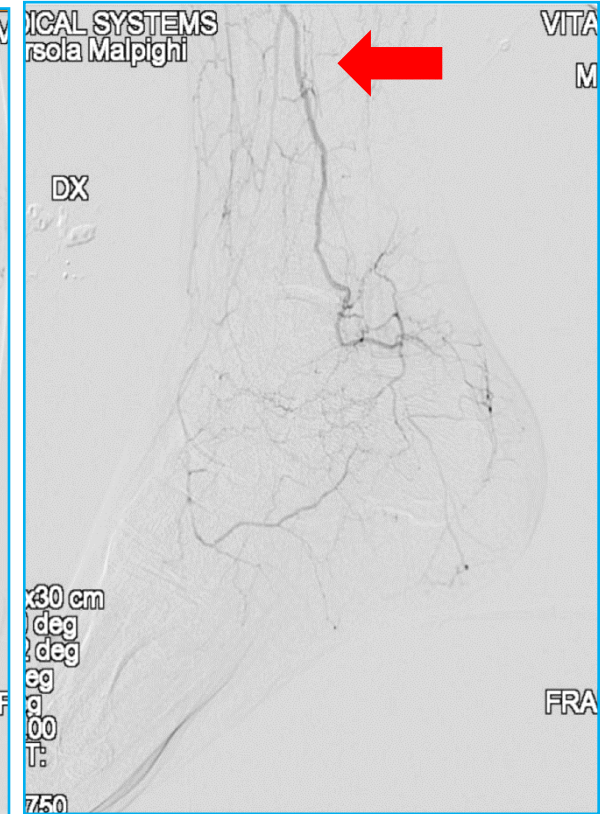
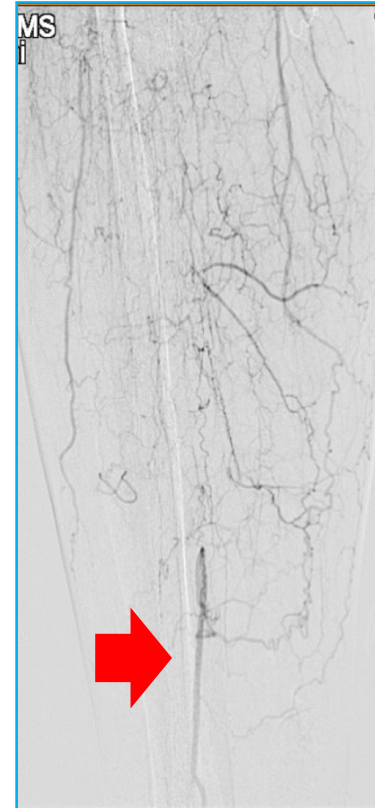
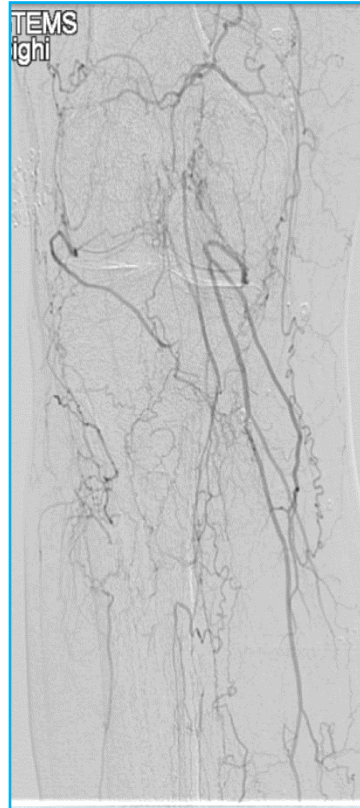
Can colour duplex mapping of the ankle and foot arteries improve the vascular program?

M Gargiulo, A Stella, S Tarantini et al ESVS 2000



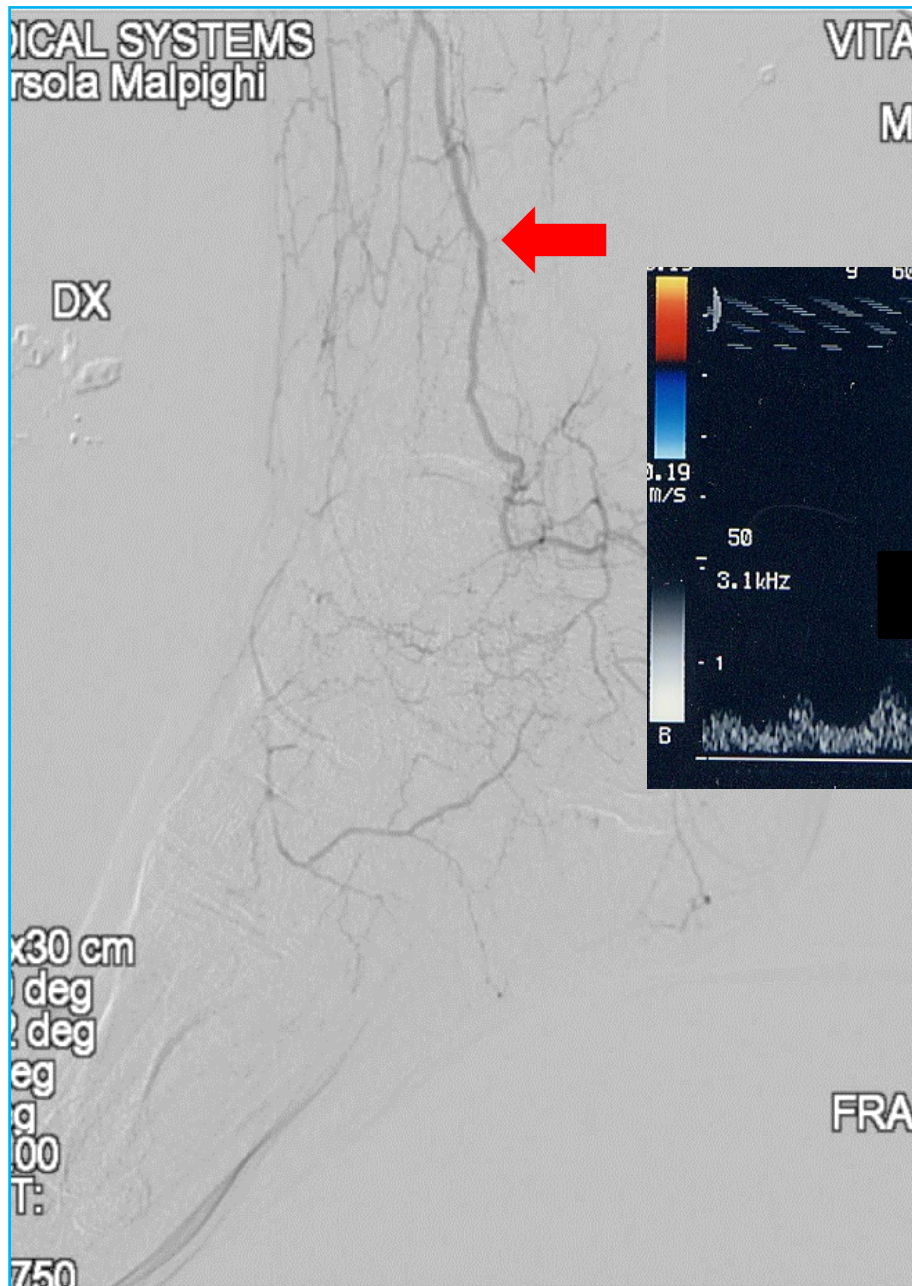
Case # 1

48 y old male - Bypass to the Peroneal Artery at the Ankle



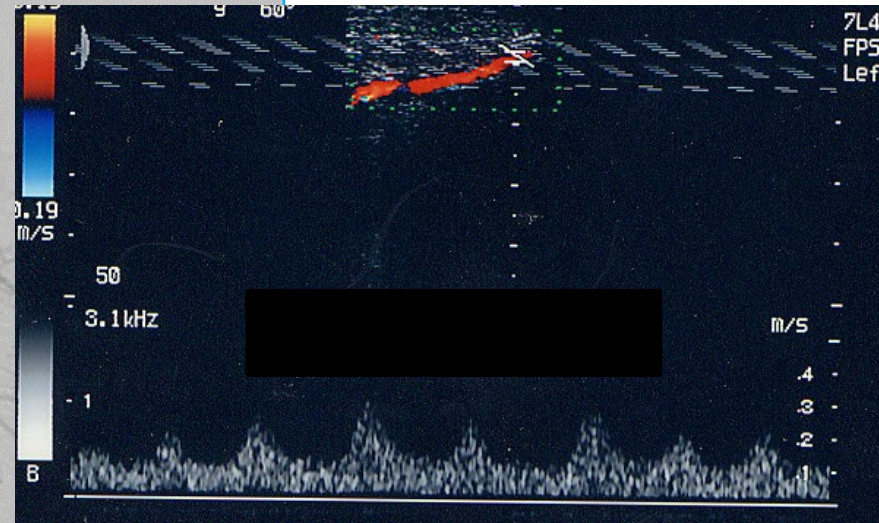
W2 I3 fi1





Case # 1

*48 y old male - Bypass to the **Peroneal Artery at the Ankle***



SAD 2
MAC 4



Case # 1

48 y old male - Bypass to the Peroneal Artery at the Ankle

DUS : suitable great ipsilateral saphenous vein :

- present along the thigh and leg,
- good parietal quality
- good diameter (proximal 5.1mm, distal 2.3 mm)

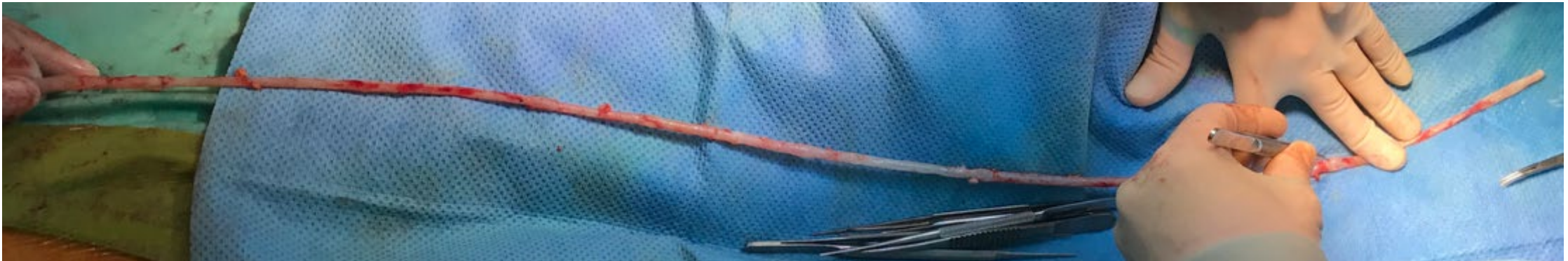
Clinical Practice Guidelines

Eur J Vasc Endovasc Surg (2023) 66, 454–483

CLINICAL PRACTICE GUIDELINE DOCUMENT

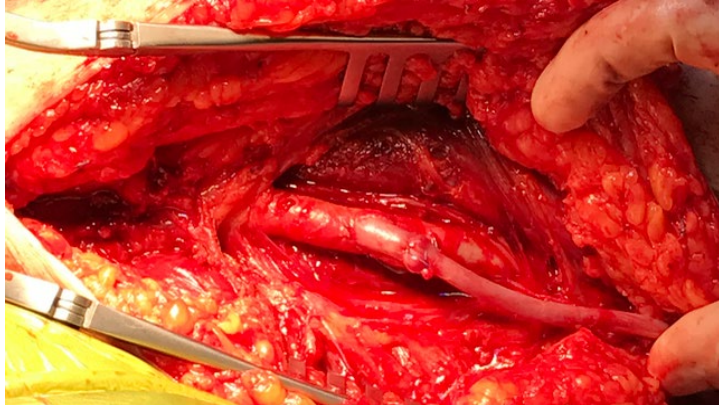
Editor's Choice – The Intersocietal IWGDF, ESVS, SVS Guidelines on Peripheral Artery Disease in People With Diabetes Mellitus and a Foot Ulcer

Robert Fitzridge[✉], Vivienne Chuter[✉], Joseph Mills[✉], Robert Hinchliffe[✉], Nobuyoshi Azuma[✉], Christian-Alexander Behrendt[✉], Edward J. Boyko[✉], Michael S. Conte[✉], Misty Humphries[✉], Lee Kirksey[✉], Katharine C. McGinley[✉], Sigrid Nikol[✉], Joakim Nordanstig[✉], Vincent Rowe[✉], David Russell[✉], Jos C. van den Berg[✉], Maarit Venermo[✉], Nicolaas Schaper[✉]

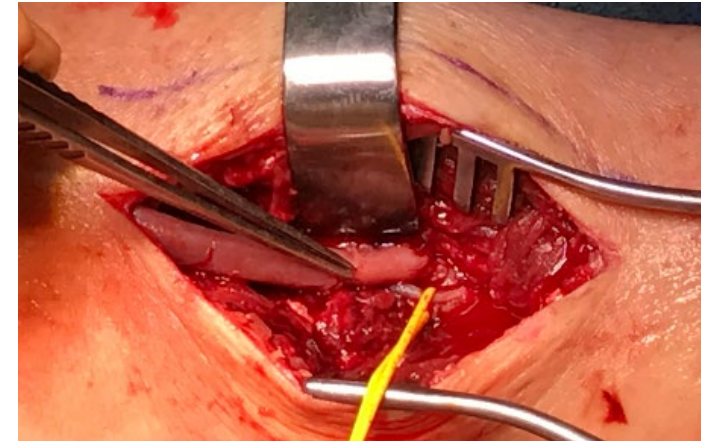


Case # 1

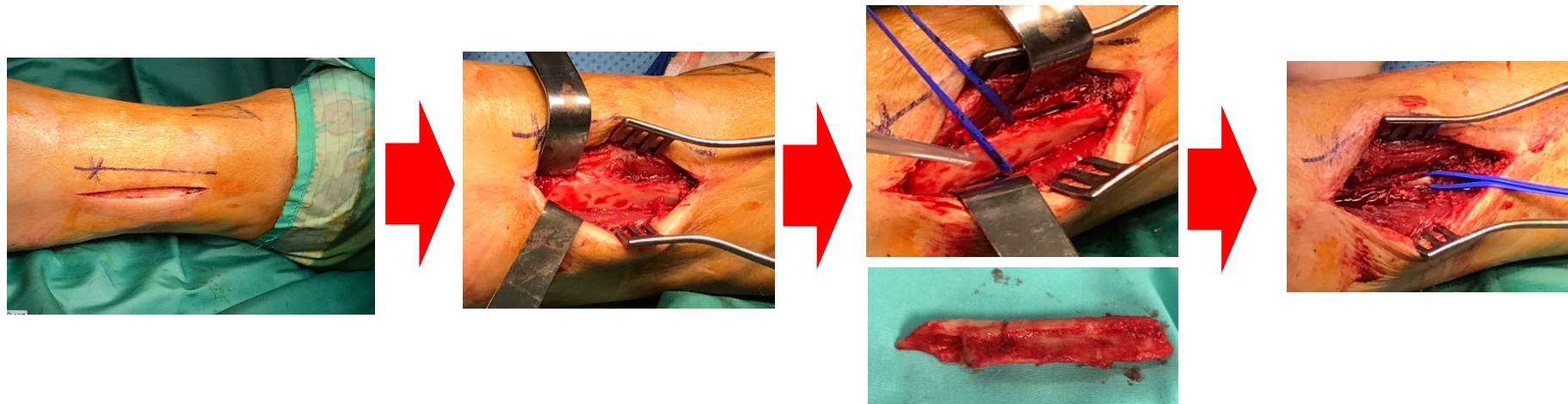
48 y old male - Bypass to the Peroneal Artery at the Ankle



Proximal anastomosis
Superficial Femoral Artery



Distal anastomosis
Distal segment of Peroneal Artery



Case # 1

48 y old male - Bypass to the Peroneal Artery at the Ankle



Pre-op



Follow up
2 – 48 months



Pedal arterial calcification score is associated with hemodynamic change and major amputation after infrainguinal revascularization for chronic limb-threatening ischemia

Iris H. Liu, MD,^a Bian Wu, MD,^a Viktoriya Krepiy, DPM,^a Rym El Khoury, MD,^a Roberto Ferraresi, MD,^b Alexander M. Reyzelman, DPM,^a Jade S. Hiramoto, MD, MAS,^a Peter A. Schneider, MD,^a Michael S. Conte, MD,^a and Shant M. Vartanian, MD,^a San Francisco, CA; and Milan, Italy

(J Vasc Surg 2022;76:1688-97.)

Table II. Association between pedal medial arterial calcification (pMAC) score and preoperative wound, ischemia, foot infection (WIFI) ischemia grade, postoperative WIFI ischemia grade, and change in WIFI ischemia grade after technically successful infrainguinal revascularization

	All (n = 306)	Univariate correlations with trichotomized pMAC score			P value
		pMAC 0-1	pMAC 2-4	pMAC 5	
Preoperative WIFI ischemia grade	n = 250	n = 100	n = 90	n = 60	.28
0	22 (8.8)	5 (5.0)	9 (10)	8 (13)	
1	55 (22)	19 (19)	23 (26)	13 (22)	
2	26 (10)	10 (10)	12 (13)	4 (6.7)	
3	147 (59)	66 (66)	46 (51)	35 (58)	
Change in WIFI ischemia grade	n = 136	n = 49	n = 55	n = 32	.004
Improved	78 (57)	37 (76)	28 (51)	13 (41)	
Unchanged or worsened	58 (43)	12 (24)	27 (49)	19 (59)	

Data are presented as number (%).

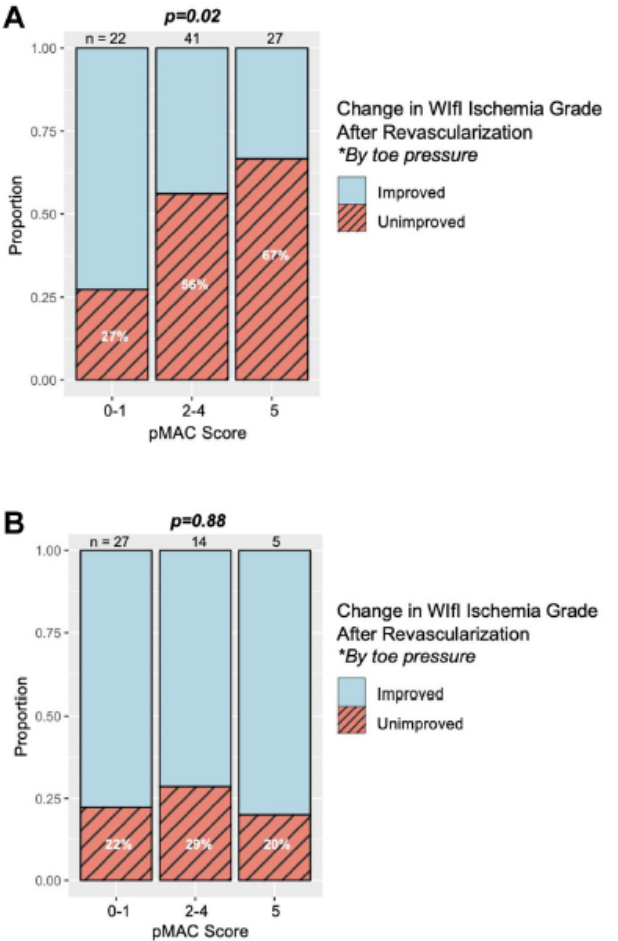
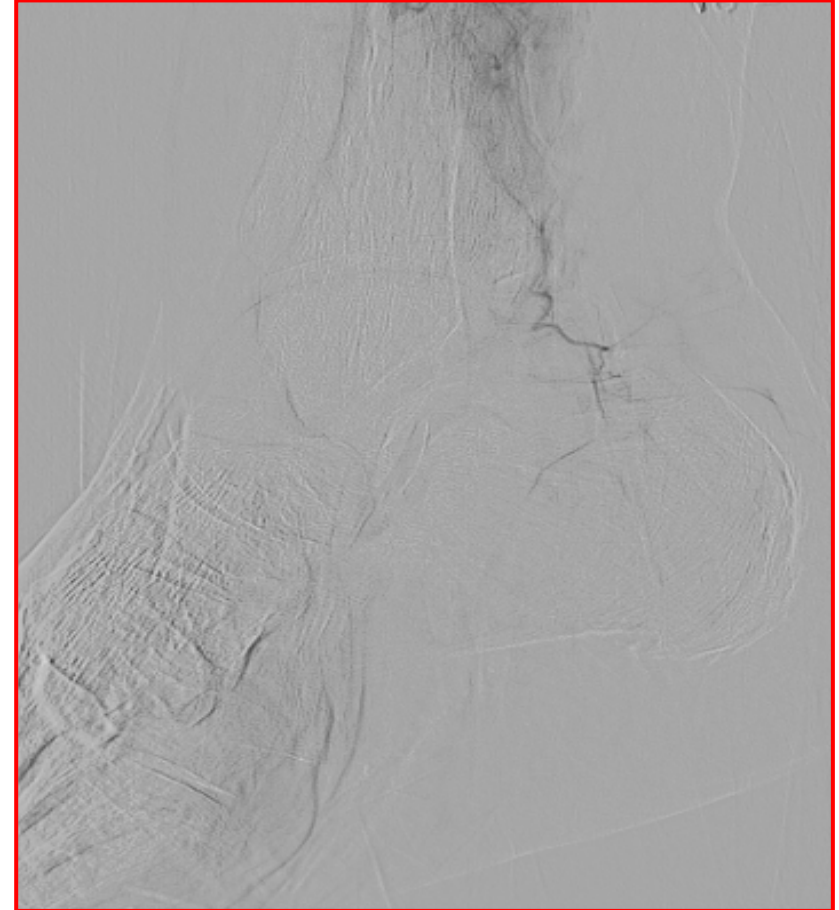
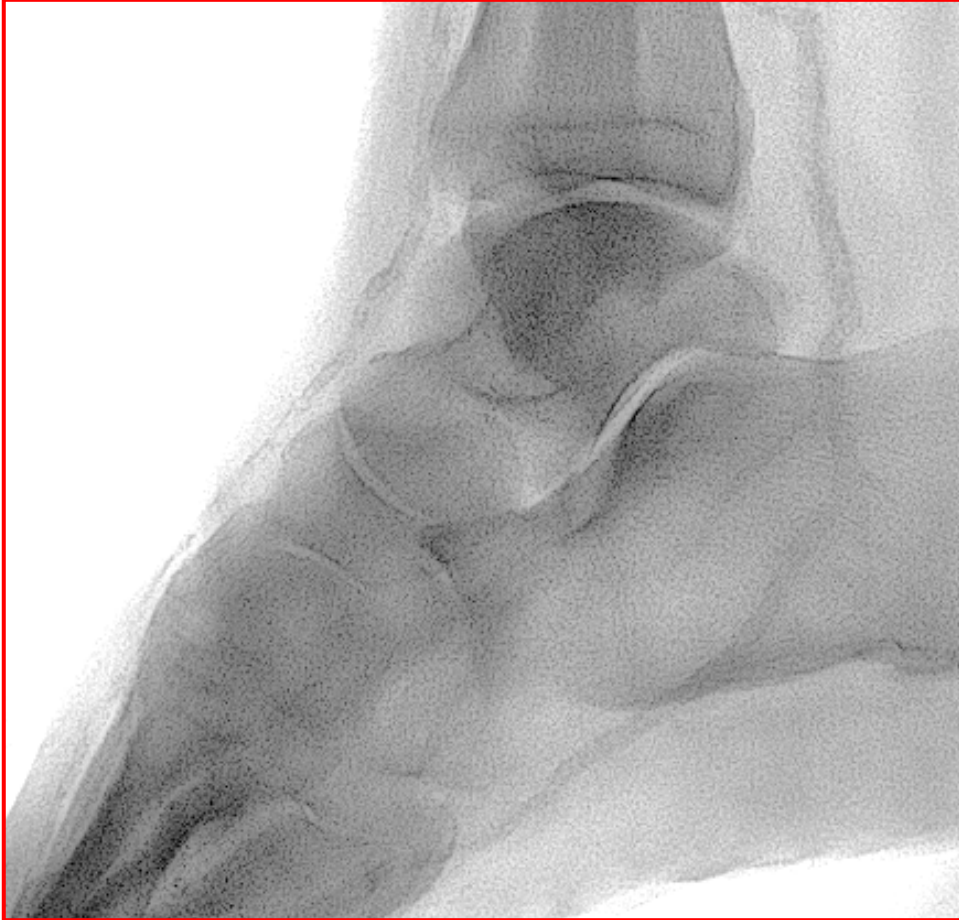


Fig 1. Change in wound, ischemia, foot infection (WIFI) ischemia grade after revascularization stratified by trichotomized pedal medial arterial calcification (pMAC) score and revascularization approach (A) endovascular and (B) open.

Conclusions: The pMAC score is independently associated with persistent distal ischemia and major amputation after technically successful revascularization for CLTI. These data suggest that pMAC may be a marker for hemodynamic response to revascularization and risk of limb loss, and it may have a stronger influence on the outcome of endoluminal interventions. (J Vasc Surg 2022;76:1688-97.)

Desert foot – No Option for Foot Arterial Revascularization

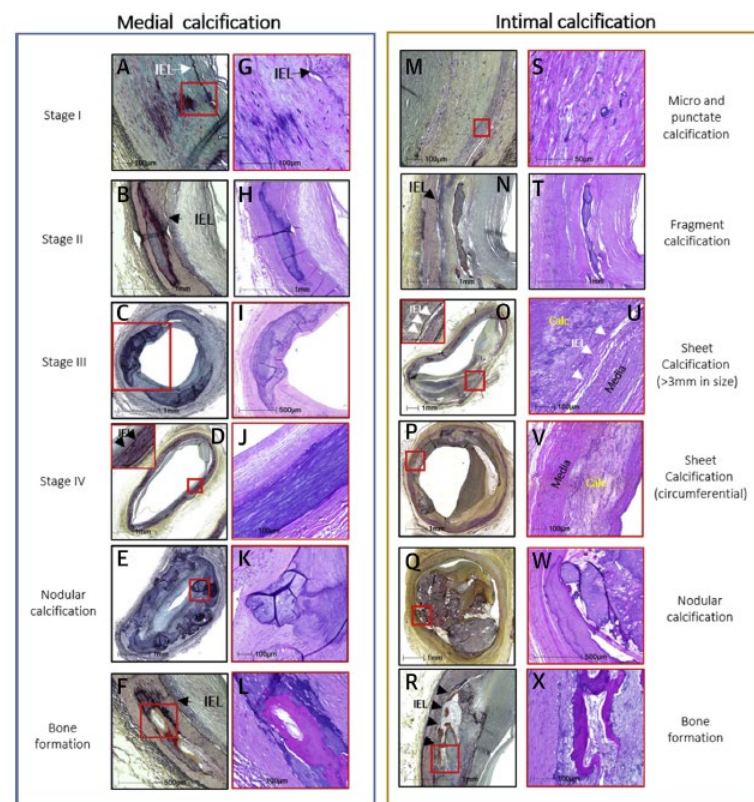


Medial Arterial Calcification

JACC State-of-the-Art Review

Peter Lanzer, MD,^a Fadil M. Hannan, DPHIL,^b Jan D. Lanzer, MD,^{c,d,e} Jan Janzen, MD,^f Paolo Raggi, MD,^g Dominic Furniss, DM, MBBCh,^h Mirjam Schuchardt, PhD,ⁱ Rajesh Thakker, ScD,^j Pak-Wing Fok, PhD,^k Julio Saez-Rodriguez, PhD,^c Angel Millan, PhD,^l Yu Sato, MD,^m Roberto Ferraresi, MD,ⁿ Renu Virmani, MD,^m Cynthia St. Hilaire, PhD^{o,p,q}

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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Medial arterial calcification (MAC) and the intimal atherosclerotic calcifications (Calc) are shown. The legends to each medial and intimal calcification pattern are summarized in Table 1. The histologic sections shown in the left and right columns of the medial and intimal calcifications were stained with (A to F and M to R) Movat pentachrome and (G to L and S to X) hematoxylin and eosin. The red boxes in the Movat pentachrome sections indicate areas of magnifications shown in the hematoxylin sections and in stage IV (medial) and sheet (intimal) Movat pentachrome sections. IEL = internal elastic lamina (black arrows, black and white arrowheads). Modified and reproduced with permission from <https://doi.org/10.1016/j.jcmg.2018.08.039> and <https://doi.org/10.1016/j.ajvs.2020.08.037>.

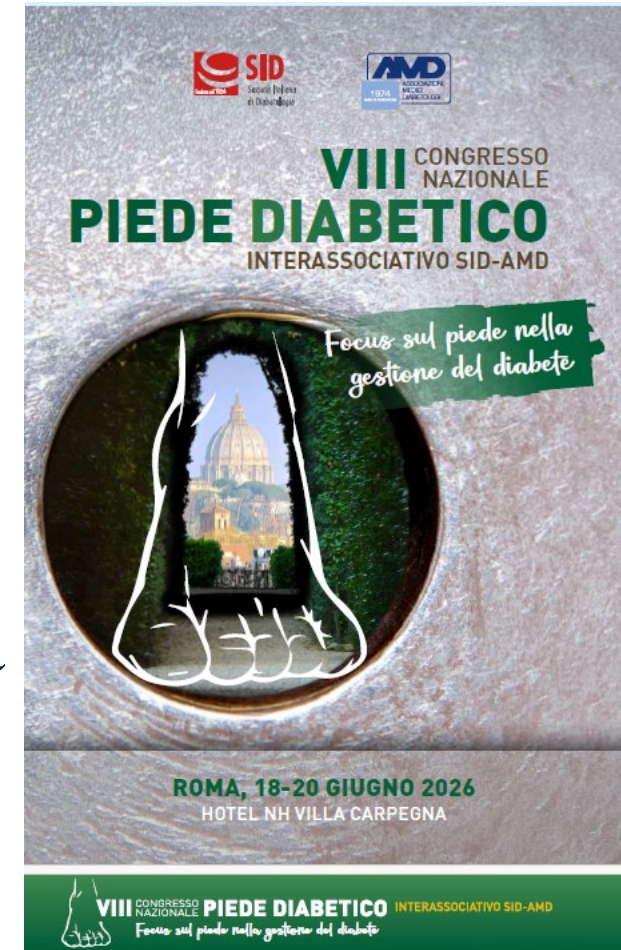
SUMMARY

- MAC is a chronic systemic vascular disorder distinct from atherosclerosis that is frequently but not always associated with DM, CKD, and aging.
- It is part of several complex phenotypes observed in numerous common diseases.
- The hallmarks of MAC include disseminated and progressive precipitation of CaP within the medial layer, compromise of hemodynamics, a prolonged and clinically silent course, and CLTI.
- The pathogenesis of MAC is unknown.

SAD e MAC guidano la scelta terapeutica?

Conclusioni

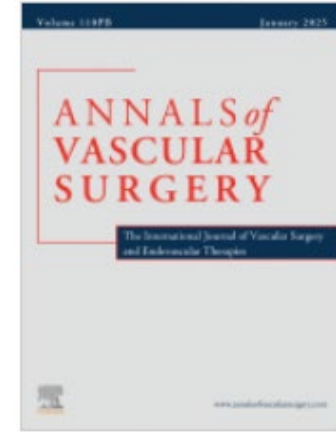
- SAD e MAC sono un importante **Alert** nella rivascularizzazione d'arto
- Nell'indicazione alla rivascularizzazione vanno associate a valutazioni emodinamiche



The Impact of Small Artery Disease (SAD) and Medial Arterial Calcification (MAC) Scores on Chronic Wound and Amputation Healing: Can It Tell Us More?

[Saranya Sundaram](#) ¹  · [Christian Barksdale](#)² · [Stephanie Rodriguez](#)¹ · [Mathew D. Wooster](#)¹

Ann Vasc Surg 2025



Conclusions

- MAC scoring showed significant promise both as individual predictor and adjunct to current predictive models of long-term wound healing outcomes.
- **Routine use of MAC scoring in chronic limb-threatening ischemia evaluation, especially when noninvasive testing is unavailable,** could promote timely referral for intervention and efficient resource utilization in limited-resource or critical care settings.
- Furthermore investigation is necessary to determine MAC's impact on revascularization and how scoring can be used to guide surgical decision-making.



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SAD e MAC guidano la scelta terapeutica?

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