CLI: What are the Grading Systems and Why Use Them?

George L. Adams MD,MHS,MBA,FACC,FSCAI

Director of Cardiovascular and Peripheral Vascular Research

UNC REX Healthcare

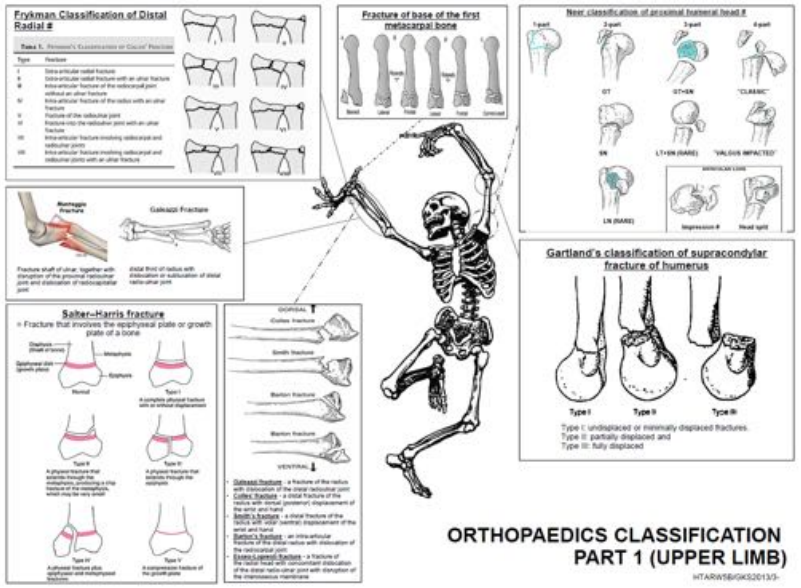
Raleigh, North Carolina - USA

Disclosures

- None

Why We Grade

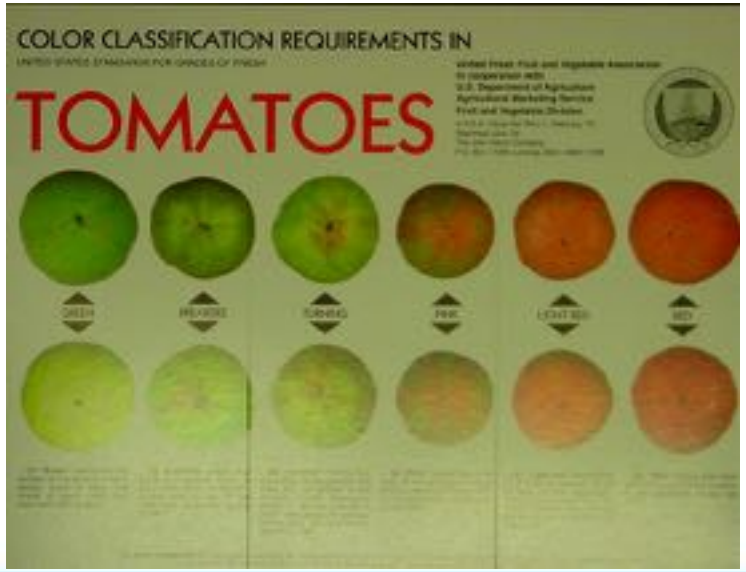
Grading Scale			
A	= 100-93	C	= 76-73
A-	= 92-90	C-	= 72-70
B+	= 89-87	D+	= 69-67
B	= 86-83	D	= 66-63
B -	= 82-80	D-	= 62-60
C+	= 79-77	F	= Below 60



To guide decision making processes

To unify opinions with limited subjectivity

Provides a defined framework for categorizing individual specimens.



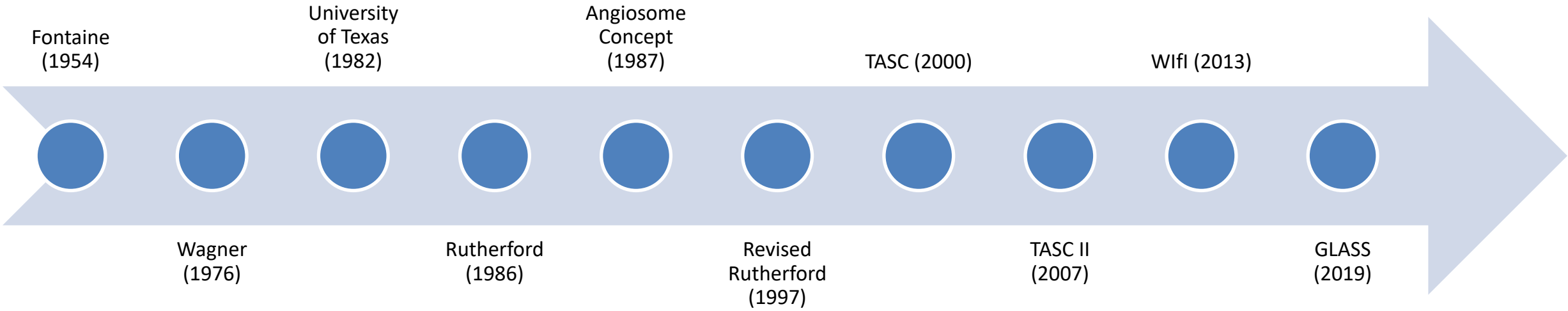
Understanding the CLI Patient

- Complex diagnosis
- Each patient presents with unique components that play a critical role in treatment options and outcomes
- Wounds, Anatomy, and Blood flow are all necessary considerations to give personalized treatment options

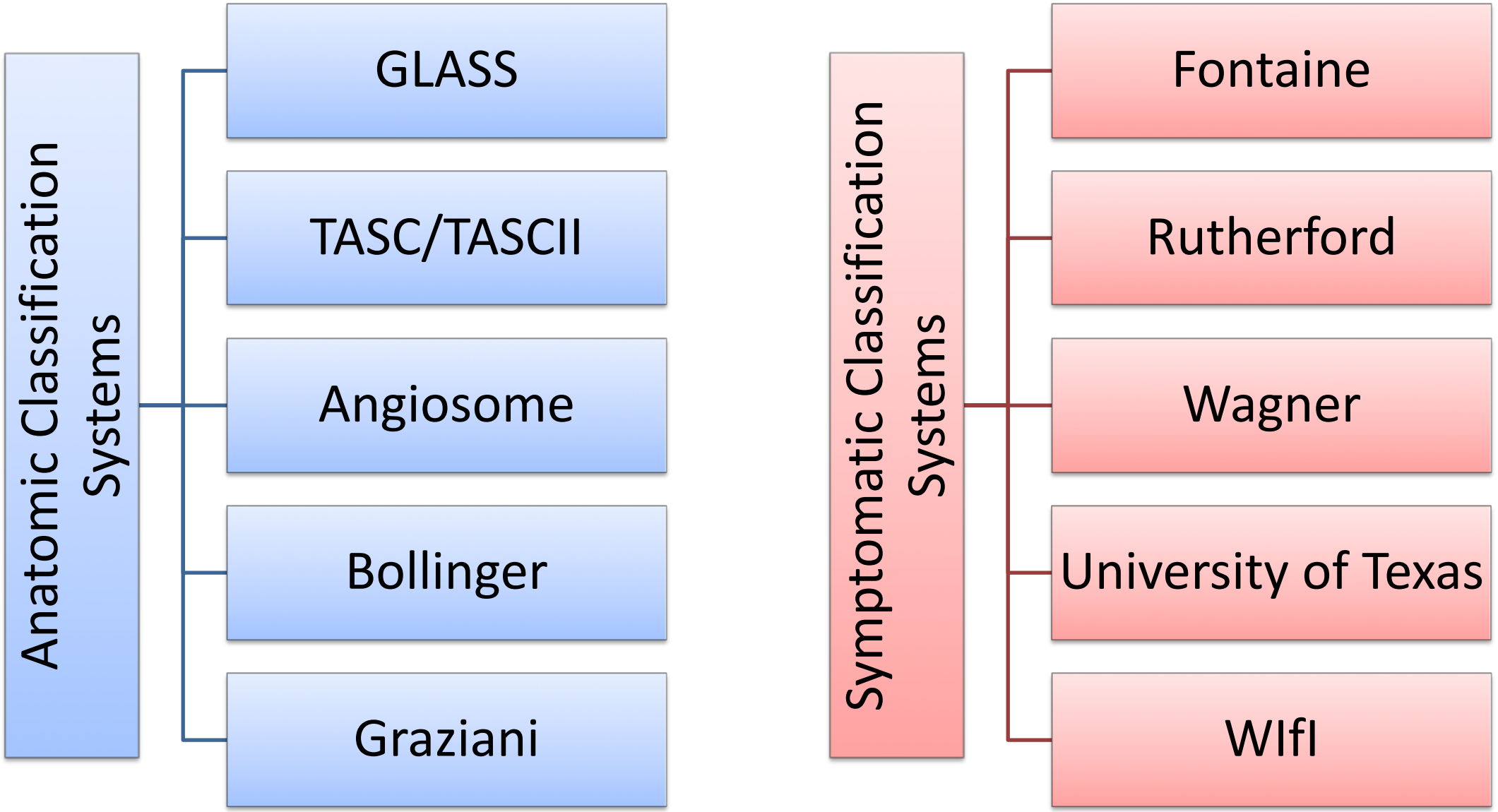
History of CLI Classifications

- CLI terminology first mentioned in the early 1980's.
- Representative classifications have evolved simultaneously with the population demographic.
- Diabetes epidemic largely responsible for increased prevalence of CLI and need for more specific categorization.

Evolution of CLI Classification Systems



Hardman, Rulon L et al. “Overview of classification systems in peripheral artery disease.” *Seminars in interventional radiology* vol. 31,4 (2014): 378-88. doi:10.1055/s-0034-1393976


Anatomic Classification Systems
GLASS
TASC/TASCII
Angiosome
Bollinger
Graziani
Symptomatic Classification Systems
Fontaine
Rutherford
Wagner
University of Texas
WIfI

Fontaine (1954)

- Purely ischemic model
- Diabetic population was only a small percentage

Stage	Symptoms
I	Asymptomatic
II	Claudication
IIa	Pain-free, claudication walking >200 m
IIb	Pain-free, claudication walking <200 m
III	Rest/nocturnal pain
IV	Necrosis/gangrene

Fontaine R, Kim M, Kieny R. Surgical treatment of peripheral circulation disorders [in German] Helv Chir Acta. 1954;21(5–6):499–533

Classifying Diabetic Foot Ulcers

Ulcer grading	Description
Grade 0	No ulcer but high-risk foot
Grade 1	Superficial ulcer
Grade 2	Deep ulcer, no bony involvement or abscess
Grade 3	Abscess with bony involvement (as shown by X-ray)
Grade 4	Localized gangrene e.g. toe, heel etc
Grade 5	Extensive gangrene involving the whole foot

Note: Grade 1–3 ulcers are termed *non-gangrenous ulcers* and Grade 4 and 5 ulcers are termed *gangrenous ulcers*

- Wagner (1976)
  - Only defines abscess and ostetis.
  - No ischemic criteria

University of Texas Diabetic Wound Classification System

Stage	Grade			
	0	I	II	III
A (no infection or ischemia)	Pre- or post-ulcerative lesion completely epithelialized	Superficial wound not involving tendon, capsule, or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone or joint
B	Infection	Infection	Infection	Infection
C	Ischemia	Ischemia	Ischemia	Ischemia
D	Infection and ischemia	Infection and ischemia	Infection and ischemia	Infection and ischemia

- University of Texas (1982)
  - Does not include ischemic severity. Ischemia = ABI<0.8
  - No angiographic criteria

Hardman, Rulon L et al. “Overview of classification systems in peripheral artery disease.” *Seminars in interventional radiology* vol. 31,4 (2014): 378-88. doi:10.1055/s-0034-1393976

Rutherford (1986)

- Ischemic model with added objective criteria for ischemia
- Most widely recognized

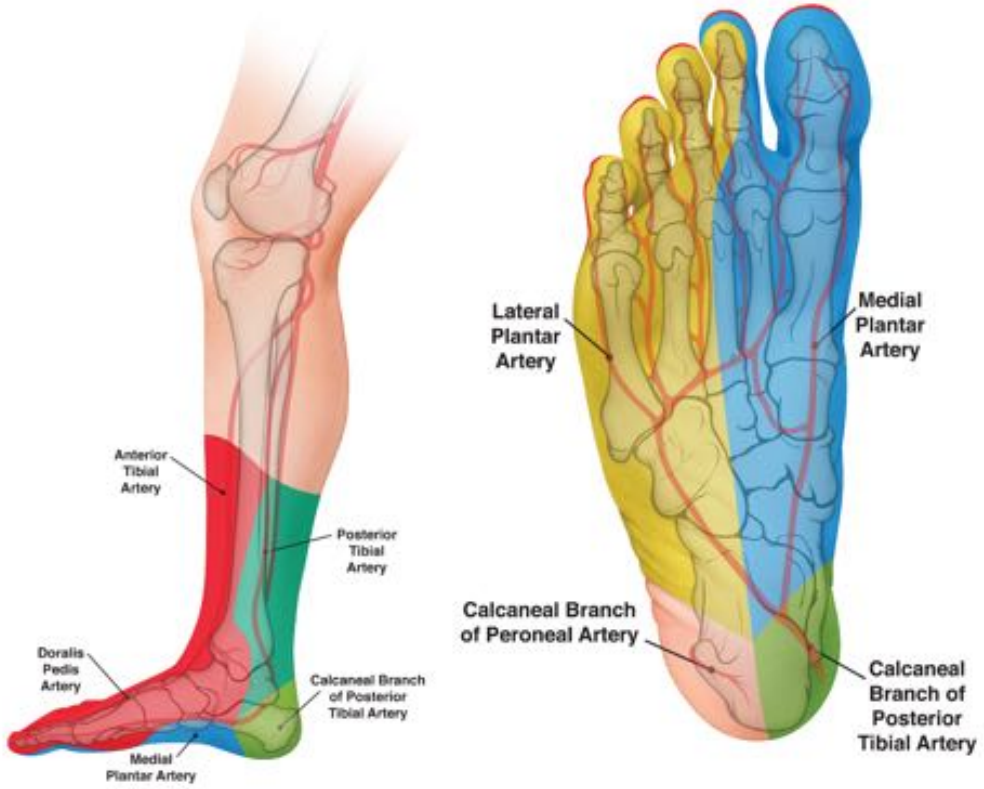
Grade	Category	Clinical description	Objective criteria
0	0	Asymptomatic-no hemodynamically significant occlusive disease	Normal treadmill or reactive hyperemia test
	1	Mild claudication	Completes treadmill exercise; AP after exercise > 50 mmHg but at least 20 mmHg lower than resting value
I	2	Moderate claudication	Between categories 1 and 3
	3	Severe claudication	Cannot complete standard treadmill exercise, and AP after exercise < 50 mm Hg
II	4	Ischemic rest pain	Resting AP < 40 mmHg, flat or barely pulsatile ankle or metatarsal PVR; TP < 30 mm Hg
III	5	Minor tissue loss non-healing ulcer, focal gangrene with diffuse pedal ischemia	Resting AP < 60 mm Hg, ankle or metatarsal PVR flat or barely pulsatile; TP < 40 mm Hg
	6	Major tissue loss-extending above TM level, functional foot no longer salvageable	Same as category 5

AP: ankle pressure; PVR: pulse volume recording; TM: transmetatarsal; TP: toe pressure.

Rutherford R B, Baker J D, Ernst C. et al.Recommended standards for reports dealing with lower extremity ischemia: revised version. J Vasc Surg. 1997;26(3):517–538

Angiosome (1987)

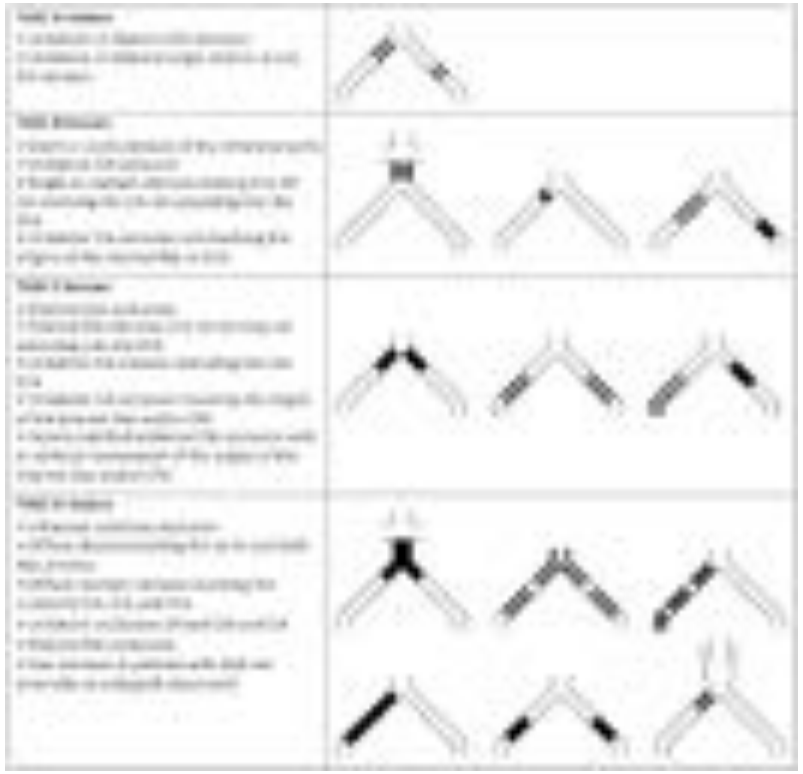
- Does not describe wound or ischemia.
- Anatomical perfusion mapping of the lower extremity into territories supplied by a specific artery.
- Can help determine which artery should be prioritized for revascularization based on location of the wound.
- Greater rates of wound healing in patients where revascularization is directly correlated with the corresponding angiosome (Iida et.al)

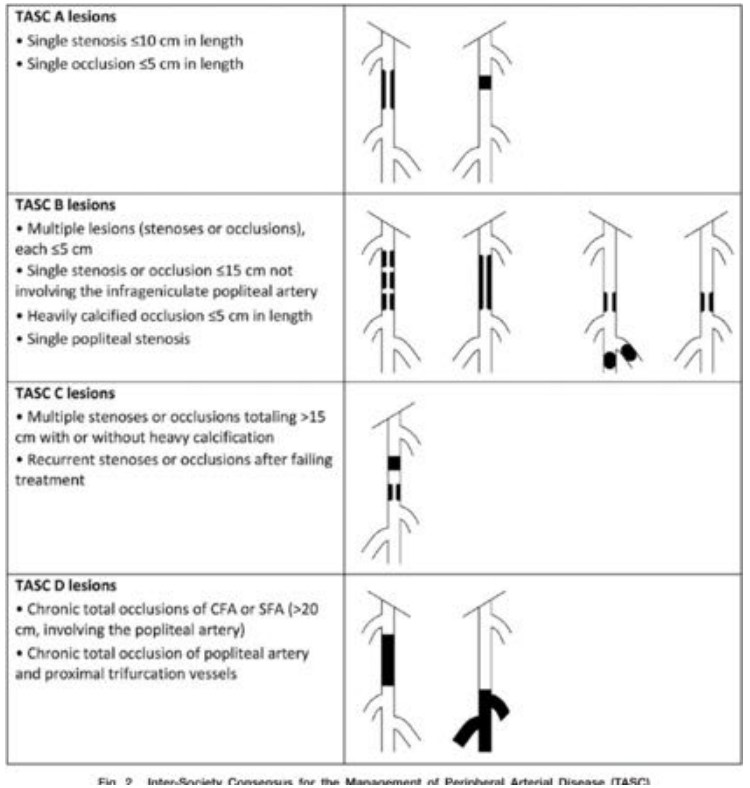


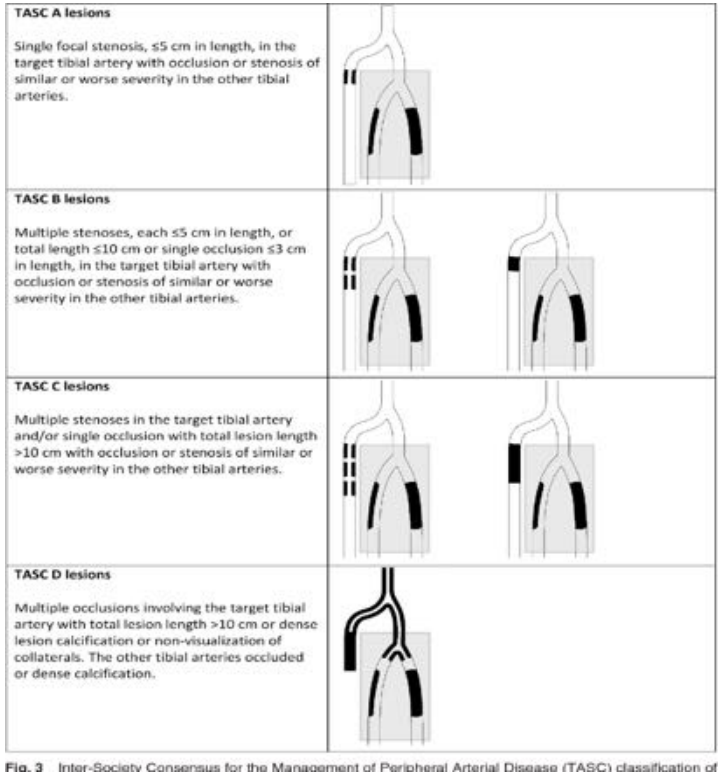
Iida,O. et al. Catheter Cardiovasc Interv. 2010 May 1;75(6):830-6.

TASC II (2007)

- Solely angiographic classification, excludes ischemic and wound criteria.







Norgren, L. et al.Journal of Vascular Surgery, Volume 45, Issue 1, S5 - S67

WIfI (2013)

- Most specific classification system including Wound, Ischemia, and foot Infection.
- Does not include angiographic information.

Component	Score	Description		
W (Wound)	0	No ulcer (ischaemic rest pain)		
	1	Small, shallow ulcer on distal leg or foot without gangrene		
	2	Deeper ulcer with exposed bone, joint or tendon ± gangrenous changes limited to toes		
	3	Extensive deep ulcer, full thickness heel ulcer ± calcaneal involvement ± extensive gangrene		
I (Ischaemia)		ABI	Ankle pressure (mmHg)	Toe pressure or $TcPO_2$
	0	≥0.80	> 100	≥60
	1	0.60–0.79	70–100	40–59
	2	0.40–0.59	50–70	30–39
	3	<0.40	<50	<30
fI (foot Infection)	0	No symptoms/signs of infection		
	1	Local infection involving only skin and subcutaneous tissue		
	2	Local infection involving deeper than skin/subcutaneous tissue		
	3	Systemic inflammatory response syndrome		

Mills, Joseph L. et al. -Journal of Vascular Surgery, Volume 59, Issue 1, 220 - 234.e2

WIfI Continued

- Composite values give risk / benefit analysis for amputation and revascularization

Estimate risk of amputation at 1 y

	Ischemia 0				Ischemia 1				Ischemia 2				Ischemia 3			
W-O	VL	VL	L	M	VL	L	M	H	L	L	M	H	L	M	M	H
W-1	VL	VL	L	M	LV	L	M	H	L	M	H	H	M	M	H	H
W-2	L	L	M	H	M	M	H	H	M	H	H	H	H	H	H	H
W-3	M	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	fL0	fL1	fL2	fL3	fL0	fL1	fL2	fL3	fL0	fL1	fL2	fL3	fL0	fL1	fL2	fL3

Estimate likelihood of benefit of/requirement for revascularization (assuming infection can be controlled first)

	Ischemia 0				Ischemia 1				Ischemia 2				Ischemia 3			
W-O	VL	VL	VL	VL	VL	L	L	M	L	L	M	M	M	H	H	H
W-1	VL	VL	VL	VL	L	M	M	M	M	H	H	H	H	H	H	H
W-2	VL	VL	VL	VL	M	M	H	H	H	H	H	H	H	H	H	H
W-3	VL	VL	VL	VL	M	M	M	H	H	H	H	H	H	H	H	H
	fL0	fL1	fL2	fL3	fL0	fL1	fL2	fL3	fL0	fL1	fL2	fL3	fL0	fL1	fL2	fL3

Abbreviations: fL, foot infection; H, high = clinical stage 4; L, low = clinical stage 2; M, moderate = clinical stage 3; VL, very low = clinical stage 1; W, wound.

Mills, Joseph L. et al. -Journal of Vascular Surgery, Volume 59, Issue 1, 220 - 234.e2

Conclusion

- Classifications can aid in the decision making process when treating CLI
- Systems are now additionally used for standardizing metrics in research
- Though no system is comprehensive, combining classification systems aid in personalization of care