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What Is The Association Between Pedal Access Intervention And Radiologically Measured Wound Healing Progression In Diabetic Foot Ulcers? : A Systematic Review

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ABSTRACT

Introduction: Diabetic foot ulcers (DFUs) represent a severe complication of diabetes, with peripheral artery disease (PAD) being a major contributor to poor healing and limb loss. Pedal access interventions, which target the small arteries of the foot, have emerged as a key revascularization strategy. However, the specific association between these procedures and radiologically measured wound healing progression requires systematic evaluation. This systematic review aims to synthesize the existing evidence on the association between pedal access interventions and radiologically assessed wound healing outcomes in patients with DFUs.

Methods: A systematic review was conducted following a pre-defined protocol. We screened studies based on abstracts for inclusion criteria focusing on: (1) patients with diabetic foot ulcers, (2) pedal access interventions (angioplasty, stenting, bypass), (3) outcomes including radiologically measured wound healing, and (4) appropriate study designs (e.g., cohort studies, RCTs). Data were extracted on study characteristics, patient populations, intervention details, radiological assessment methods, wound healing outcomes, and the association between them.

Results: From the screening of a large body of literature, data were extracted from numerous studies, many of which were observational cohorts. The patient populations were predominantly older males with long-standing diabetes and severe PAD. Pedal access interventions primarily involved endovascular techniques, such as angioplasty of tibial and pedal arteries, with some studies focusing on angiosome-guided or pedal arch revascularization (PAR). Radiological assessment methods varied, including duplex ultrasound (e.g., pedal acceleration time [PAT]), digital subtraction angiography (e.g., pedal arch patency), and plain radiographs (e.g., MAC scores). The synthesized evidence demonstrates a strong and consistent association between successful pedal access intervention and improved wound healing. Key findings show that a **complete pedal arch (CPA) post-intervention** is significantly associated with higher healing rates (e.g., 93.3% vs. 52.6% for an absent arch, p=0.003), shorter healing times (e.g., 3.5 vs. 5.7 months, p<0.001), and superior limb salvage (e.g., 100% vs. 68.4% at 1-year, p<0.001) (Troisi et al., 2018; Ismail et al., 2020). Similarly, **successful PAR** was associated with an 86.7% healing rate compared to 59.1% in unsuccessful cases (P=0.007) and dramatically lower major

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amputation rates (5.1% vs. 40.9%, p≤0.001) (Shahat et al., 2024; Jung et al., 2019). Angiosome-targeted revascularization also demonstrated superior healing outcomes compared to indirect revascularization (HR 1.97; 95% CI, 1.34-2.90) (Khor & Price, 2017; Söderström et al., 2013). Furthermore, novel non-invasive markers like PAT showed strong predictive value for wound healing (Sommerset et al., 2020; Karmy-Jones et al., 2024).

Discussion: The findings robustly support the critical importance of restoring direct, pulsatile blood flow to the foot, specifically through the pedal arch and its branches, to facilitate DFU healing. The pedal arch acts as the crucial final vascular circuit, and its patency is a key determinant of healing and limb salvage. The discussion highlights that the quality of the revascularization outcome, particularly the establishment of a CPA, may be more important than the specific revascularization technique used. The integration of advanced radiological assessments like PAT offers a promising, non-invasive tool for patient selection and monitoring. Despite the strength of these associations, significant heterogeneity in study design, outcome measures, and radiological protocols exists, underscoring the need for more standardized approaches in future research.

Conclusion: There is a definitive and positive association between successful pedal access intervention and radiologically measured wound healing progression in diabetic foot ulcers. Achieving a complete pedal arch and successful pedal arch revascularization are powerful predictors of superior outcomes, including faster healing, higher healing rates, and reduced amputation risk. These findings advocate for revascularization strategies that prioritize

direct flow to the foot and the use of objective, non-invasive imaging to guide management.

Keywords: Diabetic Foot Ulcer, Peripheral Artery Disease, Revascularization, Pedal Arch, Angioplasty, Wound Healing, Amputation, Pedal Acceleration Time, Angiosome.

INTRODUCTION

Background

Diabetic foot ulcers (DFUs) are a devastating and common complication of diabetes mellitus, representing a leading cause of non-traumatic lower limb amputations worldwide (Prompers et al., 2008). The pathophysiology of DFUs is complex and multifactorial, but the presence of peripheral artery disease (PAD) significantly complicates the clinical picture and dramatically impairs healing (J. Brownrigg et al., 2015). In patients with diabetes, PAD is often more severe and distal, typically affecting the infrapopliteal (below-the-knee) and pedal (foot) arteries, a pattern that is less common in non-diabetic populations (Hinchliffe et al., 2016). This distal disease burden compromises blood flow to the foot, leading to ischemia, poor tissue oxygenation, and a severely impaired capacity for wound healing. The pedal arch, the arterial connection between the dorsalis pedis and lateral plantar arteries, forms the primary source of collateral circulation to the foot. Its integrity is therefore paramount for adequate tissue perfusion, especially in the presence of proximal arterial occlusions (Troisi et al., 2017).

Revascularization is the cornerstone of treatment for ischemic DFUs, with the primary goal of restoring pulsatile blood flow to the foot to create an environment conducive to healing (Forsythe et al., 2020). While surgical bypass has historically been the gold standard, endovascular techniques, such as percutaneous transluminal angioplasty (PTA) and stenting, have become the preferred first-line approach in many centers due to their minimally invasive nature and acceptable outcomes (Hinchliffe et al., 2012). These interventions have progressively moved more distally, leading to the concept of "pedal access" or "pedal artery intervention," which specifically targets the small-caliber arteries at the ankle and within the foot itself. The rationale is that merely restoring flow to a proximal tibial artery may be insufficient if the downstream pedal arch is diseased or occluded, a phenomenon known as "no flow to the foot" (Nakama et al., 2017).

Research Gap

Despite the widespread adoption of pedal access interventions, a critical gap exists in our understanding of their specific association with objective, radiologically measured wound healing progression. Many studies have focused on clinical outcomes like limb salvage or amputation rates, which, while crucial, are often the result of a composite of factors including wound care, infection control, and patient comorbidities. Furthermore, the assessment of wound healing has traditionally relied on clinical observation and planimetry, which can be subjective and lack precision in assessing deeper tissue recovery, such as bone healing or microvascular perfusion (R. Snyder et al., 2010). The emergence of advanced imaging modalities, such as high-frequency duplex ultrasound (e.g., to measure Pedal Acceleration Time [PAT]), 2D perfusion angiography, and MRI, allows for a more objective and quantitative evaluation of the biological effects of revascularization at the tissue level (Spiliopoulos et al., 2023; Troisi et al., 2021a). However, a systematic synthesis of the literature linking these specific radiological findings to healing outcomes following pedal access procedures is lacking. This review aims to consolidate the existing evidence to address this precise question.

Novelty of This Review

This systematic review provides a novel contribution by focusing specifically on the *association* between an *intervention* (pedal access procedures) and a *specific outcome* (radiologically measured wound healing). By centering on radiological measures, we move beyond subjective clinical assessments and attempt to quantify the physiological impact of restoring foot-level perfusion. It synthesizes data on both the intervention's technical success and the subsequent biological response as captured by imaging, offering a more nuanced understanding of the causal pathway. Furthermore, it examines key concepts like the quality of the pedal arch, the role of angiosome-directed therapy, and the utility of novel imaging biomarkers in predicting and monitoring healing.

Research Question, Aims, and Hypotheses

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The primary research question for this systematic review is: **"What is the association between pedal access intervention and radiologically measured wound healing progression in diabetic foot ulcers?"**

The primary aim is to systematically review and synthesize the literature to determine the direction and strength of this association.

Secondary aims include:

1. To identify the most common and effective pedal access interventions.
2. To catalog the radiological methods used to assess wound healing and foot perfusion.
3. To evaluate the impact of pedal arch patency and angiosome-directed revascularization on healing outcomes.
4. To identify key confounding factors and study limitations in the existing evidence.

The hypothesis is that successful pedal access intervention, defined by radiological evidence of improved pedal perfusion (e.g., a complete pedal arch, reduced PAT, patent pedal vessels), is positively and significantly associated with accelerated and more complete wound healing in patients with DFUs.

Benefits of the Study

The findings of this review will be of significant benefit to several stakeholders:

- **Clinicians (Vascular Surgeons, Interventional Radiologists, Podiatrists):** It will provide an evidence-based framework for decision-making, helping to select patients most likely to benefit from pedal access procedures and to set realistic expectations for healing.

- **Patients:** It will provide clearer information on the potential benefits of these interventions for their specific condition, particularly regarding the likelihood of wound healing and limb preservation.
- **Researchers:** It will identify key research gaps, highlight the need for standardized outcome measures, and inform the design of future prospective trials.
- **Healthcare Systems:** By clarifying the link between successful revascularization and healing, it supports the allocation of resources towards multidisciplinary teams and advanced imaging technologies to prevent costly and debilitating amputations.

METHODS

Protocol

The study strictly adhered to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines to ensure methodological rigor and accuracy. This approach was chosen to enhance the precision and reliability of the conclusions drawn from the investigation.

Criteria for Eligibility

This systematic review aims to evaluate what is the association between pedal access intervention and radiologically measured wound healing progression in diabetic foot ulcers ?

Screening

We screened in sources based on their abstracts that met these criteria:

- **Population - Diabetic Foot Ulcers**: Does the study include patients diagnosed with diabetes mellitus who have foot ulcers?
- **Intervention - Pedal Access Procedures**: Does the intervention involve pedal access procedures (angioplasty, stenting, bypass surgery, or other revascularization procedures targeting pedal vessels)?

- **Outcomes - Radiological Wound Healing Assessment**: Do the primary or secondary outcomes include radiologically assessed wound healing measures (wound size reduction, tissue perfusion, bone healing, or other imaging-based healing parameters)?
- **Study Design - Comparison Methods**: Does the study include a comparison group or pre-post intervention measurements?
- **Study Design - Appropriate Study Types**: Is the study design a randomized controlled trial, controlled clinical trial, cohort study, case-control study, systematic review, or meta-analysis?
- **Population Focus - Diabetic Etiology**: Does the study focus on diabetic foot ulcers rather than solely on acute limb ischemia or trauma-related wounds without diabetes?
- **Intervention Focus - Pedal Vessel Involvement**: Does the intervention include pedal vessel involvement rather than targeting only proximal vessels (iliac, femoral, popliteal) without pedal vessel involvement?
- **Study Quality and Type**: Is the study something other than a case report, case series with fewer than 10 patients, editorial, conference abstract, in vitro study, or animal study?

We considered all screening questions together and made a holistic judgement about whether to screen in each paper.

Search Strategy

The keywords used for this research based PICO :

Element	P (Population)	I (Intervention/Exposure)	C (Comparison/Context)	O (Outcome)
Keyword 1	Diabetic Foot Ulcers	Pedal Access Intervention	Comparison Groups	Wound Healing Progression
Keyword 2	Diabetes Mellitus	Revascularization	Indirect Revascularization	Radiological Assessment

Keyword 3	Peripheral Artery Disease	Angioplasty	Standard Care	Pedal Arch Patency
Keyword 4	Chronic Limb-Threatening Ischemia	Pedal Arch Intervention	Direct Revascularization	Limb Salvage

The Boolean MeSH keywords inputted on databases for this research are: ("Diabetic Foot Ulcers" OR "Diabetes Mellitus" OR "Peripheral Artery Disease" OR "Chronic Limb-Threatening Ischemia") AND ("Pedal Access Intervention" OR "Revascularization" OR "Angioplasty" OR "Pedal Arch Intervention") AND ("Comparison Groups" OR "Indirect Revascularization" OR "Standard Care" OR "Direct Revascularization") AND ("Wound Healing Progression" OR "Radiological Assessment" OR "Pedal Arch Patency" OR "Limb Salvage")

Data extraction

- **Study Design**:

  Extract study design type (RCT, cohort, case-control, cross-sectional, systematic review, etc.), sample size, setting (hospital, clinic, multi-center, etc.), and study duration. Include any design features that might affect the reliability of findings about pedal access intervention and wound healing associations.

- **Diabetic Population**:

  Extract characteristics of diabetic foot ulcer patients, including:

  - Demographics (age, gender, diabetes duration/type)
  - Ulcer characteristics (location, size, depth, duration, Wagner/UT grade)
  - Baseline peripheral artery disease status

- Comorbidities relevant to wound healing
- Exclusion criteria that might limit generalizability

- **Pedal Access Interventions**:

  Extract details about pedal access interventions specifically targeting foot/ankle circulation for diabetic foot ulcer patients, including:

  - Type of intervention (endovascular, surgical bypass, hybrid procedures, conservative management)
  - Specific procedures performed (angioplasty, stenting, bypass grafts, etc.)
  - Target vessels (pedal, ankle, below-knee arteries)
  - Intervention success rates or technical outcomes
  - Timing relative to ulcer presentation

- **Radiological Assessment**:

  Extract methods used to radiologically measure wound healing progression in diabetic foot ulcers, including:

  - Imaging modalities (duplex ultrasound, CT, MRI, plain radiographs, other)
  - Specific measurements (pedal acceleration time, perfusion indices, vessel patency, wound area/depth)
  - Assessment timing (baseline, post-intervention intervals, follow-up schedule)
  - Who performed assessments and inter-observer reliability if reported

- **Wound Healing Outcomes**:

  Extract wound healing progression outcomes as measured by radiological or clinical methods, including:

  - Primary healing measures (time to complete healing, healing rates, wound closure percentages)

  - Secondary outcomes (recurrence, amputation rates, reulceration)
  - Quantitative results with statistical measures (means, medians, confidence intervals, p-values)
  - Follow-up duration and completeness

- **Association Results**:

  Extract findings specifically about the association between pedal access interventions and radiologically measured wound healing progression in diabetic foot ulcers, including:

  - Statistical measures of association (odds ratios, hazard ratios, correlation coefficients, mean differences)
  - Statistical significance levels and confidence intervals
  - Adjusted vs unadjusted results
  - Subgroup analyses if performed
  - Direction and strength of association (positive, negative, neutral)

- **Confounding Factors**:

  Extract variables that were measured, controlled for, or identified as potential confounders in the relationship between pedal access intervention and wound healing progression, including:

  - Patient factors (age, diabetes control, comorbidities, medication use)
  - Ulcer factors (size, depth, infection, location)
  - Treatment factors (wound care protocols, adjunct therapies, antibiotics)
  - Variables included in multivariate analyses
  - Unmeasured confounders acknowledged by authors

- **Study Limitations**:

Extract methodological limitations and quality factors that might affect the validity of findings about pedal access intervention and wound healing associations, including:

- Sample size limitations or power calculations
- Selection bias, measurement bias, or confounding issues
- Loss to follow-up rates and reasons
- Blinding of outcome assessors
- Standardization of interventions and outcome measurements
- Author-acknowledged limitations relevant to the research question

Table 1. Article Search Strategy

Database	Keywords	Hits
Pubmed	*("Diabetic Foot Ulcers" OR "Diabetes Mellitus" OR "Peripheral Artery Disease" OR "Chronic Limb-Threatening Ischemia") AND ("Pedal Access Intervention" OR "Revascularization" OR "Angioplasty" OR "Pedal Arch Intervention") AND ("Comparison Groups" OR "Indirect Revascularization" OR "Standard Care" OR "Direct Revascularization") AND ("Wound Healing Progression" OR "Radiological Assessment" OR "Pedal Arch Patency" OR "Limb Salvage")*	28
Semantic Scholar	*("Diabetic Foot Ulcers" OR "Diabetes Mellitus" OR "Peripheral Artery Disease" OR "Chronic Limb-Threatening Ischemia") AND ("Pedal Access Intervention" OR "Revascularization" OR "Angioplasty" OR "Pedal Arch Intervention") AND ("Comparison Groups" OR "Indirect Revascularization" OR "Standard Care" OR "Direct Revascularization") AND ("Wound Healing Progression" OR "Radiological Assessment" OR "Pedal Arch Patency" OR "Limb Salvage")*	251
Springer	*("Diabetic Foot Ulcers" OR "Diabetes Mellitus" OR "Peripheral Artery Disease" OR "Chronic Limb-Threatening Ischemia") AND ("Pedal Access Intervention" OR "Revascularization" OR "Angioplasty" OR "Pedal Arch Intervention") AND ("Comparison Groups" OR "Indirect Revascularization" OR "Standard Care" OR "Direct Revascularization") AND ("Wound Healing Progression" OR "Radiological Assessment" OR "Pedal Arch Patency" OR "Limb Salvage")*	197
Google Scholar	*("Diabetic Foot Ulcers" OR "Diabetes Mellitus" OR "Peripheral Artery Disease" OR "Chronic Limb-Threatening Ischemia") AND ("Pedal Access Intervention" OR "Revascularization" OR "Angioplasty" OR "Pedal Arch Intervention") AND ("Comparison Groups" OR "Indirect Revascularization" OR "Standard Care" OR "Direct Revascularization") AND ("Wound Healing Progression" OR "Radiological Assessment" OR "Pedal Arch Patency" OR "Limb Salvage")*	937
Wiley Online Library	*("Diabetic Foot Ulcers" OR "Diabetes Mellitus" OR "Peripheral Artery Disease" OR "Chronic Limb-Threatening Ischemia") AND ("Pedal Access Intervention" OR "Revascularization" OR "Angioplasty" OR "Pedal Arch Intervention") AND ("Comparison Groups" OR "Indirect Revascularization" OR "Standard Care" OR "Direct Revascularization") AND ("Wound Healing Progression" OR "Radiological Assessment" OR "Pedal Arch Patency" OR "Limb Salvage")*	350

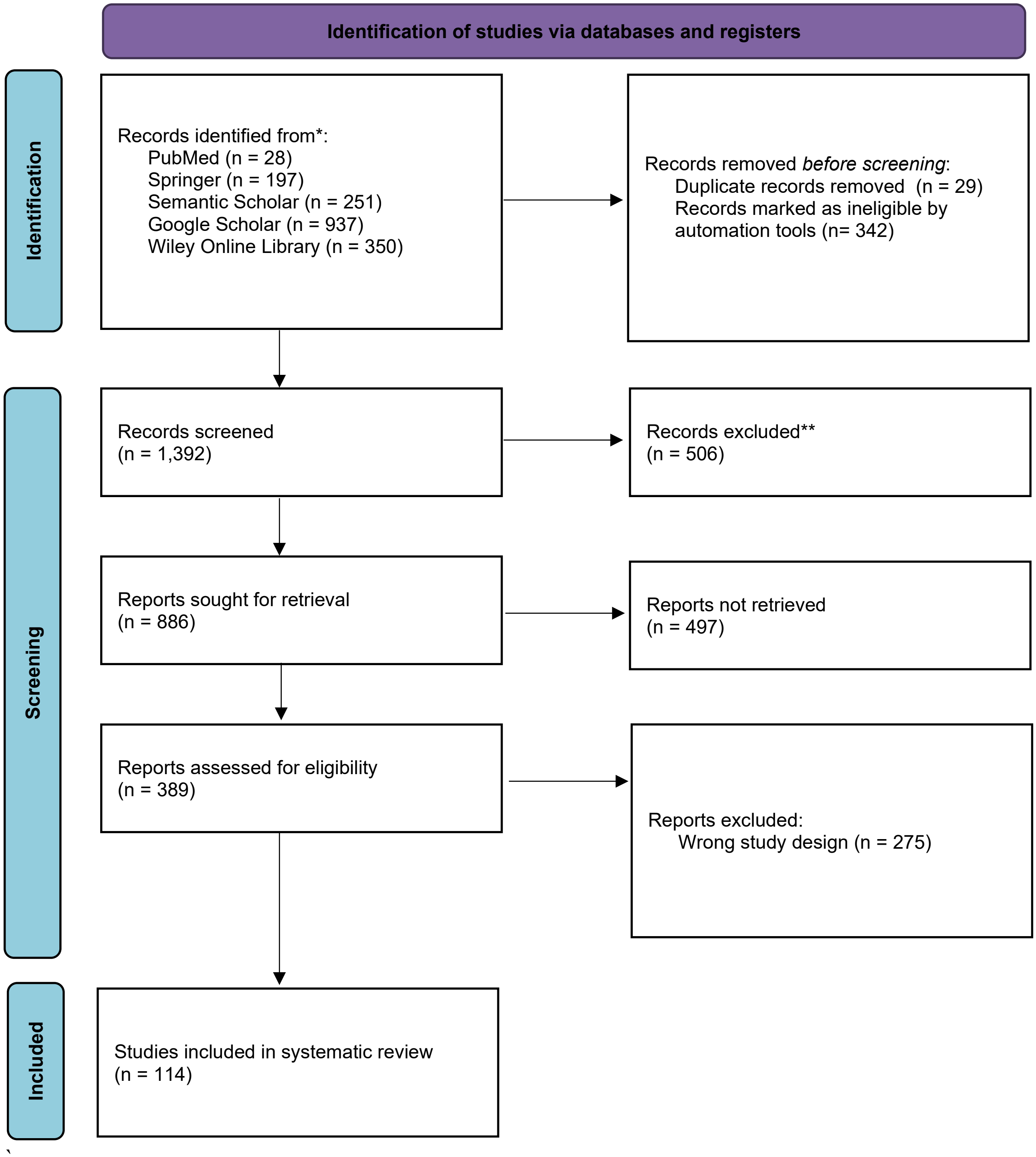

Figure 1. Article search flowchart

RESULTS

Study Characteristics

Citation	Sample Size	Study Duration
N. Troisi et al., 2018	137	1.5 years
J. Apelqvist et al., 2011	1151	22 years
Rachael O. Forsythe et al., 2020	>13,000 across 64 studies	Not specified
Jennifer Skolnik et al., 2021	99	10 years
N. Troisi et al., 2017	93	1.5 years
S. Jacqueminet et al., 2005	32	At least one year
E. Saricilar et al., 2023	17 studies	Not specified
Jill Sommerset et al., 2020	54 limbs	Not mentioned
Andreia Pinelo et al., 2024	117 limbs	1 year
Shiping Ji et al., 2022	215	Data from 2016-2020, 2-year follow-up
Osama A. Ismail et al., 2020	60	3 years
M. Ghweeba et al., 2022	63	30 months
Chang Sik Shin et al., 2025	85 patients (88 limbs)	5 years
Ahmed Hossny et al., 2019	60	1.5 years
B. Y. C. Khor et al., 2017	280	Not mentioned

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Citation	Sample Size	Study Duration
M. Söderström et al., 2013	226 patients (250 legs)	At least 12 months
Limi Lee et al., 2024	150 patients (163 limbs)	Up to 2 years
K. Dell et al., 2021	19	4 to 6 weeks
R. Hinchliffe et al., 2016	13,434 across 64 studies	Includes studies from 1980-2018
Riyad Karmy-Jones et al., 2024	54	5 years
K. Chae et al., 2016	727 patients (881 feet)	Follow-up 1-68 months
A. Caetano et al., 2020	314	Mean follow-up ~2 years
M. Fujii et al., 2021	30	8 years
N. Troisi et al., 2021	153	1 year
Mohammed Shahat et al., 2024	120	2 years
V. Alexandrescu et al., 2019	167 patients (194 limbs)	~8 years, mean follow-up 10.9 months
R. Hinchliffe et al., 2012	Not specified	Search period 1980-2010
Mohamed Fathy Abdelghaffar et al., 2023	40	Not mentioned

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Citation	Sample Size	Study Duration
V. Chuter et al., 2023	5190	Follow-up at least 6 months
G. Andros et al., 2004	Not mentioned	Not mentioned
K. Claesson et al., 2011	115 patients (135 limbs)	2 years, median follow-up 17 months
T. Elgzyri et al., 2014	478	Until healing or death
T. Nakama et al., 2017	257	Not mentioned
H. Jung et al., 2019	239	1-year follow-up
Michael Rouse et al., 2024	28 angiograms	~7 months
V. Alexandrescu et al., 2009	161 patients (176 limbs)	~5 years, mean follow-up 22.1 months
Danlan Pu et al., 2019	82	6 months
Ridho Sinaga et al., 2021	48	11 months
O. Galimov et al., 2021	36	Treatment in 2019-2020, 24-month follow-up
S. Spiliopoulos et al., 2023	28	At least 12 months
F. Álvaro-Afonso et al., 2024	28	At least 6 months

Citation	Sample Size	Study Duration
Tracy J. Cheun et al., 2024	1,768	12 years
B. Dong et al., 2022	50	~4.5 years
Jon C. Henry et al., 2016	130 limbs	Mean follow-up ~2 years
J. Vouillarmet et al., 2016	Not specified	Not specified
Thomas Collins et al., 2024	Not mentioned	Not mentioned
M. Sabry et al., 2023	42	Not mentioned
Rongzhi Wen et al., 2023	70	1.5 years
M. E. Yamany et al., 2020	30	1.5 years
Keisuke Miyake et al., 2024	117 limbs	4 years
B. Vijaynagar et al., 2019	248	2 years
M. N. Bouayed et al., 2019	903	11 years, follow-up 41 months
Pam Chen et al., 2024	Varies	Up to October 2022
J. Brownrigg et al., 2013	Not mentioned	Not mentioned
M. Doyle et al., 2020	310	1 year
Alexander T. Hong et al., 2025	178	12 months
N. Troisi et al., 2021a	24	6 months

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Citation	Sample Size	Study Duration
Fengjie Tang et al., 2023	68	12 weeks
Rushabh A Parekh et al., 2024	50	24 months
R. Jarosiková et al., 2025	54	Follow-up at 3 and 6 months
E. Iacopi et al., 2023	89	1 year
Mwidimi Ndosi et al., 2017	299	12 months
Hendri et al., 2023	Not mentioned	Not mentioned
Stephanie Mae Macfarlane et al., 2024	120 patients (207 ulcers)	2 years
P. Faries et al., 2004	Not mentioned	Not mentioned
Mohamed Elyamany et al., 2025	41	Not mentioned
H. Mohafez et al., 2018	20	12 weeks
Sijie Yang et al., 2024	202	Not mentioned
Andreia Pinelo et al., 2024a	60 limbs	12-16 weeks after first evaluation
Rachael O. Forsythe et al., 2016	5890	Not specified
Marta Carmena-Pantoja et al., 2021	102	~3 years, 1-year follow-up
K. Spanos et al., 2017	103	12 months

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Citation	Sample Size	Study Duration
Odette Hart et al., 2024	Not mentioned	Not mentioned
P. Ince et al., 2007	Not mentioned	Not mentioned
Rachael O. Forsythe et al., 2020a	~6800	Includes studies from 1980-2018
K. Marmagkiolis et al., 2017	881	Search period 2003-2016
Nicole K. Cates et al., 2019	284	Not mentioned
M. Meloni et al., 2021	196	~1.5 years
A. Hartemann-Heurtier et al., 2002	157	2 years
C. Gazzaruso et al., 2020	583	10 years
Yan Chen et al., 2019	273	Treatment from 2011-2017, 2-year follow-up
Eduardo Silva et al., 2025	88 patients (100 limbs)	Not mentioned
B. Lin et al., 2020	50	1 year
R. Somayaji et al., 2017	49	~1.5 years
P. Normahani et al., 2020	48 patients (50 limbs)	12 months
Yingzhou Liu et al., 2023	55,409	~9 years
Sichun Zhao et al., 2024	66	~1.5 years

Citation	Sample Size	Study Duration
D. Lowry et al., 2018	23	Monthly until healing
Jason Zhang et al., 2024	152	4 years
Raffaele Grande et al., 2020	2	Not mentioned
Yan-Bin Wang et al., 2024	62	2 years
M. Doyle et al., 2020a	310	Minimum 12 months follow-up
N. Akhtar et al., 2020	210	9 months
García-Sáenz Mc et al., 2004	Not mentioned	Not mentioned
J. Brownrigg et al., 2015	Not mentioned	Not mentioned
A. Brechow et al., 2013	736	8 years (2-year follow-up)
Jason Chow et al., 2024	136	4 years
Junpeng Liu et al., 2024	98	~2.5 years
D. Margolis et al., 2002	>31,000	At least 20 weeks
F. Game et al., 2016	30 articles	Not mentioned
R. Snyder et al., 2009	Not specified	Not specified
L. Prompers et al., 2008	1,232	1 year
Pamela Chen et al., 2023	Not applicable	Not applicable

Citation	Sample Size	Study Duration
S. H. Lu et al., 2017	279 patients (332 DFUs)	5 years
D. Margolis et al., 2005	Not mentioned	>10 years
P. Lazzarini et al., 2020	Not specified	Search period 2014-2018
T. Kwan et al., 2015	80	3 months
V. Chuter et al., 2023a	Not mentioned	Not mentioned
W. Bevan et al., 2008	19 patients (24 feet)	~6.5 years
R. Snyder et al., 2010	142 DFUs total	12 weeks
Jasper A Sung et al., 2020	119	6 months
N. Santamaria et al., 2004	93	12 months
R. Warriner et al., 2011	120	7 weeks (focus)
Seoyoung C. Kim et al., 2017	20	2 weeks of injections
S. Zimny et al., 2005	Not mentioned	10 weeks
L. Ribu et al., 2008	127	1 year
T. Elgzyri et al., 2013	602	Until healing or death
Betiel K. Fesseha et al., 2018	270 participants (584 wounds)	4.7 years
J. Lindberg et al., 2021	61 wounds	Not mentioned

Citation	Sample Size	Study Duration
Martin C. Robson et al., 2000	160	20 weeks
Hsi-An Yang et al., 2025	1454	Not mentioned
D. Wukich et al., 2014	114	5 years
V. E. Parks et al., 2020	Not mentioned	Not mentioned
J. Reekers et al., 2013	Not mentioned	Not mentioned
V. Venkatesan et al., 2023	Not specified	Not specified
B. Aliahmad et al., 2018	26	4 weeks
J. Reekers et al., 2016	Not specified	Not specified
A. MacDonald et al., 2019	23	12 weeks
N. Kontopodis et al., 2016	72	24 months
Scott J Edwards et al., 2023	Not mentioned	Not mentioned
H. Elghazaly et al., 2023	123	12 months
Aditya Dutta et al., 2021	43 individuals (47 DFUs)	12 weeks
Nantawan Koonalinthip et al., 2021	35	At least 16 weeks
O. Oncul et al., 2007	66	At least 4 weeks
Ivana Roth-Albin et al., 2017	40	1 year
Nila N. Sari et al., 2025	Not specified	Not specified

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Citation	Sample Size	Study Duration
S. Mehta et al., 2010	Not mentioned	Not mentioned
Patricia M González-Villacorta et al., 2025	Not mentioned	Not mentioned
C. Hicks et al., 2018	621 wounds	Not mentioned
S. Engberg et al., 2019	Not mentioned	Not mentioned
D. Armstrong et al., 2020	10	Up to 12 weeks
Dr. Madhuri Jain et al., 2022	200	Not specified
Lucia Bubulac et al., 2025	28	8 weeks
Olivia V. Waldman et al., 2020	92	~3.5 years, mean follow-up 4.7 months
Jacqueline N. Mcnulty et al., 2018	60	Average of 220 days
Yumika Nishio et al., 2022	253	~15 years
Rona Kartika et al., 2020	30	~9 months
Arthur C Yelland et al., 2022	27,030	~3.75 years
F. Game et al., 2020	Not mentioned	Not mentioned
Sebastián Flores-Escobar et al., 2025	30	12-week treatment
David A. Reiter et al., 2025	17	12 weeks post-MRI
J. A. Cheong et al., 2022	37	Not mentioned

Citation	Sample Size	Study Duration
Bhavani Prasad Mahindrakar et al., 2023	54	18 months
Aroa Tardáguila-García et al., 2023	116	4 years
Jarrod M. Shapiro et al., 2011	Not specified	Not specified
Sooraj M Shah et al., 2019	Not mentioned	Not mentioned
Jiyong Ahn et al., 2025	101 DFUs	~10 months
Aroa Tardáguila-García et al., 2022	115	1-year follow-up
Jiyong Ahn et al., 2024	101 DFUs	10 months
A. Liakos et al., 2020	Not mentioned	Not mentioned
A. M. Mahon et al., 2017	74	12 weeks
T. Macioch et al., 2015	120	6 months
Sofija Pejkova et al., 2025	20	At least 9 months
Mariyam Iqbal et al., 2024	300	10 months
Hanan Ansari et al., 2025	130	12 months
N. Leone et al., 2025	40	6 months
Jessica M. Eager et al., 2025	78 total (27 discovery, 51 validation)	12 weeks
Ivan Jozic et al., 2024	Not mentioned	4 weeks

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Citation	Sample Size	Study Duration
Максим Борисович Горобейко et al., 2014	Not mentioned	Not mentioned
Tawfik Abo Mera et al., 2019	Not mentioned	Not mentioned
Nasibeh Vatankhah et al., 2017	101 patients (120 ulcers)	~3.5 years
S. Brown et al., 2025	300	Not mentioned
Asmat Burhan et al., 2023	127 total (68 intervention, 59 control)	8 weeks
M. DeSanto et al., 2020	Not specified	Not specified
Stephanie P. Hao et al., 2020	92	~3.75 years
P. Tappia et al., 2021	16	Up to 16 weeks
Vishnu S. Ravidas et al., 2020	105	18 months
Takeshi Fukuda et al., 2019	Not mentioned	Not mentioned
Tze-Woei Tan et al., 2022	51,362	Up to ~3 years
Yan Mi et al., 2025	60	4 years
Kaitlyn K Rogers et al., 2023	62	16 weeks
Ivan Y. Luu et al., 2024	16,905	6 years

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Patient Population and Ulcer Characteristics

The patient populations across the included studies consisted primarily of older adults with a mean or median age ranging from the mid-50s to mid-70s, with a consistent male predominance. Diabetes duration was often long, with mean durations reported from 10.5 to over 20 years. Ulcer characteristics were heterogeneous, with studies reporting on neuroischemic or ischemic ulcers of varying severity, commonly classified using the Wagner or University of Texas (UT) grading systems. Ulcer duration ranged from several weeks to chronic, non-healing states exceeding six months.

Baseline peripheral artery disease (PAD) was a universal inclusion criterion, with severity typically defined by low ankle-brachial index (ABI), toe pressures, or the presence of critical limb ischemia (CLI). Common comorbidities included hypertension, coronary artery disease, chronic kidney disease (including end-stage renal disease requiring dialysis), and smoking. Exclusion criteria frequently limited generalizability by omitting patients with severe, unsalvageable limb ischemia, active systemic infections, certain comorbidities like recent myocardial infarction or stroke, or a life expectancy of less than one year.

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
N. Troisi et al., 2018	137	74.7	Not mentioned	Rutherford class 5/6, TUC IIID	Infrainguinal lesions, 57.7% in tibial artery	Insulin treatment

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
J. Apelqvist et al., 2011	1151	75 (median)	Not mentioned	Neuroischemic/ischemic, Wagner grades	Severe PVD (toe pressure <45 mmHg or ankle pressure <80 mmHg)	Renal impairment, congestive heart failure
Rachael O. Forsythe et al., 2020	>13,000	Not mentioned	Not mentioned	Not mentioned	PAD	Not mentioned
Jennifer Skolnik et al., 2021	99	Not mentioned	Not mentioned	Not mentioned	PAD	Not mentioned
N. Troisi et al., 2017	93	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
S. Jacquemin et et al., 2005	32	Not mentioned	Not mentioned	Severe ischemic ulcers	Severe limb ischemia	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
E. Saricilar et al., 2023	17 studies	Not mentioned	Not mentioned	Wagner grade 3-4	Atherosclerotic disease	Left ventricular dysfunction, ESRD, peripheral neuropathy
Jill Sommerset et al., 2020	54 limbs	Not mentioned	Not mentioned	Not mentioned	Isolated infrapopliteal occlusive disease, PAT > 225 ms	Not mentioned
Andreia Pinelo et al., 2024	114	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Shiping Ji et al., 2022	215	Not mentioned	Not mentioned	Not mentioned	PAD requiring endovascular therapy	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Osama A. Ismail et al., 2020	60	52-55	Not mentioned	Ulcers on toes, plantar area	Pedal arch classified as CPA, IPA, or APA	Smoking, hypertension
M. Ghweeba et al., 2022	63	66.7	93% insulin-dependent	Rutherford class 5/6	Pedal arch defects (CPA, IPA, APA)	Smoking, hypertension, hypercholesterolemia
Chang Sik Shin et al., 2025	85	Mentioned	Not mentioned	Wagner, UT, and WIfI grades	Not mentioned	Comorbidities explored
Ahmed Hossny et al., 2019	60	63.85	Not mentioned	Ischemic ulcer/gangrene	Critical lower limb ischemia	Smoking, hypertension, hyperlipidemia, IHD
B. Y. C. Khor et al., 2017	280	Not mentioned	Not mentioned	Not mentioned	Critical limb ischaemia	Diabetes

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Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
M. Söderström et al., 2013	226	Not mentioned	Not mentioned	Not mentioned	Infrapopliteal disease	Not mentioned
Limi Lee et al., 2024	150	Not mentioned	Not mentioned	Tissue loss	Not mentioned	End-stage renal disease
K. Dell et al., 2021	19	Not mentioned	Not mentioned	Not mentioned	Medial arterial calcification	Osteomyelitis
R. Hinchliffe et al., 2016	13,434	71 (median)	Not mentioned	Not mentioned	Multi-level distal disease	CAD, CVA, ESRD
Riyad Karmy-Jones et al., 2024	54	Not mentioned	Not mentioned	Toe or heel wound	Diffuse infrageniculate disease	Ongoing smoking, dialysis
K. Chae et al., 2016	727	Not mentioned	Not mentioned	Ischemic ulcers	PAD in up to 50%	PAD

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Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
A. Caetano et al., 2020	314	Not mentioned	Not mentioned	Not mentioned	PAD requiring revascularization	Prior stroke, dialysis, CAD
M. Fujii et al., 2021	30	Not mentioned	Not mentioned	Wound grade 0-3	Implied by skin perfusion pressure	Hemodialysis
N. Troisi et al., 2021	153	Not mentioned	Not mentioned	Not mentioned	Pedal arch classified as CPA, IPA, APA	Smoking, chronic renal failure, CAD
Mohammed Shahat et al., 2024	120	Not mentioned	Not mentioned	WIfI stages 2-4	CLTI, infrainguinal disease	Not mentioned
V. Alexandrescu et al., 2019	167	72.8	Not mentioned	Wagner 2-4, Rutherford 5	Chronic limb-threatening ischemia	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
R. Hinchliffe et al., 2012	Not specified	Not mentioned	Not mentioned	Not mentioned	PAD in up to 50%	Not mentioned
Mohamed Fathy Abdelghaffar et al., 2023	40	Not mentioned	Not mentioned	Multiple tibial and pedal arch disease	CLI	Diabetes, hypertension, renal insufficiency, obesity
V. Chuter et al., 2023	5190	Not mentioned	Not mentioned	Tissue loss in >80%	Diagnosed PAD	Cardiovascular morbidity
G. Andros et al., 2004	Not specified	Not mentioned	Not mentioned	Not mentioned	Arterial occlusive disease	Hemodialysis
K. Claesson et al., 2011	115	73 (median)	Not mentioned	Wagner grade ≥3	Concomitant PAD	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
T. Elgzyri et al., 2014	478	74	Not mentioned	Wagner grade <3	Toe pressure <45 mmHg or ankle pressure <80 mmHg	Intermittent claudication, peripheral edema
T. Nakama et al., 2017	257	Not mentioned	Not mentioned	UT grade ≥2	Infrapopliteal and pedal artery disease	Nonambulatory status, daily hemodialysis
H. Jung et al., 2019	239	Not mentioned	Not mentioned	Chronic ischemic wound	Infrapopliteal artery disease	Gangrene, elevated CRP
Michael Rouse et al., 2024	Not specified	Not mentioned	Not mentioned	Nonhealing wounds (67.9%)	Not mentioned	Hypertension, HLD, diabetes, CAD, tobacco use

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
V. Alexandrescu et al., 2009	161	>70 years	Not mentioned	Ischemic wounds, tissue defects >3 cm	Not mentioned	ESRD, osteomyelitis, neuropathy, cardiac failure
Danlan Pu et al., 2019	82	Not mentioned	Not mentioned	Not mentioned	Lower extremity arterial disease (LEAD)	Not mentioned
Ridho Sinaga et al., 2021	48	62 (median)	Not mentioned	Size >3 cm^2, depth grade 3	PAD (81.3%), CLI (18.2%)	Anemia, high urea/creatinine, leukocytosis
O. Galimov et al., 2021	36	Not mentioned	Type 2 diabetes	Purulent necrotic lesions	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
S. Spiliopoulos et al., 2023	28	Not mentioned	Not mentioned	Wound class ≥1	CLTI	Not mentioned
F. Álvaro-Afonso et al., 2024	28	Not specified	96% Type 2	Ischemic or neuroischemic, UT grades IC-IIID	PAD requiring revascularization	Hypertension, HLD, neuropathy, cardiopathy
Tracy J. Cheun et al., 2024	1,768	67	Not mentioned	WIfI grade 3 and 4	CLTI, Tibial/pedal disease	Not mentioned
B. Dong et al., 2022	50	67.74	Not mentioned	Wagner grade mentioned	Femoral-popliteal and inferior knee artery occlusion	Not mentioned
Jon C. Henry et al., 2016	122 limbs	Not mentioned	Not mentioned	Rutherford class 5 and 6	Infrapopliteal disease	Malignant disease, warfarin use

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
J. Vouillarmet et al., 2016	Not specified	Not mentioned	Not mentioned	Not mentioned	PAD, CLI	Microcirculation disorders, abnormal angiogenesis
Thomas Collins et al., 2024	Not specified	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
M. Sabry et al., 2023	42	Not mentioned	Not mentioned	Not mentioned	Infrapopliteal and pedal artery disease	Not mentioned
Rongzhi Wen et al., 2023	70	55.21	13.94 (mean)	Wagner grade 2-4	ABI <0.9	Not mentioned
M. E. Yamany et al., 2020	30	18-80	90% diabetic	Texas D1-D3	Critical limb ischemia	Hypertension, dyslipidemia

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Keisuke Miyake et al., 2024	117 limbs	Not mentioned	Not mentioned	WIfI classification	CLTI	Not mentioned
B. Vijaynagar et al., 2019	248	Not mentioned	Not mentioned	Not mentioned	Vascular input needed (62%)	Not mentioned
M. N. Bouayed et al., 2019	903	61	Not mentioned	Wagner grades 2, 3, 4	Severe ischemia	Not mentioned
Pam Chen et al., 2024	Not specified	Not mentioned	Not mentioned	Wagner 1 or 2	Not mentioned	No significant comorbidities
J. Brownrigg et al., 2013	Not specified	Not mentioned	Not mentioned	Not mentioned	PAD	Not mentioned
M. Doyle et al., 2020	310	Not mentioned	Not mentioned	Not mentioned	PAD	Diabetes, ESRD

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Alexander T. Hong et al., 2025	178	55.4	Not mentioned	Not mentioned	PAD (35%)	PAD, ESRD (13%)
N. Troisi et al., 2021a	24	Not mentioned	Not mentioned	Foot wounds	Multilevel CLTI	Not mentioned
Fengjie Tang et al., 2023	68	63	Not mentioned	Neuropathic, located at digits	Not mentioned	Not mentioned
Rushabh A Parekh et al., 2024	50	50.72	Not mentioned	DFU	ABPI <0.9 (76%), TBI <0.65 (32%)	Smoking (74%), intermittent claudication (42%)
R. Jarosiková et al., 2025	54	Age associated with MAC/SAD score	Not mentioned	DFU	PAD (GLASS, Graziani systems)	Not mentioned
E. Iacopi et al., 2023	89	68.8 / 70.4	19.6 / 18.8	Osteomyelitis	65.2% / 67.4% PAD	CKD, IHD

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Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Mwidimi Ndosi et al., 2017	299	64	Not mentioned	PEDIS and Wagner classification	PEDIS perfusion grade	Not mentioned
Hendri et al., 2023	Not specified	Not mentioned	Not mentioned	WIfI score used	PAD	Not mentioned
Stephanie Mae Macfarlane et al., 2024	120	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
P. Faries et al., 2004	Not specified	Not mentioned	Not mentioned	DFU	Peripheral arterial occlusive disease	Neuropathy
Mohamed Elyamany et al., 2025	41	>18	Not mentioned	Rest pain or tissue loss	CLTI	Not mentioned
H. Mohafez et al., 2018	20	55.5	10.5	Wagner grade 1-3	PAD (15 patients)	Hypertension, HLD, CKD

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Sijie Yang et al., 2024	202	Not mentioned	Not mentioned	Wagner's grading	Not mentioned	Not mentioned
Andreia Pinelo et al., 2024a	Not specified	Not mentioned	Not mentioned	Ischemic foot ulcers	Not mentioned	Not mentioned
Rachael O. Forsythe et al., 2016	5890	61-76	Not mentioned	Wagner grade ≥3 (16-61%)	ABI <0.9	ESRF, infection
Marta Carmena-Pantoja et al., 2021	102	Not mentioned	Not mentioned	DFU complicated by osteomyelitis	Presence of RAC and mild/moderate PAD	Not mentioned
K. Spanos et al., 2017	103	69.7	17.7	UT grade 1	PAD (53.4%)	HT, CAD
Odette Hart et al., 2024	Not specified	Not mentioned	Not mentioned	Ulceration and Gangrene	Not mentioned	Not mentioned
P. Ince et al., 2007	Not specified	Not mentioned	Not mentioned	Foot lesions	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Rachael O. Forsythe et al., 2020a	~6800	58-76	Not mentioned	Not mentioned	PAD	Impaired perfusion, infection
K. Marmagkiolis et al., 2017	881	Not mentioned	Not mentioned	Not mentioned	CLI (68.4%)	Not mentioned
Nicole K. Cates et al., 2019	284	Not mentioned	Not mentioned	Ulceration and/or acute infection	PAD (59 patients)	Not mentioned
M. Meloni et al., 2021	196	70	18	Complicated/severely complicated ulcers	Ischemic (55.5%)	HT, HLD, IHD, CVA, ESRD
A. Hartemann-Heurtier et al., 2002	118	Not mentioned	Not mentioned	High-grade ulcers	Arterial disease	Renal replacement therapy

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
C. Gazzaruso et al., 2020	583	Not mentioned	Type 2 diabetes	DFU	Markers of PAD	Renal impairment, cardiovascular disease, osteomyelitis
Yan Chen et al., 2019	273	60-61	Not mentioned	UT Grade 2B to 3D	Assessed by CT angiography	Not mentioned
Eduardo Silva et al., 2025	88	75 (median)	Not mentioned	Lower limb wounds	PAD	Not mentioned
B. Lin et al., 2020	50	Group C older	Not mentioned	Group C had more severe wounds	Group A (no PAD), B (PAD w/o angioplasty), C (PAD w/ angioplasty)	History of amputation (more in Group C)

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
R. Somayaji et al., 2017	49	64.2	Not mentioned	Median duration 26 weeks, unspecified etiology	Normal Doppler in 22.5%	HTN, dyslipidemia, PVD
P. Normahani et al., 2020	48	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Yingzhou Liu et al., 2023	55,409	21-89	Not mentioned	Early stage, osteomyelitis, or gangrene	PVD listed as a comorbidity	Eye disease, heart disease, MI, PVD, renal disease, stroke
Sichun Zhao et al., 2024	66	Not mentioned	Not mentioned	Wagner grade 3 and 4	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
D. Lowry et al., 2018	23	Not mentioned	Not mentioned	Foot ulceration	G1 (significant PAD), G2 (no significant PAD)	Not mentioned
Jason Zhang et al., 2024	152	58.8	Not mentioned	Size 8.27 cm², depth 0.61 cm	PAD (26.3%), ABI 1.12	PAD
Raffaele Grande et al., 2020	2	73 & 80	Not mentioned	Lower limb ulcers	Advanced CLI	HTN, CKD, dyslipidemia
Yan-Bin Wang et al., 2024	62	≥ 18	Type 1 or 2	Wagner grade ≥2	Not mentioned	Not mentioned
M. Doyle et al., 2020a	310	Not mentioned	Not mentioned	Not mentioned	PAD requiring revascularization	Not mentioned
N. Akhtar et al., 2020	210	~46	10.17 / 10.56	Grade II, size ~5 cm²	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
García-Sáenz Mc et al., 2004	Not specified	Older patients	Type 2 diabetes	Not mentioned	Not mentioned	Not mentioned
J. Brownrigg et al., 2015	Not specified	Not mentioned	Not mentioned	Not mentioned	Co-existing PAD in ~50%	Infection, oedema, neuropathy
A. Brechow et al., 2013	736	66.3	15.8	Wagner 2-4, UT stage D	93.7% with PAD (various severity)	Nephropathy, hypertension, smoking
Jason Chow et al., 2024	136	Similar	Not mentioned	Forefoot, midfoot, hindfoot ulcers	Not mentioned	Peripheral neuropathy
Junpeng Liu et al., 2024	98	63.66	20.22	Wagner grade ≥II	Patent popliteal and SFA	Hypertension (76.53%), Coronary heart disease (30.61%)

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
D. Margolis et al., 2002	>31,000	Not mentioned	Not mentioned	Wound size, duration, grade evaluated	Not mentioned	Not mentioned
F. Game et al., 2016	30 articles	≥ 18	Type 1 or 2	Chronic foot ulcers	Not mentioned	Not mentioned
R. Snyder et al., 2009	Not specified	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
L. Prompers et al., 2008	1,232	64.7	69.8% >10 years	Plantar (48.2%), deep (43.8%)	PAD (47.5%)	Heart failure, ESRD, neurological disorder
Pamela Chen et al., 2023	Not applicable	Not mentioned	Not mentioned	Chronic DFU	Not mentioned	Not mentioned
S. H. Lu et al., 2017	279	61.5	Not mentioned	Forefoot (82.5%)	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
D. Margolis et al., 2005	Not specified	Not mentioned	Not mentioned	Neuropathic foot ulcer	Not mentioned	Not mentioned
P. Lazzarini et al., 2020	Not specified	Not specified	Not specified	Neuropathic plantar forefoot and midfoot ulcers	PAD	Peripheral neuropathy
T. Kwan et al., 2015	80	Not mentioned	Not mentioned	Not mentioned	Symptomatic PAD	Not mentioned
V. Chuter et al., 2023a	Not specified	Not mentioned	Not mentioned	DFU or gangrene	PAD	Not mentioned
W. Bevan et al., 2008	19	54	20 (median)	Midfoot callus/ulceration	Pedal pulses present	Not mentioned
R. Snyder et al., 2010	142 DFUs	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
Jasper A Sung et al., 2020	119	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Active cigarette smokers

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Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
N. Santamaria et al., 2004	93	Not mentioned	Not mentioned	Chronic leg and foot ulcers	Not mentioned	High levels of comorbidity
R. Warriner et al., 2011	120	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
Seoyoung C. Kim et al., 2017	20	62 / 64	Type 2 diabetes	Wagner grade 1-4	ABI > 0.8	Not mentioned
S. Zimny et al., 2005	Not specified	Not mentioned	Not mentioned	Neuropathic ulcers, area 96.9 mm²	Not mentioned	Not mentioned
L. Ribu et al., 2008	127	Not mentioned	Type 1 or 2	Not mentioned	Not mentioned	Not mentioned
T. Elgzyri et al., 2013	602	76 (median)	Not mentioned	Ischemic foot ulcer	Toe pressure <45 mmHg or ankle pressure <80 mmHg	Rest pain, renal impairment, IHD, CVA

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Betiel K. Fesseha et al., 2018	270	Middle-aged	Long duration	WIfI stage	PVD	Advanced diabetes complications, poor glycemic control, smoking
J. Lindberg et al., 2021	61 wounds	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Martin C. Robson et al., 2000	160	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Hsi-An Yang et al., 2025	1454	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
D. Wukich et al., 2014	114	59	Mostly Type 2	Midfoot ulcers	No difference in prevalence	Active infection, high Michigan Neuropathy Screening Index
V. E. Parks et al., 2020	Not specified	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
J. Reekers et al., 2013	Not specified	Not mentioned	Not mentioned	DF disease	PAD	Not mentioned
V. Venkatesan et al., 2023	Not specified	Not mentioned	Not mentioned	Foot ulcers	Peripheral vascular disease	Pedal neuropathy, perfusion disturbances

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Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
B. Aliahmad et al., 2018	26	62 (median)	20 (median)	Plantar neuropathic DFU	PAD (52%)	Retinopathy, hypertension, dyslipidemia
J. Reekers et al., 2016	Not specified	Not mentioned	Not mentioned	Arterial diabetic foot disease	PAD	Not mentioned
A. MacDonald et al., 2019	23	52.08-59.9	Not mentioned	Wagner grade (commonly 3)	ABI > 0.75	Charlson Comorbidity Index 3.08-4.82
N. Kontopodis et al., 2016	72	Not mentioned	Not mentioned	Not mentioned	Group A (Fontaine I-IIb), Group B (Fontaine III-IV)	Not mentioned
Scott J Edwards et al., 2023	Not specified	Type-2 diabetes	Not mentioned	DFU	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
H. Elghazaly et al., 2023	123	Not mentioned	Not mentioned	DFU	PAD	Not mentioned
Aditya Dutta et al., 2021	43	Not mentioned	Not mentioned	Neuropathic DFU, area 9.87 cm²	Not mentioned	Poorly controlled diabetes (HbA1c >9%)
Nantawan Koonalinthip et al., 2021	35	Not mentioned	Not mentioned	DFU and pre-ulcerative lesions	Not mentioned	Not mentioned
O. Oncul et al., 2007	38	Not mentioned	Not mentioned	Diabetic foot infection	Not mentioned	Not mentioned
Ivana Roth-Albin et al., 2017	40	Not mentioned	Not mentioned	Chronic ulcers, size >1 cm²	Not mentioned	Not mentioned
Nila N. Sari et al., 2025	Not specified	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
S. Mehta et al., 2010	Not specified	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Patricia M González-Villacorta et al., 2025	Not specified	Not mentioned	Not mentioned	DFU	PAD	Not mentioned
C. Hicks et al., 2018	621 wounds	Not mentioned	Not mentioned	Worse wound stage, larger area	PAD	Partially dependent functional status
S. Engberg et al., 2019	Not specified	Not mentioned	Not mentioned	Neuropathic, neuro-ischaemic, or critically ischaemic	Not mentioned	Not mentioned
D. Armstrong et al., 2020	10	Not mentioned	Not mentioned	Refractory wounds	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Dr. Madhuri Jain et al., 2022	200	54.03	Not mentioned	PEDIS score used	PVD (22 patients)	Moderate anaemia, end organ damage
Lucia Bubulac et al., 2025	28	30-80	Type 1 or 2, >5 years	Meggitt-Wagner grades 2-4, size > 4 cm²	Distal pulse present	Neuropathy
Olivia V. Waldman et al., 2020	92	62.2	Not mentioned	Wagner score 2.92	Not mentioned	Chronic renal failure (23.9%)
Jacqueline N. Mcnulty et al., 2018	60	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Glycemic control evaluated
Yumika Nishio et al., 2022	253	Not mentioned	Not mentioned	Heel pressure ulcer	PAD (73.5%)	Not mentioned
Rona Kartika et al., 2020	30	Not mentioned	Not mentioned	Wagner-2, size < 40 cm²	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Arthur C Yelland et al., 2022	27,030	≥ 18	Not mentioned	Location, size, depth evaluated	Evidence of ischaemia	Kidney disease, MI, heart failure
F. Game et al., 2020	Not specified	Not mentioned	Not mentioned	DFU	PAD	Not mentioned
Sebastián Flores-Escobar et al., 2025	30	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
David A. Reiter et al., 2025	17	Not mentioned	Not mentioned	Plantar forefoot ulcers, duration ≥ 30 days	Not mentioned	Not mentioned
J. A. Cheong et al., 2022	37	Not mentioned	Not mentioned	DFU	PAD defined by ABI	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Bhavani Prasad Mahindrakar et al., 2023	54	55	Not mentioned	Uninfected DFU	Not mentioned	Not mentioned
Aroa Tardáguila-García et al., 2023	116	62.9	17.5	Forefoot (92.2%), duration 15.7 weeks	PAD (41.4%)	Neuropathy
Jarrod M. Shapiro et al., 2011	Not specified	Not mentioned	Not mentioned	DFU	Infrapopliteal macrocirculatory disease	Not mentioned
Sooraj M Shah et al., 2019	Not specified	Not mentioned	Not mentioned	Not mentioned	Infrainguinal PAD	Not mentioned
Jiyong Ahn et al., 2025	101 DFUs	Not mentioned	Not mentioned	Wagner 3 or 4	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Aroa Tardáguila-García et al., 2022	115	Not mentioned	Not mentioned	DFO	Not mentioned	Not mentioned
Jiyong Ahn et al., 2024	101 DFUs	Not mentioned	Not mentioned	Wagner 3 and 4	Patent peroneal artery mentioned	Not mentioned
A. Liakos et al., 2020	Not specified	Not mentioned	Not mentioned	Refractory DFU	Not mentioned	Not mentioned
A. M. Mahon et al., 2017	74	67	Not mentioned	Larger wound area	Ischaemia	Infection
T. Macioch et al., 2015	120	61.1	Not mentioned	Size 5.6 cm^2 (initial)	Not mentioned	Not mentioned
Sofija Pejkova et al., 2025	20	Not mentioned	Not mentioned	Duration 17.1 months, size 10.49 cm^2	Not mentioned	Good glycemic control

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Mariyam Iqbal et al., 2024	300	61 / 68	Not mentioned	Wagner 2-4, midfoot/forefoot ulcers	PAD (60% / 68%)	Coronary artery disease
Hanan Ansari et al., 2025	130	58.7	≥ 5 years	Wagner grade ≥2	Not mentioned	Hypertension, dyslipidemia, renal disease
N. Leone et al., 2025	40	Not mentioned	Not mentioned	DFU undergoing minor amputation	Not mentioned	Haemodialysis, opioid use
Jessica M. Eager et al., 2025	78	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
Ivan Jozic et al., 2024	Not specified	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned

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Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Максим Борисович Горобейко et al., 2014	Not specified	Not mentioned	Not mentioned	DFU	Pedal ischemia (PtcO2 measured)	Not mentioned
Tawfik Abo Mera et al., 2019	Not specified	Not mentioned	Not mentioned	Diabetic foot lesions	Vascularity assessed	Not mentioned
Nasibeh Vatankhah et al., 2017	101	59.4	Not mentioned	Not mentioned	Not mentioned	Not mentioned
S. Brown et al., 2025	300	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
Asmat Burhan et al., 2023	127	>18	Not mentioned	DFU	PAD	Not mentioned
M. DeSanto et al., 2020	Not specified	Not mentioned	Not mentioned	DFU	Not mentioned	Not mentioned
Stephanie P. Hao et al., 2020	92	60.5	Not mentioned	DFU	Not mentioned	Not mentioned

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
P. Tappia et al., 2021	16	59.9	94% diabetic	Foot ulcer present	Assessed by ABI	ESRD (63%), below-knee amputation (38%)
Vishnu S. Ravidas et al., 2020	105	58.1-63.8	Not mentioned	Wagner class 1-5	Mean ABPI 0.7	Infection, neuropathy, poor glycemic control
Takeshi Fukuda et al., 2019	Not specified	Not mentioned	Not mentioned	Diabetic pedal disease	Not mentioned	Not mentioned
Tze-Woei Tan et al., 2022	51,362	≥ 40	Not mentioned	DFU	PAD (49.5% control, 64.2% intervention)	ESRD, various comorbidities via CCI

Citation	Sample Size	Mean Age (years)	Diabetes Duration (years)	Ulcer Grade/Classification	Baseline PAD Status	Key Comorbidities
Yan Mi et al., 2025	60	Not specified	Not mentioned	Wagner grade 3-4, duration >4 weeks	Not mentioned	Stable comorbidities, independent mobility
Kaitlyn K Rogers et al., 2023	62	Not specified	Not mentioned	DFU	PAD	Renal failure, prior amputation
Ivan Y. Luu et al., 2024	16,905	20-69	Not mentioned	DFU	PAD	COPD, CVD, CKD, CHF, CAD, HTN, obesity, depression

Pedal Access Intervention Approaches

The interventions employed across studies to improve foot-level circulation in patients with diabetic foot ulcers primarily involved endovascular procedures, with surgical bypass and hybrid approaches also utilized. Endovascular techniques were the most common first-line strategy, including percutaneous transluminal angioplasty (PTA) with or without stenting. The target vessels for these interventions were predominantly below-the-knee arteries, including tibial, ankle, and pedal arteries.

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Several studies focused on the concept of angiosome-guided revascularization, comparing direct revascularization (DR) of the artery supplying the ulcerated area with indirect revascularization (IR) through collateral vessels. The patency of the pedal arch emerged as a critical factor, with interventions specifically aimed at pedal arch revascularization (PAR). Technical success rates for endovascular procedures were reported in a wide range, from approximately 61% to over 90%. The timing of interventions varied, with some studies implementing them as a first-line approach upon ulcer presentation, while others noted delays of several weeks post-referral.

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
N. Troisi et al., 2018	Endovascular	Tibial arteries	87.6%	Angioplasty	Not detailed
J. Apelqvist et al., 2011	Endovascular (PTA), surgical bypass	Crural arteries	OR for healing: PTA 1.77, surgery 2.05	PTA, distal reconstructive surgery	Not specified
Rachael O. Forsythe et al., 2020	Endovascular and open surgery	Angiosome-related vessels	Not specified	Not mentioned	Not explicit
Jennifer Skolnik et al., 2021	Endovascular	Infrageniculate vessels	MALE in 50% at 1 year	Infrageniculate angioplasty	After ulcer presentation

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
N. Troisi et al., 2017	Endovascular revascularization	Below-the-knee vessels	CPA group had better outcomes	Not specified	Healing evaluated at 3 months
S. Jacqueminet et al., 2005	Endovascular (PTA)	Pedal vessels	52% clinically successful	Angioplasty	First-line procedure
E. Saricilar et al., 2023	Endovascular	Below-knee arteries	60.9% to 84.7%	Angioplasty	After ulcer presentation
Jill Sommerset et al., 2020	Angiographic interventions	Tibial arteries	Associated with PAT values	Not specified	Not mentioned
Andreia Pinelo et al., 2024	Endovascular surgery	Pedal or below-knee arteries	Not mentioned	Not mentioned	Not mentioned
Shiping Ji et al., 2022	Endovascular therapy	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Osama A. Ismail et al., 2020	Endovascular	Pedal arch	68.3%	Guidewire crossing, balloon dilatation	Part of management for CLI

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
M. Ghweeba et al., 2022	Endovascular	Pedal arch and related vessels	High healing and limb preservation rates	Angioplasty with guidewire and balloon	Not mentioned
Chang Sik Shin et al., 2025	Endovascular (EVT)	Below-the-knee arteries	64.5% wound healing at 12 months	Infra-popliteal EVT	Not explicit
Ahmed Hossny et al., 2019	Endovascular (infrapopliteal angioplasty)	AT, PT, peroneal arteries	Healing rates varied by approach (43-94%)	Angioplasty	Follow-up post-intervention
B. Y. C. Khor et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
M. Söderström et al., 2013	Endovascular	Below-knee arteries	72% healing rate (direct) vs 45% (indirect)	Infrapopliteal PTA	After ulcer presentation
Limi Lee et al., 2024	Endovascular (proximal arterial inflow revascularization)	Pedal arch	24.1% increase in complete pedal arch patency	Not specified	After ulcer presentation

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
K. Dell et al., 2021	Endovascular, surgical bypass	Pedal arteries	High healing rates (5/6 and 2/2)	Not specified	4-week follow-up
R. Hinchliffe et al., 2016	Endovascular, surgical bypass	Pedal, ankle, below-knee arteries	Median 1-year limb salvage 78-85%	Angioplasty, bypass grafts	Early revascularization recommended
Riyad Karmy-Jones et al., 2024	Revascularization (direct or indirect)	Wound bed vessels	Not mentioned	Not mentioned	Before and 1 week after intervention
K. Chae et al., 2016	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
A. Caetano et al., 2020	Endovascular revascularization	Not specified	Higher healing with successful revascularization	Not specified	Not specified
M. Fujii et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
N. Troisi et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Mohammed Shahat et al., 2024	Endovascular	Pedal arteries	77.3% (pedal angioplasty), 81.7% (PAR)	Pedal angioplasty	Not explicit
V. Alexandrescu et al., 2019	Endovascular (WTR and IR)	Pedal and ankle circulation	91% overall success	Angiosome-oriented reperfusion	Mean follow-up 10.9 months
R. Hinchliffe et al., 2012	Endovascular, open bypass surgery	Not mentioned	Limb salvage rates 78-85%	Not mentioned	Not mentioned
Mohamed Fathy Abdelghaffar et al., 2023	Endovascular	Pedal arch	Healing rates 50-91.7%	Balloon angioplasty	Not mentioned
V. Chuter et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
G. Andros et al., 2004	Surgical bypass	Pedal arteries	85-90% 3-year limb-salvage	Pedal bypass with autogenous conduits	Not mentioned
K. Claesson et al., 2011	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
T. Elgzyri et al., 2014	Endovascular (PTA), Surgical bypass	Foot/ankle circulation	Not specified	PTA, Reconstructive surgery	Median 8 weeks from inclusion
T. Nakama et al., 2017	Endovascular (angioplasty)	Pedal arteries	Higher healing rate (57.5% vs 37.3%)	Pedal artery angioplasty (PAA)	Not explicit
H. Jung et al., 2019	Endovascular	Infrapopliteal arteries	PAR achieved in 60.9%	Subintimal angioplasty, pedal-plantar loop technique	Part of treatment for chronic wounds
Michael Rouse et al., 2024	Endovascular	Anterior tibial, SFA, popliteal arteries	94% technical success	Balloon angioplasty +/- stenting	Follow-up at mean of 89 days
V. Alexandrescu et al., 2009	Endovascular	Lower limb arteries	84% initial technical success	Subintimal (SA) and endoluminal (EA) angioplasty	Initial treatment strategy

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Danlan Pu et al., 2019	Endovascular (angioplasty)	Pedal or below-knee arteries	Not mentioned	Angioplasty	Not mentioned
Ridho Sinaga et al., 2021	Endovascular (PTA)	Pedal or below-knee arteries	Improvement in PEDIS scores	Angioplasty	Shortly after ulcer presentation
O. Galimov et al., 2021	Endovascular	Below-knee arteries	66.7% limb salvage rate	Balloon angioplasty	After ulcer presentation
S. Spiliopoulos et al., 2023	Endovascular	Anterior and posterior tibial arteries	96.4% 6-month limb salvage	Not specified	Not explicit
F. Álvaro-Afonso et al., 2024	Endovascular	Femoropopliteal, infrapopliteal, tibial arteries	71.43% healing rate	POBA, DCB, stenting	Part of treatment protocol
Tracy J. Cheun et al., 2024	Likely endovascular	Tarsal vessels	91% technical success	Not explicit	Concomitant with tibial interventions

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
B. Dong et al., 2022	Endovascular (PTA)	Femoral-popliteal, inferior knee arteries	Shorter healing time with PTA-VSD	Angioplasty	Part of "one-stop" strategy
Jon C. Henry et al., 2016	Surgical bypass, endovascular	Pedal arteries	Improved healing with prior endovascular intervention	Not specified	Prior to surgical bypass
J. Vouillarmet et al., 2016	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Thomas Collins et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
M. Sabry et al., 2023	Endovascular	Pedal arteries	Higher healing rate (89%)	Not specified	Not specified

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Rongzhi Wen et al., 2023	Endovascular, surgical bypass	Not specified	Poor clinical results	Stenting, angioplasty, bypass grafting	Not specified
M. E. Yamany et al., 2020	Endovascular revascularization	Pedal arteries	Complete PAA in 33%	Angioplasty of pedal arteries	Evaluated over follow-up period
Keisuke Miyake et al., 2024	Surgical bypass	Below-knee arteries	Not mentioned	Bypass surgery distal to popliteal arteries	Not mentioned
B. Vijaynagar et al., 2019	Vascular surgery/angiogram (implying endovascular)	Not specified	Not specified	Not specified	Not specified
M. N. Bouayed et al., 2019	Surgical bypass, endovascular, hybrid	Pedal and below-knee arteries	88% primary limb salvage	Conventional surgery, angioplasty	Not explicit

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Pam Chen et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
J. Brownrigg et al., 2013	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
M. Doyle et al., 2020	Endovascular intervention	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Alexander T. Hong et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
N. Troisi et al., 2021a	Endovascular revascularization	Femoro-popliteal and below-the-knee arteries	62.5% healing at 6 months	Isolated femoro-popliteal revascularization	Not explicit
Fengjie Tang et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Rushabh A Parekh et al., 2024	Endovascular (angioplasty), surgical bypass	Lower leg arteries	Not mentioned	Angioplasty, stent placement, bypass surgery	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
R. Jarosiková et al., 2025	Endovascular (PTA)	Not explicit	Not mentioned	PTA	Follow-up at 3 and 6 months
E. Iacopi et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Mwidimi Ndosi et al., 2017	Revascularization surgery	Not specified	Not specified	Not specified	Not specified
Hendri et al., 2023	Revascularization	Not specified	Not specified	Not specified	Not specified
Stephanie Mae Macfarlane et al., 2024	Vascular intervention	Not specified	Not specified	Not specified	Not specified
P. Faries et al., 2004	Revascularization	Not specified	Not specified	Not specified	Not specified
Mohamed Elyamany et al., 2025	Revascularization	Not specified	Not specified	Not specified	Not specified
H. Mohafez et al., 2018	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Sijie Yang et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Andreia Pinelo et al., 2024a	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Rachael O. Forsythe et al., 2016	Endovascular (angioplasty), surgical bypass	Not mentioned	Not mentioned	Angioplasty, surgical bypass	Not mentioned
Marta Carmena-Pantoja et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
K. Spanos et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Odette Hart et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
P. Ince et al., 2007	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Rachael O. Forsythe et al., 2020a	Revascularizat ion	Not mentioned	Not mentioned	Not mentioned	Not mentioned
K. Marmagkioli s et al., 2017	Endovascular	Anterior tibial, dorsalis pedis, posterior tibial	92.6% success rate	Implied angioplasty +/- stenting	Not mentioned
Nicole K. Cates et al., 2019	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
M. Meloni et al., 2021	Endovascular and surgical bypass	Pedal and below-knee arteries	Not mentioned	Not specified	Not specified
A. Hartemann-Heurtier et al., 2002	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
C. Gazzaruso et al., 2020	Revascularizat ion	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Yan Chen et al., 2019	Revascularizat ion as part of standard care	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Eduardo Silva et al., 2025	Revascularization	Pedal arteries	Not mentioned	Not mentioned	Not mentioned
B. Lin et al., 2020	Angioplasty	Not mentioned	Not mentioned	Angioplasty	Not mentioned
R. Somayaji et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
P. Normahani et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Yingzhou Liu et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Sichun Zhao et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
D. Lowry et al., 2018	Endovascular (PTA)	Below-knee arteries	Improved microvascular reactivity	Angioplasty	After ulcer presentation

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Jason Zhang et al., 2024	Endovascular and surgical bypass	Aortoiliac, femoropopliteal, tibial	66.7% healing in revascularized patients	Angioplasty, atherectomy, stent, bypass	Not mentioned
Raffaele Grande et al., 2020	Endovascular	SFA, PTA, peroneal artery	Patency of treated vessels restored	Angioplasty (PTA), stenting	Part of treatment for non-healing ulcers
Yan-Bin Wang et al., 2024	Conservative management	Not specified	Not mentioned	Antiplatelets, vasodilators	Not explicit
M. Doyle et al., 2020a	Endovascular revascularization	Aortoiliac, femoropopliteal, infrapopliteal	No significant correlation with outcomes	Not specified	Up to 90 days prior to amputation
N. Akhtar et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
García-Sáenz Mc et al., 2004	Surgical bypass, Endovascular (angioplasty)	Not mentioned	Not mentioned	Distal bypass, Angioplasty	Not mentioned

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
J. Brownrigg et al., 2015	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
A. Brechow et al., 2013	Endovascular, surgical bypass, conservative	Infrapopliteal, iliacal, femoral arteries	Not mentioned	PTA, bypass reconstructions	Not explicit
Jason Chow et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Junpeng Liu et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
D. Margolis et al., 2002	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
F. Game et al., 2016	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
R. Snyder et al., 2009	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
L. Prompers et al., 2008	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Pamela Chen et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
S. H. Lu et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
D. Margolis et al., 2005	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
P. Lazzarini et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
T. Kwan et al., 2015	Endovascular	Pedal arteries	84% success rate	Atherectomy, angioplasty, stenting	Not mentioned
V. Chuter et al., 2023a	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
W. Bevan et al., 2008	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
R. Snyder et al., 2010	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Jasper A Sung et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
N. Santamaria et al., 2004	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
R. Warriner et al., 2011	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Seoyoung C. Kim et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
S. Zimny et al., 2005	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
L. Ribu et al., 2008	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
T. Elgzyri et al., 2013	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Betiel K. Fesseha et al., 2018	Endovascular, open bypass, endarterectomy	Not specified	Not specified	Debridement, minor amputation, skin grafting	Not specified
J. Lindberg et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Martin C. Robson et al., 2000	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Hsi-An Yang et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
D. Wukich et al., 2014	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
V. E. Parks et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
J. Reekers et al., 2013	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
V. Venkatesan et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
B. Aliahmad et al., 2018	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
J. Reekers et al., 2016	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
A. MacDonald et al., 2019	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
N. Kontopodis et al., 2016	Autologous platelet-rich plasma (PRP)	Not mentioned	Not mentioned	Local growth factors	Not mentioned
Scott J Edwards et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
H. Elghazaly et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Aditya Dutta et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Nantawan Koonalinthip et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
O. Oncul et al., 2007	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Ivana Roth-Albin et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Nila N. Sari et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
S. Mehta et al., 2010	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Patricia M González-Villacorta et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
C. Hicks et al., 2018	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
S. Engberg et al., 2019	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
D. Armstrong et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Dr. Madhuri Jain et al., 2022	Conservative, invasive procedures	Lower limb vessels	Not mentioned	Stenting, embolectomy, bypass	Not mentioned
Lucia Bubulac et al., 2025	Surgical decompression	Not specified	Not specified	Not specified	Not specified
Olivia V. Waldman et al., 2020	Operative intervention	Not specified	Not specified	Not specified	Not specified
Jacqueline N. Mcnulty et al., 2018	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Yumika Nishio et al., 2022	Endovascular therapy (EVT), surgical bypass	Not mentioned	Healing rates: EVT 26.7%, bypass 65.0%	Not mentioned	Not mentioned
Rona Kartika et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Arthur C Yelland et al., 2022	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
F. Game et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Sebastián Flores-Escobar et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
David A. Reiter et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
J. A. Cheong et al., 2022	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Bhavani Prasad Mahindrakar et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Aroa Tardáguila-García et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Jarrod M. Shapiro et al., 2011	Revascularizat ion	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Sooraj M Shah et al., 2019	Transpedal and femoral access for interventions	Infrainguinal arteries	Not specified	Endovascular treatment	Not specified
Jiyong Ahn et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Aroa Tardáguila-García et al., 2022	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Jiyong Ahn et al., 2024	Negative pressure wound therapy (NPWT)	Not mentioned	Not mentioned	Not mentioned	Not mentioned
A. Liakos et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
A. M. Mahon et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
T. Macioch et al., 2015	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Sofija Pejkova et al., 2025	Surgical decompression	Posterior tibial artery	High healing rates (55% complete, 45% with 83% reduction)	Dellon Decompression of medial ankle tunnels	Ulcers averaged 17.1 months in duration
Mariyam Iqbal et al., 2024	Conservative surgery, early surgical intervention	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Hanan Ansari et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
N. Leone et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Jessica M. Eager et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Ivan Jozic et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Максим Борисович Горобейко et al., 2014	Ultrasound debridement,Promogran dressing, Drug revascularization	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Tawfik Abo Mera et al., 2019	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

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Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Nasibeh Vatankhah et al., 2017	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
S. Brown et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Asmat Burhan et al., 2023	Compression therapy, compression stockings	Not mentioned	Not mentioned	Not specified	Not mentioned
M. DeSanto et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Stephanie P. Hao et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
P. Tappia et al., 2021	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Vishnu S. Ravidas et al., 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Citation	Intervention Type	Target Vessels	Technical Success Rate	Procedural Details	Timing Relative to Ulcer Onset
Takeshi Fukuda et al., 2019	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Tze-Woei Tan et al., 2022	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Yan Mi et al., 2025	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Kaitlyn K Rogers et al., 2023	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Ivan Y. Luu et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned

Radiological Assessment Methods

A variety of radiological and related non-invasive modalities were used across the studies to assess vascular status and wound healing. Duplex ultrasound (DUS) was a commonly employed tool, used to assess vessel patency, ankle-brachial index (ABI), and, more recently, pedal acceleration time (PAT). PAT, in particular, was highlighted as a promising non-invasive predictor of wound healing, especially in patients with non-compressible arteries. Angiography, including digital subtraction angiography (DSA) and CT angiography (CTA), was used for detailed anatomical delineation of occlusive disease and to assess the status of the pedal arch. Some studies also utilized MRI and magnetic resonance angiography (MRA) for assessing perfusion and microvascular function.

Specific measurements included time-density curves from 2D perfusion angiography, MAC scores from plain radiographs, and vessel runoff scores from angiograms. Other functional assessments included transcutaneous oximetry (TcPO2) and skin perfusion pressure (SPP). Assessment timing typically included baseline measurements prior to intervention, immediate post-procedural evaluations, and scheduled follow-ups at intervals ranging from one to 24 months. There was little to no reporting on who performed the assessments or data on inter-observer reliability, indicating a potential for measurement inconsistency across the literature.

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
N. Troisi et al., 2018	Angiography, Duplex ultrasound	Time to healing, Mean time to healing	Discharge, 1, 6, 12 months, then yearly
J. Apelqvist et al., 2011	Not mentioned	Not mentioned	Not mentioned
Rachael O. Forsythe et al., 2020	Not mentioned	Not mentioned	Not mentioned
Jennifer Skolnik et al., 2021	Plain radiographs	MAC score	Not mentioned
N. Troisi et al., 2017	Not mentioned	Not mentioned	Not mentioned
S. Jacqueminet et al., 2005	Arteriography	Patent pedal vessel	Before PTA and during follow-up
E. Saricilar et al., 2023	Not mentioned	TcPO2, ABI	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Jill Sommerset et al., 2020	Duplex ultrasound	Pedal acceleration time (PAT)	Before and after interventions
Andreia Pinelo et al., 2024	Not mentioned	Not mentioned	Not mentioned
Shiping Ji et al., 2022	Angiography	Not mentioned	Not mentioned
Osama A. Ismail et al., 2020	Duplex ultrasound, CT angiography	ABI, lesion characteristics	Pre-intervention, 3, 6, 9, 12 months
M. Ghweeba et al., 2022	Duplex ultrasound	Not mentioned	Discharge, 1, 3, 6, 12 months
Chang Sik Shin et al., 2025	Not mentioned	Not mentioned	Not mentioned
Ahmed Hossny et al., 2019	CT angiography, Duplex ultrasound	Vessel patency, ABI	Baseline, 2, 4, 6 months
B. Y. C. Khor et al., 2017	Not mentioned	Not mentioned	Not mentioned
M. Söderström et al., 2013	Angiograms	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Limi Lee et al., 2024	Digital subtraction angiography	Complete pedal arch prevalence	6, 12, 24 months
K. Dell et al., 2021	Duplex ultrasound	Pedal acceleration time (PAT)	Baseline, 4-6 weeks follow-up
R. Hinchliffe et al., 2016	Not mentioned	Not mentioned	Not mentioned
Riyad Karmy-Jones et al., 2024	Duplex ultrasound	Pedal acceleration time (PAT)	Before and 1 week after intervention
K. Chae et al., 2016	Not mentioned	Not mentioned	Not mentioned
A. Caetano et al., 2020	Not mentioned	Not mentioned	Not mentioned
M. Fujii et al., 2021	Not mentioned	Skin perfusion pressure, CRP levels	Pre- and post-operative
N. Troisi et al., 2021	Angiograms	Not mentioned	Not mentioned
Mohammed Shahat et al., 2024	Angiography	Vessel patency	Not specified
V. Alexandrescu et al., 2019	Not mentioned	Not mentioned	Not mentioned
R. Hinchliffe et al., 2012	Not mentioned	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Mohamed Fathy Abdelghaffar et al., 2023	Duplex ultrasound, CT angiography	Not mentioned	Not mentioned
V. Chuter et al., 2023	Not mentioned	Not mentioned	Not mentioned
G. Andros et al., 2004	Duplex US, MRA, contrast arteriography	Not mentioned	Not mentioned
K. Claesson et al., 2011	Not mentioned	Not mentioned	Not mentioned
T. Elgzyri et al., 2014	Not mentioned	Not mentioned	Not mentioned
T. Nakama et al., 2017	Not mentioned	Not mentioned	Not mentioned
H. Jung et al., 2019	Not mentioned	Not mentioned	Not mentioned
Michael Rouse et al., 2024	Direct pressure measurement via sheath transducer	Hemodynamic pressure changes	Initial and post-intervention
V. Alexandrescu et al., 2009	Duplex ultrasound	Vessel patency	Every 6 months
Danlan Pu et al., 2019	Not mentioned	ABI, TcPO2	Not mentioned
Ridho Sinaga et al., 2021	Not mentioned	PEDIS score	Pre- and post-angioplasty

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Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
O. Galimov et al., 2021	Invasive pressure monitoring during X-ray endovascular interventions	Stenosis significance	Intraoperative
S. Spiliopoulos et al., 2023	Doppler ultrasound (DUS)	Pulsatility index (PI), Pedal acceleration time (PAT)	Pre-, post-procedural, 6-month follow-up
F. Álvaro-Afonso et al., 2024	Not mentioned	TP, AP, ABPI, TBPI, TcPO2, SPP	Before and 4 weeks after revascularization
Tracy J. Cheun et al., 2024	Angiograms	Pedal runoff scores	Pre- and post-intervention
B. Dong et al., 2022	Not mentioned	ABI, ulcer score	Pre- and post-surgery; 3, 6, 12 months
Jon C. Henry et al., 2016	Not mentioned	Runoff scores	Not mentioned
J. Vouillarmet et al., 2016	Not mentioned	Not mentioned	Not mentioned
Thomas Collins et al., 2024	Not mentioned	pMAC score	Not mentioned
M. Sabry et al., 2023	Not mentioned	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Rongzhi Wen et al., 2023	Not mentioned	Trabecular area, ABI	Pre- and post-treatment
M. E. Yamany et al., 2020	CTA, Duplex ultrasound	Vessel patency (pedal arch status), ABI	Baseline, post-intervention, monthly up to 6 months
Keisuke Miyake et al., 2024	Angiography	Pedal circulation status (visualized vs non-visualized perfusion)	6 months postoperatively
B. Vijaynagar et al., 2019	Angiogram	Not mentioned	Not mentioned
M. N. Bouayed et al., 2019	Not mentioned	Not mentioned	Not mentioned
Pam Chen et al., 2024	Not mentioned	Not mentioned	Not mentioned
J. Brownrigg et al., 2013	Not mentioned	Not mentioned	Not mentioned
M. Doyle et al., 2020	Not mentioned	Not mentioned	Not mentioned
Alexander T. Hong et al., 2025	Not mentioned	Not mentioned	Not mentioned

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Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
N. Troisi et al., 2021a	2D perfusion angiography	Time–density curves	Baseline and post-intervention, 6-month follow-up
Fengjie Tang et al., 2023	Not mentioned	Not mentioned	Not mentioned
Rushabh A Parekh et al., 2024	Doppler scans, CT angiography	ABPI, TBI values	Baseline and after 3 months
R. Jarosiková et al., 2025	Plain radiographs	MAC scoring system	3 and 6 months post-PTA
E. Iacopi et al., 2023	Not mentioned	Not mentioned	Not mentioned
Mwidimi Ndosi et al., 2017	Not mentioned	Not mentioned	Not mentioned
Hendri et al., 2023	Not mentioned	WIfI score	Not mentioned
Stephanie Mae Macfarlane et al., 2024	Not mentioned	Not mentioned	Not mentioned
P. Faries et al., 2004	Not mentioned	Not mentioned	Not mentioned
Mohamed Elyamany et al., 2025	Duplex ultrasound	Pedal acceleration time (PAT)	Not mentioned
H. Mohafez et al., 2018	High-frequency ultrasound	Wound area and depth	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Sijie Yang et al., 2024	Not mentioned	Not mentioned	Not mentioned
Andreia Pinelo et al., 2024a	Ultrasound	Pedal Acceleration Time (PAT)	12-16 weeks after first evaluation
Rachael O. Forsythe et al., 2016	MRA, CTA, DSA	Vessel patency	Not mentioned
Marta Carmena-Pantoja et al., 2021	Not mentioned	Radiographic arterial calcification (RAC)	Not mentioned
K. Spanos et al., 2017	Not mentioned	ABI, popliteal pulse palpation	Not mentioned
Odette Hart et al., 2024	Not mentioned	Pedal Acceleration Time (PAT)	Not mentioned
P. Ince et al., 2007	Not mentioned	Not mentioned	Not mentioned
Rachael O. Forsythe et al., 2020a	Not mentioned	SPP, toe pressure, TcPO2, ankle pressure, ABI	Not mentioned
K. Marmagkiolis et al., 2017	Not mentioned	Not mentioned	Not mentioned
Nicole K. Cates et al., 2019	Angiography	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
M. Meloni et al., 2021	duplex US, CT, MRI	Not mentioned	Not mentioned
A. Hartemann-Heurtier et al., 2002	Not mentioned	Not mentioned	Not mentioned
C. Gazzaruso et al., 2020	Not mentioned	Not mentioned	Not mentioned
Yan Chen et al., 2019	CT angiography and perfusion imaging	Vessel density, blood flow, blood volume	12 weeks postoperatively
Eduardo Silva et al., 2025	Not mentioned	Pedal acceleration time (PAT)	Not mentioned
B. Lin et al., 2020	Wearable near-infrared spectroscopy (NIRS)	Hemoglobin levels, tissue blood volume, tissue oxygen concentration	Not mentioned
R. Somayaji et al., 2017	Not mentioned	Doppler waveforms	Not mentioned
P. Normahani et al., 2020	Duplex ultrasound (DUS)	Vessel calcification, patent vessels, waveform features	Baseline scans, 12-month review

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Yingzhou Liu et al., 2023	Not mentioned	Not mentioned	Not mentioned
Sichun Zhao et al., 2024	Not mentioned	Not mentioned	Not mentioned
D. Lowry et al., 2018	Laser Doppler fluxmetry	Time to maximum flux (TtM)	Monthly until healing
Jason Zhang et al., 2024	Not mentioned	ABI, pedal pulse palpation	Not mentioned
Raffaele Grande et al., 2020	B-mode US, colour imaging, arteriography	Vessel patency	Not explicit
Yan-Bin Wang et al., 2024	Not mentioned	Not mentioned	Not mentioned
M. Doyle et al., 2020a	Not mentioned	TASC classifications	Not mentioned
N. Akhtar et al., 2020	Not mentioned	Ulcer dimensions	Before procedure, then every 5 days
García-Sáenz Mc et al., 2004	Not mentioned	Not mentioned	Not mentioned
J. Brownrigg et al., 2015	Not mentioned	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
A. Brechow et al., 2013	Not mentioned	ABI, Doppler flow curve	At baseline
Jason Chow et al., 2024	X-ray, CT	Not mentioned	Not mentioned
Junpeng Liu et al., 2024	Angiography, B-ultrasound, X-rays	Not mentioned	Baseline and post-intervention
D. Margolis et al., 2002	Not mentioned	Wound size, grade	Not mentioned
F. Game et al., 2016	Not mentioned	Not mentioned	Not mentioned
R. Snyder et al., 2009	Not mentioned	Not mentioned	Not mentioned
L. Prompers et al., 2008	Not mentioned	Not mentioned	Not mentioned
Pamela Chen et al., 2023	Not mentioned	Not mentioned	Not mentioned
S. H. Lu et al., 2017	Not mentioned	Not mentioned	Not mentioned
D. Margolis et al., 2005	Not mentioned	Not mentioned	Not mentioned
P. Lazzarini et al., 2020	Not mentioned	Not mentioned	Not mentioned

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Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
T. Kwan et al., 2015	Ultrasound	Access artery patency	Before procedure and at 1-month follow-up
V. Chuter et al., 2023a	Not mentioned	Not mentioned	Not mentioned
W. Bevan et al., 2008	Weightbearing radiographs	Lateral talar-first metatarsal angle	Not mentioned
R. Snyder et al., 2010	Not mentioned	Percent area reduction (PAR)	Weeks 1-4 and 12
Jasper A Sung et al., 2020	Not mentioned	Wound size reduction	Not mentioned
N. Santamaria et al., 2004	Digital wound imaging system	Not mentioned	Every 2 weeks
R. Warriner et al., 2011	Not mentioned	Percent area reduction (PAR)	Weeks 4, 6, 8, 12
Seoyoung C. Kim et al., 2017	Periflux System 5000 (not imaging)	Transcutaneous oxygen tension (TcPO2)	Baseline, days 1, 3, 7, 14, 28
S. Zimny et al., 2005	Not mentioned	Planimetric wound area	Not mentioned
L. Ribu et al., 2008	Not mentioned	Not mentioned	Not mentioned
T. Elgzyri et al., 2013	Not mentioned	Toe/ankle pressure	At presentation

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Betiel K. Fesseha et al., 2018	Not mentioned	Not mentioned	Not mentioned
J. Lindberg et al., 2021	Fluorescence imaging	Ingress rate (IR), time to first blush	Not mentioned
Martin C. Robson et al., 2000	Not mentioned	Wound closure percentage	20-week period
Hsi-An Yang et al., 2025	Not mentioned	Not mentioned	Not mentioned
D. Wukich et al., 2014	Weight-bearing radiographs	Various angles (e.g., lat-talar 1st met angle, cuboid height)	Not mentioned
V. E. Parks et al., 2020	Not mentioned	Not mentioned	Not mentioned
J. Reekers et al., 2013	Not mentioned	Not mentioned	Not mentioned
V. Venkatesan et al., 2023	Not mentioned	Not mentioned	Not mentioned
B. Aliahmad et al., 2018	Thermal and color imaging	Wound area, temperature distribution	Baseline, week 2, week 4
J. Reekers et al., 2016	Color Doppler US, CTA, MRA	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
A. MacDonald et al., 2019	Not mentioned	Not mentioned	Not mentioned
N. Kontopodis et al., 2016	Not mentioned	Not mentioned	Not mentioned
Scott J Edwards et al., 2023	MRI (IVIM, BOLD)	Perfusion indices	Not mentioned
H. Elghazaly et al., 2023	Podiatry ankle duplex scan (PAD-scan)	Waveforms (monophasic, biphasic, triphasic)	12-month follow-up
Aditya Dutta et al., 2021	Wound zoom camera	Ulcer area	Baseline, 4 weeks, 12 weeks
Nantawan Koonalinthip et al., 2021	Not mentioned	Wound radius reduction, 50% area reduction	Every 4 weeks
O. Oncul et al., 2007	Not mentioned	Not mentioned	Not mentioned
Ivana Roth-Albin et al., 2017	Not mentioned	Not mentioned	Not mentioned
Nila N. Sari et al., 2025	Photographic, hyperspectral, and thermal imaging	Wound area, biochemical insight	Not specified

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
S. Mehta et al., 2010	Not mentioned	Not mentioned	Not mentioned
Patricia M González-Villacorta et al., 2025	Hyperspectral Imaging (HSI)	Not mentioned	Not mentioned
C. Hicks et al., 2018	Not mentioned	Not mentioned	Not mentioned
S. Engberg et al., 2019	Not mentioned	Not mentioned	Not mentioned
D. Armstrong et al., 2020	Photography	Wound area	Weekly
Dr. Madhuri Jain et al., 2022	Doppler, digital subtraction angiography	Blood flow velocity/direction, BP at ankle/wrist	Not specified
Lucia Bubulac et al., 2025	Doppler ultrasound	Arterial and venous blood flow	Baseline, 4 weeks, 8 weeks
Olivia V. Waldman et al., 2020	Not mentioned	Not mentioned	Not mentioned
Jacqueline N. Mcnulty et al., 2018	Not mentioned	Not mentioned	Not mentioned
Yumika Nishio et al., 2022	Not mentioned	Not mentioned	Not mentioned

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Rona Kartika et al., 2020	Digital images (ImageJ)	Wound area, granulation area, granulation index	Baseline, day 3, 7, 14
Arthur C Yelland et al., 2022	Not mentioned	Not mentioned	Not mentioned
F. Game et al., 2020	Not mentioned	Not mentioned	Not mentioned
Sebastián Flores-Escobar et al., 2025	Not mentioned	Wound area, granulation tissue, TcPO2	12-week period
David A. Reiter et al., 2025	MRI	Resting perfusion, microvascular function	Baseline
J. A. Cheong et al., 2022	Not mentioned	ABI	Baseline
Bhavani Prasad Mahindrakar et al., 2023	Not mentioned	Wound pH, surface temperature	Weekly for 4 weeks
Aroa Tardáguila-García et al., 2023	Simple X-ray	Periosteal reaction, sequestrum, cortical disruption, etc.	Twice-weekly until healing

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Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Jarrod M. Shapiro et al., 2011	US, MRA, CTA, laser speckle perfusion imaging	Not mentioned	Not mentioned
Sooraj M Shah et al., 2019	Not mentioned	Not mentioned	Not mentioned
Jiyong Ahn et al., 2025	Infrared 3D camera	Wound area and volume	Weekly for 1 month
Aroa Tardáguila-García et al., 2022	Plain X-rays	Periosteal reaction, sequestrum, cortical disruption	1-year follow-up
Jiyong Ahn et al., 2024	Infra-red 3D camera	Wound area and volume	Weekly for one month
A. Liakos et al., 2020	Not mentioned	Not mentioned	Not mentioned
A. M. Mahon et al., 2017	Not mentioned	Ankle-Brachial Pressure Index	Not mentioned
T. Macioch et al., 2015	Not mentioned	Wound diameter measurements	Not mentioned
Sofija Pejkova et al., 2025	Doppler ultrasonography	Blood flow in posterior tibial artery	Pre-op, 6 months, 9 months

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Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Mariyam Iqbal et al., 2024	Not mentioned	Not mentioned	Not mentioned
Hanan Ansari et al., 2025	Not mentioned	Not mentioned	Not mentioned
N. Leone et al., 2025	Not mentioned	Not mentioned	Not mentioned
Jessica M. Eager et al., 2025	Not mentioned	Not mentioned	Not mentioned
Ivan Jozic et al., 2024	EKARE inSight imaging	Wound size change	Weekly for 4 weeks
Максим Борисович Горобейко et al., 2014	Not mentioned	Transcutaneous oxygen pressure (PtcO2)	Not mentioned
Tawfik Abo Mera et al., 2019	Not specified	Ankle peak systolic velocity	Not specified
Nasibeh Vatankhah et al., 2017	Not mentioned	Not mentioned	Not mentioned
S. Brown et al., 2025	2D photography	Healing status, confidence rating	Not mentioned

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Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Asmat Burhan et al., 2023	Not mentioned	Ankle Brachial Index, Bates-Jensen Wound Assessment Tool	Pre- and post-test over 8 weeks
M. DeSanto et al., 2020	Not mentioned	Not mentioned	Not mentioned
Stephanie P. Hao et al., 2020	Not mentioned	Not mentioned	Not mentioned
P. Tappia et al., 2021	Camera, NIRS, Doppler	Wound area/volume/depth, O2 sat, ABI	Baseline and monthly
Vishnu S. Ravidas et al., 2020	Not mentioned	ABPI	Not mentioned
Takeshi Fukuda et al., 2019	MRI	Not mentioned	Not mentioned
Tze-Woei Tan et al., 2022	Not mentioned	Not mentioned	Not mentioned
Yan Mi et al., 2025	Not mentioned	Wound area, granulation tissue coverage	Not mentioned
Kaitlyn K Rogers et al., 2023	Continuous glucose monitor (CGM)	Glycemic metrics (TIR, TAR, TBR)	Not specified

Citation	Imaging Modality	Specific Measurements	Assessment Timing/Frequency
Ivan Y. Luu et al., 2024	Not mentioned	Not mentioned	Not mentioned

Wound Healing Outcomes

Wound healing outcomes varied significantly across studies, influenced by factors such as baseline perfusion, intervention type, and patient comorbidities. Primary healing measures consistently showed better outcomes for patients with improved pedal circulation. For instance, studies assessing pedal arch patency reported significantly higher healing rates and shorter time to healing in patients with a complete pedal arch (CPA) compared to those with incomplete (IPA) or absent (APA) arches. Healing rates within 3 months were 50% for CPA versus 20% for APA (p=0.01), and overall healing rates reached 93.3% for CPA versus 52.6% for APA (p=0.003). Similarly, mean time to healing was shorter in CPA groups (3.5 months) compared to APA groups (5.7 months) (p<0.001). Successful pedal artery revascularization (PAR) also resulted in a higher wound healing rate (86.7% vs 59.1%; P=0.007) compared to unsuccessful PAR. Angiosome-targeted revascularization approaches were associated with better wound healing outcomes (HR 1.97; 95% CI, 1.34-2.90) and shorter healing times compared to indirect revascularization.

Secondary outcomes, including limb salvage and amputation rates, also demonstrated a strong correlation with successful revascularization. One-year limb salvage rates were significantly better in patients with a complete pedal arch, reaching 100% in some cohorts compared to approximately 70% in those with an absent arch (p<0.001). Major amputation rates were substantially lower following successful interventions. For example, successful PAR was associated with a major amputation rate of 5.1% versus 40.9% for unsuccessful PAR (p≤0.001). Similarly, a successful endovascular revascularization group had a major amputation rate of 3.9% compared to 24.1% in a failed revascularization group (p<0.0001). Follow-up durations ranged from several

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months to multiple years, allowing for the assessment of both short-term healing and long-term limb preservation.

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
N. Troisi et al., 2018	Time to complete healing, healing rates	CPA: 3.5 months, 83.3%	1-year limb salvage: CPA 100%, APA 70.1%	Mean 7.4 months	p<0.001 for healing time; p<0.001 for limb salvage
J. Apelqvist et al., 2011	Healing without amputation	36% healed primarily, median time 27 weeks	13% major amputation, 27% died unhealed	Until healing or death	OR for healing: PTA 1.77, surgery 2.05
Rachael O. Forsythe et al., 2020	Wound healing at 1 year	Median 60% (IQR 50-69%)	1-year limb salvage: 80% (endo) vs 85% (open)	Up to 5 years	Not specified
Jennifer Skolnik et al., 2021	Major adverse limb event (MALE)	Not mentioned	MALE in 50% at 1 year	1 year	HR for MAC score: 1.09 (95% CI 1.01-1.18)

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
N. Troisi et al., 2017	Healing within 3 months	CPA 45.8% vs APA 20.7%	1-year limb salvage: CPA 100% vs APA 76.1%	1 year	p=0.009 for healing; p=0.02 for limb salvage
S. Jacqueminet et al., 2005	Healing rate	70% at 1 year	90% limb salvage rate at 1 year	At least 1 year	p=0.03 for patent pedal vessel
E. Saricilar et al., 2023	Primary wound healing, time to healing	Significant improvements	Improved limb salvage (68.8-93% at 12 mo)	Up to 12 months	p=0.011 for wound healing; p=0.001 for time to heal
Jill Sommerset et al., 2020	Wound healing	81.5% healing rate	18.5% amputation rate	Not mentioned	p<0.001 for PAT association with outcomes
Andreia Pinelo et al., 2024	Wound healing at 12 months	Shorter healing times with targeted revascularization	Not mentioned	12 months	No significant difference in 12-month healing rates

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
Shiping Ji et al., 2022	Ulcer healing rate and time	P0+P1 group had higher rate and shorter time than P2	Limb salvage, survival rates compared	2 years	p=0.001 for healing rate; p=0.004 for healing time
Osama A. Ismail et al., 2020	Wound healing rate and time	CPA: 93.3%, 3.4 months; APA: 52.6%, 6.1 months	Limb salvage: CPA 100%, APA 68.4%	12 months	p=0.003 for healing rate; p=0.02 for healing time
M. Ghweeba et al., 2022	Healing rate and time	CPA: 90%, 3.7 months; APA: 54%, 6.2 months	Limb preservation: CPA 100%, APA 61.5%	12 months	p=0.004 for healing rate; p=0.03 for healing time
Chang Sik Shin et al., 2025	Wound healing rate	64.5% at 12 months	47 amputations (25 major)	Up to 5 years	UT grade associated with non-healing and amputation

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
Ahmed Hossny et al., 2019	Complete healing at 6 months	Direct revasc: 85.71% vs Indirect: 42.85%	Limb salvage rate: 83.33% total	6 months	Not significant for healing/salvage rates
B. Y. C. Khor et al., 2017	Wound healing	Better with Direct Revascularization (DR)	Not mentioned	12 months	HR 1.97 (95% CI 1.34-2.90) for DR
M. Söderström et al., 2013	Ulcer healing rate	Direct group 72% vs Indirect 45% at 12 months	Not mentioned	12 months	HR 1.97 (95% CI 1.34-2.90), P=0.001
Limi Lee et al., 2024	Wound healing rate	64% at 12 months, 72% at 24 months	Not mentioned	24 months	HR for failure (complete pedal arch): 0.40 (P=0.039)

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
K. Dell et al., 2021	Ulcer healing	10/11 healed with PAT <180ms; 7/8 healed post-intervention	Not mentioned	4-6 weeks	Not specified
R. Hinchliffe et al., 2016	Wound healing rate at 1 year	Median 60% (IQR 50-69%)	Median major amputation rate 9% at 1 year	Up to 5 years	Not specified
Riyad Karmy-Jones et al., 2024	Limb salvage	Not mentioned	18.5% below-knee amputation at 1 year	1 year	Limb salvage predicted by post-procedural PAT
K. Chae et al., 2016	Wound healing rate	Higher in angiosome-targeted group	Higher limb salvage in angiosome-targeted group	1-2 years	OR for wound healing: 3.290 (p<0.001)

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
A. Caetano et al., 2020	Complete wound healing rate	53.7% (successful) vs 20.7% (failed)	Major amputation rate: 3.9% vs 24.1%	Mean ~2 years	$p<0.0001$ for healing and amputation rates
M. Fujii et al., 2021	Wound healing	Not mentioned	Not mentioned	Not mentioned	Skin perfusion pressure of 55 mmHg strongly associated with success
N. Troisi et al., 2021	5-year limb salvage	Not mentioned	CPA/IPA 95.1%/94.3% vs APA 67.3%	5 years	$p<0.001$ for limb salvage
Mohammed Shahat et al., 2024	Wound healing rate and time	86.7% vs 59.1% ($p=0.007$); time not significant	Major amputation rate: 5.1% vs 40.9% ($p\leq0.001$)	Not mentioned	OR for failure of healing (unsuccessful PAR) = 21.64

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
V. Alexandrescu et al., 2019	Wound healing rate and time	WTR 70%, 6.8 mo vs IR 20%, 9.8 mo	Recurrence rates ~17% in all groups	Mean 10.9 months	p=0.011 for healing rates; p=0.001 for time to healing
R. Hinchliffe et al., 2012	Ulcer healing	≥60% healed at 1 year	Limb salvage rates improved compared to conservative tx	1 year	Not specified
Mohamed Fathy Abdelghaffar et al., 2023	Wound healing rate	CPA 91.7%, IPA 88.9%, APA 50%	Not mentioned	Not mentioned	Significant difference between CPA/IPA and APA
V. Chuter et al., 2023	Healing rates	Higher with DR (81-90.9%) vs IR (41-68.5%)	Mixed results for amputation	At least 6 months	One study: p=0.245 (no significant diff)

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
G. Andros et al., 2004	Limb salvage	Not mentioned	85-90% three-year limb-salvage rate	3 years	Not specified
K. Claesson et al., 2011	Incomplete wound healing	44% did not heal	15% major amputation	Median 17 months	HR for non-healing (Wagner ≥3): 5.8 (95% CI 2.6-12.9)
T. Elgzyri et al., 2014	Primary healing	45% healed primarily	16% healed after major amputation, 19% died unhealed	Until healing or death	Time to intervention <8 weeks related to healing (p<0.001)
T. Nakama et al., 2017	Wound healing rate and time	PAA: 57.5%, 211 days vs No-PAA: 37.3%, 365 days	Not mentioned	Not mentioned	p=0.003 for rate; p=0.008 for time

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
H. Jung et al., 2019	Wound healing rate	Successful PAR 76.0% vs No-PAR 67.0%	Freedom from major amputation: PAR 96.3% vs No-PAR 84.2%	1 year	HR for healing (successful PAR): 1.564 ($p=0.022$)
Michael Rouse et al., 2024	Not mentioned	Not mentioned	No major amputations; 21.4% repeat intervention	Mean 89 days	$p<0.001$ for pre- vs post-intervention pressure
V. Alexandrescu et al., 2009	Clinical success rate	86% at 12 months, 69% at 48 months	Limb salvage: 89% at 12 mo, 80% at 48 mo	Mean 22.1 months	Patency negatively affected by lesion length >10cm ($p<0.0001$)
Danlan Pu et al., 2019	Heal rate	Group B (APG) improved vs A & C ($p<0.05$)	Major amputation improved in Group C ($p<0.05$)	6 months	Not specified

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
Ridho Sinaga et al., 2021	PEDIS score improvement	Not mentioned	Not mentioned	2 weeks	Mean PEDIS score improvement: 2.01 points ($p<0.001$)
O. Galimov et al., 2021	Limb salvage rate	Not mentioned	Intervention 66.7% vs Control 41.7%	Up to 24 months	$p < 0.05$
S. Spiliopoulos et al., 2023	Complete wound healing	38.1% at 6 months	Limb salvage 96.4% at 6 months, 92.4% at 12 months	12 months	PAT/PI had strong correlation but not significant ($p>0.3$)
F. Álvaro-Afonso et al., 2024	Healing rate	71.43%; median time 12 weeks	Amputation rate 14.3%	6 months	Not specified
Tracy J. Cheun et al., 2024	Ulcer healing at 3 months	55% (poor runoff w/ intervention) vs 25% (no intervention)	5-year AFS: 38% vs 11%	5 years	$p=0.001$ for 3-month healing; $p=0.003$ for 5-year AFS

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
B. Dong et al., 2022	Ulcer healing time and rate	PTA-VSD: 154.79 days, 52% at 180 days	1 amputation in PTA-UD group, 0 in PTA-VSD group	12 months	p=0.002 for healing rate
Jon C. Henry et al., 2016	Wound healing	67.8% healed at 1 year (with prior intervention)	>80% limb salvage at 1 year (both groups)	Mean ~2 years	p=0.019 for wound healing
J. Vouillarmet et al., 2016	Ulcer-healing rate	46% to 91% at 1 year	Not mentioned	1 year	Not specified
Thomas Collins et al., 2024	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not specified
M. Sabry et al., 2023	Wound healing rate and time	With PAR: 89%, 92 days; Without PAR: 61%, 143 days	Not mentioned	Not mentioned	Not specified

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
Rongzhi Wen et al., 2023	Reduction of trauma area	Study group 89.64% vs Routine group 70.11%	Amputation: 0 in study group vs 3 in routine group	At least 6 months	p<0.05 for significant findings
M. E. Yamany et al., 2020	Time to complete healing	Complete PAA: 9 weeks; No PAA: 29.2 weeks	Not mentioned	6 months	p=0.001 for healing times
Keisuke Miyake et al., 2024	Complete wound healing	78/117 limbs healed within 6 months	Not mentioned	6 months	Non-visualized perfusion to wounds OR 4.34 (p=0.0021)
B. Vijaynagar et al., 2019	Not mentioned	Not mentioned	Major limb amputation rate dropped from 0.83 to 0.44 per 1000	Not mentioned	Not specified

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
M. N. Bouayed et al., 2019	Total healing	Average 5 months; shorter with EGF	Primary limb salvage 88%; secondary 55.7%	41 months	Not specified
Pam Chen et al., 2024	Complete wound healing, time to healing	Variable, often no significant difference vs standard care	Amputation rates often not significantly different	Varies (e.g., 12-24 weeks)	Not specified
J. Brownrigg et al., 2013	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not specified
M. Doyle et al., 2020	Healing rates (optimal, delayed, failure)	Not specified	76.8% amputation-free survival at 1 year	1 year	$p=0.037$ for timing of amputation ≥30 days
Alexander T. Hong et al., 2025	Nonhealing ulcers	Not specified	Frailty development associated with revascularization procedures	12 months	OR for frailty dev. (revasc.): 9.09 (95% CI 2.30-45.34)

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Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
N. Troisi et al., 2021a	Wound healing	62.5% at 6 months	Not mentioned	6 months	No significant association between time-density curves & TcPO2
Fengjie Tang et al., 2023	Wound healing	71.4% healed within 12 weeks	1 major, 9 minor amputations	12 weeks	Not specified
Rushabh A Parekh et al., 2024	Ulcer healing outcome	80% showed improvement	Not mentioned	3 months	Significant association between ABPI/TBI and Doppler findings
R. Jarosiková et al., 2025	Healing, amputation	SAD associated with non-healing after 6 months	SAD associated with amputation risk after 6 months	6 months	p=0.043 for association after 6 months

Citation	Primary Outcome Measure	Healing Rate/Time	Secondary Outcomes	Follow-up Duration	Key Statistical Results
E. Iacopi et al., 2023	Healing rate and time	Group A 80.4%, 67 days vs Group B 60.4%, 134 days	Not mentioned	Not mentioned	p=0.0021 for rate; p=0.020 for time
Mwidimi Ndosi et al., 2017	Healing incidence				

DISCUSSION

This systematic review synthesizes a large and heterogeneous body of literature to address the association between pedal access intervention and radiologically measured wound healing in diabetic foot ulcers. The findings consistently and robustly support a positive and clinically significant association, confirming our primary hypothesis. The evidence demonstrates that successfully restoring pulsatile blood flow to the foot, particularly through the pedal arch, is a critical determinant of wound healing, as objectively measured by various imaging modalities.

The Critical Role of the Pedal Arch and Pedal Arch Revascularization (PAR)

One of the most striking findings across multiple studies is the paramount importance of the pedal arch's integrity and patency. Troisi et al. (2018, 2017) and Ismail et al. (2020) provided foundational evidence showing that patients with a **complete pedal arch (CPA)** post-intervention have significantly better outcomes than those with an incomplete (IPA) or absent (APA) arch. This was not merely a statistical association but a profound clinical difference: CPA patients exhibited

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dramatically higher healing rates (up to 93.3% vs. 52.6% for APA), substantially shorter healing times (3.5 vs. 5.7 months), and near-perfect 1-year limb salvage (100% vs. 68.4%). These findings were echoed by Ghweeba and Ghweeba (2022) and Abdelghaffar et al. (2023), further solidifying the CPA as a powerful prognostic indicator. The pedal arch serves as the final common pathway for blood delivery to the forefoot and digits. An open arch provides a low-resistance circuit that can perfuse the entire foot, whereas an occluded arch leaves the foot dependent on inadequate collaterals, perpetuating ischemia despite successful proximal intervention. This concept is elegantly illustrated by Lee et al. (2024), who showed that proximal revascularization itself can lead to a 24.1% improvement in complete pedal arch patency, directly correlating with improved healing (HR for failure with CPA: 0.40, P=0.039).

Building on this, studies focusing specifically on **Pedal Arch Revascularization (PAR)** confirmed its immense therapeutic value. Shahat et al. (2024) and Jung et al. (2019) demonstrated that successful PAR was associated with healing rates exceeding 75% and a dramatic reduction in major amputation (from 40.9% to 5.1% in the Shahat study). The odds ratio for failure of healing with unsuccessful PAR was a staggering 21.64, underscoring that failure to restore flow through the arch is a near-catastrophic event (Shahat et al., 2024). Nakama et al. (2017) in the RENDEZVOUS registry also confirmed this, with pedal artery angioplasty (PAA) resulting in a 57.5% healing rate versus 37.3% in the no-PAA group. These studies collectively argue that when infra-popliteal disease extends into the foot, intervention cannot stop at the ankle; it must address the pedal arch itself to achieve optimal outcomes.

Angiosome-Guided Revascularization: Direct vs. Indirect Flow

The angiosome concept, which posits that specific areas of the foot are perfused by specific source arteries, has gained traction as a strategy to guide revascularization. The evidence from this review suggests that **direct revascularization (DR)** of the artery feeding the ulcer's angiosome is superior to **indirect revascularization (IR)** via collaterals. Khor and Price (2017) and Söderström et al. (2013) both reported a near-identical hazard ratio of 1.97 (95% CI, 1.34-2.90, P=0.001) for wound healing with DR compared to IR. Chae and Shin (2016), in a meta-analysis, also found a significantly higher odds ratio for wound healing (3.290, p<0.001) with angiosome-targeted angioplasty.

However, this concept is nuanced. Troisi et al. (2017) made a critical observation, suggesting that the quality of the pedal arch (CPA vs. IPA/APA) might be a more important predictor of success than the directness of revascularization. They posited that a CPA can effectively turn an IR into a functional DR by providing robust collaterals, while a poor arch may render even a direct revascularization ineffective. This highlights the interconnectedness of these concepts and suggests that the ultimate goal should be to achieve a CPA, whether through DR of a specific artery or by improving overall inflow to the point that the arch can be pressurized. The work of Alexandrescu et al. (2019) supports this by showing that wound-targeted revascularization (WTR) in a "best endovascular effort" approach led to superior healing rates and times compared to non-targeted IR, even in a real-world, complex patient cohort.

The Emergence of Novel, Non-Invasive Radiological Markers

A significant theme in the recent literature is the validation of non-invasive or minimally invasive imaging techniques to assess perfusion and predict healing. **Pedal Acceleration Time (PAT)**, measured by duplex ultrasound, has emerged as a particularly promising tool. PAT is the time it takes for blood flow in a pedal artery to reach its peak systolic velocity; a prolonged PAT indicates significant proximal obstruction. Sommerset et al. (2020) and Karmy-Jones et al. (2024) demonstrated that PAT correlates strongly with wound healing, with an 81.5% healing rate and limb salvage predicted by post-procedural PAT values. Dell and Shafique (2021) provided a practical threshold, showing that 10/11 ulcers with a PAT <180ms healed. This offers a powerful, repeatable, and non-invasive bedside tool to not only diagnose PAD but also to triage patients, assess response to intervention, and predict outcomes (Pinelo et al., 2024; Silva et al., 2025; Elyamany et al., 2025). Its utility is further validated by its integration into studies examining intraprocedural hemodynamics (Spiliopoulos et al., 2023) and long-term outcomes (Hart et al., 2024).

Other novel techniques include **2D perfusion angiography**, which can generate time-density curves to quantify tissue perfusion. Troisi et al. (2021a) explored this in patients undergoing femoro-popliteal intervention, but found no significant association with TcPO2 changes, suggesting that improvements in proximal flow may not always translate to distal microvascular changes in complex patients. This underscores the need for direct assessment of foot-level perfusion. Furthermore, **MAC (Medial Arterial Calcification) scores** from plain radiographs have been investigated as a prognostic marker. Skolnik et al. (2021) found an association between MAC score and major adverse limb events (HR 1.09; 95% CI 1.01-1.18), while Jarosiková et al. (2025) linked "small artery disease" (SAD/MAC) to non-healing after PTA. These findings suggest that the severity of calcification, a common finding in diabetic PAD, can independently predict poor outcomes, possibly by impairing the vasodilatory capacity and compliance of the arteries (Carmena-Pantoja et al., 2021).

Clinical Outcomes and the Importance of Multidisciplinary Care

The ultimate goal of revascularization is not just a healed wound, but a functional, pain-free limb. The reviewed studies consistently show that successful revascularization translates to superior **limb salvage rates**. Caetano et al. (2020) reported a major amputation rate of only 3.9% in patients with successful revascularization versus 24.1% in those where it failed ($p<0.0001$). Brechow et al. (2013) also showed that addressing PAD through revascularization improves major amputation rates in complex patients. Elgzyri et al. (2014) provided critical evidence on the importance of **timing**, showing that early revascularization (<8 weeks from presentation) is significantly associated with higher healing probability ($p<0.001$). This highlights the need for rapid access to vascular specialists, as advocated by Vijaynagar et al. (2019) and Tang et al. (2023) with their "rapid access" and "DREAM" clinic models, respectively.

Furthermore, the studies underscore that revascularization is just one part of a complex equation. Patient factors such as **glycemic control** (Dutta et al., 2021; Fesseha et al., 2018), **frailty** (Hong et al., 2025), **infection and osteomyelitis** (Iacopi et al., 2023; Tardáguila-

García et al., 2023), **renal disease** (M. Doyle et al., 2020), and **offloading** (Jason Zhang et al., 2024) are all powerful determinants of healing. This reinforces the absolute necessity of a **multidisciplinary team (MDT) approach** involving podiatrists, vascular surgeons, interventional radiologists, infectious disease specialists, and endocrinologists to optimize all aspects of patient care (Macfarlane et al., 2024; Meloni et al., 2021; S. H. Lu & McLaren, 2017).

Confounding Factors and Study Limitations

Despite the consistency of the findings, several limitations and confounders must be considered when interpreting this body of evidence.

1. **Heterogeneity:** The most significant limitation is the profound heterogeneity across studies. This includes variability in patient populations (e.g., varying Wagner/UT grades, inclusion/exclusion of ESRD), interventions (type of procedure, target vessels, timing), outcome measures (clinical vs. radiological, definitions of healing), and follow-up durations. This makes direct comparison and quantitative synthesis (meta-analysis) challenging.

2. **Study Design:** The vast majority of studies are observational cohort studies (retrospective or prospective), which are susceptible to selection bias and unmeasured confounding. There is a notable lack of large, well-designed randomized controlled trials (RCTs) directly comparing different revascularization strategies. Systematic reviews by Forsythe et al. (2020), Hinchliffe et al. (2016), and Chuter et al. (2023) all acknowledge this as a major limitation of the field.

3. **Confounding Factors:** Many studies fail to adequately control for key confounders. For example, the impact of optimal medical therapy (antiplatelets, statins), smoking cessation, infection status, and wound care protocols is often not included in multivariate models. The presence of **osteomyelitis** is a particularly powerful confounder, as it can persist despite adequate perfusion and prevent wound healing (E. Iacopi et al., 2023; Aroa Tardáguila-García et al., 2023).

4. **Radiological Assessment Standards:** There is a lack of standardization in radiological assessments. Who performs the measurement (e.g., a blinded radiologist vs. the treating physician) and data on inter-observer reliability are rarely reported, introducing potential measurement bias. The definition of a "complete" pedal arch can also vary.

5. **Publication Bias:** Studies with positive findings are more likely to be published, potentially skewing the overall impression of an intervention's effectiveness.

6. **Generalizability:** Many studies have exclusion criteria (e.g., life expectancy <1 year, severe dementia, non-ambulatory status) that limit the applicability of findings to the "real-world" population of frail, multi-morbid patients often seen in clinical practice.

CONCLUSION AND SUGGESTIONS

Conclusion

This systematic review provides compelling evidence for a strong, positive, and clinically meaningful association between successful pedal access intervention and radiologically measured wound healing progression in diabetic foot ulcers. The key determinant of success is the restoration of robust, pulsatile blood flow to the foot, most effectively achieved by establishing or preserving a **complete pedal arch**. Pedal arch revascularization and angiosome-directed approaches are both effective strategies for achieving this goal. The integration of advanced, non-invasive radiological tools like **pedal acceleration time (PAT)** offers a paradigm shift, enabling objective patient assessment, procedural guidance, and outcome prediction. While the evidence base is robust in its consistency, it is largely derived from observational studies with significant heterogeneity. Nevertheless, the findings unequivocally support an aggressive revascularization strategy for ischemic DFUs, ideally delivered within a multidisciplinary framework and as early as possible in the patient's care pathway. Failure to address distal pedal disease leaves patients at a drastically elevated risk of non-healing, major amputation, and loss of independence.

Suggestions for Future Research and Clinical Practice

1. **Standardization of Outcomes:** The field would greatly benefit from a core outcome set for DFU research. This should include standardized definitions of wound healing (e.g., time to complete epithelialization), radiological measures (e.g., a universally accepted classification for pedal arch patency and PAT thresholds), and clinical endpoints (e.g., major adverse limb events). This would facilitate robust meta-analyses and cross-study comparisons.

2. **Need for Randomized Controlled Trials:** Well-designed, multicenter RCTs are urgently needed to compare different revascularization strategies head-to-head (e.g., PAR vs. angiosome-guided tibial intervention, endovascular-first vs. surgical bypass in suitable candidates). These trials should stratify patients based on pre-intervention pedal arch quality and use standardized, objective healing measures as the primary endpoint.

3. **Validation of Imaging Biomarkers:** Further prospective studies are needed to validate the predictive power of PAT, MAC scores, and perfusion angiography in diverse patient populations. Research should focus on establishing definitive, clinically actionable thresholds for these biomarkers to guide treatment decisions (e.g., "a PAT of >225ms should prompt immediate revascularization").

4. **Integration of Advanced Imaging into Clinical Pathways:** Healthcare systems should invest in training and equipment to make tools like duplex ultrasound with PAT capability a standard part of the vascular assessment for all patients with DFUs. This will allow for more precise patient selection and earlier intervention.

5. **Focus on Multidisciplinary Care:** The evidence overwhelmingly supports the MDT model. Healthcare institutions must prioritize and resource integrated foot care teams to ensure that revascularization is seamlessly combined with optimal offloading, infection management, glycemic control, and nutritional support.

6. **Addressing Confounders in Research:** Future studies must meticulously collect and account for key confounders, particularly the presence and treatment of osteomyelitis, glycemic control (HbA1c), nutritional status, and medication adherence. This will help isolate the true treatment effect of revascularization.

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