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The Angiosome Concept in Endovascular Treatment of Peripheral Arterial Disease of the Lower Leg Arteries

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Abstract

Aim: The aim of this paper is to explain the angiosome concept and its role in planning endovascular treatment of infrapopliteal peripheral arterial disease, with particular emphasis on the appropriate selection of the target artery to restore foot perfusion and prevent adverse outcomes, including amputation and death. **Materials and Methods**: This paper is based on a narrative review of the available scientific and professional literature on peripheral arterial disease, endovascular treatment and the angiosome concept. The analysis included textbooks, original and review scientific articles and professional online resources retrieved from bibliographic databases (PubMed) and other relevant medical sources. **Results**: The reviewed literature indicates that endovascular revascularisation is one of the most effective treatment options for infrapopliteal peripheral arterial disease and plays a crucial role in patients with chronic limb-threatening ischemia. Application of the angiosome concept may improve wound healing and increase limb salvage by achieving direct revascularisation of the artery supplying the affected vascular territory. However, the angiosome concept has certain limitations, highlighting the importance of an individualised approach to each patient. **Conclusion**: The angiosome concept represents an effective strategy for restoring adequate arterial perfusion to ischemic tissue by directly linking the affected vascular territory with its corresponding source artery through endovascular revascularisation. This approach contributes to improved wound healing, limb preservation, reduced amputation rates, and lower mortality. Although numerous studies support the advantages of direct angiosome-targeted revascularisation, collateral circulation, anatomical variations, and technical feasibility should also be considered. Therefore, indirect revascularisation may represent an appropriate alternative in selected cases, emphasising the importance of an individualised treatment approach for each patient.

Keywords: angiosome; limb; endovascular revascularization; ischemia; peripheral arterial disease

1. Introduction

The angiosome concept plays an important role in planning endovascular treatment in patients with peripheral arterial disease affecting the arteries of the lower leg. This condition represents a significant risk factor for the development of ulcerations, ischemia, and gangrene. The angiosome concept links the localisation of the ischemic lesion to the selection of the target artery for intervention and its impact on clinical treatment outcomes. Furthermore, there is a distinction between direct and indirect revascularisation in achieving optimal perfusion, with the aim of promoting wound healing and achieving favourable outcomes, such as limb salvage and a reduction in the risk of mortality, ultimately contributing to an improved quality of life for the patient.

1.1. Peripheral arterial disease

Peripheral arterial disease (PAD), also referred to as peripheral vascular disease (PVD), is a condition characterised by systemic atherosclerotic involvement and affects more than 200 million people worldwide. It most commonly affects older adults, patients with diabetes, smokers, and individuals with chronic kidney disease. Atherosclerosis is a chronic progressive disease characterised by the accumulation of lipid plaque within the arterial walls, leading to narrowing (stenosis) or occlusion of the arteries. PAD results from this progressive arterial narrowing and most commonly affects the aortoiliac, femoropopliteal, and infrapopliteal segments. Consequently, perfusion of the lower extremities is impaired (1).

PAD manifests in various forms, ranging from asymptomatic disease to intermittent claudication (pain occurring

during movement) and chronic limb-threatening ischemia (CLTI), which carries a risk of limb loss. Coronary artery disease is present in approximately 70% of patients with PAD. Therefore, timely diagnosis and treatment are of great importance in order to prevent adverse outcomes and reduce mortality rates (1).

1.2. Classification of arterial insufficiency

To assess the severity of peripheral arterial disease (PAD), various classification systems are used. The most commonly used are the Rutherford and Fontaine classification systems (presented in Tables 1 and 2), which are used to determine the risk of limb ischemia that may occur in patients who are already at risk of amputation, particularly in the presence of infected wounds, such as those associated with diabetic foot disease (2).

Table 1. Rutherford Classification (2)

Grade	Clinical presentation
0	Asymptomatic
1	Mild claudication
2	Moderate claudication
3	Severe claudication
4	Ischemic rest pain
5	Tissue loss with ulceration
6	Severe ischemic ulcers and gangrene

Table 2. Fontaine Classification (2)

Stage	Clinical presentation
I	Asymptomatic
II	Intermittent claudication
IIa	Intermittent claudication after walking >200 m without pain
IIb	Intermittent claudication after walking <200 m
III	Rest pain
IV	Ischemic ulcers and gangrene

1.3. Infrapopliteal arterial disease

Infrapopliteal arterial disease refers to peripheral arterial disease (PAD) located in the arteries of the lower leg, i.e., below the popliteal bifurcation. It affects the anterior tibial artery, posterior tibial artery, and fibular (peroneal) artery. Chronic stable limb ischemia is generally asymptomatic, while approximately 20% of patients experience intermittent claudication. As a result of impaired blood flow, compensatory mechanisms and collateral circulation develop. When these mechanisms are no longer sufficient to meet the oxygen demands of the tissues, rest pain and tissue necrosis may occur. Pain usually develops in the distal parts of the foot, particularly in the toes or heel. Other characteristic symptoms include cold intolerance, joint stiffness, hyperesthesia (increased sensitivity to stimuli), and erythema accompanied by pallor upon elevation of the limb (Buerger's sign), among others (3).

1.4. Diagnosis of peripheral arterial disease

Since PAD is asymptomatic in most cases, timely recognition of any signs and symptoms, diagnosis, and treatment are of great importance. Early intervention reduces the likelihood of adverse outcomes, such as amputation or death (4).

One of the primary diagnostic methods is physical examination, during which limb pallor or abnormalities in the arterial pulse may be detected as part of the basic vascular assessment. Physical examination can also be used to rule out the presence of abdominal or popliteal artery aneurysms (4).

An objective and quantitative assessment of the disease can be obtained using non-invasive diagnostic methods, such as measurement of the ankle-brachial index (ABI), segmental resting pressure measurements and measurements following an exercise test, colour Doppler ultrasound (DUS), computed tomography angiography (CTA), or magnetic resonance angiography (MRA) (4).

In addition to the aforementioned non-invasive methods, digital subtraction angiography (DSA) is considered the gold standard for vascular imaging. DSA is an invasive diagnostic method that provides an accurate assessment of the severity and anatomical location of PAD. It provides a detailed visualisation of vascular anatomy and is used for planning endovascular interventions and surgical procedures. During the examination, both the patient and medical staff are continuously exposed to ionising radiation. In addition, the use of iodinated contrast media may result in adverse effects, including nephrotoxicity, particularly in patients with renal artery or renal parenchymal disease. DSA provides excellent visualisation of stenoses, occlusions, atherosclerotic plaques, filling defects, dilated arteries, and other vascular abnormalities (4).

1.5. Endovascular treatment

Endovascular treatment is a therapeutic approach aimed at preserving or restoring the patency of a diseased or damaged blood vessel in order to re-establish distal perfusion, promote wound healing, and preserve the affected limb. The procedure is performed using catheters, most commonly without the need for conventional surgical incision. Instead of open surgery, the physician introduces a catheter through an artery, most commonly via the groin or wrist, and under fluoroscopic or angiographic guidance advances it to the site of the vascular lesion, where the therapeutic intervention can then be performed (5).

The main methods of endovascular treatment include percutaneous transluminal angioplasty (PTA) and stent placement, the primary purpose of which is to dilate occluded or stenotic blood vessels, most commonly as a result of atherosclerosis, using a balloon catheter and a stent. These techniques are most commonly used in the treatment of coronary and peripheral arterial disease (Figure 1) (5).

Other endovascular techniques include embolisation, which involves intentional occlusion of a blood vessel and is used in the treatment of bleeding or tumours; treatment of aneurysms using coils (coiling) or stent grafts;

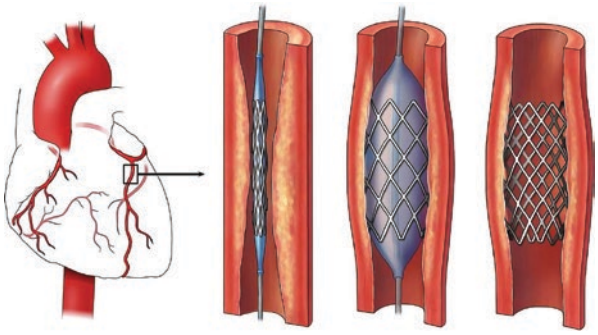


Figure 1. PTA and stent placement
Source: https://kardiocentar.com/wp-content/uploads/2019/04/stent-1-800.jpg

and thrombectomy, a procedure in which blood clots are mechanically removed, most commonly in the treatment of acute ischemic stroke (5).

Successful peripheral endovascular interventions require an angiography suite equipped with a C-arm with a large range of motion (Figure 2), as well as long guidewires. To obtain high-quality imaging, fluoroscopy, digital subtraction angiography (DSA), road mapping, and adequate image storage capacity are also used. In addition, continuous monitoring of the patient's vital signs is essential, as is careful selection of the vascular access site, arterial sheath, guidewire, catheter, stents, and any medications that may be required during the procedure (4).



Figure 2. C-arm for fluoroscopic imaging
Source: https://rgshealthcare.com/c-arm/

Endovascular procedures offer several advantages, including a lower risk of infection, shorter recovery time, avoidance of a large surgical incision, and the possibility of performing the procedure under local anaesthesia in many cases. However, certain complications may occur, although they are generally rare. These include bleeding at the catheter insertion site, vascular injury, allergic reactions to contrast media, embolisation, and vessel rupture (5).

1.6. Arteries of the lower leg

The main artery of the lower extremity is the femoral artery (*a. femoralis*), which continues directly as the popliteal artery (*a. poplitea*). The popliteal artery gives off branches supplying the knee joint and subsequently divides into two main branches: the anterior tibial artery (*a. tibialis anterior*) and the posterior tibial artery (*a. tibialis posterior*) (6).

The anterior tibial artery (*a. tibialis anterior*) passes through an opening in the superior part of the interosseous membrane and extends from the popliteal fossa between the muscles of the anterior compartment of the lower leg. After passing beneath the extensor retinaculum, it reaches the dorsum of the foot, where it continues as the dorsalis pedis artery (*a. dorsalis pedis*). This artery gives rise to two collateral branches: the arcuate artery (*a. arcuata*) and the deep plantar artery (*a. plantaris profunda*). The arcuate artery gives off branches to the intermetatarsal spaces and toes, while the deep plantar artery passes through the first intermetatarsal space and joins the plantar arterial circulation on the sole of the foot (6).

The posterior tibial artery (*a. tibialis posterior*) supplies the posterior and lateral muscle compartments of the lower leg. It passes between the muscles of the posterior compartment, travels posterior to the medial malleolus, and reaches the sole of the foot. It then divides into two branches that course along the plantar aspect of the foot. The proximal portion of the artery gives rise to the peroneal (fibular) artery (*a. peronea*, *a. fibularis*), which courses through the region of the muscles of the lateral compartment. The posterior tibial artery has two terminal branches: the medial plantar artery (*a. plantaris medialis*), which runs through the medial plantar groove, and the lateral plantar artery (*a. plantaris lateralis*), which gives off branches to the intermetatarsal spaces and toes (6).

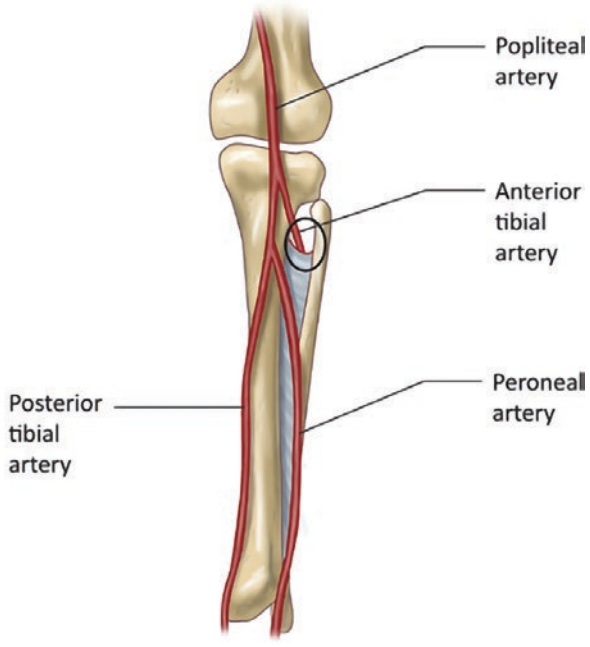


Figure 3. Main arteries of the lower leg
Source: https://www.cambridge.org/core/books/abs/atlas-of-surgical-techniques-in-trauma/lower-extremities/14A0823D78F69D00D097C7033253E678

Figure 3 illustrates the main arteries of the lower leg that are essential for supplying the angiosomes of the foot and ankle, namely the posterior tibial artery (*a. tibialis posterior*), anterior tibial artery (*a. tibialis anterior*), and peroneal (fibular) artery (*a. peronea* / *a. fibularis*).

1.7. Recanalization of the arteries of the lower leg

Adequate blood flow through the infrapopliteal arteries is essential for limb preservation. Although PTA has proven effective in the treatment of stenotic and occlusive disease of the iliac and femoral arteries, its application in atherosclerotic disease of the popliteal and tibial arteries is limited due to the technical complexity of the procedure and its limited effectiveness in patients classified as Rutherford stages III–VI, in whom surgical reconstruction or amputation has traditionally been considered the most common treatment option. In the presence of stenosis or occlusion, the primary objective is to restore vascular patency and re-establish blood flow in order to preserve the threatened limb. Figure 4 shows successful recanalisation of the anterior tibial artery. However, when multiple infrapopliteal lesions are present, the question is which artery to select as the target for intervention (4).

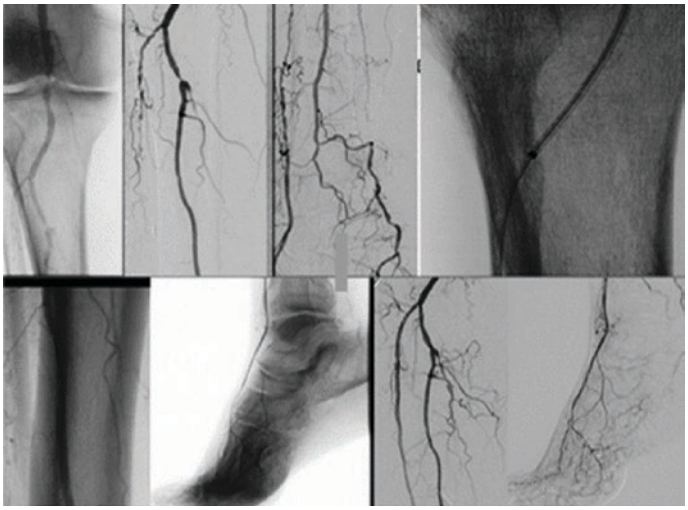


Figure 4. Recanalisation of the anterior tibial artery; stenosis before angioplasty, during the procedure, and the final result
Source: https://www.sciencedirect.com/science/article/pii/S2211568415000182

There are several approaches to arterial recanalisation, including:

- **angiosome-directed revascularisation**;
- ***easiest-first* strategy**;
- ***as many as possible* strategy**; and
- ***as far as possible* strategy** (7).

According to the angiosome concept, the foot and ankle are divided into six anatomical regions (angiosomes), each supplied by a source artery. Direct revascularisation targets the source artery supplying the angiosome in which the wound is located, with the aim of achieving improved and faster wound healing. If revascularisation through the source artery cannot be achieved, indirect revascularisation is performed through an alternative artery that can provide adequate perfusion of the foot via collateral vessels (7).

The ***easiest-first* strategy** involves recanalisation of the artery that is technically the most accessible, regardless of whether it is the artery that directly supplies the angiosome containing the wound. The aim of this approach is to restore adequate blood flow to the foot through the artery that can be crossed and treated most easily (7).

The ***as many as possible* strategy** involves recanalising as many infrapopliteal arteries as possible, regardless of lesion length or the angiosome to which the lesion corresponds, with the aim of maximising foot perfusion and increasing collateral circulation. Increasing the number of patent arteries may improve wound healing and increase the likelihood of limb salvage (7).

The ***as far as possible* strategy** aims to achieve recanalisation of the most distal areas of the foot, such as the dorsalis pedis artery, plantar arteries, or arteries of the pedal arch, in order to provide perfusion to distal wounds of the foot or toes (7).

Therefore, the goal of recanalisation is not merely to technically restore patency of the target artery, but to achieve effective distal perfusion. When selecting a recanalisation strategy, the anatomy and location of the lesion, wound location, status of distal blood flow and collateral circulation, as well as the patient's overall clinical condition, should be taken into consideration. The angiosome concept may assist in selecting the target artery, and direct revascularisation often results in better wound-healing outcomes; however, it may sometimes be technically challenging or not feasible (7).

1.8. Definition of the angiosome

The angiosome concept was introduced by Taylor and Palmer in their research in 1987. The concept is based on the idea that blood vessels form a continuous three-dimensional network that supplies the skin and underlying

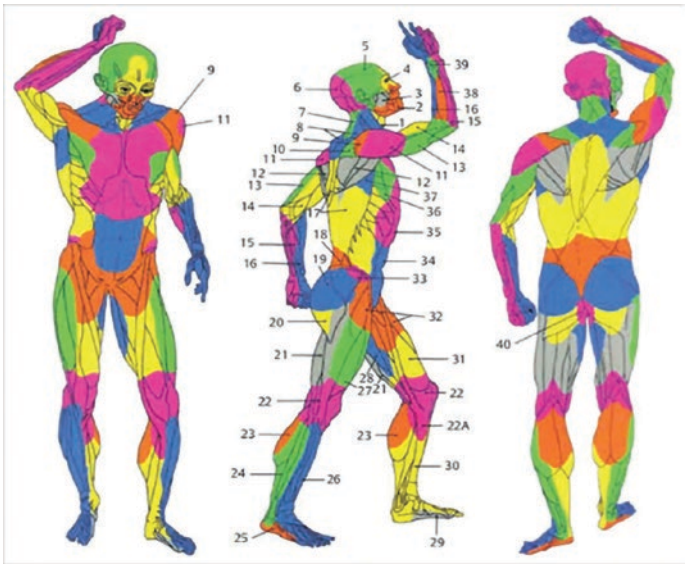


Figure 5. The 40 angiosomes of the human body
Source: https://www.researchgate.net/publication/366255248/figure/fig3/AS:11431281108032711@1671206870835/an-Taylors-vascular-territories-angiosomes-of-the-integument-of-the-skin-according-to.ppm

tissues. Each three-dimensional anatomical territory is supplied by a source artery that passes through the skin and subcutaneous tissue and extends into the deeper tissues. Based on this connection between the skin and deeper tissues through the source artery, the human body can be divided into 40 blocks, or vascular territories, i.e., segments known as angiosomes, which are illustrated in Figure 5 (8).

2. Aim of the study

The aim of this study is to explain the angiosome concept and to highlight its effectiveness in planning endovascular treatment of peripheral arterial disease affecting the arteries of the lower leg, with particular emphasis on the appropriate selection of the target artery through which foot perfusion can be restored and adverse outcomes prevented. This study is based on a narrative review of the available scientific and professional literature on peripheral arterial disease, endovascular treatment, and the angiosome concept. The analysis also includes relevant textbooks, scientific articles, and professional online sources identified through bibliographic databases, such as PubMed, as well as other medical sources.

3. Discussion

3.1. Organization of vascular territories

The human body is divided into 40 angiosomes. Each angiosome represents a three-dimensional anatomical territory or block consisting of several tissue layers, including the skin, subcutaneous tissue, fascia (the connective tissue layer surrounding muscles and internal organs), muscle, and bone. Each block is supplied by a source artery (8).

The internal vascular supply of an angiosome is provided by perforators, which are small blood vessels originating from deeper tissue layers, such as muscle or fascia, and extending toward the skin (8).

The vascular territories are not isolated from one another but are interconnected by so-called *choke vessels*, which may also be referred to as communicating vessels. Choke vessels are small blood vessels (arterioles) with a narrow lumen and limited blood flow that are constricted under normal physiological conditions but can dilate when required, such as in response to ischemia in a particular tissue territory. Their importance lies in providing collateral perfusion between adjacent territories, thereby enabling indirect tissue perfusion. Thus, these vessels allow blood flow between adjacent angiosomes when flow through the source artery is interrupted, for example, due to an obstruction. In addition to this indirect vascular supply, direct arterio-arterial connections also exist, allowing blood flow to bypass obstructions within the vascular network more immediately (8).

3.2. Application of the angiosome concept

The angiosome concept was initially introduced in the field of plastic and reconstructive surgery. The angiosome concept of reperfusion can be applied when planning surgical incisions and tissue dissection in a manner that preserves blood flow, thereby promoting wound healing and helping to predict which vascular territory can be successfully utilised and whether an amputation site is likely to heal. The angiosome concept may also assist in selecting the most appropriate revascularisation method, such as bypass grafting or endovascular therapy, that is more likely to result in successful healing of an existing ischemic ulcer (9).

3.3. Angiosomes of the foot and ankle

The foot and ankle region can be divided into six angiosomes, each of which is supplied by a specific artery of the lower leg. The foot and ankle represent the distal part of the lower extremity, where the major arteries have numerous additional arterial connections that provide alternative pathways for blood flow when flow through a major artery is compromised. Knowledge of the foot and ankle angiosomes and the interactions between their source arteries is clinically important in foot and ankle surgery, particularly in peripheral arterial disease (PAD) (10).

The six angiosomes of the foot and ankle originate from three major arteries: the posterior tibial artery (*a. tibialis posterior*), anterior tibial artery (*a. tibialis anterior*), and peroneal (fibular) artery (*a. peronea* / *a. fibularis*). Each of these arteries supplies a specific region of the foot and ankle. The posterior tibial artery supplies the medial ankle, plantar aspect of the foot, and medial aspect of the heel; the anterior tibial artery supplies the dorsal aspect of the foot; while the peroneal artery supplies the lateral ankle, the posterolateral aspect of the foot, and the lateral aspect of the heel (10).

Figure 6 illustrates the six angiosomes of the foot and ankle:

1. **Anterior communicating artery angiosome** (from the peroneal artery)
2. **Dorsalis pedis artery angiosome** (from the anterior tibial artery)



Figure 6. Angiosomes of the foot and ankle
Source: https://www.researchgate.net/figure/A-global-illustration-of-the-currently-described-foot-angiosomes-1-The-Anterior_fig1_331734135

3. **Lateral plantar artery angiosome** (from the posterior tibial artery)
4. **Lateral calcaneal artery angiosome** (from the peroneal artery)
5. **Medial calcaneal artery angiosome** (from the posterior tibial artery)
6. **Medial plantar artery angiosome** (from the posterior tibial artery) (11).

This division into vascular territories establishes a link between the location of a wound and the corresponding arterial blood supply to that region, which in turn forms the basis for planning revascularisation (10).

3.4. The angiosome concept in planning optimal revascularization

The primary goal of revascularisation is to achieve adequate distal perfusion rather than merely restoring patency of the target artery. The aim is therefore to restore arterial perfusion to the ischemic region, thereby ensuring sufficient blood flow to the distal parts of the limb and, consequently, improving tissue oxygenation and nutrient supply. Furthermore, optimal revascularisation promotes more effective healing of wounds and ulcers by facilitating faster tissue regeneration and, consequently, more rapid wound closure. The ultimate goal is to preserve the limb and its function in order to prevent adverse outcomes such as amputation or death. In addition to these favourable outcomes of successful revascularisation, alleviation of rest pain, sustained restoration of adequate distal perfusion, and improvement in the patient's quality of life are also important considerations (10).

To achieve these objectives, an appropriate target artery must be selected to provide optimal perfusion of the ischemic region, and the angiosome concept represents one approach that can be used for this purpose. Thus, restoring patency of any artery may not be sufficient, particularly in the presence of infrapopliteal lesions. The selection of the target artery may depend on the location of the wound, and the angiosome concept enables the anatomical region of the ischemic lesion to be linked to the artery that primarily supplies it (10). Figure 7 shows necrosis involving the right great toe, together with the corresponding angiosome and an angiogram of the foot circulation.

Although revascularisation techniques have advanced considerably, approximately 25% of patients with heel ulcers still undergo lower-limb amputation despite a palpable pulse in the foot (12). Such an adverse outcome may be associated with inadequate wound care or insufficient revascularisation of the local ischemic region, which may result from occlusion of vascular connections between the revascularised artery and the source artery supplying the ischemic area. This highlights the importance of successful revascularisation of an ischemic wound, which involves a more complex process than simply restoring blood flow through a particular artery (10).

Two main revascularisation strategies can be distinguished: surgical bypass grafting and endovascular therapy (EVT). Bypass surgery has been associated with greater risk due to a higher rate of mortality related to operative complications, such as wound infection, cardiovascular shock, early bypass graft occlusion, renal failure, and other complications. Approximately 15% of patients undergoing bypass surgery subsequently undergo amputation. The introduction of the angiosome concept has contributed to improved effectiveness of revascularisation procedures. Limb salvage rates following bypass surgery with direct revascularisation were reported to be 91%, compared with 62% following indirect revascularisation. On the other hand, EVT has proven to be an effective revascularisation method due to the development of various techniques, its low complication rate, and high limb salvage rate. Based on these findings, the effectiveness of applying the angiosome concept in the context of EVT has been investigated (9).

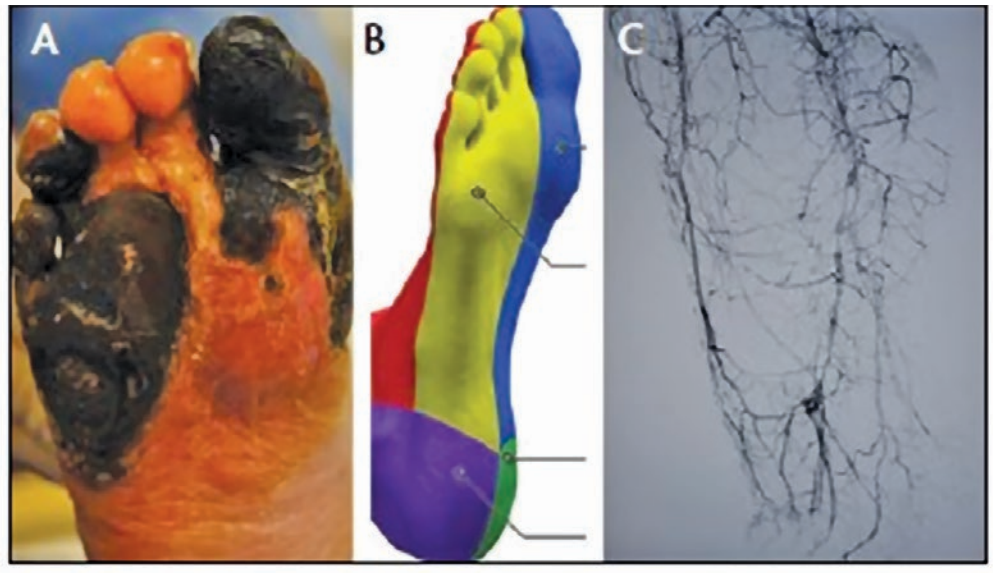


Figure 7. Necrosis of the great toe and visualization of the circulation of the corresponding angiosome. Tissue necrosis of the foot (A). Angiosome model of the foot (B). Arterial angiogram of the foot circulation (C).
Source: https://evtoday.com/articles/2014-may/angiosome-directed-therapy-for-the-cli-patient

3.4.1. Direct and indirect revascularization

Each wound corresponds to a specific angiosome supplied by a source artery (Figure 8). This artery is the primary target for revascularisation in order to achieve a favourable clinical outcome, namely healing of the corresponding wound and, ultimately, limb salvage. Therefore, the artery that directly supplies the angiosome affected by the wound should be revascularised endovascularly (direct revascularisation, DR). For heel wounds, the target arteries are the peroneal artery or the posterior tibial artery. For wounds involving the plantar aspect of the foot, the posterior tibial artery should be revascularised. In wounds located in the lateral ankle region, the peroneal artery should primarily be targeted. For wounds involving the dorsal aspect of the foot, the anterior tibial artery should be targeted. If revascularisation through the primary source artery cannot be achieved, revascularisation may instead be performed through another artery in order to establish perfusion via collateral connections (indirect revascularisation, IR) (10).

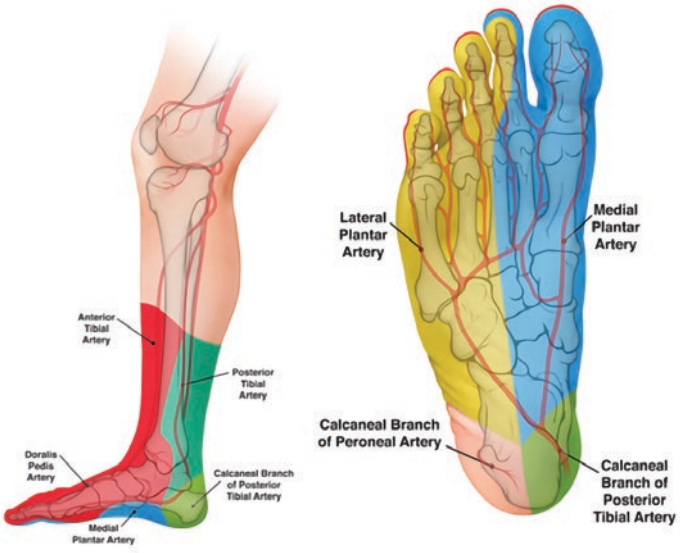


Figure 8. Angiosomes of the foot and ankle and their corresponding major source arteries
Source: https://diabeticfootonline.com/2013/08/26/does-direct-angiosome-revascularization-with-runoff-scoring-improve-outcomes/

EVT has proven useful in increasing blood volume and improving hemodynamics. During intervention, the angiosome-directed approach has demonstrated that DR can significantly improve perfusion of the ischemic region compared with perfusion achieved through collateral circulation alone. Compared with IR, angiosome-directed DR has been shown to be more effective in promoting wound healing and achieving adequate tissue perfusion (13). In particular, DR has been associated with a greater increase in tissue blood volume in the foot than IR, thereby improving local perfusion. Furthermore, TTP (*time to peak*), which represents the time required for the contrast agent to reach its peak concentration, has been shown to be significantly shorter following DR than IR. This indicates that blood reaches the distal parts of the limb, particularly the foot, more rapidly (14). Figure 9 demonstrates tissue

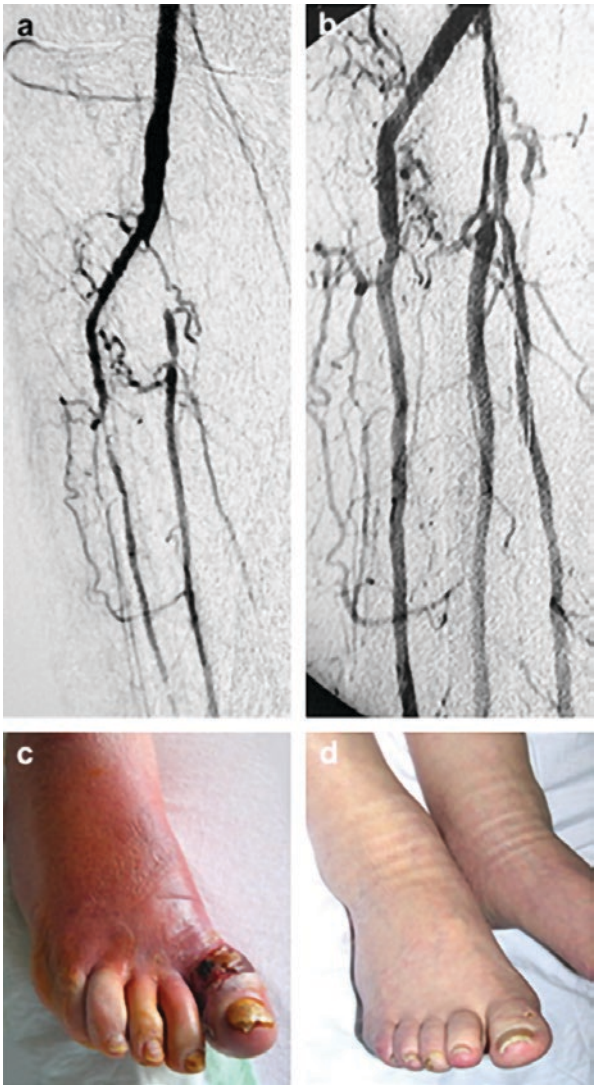


Figure 9. Clinical outcome of great toe revascularization after five months. Atherosclerotic arterial occlusion (A). Patent tibial arterial tree following revascularization (B). Right foot with great toe necrosis (C). Clinical outcome five months after revascularization (D).
Source: https://www.sciencedirect.com/science/article/pii/S1078588408006813

regeneration of the foot five months after revascularisation and the resulting limb salvage, while Figure 10 shows a healed heel ulcer five weeks after revascularisation.

3.5. Role of imaging in perfusion assessment during planning and after revascularization

Radiological imaging methods are used during the planning of revascularisation and endovascular procedures to assess tissue blood volume and blood flow velocity. Parenchymal blood volume (PBV) is a parameter determined following the administration of contrast media and subsequent CT imaging, which allows assessment of the amount of contrast agent present within the tissues of the foot. In this way, local tissue perfusion can be evaluated, providing information not only about arterial patency but also about the amount of blood reaching the foot. Another useful angiographic method is colour-coded quantitative digital subtraction angiography (CCQ-DSA), in which DSA

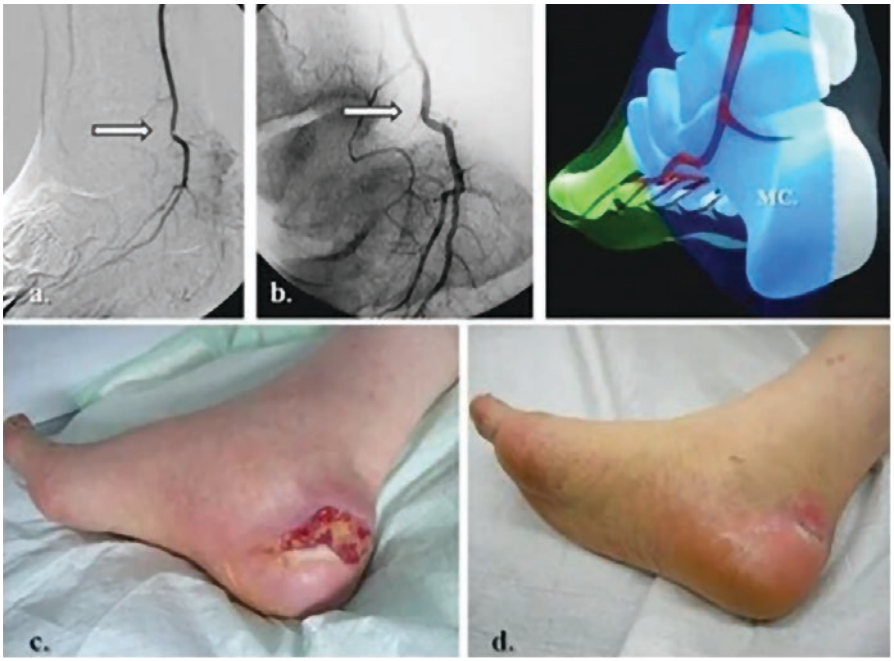


Figure 10. Revascularization of the posterior tibial and medial calcaneal artery angiosomes in a heel wound. Stenosis of the distal posterior tibial artery (A). Angiographic findings following selective angioplasty (B). Heel ulcer (C). Outcome five weeks after revascularization (D).
Source: https://www.researchgate.net/figure/Specific-posterior-tibial-and-adjacent-medial-calcaneal-artery-angiosome_fig8_51691463

is performed, and specialised software uses colour coding to visualise the passage of contrast through the blood vessels, thereby allowing assessment of flow dynamics. This method can be used to determine the time to peak (TTP) and assess how rapidly blood reaches the distal parts of the limb (14).

To demonstrate improvement in perfusion following revascularisation, various three-dimensional (3D) imaging methods have been used, including CT, MRI, and the hybrid imaging modality single-photon emission computed tomography/computed tomography (SPECT/CT). These methods enable assessment of blood volume within the foot and allow foot perfusion to be evaluated according to the angiosome concept. They have demonstrated greater effectiveness than two-dimensional (2D) assessment methods, such as Doppler flowmetry and tissue spectroscopy, which have not demonstrated substantial differences between direct and indirect revascularisation. The quantitative data obtained using these imaging methods may provide clinicians with an objective basis for developing more effective revascularisation strategies (14).

3.6. Limitations of the angiosome concept

Angiosomes vary among individual patients. In patients with PAD, blood vessels may be altered due to stenosis, occlusion, impaired blood flow, differences in the development of collateral circulation, and other vascular changes. Therefore, the main artery supplying an ischemic region is not necessarily the only or the optimal choice for revascularisation in every patient (9).

In a vascular-compromised foot, i.e., a foot with impaired circulation, the distribution of angiosomes may be altered, and blood flow may not necessarily follow the classical vascular pathways. The ischemic region may receive blood through alternative pathways and even from an adjacent angiosome via collateral arterial connections between the territories (9).

Given that the development of collateral circulation and the microcirculation may alter the actual blood supply to tissues, some researchers suggest that the classical angiosome concept may not be fully applicable in patients with PAD (14).

Therefore, in PAD, the normal pattern of perfusion may be altered due to the presence of vascular lesions or collateral circulation, resulting in changes to the angiosome map compared with that observed in normal anatomy (9).

4. Conclusion

Peripheral arterial disease affecting the arteries of the lower leg represents one of the major causes of chronic limb-threatening ischemia and may lead to serious adverse outcomes, such as ischemic ulceration, gangrene, and amputation. One of the fundamental treatment approaches is endovascular revascularisation, the success of which depends not only on technically successful performance of the procedure but also on achieving adequate perfusion of the ischemic region. The angiosome concept represents an approach to achieving adequate arterial perfusion of the ischemic region. By applying this concept, it is possible to identify the target artery supplying the angiosome affected by the wound. Endovascular revascularisation of the target artery may promote wound healing, increase the likelihood of limb preservation, and reduce the need for amputation. A substantial body of research indicates the potential benefits of direct revascularisation, which targets the main artery supplying the affected angiosome. However, collateral circulation, possible anatomical variations, and the technical complexity of the procedure must also be taken into consideration,

in which case indirect revascularisation may represent an alternative approach. Therefore, the angiosome concept represents an important approach to planning endovascular treatment of peripheral arterial disease affecting the arteries of the lower leg. By integrating clinical, anatomical, and radiological data, an individualised approach to each patient can be achieved, with the ultimate goals of limb preservation, prevention of adverse outcomes, and improvement of quality of life.

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Koncept angiosoma u endovaskularnom liječenju periferne arterijske bolesti potkoljeničnih arterija

Sažetak

Cilj rada: Cilj ovoga rada je objasniti koncept angiosoma te ukazati na njegovu učinkovitost u planiranju endovaskularnog liječenja periferne arterijske bolesti potkoljeničnih arterija s naglaskom na pravilan odabir ciljne arterije uz pomoć koje će se obnoviti perfuzija stopala i time spriječiti neželjeni ishodi (amputacija, smrt). **Materijali i metode**: Rad se temelji na narativnom pregledu dostupne znanstvene i stručne literature o perifernoj arterijskoj bolesti, endovaskularnom liječenju i konceptu angiosoma. Također su u analizu uključeni i dostupni udžbenici, znanstveni radovi te stručni internetski izvori dostupni u bibliografskim bazama podataka (PubMed) i medicinskim izvorima. **Rezultati**: Analizom dostupne literature pokazalo se da je endovaskularna revaskularizacija jedno od učinkovitijih rješenja u liječenju periferne arterijske bolesti potkoljeničnih arterija te je izrazito značajna u primjeni kod bolesnika s kroničnom ishemijom ekstremiteta. Primjenom koncepta angiosoma može se poboljšati cijeljenje rana te time i očuvati ekstremitet ostvarenjem revaskularizacije arterije koja opskrbljuje određeni vaskularni segment. Angiosomski koncept ima i svoja ograničenja te se naglasak stavlja na individualnom pristupu svakom pacijentu. **Zaključak**: Angiosomski koncept jedno je od učinkovitijih rješenja za postizanje kvalitetne arterijske opskrbe ishemijskog područja kojim se rana određenog vaskularnog segmenta izravno povezuje s arterijom koja opskrbljuje navedeno područje te se primjenom endovaskularne revaskularizacije ostvaruju pozitivni ishodi poput cijeljenja rane, sprječavanja amputacija i smanjenja stope smrtnosti. Veliki broj istraživanja ukazuje na prednosti direktne revaskularizacije kojom se djeljuje na glavnu arteriju koja opskrbljuje angiosom, međutim, važno je uzeti u obzir i kolateralnu cirkulaciju, moguće anatomske varijacije i zahtjevnost tehničke izvedbe prilikom čega se kao drugo rješenje postavlja indirektna revaskularizacija uz naglasak na individualizirani pristup svakom pacijentu.

Ključne riječi: angiosom; ekstremitet; endovaskularna revaskularizacija; ishemija; periferna arterijska bolest