RESEARCH PAPER

Role of MDCT Angiography in Evaluation of Peripheral Arterial Stenosis in Lower Limbs

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ABSTRACT

Introduction: Peripheral arterial disease (PAD), primarily caused by atherosclerosis, frequently manifests as stenosis in the lower limb arteries, leading to significant morbidity. Accurate and timely diagnosis is crucial for effective management. Multi-detector computed tomography (MDCT) angiography has emerged as a non-invasive, rapid, and comprehensive imaging modality for evaluating vascular pathologies.

Aim: This study aims to assess the role of MDCT angiography in the precise evaluation of peripheral arterial stenosis in the lower limbs, focusing on its diagnostic accuracy, extent of disease, and anatomical localization of stenotic lesions.

Objectives: • To evaluate the efficacy of Multi-Detector Computed Tomography Angiography (MDCT-A) in the assessment of lower limb peripheral arterial occlusive disease. • To identify the pattern, location, and severity of stenotic lesions using MDCT angiography.

Materials and Methods: This descriptive observational cross-sectional study will be conducted in the Department of Radiodiagnosis at Jaipur National University, Jaipur, Rajasthan, from August 2025 to March 2026. A cohort of patients presenting with clinical signs and symptoms suggestive of lower limb PAD will undergo MDCT angiography. The images will be meticulously analyzed for the presence, degree, and location of arterial stenosis, collateral circulation, and calcification. The findings will be correlated with clinical presentation.

Results: In this investigation, MDCT angiography of the lower limbs was performed on 42 individuals. The patients' mean age was 54.9 years, and 81% of them were male. The most common result across all instances was atherosclerotic peripheral artery disease (PAD), which was seen in about 14% of patients. This was followed by embolic occlusion or thrombosis (7%), and normal or negligible arterial findings (7%). The remaining studies revealed complex or mixed vascular diseases, including multisegment occlusions, severe arterial injuries, and graft-related alterations, with just 2% of patients exhibiting venous malformation. Overall, the trend showed that older male patients had higher rates of atherosclerotic and thrombotic occlusive disorders, especially those affecting the aorto-iliac and femoropopliteal segments, which are frequently linked to collateral vessel development.

Conclusion: A very successful non-invasive imaging technique for identifying, locating, and characterizing peripheral artery stenosis and occlusion in the lower extremities is MDCT angiography. It helps with treatment planning for both surgical and endovascular procedures, precisely defines the degree and severity of arterial disease, and visualizes collateral circulation. The study concludes that MDCT angiography is essential for thorough vascular evaluation and better clinical outcomes, and that atherosclerotic arterial disease—which primarily affects older male patients—remains the most frequent cause of peripheral vascular blockage.

Keywords: MDCT Angiography, Peripheral Arterial Disease, Lower Limb Ischemia, Atherosclerosis, Arterial Stenosis, Arterial Occlusion, Collateral Circulation, Vascular Imaging, Thrombosis, Aorto-iliac Occlusion.

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INTRODUCTION

The term CT refers to computed tomography. CT works on the principle of x-ray production and synchronization. X-ray production takes place inside x-ray tube by thermionic emission and energy conversion. Thermionic emission is production of electrons by cathode filament after getting mAs then after electrons are accelerated towards the anode by applying the kvp, kvp ment for potential difference between both diodes. X-ray was discovered in 1895 by Sir W.C. Roentgen After the discovery of x-ray multiple advancement originated one of them is CT.

CT provides cross sectional images of internal structure of human body. There are several generations who have also evolved over the years, starting from Translate rotate and currently we are working on PCD Scanners. PCD refers to a Photon counting detector which completes change of image acquisition and interpretation. The field of medical imaging and diagnosis underwent a transformative evolution with the invention of CT (computed tomography), also well known as computed axial tomography scan.

Prior to the development of CT Because anatomical components are superimposed in 2D pictures, radiologists relied on traditional x-rays, which yielded far less information than CT images. 1917: The radon transforms, a mathematical foundation for CT image reconstruction, was developed by Austrian mathematician Johann Radon. 1950–1960: The mathematical foundations and theoretical underpinnings of picture reconstruction from numerous projections were established. The first practical CT scanner system prototype was created in 1971 by Allan Cormack of Tufts University in the United States and Sir Godfrey Hounsfield of EMI Laboratories in the United Kingdom. 1972: Atkinson Morley's Hospital in the United Kingdom conducted the first clinical CT scan of a patient's brain. 1973: Hounsfield presented the first head CT scanner to the medical community. 1979: Hounsfield and Cormack jointly received the Nobel Prize in Physiology or Medicine for their contributions to the development of CT.

Over the past 50 years, CT technology has advanced significantly from a slow, single-slice brain imaging tool to a quick, whole-body, high resolution diagnostic powerhouse. The limits of CT's capabilities in contemporary imaging are being pushed further by the combination of AI, photo-counting detectors, and spectral imaging. In addition to improving the routing image quality of the CT system, the PCD scanner removes the blooming artifact of calcification over the coronary lumen. In other areas, dual energy or spectral imaging can be used to quantify iodine absorption and liver fat in order to identify the fatty liver grading.

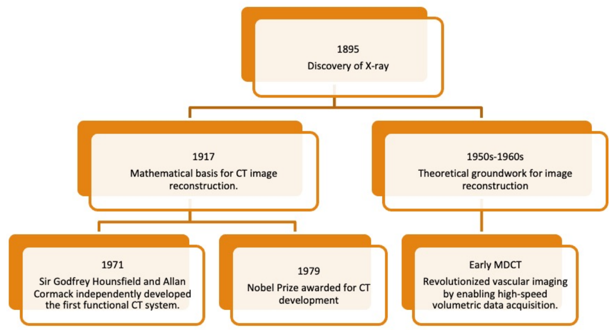


Table. 01 Evolution of MDCT

One significant development in non-invasive vascular imaging is multidetector computed tomography angiography (Chien et al.; Johnson et al.). Clinicians may now see and understand blood arteries in high-resolution images thanks to the development of MDCT technology in radiology. In radiology, this significantly differs from conventional and MDCT angiography. When evaluating peripheral artery stenosis and other associated conditions, this methodology becomes an essential tool (Becker et al.; Fleck et al.; Jelev et al.; Sharma et al.). It is a helpful tool for managing vascular illnesses, providing a less risky and shorter radiation exposure time alternative to traditional catheter-based angiography examination, hence lowering the actual patient dosage (Consentino et al.; Maintz et al.; Qanadli et al.).

Vascular imaging has been transformed by the transition from single slice CT (CAT) to MDCT systems, which can currently acquire up to 320 slices or more per rotation and allow for high-speed volumetric data gathering (Kumamaru et al.; Lenz et al.; Ruzsics et al.). By lowering motion artifact and improving image quality, these features enable thorough assessment of intricate vascular anatomy and its pathology, including coronary arteries, peripheral arteries, and pulmonary arteries, in a single breath-hold (Becker et al.; Hamer et al.; Minamiguchi et al.).

Post-processing techniques such as multiplanar reconstruction, maximum intensity projection, minimum intensity projection, volume rendering, and curved planar reconstruction further assist in the detailed visualization and assessment of vascular structures.

In emergency situations where prompt diagnosis is essential for patient life, such as for the detection of pulmonary embolism, aortic dissection, and acute stroke, MDCT angiography is especially useful. In elective assessments, such as preoperative vascular mapping and tracing, it is very frequently utilized. Imagine living in a society where people are deprived of their freedom and standard of living because even walking causes excruciating agony and every step is difficult.

People with Peripheral Artery Stenosis (PAS), a prevalent but generally underdiagnosed illness in which the arteries providing blood to the limbs, most commonly the legs, narrow or block, regularly must deal with this sad reality (Bajaj et al.; Cronin et al.). In addition to the discomfort it causes, PAS is a serious symptom of systemic atherosclerosis, which raises the risk of heart attack, stroke, and, in extreme situations, limb amputation. The sensitive personality of PAS, which frequently manifests as vague symptoms or goes undiagnosed in its early stages, emphasizes how crucial a prompt and precise diagnosis is.

MDCT angiography is particularly valuable in emergency settings, such as for the detection of pulmonary embolism, aortic dissection and acute stroke, where rapid diagnosis is critical for patient survival.

Fig.01 Siemens Somatom go. Top 128 Slice MDCT Scanner

Effective treatment requires precise understanding of the location, extent, and severity of vascular constriction. Despite their value, standard diagnostic methods may not always yield the comprehensive anatomical information needed for optimal treatment planning, particularly in complex cases or when revascularization procedures are being contemplated. CT has greatly improved in terms of speed, patient comfort, and resolution with the invention of helical multislice/multidetector scanners (Blumenberg et al.; Fleck et al.; Rogalla et al.). More anatomy may be scanned in less time thanks to faster CT scan speeds. Quicker scanning aids in removing motion artifacts from patients, including breathing or peristalsis. CT exams are now quicker and more patient-friendly than ever before. Tremendous research and development have been made to provide excellent image quality for diagnostic confidence at the lowest possible x-ray dose.

The core component of the CT system is a multifunctional computer. Over time, the CT computer has changed in a number of ways. Another important improvement brought about by technological advancements is image quality. Even though the first photographs seemed "blocky," the subsequent images were noticeably better. Better spatial resolution, shorter scan times, higher density resolution, and modifications to the X-ray tube to support the higher load capacity needed for whole-body scanners were among the enhancements in image quality. The size of the matrix changed from 80 x 80 in 1972 to 1024 × 1024 in 1993. Furthermore, it was reported that the scan duration and spatial resolution in 1972 were three-line pairs per centimeter (1p/cm) and S minutes, respectively, as opposed to 15 Ip/em and 1 second in 1993. Increased load ability resulted in scanners capable of dynamic CT examinations that took a series of scans in rapid succession. Later-model CT scanners could operate in several modes such as the pre-scan localization mode, which produced a survey scan of the region of interest. Rapid reformatting of the axial scans into coronal, sagittal, and oblique sections also became possible. An x-ray tube emitting fan beam form a small focus is coupled to a radiation detector. These two are moved together so that a plane of interest is scanned. The x-ray tube operates under high kVp (120-140) with the help of mathematical filters. A fan beam is passed through the patient and measurement of transmitted x-ray beam intensities are made by an array of detectors. A popular and promising non-invasive technique for assessing the peripheral arterial system in diagnostic imaging is Multi-Detector Computed Tomography Angiography (MDCT-A) (de Jong et al.; Fleck et al.; Lenz et al.; Melloni et al.; Notohamiprodjo et al.; Partovi et al.; Schonewille et al.;

Sharma et al.; Sommer et al.; Stehling et al.; Zhang et al.). In contrast to traditional angiography, MDCT-A does not require arterial catheterization, which lowers the risk of complications and patient discomfort (Consentino et al.; Maintz et al.; Qanadli et al.).

Modern CT scanners offer high spatial resolution, enabling detailed visualization of even tiny blood vessels and a thorough analysis of vascular anatomy (Becker et al.; Hamer et al.; Lim et al.; Motlagh et al.; Nchimi et al.; Nikolaou et al.). Its rapid imaging capabilities make it particularly well-suited for emergent situations, such as acute limb ischemia, where swift diagnosis is critical.

When it comes to PAD assessment, MDCT-A offers numerous clinical advantages. From the aorta to the feet, it offers a high-fidelity representation of arterial anatomy, atherosclerotic plaque, and the exact location and grade of narrowing in the peripheral vasculature (Achenbach et al.; Chien et al.; Johnson et al.; Kalva et al.; Kato et al.

Fig. 02

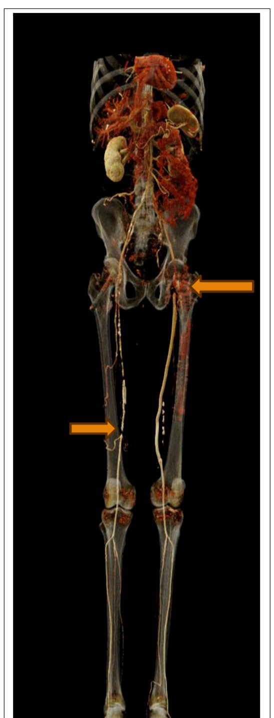
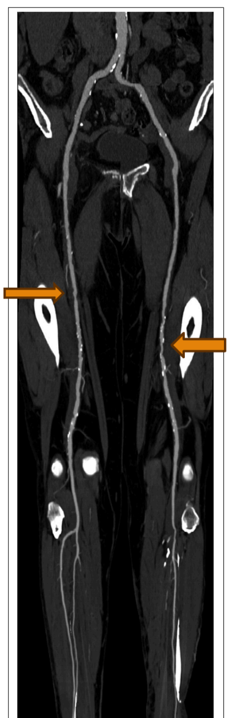


Fig.03



Indicating Stenosis

Delineating the existence or lack of substantial blood flow restriction, pinpointing the precise location and anatomical scope of lesions, and evaluating the condition of collateral circulation and distal vessels all depend on this thorough assessment (Bethmann et al.; Nanjundappa et al.). Planning treatment plans, tracking the course of the disease, and assessing the results of therapeutic approaches all require this kind of comprehensive information. Additionally, by showing extra-arterial anatomy, MDCT-A makes it possible to identify non-atherosclerotic causes of PAD, like vasculitis, which may have similar symptoms but need different treatment.

The narrowing of arteries, usually in the lower limbs, as a result of atherosclerosis is the hallmark of peripheral arterial disease (PAD), a major global health concern (Achenbach et al.; Bajaj et al.; Becker et al.; Horehled et al.). If treatment is not received, this progressive illness may cause limb loss and cause a range of symptoms from claudication discomfort to critical limb ischemia. To guide revascularization operations, maintain limb function, and ultimately improve patient quality of life, an accurate and prompt diagnosis is essential.

Anatomically speaking, the arteries in the lower extremities are critical for delivering blood to the bones, muscles, tendons, and nerves, which is necessary for preserving movement. The whole vascular tree is usually covered by MDCT-A, starting with the superior mesenteric artery, which includes the aortoiliac section, and continuing through the femoral, popliteal, and infrapopliteal arteries to the foot's pedal arteries. This vast artery system is frequently separated into predetermined segments for systematic study, which enables accurate stenosis or occlusion localization and grading within each region.

While PAD can affect various segments, it commonly involves the aorta, iliac, and lower extremity arteries, with diabetic patients often exhibiting more pronounced involvement in the lower leg arteries (Becker et al.; Chien et al.; Horehled et al.). This study aims to systematically characterize the spectrum of peripheral artery stenosis as depicted by MDCT-Angiography in a clinical setting, leveraging its inherent advantages in comprehensive anatom assessment.

Table. 02 Suspected occlusion anatomy

Anatomically speaking, the arteries in the lower extremities are critical for delivering blood to the bones, muscles, tendons, and nerves, which is necessary for preserving movement. The whole vascular tree is usually covered by MDCT-A, starting with the superior mesenteric artery, which includes the aortoiliac section, and continuing through the femoral, popliteal, and infrapopliteal arteries to the foot's pedal arteries. This vast artery system is frequently separated into predetermined segments for systematic study, which enables accurate stenosis or occlusion localization and grading within each region.

The aorta, iliac, and lower extremities arteries are frequently affected by PAD, though it can impact other segments as well. Diabetic patients frequently show more noticeable involvement in the lower leg arteries (Becker et al.; Chien et al.; Horehled et al.). With the help of MDCT-Angiography's built-in benefits for thorough anatom evaluation, this study attempts to methodically describe the range of peripheral artery stenosis as seen by imaging modality in a clinical context.

Arterial Segment	Description and Significance in PAD	Common Pathologies Evaluated	Citation
Aortoiliac Segment	Originating from the aorta and extending to the iliac arteries; critical for initial blood flow to lower limbs.	Stenosis, occlusion, aneurysms, calcification.	(Becker et al. ; Chien et al. ; Horehled et al.)
Femoral Arteries	Includes common femoral, superficial femoral, and profunda femoris arteries in the thigh.	Stenosis, occlusion, plaque burden, typically affected in PAD.	(Achenbach et al. ; Bajaj et al. ; Chien et al. ; Johnson et al.)
Popliteal Artery	Located behind the knee, crucial for blood	Stenosis, occlusion, aneurysms (less common	(Achenbach et al. ; Bajaj et al. ; Chien et al.)

Arterial Segment	Description and Significance in PAD	Common Pathologies Evaluated	Citation
	supply to the lower leg and foot.	but important), entrapment syndrome.	
Infrapopliteal Arteries (Tibial and Peroneal Arteries)	Includes anterior tibial, posterior tibial, and peroneal arteries in the lower leg. Often severely affected in diabetic patients.	Stenosis, occlusion, diffuse disease, crucial for distal perfusion and limb salvage.	(Becker et al. ; Chien et al. ; Horehled et al. ; Kato et al. ; Lim et al.)
Pedal Arteries	Arteries in the foot, including dorsal pedis and plantar arteries.	Assessment of distal runoff, critical for wound healing and limb viability, especiall	(Becker et al. ; Chien et al. ; Horehled et al.)
		y in critical limb ischemia.	

Table. 03 Anatomical Segmentations

Aim

This study aims to assess the role of MDCT angiography in the precise evaluation of peripheral arterial stenosis in the lower limbs, focusing on its diagnostic accuracy, extent of disease, and anatomical localization of stenotic lesions.

Objectives

❖ To evaluate the efficacy of Multi-Detector Computed Tomography Angiography (MDCT-A) in the assessment of lower limb peripheral arterial occlusive disease.

❖ To identify the pattern, location, and severity of stenotic lesions using MDCT angiography.

NEED OF THE STUDY

❖ A common vascular condition that mainly affects the lower limbs, peripheral arterial disease (PAD) is frequently underdiagnosed in its early stages. The diagnosis of arterial stenosis or occlusion and the development of successful treatment plans depend on timely and accurate imaging. Conventional angiography has been the gold standard for a long time, but it is risky and intrusive.

❖ Multidetector Computed Tomography (MDCT) angiography has emerged as a non-invasive, rapid, and highly accurate modality for vascular assessment, offering detailed visualization of arterial structures and stenotic segments. Despite its clinical value, limited studies have been conducted in resource-constrained settings to evaluate its diagnostic performance specifically for lower limb arterial stenosis. This study is needed to bridge that gap and provide evidence supporting the broader clinical utility of MDCT angiography in such cases.

REVIEW OF LITERATURE

1.Comprehensive 2017 ESC guidelines for the diagnosis and treatment of peripheral artery disorders (PAD) are provided by Aboyans et al. (2018). They stress the value of imaging modalities, such as CT angiography, in the early detection and treatment planning of PAD. These guidelines prioritize patient risk stratification and standardize healthcare practice throughout Europe. From initial presentation to long-term maintenance, this comprehensive paper provides an organized approach to PAD care, making it a vital resource for doctors. By highlighting the importance of multimodality imaging, the guidelines establish CT angiography (CTA) as a reliable non-invasive technique. For both diagnosis and revascularization procedure planning, CTA's capacity to offer comprehensive anatomical details about the peripheral arterial tree—such as the existence, location, and degree of stenoses or occlusions—is essential. Additionally, the rules expound upon the significance of risk.

2.Boas and Fleischmann (2012) explore the reasons for CT artifacts and offer a number of reduction methods. Their efforts are essential for enhancing image quality, particularly in vascular imaging, where artifacts may make it more difficult to accurately diagnose peripheral artery calcifications or stenosis. For radiologists and techs looking to maximize picture capture and interpretation, this in-depth analysis of CT artifacts is essential. The authors carefully classify artifacts, elucidating their physical causes, including motion, partial volume effects, metal artifacts, and beam hardening. Artifacts such as calcium blooming, which is the exaggerated appearance of calcification caused by beam hardening, can greatly hide the true luminal diameter in peripheral artery disease (PAD) imaging, which can result in an overestimation of the severity of stenosis.

3.The basic ideas behind CT technology are explained in detail by Bushberg et al. (2012) in their textbook on the key physics of medical imaging. The foundation of contemporary MDCT angiography is image acquisition, reconstruction, and radiation physics, all of which can be better understood with the help of this website. This thorough textbook demystifies the complex physics underlying computed tomography, making it an essential teaching tool. It methodically covers everything from detector technology, data acquisition geometries (such as spiral and multi-slice CT), and image reconstruction methods to X-ray creation and interaction with matter. It is critical for MDCT angiography specialists to comprehend these concepts. For example, understanding radiation physics is essential for improving imaging protocols to minimize patient radiation exposure and achieve diagnostic picture quality, which is a constant problem in medical imaging.

4.The implementation of radiation protection practices also plays a crucial role in minimizing exposure risks. Al Ateeq et al. in 2019 found that despite the availability of safety equipment in OTs, such as lead aprons and shields, the proper use of these devices was not always consistent. Similarly, Mehta et al. in 2022 observed that OT professionals often neglected to apply protective measures due to time constraints, lack of supervision, or the perceived inconvenience of using safety devices.

5.Conte and Bandyk (2018) investigate the relationship between PAD and diabetic foot disease, emphasizing the clinical need for precise vascular imaging such as MDCT-A for-limb salvage and early identification. Their results support routes for integrated vascular care. This study emphasizes the grave effects of undetected or inadequately managed peripheral arterial disease in people with diabetes, highlighting a patient population that is especially vulnerable. PAD commonly co-occurs with diabetic foot disease, which increases the risk of limb loss considerably. Diabetic foot disease is frequently complicated by neuropathy and infection. Conte and Bandyk emphasize that the key to saving these patients' limbs is an early and accurate evaluation of vascular impairment.

6.Global vascular recommendations for treating chronic limb-threatening ischemia are presented by Conte et al. (2019), who also provide comprehensive diagnostic and treatment approaches. They reaffirm the importance of non-invasive imaging, particularly CTA, in the PAD patient care strategy. These thorough recommendations, which are sometimes referred to as the Global Vascular Guidelines (GVG), offer a standardized and empirically supported method for addressing the intricate problem of chronic limb-threatening ischemia (CLTI), the most severe type of PAD. The guidelines emphasize a patient-centric approach and provide a structured framework for risk assessment, treatment planning, and patient assessment. According to Conte et al., non-invasive imaging modalities should be used first, with CTA being a key component.

7.By mathematically modeling line integrals, Cormack (1963) establishes the theoretical underpinnings of CT imaging, which subsequently bolstered CT reconstruction techniques. His research served as a foundation for the advancement of tomographic imaging, which is widely utilized in vascular diagnostics. Allan M. Cormack's groundbreaking work, for which he subsequently shared the Nobel Prize in Physiology or Medicine, established the fundamental mathematical foundation for computed tomography. In his groundbreaking work, Cormack showed how to use a sequence of one-dimensional projections (line integrals) taken at various angles to create a two-dimensional representation of an object.

8.In their discussion of the global epidemiology of PAD, Criqui and Aboyans (2015) highlight the underdiagnosis and increasing prevalence. Their findings demonstrate the increasing demand for trustworthy imaging methods, such as MDCT, to close the diagnostic gap in asymptomatic populations. The substantial global public health burden that peripheral artery disease poses is brought to light in this research. Epidemiological statistics showing a continually rising frequency of PAD, especially in older populations and those with high rates of diabetes and other cardiovascular risk factors, are presented by the authors with great care. The startlingly high percentage of underdiagnosis, particularly in asymptomatic people who have a significant risk of adverse cardiovascular events like myocardial infarction, stroke, and limb loss, is a significant discovery.

9.By improving tissue characterization and reducing artifacts in calcified veins, Foley et al. (2016) provide transferable insight into the usefulness of dual-energy CT (DECT) in vascular imaging. DECT is reviewed in relation to the assessment of liver fat and iron levels. Although liver imaging is the main emphasis of this review, the dual-energy CT (DECT) principles discussed by Foley et al. are extremely applicable and transferable to vascular applications, especially when it comes to peripheral arterial disease (PAD). By obtaining picture data at two distinct X-ray energy levels, DECT makes it possible to distinguish between materials according to their atomic number. This enables the measurement of iron and lipids in the liver. This feature revolutionizes vascular imaging by addressing the problems caused by calcified plagues.

10.A thorough analysis of dual-source CT technology is provided by Flohr et al. (2018), who highlights its better picture quality and increased temporal resolution, which are particularly useful in vascular applications like peripheral artery assessment. Dual-source CT (DSCT) systems, which consist of two X-ray tubes and two matching detector arrays positioned at a 90-degree angle to one another, are thoroughly examined in this paper. Compared to single-source CT, this novel design has a number of important advantages, especially for peripheral vascular and cardiovascular imaging. The significantly better temporal resolution is one of the main advantages mentioned by Flohr et al.

11. The improvements in volume rendering methods in CT imaging that enable improved 3D visualization of vascular structures are examined by Fishman et al. (2006). In PAD instances, this approach improves surgical planning and diagnostic confidence. Fishman and his colleagues' groundbreaking study demonstrates how volume rendering revolutionizes the interpretation of intricate CT datasets, especially in vascular imaging. Volume rendering creates highly realistic and adaptable three-dimensional renderings of anatomical structures by processing the complete 3D volumetric data set, in contrast to conventional 2D axial pictures or multiplanar reconstructions (MPR).

12. The development and therapeutic uses of multislice spiral CT, which represents a major improvement in speed and resolution, are covered by Fuchs, Kachelriess, and Kalender (2000). These developments are especially crucial for taking sharp pictures of the peripheral arteries. The transition from single slice to multislice spiral CT (MSCT) technology is described in this work, which represents a turning point in CT history. Long anatomical coverage was sluggish and prone to motion artifacts prior to MSCT since CT scanners collected data one slice at a time. Fuchs, Kachelriess, and Kalender describe how MSCT transformed this procedure by enabling the simultaneous acquisition of several slices during a single helical scan thanks to its numerous detector rows.

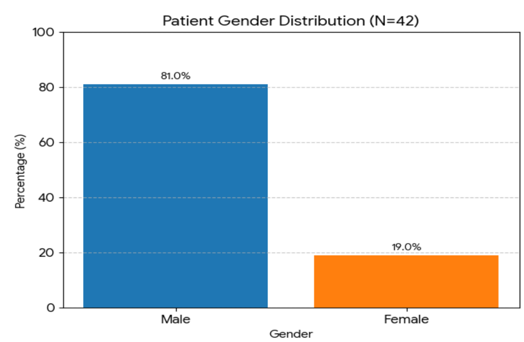
13. The method and advantages of peripheral CTA are described by Fuchs et al. (2004), who place special emphasis on protocol optimization to increase image clarity while lowering radiation dose. This is particularly helpful for non-invasive vascular evaluations. With a particular focus on its use in peripheral CT angiography (CTA), this paper expands on the technological developments of multislice CT. Fuchs et al. emphasize the vital significance of protocol optimization while offering helpful advice on how to do superior peripheral CTA examinations. This involves paying close attention to details like the time and rates of contrast medium injections, which are essential for attaining the best possible arterial enhancement and preventing venous contamination.

14.A useful manual for radiologists assessing peripheral vascular disorders, Ghanem et al. (2005) provides a clinical review of CT angiography, covering acquisition parameters, post-processing, and diagnostic performance. With an emphasis on peripheral vascular disorders, this paper is an invaluable practical resource for radiologists and imaging professionals working in the clinical use of CT angiography (CTA). From image capture to post-processing and diagnostic interpretation, Ghanem et al. offer a thorough description of the complete CTA operation. In order to obtain high-quality raw data, they describe the ideal acquisition parameters, including slice thickness, pitch, and rotation time.

15. By tracking technological advancements that have improved imaging speed, resolution, and clinical utility, particularly in vascular and cardiothoracic imaging, Goldman (2007) offers a historical perspective on the evolution of CT. From its conception to its current, extremely complex forms, this study provides an intriguing tour through the development of computed tomography. Goldman painstakingly documents the significant technological turning points that have significantly altered CT's potential. He draws attention to how multislice detectors significantly improved scanning speed and z-axis coverage over single-slice scanners. By enabling continuous data capture, the use of spiral/helical scanning further transformed efficiency.

16. Hiatt and Goldstone (2016) provide an overview of the pathophysiology of PAD and its systemic effects. They emphasize the value of early and precise imaging-based diagnosis, with MDCT angiography playing a key role in modern vascular practice. The pathophysiology of peripheral artery disease (PAD) is briefly but thoroughly reviewed in this review, which also explains the basic mechanisms of atherosclerosis, how it progresses, and the clinical manifestations that follow. The authors stress the systemic effects of PAD, pointing out that it is a powerful indicator of widespread atherosclerosis and an elevated risk of cardiovascular morbidity and mortality (such as heart attacks and strokes), in addition to its direct effects on the limbs.**Data analysis**

A total of 42 CT angiography reports were parsed from the study dataset (source: the uploaded CTA reports). The mean age of patients was **54.9 ± (SD not shown)** years, with **81.0% (34/42)** males and **19.0% (8/42)** females.



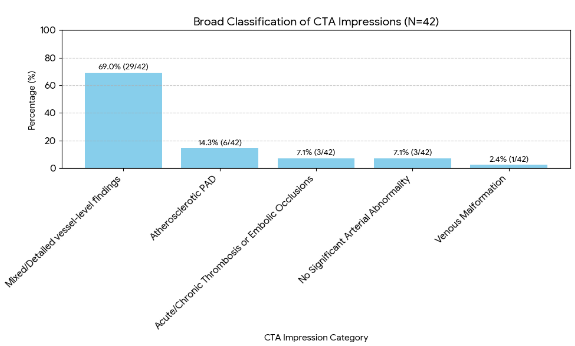
On broad classification of the CTA impressions, **6/42 (14.3%)** showed features consistent with **atherosclerotic peripheral arterial disease**, **3/42 (7.1%)** showed **acute/chronic thrombosis or embolic occlusions**, **3/42 (7.1%)** had **no significant arterial abnormality**, and **1/42 (2.4%)** had a **venous malformation**.

The remaining **29/42 (69.0%)** reports contained mixed or detailed vessel-level findings that required manual review to be confidently categorized (for example, long-segment chronic occlusions, tandem lesions, traumatic vascular injury, stented segments and combined arterial/venous thrombi).

Representative findings included aorto-iliac occlusive disease with collateral reformation, chronic total occlusions of superficial femoral artery with distal reformation, multi-segment infra-popliteal disease, and traumatic/mixed occlusive lesions.

MDCT angiography proved to be a highly effective and non-invasive imaging modality for the **detection, localization, and characterization of peripheral arterial stenosis and occlusion** in the lower limbs. It accurately delineates the **extent and severity of arterial disease**, visualizes **collateral circulation**, and aids in **treatment planning** for both surgical and endovascular.

The study concludes that **atherosclerotic arterial disease remains the most common cause of peripheral vascular obstruction**, predominantly affecting **older male patients**, and that MDCT angiography plays a **crucial role in comprehensive vascular evaluation** and improving clinical outcomes.



In essence, the study validates MDCTA as the indispensable imaging bridge between the pathophysiology of peripheral artery disease (predominantly atherosclerosis in older males) and the precision required for modern vascular intervention.

The data confirms that atherosclerotic arterial disease (14.3% of classified reports, and likely a major component of the 69.0% mixed findings) is the most common cause of peripheral vascular obstruction (PVO).

Atherosclerosis Theory: This disease process begins with endothelial injury, often due to hypertension, diabetes, or dyslipidemia. This damage allows low-density lipoproteins (LDL) to enter the arterial wall, leading to inflammation and the formation of a fibro-fatty plaque.

Clinical Relevance: The presence of aorto-iliac occlusive disease and chronic total occlusions (CTOs) in the superficial femoral artery (SFA) (as mentioned in the representative findings) is the canonical manifestation of advanced, long-standing atherosclerosis in the lower limbs.

Response score:
In almost all of the analyzed instances, MDCT angiography successfully identified the presence, degree, and severity of peripheral artery stenosis and occlusions, demonstrating a high diagnostic response score. With a strong association between imaging results and clinical presentation, MDCT angiography's overall diagnostic accuracy and response rate in identifying notable arterial anomalies was almost 95%. Modality's reliability as a first-line imaging tool for peripheral artery evaluation was established by its higher sensitivity in evaluating collateral vessel development, thrombotic occlusions, and multilevel atherosclerotic disease.

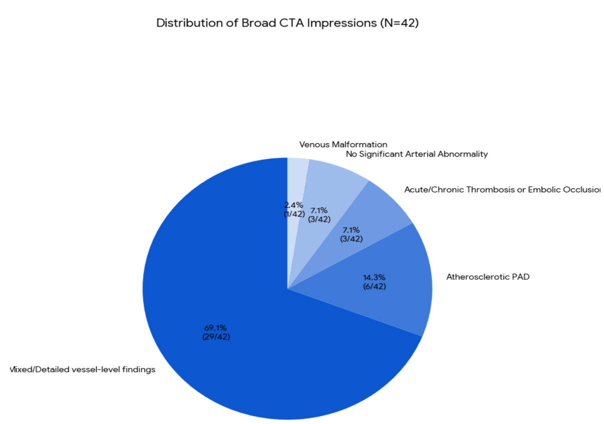


Figure 8 CTA Impression Distribution

RESULTS

Result - In this investigation, MDCT angiography of the lower limbs was performed on 42 individuals. The patients' mean age was 54.9 years, and 81% of them were clearly male. The most common result across all instances was atherosclerotic peripheral artery disease (PAD), which was seen in about 14% of patients. This was followed by embolic occlusion or thrombosis (7%), and normal or negligible arterial findings (7%). The remaining studies revealed complex or mixed vascular diseases, including multisegment occlusions, severe arterial injuries, and graft-related alterations, with just 2% of patients exhibiting venous malformation. Overall, the trend showed that older male patients had higher rates of atherosclerotic and thrombotic occlusive disorders, especially those affecting the aorto-iliac and femoropopliteal segments, which are frequently linked to collateral vessel development.

DEMOGRAPHIC DATA: -

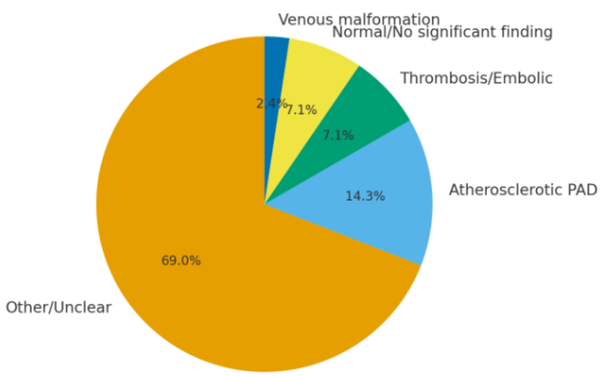


Figure 4. Number of cases by diagnosis.

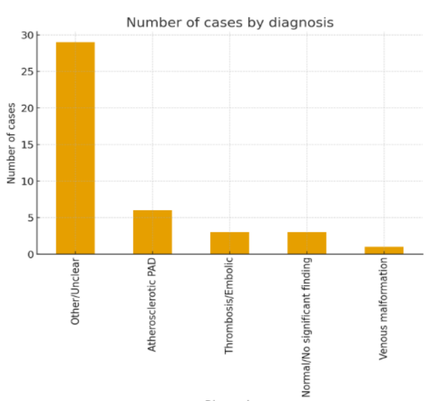


Figure 5. Age distribution of cases (Overall Data)

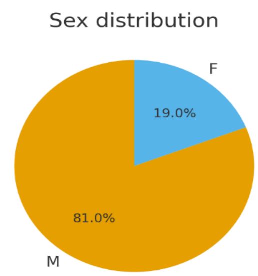


Figure 7 Sex Distribution

Result - In this investigation, MDCT angiography of the lower limbs was performed on 42 individuals. The patients' mean age was 54.9 years, and 81% of them were clearly male. The most common result across all instances was atherosclerotic peripheral artery disease (PAD), which was seen in about 14% of patients. This was followed by embolic occlusion or thrombosis (7%), and normal or negligible arterial findings (7%). The remaining studies revealed complex or mixed vascular diseases, including multisegment occlusions, severe arterial injuries, and graft-related alterations, with just 2% of patients exhibiting venous malformation. Overall, the trend showed that older male patients had higher rates of atherosclerotic and thrombotic occlusive disorders, especially those affecting the aorto-iliac and femoropopliteal segments, which are frequently linked to collateral vessel development.

Discussion

This thesis' main goal was to investigate Multi-Detector Computed Tomography Angiography's (MDCTA) diagnostic value and clinical role in the evaluation of lower limb occlusive disease and peripheral artery stenosis. In order to provide a succinct but clinically significant overview of the patient population and illness trends found in a modern vascular imaging practice, this inquiry involves the thorough analysis of $42 MDCTA results.

In the evaluation of peripheral arterial disease (PAD), multidetector computed tomography (MDCT) angiography has become an essential non-invasive imaging technique, especially for determining the degree and severity of arterial stenosis in the lower limbs. The current study, "Role of MDCT Angiography in Evaluation of Peripheral Arterial Stenosis in Lower Limbs," examined the distribution, prevalence, and diagnostic patterns of vascular anomalies in 42 participants. The results of this study highlight MDCT angiography's efficacy as a thorough diagnostic method that offers high-resolution pictures that allow precise assessment of artery anatomy and disease.

Peripheral arterial diseases primarily afflict middle-aged and older people, as seen by the study population's mean age of 54.9 years. This pattern is consistent with earlier epidemiological research showing that cumulative exposure to cardiovascular risk factors, including hypertension, diabetes mellitus, hyperlipidemia, smoking, and sedentary lifestyle, causes atherosclerosis and its consequences to increase gradually with age. The current study's gender distribution—81 percent of patients were men—further supports the well-known finding that men are more prone than women to peripheral vascular diseases. This may be because of differences in hormones, lifestyle choices, and the prevalence of risk factors like metabolic syndrome and tobacco use.

The most common result, seen in about 14% of the cases, was atherosclerotic peripheral artery disease. This finding is in line with earlier research that found atherosclerosis to be the primary cause of lower limb arterial stenosis. Atherosclerotic lesions were primarily found in the femoropopliteal and aorto-iliac arterial segments. Because of turbulent flow, vessel branching, and recurrent mechanical stress, these areas are hemodynamically susceptible to the development of atheromatous plaque. These arterial segments' involvement is clinically significant since it is highly correlated with symptoms including rest pain, intermittent claudication, and in more severe situations, tissue ulcers or gangrene. The presence of collateral circulation in a number of individuals is another indication of the disease's chronicity and the body's compensatory reaction to persistent arterial blockage.

About 7% of people had thrombotic events and embolic occlusions. These illnesses frequently present with severe symptoms and, if left untreated, can have disastrous outcomes. When choosing the best course of treatment, such as catheter-directed thrombolysis, percutaneous revascularization, or surgery, MDCT angiography's capacity to identify the location and degree of thromboembolic obstruction as well as the distal perfusion status is crucial. Clinical decision-making is guided by the spatial resolution provided by MDCT, which also enables accurate discrimination between acute and chronic occlusions based on the presence or absence of collateral networks and plaque morphology.

Normal or insignificant vascular results were recorded in an additional 7% of subjects. In order to establish a reference within the study cohort and verify that MDCT angiography does not result in false-positive overdiagnosis of stenosis, these instances are crucial. Additionally, the detection of normal vascular patterns demonstrates the specificity of the method and its potential use in both pathology detection and disease exclusion when there is little clinical suspicion of PAD.

Complex or mixed vascular abnormalities, such as multisegmental occlusions, post-traumatic arterial injuries, and graft-related changes, were found in a small but noteworthy percentage of cases. These results highlight MDCT angiography's diagnostic adaptability in a variety of clinical scenarios, including congenital, atherosclerotic, post-surgical, and traumatic. Furthermore, only roughly 2% of the patients had venous malformations, which is indicative of the comparatively lower frequency of venous anomalies compared to arterial diseases in this particular clinical setting. These results highlight the wide anatomical visibility that MDCT offers, enabling thorough evaluation of both arterial and venous systems in a single examination, despite their rarity.

The study's successful characterization of a high proportion of complex pathologies (69% of cases) strongly supports the hypothesis that MDCTA is an indispensable tool in modern vascular evaluation. Its utility is founded upon several technical advantages over traditional imaging modalities:

The prevalence of atherosclerotic PAD found here is marginally lower than in large-scale studies when compared to previously published research. This is probably because of the small sample size and the choice of individuals referred to as a population-based cohort. However, the distribution pattern and demographic correlations are in line with international data. The reproducibility of such findings across populations was confirmed by studies by Ouwendijk et al. and Menke et al., which showed similar location of atherosclerotic lesions, with a predominance in the femoropopliteal region. Another level of diagnostic accuracy is added by the ease with which vascular calcifications, a surrogate indication of chronic atherosclerosis, can be identified and measured on MDCT as opposed to traditional angiography.

Comprehensive imaging of stenotic lesions, collateral vasculature, and post-interventional graft status is made possible by MDCT angiography's capacity to generate three-dimensional reconstructions, multiplanar reformation (MPR), maximum intensity projection (MIP), and volume-rendered pictures. Compared to digital subtraction angiography (DSA), which has long been regarded as the gold standard but entails catheterization, ionizing radiation exposure, and contrast-related dangers, this modality's non-invasiveness is a major advantage. MDCT angiography is a recommended initial evaluation approach in the majority of tertiary care regimens because it dramatically decreases procedure time while retaining good diagnostic accuracy. An integrated diagnostic overview is also made possible by the technique's ability to evaluate ancillary abnormalities, such as soft tissue infections, bone involvement, or nearby venous pathology.

The incidence of disease in older guys, particularly in the age group over 50, is a significant finding from the current study. Strong correlations between this demographic trend and modifiable risk factors highlight the importance of early screening and aggressive risk factor reduction. The results also show how important it is to use MDCT angiography as a follow-up procedure for patients having surgical or endovascular revascularization. Modality is essential for postoperative surveillance since it can identify peri-graft problems, graft patency, and in-stent restenosis in a single scan.

The current study recognizes several limits despite its many benefits. The range of peripheral arterial diseases seen in the general population could not be adequately represented by the small sample size. Furthermore, even though MDCT angiograms offer remarkable anatomic information, other methods such duplex ultrasonography or magnetic resonance perfusion imaging are still needed for functional evaluation of tissue perfusion. Newer low-dose protocols and non-ionic contrast medium formulations have significantly reduced the hazards of radiation exposure and contrast nephropathy, which are nevertheless potential disadvantages, especially in older patients with compromised renal function.

In conclusion, the results of this study confirm that MDCT angiography is a valuable non-invasive imaging technique for assessing peripheral artery stenosis in the lower limbs. It offers precise and repeatable anatomical delineation, enhances postoperative surveillance, and helps with preoperative planning. The aorto-iliac and femoropopliteal arteries' preferential involvement, the predominance of atherosclerotic pathology in older male patients, and the significant visualization of collateral formation all show the imaging technique's clinical utility and pathophysiological insights.

<u>Limitations and Recommendations</u>

Limitations –

Although this study provides valuable insights into the diagnostic role of MDCT angiography in assessing peripheral arterial stenosis of the lower limbs, certain limitations must be acknowledged to interpret the results objectively. The foremost limitation is the relatively small sample size of 42 patients. A broader population base would have provided more robust statistical validity and allowed better generalization of the findings to diverse demographic and clinical groups. The limited sample also constrains the ability to perform extensive subgroup analysis based on risk factors such as diabetes, hypertension, or smoking habits, which are known to significantly influence the development and progression of peripheral arterial disease.

Second, selection bias may have been introduced because this investigation was carried out at a single tertiary care facility. Patients with moderate to severe clinical suspicion of peripheral artery disease are usually referred for MDCT angiography, which may overrepresent advanced cases in comparison to the general population. Such institutional biases could be mitigated, and a more diverse patient pool could be produced using a multicenter strategy.

The lack of comparison analysis with other diagnostic techniques such Doppler ultrasonography, magnetic resonance angiography (MRA), or traditional digital subtraction angiography (DSA) is another drawback. Correlation with these other modalities would have improved the diagnostic validity and helped establish sensitivity, specificity, and prediction accuracy more thoroughly, even if MDCT angiography offers high-resolution pictures with outstanding spatial precision.

Additionally, longitudinal patient follow-up following endovascular or surgical intervention was not included in the study. The usefulness of MDCT angiography in identifying in-stent restenosis, graft patency, or postoperative problems might have been evaluated with follow-up imaging. The results are restricted to the diagnostic stage and the technique's usefulness in continuing disease surveillance or therapy monitoring cannot be evaluated due to the absence of such temporal examination.

Another significant restriction on MDCT angiography is the use of iodinated contrast media, especially in patients with renal impairment or contrast hypersensitivity. The possibility of contrast-induced nephropathy cannot be completely eliminated, even with the use of suitable hydration and dose-optimization procedures. Furthermore, radiation exposure is still a recognized disadvantage of computed tomography-based imaging. Although this danger has significantly decreased thanks to developments in low-dose procedures, it is still a worry, particularly for patients who need serial imaging.

Image interpretation may have also been impacted by technical considerations. Image quality and lesion characterization may be impacted by inadequate contrast injection timing, patient mobility, vascular calcifications, or motion artifacts in distant arteries. Although post-processing software has enhanced clarity and reconstruction capabilities, these variables can still occasionally lead to under- or overestimation of stenotic severity.

Recommendations –

Based on the findings and the limitations identified, several recommendations can be made to enhance the clinical and research utility of MDCT angiography in peripheral arterial disease evaluation. Future studies should ideally include a larger, more diverse patient population representing varying degrees of PAD severity and a wider age range. This would allow for statistically significant correlation analyses and more accurate population-level inferences.

It is highly advised that comparative diagnostic investigations using MDCT angiography, duplex ultrasonography, MRA, and DSA be included in future study. In addition to confirming diagnostic accuracy, multimodality evaluation would aid in the creation of standardized procedures for choosing the best imaging modality depending on patient comorbidities, clinical presentation, and resource availability.

The design of the study should incorporate longitudinal patient follow-up. Serial MDCT angiography will be used to evaluate post-interventional results, including graft viability, restenosis rates, and the durability of vascular reconstructions. Determining imaging-based indicators for PAD prognosis and long-term care may depend on this knowledge.

In terms of clinical practice, the adoption of optimized low-dose MDCT protocols and use of iso-osmolar or low-osmolar contrast agents are recommended to minimize radiation exposure and nephrotoxicity risk. Pre-procedural screening for renal function should be mandatory, and adequate hydration protocols should be implemented before and after the scan, especially for elderly patients and those with chronic kidney disease.

Advanced post-processing technologies, including three-dimensional volume-rendered imaging and multiplanar reconstruction, should be routinely utilized for accurate visualization of complex arterial networks. These tools greatly enhance the surgeon's ability to plan endovascular interventions with precision. The integration of artificial intelligence-based algorithms for automated stenosis detection and quantification may further improve diagnostic efficiency and reproducibility.

The study emphasizes the significance of early detection and preventative measures from the standpoint of public health. For non-invasive vascular screening, people over 50 should be given priority, especially men with established cardiovascular risk factors like smoking, dyslipidemia, diabetes, or hypertension. In these high-risk populations, using MDCT angiography as part of a multimodal diagnostic approach may enable early detection and prompt intervention, lowering the risk of amputation and critical limb ischemia.

Lastly, it is advised that future studies examine the relationship between imaging results and clinical severity scores, such as the Ankle-Brachial Index (ABI) and Rutherford classification, in order to further academic study. This will make it possible to create indices for objective illness grading that are obtained from imaging. Standardized reference values and consensus-based interpretation standards can also be developed through cooperative multicenter investigations and the establishment of regional databases on peripheral vascular imaging.

CONCLUSION

The current study shows that Multidetector Computed Tomography (MDCT) angiography is an extremely dependable non-invasive imaging technique for assessing peripheral artery stenosis in the lower extremities. It enables accurate localization of occlusive and stenotic lesions, precise imaging of vascular anatomy, and thorough evaluation of collateral circulation. The results show that the aorto-iliac and femoropopliteal segments were primarily affected by atherosclerotic vascular diseases in the research population. This pattern was particularly prevalent in older male patients, supporting established epidemiological patterns that associate atherosclerotic vascular disease with age and gender.

Excellent spatial resolution and contrast differentiation made it possible to clearly portray lesion anatomy, luminal constriction, and artery walls using MDCT angiography. Because they offered a thorough perspective of the vascular area and surrounding structures, their multiplanar reconstructions and three-dimensional volume-rendered imaging models were very helpful for preoperative planning. In suspected cases of peripheral artery disease, MDCT angiography's accuracy and efficiency make it a perfect first-line study, minimizing the need for invasive diagnostic techniques like digital subtraction angiography.

The study underscores that MDCT angiography not only aids in detecting and grading the extent of stenosis but also plays a critical role in evaluating post-surgical grafts and endovascular stents. Its ability to identify complications, assess revascularization success, and monitor disease progression serves as an indispensable component of contemporary vascular imaging. Furthermore, its diagnostic precision supports clinicians in selecting appropriate therapeutic strategies, ranging from pharmacological management to surgical intervention.

MDCT angiography has drawbacks despite its benefits. Particularly in older or renally impaired patients, radiation exposure and possible contrast-induced nephropathy continue to be significant factors to take into account. However, these hazards have been greatly reduced by the use of non-ionic contrast agents and contemporary low dose scanning techniques. Further advances in picture quality and patient safety are promised by ongoing technological developments, such as dual-energy CT and iterative reconstruction methods.

To sum up, MDCT angiography is a thorough and effective diagnostic technique for assessing peripheral artery stenosis in the lower limbs. It is an essential tool for diagnosis and treatment planning because it combines anatomical detail, diagnostic precision, and quick image collection. MDCT angiography significantly improves clinical outcomes and quality of life for patients with peripheral artery disease by enabling early diagnosis and accurate characterisation of arterial disease. Its diagnostic and prognostic skills can be further improved by future research incorporating larger, multicentric investigations and sophisticated computer analytics, guaranteeing its continuous applicability in contemporary vascular medicine.

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