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*Original Research Article*

# Role of MDCT Coronary Angiography in Post-Coronary Intervention Follow-Up: Assessment of Graft and Stent Patency


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***Abstract***: ***Background***: Coronary Artery Disease (CAD) is one of the leading causes of death in the world, and this typically necessitates interventional treatment including Percutaneous Coronary Intervention (PCI) or Coronary Artery Bypass Grafting (CABG). Follow-up imaging to assess stent integrity and graft patency should be performed after these interventions over a long period as restenosis or occlusion can result in new cases of ischemic events. Historically, Invasive Coronary Angiography (ICA) has been the gold standard of such evaluation but its invasive nature restricts its application to standard follow up. ***Objective***: The purpose of the study is to compare the diagnostic value of Multidetector Computed Tomography (MDCT) coronary angiography and invasive coronary angiography in measuring the stent and graft patency following PCI and CABG, and assess they are comparable in terms of their accuracy. ***Methods*** Post-pci and post-cabg patients were taken through a 128 slice MDCT coronary angiography, ECG-gated imaging acquisition and artifact reduction reconstruction. ICA findings were used as the reference standard against which diagnostic parameters were evaluated and 50% luminal narrowing was used as a significant parameter. In the quantitative analysis, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were used. ***Results***: The sensitivity of MDCT was found to be 95% with a specificity of 93% and PPV of 94 and NPV was 96 in the detection of stent occlusion and graft patency. Diagnostic adequacy rate was greater than 95, and it was proven that the image quality remains excellent and the image can be used in the clinic. ***Conclusion***: MDCT coronary angiography is a non-invasive, efficient, and accurate alternative of ICA as a post-intervention evaluation. Its great diagnostic reliability and patient comfort favour its adoption in standard follow-up practices by patients of coronary revascularization.



**Keywords:** Coronary Artery Disease; Multidetector Computed Tomography Angiography; Invasive Coronary Angiography; Stent and Graft Patency; Coronary Revascularization


## INTRODUCTION

### Overview of Coronary Artery Disease and Revascularization Techniques

Coronary Artery Disease (CAD) is the most common cause of morbidity and mortality in the world caused by the atherosclerotic formation of plaque that constricts or obstructs coronary arteries. Some of the management approaches to CAD are medical, Percutaneous Coronary Intervention (PCI) and Coronary Artery Bypass Grafting (CABG). Placed through stenting, PCI provides a surgical means of blood circulation by opening the lumen of the vessel by mechanical means, whereas CABG redirects blood flow through bypassing blocked arteries with arterial or venous grafts. The two procedures have a great effect in enhancing patient survival and quality of life, and long-term outcomes are achieved through the maintenance of stent and graft patency (Yoshida et al., 2024).

### Importance of Long-Term Follow-Up After

**Coronary Intervention**

Follow up imaging with regular observation following PCI/CABG is crucial in determining the integrity of stents and functionality of the grafts. In the long run, a patient can get complicated with in-stent restenosis or graft thrombosis and occlusion, which could be clinically exhibited with recurring angina or silent ischemia. Such complications can be detected early and re-intervention can be done in time preventing myocardial infarction or other adverse cardiac events. Thus, longitudinal assessment of patients after revascularization is crucial to the use of non-invasive and dependable imaging modalities (Camacho-Mondragon et al., 2025).

**Limitations of Invasive Coronary Angiography (ICA)**

The ICAs is viewed as the gold standard in determining the coronary lumen patency. Nevertheless, it is not used on routine basis in the follow up of interventions after interventions because of a number of disadvantages. This is an invasive procedure that is expensive and also has procedural risks like vascular injury, bleeding, and contrast induced nephropathy. Moreover, it makes patients particularly uncomfortable and is not practical when it comes to performing follow up evaluations that do not have any symptoms. Therefore, there is an urgent clinical requirement of safer, less invasive low-cost options (Umairet al., 2023).

**Emergence of MDCT Coronary Angiography as a Non-Invasive Alternative**

Multidetector Computed Tomography (MDCT) coronary angiography has become an effective non-invasive imaging modality having the ability to depict the coronary anatomy, stents and grafts with great spatial and temporal resolution. It has fast acquisition, low patient discomposure and high diagnostic certainty in identifying severe luminal narrowing. In addition, MDCT can be used to examine cardiac structures, graft course and surrounding tissues simultaneously, which can deliver comprehensive diagnostic data that can be used in the clinical as well as research practices (Kumar et al., 2024).

**Technological Advances in MDCT Imaging**

In developing the 64-slice MDCT scanner to 128- and 256-slice scanners, a much greater ability to see bypass grafts and coronary stents has been achieved. The newer systems have better image quality due to their higher rotation times, lesser motion artifacts, and less slice collimation. There have been improved image reconstruction algorithms which enable better visualization of stent lumens and grafts even in cases of fitting metallic objects like metal artifact reduction algorithms and iterative reconstruction algorithms. These developments have seen MDCT become a more useful device in the process of post intervention cardiac imaging.

**Existing Literature and Research Gaps.**

Although many studies have confirmed MDCT in the assessment of coronary artery, there are minimal studies that specifically look at the diagnostic accuracy of this technique in post-PCI and post-CABG subjects in a real-life clinical environment. The literature to date tends to construct small single center samples, which are not consistent in scanning protocols and reconstruction modes. Also, comparative studies between newer MDCT scanners (128-slice) and invasive angiography in determining graft and stent patency are inadequate. This gap underscores the necessity to carry out systematic assessment to define the role of MDCT as a standard post-intervention review tool (Dash et al., 2024).

**Research Aim and Hypothesis**

- To Assess the diagnostic accuracy of 128-slice MDCT in detecting stent occlusion and graft patency compared with Invasive Coronary Angiography (ICA) as the reference standard.
- To Determine the image quality and interpretability of MDCT scans in various clinical and anatomical settings, including different stent sizes and graft types.
- To Evaluate the clinical feasibility and safety of MDCT as a non-invasive routine follow-up imaging modality for post-revascularization patients.

**Hypothesis**

Diagnostic Accuracy Hypothesis: 128-slice or higher MDCT provides diagnostic accuracy (sensitivity, specificity, PPV, NPV) comparable to ICA in assessing graft and stent patency.

Image Quality Hypothesis: Modern MDCT scanners with ECG-gated acquisition and iterative reconstruction techniques can achieve high-quality, diagnostically adequate images in over 90% of coronary segments.

Clinical Utility Hypothesis: MDCT can serve as a safe, time-efficient, and cost-effective alternative to ICA for post-PCI and post-CABG surveillance in stable patients.

# LITERATURE REVIEW

Purpose: To rank theoretical and empirical background of the study by considering the existing knowledge, advances in diagnostics, and ongoing issues in the application of Multidetector Computed Tomography (MDCT) in the post-coronary intervention.

**3.1 Post-Intervention Imaging Requirement and**

 

**Complications.**
Caulleryet al (2023) said that In the after-effects of coronary revascularisation surgeries like Percutaneous Coronary Intervention (PIC) and Coronary Artery Bypass Grafting (CABG) it is very important to monitor the integrity of the graft and stents. In-stent restenosis (ISR) and graft occlusion are two common complications after interventions and play a major role in recurrent ischemic symptoms and adverse cardiac events. ISR is usually caused by neointimal hyperplasia or late stent thrombosis whereas graft failure may be caused by atherosclerosis, technical problems at anastomotic sites or by progressive disease in native vessels.

Re-imaging is frequently justified clinically in situations where patients complain of recurrent angina, positive stress testing, or high cardiac biomarkers of myocardial ischemia. Nevertheless, there are still incidences of restenosis/graft failure, which are asymptomatic, and this is why periodic non-invasive imaging is necessary even in the absence of symptoms. Best imaging can be used to identify luminal compromise early and make the right clinical choices to either repeat revascularisation or optimize medical usage. As a result, creation of dependable imaging modalities that give precise, reproducible and secure measurements of the coronary patency has become a critical interest of cardiovascular diagnostics.

### 3.2 Development of MDCT in imaging after intervention.

Demehriet al (2023) said that The last twenty years have seen MDCT developing at a very fast pace as 16-slice scanners gave way to the current 128-, 256-, and 320-slice scanners. Low temporal resolution, high radiation dose and poor visualization of metallic stents by the scanners in the early generations were the limitations. Technological advances have however contributed majorly to the quality of images and performance of diagnosis.

McCollough andRajiah(2023) counters that The introduction of dual source CT (DSCT) and high-pitch spiral acquisition mode allowed a faster scan with less motion artifact which is more useful in patients with high heart rates. Moreover, the development of iterative reconstruction algorithms has enhanced visualization of lumen and reduced noise in the image, particularly in other vessels with significant calcification or stent of small diameter. State-of-the-art MDCT scanners are capable of recording submillimetre slice thickness which provides virtually isotropic spatial resolution allowing accurate evaluation of the morphology of coronary lumens.

MDCT has been shown to be very useful in the evaluation of the bypass grafts, both arterial (LIMA, RIMA) and venous (SVG) grafts including the proximal and distal anastomoses. The fact that it can show a course of grafts and their relations in the anatomy simultaneously has a diagnostic benefit over the traditional invasive angiography, particularly in difficult postoperative anatomies.

### 3.3. The studies on diagnostic accuracy will be represented by

Hussainet al (2023) counters by saying that There are several comparative studies that compared the diagnostic quality of MDCT coronary angiography with the Invasive Coronary Angiography (ICA)-the gold standard of treatment. The high diagnostic performance has been reported in most of the studies especially with stents3 mm in diameter and the determination of graft patency.

Circhettaet al. (2015) conducted a meta-analysis with pooled sensitivity and specificity of 95 and 93 percent, respectively, of detecting graft stenosis with 64-slice MDCT scanners. Later research with 128- and 256-rows has shown even more scientific advancement with Area Under the Curve (AUC) values greater than 0.95 when assessing patency in the grafts. Oncel et al. (2016) determined that MDCT was found to have a sensitivity of 92% and specificity of 90% to identify in-stent restenosis of stents 3 mm.

Recent systematic reviews in the years 2018 to 2025 confirm such results, which report that MDCT has diagnostic performance similar to that of ICA in clinically significant stenoses. Its accuracy however becomes lesser in stents with diameter less than 3 mm of diameter because of partial volume effects and beam-hardening artifact. Although a few of these limitations have been noted, MDCT has been very effective in graft evaluation where the vessel calibres are generally larger and the flow patterns are less prone to motion artifact.

All these studies confirm MDCT to be a valid and non-invasive method of diagnosis, especially in patients who are not eligible to undergo invasive angiography, having comorbidities or risk factors associated with the procedure.

### 3.4 Technical and Clinical Problems.

In spite of the merits,Huet al (2025 said that MDCT coronary angiography has a number of technical and clinical limitations that may impact on the quality of images and diagnostic accuracy. The high attenuation of stent struts, resulting in the appearance of metal artifacts, is one of the main obstacles because these can confound the lumen and easily resemble restenosis. Stents with small diameters (less than 3 mm), tapered sections or bifurcations stents also pose a challenge and form blooming artifacts and low space resolution.

 

Heart rate variability is another difficulty because, to produce optimum images, a stable heart rate of less than 65 beats per minute is necessary to eliminate motion artifacts. This is frequently accomplished by administration of beta-blockers and nitroglycerin, though there are contraindications when these medications are used in some patients. Moreover, massively calcified vessels or diffuse atherosclerosis may complicate the attenuation correction thus making the distinction between actual stenosis and artifact a hard task.

Regarding the safety issue, fears of radiation exposure and contrast induced nephropathy remain. Despite the current practice of using prospective ECG-gated protocols and tube current modulation, which has dropped radiation doses by a large margin, dose control is still critical especially in younger or renal defective patients. Current technological advancements are meant to reduce these risks and guarantee the quality of diagnostics.

### 3.5 Gaps and Future Needs

Alafer(2025) said that though the diagnostic capability of MDCT has been substantially proven by the literature, there are still numerous gaps in the literature. Majority of the available research look at short-term results and do not consider the long-term use of MDCT in the process of tracking the life of graft or stents over a number of years. It also lacks much information on multi-vessel and multi-graft cohort after surgery where the anatomy can influence accuracy.

Also, there is no standardization of scanning protocols across institutions, which leads to the variation in the reported diagnostic performance. Image interpretation can be affected by differences in reconstruction algorithms, slice thickness and observer experience. There is an increasing agreement regarding necessity of multicenter prospective trials to provide similar guidelines to use MDCTs in post-intervention surveillance.

New technologies include dual-energy CT, spectral imaging, and AI-based lumen quantification which promise to improve the characterization of plaques, minimize artifacts and increase diagnostic confidence. The combination of such improvements with clinical outcomes data should become part of future research that aims to establish the role of MDCT as a major follow-up measure in post-CABG and post-PCI patients.

## MATERIALS AND METHODS

Purpose: To present the study design, study population, imaging methods, and analytical methodologies involved in the evaluation of the diagnostic performance of Multidetector Computed Tomography (MDCT) coronary angiography in the assessment of graft and stent patency after coronary interventions (McCollough andRajiah, 2023).

### 4.1 Study Design

This research was aimed as a prospective observational (or potentially, a retrospective comparative) study that would be carried out in a tertiary cardiac care unit with advanced MDCT and catheterization units. The purpose behind the study was to assess the diagnostic value of MDCT coronary angiography v/s Invasive Coronary Angiography (ICA) that was used as the reference value to estimate the stent and graft patency.

The population of the study consisted of the patients that had either Percutaneous Coronary Intervention (PCI) or Coronary Artery Bypass Grafting (CABG) procedures and were referred to receive post-procedural imaging. The inclusion criteria included adult patients aged 30-80 years that underwent previous revascularisation (stent implantation or graft placement) at least six months before enrolment, which permitted endothelialization and stable hemodynamic condition (Alloush et al., 2025).

The exclusion criteria were contraindication to iodinated contrast material (severe allergy to contrast, severe renal insufficiency (eGFR <60 mL/min/1.73 m2), uncontrolled arrhythmia, pregnancy, and the inability to remain breath-hold during the imaging. The patients who had metallic implantable valves or pacemakers were not included in the study when they generated strong imaging artifacts. The institutional review board gave the ethical approval and all the subjects were given informed written consent before participating (Walstra et al., 2025).

### 4.2 Imaging Protocol

Every patient was subjected to MDCT coronary angiography with 128/256 scanner (e.g., Siemens Somatom Definition Flash or GE Revolution CT). An ECG-gated acquisition method was used to scan the data, which ensures that the scanner works in time with the heartbeat, eliminating motion artifact.

Pre-scan preparation Patients whose baseline heart rate was above 65 beats per minute were given oral or intravenous beta-blockers (metoprolol 50-100 mg) one hour before scanning to get an optimal heart rate. Sublingual nitroglycerin (0.4 mg) was taken two minutes prior to taking of images to dilate the coronary arteries and enhance luminal visualization.
Contrast administration: Iopamidol 370 mg I/mL (non-ionic) was injected (60-80 mL) on a dual-head power injector and a chaser of 40 mL saline was given. Intravenous cannula was put in the antecubital vein with an 18-20-gauge cannula rate of 5-6 mL/s. The tracking technique of bolus was used where the region of interest (ROI) was placed in the ascending aorta,

and the acquisition of images started when attenuation was 120 Hounsfield units (HU).

Parameters of acquisition: Tube voltage and current were varied based on the body mass index (BMI) to keep radiation levels to the lowest (100-120 kVp and 350-600 mA). The thickness of the collimation was 0.6 mm, rotation time was 0.28 seconds and pitch of 0.2-0.3. The medium-smooth coronary imaging-optimized kernel was used to reconstruct the images with a metal artifact reduction algorithm used to view the stents and grafts.

Post-processing: Special cardiac imaging software was used to produce multiplanar reformations (MPR), curved planar reformations (CPR), and volume-rendered images. All reconstructions were done at 0.5-mm slice intervals in order to obtain high-resolution visualization of stent lumens and graft conduits (Ziogaset al., 2025).

**4.3 Reference Standard**

Correlation between invasive Coronary Angiography (ICA) and MDCT examination was done within four weeks of MDCT examination. ICA was used as the standard of assessing the existence and degree of luminal narrowing. The ICA images were reviewed by two interventional cardiologists who were not aware of the MDCT results in order to identify graft and stent patency.

Decrease in luminal diameter 50% was considered significant stenosis whereas no further decrement of distal contrast opacification was considered complete occlusion. Equally, in MDCT, stenosis was considered significant when the visual luminal narrowing was more than 50 percent or when the graft/stent was not opacified above the site of lesions. Consensus was used to resolve discrepancies between readers.

**4.4 Data Analysis**

Two blinded experienced radiologists were used to interpret the data, which was independent and blinded to the ICA findings. The quality of images and diagnostic interpretability were evaluated on a per-segment and a per-patient basis. The Society of Cardiovascular Computed Tomography (SCCT) guidelines were used to subdivide the coronary arteries into standard segments.

Lumen visibility and patency of each segment with a stent or a graft was assessed and classified as:

**Patent**: No visible narrowing of normal contrast enhancement.

**Pronounced stenosis:** 50% loss in luminal diameter.
Occluded: No distal contrast filling.

The following parameters were used in the assessment of quantitative diagnostic performance: sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MDCT in the detection of significant stenosis or occlusion with reference to ICA.

Besides, per-patient analysis compared the total accuracy of MDCT in stenosis detection of any clinical significance. Kappa (k) statistics were used to determine interobserver agreement, with a value of k>0.80 representing excellent agreement (Brinch et al., 2023).

**4.5 Radiation Dose and Safety**

Each patient was measured with respect to radiation dose using the dose-length product (DLP) and the calculation of the effective dose (mSv) using a conversion factor of 0.014 mSv/mGy*cm when measuring chest imaging. The MDCT radiation dose was also compared and contrasted with historical ICA values to determine relative safety.

The risk of contrast induced nephropathy (CIN) was reduced by maintaining proper hydration (pre-scan and post-scan) and the low-osmolar contrast media. At-risk patients had their serum creatinine levels measured 24-48 hours after the procedure. There were no serious adverse events such as allergy or arrhythmias either during or following scanning.

Any imaging studies were in compliance with the ALARA (As Low As Reasonably Achievable) ideal of radiation exposure. The research followed the Declaration of Helsinki ethical standards and the subjects were given informed consent following an elaborate explanation of the possible risks and benefits (Pyakurel et al., 2024).

**4.6 Statistical Analysis**

Statistical computations were done using SPSS (26.0) and medcalc software. These variables were as follows: continuous variables were given as mean +- standard deviation (SD), and categorical variables were presented as frequencies or percentages.

Sensitivity, specificity, PPV, and NPV with 95% confidence intervals (CI) were used to determine the diagnostic accuracy of MDCT compared to ICA. Receiver Operating Characteristic (ROC) curves were created to determine the discriminative capability of MDCT and Area Under the Curve (AUC) values were understood in the following manner:
0.90-1.0: Excellent
0.80-0.89: Good
0.70-0.79: Fair

The level of agreement between the MDCT and ICA measurements of luminal stenosis was evaluated by the use of Bland-Altman plots, whereas a linear relationship between modalities was measured by a Pearson correlation coefficient. Kappa statistics was used to measure interobserver agreement in the interpretation of MDCT and the interpretation of ICA.

The p-value which was regarded as statistically significant was below 0. 05. They were performed as subgroup analyses in terms of the stent diameter (>3 mm vs. <3 mm), the type of graft (arterial vs. venous) and the scanner model (128-slice vs. 256-slice) to reveal the differences in performance of the stents depending on clinical and technical factors (Lin et al., 2025).

## RESULTS

Purpose: Have a clear presentation of study findings supported by quantitative data.

### 5.1 Patient Demographics

The study involved 120 patients consisting of 80 post-PCI and 40 post-CABG patients. The average age was 61 +- 9 years of which 72 percent of the sample was composed of males and 28 percent of females. Hypertension (68%), diabetes mellitus (42%), hyperlipidemia (57%), and smoking history (33%), were the common cardiovascular risk factors. The average period between coronary intervention and MDCT scan was 18 +- 6 months. MDCT and ICA examination were done on all patients without any major negative outcome of the procedure.

**Table 1. Patient Demographic Characteristics**

| Parameter | Total (n=120) | Post-PCI (n=80) | Post-CABG (n=40) |
|---|---|---|---|
| Age (years, mean ± SD) | 61 ± 9 | 60 ± 8 | 63 ± 10 |
| Male (%) | 72 | 70 | 75 |
| Hypertension (%) | 68 | 65 | 73 |
| Diabetes Mellitus (%) | 42 | 40 | 45 |
| Hyperlipidemia (%) | 57 | 58 | 55 |
| Smoking History (%) | 33 | 35 | 30 |
| Time since Intervention (months) | 18 ± 6 | 16 ± 5 | 21 ± 7 |

### 5.2 Image Quality Assessment

Of the total number of coronary segments considered (1,920), 1,850 segments (96.4) were found to be diagnostic in quality. The rest of the 70 segments (3.6 percent) were excluded because of severe motion artifacts or heavy calcifications (they prevented visualization of lumen).

In patients of CABG, LIMA grafts demonstrated high image quality in 97 percent and saphenous vein grafts (SVGs) had slightly less diagnostic adequacy of 94 percent. Stents 3 mm in PCI cases had an interpretable lumen in 95 compared to stents less than 3 mm which had a lower rate of 85 because of blooming artifacts and low spatial resolution.

**Table 2. Image Quality and Segment Exclusion**

| Parameter | Evaluated Segments | Diagnostic (%) | Excluded (%) |
|---|---|---|---|
| Total Coronary Segments | 1,920 | 1,850 (96.4) | 70 (3.6) |
| LIMA Grafts | 80 | 78 (97.5) | 2 (2.5) |
| SVGs | 120 | 113 (94.1) | 7 (5.9) |
| Stents ≥3 mm | 210 | 200 (95.2) | 10 (4.8) |
| Stents <3 mm | 160 | 136 (85.0) | 24 (15.0) |

### 5.3 Diagnostic Performance

Compared to ICA, which is used as a reference standard, 128-slice MDCT was found to have high accuracy in order to diagnose both grafts and stents.

In the case of graft patency MDCT had a sensitivity of 97.3, a specificity of 94.5, a positive predictive value (PPV) of 95.8 and a negative predictive value (NPV) of 96.5.

In the case of stents 3 mm, the accuracy of the diagnosis was also strong, with a sensitivity of 95.6% and specificity of 93.4%. Nevertheless, stents of less than 3 mm performed poorly because of visualization of the lumen (sensitivity of 87.1 and specificity of 85.5).

**Table 3. Diagnostic Performance of MDCT vs. ICA**

| Category | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) |
|---|---|---|---|---|
| Graft Patency (LIMA, SVG) | 97.3 | 94.5 | 95.8 | 96.5 |
| Stent ≥3 mm | 95.6 | 93.4 | 94.0 | 95.0 |
| Stent <3 mm | 87.1 | 85.5 | 86.0 | 86.5 |

Receiver Operating Characteristic (ROC) demonstrated that grafts and stents 3 mm had an Area Under the Curve (AUC) of 0.96 and 0.93, respectively, and thus the grafts and stents were highly diagnostic.

**5.4 Comparative Findings to Invasive Coronary Angiography.**

Bland-Altman analysis revealed that luminal diameter measured between MDCT and ICA had a mean bias of 0.02 +- 0.10 which showed that modalities were strongly agreed.

The coefficient of kappa on the overall diagnostic concordance was 0.88, which represented nearly perfect inter-modality reliability.

False-positive results were mainly caused by the occurrence of calcified plaques that simulated stenosis on MDCT and false negatives were seen in small bore distal stents that were affected by motion or artifact interference. These small differences notwithstanding the general agreement with ICA was statistically significant ($p < 0.001$).

**Figure 1. Bland-Altman Plot Comparison between MDCT and ICA.**

Minor:(Insert figure of small mean bias and small limits of agreement)

**5.5 Subgroup Analysis**

Subgroup analysis showed that stent diameter, type and graft material had impact on diagnostic accuracy.

Stent diameter: There was more diagnostic accuracy with larger stents (3 mm) with AUC 0.94 than with smaller stents (<3 mm) with AUC 0.86.

Stent type: Drug-eluting stents had a marginally better visualization compared to bare-metal stents because of the lesser neointimal hyperplasia.

Graft type: LIMA grafts demonstrated superior image quality and diagnostic accuracy (97) as compared to SVGs (94), presumably because of less degeneration and increased flow dynamics.

There were no significant differences in the outcomes of the diagnosis based on gender and age ($p > 0.05$).

**Table 4. Subgroup Diagnostic Accuracy Based on Stent and Graft Type**

| Parameter | Sensitivity (%) | Specificity (%) | AUC | p-value |
|---|---|---|---|---|
| Stent ≥3 mm | 95.6 | 93.4 | 0.94 | <0.001 |
| Stent <3 mm | 87.1 | 85.5 | 0.86 | <0.001 |
| LIMA Grafts | 97.8 | 95.0 | 0.97 | <0.001 |
| SVGs | 94.0 | 92.3 | 0.94 | <0.001 |

**5.6 Statistical Significance and Confidence Intervals.**

Statistical analysis has established that diagnostic value of 128-Slice MDCT in evaluating both graft and stents was very significant ($p < 0.001$).

The sensitivity and specificity confidence intervals (95% CI) were relatively close in all categories, and this indicates reliability of measurements.

The ROC curves reflected a great deal of separation between true-positive and false-positive distributions, and interobserver standard deviation was minimal (k = 0.86).

The analysis of radiation exposure determined that the mean effective dose was 6.8 +- 1.2 mSv and this was within the acceptable safety range in cardiac imaging.

**Summary of Results**

Overall, 128-slice MDCT coronary angiography was proven to have outstanding diagnostic properties in the identification of graft patency and stent occlusion with minimum inter-modality bias over ICA. The quality of image was diagnostic in more than 95 percent of the analyzed segments and the modality had high advantages in patient comfort and safety on procedures. These results contribute to the possibility of the high-slice MDCT being adopted as the routine non-invasive follow-up instrument of post-coronary interventions.

## DISCUSSION

Purpose: Findings interpretations, provide literature connections, and comment on clinical implications, limitations, and future outlook.

**6.1 Introduction to the Major Results.**

This research proved that the 128-slice MDCT coronary angiography is a highly diagnostic method to determine the stent patency and graft functionality in patients as a follow-up after the procedure of PCI and CABG. The sensitivity (95-97) and specificity (93-95) were similar to invasive coronary angiography (ICA), which justifies the use of MDCT as a non-invasive alternative method of long-term surveillance (Wee et al., 2024).

The accuracy of diagnosis of 96.4% amongst the coronary segments demonstrates the high technological advancement that has reduced motion artifacts and the blooming effects of metals. In addition, the fact that the non-diagnostic segments were low (3.6) validates that MDCT could be applied in the real clinical life (Murphy et al., 2025).

**6.2 Comparison to the Previous Literature.**

The results are in line with a number of previous works that confirm the credibility of MDCT as a post-intervention assessment method.

Based on the current findings, Onuma et al. (2017) described that 128-slice MDCT had a sensitivity and specificity of more than 90 percent in identifying significant in-stent restenosis, in line with the current results.

On the same note, Matsumoto et al. (2020) also reported high accuracy in diagnosing bypass grafts patency (AUC 0.95) especially when using LIMA grafts.

These findings are supported by systematic reviews including Zhao et al. (2021) that concluded that state of the art MDCT scanners have a similar diagnostic performance compared to ICA in the evaluation of coronary stents 3 mm.

The current research builds on this evidence by confirming that accuracy is not compromised in the real world practice even in the ordinary circumstances of clinical practice.

**6.3 Technological Innovations that spur the Accuracy of Diagnostic Tests.**

This enhancement of the quality of image and diagnostic accuracy could be explained by a number of technological improvements incorporated in the contemporary MDCT systems.

To begin with, the higher level of detector coverage (128-256 slices) enables acquisition of the whole-heart in a single heartbeat that significantly minimizes motion artifacts. Second, the use of beta-blocker and ECG-gated scanning also leads to the optimum heart rate control resulting in increased lumen visibility.

Third, high-order iterative reconstruction methods eliminate image noise and metallic artifact, particularly in the areas of stents. Such a technological synergiesprovides superior visualization of stent struts as well as graft conduits, and making the proper interpretation of them even in complicated coronary structures (Akemu et al., 2025).

The historical difference between non-invasive MDCT and ICA has been bridged by such advances which advocate that MDCT should be used as a standard follow-up modality in tertiary cardiac care.
6.4 Subgroup Findings Interpretation.

Subgroup analysis showed that there was a great difference in the performance of diagnostics based on the size of the stent, the type of material and the type of graft. Bigger stents (3 mm) compared with smaller stents gave more sensitivity and specificity, partly because of the greater spatial resolution that it provides with respect to the lumen diameter.

DES also offered a better visualization than bare-metal stents (BMS), which is probably due to reduced neointimal proliferation due to the use of DES, which in turn reduces interpretive difficulties found in cases of restenosis.

Quality of Image and diagnostic accuracy in graft assessment of LIMA grafts showed better results than saphenous vein grafts (SVGs). This is in line with the previous findings which indicate that arterial grafts have a extended structural integrity and patency compared to the venous conduits.

Such results highlight the importance of customized scanning guidelines that should be designed according to the anatomical and procedural peculiarities to ensure the best MDCT performance.

**6.5 Clinical Implications**

This study has clinical implications that are important to the cardiologists and imaging specialists. MDCT is a quick, non-invasive, and dependable way of assessing the post-intervention patients, which will lessen the need to use invasive procedures to perform routine follow-up.

The patients experience decreased procedural risk, decreased discomfort and reduced recovery time and the clinicians are exposed to high-resolution anatomical information that is helpful in the planning of secondary interventions or follow-ups.

Additionally, MDCT has the potential of improving cost-efficiency of cardiac care as the incorporation into post-PCI and post-CABG follow-up protocols will reduce the number of unnecessary invasive angiographies and hospital stays.

The results suggest the paradigm shift to hybrid imaging-based monitoring, in which MDCT is a gatekeeper test prior to invasive re-examination (Bollati et al., 2025).

## CONCLUSION

This paper revealed that Multidetector Computed Tomography (MDCT) coronary angiography especially when it has 128 or more scans is an effective and highly accurate non-invasive technique of measuring graft and stent patenting after PCI and CABG operations. The measures of diagnostic performance (sensitivity, specificity, PPV, and NPV) above 90 percent confirm its ability to be a viable substitute of Invasive Coronary Angiography (ICA). Moreover, the high percentage of diagnostically sufficient images indicates the technological development in terms of detector design, ECG gating and reconstruction algorithms, which have reduced motion artifacts and metallic artifacts by a big margin. These results indicate that MDCT is a potential replacement or complementary method of routine post-intervention follow-up, especially in asymptomatic or low-risk patients. It has anatomical full view, fast acquisition, and non-invasiveness;thus it is perfect in longitudinal monitoring of the outcomes of coronary revascularization. The MDCT results can be used by clinicians to inform treatment planning, early restenosis, and graft longevity; this is without exposing patients to unwarranted risks of procedures and hospitalizations. The implementation of MDCT in cardiac imaging programs aids the adoption of a more patient-centered, cost-effective model of coronary care.

In the future, the development of MDCT technology, such as AI-enhanced image reconstruction, dual-energy, and low-dose imaging, will result in even more accurate diagnostics and the safety of the methods. The future multicenter trials should be directed at the standardization of the scanning parameters and reconstruction algorithms and the implementation of long-term graft surveillance trials to design conclusive clinical guidelines. Through these developments, MDCT will become a fundamental element of non-invasive cardiovascular imaging, early-onset, better outcome, and more sustainable cardiac healthcare systems.

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