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ORIGINAL ARTICLE

Assessment of left main coronary artery luminal diameter using quantitative coronary analysis and optical coherence tomography

Zlatko Mehmedbegovic[1,2], Dario Jelic[1], Djordje Mladenovic[1], Lazar Travica[1], Damjan Simic[1], Djordje Dukic[1], David Sarenac[1], Marko Ristic[1], Nikola Zejak[1], Dijana Bojovic[2], Goran Stankovic[1,2]

[1] University Clinical Center of Serbia, Department of Cardiology, Belgrade, Serbia

[2] University of Belgrade, Faculty of Medicine, Belgrade, Serbia

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Correspondence to:

Zlatko Mehmedbegovic

University Clinical Center of Serbia, Department of Cardiology

11000 Belgrade, Serbia

Email: zlatkombegovic@gmail.com

Summary

Introduction: Accurate assessment of left main (LM) coronary lumen dimensions is essential during percutaneous coronary intervention (PCI). Quantitative coronary analysis (QCA) is routinely used, yet its agreement with high-resolution intravascular imaging modalities such as optical coherence tomography (OCT) in the LM segment remains incompletely defined.

Methods: Thirty patients who underwent LM PCI were evaluated using follow-up angiography and OCT. Eight matched lumen parameters were assessed using 2D QCA, 3D QCA, and OCT. Differences between modalities were analyzed using repeated-measures ANOVA for normally distributed variables and Friedman's test for minimal lumen area (MLA). The correlations were assessed descriptively, and agreement was evaluated using Bland-Altman analysis.

Results: Significant modality-dependent differences were observed across most lumen parameters. QCA demonstrated strong associations with OCT for reference- and mean-based lumen metrics, whereas correlations were weaker for extreme (minimal and maximal) dimensions. Bland-Altman analysis revealed minor mean differences between QCA and OCT but wide limits of agreement, indicating substantial inter-individual variability despite consistency at the group level.

Conclusion: QCA provides reasonably consistent estimates of reference and mean lumen dimensions in the LM segment but shows limited association with OCT for extreme measurements. Despite strong associations, individual variability remains considerable, supporting OCT as the preferred modality for precise lumen assessment, stent sizing, and procedural optimization in LM PCI.

Keywords: optical coherent tomography, quantitative coronary angiography, left main coronary artery, correlation analysis, lumen sizing

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INTRODUCTION

Precise assessment of coronary lumen dimensions is fundamental for planning and evaluating percutaneous coronary intervention (PCI), especially in anatomically large and clinically critical segments such as the left main coronary artery (LMCA) (1, 2). Quantitative coronary analysis (QCA) remains the most widely used technique for quantifying angiographic lumen size in routine practice (3). Modern QCA software provides both two-dimensional (2D) measurements, such as reference and minimal diameter, as well as three-dimensional (3D) reconstructions, enabling the calculation of lumen areas, including reference, minimal, and mean cross-sectional areas (3). On the other hand, the LMCA is a short vessel segment that frequently exhibits plaque and lumen asymmetry, complex bifurcation geometry, and significant tapering (4). These anatomical features introduce variability in 2D and 3D QCA measurements and restrict the accuracy of angiographic assessment (3). Consequently, QCA may underestimate accurate lumen dimensions, particularly in large-caliber or non-cylindrical regions, and may be influenced by projection angle, vessel eccentricity, and foreshortening (5). Optical coherence tomography (OCT), together with intravascular ultrasound (IVUS), is established as the reference imaging modality for intracoronary lumen evaluation due to its high spatial resolution and ability to provide accurate cross-sectional measurements (1, 2). OCT allows precise quantification of diameter, minimal and mean lumen areas, and geometric characteristics of bifurcation segments, making it the ideal modality for comparing QCA measurements (1, 2). Although the correlation between angiographic and intravascular imaging metrics has been demonstrated in other coronary segments, systematic evaluation of these relationships specifically within the LMCA remains limited. Therefore, a comprehensive comparison of QCA-derived lumen variables with OCT findings would enable identification of which angiographic parameters most closely reflect OCT measurements, where systematic discrepancies occur, and how QCA can be used more reliably in settings where intravascular imaging is unavailable. Understanding inter-modality differences and levels of agreement is clinically relevant for procedural planning and stent sizing in left main PCI.

This study aimed to compare quantitative measurements obtained with 2D QCA, 3D QCA, and OCT, and to assess their agreement and potential clinical interchangeability in assessing left main coronary artery lesions.

METHOD

Sample

This study included 30 patients who underwent invasive follow-up with OCT control after primary PCI of the LMCA guided only by angiography and remained free of adverse events during long-term follow-up. Given the exploratory nature of the study, no formal sample size calculation was performed. The sample size was determined by the number of patients with complete paired angiographic and OCT datasets available for analysis.

Ethical approval and informed consent

This study was approved by the University Clinical Centre Ethical Committee (1500/34/2025; September 29, 2025), by the Council of Scientific Field of Medical Sciences, of the Faculty of Medicine, University of Belgrade (61206-4744/2-21, September 30, 2021), and the Research Board of the Department of cardiology of the University Clinical Center of Serbia (review No: 1883/21, August 24, 2021). All participants provided written informed consent before enrollment and before undergoing any study-related procedures.

Lumenometric analysis

A unified set of eight measurements was calculated using both QCA and OCT, enabling direct one-to-one comparison between modalities. These included: minimal lumen

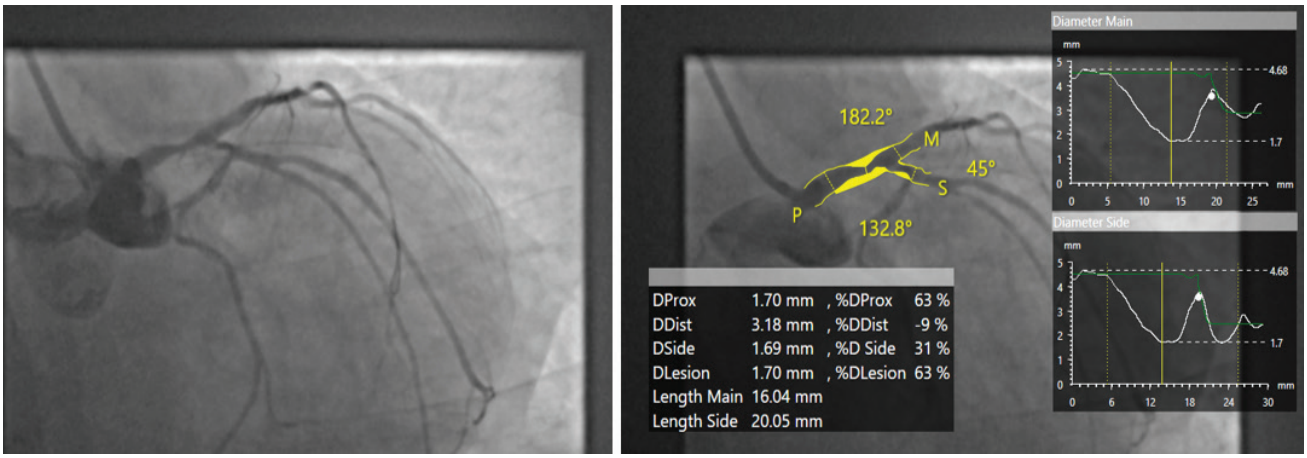

Figure 1. Left panel – caudal projection, still frame selected during coronarography; Right panel – 2D QCA analysis from the chosen projection and frame.

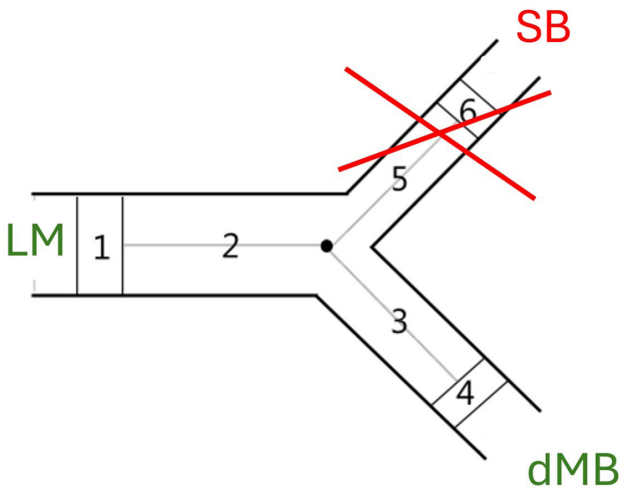

Figure 2. QCA segment analysis: 1 – reference segment of LM, 2 – LM segment, 3 - dMB segment, 4 – reference of dMB segment, 5 and 6 SB segments.

Abbreviations: dMB – distal main branch; QCA – quantitative coronary analysis; LM – left main; SB – side branch.

diameter (MLD), maximal lumen diameter (MaxD), mean lumen diameter (MeanD), reference diameter (RD), minimal lumen area (MLA), reference lumen area (RefA), maximal lumen area (MaxA), and mean lumen area (MeanA).

QCA analysis

CAAS Workstation 7.3 with the bifurcation module was used for QCA measurements. To guarantee complete contrast filling and no vessel overlap, angiographic projections with the best LMCA visualization were chosen for 2D QCA. The 6F or 7F catheter filled with contrast was used for calibration. After tracing the vessel's centerline, automated edge detection was used to define the LMCA contours. When necessary, manual contour correction was used, but it was kept to less than 15% of the segment length **(Figure 1)**.

Reference diameter was defined from a 5-mm normal reference segment proximal and distal to the lesion, or the ostium when applicable. Segmental analysis was performed using the six-segment model integrated into the software, allowing extraction of all lumenometric parameters. Since OCT analysis was available only for the LM and distal main branch (dMB) segments (segments 5 and 6), corresponding to the side-branch (SB) region, these segments were excluded from further analysis **(Figure 2)**.

The identical analysis was repeated for 3D QCA in a second projection that was more than 30° apart. By combining the two perspectives, the software produced a 3D reconstruction with spatially corrected measurements (Figure 3). All lumenometric variables were extracted from the 3D model of the LMCA bifurcation **(Figure 4)**.

OCT analysis

OCT pullbacks were recorded with standard contrast-flush acquisition. Quantitative lumenometric analysis was performed using CAAS Intravascular at 0.2-mm cross-section intervals across the LMCA bifurcation. All frames were reviewed for image quality, and sections with inadequate visualization or flushing artifacts were excluded.

To match the QCA results export in two segments, OCT analysis was also performed using a two-segment LMCA model: LM and distal main branch (dMB) **(Figure 5)**.

For each segment, the same eight lumenometric parameters were extracted: MLD, MaxD, RD, MeanD, MLA, RefA, MaxA, and MeanA.

Statistical analysis

Normality of continuous variables was assessed using visual inspection of histograms and Q–Q plots, as well

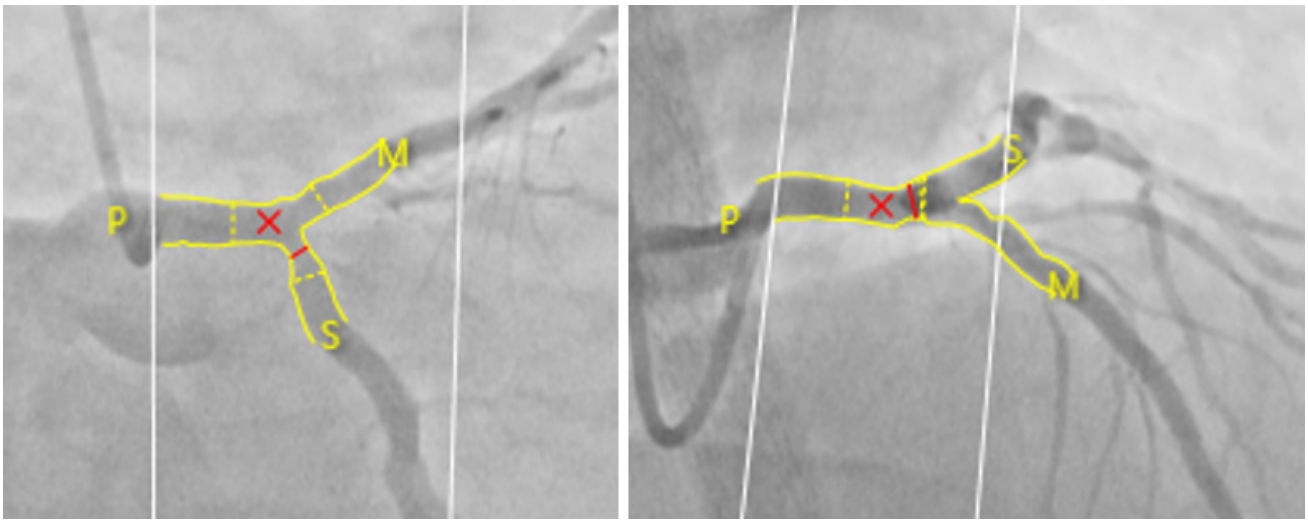

Figure 3. 3D QCA analysis. Left panel – caudal projection analysis; Right panel – cranial projection analysis.

Abbreviations: 3D QCA – three-dimensional quantitative coronary analysis

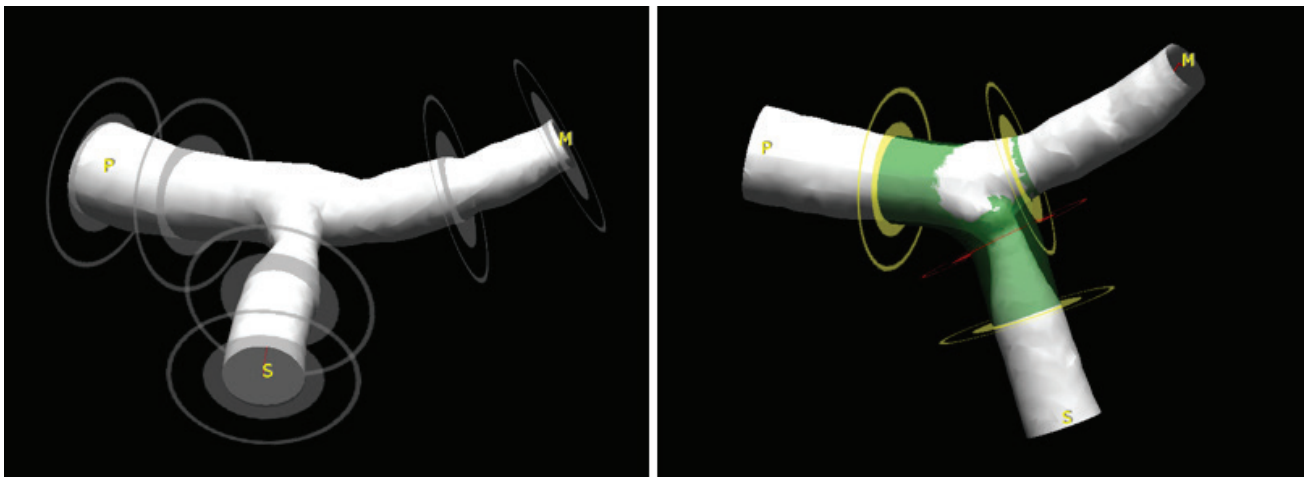

Figure 4. 3D model of LMCA generated during 3D QCA analysis.
Abbreviations: LMCA – left main coronary artery; 3D QCA – three-dimensional quantitative coronary analysis.

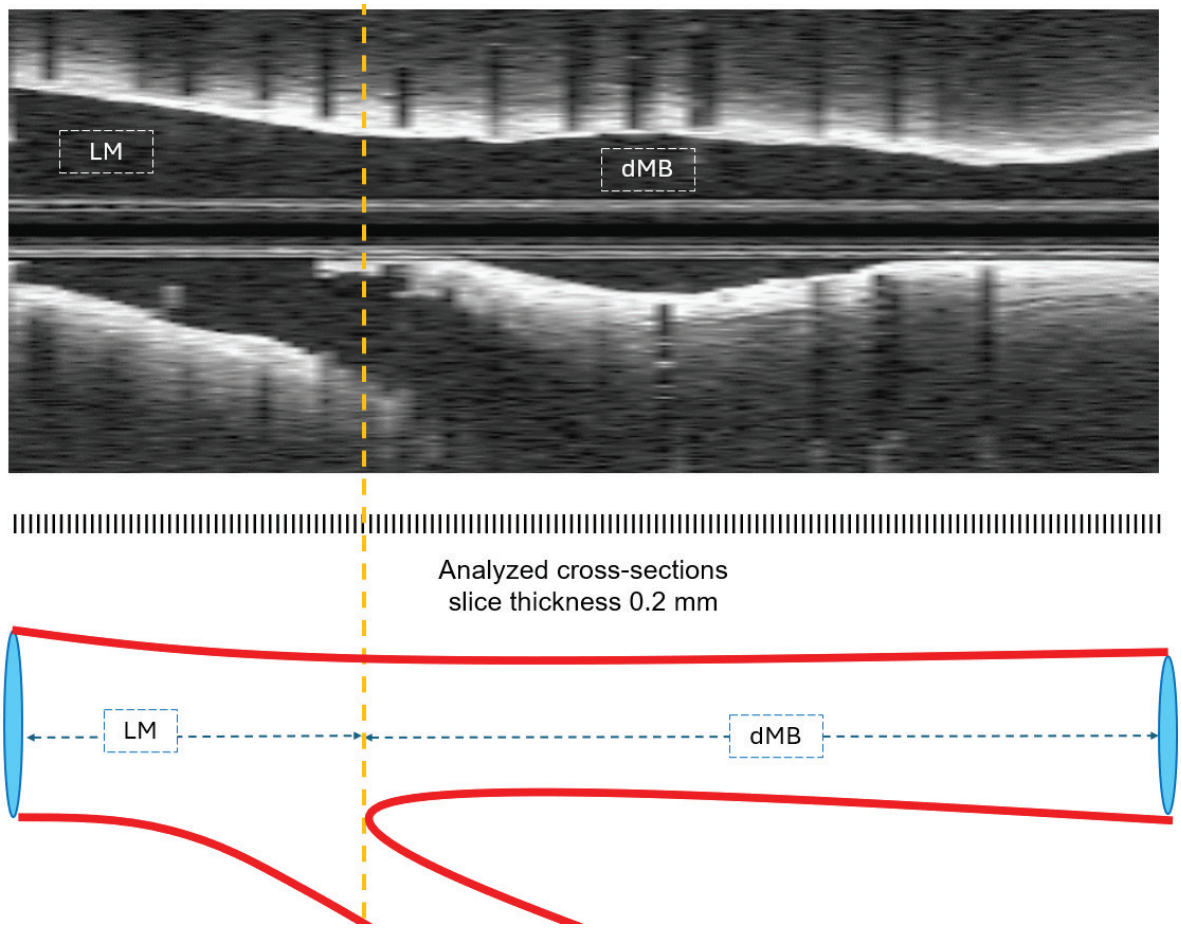

Figure 5. OCT analysis adapted for bifurcation anatomy.
Abbreviations: dMB – distal main branch; LM – left main.

as the Shapiro–Wilk test. Continuous variables are presented as mean ± standard deviation, whereas MLA is presented as median with interquartile range due to non-normal distribution. Differences between measurement modalities were assessed using a repeated-measures ANOVA with Greenhouse–Geisser correction for normally distributed variables and Friedman's test for MLA due to non-normality. Post-hoc pairwise comparisons were adjusted for multiple testing using Bonferroni correction. Correlation analyses (Pearson for normally distributed variables and Spearman for MLA) were used for descriptive purposes only to characterize the strength of correlation between measurements obtained by different imaging modalities and do not imply agreement. Agreement between modalities was primarily assessed using Bland–Altman analysis, including calculation of mean bias and 95% limits of agreement. Statistical significance was defined as $p < 0.05$. Statistical analyses were

performed using IBM SPSS Statistics (version 26.0; IBM Corp., Armonk, NY, USA) and Python (version 3.1), using standard scientific libraries for statistical analysis and data visualization.

RESULTS

The study population consisted of 30 patients undergoing quantitative coronary analysis and optical coherence tomography of the left main coronary artery. The cohort included predominantly male patients (74%), with a mean age of 66.1 ± 13.7 years. Two-dimensional QCA was performed in all 30 patients, whereas three-dimensional QCA was performed in 29 cases due to insufficient numbers of suitable angiographic projections. A total of 29 OCT pullbacks were included in the final analysis, with one recording excluded due to suboptimal image quality. Paired 2D QCA, 3D QCA, and OCT measurements enabled direct within-patient comparisons across imaging modalities for the available datasets. *Lumenometric analysis*

The lumenometric assessment revealed significant systematic differences between 2D QCA, 3DQCA, and OCT across all anatomical segments **(Table 1)**.

Left main sub-segment

In the LM subsegment, OCT identified significantly lower MLD values compared to QCA modalities, while simultaneously recording the highest MaxD. This divergence highlights OCT's superior sensitivity for detecting vessel eccentricity in the proximal segment, where angiographic projections often underestimate the major axis of elliptical lumens.

Distal main branch (dMB) sub-segment

In the dMB subsegment, 3DQCA consistently yielded the most conservative estimates for luminal areas, suggesting a systematic bias toward smaller vessel dimensions in 3D reconstructions.

Combined LM + dMB analysis

Notably, the combined analysis (LM + dMB) yielded results comparable to those of 2D QCA and OCT for area estimation, with no statistically significant differences observed for Reference Area and MLA. This suggests that, despite differences in linear-diameter measurements, 2D QCA remains a robust surrogate for cross-sectional area estimation across the overall bifurcation. In contrast, 3D QCA significantly underestimated these parameters compared to both 2D QCA and OCT, reinforcing its role as the most restrictive modality in bifurcated lesion assessment.

Correlation analysis

Overall, correlations with OCT were strongest in the LM segment and weaker in the dMB, with consistently higher correlations for 3D QCA compared with 2D QCA, particularly in distal measurements. Across segments, the strongest associations with OCT were observed for reference-based and global lumen indices, whereas correlations for minimal and focal diameter parameters were more variable.

In the LM segment, both QCA techniques showed strong correlations with OCT, particularly for mean diameter and area-based parameters, including MLA and meanA. In contrast, correlations in the dMB were generally attenuated, with several nonsignificant associations, especially for reference diameter and reference area, reflecting increased variability in distal segments. When LM and dMB were analyzed together, correlations were highest and most consistent, confirming a stable association between QCA- and OCT-derived measurements across the whole left main bifurcation anatomy **(Table 2)**.

Bland-Altman analysis was performed to assess agreement between 2D and 3D QCA and OCT for the two most clinically relevant luminal parameters used for PCI guidance and stent sizing, namely RD and RefA. Scatter plots were used to illustrate the linear association between measurements. Scatter analysis demonstrated significant positive correlations between QCA and OCT for both RD and RefA **(Figure 6)**. For RD, both 2D and 3D QCA showed strong linear associations with OCT, with slightly higher correlation coefficients observed for 3D QCA and a visually tighter distribution of data points. For RefA, similarly strong correlations were observed for both QCA techniques across the range of values assessed. Despite these significant correlations, scatter plots suggested a tendency toward underestimation by both QCA methods at larger lumen sizes. Overall, these findings indicate a stable linear relationship between QCA- and OCT-derived measurements, while highlighting potential systematic differences at higher values. These findings reflect a linear association rather than agreement.

Bland-Altman analysis for 2D QCA demonstrated a slight mean bias relative to OCT for both RD and RefA **(Figure 7)**. However, the limits of agreement were wide, indicating substantial variability at the individual level. For RD, the observed dispersion suggests that deviations of a magnitude potentially relevant to procedural decision-making may occur, whereas for RefA, variability increased with larger lumen dimensions. For 3D QCA, the mean bias remained similarly low, and the limits of agreement were consistently narrower than in 2D QCA, indicating improved geometric agreement with OCT. Nevertheless, clinically relevant dispersion persisted for both RD and RefA, particularly at higher values, suggesting that individual measurements may still deviate mean-

Table 1. Lumenometric analysis, comparison between 2D QCA, 3D QCA, and OCT measurements.

LM segment	2D QCA	3D QCA	OCT	p (all)	p 2D–3D	p 2D–OCT	p 3D–OCT
MLD (mm, mean±SD)	3.6±0.8	3.5±0.7	2.7±0.7	<0.001	0.121	<0.001	<0.001
MaxD (mm, mean±SD)	4.7±0.7	4.3±0.5	5.6±0.9	<0.001	<0.001	<0.001	<0.001
MeanD (mm, mean±SD)	4.1±0.6	3.8±0.6	3.6±0.7	<0.001	<0.001	<0.001	0.108
RD (mm, mean±SD)	4.6±0.7	3.9±0.6	4.7±0.7	<0.001	<0.001	0.176	<0.001
MLA (mm², median [IQR])	10.8 [8.4–13.5]	9.9 [7.9–11.7]	10.0 [7.8–14.2]	0.084	0.086	0.696	0.123
RefA (mm², mean±SD)	16.8±5.4	12.5±3.5	17.7±4.9	<0.001	<0.001	0.18	<0.001
MaxA (mm², mean±SD)	18.1±5.3	14.7±3.6	17.9±4.9	<0.001	<0.001	0.721	<0.001
MeanA (mm², mean±SD)	13.4±3.5	12.1±3.4	13.7±4.1	0.010	0.017	0.476	0.010
dMB segment	**2D QCA**	**3D QCA**	**OCT**	**p (all)**	**p 2D–3D**	**p 2D–OCT**	**p 3D–OCT**
MLD (mm, mean±SD)	2.9±0.5	2.5±0.4	2.4±0.5	<0.001	<0.001	<0.001	0.234
MaxD (mm, mean±SD)	4.3±0.5	3.9±0.5	3.9±0.5	0.002	0.001	0.004	0.862
MeanD (mm, mean±SD)	3.3±0.4	3.0±0.4	2.9±0.4	<0.001	<0.001	<0.001	0.020
RD (mm, mean±SD)	3.2±0.6	2.9±0.4	3.2±0.4	0.014	0.002	0.808	0.009
MLA (mm², median [IQR])	6.5 [4.6–7.4]	4.9 [4.1–6.1]	6.4 [5.2–7.4]	<0.001	<0.001	0.849	0.005
RefA (mm², mean±SD)	8.6±2.5	6.2±2.4	8.1±2.1	<0.001	<0.001	0.59	<0.001
MaxA (mm², mean±SD)	14.6±3.7	11.8±3.8	9.7±2.1	<0.001	0.005	<0.001	0.006
MeanA (mm², mean±SD)	8.8±2.2	6.7±1.5	7.9±1.7	<0.001	<0.001	0.001	<0.001
Combined LM + dMB	**2D QCA**	**3D QCA**	**OCT**	**p (all)**	**p 2D–3D**	**p 2D–OCT**	**p 3D–OCT**
MLD (mm, mean±SD)	3.2±0.8	3.0±0.7	2.6±0.6	<0.001	<0.001	<0.001	<0.001
MaxD (mm, mean±SD)	4.5±0.7	4.1±0.6	4.8±1.1	<0.001	<0.001	0.017	<0.001
MeanD (mm, mean±SD)	3.7±0.6	3.4±0.6	3.2±0.7	<0.001	<0.001	<0.001	0.009
RD (mm, mean±SD)	3.9±0.9	3.4±0.7	4.0±1.0	<0.001	<0.001	0.446	<0.001
MLA (mm², median [IQR])	7.6 [5.7–10.8]	6.4 [4.8–9.7]	7.5 [6.1–10.4]	<0.001	0.001	0.633	0.003
RefA (mm², mean±SD)	12.7±5.9	9.3±4.4	12.9±6.1	<0.001	<0.001	0.405	<0.001
MaxA (mm², mean±SD)	16.4±4.9	13.3±3.9	13.7±5.6	<0.001	<0.001	<0.001	0.597
MeanA (mm², mean±SD)	11.1±3.7	9.4±3.8	10.7±4.3	<0.001	<0.001	0.189	<0.001

Abbreviations: 2D QCA – two-dimensional quantitative coronary analysis; 3D QCA – three-dimensional quantitative coronary analysis; dMB – distal main branch; IQR – inter-quartile range; MaxA - maximal lumen area; MaxD - maximal lumen diameter; MeanA - mean lumen area; MeanD - mean lumen diameter; MLA - minimal lumen area; MLD - minimal lumen diameter; LM – left main; OCT – optical coherence analysis; RD - reference diameter; RefA - reference lumen area; SD – Standard deviation.

Table 2. Correlation analysis between 2D QCA, 3D QCA, and OCT measurements.

LM	MLD r (p)	MaxD r (p)	MeanD r (p)	RD r (p)	MLA ρ (p)	RefA r (p)	MaxA r (p)	MeanA r (p)
2D QCA vs. OCT	0.509 (p<0.001)	0.689 (p<0.001)	0.779 (p<0.001)	0.607 (p<0.001)	0.841 (p<0.001)	0.593 (p<0.001)	0.747 (p<0.001)	0.794 (p<0.001)
3D QCA vs. OCT	0.661 (p<0.001)	0.472 (p=0.013)	0.711 (p<0.001)	0.597 (p<0.001)	0.725 (p<0.001)	0.569 (p=0.001)	0.566 (p=0.002)	0.725 (p<0.001)
dMB	**MLD r (p)**	**MaxD r (p)**	**MeanD r (p)**	**RD r (p)**	**MLA ρ (p)**	**RefA r (p)**	**MaxA r (p)**	**MeanA r (p)**
2D QCA vs. OCT	0.287 (p<0.001)	0.476 (p<0.001)	0.572 (p<0.001)	0.110 (p<0.001)	0.465 (p<0.001)	0.169 (p<0.001)	0.582 (p<0.001)	0.667 (p<0.001)
3D QCA vs. OCT	0.493 (p<0.001)	0.486 (p<0.001)	0.715 (p<0.001)	0.288 (p<0.001)	0.484 (p<0.001)	0.279 (p<0.001)	0.202 (p<0.001)	0.538 (p<0.001)
LM + dMB	**MLD r (p)**	**MaxD r (p)**	**MeanD r (p)**	**RD r (p)**	**MLA ρ (p)**	**RefA r (p)**	**MaxA r (p)**	**MeanA r (p)**
2D QCA vs. OCT	0.549 (p<0.001)	0.633 (p<0.001)	0.809 (p<0.001)	0.761 (p<0.001)	0.751 (p<0.001)	0.784 (p<0.001)	0.690 (p<0.001)	0.856 (p<0.001)
3D QCA vs. OCT	0.613 (p<0.001)	0.521 (p=0.001)	0.605 (p<0.001)	0.795 (p<0.001)	0.785 (p<0.001)	0.783 (p<0.001)	0.511 (p<0.001)	0.848 (p<0.001)

Abbreviations: 2D QCA – three-dimensional quantitative coronary analysis; 3D QCA – three-dimensional quantitative coronary analysis; dMB – distal main branch; MaxA - maximal lumen area; MaxD - maximal lumen diameter; MeanA - mean lumen area; MeanD - mean lumen diameter; MLA - minimal lumen area; MLD - minimal lumen diameter; LM – left main; OCT – optical coherence analysis; RD - reference diameter; RefA - reference lumen area; r – Pearson correlation coefficient; ρ – Spearman rank correlation coefficient.

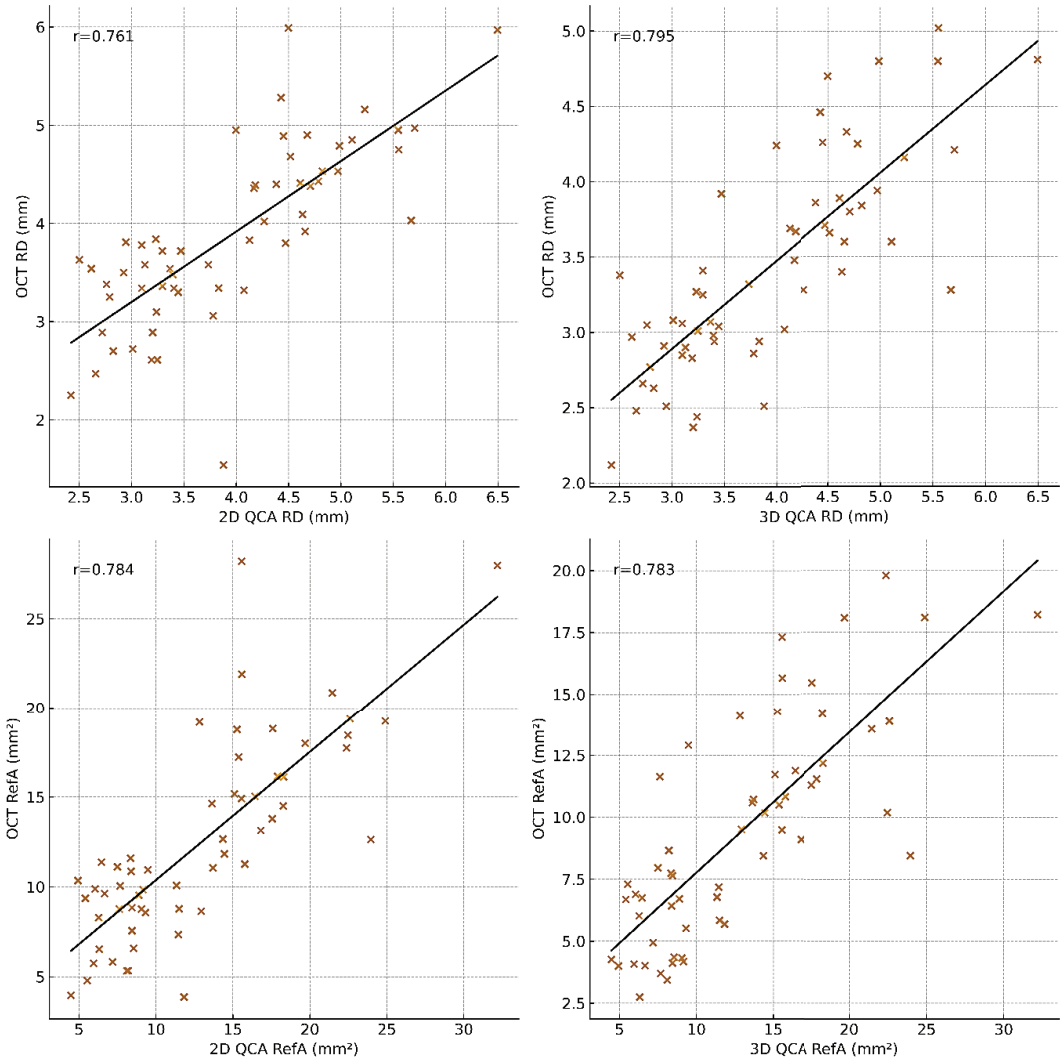

Figure 6. Upper left panel – scatter plot 2D QCA-OCT for RD; Upper right panel - scatter plot 3D QCA-OCT for RD; Lower left panel - scatter plot for 2D QCA-OCT for RefA; Lower right panel – scatter plot 3D QCA-OCT for RefA.

Abbreviations: 2D QCA – two-dimensional quantitative coronary analysis; 3D QCA – three-dimensional quantitative coronary analysis; OCT – optical coherence analysis; RD - reference diameter; RefA - reference lumen area.

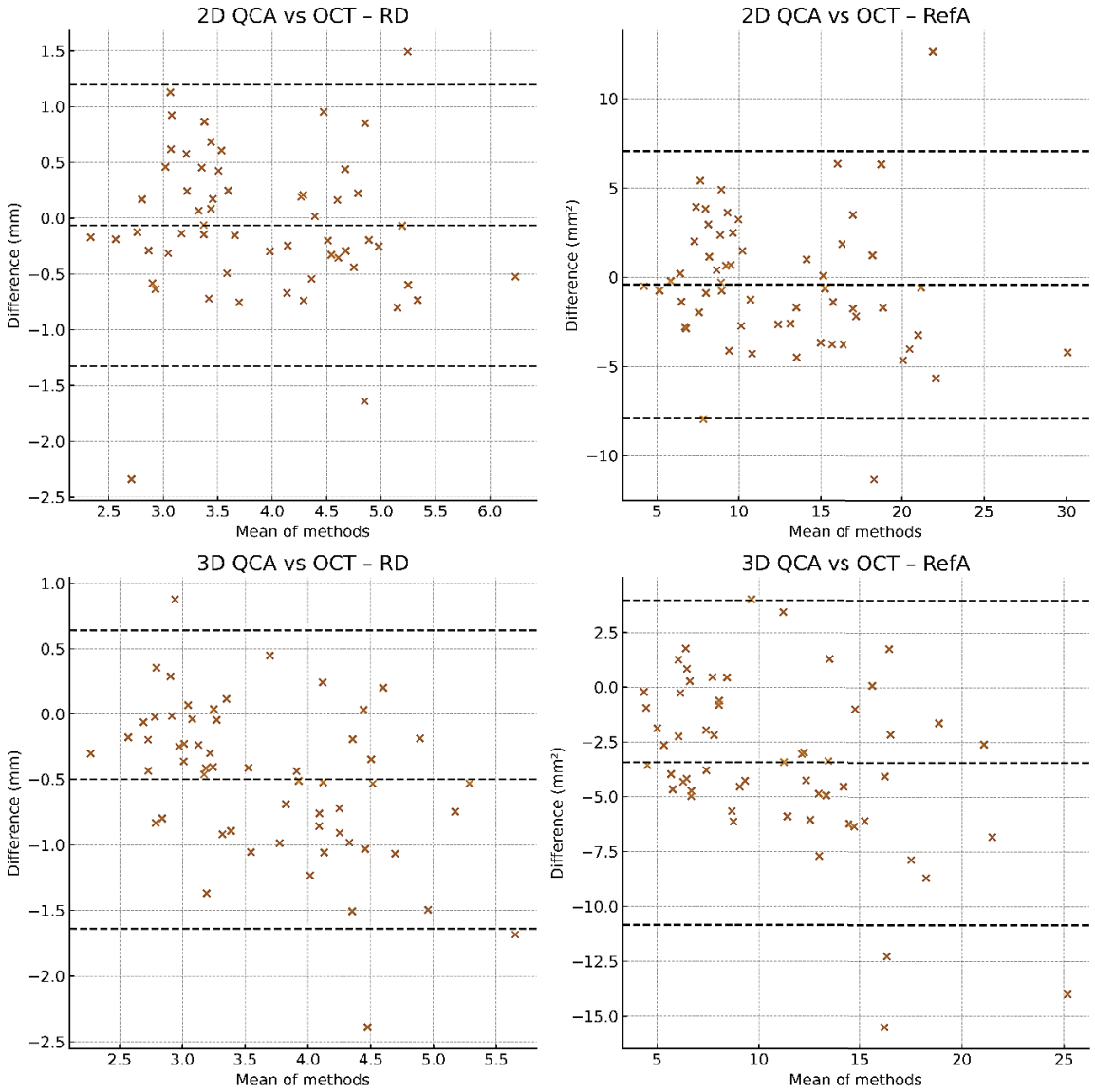

Figure 7. Bland-Altman analysis for 2D-OCT and 3D QCA-OCT for RD and RefA.

Upper left panel – Bland-Altman analysis 2D QCA-OCT for RD; Upper right panel - Bland-Altman analysis 2D QCA-OCT for RefA; Lower left panel - Bland-Altman analysis 3D QCA-OCT for RD; Lower right panel – Bland-Altman analysis 3D QCA-OCT for RefA.

Abbreviations: 2D QCA – two-dimensional quantitative coronary analysis; 3D QCA – three-dimensional quantitative coronary analysis; OCT – optical coherence analysis; RD - reference diameter; RefA - reference lumen area.

ingfully from OCT-derived reference values. 3D QCA demonstrated reduced geometric dispersion compared with 2D QCA; however, clinically relevant variability persisted, underscoring the limitations of angiography-based measurements for precise lumen assessment in LM PCI and supporting the complementary role of IVI.

DISCUSSION

In this study, we systematically compared 2D and 3D quantitative coronary analysis with optical coherence tomography for the assessment of left main coronary lumen dimensions. The main findings can be summarized as follows: first, significant and systematic differences were observed between angiography-based measurements and OCT across most luminal parameters; second, QCA demonstrated strong associations with OCT, particularly for reference-based and mean lumen metrics; and third, despite these associations, absolute agreement at the individual patient level remained limited, with wide limits of agreement that challenge the clinical interchangeability of these modalities. Notably, 3D QCA consistently reduced geometric dispersion compared with 2D QCA, yet did not fully overcome the limitations inherent to angiography-based assessment in the left main segment.

The RD measured in this study was consistent with those described in previous QCA analyses of LM bifurcation anatomy. Reddy et al. reported QCA-derived RD of 4.50 ± 0.79 mm for LM and 3.45 ± 0.63 mm for LAD (here dMB), while Goel et al. found LM values of 3.89 ± 0.25 mm with LAD measurements of 3.36 ± 0.28 mm

(6, 7). In the present analysis, the LM reference diameter of 4.52 mm closely mirrors Reddy's findings, whereas the LAD reference diameter of 3.22 mm is modestly smaller. This reduction is compatible with long-term post-PCI follow-up measurements, in which late lumen loss (typically around 0.10 mm) contributes to smaller lumen dimensions, particularly in the LAD. The magnitude and direction of the modality differences observed here align well with previously published comparisons of intravascular imaging (IVI) and QCA. Goel et al. and Reddy et al. consistently demonstrated that IVUS-derived diameters exceed QCA-derived measurements in LM and LAD segments; IVUS LM diameters reached 4.33 ± 0.32 mm compared with 3.89 ± 0.25 mm by QCA, while LAD IVUS measurements (3.71 ± 0.60 mm) exceeded QCA values (3.45 ± 0.63 mm). Furthermore, IVUS has been shown to provide larger measurements than OCT, and both exceed histomorphometric references. The measurement hierarchy demonstrated here, with OCT producing the smallest MLD values, QCA systematically underestimating reference dimensions, is consistent with the inter-modality gradient reported across prior intravascular imaging studies, where IVUS exceeds both.

3D QCA was developed to overcome the geometric and projectional limitations of 2D QCA by integrating multiple angiographic views into a three-dimensional reconstruction that better accounts for vessel tortuosity and lesion eccentricity (8-10). Although it shares the resolution constraints of angiography, multiple phantom and stent-validation studies have demonstrated high measurement accuracy, supporting its theoretical advantage in complex coronary anatomy. Comparative imaging literature consistently confirms a modality hierarchy, first described by Tu et al. and later corroborated by Tomaniak et al., in which IVUS yields the largest lumen dimensions, OCT slightly smaller, and 3D QCA the smallest, with IVUS exceeding 3D QCA by 6–14% in diameters and >20% in lumen area, and OCT by 5–10% in diameters and ~16.5% in area (8, 11).

Findings in this study are consistent with prior findings: 3D QCA systematically underestimated OCT, with differences of approximately 13% for RD, 28% for RefA, and 12% for MeanA, mainly attributable to an eccentric lumen geometry (OCT eccentricity ~0.2) and the inherent limitations of diameter-based reconstruction. The most significant discrepancies were observed for refA, expected given that 3D QCA calculates area from at least two diameters, neither of which is guaranteed to represent the actual maximal axis. In contrast, 2D QCA showed markedly fewer deviations (~1.5% in the reference area), likely because all measurements were performed in a caudal projection that naturally aligns with the maximal diameter plane of the LM bifurcation.

Despite these systematic underestimations, 3D QCA demonstrated strong correlations with OCT for key geometric indices in our study ($r \approx 0.78–0.85$), consistent with the conclusions of Tu et al., who reported superior OCT–3D QCA agreement compared with IVUS. Collectively, these findings reinforce that while 3D QCA cannot replace OCT, it provides a meaningfully improved geometric assessment over 2D QCA and offers practical benefit for evaluating complex LM segments when intravascular imaging is unavailable.

Taken together, these findings show that QCA and OCT demonstrate strong associations for lumen and reference-based geometric parameters, while diverging for measurements influenced by extreme vessel sizes, with inter-modality differences comparable in magnitude to those reported in prior QCA–IVUS–OCT studies. (6-8, 12, 13).

CLINICAL IMPLICATIONS

The results of this study have practical implications for the assessment of LM and proximal dMB. While QCA provides reliable information on lumen and reference dimensions, reduced agreement with OCT for minimal and maximal luminal measurements underscores its limitations in characterizing the extremes of lumen geometry. Because slight differences in minimal and maximal lumen dimensions parameters may influence stent sizing and optimization strategies, particularly in LM interventions, intravascular imaging remains the preferred modality for precise evaluation. Nonetheless, the strong correlations observed between RD and RefA indicate a consistent association across modalities, despite the individual variability observed in the Bland–Altman analysis.

STUDY LIMITATIONS

This study has several limitations that should be acknowledged. First, the analysis was restricted to two predefined segments—the left main and distal main branch—without evaluation of the circumflex or additional bifurcation daughter vessels, which limits generalizability to complete bifurcation anatomy. Second, lumen measurements were obtained during long-term post-PCI follow-up, a period in which neointimal proliferation and late lumen loss may influence absolute dimensions; therefore, comparisons with studies based on pre-intervention or acute-phase imaging must be interpreted cautiously. Third, although OCT served as the reference modality, differences in resolution, segmentation algorithms, and frame selection across techniques may have contributed to measurement variability, particularly for parameters defined by maximal luminal contours. Fourth, the sample size, while adequate for paired comparisons and correlation analyses, limits the ability to perform subgroup analyses or adjust for clinical and anatomical covariates. Finally, Bland–Altman plots demonstrated broad limits

of agreement at the individual level, which may affect lesion-level decision-making. The relatively small sample size is a limitation of this study, and further investigations in larger cohorts are warranted.

CONCLUSION

Both 2D and 3D QCA demonstrated significant positive correlations with OCT. However, wide limits of agreement in both modalities confirm that QCA cannot reliably substitute for precise LM lumen sizing with OCT. These findings highlight the value of IVI and support the use of OCT whenever accurate lumen-geometric assessment is required in the LMCA segment.

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PROCENA DIJAMETRA LUMENA GLAVNOG STABLA LEVE KORONARNE ARTERIJE KVANTITATIVNOM KORONARNOM ANGIOGRAFIJOM I OPTIČKOM KOHERENTNOM TOMOGRAFIJOM

Zlatko Mehmedbegović[1,2], Dario Jelić[1], Đorđe Mladenović[1], Lazar Travica[1], Damjan Simić[1], Đorđe Dukić[1], David Šarenac[1], Marko Ristić[1], Nikola Zejak[1], Dijana Bojović[2], Goran Stanković[1,2]

Sažetak

Uvod: Precizna procena dimenzija lumena glavnog stabla leve koronarne arterije (LM) od ključnog je značaja tokom perkutane koronarne intervencije (PCI). Kvantitativna koronarna analiza (QCA) se rutinski koristi u kliničkoj praksi, dok stepen njenog slaganja sa intravaskularnim modalitetima visoke rezolucije, poput optičke koherentne tomografije (OCT), u LM segmentu nije u potpunosti razjašnjen.

Metode: U studiju je uključeno 30 bolesnika kod kojih je tokom praćenja sprovedena angiografija i OCT nakon PCI na LM. Analizirano je osam odgovarajućih parametara lumena dobijenih pomoću 2D QCA, 3D QCA i OCT. Razlike između metoda procenjivane su Friedmanovim testom, povezanost analizirana je Pearsonovom korelacijom, dok je slaganje metoda ispitivano Bland-Altman analizom.

Rezultati: Uočene su značajne razlike između modaliteta za većinu analiziranih parametara lumena. QCA je pokazala snažnu povezanost sa OCT za referentne i srednje vrednosti lumena, dok je povezanost bila slabija za ekstremne (minimalne i maksimalne) dimenzije. Bland-Altman analiza je pokazala mala prosečna odstupanja između QCA i OCT, ali uz široke granice slaganja, što ukazuje na izraženu interindividualnu varijabilnost uprkos konzistentnosti na nivou grupe.

Zaključak: QCA obezbeđuje relativno konzistentne procene referentnih i srednjih dimenzija lumena u LM segmentu, ali pokazuje ograničenu korelaciju sa OCT, naročito za ekstremne vrednosti. Uprkos snažnoj povezanosti, individualna varijabilnost merenja ostaje značajna, što potvrđuje OCT kao preferentni modalitet za preciznu procenu lumena, izbor veličine stenta i optimizaciju PCI na LM.

Ključne reči: optička koherentna tomografija, kvantitativna koronarna angiografija, glavno stablo leve koronarne arterije, korelaciona analiza, veličina lumena

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