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Computed Tomography-Based High-Risk Coronary Plaque Score to Predict Acute Coronary Syndrome Among Patients With Acute Chest Pain – Results from the ROMICAT II Trial

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Abstract

Background—Coronary computed tomography angiography (CTA) can be used to detect and quantitatively assess high-risk plaque features.

Objective—To validate the ROMICAT score, which was derived using semi-automated quantitative measurements of high-risk plaque features, for the prediction of ACS.

Material and methods—We performed quantitative plaque analysis in 260 patients who presented to the emergency department with suspected ACS in the ROMICAT II trial. The readers used a semi-automated software (QAngio, Medis medical imaging systems BV) to measure high-risk plaque features (volume of <60HU plaque, remodeling index, spotty calcium, plaque length) and diameter stenosis in all plaques. We calculated a ROMICAT score, which was derived from

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the ROMICAT I study and applied to the ROMICAT II trial. The primary outcome of the study was diagnosis of an ACS during the index hospitalization.

Results—Patient characteristics (age 57 ± 8 vs. 56 ± 8 years, cardiovascular risk factors) were not different between those with and without ACS (prevalence of ACS 7.8%). There were more men in the ACS group (84% vs. 59%, $p=0.005$). When applying the ROMICAT score derived from the ROMICAT I trial to the patient population of the ROMICAT II trial, the ROMICAT score (OR 2.9, 95%CI 1.4–6.0, $p=0.003$) was a predictor of ACS after adjusting for gender and 50% stenosis. The AUC of the model containing ROMICAT score, gender, and 50% stenosis was 0.91 (95%CI 0.86–0.96) and was better than with a model that included only gender and 50% stenosis (AUC 0.85, 95%CI 0.77–0.92; $p=0.002$).

Conclusions—The ROMICAT score derived from semi-automated quantitative measurements of high-risk plaque features was an independent predictor of ACS during the index hospitalization and was incremental to gender and presence of 50% stenosis.

Keywords

coronary computed tomography angiography; acute coronary syndrome; coronary atherosclerotic plaque; acute chest pain; risk score

Introduction

Coronary computed tomography angiography (CTA) has been established as a reliable assessment tool for coronary artery disease (CAD) and the detection of coronary atherosclerotic plaque and stenosis.^{1–4} Several previously published randomized, multicenter trials have shown that coronary CTA allows for the rapid and efficient triage in patients presenting to the emergency department (ED) with suspected acute coronary syndrome (ACS).^{5–7} However, the traditional qualitative assessment for stenosis may lead to an increase in downstream testing. In addition, there is uncertainty in managing patients with significant CAD based on coronary CTA results since the positive predictive value of coronary CTA for significant CAD remains moderate.^{7–10} Since coronary CTA provides information on plaque burden and high-risk plaque features, the addition of such parameters to the traditional interpretation of coronary CTA, which is limited to stenosis detection, could improve the method's efficiency in patients with acute chest pain.

Clinicians who use coronary CTA results for triaging patients with suspected ACS look for a simple method of incorporating high-risk plaque findings into decision-making. Previous studies have associated high-risk plaque characteristics (e.g. positive remodeling, low CT attenuation plaque, napkin-ring sign and spotty calcium), as characterized by coronary CTA, with culprit lesions of ACS.^{11–17} While studies in patients with suspected ACS have shown that evaluation for high-risk plaque features improved the diagnostic accuracy for ACS^{12–15}, quantitative analysis of a large number of data sets regarding features of plaque vulnerability would be extremely time consuming and subject to substantial interobserver variability. These obstacles can partly be addressed by using novel analytic platforms which improve the reproducibility and feasibility of quantitative plaque measurements in coronary CTA.^{18–26}

Furthermore, investigators have utilized the quantitative analysis of high-risk coronary plaque features to derive scores that differentiate patients with and without ACS.^{12,13} However, these studies focused on patients with significant stenosis and were not designed to validate the scores. The validation of the scores in an independent population would be critical for the acceptance in clinical practice.

In this study, we investigated the association of high-risk plaque features detected by semi-automated quantitative analysis with the outcome of ACS. Our aim was to validate the diagnostic value of the score of high-risk coronary plaque features derived in the ROMICAT I trial to improve detection of ACS in patients with suspected ACS in the ROMICAT II trial.

Material and methods

Patient population

The study cohort consisted of patients who were randomized to the coronary CTA arm of the Rule Out Myocardial Infarction/Ischemia Using Computer Assisted Tomography (ROMICAT) II trial and also underwent coronary CTA (Figure 1). A detailed description of the patient population was previously reported.⁷ In brief, between April 2010 and January 2012, 1000 patients presenting to the ED of nine hospitals in the United States with chest pain and a clinical suspicion for ACS, but negative initial cardiac troponin and electrocardiogram with no ischemic changes, were enrolled. All study participants provided written consent for participation. The local institutional review boards approved the study.

Quantitative coronary CTA analysis

Coronary CTA images were acquired using either retrospectively ECG-gated or prospectively ECG-triggered protocols on scanners from three vendors (Siemens, General Electric, Toshiba) and different scanner generations (64-, 128-, 256-row, and dual source). The images were transferred to a central core lab where four readers with at least 5 years of experience and level III training in coronary CTA analyzed the datasets on a dedicated cardiac workstation with quantitative plaque analysis software (QAngio CT RE 2.0, Medis, Leiden, the Netherlands). Each reader analyzed one fourth of the randomly assigned datasets. Further, all four readers analyzed 20 randomly selected coronary CTA datasets to determine interobserver agreement.

The quantitative analysis of coronary plaque was performed only in coronary segments with visually detectable plaques. No quantitative analysis was performed in coronary segments with non-diagnostic image quality (number of segments with non-diagnostic image quality n=108/3,804 coronary segments).

Analysis began with the automatic detection of the coronary arteries followed by the segmentation of luminal and outer vessel boundaries (Figure 2). If needed, manual adjustments of the vessel centerline and boundaries were performed. The reader then determined the proximal and distal reference of the coronary plaque in the adjacent normal vessel (Figure 3). The final results of the coronary CTA analysis were reported per coronary segment using the model of the Society of Cardiovascular Computed Tomography.²⁷ If multiple plaques were found in one coronary segment (number of segments with multiple

plaques n=66/3,804 coronary segments), the quantitative measurements from all plaques were summed for given segment. If a plaque was continuous through more than one coronary segment, the anatomic boundaries of the coronary segment were used for the beginning and end of the plaque measurements.

We reported the volumes of plaque subcomponents with <30 HU and <60 HU. The remodeling index was calculated as the outer vessel wall area at the site of the minimal luminal area divided by the vessel area defined by the vessel wall reference at that location. The vessel wall reference provides the estimate of the normal tapering of the coronary artery. We defined positive remodeling as the remodeling index >1.1. The plaque length was calculated as the centerline length from the proximal to distal end of the plaque. The diameter stenosis was calculated as the minimal luminal diameter divided by the average of the luminal diameter at the proximal and distal references. The quantitative plaque measurements were exported automatically from the plaque analysis software.

The ROMICAT score

We used the data from our previously published results obtained in the ROMICAT I trial to define the score for prediction of ACS.¹³ The ROMICAT score (range of the score from 0 to 4 points) assigned one point for each high-risk plaque feature (positive remodeling, low CT attenuation plaque, spotty calcium or plaque length). The variables were dichotomized by using the cut-points with the best discriminatory capacity (highest AUC) for ACS in the ROMICAT I trial. In accordance with the new literature published since our original manuscript, we modified the criterium for positive remodeling as a remodeling index >1.1.^{15,28–30} Spotty calcium was defined as the volume of plaque between 9 mm³ and 90 mm³ with >130 HU the values that provided the best accuracy in the ROMICAT I trial. Thresholds were >13.8 mm for plaque length, >15 mm³ for low CT attenuation (< 30 HU) plaque volume, and >52 mm³ for low CT attenuation (< 60 HU) plaque volume.

We used two methods to calculate the ROMICAT score.

ROMICAT score from all coronary segments—The first method involved analyzing all coronary segments in each patient. If a high-risk plaque feature was present in any of the coronary segments, one point was assigned for each of the high-risk plaque features present (maximum score 4).

ROMICAT score from the coronary segment with the maximum diameter stenosis—The second method involved analyzing only the plaque with the maximum diameter stenosis for high-risk plaque features (maximum score 4).

Definition and adjudication of acute coronary syndrome

For this study, the primary outcome of the study was ACS during the index hospitalization defined as acute myocardial infarction or unstable angina pectoris according to the American College of Cardiology/American Heart Association Guidelines.³¹ The endpoint was predefined and adjudicated by an external, independent clinical end-point committee.⁷

Statistical Analysis

All statistical analyses were performed using Stata 13.1 (StataCorp LP, College Station, Texas). The continuous data are presented as mean $\pm$ standard deviation or median and interquartile range and comparisons between groups were performed with an independent student t-test or the Wilcoxon rank-sum test for continuous variables and Fisher's exact test for categorical variables. Intraclass correlation coefficient (ICC) was calculated by the use of a two-way random-effects model and was used to evaluate interobserver agreement among four readers. To determine whether the ROMICAT score of high-risk plaque features is an independent predictor of ACS, we performed multivariable logistic regression analyses and adjusted for the presence of 50% stenosis, 70% stenosis and gender. The discriminatory capacity of the ROMICAT score, 50% stenosis, 70% stenosis and gender for the prediction of ACS was assessed using c-statistics. The asymptotic 95% confidence intervals (95%CI) for the AUC were estimated using a nonparametric approach which is closely related to the jackknife technique.³² For all analyses, a 2-tailed p value of <0.05 was required to reject the null hypothesis.

Results

Study population

Of the 501 patients randomized to coronary CTA, 473 underwent coronary CTA. Reasons for not undergoing coronary CTA were: patient declined coronary CTA (n=9), safety concerns (n=5), unavailability of coronary CTA (n=5), or technical difficulties (n=9). Coronary plaque was detected in 260 patients, in whom we performed quantitative analysis. The baseline patient characteristics stratified by the diagnosis of ACS (prevalence 7.8%, myocardial infarction n=5; unstable angina pectoris n=32) are summarized in Table 1. There were more men among ACS patients. There were no significant differences in age and the prevalence of cardiovascular risk factors.

Interobserver variability of quantitative coronary plaque analysis

We observed good to very good interobserver agreement among four readers for the quantitative measurements of volume of plaque with <30HU (ICC 0.80, 95% CI 0.74 to 0.86), volume of plaque with <60HU (ICC 0.87, 95% CI 0.82 to 0.91), positive remodeling (ICC 0.69, 95% CI 0.60 to 0.77), and plaque length (ICC 0.98, 95% CI 0.98 to 0.99).

Quantitative plaque characteristics and the ROMICAT score in patients with and without ACS

We compared the quantitative plaque characteristics in patients with and without ACS. First, when looking at the worst lesion for each of the high-risk plaque features (i.e. plaque with the highest volume of low HU component, plaque with the highest remodeling index, longest plaque in each patient) (Table 2), patients with ACS had larger volume of plaque with <30 HU and <60 HU, higher remodeling index and longer plaques. In addition, the proportion of lesions with positive remodeling and spotty calcium was higher in patients with ACS. ROMICAT score calculated from all coronary segments were higher in patients with ACS.

We also performed a separate analysis of the coronary segment with maximum diameter stenosis (i.e. analysis of one plaque in each patient). The results were similar except for the prevalence of spotty calcium (Table 3). ROMICAT scores from the coronary segment with the maximum diameter stenosis were higher in patients with ACS.

Validation of the ROMICAT high-risk plaque score for the prediction of ACS in ROMICAT II population

We applied the ROMICAT score derived in the ROMICAT I trial to the population of patients in the ROMICAT II trial. In univariable logistic regression analysis, the ROMICAT score (using low CT attenuation plaque with <60 HU) calculated from all coronary segments (OR 5.7, 95% CI 3.1 to 10.3, $p<0.001$), 50% stenosis (OR 49.6, 95% CI 19.0 to 129.2, $p<0.001$), and female gender (OR 0.3, 95% CI 0.1 to 0.7, $p=0.006$), but not age and number of cardiovascular risk factors, were predictors of ACS. In multivariable analysis, the ROMICAT score (OR 2.9, 95% CI 1.4 to 6.0, $p=0.003$) remained a significant predictor of ACS after adjusting for gender and the presence of 50% stenosis. The AUC of the model containing ROMICAT score, gender, and 50% stenosis was 0.91 (95% CI 0.86 to 0.96) and was significantly better than the model with gender and 50% stenosis (AUC 0.85, 95% CI 0.77 to 0.92; $p=0.002$) (Figure 4).

We performed a separate analysis for the ROMICAT score calculated from the coronary segment with the maximum diameter stenosis. In multivariable analysis, the ROMICAT score (OR 1.9, 95% CI 1.0 to 3.5, $p=0.04$) remained a significant predictor of ACS after adjusting for gender and the presence of 50% stenosis. The AUC of the model containing ROMICAT score, gender, and 50% stenosis was 0.88 (95% CI 0.81 to 0.96) and was significantly better than the model with gender and 50% stenosis (AUC 0.85, 95% CI 0.77 to 0.92; $p=0.02$) (Figure 4).

Finally, we repeated all analyses for the definition of a significant stenosis at a threshold level of 70%. The ROMICAT score calculated from all coronary segments (OR 3.5, 95% CI 1.8 to 6.6, $p<0.001$) was a significant predictor of ACS after adjusting for gender and 70% stenosis. The AUC of the model containing ROMICAT score, gender, and 70% stenosis was 0.87 (95% CI 0.80 to 0.93) and was significantly better than the model with gender and 70% stenosis (AUC 0.78, 95% CI 0.70 to 0.86; $p<0.001$). Using the coronary segment with the maximum diameter stenosis, the ROMICAT score (OR 2.2, 95% CI 1.3 to 3.8, $p<0.01$) was a significant predictor of ACS after adjusting for gender and 70% stenosis. The AUC of the model containing ROMICAT score, gender, and 70% stenosis was 0.84 (95% CI 0.75 to 0.93) and was significantly better than the model with gender and 70% stenosis (AUC 0.78, 95% CI 0.70 to 0.86; $p=0.01$).

Similar results were observed for the ROMICAT scores calculated with the low CT attenuation plaque with <30HU.

Discussion

In patients with suspected ACS from the large, multicenter ROMICAT II trial, we found an association between high-risk coronary plaque features from quantitative analysis (volume

of low CT attenuation plaque, positive remodeling, spotty calcium, plaque length) and the presence of ACS. In addition, we validated the score previously derived in the ROMICAT I trial. This ROMICAT score, which was derived from semiautomated quantitative measurements of high-risk plaque features, was independent and incremental to gender, 50% stenosis, and 70% stenosis for the diagnosis of ACS.

Coronary plaque and ACS

Initial observations in patients with ACS and stable angina pectoris demonstrated that larger plaques and positive remodeling were associated with ACS.³³ Subsequent studies confirmed a significant difference between culprit plaques of ACS and stable obstructive coronary plaques.^{11,15,16,34,35} Those studies defined the plaque characteristics associated with the presence of ACS (larger plaque volume, plaque with low CT attenuation, positive remodeling, large plaque burden, spotty calcium and napkin-ring sign).

In our study, larger plaque volume with low CT attenuation, positive remodeling, longer lesions, and higher prevalence of spotty calcium were present in patients with ACS. Previous investigations compared the culprit lesions of ACS to the stenotic plaques in patients with stable CAD in small single center studies.^{11,15,16,34,35} We performed analysis of all coronary plaques in a large multicenter multivendor study of patients with suspected ACS. Two separate analyses were performed and included the detection of high-risk plaque features in all plaques as well as in the plaque with the maximum diameter stenosis in each patient. The association between high-risk plaque features and ACS was confirmed in both analyses.

Quantitative assessment of coronary atherosclerotic plaque

The quantification of coronary atherosclerotic plaque by coronary CTA has been extensively validated against intravascular imaging.³⁶ Coronary CTA permits accurate quantification of total plaque volume.^{18,37,38} In addition, the plaque subcomponents at predefined CT number thresholds, can be also quantified based on individual voxel analysis. The presence of low CT attenuation plaque is associated with the presence of a lipid-rich necrotic core both *ex vivo* and in patients.^{19–21,39–41} Additional high-risk plaque features such as positive remodeling^{28,42,43} and spotty calcium^{43,44} can be also reliably detected by coronary CTA as compared to intravascular imaging. The reproducibility of quantitative plaque assessment is good.^{18,23} However, the validation studies for the quantification of coronary plaque have been mostly performed in small populations at single centers.

In our study, we showed the feasibility of quantitative coronary plaque assessment in a large population of ED patients from a multicenter study, which utilized various CT scanner technologies. We excluded only 2.8% of segments from the analysis due to low image quality. This observation confirms that the CT technology has matured to the point where it provides high-quality images suitable for quantitative plaque analysis, using semi-automated software, in the real-world clinical setting.

Validation of the ROMICAT high-risk coronary plaque score for the prediction of ACS

Previous studies derived coronary plaque scores for the prediction of ACS from small patients samples and single center studies. Kim et al. compared culprit plaques of 35 patients with ACS and 36 patients with stable angina pectoris.¹² They created a score that included low CT attenuation plaque with <60HU, positive remodeling and spotty calcium and each plaque characteristic was weighted for optimized performance. The AUC of this optimized score for ACS was 0.91. In our analysis of the ROMICAT I trial, we compared culprit lesions with >50% stenosis in 34 patients with acute chest pain (21 patients with ACS and 13 patients without ACS).¹³ The ROMICAT I score, which assigned 1 point to each of 4 high-risk plaque features (positive remodeling, low CT attenuation plaque, spotty calcium and stenosis length), had an AUC of 0.83 for ACS. The scores were derived in patients with coronary stenosis and no adjustment for the presence of luminal narrowing was performed. Further, the scores have not been validated in independent samples. In our study we analyzed all patients with coronary plaque. In this unbiased approach, we demonstrated that the ROMICAT score was independent and incremental to gender, 50% stenosis, and 70% stenosis for the prediction of ACS. Our results provide the base for the testing of the ROMICAT score based on quantitative assessment of high-risk plaque features in future clinical trials.

Limitations

The quantitative analysis of coronary plaque is labor intensive and despite the use of semi-automated software, we had to perform manual adjustments of the vessel and plaque boundaries. The quantitative analysis required between 30 to 60 minutes in patients with multiple plaques. Therefore, a more automated assessment will be required in order to implement the ROMICAT score in routine clinical practice. However, fully automated approaches with plaque detection by the software were reported recently.⁴⁵ Another limitation we encountered was that the design of the ROMICAT II trial precluded studying the predictive value of quantitative plaque measurements for the prediction of future cardiovascular events. Other studies, demonstrated the value of quantitative coronary plaque assessment for the prediction of future events.^{24,46} A third limitation was that the number of outcomes (ACS, n=37) precluded the creation of multivariable models with more variables. Finally, the results of the plaque assessment were not available to the clinicians at the time of coronary CTA interpretation. Future studies will be required to demonstrate the improvement in the efficiency of coronary CTA assessment that will include quantitative plaque measurements in clinical practice.

Conclusions

The ROMICAT score derived from semi-automated quantitative measurements of high-risk plaque features is independent and incremental to gender, 50% stenosis, and 70% stenosis for the diagnosis of ACS. The score may provide a new risk stratification instrument for patients presenting to the ED with low-to-intermediate likelihood of ACS.

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Abbreviations

CTA	computed tomography angiography
ACS	acute coronary syndrome
CAD	coronary artery disease
HU	Hounsfield units
ROMICAT	Rule Out Myocardial Infarction/Ischemia Using Computer Assisted Tomography
CI	confidence interval
AUC	area under the receiver operating curve
ED	emergency department

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Highlights

- Quantitative assessment of high-risk coronary plaque is feasible using semiautomated software in the setting of a large multicenter trial.
- ROMICAT score was derived from the quantitative assessment of high-risk plaque features in the ROMICAT I trial and applied in the population of patients in the ROMICAT II trial.
- ROMICAT score is independent and incremental to 50% stenosis and gender for prediction of ACS in patients with acute chest pain.

Figure 1. Study population enrollment, exclusion and inclusion
CCTA - coronary computed tomography angiography

Figure 2. An example of the automatic segmentation of the right coronary artery

Panel A – The automated software performs the detection of the coronary tree (green lines) and the reader manually selects the right coronary artery (RCA; blue line).

Panel B – Curved multiplanar reformatted image of the RCA.

Panel C – Straightened vessel view of the RCA demonstrates a non-calcified plaque (arrowhead) in the proximal segment (left image). The software performs automated segmentation of luminal (yellow line) and outer vessel (orange line) boundaries (right image).

Figure 3. An example of the quantitative plaque measurements

Panel A – The large coronary plaque in the proximal right coronary artery (RCA) showed in long-axis view in the multiplanar reformatted image. The red line shows a site of the vessel cross-section.

Panel B – The cross-sectional view of the proximal RCA demonstrates a large plaque. The software detects plaque components with low CT attenuation <30HU (red), 31 to 60HU (light green) and 61 to 130HU (dark green).

Panel C – The curved multiplanar reformatted image of the RCA. The proximal and distal normal cross sections (blue lines) are selected manually by the reader to mark the beginning and end of the plaque. The software automatically selects the minimal luminal area (stenosis).

Panel D – The software provides quantitative measurements of the selected coronary plaque including total plaque volume (127 mm³), remodeling index (2.04), stenosis degree (21%) and plaque length (11.7 mm). The volumes of plaque subcomponents (<30HU – red, 31 to 60HU – light green, 61 to 130HU – dark green) are also reported.

Figure 4.

Panel A AUC of the logistic regression model with ROMICAT score calculated from all coronary segments, 50% stenosis and gender as compared to the model with 50% stenosis and gender

Panel B AUC of the logistic regression model with ROMICAT score calculated from the coronary segment with the maximum diameter stenosis, 50% stenosis and gender as compared to the model with 50% stenosis and gender

Table 1

Characteristics of patients with coronary plaque stratified by diagnosis of acute coronary syndrome

	ACS (N=37)	No ACS (N=223)	P value
Age (years)	57.2 ± 8.3	55.9 ± 7.8	0.383
Male gender, n (%)	31 (83.8)	132 (59.2)	0.005
Cardiovascular risk factors, n (%)			
Hypertension	22 (59.5)	135 (60.5)	1.000
Diabetes mellitus	7 (18.9)	46 (20.6)	1.000
Dyslipidemia	25 (67.6)	117 (52.5)	0.109
Former or current smoker	25 (67.6)	120 (53.8)	0.153
Family history of premature CAD	11 (29.7)	54 (24.2)	0.539
Number of cardiovascular risk factors, n (%)			0.310
0 or 1	8 (21.6)	66 (29.6)	
2 or 3	23 (61.2)	128 (57.4)	
4	6 (16.2)	29 (13.0)	

ACS = Acute Coronary Syndrome; CAD = Coronary Artery Disease

Table 2

Quantitative plaque characteristics of the worst coronary segment for each of the high-risk plaque features stratified by diagnosis of acute coronary syndrome

	ACS (N=37)	No ACS (N=223)	P value
Volume of plaque with <60 HU (mm ³)	11.9 (6.1–25.1)	2.0 (0.4–5.5)	<0.001
Volume of plaque with <30 HU (mm ³)	3.8 (1.7 – 7.3)	0.7 (0.1 – 2.0)	<0.001
Spotty calcium, n (%)	37 (100.0)	194 (87.0)	0.020
Remodeling index	1.36 (1.14–1.52)	1.12 (1.01–1.24)	<0.001
Positive remodeling, n (%)	31 (83.8)	126 (56.5)	0.002
Plaque length (mm)	22.2 (15.6–31.4)	7.9 (4.2–12.1)	<0.001
Diameter stenosis (%)	66.5 (44.5–83.3)	14.7 (7.8–25.0)	<0.001
ROMICAT score, n (%)			<0.001
Score = 0	0 (0.0)	18 (8.1)	
Score = 1	1 (2.7)	81 (36.3)	
Score = 2	11 (29.7)	87 (39.0)	
Score = 3	23 (62.2)	36 (16.1)	
Score = 4	2 (5.4)	1 (0.5)	

ACS = Acute Coronary Syndrome, HU = Hounsfield Units; IQR = Interquartile Range

Table 3

Quantitative plaque characteristics of the coronary segment with the maximum diameter stenosis stratified by diagnosis of acute coronary syndrome

	ACS (N=37)	No ACS (N=223)	P value
Volume of plaque with <60 HU (mm ³)	9.8 (3.7–14.1)	0.9 (0.1–4.0)	<0.001
Volume of plaque with <30 HU (mm ³)	2.3 (0.8 – 5.4)	0.2 (0.0 – 1.2)	<0.001
Spotty calcium, n (%)	18 (48.7)	166 (74.4)	0.003
Remodeling index	1.12 (0.88–1.33)	0.99 (0.89–1.09)	0.039
Positive remodeling, n (%)	19 (51.4)	54 (24.2)	0.001
Plaque length (mm)	15.9 (8.6–27.2)	5.9 (3.5–9.7)	<0.001
Diameter stenosis (%)	66.5 (44.5–83.3)	14.7 (7.8–25.0)	<0.001
ROMICAT score, n (%)			<0.001
Score = 0	3 (8.1)	34 (15.3)	
Score = 1	13 (35.1)	130 (58.3)	
Score = 2	18 (48.7)	55 (24.7)	
Score = 3	1 (2.7)	3 (1.4)	
Score = 4	2 (5.4)	1 (0.5)	

ACS = Acute Coronary Syndrome, HU = Hounsfield Units