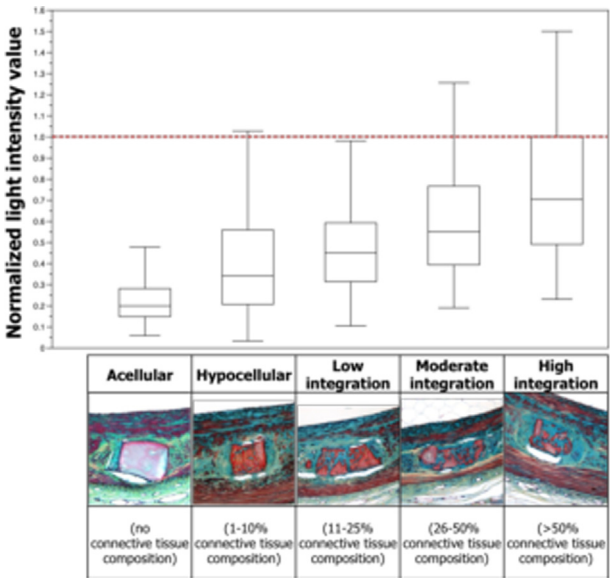

TCT-369

Human coronary plaque characterization using a fully integrated intravascular ultrasound and optical coherence tomography (IVUS-OCT) system

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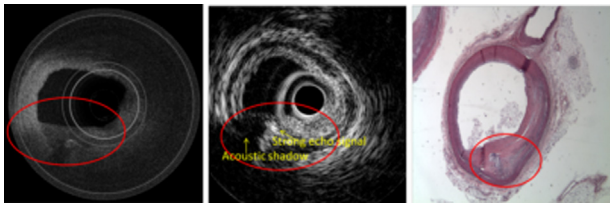
Background: The comparisons of diagnostic accuracy of OCT/IVUS have been investigated. Combined use of IVUS and OCT was proposed to increase accuracy. Fully-integrated OCT-IVUS system has also been reported. However, the diagnostic accuracy of this system for classifying different plaque types has not been studied yet.
Methods: A total of 241 coronary plaque regions from 20 cadavers were imaged by an integrated real-time OCT-IVUS system using a single fully-integrated catheter. A spatial resolution of ~8μm and a penetration depth of ~4mm were simultaneously achieved by this system at 10 frames/s and up to 2.5mm/s pull-back speed. These obtained images were randomly ordered and classified by the two cardiologists. Using histology analysis as a gold standard, we calculated the agreement between results by each imaging technique and histopathogy diagnosis by Cohen's k test. Interobserver and intraobserver variability of each imaging technique were also analyzed using Cohen's k test.
Results: IVUS-OCT had significantly higher sensitivity for characterizing lipid than IVUS (90% v.s. 63%), higher specificity for fibrosis than IVUS (98% v.s. 90%) and higher sensitivity for characterizing calcification than OCT (100% v.s. 96%). The overall agreement between IVUS-OCT and histology diagnoses was excellent (cohen's K=0.962).



Conclusions: This study shows that an integrated OCT-IVUS system, with better penetration depth or higher resolution, provides a more accurate assessment of plaque components than using OCT or IVUS alone.

TCT-370

Histopathological validation of coronary plaque classification using virtual histology intravascular ultrasound and optical coherence tomography

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Background: The majority of myocardial infarctions are due to fibroatheromata (FA), advanced atherosclerotic plaques with a large necrotic lipid core and thin overlying fibrous cap. Virtual histology intravascular ultrasound (VH-IVUS) and optical coherence tomography (OCT) are invasive imaging techniques that may permit in vivo plaque classification through identification of individual plaque components. However, data validating plaque classification by these techniques are minimal.
Methods: LAD arteries were obtained at autopsy and attached to a proprietary imaging rig. The vessel was submerged and pressure-perfused with pre-warmed PBS (to 37°C) at 100mmHg, both prior to and during imaging. Both VH-IVUS (Eagle-Eye Gold, Volcano) and OCT (Dragonfly C7, St Jude Medical) imaging was performed. Regions of interest (ROI) were marked at 5mm intervals, with sections cut at ~150μm. Each ROI was meticulously matched to co-registered imaging sets offline (Indec Medical Systems, US). Hierarchical plaque classification was performed, based on previously published classification algorithms.
Results: 86 ROI were identified from five autopsied hearts, producing 372.7mm of IVUS and 358.6mm of OCT imaging. Classification was performed on a median of 15 [IQR 13-17] VH and 25 [IQR 25-26] OCT frames, for each ROI. ROI were classified as FA 12 (14.0%), fibrocalcific 29 (33.7%), pathological intimal thickening (PIT) 25 (29.1%) or non-atherosclerotic vessel 20 (23.3%) on histology. The sensitivity for VH-IVUS and OCT to identify FA was 81.8% and 80.0% (p=0.09), with sensitivities of 40.9% and 85.0% for fibrocalcific plaque (p=0.02) and 75.0% and 94.7% for PIT (p=0.12), respectively. However, the specificity for OCT was significantly higher than that of VH-IVUS (95.7% vs. 71.7% p< 0.001). Overall, the diagnostic accuracy for intra-vascular imaging to identify a FA was 73.2% for VH-IVUS and 92.9% for OCT.
Conclusions: These data suggest that both VH-IVUS and OCT can reliably identify FA in vivo. However, VH-IVUS appears to have a lower specificity and diagnostic accuracy than OCT, with consequent potential for over reporting of FA in conventional plaque classification algorithms.

TCT-371

Evaluation of Highly Automated Software for Analyzing Intravascular Optical Coherence Tomography Pullbacks of Stents

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Background: Intravascular optical coherence tomography (OCT) has been widely used to assess stent tissue coverage and malapposition in clinical evaluation trials. Typically, stent analysis is done manually with very limited software assistance, requiring 6-12 hours per pullback. Inter- and intra-observer variability is inevitable.
Methods: We developed image analysis algorithms to automate objective stent analysis. Guide wire artifact and lumen boundary were segmented using dynamic programming. Advanced machine learning algorithms were employed to detect stent struts and determine the presence of tissue coverage for each strut. Strut-level tissue coverage thickness and malapposition distance and frame-level NIH and malapposition areas were automatically determined. Algorithms were incorporated into a comprehensive software package, OCT image visualization and analysis toolkit for stent analysis (OCTivat-Stent). Convenient manual review and editing tools were included for refinement of automatic results. The software was trained on previously acquired OCT data, fixed, and used to analyze 292 stent pullbacks in the ROBUST study (NCT00888758). A cardiologist reviewed and edited automated analysis. Clinical results from our analysis of ROBUST data will be presented in other reports.
Results: The concordance correlation coefficients between automatically measured stent and lumen areas, and manual measurements were 0.97 and 0.99, respectively. 11% of struts were missed, mostly when surrounding complex plaques eliminated the telltale strut shadow. There were 1% false positive strut detections. Software mislabeled 18% of human-classified uncovered and 1% of covered struts. Compared to fully manual analysis, average inter-observer agreement for sensitivity/specificity of strut classification was improved from 62%/92% to 74%/98% using the software. Analyst time for a full stent analysis was reduced from 6-12 hours to 27+/-18 minutes.
Conclusions: Application of this software to stent trials should enable faster, larger, and more reproducible studies. There is a potential to add training examples to improve automated analysis. Online assessment is possible if algorithms are incorporated into clinical OCT platforms.