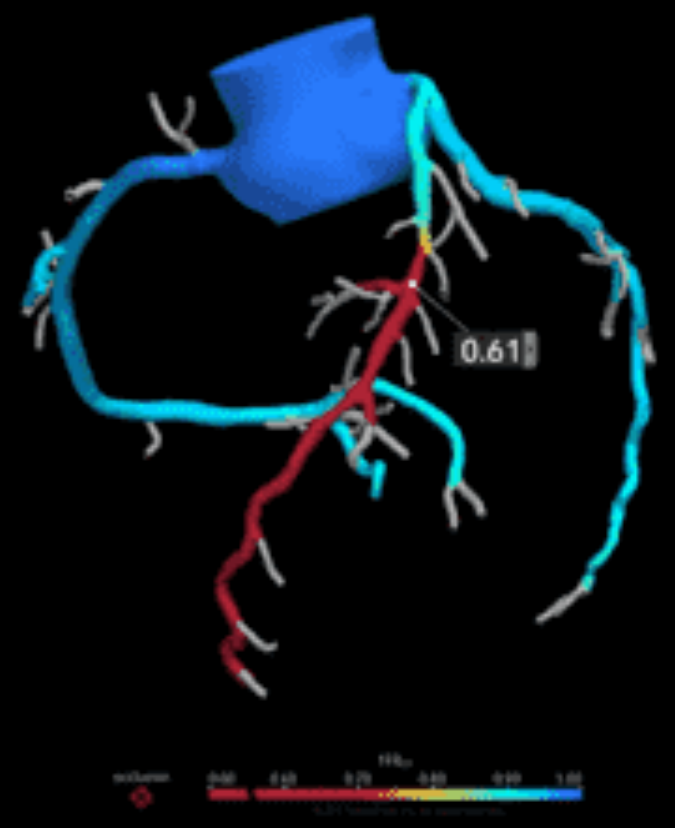


Can Coronary Computed Tomography Angiography Image Acquisition be Improved through Analysing Heartflow CT-Fractional Flow Reserve Rejections?



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Background

- In patients with stable or suspected ischaemic heart disease, non-invasive functional imaging is recommended to ascertain the severity of coronary arterial disease.
- If vessel disease is noted on coronary computed tomography angiography (CCTA), these images can then be sent for further functional analysis.
- Heartflow® uses CCTA images to perform CT-fractional flow reserve (CT-FFr) analysis
 - This provides functional information regarding the ischaemic disease
 - This information can then be utilised in guiding subsequent investigation and management strategies
- High quality image acquisition during initial CCTA imaging is extremely important to enable CT-FFr analysis to be performed**

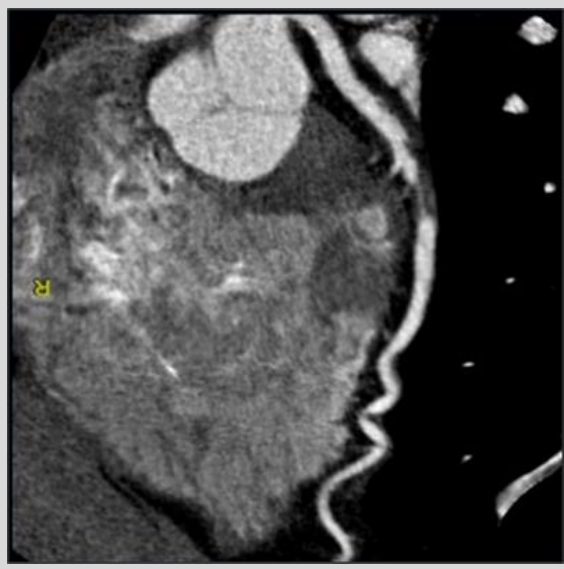


Figure 1 – Example CCTA Image¹

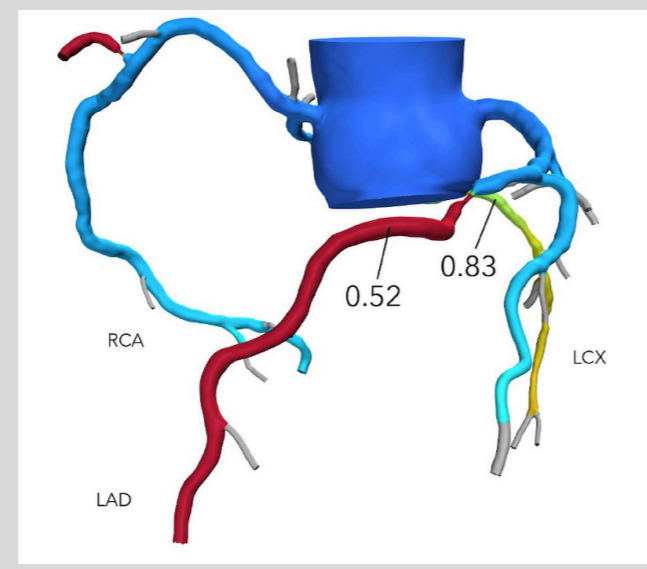


Figure 2 – Example CT-FFr Image Analysis²

Methods

- High-quality image acquisition for CT-FFr analysis requires:
 - Clear and high-contrast view of coronary arteries and plaque
 - Free from artifacts affecting visibility of the lumen boundary
- The acceptance rate that centres have to achieve for Heartflow is 90%
 - This is taken from a published paper from Aarhus University Hospital, Denmark³
 - One of the first centres to fully adopt FFR_{CT} into clinical practice
 - This is referenced in Heartflow training materials
- A retrospective analysis was performed of the CCTA images acquired which were sent to Heartflow® for CT-FFr analysis
- The data was collected at Kingston Hospital, a large District General Hospital, over a 10-month period
- Images rejected from Heartflow with CT-FFr analysis not performed were examined
 - Reasons for rejection of the images were explored in detail
 - A discussion was held with Heartflow representatives regarding Kingston Hospital rejection rate and reducing the number of images rejected for CT-FFr analysis

Results

- The total number of patient images sent to Heartflow® for analysis in the 10-month time period was 85
 - Of the total number of patient images sent, 22% (19) were rejected and returned without functional CT-FFr analysis, an acceptance rate of 78%
 - Of the returned images:
 - 63% (12) were rejected due to misalignment
 - 16% (3) were rejected due to motion
 - 5% (1) was rejected due to pixel spacing
 - 5% (1) was rejected due to noise
 - 5% (1) was rejected due to a stent
 - 5% (1) was rejected due to a clipped coronary artery

Artifact

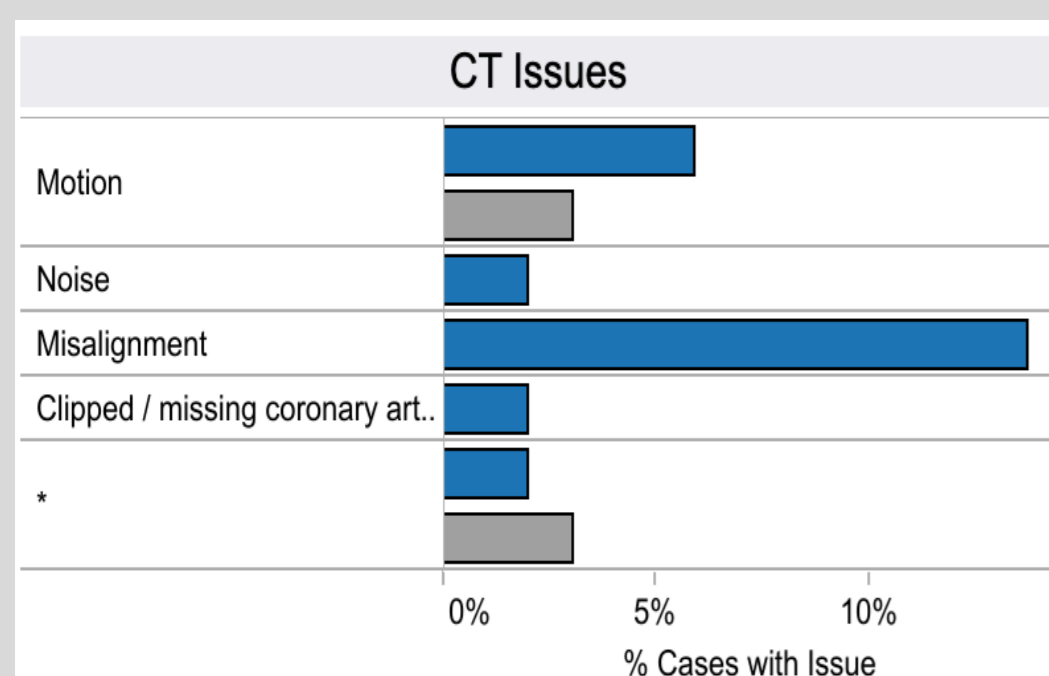


Figure 3 - Percentage of all cases submitted where an artifact is noted (whether case is accepted or not)

- Kingston indicated by Blue bars
- Blended average of site with a similar scanner in the UK by Grey bars
- * indicates multiple artifacts

Results (cont.)

Heart Rate Control

As patient heart rate increases during image acquisition, the acceptance rate for CT-FFr analysis by Heartflow decreases

	selected site	reference sites
Number Of Centers	1	1
Acceptance Rate	78%	90%
Average Heartrate All Cases	64.23	58.57
Percent of cases with HR <= 60bpm	25%	64%
Resubmission Rate	20%	67%

Figure 4 - CT Metrics for Kingston Hospital compared to reference site (similar scanner)

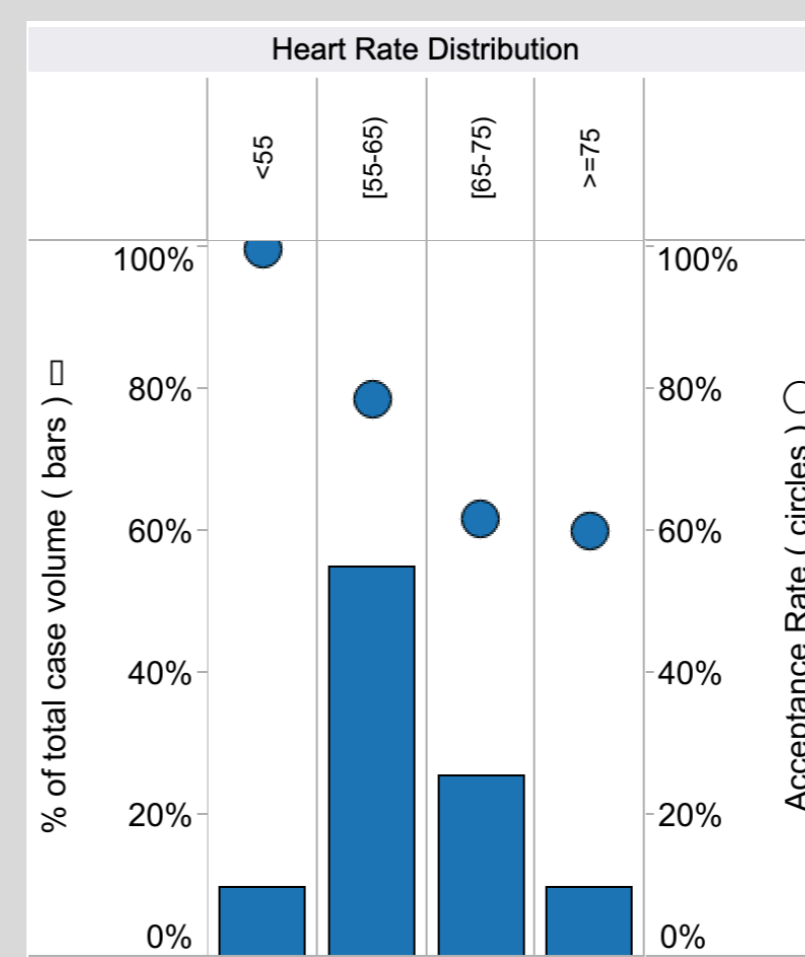


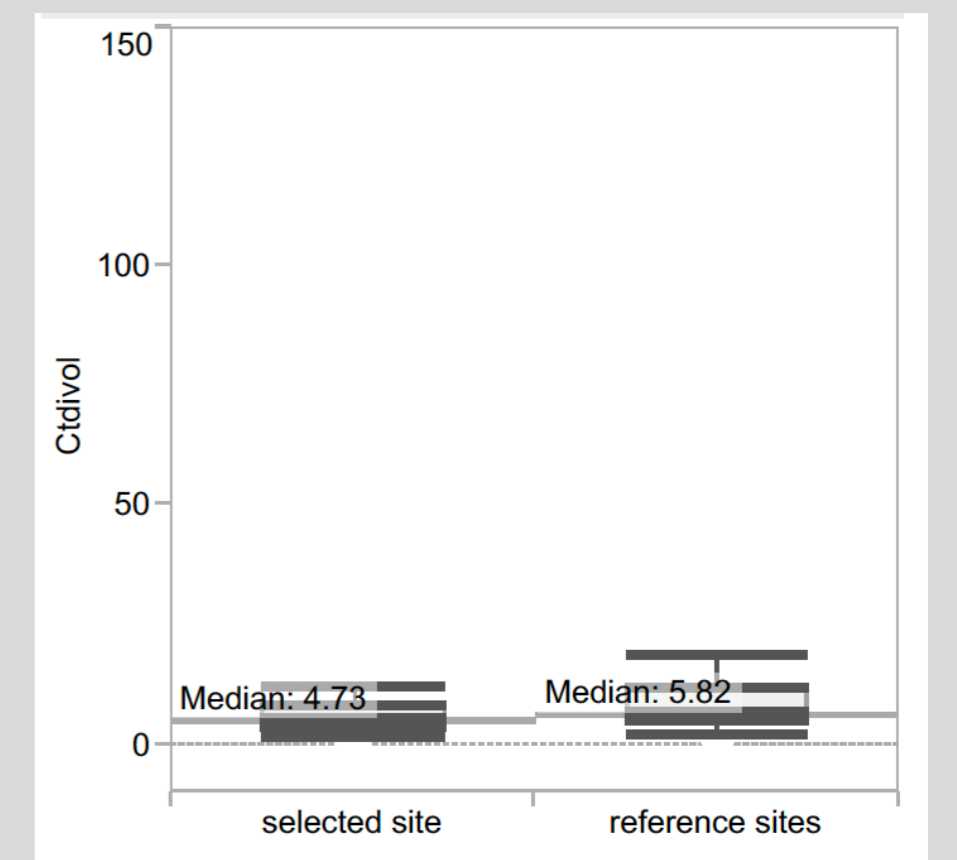
Figure 5 – Graph illustrating Heartflow acceptance rates with Heart rate distribution.

- Each column contains a HR range
- Blue bars = percentage of case volume received per HR range.
- Blue circles = acceptance % per HR range

Dose Comparison

Figure 6 – Graph illustrating radiation dose comparison of Kingston Hospital and Reference Site.

- Kingston Median Dose 4.73
- Reference site Dose 5.82



Conclusions

- CT-FFr provides valuable functional data**
- High quality image acquisition during initial CCTA imaging is essential to enable CT-FFr analysis to be performed**
- Reduced artifact is required to improve acceptance rates**
- Greater heart rate control is required to improve acceptance rates**
- Kingston Hospital does not currently achieve the expected acceptance rate for Heartflow analysis**

Recommendations

- Presentation of findings to radiology department and CT radiographers
- Training with Heartflow representative for radiographers
- Decreasing rate of artifact in imaging and increasing heart rate control
- Reaudit data following these implementations to review CT rejection rates

References

- Example CCTA Image. <https://www.google.com/search?q=ccta+images>
- CT-FFr Image, Heartflow UK. Unlocking the Power of Coronary CTA. <https://www.heartflow.com/ct-flow/>
- Nørgaard, BL et al. Clinical Use of Coronary CTA-Derived FFR for Decision-Making in Stable CAD. JACC: Cardiovascular Imaging, Vol. 10, No. 5, 2017