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Supplementary Figures

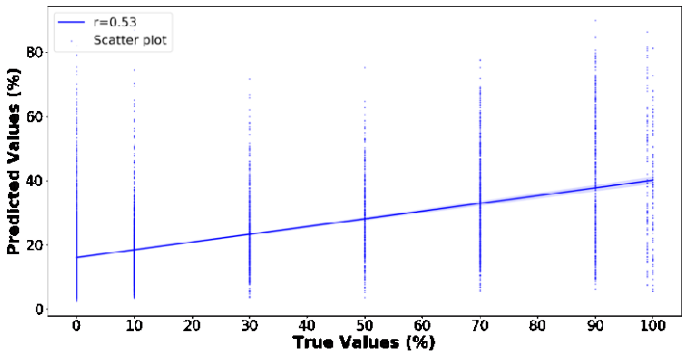
Supplementary Figure 1. Example of a (a) reference frame, (b) unregistered frame N and (c) registered frame N within a video (white square represents the limits of the reference area)

Legend. Example of an unregistered frame within a video and its registered form in reference to the reference area. **White box**: Resized stenosis box.

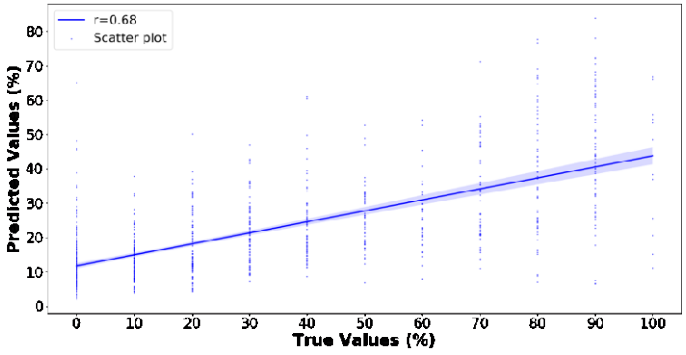
Supplementary Figure 2. Interface for Dataset B Annotations.

Legend. Interface which was used by the two cardiologists to annotate the percentage of stenosis, coronary artery segment being tracked, correctness of the registration and presence of a PCI in Dataset B. Annotations were made on labelbox.com.

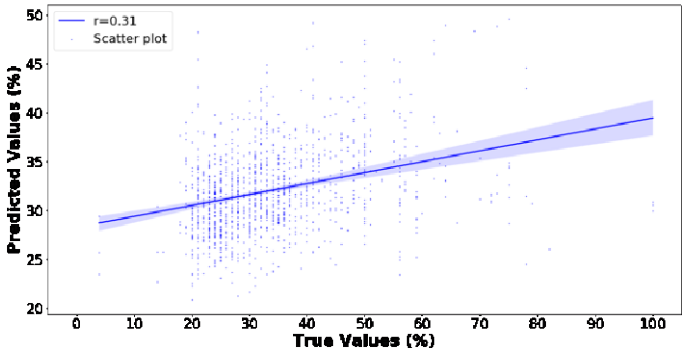
Supplementary Figure 3. Scatterplot of DeepCoro's Predictions as a Function of the Annotated Percentage Stenosis for (a) Dataset A, (b) Dataset B and (c) Dataset D



a.



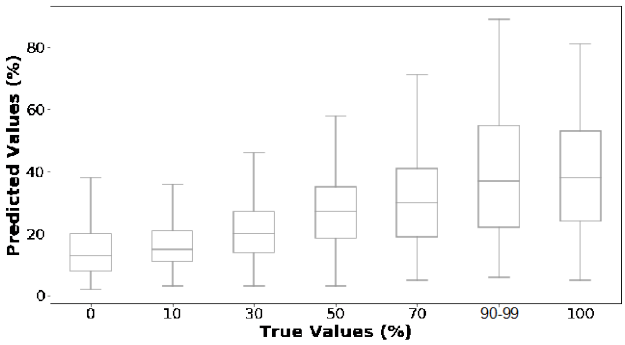
b.



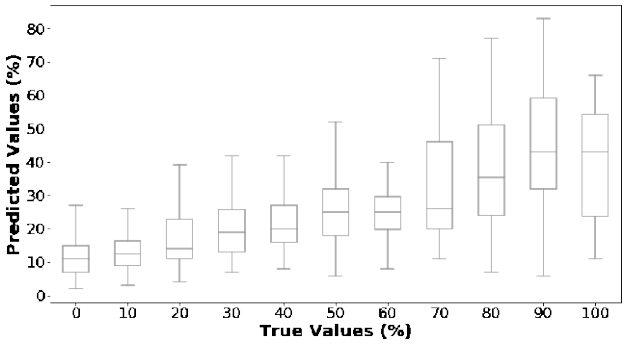
c.

Legend. DeepCoro's predictions at the video-level, in the Test Set, plotted against the annotated percentage stenosis, which is obtained with visual assessment from clinical reports for Dataset A, visual re-assessment for Dataset B and QCA for Dataset D. **Abbreviations**. QCA: Quantitative Coronary Angiography, *r*: Pearson's correlation coefficient.

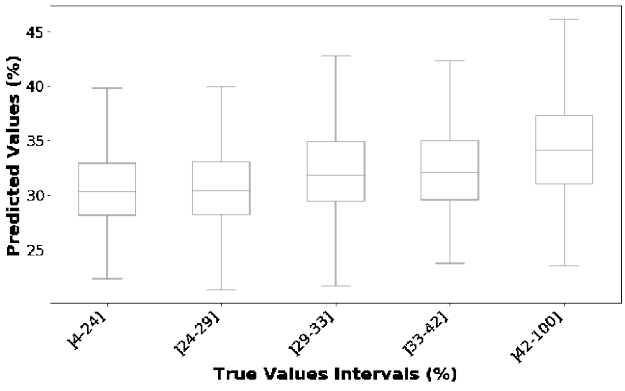
Supplementary Figure 4. DeepCoro's Predictions as a Function of the Annotated Percentage Stenosis for (a) Dataset A, (b) Dataset B and (c) Dataset D Presented with Boxplots



a.



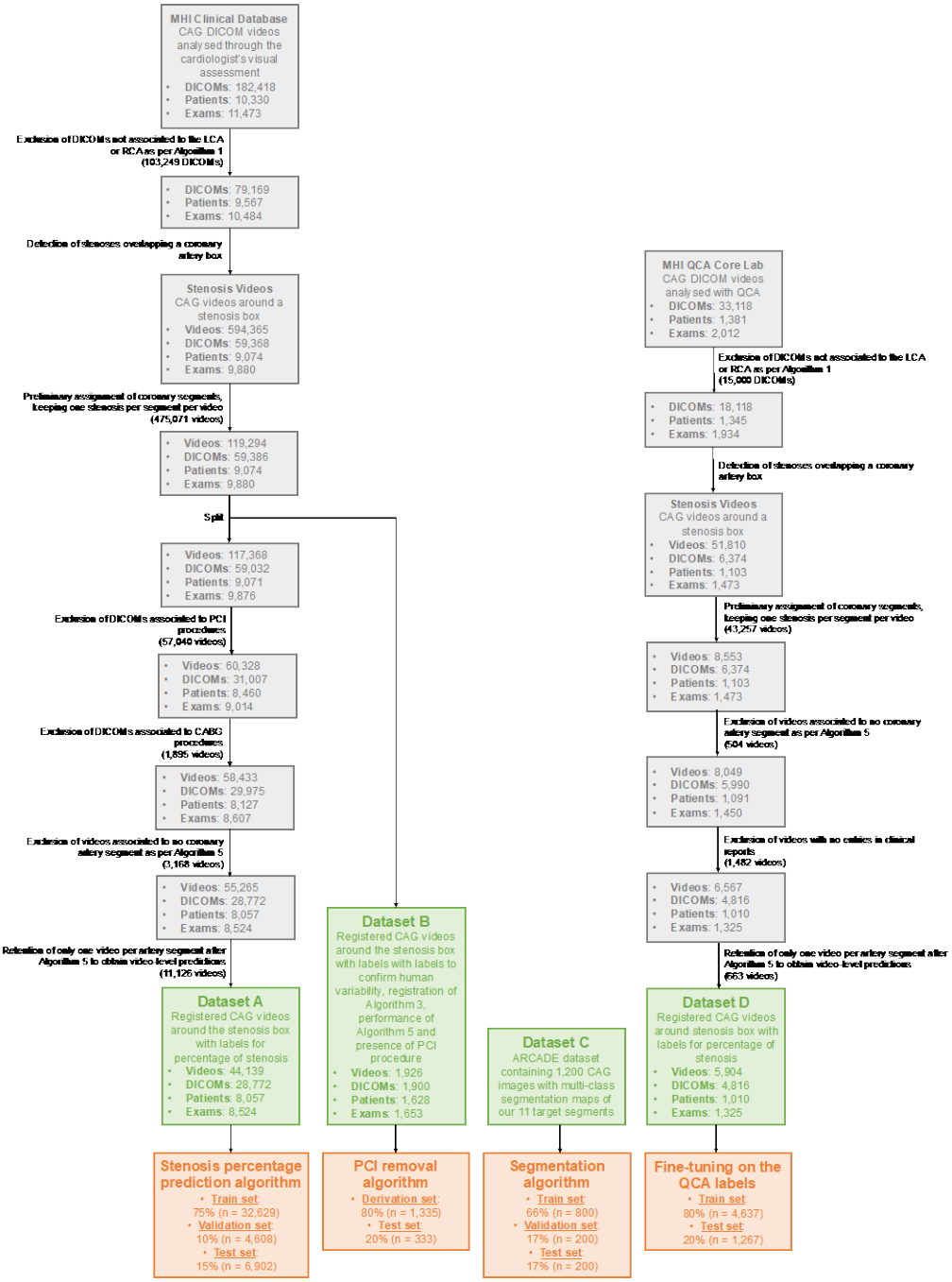
b.



c.

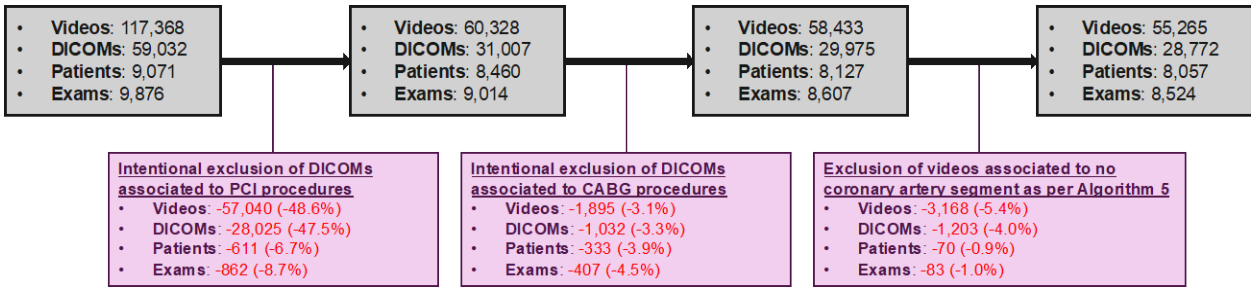
Legend. DeepCoro's predictions at the video-level presented as overlapping boxplots, in the Test Set, plotted against the annotated percentage stenosis, which is obtained with visual assessment from clinical reports for Dataset A, visual re-assessment for Dataset B and QCA for Dataset D. The intervals in part c. of the figure are established to ensure an equal separation of samples within each interval. **Boxplot centerline**: Median of the data. **Boxplot limits**: First quartile (25th percentile) and third quartile (75th percentile) of the data. **Boxplot whiskers**: Range of the data within 1.5 times of the quartiles. **Abbreviations**. QCA: Quantitative Coronary Angiography.

Supplementary Figure 5. Detailed datasets and patients size change.



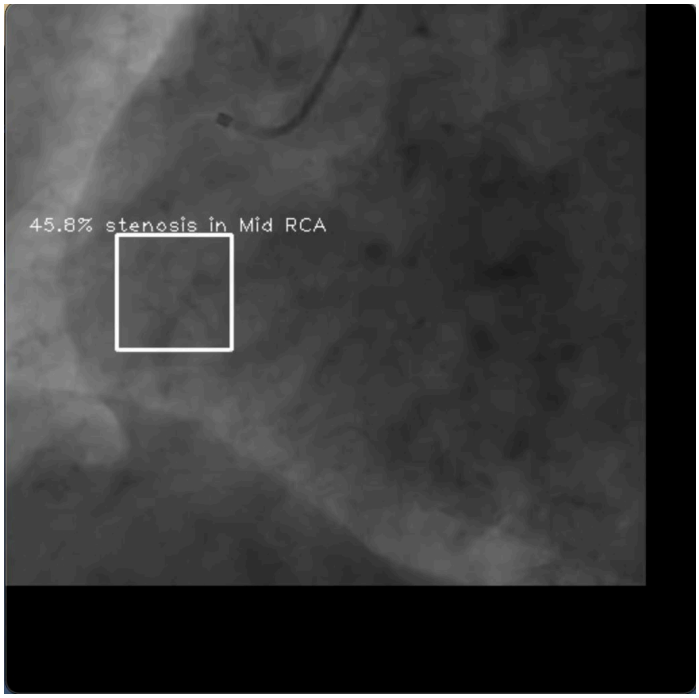
Legend. Detailed datasets change in size when our algorithms are applied to our datasets. **Grey box**: Intermediate datasets. **Green box**: Final datasets. **Orange box**: Dataset split for the development of an algorithm. **Abbreviations**: ARCADE: Automatic Region-based Coronary Artery Disease diagnostics using X-ray angiography imagEs, CABG: Coronary Artery Bypass Grafting, CAG: Coronary Angiography, DICOM: Digital Imaging and Communications in Medicine, MHI: Montreal Heart Institute, PCI: Percutaneous Coronary Intervention, QCA: Quantitative Coronary Angiography.

Supplementary Figure 6. Summarisation of the number and fractions of sample that could not be processed due to technical limitations in the creation of Dataset A



Legend. Number of stenosis videos, DICOMs, patients and exams that could not be processed due to the intentional exclusion or limitations of DeepCoro in the creation of Dataset A. **Grey box**: Dataset size. **Purple box**: Exclusion box indicating the number of samples being removed. **Red text**: Samples removed. **Abbreviations**. DICOM: Digital Imaging and Communications in Medicine, CABG: Coronary Artery Bypass Grafting, PCI: Percutaneous Coronary Intervention.

Supplementary Video 1. Video Example of Outputs from the DeepCoro Pipeline



Legend. Video example of DeepCoro being applied to a video of the RCA with the outputs from all algorithms assembled. In the PDF version of this article, please click anywhere on the figure or caption to play the video in a separate window. **Abbreviations**. Mid RCA: middle right coronary artery, RCA: right coronary artery.

Supplementary Tables

Supplementary Table 1. Baseline Characteristics of Datasets

Characteristic			Dataset A	Dataset B	Dataset C	Dataset D
Patient information						
Age (mean ± SD)			67.6 ± 11.0	67.6 ± 11.1	Unspecified	61.7 ± 9.0
Sex	Female		2,344	430	0	0
	Male		5,532	1,162	0	0
	Unspecified		181	36	1,200	1,010
Dataset information						
Data type			Video	Video	Image	Video
Number of videos or images			44,139	1,926	1,200	5,904
Number of severe stenoses (n (%))			7,076 (16%)	431 (22%)	Unspecified	493 (8%)
Number of severe non-stenoses (n (%))			37,063 (84%)	1,495 (78%)	Unspecified	5,411 (92%)
Number of stenoses >0% (n (%))			22,626 (51%)	1,367 (71%)	Unspecified	5,904 (100%)
Number of healthy vessels, 0% stenoses (n (%))			21,513 (49%)	559 (29%)	Unspecified	0 (0%)
Average percentage of stenoses (mean ± SD)			20.6 ± 30.2	32.1 ± 31.3	Unspecified	33.7 ± 11.7
Median percentage stenosis and interquartile range (median (Q1, Q2))			10 (0, 30)	20 (0, 60)	Unspecified	31.3 (25.4, 39.0)
Number of videos for each artery	LCA		21,892	1,011	759	2,595
	RCA		22,247	915	441	3,309
Number of patients			8,057	1,628	Unspecified	1,010
Number of exams			8,524	1,653	Unspecified	1,325
Number of videos or images per patient (mean ± SD)			5.5 ± 3.7	1.2 ± 0.5	Unspecified	5.8 ± 5.8
Number of exams per patient (mean ± SD)			1.1 ± 0.3	1.0 ± 0.1	Unspecified	1.3 ± 1.5
Number of videos from exams in the corresponding artery segment						
RCA	Single stenoses		7,113	211	Unspecified	457
	Multiple stenoses		12,410	638	Unspecified	2,852
LCA	All	Single stenoses	4,621	174	Unspecified	230
		Multiple stenoses	16,158	806	Unspecified	2,365
	LCX	Single stenoses	11,178	513	Unspecified	961
		Multiple stenoses	2,992	149	Unspecified	803
	LAD	Single stenoses	11,305	506	Unspecified	622
		Multiple stenoses	7,928	432	Unspecified	1,831

Legend. Detailed table of the characteristics of each dataset. Severe stenoses are ≥70% for Datasets A and B, and ≥50% for Dataset D. **Abbreviations**. LCA: Left Coronary Artery, RCA: Right Coronary Artery, SD: Standard Deviation.

Supplementary Table 2. Baseline Characteristics of the Train, Validation, Derivation and Test Sets for Each Datasets

Characteristic		**Dataset A**			**Dataset B**		**Dataset C**		**Dataset D**	
Task		Stenosis percentage prediction algorithm			PCI removal algorithm		Segmentation algorithm		Fine-tuning on the QCA labels	
Split		**Train**	**Validation**	**Test**	**Derivation**	**Test**	**Train and validation**	**Test**	**Train**	**Test**
Patient information										
Age (mean ± SD)		67.4 ± 11.0	68.9 ± 10.6	67.5 ± 11.2	67.8 ± 11.2	66.9 ± 10.8	Unspecified	Unspecified	61.6 ± 9.0	62.0 ± 8.9
Sex	Female	1,773	236	335	315	91	0	0	0	0
	Male	4,163	536	833	836	227	0	0	0	0
	Unspecified	131	23	27	29	7	1,000	200	825	206
Dataset information										
Data type		Video			Video		Image		Video	
Number of videos or images		32,629	4,608	6,902	1,335	333	1,000	200	4,637	1,267
Number of severe stenoses (n (%))		4,802 (15%)	912 (20%)	1,353 (20%)	300 (22%)	71 (21 %)	Unspecified	Unspecified	341 (7%)	152 (12%)
Number of severe non-stenoses (n (%))		27,827 (85%)	3,696 (80%)	5,549 (80%)	1,005 (78%)	262 (7 9%)	Unspecified	Unspecified	4,296 (93%)	1,115 (88%)
Number of stenoses >0% (n (%))		16,493 (51%)	2,521 (55%)	3,612 (52%)	947 (71%)	242 (73%)	Unspecified	Unspecified	4,637 (100%)	1,267 (100%)
Number of healthy vessels, 0% stenoses (n (%))		16,136 (49%)	2,087 (45%)	3,290 (48%)	388 (29%)	91 (27%)	Unspecified	Unspecified	0 (0%)	0 (0%)
Average percentage of stenoses (mean ± SD)		19.6 ± 29.4	23.8 ± 32.2	23.2 ± 32.1	31.8 ± 31.1	32.8 ± 31.2	Unspecified	Unspecified	33.5 ± 11.6	34.4 ± 12.3
Median percentage stenosis and interquartile range (median (Q1, Q2))		10 (0, 30)	10 (0, 30)	10 (0, 50)	20 (0, 60)	20 (0, 60)	Unspecified	Unspecified	31.0 (25.5, 39.0)	31.9 (25.4, 40.1)
Number of videos for each artery	LCA	16,208	2,268	3,416	694	175	625	134	2,039	556
	RCA	16,421	2,340	3,486	641	158	375	66	2,598	711
Number of patients		6,067	795	1,195	1,180	325	Unspecified	Unspecified	825	206
Number of exams		6,390	849	1,285	1,194	326	Unspecified	Unspecified	1,063	262

Number of videos or images per patient (mean ± SD)			5.4 ± 3.6	5.9 ± 3.7	5.9 ± 4.0	1.1 ± 0.4	1.0 ± 0.2	Unspecified	Unspecified	5.6 ± 5.4	6.2 ± 7.0
Number of exams per patient (mean ± SD)			1.1 ± 0.3	1.1 ± 0.3	1.1 ± 0.3	1.0 ± 0.1	1.0 ± 0.1	Unspecified	Unspecified	1.3 ± 0.5	1.3 ± 0.5
Number of videos from exams in the corresponding artery segment											
RCA	Single stenoses		5,348	668	1,097	132	46	Unspecified	Unspecified	346	111
	Multiple stenoses		8,942	1,462	2,006	469	96	Unspecified	Unspecified	2,252	600
LCA	All	Single stenoses	3,601	429	591	121	33	Unspecified	Unspecified	198	32
		Multiple stenoses	11,728	1,763	2,667	551	135	Unspecified	Unspecified	1,841	524
	LCX	Single stenoses	8,158	1,228	1,792	349	90	Unspecified	Unspecified	748	213
		Multiple stenoses	2,096	329	567	104	17	Unspecified	Unspecified	613	190
	LAD	Single stenoses	8,431	1,135	1,739	350	84	Unspecified	Unspecified	491	131
		Multiple stenoses	5,743	880	1,305	289	79	Unspecified	Unspecified	1,429	402

Legend. Detailed table of the characteristics of each split of each dataset. Severe stenoses are ≥70% for Datasets A and B, and ≥50% for Dataset D. **Abbreviations**. LCA: Left Coronary Artery, RCA: Right Coronary Artery, SD: Standard Deviation

Supplementary Table 3. Possible Class Outputs of Algorithm 1, Algorithm 2 and Algorithm 4 and Their Definitions

Algorithm	Possible class outputs	Definitions
Primary anatomic structure identification Algorithm (Algorithm 1) [1]	Aorta	"Ascending aorta, the arch or descending aorta, as delimited during aortography." [1]
	Catheter	"Any guiding catheter or diagnostic catheter without any other underlying structure." [1]
	Femoral artery	"Either the superficial, deep or common femoral artery." [1]
	Bypass graft	"Venous graft, internal mammary graft or radial graft." [1]
	Left ventricle	"Ventricle, as delimited during ventriculography" [1]
	Left coronary artery	"Artery that arises from the aorta above the left cusp of the aortic valve" [1]
	Other	"Any images not belonging to the other classes (for example, kidneys, pacemaker, etc) " [1]
	Pigtail catheter	"Pigtail catheter without any other underlying structure" [1]
	Radial artery	"Major artery in the forearm" [1]
	Right coronary artery	"Artery that arises from the aorta above the right cusp of the aortic valve" [1]
	Stenting procedure	Stenting procedure
Stenosis detection algorithm (Algorithm 2) [1]	Proximal right coronary artery	"From ostium to one half the distance to the acute margin of the heart. " [1,2]
	Middle right coronary artery	"From end of first segment to acute margin of heart. " [1,2]
	Distal right coronary artery	"From the acute margin of the heart to the origin of the posterior descending artery. " [1,2]
	Posterior descending artery	"Artery running the posterior interventricular groove. " [1,2]
	Posterolateral branch from the right coronary artery	"Posterolateral branch originating from the distal coronary artery distal to the crux. If left posterolateral, it was chosen as the artery running to the posterolateral surface of the left ventricle. " [1,2]
	Left main artery	"From the ostium of the LCA through bifurcation into left anterior descending and left circumflex branches. " [1,2]
	Proximal left anterior descending artery	"Vessel between left main and proximal to and including the first septal" [1,2]
	Middle left anterior descending artery	"LAD immediately distal to the origin of first septal branch and extending to the point where the LAD forms an angle (right anterior oblique projection). If angle is not identifiable, this segment ends at one half the distance form the first septal and the apex of the heart" [1,2]
	Distal left anterior descending artery	"Terminal portion of LAD, beginning at the end of previous segment and extending to or beyond the apex. " [1,2]
	Proximal left circumflex artery	"Main stem of circumflex from its origin of left main to and including origin of first obtuse marginal branch. " [1,2]
	Distal left circumflex artery	"The stem of the circumflex distal to the origin of the most distal obtuse marginal branch and running along the posterior left atrioventricular grooves. Caliber may be small or artery absent. " [1,2]
	Valve	"Presence of a mechanical valve, annuloplasty or valvular calcifications" [1,2]
	Catheter	"Presence of a catheter, such as a diagnostic catheter, pigtail or guiding catheter" [1,2]

	Sternotomy	"Presence of sternotomy wires" [1,2]
	Stent	"Stent landmarks on a guidewire or in a vessel" [1,2]
	Pacemaker	"Presence of a pacemaker or pacemaker lead" [1,2]
	Guidewire	"Presence of a guide wire" [1,2]
	Stenosis*	"Any visible stenosis" [1,2]
	Obstruction	"100% obstruction of an artery, either by thrombus or chronically occluded. Defined by a blunt stump at the end to a vessel or by the 'absence' of contrast in between two healthy vessel segments with bridging collaterals. " [1,2]
Segmentation algorithm (Algorithm 4) [2,3]	Proximal right coronary artery (1)	"From the ostium to one half the distance to the acute margin of the heart." [2]
	Middle right coronary artery (2)	"From the end of first segment to acute margin of heart. " [2]
	Distal right coronary artery (3)	"From the acute margin of the heart to the origin of the posterior descending artery. " [2]
	Posterior descending artery (4)	"Running in the posterior interventricular groove" [2]
	Left main artery (5)	"From the ostium of the LCA through bifurcation into left anterior descending and left circumflex branches. " [2]
	Proximal left anterior descending artery (6)	"Proximal to and including first major septal branch." [2]
	Middle left anterior descending artery (7)	"LAD immediately distal to origin of first septal branch and extending to the point where LAD forms an angle (right anterior oblique view). If this angle is not identifiable this segment ends at one half the distance from the first septal to the apex of the heart. " [2]
	Distal (apical) left anterior descending artery (8)	"Terminal portion of LAD, beginning at the end of previous segment and extending to or beyond the apex" [2]
	First diagonal (9)	"The first diagonal originating from segment 6 or 7. " [2]
	First diagonal a (9a)	"Additional first diagonal originating from segment 6 or 7, before segment 8. " [2]
	Second diagonal (10)	"Originating from segment 8 or the transition between segment 7 and 8. " [2]
	Second diagonal a (10a)	"Additional second diagonal originating from segment 8. " [2]
	Proximal left circumflex artery (11)	"Main stem of circumflex from its origin of left main and including origin of first obtuse marginal branch" [2]
	Intermediate/anterolateral (12)	"Branch from trifurcating left main other than proximal LAD or LCX. It belongs to the circumflex territory. " [2]
	Obtuse marginal a (12a)	"First side branch of circumflex running in general to the area of obtuse margin of the heart. " [2]
	Distal left circumflex artery (13)	"The stem of the circumflex distal to the origin of the most distal obtuse marginal branch, and running along the posterior left atrioventricular groove. Caliber may be small or artery absent. " [2]
	Left posterolateral (14)	"Running to the posterolateral surface of the left ventricle. May be absent or a division of obtuse marginal branch. " [2]
	Left posterolateral a (14a)	"Distal from 14 and running in the same direction." [2]
	Posterior descending artery (15)	"Most distal part of dominant left circumflex when present. It gives origin to septal branches. When this artery is present, segment 4 is usually absent. " [2]

	Posterolateral branch from the right coronary artery (16)	"Posterolateral branch originating from the distal coronary artery distal to the crux. " [2]
	Posterolateral branch from the right coronary artery a (16a)	"First posterolateral branch from segment 16. " [2]
	Posterolateral branch from the right coronary artery b (16b)	"Second posterolateral branch from segment 16. " [2]
	Posterolateral branch from the right coronary artery c (16c)	"Third posterolateral branch from segment 16. " [2]
	Obtuse marginal b (12b)	"Second additional branch of circumflex running in the same direction as 12" [2]
	Left posterolateral b (14b)	"Distal from 14 and 14 a and running in the same direction. " [2]

Legend. Listing of the classes and definitions of our different multi-class algorithms. **Asterix**: Only this class was pertinent for for DeepCORO, the other classes are legacy and deprecated, they belong to previous work on CathAI.

Abbreviations. LAD: Left Anterior Descending Artery, LCA: Left Coronary Artery, LCX: Left Circumflex.

Supplementary Table 4. Segmentation Performance of DeepCoro's Algorithm 4 on the Test Set of Dataset C

Coronary artery	Coronary artery segment	Number of instances	Dice Score (%)	PPV (%)	Sensitivity (%)
LCA	left main artery	129	77.84	86.48	70.77
	proximal left anterior descending artery	108	70.89	68.70	73.22
	middle left anterior descending artery	73	74.20	76.53	72.01
	distal left anterior descending artery	71	71.40	74.13	68.87
	proximal left circumflex artery	67	75.14	74.35	75.96
	distal left circumflex artery	62	60.39	61.15	59.66
RCA	proximal right coronary artery	65	80.33	80.92	79.76
	middle right coronary artery	66	72.58	78.87	67.22
	distal right coronary artery	66	77.26	76.92	77.60
	posterolateral branch from the right coronary artery	49	63.08	82.44	51.09
	posterior descending artery	48	74.11	77.02	71.42
weighted average			72.93	75.96	70.12

Legend. Detailed performance of DeepCoro's Algorithm 4 on the test set of Dataset C across coronary artery segments. **Abbreviations**. LCA: Left Coronary Artery, PPV: Positive Predictive Value, RCA: Right Coronary Artery.

Supplementary Table 5. Comparative Performance of DeepCoro's Segmentation and CathAI's Bounding Box Method for Stenosis Assignment to Coronary Segments in Dataset B

Coronary artery	Artery segment	Number of videos	Metric					
			PPV (%)		*Sensitivity (%)*		*F1-score (%)*	
			RetinaNet	*Segmentation*	*RetinaNet*	*Segmentation*	*RetinaNet*	*Segmentation*
LCA	left main artery	129	47.09	**81.65**	**75.19**	68.99	57.91	**74.79**
	proximal left anterior descending artery	207	40.74	**52.79**	53.14	**77.78**	46.12	**62.89**
	middle left anterior descending artery	207	54.76	**63.69**	33.33	**51.69**	41.44	**57.07**
	distal left anterior descending artery	91	65.06	**85.71**	59.34	**65.93**	62.07	**74.53**
	proximal left circumflex artery	204	49.22	**72.89**	46.57	**59.31**	47.86	**65.41**
	distal left circumflex artery	62	37.50	**43.42**	9.68	**53.23**	15.38	**47.83**
RCA	proximal right coronary artery	281	77.42	**82.57**	76.87	**89.32**	77.14	**85.81**
	middle right coronary artery	361	76.56	**78.69**	67.87	**79.78**	71.95	**79.23**
	distal right coronary artery	185	59.57	**71.59**	45.41	**68.11**	51.53	**69.81**
	posterolateral branch from the right coronary artery	29	19.10	**53.85**	**58.62**	48.28	28.81	**50.91**
	posterior descending artery	51	33.33	**68.29**	54.90	54.90	41.48	**60.87**
weighted average			59.10	**71.89**	56.50	**70.72**	56.50	**70.71**

Legend. Comparative table of the coronary artery segment prediction algorithm from CathAI and DeepCoro. RetinaNet corresponds to CathAI's method to identify coronary artery segments and segmentation referrers to DeepCoro's method. The statistically significant metrics where the confidence intervals don't overlap are shown in bold. **Abbreviations**, LCA: Left Coronary Artery, PPV: Positive Predictive Value, RCA: Right Coronary Artery.

Supplementary Table 6. Artery-Level Performance of CathAI on the Test Set of Dataset A and Comparison to DeepCoro

Task	Metric	Coronary artery					
		LCA		*RCA*		*RCA + LCA*	
		Image-based model	***Video-based model***	***Image-based model***	***Video-based model***	***Image-based model***	***Video-based model***
Number of exams		2568		2259		4827	
Number of severe stenoses, ⩾ 70%		536		345		881	
Number of healthy vessels, 0% stenoses		1253		1075		2328	
Classification	AUROC	0.7418 (0.7303 - 0.7526)	**0.8017 (0.7919 - 0.8124)**	0.8561 (0.8455 - 0.8682)	0.8643 (0.8537 - 0.8745)	0.7953 (0.7875 - 0.8038)	**0.8294 (0.8215 - 0.8373)**
	AUPRC	0.4235 (0.4029 - 0.4429)	**0.5092 (0.4868 - 0.5329)**	0.5312 (0.5008 - 0.5619)	0.5578 (0.5242 - 0.5890)	0.4670 (0.4497 - 0.4849)	**0.5239 (0.5041 - 0.5421)**
	Sensitivity (%)	61.01 (59.00 - 63.05)	**70.70 (68.75 - 72.73)**	78.02 (75.87 - 80.28)	76.20 (73.98 - 78.60)	67.64 (66.09 - 69.31)	**72.86 (71.24 - 74.47)**
	Specificity (%)	74.61 (73.68 - 75.55)	74.51 (73.56 - 75.43)	80.75 (79.86 - 81.57)	79.03 (78.10 - 80.04)	77.57 (76.92 - 78.22)	76.71 (76.05 - 77.36)
	PPV (%)	38.78 (37.15 - 40.32)	41.06 (39.48 - 42.70)	**42.25 (40.23 - 44.11)**	37.08 (35.11 - 39.00)	40.25 (38.97 - 41.55)	39.42 (38.15 - 40.68)
	F1-score (%)	47.41 (45.81 - 48.96)	**51.95 (50.32 - 53.58)**	**54.81 (52.81 - 56.53)**	49.88 (47.86 - 51.78)	50.46 (49.23 - 51.72)	51.15 (49.81 - 52.39)
Regression	MAE (%)	23.81 (23.42 - 24.22)	**22.19 (21.82 - 22.52)**	19.11 (18.76 - 19.46)	**17.82 (17.48 - 18.16)**	21.61 (21.35 - 21.87)	**20.15 (19.88 - 20.40)**
	r	0.3704 (0.3520 - 0.3880)	**0.4890 (0.4704 - 0.5087)**	0.5554 (0.5349 - 0.5770)	**0.6200 (0.6018 - 0.6372)**	0.4571 (0.4430 - 0.4711)	**0.5497 (0.5360 - 0.5630)**

Legend. Comparative table of the artery-level performance of the percentage of stenosis prediction algorithm from CathAI and DeepCoro. The image-based refers to the retrained classifier from CathAI and the video-based refers to DeepCoro Algorithm 6. The statistically significant metrics where the confidence intervals don't overlap are shown in bold. DeepCoro and CathAI predictions were binarized with a threshold of 0.23 and 0.22 respectively, as determined on the validation set. The range in parentheses is the 95% confidence interval generated by bootstrapping. **Abbreviations**. AUPRC: Area Under the Precision-Recall Curve, AUROC: Area Under the Receiver Operating Curve, LCA: Left Coronary Artery, MAE: Mean Absolute Error, PPV: Positive Predictive Value, *r*: Pearson's correlation coefficient, RCA: Right Coronary Artery.

Supplementary Table 7. Video-Level Performance of CathAI on the Test Set of Dataset A and Comparison to DeepCoro

Task	Metric	Coronary artery					
		LCA		*RCA*		*RCA + LCA*	
		Image-based model	***Video-based model***	***Image-based model***	***Video-based model***	***Image-based model***	***Video-based model***
Number of videos		3416		3486		6902	
Number of severe stenoses, ⩾ 70%		776		577		1353	
Number of healthy vessels, 0% stenoses		1782		1830		3612	
Classification	AUROC	0.7197 (0.7099 - 0.7292)	**0.7798 (0.7713 - 0.7886)**	0.8355 (0.8265 - 0.8452)	0.8463 (0.8378 - 0.8552)	0.7767 (0.7700 - 0.7838)	**0.8114 (0.8052 - 0.8177)**
	AUPRC	0.4266 (0.4095 - 0.4449)	**0.5220 (0.5039 - 0.5415)**	0.5132 (0.4911 - 0.5350)	**0.5776 (0.5547 - 0.5989)**	0.4637 (0.4498 - 0.4780)	**0.5428 (0.5279 - 0.5586)**
	Sensitivity (%)	58.39 (56.68 - 60.16)	**67.15 (65.54 - 68.89)**	76.28 (74.67 - 78.02)	77.31 (75.65 - 79.10)	65.98 (64.78 - 67.21)	**71.45 (70.31 - 72.74)**
	Specificity (%)	73.03 (72.20 - 73.85)	73.53 (72.63 - 74.41)	78.30 (77.53 - 79.02)	77.37 (76.61 - 78.12)	75.77 (75.22 - 76.36)	75.55 (75.02 - 76.13)
	PPV (%)	38.88 (37.46 - 40.26)	**42.74 (41.40 - 44.15)**	41.06 (39.54 - 42.64)	40.38 (38.93 - 41.85)	39.87 (38.94 - 40.82)	41.61 (40.54 - 42.56)
	F1-score (%)	46.67 (45.31 - 48.00)	**52.23 (50.89 - 53.50)**	53.38 (51.89 - 54.83)	53.05 (51.63 - 54.53)	49.71 (48.77 - 50.63)	**52.59 (51.57 - 53.59)**
Regression	MAE (%)	24.60 (24.26 - 24.93)	**22.97 (22.66 - 23.29)**	19.60 (19.32 - 19.87)	**18.25 (17.96 - 18.51)**	22.07 (21.86 - 22.30)	**20.59 (20.38 - 20.80)**
	r	0.3470 (0.3312 - 0.3631)	**0.4624 (0.4476 - 0.4771)**	0.5389 (0.5223 - 0.5553)	**0.6027 (0.5878 - 0.6179)**	0.4432 (0.4321 - 0.4545)	**0.5312 (0.5210 - 0.5423)**

Legend. Comparative table of the video-level performance of the percentage of stenosis prediction algorithm from CathAI and DeepCoro. The image-based refers to the retrained classifier from CathAI and the video-based refers to DeepCoro Algorithm 6. The statistically significant metrics where the confidence intervals don't overlap are shown in bold. DeepCoro and CathAI predictions were binarized with a threshold of 0.23 and 0.22 respectively, as determined on the validation set. The range in parentheses is the 95% confidence interval generated by bootstrapping. **Abbreviations**. AUPRC: Area Under the Precision-Recall Curve, AUROC: Area Under the Receiver Operating Curve, LCA: Left Coronary Artery, MAE: Mean Absolute Error, PPV: Positive Predictive Value, *r*: Pearson's correlation coefficient, RCA: Right Coronary Artery.

Supplementary Table 8. Performance of DeepCoro at the Arterial Level on Dataset A's Test Set, Segregated by Age and Sex

Category	Number of exams	Number of severe stenoses	Classification				Regression	
			AUROC	AUPRC	Sensitivity (%)	Specificity (%)	MAE (%)	*r*
Sexes								
Female	2655	605	0.8420 (0.8283 - 0.8564)	0.4950 (0.4565 - 0.5350)	72.29 (69.23 - 75.48)	77.51 (76.27 - 78.81)	19.13 (18.62 - 19.59)	0.5649 (0.5392 - 0.5907)
Male	1069	198	0.8203 (0.8115 - 0.8295)	0.5260 (0.5055 - 0.5491)	72.30 (70.62 - 74.06)	76.25 (75.40 - 77.05)	20.53 (20.20 - 20.83)	0.5438 (0.5284 - 0.5596)
Age groups								
< 60	1127	155	0.8549 (0.8400 - 0.8729)	0.5747 (0.5331 - 0.6197)	67.72 (64.17 - 71.54)	83.83 (82.82 - 84.94)	17.98 (17.51 - 18.47)	0.5696 (0.5431 - 0.5970)
≥ 60 and < 67	1030	175	0.8107 (0.7943 - 0.8281)	0.5116 (0.4745 - 0.5508)	69.10 (65.54 - 72.66)	78.34 (76.99 - 79.71)	19.62 (19.06 - 20.14)	0.5425 (0.5144 - 0.5702)
≥ 67 and < 75	1233	213	0.8064 (0.7919 - 0.8216)	0.4523 (0.4163 - 0.4841)	71.82 (68.82 - 75.14)	73.53 (72.22 - 74.82)	20.64 (20.12 - 21.15)	0.5123 (0.4868 - 0.5382)
≥ 75	1369	271	0.8308 (0.8180 - 0.8440)	0.5580 (0.5244 - 0.5911)	77.48 (75.24 - 79.91)	72.57 (71.23 - 73.98)	21.54 (21.07 - 21.97)	0.5646 (0.5429 - 0.5885)

Legend. DeepCoro's performance stratified across ages and sexes. The range in parentheses is the 95% confidence interval generated by bootstrapping. **Abbreviations**. AUPRC: Area Under the Precision-Recall Curve, AUROC: Area Under the Receiver Operating Curve, MAE: Mean Absolute Error, PPV: Positive Predictive Value, *r*: Pearson's correlation coefficient.

Supplementary Table 9. Video-level and Artery-level Performance DeepCoro on Dataset D

Metrics	Coronary artery		
	LCA	***RCA***	***RCA + LCA***
Artery-level			
Number of exams	310	319	629
MAE (%)	8.18 (7.71 - 8.59)	7.31 (6.82 - 7.72)	7.75 (7.37 - 8.07)
r	0.2858 (0.1997 - 0.3609)	0.3899 (0.3353 - 0.4492)	0.3439 (0.2970 - 0.3898)
Video-level			
Number of videos	568	699	1267
MAE (%)	8.43 (8.11 - 8.75)	8.43 (8.11 - 8.75)	8.43 (8.21 - 8.64)
r	0.2688 (0.2222 - 0.3146)	0.3276 (0.2866 - 0.3683)	0.3090 (0.2779 - 0.3396)

Legend. DeepCoro's performance when fine-tuned on QCA labels. The range in parentheses is the 95% confidence interval generated by bootstrapping. **Abbreviations**. LCA: Left Coronary Artery, MAE: Mean Absolute Error, QCA: Quantitative Coronary Angiography, *r*: Pearson's correlation coefficient, RCA: Right Coronary Artery.

Supplementary Table 10. Parameters and Validation Set of Dataset C Dice Coefficient of the Seven Selected Models as Part of Algorithm 4

Training parameters	Dice coefficient on the validation set
Model = FPN Loss function = Lovasz Loss Batch size = 64 Learning rate = 0.00107809	0.6730
Model = DeepLabV3+ Loss function = Lovasz Loss Batch size = 64 Learning rate = 0.00242160	0.6816
Model = PAN Loss function = Tversky Loss Batch size = 64 Learning rate = 0.00129894	0.6744
Model = DeepLabV3 Loss function = Tversky Loss Batch size = 4 Learning rate = 0.00059902	0.6294
Model = FPN Loss function = Lovasz Loss Batch size = 16 Learning rate = 0.00993245	0.6287
Model = DeepLabV3 Loss function = Lovasz Loss Batch size = 16 Learning rate = 0.00232125	0.6225
Model = PAN Loss function = Dice Loss Batch size = 64 Learning rate = 0.00646546	0.6683

Legend. Parameters used for training the several selected segmentation model and the validation set Dice coefficient that allowed them to be selected. The Dice Coefficient here was calculated over the 25 coronary artery segments available in the ARCADE dataset.

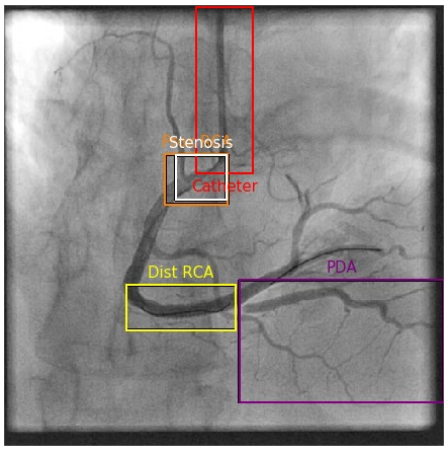
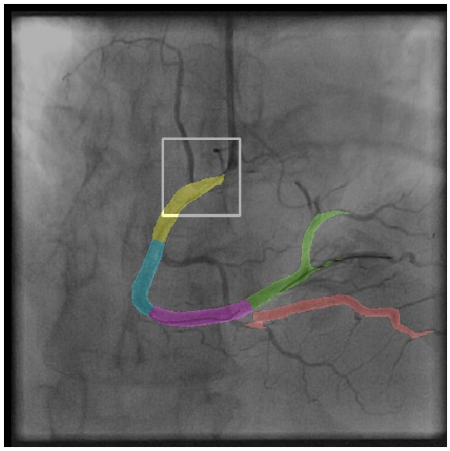
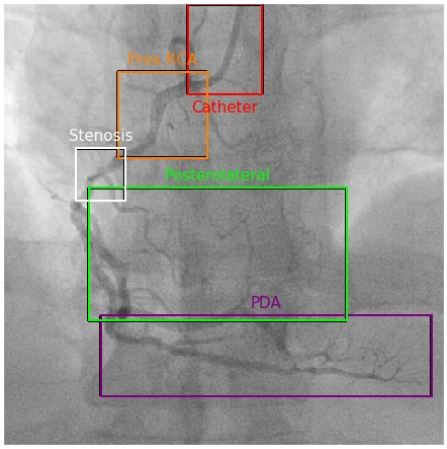
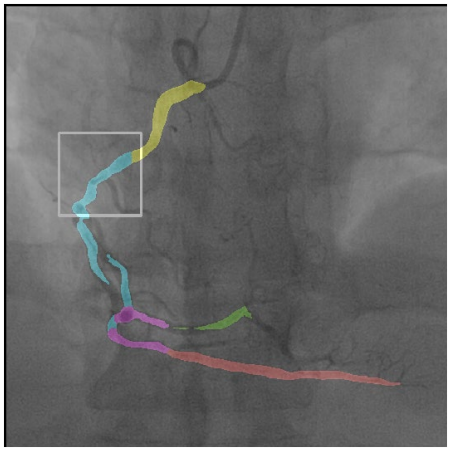
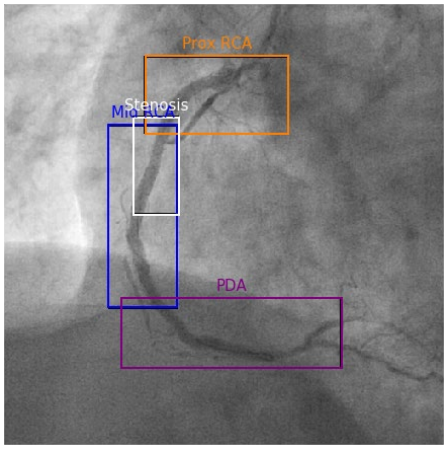
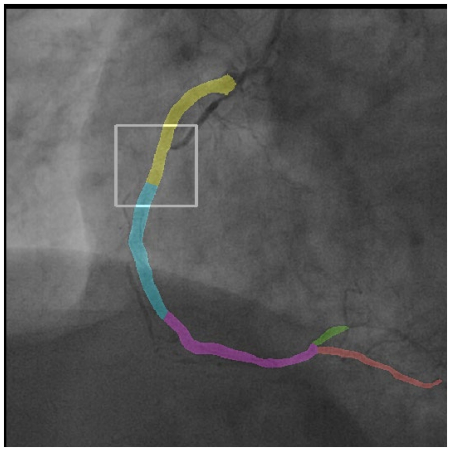
Supplementary Table 11. Video-based model trainings for stenosis severity (Algorithm 6) as part of DeepCoro's pipeline.

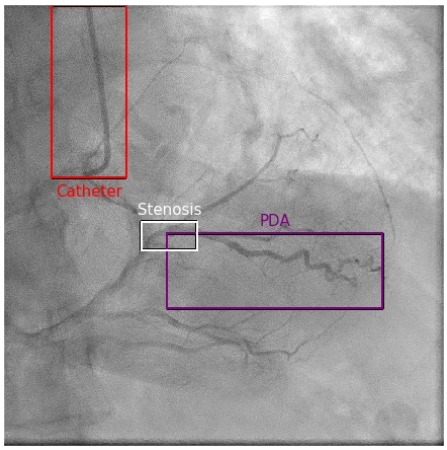
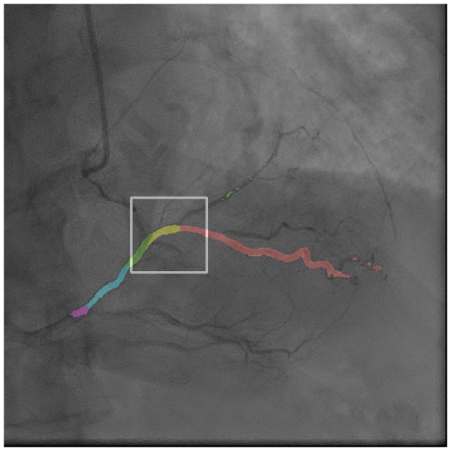
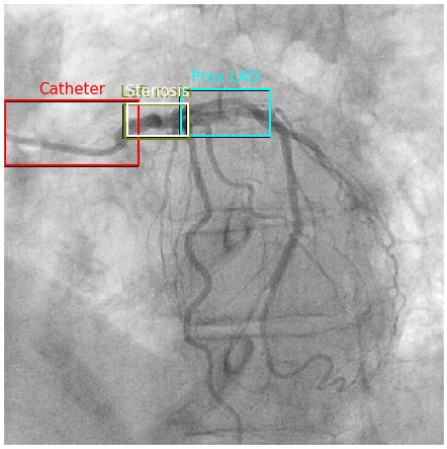
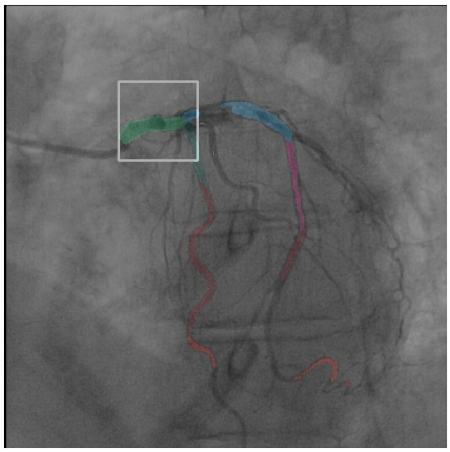
Training description	Training parameters	Best valdiation loss	Validation AUC associated to the best loss
Swin3D (B) training for regression on Dataset A	LR = 1e-3 Loss = Mean square error Model = Swin3D (B)	0.07432	0.8143
Swin3D (B) training for regression on Dataset A	LR = 1e-4 Loss = Mean square error Model = Swin3D (B)	0.07724	0.8085
Swin3D (B) training for regression on Dataset A	LR = 1e-5 Loss = Mean square error Model = Swin3D (B)	0.08225	0.7789
Swin3D (B) training for regression on Dataset A without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v2) and RetinaNet for coronary artery assignment	LR = 1e-4 Loss = Mean square error Model = Swin3D (B)	0.07305	0.7549
SlowFast training for regression on Dataset A without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v2) and RetinaNet for coronary artery assignment	LR = 1e-4 Loss = Mean square error Model = SlowFast (R101)	0.07627	0.7237
X3D (L) training for regression on Dataset A using RetinaNet for coronary artery assignment, and without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v2)	LR = 1e-4 Loss = Mean square error Model = X3D (L)	0.07337	0.7281
Swin3D (B) training for classification on Dataset A using RetinaNet for coronary artery assignment, and without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v2)	LR = 1e-4 Loss = Cross entropy Model = Swin3D (B)	0.5384	0.7658
Swin3D (S) training for classification on Dataset A using RetinaNet for coronary artery assignment, and without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v2)	LR = 1e-4 Loss = Cross entropy Model = Swin3D (S)	0.5483	0.7422
Swin3D (S) training for classification on Dataset A using RetinaNet for coronary artery assignment, and without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v2)	LR = 1e-3 Loss = Cross entropy Model = Swin3D (S)	0.5209	0.7639
Swin3D (S) training for classification on Dataset A using RetinaNet for coronary artery assignment, and without adding age and artery segments in the last feature layer using different parameters for PCI cleaning (v1)	LR = 1e-3 Loss = Cross entropy Model = Swin3D (S)	0.5519	0.7390
MViT training for classification on Dataset A (2017, 2018, 2019) using RetinaNet for coronary artery assignment, and without adding age, removal of CAGB and artery segments in the last feature layer using different parameters for PCI cleaning (v1)	LR = 1e-2 Loss = Cross entropy Model = MviT	0.5423	0.6423
X3D (L) training for classification on Dataset A (2017, 2018, 2019) using RetinaNet for coronary artery assignment, and without adding age, removal of CAGB and artery segments in the last feature layer using different parameters for PCI cleaning (v1)	LR = 1e-2 Loss = Cross entropy Model = X3D (L)	0.5151	0.6889

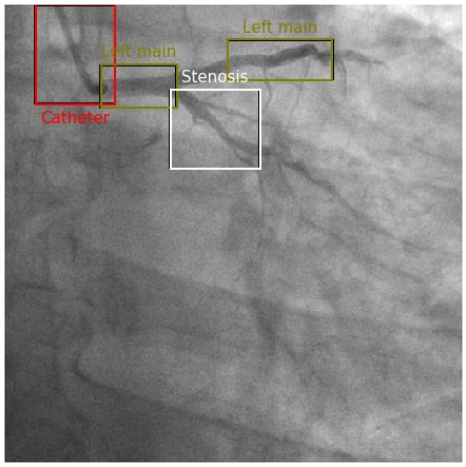
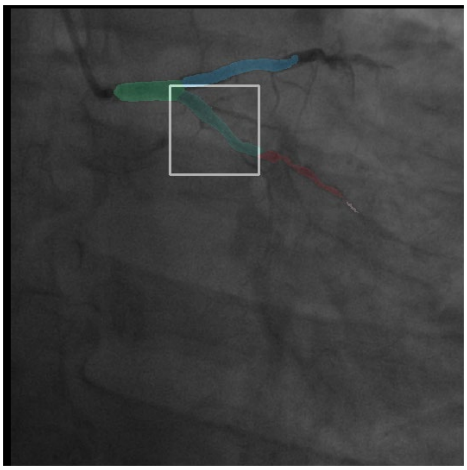
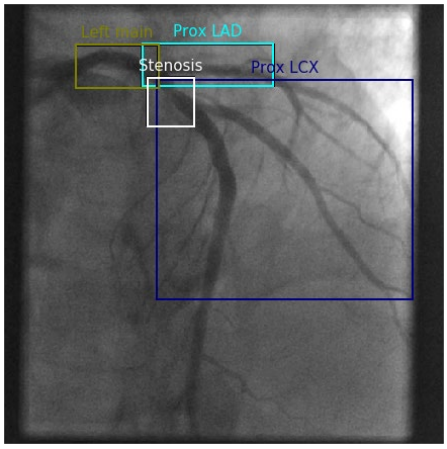
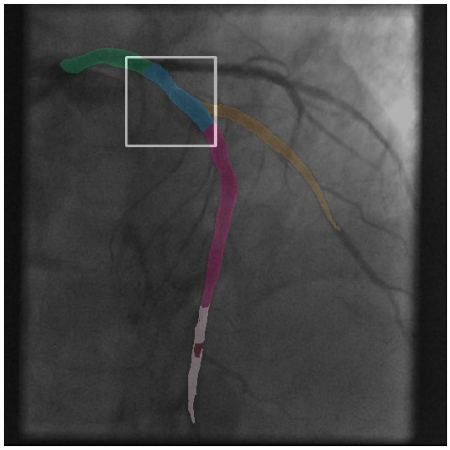
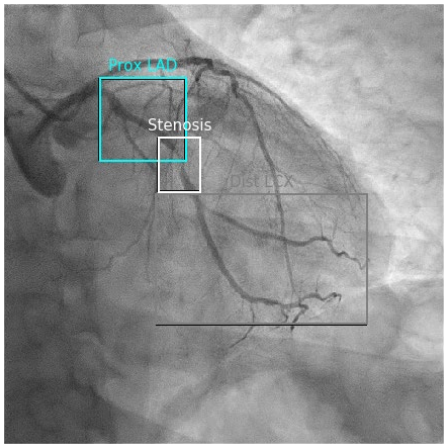
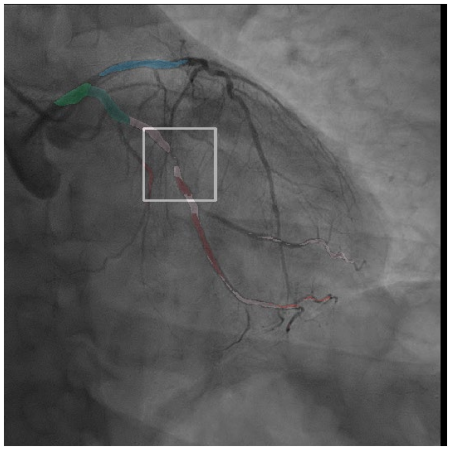
X3D (M) training for classification on Dataset A (2017, 2018, 2019) using RetinaNet for coronary artery assignment, and without adding age, removal of CAGB and artery segments in the last feature layer using different parameters for PCI cleaning (v1)	LR = 1e-2 Loss = Cross entropy Model = X3D (M)	0.5244	0.6678
R(2+1)D training for classification on Dataset A (2017, 2018, 2019) using RetinaNet for coronary artery assignment, and without adding age, removal of CAGB and artery segments in the last feature layer using different parameters for PCI cleaning (v1)	LR = 1e-2 Loss = Cross entropy Model = R(2+1)D	0.5505	0.5334

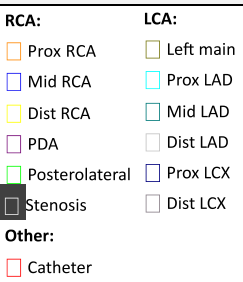
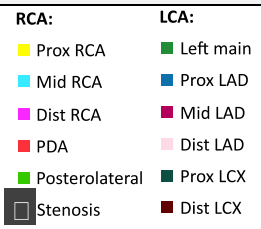
Legend. Various examples of trainings performed as part of the development process of DeepCoro for stenosis assessment. **Abbreviations**. CABG: Coronary Artery Bypass Grafting, LR: Learning Rate, PCI: Percutaneous Coronary Intervention.

Supplementary Table 12. Examples of CathAI's vs. DeepCoro's Approach for Coronary Artery Segment Assignment

Case	CathAI	DeepCoro
RCA		
DeepCoro's output and CathAI's output are correct *(Ground truth: Prox RCA)*	 **Output**: Prox RCA	 **Output**: Prox RCA
DeepCoro's output is correct and CathAI's output is incorrect *(Ground truth: Mid RCA)*	 **Output**: Posterolateral (No Mid RCA bounding boxes were detected, and the stenosis box overlaps primarily with a Posterolateral box.)	 **Output**: Mid RCA
DeepCoro's output is incorrect and CathAI's output is correct *(Ground truth: Mid RCA)*		

	Output: Mid RCA	**Output**: Prox RCA (The stenosis is located at the junction of the Prox RCA and Mid RCA segments. While the human operator identified the stenosis in Mid RCA, DeepCoro mistakenly assigned it to Prox RCA.)
DeepCoro's output and CathAI's output are incorrect *(Ground truth: Posterolateral)*	 **Output**: PDA (No Posterolateral bounding boxes were detected, and the stenosis box overlaps primarily with a PDA box.)	 **Output**: Prox RCA (Although Posterolateral pixels were detected within the resized stenosis box, the central pixels to which the stenosis was associated was Prox RCA.)
LCA		
DeepCoro's output and CathAI's output are correct *(Ground truth: Leftmain)*	 **Output**: Leftmain	 **Output**: Leftmain

DeepCoro's output is correct and CathAI's output is incorrect *(Ground truth: Prox LCX)*	 **Output**: Leftmain (No Prox LCX bounding boxes were detected, and the stenosis box only overlaps with a Leftmain box.)	 **Output**: Prox LCX
DeepCoro's output is incorrect and CathAI's output is correct *(Ground truth: Prox LCX)*	 **Output**: Prox LCX	 **Output**: Prox LAD (No Prox LCX pixels were detected, and DeepCoro mistakenly identified the LAD segments of the LCA as the LCX segments.)
DeepCoro's output and CathAI's output are incorrect *(Ground truth: Dist LCX)*	 **Output**: Prox LAD	 **Output**: Dist LAD

	(CathAI mistakenly identified the LCX sub-segments and LAD sub-segments in the LCX branch of the LCA. The stenosis box only overlaps with Prox LAD.)	(No Dist LCX pixels were detected, and DeepCoro mistakenly identified the LCX sub-segments and LAD sub-segments in the LCX branch of the LCA.)
Legends		
		

Legend. Visual representation of results used to assign a coronary artery segment with CathAI and DeepCoro for four different cases. Unlike DeepCoro, which assesses the coronary artery tree as an interconnected structure, CathAI employs a method that identifies individual elements within an image using bounding boxes, without linking the various artery segments together. This approach results in CathAI assigning stenoses to specific bounding boxes without considering the underlying anatomy of the vessel. **Green highlight**: Correct output by the coronary artery segment assignment algorithm. **Red highlight**: Incorrect output by the coronary artery segment assignment algorithm. **Abbreviations**. Dist LAD: distal left anterior descending artery, Dist LCX: distal left circumflex artery, Dist RCA: distal right coronary artery, Left main: left main artery, LCA: Left Coronary Artery, Mid LAD: middle left anterior descending artery, Mid RCA: middle right coronary artery, PDA: posterior descending artery, Posterolateral: posterolateral branch from the right coronary artery, Prox LAD: proximal left anterior descending artery, Prox LCX, proximal left circumflex artery, Prox RCA: proximal right coronary artery, RCA: Right Coronary Artery.

Supplementary Table 13. Performance of DeepCoro's Algorithm 6 at the Video Level on Dataset A's Test Set, Segregated by According to the Number of Stenoses Associated to the Exam

Task	Metric	Coronary artery					
		LCA				RCA	
		All		LCX	LAD		
		Single stenosis	Multiple stenosis	Multiple stenosis	Multiple stenosis	Single stenosis	Multiple stenosis
Number of videos		591	2,667	567	1,305	1,097	2,006
Number of severe stenoses		52	724	191	451	102	475
Classification	AUROC	0.8493 (0.8259 - 0.8754)	0.7542 (0.7447 - 0.7634)	0.7270 (0.7063 - 0.7483)	0.7576 (0.7454 - 0.7689)	0.8988 (0.8839 - 0.9166)	0.7999 (0.7878 - 0.8129)
	AUPRC	0.4405 (0.3616 - 0.5025)	0.5394 (0.5207 - 0.5587)	0.5745 (0.5365 - 0.6133)	0.6112 (0.5878 - 0.6354)	0.5968 (0.5441 - 0.6479)	0.5913 (0.5670 - 0.6156)
	Sensitivity (%)	63.34 (57.14 - 70.01)	67.42 (65.75 - 69.11)	63.87 (60.66 - 67.31)	69.84 (67.74 - 71.86)	86.21 (83.33 - 89.61)	75.37 (73.42 - 77.45)
	Specificity (%)	82.58 (80.92 - 84.30)	69.58 (68.61 - 70.54)	66.68 (64.38 - 69.08)	66.32 (64.76 - 67.75)	80.88 (79.63 - 82.12)	70.75 (69.58 - 71.83)
	PPV (%)	25.99 (22.00 - 29.70)	45.25 (43.87 - 46.62)	49.35 (46.28 - 52.24)	52.28 (50.21 - 54.19)	31.60 (28.69 - 34.11)	44.42 (42.81 - 46.08)
	F1-score (%)	36.83 (31.94 - 41.03)	54.15 (52.89 - 55.46)	55.67 (52.78 - 58.29)	59.79 (58.06 - 61.47)	46.23 (42.90 - 49.17)	55.89 (54.25 - 57.52)
Regression	MAE (%)	17.64 (17.06 - 18.17)	24.72 (24.36 - 25.06)	27.21 (26.33 - 28.04)	25.89 (25.34 - 26.42)	16.06 (15.64 - 16.48)	20.69 (20.27 - 21.11)
	r	0.4385 (0.3816 - 0.4832)	0.4325 (0.4157 - 0.4500)	0.3911 (0.3529 - 0.4276)	0.4607 (0.4399 - 0.4823)	0.6126 (0.5813 - 0.6407)	0.5539 (0.5346 - 0.5737)

Legend. DeepCoro's performance stratified across the number of stenoses. The range in parentheses is the 95% confidence interval generated by bootstrapping. **Abbreviations**. AUPRC: Area Under the Precision-Recall Curve, AUROC: Area Under the Receiver Operating Curve, LAD: Left Anterior Descending Artery, LCA: Left Coronary Artery, LCX: Left Circumflex Artery, MAE: Mean Absolute Error, PPV: Positive Predictive Value, r: Pearson's correlation coefficient, RCA: Right Coronary Artery.

Supplementary Table 14. Time per DICOM to Analyse Every DICOM in the Test Set of Dataset A with DeepCoro from End-to-End

Part	The algorithm is applied to…	Time per DICOM (second) (mean ± SD)
Algorithm 1	Every frame of the DICOM	3.41 ± 0.72
Algorithm 2	Every frame of the DICOM	8.73 ± 1.49
Algorithm 3	Every frame of the DICOM, in reference to each stenosis detected by Algorithm 2	24.31 ± 28.24
Algorithm 4	Every frame of the DICOM	4.67 ± 2.14
Algorithm 5	Every registered segmented stenosis video	0.84 ± 0.97
Algorithm 6	Every registered stenosis video kept	10.12 ± 5.00
Model loading and operations between algorithms	--	10.50 ± 2.38
Total		**62.60 ± 33.34**

Legend. Average time and standard deviation for DeepCoro to analyse every DICOM in the test set of Dataset A, which have been separated per component of DeepCoro. Samples were analysed on a single NVIDIA RTX3090 GPU with a batch size of 1 for this analysis. **Abbreviations**. SD: Standard Deviation.

Supplementary Table 15. DeepCoro's MAE in Videos from Dataset B Associated to Exam, PCI and CABG Procedures

Metric	Coronary artery								
	LCA			*RCA*			*RCA + LCA*		
	Diagnostic Exam	***PCI***	***CABG***	***Diagnostic Exam***	***PCI***	***CABG***	***Diagnostic Exam***	***PCI***	***CABG***
Number of videos	475	479	15	490	409	15	965	409	30
Number of severe stenoses, ⩾ 70%	105	107	6	92	106	6	197	106	12
MAE (%)	20.26 (19.51 - 21.00)	21.53 (20.70 - 22.37)	21.60 (18.09 - 24.52)	18.31 (17.56 - 18.98)	21.29 (20.53 - 22.09)	26.09 (21.41 - 30.61)	19.27 (18.70 - 19.76)	21.44 (20.83 - 21.98)	23.86 (20.68 - 26.63)

Legend. Difference in DeepCoro's performance observed in the LCA and RCA for videos during the diagnostic coronary angiogram, during PCI (detected by the PCI detection algorithm) and in patients with previous CABG (detected by the CABG detection algorithm). Abbreviations. CABG: Coronary Artery Bypass Grafting, LCA: Left Coronary Artery, MAE: Mean Absolute Error, PCI: Percutaneous Coronary Intervention, RCA: Right Coronary Artery.

Supplementary References

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