Digital Imaging and Communications in Medicine (DICOM)

Supplement 76: Quantitative Arteriography and Ventriculography Structured Reports

Prepared by:

DICOM Standards Committee, Working Group 1 Cardiovascular Information

1300 N. 17th Street, Suite 1847

Rosslyn, Virginia 22209 USA

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Please send comments to Howard Clark, NEMA (how_clark@nema.org)

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Foreword

This supplement to the DICOM standard introduces the templates to format the results of

- Quantitative Ventricular Analysis
- Quantitative Arterial Analysis

This document is a Supplement to the DICOM Standard. It is an extension to the following parts of the published DICOM Standard:

PS 3.16 -	Content Mapping Resource
PS 3.17 -	Explanatory Information

This Supplement was developed by Working Group 1 (Cardiovascular Information) of the DICOM Standards Committee, with significant input from the European Society of Cardiology and the American College of Cardiology.

Introduction - will not appear in final standard

Introduction

I.1 SCOPE AND FIELD OF APPLICATION

The information objects defined in this supplement are part of the effort to fully digitize and integrate data flow within and beyond the cardiac catheterization laboratory. The cath procedure is an image-guided interventional procedure, involving the acquisition and analysis of images and waveforms, the administration of drugs and therapies, and consultation and interaction between many medical disciplines. The cath lab is a multi-modality mix of many types of equipment from many different manufacturers.

Integration of this mix involves various structured data interchanges in the cath lab. This structured data includes procedure logs, quantitative and qualitative measurements, and clinical reports, and requires several specializations of the DICOM Structured Report capabilities.

The information objects defined in this supplement contain reports of vessel and cardiac chamber contour analysis from images created by projection X-Ray equipment.

I.1.1 Quantitative Ventricular Analysis Report

The purpose of the Quantitative Ventricular Analysis Report is to give information about the cardiac output and the contractility of the left ventricle. Based upon X-Ray images, the ventricular cross-sectional areas (from the projection image) at the end of diastole (ED) and end of systole (ES) are determined. From those measurements the various cardiac volumetric values are determined. Besides this, movements of the ventricular wall are measured.

The following methods of ventricular volume calculation are available:

- Area-Length
- Multiple Slices
- Boak
- TS Pyramid
- Two Chamber
- Parallelepiped

The following methods of wall motion calculations are available:

- Centerline Wall Motion
- Radial Based Wall Motion
- Landmark Based Wall Motion

I.1.2 Quantitative Arteriography Analysis Report

Quantitative Arteriography Analysis is used as a diagnostic and research tool to investigate the condition of blood vessels, typically those that supply the heart with blood (the coronaries), but also potentially non-coronary vessels. The measurements done with the Quantitative Arteriography Analysis software are performed on an X-ray image of the vessels.

When using Quantitative Arteriography Analysis the contours of the vessel can be detected very easily and the diameter at any point in the vessel can be determined. After the contour detection, analysis on the stenotic segment of the vessel or at any other segment of interest can be performed. Important results that can be obtained are:

- position of a stenosis
- length of a stenosis
- minimal diameter/area
- reference diameter/area
- percentage diameter/area stenosis
-

I.2 LITERATURE OVERVIEW

Literature on Cardiac Volumes and Wall Motion Assessment:

[1] Heintzen PH (Hrsg) (1971) Roentgen-, Cine- an Videodensitometry. Thieme, Stuttgart

[2] Heintzen PH, Bürsch JH (Hrsg) (1978) Roentgen-Video-Techniques. Thieme, Stuttgart

[3] Heintzen PH, Brennecke R (Hrsg) (1983) Digital imaging in cardiovascular radiology. Thieme, Stuttgart

[4] Scampardonis G, Yang SS, Maranhao V, Goldberg H, Gooch AS (1973) Left ventricular abnormalities in prolapsed mitral leaflet syndrome. Review of eighty-seven cases. Circulation 48.287

[5] Carlsson E, Gross R, Holt RG (1977) The radiological diagnosis of cardiac valvar insufficiencies. Circulation 55:591

[6] Sandler H,Dodle HT (1968) The use of single plane angiocardiograms for the calculation of left ventricular volume in man. Am Heart J 75:325

[7] Arcilla RA, Tsai P, Thilenius 0, Ranniger K (1971) Angiographic method for volume estimation of right and left ventricles. Chest 60:446

[8] Lange P, Onnasch D, Moldenhauer H, Malerczyk V, Farr F, Nüttig G, Heintzen PH (1976) The analysis of size, shape and contraction pattern ofthe right ventride from angiocardiograms. Eur J Cardiol 4: 153-168

[9] Kennedy JW, Baxley WA, Figley MM, Dodge HT, Blackmon JR (1966) Quantitative cangiocardiography. I. The normal left ventride in man. Circulation 34:272

[10] Chatterjee K, Sacoor M, Sutton GC, Miller GAH (1971) Assessment of left ventricular function by single plane cine-angiographic volume analysis. Br Heart J 33:565

[11] Karliner JS, Gault)H, Eckberg D, Mullins CB, ROSS J (1971) Mean velocity of fiber shortening.

[12] simplified measure of left ventricular myocardial contractility. Circulation 44:323

[13] Benzing G, Stockert I, Nave E, Kaplan S (1974) Evaluation of left ventricular performance.

[14] Circumferential fiber shortening and tension. Circulation 49:925

[15] Peterson KL, Skloven D, Ludbrook P, Uther JB, ROSS] (1974) Comparison of isovolumic and ejection phase indices of myocardial performance in man. Circulation 49:1088

[16] Moraski RE, Russell RO, McKamy Smith, Rackley CE (1975) Left ventricular function in patients with and without myocardial infarction and one, two or three vessel coronary artery disease. Am J Cardiol 35:1

[17] Rackley CE (1976) Quantitative evaluation of left ventricular function by radiographic techniques. Circulation 54:862

[18] Ross J, Braunwald E (1964) The study of left ventricular function in man by increasing resistance to ventricular ejection with angiotensin. Circulation 29:739

[19] Borow KM. Neumann A, Wynne (1982) Sensitivity of end-systolic pressure-dimension and pressure-volume relations to the inotropic state in humans. Circulation 65:988

[20] Gaasch WH, Battle WE, Oboler AA. Banas JS, Levine HI (1972) Left ventricular stress and compliance in man. With special reference to normalized ventricular function curves. Circulation 45:746

[21] Gault JH, Ross I, Braunwald E (1968) Contractile state of the left ventricle in man. Instantaneous tension velocity-length relations in patients with and without disease of the left ventricular myocardium. Circ Res 22:451

[22] Dodge HT, Tannenbaum HL (1956) Left ventricular volume in normal man and alterations with disease. Circulation 14:92

[23] Arvidsson H (1958) Angiocardiographic observations in mitral disease, with special reference to volume variations in the left atrium. Acta Radiol Scan [Suppl]: 158

[24] Arvidsson H (1961) Angiocardiographic determination of left ventricular volume. Acta Radiol Scan 56:321

[25] Bunnell IL, Ikkos D, Rudke UG, Swan HJC (1961) Left heart volumes in coarctation of the aorta. Am Heart J 61,165

[26] Miller GAH, Swan HJC (1964) Effect of chronic pressure and volume overload on left heart volumes in subjects with congenital heart disease. Circulation 30:205

[27] Davila JC, Sanmarco ME (1966) An analysis of the fit of rnathematical models applicable to the measurement of left ventricular volume. Am J Cardiol 18:31

[28] Greene DG, Carlisle R, Grant C, Brunnell IL (1967) Estimation of left ventricular volume by one-plane cine angiography. Circulation 35:61

[29] Dodge HT, Sandler H, Ballew DW, Lord JD (1960) The use of biplane angiocardiography for the measurement of left ventricular volume in man. Am Heart J 60:762

[30] Wynne J, Green LH, Mann T, Levin D, Grossman W (1978) Estimation of left ventricular volumes in man from biplane cineangiograms filmed in oblique projections. Am Cardiol 41:726

[31] Kennedy JW, Trenholme SE, Kasser IS (1970) Left ventricular volume and mass from single-plane cineangiocardiogram. A comparison of anteroposterior and right anterior oblique methods. Am Heart J 80:343

[32] Tynan M, Reid DS, Hunter S, Kaye HH, Osme S, Urquhart W, Davies P (1975) Ejection phase indices of left ventricular performance in infants, children and adults. Br Heart J 37:196

[33] Chapman CB, Baker 0, Reynolds J, Bonte FJ (1958) Use of biplane cinefluorography for measurement of ventricular volume. Circulation 18:1104

[34] Goerke J, Carlsson E (1967) Caiculation of right and left cardiac ventricular volumes. Method using Standard Computer equipment and biplane angiocardiograms. Invest Radiol 2:360

[35] Heywood JT, Grimm J, Hess OM, Jakob M, Krayenbühl HP (1990) Right ventricular diastolic function during exercise: Effect of ischemia. J Am Coll Cardiol 16:611

[36] Murray JA, Kennedy JW, Figley MM (1968) Quantitative angiocardiography. II. The normal left atrial volume in man. Circulation 37:800

[37] Sauter HJ, Dodge HT, Johnson RR (1964) The relationship of left atrial pressure and volume in patients with heart disease. Am Heart J 67:635

[38] Kasser IS, Kennedy JW (1969) Measurement of left ventricular volumes in man by single plane cineangiocardiography. Investig Radiol 4:83

[39] Karliner JS, Bouchard RJ, Gault JH (1971) Dimensional changes of the human left ventricle prior to aortic valve opening. A cineangiograpic study in patients with and without left heart disease. Circulation 44:312

[40] Sandler H, Dodge HT (1974) Angiographic methods for determination of left ventricular geometry and volume. In: Mirsky I, Ghista D, Sandler H (eds) Cardiac mechanics. Physiological, clinical and mathematical considerations Wiley & Sons, New York

[41] Sandler H, Dodge HT (1963) Left ventricular tension and stress in man. Circ Res 13:91

[42] Kass DA, Maughan WL (1988) From „Ernax" to pressure-volume relations: a broader view. Circulation 77:1203

[43] Mirsky I (1983) Assessment of diastolic function: suggested methods and future considerations. Circulation 69:836

[44] Rackley CE, Dodge HT, Coble YD,Hay RE(1964)A method for determining left ventricular mass in man. Circulation 29:666

[45] Bardeen CR (1918) Determination of the size of the heart by means of X-rays. Am J Anataomy 23:423

[46] Kennedy JW, Reichenbach DD, Baxley WA, Dodge HT (1967) Left ventricular mass. A comparison of angiocardiographic measurements with autopsy weight. Am J Cardiol 19:221

[47] Chatterjee K, Sacoor M, Sutton GC, Miller GAH (1971) Angiographaic assessment of left ventricular function in patients with ischaemic heart disease without clinical heart failure. Br Heart J 33: 559

[48] Herman MV, Heinle RA, Klein MD, Gorlin R (1967) Localized disorders in myocardial contraction. Asynergy and its role in congestive heart failure. New Engl J Med 277:222

[49] Heintzen PH, Moldenhauer K, Lange PE (1974) Three-dimensional computerized contraction pattern analysis. Eur J Cardiol l: 229

[50] Rickards A, Seabra-Gomes R, Thurston P (1977) The assessment of regional abnormalities of the left ventricle by angiography. Eur J Cardiol 5:167

[51] Sniderman AD, Marpole D, Fallen EL (1973) Regional contraction patterns in normal and ischemic left ventride in man. Am J Cardiol 31:484

[52] Hamilton GW, Murray JA, Kennedy JW (1972) Quantitative angiocardiography in ischemic heart disease. The spectrum of abnormal left ventricular function and the role of abnormally contracting Segments. Circulation 45; 1065

[53] Harris LD, Clayton PD, Marshall HW, Warner HR (1974) A technique for the detection of asynergistic motion in the left ventride. Comput Biomed Res 7:380

[54] Hernandez-Lattuf PR, Quinones MA, Gaasch WH (1974) Usefulness and limitations of circumferential fibre shortening velocity in evaluating segmental disorders of left ventricular contraction.Br Heart J 36:1167

[55] Stewart DK, Hamilton GW, Murray JA, Kennedy)W (1974) Left ventricular function and coronary artery anatomy before and after myocardial infarction. A study of six cases. Circulation 49:47

[56] Simon R, Krayenbühl HP, Rutishauser W, Steiger U, Brunner HH, Schönbeck M (1974) Evaluation of contraction performance in the normal human left ventride. Eur J Clin. Invest 4:368

[57] Reddy SP, Curtiss EI, O'Toole D, Matthews RG, Salerni R, Leon DF, Shaver JA (1975) Reversibility of left ventricular asynergy by Nitroglycerin in coronary disease. Am Heart J 90:479

[58] Hood WP, Smith LR, Amende I, Simon R, Lichtlen PR (1977) Application of a computerized System for analysis of regional left ventricular function. Computers in Cardiology, Rotterdam, p 359

[59] Sheehan FH, Bolson EL, Dodge HT, Mathey DG, Schofer J, Woo HW (1986) Advantages and applications of the centerline method for characterizing regional ventricular function. Circulation 74:293-305

[60] Sheehan FH, Stewart DK, Dodge HT, Mitten S, Bolson EL, Brown BG (1983) Variability in the measurement of regional ventricular wall motion from contrast angiograms. Circulation 68:550

[61] Sheehan FH, Bolson EL, Dodge HT, Mitten S (1984) Centerline method - comparison with other methods for measuring regional left ventricular motion. In: Sigwart U, Heintzen PH (eds) Ventricular wall motion. Thieme, Stuttgart

[62] Masquet C, Slama MS, Dibie A, Sheehan FH, Lienard J (1998) Normal left ventricular volumes and ejection fraction: assesment with quantitative digital cardiography. Int J Card Imaging 14 (1)

[63] Boak, J. G., Bove, A. A., Kreulen, T. & Spann, J. F. A geometric basis for calculation of right ventricular volume in man. *Cathet Cardiovasc Diagn* **3**, 217-30, 1977.

[64] Ferlinz, J. Measurements of right ventricular volumes in man from single plane cineangiograms. A comparison to the biplane approach. *Am Heart J* **94**, 87-90, 1977.

[65] Graham, T. P., Jr., Jarmakani, J. M., Atwood, G. F. & Canent, R. V., Jr. Right ventricular volume determinations in children. Normal values and observations with volume or pressure overload. *Circulation* **47**, 144-53, 1973.

I.3 MOST COMMONLY USED METHODS FOR QUANTITATIVE VENTRICULAR ANALYSIS

Ventricular Volumes

Biplane Area Length Methods

[66] Arcilla RA, Tsai P, Thilenius 0, Ranniger K (1971) Angiographic method for volume estimation of right and left ventricles. Chest 60:446

$$LV_{true} = 0,992 \times LV_{calc} - 0,78 \text{ ml}$$

$$RV_{true} = 0,875 \times RV_{calc} + 4,4 \text{ ml}$$

[67] Davila JC, Sanmarco ME (1966) An analysis of the fit of rnathematical models applicable to the measurement of left ventricular volume. Am J Cardiol 18:31

$$LV_{true} = 0,95 \times LV_{calc} - 8,5 \text{ ml}$$

[68] Dodge HT, Sandler H, Ballew DW, Lord JD (1960) The use of biplane angiocardiography for the measurement of left ventricular volume in man. Am Heart J 60:762

LV_{true} = 0,928 x LV_{calc} - 3,8 ml

[69] Wynne J, Green LH, Mann T, Levin D, Grossman W (1978) Estimation of left ventricular volumes in man from biplane cineangiograms filmed in oblique projections. Am J Cardiol 41: 726

LV_{true} = 0,989 x LV_{calc} - 8,1 ml

Single Plane Area Length Methods

[70] Reiber et al. (1996) Left ventricular regression equations from single plane cine and digital x-ray ventriclograms revisited, International Journal of Cardiac Imaging 12: 69-78

LV EDV 0.783*EDVcalc-3.759

LV ESV 0.783*ESVcalc-3.759

[71] Sandler H,Dodle HT (1968) The use of single plane angiocardiograms for the calculation of left ventricular volume in man. Am Heart J 75:325

LV_{true} = 0,951 x LV_{calc} - 3,0 ml

[72] Kennedy JW, Trenholme SE, Kasser IS (1970) Left ventricular volume and mass from single-plane cineangiocardiogram. A comparison of anteroposterior and right anterior oblique methods. Am Heart J 80:343

LV_{true} = 0,81 x LV_{calc} + 1,9 ml

[73] Tynan M, Reid DS, Hunter S, Kaye HH, Osme S, Urquhart W, Davies P (1975). Ejection phase indices of left ventricular performance in infants, children and adults. Br Heart J 37:196

LV_{true} = 0,59 x $LV_{calc}^{1,09}$

[74] Masquet C, Slama MS, Dibie A, Sheehan FH, Lienard J (1998) Normal left ventricular volumes and ejection fraction: assesment with quantitative digital cardiography. Int J Card Imaging 14 (1)

LV_{true} = 0,693 x LV_{calc} + 8.65 cm3

LV_{true} = 0,85 x LV_{calc} + 4.72 cm3

Simpsons Rule Biplane

[75] Goerke J, Carlsson E (1967) Calculation of right and left cardiac ventricular volumes. Method using Standard Computer equipment and biplane angiocardiograms. Invest Radiol 2:360

LV_{true} = 0,813 x LV_{calc} - 13,2 ml

[76] Davila JC, Sanmarco ME (1966) An analysis of the fit of rnathematical models applicable to the measurement of left ventricular volume. Am J Cardiol 18:31

LV_{true} = 0,99 x LV_{calc} - 8,0 ml

[77] Lange P, Onnasch D, Farr FL, Malerczyk V, Heintzen PH (1978): Analysis of left and right ventricular size and shape as determined from human casts. Description of the method and its validation. Europ J cardiol :8/4-5: 431

LV_{true} = 0,724 x LV_{calc} -10,0 ml

RV_{true} = 0, 583 x RV_{calc} - 6,1 ml

[78] Heywood JT, Grimm J, Hess OM, Jakob M, Krayenbühl HP (1990) Right ventricular diastolic function during exercise: Effect of ischemia. J Am Coll Cardiol 16:611

RV_{true} = 0, 77 x RV_{calc} - 12 ml

Simpsons Rule Monoplane

[79] Reiber et al. (1996) Left ventricular regression equations from single plane cine and digital x-ray ventriclograms revisited, International Journal of Cardiac Imaging 12: 69-78

LV EDV 0.737*EDVcalc-4.649

LV ESV 0.737*ESVcalc-4.649

Left Atrial Volume

Area Length

[80] Sauter HJ, Dodge HT, Johnston RR, Graham TP (1964). The relationship of left atrial pressure and volume in patients with heart disease. Am Heart J 67: 635

$LA_{true} = 1,12 \times LA_{calc} - 10,6$ ml

Left Ventricular Mass

[81] Rackley ChE, Dodge HT, Coble YD, Hay RE (1964). A method for determining left ventrivular mass in man. Circulation 29: 666

$LVM_{true} = 1,01 \times LVM_{calc} + 11$ g

[82] Kennedy JW, Reichenbach D, Baxley WA, Dodge HAT (1967). Left ventricular mass. A comparison of angiocardiographic measurements with autopsy weight. Am J Cardiol 19:221

$LVM_{true} = 1,04 \times LVM_{calc} - 6,5$ g

Changes to NEMA Standards Publication PS 3.16-2003

Digital Imaging and Communications in Medicine (DICOM)

Part 16: Content Mapping Resource

Add the following references to Section 2

Quantitative Arteriography and Ventriculography

[Sheehan, 1986] Sheehan FH, Bolson EL, Dodge HT, Mathey DG, Schofer J, Woo HW (1986) Advantages and applications of the centerline method for characterizing regional ventricular function. Circulation 74:293-305

[Slager] Slager CJ, Hooghoudt TE, Serruys PW, Schuurbiers JC, Reiber JH, Meester GT, Verdouw PD, Hugenholtz PG. Quantitative assessment of regional left ventricular motion using endocardial landmarks. *J Am Coll Cardiol*. 1986;7:317-26.

[Kennedy, 1970] Kennedy JW, Trenholme SE, Kasser IS (1970) Left ventricular volume and mass from single-plane cineangiocardiogram. A comparison of anteroposterior and right anterior oblique methods. Am Heart J 80:343

[Dodge, 1960] Dodge HT, Sandler H, Ballew DW, Lord JD (1960) The use of biplane angiocardiography for the measurement of left ventricular volume in man. Am Heart J 60:762

[Wynne] Wynne J, Green LH, Mann T, Levin D, Grossman W (1978) Estimation of left ventricular volumes in man from biplane cineangiograms filmed in oblique projections. Am J Cardiol 41: 726

[Boak] Boak, J. G., Bove, A. A., Kreulen, T. & Spann, J. F. A geometric basis for calculation of right ventricular volume in man. *Cathet Cardiovasc Diagn* **3**, 217-30, 1977.

[Ferlinz] Ferlinz, J. Measurements of right ventricular volumes in man from single plane cineangiograms. A comparison to the biplane approach. *Am Heart J* **94**, 87-90, 1977.

[Graham] Graham, T. P., Jr., Jarmakani, J. M., Atwood, G. F. & Canent, R. V., Jr. Right ventricular volume determinations in children. Normal values and observations with volume or pressure overload. *Circulation* **47**, 144-53, 1973.

[Arcilla] Arcilla RA, Tsai P, Thilenius 0, Ranniger K (1971) Angiographic method for volume estimation of right and left ventricles. Chest 60:446

Add the following templates to Annex A

Annex A Structured Reporting Templates (Normative)

QUANTITATIVE VENTRICULAR ANALYSIS REPORT SR IOD TEMPLATES

The templates that comprise the Quantitative Ventricular Analysis SR are interconnected as in Figure A-X.1:

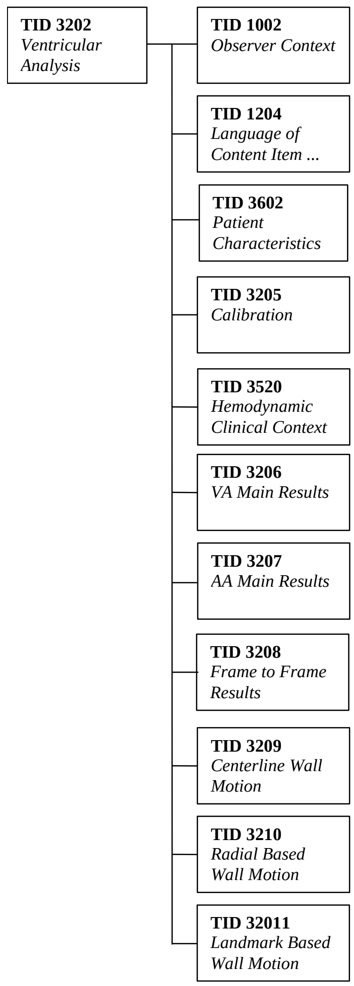


Figure A-X.1: Quantitative Ventricular Analysis Report SR IOD Template Structure

TID 3202 Ventricular Analysis Template

The Ventricular Analysis Template provides a CONTAINER with a structure for reporting the result of the ventricular analysis.

Type: Extensible

TID 3202
VENTRICULAR ANALYSIS

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (122292, DCM, "Quantitative Ventriculography Report”)	1	M		
2	>	HAS CONCEPT MOD	INCLUDE	DTID (1204) Language Of Content Item And Descendants	1	M		
3	>	HAS OBS CONTEXT	INCLUDE	DTID (1002) Observer Context	1	M		
4	>	CONTAINS	INCLUDE	DTID (3602) Patient Characteristics	1	U		
5	>	CONTAINS	CONTAINER	EV (122144, DCM, “Quantitative Analysis”)	1-n	M		
6	>>	HAS OBS CONTEXT	INCLUDE	DTID (1002) Observer Context	1	U		
7	>>	HAS OBS CONTEXT	TEXT	EV (111001, DCM, “Algorithm Name”)	1	M		
8	>>	HAS OBS CONTEXT	TEXT	EV (111003, DCM, “Algorithm Version”)	1	M		
9	>>	HAS OBS CONTEXT	TEXT	EV (122405, DCM, “Algorithm Manufacturer”)	1	M		
10	>>	CONTAINS	IMAGE	EV (121112, DCM, “Source of Measurements”)	1-n	M		
11	>>>	HAS CONCEPT MOD	CODE	EV (G-A60B), SRT, “Cardiac Phase”	1	M		DCID (3222) Cardiac Phase
12	>>>	HAS CONCEPT MOD	CODE	EV (111031, DCM, “Image View”)	1	MC	If Biplane Analysis	DCID (3466) Plane Identification
13	>>	HAS ACQ CONTEXT	INCLUDE	DTID (3205) Calibration	1-2	U	VM = 1: Single plane analysis, VM = 2: Biplane analysis	$CalibrationPlane = DCID (3466) Plane Identification
14	>>	HAS ACQ CONTEXT	INCLUDE	DTID (3520) Hemodynamic Clinical Context	1	U		
15	>>	CONTAINS	INCLUDE	DTID (3206) VA Main Results	1	M		
16	>>	CONTAINS	INCLUDE	DTID (3207) AA Main Results	1	U		
17	>>	CONTAINS	INCLUDE	DTID (3208) Frame to Frame Results	1	U		
18	>>	CONTAINS	INCLUDE	DTID (3209) Centerline Wall Motion	1-2	U	VM = 1: Single plane analysis, VM = 2: Biplane analysis	
19	>>	CONTAINS	INCLUDE	DTID (3210) Radial Based Wall Motion	1-2	U	VM = 1: Single plane analysis, VM = 2: Biplane analysis	
20	>>	CONTAINS	INCLUDE	DTID (3211) Landmark Based Wall Motion	1-2	U	VM = 1: Single plane analysis, VM = 2: Biplane analysis	

Content Item Descriptions

Row 7	Identifies the Ventricular Analysis program
Row 8	Identifies the Ventricular Analysis program version
Row 9	Identifies the Ventricular Analysis program manufacturer

Row 10	Identifies the ES and ED images on which the analysis is based, for frame by frame analysis the analyzed image are specified in the frame by frame results (3208) template

TID 3205 Calibration Template

The Calibration Template consists of a CONTAINER, with a structure for reporting of the calibration of images used in the analysis.

Parameter Name	Parameter Usage
$CalibrationPlane	XA Imaging plane

Type: Extensible

TID 3205
CALIBRATION

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (122505, DCM, “Calibration”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (111031, DCM, “Image View”)	1	U		$CalibrationPlane
3	>	HAS OBS CONTEXT	TEXT	EV (111001, DCM, “Algorithm Name”)	1	MC	If different from Analysis program specified in the invoking template	
4	>	HAS OBS CONTEXT	TEXT	EV (111003, DCM, “Algorithm Version”)	1	MC	If different from Analysis program specified in the invoking template	
5	>	HAS OBS CONTEXT	TEXT	EV (122405, DCM, “Algorithm Manufacturer”)	1	MC	If different from Analysis program specified in the invoking template	
6	>	CONTAINS	CODE	EV (122422, DCM, “Calibration Method”)	1	M		DCID (3452) Calibration Methods
7	>	CONTAINS	CODE	EV (122421, DCM, “Calibration Object”)	1	MC	If row 6 value specifies Calibration Object Used	DCID (3451) Calibration Object
8	>	CONTAINS	NUM	EV (122423, DCM, “Calibration Object Size”)	1	MC	If row 6 value specifies Calibration Object Used	DCID (3510) Catheter Size Units
9	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (111026, DCM, “Horizontal Pixel Spacing”) $Unit = DT (mm/{pixel}, UCUM, “mm/pixel”) $ImagePurpose = EV (121112, DCM, “Source of Measurement”)
10	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (111066, DCM, “Vertical Pixel Spacing”) $Unit = DT (mm/{pixel}, UCUM, “mm/pixel”) $ImagePurpose = EV (121112, DCM, “Source of Measurements”)
11	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 3	Identifies the Calibration program
Row 4	Identifies the Calibration program version
Row 5	Identifies the Calibration program manufacturer
Row 7	Besides a Sphere and a Catheter, a Distance can be identified as a Calibration Object. In this case a distance measurement of a known dimension of the object is used to calculate the pixel size.

Row 8	The catheter size units is also used to specify the size of other calibration objects (e.g. sphere)
Row 9,10	Spacing in the patient body. Point to a single frame containing the image used for calibration if applicable, the actual measurements may be indicated by a SCOORD (see TID 320, row 3)
Row 11	Secondary Capture image with calibration position

TID 3206 VA Main Results Template

The VA Main Results Template consists of a CONTAINER with a structure for reporting the main ventricular analysis measurements.

Type: Extensible

TID 3206
VA MAIN RESULTS

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Site”)	1	M		DCID (3462) Chamber Identification
3	>	CONTAINS	CODE	EV (122429, DCM, “Volume Method”)	1	M		DCID (3453) Volume Methods
4	>	CONTAINS	NUM	EV (122435, DCM, “Regression Volume Exponent”)	1	U		Unit = DT (1, UCUM, “no units”)
5	>	CONTAINS	NUM	EV (122431, DCM, “Regression Slope ED”)	1	U		Unit = DT (1, UCUM, “ratio”)
6	>	CONTAINS	NUM	EV (122432, DCM, “Regression Offset ED”)	1	U		Unit = DT (ml, UCUM, “ml”)
7	>	CONTAINS	NUM	EV (122433, DCM, “Regression Slope ES”)	1	U		Unit = DT (1, UCUM, “ratio”)
8	>	CONTAINS	NUM	EV (122434, DCM, “Regression Offset ES”)	1	U		Unit = DT (ml, UCUM, “ml”)
9	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = DCID (3467) Ejection Fraction $Unit = DT (%, UCUM, “%”)
10	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3468) ED Volume $Unit = DT (ml, UCUM, “ml”)
11	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3469) ES Volume $Unit = DT (ml, UCUM, “ml”)
12	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (20562-5, LN, “Stroke Volume”) $Unit = DT (ml, UCUM, “ml”)
13	>	CONTAINS	NUM	EV (8867-4, LN, “Heart Rate”)	1	U		Unit = DT ({hb}/min, UCUM, “beats/min”)
14	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3468) ED Volume $ModType = EV (121425, DCM, “Index”) $ModValue = DCID (3455) Index Methods $Unit = DT (ml/m2, UCUM, “ml/m^ 2”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
15	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3468) ED Volume $ModType = EV (121425, DCM, “Index”) $ModValue = EV (29463-7. LN, “Patient Weight”) $Unit = DT (ml/kg, UCUM, “ml/kg”)
16	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3469) ES Volume $ModType = EV (121425, DCM, “Index”) $ModValue = DCID (3455) Index Methods $Unit = DT (ml/m2, UCUM, “ml/m^2”)
17	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3469) ES Volume $ModType = EV (121425, DCM, “Index”) $ModValue = EV (29463-7. LN, “Patient Weight”) $Unit = DT (ml/kg, UCUM, “ml/kg”)
18	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (20562-5, LN, “Stroke Volume”) $ModType = EV (121425, DCM, “Index”) $ModValue = DCID (3455) Index Methods $Unit = DT (ml/m2, UCUM, “ml/m^2”)
19	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (20562-5, LN, “Stroke Volume”) $ModType = EV (121425, DCM, “Index”) $ModValue = EV (29463-7. LN, “Patient Weight”) $Unit = DT (ml/kg, UCUM, “ml/kg”)
20	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (F-32100, SRT, “Cardiac Output”) $Unit = DT (l/min, UCUM, “l/min”)
21	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (F-32110, SRT, “Cardiac Index”) $ModType = EV (121425, DCM, “Index”) $ModValue = DCID (3455) Index Methods $Unit = DT (l/min/m2, UCUM, “l/min/m^2”)
22	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122445, DCM, “Wall Thickness”) $Unit = DT (mm, UCUM, “mm”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
23	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122446, DCM, “Wall Volume”) $Unit = DT (ml, UCUM, “ml”)
24	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122447, DCM, “Wall Mass”) $Unit = DT (g, UCUM, “gram”)
25	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122447, DCM, “Wall Mass”) $ModType = EV (121425, DCM, “Index”) $ModValue = DCID (3455) Index Methods $Unit = DT (g/m2, UCUM, “gram/m^2”)
26	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122447, DCM, “Wall Mass”) $ModType = EV (121425, DCM, “Index”) $ModValue = EV (29463-7. LN, “Patient Weight”) $Unit = DT (g/kg, UCUM, “gram/kg”)
27	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122448, DCM, “Wall Stress”) $Unit = DT (dyn/cm2, UCUM, “dynes/cm^2”)
28	>	CONTAINS	IMAGE	No purpose of reference	1-n	U		

Content Item Descriptions

Row 28	Secondary Capture image with ED and/or ES contours

TID 3207 AA Main Results Template

The AA Main Results Template consists of a CONTAINER with a structure for reporting the main atrial analysis measurements.

Type: Extensible

TID 3207
AA MAIN RESULTS

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Site”)	1	M		DCID (3462) Chamber Identification
3	>	CONTAINS	CODE	EV (122429, DCM, “Volume Method”)	1	M		DCID (3453) Volume Methods
4	>	CONTAINS	NUM	EV (122435, DCM, “Regression Volume Exponent”)	1	U		Unit = DT (1, UCUM, “no units”)
5	>	CONTAINS	NUM	EV (122431, DCM, “Regression Slope ED”)	1	U		Unit = DT (1, UCUM, “ratio”)
6	>	CONTAINS	NUM	EV (122432, DCM, “Regression Offset ED”)	1	U		Unit = DT (ml, UCUM, “ml”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
7	>	CONTAINS	NUM	EV (122433, DCM, “Regression Slope ES”)	1	U		Unit = DT (1, UCUM, “ratio”)
8	>	CONTAINS	NUM	EV (122434, DCM, “Regression Offset ES”)	1	U		Unit = DT (ml, UCUM, “ml”)
9	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3468) ED Volume $Unit = DT (ml, UCUM, “ml”)
10	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = DCID (3469) ES Volume $Unit = DT (ml, UCUM, “ml”)
11	>	CONTAINS	IMAGE	No purpose of reference	1-n	U		

Content Item Descriptions

Row 11	Secondary Capture image with ED and/or ES contours

TID 3208 Frame-to-Frame Results Template

The Frame-to-Frame Result Template consists of a CONTAINER providing measurements derived from the angiographic images on frame-by-frame basis.

Type: Extensible

TID 3208
FRAME-TO-FRAME RESULT

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, “Procedure Reported”)	1	M		EV (122499, DCM, “Frame to Frame Analysis”)
3	>	CONTAINS	IMAGE	EV (121112, DCM, “Source of Measurements”)	1-2	M	VM = 1: Single plane analysis, VM = 2: Biplane analysis	
4	>	CONTAINS	CODE	EV (122429, DCM, “Volume Method”)	1	M		DCID (3453) Volume Methods
5	>	CONTAINS	INCLUDE	DTID (300) Measurement	n	M		$Measurement = DCID (3471) Estimated Volumes $TargetSite = DCID (3462) Chamber Identification $Unit = DT (ml, UCUM, “ml”)
6	>	CONTAINS	INCLUDE	DTID (300) Measurement	n	U		$Measurement = EV (122445, DCM, “Wall Thickness”) $Unit = DT (mm, UCUM, “mm”)
7	>	CONTAINS	IMAGE	No purpose of reference	1-n	U		

Content Item Descriptions

Row 3	Identifies each frame analyzed, using the multi-valued Referenced Frame Number (0008,1160) attribute of the IMAGE content item.
Row 5,6	Includes one measurement for each frame referenced in Row 3.
Row 7	Secondary Capture image with ventricular contours

TID 3209 Centerline Wall Motion Template

The Centerline Wall Motion Template consists of a CONTAINER providing measurements of the centerline wall motion.

Type: Extensible

TID 3209
CENTERLINE WALL MOTION

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, “Procedure Reported”)	1	M		EV (122449, DCM, “Centerline Wall Motion Analysis”)
3	>>	HAS CONCEPT MOD	CODE	EV (122410, DCM, “Contour Realignment”)	1	M		DCID (3458) Contour Realignment
4	>	CONTAINS	INCLUDE	DTID (300) Measurement	100	M		$Measurement = EV (122450, DCM, “Normalized Chord Length”) $Unit = DT (%, UCUM, “%”)
5	>	CONTAINS	NUM	EV (122411, DCM, “Threshold Value”)	1	M		Values shall be 1, 2 or 3 Units = EV ({sd}, UCUM, “Standard Deviations”)
6	>	CONTAINS	CONTAINER	EV (122451, DCM, “Abnormal Region”)	1-6	U		
7	>>	CONTAINS	CODE	EV (F-32050, SRT, “Cardiac Wall Motion”)	1	M		DCID (3703) Wall Motion
8	>>	CONTAINS	CODE	EV (R-404F0, SRT, “Circumferential Extent”)	1	U		DCID (3460) Circumferential Extent
9	>>	CONTAINS	NUM	EV (122452, DCM, “First Chord of Abnormal Region”)	1	M		Unit = DT (1, UCUM, “no unit”)
10	>>	CONTAINS	NUM	EV (122453, DCM, “Last Chord of Abnormal Region”)	1	M		Unit = DT (1, UCUM, “no unit”)
11	>	CONTAINS	CONTAINER	EV (122417, DCM, “Regional Abnormal Wall Motion ”)	1-4	U		
12	>>	HAS CONCEPT MOD	CODE	EV (G-C03E, SRT, “Finding Site”)	1	M		DCID (3461) Regional Extent
13	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122459, DCM, “Territory Region Severity”) $ModType = EV (F-32050, SRT, “Cardiac Wall Motion”) $ModValue = DCID (3703) Wall Motion $Unit = DT ({sd}, UCUM, “Standard Deviations”)
14	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122461, DCM, “Opposite Region Severity”) $ModType = EV (F-32050, SRT, “Cardiac Wall Motion”) $ModValue = DCID (3703) Wall Motion $Unit = DT ({sd}, UCUM, “Standard Deviations”)
15	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 4	Normalized lengths of the chords determined between ED and ES contour. The measurement template allows the specification of the statistical properties of the normal population and of the chord measurement relative to the population.
Row 8	If the Circumferential Extent is not specified no limitations to the boundaries for regions are assumed.
Row 11	The Regional Abnormal Wall Motion container holds the information on the severity of the decreased or increased wall motion of the 4 predefined regions as described in [Sheehan, 1986].
Row 12	The name of the region with an abnormal ventricular wall motion as described in [Sheehan, 1986].
Row 13	The severity of the wall motion abnormality expressed in Standard Deviations above or below normal in the territory region as described in [Sheehan, 1986].
Row 14	The severity of the wall motion abnormality expressed in Standard Deviations above or below normal in the opposite region as described in [Sheehan, 1986].
Row 15	Secondary Capture image with centerline analysis result

TID 3210 Radial Based Wall Motion Template

The Radial Based Wall Motion Template consists of a CONTAINER providing measurements of the radial based wall motion.

Type: Extensible

TID 3210
RADIAL BASED WALL MOTION

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, “Procedure Reported”)	1	M		EV (122493, DCM, “Radial Based Wall Motion Analysis”)
3	>	HAS CONCEPT MOD	CODE	EV (122410, DCM, “Contour Realignment”)	1	M		DCID (3458) Contour Realignment
4	>	CONTAINS	CONTAINER	EV (121070, DCM, “Findings”)	1-n	M		
5	>>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Sites”)	1	M		DCID (3718) Myocardial Wall Segments in Projection
6	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122495, DCM, “Regional Contribution to Ejection Fraction”) $Unit = DT (%, UCUM, “%”)
7	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	U		$Measurement = EV (122496, DCM, “Radial Shortening”) $Unit = DT (%, UCUM, “%”)
8	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 6	The CREF values of the 6 regions determined for the radial based wall motion
Row 7	The shortening of the measured radials within the region
Row 8	Secondary Capture image with radial based analysis result

TID 3211 Landmark Based Wall Motion Template

The Landmark Based Wall Motion Template consists of a CONTAINER providing measurements of the landmark based wall motion.

Type: Extensible

TID 3211
LANDMARK BASED WALL MOTION

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (121058, DCM, “Procedure Reported”)	1	M		EV (122497, DCM, “Landmark Based Wall Motion Analysis”)
4	>>	HAS CONCEPT MOD	CODE	EV (122410, DCM, “Contour Realignment”)	1	M		DCID (3458) Contour Realignment
3	>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	M		$Measurement = EV (122498, DCM, “Slice Contribution to Ejection Fraction”) $Unit = DT (%, UCUM, “%”)
4	>	CONTAINS	CONTAINER	EV (121070, DCM, “Findings”)	5	M		
5	>>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Sites”)	1	M		DCID (3718) Myocardial Wall Segments in Projection
6	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122495, DCM, “Regional Contribution to Ejection Fraction”) $Unit = DT (%, UCUM, “%”)
7	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 7	Secondary Capture image with Landmark Based Analysis result

QUANTITATIVE ARTERIAL ANALYSIS REPORT SR IOD TEMPLATES

The templates that comprise the Quantitative Arterial Analysis SR are interconnected as in Figure A-X.1:

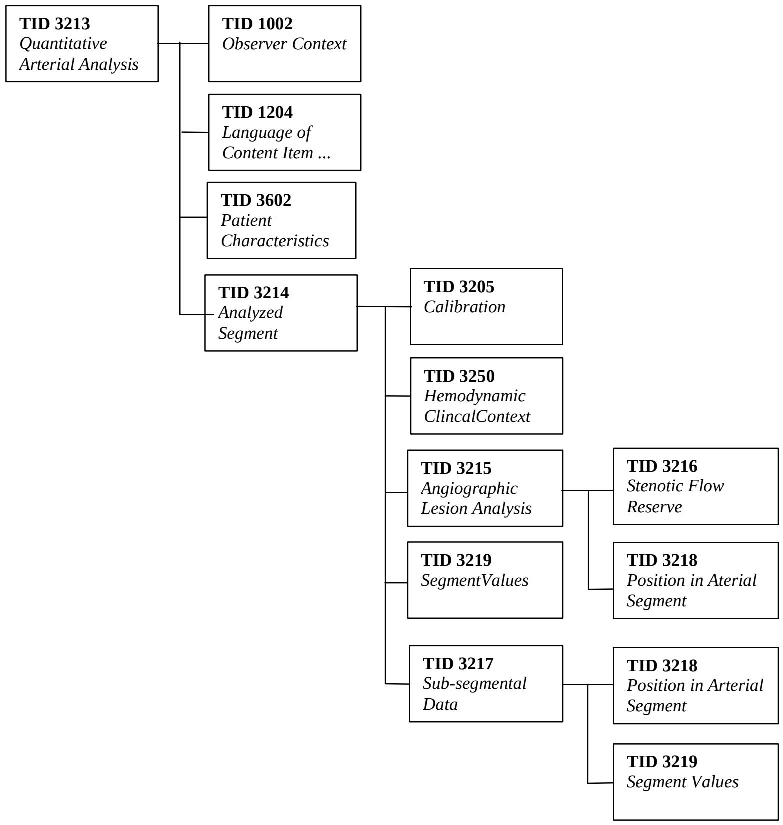


Figure A-X.2: Quantitative Arterial Analysis Report SR IOD Template Structure

TID 3213 Quantitative Arterial Analysis Template

The Quantitative Arterial Analysis Template consists of a CONTAINER with a structure for reporting the result of the quantitative arterial analysis process.

Type: Extensible

TID 3213
QUANTITATIVE ARTERIAL ANALYSIS

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (122291, DCM, “Quantitative Arteriography Report”)	1	M		
2	>	HAS CONCEPT MOD	INCLUDE	DTID (1204) Language Of Content Item And Descendants	1	M		
3	>	HAS OBS CONTEXT	INCLUDE	DTID (1002) Observer Context	1	M		
4	>	CONTAINS	INCLUDE	DTID (3602) Patient Characteristics	1	U		

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
5	>	HAS OBS CONTEXT	TEXT	EV (111001, DCM, “Algorithm Name”)	1	M		
6	>	HAS OBS CONTEXT	TEXT	EV (111003, DCM, “Algorithm Version”)	1	M		
7	>	HAS OBS CONTEXT	TEXT	EV (122405, DCM, “Algorithm Manufacturer”)	1	M		
8	>	CONTAINS	INCLUDE	DTID (3214) Analyzed Segment	1-n	M		

Content Item Descriptions

Row 5	Identifies the Arterial Analysis program
Row 6	Identifies the Arterial Analysis program version
Row 7	Identifies the Arterial Analysis program manufacturer

TID 3214 Analyzed Segment Template

The Analyzed Segment Template consists of a CONTAINER providing quantitative arterial analysis measurements derived from the angiographic images.

Type: Extensible

**TID 3214
ANALYZED SEGMENT**

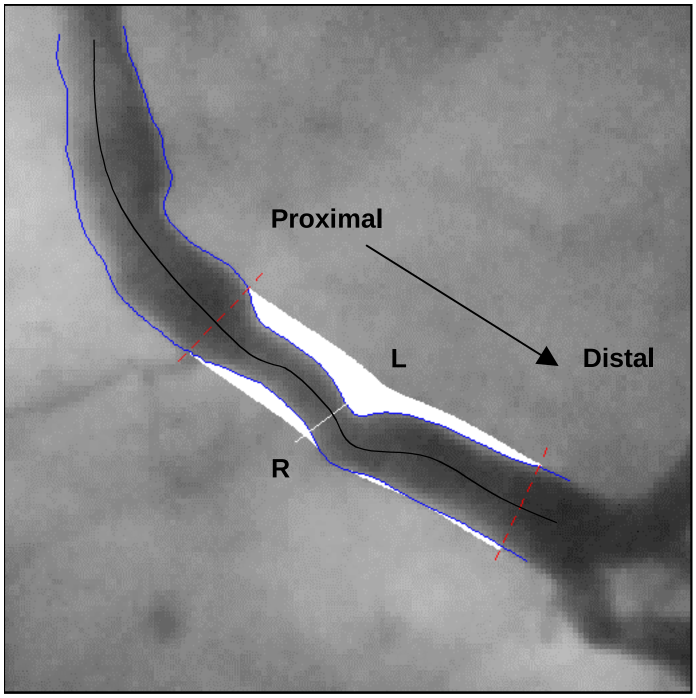
	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Site”)	1	M		DCID (3604) Arterial lesion locations
3	>	CONTAINS	IMAGE	EV (121112, DCM, “Source of Measurements”)	1	M		
4	>	CONTAINS	INCLUDE	DTID (3205) Calibration	1	M		
5	>	HAS ACQ CONTEXT	INCLUDE	DTID 3520 Hemodynamic Clinical Context	1	U		
6	>	CONTAINS	SCOORD	EV (122507, DCM, “Left Contour”)	1	M		GRAPHIC TYPE = POLYLINE
7	>>	R-SELECTED FROM	IMAGE		1	M		Must reference Row 3
8	>	CONTAINS	SCOORD	EV (122508, DCM, “Right Contour”)	1	M		GRAPHIC TYPE = POLYLINE
9	>>	R-SELECTED FROM	IMAGE		1	M		Must reference Row 3
10	>	CONTAINS	INCLUDE	DTID (3219) Segment Values	1	M		
11	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation = (R-404FB, SRT, “Minimum”) $Unit = DT (mm, UCUM, “mm”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
12	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation =(G-A437, SRT, “Maximum”) $Unit = DT (mm, UCUM, “mm”)
13	>	CONTAINS	CONTAINER	EV (122509, DCM, “Diameter Graph”)	1	U		
14	>>	CONTAINS	NUM	EV (122511, SUP76, “Graph Increment”)	1	M		Value = 1 Units = DT ({pixels}, UCUM, “pixels”)
15	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Unit = DT (mm, UCUM, “mm”)
16	>	CONTAINS	NUM	EV (122382, DCM, “Site of Luminal Minimum ”)	1	U		Units = DT ({pixels}, UCUM, “pixels”)
17	>	CONTAINS	NUM	EV (122516, DCM, “Site of Luminal Maximum”)	1	U		Units = DT ({pixels}, UCUM, “pixels”)
18	>	CONTAINS	INCLUDE	DTID (3215) Angiographic Lesion Analysis	1-n	U		
19	>	CONTAINS	INCLUDE	DTID (3217) Sub-Segmental Data	1-n	U		
20	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 1	Observation DateTime (0040,A032) of container needs to be flagged with the time of the analysis
Row 6	Numeric coordinates (x,y) identifying the contour points from proximal to distal of left contour. Left is relative to the direction of the blood flow.
Row 8	Numeric coordinates (x,y) identifying the contour points from proximal to distal of right contour. Right is relative to the direction of the blood flow.
Row 11,12	Positions are relative to the midpoint between the first left and right contour points and measured along the midline between the left and right contour.
Row 13	The X-axis exists of the pixel points of the midline of the vessel from proximal to distal. The points on the midline are not necessarily equidistant.
Row 15	For each point of the midline of the vessel a measurement value for the diameter is calculated.
Row 16,17	The positions in the graph are related to the points on the midline of the vessel.
Row 20	Secondary Capture image with Arterial Analysis contour.

Definition of Left and Right defined by the direction of the blood flow:



TID 3215 Angiographic Lesion Analysis Template

The Angiographic Lesion Analysis Template consists of a CONTAINER providing quantitative arterial analysis measurements derived for an obstruction in a total analyzed segment.

Type: Extensible

TID 3215
ANGIOGRAPHIC LESION ANALYSIS

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (F-00585, SRT, “Lesion Finding”)	1	M		
2	>	CONTAINS	TEXT	EV (121151, DCM, “Lesion Identifier”)	1	M		
3	>>	HAS PROPERTIES	CODE	EV (G-C0E3, SRT, “Finding Site”)	1	M		DCID (3604) Arterial lesion locations
4	>>>	HAS CONCEPT MOD	CODE	EV (G-A1F8, SRT, “Topographical modifier”)	1	U		DCID (3019) Cardio-vascular Anatomic Location Modifiers
5	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation =(R-404FB, SRT, “Minimum”) $Unit = DT (mm, UCUM, “mm”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
6	>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	U		$Measurement = EV (G-0366, SRT, “Vessel Lumen Cross-Sectional Area”) $Method = DCID (3470) Vessel Lumen Cross-Sectional Area Calculation Methods $Derivation =(R-404FB, SRT, “Minimum”) $Unit = DT (mm2, UCUM, “mm^2”)
7	>	CONTAINS	CODE	EV (122430, DCM, “Reference Method”)	1	M		DCID (3465) QA Reference Method
8	>	CONTAINS	NUM	EV (122337, DCM, “Relative Position”)	1-n	U		$Unit = DT (mm, UCUM, “mm”)
9	>>	HAS PROPERTIES	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Unit = DT (mm, UCUM, “mm”)
10	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $TargetSite = (122382, DCM, ”Site of Luminal Minimum”) $Unit = DT (mm, UCUM, “mm”)
11	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (G-0366, SRT, “Vessel Lumen Cross-Sectional Area”) $Derivation = EV (122404, DCM, “Reconstructed”) $TargetSite = (122382, DCM, ”Site of Luminal Minimum”) $Unit = DT (mm2, UCUM, “mm^2”)
12	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation = EV (R-41D2D, SRT, “Calculated”) $TargetSite =EV (122481, DCM, “Contour Start”) $Unit = DT (mm, UCUM, “mm”)
13	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation = EV (R-41D2D, SRT, “Calculated”) $TargetSite = EV (122482, DCM, “Contour End”) $Unit = DT (mm, UCUM, “mm”)
14	>	CONTAINS	INCLUDE	DTID (3218) Position in Arterial Segment	1	M		
15	>	CONTAINS	CONTAINER	EV (122517, DCM, “Densitometrical Luminal Cross-sectional Area Graph”)	1	U		
16	>>	CONTAINS	NUM	EV (122511, SUP76, “Graph Increment”)	1	M		Value = 1 Units = DT ({pixels}, UCUM, “pixels”)
17	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	U		$Measurement = EV (G-0366, SRT, ”Vessel Lumen Cross-Sectional Area”) $Unit = (mm2, UCUM, “mm^2”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
18	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (G-0366, SRT, “Vessel Lumen Cross-Sectional Area”) $Derivation = EV (R-41D2D, SRT, “Calculated”) $TargetSite =EV (122481, DCM, “Contour Start”) $Unit = (mm2, UCUM, “mm^2”)
19	>>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (G-0366, SRT, “Vessel Lumen Cross-Sectional Area”) $Derivation = EV (R-41D2D, SRT, “Calculated”) $TargetSite = EV (122482, DCM, “Contour End”) $Unit = (mm2, UCUM, “mm^2”)
20	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (R-101BC, SRT, “Lesion Length”) $Unit = DT (mm, UCUM, “mm”)
21	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (R-101BB, SRT, “Lumen Diameter Stenosis”) $Unit = DT (%, UCUM, “%”)
22	>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	U		$Measurement = EV (R-101BA, SRT, “Lumen Area Stenosis”) $Method = DCID (3470) Vessel Lumen Cross-Sectional Area Calculation Methods $Unit = DT (%, UCUM, “%”)
23	>	CONTAINS	INCLUDE	DTID (300) Measurement	1-n	U		$Measurement = EV (122372, DCM, “Lumen Volume”) $Method = DCID (3470) Vessel Lumen Cross-Sectional Area Calculation Methods $Unit = DT (mm3, UCUM, “mm^3”)
24	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122542, DCM, “Plaque Area”) $Unit = DT (mm2, UCUM, “mm^2”)
25	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122376, DCM, “Total Plaque Volume”) $Unit = DT (mm3, UCUM, “mm^3”)
26	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122544, DCM, “Diameter Symmetry”) $Unit = DT ({ratio}, UCUM, “ratio”)
27	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122545, DCM, “Area Symmetry”) $Unit = DT ({ratio}, UCUM, “ratio”)
28	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122546, DCM, “Inflow Angle”) $Unit = DT (deg, UCUM, “degrees”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
29	>	CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122547, DCM, “Outflow Angle”) $Unit = DT (deg, UCUM, “degrees”)
30	>	CONTAINS	INCLUDE	DTID (3216) Stenotic Flow Reserve	1	U		
31	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 8	User defined reference position for method that requires local reference position.
Row 9	Diameter at a local reference position.
Row 10	The reference diameter for the arterial lesion calculated with the applicable reference method
Row 11	The reference area for the arterial lesion calculated with the applicable reference method
Row 12	The diameter measurement at the start of the reconstruction line in the diameter graph (3214)
Row 13	The diameter measurement at the end of the reconstruction line in the diameter graph (3214)
Row 14	The positions of the lesion, borders of the lesion, etc.
Row 15	The graph with the calculated cross sectional area results based on the densitometric method
Row 17	The cross sectional area measurements calculated based on the densitometric method
Row 18	The cross sectional area measurement at the start of the reconstruction line in the area graph
R0w 19	The cross sectional area measurement at the end of the reconstruction line in the area graph
Row 20	Measured along the midline of the left and right contour
Row 21	The diameter stenosis is calculated as follows: (Reference Luminal Diameter – Minimum Luminal Diameter / Reference Luminal Diameter) * 100%
Row 22	The circular and the densitometric area stenosis are calculated respectively as: (Reference Vessel Lumen Cross-Sectional Area – Minimum Luminal Circular Area / Reference Vessel Lumen Cross-Sectional Area) * 100% (Reference Vessel Lumen Cross-Sectional Area – Minimum Luminal Densitometric Area / Reference Vessel Lumen Cross-Sectional Area) * 100%
Row 23	Estimated lumen volume between proximal border and distal border of lesion (TID 3218, row 1 and 2)
Row 31	Secondary Capture image with obstruction analysis contour

TID 3216 Stenotic Flow Reserve Template

The Obstruction Template consists of a CONTAINER providing quantitative arterial analysis measurements derived for an obstruction in a total analyzed segment.

Type: Extensible

TID 3216
STENOTIC FLOW RESERVE

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122548, DCM, “Stenotic Flow Reserve”) $Unit = DT ({ratio}, UCUM, “ratio”)
2		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122549, DCM, “Poiseuille Resistance”) $Unit = DT (mm[Hg]s/cm, UCUM, “mmHGs/cm”)

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
3		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122550, DCM, “Turbulence Resistance”) $Unit = DT (mm[Hg]s2/cm2, UCUM, “mmHGs^2/cm^2”)
4		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122555, DCM, “Estimated Normal Flow”) $Unit = DT (ml/s, UCUM, “ml/s”)
5		CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (122551, DCM, “Pressure Drop at SFR”) $Unit = DT (mm[Hg], UCUM, “mmHg”)
6		CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 6	Secondary Capture image with SRF analysis contour

TID 3217 Sub-segmental Data Template

The Sub-segmental Data Template consists of a CONTAINER providing quantitative arterial analysis measurements derived for a sub-segment in a total analyzed segment.

Type: Extensible

TID 3217
SUB-SEGMENTAL DATA

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			CONTAINER	EV (121070, DCM, “Findings”)	1	M		
2	>	HAS CONCEPT MOD	CODE	EV (G-C0E3, SRT, “Finding Site”)	1	M		DCID (3604) Arterial lesion locations
3	>>	HAS CONCEPT MOD	CODE	EV (G-A1F8, SRT, “Topographical modifier”)	1	U		DCID (3019) Cardio-vascular Anatomic Location Modifiers
4	>	CONTAINS	CODE	EV (122554, DCM, “Segmentation Method”)	1	M		DCID (3456) Sub-segment Methods
5	>	CONTAINS	INCLUDE	DTID (3469) Segment Values	1	U		
6	>	CONTAINS	INCLUDE	DTID (3218) Position in Arterial Segment	1	M		
7	>	CONTAINS	IMAGE	No purpose of reference	1	U		

Content Item Descriptions

Row 7	Secondary Capture image with obstruction analysis contour

TID 3218 Position in Arterial Segment

The Position in Arterial Segment Template consists of the position content items common for the Angiographic Lesion Analysis and Sub-Segmental Data.

Type: Extensible

TID 3218
POSITION IN ARTERIAL SEGMENT

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122528, DCM, “Position of Proximal Border”) $Unit = DT (mm, UCUM, “mm”)
2		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122529, DCM, “Position of Distal Border”) $Unit = DT (mm, UCUM, “mm”)
3		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122382, DCM, “Site of Luminal Minimum”) $Unit = DT (mm, UCUM, “mm”)
4		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122516, DCM, “Site of Luminal Maximum”) $Unit = DT (mm, UCUM, “mm”)
5		CONTAINS	NUM	EV (122528, DCM, “Position of Proximal Border”)	1	UC		Units = DT ({pixels}, UCUM, “pixels”)
6		CONTAINS	NUM	EV (122529, DCM, “Position of Distal Border”)	1	UC		Units = DT ({pixels}, UCUM, “pixels”)
7		CONTAINS	NUM	EV (122382, DCM, “Site of Luminal Minimum”)	1	UC		Units = DT ({pixels}, UCUM, “pixels”)
8		CONTAINS	NUM	EV (122516, DCM, “Site of Luminal Maximum”)	1	UC		Units = DT ({pixels}, UCUM, “pixels”)

Content Item Descriptions

Row 1,2,3,4	Positions are relative to the midpoint of the first left and right contour points and measured along the midline of the left and right contour
Row 5,6,7,8	The positions are relative to the measurement locations of the Diameter Graph of TID 3214 row 13.

TID 3219 Segment Values Template

The Segment Values Template consists of content items providing quantitative arterial analysis measurements for a total analyzed segment or sub segment.

Type: Extensible

TID 3219
SEGMENT VALUES

	NL	Rel with Parent	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (122510, DCM, “Length Luminal Segment”) $Unit = DT (mm, UCUM, “mm”)
2		CONTAINS	INCLUDE	DTID (300) Measurement	2	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation = (R-404FB, SRT, “Minimum”) $Unit = DT (mm, UCUM, “mm”)
3		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation =(G-A437, SRT, “Maximum”) $Unit = DT (mm, UCUM, “mm”)
4		CONTAINS	INCLUDE	DTID (300) Measurement	1	M		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation = R-00317, SRT, “Mean”) $Unit = DT (mm, UCUM, “mm”)
5		CONTAINS	INCLUDE	DTID (300) Measurement	1	U		$Measurement = EV (G-0364, SRT, “Vessel Luminal Diameter”) $Derivation = R-10047, SRT, “Standard Deviation”) $Unit = DT (mm, UCUM, “mm”)

Content Item Descriptions

Row 1	Measured along the midline of the left and right contour.

Change the following context groups from Annex B

Annex B DCMR Context Groups (Normative)

CID 3718 MYOCARDIAL WALL SEGMENTS IN PROJECTION

This context group specifies the left ventricular myocardial wall segments as seen in typical right anterior oblique (RAO) and left anterior oblique (LAO) angiographic projections.

Context ID 3718
Myocardial Wall Segments in Projection
Type: Extensible Version: 20040614

Coding Scheme Designator	Code Value	Code Meaning
SRT	T-32619	left ventricle basal anterior segment
SRT	T-32634	myocardium of anterolateral region
SRT	T-32636	myocardium of apex of heart
SRT	T-32632	myocardium of diaphragmatic region
SRT	T-32615	left ventricle basal inferior segment
SRT	T-32603	left ventricle basal lateral segment
SRT	T-32633	myocardium of posterolateral region
SRT	T-32637	myocardium of inferolateral region
SRT	T-32614	left ventricle apical septal segment
SRT	T-32601	left ventricular basal septal segment
SRT	**R-101C0**	**left ventricular posterobasal segment**

Add the following context groups to Annex B

CID 3451 CALIBRATION OBJECTS

Context ID 3451
Calibration Objects
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	A-26800	Catheter
SRT	A-10141	Measuring Ruler
DCM	122485	Sphere

CID 3452 CALIBRATION METHODS

Context ID 3452
Calibration Methods
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122486	Geometric Isocenter
DCM	122487	Geometric Non-Isocenter
DCM	122488	Calibration Object Used

CID 3453 VOLUME METHODS

Context ID 3453
Volume Methods
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122558	Area Length Kennedy
DCM	122559	Area Length Dodge
DCM	122560	Area Length Wynne
DCM	122562	Multiple Slices
DCM	122563	Boak
DCM	122564	TS Pyramid
DCM	122565	Two Chamber
DCM	122566	Parallelepiped

CID 3455 INDEX METHODS

Context ID 3455
Index Methods
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
LN	8277-6	BSA
DCM	122572	BSA^1.219

CID 3456 SUB-SEGMENT METHODS

Context ID 3456
Sub-Segment Methods
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122574	Equidistant method
DCM	122575	User selected method

CID 3458 CONTOUR REALIGNMENT

Context ID 3458
Contour Realignment
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122475	Center of Gravity
DCM	122476	Long Axis Based
DCM	122477	No Realignment

CID 3460 CIRCUMFERENTIAL EXTENT

Context ID 3460
Circumferential Extent
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122464	LAD Region in RAO Projection
DCM	122465	RCA Region in RAO Projection

CID 3461 REGIONAL EXTENT

Context ID 3461
Regional Extent
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122466	Single LAD Region in RAO Projection

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122467	Single RCA Region in RAO Projection
DCM	122468	Multiple LAD Region in RAO Projection
DCM	122469	Multiple RCA Region in RAO Projection
DCM	122470	LAD Region in LAO Projection
DCM	122471	RCA Region in LAO Projection
DCM	122472	CFX Region in LAO Projection

CID 3462 CHAMBER IDENTIFICATION

Context ID 3462
Chamber Identification
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	T-32600	Left Ventricle
SRT	T-32500	Right Ventricle
SRT	T-32300	Left Atrium
SRT	T-32200	Right Atrium

CID 3465 QA REFERENCE METHODS

Context ID 3465
QA Reference Methods
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122489	Curve Fitted Reference
DCM	122490	Interpolated Local Reference
DCM	122491	Mean Local Reference

CID 3466 PLANE IDENTIFICATION

Context ID 3466
Plane Identification
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	R-10218	Right Anterior Oblique

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	R-10220	Left Anterior Oblique
SRT	R-10206	Antero-posterior
SRT	R-10236	Left Lateral
SRT	R-101C3	Cranial LAO
SRT	R-101C5	Cranial RAO
SRT	R-101C4	Caudal LAO
SRT	R-101C6	Caudal RAO

CID 3467 EJECTION FRACTION

Context ID 3467
Ejection Fraction
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
LN	8808-8	Left Ventricular Ejection Fraction by Angiography
LN	8815-3	Right Ventricular Ejection Fraction by Angiography
DCM	122406	Left Atrial Ejection Fraction by Angiography

CID 3468 ED VOLUME

Context ID 3468
ED Volume
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
LN	8821-1	Left Ventricular ED Volume
LN	8822-3	Right Ventricular ED Volume
DCM	122407	Left Atrial ED Volume

CID 3469 ES VOLUME

Context ID 3469
ES Volume
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
LN	8823-7	Left Ventricular ES Volume

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
LN	8824-5	Right Ventricular ES Volume
DCM	122408	Left Atrial ES Volume

CID 3470 VESSEL LUMEN CROSS-SECTIONAL AREA CALCULATION METHODS

Context ID 3470
Vessel Lumen Cross-Sectional Area Calculation Methods
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	122473	Circular method
DCM	122474	Densitometric method

CID 3471 ESTIMATED VOLUMES

Context ID 3471
Estimated Volumes
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121216	Volume estimated from single 2D region
DCM	121218	Volume estimated from two non-coplanar 2D regions

CID 3472 CONTRACTION PHASE

Context ID 3472
Contraction Phase
Type: Extensible Version: 20040614

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	F-32020	Systolic
DCM	F-32010	Diastolic

Add the following Definitions to Annex D

Annex D DICOM Controlled Terminology Definitions (Normative)

DICOM Code Definitions (Coding Scheme Designator “DCM” Coding Scheme Version “01”)

Code Value	Code Meaning	Definition	Notes
122404	Reconstructed	Value estimated for a vessel in the absence of a stenosis	
122405	Algorithm Manufacturer	Manufacturer of application used	
122406	Left Atrial Ejection Fraction by Angiography	Left Atrial Ejection Fraction by Angiography	
122407	Left Atrial ED Volume	Left Atrial End Diastolic Volume	
122408	Left Atrial ES Volume	Left Atrial End Systolic Volume	
122410	Contour Realignment	Contour repositioning of End Diastolic relative to End Systolic contour	
122411	Threshold Value	The minimum standard deviation to define the hypokinesis and hyperkinesis	
122417	Regional Abnormal Wall Motion	Report of differentiation of wall motion compared to normal	
122421	Calibration Object	Object used for Calibration	
122422	Calibration Method	Method used for Calibration	
122423	Calibration Object Size	Size of calibration object	
122428	Area Length Method	Method how long axis is positioned	
122429	Volume Method	Model for ventricular volume calculation	
122430	Reference Method	Method to define original diameter of the artery	
122431	Regression Slope ED	Relation between calculated End Diastolic volume and ventricular End Diastolic volume. The specific meaning is dependent on volume method used.	
122432	Regression Offset ED	Correction factor for the calculated End Diastolic volume and ventricular End Diastolic volume. The specific meaning is dependent on volume method used.	
122433	Regression Slope ES	Relation between calculated End Systolic volume and ventricular End Systolic volume. The specific meaning is dependent on volume method used.	
122434	Regression Offset ES	Correction factor for the calculated End Systolic volume and ventricular End Systolic volume. The specific meaning is dependent on volume method used.	

122435	Regression Volume Exponent	Exponent of volume in regression formula	
122445	Wall Thickness	Average thickness of the chamber wall in the current view	
122446	Wall Volume	Volume of the chamber wall estimated from the current view	
122447	Wall Mass	Mass of the chamber wall	
122448	Wall Stress	Peak systolic stress of chamber wall	
122449	Centerline Wall Motion Analysis	Method to calculate wall motion [example: Sheehan, 1986]	
122450	Normalized Chord Length	The length between End Diastolic and End Systolic contour perpendicular on the centerline normalized by a method dependent ventricular perimeter length. The centerline is the line equidistant between the End Diastolic and End Systolic contour [example: Sheehan, 1986]	
122451	Abnormal Region	The report of the boundaries of the abnormal (hyperkinetic, hypokinetic, a-kinetic) regions associated with the territory of the artery [example: Sheehan, 1986]	
122452	First Chord of Abnormal Region	The chord number specifying the begin of abnormal region [example: Sheehan, 1986]	
122453	Last Chord of Abnormal Region	The chord number specifying the end of abnormal region [example: Sheehan, 1986]	
122459	Territory Region Severity	Severity at the regional abnormality extent [example: Sheehan, 1986]	
122461	Opposite Region Severity	Severity at the opposite regional abnormality extent [example: Sheehan, 1986]	
122464	LAD Region in RAO Projection	Based on a total number of chords of 100 and RAO project the range of chords belonging to this circumferential extent lies between 5 – 85. [Sheehan, 1986]	
122465	RCA Region in ROA Projection	Based on a total number of chords of 100 and RAO project the range of chords belonging to this circumferential extent lies between 25 – 85. [Sheehan, 1986]	
122466	Single LAD Region in RAO Projection	Based on a total number of chords of 100 and RAO projection the range of chords belonging to this regional extent lies between 10 – 66 (hypokinetic) and 67 – 80 (hyperkinetic). [Sheehan, 1986]	
122467	Single RCA Region in RAO Projection	Based on a total number of chords of 100 and RAO projection the range of chords belonging to this regional extent lies between 51 – 80 (hypokinetic) and 10 – 50 (hyperkinetic). [Sheehan, 1986]	

122468	Multiple LAD Region in RAO Projection	Based on a total number of chords of 100 and RAO projection the range of chords belonging to this regional extent lies between 10 – 58 (hypokinetic) and 59 –80 (hyperkinetic). [Sheehan, 1986]	
122469	Multiple RCA Region in RAO Projection	Based on a total number of chords of 100 and RAO projection the range of chords belonging to this regional extent lies between 59 – 80 (hypokinetic) and 10 – 58 (hyperkinetic). [Sheehan, 1986]	
122470	LAD Region in LAO Projection	Based on a total number of chords of 100 and LAO projection the range of chords belonging to this regional extent lies between 50 –100 (hypokinetic) and 20 – 49 (hyperkinetic). [Sheehan, 1986]	
122471	RCA Region in LAO Projection	Based on a total number of chords of 100 and LAO projection the range of chords belonging to this regional extent lies between 19 – 67 (hypokinetic) and 68 – 100 (hyperkinetic). [Sheehan, 1986]	
122472	CFX Region in LAO Projection	Based on a total number of chords of 100 and LAO projection the range of chords belonging to this regional extent lies between 38 –74 (hypokinetic) and 75 – 100 (hyperkinetic). [Sheehan, 1986]	
122473	Circular Method	Method based on assumption that the image object is circular.	
122474	Densitometric Method	Method based on the gray value distribution of the image.	
122475	Center of Gravity	End Systolic contour realigned to End Diastolic contour based on the center of gravity	
122476	Long Axis Based	End Systolic contour realigned to End Diastolic contour based on the mid point of the long axis. The long axis end points are defined as the posterior and apex.	
122477	No Realignment	No Contour Realignment applied	
122480	Vessel Lumen Cross-Sectional Area	Calculated Vessel Lumen Cross-Sectional Area based on the referenced method	
122481	Contour Start	Location of the beginning of a contour	
122482	Contour End	Location of the end of a contour	
122485	Sphere	Sphere is used as calibration object	
122486	Geometric Isocenter	Object of interest in isocenter of image and pixel separation is calculated from geometric data	
122487	Geometric Non-Isocenter	Object of interest not in isocenter of image and pixel separation is calculated from geometric data and out of isocenter distances	
122488	Calibration Object Used	Object used for calibration (e.g. sphere)	

122489	Curve Fitted Reference	Application dependent method to calculate the reference diameter based on the multiple diameter values.	
122490	Interpolated Local Reference	Application dependent method to calculate reference by interpolation, based on the diameter of two or more user defined reference positions.	
122491	Mean Local Reference	Application dependent method to calculate by averaging the reference, based on the diameter of one or more user defined reference positions.	
122493	Radial Based Wall Motion Analysis	Method to calculate wall motion based on the lengths of the radials in the predefined regions [Ingels]	
122495	Regional Contribution to Ejection Fraction	Contribution of Region to global Ejection factor based on radial or landmark based wall motion method	
122496	Radial Shortening	The reduction of area between End Systolic and End Diastolic based on radial wall motion analysis	
122497	Landmark Based Wall Motion Analysis	Method to calculate wall motion based on the move of landmarks on the wall [Slager]	
122498	Slice Contribution to Ejection Fraction	Contribution to the ejection fraction of a specific slice region [Slager]	
122499	Frame to Frame Analysis	Method to calculate volumes of heart chambers for every image in a range	
122505	Calibration	Procedure used to calibrate pixel size	
122507	Left Contour	Left contour of lumen (direction proximal to distal)	
122508	Right Contour	Right contour of lumen (direction proximal to distal)	
122509	Diameter Graph	Ordered set of diameters values derived from contours (direction proximal to distal)	
122510	Length Luminal Segment	Length Luminal Segment	
122511	Graph Increment	Increment value along X-axis in Diameter Graph	
122516	Site of Maximum Luminal	Location of the maximum lumen area in a lesion or vessel.	
122517	Densitometrical Luminal Cross-sectional Area Graph	Ordered set of cross-sectional Vessel Lumen Cross-Sectional Area values derived from contours (direction proximal to distal) based on densitometric method	
122528	Position of Proximal Border	Position of proximal border of segment relative to the contour start (proximal end of analysis area)	
122529	Position of Distal Border	Position of distal border of segment relative to the contour start (proximal end of analysis area)	
122542	Plaque Area	Longitudinal cross sectional area of plaque	

122544	Diameter Symmetry	Symmetry of stenosis (0 = complete asymmetry, 1 = complete symmetry) [reference PS 3.17 X.2]	
122545	Area Symmetry	Symmetry of plaque (0 = complete asymmetry, 1 = complete symmetry) [reference PS 3.17 X.2]	
122546	Inflow Angle	The average slope of the diameter function between the position of the minimum luminal diameter and the position of the proximal border of the segment	
122547	Outflow Angle	The average slope of the diameter function between the position of the minimum luminal diameter and the position of the distal border of the segment	
122548	Stenotic Flow Reserve	The relation between coronary pressure and coronary flow	
122549	Poiseuille Resistance	Poiseuille Resistance at the location of the stenosis	
122550	Turbulence Resistance	Turbulence Resistance at the location of the stenosis	
122551	Pressure Drop at SFR	Pressure drop over the stenosis at maximum heart output	
122554	Segmentation Method	Method for selection of vessel sub-segments	
122555	Estimated Normal Flow	Estimate of the volume of blood flow in the absence of stenosis	
122558	Area Length Kennedy	Area Length method defined by Kennedy [Kennedy, 1970]	
122559	Area Length Dodge	Area Length method defined by Dodge [Dodge, 1960]	
122560	Area Length Wynne	Area Length method defined by Wynne [Wynne]	
122562	Multiple Slices	Volume method based on multiple slice	
122563	Boak	Volume method defined by Boak [Boak]	
122564	TS Pyramid	Volume method defined by Ferlinz [Ferlinz]	
122565	Two Chamber	Volume method defined by Graham [Graham]	
122566	Parallelepiped	Volume method defined by Arcilla [Arcilla]	
122572	BSA^1.219	Corrected Body Surface area for indexing the hemodynamic measurements for a pediatric patient	
122574	Equidistant method	Method for selecting sub-segments that are all of the same length	
122575	User selected method	Manually selected start and end of sub-segment	
122582	Left ventricular posterobasal segment	Left ventricular posterobasal segment	

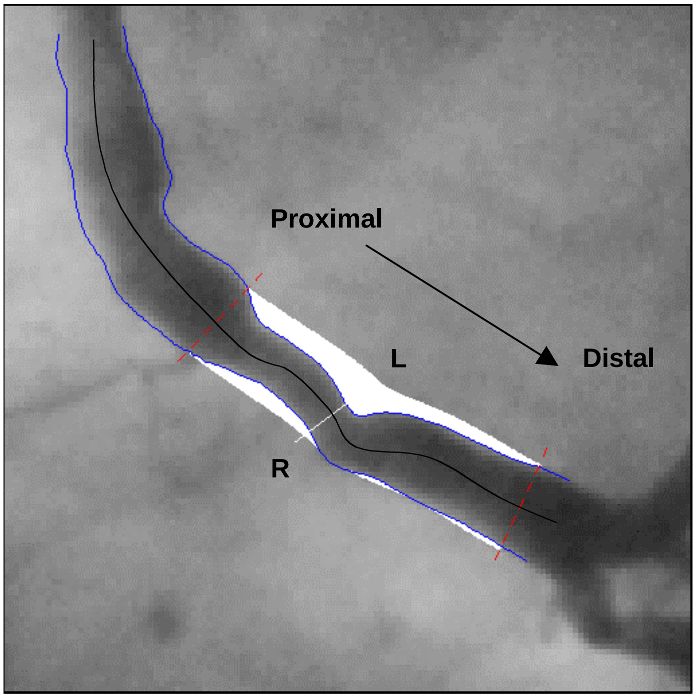
Changes to NEMA Standards Publication PS 3.17-200x

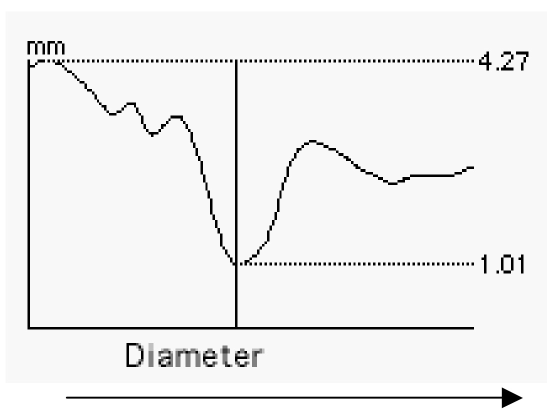
Digital Imaging and Communications in Medicine (DICOM)

Part 17: Explanatory Information

Annex X Quantitative Analysis References (Informative)

X.1 DEFINITION OF LEFT AND RIGHT IN THE CASE OF QUANTITATIVE ATERIAL ANALYISIS

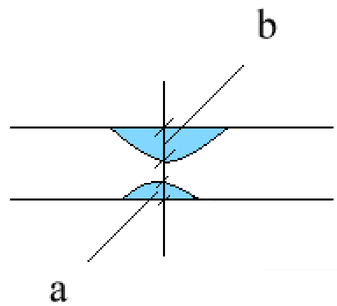




proximal **distal**

X.2 DEFINITION OF DIAMETER SYMMETRY WITH ATERIAL PLAQUES

The Diameter Symmetry of a Stenosis is a parameter determining the symmetry in arterial plaque distribution.



The Symmetry Index is defined by: **a**/**b** where **a** is smaller or equal to than **b**. **a** and **b** are measured in the reconstructed artery at the position of the minimal luminal diameter.

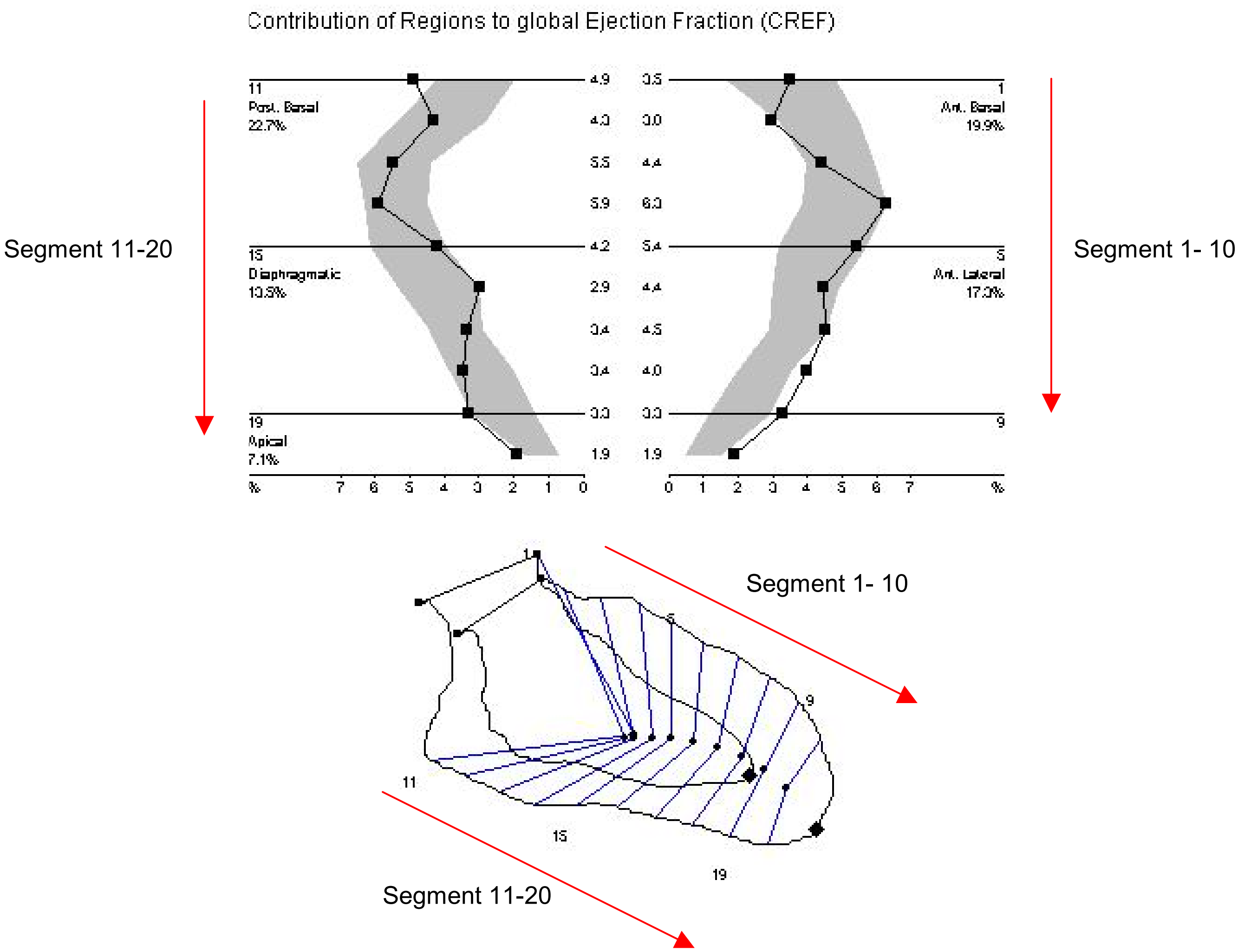
Possible values of symmetry range from 0 to 1, where 0 indicates complete asymmetry and 1 indicates complete symmetry.

Reference: Quantitative coronary arteriography; physiological aspects, page 102-103 in: Reiber and Serruys, Quantitative coronary arteriography, 1991

X.3 WALL MOTION REGIONS

X.3.1 Landmark Based Wall Motion Regions

Landmark based Wall Motion



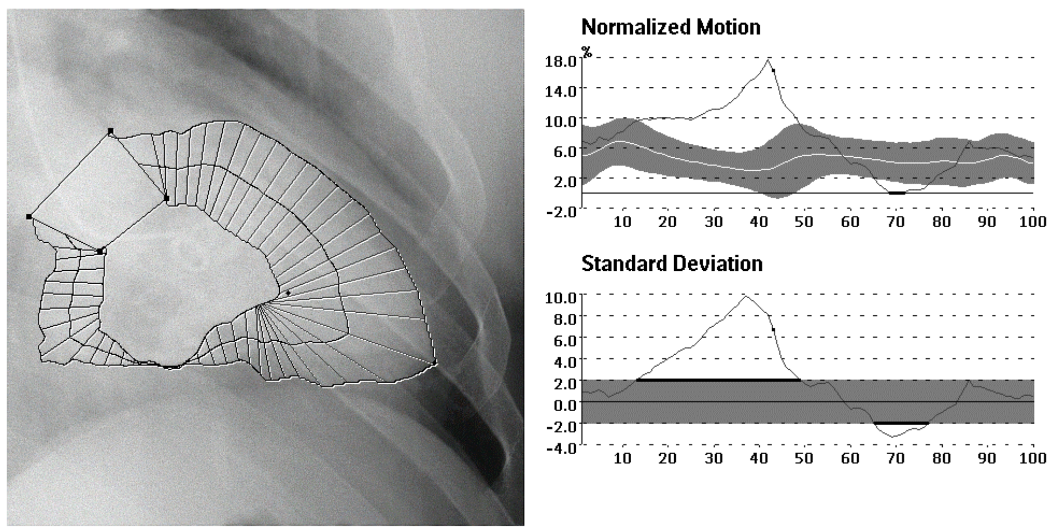
To compare the quantitative results with those provided by the usual visual interpretation, the left ventricular boundary is divided into 5 anatomical regions, denoted:

1. Anterobasal
2. Anterolateral
3. Posterobasal
4. Diaphragmatic
5. Apical

X.3.2 Centerline Wall Motion Region

660 Example of Centerline Wall Motion Template usage.

Centerline Wall Motion



Extent	LAD			RCA		
(+/- 2 sdev)	Length	Start	End	Length	Start	End
Hypokinetic	11	66	76	11	66	76
Hyperkinetic	35	14	48	24	25	48
Akinetic	3	69	71	3	69	71

Territorial (+/- 2 sdev)	Type	Severity	Opp. Type	Opp. Severity
LAD	Hyper	6.6	Hypo	3.1
RCA	Hypo	2.6	Hyper	7.6
Mult. LAD	Hyper	7.1	Hypo	2.9
Mult. RCA	Hypo	2.9	Hyper	7.1

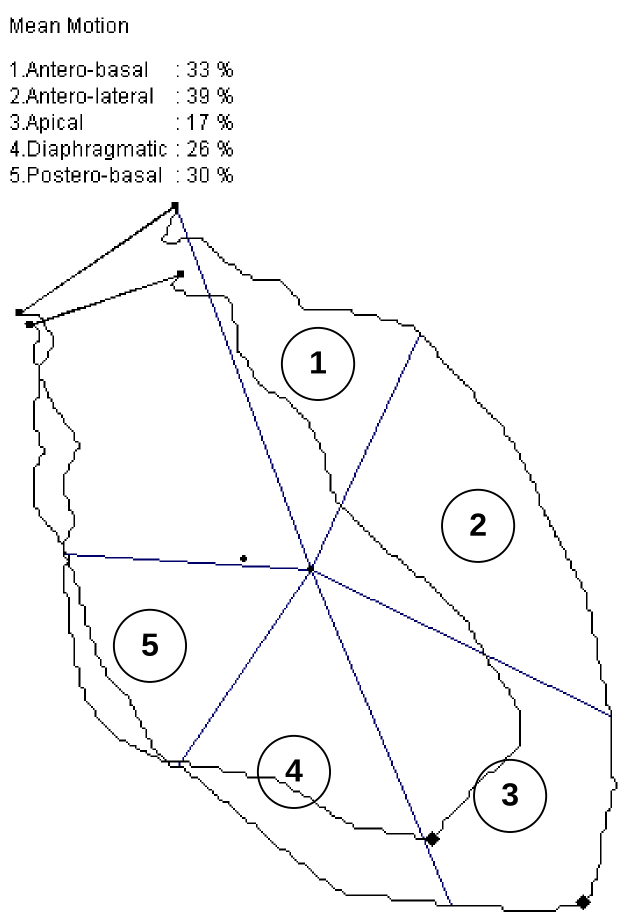
Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
X.X	Findings		
X.X.1	Procedure Reported	Centerline Wall Motion Analysis	3208
X.X.2	Contour Realignment	Center of Gravity	3208
X.X.3	Normalized Chord Length	5.0 %	300
X.X.4	Normalized Chord Length	5.1 %	300
X.X.5	Normalized Chord Length	5.3 %	300
…	…	…	…
X.X.102	Normalized Chord Length	4.5 %	300

Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
X.X.103	Threshold Value	2	3208
X.X.104	Abnormal Region		3208
X.X.104.1	Cardiac Wall Motion	Hypokinetic	3208
X.X.104.2	Circumferential Extend	LAD Region	3208
X.X.104.3	First Chord of Abnormal Region	66	3208
X.X.104.4	Last Chord of Abnormal Region	76	3208
X.X.104.5	Cardiac Wall Motion	Hypokinetic	3208
X.X.104.6	Circumferential Extend	RCA Region	3208
X.X.104.7	First Chord of Abnormal Region	66	3208
X.X.104.8	Last Chord of Abnormal Region	76	3208
X.X.104.9	Cardiac Wall Motion	Hyperkinetic	3208
X.X.104.10	Circumferential Extend	LAD Region	3208
X.X.104.11	First Chord of Abnormal Region	14	3208
X.X.104.12	Last Chord of Abnormal Region	48	3208
X.X.104.13	Cardiac Wall Motion	Hyperkinetic	3208
X.X.104.14	Circumferential Extend	RCA Region	3208
X.X.104.15	First Chord of Abnormal Region	25	3208
X.X.104.16	Last Chord of Abnormal Region	48	3208
X.X.104.17	Cardiac Wall Motion	Akinetic	3208
X.X.104.18	Circumferential Extend	LAD Region	3208
X.X.104.19	First Chord of Abnormal Region	69	3208
X.X.104.20	Last Chord of Abnormal Region	71	3208
X.X.104.21	Cardiac Wall Motion	Akinetic	3208
X.X.104.22	Circumferential Extend	RCA Region	3208
X.X.104.23	First Chord of Abnormal Region	69	3208
X.X.104.24	Last Chord of Abnormal Region	71	3208
X.X.105	Regional Abnormal Wall Motion		3208
X.X.105.1	Finding Site	Single LAD Region in RAO Projection	3208
X.X.105.2	Territory Region Severity	6.6	300
X.X.105.2.1	Cardiac Wall Motion	Hypokinetic	300
X.X.105.3	Opposite Region Severity	3.1	300
X.X.105.3.1	Cardiac Wall Motion	Hyperkinetic	300
X.X.105.4	Finding Site	Single RCA Region in RAO Projection	3208
X.X.105.5	Territory Region Severity	2.6	300
X.X.105.5.1	Cardiac Wall Motion	Hyperkinetic	300
X.X.105.6	Opposite Region Severity	7.6	300
X.X.105.6.1	Cardiac Wall Motion	Hypokinetic	300
X.X.105.7	Finding Site	Multiple LAD Region in RAO Projection	3208

Node	Code Meaning of Concept Name	Code Meaning or Example Value	TID
X.X.105.8	Territory Region Severity	7.1	300
X.X.105.8.1	Cardiac Wall Motion	Hyperkinetic	300
X.X.105.9	Opposite Region Severity	2.9	300
X.X.105.9.1	Cardiac Wall Motion	Hyperkinetic	300
X.X.105.10	Finding Site	Multiple RCA in Region RAO Projection	3208
X.X.105.11	Territory Region Severity	2.9	300
X.X.105.11.1	Cardiac Wall Motion	Hypokinetic	300
X.X.105.12	Opposite Region Severity	7.1	300
X.X.105.12.1	Cardiac Wall Motion	Hyperkinetic	300
X.X 106	…	…	3208

X.3.4 Radial Based Wall Motion Region

Radial Based Wall Motion



X.4 QUANTITATIVE ARTERIAL ANALYSIS REFERENCE METHOD

Defined Terms:

1. Computer Calculated Reference
2. Interpolated Local Reference
3. Mean Local Reference

X.4.1 Computer Calculated Reference

The computer-defined obstruction analysis calculates the reconstruction diameter based on the diameters outside the stenotic segment. This method is completely automated and user independent. The reconstructed diameter represents the diameters of the artery had the obstruction not been present.

The proximal and distal borders of the stenotic segment are automatically calculated.

The difference between the detected contour and the reconstructed contour inside the reconstructed diameter contour is considered to be the plaque.

Based on the reconstruction diameter at the Minimum Luminal Diameter (MLD) position a reference diameter for the obstruction is defined.

X.4.2 Interpolated Reference

The interpolated reference obstruction analysis calculates a reconstruction diameter for each position in the analyzed artery. This reconstructed diameter represents the diameters of the artery when no disease would be present. The reconstruction diameter is a line fitted through at least two user-defined reference markers by linear interpolation.

By default two references are used at the positions of the reference markers are automatically positioned at 5% and 95% of the artery length.

To calculate a percentage diameter stenosis the reference diameter for the obstruction is defined as the reconstructed diameter at the position of the MLD.

In cases where the proximal and distal part of the analyzed artery have a stable diameter during the treatment and long-term follow-up, this method will produce a stable reference diameter for all positions in the artery.

X.4.3 Mean Local Reference

In case of mean local reference obstruction the reference diameter will be an average of the diameters at the position of one or more the reference markers.

This method is particularly appropriate for the analysis of bifurcated arteries.

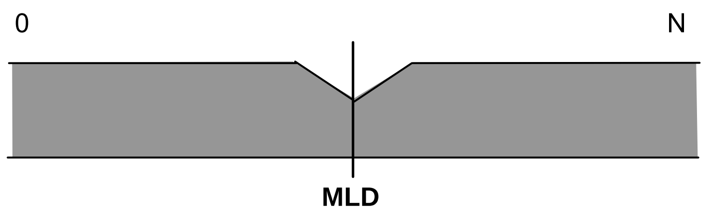
X.5 POSITIONS IN DIAMETER GRAPHIC

A vessel segment length as seen in the image is not always indicated as the same X-axis difference in the graph.

The X-axis of the graph is based on pixel positions on the midline and these points are not necessarily equidistant. This is caused by the fact that vessels do not only run perfectly horizontally or vertically, but also at angles.

When a vessel midline is covering a number of pixel positions perfectly horizontal or vertical, it will cover less space in mm compared to a vessel that covers the same number of pixel positions under an angle. When a segment runs perfectly horizontal or vertical, the segment length is equal to the amount of midline pixel points times the pixel separation (each point of the midline is separated exactly the pixel spacing in mm) and the points on the X-axis also represent exactly one pixel space. This is not the case when the vessel runs under an angle. For example an artery that is positioned at a 45 angle, the distance between two points on the midline is 0.7 times the pixel spacing.

As example, the artery consists of 10 elements (n =10); each has a length of 1mm(pixel size). If the MLD was exactly in the center of the artery you would expect the length from 0 to the MLD would be 5 sub segments long, thus 5 mm. This is true if the artery runs horizontal or vertically (assumed aspect ratio is 1).



If the artery is positioned in a 45º angle then the length of each element is √2 times the pixel size compared to the previous example. Thus the length depends on the angle of the artery.