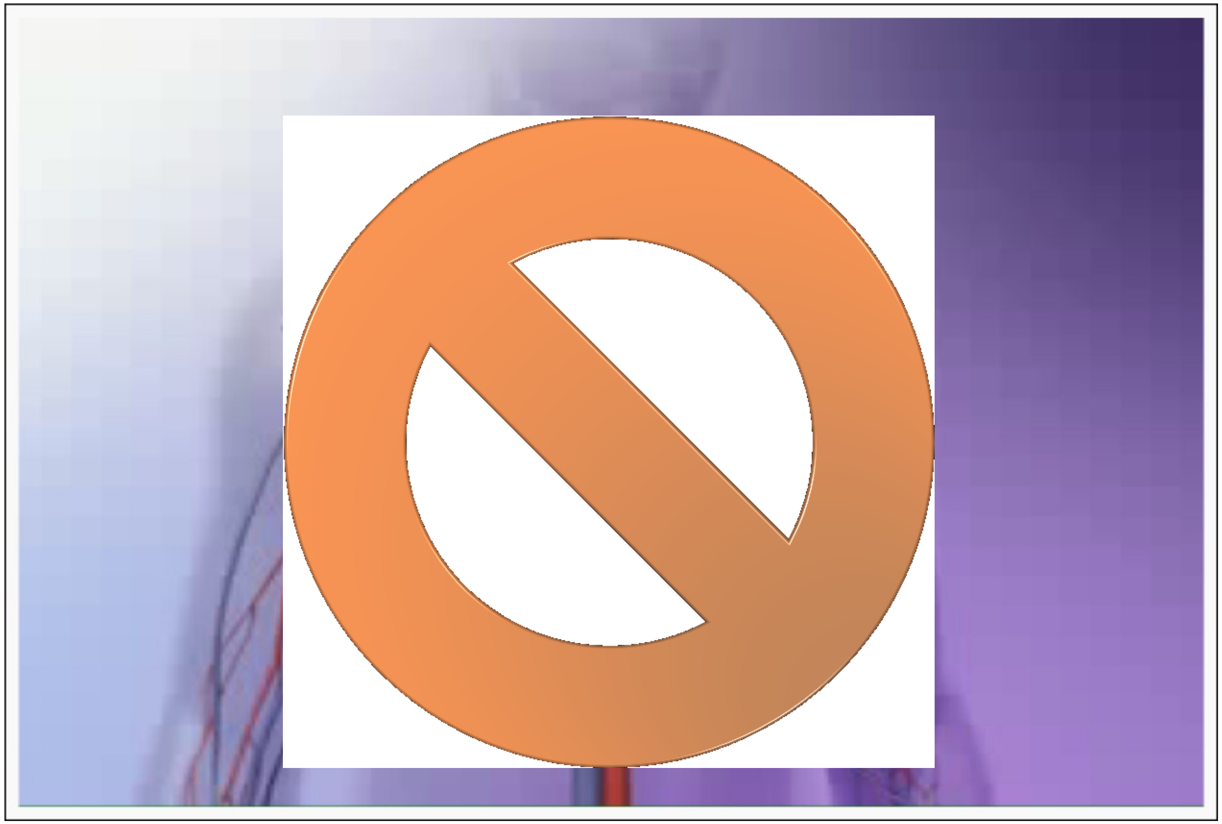
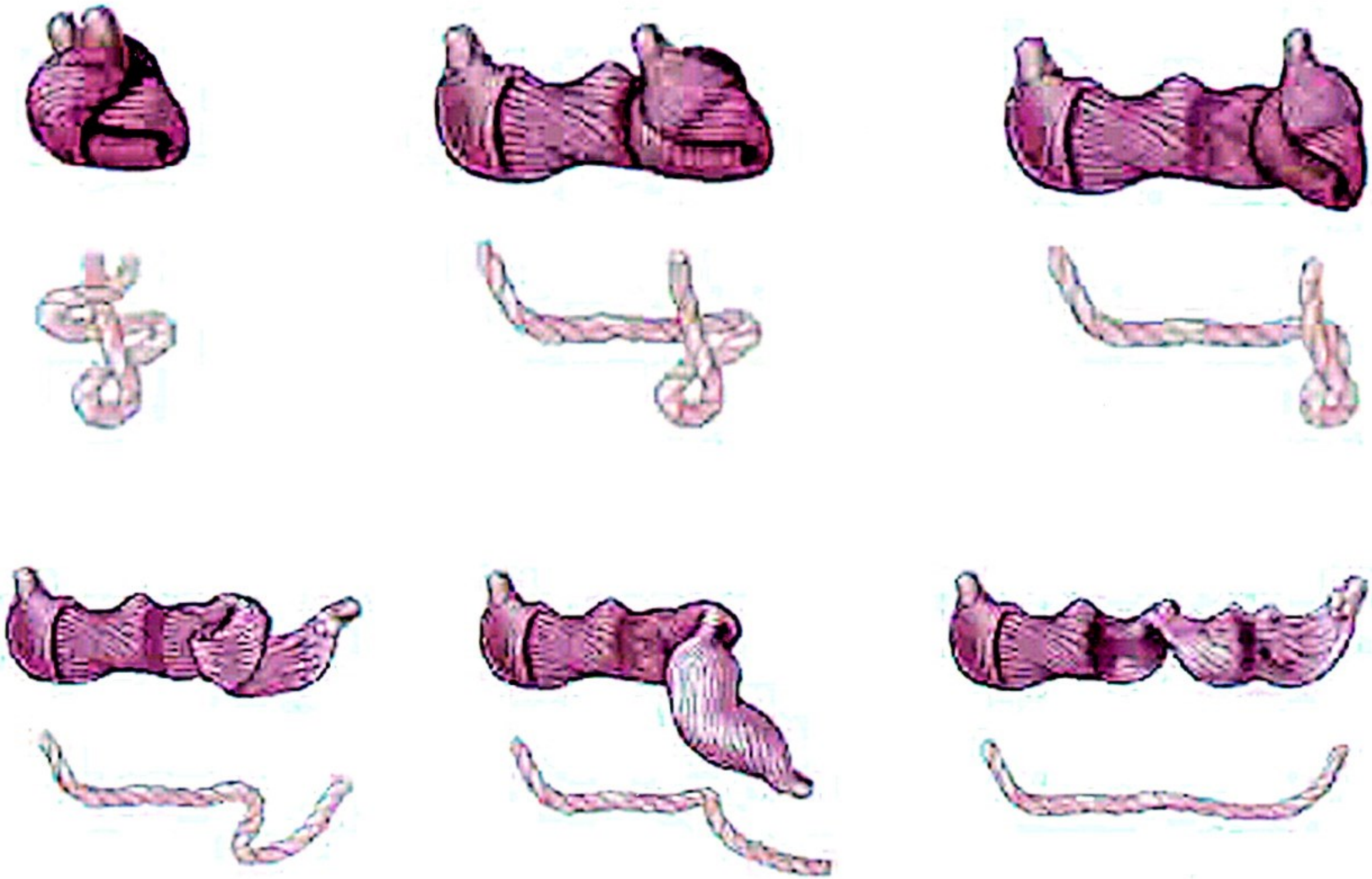
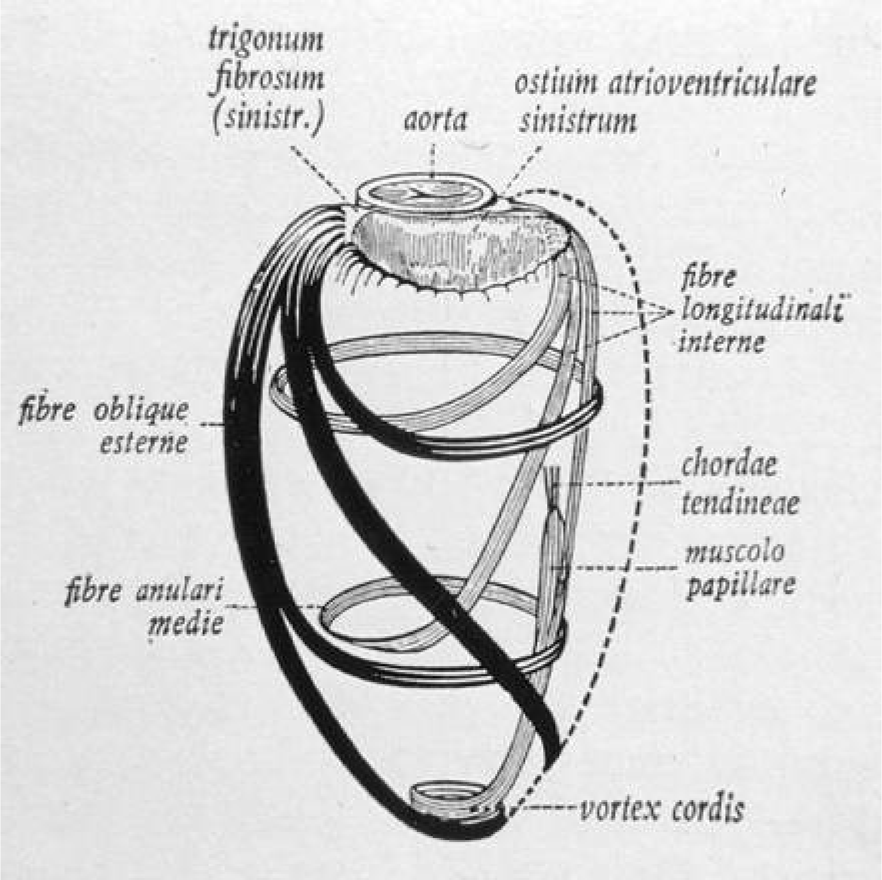
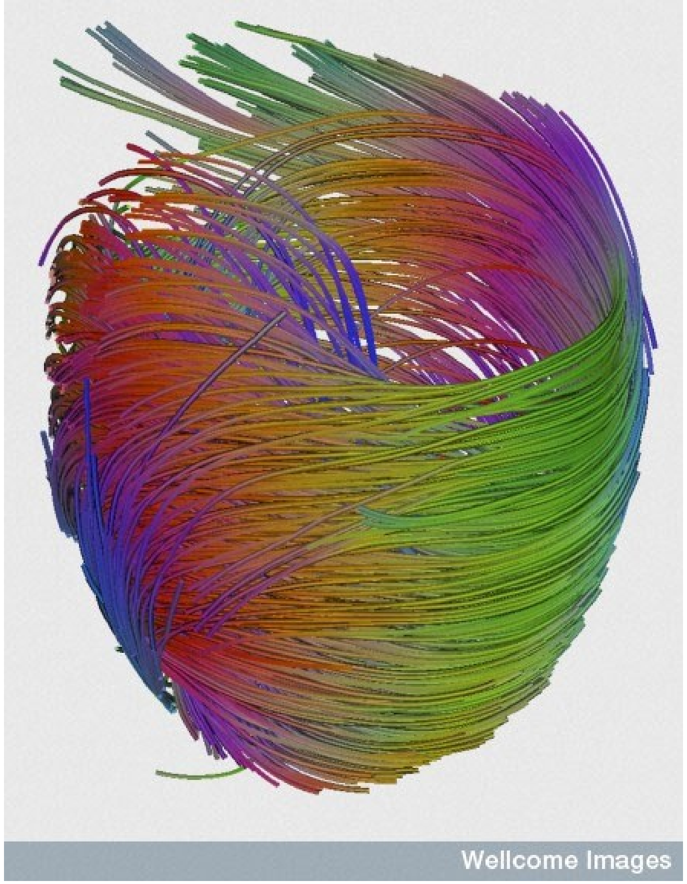
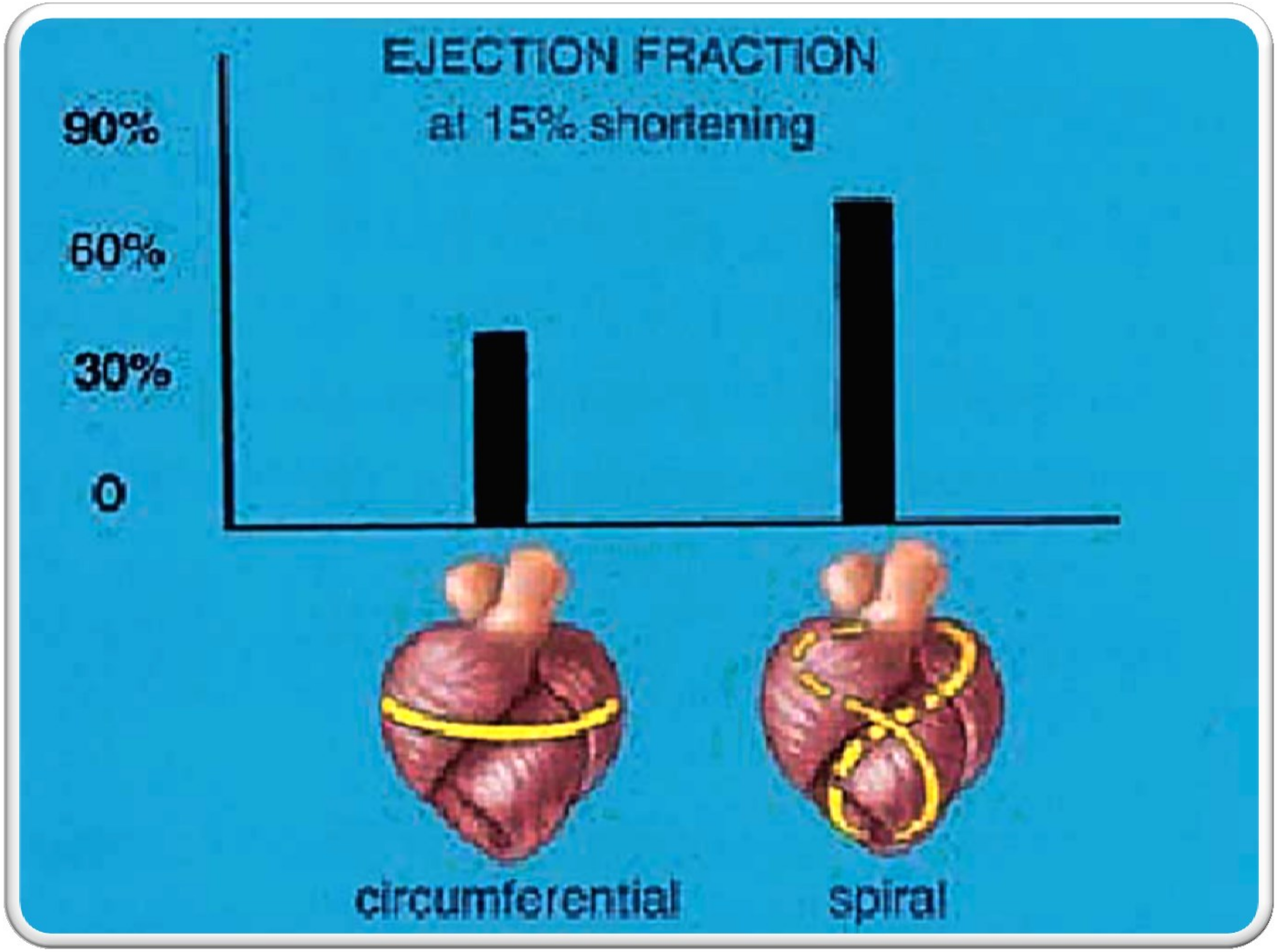
Bij hartfalen



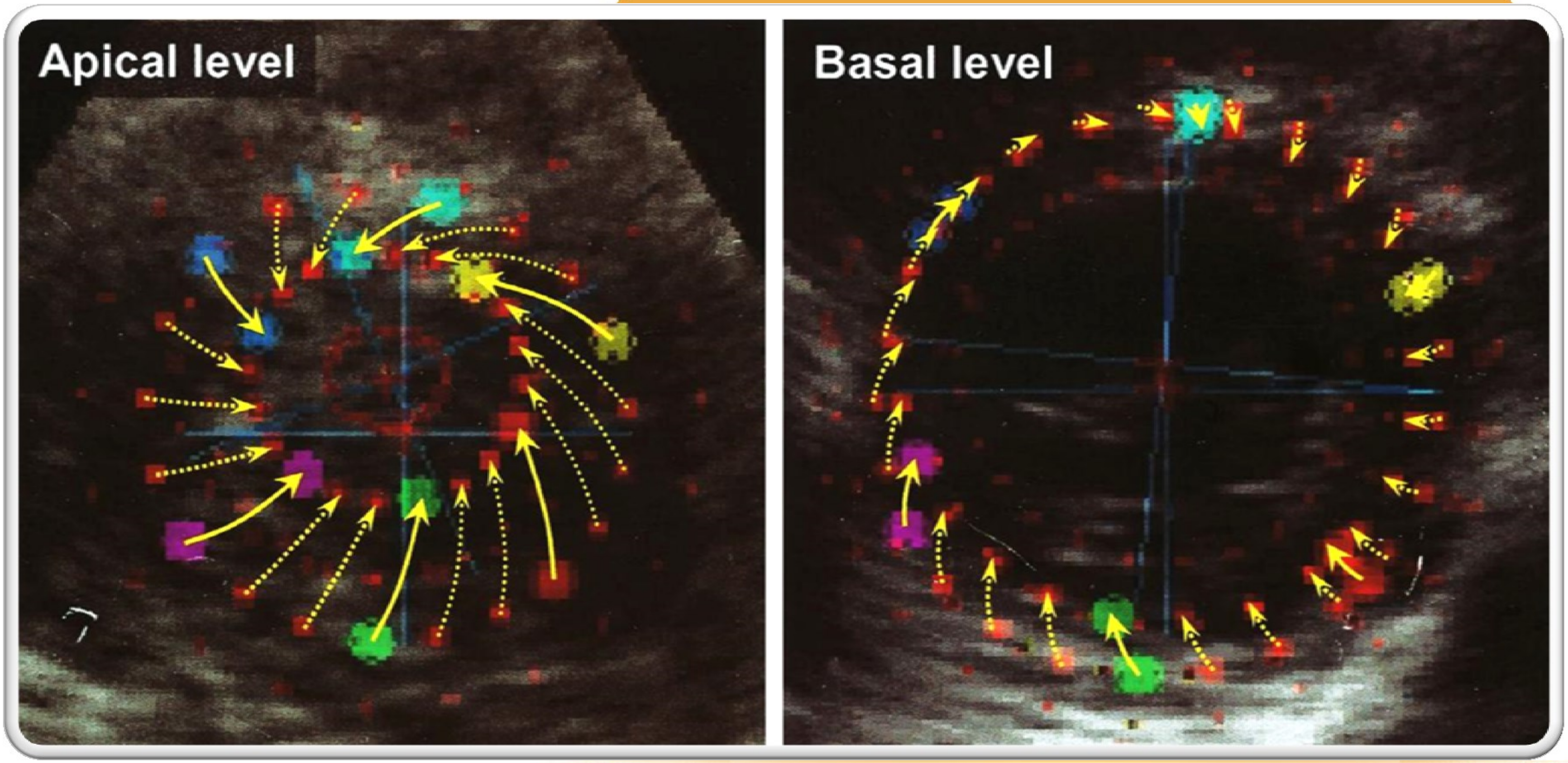



trigonum
fibrosum
(sinistr.)
aorta
ostium atrioventriculare
sinistrum
fibre
longitudinali
interne
fibre oblique
esterne
chordae
tendineae
muscolo
papillare
fibre anulari
medie
vortex cordis

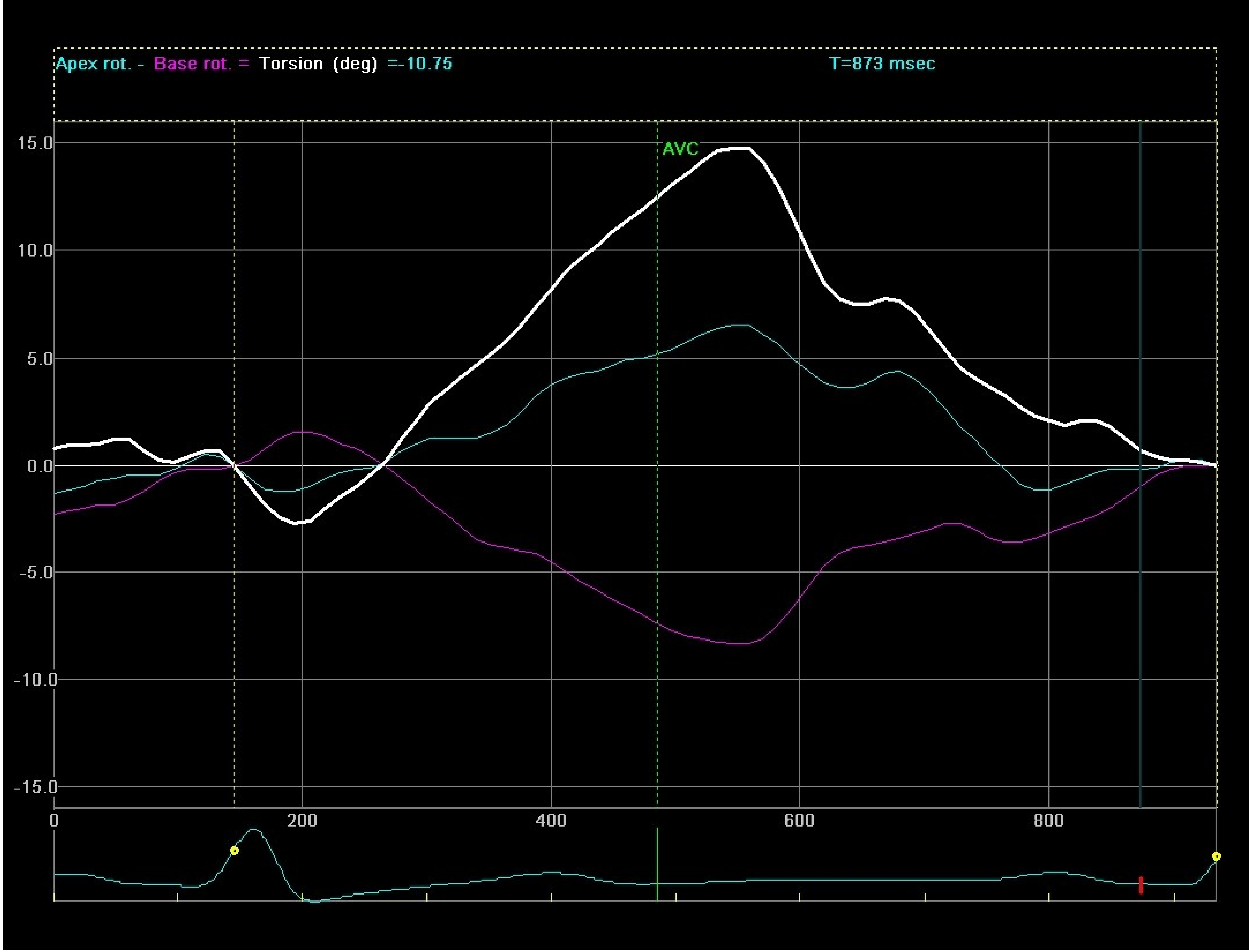

Wellcome Images



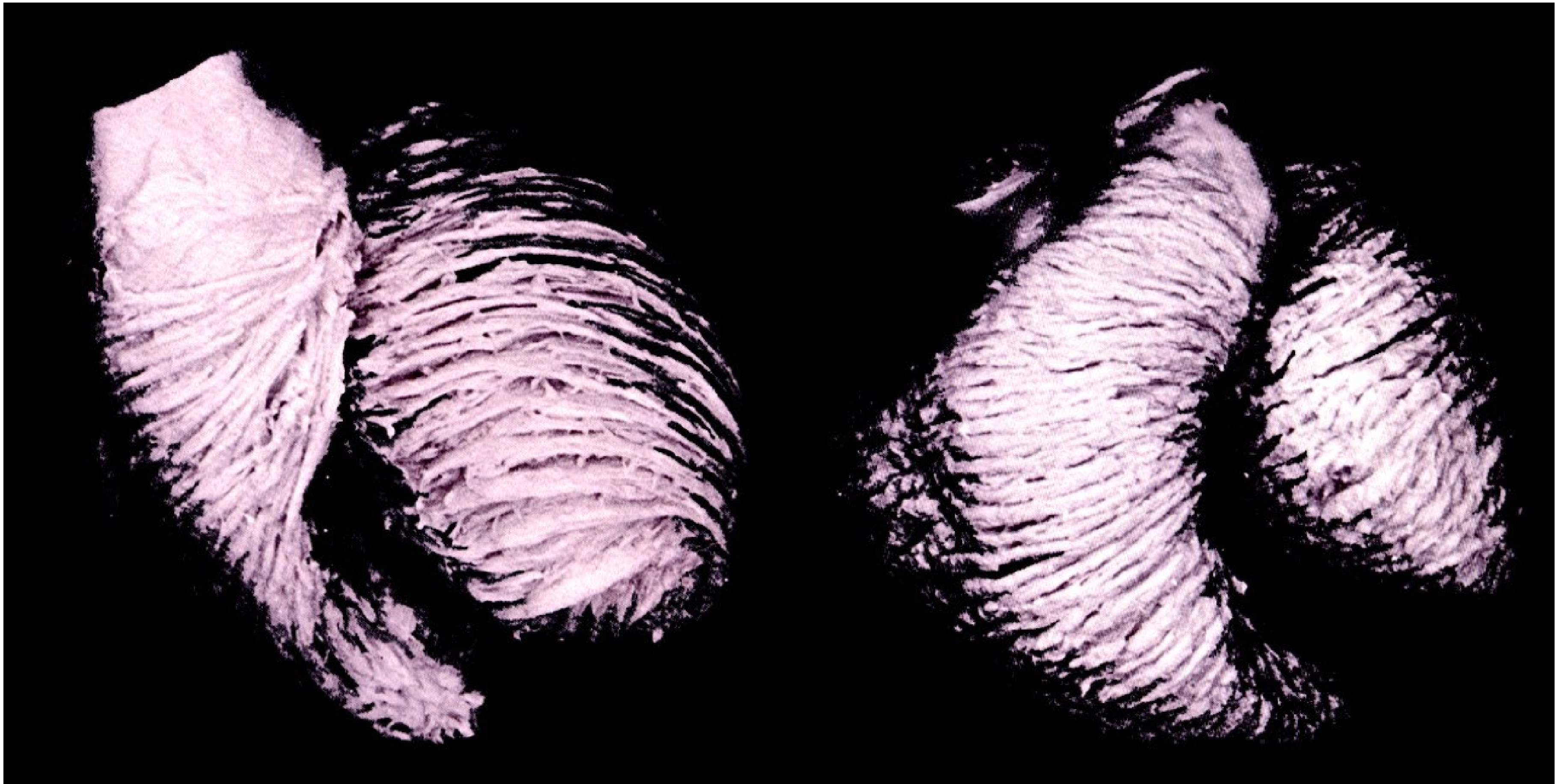
EJECTION FRACTION
at 15% shortening
90%
60%
30%
0
circumferential
spiral



Left ventricular rotation (LVrot) at apical and basal levels during systole

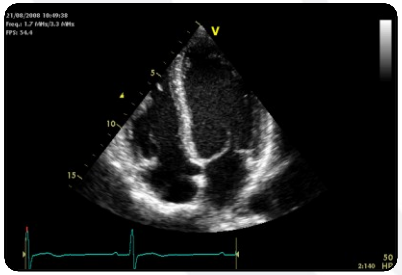


Apex rot. - Base rot. = Torsion (deg) =-10.75
T=873 msec
AVC
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
0
200
400
600
800

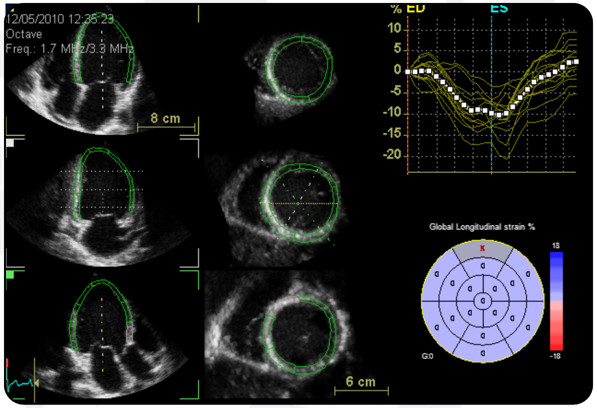


2D & 4D Quantification

Quantification Outlook



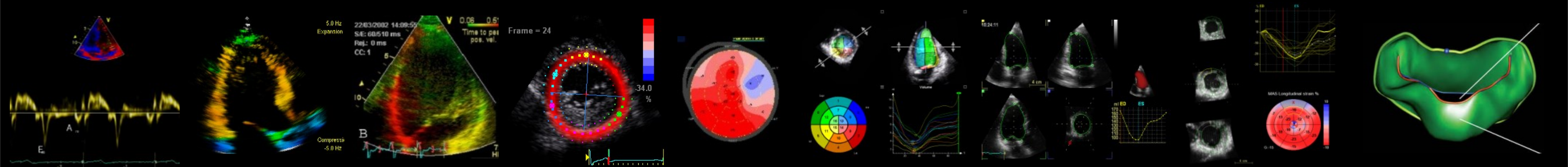
Eye-balling



Quantification

Early quantitative detection is key!

Raw Data is enabler for development of quantitative tools.



TDI ***Strain*** ***TSI*** ***2D Strain*** ***AFI*** ***4DLV Vol.*** ***4D LVQ*** ***4D Strain*** ***4D MV***

1995 *2001* *2003* *2005* *2006* *2007* *2009* *2010* *2012*

2D AutoEF

AutoEF

Automatic EF Quantification

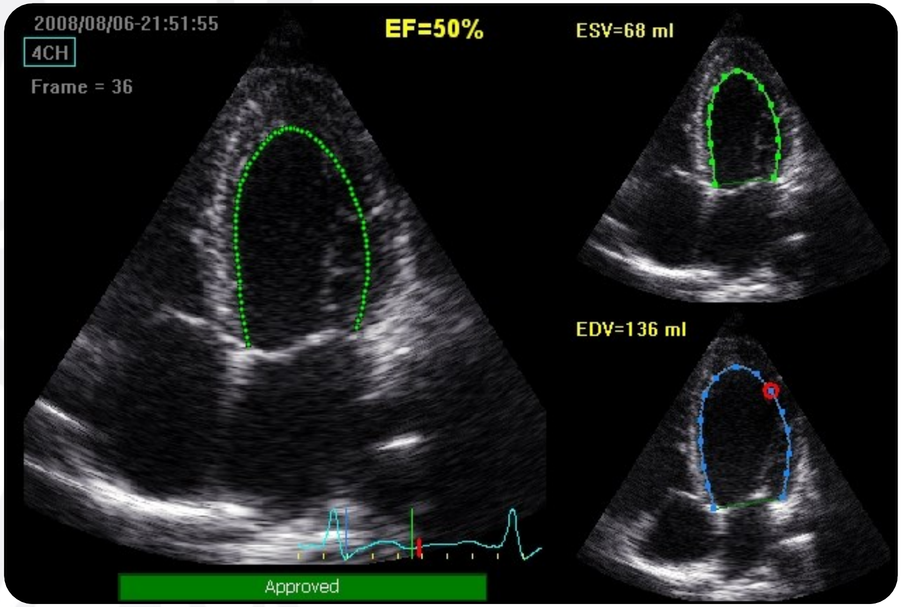
- Based on 2D Speckle tracking algorithm
- Easy to use
- Quick

Potential Benefits:

- Higher Reproducibility
- Lower Inter-observer variability

Confidence in the AutoEF algorithm:

- Based on (biplane) Simpson
- Has several inherent quality checks
- Is clinically used since > 3 years
- Last responsibility is on the user"



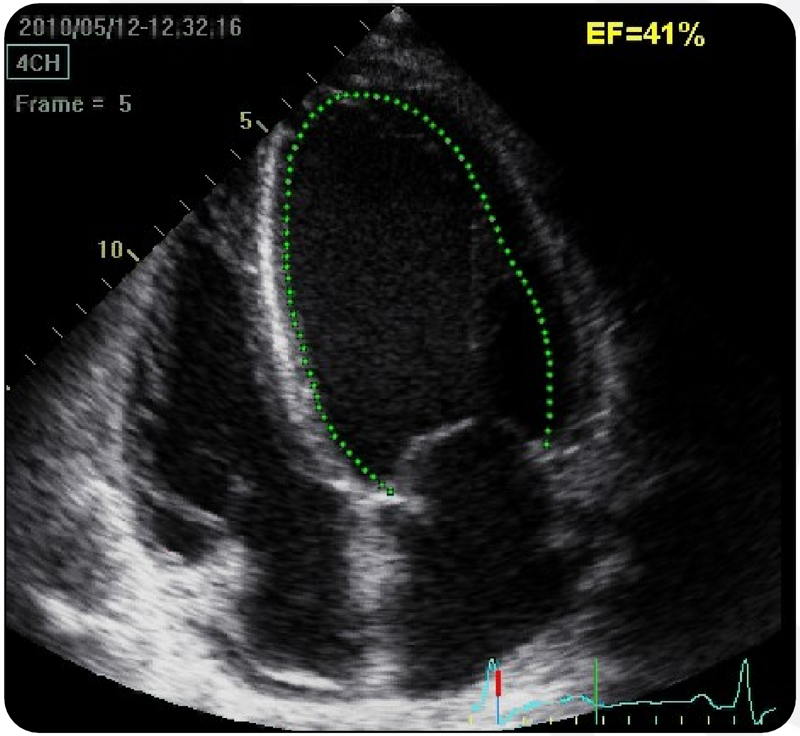
Volumes, EF
Hemodynamic values
CO, SV, HR

	4CH
HR	82.7 bpm
EF	50 %
CO	5.6 l/min
ESV	68 ml
EDV	136 ml
SV	68 ml

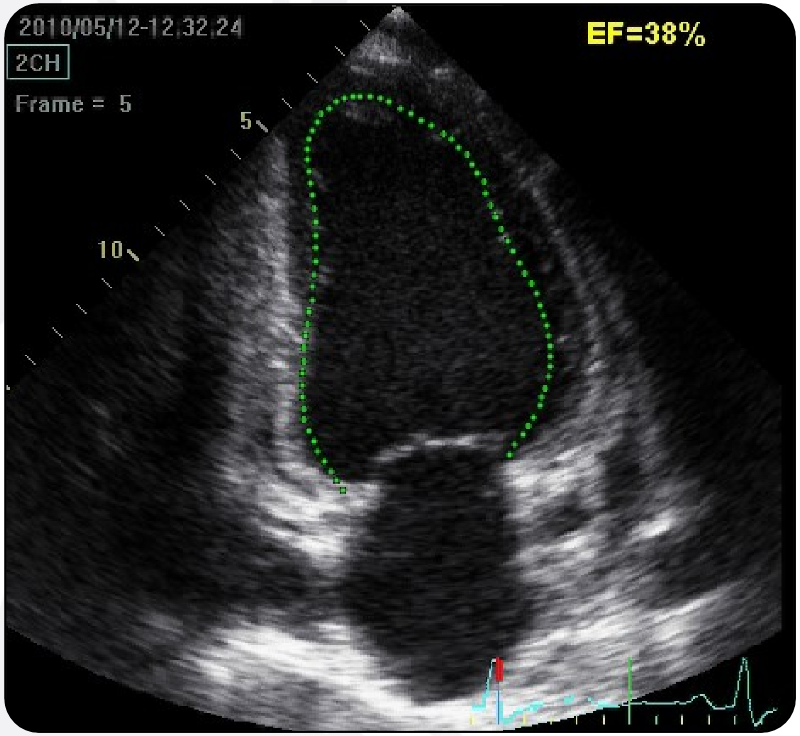
imagination at work

AutoEF

Automatic EF Quantification



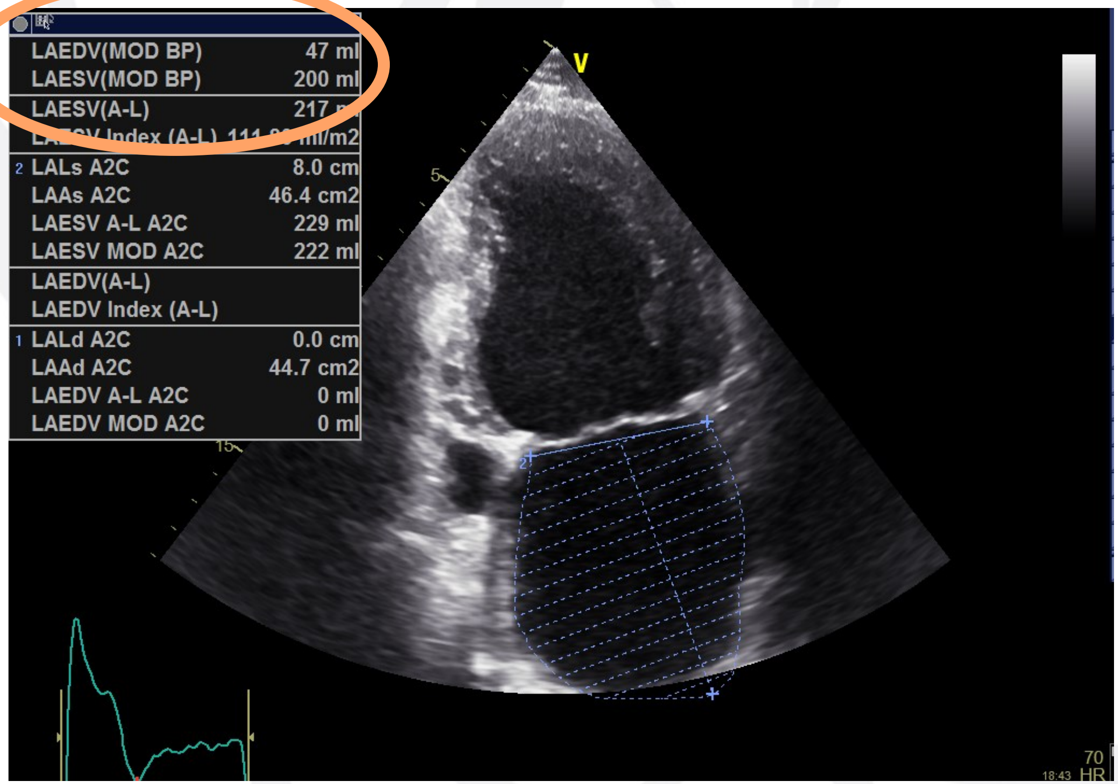
DCM A4CH



DCM A2CH

Left Atrial Volume quantification

Meeting increasing requests for more accurate LA volume quantification by supporting Biplane Simpson MOD forLA EDV and LA ESV



Note: Both ES and ED must be traced to obtain the biplane volumes.

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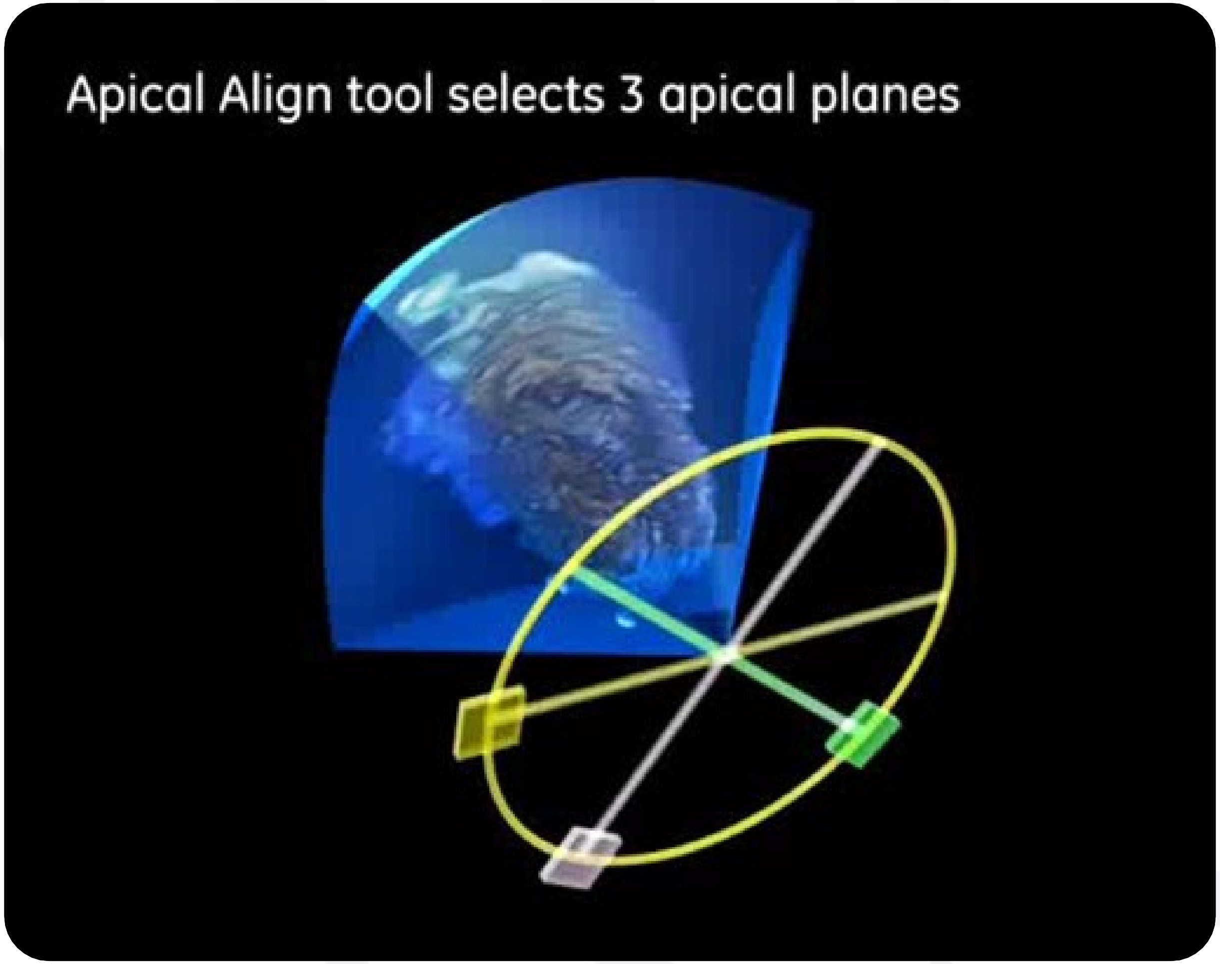
4D Auto LVQ

with Auto Alignment

Apical Alignment

Ensure accuracy for 4D LVQ, 4D LV mass & 4D Strain



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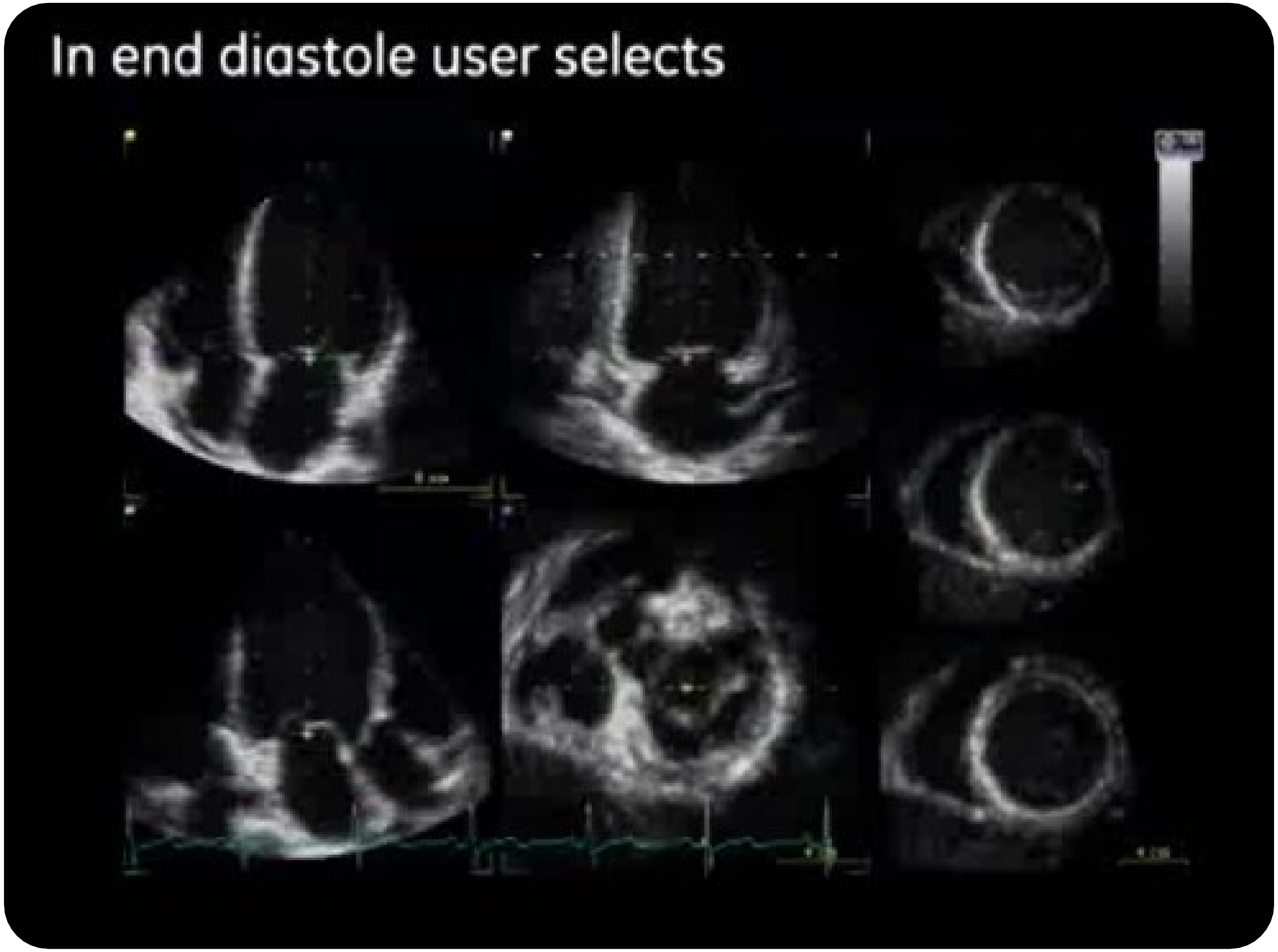
4D Auto LVQ

Mesh based surface tracking
Pure 4D utilizes temporal data for EF



imagination at work

Sphericity Index (SpI)

New measurement at ED

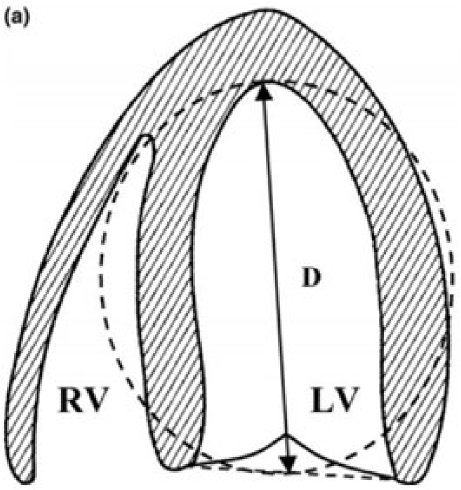
- Index for how dilated (round) the ventricle is
- Uses automatic diameter detection to make the measurement more reproducible (pat. pend.).
- Higher values are worse.

Early identification of left ventricular remodelling after myocardial infarction, assessed by transthoracic 3D echocardiography

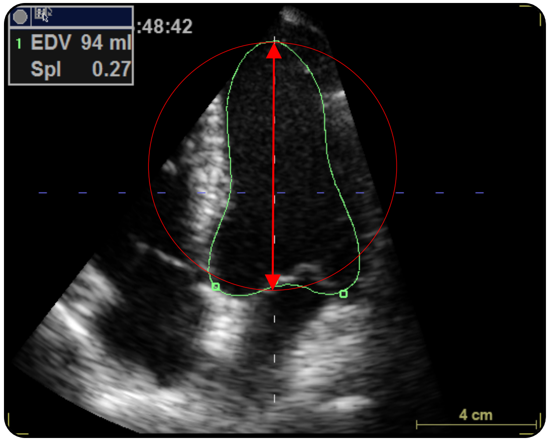
Herman F.J. Mannaerts*, Johannes A. van der Heide, Otto Kamp, Martin G. Stoel, Jos Twisk, Cees A. Visser

Department of Cardiology, VU University Medical Center, P.O. Box 7057, 1007 MB Amsterdam, The Netherlands

(a)



Cut off 0.25



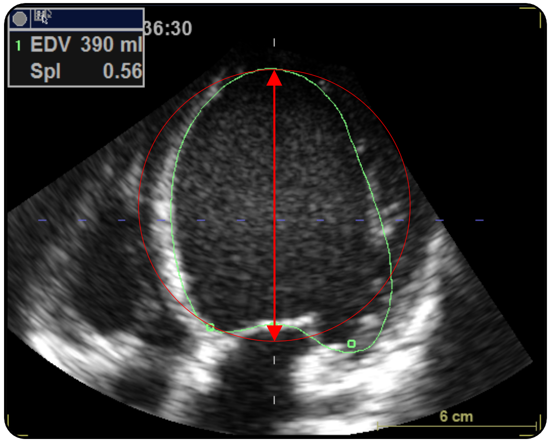
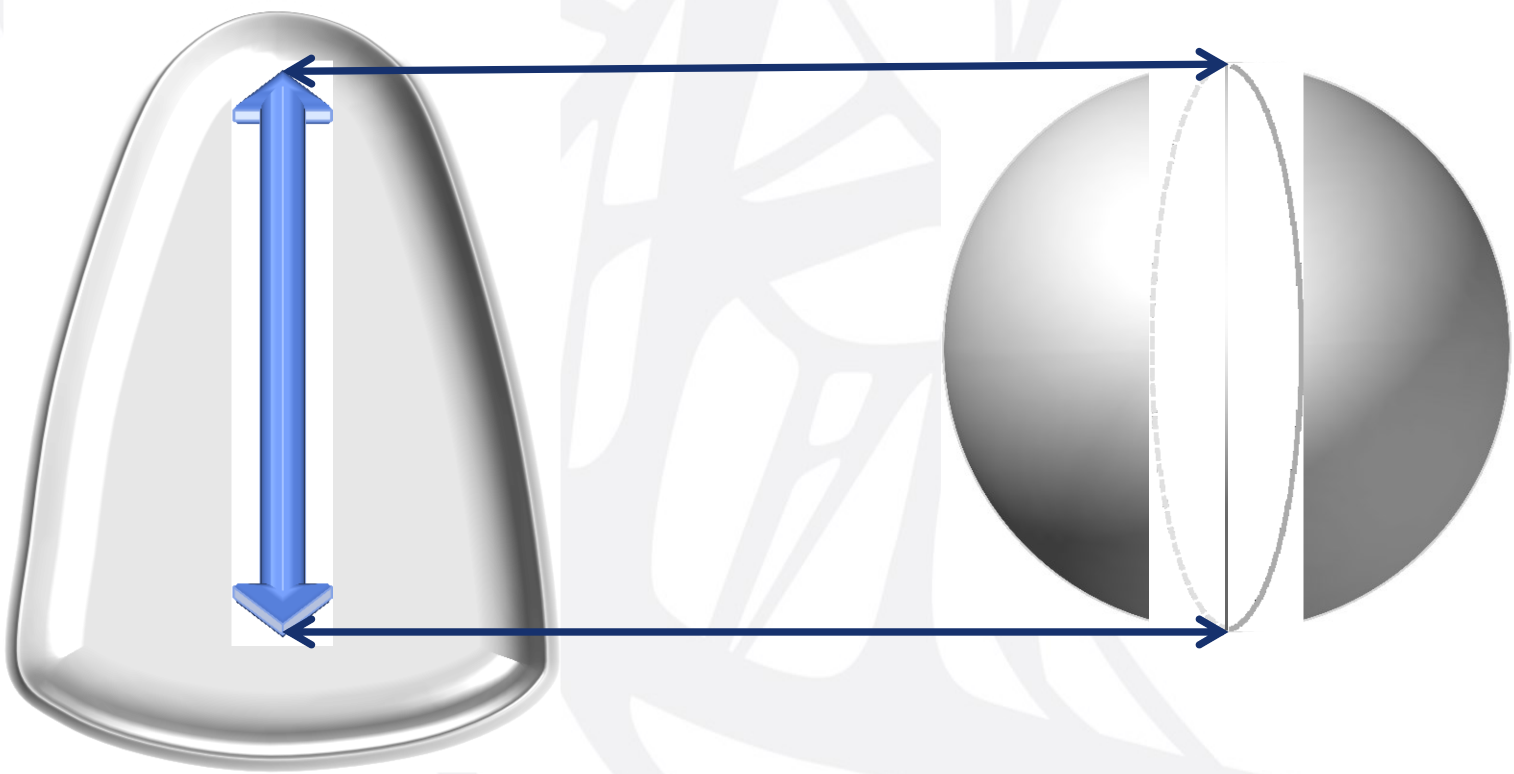


Fig. 1 (a) Schematic drawing of calculation of the 3D sphericity index. The LV cavity is shown, of which *D* is the LV end-diastolic major long axis. With the formula: $(4/3 \cdot \pi \cdot (D/2)^3)$ a spherical volume in mL can be calculated, of which *D* is the diameter (cm). The 3D sphericity index is calculated as $EDV/(4/3 \cdot \pi \cdot (D/2)^3)$.

EHJ (2004) 25, 680-687

Sphericity Index (SpI) Calculation

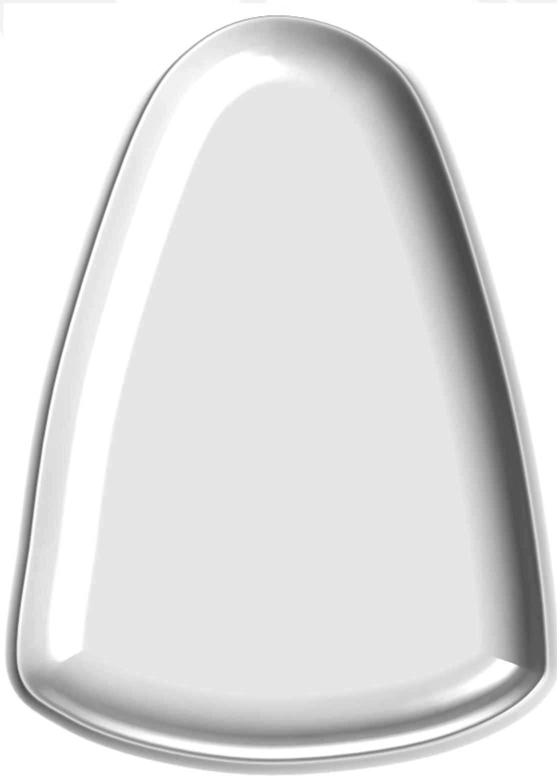
Creating a sphere based on the LV length



Length of LV in ED = Diameter [D] of the Sphere

Sphericity Index (SpI) Calculation

LV end diastolic volume / Volume of the sphere



Volume of the LV derived from the 4D dataset in end- diastole

Calculating the volume of the sphere:

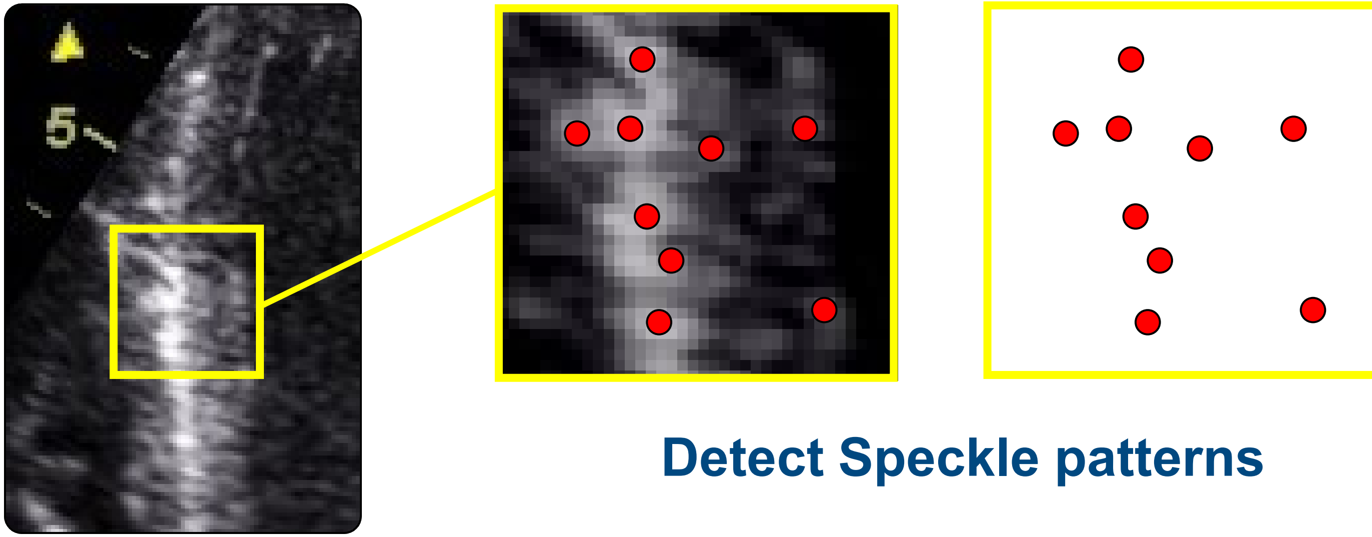
Volume = $(4/3 * \pi * (D/2)^3)$

AFI

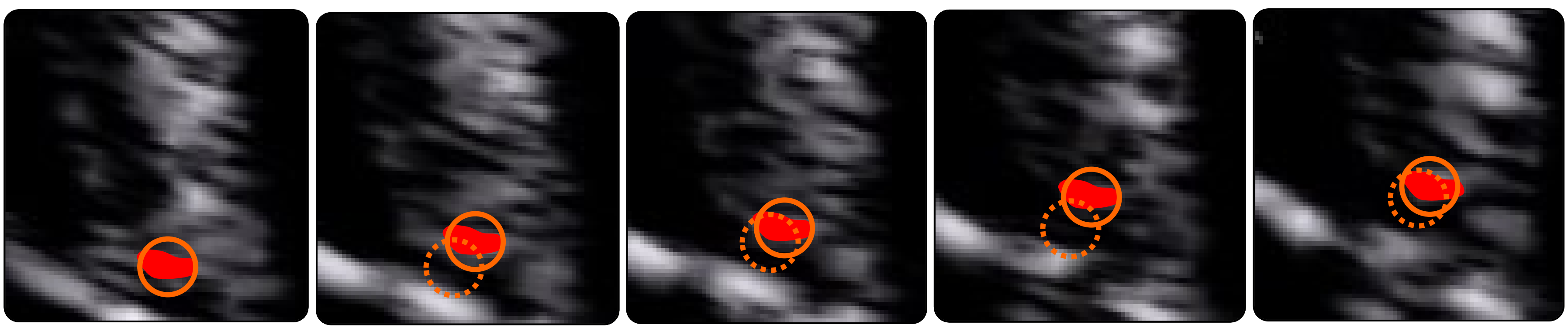
Automated Function Imaging

Tri-Plane AFI

Principle of Speckle Tracking 2D Strain



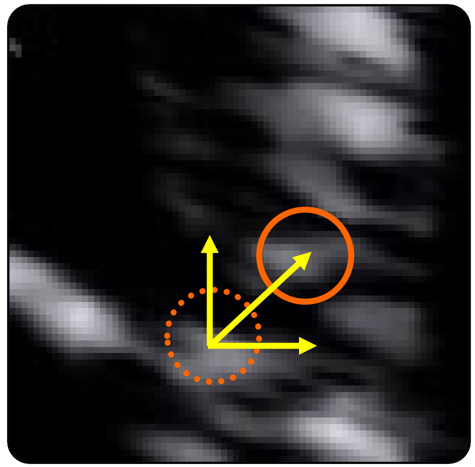
Detect Speckle patterns



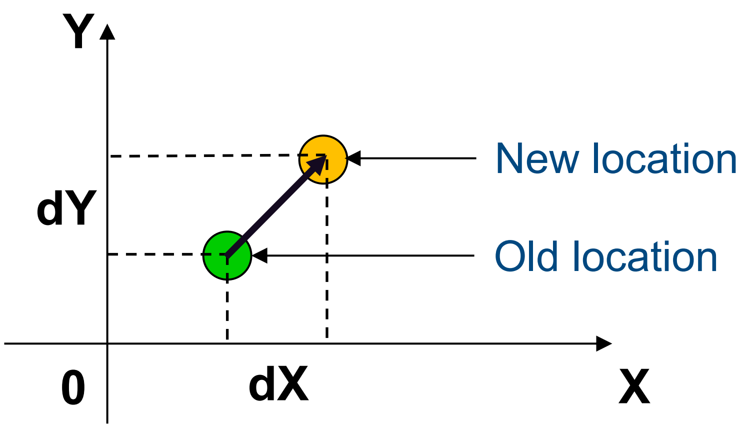
Frame 1 2 3 4

Detecting Speckle Pattern of consecutive 2D frames
Myocardial Motion Characterization by Natural Acoustic "Tagging"

Principle of Speckle Tracking 2D Strain



at e.g. 50 Fps; Time from Frame 1 to 2 = 20ms
For each „tracked“ feature velocity data is calculated.



2D velocity vector:
$(V_x, V_y) = (dX, dY) / FrameTime$

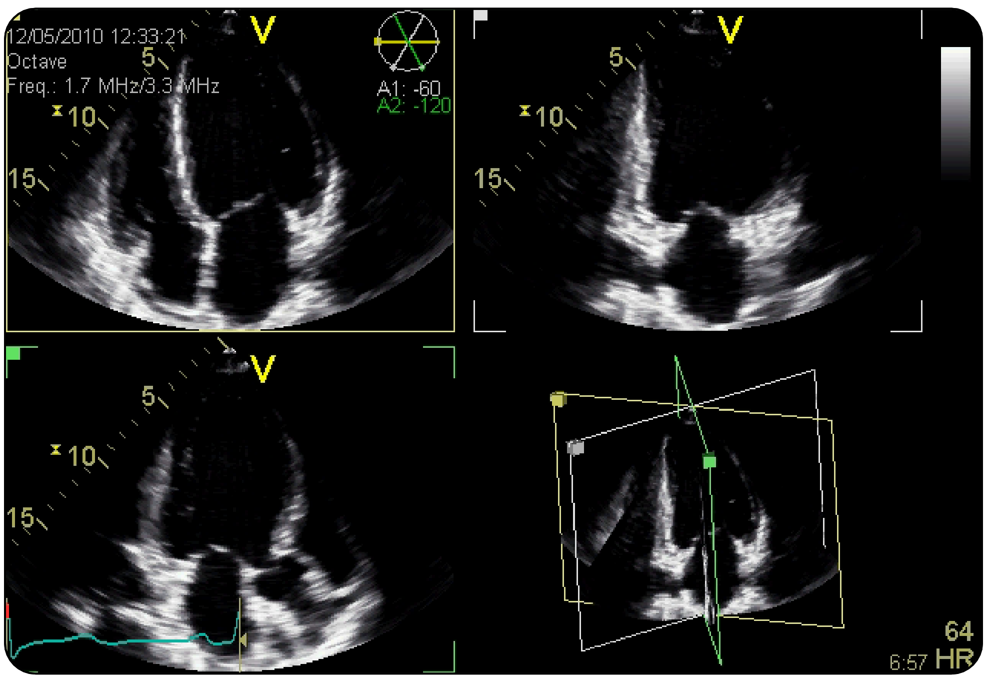
The local tissue velocity is estimated as a shift of correspondent feature divided by time between successive frames

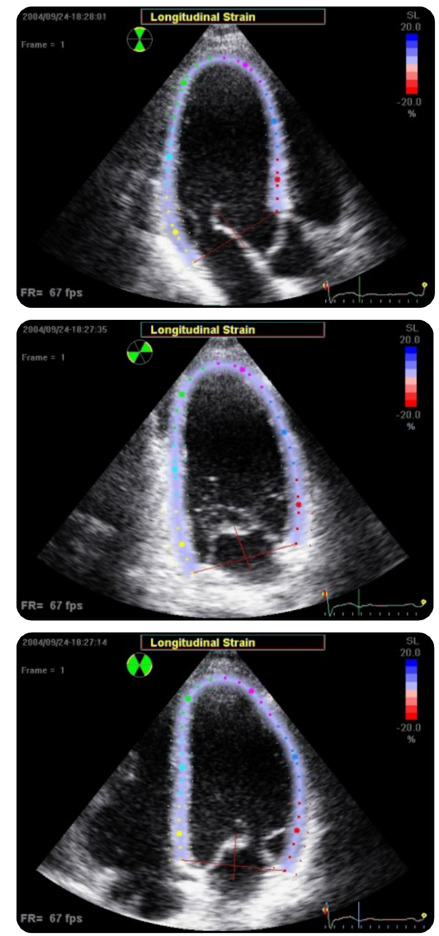
AFI – Automated Function Imaging

To Detect Peak Systolic Longitudinal Strain on Tri-Plane Imaging

AFI is giving information about the global LV function and indicating regional contraction differences.

To Detect Peak Systolic Longitudinal Strain based on 2D Strain Data

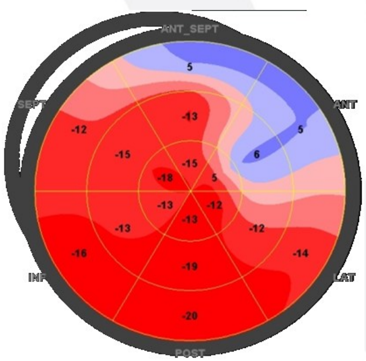


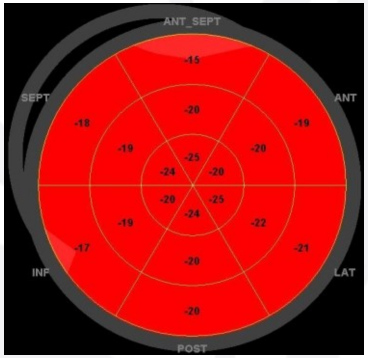


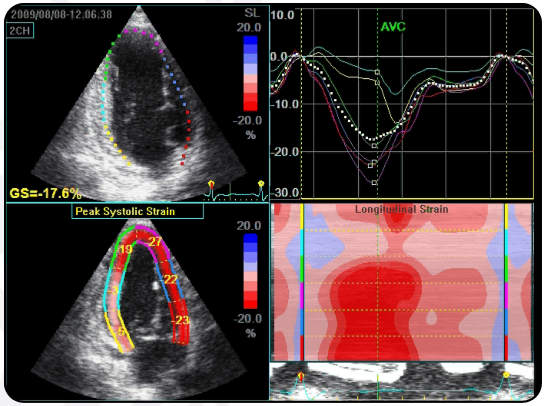
AFI – Automated Function Imaging

Now available on Tri-Plane Imaging

Bulls-Eye View for **regional** longitudinal peak systolic Strain







Values for **global** longitudinal peak Systolic Strain

GLPSS_LAX	-11.9 %
GLPSS_A4C	-12.0 %
GLPSS_A2C	-11.0 %
GLPSS_Avg	-11.6 %

imagination at work

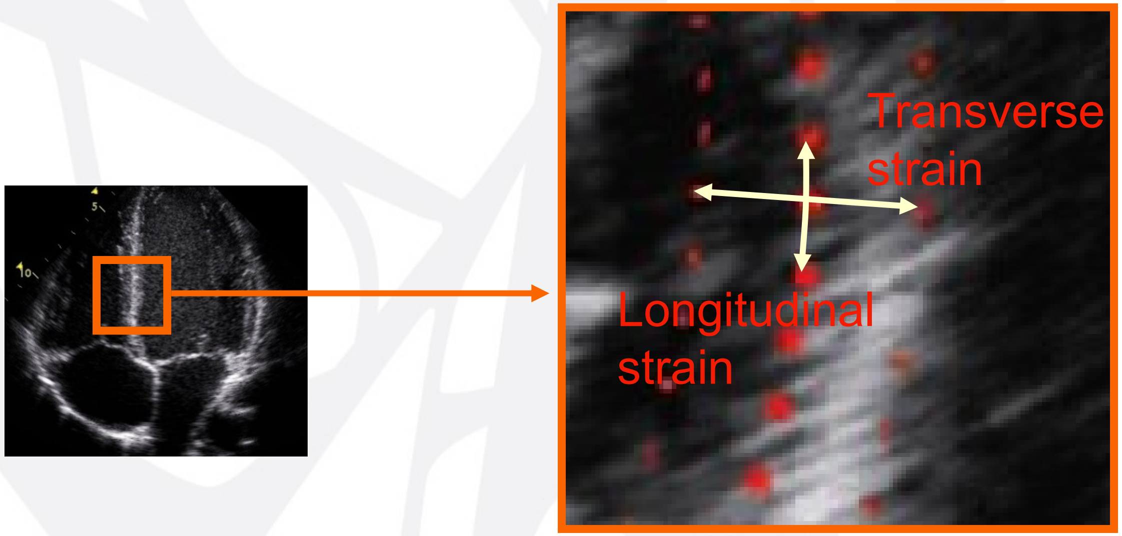
4D Strain

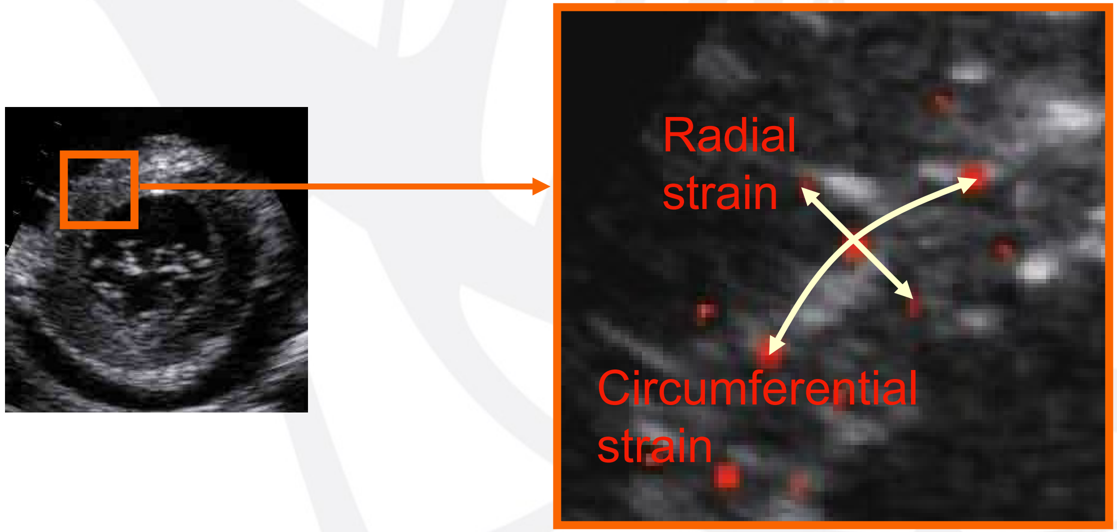
4D Strain

- 4D Strain is based on speckle tracking
- Deformation from 4D Data sets
- Automated ROI, Dynamic Bulls Eyes, Traces, parameters
- Tracks all points from endocardium to epicardium
- Display of APLAX, A4CH, A2CH, 3 SAX's
- Quality Check
- Ability to accept and reject segments
- Integrated with LV Mass

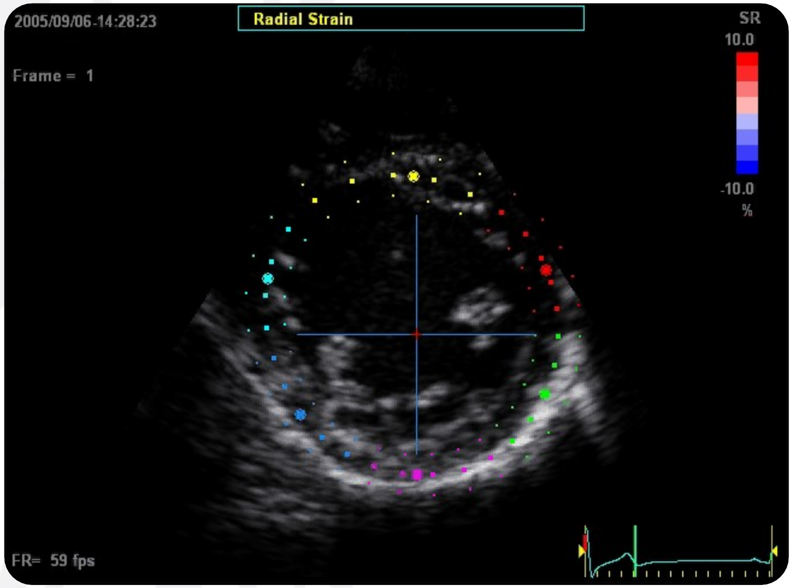
imagination at work

Deformation Vectors in 2D Strain





2D Strain Cutplane in a moving ventricle



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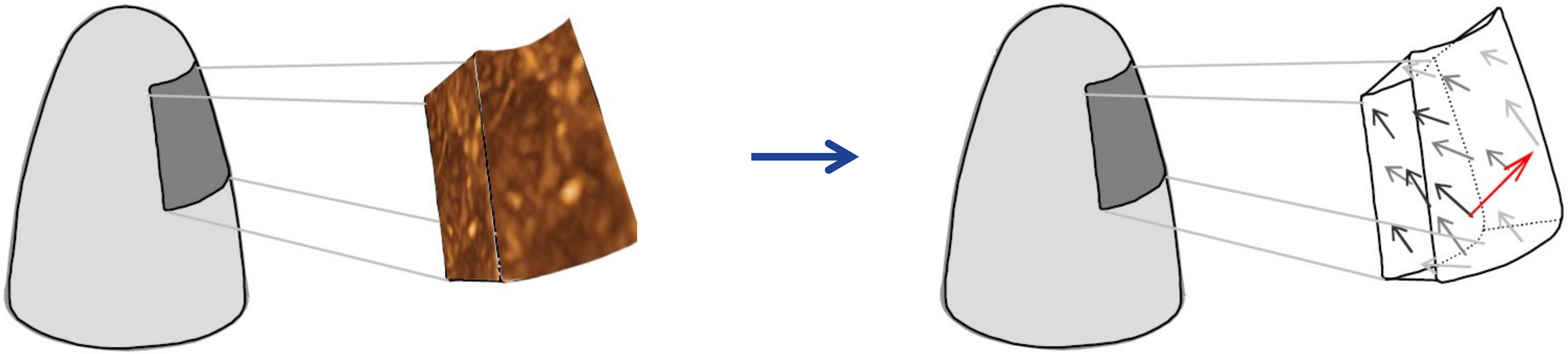
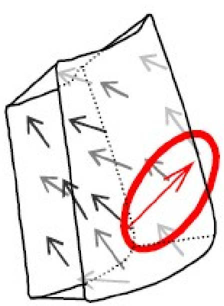
4D Strain

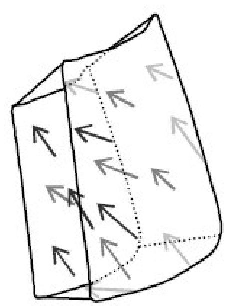


The Tracking

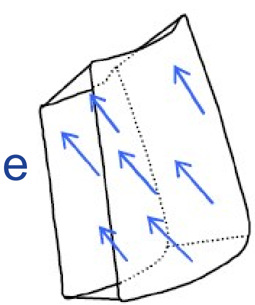
The system detects all speckles inside the myocardium and tracks them frame-by-frame. In this way the movement over time of all speckles is known. According to the movement the vector of each speckle can be calculated.



Reject outliner



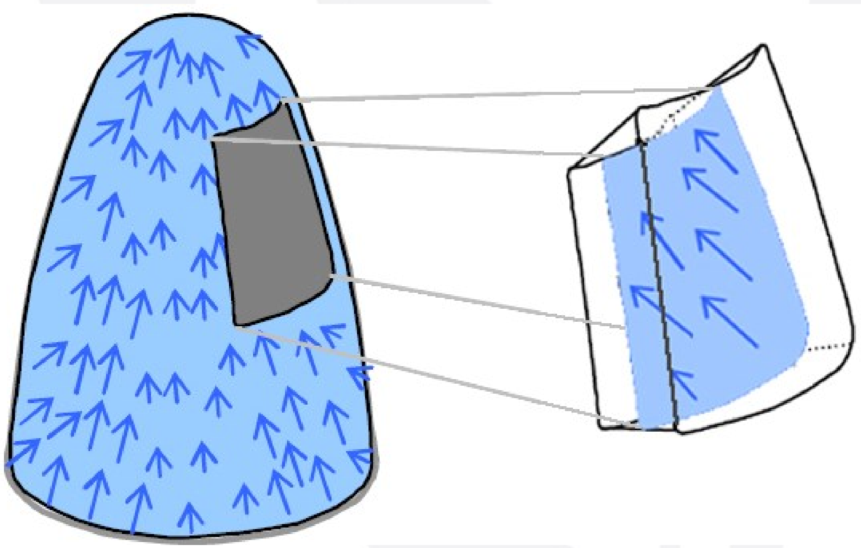
then built the average

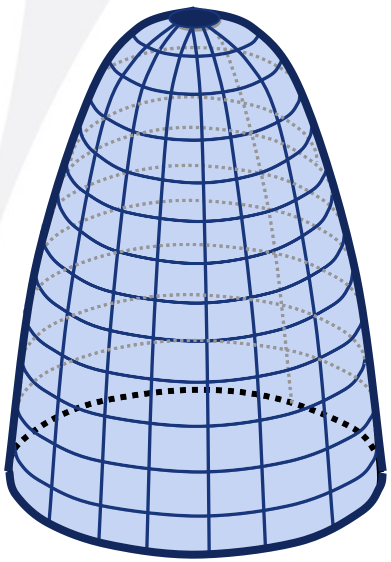


Smart averaging

To get more robustness into the analysis, the system reject the outliner from the dataset and averages the data in a smart way.

4D Strain



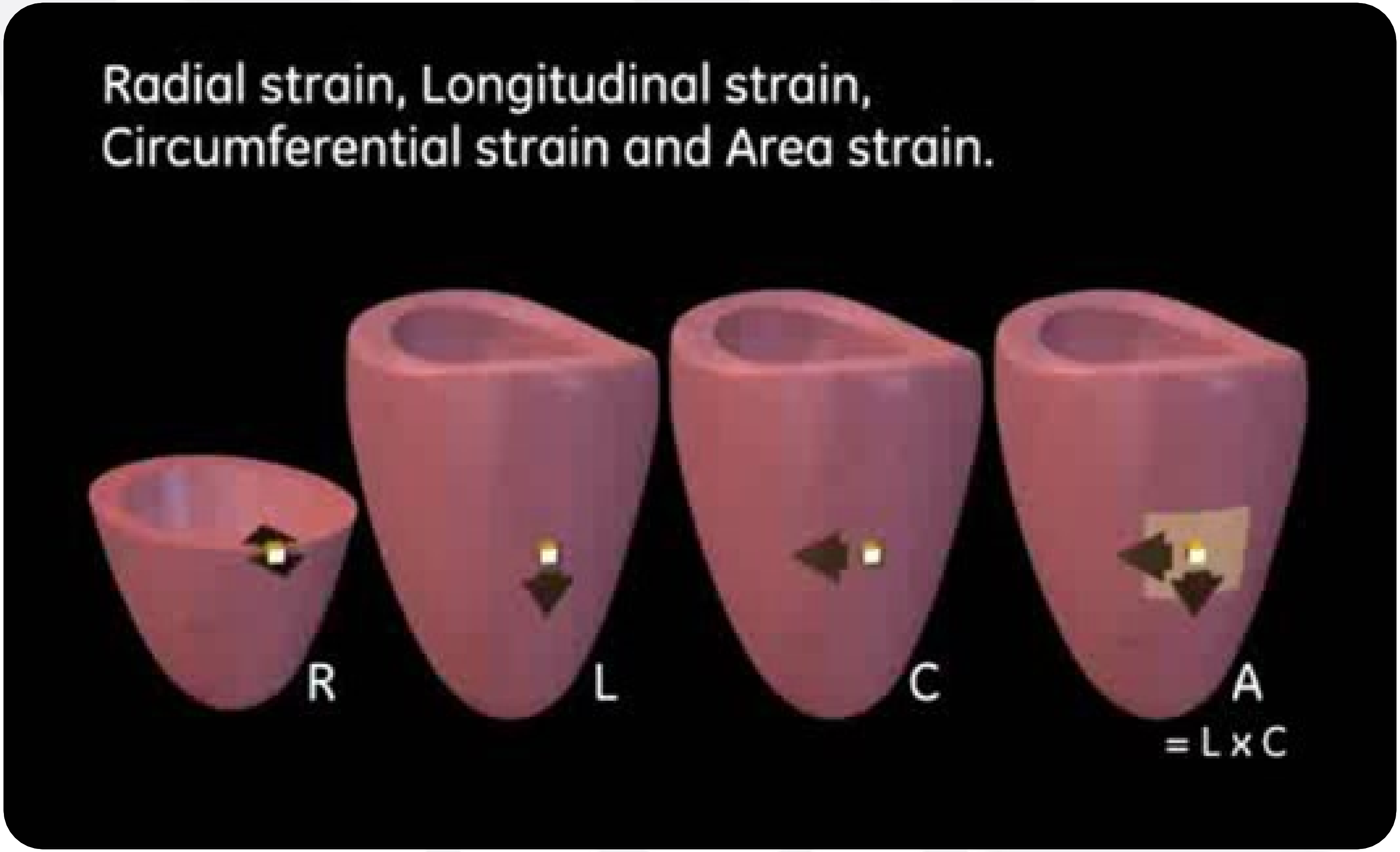


Mesh model

The values will be averaged onto a mesh model to “display” the myocardial motion.

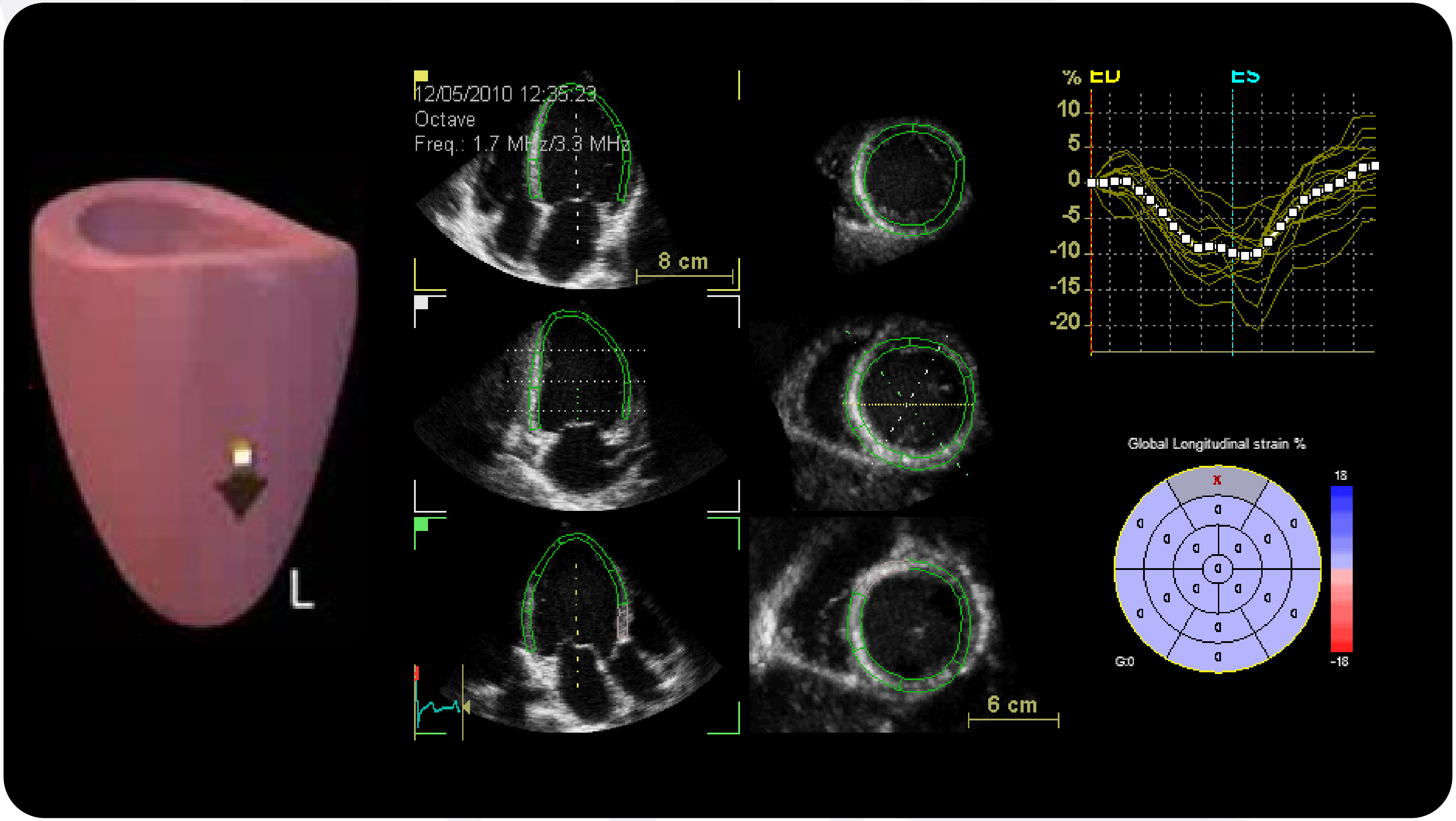
This mesh model will be placed in the mid myocardium of the 4D dataset.

4D Strain



Radial strain, Longitudinal strain,
Circumferential strain and Area strain.
R
L
C
A
= L x C

4D Longitudinal Strain



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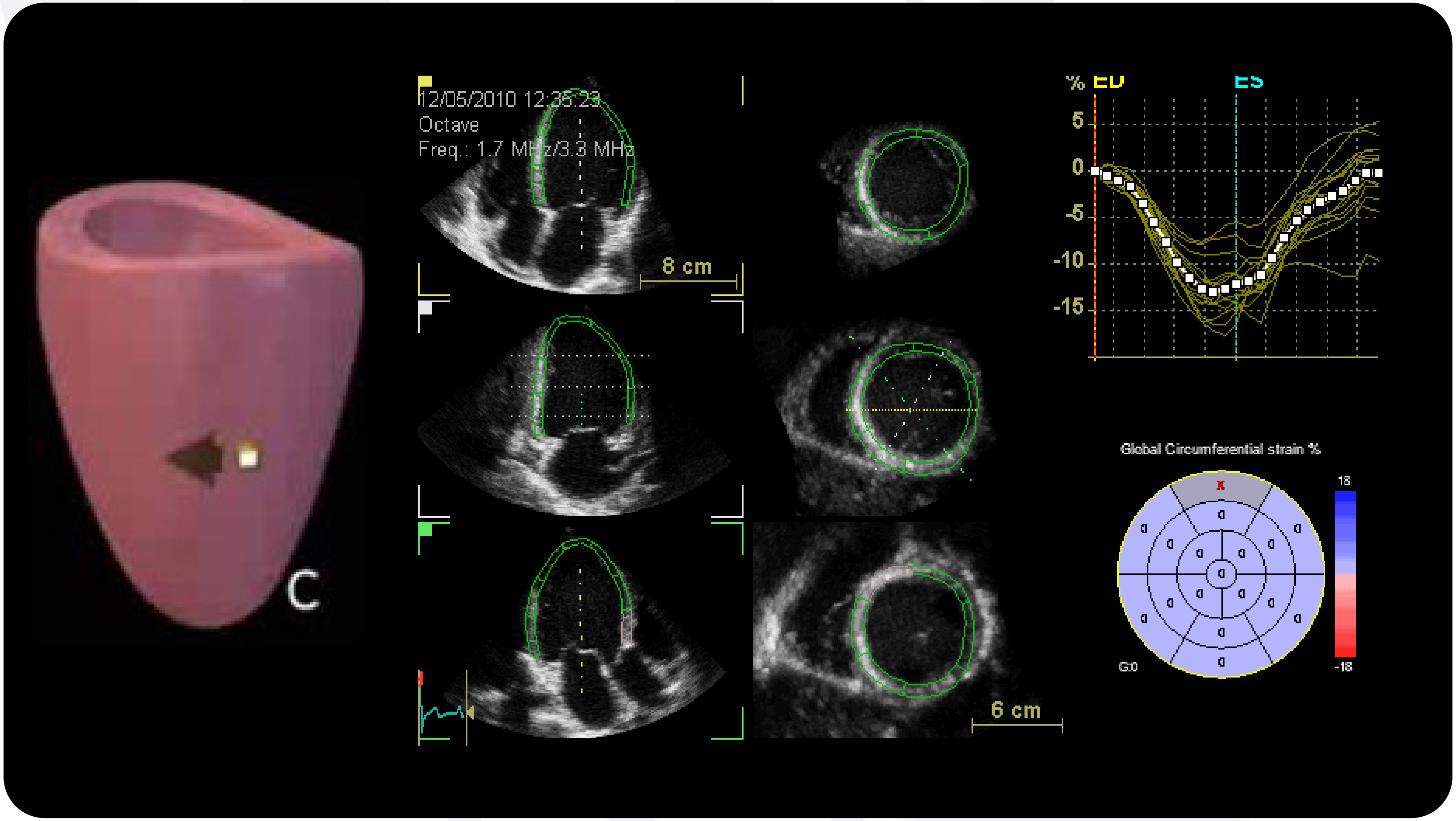
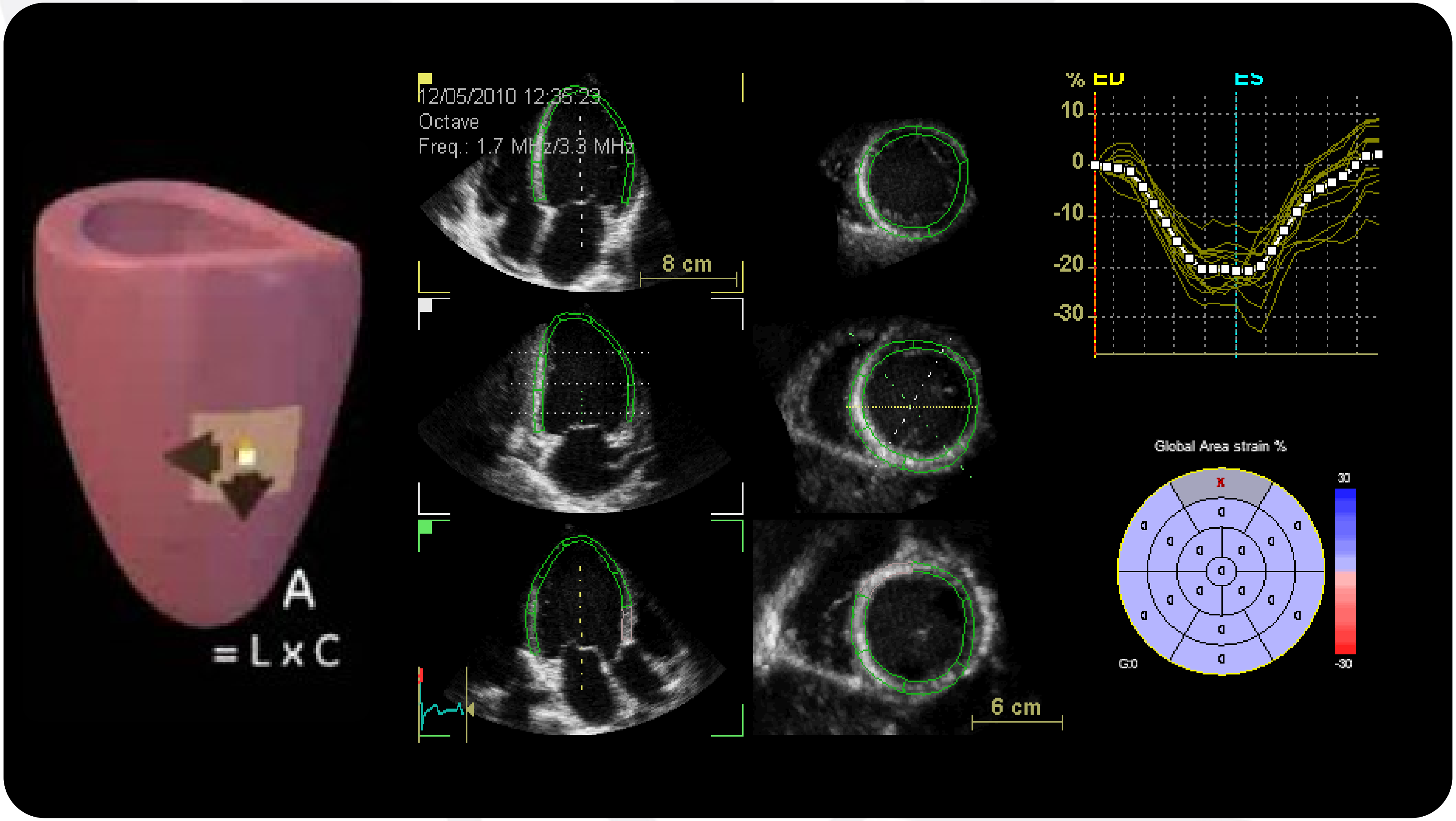
4D Circumferential Strain

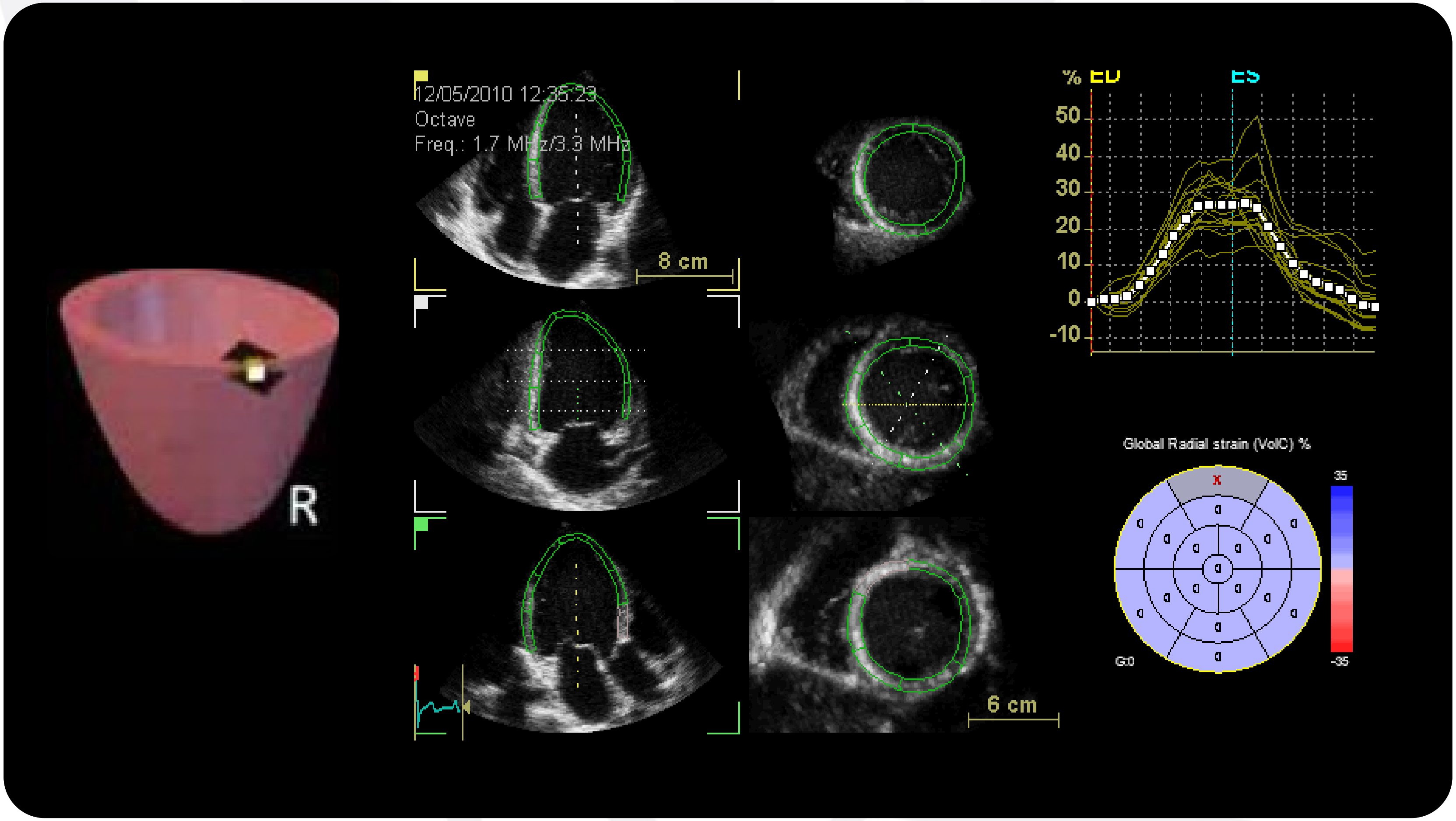


4D Area Strain



Area strain shows % of change of an area from a mid-myocardial layer.
It reflects a combination of longitudinal and circumferential strain.

4D Radial Strain



4D Radial Strain is estimated from the area strain using an assumption of volume conservation. The parameter is therefore called "Radial Strain".

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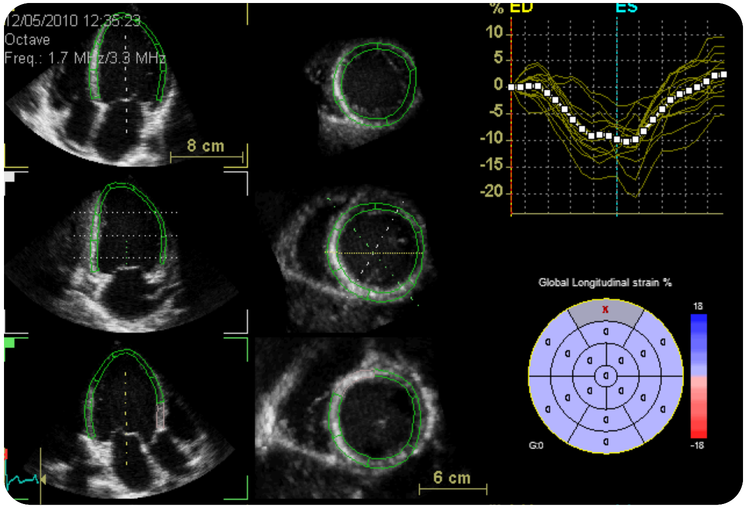
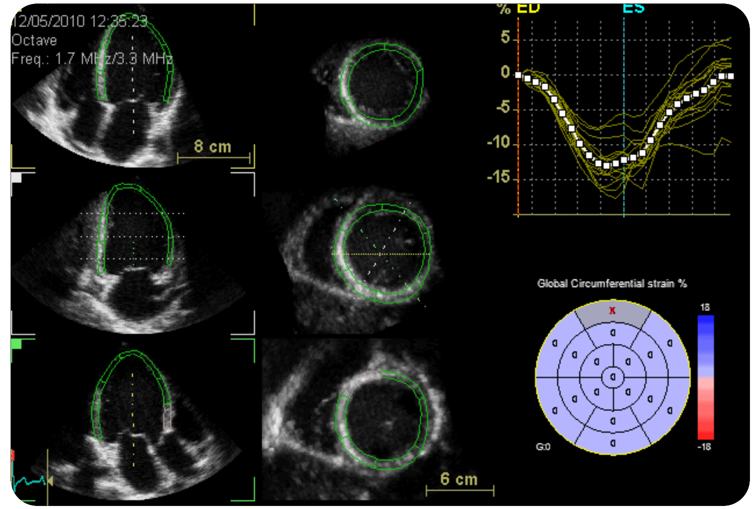
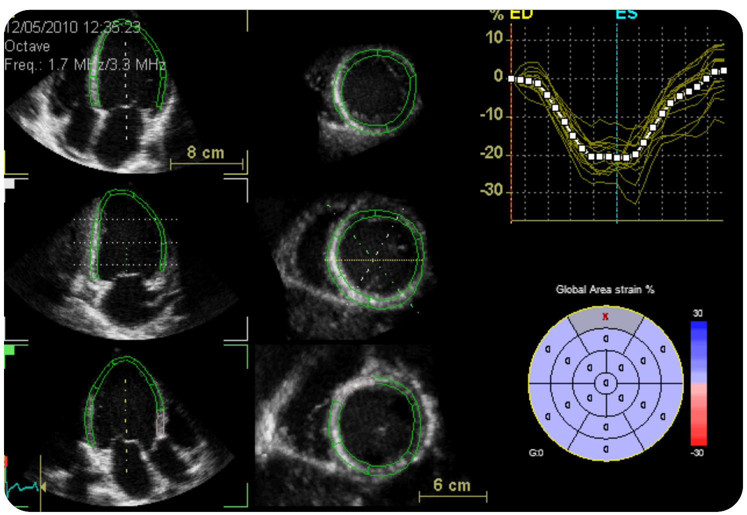
4D Strain Results



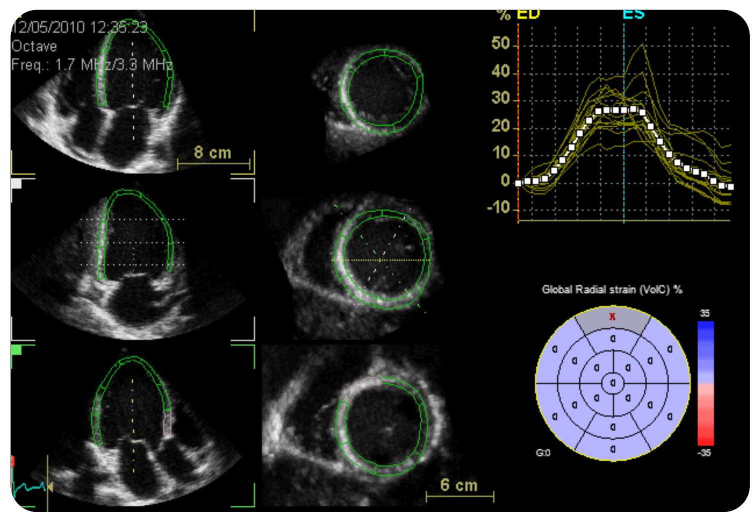
Longitudinal



Circumferential

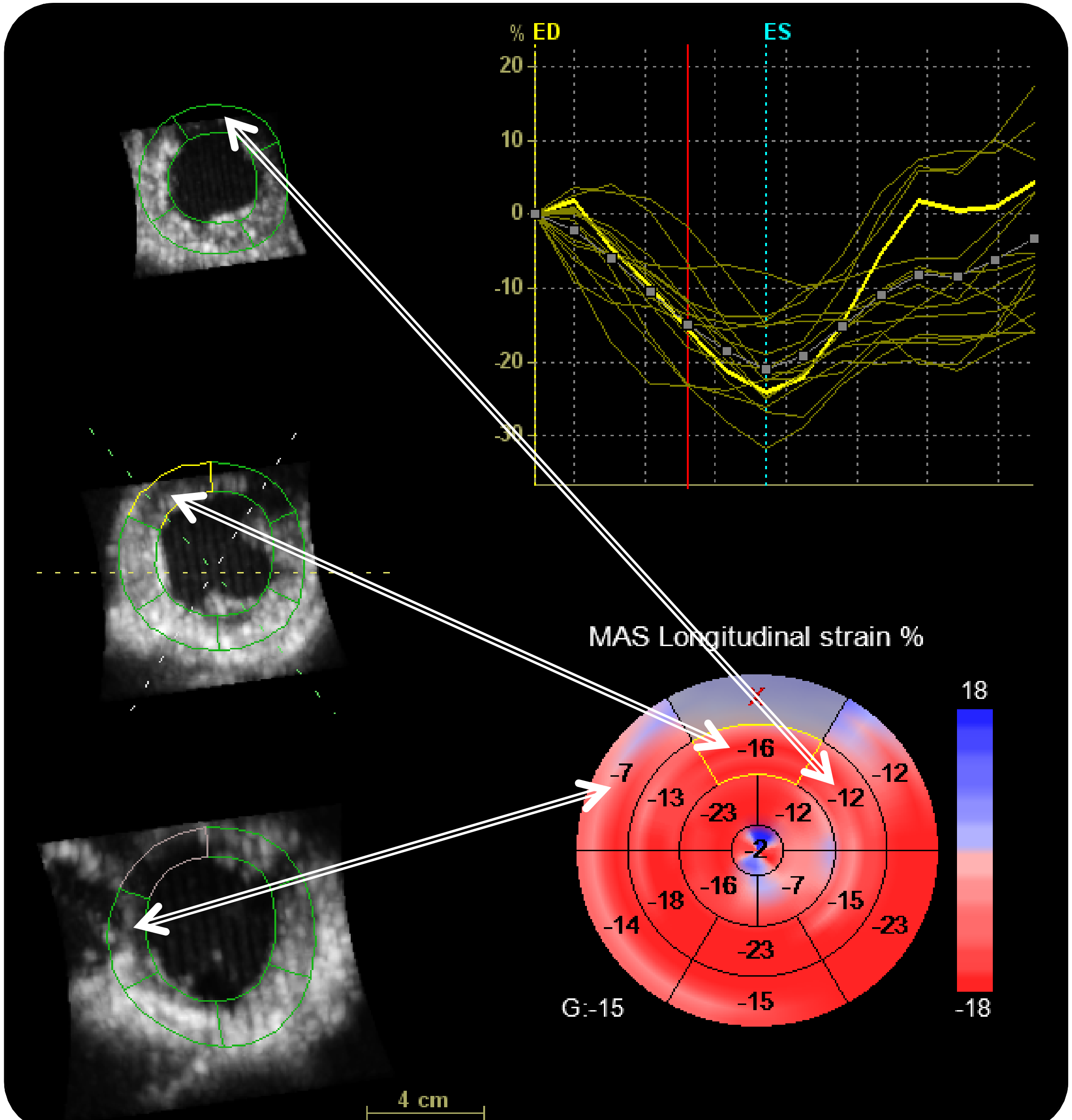


Area



Radial

4D Strain Results

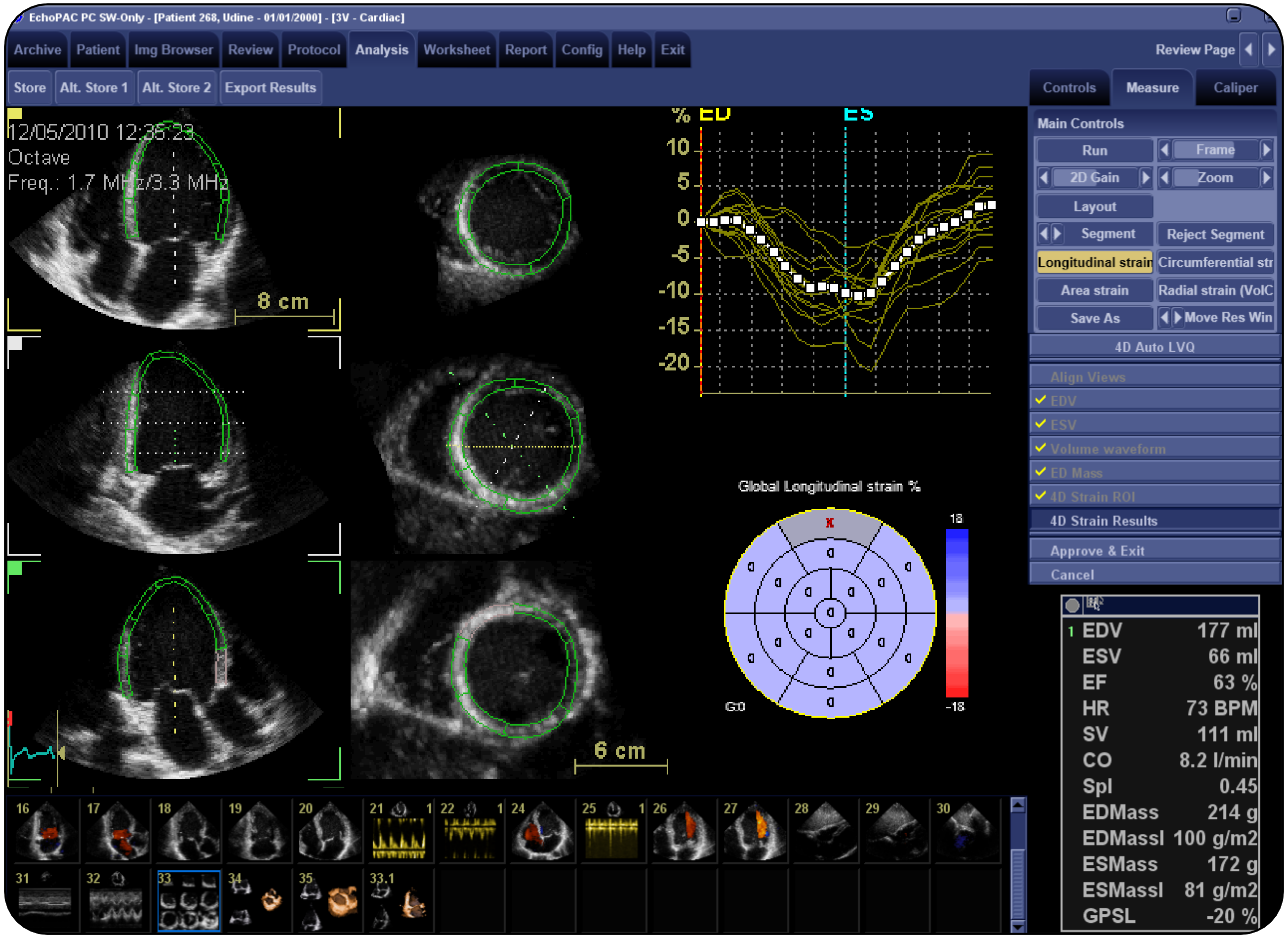


<u>Outer ring of BE</u> correlates with basal SAX view

<u>Middle ring of BE</u> correlates with middle SAX view

<u>Inner ring of BE</u> correlates with apical SAX view

4D Strain Results



You have the ability to accept or reject any segments manually.

Only accepted segments will contribute to GSPL

Global strain value in results box

GPSL= Global Peak Strain Longitudinal