Advances in Imaging in Hypertrophic Cardiomyopathy: MRI and MDCT

Pr Philippe Douek

Hopital Louis Pradel, Lyon

OUTLINE

- **Introduction**
- **Diagnostic of Hypertrophic Cardiomyopathy:MRI and MDCT**
  - Phenotype Characterization
  - Genotype Positive/Phenotype Negative HCM Patients
- **Additional Considerations**
  - Hemodynamic Assessment of Outflow Obstruction
  - Surgical septal myectomy
  - Alcohol septal ablation
- **LVH and Risk Stratification**
  - LV hypertrophy
  - LV Mass
- **Significance and Clinical Implications of LGE**
- **Role for CMR in Differential Diagnosis of LV hypertrophy**

Introduction

- Although echocardiography is the simplest imaging technique to use for screening,
- CMR and MDCT are:
  - less operator dependent not subject to acoustic window limitations

- Cine MR imaging with the steady-state free precession pulse sequence can offer the advantages of:
  - multiplanar imaging,
  - complete coverage of the entire myocardium without obliquity,
  - excellent soft-tissue contrast between the myocardial border and the blood pool.

Introduction

- CMR imaging can allow:
- better characterization of the pattern and distribution of LV hypertrophy in HCM.
- In addition, the status of myocardial blood flow can be assessed by using adenosine stress cardiac MR imaging.
- Delayed enhancement (DE) MR imaging techniques can provide unique information for tissue characterization, specifically for the identification of myocardial fibrosis or scarring

Introduction

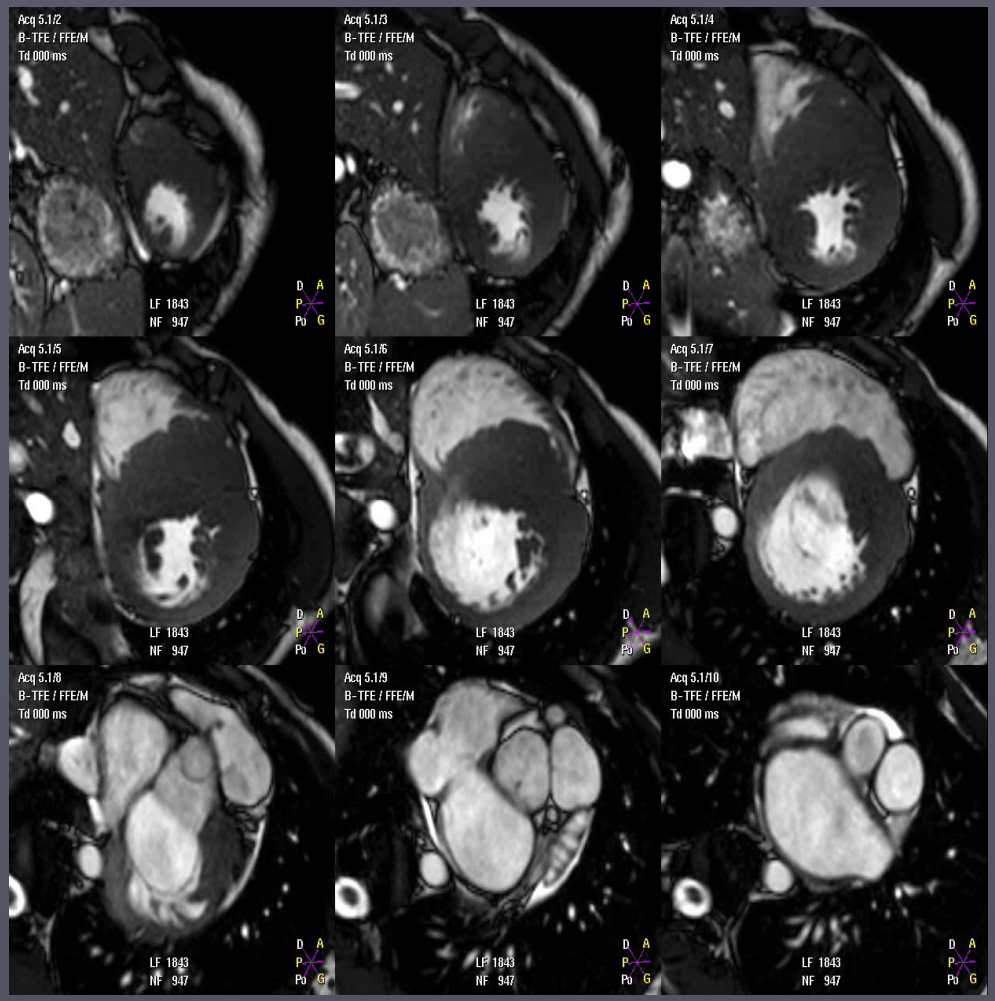
- In comparison, the spatial resolution of MDCT is higher,
- which enables high-quality multiplanar three-dimensional reformatted images
- high-quality noninvasive coronary angiography .

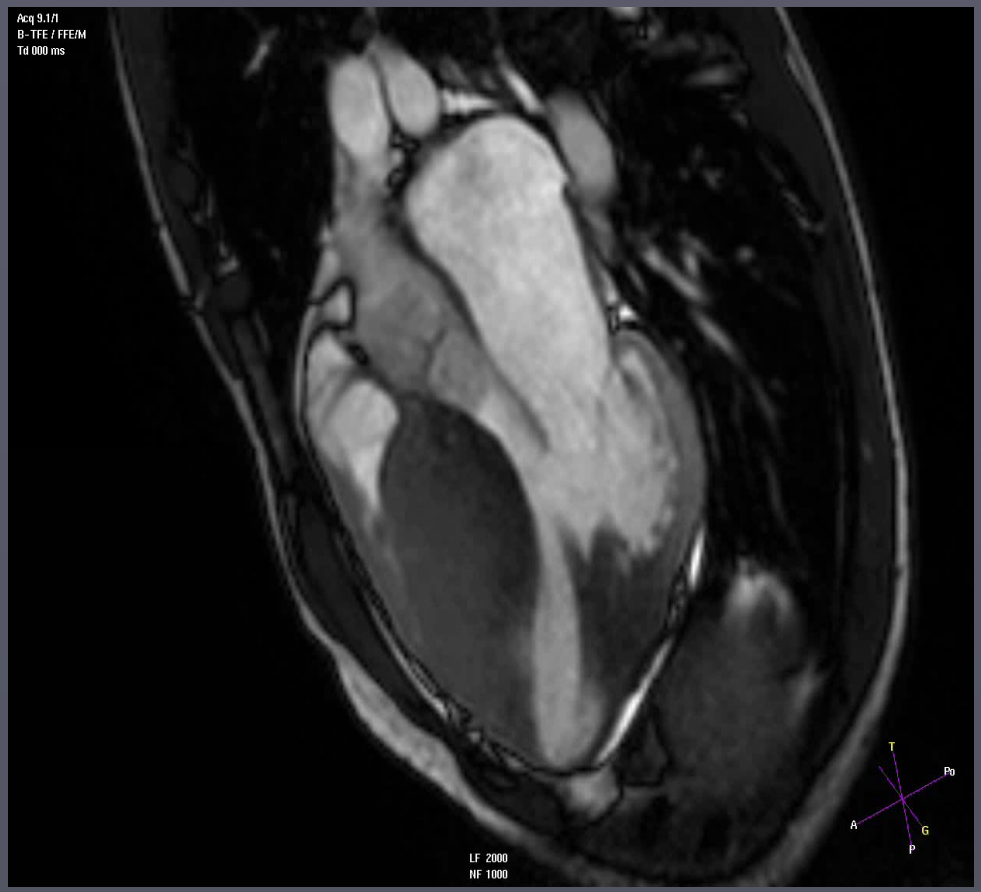
- **Diagnostic of Hypertrophic Cardiomyopathy:MRI and MDCT**

  - Phenotype Characterization

30 year old man
Recent episode of malaise
No particular personal history
Familial history of cardiac arrest in the father related to HCM
ECG abnormalities: Q wave in the inferior leads and deep S wave in right precordial leads

Asymmetric involvement of the interventricular septum

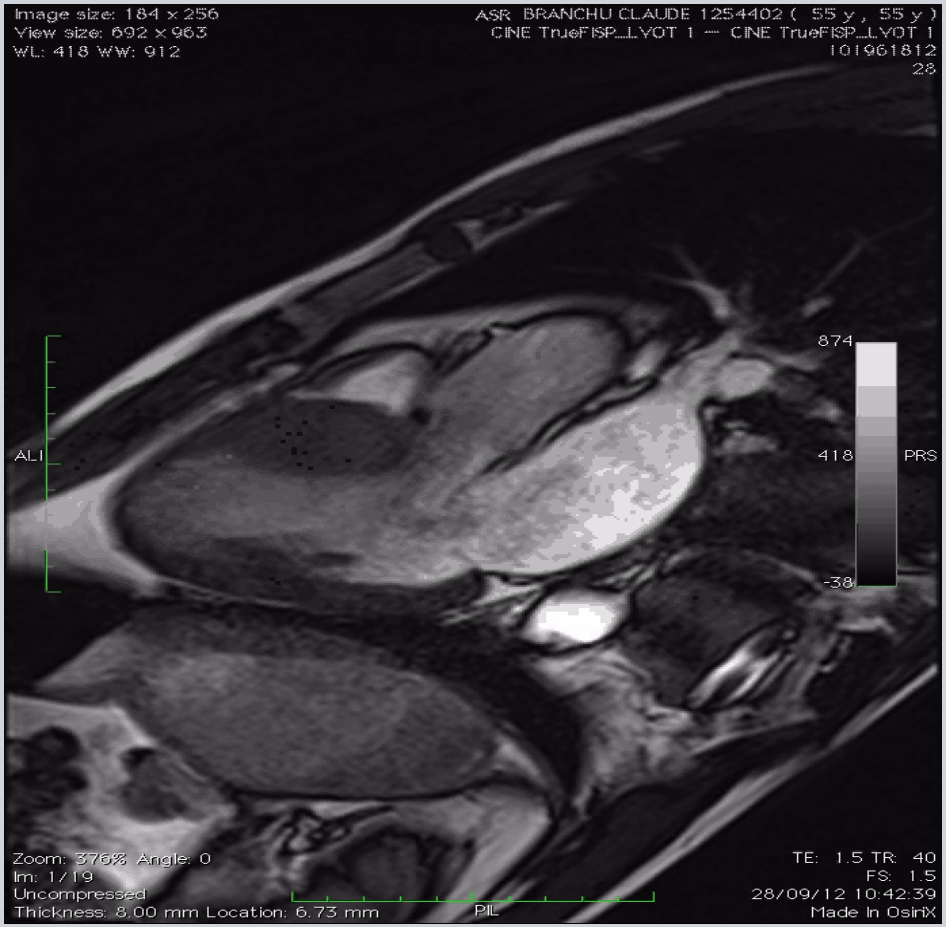




EFLV 68%
EDVi 70 ml/m^2
ESVi 15 ml/m^2
Mass 171 g (75-175) 101g/m^2 (63-95)

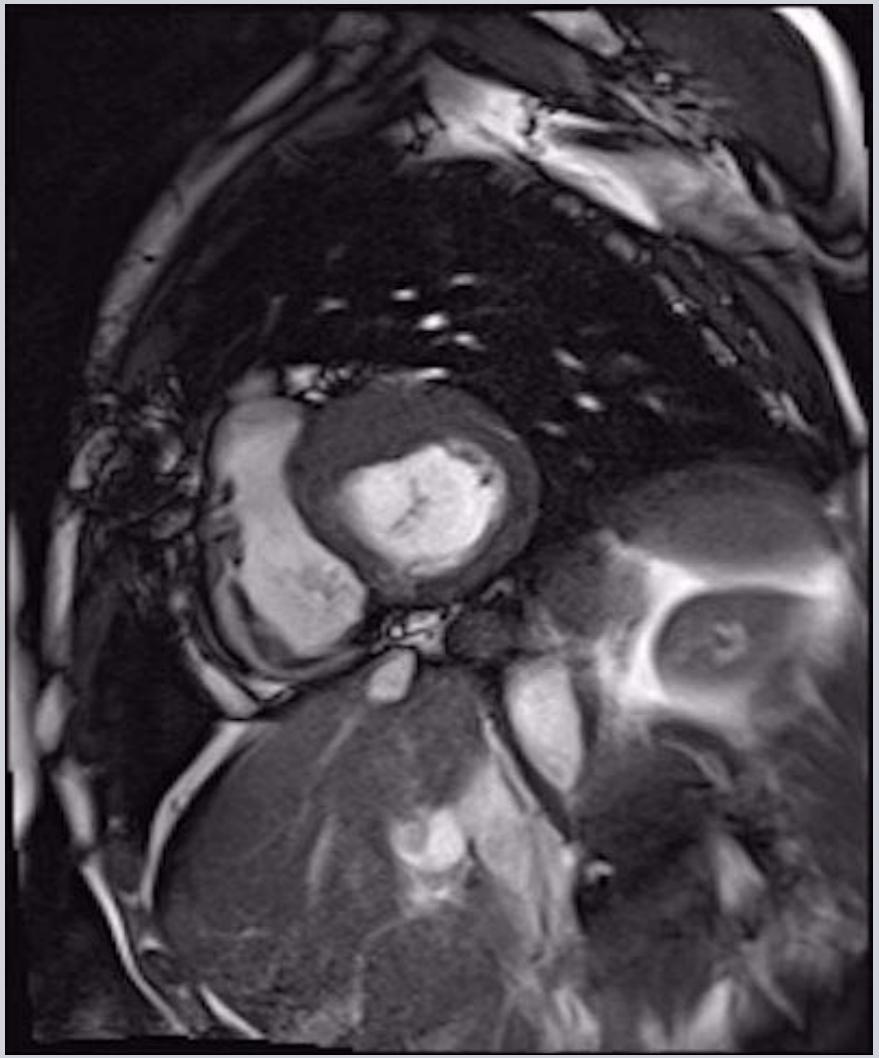
- Cine cardiac MR imaging clearly demonstrates:
  - systolic anterior motion of the mitral leaflets
  - a high-velocity jet depicted as an area of high signal intensity or signal void within the LVOT

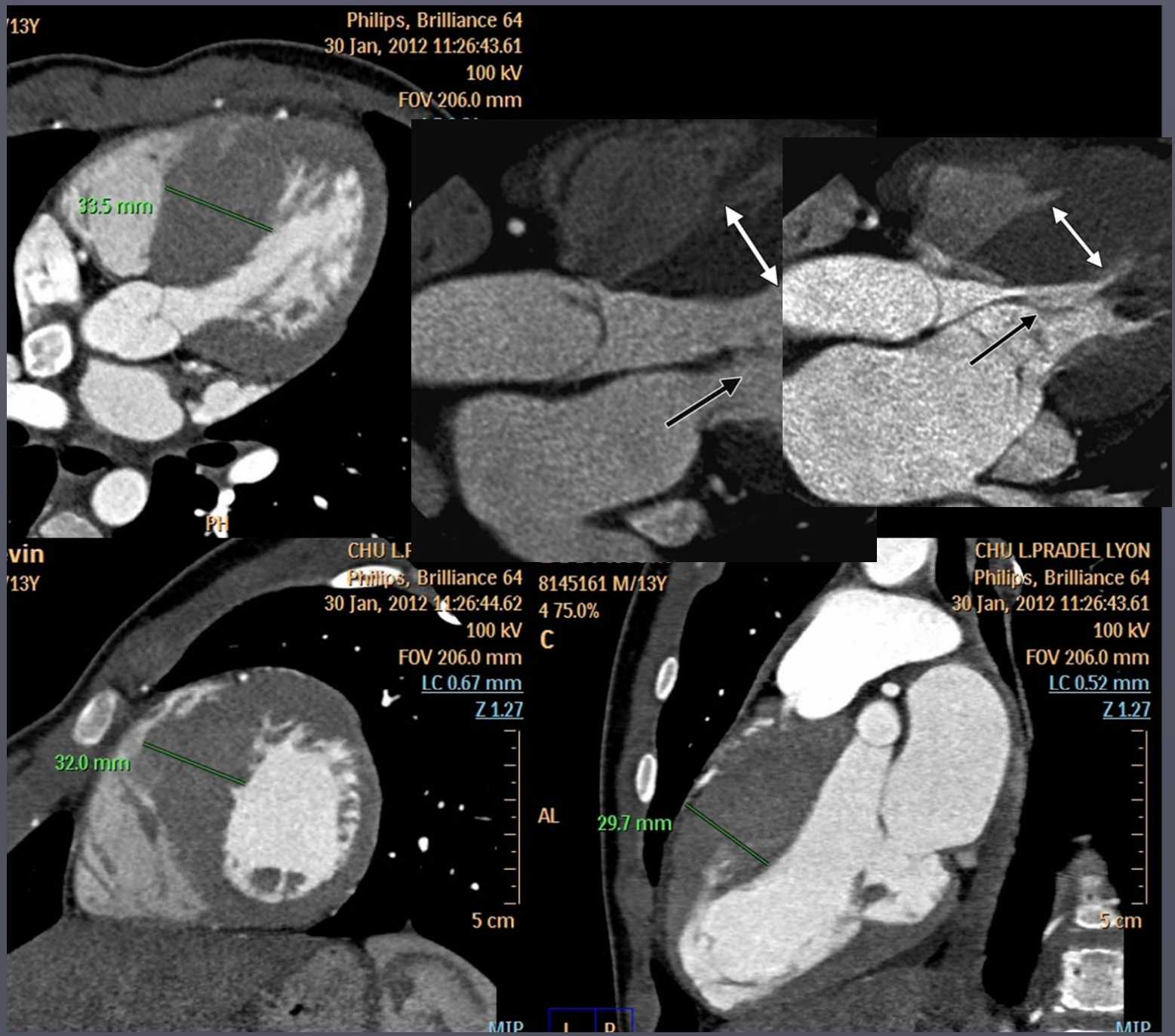
Before



After Mitraclip

After Mitraclip




13Y
Philips, Brilliance 64
30 Jan, 2012 11:26:43.61
100 kV
FOV 206.0 mm
33.5 mm
PH
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13Y
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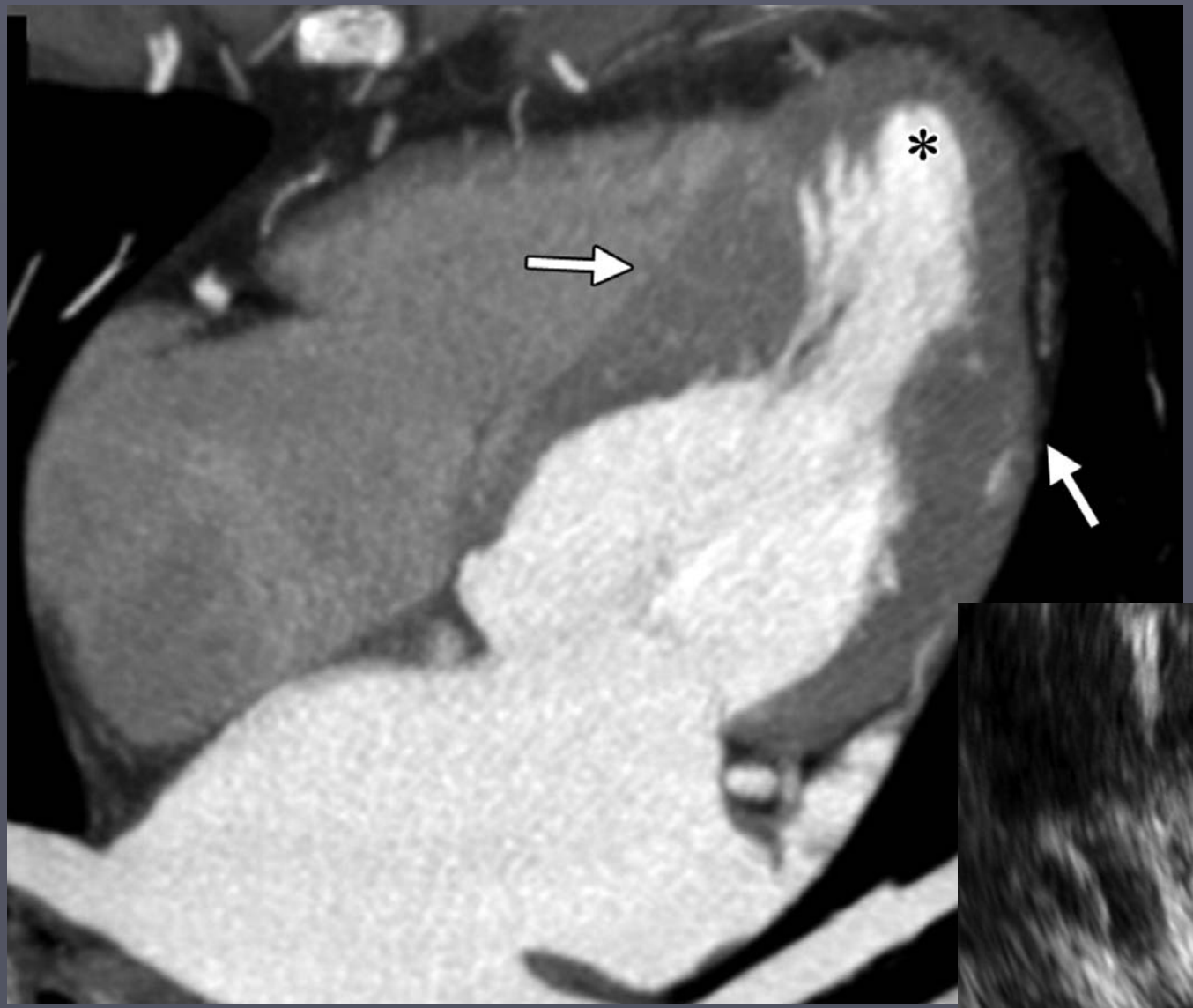
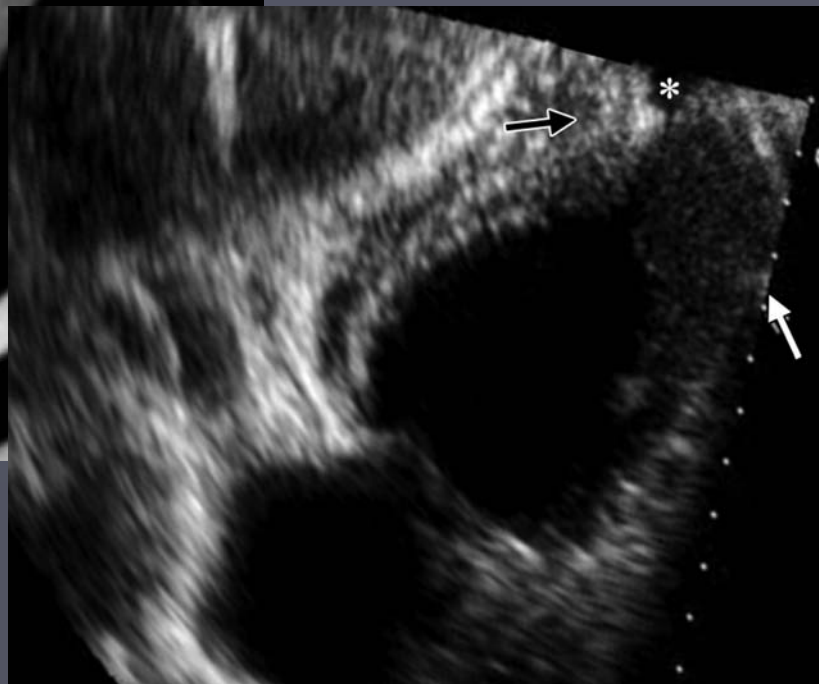
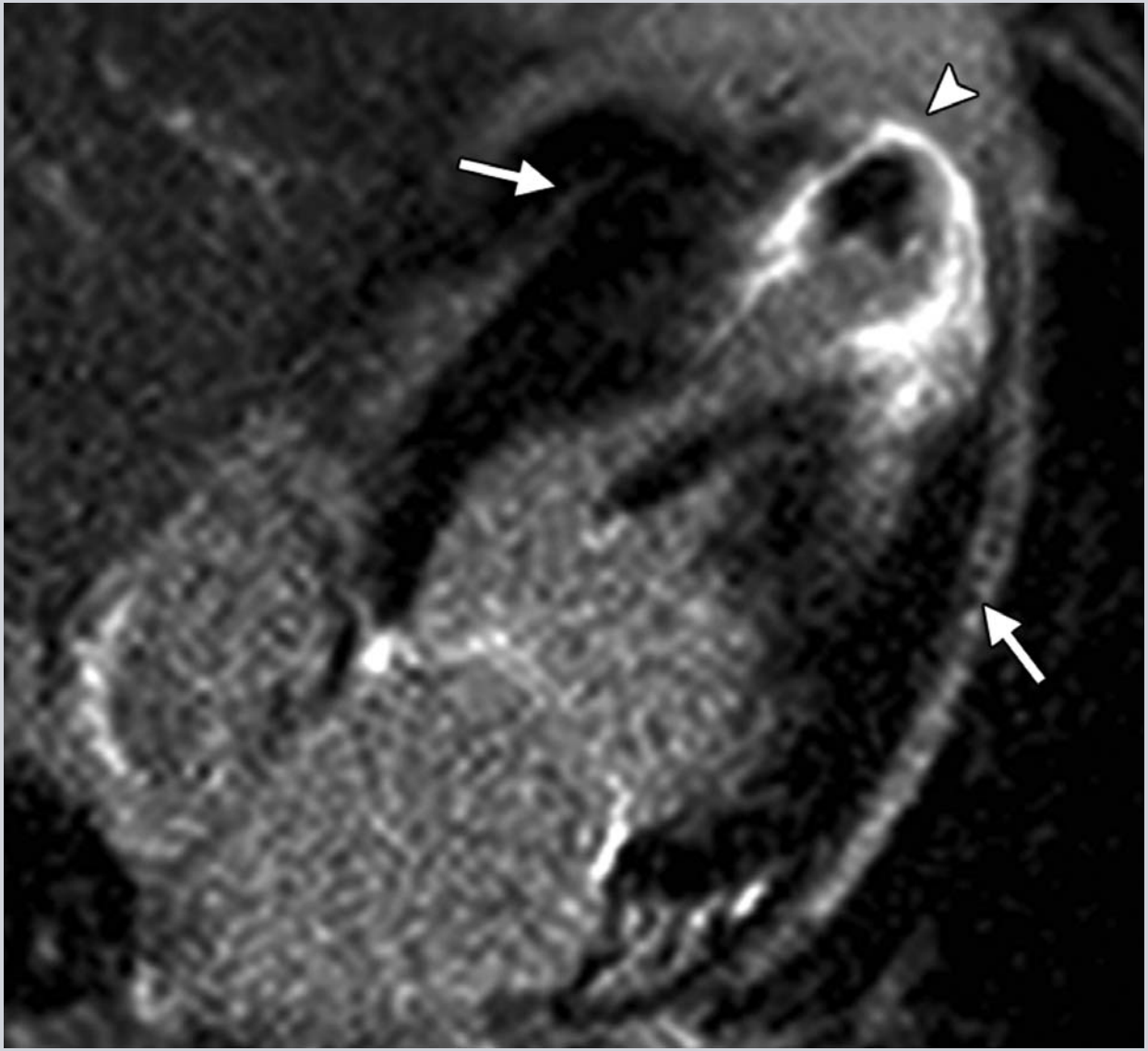
Philips, Brilliance 64
30 Jan, 2012 11:26:44.62
100 kV
FOV 206.0 mm
LC 0.67 mm
Z 1.27
32.0 mm
5 cm
MIP
8145161 M/13Y
4 75.0%
C
AL
CHU L.PRADEL LYON
Philips, Brilliance 64
30 Jan, 2012 11:26:43.61
100 kV
FOV 206.0 mm
LC 0.52 mm
Z 1.27
29.7 mm
5 cm
MIP

Midventricular HCM in a 56-year-old man with dyspnea.

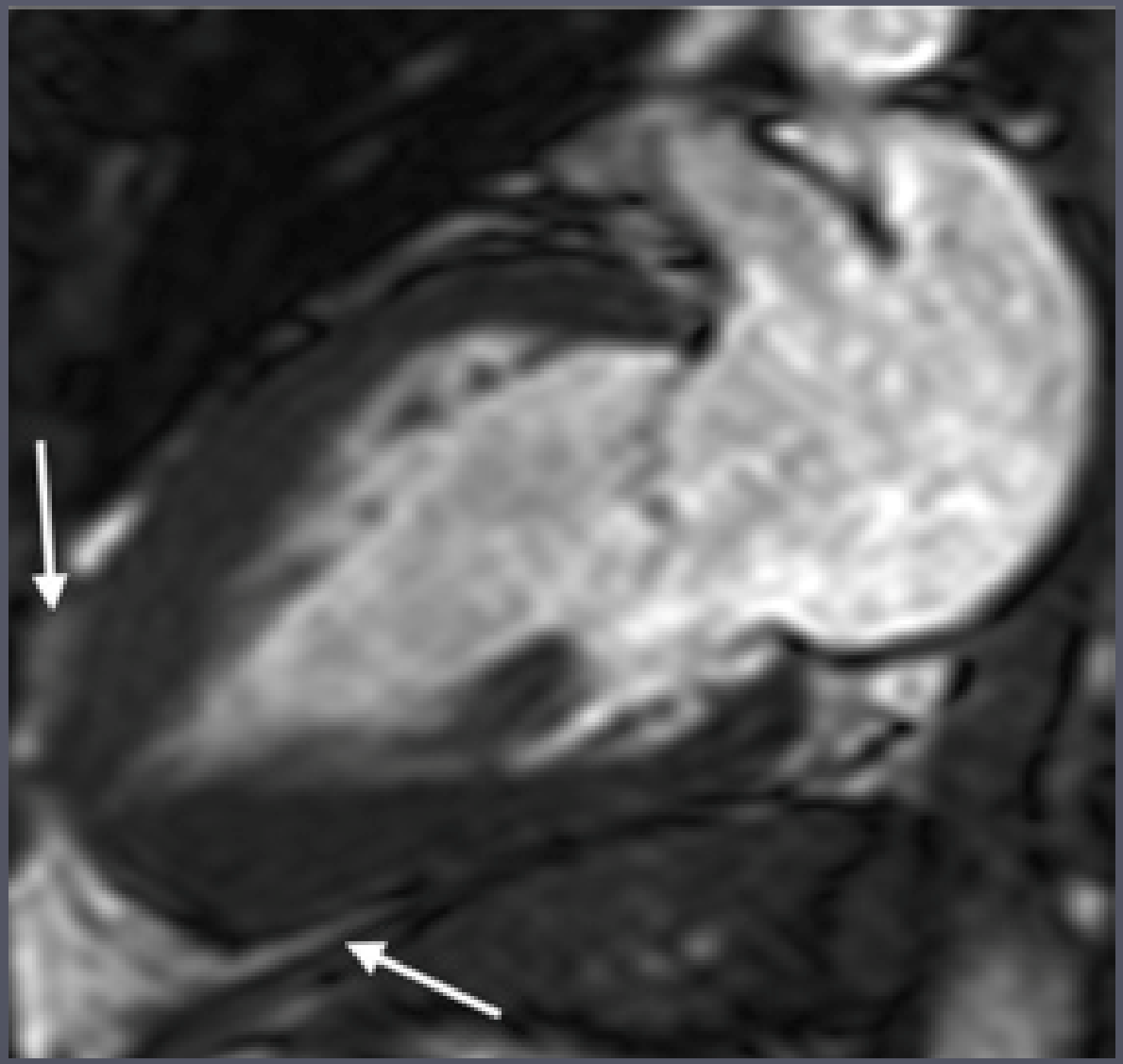




Midventricular to apical HCM in the burned-out phase in a 43-year-old woman with severe dyspnea.

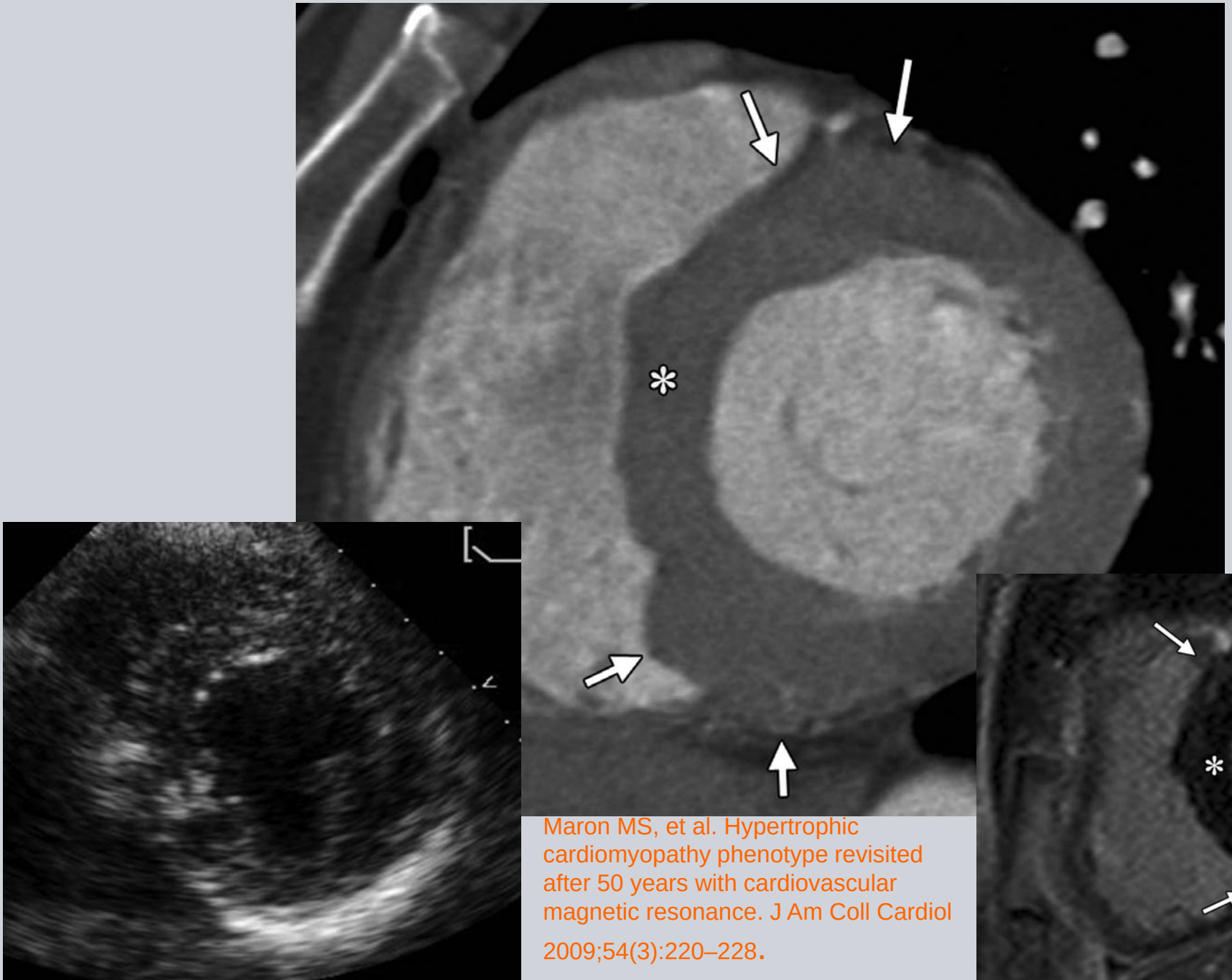


Apical HCM in a 56-year-old man with dyspnea.



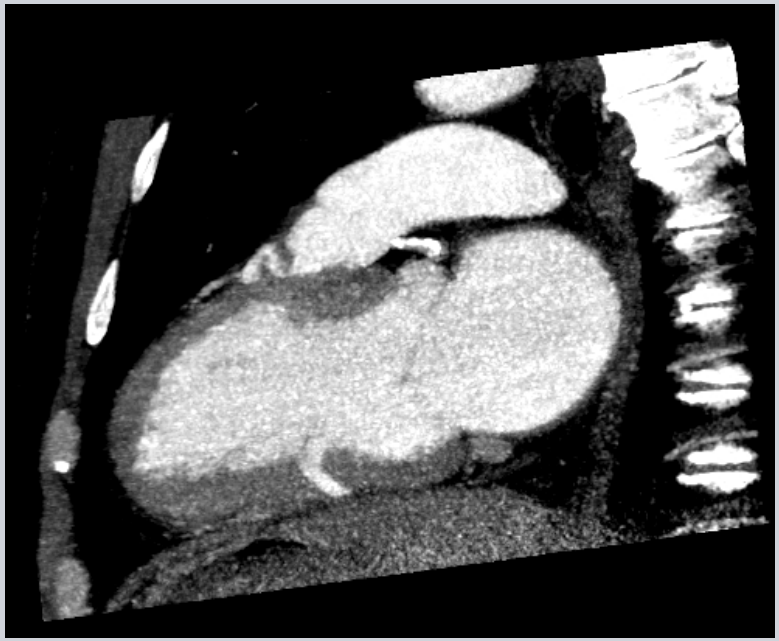
Ghersin et alS. Comprehensive multidetector CT assessment of apical hypertrophic cardiomyopathy. Br J Radiol 2006;79(948):e200–e204

Noncontiguous HCM in a 38-year-old man with electrocardiographic abnormalities of ST elevation in leads V2 through V4 and T-wave inversion in leads V4 through V6.



Maron MS, et al. Hypertrophic cardiomyopathy phenotype revisited after 50 years with cardiovascular magnetic resonance. J Am Coll Cardiol 2009;54(3):220–228.

Preclinical HCM: LV Crypt

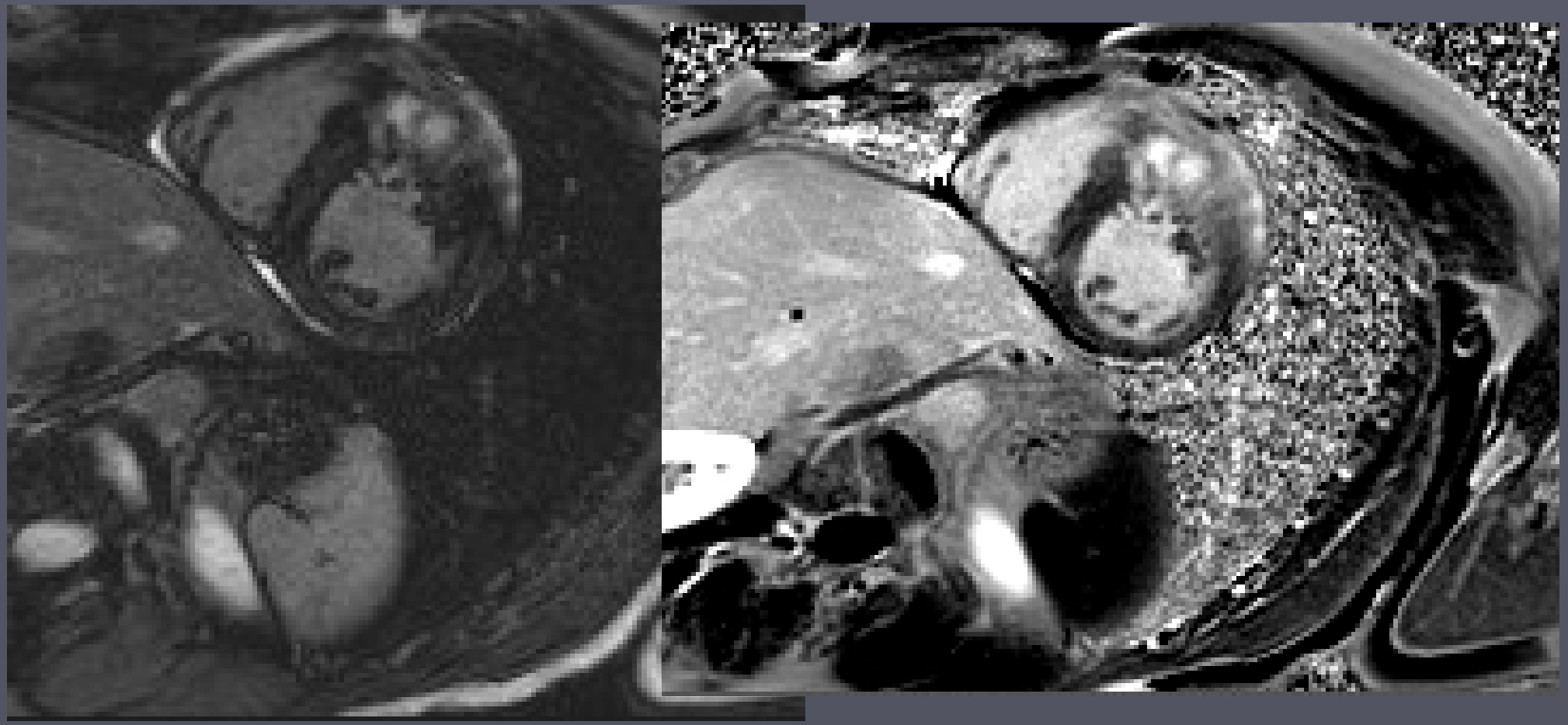


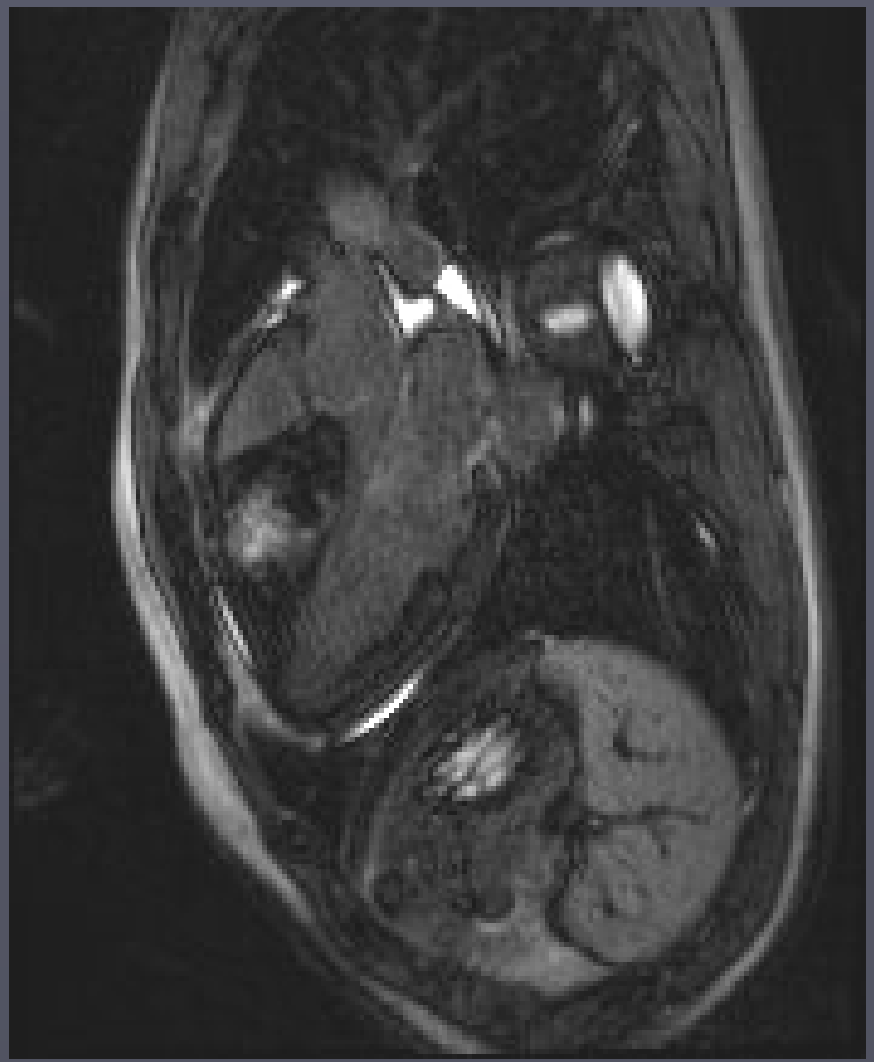
Risk Stratification of HCM

(predictor of the risk of sudden death)

- LV maximal wall thickness of 30 mm or more
- LVOT gradient of 30 mm Hg or more at rest or 50 mm Hg or more with provocation
- LV dilatation with depressed ejection fraction
- Presence of fibrosis
- Perfusion defect
- Reduced functional reserve flow

Significance and Clinical Implications of LGE

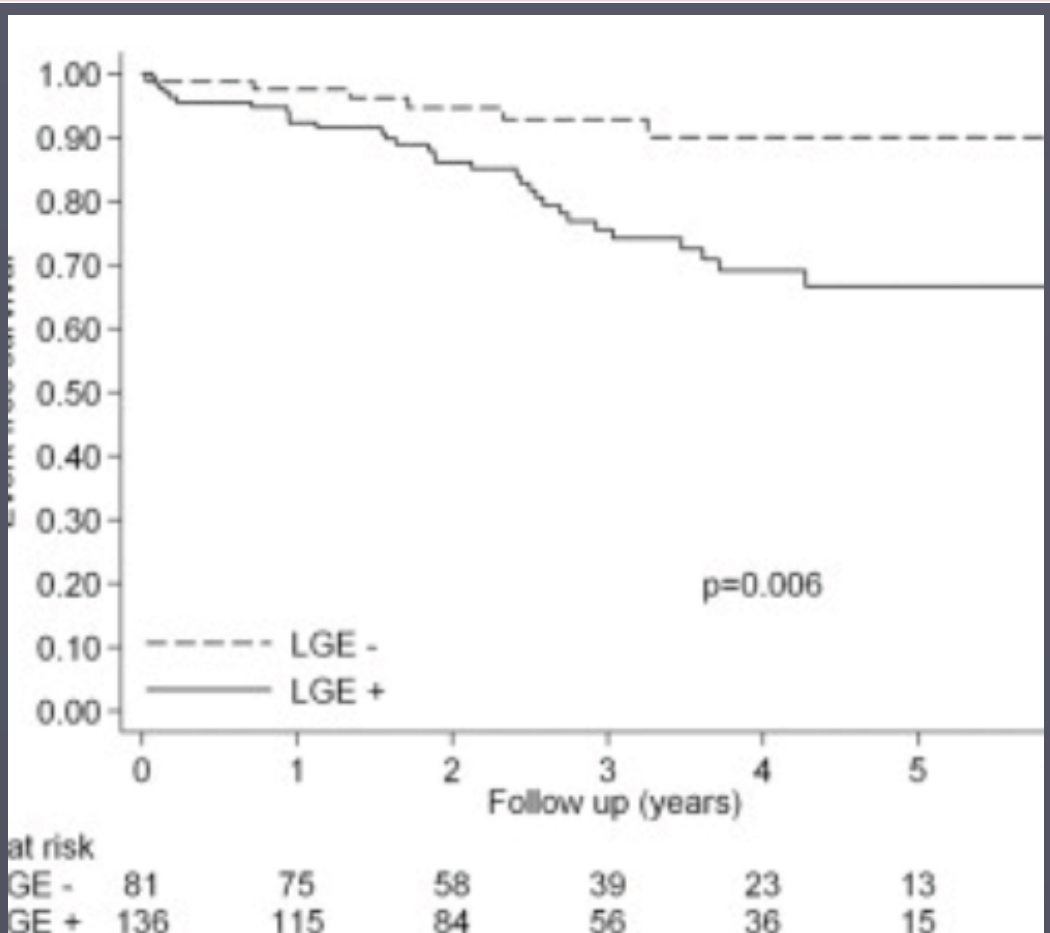




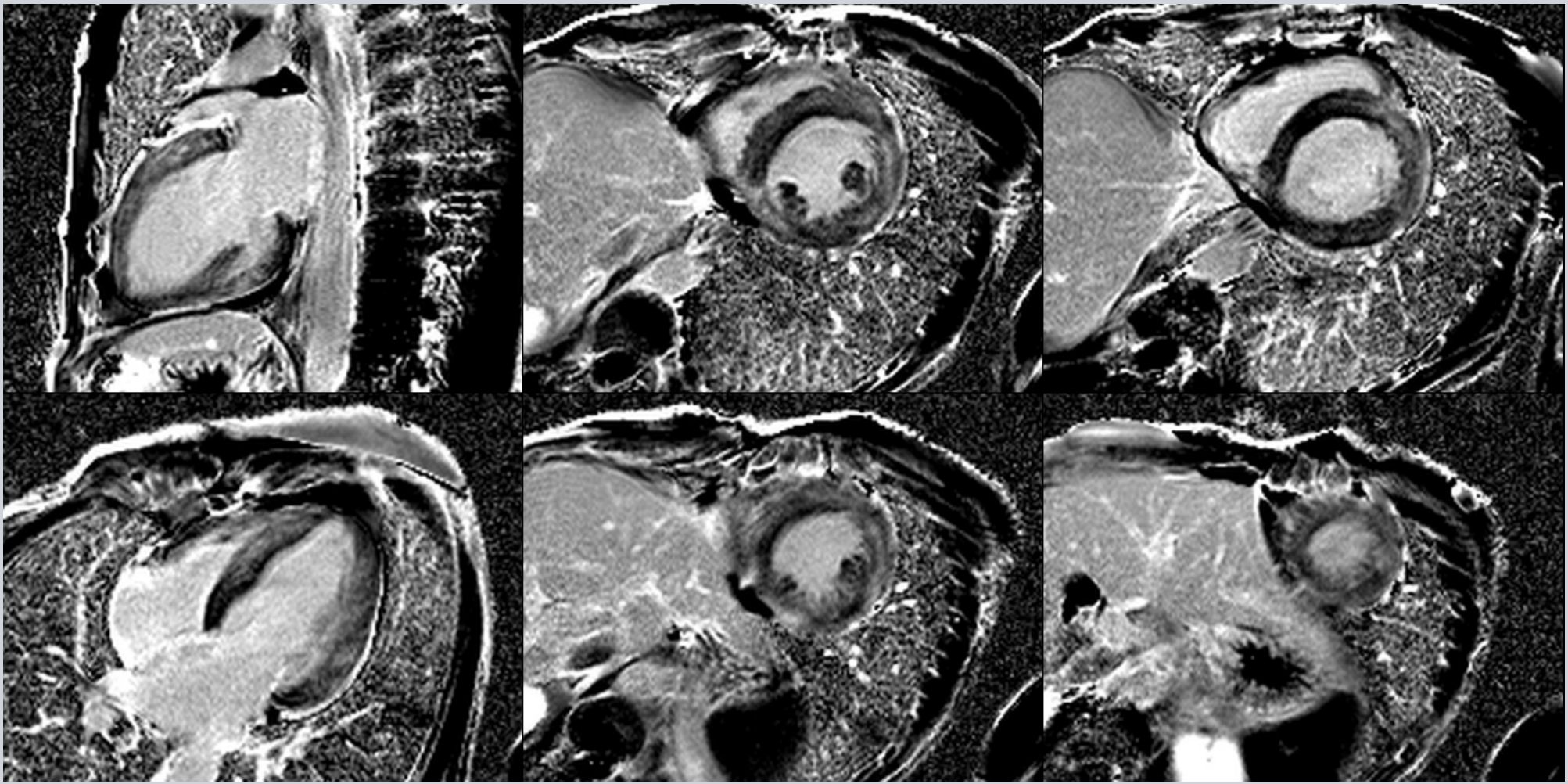
Prognostic Significance of Myocardial Fibrosis in Hypertrophic Cardiomyopathy

Rory O'Hanlon, MD,* Agata Grasso, MD,* Michael Roughton, MSc,¶ James C. Moon, MD,§ Susan Clark, RN,* Ricardo Wage,* Jessica Webb, MD,* Meghana Kulkarni, MD,* Dana Dawson, MD, PhD,* Leena Sulaibeekh, MD,* Badri Chandrasekaran, MD,* Chiara Bucciarelli-Ducci, MD,* Ferdinando Pasquale, MD,§ Martin R. Cowie, MD,† William J. McKenna, MD,‖ Mary N. Sheppard, MD,‡ Perry M. Elliott, MD,‖ Dudley J. Pennell, MD,* Sanjay K. Prasad, MD*

London, United Kingdom

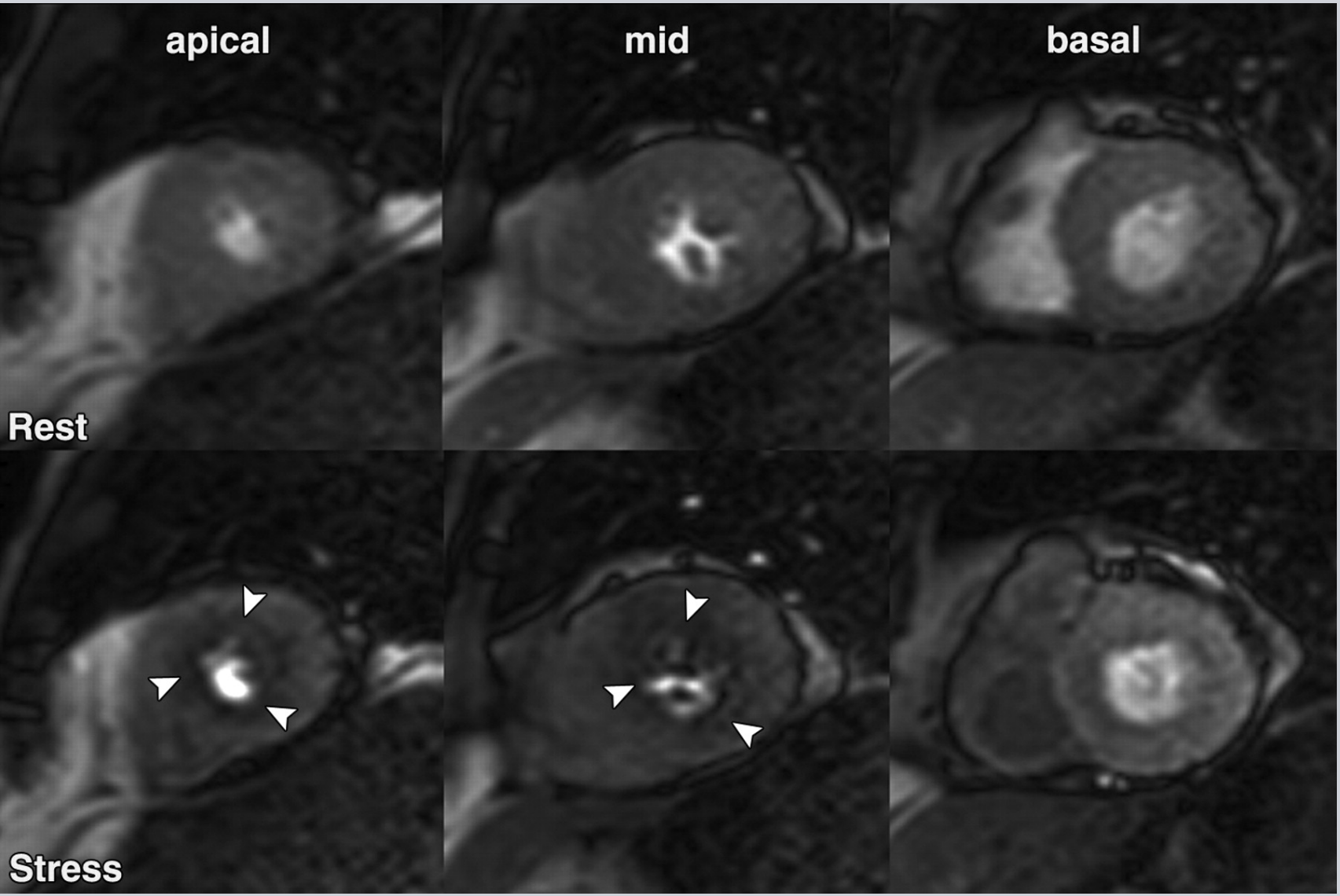


HCM in a 46-year-old man with recurrent ventricular tachycardia.

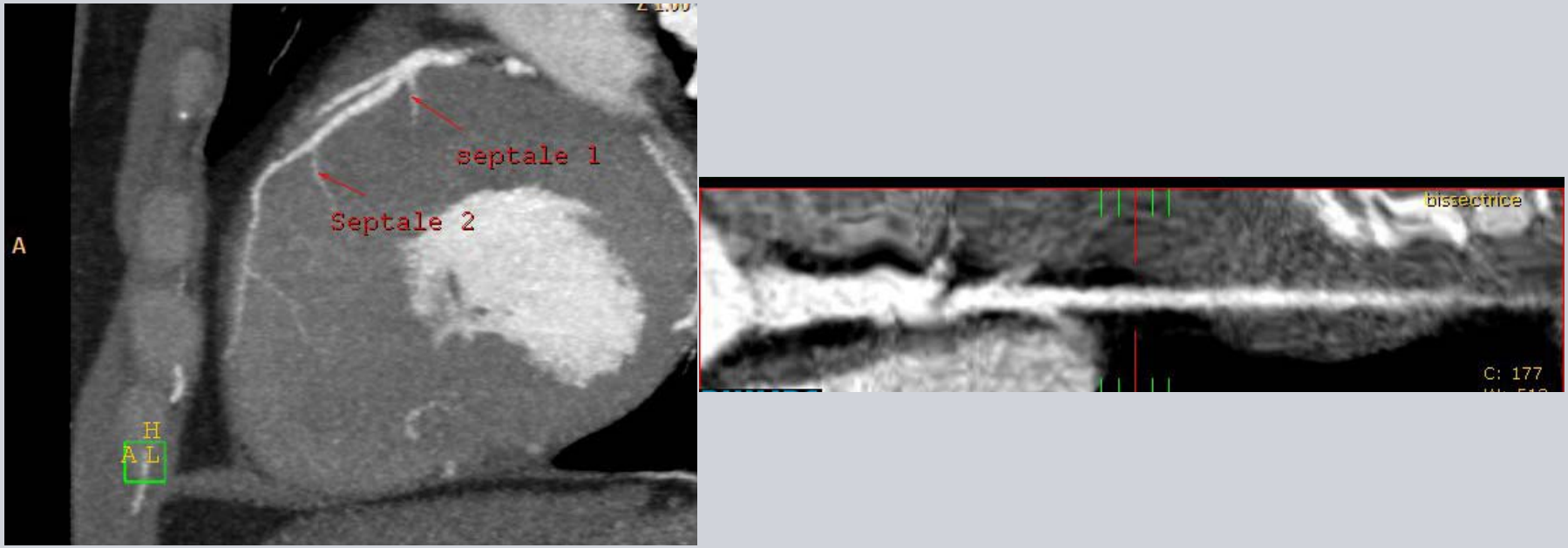


- **Delayed hyperenhancement has been correlated with**
  - **wall thickness**
    regional wall motion abnormalities
  - **development of ventricular tachyarrhythmia**

Midventricular to apical HCM in a 67-year-old man with chest discomfort.



HCM: MDCT Myocardial Bridge



rest

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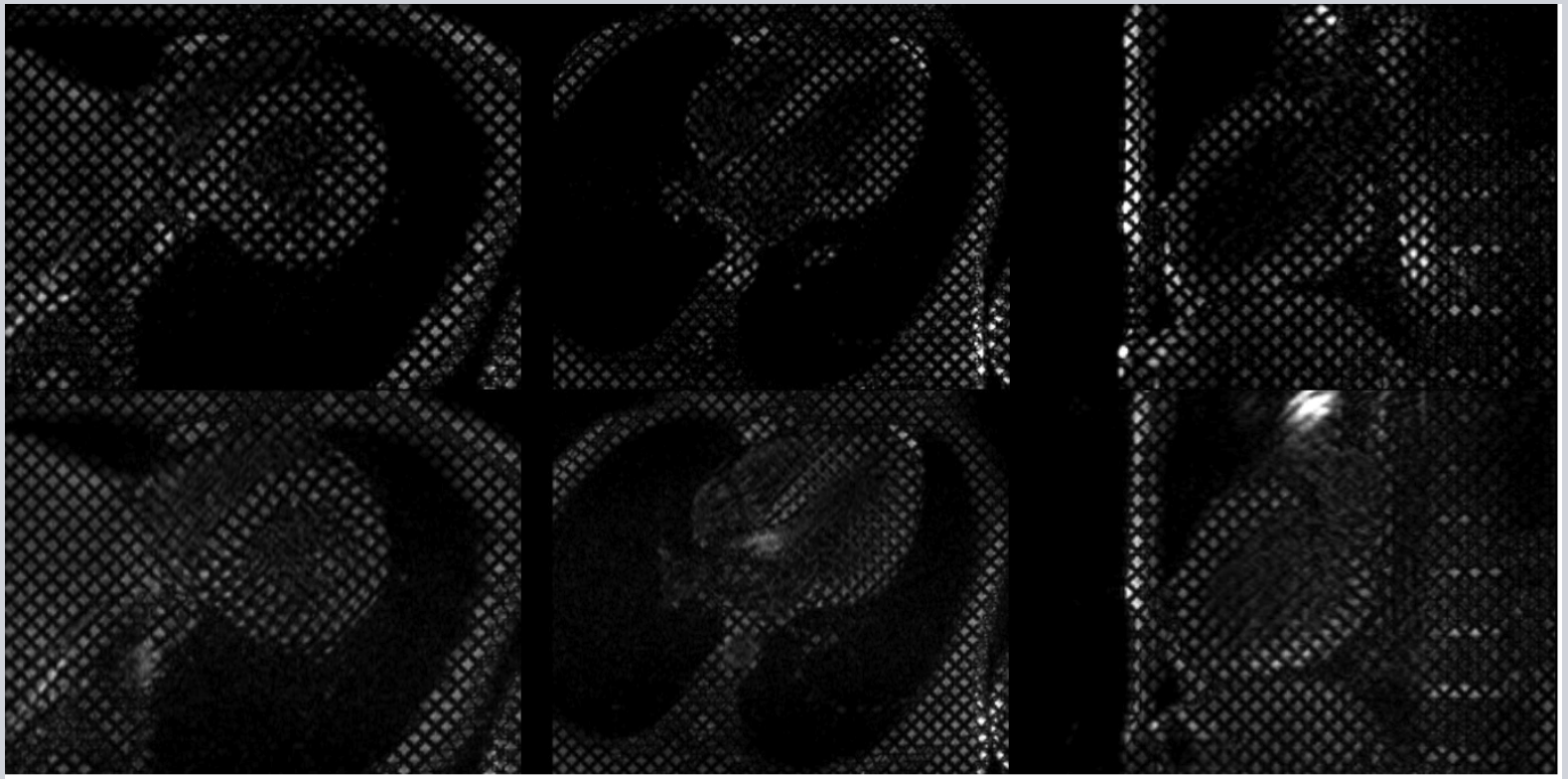

SA

rest

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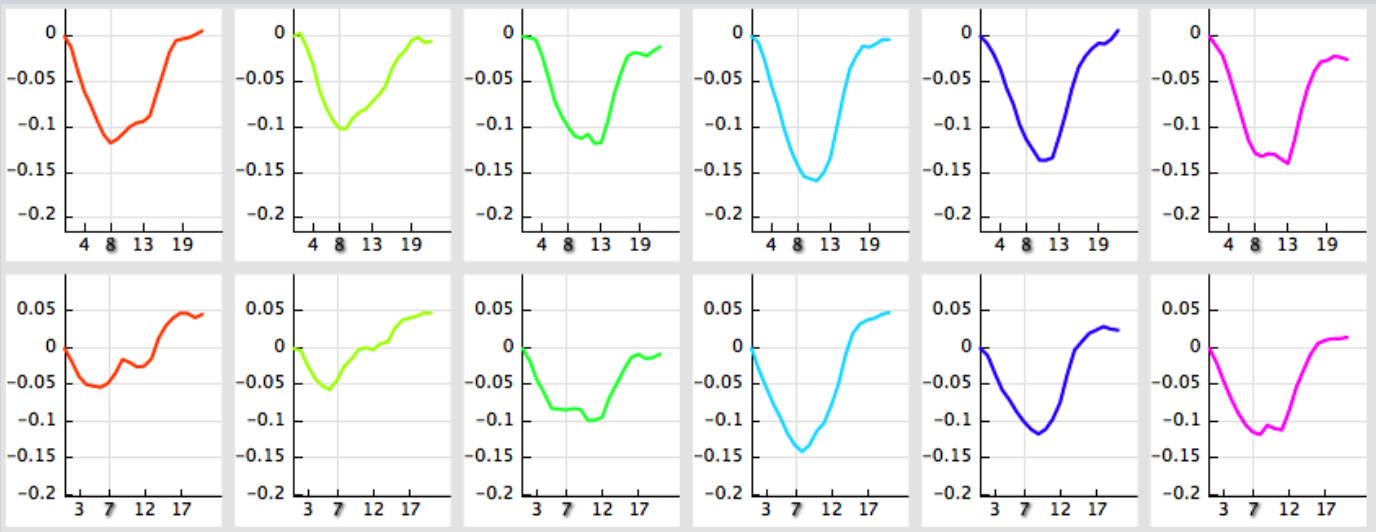
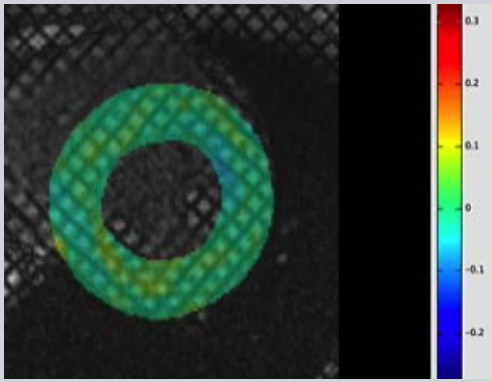
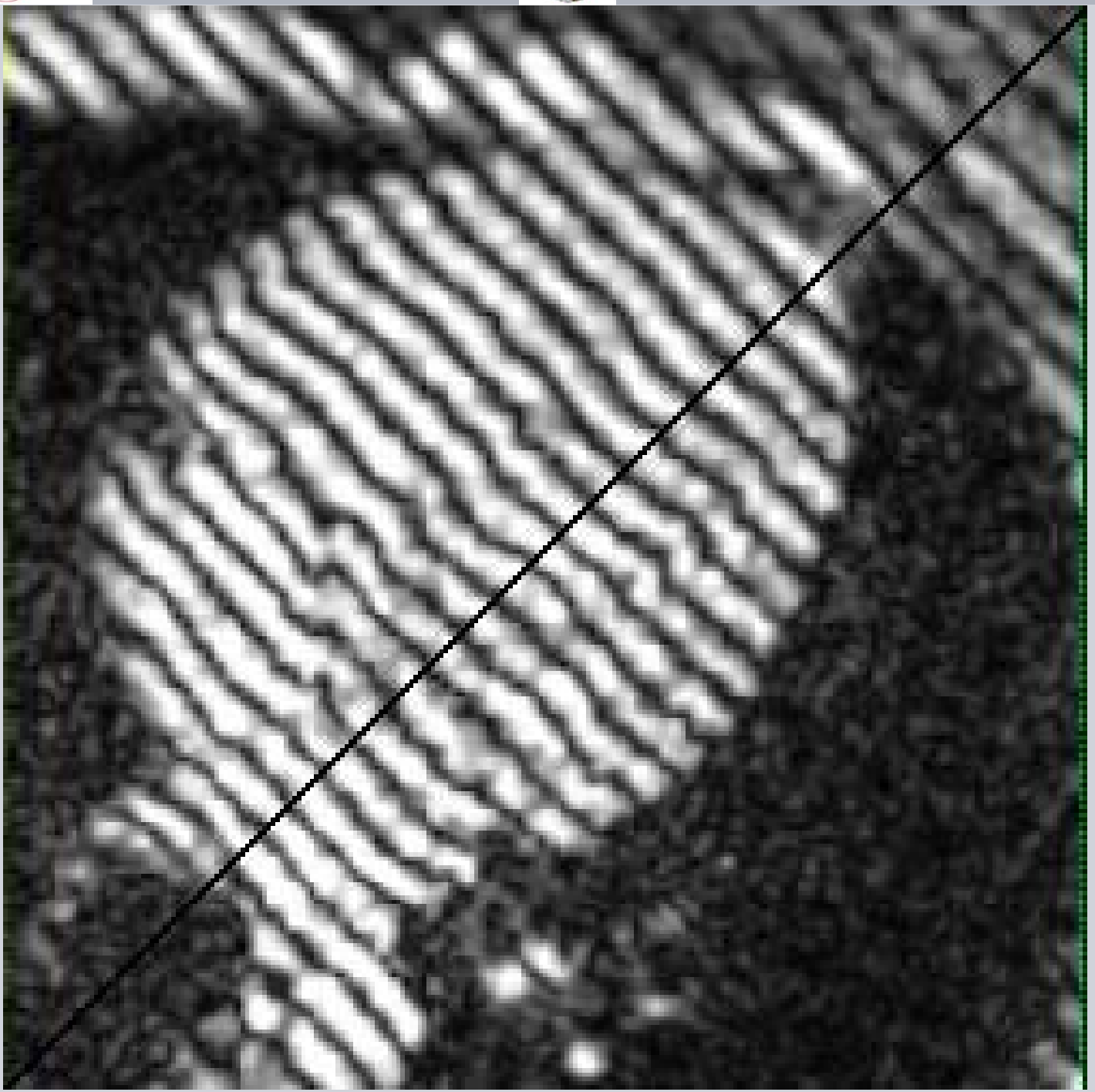
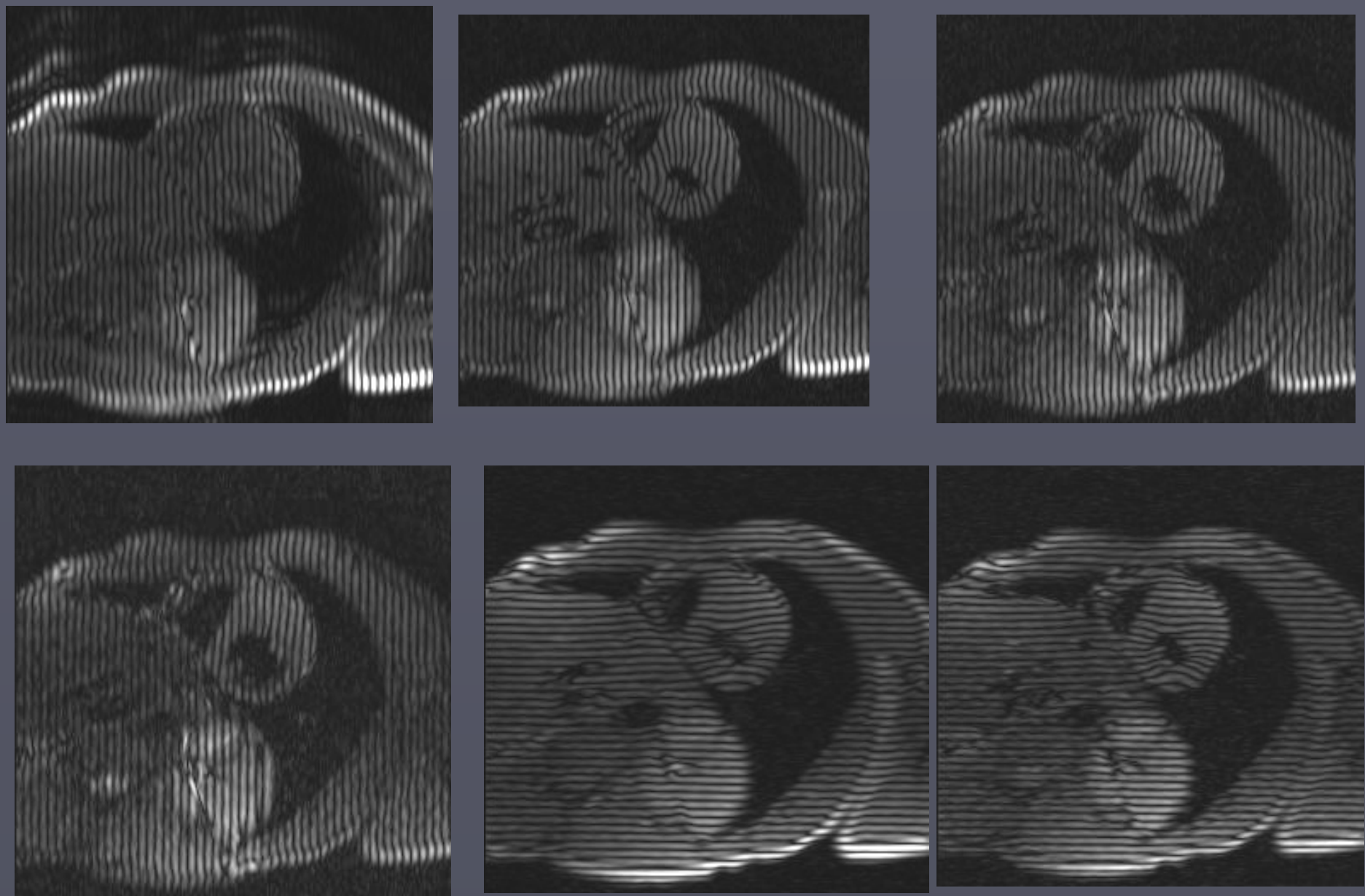


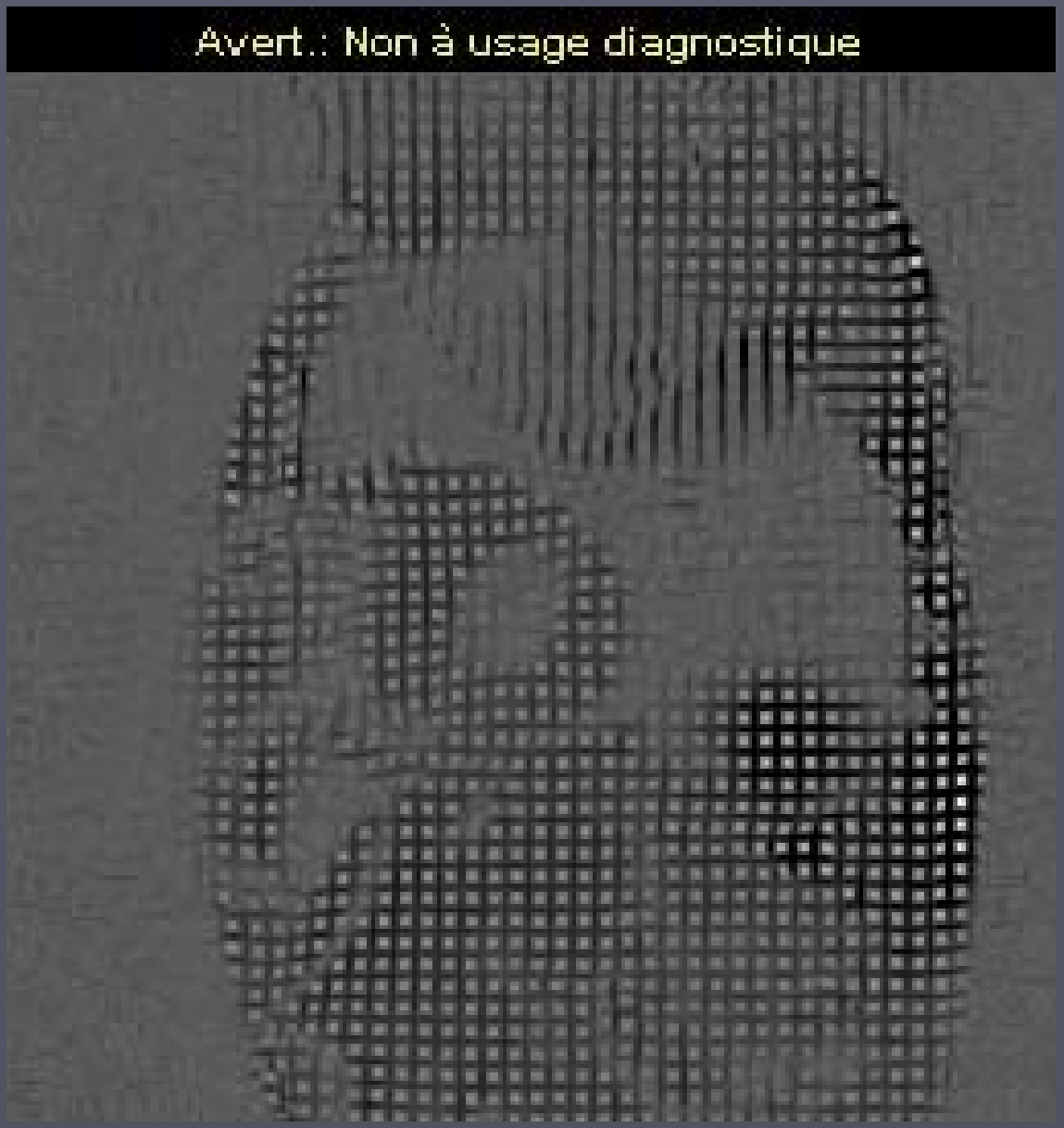


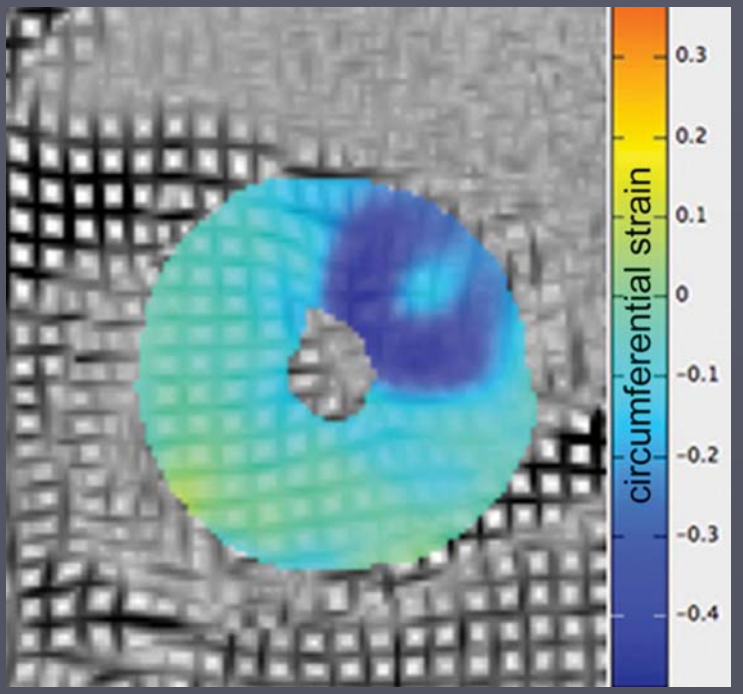
InTag *in OsiriX*

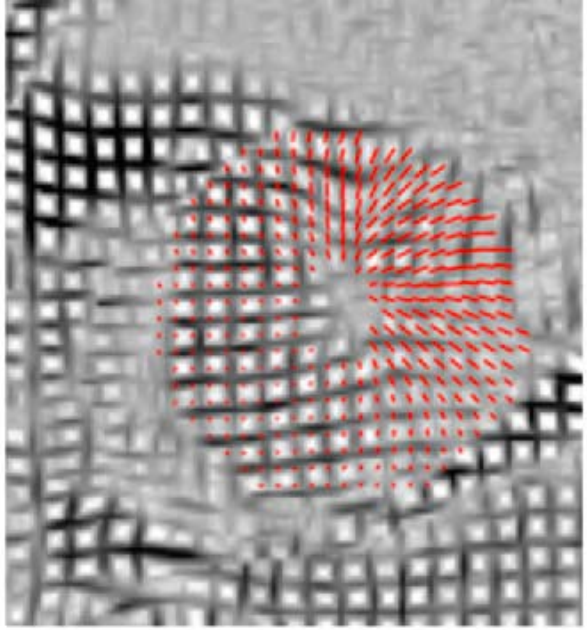
Creatis LRMN

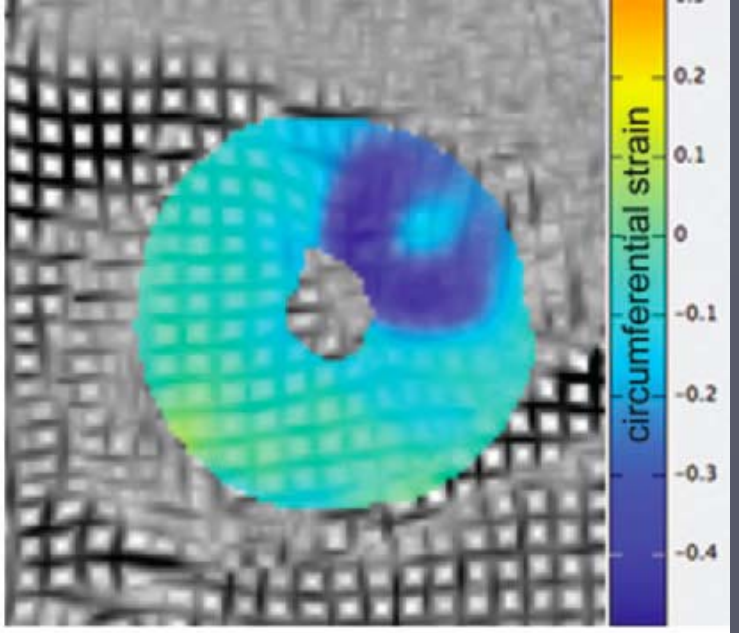





Avert.: Non à usage diagnostique

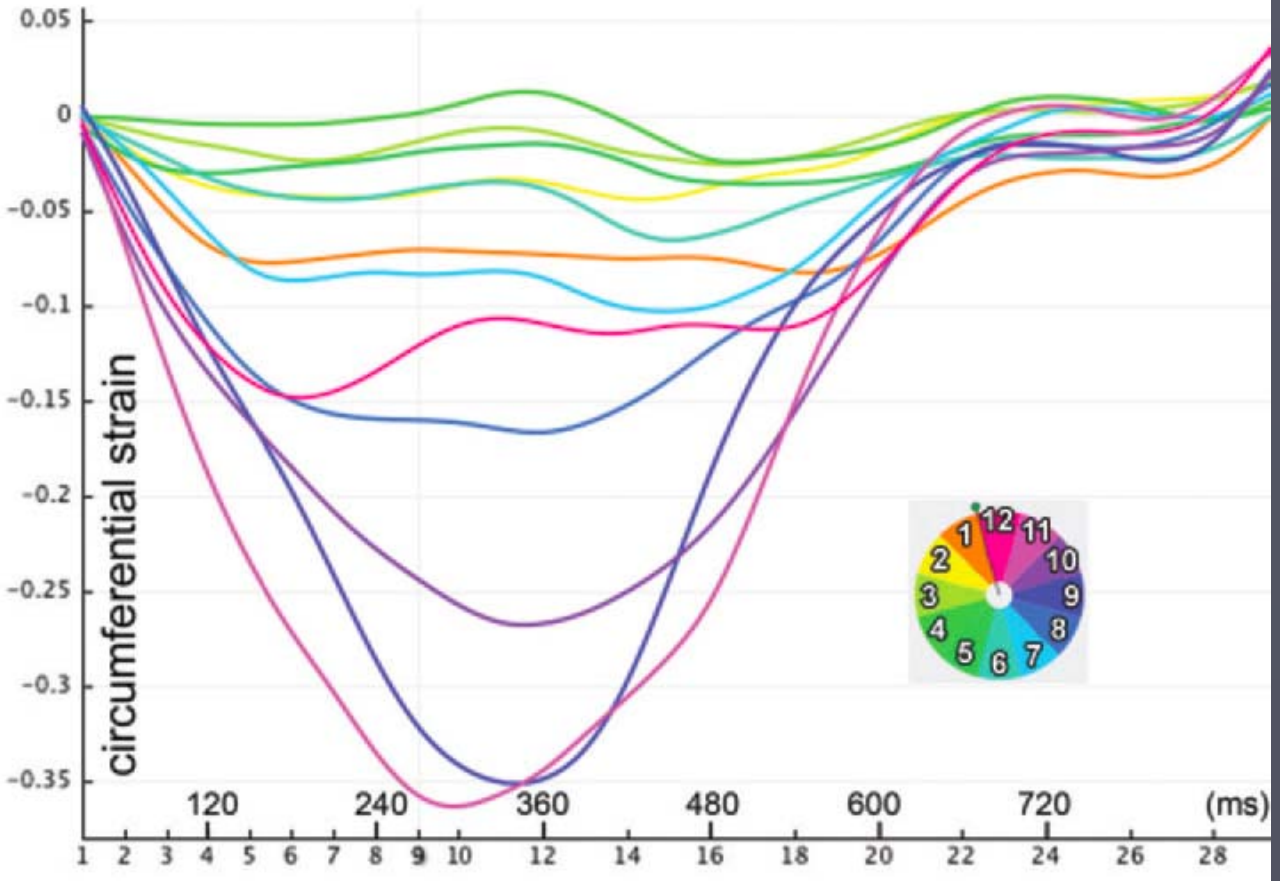

circumferential strain
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4




circumferential strain
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4

14b.

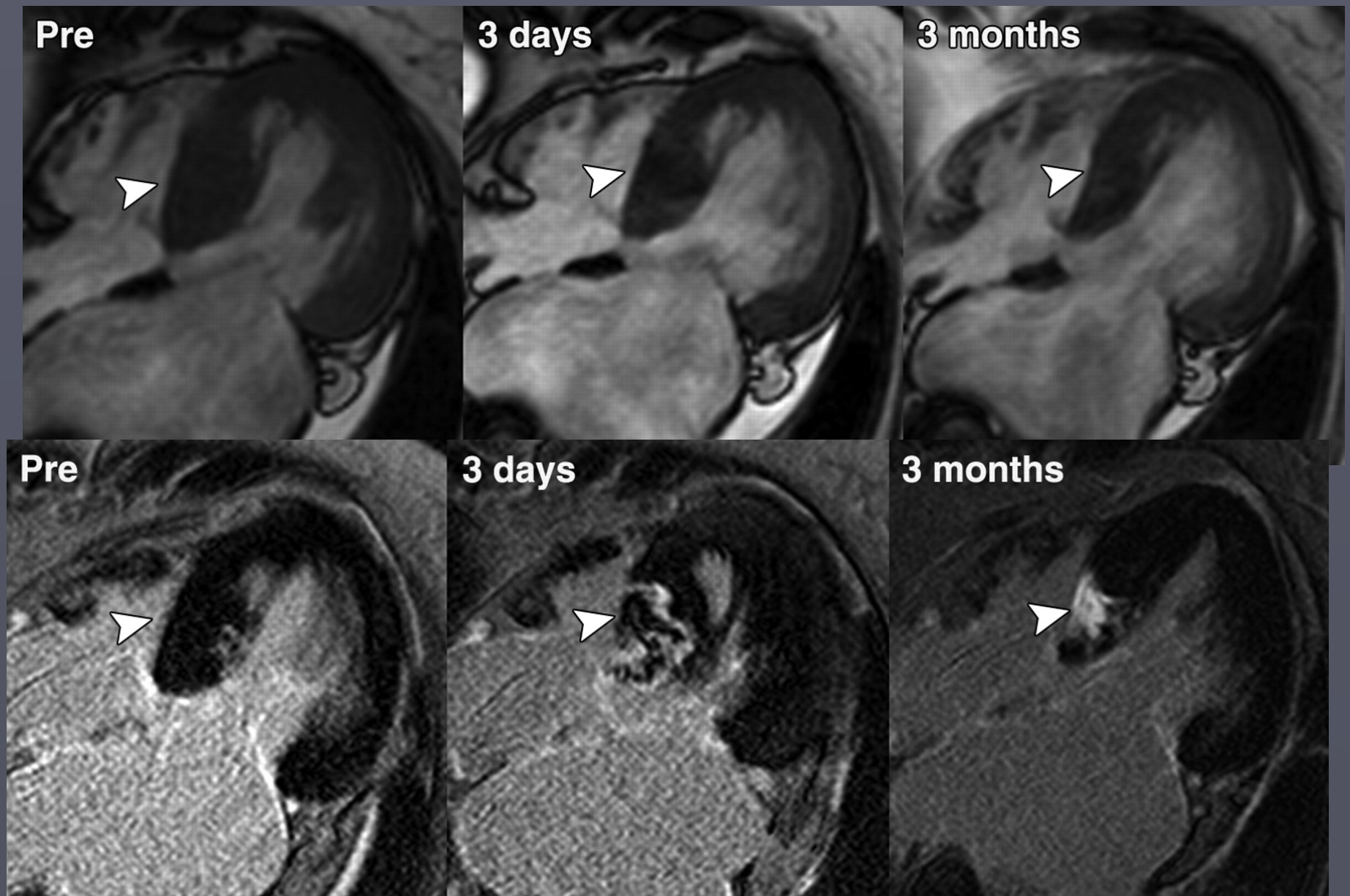
14c.


0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
circumferential strain
120
240
360
480
600
720
(ms)
1 2 3 4 5 6 7 8 9 10 12 14 16 18 20 22 24 26 28
12
1
11
2
10
3
9
4
8
5
6
7

Additional Considerations

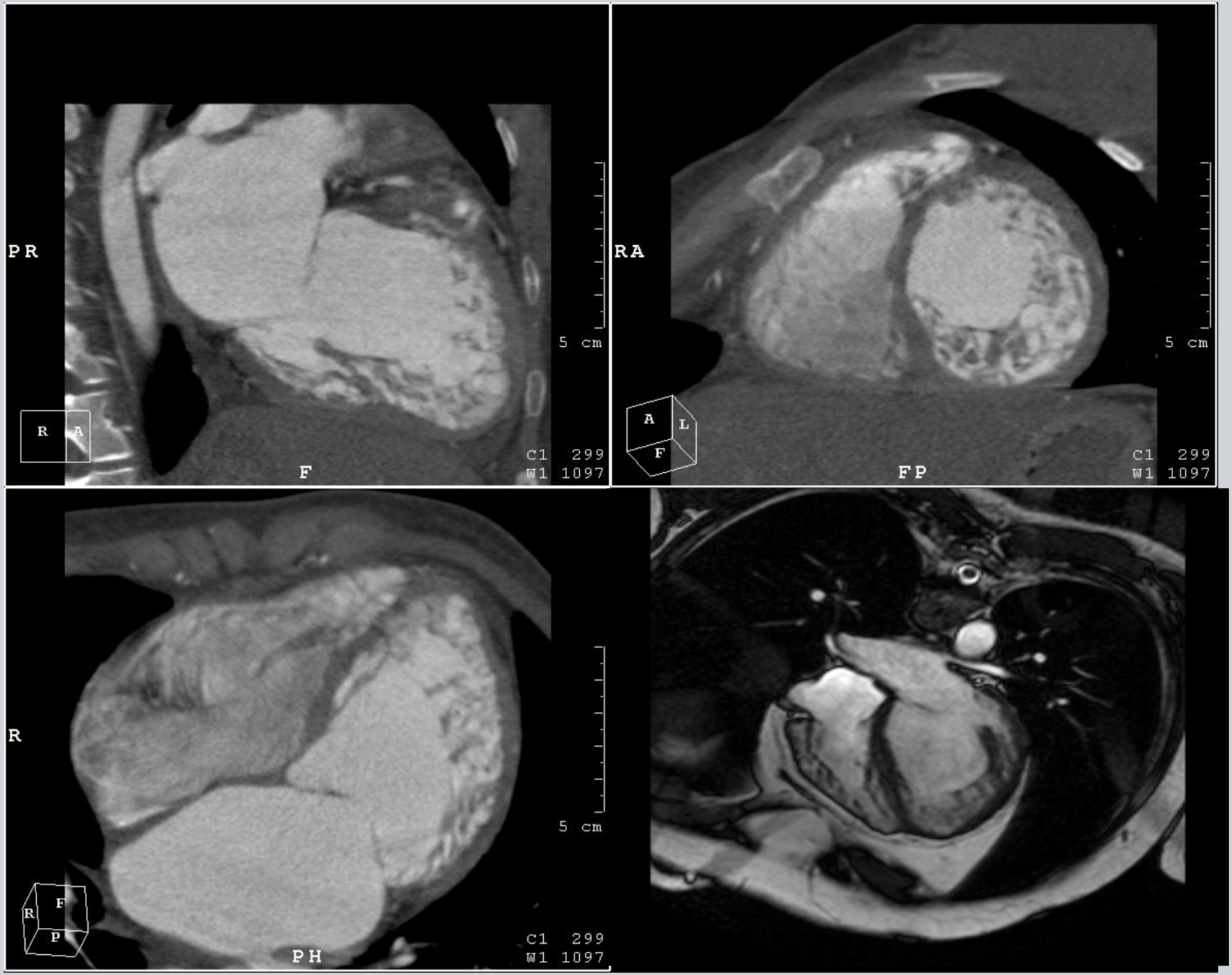
Alcohol septal ablation

Asymmetric (septal) HCM with LVOT obstruction in a 74-year-old man who was treated with septal alcohol ablation.

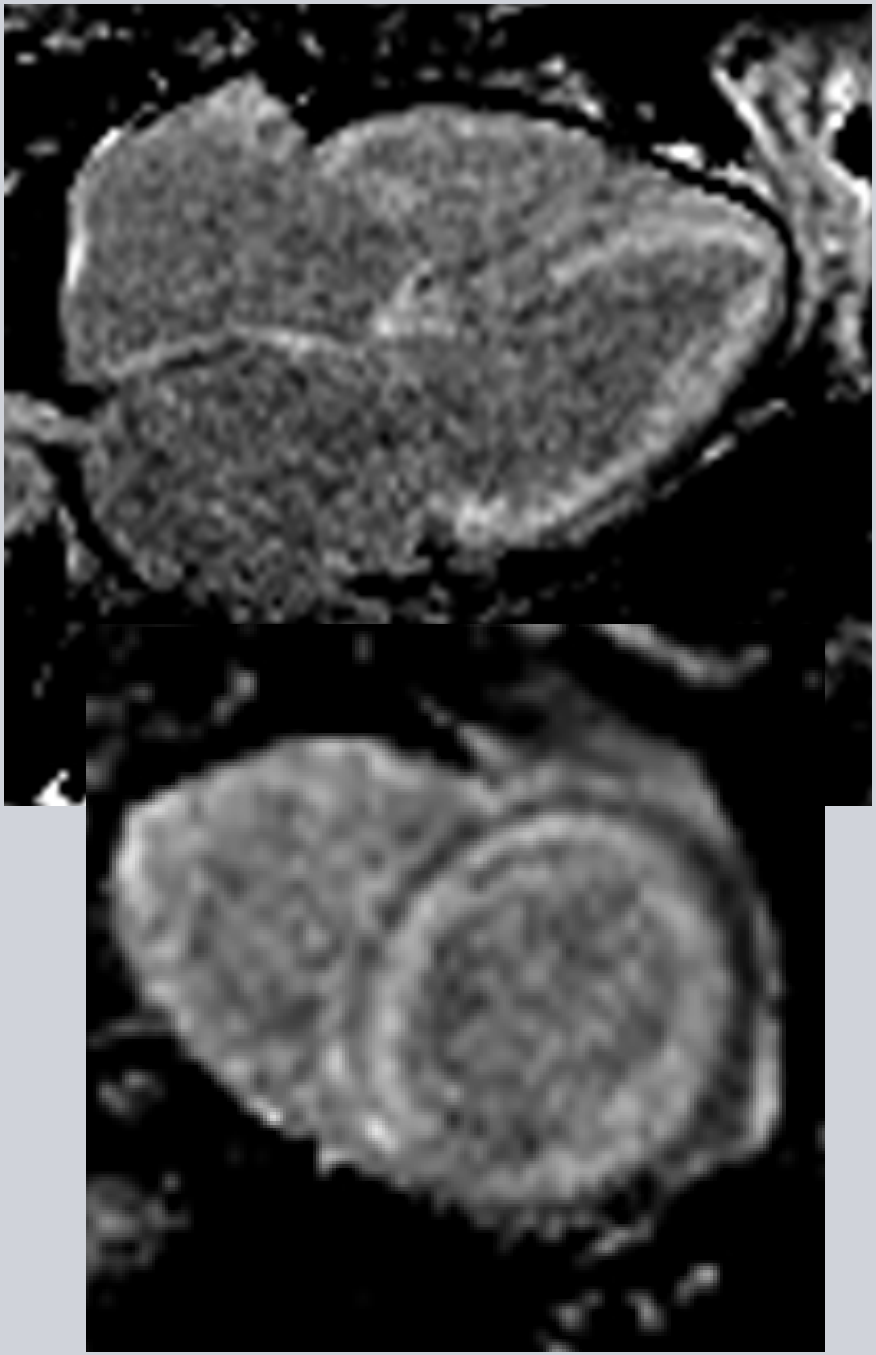


Role for CMR in Differential Diagnosis of LV hypertrophy

Differential Diagnosis: MDCT MRI LV Non Compaction



Symmetric HCM (concentric HCM:) Cardiac amyloidosis in a 58-year-old man with dyspnea.



CONCLUSIONS

- Cardiac MR imaging or MDCT should be considered as the reference standard for establishing a diagnosis of HCM when
  - the results from echocardiography are inconclusive

  are suspected of being false-negative findings.

- Cardiac MR imaging is a powerful imaging modality for :
  - differentiating HCM from other cardiomyopathies
  - risk stratification of HCM in selected patients.

- Cardiac MDCT is less useful for the assessment of HCM currently because:
  - MDCT involves radiation exposure and contrast medium– related problems
  - provides less information than MR imaging:
    - hemodynamic information, tissue characterization such as fibrosis

- Cardiac MDCT would be more appropriate :
  - when specific anatomical details are requested
  - to exclude coronary artery disease and i
  - In patients with contraindications for MR imaging, such as a pacemaker