Analysis of cardiac deformation from MRI:
Initial experience of a cine DENSE acquisition at 1.5T compared with feature tracking

Eva Maret[1,2], Britt-Marie Ahlander[2], Per-Gunnar Björklund[2], Johan Kihlberg[3,4], Jan Engvall[4,5,6]

1 Karolinska University Hospital, Dpt of Clinical Physiology, Stockholm, Sweden
2 Ryhov County Hospital, Dpt of Radiology, Jönköping, Sweden
3 Linkoping University Hospital, Dpt of Radiology, Linköping, Sweden
4 Linkoping University Hospital, Center for Medical Image Science and Visualization, Linköping, Sweden
5 Linkoping University Hospital, Dpt of Medical and Health Sciences/CVM/Clinical Physiology, Linköping, Sweden
6 Linkoping University Hospital, Dpt of Clinical Physiology, Linköping Sweden

Introduction

Myocardial deformation can be used for the objective quantification of myocardial contraction. Feature tracking (FT) is a recently introduced technique that uses image processing of cine MRI. DENSE, "displacement encoding with stimulated echoes", has high spatial resolution, but was previously available only at a few time points in the cardiac cycle. Our aim was to detect peak strain applied with DENSE compared to FT.

Methods

Twenty-four patients were investigated, mean age 53 ±15 years. DENSE was acquired from a midventricular slice as well as cine and scar images. DENSE analysis was performed using "CIM" software, University of Auckland, NZ, and was reported in the circumferential and radial directions. Feature tracking analysis was performed on the corresponding cine slice using commercially available software (2D-CPA, TomTec). Volumes and ejection fraction were obtained with SyngoVia (Siemens).
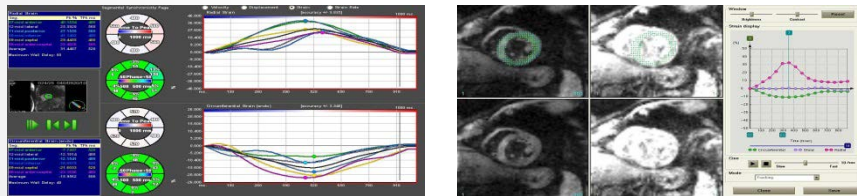

Fig 1. Example of a patient of good tracking quality. Left: feature tracking in radial direction upper graph and cicumferential lower graph. Right: analysis of DENSE. Graph to the right shows strain in radial direction (red) and circumferential (green).
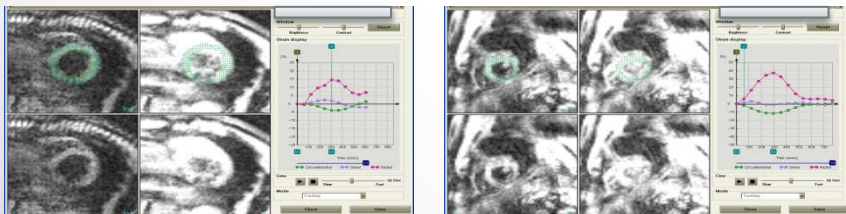

Fig 2. Image problems in DENSE acquisition and tracking. To the left an example of diastolic fading causing an increase in diastolic strain value. To the right good tracking despite poor acquisition quality.

Results

Mean LV volume was 218 ml, LV mass 168 g and ejection fraction 41%.
Image quality was satisfactory in cine allowing FT to be performed in all patients. The DENSE acquisition showed artifacts or fading that negatively affected analysis in 8 of the 24 patients. Circumferential strain DENSE was -9.9% and FT -14.5%, mean difference 4.8 percentage points (pp). Radial strain DENSE was 22.8% and FT 14.8%, mean difference 7.9 pp. Circumferential strain showed a fairly good agreement between DENSE and FT while radial strain had low agreement regardless of image quality (fig 3). In a comparison with ejection fraction as reference, circumferential strain with FT was clearly superior to DENSE (fig 4).
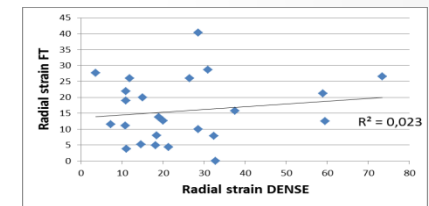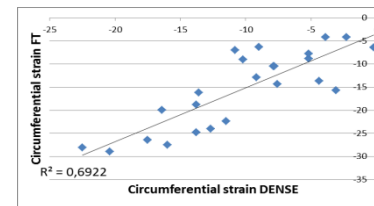

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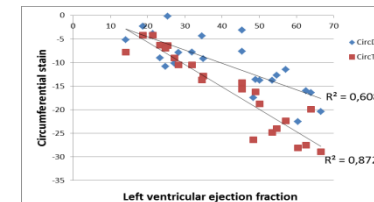

Fig 4. In a comparison with ejection fraction as reference, circumferential strain with FT was clearly superior to DENSE

Conclusions

This pilot study in unselected patients referred for cMRI showed that cine DENSE is feasible but needs further refinement in order to lower sensitivity to artifacts. In our experience attention has to be paid to the DENSE acquisition procedure to ensure optimal results.

Contact information: eva.maret@karolinska.se

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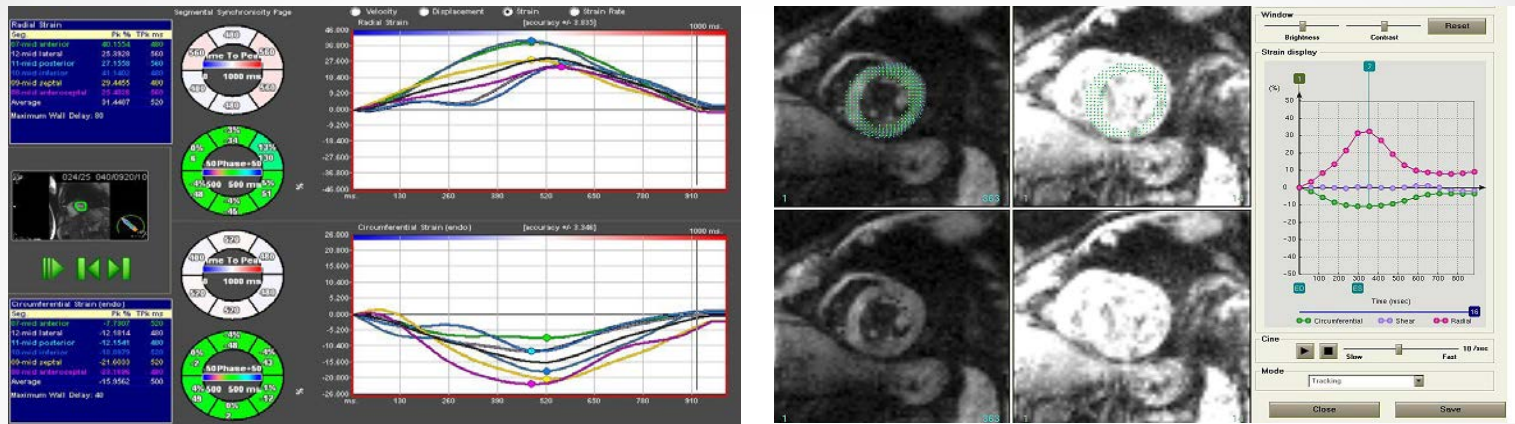Volumes and ejection fraction were obtained with SyngoVia (Siemens).

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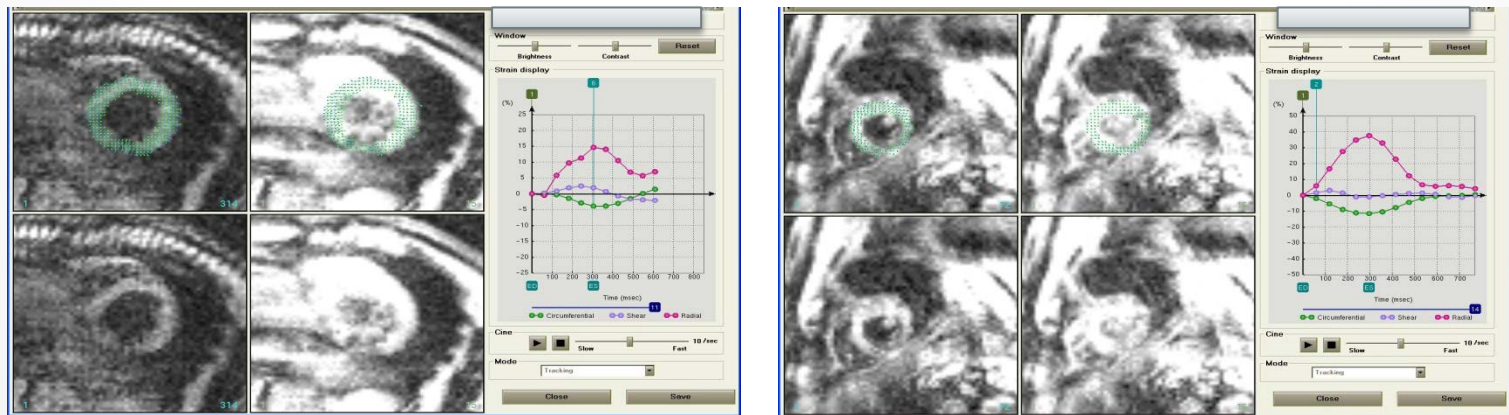

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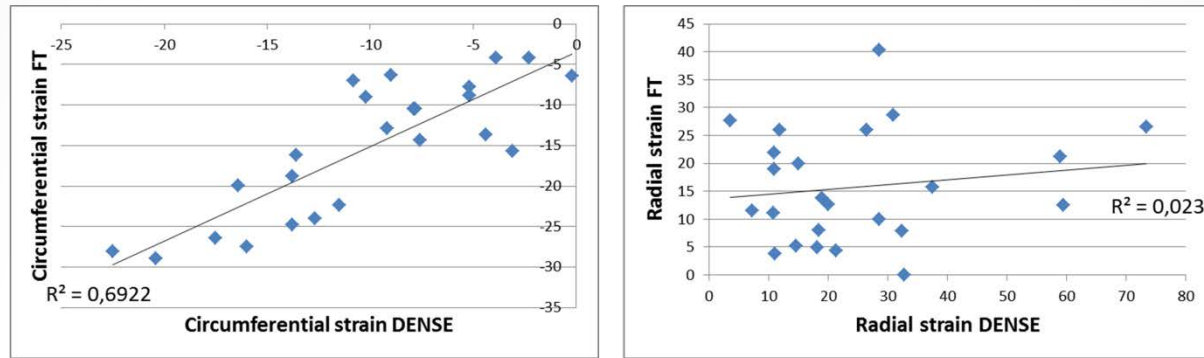
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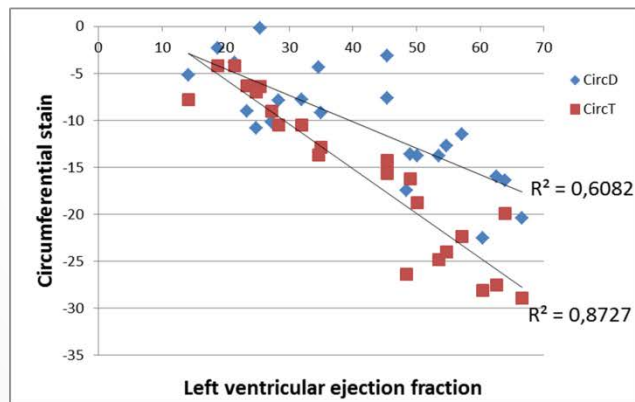

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