GE Healthcare

Automated Function Imaging (AFI)

Overview

Automated Function Imaging (AFI) provides a clinical decision support tool for assessing left ventricular function at rest. When left ventricular function can be visualized, yet assessment is questionable, AFI uses computerized quantitative assessment to highlight potential wall motion abnormalities. AFI can also potentially be used to differentiate disease from non-disease segments, and to learn more about the various strain patterns indicative of specific disease types.

The computerized assessment presents the data in four different modes: a parametric image, an anatomical M-Mode, a strain graph and bull's-eye display. The AFI algorithm non-invasively tracks and analyzes peak systolic strain based on 2D strain.

In addition to providing clinical decision support, AFI also decreases LV function assessment variability and streamlines workflow while improving laboratory quality assurance. The clinician selects the views to activate the algorithm, marks aortic valve closure timing critical to accuracy, and then anchors three points inside the myocardial tissue. The algorithm differentiates tissue from blood space to improve accuracy when defining the Region of Interest (ROI).

The three-click method minimizes variability potentially created in a manual tracing process. Two points placed at the base along the mitral valve annulus, and one at the apex, triggers the automated process. The clinicians can override the processed image results at any time.

AFI is available on Vivid™ 7 Dimension system and EchoPAC™ workstation. It can process and analyze data acquired on any GE Vivid product that meets the algorithm's minimum requirements.

How AFI works

The algorithm tracks the wall motion and calculates the percentage of lengthening or shortening in a set of three longitudinal 2D-image planes (apical long, two chamber and four chamber) and displays the results for each plane. It then combines the results of all three planes in a single bull's-eye summary, which presents the analysis for each segment along with a global peak strain value for the left ventricle.

Similar in concept to MRI tagging, AFI objectively analyzes myocardial motion by tracking features (natural acoustic tags) in the ultrasonic image in two dimensions (see Figure 1). AFI could potentially be used to differentiate disease from non-disease segments, and to learn more about the various strain patterns indicative of specific disease types.

Integrating into clinical practice

AFI is easily integrated into routine clinical practice. The following steps require little time to become proficient.

Vivid 7 Dimension AFI Acquisition

- Acquire APLAX, 4CH and 2CH and store. Acquiring all views consecutively will assure similar heart rate.

Vivid 7 Dimension and EchoPAC analysis

Measurement:

- Load APLAX view, press Measure and select AFI folder. Then define APLAX view.
- Define ROI by following instructions on screen.
- Assess tracking, then press Approve.
- Adjust AVC closure by preferred method.
- Repeat the define and assess process for A4CH and A2CH.

Analysis:

- Bull's eye and traces appear.
- Check correct AVC position.
- Store the bull's eye to transfer the measurements to the worksheet.

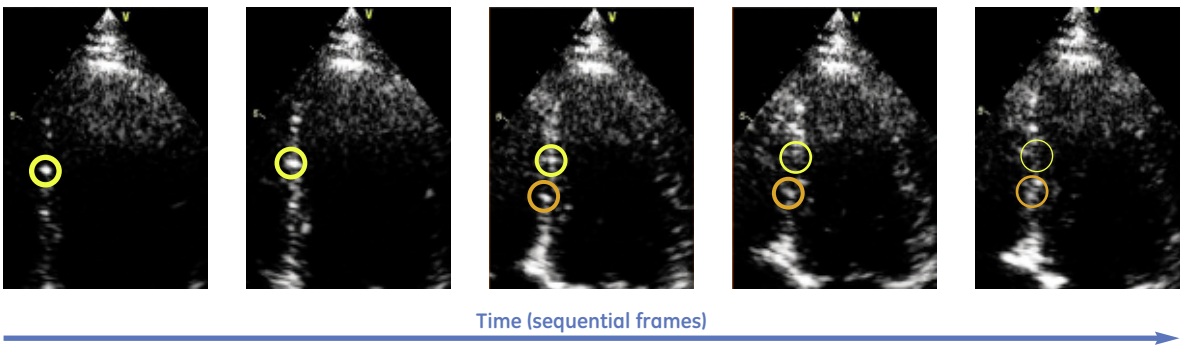


Figure 1.
Motion and velocities are analyzed by calculating frame-to-frame changes using "natural acoustic tagging." New features (orange circles) keep coming into the image as old ones (yellow circles) fade away.

AFI Simplified Workflow

AFI is a measurement. As with all measurements, it must be performed correctly to obtain an accurate value. With this in mind, AFI contains workflow enhancements to aid the non-expert user in obtaining a robust and reproducible measurement.

Quick Tips with expanded text

To increase productivity and reproducibility, there is a reference image demonstrating where to place the ROI. The reference image will update to the next ROI as one proceeds through the measurement. The users can also press "click here for tips" for a more detailed description and help (see Figure 1).

Figure 1.
Reference image and Quick Tips.

Trace screen for increased clinical confidence

The trace screen will display the strain curves and bull's eye derived from all three AFI views in a quad format. This allows the user to correlate the strain curves with the bull's eye (see Figure 2).

Adaptive Region of Interest (ROI)

AFI simplified workflow includes a semi-automated ROI. Correct placement of the three-endocardial points is important for an accurate strain measurement. Once the user places a point, the system will automatically assess and, if image quality allows, correct the position of the three points.

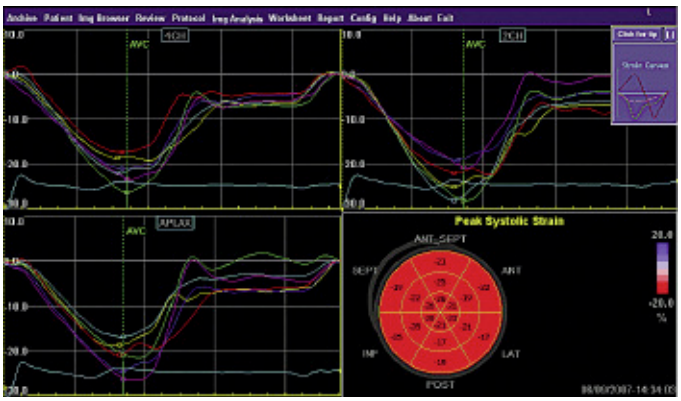
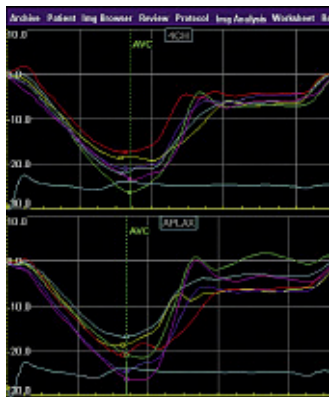
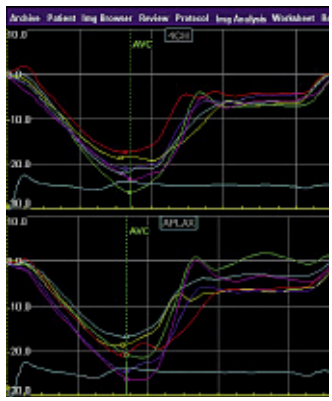


Figure 2.
Quad trace screen.



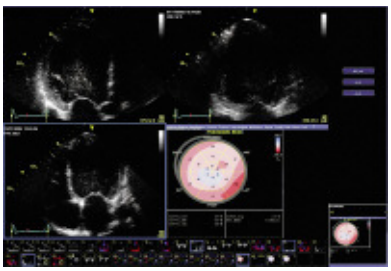
User placement of points.



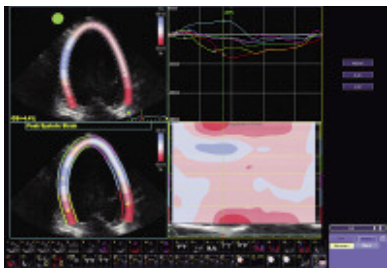
Adaptive ROI placement of points.

Case study one

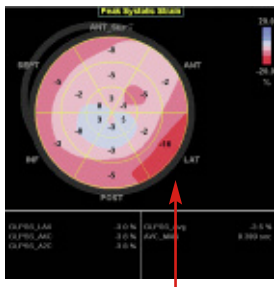
Evaluating cardiomyopathy correlating AFI with MRI



This patient had an MRI study showing diffuse scar with a regionally viable area that localized very well on the AFI strain bull's eye.

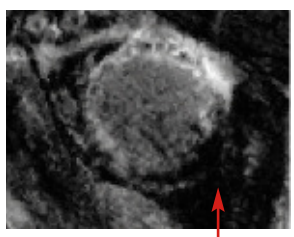


Display of the 2D parametric image, anatomical M-Mode, strain graph and bull's eye for each plane helps the clinician build knowledge of the patient's heart before the three planes are combined for final result.



AFI

The patient has non-ischemic cardiomyopathy with global hypokinesis and akinesis on MRI. AFI displays viable tissue in the lateral wall.

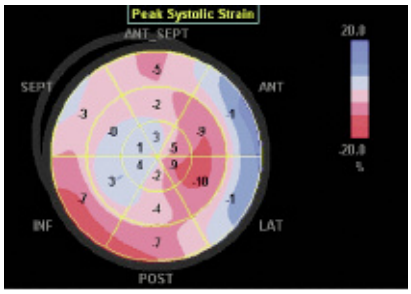


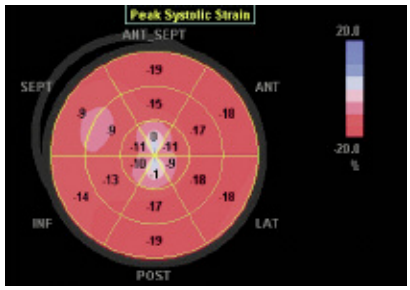
MRI

The contrast-enhanced MRI in the short axis shows extensive transmural scar with relative preservation of the lateral wall.

Case study two

Myocarditis





Myocarditis **Recovery**

The bull's-eye parametric image of the peak systolic deformation (strain) is from a patient with myocarditis. The left image was taken at the onset of the disease. The right image is after recovery.

Not all features may be available in your current software package. Please consult your sales representative to inquire about additional features for your Vivid 7 Dimension or your EchoPAC.

For more information on AFI, please visit us on the web at www.gehealthcare.com

References:

1. Becker M, Bilke E, Kuhl H, Katoh M, Kramann R, Franke A, Bucker A, Hanrath P, Hoffmann R. Analysis of myocardial deformation based on pixel tracking in 2D echocardio-graphic images allows quantitative assessment of regional left ventricular function. Heart. 2005 Dec 30;published online.
2. Korinek J, Wang J, Sengupta P, Miyazaki C, Kjaergaard J, McMahon E, Abraham T, Belohlavek M. Two-dimensional strain–doppler-independent ultrasound method for quantitation of regional deformation: validation in vitro and in vivo. J Am Soc Echocardiogr. 2005;18(12):1247-1253.
3. Reisner SA, Lysyansky P, Agmon Y, Mutlak D, Lessick J, Friedman Z. Global longitudinal strain: a novel index of left ventricular systolic function. J Am Soc Echocardiogr. 2004;17(6):630-633.

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imagination at work

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