

An introduction to Area Tracking, a new parameter using 3D Wall Motion Tracking

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Background

Area Tracking is a new parameter of regional and global LV function provided by 3D Wall Motion Tracking on the ARTIDA premium class ultrasound system from Toshiba Medical Systems.

3D Wall Motion Tracking (3D WMT) is based on the 3D speckle tracking technique and provides various parameters using a full volume dataset of the heart obtained over four or six heart cycles or by a one-beat acquisition.

The advantage of this method is that all segments of the LV can be analyzed in their anatomical relation to each other and that the acquisition is much faster than acquiring 2D planes covering the heart individually.

Based on a full volume dataset of the LV, 16 of 17 segments according to ASE or AHA standards are defined automatically. In each of these segments, hundreds of speckles are tracked and the results are displayed in a graphical plot. The basic information of speckle tracking is 'displacement' and from this information, various parameters, like real 3D strain, longitudinal and circumferential strain, twist and rotation can be calculated.

For LV function strain parameters are important because they reflect myocardial thickening or shortening. In 3D speckle tracking, longitudinal and circumferential strain are very stable and reproducible parameters and can be used for your clinical routine application.

What is Area Tracking?

To assess thickening of the myocardium in all segments real 3D strain can be used to provide the appropriate information in all segments. However, in daily routine tracking of both endocardial and epicardial speckle signals can be limited by the quality of the data due to limited image quality in some patients who are difficult to scan.

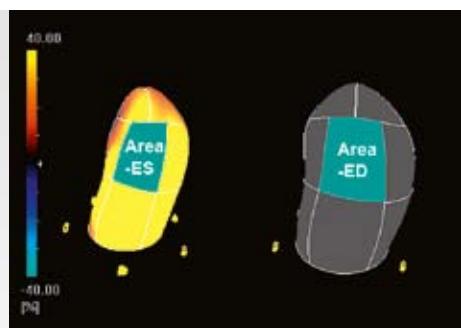
Area Tracking based on 3D Wall Motion Tracking reflects the 3D radial strain and is based on endocardial changes only, which makes the method very sensitive for detecting ischemic reactions in the myocardium which are most detectable in the sub-endocardial layers. Area Tracking reflects the deformation of the endocardial surface during LV contraction and relaxation.

Since an area is the product of length and width, Area Tracking can be considered a combination of longitudinal and circumferential tracking. A segment of the LV will change in shape during the cardiac cycle. The inner endocardial surface will decrease in systole due to longitudinal shortening (longitudinal strain) and circumferential shortening (circumferential strain) myocardial thickness will increase (radial strain).

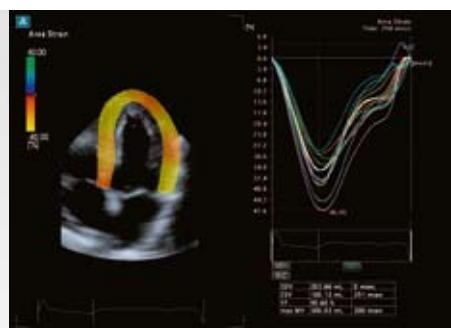
Since the myocardial volume (or LV mass) is constant during the cardiac cycle, the Area Tracking curve \times radial strain = constant. The Area Tracking value will be the inverse of the thickening which is reflected by 3D radial strain.

Global Performance Plot*

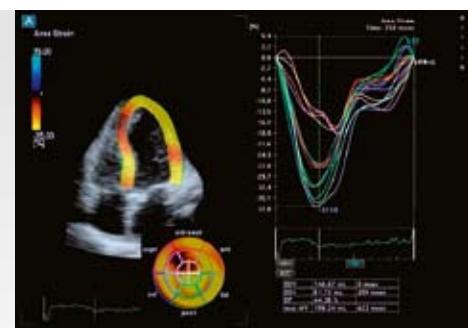
In order to present the outcome of a 3D WMT analysis, several parameters can be combined in a graphical display to facilitate readout of the contraction components. One example that is used for research purpose is the GPP (Global Performance Plot). In this plot the peak value of the global Area Tracking based on all 16 segments is



Endocardial surface area change of the mid-posterior segment in a normal heart.



Area Tracking in normal heart.



Area Tracking in case of an anterior infarction.

combined with the Standard Deviation Index (SDI) as presented by the group of M. Monaghan (S. Kapetanakis et al). In this case the Standard Deviation Index reflects the time-to-peak Area Tracking related to the heart cycle. In a normal heart, we find a global Area Tracking value of around 40 %, where the SDI is typical below 5 %. In case of ischemic heart disease, the global value will decrease where the SDI will increase.

Applications

Area Tracking can be calculated per segment, but it can also be displayed as a global LV parameter so it can be used in a variety of situations where it can add clinical diagnostic value to existing routine.

Routine echocardiography exams

Since reproducibility and robustness are high and can be applied to one-beat 4D acquisitions, Area Tracking can be integrated easily into routine echocardiography studies.

Stress echo

Since Area Tracking is based on endocardial changes which are highly sensitive for ischemic reactions in the myocardium, the application in combination with stress echo is a very promising tool to quantify stress echo readings.

Cardiac resynchronization therapy

Since Area Tracking is quite easy to use and robust and sensitive for dyssynchronous wall motion, it facilitates detection of dyssynchrony and can be used in the selection of patients for CRT. Also in the localization of delayed contracting segments and optimization of CRT devices, Area Tracking promises an easy and fast method to optimize the timing of the lead delays. Initial work is in progress to study the advantages of the method for this application.

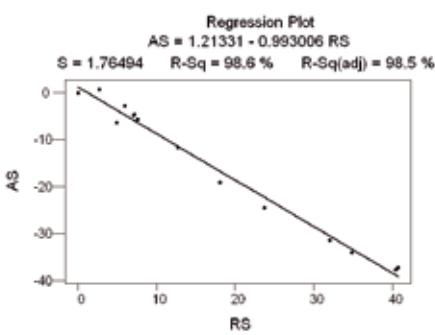
Conclusion

Area Tracking, a promising new parameter for clinical echocardiography routine, provides global and regional function simultaneously with the LV volume and ejection fraction. Applications in relation to screening and follow-up of patients with ischemic heart disease or CRT are being evaluated. Stress echo Area Tracking has the potential to provide objective parameters to evaluate stress echo data.

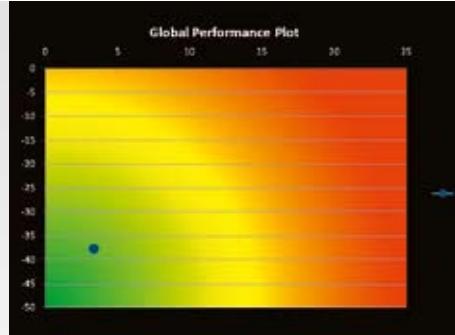
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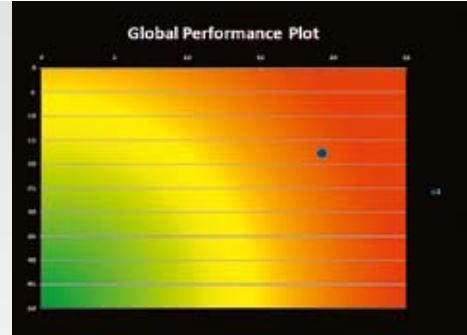
*works in progress, available for research now



An example of Area Tracking (or strain, AS) and radial strain relation in a normal individual measured with the Artida system. It reflects the close correlation between Area Tracking (AS) and radial strain (RS).



An example of the Global Performance Plot (GPP) based on Area Tracking in a normal individual. The typical normal plot shows a high Area Tracking value (38 % area change) combined with a low SDI of (3 %).



In case of dyssynchrony (on the right), a reduced Area Tracking value is found in combination with a high SDI value.

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