

Clinical Application of Real Time 3D TEE

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Real Time 2D TEE

- Transesophageal Echocardiography is part of heart surgery and cardiac anesthesia.
- It is an effective tool for fast evaluation of LV function, valve problems and atherosclerosis of the aorta.
- It is important in evaluating the results of cardiac surgery.

Real Time 2D TEE

- It needs advanced skills to use 2D images for describing 3D structures.
- Volume measurements are based on geometrical assumptions with significant errors.
- Exact localization of valve or other anatomical defects is difficult.

3D TEE

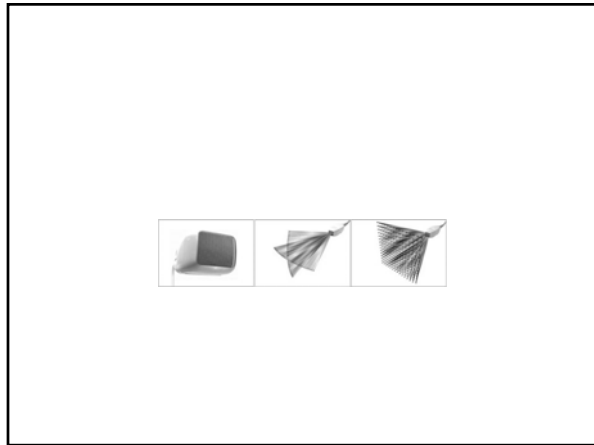
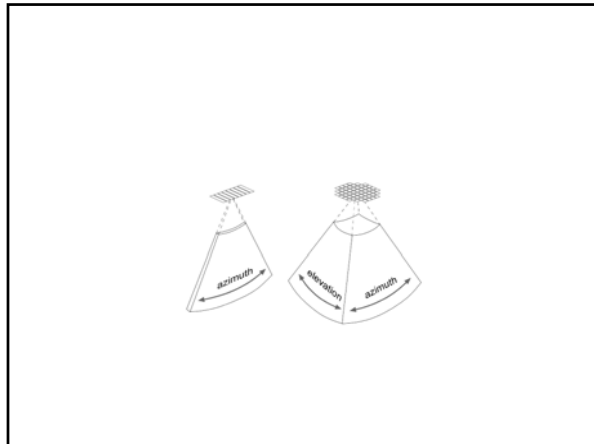
- There were attempts to reconstruct 3D structures from 2D images.
- These 3D TEE systems are sensitive for changes in ECG or ventilation and the image processing was time consuming.

Real-time Imaging

- The ideal way of three-dimensional echocardiography is on-line acquisition of a three-dimensional dataset of the heart without the need for ECG and respiratory gating avoiding spatial motion artifacts.

Real-time Imaging

- The system has a sparse matrix phased array transducer of 512 elements to scan a $60^\circ \times 60^\circ$ pyramidal tissue volume using parallel processing technology.



- The piezoelectric material in an ultrasound transducer is a fundamental determinant of system image quality.
- The same piezoelectric material – PZT (lead-zirconatetitanate) ceramics or PZT-composites – has been used for medical imaging for more than 40 years.

- A new PureWave crystal technology, a transducer technology using piezocrystals that exhibit improved electromechanical coupling.
- Compared to PZT ceramics, PureWave crystals are purer, more uniform, and are able to transfer energy with greater precision and efficiency.

Pure Wave Crystal Technology

Two microscopic images of PureWave crystals. The left image shows a rough, irregular surface. The right image shows a smooth, uniform surface with a grid-like pattern.

Real Time 3D TEE Transducer



Real Time 3D Echo

- Live 3D Echo provides quick and easy visualization of complex cardiac anatomy previously concealed during routine echo exams and has the potential for:
 - Better visualization of complex anatomic features
 - Better assessment of valvular function

Real Time 3D Echo

- Better visualization of catheters in 3D space
- Better assessment of global/regional function
- Better productivity due to decreased exam times

Real Time 3D Echo

- Modalities:
 - Parallel imaging
 - Live 3D
 - 3D Zoom
 - Full volume
 - Analyzing structures
 - Volume measurement
 - Color full volume images

Parallel Imaging

- View of the same structure in 90° rotation
- View of the same structure in rotation of variable angles

Live 3D Images

- Switch from 2D to 3D real time images
 - Real time image optimization
 - Real time rotation

3D Zoom Images

- Localize anatomical structures with parallel imaging
- Switch to zoomed real time 3D image
 - Rotation

Full Volume

- Analyzing Structures
 - Parallel imaging for optimizing the anatomical structures
 - ECG gated image collection
 - Analysis of 3D images
 - Rotation
 - Cropping for inspection inside structures

Full Volume

- Volume measurement
 - Parallel imaging for optimization
 - ECG gated image collection
 - Segment analysis
 - Parametric Imaging

Full Volume

- Color Full Volume Imaging
 - Color Doppler image of flow at valves or other structures
 - Parallel imaging for optimization
 - ECG gated image collection
 - Analysis of the color flow in 3D
 - Relating the flow to anatomical structures

Mitral Valve 3D Model

- LV full volume modality
 - Localization and orientation of the mitral valve
 - Add reference points to localize the annulus (8 points) and the coaptation line (4 points)
 - Scan the surface of the mitral valve using 18 cross-sectional views
 - Visualize the mitral valve model with detailed parameters