Knowledge-Based Automatic Slice-Alignment Method in Cardiac Magnetic Resonance Imaging for Aortic Valve Evaluation: Comparison with Inter-observer Error

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<u>Target Audience</u>   Radiologist, Radiologic technologist, Cardiologist

<u>Purpose</u>

Cardiac magnetic resonance (CMR) imaging is also very useful for functional evaluation of the cardiac valves such as the aortic valve and pulmonary valve because it can be used to examine the valve openings and their shapes and to calculate flow rates based on the flow curves obtained using the phase contrast method. However, detection of the reference planes for valve evaluation has been difficult. We have developed "CardioLine", which can automatically set the reference planes for the left and right ventricles, and have reported its usefulness. In the present study, we investigated the usefulness of "CardioLine" in detecting the aortic valve planes.

<u>Method</u>

The subjects were 5 healthy volunteers. Steady-state free precession sequences covering the range from the cardiac base to the apex were used to acquire multislice images in approximately 20 s (matrix = 256×256, slice spacing = 1.17×1.17, slice thickness = 7 mm, interslice gap = 7 mm, 16-21 slices). These images were scanned using a 1.5-T MRI system (Excelart Vantage™ powered by Atlas, Toshiba Medical Systems, Otawara-shi, Japan). The morphological features of the heart were extracted from these series of images using the knowledge-based recognition method, and all of the planes required for cardiac imaging were calculated based on the extracted features. Then, the planes for performing flow analysis at the aortic valve were determined and set as the reference planes. The accuracy of the detected planes was evaluated by comparison with the angular error between the planes set by three technologists with various levels of experience (35 years, 25 years, and 1 year) using the conventional method (inter-observer error). The reproducibility of plane setting by the three technologists using "CardioLine" was also evaluated.
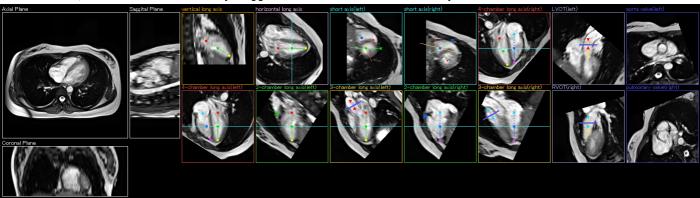
<u>Results</u>

Automatic slice alignment was performed successfully in all subjects, and slice alignment could be performed quickly and accurately. The time required for automatic slice alignment was 2'11" ±0'31", which was significantly shorter than the time required for slice setting using the conventional method (10'48" ±4'24").

In the comparison of angular errors, the error in automatic slice alignment was 5.24±4.17, which was significantly smaller than the inter-observer error (11.3±8.93). In plane setting using the conventional method, when the planes set by the most experienced technologist were used as the reference, the error in the planes set by the other technologists was 9.68±7.76. The error in automatic slice alignment using this method was smaller than this value, and reproducibility is therefore judged to be high.

<u>Discussion & Conclusion</u>

The knowledge-based automatic slice-alignment method described here permits the aortic valve reference planes, which are difficult to determine using the conventional method, to be detected quickly and easily. This method can detect the reference planes with high reproducibility irrespective of the skill of the technologist. It is therefore considered that this method can help to ensure reliable examinations.

In conclusion, the results of this study suggest that our method is clinically useful for evaluation of the aortic valve.