DEEP LEARNING FOR AUTOMATED INSERTION POINT ANNOTATION OF CMR T1 MAPS

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1. BACKGROUND

Quantitative T1 mapping is a novel approach in cardiovascular magnetic resonance (CMR) for myocardial tissue characterisation [1]. The evaluation of myocardial territories requires left ventricular (LV) segmental analysis, based on the AHA 16-segment model. Recent advancements have focused on automated myocardial segmentation [2]. However, accurate manual annotation of the anterior right ventricular (RV) insertion point is still required for complete segmental quantification. This study introduces a deep learning approach for automated anterior RV insertion point annotation in T1 maps.

2. METHODS

We modified our existing CMR tracking technology [3] to identify the RV entry line, marked by the LV centre point and the anterior RV insertion point, on ShMOLLI T1 maps. The approach utilises a residual neural network architecture to estimate the Cartesian coordinates of both points within each image. The study dataset comprised 3834 short-axis images from 166 subjects scanned at Oxford and Taipei[1]. A randomly selected set of 768 images was used for independent testing, and the rest for training the residual neural network. Evaluation metrics included the Euclidean distance (mm) and the absolute angular error (º) between the predicted and ground-truth RV entry lines. Model performance consistency across slice positions was assessed with one-way ANOVA.

Table 1. Model performance evaluated with Euclidan distance (ED) and angular distance (AD) in the test set (n=768).

Error	All slices	Basal	Mid-ventricular	Apical
ED (mm)	2.7±2.5	2.6±2.6	2.7±2.5	2.6±2.4
AD (º)	6.8±5.6	6.7±5.6	6.7±6.0	7.1±5.2

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[1]Ethics approval and written informed consent were obtained from the respective local ethics committee as appropriate for each study.

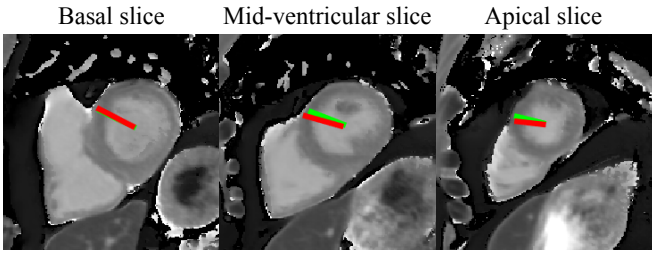

Fig. 1. Representative example of manual (green) and automated (red) entry lines at the anterior right ventricular insertion point in CMR T1 maps, across 3 slices.

3. RESULTS

The developed model demonstrated high precision in identifying the RV entry line across the test images (Figure 1). The overall Euclidean distance error stood at 2.7±2.5 mm, with an angular error of 6.8±5.6º. In the stratified analysis, the performance on each of the slices were similar (Table 1) and with no significant difference ($p>0.05$).

4. CONCLUSION

Our deep learning strategy is robust and effective for the anterior RV insertion point annotation in CMR T1 maps. This methodology enables the automated segmental quantification toolkit for clinical T1 mapping analysis.

5. REFERENCES

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