Laymen's Summary Minor Project Sofía Gutiérrez Santamaría

Background: Vascular calcification is the pathological deposition of calcium in vascular structures and it is associated with several cardiovascular pathological features, including hypertension, heart failure, hypertrophy, ischemia and increased risk of myocardial infarction and stroke. Therefore, calcifications are a significant risk factor for morbidity and mortality in cardiovascular disease, which are considered a complication of atherosclerosis. Vascular calcium detection by CT can be used as a clinical marker of atherosclerosis. Nowadays, calcium scoring is mainly based on the Agatston method which is mostly used for coronary arteries.

Goal: So far, the calcium-scoring application based on imageXplorer has been used. However, this software was implemented in C++ which is an increasingly unused programming language, and it was created in 1997, which makes the software obsolete and difficult to maintain at present. For this reason, this project focuses on the further implementation of a new calcium-scoring software application based on MeVisLab. This will enable new functionalities to be built on top of what already exists, allowing the use of semi-automated tasks, thus saving time for clinicians.

Methods: First, improving the graphical interface to give it a more formal appearance and make it more user-friendly. To this end, buttons were added and regrouped into different sections. The interface layout was evaluated by two radiologists from the UMC by means of a questionnaire. Second, implementing the slice interpolation of calcium segmentations, making use of the MeVisLab module CSOSliceInterpolator. This module generates interpolated contours for existing Contour Segmented Objects, also known as CSOs, that are parallel on z-slices. The interpolation itself is done by establishing a spline surface function out of the path points of the contours and then scanning the missing slices in between by a marching squares algorithm. The evaluation of the interpolated segmentations was assessed by means of a comparison with imageXplorer results through the calculation of the Dice similarity coefficient. Third, computing the calcium scores as described in the paper by Agatston et al. The evaluation of the scores was assessed based on a comparison with the imageXplorer results by means of a Student t-test, using a p-value of 0.05 as the threshold for statistical significance.

Results: For the interpolation of calcification segmentations, Dice coefficients that compare the similarity between the segmentations performed in imageXplorer and MeVisLab were calculated. The values obtained before using the editing modes fall in the range [2.3·10-4 - 0.7] and those obtained afterwards are in the range [0.8 - 1.0]. As for the computation of the calcium scores, a Student t-test between the calcium scores from imageXplorer and MeVisLab was conducted. For both the Agatston Score ($t32 = 0.03$, $p = 0.97$) and the volume score ($t32 = 0.04$, $p = 0.96$) not statistically difference was found. Both the interpolation of calcification segmentations and the computation of the calcium scores are validated, although some future improvements are suggested.

Conclusion: The implementation of the calcium-scoring application in MeVisLab has a lot of potential due to its ability to build new functionalities on top of what already exists, allowing the use of semi-automated tasks, which will save a lot of time for clinicians.