Correlation between deep learning based predicted ages from structural brain image and time-of-flight cerebral angiography

Introduction

Age-related changes were observed in both structural brain image and cerebral angiography. However, quantitative methods for measuring those changes were limited in practice. Recently, deep learning based age prediction models have been proposed as practical tools for capturing those changes from the MR images. The models trained from both the structural images and the angiography shows good correlations between the predicted ages and the chronological ages. However, the relationship between the predicted ages from two different images has not yet been analyzed. In this study, we investigate the correlation between the predicted ages from the structural image and the angiography.

Materials and methods

In this study, we utilized IXI dataset (brain-development.org/ixi-dataset). A total 460 of subjects were included. All subjects have both the T1-weighted MPRAGE (T1) and the time-of-flight 3D angiography (TOF). For deep learning model training, 410 subjects were used. The remaining 50 subjects were used for model validations and comparison between the models. We trained three different models 1) using raw T1, 2) using raw TOF, and 3) using processed TOF (vessel segmentation), respectively. Figure 1 shows three different inputs for the different models. Identical 3D networks (Figure 2) were trained and tested for all models. After model training, correlation coefficients between the models and mean absolute errors (MAEs) between the predicted and actual ages were calculated for validation set.

Results

The MAEs for validation set were 7.09 for T1(raw), 8.42 for TOF(raw), and 8.99 for TOF(vessel), respectively. Figure 3 shows the relationships between the models. Figure 3 summarizes the correlation coefficients between the models. T1(raw) and TOF(raw) showed the highest value (0.86) and TOF(vessel) showed the lowest value (0.73).

Discussion

Compared to the predicted ages from T1, the predicted ages showed slightly lower correlations when using vessel segmented TOF. Further validation should be performed to specify the clinical utility of each model.

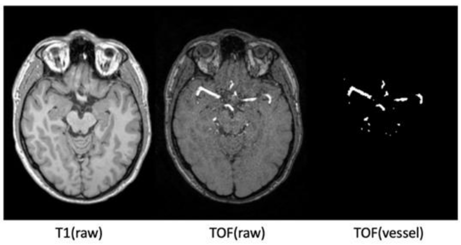

Figure 1. Three different inputs for deep learning based age prediction models

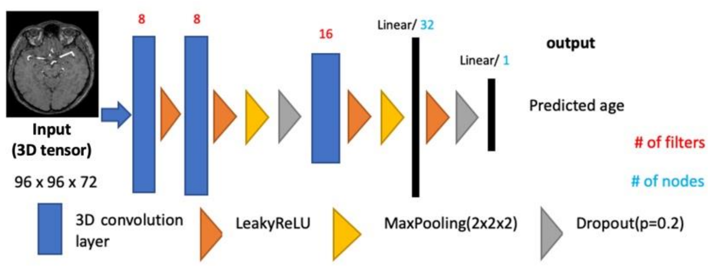

Figure 2. Deep learning model architecture for age prediction

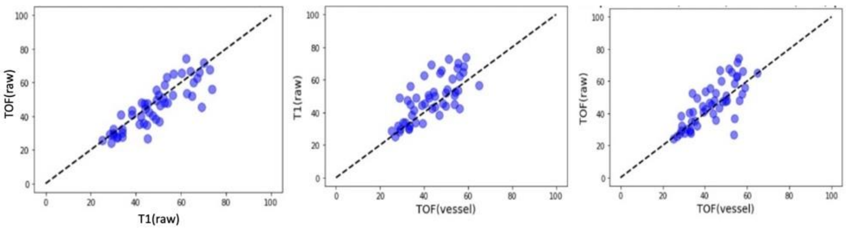

Figure 3. Scatterplot between the models

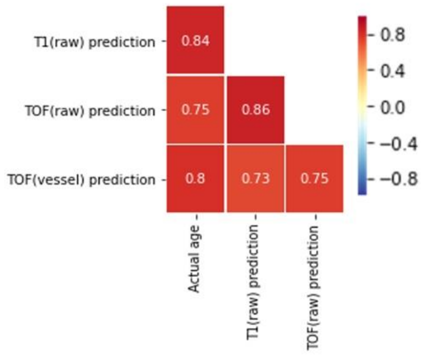

Figure 4. Correlation matrix between the models