

Providing standardized labels of the EADC-ADNI Harmonized Hippocampal Protocol for automated algorithm training

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Background

The EADC-ADNI Harmonized Protocol (HP) is a Delphi definition of manual hippocampal segmentation from magnetic resonance images (MRI). The project produced benchmark, standardized labels enabling training and qualification of future human tracers. However, training automated segmentation algorithms requires larger datasets representative of wider physiological variability. This work aims to produce a set of standardized labels allowing proper training of automated segmentation algorithms.

Methods

We selected 135 ADNI images from different subjects, balanced by diagnosis, degree of medial temporal atrophy (Scheltens' visual scale, 1992), scanner type, magnet field strength, and age. We recruited tracers among HP segmentation experts based on excellent tracing performance as judged by volume $ICC > 0.94$ or Jaccard > 0.82 (Figure). We certified standardized labels as HP-compliant after centralized quality checks and corrections. Internal hippocampal CSF spaces were separately labelled, and excluded from hippocampal volume. We run t-tests and correlation analyses to evaluate volume differences across diagnoses and medial temporal atrophy.

Results

We have completed segmentations, double step quality check, corrections and final certification for N=68 subjects at 1.5T MRIs, with a single tracer. Uncorrected hippocampal volumes of patients differed significantly from controls: AD patients had 19% smaller volumes than controls (left: mm³ 2386, SD=510, $p=0.001$, right: 2427 SD=568, $p=0.001$); MCI had 14% smaller volumes than controls (left: 2576, SD=521, $p=0.026$, right: 2550 SD=614, $p=0.013$); Controls: left 2953, SD=590, right: 2994 SD=537. These raw volumes significantly correlated with atrophy severity at Scheltens' scale (Table). CSF spaces were larger in controls: AD, left: mm³ 16, SD=16, $p=0.036$, right: 31, SD=30, $p=0.074$; MCI, left: 17, SD=9, $p=0.033$, right: 29, SD=16, $p=0.102$; Controls, left, 34 SD=35, right: 34 SD=37. Two subjects (3%) presented with unusual anatomy.

Conclusions

The Harmonized Hippocampal Expansion project is designed to provide reference hippocampal standardized labels for the training of automated segmentation algorithms. The platform for the training and qualification of human tracers, currently used for the HP project, will be modified to allow for the certification of automated segmentation algorithms.