Delphi Consensus on Landmarks for the Manual Segmentation of the Hippocampus on MRI: EADC-ADNI Harmonized Protocol for Manual Hippocampal Segmentation

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Objective

To define a Harmonized Protocol for manual hippocampal segmentation from MRI scans.

Background

Heterogeneity of landmarks among protocols leads to different volume estimates, hampering comparison of studies and clinical use. Landmark differences among the 12 most common protocols were extracted, operationalized, and quantitatively investigated. The results were presented to the Delphi panel, consisting of sixteen experts in hippocampal segmentation, to reach an evidence-based consensus on segmentation landmarks.

Methods

The 16 Delphi panelists participated in recursive anonymous voting sessions where feedback from previous rounds was utilized to progressively facilitate their agreement. Panelists were presented with tracing alternatives, each associated with quantitative data relating: reliability, impact on whole hippocampal volume, and correlation with AD pathology. Panelists were asked to choose among alternatives and provide justification and comments. Anonymous votes and comments, and voting statistics of one round were fed into the subsequent Delphi round (**Figure 1**). Exact probability on binomial test of choices was computed.

Results

Five Delphi rounds were completed. As shown in **Figure 2**, agreement was achieved for the inclusion of the most inclusive Segmentation Units. Agreement was also significant on inclusion of the vestigial gray matter (63%, p=0.022), on separating the Alveus/fimbria from fornix based on divergent inclination (63%, p=0.039), on exclusion of internal CSF pools (86%, p=0.004) and on the criterion for segmenting very atrophic structures (100%, p<0.0005). Based on the previous quantitative investigation of landmark differences, the hippocampus so defined covers 100% of hippocampal tissue, captures 100% of AD-related atrophy. It has good intra- (0.98) and inter-rater (0.94) reliability measured on volume statistics between 4 experts tracers from different centres.

Figure 1. Steps from operationalization of landmark differences to the definition of the Harmonized Protocol.

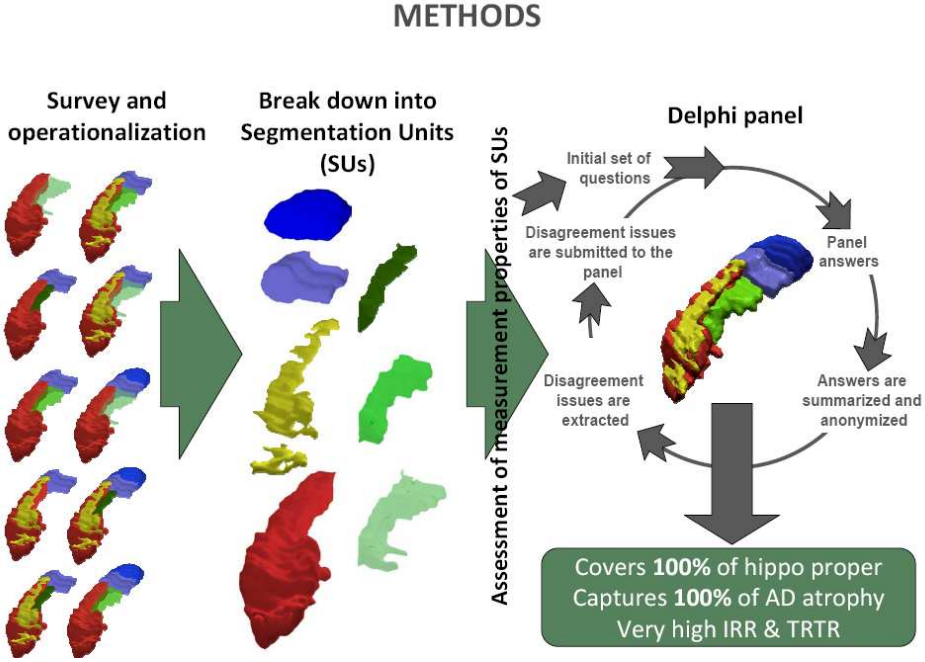
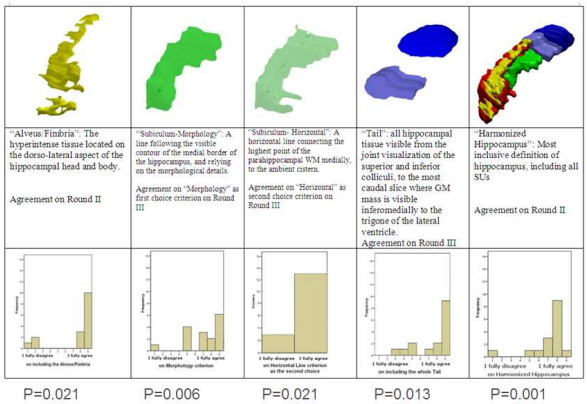


Figure 2. Consensus on landmarks through the five Delphi panel voting rounds.



Conclusions

This protocol is characterized by the most inclusive landmarks, and will be validated for clinical and research use in AD. It should be considered as an optimal compromise for clinical and experimental use in Alzheimer's disease.