

Histological delineation of the entorhinal, perirhinal, and parahippocampal cortices for the development of a harmonized segmentation protocol for 3T MRI

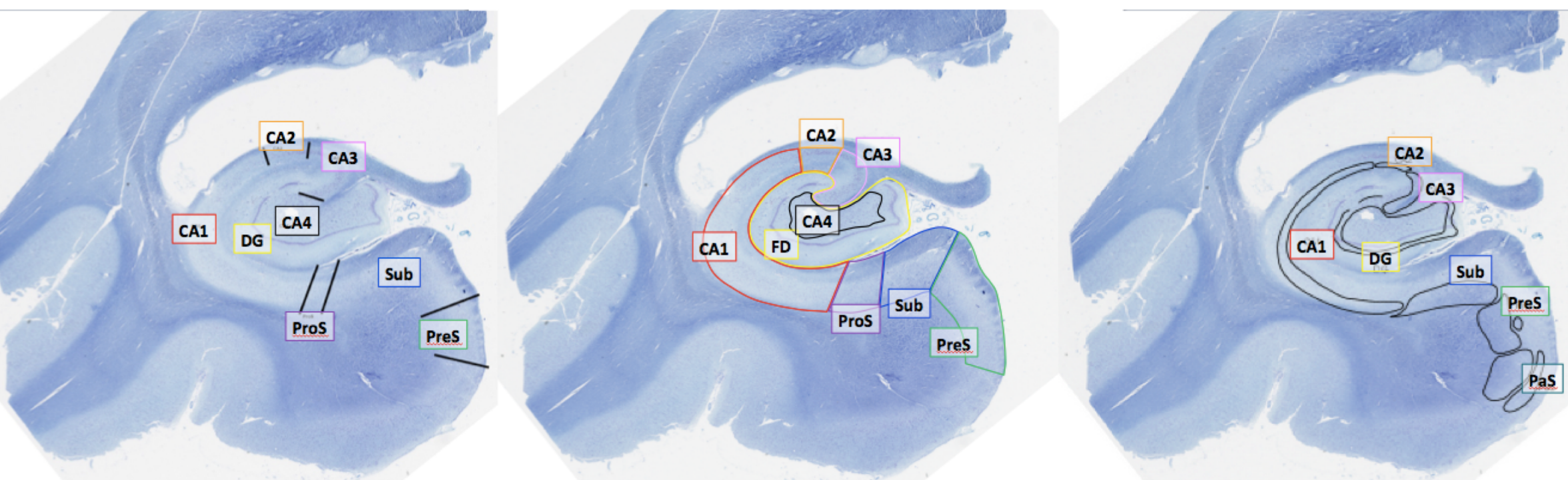
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Introduction

- Magnetic resonance resonance imaging (MRI) segmentation protocols for boundaries of the entorhinal, perirhinal, and parahippocampal cortices (ERC, PRC, and PHC) vary significantly across laboratories.
- The Hippocampal Subfields Group will create a valid, reliable protocol for the segmentation of the medial temporal lobe (MTL) cortices in vivo 3 tesla structural MRI.
- To ensure validity of the protocol, neuroanatomists from four independent laboratories annotated MTL divisions based on cytoarchitecture, using digital histology.
- Our working group used a similar approach in the hippocampal body (see Olsen et al., 2019).



- These segmented histological cases will be used to guide the development of a new harmonized protocol for the MTL cortex subregions that can be applied to in vivo MRI.

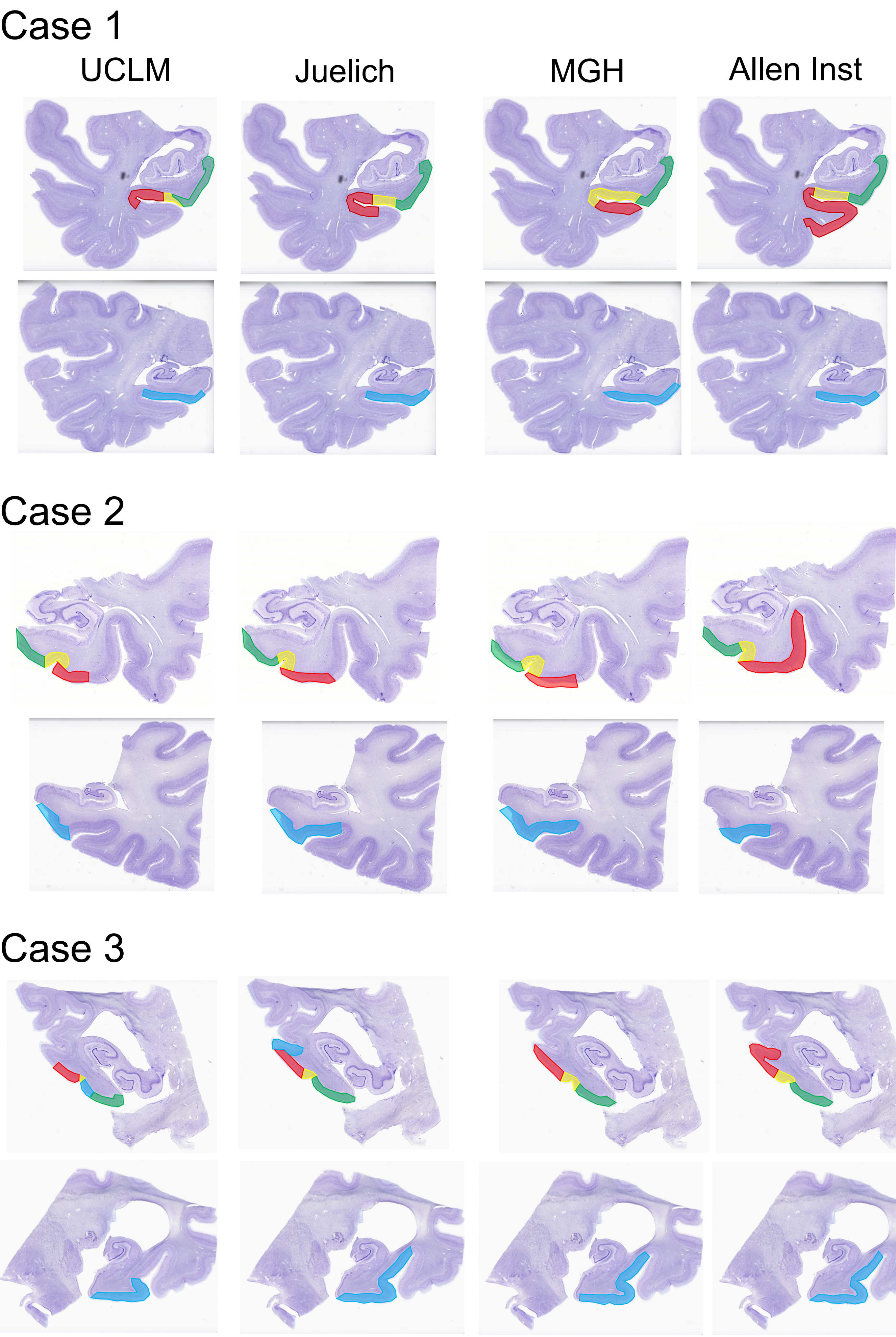
Methods

Case 1: 90 year old male, normal control, right hemisphere
Case 2: 66 year old female, normal control, left hemisphere
Case 3: 83 year old female, Alzheimer's disease
neuropathologic change & progressive supranuclear palsy, right hemisphere

Nissl-stained slice series were prepared perpendicular to the long axis of the temporal lobe, beginning at the temporal pole.

Four neuroanatomists (J. Augustinack-MGH, S-L. Ding-Allen Institute, R. Insausti-UCLM, and O. Kedo/K. Amunts-Juelich) identified boundaries for the ERC (green), BA35 (yellow), BA36 (red), and PHC (light blue) on 15-16 sections, 5mm apart.

Examples of labeled histology



Take home

Some disagreement exists across neuroanatomy labs in the boundaries of MTL cortical subregions. A harmonized segmentation protocol will provide a common definition for use in MRI research.

Rater agreement varies by region

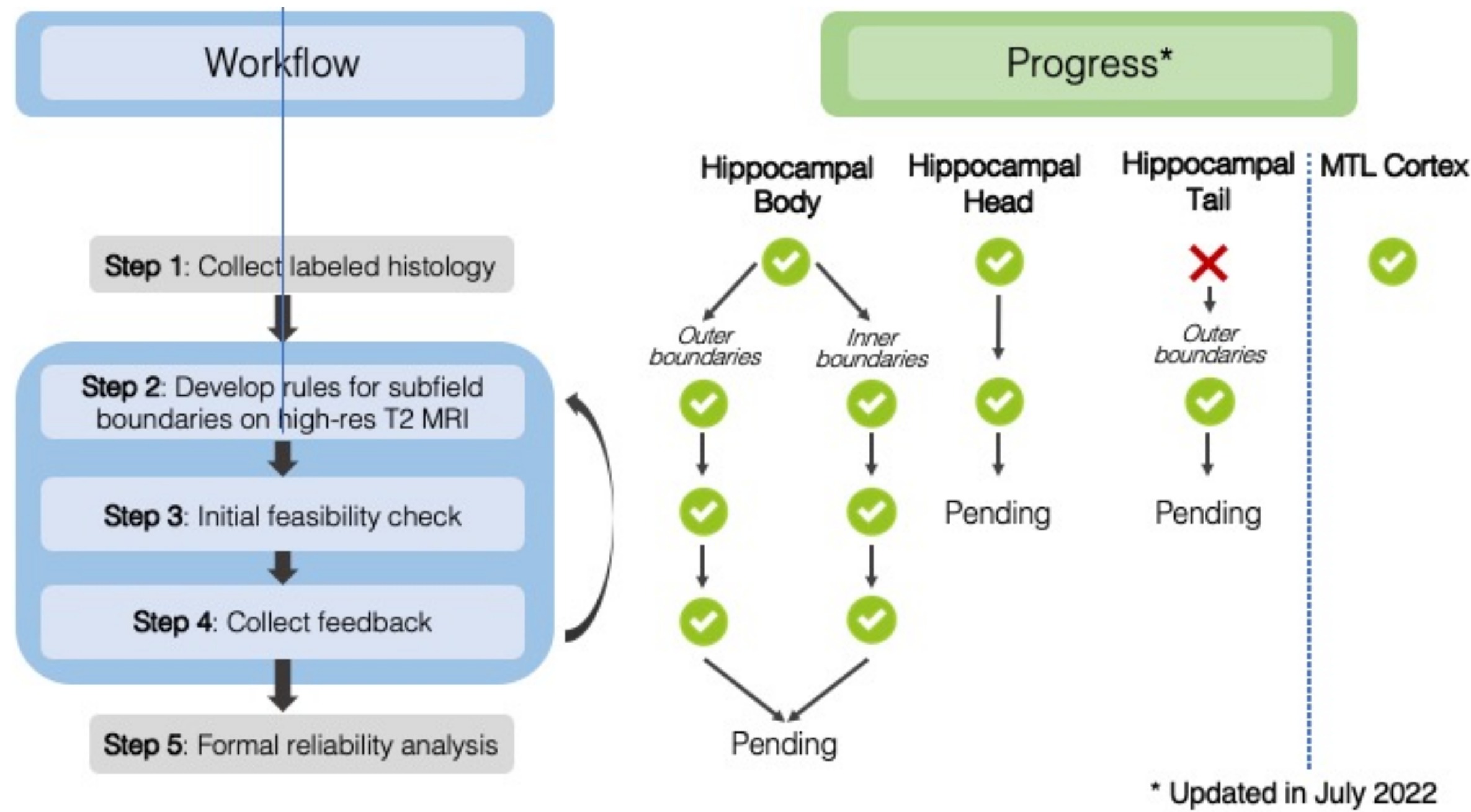
ROI	ERC	BA35*	BA36*	PHC
Medial Boundary	Consistent	Consistent	Varies along collateral sulcus (CS)	Consistent
Lateral Boundary	Consistent	Varies along the CS	Varies along CS/fusiform gyrus	Varies along the CS

Agreement lower in "transition" slices

		Measurement in mm from Temporal Pole															
Case#	Region	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
Case 1	ERC	0	0	0	0	0.5	1	1	1	1	1	0	0	0	0	0	0
	BA35	0	0	0.25	0.5	1	1	1	1	1	0.75	0.75	0	0	0	0	0
	BA36	0	0.5	0.5	0.75	1	1	1	1	1	0.75	0.25	0	0	0	0	0
	PHC	0	0	0	0	0	0	0	0	0	0.5	0.75	1	1	0.75	0.5	0.25
Case 2	ERC	0	0	0	0.75	1	1	1	1	1	0	0	0	0	0	0	0
	BA35	0	0	0.75	1	1	1	1	1	1	0.75	0	0	0	0	0	0
	BA36	0	0.75	0.75	1	1	1	1	1	1	0.25	0	0	0	0	0	0
	PHC	0	0	0	0	0	0	0	0	0.25	0.75	1	1	1	0.5	0.25	0
Case 3	ERC	0	0	0	0.5	1	1	1	1	0.75	0	0	0	0	0	0	0
	BA35	0	0	0.25	1	1	1	1	1	0.5	0.25	0	0	0	0	0	0
	BA36	0	0.25	0.5	1	1	1	1	1	0.75	0	0	0	0	0	0	0
	PHC	0	0	0	0	0	0	0	0.5	0.5	1	1	1	0.75	0.25	0.25	0

Number in cell corresponds to the number of raters that defined each region on each slice (e.g. 0/4, 1/4, 2/4, 3/4, or 4/4)

Harmonization Progress



* Updated in July 2022