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NEW IMAGING METHODS

# Whole brain MRI-free tau and amyloid PET quantification

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## Abstract

**Background:** The growing use of PET imaging in Alzheimer's research and clinical practice has resulted in the need for PET quantification when an MRI is unavailable or contraindicated. The Desikan-Killiany (DK) atlas in Freesurfer (FS) is often used in conjunction with a native space MRI to define regions of interest for tau and amyloid PET quantification. Here we developed a template-space DK atlas for use in MRI-free amyloid & tau quantification, and validated the performance of the template using MRI-free florbetapir and flortaucipir SUVrs in relation to our gold standard native space SUVrs.

**Method:** To develop a template-space atlas made up of 112 DK regions identical to those used in our native-space, MRI-dependent pipeline, we segmented T1 MRIs from a subset of 200 cognitively normal ADNI participants using Freesurfer 7.1. Each binary region was nonlinearly warped to template space, smoothed, and averaged across the 200 MRIs to create 112 ROI probability maps (Fig 1A). Each region probability map was normalized between 0 and 1 then merged together into a single template-space atlas by ranking each voxel in relation to each ROI (Fig 1B). To calculate MRI-free SUVrs, ADNI baseline flortaucipir (n=768) and florbetapir (n=1290) images were spatially normalized to PET-only, tracer-specific templates developed in subsets of ADNI scans. We examined several key amyloid and tau target SUVrs based on the MRI-free atlas in relation to corresponding MRI-dependent SUVrs calculated using our gold standard pipeline.

**Result:** MRI-free region-wise cortical SUVRs were highly correlated with their MRI-dependent counterparts for both florbetapir (average R2 across cortical ROIs = 0.80, cortical summary R2 = 0.84; Fig 2A) and flortaucipir (average R2 across cortical ROIs = 0.87, entorhinal R2 = 0.88, temporal metaROI R2 = 0.97; Fig 2B). Positive/negative status agreement between MRI-free and MRI-dependent approaches using previously-validated MRI-dependent thresholds was 91% (A$\beta$) and 92% (temporal metaROI tau).

**Conclusion:** Amyloid and tau SUVRs and +/− status calculated using a template-space DK atlas are comparable to those calculated using our gold standard MRI-dependent approach. This MRI-free approach will be useful for region-wise PET quantification when structural scans are unavailable.

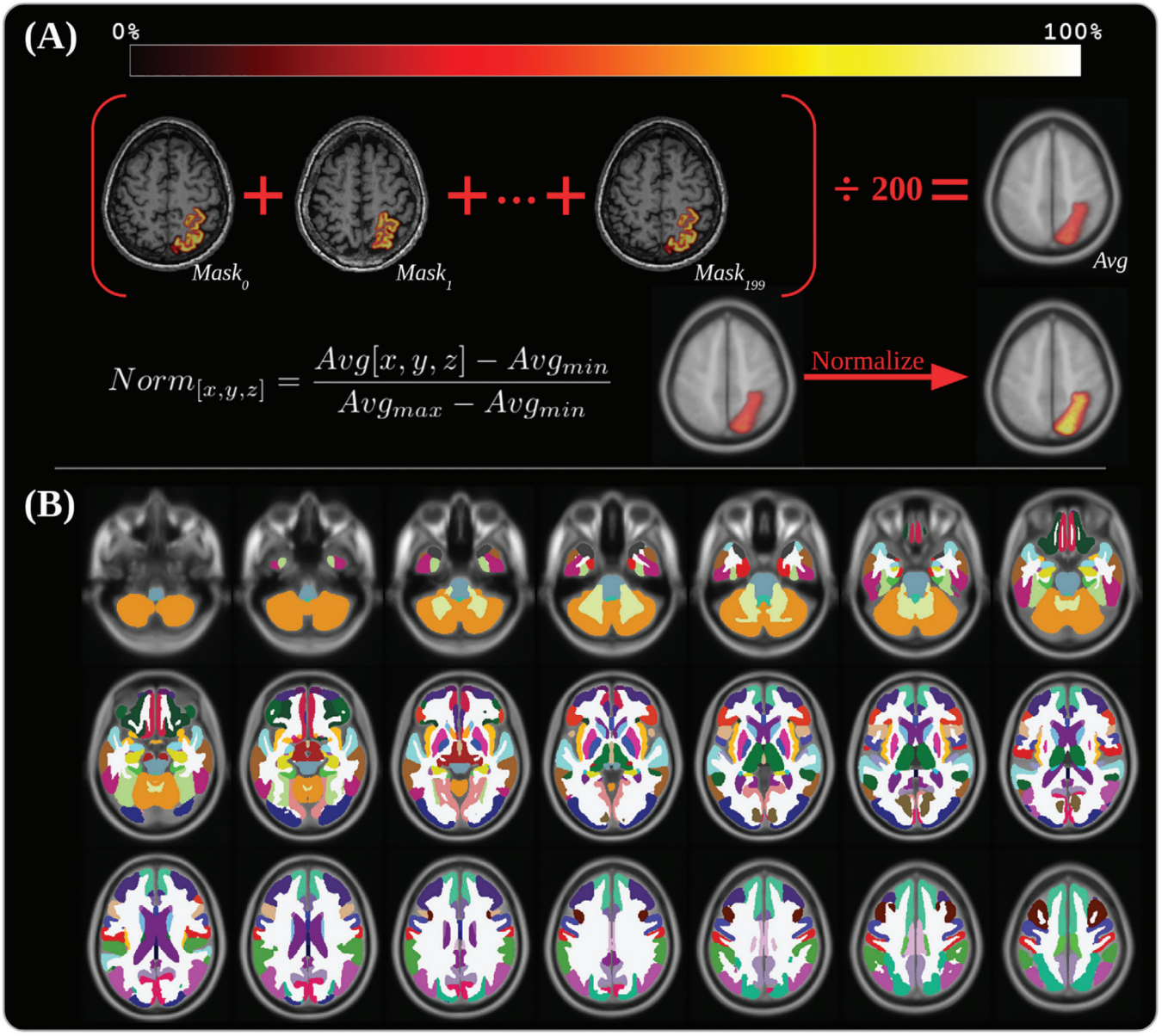


Figure 1 – Generation of a single template space DK ROI, right superior parietal gyrus (A). A whole-brain atlas is created by assigning each template space voxel to the regional map with the highest value (B).

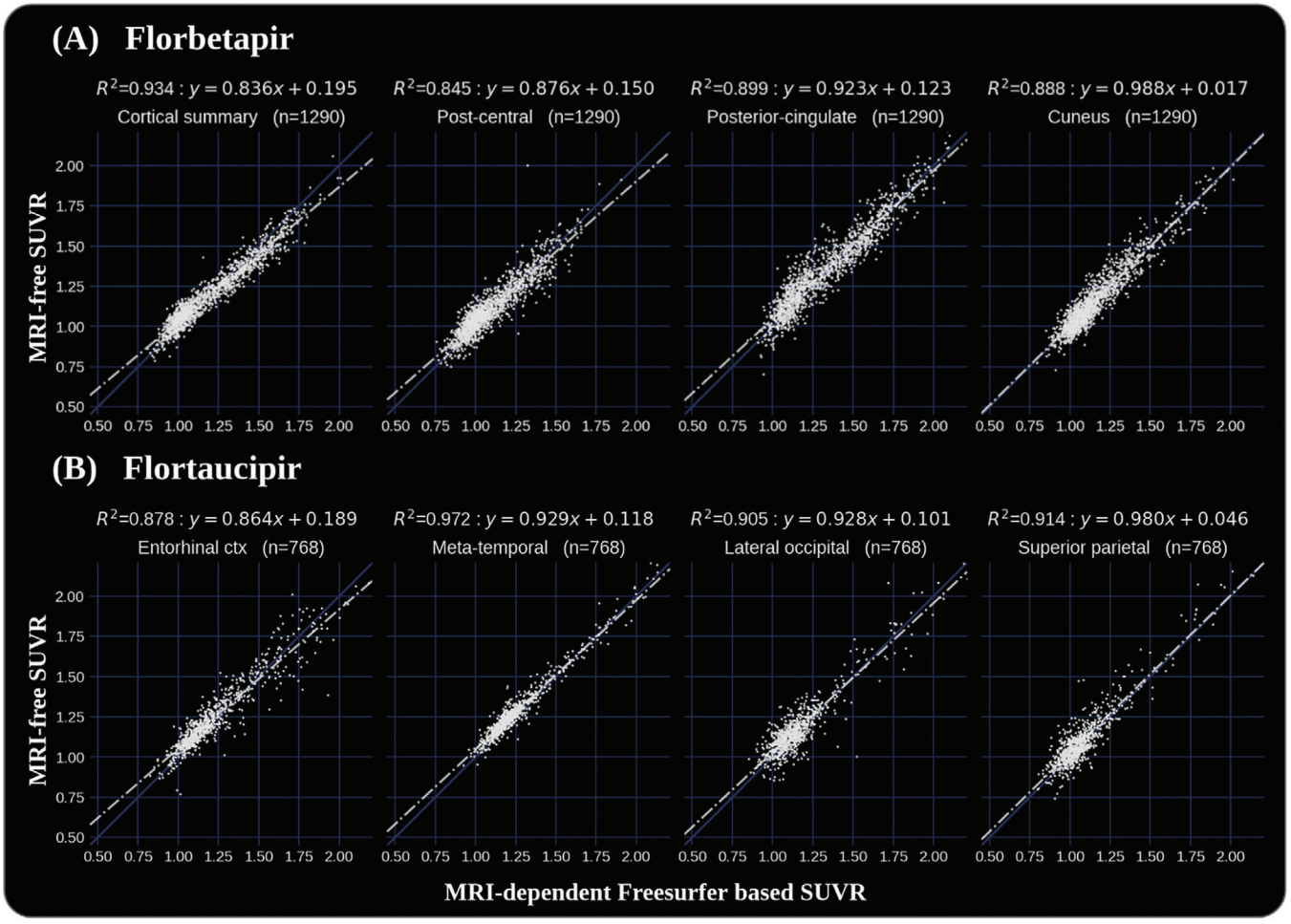


Figure 2 – MRI-free SUVRs are shown in relation to Freesurfer-based MRI-dependent SUVRs for key regions of interest for florbetapir relative to whole cerebellum (A), flortaucipir relative to inferior cerebellar grey matter (B).