Cortical thickness

- Structural Alterations Associated With Cardiovascular Autonomic Failure in Multiple System Atrophy
- Brain-Inspired Multisensory Learning: A Systematic Review of Neuroplasticity and Cognitive Outcomes in Adult Multicultural and Second Language Acquisition
- Application Value and Clinical Correlation of Ultrasonic Shear Wave Elastography in Chronic Kidney Disease
- The causal effect of smoking on psychiatric disorders: an examination of brain volume as a potential pathway
- Positive school climate boosts children's reading achievement, mental health and cortical thinning
- Isolated human lens interferometric surface radius of curvatures: Implications for the mechanism of accommodation
- Polystyrene microplastic pollution induces species-specific shifts in root traits and rhizosphere conditions in a temperate forest
- Primary Pectoralis Major Tendon Repair Using Suture Anchors With Internal Bracing: A Surgical Technique

Cortical thickness refers to the distance between the pial surface (the outermost layer of the cerebral cortex) and the underlying white matter.

Measuring cortical thickness is a common technique used in neuroimaging research, particularly in studies related to brain structure and function. Magnetic Resonance Imaging (MRI) is a commonly used method to assess cortical thickness. The analysis involves creating high-resolution structural images of the brain, and then software tools are used to measure the thickness of the cortex at different points across the brain.

Changes in cortical thickness have been associated with various neurological and psychiatric conditions. For example, research has shown that cortical thinning may be linked to aging, neurodegenerative disorders (such as Alzheimer's disease), and psychiatric disorders (such as schizophrenia or depression). Additionally, studies often investigate cortical thickness in specific brain regions to understand its relationship to specific functions or diseases.

It's important to note that cortical thickness is just one aspect of brain structure, and researchers often use multiple measures, including volumetric assessments and surface area, to gain a more comprehensive understanding of brain anatomy.

The clinical applications of the association of cortical thickness and white matter fiber with freezing of gait (FoG) are limited in patients with Parkinson's disease (PD). In this retrospective study, using white matter fiber from diffusion-weighted imaging and cortical thickness from structural-weighted imaging of magnetic resonance imaging, we investigated whether a machine learning-based model can help assess the risk of FoG at the individual level in patients with PD. Data from the Parkinson's Disease Progression Marker Initiative database were used as the discovery cohort, whereas those from the Fujian Medical University Union Hospital Parkinson's Disease database were used as the external validation cohort. Clinical variables, white matter fiber, and cortical thickness were selected by random forest regression. The selected features were used to train the support vector machine(SVM) learning models. The median area under the receiver operating characteristic curve (AUC) was calculated. Model performance was validated using the external validation cohort. In the discovery cohort, 25 patients with PD were defined as FoG converters (15 men, mean age 62.1 years), whereas 60 were defined as FoG nonconverters (38 men, mean age 58.5 years). In the external validation cohort, 18 patients with PD were defined as FoG converters (8 men, mean age 66.9 years), whereas 37 were defined as FoG nonconverters (21 men, mean age 65.1 years). In the discovery cohort, the model trained with clinical variables, cortical thickness, and white matter fiber exhibited better performance (AUC, 0.67-0.88). More importantly, SVM-radial kernel models trained using random over-sampling examples, incorporating white matter fiber, cortical thickness, and clinical variables exhibited better performance (AUC, 0.88). This model trained using the above mentioned features was successfully validated in an external validation cohort (AUC, 0.91). Furthermore, the following minimal feature sets that were used: fractional anisotropy value and mean diffusivity value for right thalamic radiation, age at baseline, and cortical thickness for left precentral gyrus and right dorsal posterior cingulate gyrus. Therefore, machine learning-based models using white matter fiber and cortical thickness can help predict the risk of FoG conversion at the individual level in patients with PD, with improved performance when combined with clinical variables [1)].

The widely used rubber hand illusion (RHI) paradigm provides insight into how the brain manages conflicting multisensory integration regarding bodily self-consciousness. Previous functional neuroimaging studies have revealed that the feeling of body ownership is linked to activity in the premotor cortex, the intraparietal areas, the occipitotemporal cortex, and the insula. Matuz-Budai et al. investigated whether the individual differences in the sensation of body ownership over a rubber hand, as measured by the subjective report and the proprioceptive drift, are associated with structural brain differences in terms of cortical thickness in 67 healthy young adults. Matuz-Budai et al. found that individual differences measured by the subjective report of body ownership are associated with the cortical thickness in the somatosensory regions, the temporoparietal junction, the intraparietal areas, and the occipitotemporal cortex, while the proprioceptive drift is linked to the premotor cortex and the anterior cingulate cortex. These results are in line with functional neuroimaging studies indicating that these areas are indeed involved in processes such as cognitive-affective perspective-taking, visual processing of the body, and the experience of body ownership and bodily awareness. Consequently, these individual differences in the sensation of body ownership are pronounced in both functional and structural differences [2)].

Younger age at first exposure (AFE) to repetitive head impacts while playing American football increases the risk for later-life neuropsychological symptoms and brain alterations.

Results suggest an association between younger AFE and decreased cortical thickness, which in turn is associated with worse neuropsychological performance. Furthermore, an association between younger AFE and signs of neurodegeneration later in life in symptomatic former American football players seems likely [3)].

Sixty-three former professional National Football League players (55.5 ± 7.7 years) with cognitive, behavioral, and mood symptoms underwent neuroimaging and neuropsychological testing. First, the association between cortical thickness and AFE was tested. Second, the relationship between clusters of decreased cortical thickness and verbal and visual memory, and composite measures of mood/behavior and attention/psychomotor speed were assessed. AFE was positively correlated with cortical thickness in the right superior frontal cortex (cluster-wise P-value [CWP] = 0.0006), the left parietal cortex (CWP = 0.0003), and the occipital cortices (right: CWP = 0.0023; left: CWP = 0.0008). A positive correlation was found between cortical thickness of the right superior frontal cortex and verbal memory (R = 0.333, P = 0.019), and the right occipital cortex and visual memory (R = 0.360, P = 0.012). In conclusion, the results suggest an association between younger AFE and decreased cortical thickness, which in turn is associated with worse neuropsychological performance. Furthermore, an association between younger AFE and signs of neurodegeneration later in life in symptomatic former American football players seems likely [4].

Patients (n=106) with refractory MTLE-HS submitted to corticoamygdalohippocampectomy (CAH) (57 left mesial temporal lobe epilepsy (MTLE); 45 males) were enrolled. To determine if the IQ was a predictor of seizure outcome, totally seizure-free (SF) versus nonseizure-free (NSF) patients were evaluated. FreeSurfer was used for cortical thickness and volume estimation, comparing groups with lower (<80) and higher IQ (90-109) levels.

In the whole series, 42.45% of patients were SF (Engel Class 1a; n=45), and 57.54% were NSF (n=61). Total cortical volume was significantly reduced in the group with lower IQ (p=0.01). Significant reductions in the left hemisphere included the following: rostral middle frontal (p=0.001), insula (p=0.002), superior temporal gyrus (p=0.003), thalamus (p=0.004), and precentral gyrus (p=0.02); and those in the right hemisphere included the following: rostral middle frontal (p=0.003), pars orbitalis (p=0.01), and insula (p=0.02). Cortical thickness analysis also showed reductions in the right superior parietal gyrus in patients with lower IQ. No significant relationship between IQ and seizure outcome was found.

This is the first study of a series of patients with pure MTLE-HS, including those with low IQ and their morphometric magnetic resonance imaging (MRI) features using FreeSurfer. Although patients with lower intellectual scores presented more areas of brain atrophy, IQ was not a predictor of surgical outcome. Therefore, when evaluating seizure follow-up, low IQ in patients with MTLE-HS might not contraindicate resective surgery [5].

[1]
Lin F, Zou X, Su J, Wan L, Wu S, Xu H, Zeng Y, Li Y, Chen X, Cai G, Ye Q, Cai G. Cortical thickness and white matter microstructure predict freezing of gait development in Parkinson's disease. NPJ Parkinsons Dis. 2024 Jan 9;10(1):16. doi: 10.1038/s41531-024-00629-x. PMID: 38195780.
[2]
Matuz-Budai T, Lábadi B, Kohn E, Matuz A, Zsidó AN, Inhóf O, Kállai J, Szolcsányi T, Perlaki G, Orsi G, Nagy SA, Janszky J, Darnai G. Individual differences in the experience of body ownership are related to cortical thickness. Sci Rep. 2022 Jan 17;12(1):808. doi: 10.1038/s41598-021-04720-8. PMID: 35039541.
[3], [4]
Kaufmann D, Sollmann N, Kaufmann E, Veggeberg R, Tripodis Y, Wrobel PP, Kochsiek J, Martin BM, Lin AP, Coleman MJ, Alosco ML, Pasternak O, Bouix S, Stern RA, Shenton ME, Koerte IK. Age at First Exposure to Tackle Football is Associated with Cortical Thickness in Former Professional American Football Players. Cereb Cortex. 2021 Mar 2:bhab021. doi: 10.1093/cercor/bhab021. Epub ahead of print. PMID: 33676369.
[5]
Gaça LB, Garcia MTFC, Sandim GB, Assumption Leme IB, Noffs MHS, Carrete H Júnior, Centeno RS, Sato JR, Yacubian EMT. Morphometric MRI features and surgical outcome in patients with epilepsy related to hippocampal sclerosis and low intellectual quotient. Epilepsy Behav. 2018 Apr 3;82:144-149. doi: 10.1016/j.yebeh.2018.03.011. [Epub ahead of print] PubMed PMID: 29625365.