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Classification of Patients with Epilepsy and Healthy Subjects Using Structural MRI; A Tensor-Based Morphometry Study

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Computational neuroanatomy using magnetic resonance imaging (MRI) has been used extensively in studies of epilepsy to detect morphological abnormalities (Grey matter and White matter volumes) of the brain. However, it is unclear how epilepsy affects gross volume changes in the human brain. The aim of this study was to explore gross volume changes in the epileptic brain and to test the potential of gross volume changes to develop a neuroimaging tool for the objective diagnosis of epilepsy. We recruited 47 healthy controls and 48 epilepsy patients and T1 weighted structural MR brain scans were acquired using a 1.5 Tesla scanner at Army Hospital, Narahenpita, Sri Lanka. We applied the tensor-based morphometry (TBM) method (a variation of DBM) to generate voxel-level Jacobian determinant images using the Computational Anatomy Toolbox (CAT). Furthermore, group-level univariate analysis was conducted using two sample t-tests including age and gender as covariates. In addition, Multivariate pattern analysis (MVPA) was performed using univariate findings to distinguish patients with epilepsy healthy controls. We found widespread gross volume reductions in anatomical regions in frontal, temporal, and occipital regions and subcortical structures such as hippocampus and anterior cingulum. The multivariate pattern analysis (MVPA) results showed that gross brain volume changes can be effectively used to distinguish patients with epilepsy healthy controls (TBM: accuracy =70.83%). In summary, our study concludes that gross volume changes detected in epileptic brain should be considered when developing a neuroimaging tool for objective diagnosis of epilepsy.

Keywords: *deformation-based morphometry, structural MRI, multivariate pattern analysis, epilepsy*