Tractography of fornix and gyrus subcallosus and paraterminalis in patients with Alzheimer's disease

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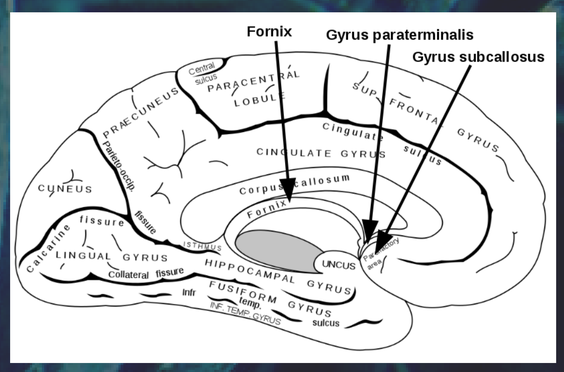
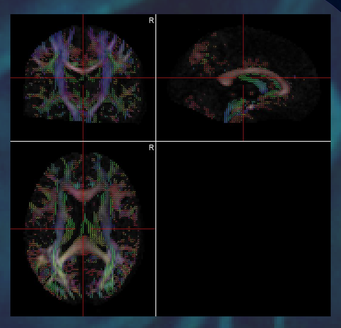
Introduction:
Alzheimer's disease (AD) is neurodegenerative disease characterized by extracellular, insoluble beta-amyloid plaques and intracytoplasmic tau-associated neurofibrillary tangles. This process leads to the loss of neurons and connectivity. Diffusion tensor imaging (DTI)-based tractography is able to visualize neural tracts and white matter damage using the measurement of the restricted diffusion of water in tissue. Using this method and visualization we can measure DTI parameters, see neural connections and results can be used in diagnosis of AD.

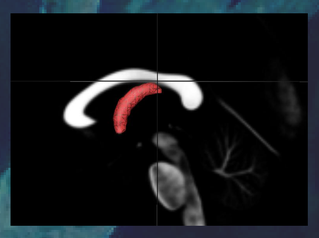
Aim:
The aim of this study was to measure parameters of fornix and gyrus subcallosus and paraterminalis in patients with AD and healthy controls of similar age.
Then compare results and determine statistical differences between both groups.

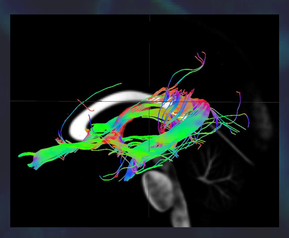


Methods:
Patients with AD and controls were divided by a neurologist based on psychological and clinical examination.
DTI scans were acquired on 3T MRI at Institute for Clinical and Experimental Medicine (IKEM).
DSI Studio was used for QSDR image reconstruction.



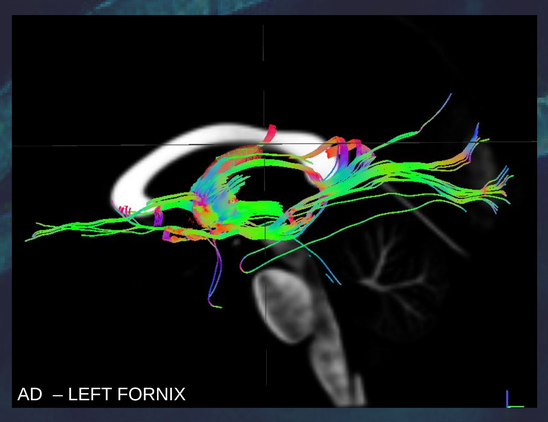
The area of fornix and gyrus subcallosus and paraterminalis was drawn manually according to anatomical position in all dimensions on T2 weighted MRI images.
Then tractography, visualization of neural tracts, was created.

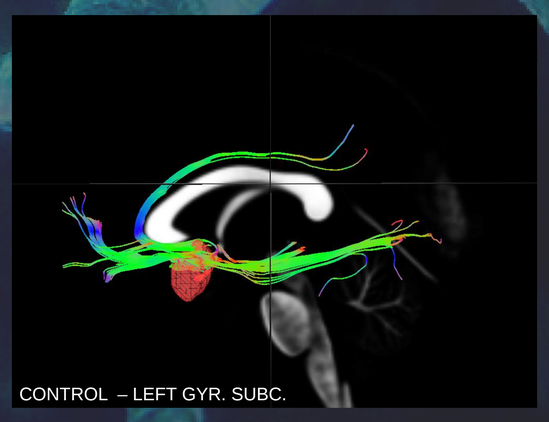


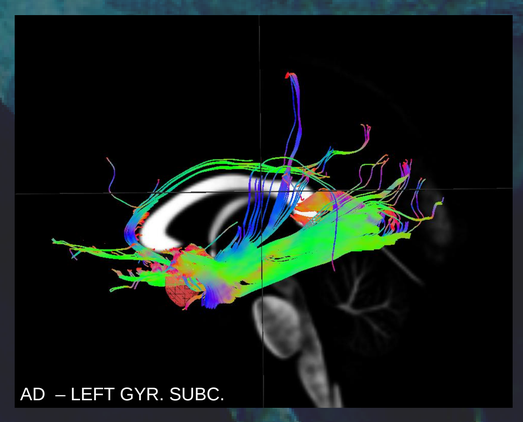


Based on reconstructed neural tracts we obtained these parameters: number of tracts, tract length, tract volume, quantitative anisotropy (qa) and generalized fractional anisotropy (gfa). Statistical analysis was performed using STATISTICA 13 (t-test).

Results:
We compared 32 patients with AD and 32 control patients. There was statistically s ignificant decrease of number of tracts and tract length and statistically significant increase of qa in the area of left fornix in patients with AD. Statistically significant decrease of number of tracts, tract length and gfa was also observed in the area of right fornix in patients with AD. There was an increase of number of tracts, tract volume, qa and gfa in the left and right area of gyrus subcallosus and paraterminalis in patients with AD.







Conclusion:
Fornix is a part of the limbic system associated with episodic memory, the ability to recall an event from recent or distant past. Degeneration of fornix according to DTI analysis explains long-term memory loss in patients with AD. There was significant increase in parameters in the area of gyrus subcallosus and paraterminalis, area associated with short-term memory. A higher gfa value, registered in gyrus subcallosus and paraterminalis, indicates better integrity of the neural fiber bundles which might represent the compensation of AD. Tractography could help diagnose AD.