

Quantitation of digitized (DATSCAN) imaging for accurate differentiation of parkinsonism and essential tremor

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AIM

To extract parameters by digitized processing of [123I]-FP-CIT (DATSCAN) images to differentiate between parkinsonism and essential tremor (ET) and Evaluate SPECT imaging of the dopamine transporters in vivo, by the display of pattern recognition.

Introduction

- DATSCAN is a cocaine analogue that binds to presynaptic dopamine.
- Imaging of dopamine transporters, situated in the membrane of dopaminergic neurons could detect degeneration of the dopaminergic nigrostriatal pathway
- Datscan imaging studies have shown the ability to detect loss of striatal dopamine transporters. This would allow distinguishing Parkinson's from Essential tremor.
- It is valuable to confirm or exclude the existence of degeneration of nigrostriatal dopaminergic cells by using the digitized data of Datscan imaging.

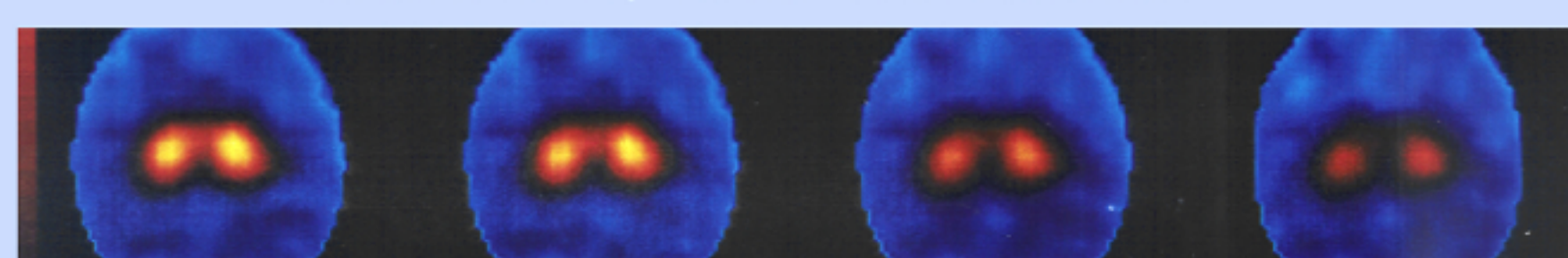
Method 1

- [123I]-FP-CIT SPECT imaging was conducted in a study of 24 patients with a diagnosis of Parkinsonism compared with 10 ET diagnosed cases. All patients were scanned during a 12-month period.
- We have imaged the striatal dopamine transporters in our two groups of patients. 110 MBq DATscan was injected intravenously and tomographic SPECT studies were performed with a SPECT gamma camera 3h post-injection
- Note: There is a variability in size of striatum ~15%. - Caudate is fatter than putamen.-Specific uptake ratio decreases with age.*

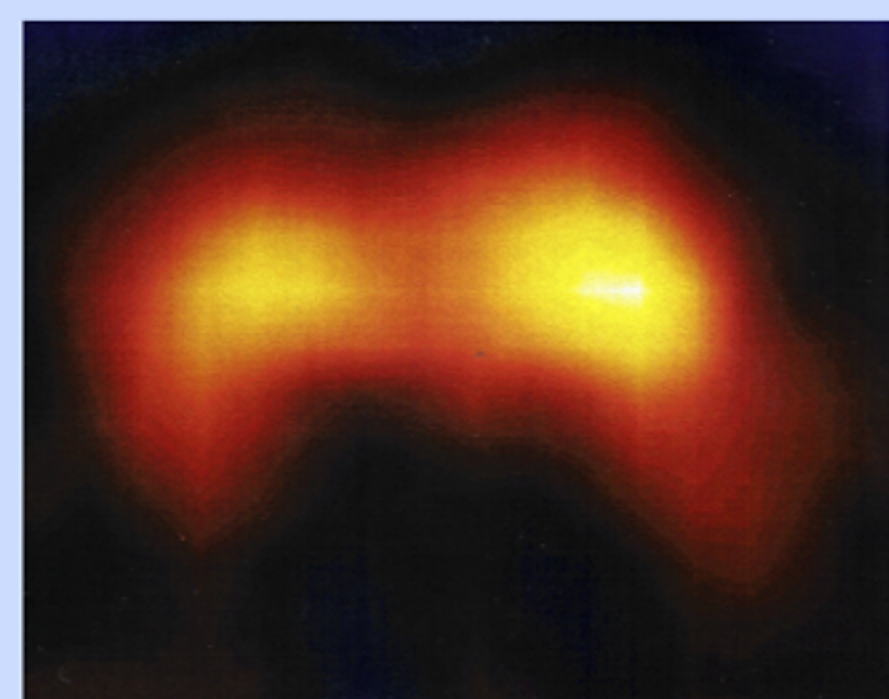
Method 2

- We analysed the image data producing a dicom format image file. We have transferred the dicom images in a PC and saved in an uncompressed bitmap format in order to be processed by Interactive Data Language (IDL) tools and Matlab program.
- Ellipse ROIs are created around the striatum while rectangular ROIs include caudate and putamen uptake data.
- Data were extracted and Area, Eccentricity, major & minor axis length, Orientation, equivalent Diameter and Integral Intensity of both left & right gaggia were calculated.

Series of DATscan slices

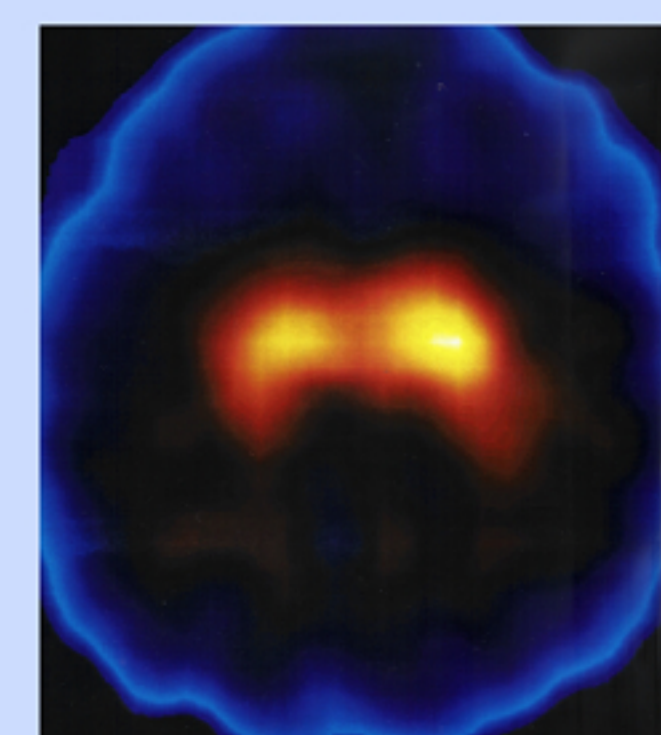


Normal DATSCAN uptake is highest in middle slices of Striatum

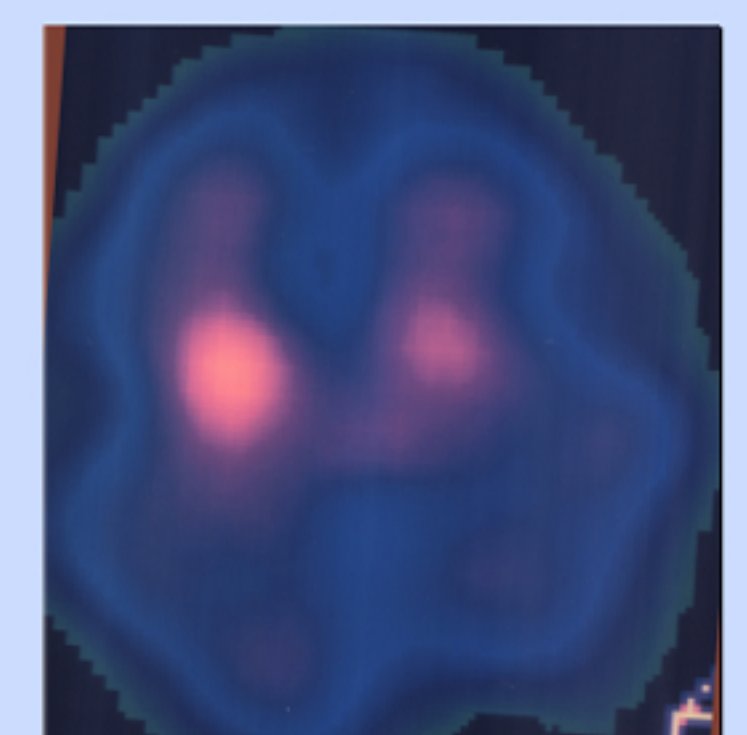


Magnified striatum image
Processing and data collection

Datscan SPECT central slice



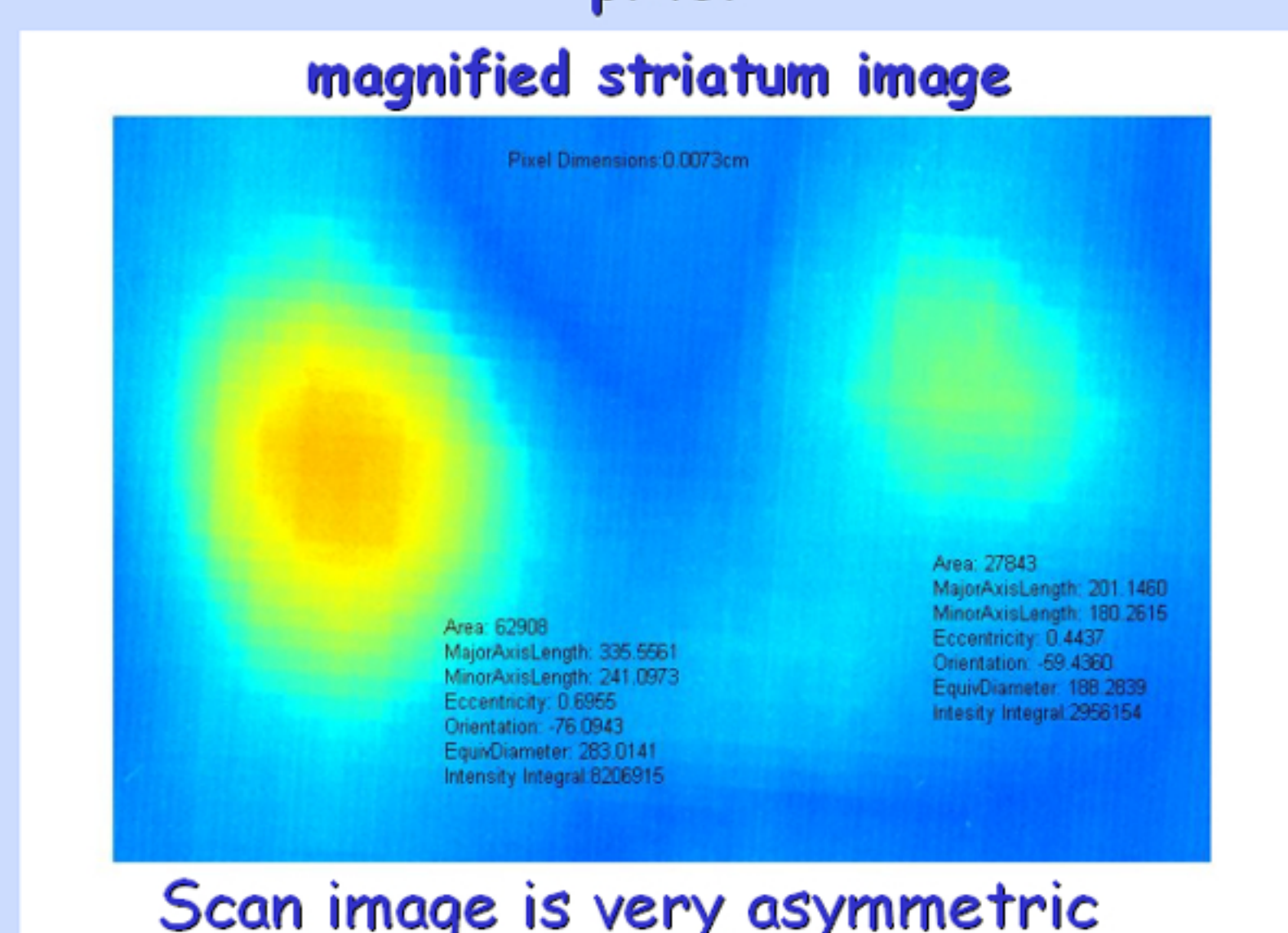
Loss in uniformity



Background is higher

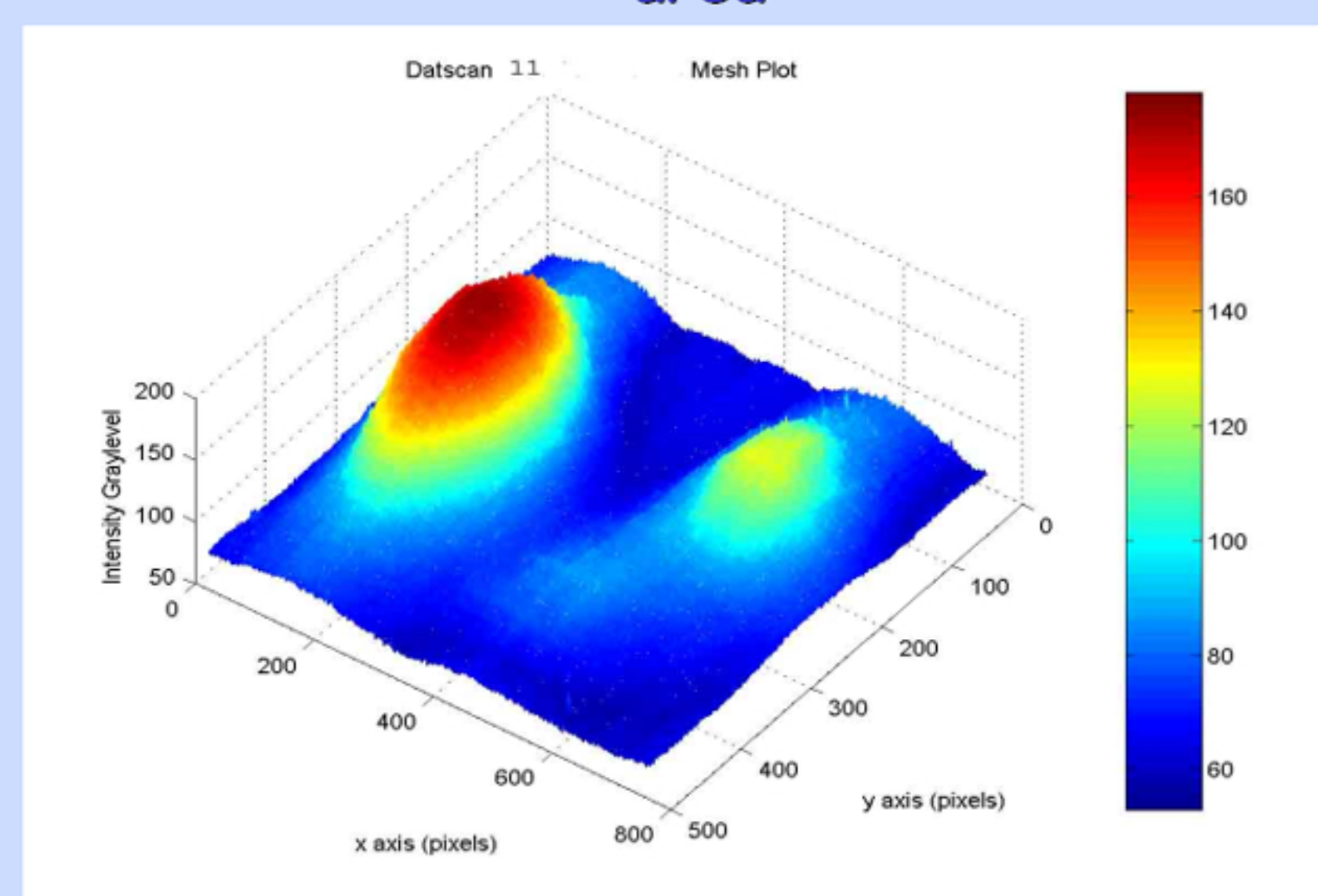
Degeneration of the nigrostriatal pathway was found scintigraphically in the first group. In second group of ET subjects, no degeneration signs were found scintigraphically

Calculated parameters / dimensions in pixel

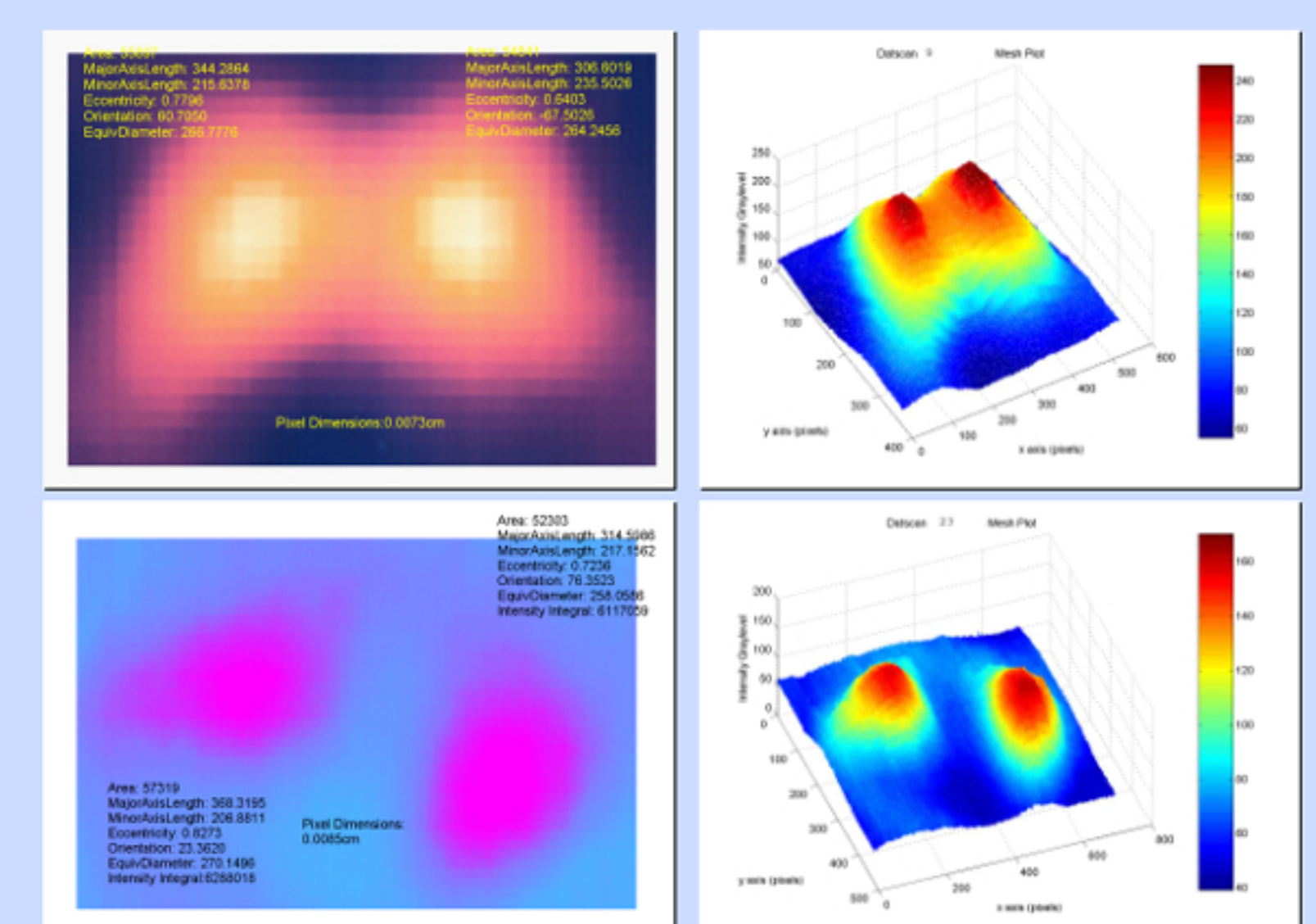


Scan image is very asymmetric

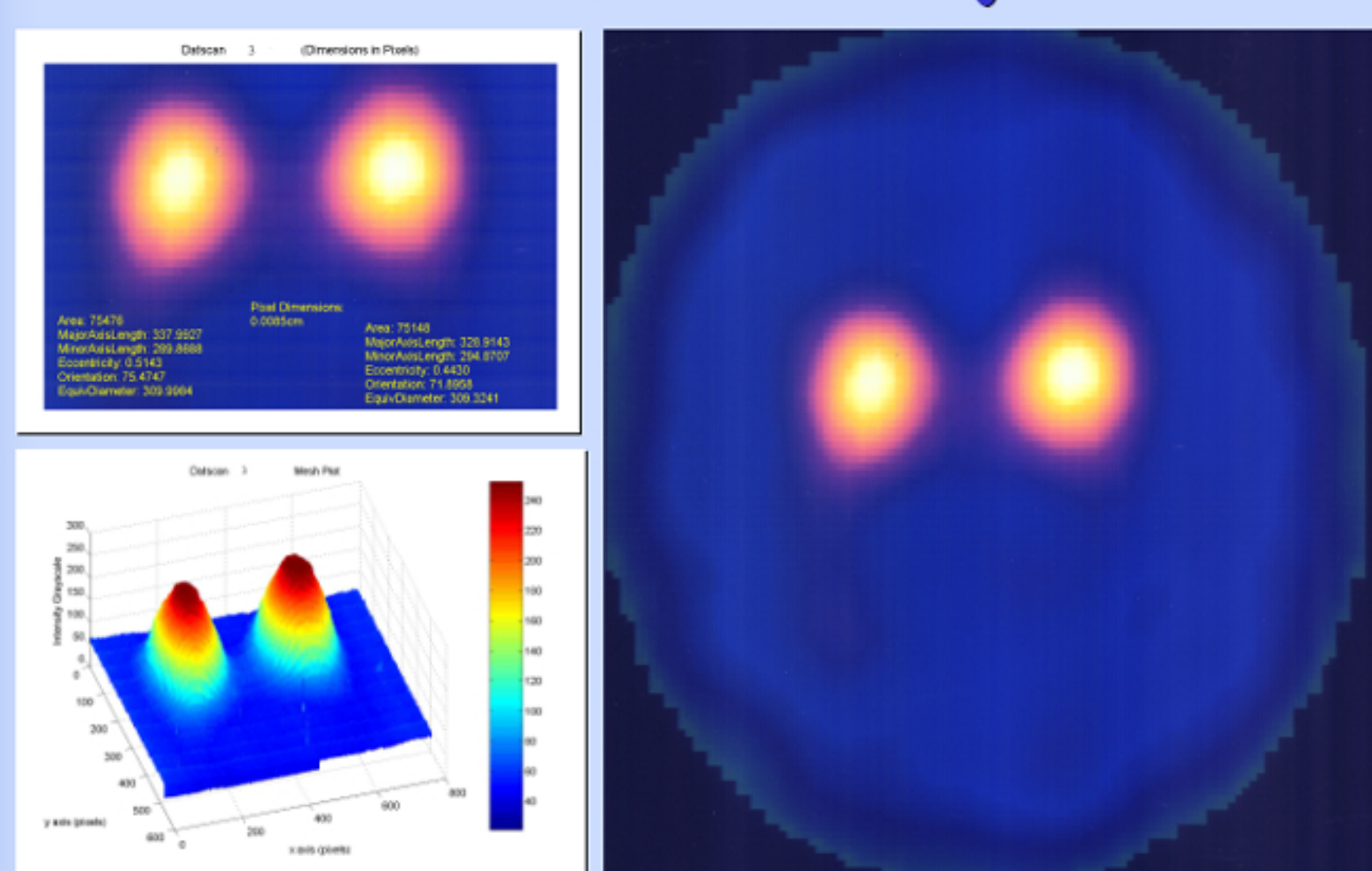
Intensity plotting of dopamine receptors area



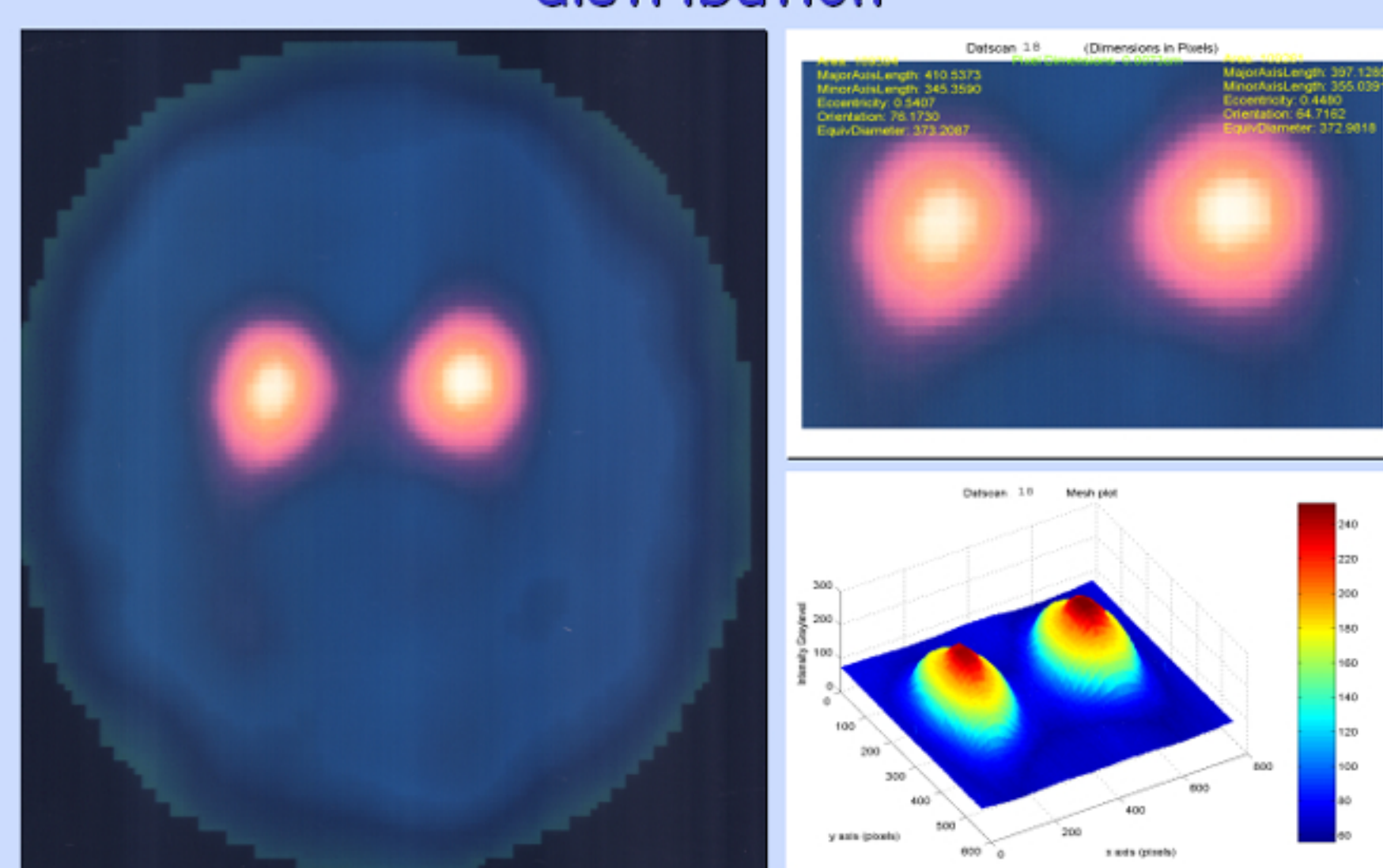
Loss in uniformity-Mesh plotting distribution (right) is used for grades extraction: ratio of intensities and areas



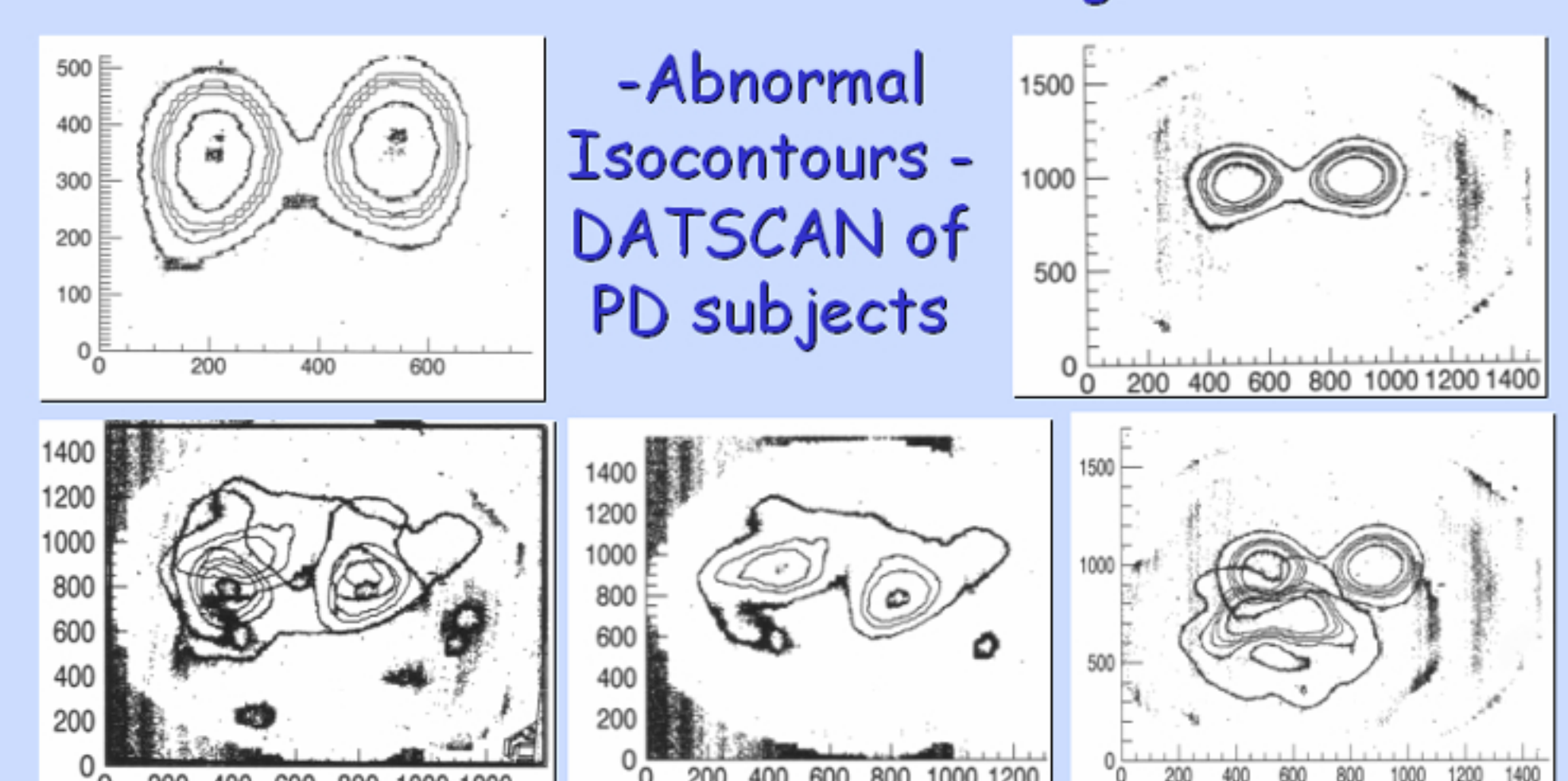
Specific to non specific ratio is lower in PD than not in ET subjects



Mesh Intensity plotting (down right) of the striatum image gives a semi quantitative index using parameters of area, intensity and distribution



ISOCONTOUR Intensity Distributions are specific for each case and they are important factors and are included in categorization



-Abnormal Isocontours - DATSCAN of PD subjects

Results

- Via IDL & Matlab program we integrated an array oriented language and a graphical display technique by profiles of the regions of interest data. Quantitative profile indices were extracted and ratios of specific to non-specific binding were calculated for the caudate nucleus and putamen imaging of all subjects (PD & ET) and compared with ratios obtained in 3 volunteer healthy controls.
- Striatal uptake ratio and profiles were graded from normal up to 4 abnormal levels. Group of ET subjects covered the 1 abnormal grade and intersect to abnormal grade 2.

Conclusion

- Quantitative processing of Datscan images is a useful diagnostic test in the differential diagnosis of tremor disorders. Semi-quantitative analysis of specific: non-specific caudate and putamen uptake were consistent with the results of visual inspection and clinical diagnosis.
- Our results show that quantitative analysis of Datscan images provides an objective way to extract and interpret image data.
- The performance of a pattern recognition program can aid to detect parkinsonism in early stage.

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