

## Original Article

# The impact of DaTscan on the diagnosis and management of movement disorders: A retrospective study

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**Abstract:** Background: The diagnosis of Parkinson's disease remains a challenge in patients who have abnormal symptoms or show a lack of response to medication. The imaging technique, DaTscan, can be used to visualize dopamine degeneration in the nigro-striatum, which is associated with Parkinsonian Syndrome. We examined the use of the DaTscan in diagnosis, confidence in diagnosis, and clinical management. Methods: Physicians of 125 patients were contacted to fill out a brief survey about changes in diagnosis, confidence of diagnosis, and clinical management after assessment with the DaTscan. Results: There was an overall increase in confidence of diagnosis with the results of the DaTscan. Physicians also stated that the DaTscan impacted their diagnosis in 68% of the patients, as well as an impact in the clinical management of 58% of the patients. Conclusion: The DaTscan can be used as a tool to help diagnose Parkinsonian Syndrome in patients with unclear symptoms.

**Keywords:** DaTscan, parkinsonian syndrome, 123I loflupane

## Introduction

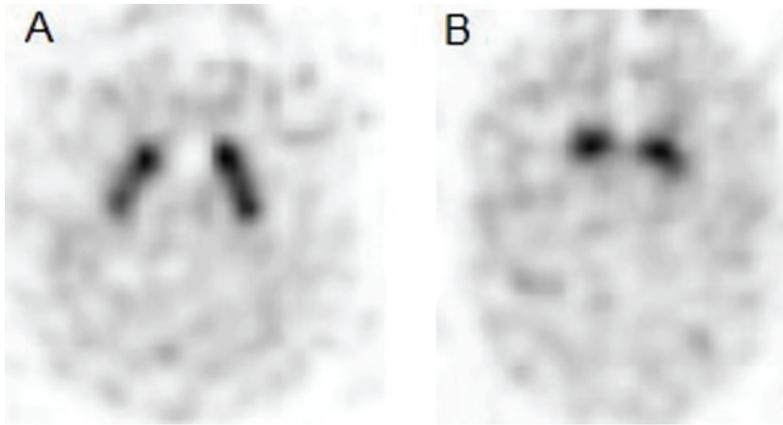
Parkinson's disease (PD) remains one of the most common neurodegenerative disorders with an incidence rate of 17 out of 100,000 [1, 2]. PD is part of a group of diseases with common features labeled Parkinsonian Syndrome (PS), including Progressive Supranuclear Palsy (PNP) and Multiple System Atrophy (MSA). The true definitive diagnosis of the PS disorders can only be made from a post-mortem examination of the brain. The diagnosis of PS until recently was a clinical one, and often proven incorrect with further clinical followup. Pathology only confirms about 80% of clinically diagnosed PD cases [3, 4].

The clinical diagnosis of classic PD is based on four cardinal features: bradykinesia, tremor, rigidity, or postural instability [5]. While most patients present with clear clinical symptoms, there is a subset of patients that are hard to diagnose due to unclear clinical presentation or lack of response to treatment. There is a ten-

dency to both under and over-diagnose PD, resulting in either a lack of treatment and delayed diagnosis or administering treatment and procedures that are unnecessary [6-14]. Therefore, a more accurate way to diagnose Parkinson's Disease is needed.

The DaTscan (GE), a dopamine transporter (DAT) single photon emission computerized tomography (SPECT) imaging technique, has recently been approved in the United States to evaluate patients with suspected PS. The DaTscan has been approved for clinical use in Europe for many years for the detection of nigro-striatal dopaminergic neurodegeneration associated with PS and has shown to have a high specificity for PS [6, 10, 15-18]. This type of imaging uses 123I loflupane to bind to the DAT in the striatum and then SPECT visualizes the amount of transporter present. These transporters normally function to reuptake dopamine from the synaptic cleft. The DAT plays a crucial role in the maintenance of the presynaptic neuron and is reduced 50-70% in patients

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**Figure 1.** Representative normal (A) and abnormal (B) scans.

with Parkinson's [19-21]. Several studies show a high correlation between abnormal DaTscan and a final diagnosis of either PD or MSA via autopsy although the DaTscan cannot distinguish between the different PS disorders [22, 23].

The DaTscan provides a potential tool to evaluate patients with unclear PS symptoms. It can be used to differentiate between disorders of essential tremor or drug induced PS, which does not have nigro-striatal dopamine transporter loss, from PS as true PS will have DAT degeneration [6, 10, 17, 23-25]. The results of the scan can allow physicians to provide accurate clinical management of the patient and prevention of unnecessary medications and procedures.

There have been very few studies performed to date to assess whether the DaTscan affects the diagnosis and treatment of patients. The purpose of this study was to evaluate how the DaTscan affects diagnosis, confidence of diagnosis, and clinical management of the patient.

### Materials and methods

#### Subjects

Between July 2011 and May 2012, 124 patients were sent to Boca Raton Regional Hospital for administration of the DaTscan. All ordering physicians were contacted retrospectively to complete a brief survey. The survey focused on questions about the diagnosis, confidence percentage in their diagnosis, and clinical management of each patient before versus after the DaTscan. This study was approved by

the IRB at Boca Raton Regional Hospital. Due to the retrospective nature of this study as well as absolute maintenance of anonymity, the use of consent forms was waived.

#### DaTscan

One hour before loflupane administration, the thyroid was blocked with 100mg P.O. sodium iodide to prevent uptake of iodine 123 into the thyroid. A dose generally between 4-6 mCi, based on patient body weight, of <sup>123</sup>I loflupane was given intravenously. SPECT imaging was performed 3-6 hours after injection.

Each scan was interpreted by a trained neuro-radiologist using a binary read which classified the scan as normal or abnormal. A normal interpretation was given when there was a homogeneous symmetrical comma type pattern in the striatal nuclei. Any other pattern was interpreted as abnormal, indicating PS or variant. A representative scan of both normal (**Figure 1A**) and abnormal (**Figure 1B**) can be seen in **Figure 1**.

#### Statistical analysis

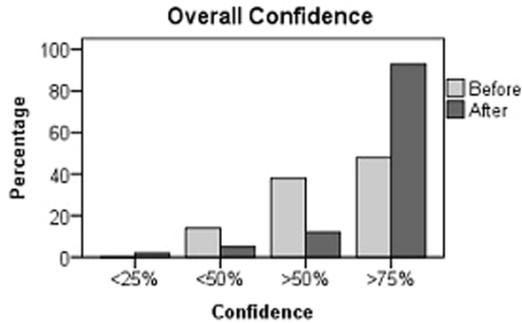
A McNemar test was used to determine if the distribution of the confidence of diagnosis was significantly different when comparing before confidence and after confidence levels. Next, paired 2-tailed t-tests were utilized to determine significance within a specific confidence range before and after. All statistics were performed using SPSS.

### Results

One patient was dropped from the study due to incomplete physician information and one patient was dropped from the study due to the physician retiring and unable to be contacted. Eleven patients were dropped due to lack of physician participation.

Results from the survey show that physicians requested a DaTscan for the following reasons: 63% (70/112) requested a DaTscan due to

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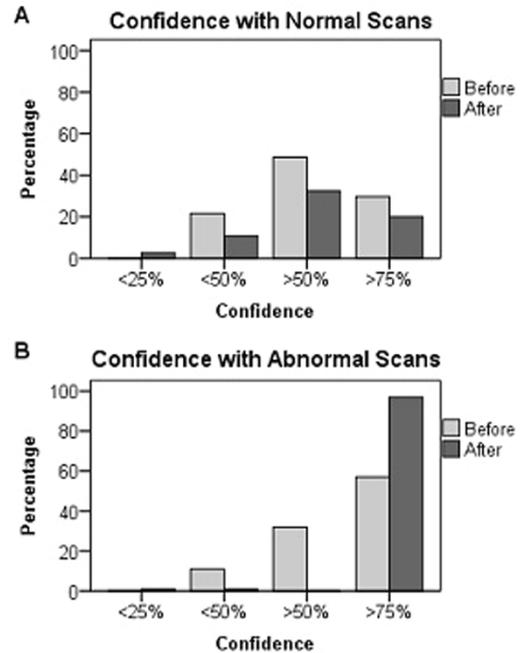


**Figure 2.** Overall confidence levels before and after DaTscan.

ambiguous clinical presentation, 46% (51/112) due to the patient not responding to treatment, 2% (2/112) because the patient was considering surgical intervention, and <1% (1/112) due to the patient being considered for a clinical trial. There were several other reasons filled in by the physician, the two most common being that the patient was taking a pharmaceutical drug known to cause Parkinsonism symptoms and the patient or family requested the scan to make certain of the diagnosis. Physicians could list multiple reasons for each scan.

The results did not focus exclusively on the diagnosis of PD, but instead focused on how confident the physician was on their initial diagnosis regardless of what it was. Our results showed an overall change in the distribution of the confidence in diagnosis that was significant using a McNemar Test (**Figure 2**). The highest confidence range, >75%, was assessed using a paired t-test and showed a significant increase of confidence at  $\alpha < 0.01$ . When comparing movement disorder specialists to general neurologists, there was not a significant difference in the confidence distribution. Interestingly, the result of the scan played a significant role in whether the confidence changed. Separating out normal and abnormal results, the normal scans, suggesting no dopaminergic degeneration, did not show a significant difference in confidence, while the abnormal scans were significant different using both McNemar and t-test assessing increases of >75% confidence at  $\alpha < 0.01$  (**Figure 3**).

In response to the DaTscan itself, there was an actual change in diagnosis in 31% (31/112) of the patients. However, regardless of whether the diagnosis itself changed, physicians felt



**Figure 3.** Change in confidence with a normal DaTscan results (A) and change in confidence with abnormal DaTscan results (B).

that the scan impacted their diagnosis in 68% (76/112) of the patients and also impacted their clinical management in 58% (65/112) of the patients. Many physicians stated that the scan confirmed the diagnosis despite the poor response to medication and established the need for different medications.

### Discussion

The DaTscan is presently being used as a tool to determine if dopamine degeneration is present, suggestive of a diagnosis of PD, MSA, PSP, or other variants. This study focused on evaluating whether the DaTscan impacted the diagnosis, confidence of diagnosis, or clinical management of patients.

Overall, physicians in this study felt that the DaTscan impacted their diagnosis. This is confirmed in several previous studies showing a change in management or diagnosis after receiving results from the DaTscan [15, 26-29]. Løkkegaard et al. found a significant impact with the DaTscan, noting a change of either diagnosis or clinical management in 27% of their patients, which is close to our result of a change in diagnosis in 31% of patients [29]. It is important to note that, although our results showed that only 31% of patients actually had a

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change in the diagnosis, 68% of the patients' physicians stated that their diagnosis was impacted by the DaTscan. This is important to mention as physicians in this study felt that the DaTscan impacted their confidence to keep a certain diagnosis after receiving the results of the scan, not just change their diagnosis.

Confidence in diagnosis was affected by the DaTscan in this study as well. As seen in **Figure 2**, physicians had a higher confidence level after receiving the DaTscan. Kupsche et al. noted a significant difference in the confidence of physicians who had results from a DaTscan then from those that did not [27]. Catafau et al. noted an interesting finding of an increase in confidence when the scan results were abnormal but a decrease in confidence when the scan was normal [26]. Although we did not see a decrease in confidence with normal scan results, our results do show that confidence before and after were not significantly different with normal scans, reflected in **Figure 3**. With abnormal scans, we saw a large and statistically significant increase in confidence >75% at  $\alpha < 0.01$ . An increase in confidence in the diagnosis will permit physicians to better treat these patients, including allowing patients to participate in clinical trials or suggesting alternative and sometimes invasive procedures for patients who cannot tolerate medication.

Our results show that physicians feel that the DaTscan affects their clinical management. Catafau et al. saw a high change in clinical management of 72% of their patients that they attributed to initiation of medication with an abnormal scan [27]. Kupsche et al. state that they also found a significant difference in the clinical management of patients who had a DaTscan compared with those who did not [27]. With the rising cost of healthcare, confirming that a patient is receiving the correct clinical treatment is important. Our results show that physicians felt that the DaTscan affected their clinical management of a patient in 58% of patients that received a DaTscan. This may have included stopping unnecessary medication because the scan was normal, starting a patient on a medication because their scan was abnormal, or increasing/adjusting a patient's treatment plan even though the response had been minimal. All of these changes involve assuring that the patient is on the right treatment and thus may save money by

avoiding further unnecessary medications, diagnostic, and or invasive procedures.

A recent paper by Kupsch et al. discussed a possible difference in results between general neurologists and movement disorder specialists [27]. Their results showed no significant difference in change of management due to DaTscan results, however they noted a significantly higher change in diagnosis with general neurologists. They attributed this to the movement disorder specialists having a higher quality differential diagnosis and being more experienced with PS than general neurologists. The results of our study do not agree with this previous study, our results showing no significant difference in change in diagnosis between general neurologists and movement disorder specialists. In addition, when comparing confidence between the two groups, we found no significant difference between general neurologists and movement disorder specialists. We credit the inconsistency between our study and theirs to the patient population. Kupsch et al. researched patients in several clinics across Europe and in the United States. We limited our research subjects to patients who had their scan at Boca Raton Regional Hospital, thus possibly limiting our patient population and expertise range of physicians.

While our results are consistent with other recent studies, we do acknowledge several limitations to our study. The first is that this is a retrospective study. We recognize that by asking physicians when they have already seen the results of the scan what their confidence was in their diagnosis before the scan, we may have received some inaccurate responses. However, we feel that due to the large number of patients and physicians in this study, any bias one physician would have would be minimal in the overall average of our results. A potential future study would include a prospective project requiring participating physicians to fill out a survey before sending the patient for the scan.

Another limitation to our study is the use of only one radiologist assessing the DaTscan. Many DaTscan studies use multiple radiologists [6, 10, 18, 24, 30, 31]. However, these studies failed to report any disagreement between the radiologists and therefore we felt the need for a second radiologist was unnecessary. In the studies that reported any inter-reader assess-

ment, all stated a high inter-reader agreement, one even stating a value of less than 6% disagreement confirming that there is little need for multiple readers [10, 18, 24, 31]. Being consistent with common clinical practice, many studies have only used one reader as was done in this study [15, 17, 26, 27, 29].

In conclusion, our study showed that the DaTscan does have an impact on clinical decision making. Although the diagnosis itself may not change much, physicians stated that the scan did have an impact on their final diagnosis, confidence in their diagnosis, and clinical management of the patient. Therefore, the DaTscan has the potential to provide support in diagnosis, especially for those patients who have an unclear presentation of PS.

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