

## Original articles

## Does subthalamic stimulation induce personality modifications in Parkinson's disease ? A Rorschach Test explorative study

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### Abstract

*The aim of this study was to investigate personality, by means of the Rorschach Psychodiagnostic test, in a consecutive series of fourteen patients with Parkinson's disease (PD) submitted to bilateral deep brain stimulation of the subthalamic nucleus (DBS STN). Patients were evaluated pre-operatively and 1 year after surgery. Patients were also assessed for motor disability and cognitive status.*

*All the patients obtained a significant amelioration of motor symptoms and could reduce the dopaminergic treatment after surgery. No cognitive decline was observed comparing the pre- to the post-operative neuropsychological assessment.*

*The comparison between pre- and post-operative Rorschach indexes showed no major modifications of personality structure.*

*The results of the present explorative study suggest that DBS of STN does not result in relevant personality modifications in patients with Parkinson's disease.*

**Key words :** Parkinson's disease ; DBS of the subthalamic nucleus ; personality.

### Introduction

Several studies showed the effectiveness of deep brain stimulation of the subthalamic nucleus (STN-DBS) in the treatment of motor symptoms in patients with advanced Parkinson's disease (PD) (Kleiner-Fisman *et al.* 2006). STN-DBS was also found to be relatively safe on global cognitive functioning (Castelli *et al.* 2006 ; Voon *et al.* 2006), while psychiatric and psychosocial evidences are still controversial (Temel *et al.* 2006).

A recent study reported a high prevalence (68%) of psychiatric symptoms in a series of 40 PD patients presenting for DBS surgery, highlighting that psychiatric disorders are very common in these patients independently of DBS itself (Voon *et al.* 2005) ; a recent review further claimed that "Parkinson's disease is a neuropsychiatric disorder" (Agid *et al.* 2003).

STN stimulation seems to modulate not only motor but also cognitive and affective functions. The behavioural and psychiatric side-effects reported after STN DBS are mostly transient and usually affect only individual patients (Castelli *et al.* 2006 ; Voon *et al.* 2006 ; Temel *et al.* 2006) ; nevertheless, they can have a negative impact on the quality of life of patients and caregivers. For these reasons it is important to further investigate psychiatric modifications that may occur after STN-DBS by means of specific psychiatric instruments.

The Rorschach psychodiagnostic test (RT) is a projective test widely used in psychiatric practise in order to investigate personality structure. The scope of the Rorschach technique is to elicit information about the structure and dynamics of an individual's personality functioning. The test provides information about the quality of thought processes, perceptions, affectivity expression and interpersonal relationship.

In earlier studies (Christensen *et al.* 1970 ; Jurko, Andy 1973) the RT was used to evaluate personality in PD patients submitted to stereotaxic ablative surgery (chemopallidectomy, thalamectomy and cryothalamectomy). The results of these studies did not show relevant post-operative personality modifications. To our knowledge, the RT has never been used to investigate patients undergoing modern DBS procedure.

The aim of this study was to explore possible personality changes by means of the RT in a population of PD patients undergoing STN-DBS.

### Methods

Fourteen consecutive PD patients (8 male/6 female) submitted to bilateral STN-DBS were included in the study and gave their written and informed consent. The mean (sd) age of the patients was 61.4 (6.6) years and the mean (sd) duration of the disease was 15.9 (5.0) years.

The inclusion criteria and the surgical procedure were previously described (Lanotte *et al.* 2002). A post-operative MRI fused with the pre-operative CT was performed to exclude surgical complications and to check the correct position of the electrodes.

All the patients performed motor, cognitive and personality assessments two weeks prior to surgery and 1 year after surgery.

The rate of motor improvement induced by STN stimulation was assessed through the UPDRS section III in the pre-operative medication-off (med-off) and in the post-operative stimulation-on medication-off condition (stim-on/med-off).

All patients were administered a neuropsychological tests battery assessing reasoning, memory and executive functions (Castelli *et al.* 2006). Visuo-spatial reasoning was evaluated by means of the Raven Colour Matrices (PM 47); verbal and spatial short-term memory were assessed by means of the Bisyllabic Words Repetition test (BWR) and Corsi's Block Tapping test (CBT) respectively. The assessment of verbal learning was achieved by means of the Paired Associate Learning (PAL)- a Weschler Memory scale subtest. Frontal lobe executive functions, including the development of abstract concepts and the shift of attentional and motor sets, were assessed by means of the Trail Making Test part B and Nelson Modified Card Sorting test (MCST), a modified version of the Wisconsin Card Sorting test. In addition, patients were administered the phonemic and category verbal fluency tasks. Two parallel forms were used for all the memory tests (BWR, CBT, PAL) in order to avoid the test re-test effect.

RT was administered and scored by an expert psychologist in accordance with accepted criteria and practises, following the Anglo-Saxon scoring model of Rapaport (Rapaport D. *et al.*, 1968 ; Passi-Tognazzo 1994 ; Lerner 1998).

RT, as well as the cognitive assessment, was performed during the daily usual clinical condition of the patients : medication-on (med-on) before surgery and stimulation-on medication-on (stim-on/med-on) after surgery.

Data were analysed using the t-test for paired samples (2-tailed). Given the explorative nature of the study, non-corrected p values < 0.05 were considered statistically significant.

## Results

The PD patients of this series obtained a significant post-operative improvement in motor disability (med-off Vs stim-on/med-off scores, UPDRS III) equal to 54%, ( $p < 0.001$ ), with a levodopa equivalent daily dosage (LEDD) reduction of 74% ( $p < 0.001$ ). See Table 1.

Data of the neuropsychological assessment of the two groups are shown in Table 2. The comparison between pre- and post-operative assessments

showed no significant differences. None of the patients of the present series developed dementia.

Also, none of the patients developed post-operative relevant psychiatric disorders, as assessed by psychiatric clinical interviews.

Table 1 shows pre- and post-operative RT indexes. The only variable which showed a significant post-operative modification was the reality index (RI) ( $p < 0.05$ ) : a significant decrease of the ability to maintain an adaptive contact to reality was observed, even if its post-operative mean value was still within the normative range (4-6) (Passi-Tognazzo 1994 ; Lerner 1998).

A trend toward a worsening was found in two other variables : average reaction time (T) ( $p = 0.059$ ) and number of positive form (F+) ( $p = 0.059$ ).

All other RT indexes remained stable ; in particular, affectivity expression, interpersonal relationship and body-self indexes did not show post-operative modifications.

## Discussion

A wide range of psychiatric symptoms was reported following STN-DBS : apathy, depression, anxiety, hypomanic-manic symptoms, psychotic symptoms, emotional dysregulation (Voon *et al.* 2006). The majority of symptoms appear to be transient even if the literature on this issue is still far from conclusive.

To date, few studies have investigated the personality of STN-stimulated PD patients (Castelli *et al.* 2006 ; Houeto *et al.* 2006). In a previous follow-up study we used a semi-structured clinical interview, based on DSM III axis II criteria (SCID II), to investigate personality traits before and 15 months after STN-DBS (Castelli *et al.* 2006). The results highlighted an improvement in paranoid and obsessive-compulsive traits.

Another outcome study used the Temperamental and Character Inventory (TCI) based on Cloninger's psychobiological personality model to assess 20 PD patients submitted to STN-DBS (Houeto *et al.* 2006). Giving the absence of relevant post-operative changes, the investigators concluded that the surgical procedure did not induce modifications in patients' personality or permanent psychiatric adverse events.

At variance from self-report scales, as the SCID II and the TCI, the RT does not rely on patients' insight, and allows to provide a deeper insight into personality structure. Even if there is still a debate about the validity of the test, RT is considered a clinically useful, and reliable instrument to obtain an in-depth evaluation of personality (Fassino *et al.* 2003). In any case, the specific aim of the present study was not to provide psychoanalytic implications of the RT scores but to compare the most

Table 1

Motor, pharmacological and Rorschach Test outcome of the 14 PD patients undergoing STN-DBS. Mean, (SD) and t-test analysis are shown

	Before Surgery	After Surgery 1 year	T (df)	P
<b>Motor outcome</b>				
UPDRS part III	62.0 (13.1)	27.5 (7.0)	7.3 (13)	< 0.001
<b>Dopaminergic Drugs</b>				
LEDD	1181.7 (485.4)	303.5 (275.5)	6.3 (13)	< 0.001
<b>Rorschach test indexes</b>				
NR (Number Responses)	15.4 (3.8)	14.4 (3.7)	0.9 (13)	ns
T (Reaction Time)	10.6 (4.4)	13.4 (6.5)	-2.1 (13)	p = 0.059
RI (Reality Index)	5.0 (1.6)	4.0 (1.7)	2.4 (13)	p = 0.033
<i>Localizations</i>				
W (whole answers)	6.4 (2.2)	6.1 (2.3)	0.6 (13)	ns
D (big detail)	8.1 (3.2)	7.5 (4.1)	0.7 (13)	ns
Dd (little detail)	0.5 (1.2)	0.5 (0.8)	0.0 (13)	ns
<i>Determinants</i>				
F (form)	11.6 (4.3)	10.5 (4.6)	0.9 (13)	ns
F+ (positive form)	7.8 (2.4)	6.6 (2.2)	2.1 (13)	p = 0.059
M (human movement)	1.0 (1.2)	0.9 (1.6)	0.3 (13)	ns
FM (animal movement)	0.6 (0.6)	0.4 (0.8)	0.9 (13)	ns
m (object movement)	0.2 (0.6)	0.1 (0.3)	0.8 (13)	ns
FC (form-color)	1.2 (1.5)	1.3 (1.1)	0.2 (13)	ns
CF (color-form)	0.3 (0.6)	0.3 (0.6)	0.0 (13)	ns
C (color)	0.2 (0.4)	0.1 (0.4)	0.6 (13)	ns
FCh (form-shading)	0.5 (0.9)	0.7 (1.2)	-0.7 (13)	ns
ChF (shading-form)	0.3 (0.6)	0.1 (0.5)	0.6 (13)	ns
<i>Contents</i>				
A (animal)	7.5 (2.3)	8.1 (2.6)	-0.7 (13)	ns
Ad (animal detail)	0.5 (0.9)	0.7 (1.1)	-0.8 (13)	ns
H (human person)	1.6 (2.2)	1.5 (2.4)	0.3 (13)	ns
Hd (human detail)	0.3 (0.6)	0.1 (0.3)	1.2 (13)	ns

ns : not significant ( $\geq 0.05$ ).

Table 2

Neuropsychological test scores of the 14 PD patients undergoing STN DBS. Mean, (SD) and t-tests analysis are shown

	Before surgery	After surgery -1 year-	T (df)	P
Raven colour matrices	25.1 (4.8)	24.4 (5.8)	0.3 (13)	ns
Bi-syllabic words repetition	4.5 (0.8)	4.0 (0.6)	3.1 (13)	ns
Corsi's block tapping test	4.4 (0.7)	4.2 (0.9)	1.3 (13)	ns
Paired associate learning	10.6 (3.5)	9.5 (3.0)	1.4 (13)	ns
Trail making B	342.2 (216.2)	369.5 (201.0)	-0.4 (13)	ns
Nelson MCST				
Categories	4.1 (1.8)	5.3 (1.3)	-1.8 (13)	ns
Errors	14.9 (12.3)	9.3 (9.5)	1.4 (13)	ns
Perseverations	7.2 (7.1)	2.9 (6.5)	1.5 (13)	ns
Phonemic Fluency	34.3 (12.7)	34.7 (14.5)	-0.1 (13)	ns
Semantic fluency	14.9 (5.1)	14.7 (5.5)	0.1 (13)	ns

ns : not significant ( $\geq 0.05$ ).

common RT indexes before and after STN-DBS (longitudinal follow-up study).

The post-operative modifications evidenced by the RT on the present series of STN-stimulated PD patients were few and mild. The ability to carry on an adaptive contact to reality showed a post-operative worsening but it was still within the normative

range after STN-DBS. A slight worsening was also found for other indexes mainly relative to the cognitive domain : critical judgment, attention and level of concentration (F+), and information processing speed (T).

Interestingly, no relevant modifications were evidenced for the affectivity expression. Indexes

relative to colour and shading responses were found to be unchanged at 1 year follow-up. Also the variables relative to the quality of interpersonal relationships did not change after surgery.

Taken together, these findings suggest that the emotional and the psycho-social state analysed with the use of the RT did not change after surgery, despite the relevant motor improvement.

Independently of STN-DBS, PD patients evidenced stereotyped thinking with a controlled and ego-centred affectivity ; in addition, their interpersonal relationships were quite formalised and conventional, confirming previous evidences (Sevilla *et al.* 1973 ; Passi-Tognazzo 1994 ; Ishihara, Brayne 2006). This pattern of personality and psycho-social adaptation to reality, did not change after surgery ; these findings are in agreement with a previous study which showed unchanged personal, familiar and social adaptation after STN-DBS (Houeto *et al.* 2006).

Given the significant post-operative improvement in motor disability, we expected some changes in patients' perception of body-self. On the contrary, no difference between pre- and post-operative assessment was observed, suggesting that STN DBS probably does not affect the representation of somatic identity.

In conclusion, the present explorative study suggests that there is no evidence of personality change in PD patients submitted to STN-DBS. Given the small sample size, further study are necessary to better investigate this issue and come to more definitive conclusions.

#### REFERENCES

- AGID Y., ARNULF I., BEJANI P., BLOCH F., BONNET A. M. *et al.* Parkinson's disease is a neuropsychiatric disorder. *Adv. Neurol.*, 2003, **91** : 365-370.
- CASTELLI L., PEROZZO P., ZIBETTI M., CRIVELLI B., MORABITO U. *et al.* Chronic deep brain stimulation of the subthalamic nucleus for Parkinson's disease : effects on cognition, mood, anxiety and personality traits. *Eur. Neurol.*, 2006, **55** : 136-144.
- CHRISTENSEN A. L., JUUL-JENSEN P., MALMROS R., HARMSEN A. Psychological evaluation of intelligence and personality in parkinsonism before and after stereotaxic surgery. *Acta Neurol. Scand.*, 1970, **46** : 527-37.
- FASSINO S., AMIANTO F., LEVI M., ROVERA G. G. Combining the Rorschach test and the Temperament Character Inventory : a new perspective on personality assessment. *Psychopathology*, 2003, **36** : 84-91.
- HOUETO J. L., MALLET L., MESNAGE V., TEZENAS DU MONTCEL S., BEHAR C. *et al.* Subthalamic stimulation in Parkinson disease : behavior and social adaptation. *Arch. Neurol.*, 2006, **63** : 1090-1095.
- ISHIHARA L., BRAYNE C. What is the evidence for a pre-morbid parkinsonian personality : a systematic review. *Mov. Disord.*, 2006, **21** (8) : 1066-72.
- JURKO M. F., ANDY O. J. Psychological changes correlated with thalamotomy site. *J. Neurol. Neurosurg. Psychiatry*, 1973, **36** : 846-52.
- KLEINER-FISMAN G., HERZOG J., FISMAN D. N., TAMMA F., LYONS K. E. *et al.* Subthalamic nucleus deep brain stimulation : summary and meta-analysis of outcomes. *Mov. Disord.*, 2006, **21** (14) : S290-304.
- LANOTTE M., RIZZONE M., BERGAMASCO B., FACCANI G., MELCARNE A. *et al.* Deep brain stimulation of the subthalamic nucleus : anatomical, neurophysiological, and outcome correlations with the effects of stimulation. *J. Neurol. Neurosurg. Psychiatry*, 2002, **72** : 53-58.
- LERNER P. M. Psychoanalytic Perspectives on the Rorschach. Hillsdale, New Jersey, Analytic Press Publisher, 1998.
- PASSI-TOGNAZZO D. Il metodo Rorschach. Firenze, Giunti Editore Publisher, 1994.
- RAPAPORT D., GILL M. M., SCHAFER R. Diagnostic Psychological Testing. Chicago : Yearbook Publishers. New York : Int. Univ. Press, 1968.
- SEVILLA M., VERNET J. P., BECLE J., DARCOURT G. The Rorschach test in parkinsonian patients. Its course during treatment with L-dopa. Its prognostic value. *Ann. Med. Psychol.*, 1973, **1** (5) : 577-608.
- TEMEL Y., KESSELS A., TAN S., TOPDAG A., BOON P. *et al.* Behavioural changes after bilateral subthalamic stimulation in advanced Parkinson disease : a systematic review. *Parkinsonism Relat. Disord.*, 2006, **12** (5) : 265-72.
- VOON V., SAINT CYR J., LOZANO A. M., MORO E., POON Y. Y. *et al.* Psychiatric symptoms in patients with Parkinson disease presenting for deep brain stimulation surgery. *J. Neurosurg.*, 2005, **103** (2) : 246-251.
- VOON V., KUBU C., KRACK P., HOUE TO J. L., TROSTER A. I. Deep Brain Stimulation : neuropsychological and neuropsychiatric issues. *Mov. Disord.*, 2006, **21** (14) : S305-326.

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