Development and initial validation of a screening tool for Parkinson disease surgical candidates

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Abstract—As there is currently no standardized assessment tool for evaluating Parkinson disease (PD) patients for deep brain stimulation (DBS), the authors developed the Florida Surgical Questionnaire for Parkinson Disease (FLASQ-PD). Part I of the study was a retrospective analysis of 174 patients presenting for a surgical screening. Part II was a multicenter study to assess the correlation of FLASQ-PD scores. The results of this study suggest that the FLASQ-PD may be a useful triage tool for screening PD patients for DBS surgery.

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Although various groups have made recommendations regarding appropriate patient selection for Parkinson disease (PD) surgery,[1-5] there is no standardized assessment tool, and no tool has been specifically designed for deep brain stimulation (DBS).[6,7] At one of the PD surgical centers in this study (University of Florida), among 174 parkinsonian patients referred from private practice neurologists and general practitioners, only 107 had probable idiopathic PD; of those, only a relatively small fraction were ideal surgical candidates (tables 1 and 2). In an effort to improve surgical referral patterns, a collaboration was created to develop a tool for screening DBS candidates: the Florida Surgical Questionnaire for Parkinson Disease (FLASQ-PD). This questionnaire was designed primarily to address the needs of the general neurologists and other healthcare practitioners who provide the vast majority of routine care to parkinsonian patients and who will be referring most of the candidates for DBS surgery to centers specializing in the care of PD patients.

Methods. The FLASQ-PD is a five-section questionnaire (see the supplementary material on the *Neurology* Web site; go to www.neurology.org) that includes (A) criteria for the diagnosis of "probable" idiopathic PD, (B) potential contraindications to PD surgery, (C) general patient characteristics, (D) favorable/unfavorable characteristics, and (E) medication trial information subscores.

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The scoring system was designed to assign higher scores to better surgical candidates. The highest/best possible FLASQ-PD score is 34 with 0 red flags, and the lowest/worse possible FLASQ-PD score is 0 with 8 red flags.

Part I of the study was a single-center retrospective analysis designed to determine whether the FLASQ-PD could appropriately select good surgical candidates, exclude poor candidates, and identify patients without idiopathic PD. Patients presenting for surgical screening (n = 174) at the University of Florida Movement Disorders Center were examined in both medication "on" and "off" states using the Unified Parkinson's Disease Rating Scale (UPDRS) Motor Section Part III (off medication for 12 hours, then re-evaluated on medication). These patients were seen by a movement disorders specialist and clinically placed into one of four categories: 1) idiopathic PD—ready for surgery, 2) idiopathic PD—not ready for surgery but potentially a candidate in the future, 3) idiopathic PD—not a candidate for surgery, and 4) not idiopathic PD—therefore not a candidate for PD surgery (see table 1). The charts of the patients were then reviewed by a blinded investigator who completed the FLASQ-PD questionnaire for each patient.

Part II was a multicenter study designed to assess the correlation of the FLASQ-PD scores of the "ideal candidates" for surgery identified by the movement disorders specialist in Part I of the study with the retrospectively completed FLASQ-PD scores of 55 patients (45 patients with bilateral subthalamic nucleus [STN] DBS, 6 with unilateral STN DBS, 2 with unilateral globus pallidus internus [GPi] DBS, 1 with thalamic DBS, and 1 with a right GPi/left STN DBS combination) selected for surgery at four centers experienced with DBS (University of Kansas, Beth Israel Deaconess Medical Center [Harvard Medical School], Brown University, and University of Florida) (see table 2). Patients underwent complete screening for PD surgery including "on"/"off" UPDRS evaluations, screening by a movement disorder neurologist and neurosurgeon, MRI, and complete neuropsychological testing. In addition to the retrospective FLASQ-PD score, global outcomes as rated by the patients and investigators were collected

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Table 1 *FLASQ-PD results (n = 174) by diagnosis (chart review UF MDC)*

Diagnosis	n	CI*	GC*	F/U*	MT*	Total*	UPDRS†
PD	107	0.77	4.33	9.38	3.66	17.36	30.80
PSP	9	3.78	2.44	6.44	1.44	10.33	−1.19
MSA	10	2.1	3.80	7.50	3.60	14.90	2.53
DLB	7	1.86	3.43	7.00	2.29	12.71	12.90
CBGD	6	2.33	4.17	8.67	1.17	14.00	−24.54
OPCA	2	2.00	2.00	8.00	2.50	12.50	−3.70
Other	33	1.39	3.33	9.85	0.64	13.80	4.68

* Mean scores.
† Mean percent change in the "on" vs "off" UPDRS motor scores.

FLASQ-PD = Florida Surgical Questionnaire for Parkinson Disease; UF MDC = University of Florida Movement Disorders Center; PD = idiopathic Parkinson disease; PSP = progressive supranuclear palsy; MSA = multiple-system atrophy; DLB = dementia with Lewy bodies; CBGD = corticobasal degeneration; OPCA = olivopontocerebellar atrophy; Other = other parkinsonian syndrome; CI = contraindications (flags) subscore; GC = general characteristics subscore; F/U = favorable/unfavorable characteristics subscore; MT = medication trial subscore; Total = total FLASQ score; UPDRS = Unified Parkinson's Disease Rating Scale.

6 months postoperatively. The 7-point Clinical Global Impression Scale (CGIS) was used. Scores on the FLASQ-PD, UPDRS "on"/"off" evaluation, and CGIS were compared with the scores of the surgical candidates in Part I of the study (see table 2).

Data analysis. Internal consistency of the FLASQ-PD was evaluated in the sample of idiopathic PD patients only (n = 107), consistent with the stated goals of the FLASQ as a surgical screening questionnaire for idiopathic PD patients. Mean group comparisons were evaluated using analysis of variance, with the modified version of Ryan's procedure (REGWQ) used for post-hoc analyses.

Results. *Single-center FLASQ-PD scores by individual parkinsonian syndrome.* Table 1 presents the FLASQ-PD scores obtained from the retrospective chart review of 174 patients at the University of Florida Movement Disorders Center. There was a difference in the mean FLASQ-PD total scores among the diagnostic groups ($p < 0.001$). In particular, patients with idiopathic PD had a higher general patient characteristic subscore ($p < 0.01$), potential contraindication subscore ($p < 0.05$), medication trial subscore ($p < 0.001$), and total score ($p < 0.001$) on the FLASQ-PD than the group of patients diagnosed clinically with other parkinsonian syndromes. Additionally, the on/off levodopa percent change scores were higher in the idiopathic PD group ($p < 0.001$).

Single-center "ready for surgery" candidates vs "future" and "nonsurgical" candidates. Internal consistency of the FLASQ-PD was adequate (Cronbach $\alpha = 0.69$). The surgical category groups (see table 2) differed on mean total FLASQ-PD scores ($p < 0.01$). In particular, the "ready for surgery" PD candidates (category 1) obtained a greater mean total FLASQ-PD score than the other three surgical category groups ($p < 0.05$). Potential future surgical candidates had a better contraindications (flags) subscore ($p < 0.01$) and a greater response to levodopa as indexed by UPDRS percent change scores ($p < 0.01$). Category 2 and 3 patients in turn obtained a greater mean total FLASQ-PD score than the group of non-PD, nonsurgical candidates (category 4) ($p < 0.05$).

Multicenter FLASQ-PD data. The retrospective FLASQ-PD scores (multicenter) were compared with the FLASQ-PD scores of the patients from Part I of the study (see table 2). The patients in the multicenter group had an

Table 2 *FLASQ-PD results of Part I cohort (single-center blinded chart review) compared with Part II cohort (multicenter PD patient who underwent surgery)*

Surgical category	n	Mean CI	Mean GC	Mean F/U	Mean MT	Mean total	Mean UPDRS*
Part I†							
Category 1/surgery-ready	8	0.13	7.88	9.75	7.38	25.00	59.23
Category 2/future surgery	57	0.60	4.21	10.09	2.95	17.21	32.98
Category 3/PD—no surgery	42	1.12	3.81	8.36	3.93	16.10	20.93
Category 4/not PD—no surgery	67	1.97	3.33	8.58	1.46	13.36	1.43
Part II‡							
Multicenter PD cohort	55	0.05	6.91	11.60	7.96	26.47	50.84

* Mean percent change in the "on" vs "off" UPDRS motor score.
† Data obtained from a single-center retrospective chart review and categorization by a blinded movement disorders neurologist; 174 patients were placed into four surgical categories by a movement disorders specialist.
‡ Pooled data from a multicenter retrospective chart review of 55 patients who went on to have deep brain stimulation performed.

FLASQ-PD = Florida Surgical Questionnaire for Parkinson Disease; CI = contraindications (flags) subscore; GC = general characteristics subscore; F/U = favorable/unfavorable characteristics subscore; MT = medication trial subscore; Total = total FLASQ score; UPDRS = Unified Parkinson's Disease Rating Scale.

excellent overall outcome as rated by the patient (mean patient global outcome score of 2.02/7) and investigator (mean investigator global outcome score of 2.16/7).

The multicenter data matched closely the blinded assessment of the category 1 patients ("ready for surgery" candidates) in Part I of the study (multicenter mean total FLASQ-PD score = 26.5 vs "ready for surgery" mean total FLASQ-PD score = 25.0), with no difference between the two groups ($p = 0.30$) (see table 2).

Discussion. Although our cumulative experience over many years brings us closer to defining the "ready for surgery" candidate, not uncommonly, the clinician may be faced with a difficult decision in a parkinsonian patient desperate to undergo surgical treatment for severe motor fluctuations or poor medication response. Without a formal screening tool, the severity of motor impairment and the patient's sense of urgency and desperation may cloud the clinician's objectivity in assessing the appropriateness of surgery. The data presented in this pilot study suggest that the FLASQ-PD may be a useful screening tool for physicians and healthcare professionals evaluating PD patients for DBS surgery.

Scores of ≥25 seemed to reflect the best surgical candidates; however, this will need prospective validation. Scores on the FLASQ-PD of ≤15 may suggest either late stage PD or another parkinsonian syndrome (see tables 1 and 2) and reflect poor surgical candidates. Examination of subscores and the addition of the UPDRS may be useful in distinguishing between groups. Although primitive reflexes were included as a contraindication on this scale, many PD patients have a Myerson sign, and this question will need further investigation.

This pilot study showed that the FLASQ-PD was a useful triage tool for the workup of PD surgical candidates. We suspect this simple questionnaire will be most useful to general neurologists and other healthcare professionals who care for parkinsonian patients but are not subspecialists in the treatment of movement disorders. Specific scoring guidelines and recommendations for use of the questionnaire will evolve as the findings of this pilot study are prospectively evaluated and used by general neurologists and practitioners. The FLASQ-PD may prove to be a useful triage tool for PD surgery, but it is not intended to replace the complete interdisciplinary presurgical workup.

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