



## Review Article

# Effects of subthalamic nucleus deep brain stimulation on quality of life and motor and depressive symptoms in Parkinson's disease



Jiin-Ling Jiang<sup>a</sup>, Sheng-Tzung Tsai<sup>b, c</sup>, Shin-Yuan Chen<sup>b, c, \*</sup>

<sup>a</sup> Department of Nursing, Tzu Chi University, Hualien, Taiwan

<sup>b</sup> Department of Neurosurgery, Buddhist Tzu Chi General Hospital, Hualien, Taiwan

<sup>c</sup> Department of Medicine, Tzu Chi University, Hualien, Taiwan

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## ABSTRACT

The objective of this paper is to review the available literature concerning the effects of subthalamic nucleus deep brain stimulation (STN-DBS) on quality of life (QoL) and motor and depressive symptoms in patients with Parkinson's disease (PD). These studies demonstrate that STN-DBS has an effect on QoL and symptoms in patients with PD. There was a significant improvement in QoL following STN-DBS compared with no improvement after medical therapy. PD patients treated with STN-DBS had a 40–50% improvement in motor function. Nevertheless, depressive symptoms did not reveal consistent change.

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## 1. Introduction

Parkinson's disease (PD) is a chronic neurodegenerative disease that places a substantial burden on patients and their families and caregivers, as well as society. It is characterized by muscle rigidity, resting tremor, bradykinesia, and postural instability [1]. Although optimal pharmacological therapy with levodopa and other adjuvant regimens can be achieved, complications associated with the treatment of PD, such as dyskinesia and motor fluctuation, inevitably occur around 5 years after the initiation of therapy [2–4]. The progressive decline in motor function and the comorbidity associated with PD negatively affect quality of life (QoL) [5]. Depression is one of the most common psychiatric disorders in PD [6], with 35% of patients reporting some level of depressive symptoms, including 17% with major depressive disorders and 22% with minor depression [7]. Depressive symptoms have been recognized as a major contributor to poor QoL, poor motor and cognitive function, and caregiver burden [8].

Subthalamic nucleus deep brain stimulation (STN-DBS) therapy has emerged as an additional option for PD treatment and provides PD patients with improved QoL and control of motor symptoms. Although the precise mechanism by which deep brain stimulation (DBS) exerts benefits is still elusive, increasing evidence suggests that it might involve multidisciplinary effects on the target where afferent nerves are stimulated and neurotransmitters are released [9,10]. Despite a rapid increase in the number of studies of STN-DBS in patients with PD, there is still some disagreement on its impact.

Clinical evaluation of PD is usually carried out by assessing a variety of functional and mental aspects in addition to data gathered from medical examinations. The Core Assessment Program for Surgical Intracerebral Therapies protocol [11] recommends assessment of QoL using an instrument such as a rating scale before starting the preoperative evaluation and, thereafter, at 6 months, 1 year, and 2 years, and then every year if evaluation is continued. Comparison of pre- and postoperative findings is important in this group of STN-DBS patients. This review seeks to identify studies that provide information regarding outcomes of STN-DBS in patients with PD, and summarize and compare changes in QoL and motor and depressive symptoms from these studies.

Conflict of interest: none.

\* Corresponding author. Department of Neurosurgery, Buddhist Tzu Chi General Hospital, 707, Section 3, Chung-Yang Road, Hualien, Taiwan. Tel.: +886 3 8561825x2151; fax: +886 3 8463164.

E-mail address: [willam.sychen@msa.hinet.net](mailto:willam.sychen@msa.hinet.net) (S.-Y. Chen).

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## 2. Materials and Methods

### 2.1. Search methods

A search strategy was developed to identify published studies on the impact of STN stimulation on QoL in patients with PD. An expert panel was established to guide the review process. The search for eligible studies was comprehensive and involved multiple strategies. Data were sought from published studies in English language journals. Searches were limited to human-based studies. An initial limited literature search of PubMed was conducted to identify relevant keywords contained in the title, abstract, and subject descriptions. We used Medical Subjects Headings to select search terms. STN-DBS was first applied for PD in 1993 [12]. Similar strategies were used in searching other bibliographic databases (Table 1) for relevant research articles published between 1993 and 2014. In addition, we reviewed references from articles identified in the aforementioned searches to include any additional papers related to outcomes of DBS that may have been missed.

We used the following terms as keywords: *deep brain stimulation, subthalamic nucleus stimulation, neurostimulation, quality of life, health-related quality of life, motor symptom, nonmotor symptom, psychiatric symptom, mood, and Parkinson's disease*. The key words used to search for publications that met the design criteria were *randomized controlled trial/s, controlled trial/s, random allocation, and clinical trials*. Figure 1 shows the flow of information through the different phases.

To identify potentially eligible articles, two authors (J.L.J. and S.T.T.) screened the titles and abstracts obtained from the electronic search strategy. Retrieved abstracts were further scrutinized to include only those studies that had at least 6 months of follow-up. In addition, authors scanned abstracts to ensure the presence of outcome data, including pre- and postsurgical QoL scores. If a decision could not be made regarding eligibility for inclusion, the full text of the article was examined. Full length articles of all selected abstracts were retrieved and assessed by the same reviewers for the inclusion criteria reported below.

### 2.2. Inclusion criteria

#### 2.2.1. Types of studies

The selection criteria were studies restricted to randomized or nonrandomized control trials on the effectiveness of STN-DBS for treatment of idiopathic Parkinson's disease. Randomized controlled trials (RCTs) provide the best possible evidence on clinical outcomes. If filtering only identified a small number of RCTs, clinical controlled trials could also be included. The use of nonrandomized data required careful consideration of the comparability of the treatment and control groups in those studies. Retrieved abstracts were further scrutinized to include only those studies with at least 6 months of follow-up.

Excluded from the review were investigations that primarily examined factors that predicted changes in QoL and other systematic reviews relevant to this topic [13,14]. Studies documenting

only nonmotor outcomes (for example, cognitive function) or surgical parameters (such as microelectrode recording) were not considered in our review. We also excluded studies if the electrode implantation site was not the subthalamic nucleus. Only articles meeting the inclusion criteria were retained for analysis.

#### 2.2.2. Participants

Studies of human individuals were included, and animal and laboratory studies were excluded. There were a number of animal and laboratory studies in this area, but the generalizability from laboratory animal models to clinical patients is problematic.

#### 2.2.3. Intervention

The intervention of interest was STN-DBS used to change QoL, motor symptoms and psychiatric symptoms in patients with idiopathic PD.

#### 2.2.4. Outcome measurements

**2.2.4.1. QoL: Disease-specific 39-item PD questionnaire.** The World Health Organization defines QoL as "individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns" [15]. Several QoL tools have been used in PD. A movement disorder society task force was commissioned to rate the psychometric quality of available QoL scales as applied to PD. Siderowf et al [16] reported that generic instruments may represent relatively lower sensitivity to change as shown by the 36-Item short-form health survey compared with the 39 item Parkinson's disease questionnaire (PDQ-39). The PDQ-39 is the most thoroughly tested and applied questionnaire for PD [17]. It has adequate psychometric properties and adequately covers physical, mental, and social domains. It is composed of 39 items grouped in eight subscales: mobility, activities of daily living (ADL), emotional well-being, stigma, social support, cognition, communication, and bodily discomfort [18].

**2.2.4.2. Motor symptoms: unified PD rating scale.** PD is characterized by motor symptoms. The unified PD rating scale (UPDRS) is the most commonly used scale in the clinical study of PD.

**2.2.4.3. Depressive symptoms: Beck depression inventory.** Depression is one of the most common psychiatric disorders in PD. The Beck depression inventory is one of the most widely used instruments for measuring the severity of depression.

## 3. Results

The database search and reviewed references from included articles yielded 39 citations published between January 1, 1993, and November 30, 2014. Articles were excluded based on information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment. Twenty-eight studies met the inclusion criteria. Eight studies reported on QoL, 12 on motor symptoms, and eight on depressive symptoms in patients with PD after STN-DBS surgery.

### 3.1. STN-DBS effects on QoL

Kuehler et al [19] suggested that there is a need to determine whether such a sophisticated and costly treatment is not only safe and effective, but also whether it enhances QoL. Several RCTs of DBS have confirmed its efficacy [20–23]. The end points of these trials included QoL, mood, or the severity of motor symptoms when the patient was not taking medication, and the number of hours per day spent in the *on* state without dyskinesia. Six RCTs (1184

**Table 1**  
Electronic databases searched.

Database searched	Publication dates
PubMed	1993–Nov 2014
Cochrane Library	1993–Nov 2014
MEDLINE via Ovid online	1993–Nov 2014
EBSCO host	1993–Nov 2014
CINAHL	1993–Nov 2014
CEPS + CETD	1993–Nov 2014

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