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Original Article

The future role of using deep brain stimulation: The things that pass through the minds of two high school students

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Abstract

Objective: Parkinson's disease is a brain condition that results in unintentional or uncontrollable movements like trembling, stiffness, and issues with balance and coordination. Typically, symptoms start mildly and get worse over time. People could experience difficulties speaking and walking as the illness worsens. The most often performed surgical treatment for Parkinson's is deep brain stimulation (DBS). DBS is not for everyone while being transformational for some. Our study aims to analyze the results of two high school students on DBS Parkinson's patients and to reveal their thoughts on its future usability.

Materials and Methods: The study was carried out with the prospective evaluation of Parkinson's patients who had DBS surgery in the Neurosurgery clinic of our hospital between August 2021 and July 2022.

Results: DBS surgery was performed in 18 patients. Due to the deaths of three of these patients during the trial, they were not included in the analysis. In addition, 4 patients who were not able to be reached did not request post-operative follow-ups. There was a statistically significant increase in the study group's post-procedure SF 36 scale score changes for the physical function (p:0.001), physical role difficulty (p:0.008), pain (p:0.042), general health (p:0.003), and social functionality (p:0.004) subscales. Energy/aliveness/vitality, emotional role difficulty, and mental health subscale scores did not significantly correlate with one another (p>0.05). The amounts of change in the SF-36 subscale scores were found to be statistically equivalent when the distribution of the change in post-procedure scores by gender was investigated (p>0.05). A significant and adverse correlation between the change in the general health subscale score and age was discovered when the relationship between SF-36 subscale scores and age were investigated (Rho: -0.681, p:0.021). Age and the change in other subscale scores were not correlated statistically significantly (p>0.05).

Conclusions: In the comparison of 11 Parkinson's patients treated with DBS with SF-36 form before and after DBS, physical function, physical role difficulty, pain, general health, and social functionality increased at a certain level after DBS and were found to be statistically significant.

Keywords: deep brain stimulation, Parkinson, neurosurgery

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Introduction

Stimulation of the subthalamic nucleus to treat several motor side effects in Parkinson's disease has become an increasingly popular treatment method recently (1). However, in addition to this treatment, deep brain stimulation (DBS) has many long-term side effects, which should be considered in the decision to use this treatment (2) (**Figure 1**). In recent studies, it was shown that DBS improves motor symptoms and causes different results in terms of psychosocial aspects of patients. It is still not understood whether this is due to the progression of the disease, surgery, or continuous stimulation due to DBS (3). Patients who are difficult to control with medical drugs and patients with advanced motor functions are more suitable candidates for this treatment. Therefore, the technical skill of the surgeon, appropriate patient selection, and multidisciplinary evaluation is important when selecting these patients to be beneficial to the patient (4).

This study aims to evaluate the results based on the characteristics of patients with motor symptoms, such as psychosocial and physical function, before and after DBS.

Materials and Methods

This study is a prospective cohort study and was carried out with the approval of the Okan University Faculty of Medicine Ethics Committee. In our hospital, 18 Parkinson's patients who were suitable for treatment and accepted DBS treatment due to worsening mobility because of illness were determined. Patients with cognitive disorders such as atypical Parkinsonism, secondary Parkinsonism, dementia, and uncontrollable mental disorders, patients who did not want to participate in the study, and patients who died due to different reasons during the treatment were excluded from the study.

The Short Form (36) Health Survey (SF-36) is a type of questionnaire consisting of 36 forms with 8 subheadings that enable us to determine the functional health and mood of patients. Scoring is between 0 and 100, and low scores indicate a poor subjective lifestyle.

For this purpose, SF-36 forms of patients with primary Parkinson's disease were filled out before DBS treatment upon obtaining voluntary consent forms from volunteer patients. Subsequently, the patients underwent surgical intervention for DBS. The patients were followed up for 1 year. Three of these patients were excluded from the study as they died during the study. And 4 patients did not apply for follow-ups after surgery, and they could not be reached.

Statistical Analysis

In the study, descriptive data were shown with numbers and percentages, and measurement data with mean ± standard deviation and median (minimum-maximum) values, whichever was appropriate. The Shapiro-Wilk test and histogram graphs were used to examine the normal distribution assumption of the measurements. The t-test was used to compare the normally distributed measurements in the paired groups, and the Wilcoxon test was used to compare non-normally distributed measurements. The Spearman correlation analysis was used to examine the correlation of the measurements with each other. A P value of <0.05 was accepted as statistically significant. All analyses were performed with the SPSS 20 program.

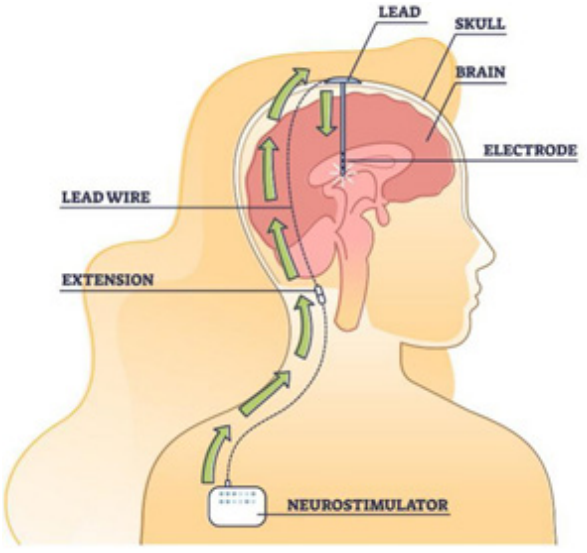

Figure 1: Deep brain stimulation

Results

Our study was completed with 11 patients, 7 of whom were male and 4 were female. The mean age of the study group was 71.0 ± 12.2 (Table 1).

Table 1: Demographic characteristics of the study group

		n	(%)
Gender	Male	7	(63.6)
	Female	4	(36.4)
Age*		71.0	± 12.2

*mean±standard deviation

When post-procedure SF 36 scale score changes in the study group were examined, it was determined that there was a statistically significant increase in physical function (p:0.001), physical role difficulty (p: 0.008), pain (p: 0.042), general health (p: 0.003), and social functionality (p:0.004) subscale scores after the procedure. No statistically significant relationship was found between energy/aliveness/vitality, emotional role difficulty, and mental health subscale scores (p>0.05) (Table 2).

Table 2: SF-36 Examination of pre-procedure and post-procedure values of the quality of life scale

	Before	After	p
	Mean ± Std. deviation	Mean ± Std. deviation	
Physical Function	60.5% ± 16.9%	74.5% ± 15.9%	**0.001** [a]
Physical Role Difficulty	50.0% (0.0% -75.0%)	75.0% (0.0%-100.0%)	**0.008** [b]
Pain	77.5% (0.0%-100.0%)	100.0% (0.0%-100.0%)	**0.042** [b]
General Health	41.4% ± 23.6%	55.0% ± 23.5%	**0.003** [a]
Energy/Liveliness/Vitality	49.5% ± 27.2%	58.6% ± 28.8%	0.080 [a]
Social Functioning	52.3% ± 22.9%	69.3% ± 31.3%	**0.004** [a]
Emotional Role Difficulty	33.3% (0.0%-100.0%)	33.3% (0.0%-100.0%)	0.380 [b]
Mental Health	60.0% (8.0% -88.0%)	72.0% (16.0%-100.0%)	0.078 [b]

[a] T-test in paired groups, [b] Wilcoxon test

* Median (minimum-maximum) values are presented.

Table 3: Distribution of the change by gender in SF 36 scale scores after the procedure

	Male	Female	p
	Median (Min-Max)	Median (Min-Max)	
Physical Function	15.0 (-5.0-40.0)	12.5 (10.0-15.0)	0.788 [a]
Physical Role Difficulty	25.0 (0.0-100.0)	25.0 (0.0-25.0)	0.648 [a]
Pain	0.0 (0.0-45.0)	5.0 (0.0-22.5)	0.927 [a]
General Health*	15.0 ± 11.9	11.3 ± 13.1	0.639 [b]
Energy/Liveliness/Vitality	5.0 (-5.0-50.0)	2.5 (0.0-15.0)	0.788 [a]
Social Functioning	14.3 ± 16.8	21.9 ± 12.0	0.451 [b]
Emotional Role Difficulty*	19.0 ± 42.4	8.3 ± 31.9	0.672 [b]
Mental Health	4.0 (-8.0-40.0)	6.0 (-4.0-20.0)	0.788 [a]

[a] Wilcoxon test, [b] T-test in paired groups

* Mean ± Standard Deviation values are presented.

When the distribution of the change in post-procedure scores by gender was examined, the amounts of change in SF-36 subscale scores were observed to be statistically similar (p>0.05)

When the correlation between SF-36 subscale scores and age was examined, a strong and negative correlation was found between the change in the general health subscale score and age (Rho: -0.681, p:0.021). No statistically significant correlation was found between the change in other subscale scores and age (p>0.05) (Table 4).

Table 4: Correlation of the change in SF 36 scale scores after the procedure with age

	Age	
	Rho	p
Physical Function	223	0.510
Physical Role Difficulty	123	0.719
Pain	-0.007	0.983
General Health	-0.681	**0.021**
Energy/Liveliness/Vitality	0.021	0.951
Social Functioning	-0.092	0.788
Emotional Role Difficulty	0.037	0.913
Mental Health	-0.441	0.174

*Spearman Correlation Analysis

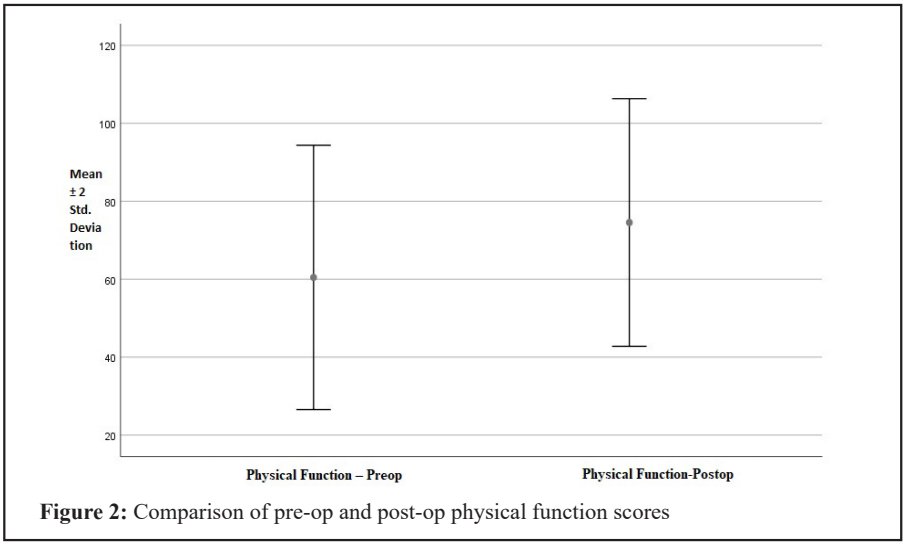

Figure 2: Comparison of pre-op and post-op physical function scores

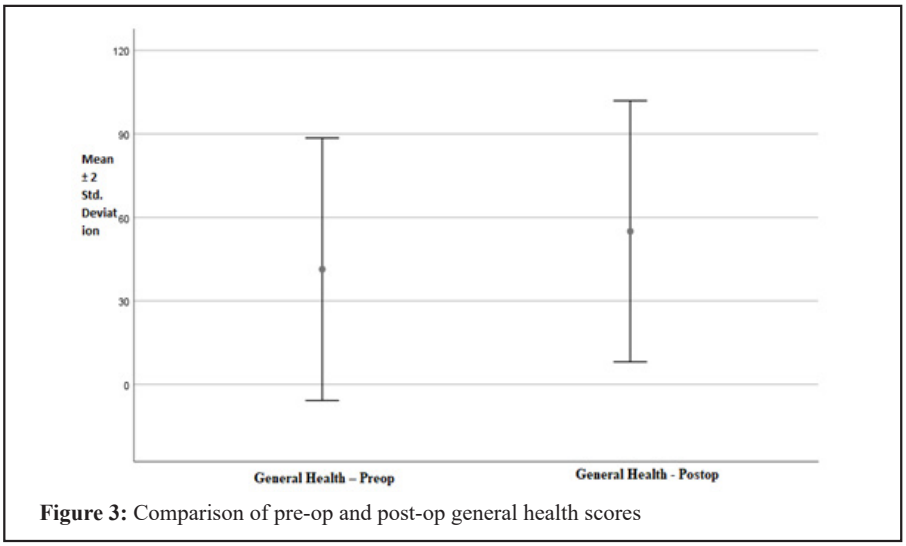

Figure 3: Comparison of pre-op and post-op general health scores

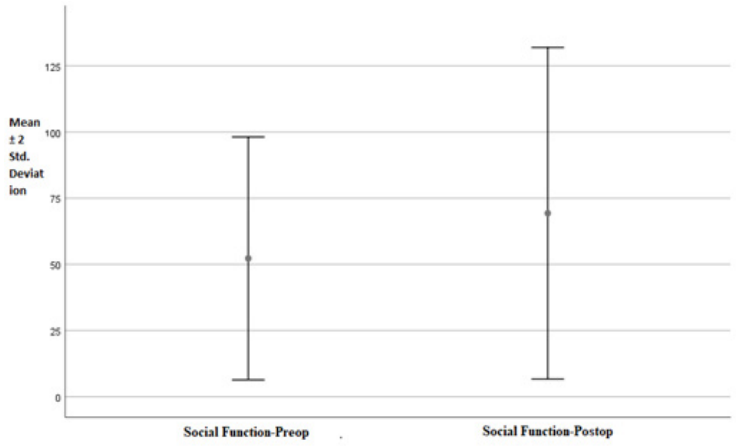

Figure 4: Comparison of pre-op and post-op social function scores

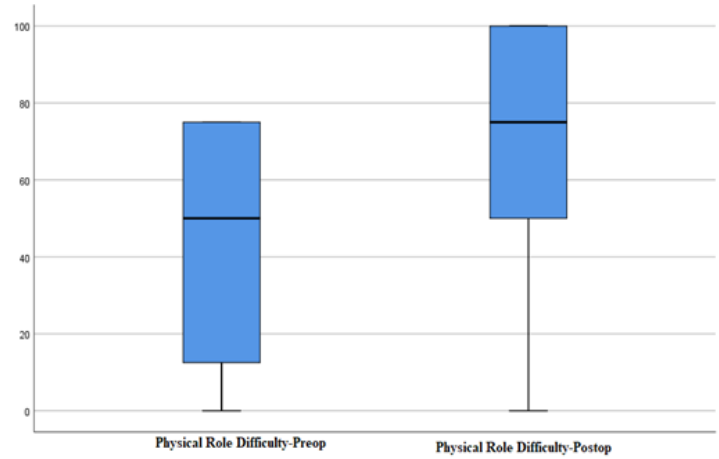

Figure 5: Comparison of pre-op and post-op physical role difficulty scores

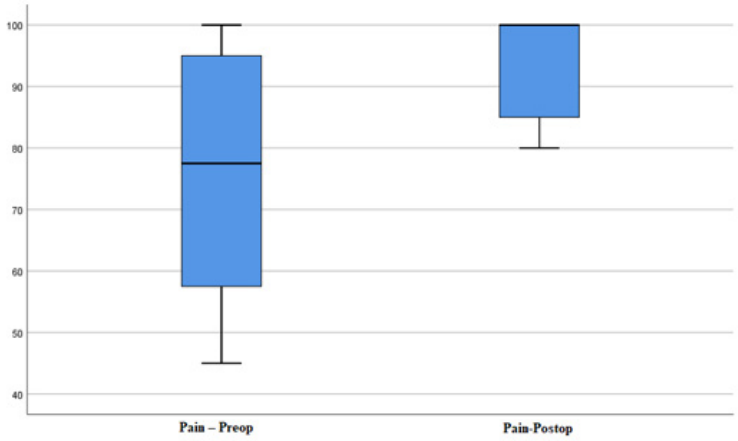

Figure 6: Comparison of pre-op and post-op pain scores

Discussion

During our study, feedback was received from 11 Parkinson's patients (7 males, 4 females) treated with 11 DBS using the Sf-36 form. The Sf-36 form has headings for physical function, physical role difficulty, pain, general health, and social functioning. These feedbacks differed in 11 patients with a mean age of 71, and the feedbacks were statistically compared. We interviewed the patients' relatives and asked about the condition of the patients because Parkinson's disease is seen mostly in the elderly. Thus, we had the opportunity to empathize with both the patients and their relatives. Even before analyzing the data, we had the chance to compare young Parkinson's patients with elderly Parkinson's patients with additional comorbid diseases. Elderly Parkinson's patients with comorbid diseases who had undergone DBS surgery are not sure that they benefited from DBS surgery treatment. This brings to mind a few possibilities, mainly due to the comorbid disease, the effect of DBS on the brain decreases, or the drug treatment due to comorbid diseases or other treatments may have affected the functions of the DBS battery, and this suggests that additional research should be conducted. The reason for this difference was determined as a result of the analysis of interviews.

When the statistics were examined, we realized that they should be improved to reduce the error rate and obtain more reliable data in future studies. Because only 11 of the 18 patients who underwent surgery at the beginning of our study had a response. However, it is a known fact that as the number of patients increases, reliability and statistical means give more accurate results. Additionally, the SF 36 form was filled out by contacting the patients on certain days. The psychology of the patient, which may vary depending on external factors, may have caused the patient to display a biased attitude in the Sf-36 filling interview. The best way to prevent this is to give the same questionnaire to the same patient several times when there are no external factors, psychological pressure, or discomfort.

Thus, it is recommended to do more than one interview with each patient at certain intervals to minimize these variations and error rates. For example, if the questions are evenly distributed on certain days of the week and at certain times of the day, this error can be reduced. Such improvements will positively affect the results obtained with the help of the Sf-36 form and lead to more reliable results.

The most important part of our study is the wide vision it provides for us. Deep Brain Stimulation (DBS) is a technique that uses electrical and chemical stimulation to change the function of the nervous system as desired with minimal side effects. It has already been used in the treatment of many conditions such as Parkinson's disease, essential tremor, dystonia, obsessive-compulsive disorder, and epilepsy (2). We believe that the most likely future benefits of DBS are memory impairment, addiction treatment, and mental health. DBS for memory impairment has already been used in some patients with traumatic brain injuries to improve memory (5). Although the success rate of this treatment for these indications has not yet been proven, another possible benefit of DBS would be to improve memory in healthy brains. This will be a novelty and have a huge impact on the market. This is because memory enhancement will be useful in everyone's life, whether law students, healthcare professionals, or actors... As a result, DBS would be of great interest if it could be used to improve memory. There were also studies to investigate the effects of DBS on addiction. Because DBS focuses on a specific part of the brain, DBS for addiction needs to be targeted to modulate specific brain regions involved in reward, motivation, and impulse control (6).

However, a successful outcome has not yet been reached. Soon, it can only be used to help patients struggling with addiction if non-invasive methods are tried and proven ineffective.

The main neuropathological finding is a-synuclein-containing Lewy bodies and loss of dopaminergic neurons in the substantia nigra, manifesting as reduced facilitation of voluntary movements (7).

Although this situation leads to more risky surgeries, surgeons need to be well-trained. Finally, neuromodulation is used to treat depression. This means it can also be used to treat other mental disorders, such as schizophrenia or obsessive-compulsive disorder (8). Contrary to the present benefits of DBS, its use in different areas of human health may have provided more benefits than the use of current DBS.

Brain-machine interfaces promise hope for the restoration of sensory and motor function and the treatment of neurological disorders (9). This can have a wide range of applications, from restoring movement to communication (9).

For paralyzed people, their ability to strengthen their memory or learn to communicate telepathically between people is a few of them. Neuralink's goal is to develop brain implants that will allow the brain to interface wirelessly with computers. Its long-term goal is to increase the capacities of the human brain and possibly treat it neurologically (10).

Neuralink's primary study topic is the use of brain frequencies for communication between the brain and technology, and this study has the potential to have a major impact on both neuroscience and technology. Although the technology is still in its infancy, Neuralink's achievements can lead to breakthroughs in brain-computer interface technology, which will ultimately benefit those suffering from disabilities and other medical conditions. Implanting an electrode in the brain is also a component of Neuralink technology. Neuralink's technology has the potential to be used in conjunction with DBS to provide more sensitive stimulation to specific brain regions, which can increase the effectiveness of DBS treatment.

Conclusions

In the comparison of 11 Parkinson's patients treated with DBS with SF-36 form before and after DBS, physical function, physical role difficulty, pain, general health, and social functionality increased at a certain level after DBS and were found to be statistically significant.

No statistical difference was found in the SF-36 forms performed between the scores before and after DBS in terms of gender, and the results were found to be similar.

In the SF-36 form performed after DBS, it was found to be statistically significant that there were poorer DBS results as the age of the patients increased in the general health subgroup.

We think that many diseases in medicine will be treated more effectively by developing techniques similar to neuromodulation surgery. We think that similar treatments can be applied in many areas, such as the use of DBS therapy in the treatment of Parkinson's disease and the use of pacemakers in heart failure.

Declaration of interest:

The authors report no conflicts of interest.

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Ethical approval:

Ethical approval was obtained from the Okan University Faculty of Medicine Ethics Committee and written informed consent forms were obtained from all participants

Peer-review:

Evaluated by independent reviewers working in the at least two different institutions appointed by the field editor.

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Contributions

Research concept and design: **AY, BS, ZEÇ**
Data analysis and interpretation: **AY, BS, ZEÇ**
Collection and/or assembly of data: **AY, BS, ZEÇ**
Writing the article: **AY, BS, ZEÇ**
Critical revision of the article: **AY, BS, ZEÇ**
Final approval of the article: **AY, BS, ZEÇ**

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