**Therapeutic Brief**

**Title: Difference in the effectiveness of subthalamic nucleus and globus pallidus deep brain stimulation in Parkinson's disease**

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**Abstract**

Deep brain stimulation (DBS) is regarded as a feasible Parkinson's disease treatment option (PD). DBS is most commonly performed on the subthalamic nucleus (STN) and globus pallidus (GPi). The following criteria were used to select studies that examined the Unified PD Rating Scale (UPDRS) III: (1) had at least three months of follow-up; (2) compared both GPi and STN DBS; (3) each group included at least five individuals; (4) were completed after 2010. The majority of studies found no statistically significant difference in UPDRS score improvements between groups. Although there were some encouraging findings in terms of action tremor, rigidity, and urinary symptoms, indicating that STN DBS would be a better alternative, GPi appeared to be better in terms of side effects; nonetheless, it cannot be said that it is superior. Other larger randomized clinical trials with longer follow-up periods and control groups are required to determine which target is more effective for stimulation and has fewer negative side effects on patients.

**Keywords:** Deep brain stimulation, globus pallidus, Parkinson's disease, subthalamic nucleus, UPDRS

PD is the most common mobility condition, as well as the second most common progressive, debilitating, and neurodegenerative disease, with 12.9 million cases projected by 2040 [1-4]. Slow motions, rigidity, and low amplitude movements without antecedent automaticity characterize Parkinson's disease. In 1911, the dopamine precursor levodopa was developed for the first time[5]. It has been used as an effective PD treatment for more than 50 years, although its efficacy has been demonstrated to decrease as the disease advances [6, 7]. The DBS technique was first used in 1987 to treat movement disorders by targeting the ventral intermediate nucleus of the thalamus [8, 9]. DBS is a frequent and effective surgical treatment for motor symptom relief. It was first used roughly three decades ago and is now used on a variety of new brain targets, including the STN and GPi [10-12]. According to studies, the efficacy of these two targets is varied. It has been suggested that in PD, there is chronic beta-band oscillation coordination, and short-term bursts of these oscillations demonstrate normal sensory and motor processing. In Parkinson's disease, DBS can shorten bursts and enhance movement [13].

Embase, Cochrane Library, and PubMed databases were searched for potentially relevant English-language papers published between 2010 and 2021. We looked for studies that included both the targets (GPi and STN) as well as their associated characteristics. Deep brain stimulation (DBS) [MeSH term] or a combination of the following keywords: Controlled Clinical Trial [Publication Category], Randomized Controlled Trial [Publication Category], Globus Pallidus internus [MeSH term],Globus Pallidus [MeSH term], GPi [MeSH term], STN [MeSH term], and Parkinson's disease [MeSH term].

We included clinical studies that (1) evaluated the unified PD rating scale (UPDRS) III before and after deep brain stimulation; (2) compared GPi-DBS and STN-DBS for PD; (3) recruited more than five subjects in the GPi and STN groups; (4) had a description of adverse events; (5) had a follow-up period of more than three months; (6) were available in English full text. The main characteristics of the studies are shown in table 1.

Table 1 Main characteristics of studies

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | reference | target | age | Sample size | UPDRS on-period- baseline | UPDRS off-period- baseline | Follow up period | Location |
| 1 | Odekerken [14] | GPi  STN | 59·1± 7.8  60.9± 7.6 | 62  63 | 16±8  17±9.9 | 43.8±13.5  44.4±15.5 | 12 | Europe |
| 2 | Troche [15] | GPi  STN | 64.26±8.79  66.5±7.02 | 19  14 | 23.13±6.73  23.43±10.64 | 39.89±11.06  35.93±8.98 | 6 | Asia |
| 3 | Odekerken [[16](#_ENREF_4)] | GPi  STN | 59.1±7.8  60.9±7.6 | 43  47 | NA | 43  41 | 36 | Europe |
| 4 | Gong [[17](#_ENREF_5)] | GPi  STN | 63.2±9.1  62.3±10.4 | 28  36 | 26.2±7.5  29.0±10.0 | NA | 4 | Asia |
| 5 | Fan [[18](#_ENREF_6)] | GPi  STN | 60.43±8.44  59.65±9.11 | 23  20 | NA | 50.68±15.36  47.85±14.95 | 18.26±8.38 and  21.60±8.79 | Asia |
| 6 | Celiker [[20](#_ENREF_7)] | GPi  STN | 54±4.51  56.16±9.6 | 6  6 | 22.50±6.65  22.16±6.55 | 49.00±13.57  47.00±14.01 | 24 | Asia |
| 7 | Okun [[21](#_ENREF_8)] | GPi  STN | 60.1±5.5  58.0±10.7 | 14  16 | 20.8±8.68  21.3±7.56 | 40.5±11.2  41.2±9.32 | 12 | USA |
| 8 | Wong [[19](#_ENREF_9)] | GPi  STN | 63±8.12  61±10.33 | 31  57 | NA | 47.32±11.79  44.12±10.45 | 12 | USA |

Note: Data presented as Mean±SD

Odekerken et al. found that the GPi group had a lower change in UPDRS score during the off-drug phase than the STN group, and the GPi group had less dyskinesia during the on-drug period than the STN group. The reduction in time was similar in both phases, however, it was only significant in the off-phase (p = 0.02) [14]. Troche et al. found that both groups' UPDRS scores improved significantly in the off-medication state before and after surgery (p 0.001) [15]. Odekerken et al. found that the STN group showed larger improvements in the off-drug phase UPDRS-ME score after three years (p = 0.04), whereas there were no between-group differences in the on-drug phase [16]. Gong et al. found that four months after DBS, all patients had a 30% improvement in UPDRS score in the off-period, and pain symptoms improved at 7927 percent and 75 percent 27 percent in the STN and GPi groups, respectively [17]. In the drug off-phase, Fan et al. found that the mean improvement of UPDRS in the STN and GPi groups was 41.50 percent and 43.56 percent, respectively, with no significant difference between the groups (p = 0.609). GPi DBS also demonstrated anti-dyskinesia effects directly [18]. When compared to GPi DBS, Wong et al. found that STN DBS was associated with a statistically significant decrease in bradykinesia and rigidity at six months (p 0.001 and p = 0.025, respectively). In terms of tremor results, however, there was no significant difference between groups. [19]. Celiker et al. found that on-phase UPDRS motor scores decreased considerably in both the STN and GPi groups (p 0.05) and that STN DBS improved bladder symptoms better. Furthermore, both groups experienced reduced sleep issues following surgery [20]. Okun and colleagues looked at the effects of unilateral and staged bilateral STN and GPI DBS. They discovered that off-phase UPDRS motor scores improved considerably after four and twelve months of follow-up in both unilateral and staged bilateral modes [20]. In terms of adverse events, Odekerken et al. found no statistically significant difference between groups (p > 0.05) [14]. According to Troche et al., mean penetration-aspiration (PA) ratings did not change substantially for individuals who got GPi surgery (p = 0.857), but significantly worsened for those who received STN DBS (p = 0.007), indicating that STN DBS has a negative impact on swallowing performance. Unilateral GPi DBS, on the other hand, does not have this negative effect [15]. In the study by Fan et al., 50% of patients in the STN group showed dyskinesia caused by stimulation. The direct anti-dyskinesia effect of STN DBS was also observed in eleven of these patients [18]. Okun et al. found relatively minor effects on mood and apathy that were not significant [21]. Odekerken et al. revealed no significant differences in adverse events between the two groups in another trial; only mild incidents were noted [16]. The most prevalent adverse events, according to Wong et al., were difficulties with DBS lead hardware and bleeding, both of which were small and quickly treated [19].

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**Conclusion**

Although STN was superior in terms of alleviating action tremor and GPi was linked to less adverse events, neither goal could be proven to be superior. To determine which target is clearly preferable, further clinical trials with large sample sizes, longer follow-up periods, and more specific outcome assessments are required.

**DECLARATION**

**Acknowledgments**

The author would like to express his gratitude to the Clinical Research Development Unit of Imam Khomeini Hospital, Urmia University of Medical Sciences, for English editing, especially Dr. Nazila Farrokh Eslamloo.

**Authors’ contributions**

The author contributed solely to the article

**Availability of data and materials**

Not applicable

**Financial support and sponsorship**

None

**Conflicts of interest**

Single author - None

**Ethical approval and consent to participate**

Not applicable.

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