v. 3, n. 40, 2023

International Journal of Health Science

DEEP BRAIN STIMULATION (DBS) IN PATIENTS WITH PARKINSON'S DISEASE: AN INTEGRATIVE REVIEW ON EFFECTIVENESS, INDICATIONS AND COMPLICATIONS

Grasiele Mattei Ise dos Santos
Centro Universitário UNIFACIG
Manhuaçu - MG
https://orcid.org/0009-0003-7502-6387

Mariana Pirslhner Managna
Centro Universitário do Espírito Santo (UNESC)
Colatina - ES
http://lattes.cnpq.br/7365232963616308

Danielle Beltrão Araujo Mendes Amorim
Centro Universitário CESMAC
Maceió - AL
http://lattes.cnpq.br/0799986886154235

Larissa Faria Reis
Centro Universitário de Valença (UNIFAA)
Valença - RJ
https://lattes.cnpq.br/7136943669024440

Claudia Suzana da Matta Pereira
Universidade Vila Velha (UVV)
Vila velha - ES
https://lattes.cnpq.br/9624058376236285

Heuller Alexandre Marteline Bendia
Centro Universitário UNIFACIG
Manhuaçu - MG
https://lattes.cnpq.br/6351070417163615

Luana Amanda Antunes de Souza
Centro Universitário do Espírito Santo (UNESC)
Colatina - ES
http://lattes.cnpq.br/2763771296748995

Pedro Pereira de Medeiros
Centro Universitário de Valença (UNIFAA)
Valença - RJ
https://lattes.cnpq.br/5659210154219394

Eduarda Soares Sarmento da Costa
Centro Universitário do Espírito Santo (UNESC)
Colatina- ES
https://lattes.cnpq.br/0053611821035854

Thayná Vargas de Jesus Alves
Centro Universitário MULTIVIX
Cachoeiro de Itapemirim - ES
http://lattes.cnpq.br/6738275981718888

Rafael Dias Moura Farias da Paixão
União Educacional do Vale do Aço (UNIVAÇO)
IPATINGA - MG
https://lattes.cnpq.br/1784163365485775

Vyctor de Almeida Fochat
Centro Universitário UNIFACIG
Manhuaçu - MG
https://lattes.cnpq.br/8246520882659623

Abstract: The objective of this integrative review is to present a critical and up-to-date analysis of the evidence available in the literature on the efficacy, indications and complications of the DBS procedure in patients with PD.Methodology: For this integrative review, the search was in indexed databases such as PubMed, Scopus and Web of Science, using a combination of keywords related to the terms "deep brain stimulation", "Parkinson's Disease" and their variations. Results: After the complete analysis, 8 studies that met the established inclusion criteria were included in the systematic review table. Based on the studies, DBS is an effective treatment option for patients with advanced Parkinson's disease who do not respond adequately to drug treatment. It can produce benefits by significantly reducing chronic pain, improving postural disorders and being an effective therapeutic option for patients with camptocormia related to Parkinson's disease. These results suggest that DBS may be an important treatment option for patients with advanced Parkinson's disease. Conclusion: DBS has been shown to be a promising alternative for the treatment of PD, especially for patients who can no longer control their symptoms with conventional medications. Research is needed to improve DBS techniques and evaluate the long-term benefits of deep brain stimulation in PD patients.
Keywords: Deep brain stimulation; Parkinson disease; Therapeutics.

INTRODUCTION

Parkinson's disease (PD) is a chronic neurodegenerative condition that mainly affects motor coordination, causing tremors, muscle stiffness and walking difficulties. Although conventional treatment with dopaminergic drugs can be effective in controlling symptoms, many patients end up developing motor complications and

unwanted long-term side effects. For these patients, Deep Brain Stimulation (DBS) has proven to be a promising alternative. DBS is a minimally invasive surgical procedure that involves implanting a small device in the brain that emits electrical impulses to regulate abnormal neuronal activity. Although the DBS process is complex and involves multiple steps, the procedure has been shown to be effective in managing PD motor symptoms and has been widely used worldwide (Eskandar et al., 2017).

DBS is usually considered when the symptoms of PD can no longer be controlled with medication, or when the side effects of these medications become unbearable for the patient. Although DBS was originally developed to treat tremors, the procedure can also be effective in managing other motor symptoms such as rigidity and bradykinesia. Careful selection of patients is important to ensure that DBS is the most appropriate treatment for them. The selection process involves clinical, neuropsychological and imaging evaluation, as well as detailed discussions between the patient and the medical team. The choice of target brain area for device implantation is also critical for successful treatment (Eskandar et al., 2017).

It is generally considered safe and effective, as with any surgical procedure there are potential risks involved. Complications can include bleeding, infection and, in rare cases, permanent damage to the brain or other parts of the body. Additionally, DBS can have unwanted side effects such as cognitive impairments, personality changes, and mood swings. However, these side effects are usually reversible and can be managed with careful adjustments to device programming. It is important that patients and their families are aware of the potential risks and benefits of DBS before making the decision to go ahead with the procedure (Ehm et al., 2018).

The aim of this integrative review is to present a critical and up-to-date analysis of the evidence available in the literature on the efficacy, indications and complications of the DBS procedure in patients with PD. It is intended to discuss the clinical implications of this evidence and its potential applications in clinical practice, aiming to contribute to the improvement of care for patients with PD.

METHODOLOGY

For this integrative review, the methodology adopted for the search for scientific articles included an electronic search in indexed databases such as PubMed, Scopus and Web of Science, using a combination of keywords related to the terms "deep brain stimulation", "Disease of Parkinson's" and its variations. In addition, manual searches were carried out in relevant bibliographic references found in the selected articles. The inclusion criteria used were: original articles published in English between 2010 and 2022, which addressed the efficacy, indications and complications of DBS in patients with Parkinson's disease. Review articles, case reports, editorials, letters to the editor and articles in other languages were excluded. Two independent researchers performed the selection of articles and any disagreement was resolved by consensus among reviewers. In the end, 8 articles were selected that met the inclusion criteria and were analyzed in this integrative review.

RESULTS

The number of articles selected in the databases is shown in Figure 1. 525 studies were found in the systematic search in the databases. After reading the titles, 486 studies were excluded, leaving 39 for abstract evaluation. After screening titles and abstracts, 12 studies were selected for full reading. After the complete analysis, 8 studies that met the established inclusion criteria were included in

the systematic review table.

Eight studies with evidence available in the literature were selected. In summary, information about the studies was listed referring to the author/year, objective, methods and main results, as shown in **Table 1**.

DISCUSSION

Based on the studies, DBS is an effective treatment option for patients with advanced Parkinson's disease who do not respond adequately to drug treatment. The systematic review and meta-analysis by Flouty et al. (2022) showed that DBS can significantly reduce chronic pain in patients with idiopathic Parkinson's disease. Furthermore, Spindler et al.'s (2022) meta-analysis indicated that DBS may improve postural disturbances in patients with disease-related Parkinson's disease. Other studies, such as that by Liang et al. (2020), suggest that DBS may be an effective therapeutic option for patients with camptocormia related to Parkinson's disease. These results suggest that DBS may be an important treatment option for patients with advanced Parkinson's disease.

Although DBS appears to be an effective treatment option for patients with advanced Parkinson's disease, the indication for the procedure must be carefully evaluated. The study by Tsuboi et al. (2020) highlighted the importance of careful evaluation of patients who are candidates for DBS. The study noted that most patients showed significant improvement in motor symptoms after the procedure, but some patients still had psychiatric symptoms, such as depression and anxiety, after the procedure. For Koivu et al. (2022) the choice of the DBS target area can affect the effectiveness of the procedure and must be individualized for each patient. These results highlight the importance of careful individualized evaluation of patients before deciding to indicate the DBS procedure.

The study by Flouty et al. (2022) presents a systematic review and meta-analysis on the relationship between idiopathic Parkinson's disease and chronic pain, as well as the effectiveness of DBS in pain management in patients with Parkinson's. The results indicate that chronic pain is a common problem in patients with Parkinson's, affecting about 50% of cases. DBS has been shown to be effective in reducing pain in Parkinson's patients, but with some limitations and potential adverse effects. The authors emphasize the importance of adequate pain assessment and treatment in patients with Parkinson's, since chronic pain can have a significant impact on the quality of life of these patients. It also highlights the need for more research to determine the best treatment protocol and the identification of risk factors for the development of chronic pain in patients with Parkinson's. These results could be useful for healthcare professionals who treat patients with Parkinson's and for researchers looking to develop new treatment approaches for chronic pain in patients with Parkinson's.

The results of the study by Spindler et al. (2022) indicate that DBS may be an effective option for treating postural abnormalities in patients with PD, with a mean improvement in the PD Unified Rating Scale score of about 30%. The authors point out that postural abnormalities are common in patients with PD and can have a significant impact on quality of life. DBS has been widely used in the treatment of motor symptoms in PD, but its effectiveness in the treatment of postural abnormalities is less known. included. This highlights the need for further research to determine the role of DBS in the treatment of postural abnormalities in PD patients.

Roediger et al. (2019) investigate the effect of subthalamic DBS on postural control in

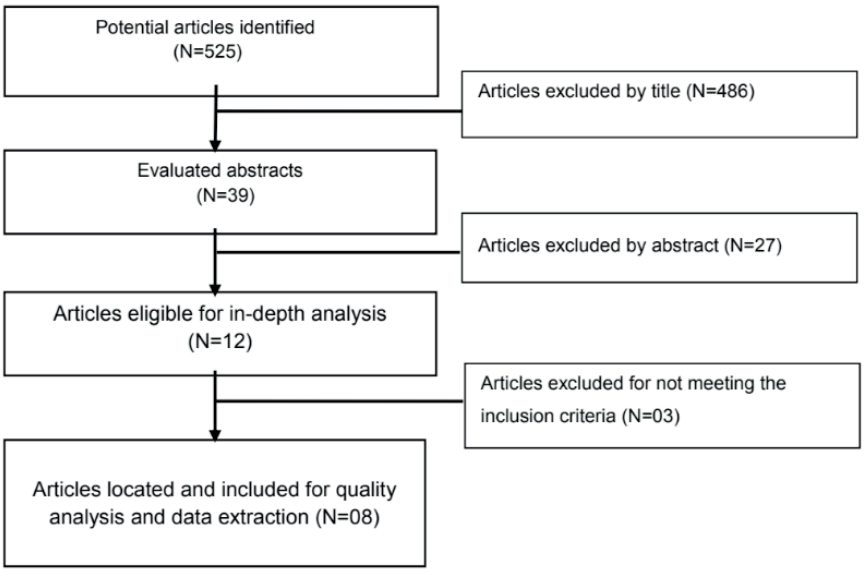

Figure 1.0 Flowchart of the distribution of articles found and selected.

Study	Objective	Methods	Main results
Flouty et al. (2022)	Evaluate the effectiveness of DBS on chronic pain in patients with PD	Systematic review and meta-analysis	DBS significantly reduced chronic pain in patients with idiopathic PD
Spindler et al. (2022)	Evaluate the effectiveness of DBS in correcting PD-related postural abnormalities	Systematic review and meta-analysis	DBS significantly improved PD-related postural abnormalities
Roediger et al. (2019)	To evaluate the effect of sub-thalamic DBS on posture in patients with PD	computerized blind analysis	DBS improved posture in PD patients
Soares et al. (2019)	To evaluate automated and objective measurements of gait dynamics in patients with PD and camptocormia treated with subthalamic DBS	Single case study	Subthalamic DBS improved gait dynamics in patients with PD and camptocormia
Liang et al. (2020)	Evaluate the effectiveness of DBS for the treatment of camptocormia in patients with PD	Single case study	DBS significantly improved posture and quality of life in patients with PD and camptocormia
Koivu et al. (2022)	Evaluate the clinical experience of directional DBS in patients with advanced PD	Retrospective cohort study	Directional DBS was safe and effective in the treatment of advanced PD, with significant improvement in motor symptoms and quality of life.
Tsuboi et al. (2020)	To evaluate the long-term clinical outcomes of bilateral DBS on the internal globus pallidus in patients with advanced PD	Retrospective cohort study	Bilateral DBS on internal globus pallidus was safe and effective in the treatment of advanced PD, with significant improvement in motor symptoms and quality of life
Ehm et al. (2018)	To evaluate the long-term effects of unilateral DBS on the subthalamus in patients with highly asymmetrical PD	Retrospective cohort study	Unilateral subthalamic DBS was effective in treating motor symptoms in patients with highly asymmetrical PD, with significant improvement in health-related quality of life

Table 1.0– Distribution of scientific productions according to the following variables: study, objective, methods and results (n=08).

patients with PD. Study results indicate that subthalamic DBS significantly improves postural control in PD patients. The authors highlight that postural control is an important function that is often compromised in PD patients. Subthalamic DBS has been widely used in the treatment of motor symptoms in PD, but its effect on postural control is less known. force platform during DBS stimulation compared to off stimulation. However, the authors point out some limitations of the study, including the relatively small sample size and the fact that the study was conducted in a laboratory setting rather than in real-world situations. This highlights the need for further research to confirm these results and determine the role of subthalamic DBS in the treatment of postural control in patients with PD.

Soares et al. (2019) investigates the effects of subthalamic DBS on gait dynamics in patients with Parkinson's disease who have camptocormia. Camptocormia is a condition characterized by an exaggerated curvature of the spine, which can affect the patient's ability to walk normally. The study used an automated gait analysis system to collect objective data on patients' gait dynamics before and after DBS stimulation. It was evident that subthalamic DBS improved gait speed, step length and foot swing time during walking compared to the off condition. The authors also observed that the effects of subthalamic DBS on gait dynamics were maintained over the long term in patients who underwent a one-year follow-up. These results are important because camptocormia is a difficult condition to treat and no effective treatments are currently available.

Liang et al. (2020) presents a study that investigated the effects of subthalamic DBS on camptocormia associated with Parkinson's disease. The authors performed a retrospective study in a group of patients with Parkinson's disease and camptocormia who underwent subthalamic DBS. They assessed the severity of camptocormia before and after surgery using the Camptocormia Scale (CS). In addition, they assessed the severity of P using the Unified Parkinson's Disease Rating Scale (UPDRS). Study results indicated that subthalamic DBS significantly improved camptocormia in PD patients. The mean CS score significantly decreased after surgery compared to the preoperative period. Subthalamic DBS was well tolerated by patients and there were no serious adverse effects related to the surgery.

The study by Koivu et al. (2022) presents an analysis of the clinical outcomes of patients with advanced Parkinson's disease treated with directional deep brain stimulation (DBS). The retrospective study used a group of patients with advanced PD who underwent directional DBS. They assessed the severity of PD before and after surgery using the UPDRS, in addition to assessing the effect of deep brain stimulation therapy on patients' quality of life and cognitive function. Study results indicated that directional DBS was effective in treating patients with advanced PD. The mean UPDRS score significantly decreased after surgery compared to the preoperative period. In addition, the authors observed significant improvements in patients' quality of life and cognitive function after surgery, which was well tolerated by patients and that there were no serious adverse effects related to the surgery.

The study by Tsuboi et al. (2020) evaluated the long-term results of bilateral DBS on the internal globus pallidus (GPi) in patients with advanced Parkinson's disease. The results showed that bilateral DBS in the GPi significantly improved motor and non-motor symptoms in patients with advanced Parkinson's disease and the improvement in symptoms was maintained for a period of five years or more after surgery. Patients

showed significant improvement in health-related quality of life as well as cognitive function. Some surgical complications have been reported, such as the need for revision of the DBS system in some patients due to infections or hardware problems, as well as the occurrence of neuropsychiatric adverse events in some cases. Therefore, although bilateral DBS in the GPi appears to be effective in treating advanced Parkinson's disease, it is important to carefully assess the risks and benefits of surgery in each individual patient.

Ehm et al. (2018) aimed to evaluate the long-term effects of unilateral deep brain stimulation on the subthalamus (STN) in patients with highly asymmetric Parkinson's disease. The results showed that unilateral deep brain stimulation in the STN was effective in treating motor symptoms in patients with highly asymmetric Parkinson's disease and that the positive effects of stimulation were maintained for a period of 7 years after surgery. Surgery also improved health-related quality of life in patients with Parkinson's disease.

FINAL CONSIDERATIONS

DBS has shown to be a promising alternative for the treatment of PD, especially for patients who can no longer control their symptoms with conventional medications. It is important that patients and their families are aware of the potential risks and benefits of DBS before making a decision to go ahead with the procedure. Careful patient selection and choice of brain area to target are crucial to ensure treatment success. More research is needed to improve DBS techniques and evaluate the long-term benefits of deep brain stimulation in PD patients.

REFERENCES

Ehm G, et al. Effect of unilateral subthalamic deep brain stimulation in highly asymmetrical Parkinson's disease: 7-year follow-up [published online ahead of print. J Neurosurg., p. 1-6, 2018.

Eskandar EM, et al. A randomized trial of a delayed intervention for worsening signs and symptoms of Parkinson's disease: the Stimulation of the Subthalamic Nucleus Against Parkinsonian Tremor (STAPS) trial. JAMA neurology, v. 74, n. 7, p. 793-801, 2017

Flouty O, Yamamoto K, Germann J, et al. Doença de Parkinson idiopática e dor crônica na era da estimulação cerebral profunda: uma revisão sistemática e meta-análise. J Neurocirurg., v. 137, n. 6, p. 1821-1830, 2022.

Koivu M, et al. Real-Life Experience on Directional Deep Brain Stimulation in Patients with Advanced Parkinson's Disease. J Pers Med., v. 12, n. 8, p.1224, 2022.

Liang S, et al. The Study of Subthalamic Deep Brain Stimulation for Parkinson Disease-Associated Camptocormia. Med Sci Monit., v. 26, p. e919682, 2020.

Roediger J, Artusi CA, Romagnolo A, et al. Effect of subthalamic deep brain stimulation on posture in Parkinson's disease: A blind computerized analysis. Parkinsonism Relat Disord., v. 62, p. 122-127, 2019.

Soares C, et al. Automated and objective measures of gait dynamics in camptocormia Parkinson's Disease subthalamic deep brain stimulation. Clin Neurol Neurosurg., v. 186, p. 105537, 2019.

Spindler P, et al. Deep brain stimulation for Parkinson's disease-related postural abnormalities: a systematic review and meta-analysis. Neurosurg Rev., v. 45, n. 5, p. 3083-3092, 2022.

Tsuboi T, et al. Long-term clinical outcomes of bilateral GPi deep brain stimulation in advanced Parkinson's disease: 5 years and beyond. 2020