

**Compare and contrast the two treatments discussed in the TED Talks. Please list at least one advantage and disadvantage for each?**

- By circumventing the blood-brain barrier, intranasal delivery of GDNF transgene expressions is able to reach deep layers of the brain, and in mice models it slows down progression of PD by reducing considerably the loss of dopaminergic neurons. It is also easy to use, and easily customizable; if there is a need to design tailored protocols in term of frequency and dosage for each patient. It is also easy to deploy to a large number of patients. On the downside, it is a technique which spreads throughout the brain and might be undesirable when there is a need to target specific areas of the brain [1].
- Transcranial direct current stimulation (tDCS) is another non-invasive treatment of PD which uses a low electric current, transmitted by electrodes attached to the scalp, to modulate cortical excitability and improve patient motor speed and coordination. tDCS may have therapeutic potential in PD but it presents challenges and source of variability like [2]:
  - correct placement or strapping of the electrodes,
  - choice of gel or saline applied to not only ensure conductivity but also protects against burns due to the heat dissipation from the current
  - choice of region of interest targeted by the stimulation since the stimulation is localized
  - stimulation intensity level and duration

Also, mild adverse effects have been observed in patients such as headache, moderate fatigue, difficulty concentrating, mood changes and nausea.

**Find another treatment option and discuss how it might be more beneficial than the types of treatment listed above**

Although currently there is no cure of PD, deep brain stimulation (DBS) non-invasive techniques have demonstrated improvement of motor and non-motor neurological symptoms. It seems that more studies are needed to establish the duration of the treatments, their long-term efficiency and long-term side-effects [3]. Focused ultra-sound is FDA-approved, uses MRI to guide high energy waves to destroy specific areas in the brain connected to tremor and unlike DBS, it is irreversible and permanent. Clinical trials are testing FUS for other PD symptoms such as dyskinesia, additional research is needed to validate fully this procedure [4].

- [1] A. E.-E. Aly, B. T. Harmon, L. Padegimas, O. Sesenoglu-Laird, M. J. Cooper, and B. L. Waszczak, "Intranasal Delivery of pGDNF DNA Nanoparticles Provides Neuroprotection in the Rat 6-Hydroxydopamine Model of Parkinson's Disease," *Mol. Neurobiol.*, vol. 56, no. 1, pp. 688–701, Jan. 2019, doi: 10.1007/s12035-018-1109-6.
- [2] H. Thair, A. L. Holloway, R. Newport, and A. D. Smith, "Transcranial Direct Current Stimulation (tDCS): A Beginner's Guide for Design and Implementation," *Front. Neurosci.*, vol. 11, p. 641, Nov. 2017, doi: 10.3389/fnins.2017.00641.
- [3] "PubMed Central Full Text PDF." Accessed: Oct. 29, 2021. [Online]. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1739437/pdf/v076p01614.pdf>
- [4] "Other Surgical Options," *Parkinson's Foundation*. <https://www.parkinson.org/Understanding-Parkinsons/Treatment/Surgical-Treatment-Options/Other-Surgical-Options> (accessed Oct. 29, 2021).