Dysphagia (2023) 38:330–339
https://doi.org/10.1007/s00455-022-10470-0

ORIGINAL ARTICLE

Improving Swallowing Function and Ability in Post Stroke Dysphagia: A Randomized Clinical Trial

Sima Farpour[1] · Majid Asadi-Shekaari[1] · Afshin Borhani Haghighi[2,3] · Hamid Reza Farpour[4,5,6]

Received: 11 December 2021 / Accepted: 21 May 2022 / Published online: 17 June 2022

Abstract

Post-stroke dysphagia is a prevalent, life threatening condition. Scientists recommended implementing behavioral therapies with new technologies such as transcranial direct current of stimulation (TDCS). Studies showed promising TDCS effects, and scientists suggested the investigation of the effectiveness of different montages. Supramarginal gyrus (SMG) is important in swallowing function. Our study aimed to investigate the effectiveness of stimulating SMG in improving post-stroke dysphagia. Forty-four patients finished the study (a randomized, double-blind one). All of them received behavioral therapy. The real group received anodal (2 mA, 20 min) stimulation on the intact SMG, and the sham group received the same for 30 s (5 sessions). Patients were assessed with Functional Oral Intake Scale (FOIS) and Mann Assessment of Swallowing Ability (MASA) after treatment and at one-month follow-up. The results showed that the difference between groups at baseline was not significant. According to MASA both groups improved significantly during the time (p-value < 0.001). The improvement in the real group was significantly higher than in the sham group after treatment (p-value $= 0.002$) and after one-month follow-up (p-value < 0.001). According to FOIS, most of the patients in the real group (72.70%) reached level 6 or 7 after one-month follow-up which was significantly higher than the sham group (31.80%, p-value $= 0.007$). In conclusion, TDCS applied to the scalp's surface associated with SMG localization may improve swallowing function in the stroke patients with dysphagia.

Keywords Deglutition · Stroke · Electrical stimulation · Transcranial direct current stimulation · Randomized clinical trial · Dysphagia

Majid Asadi-Shekaari and Afshin Borhani Haghighi have equally contributed as corresponding authors.

✉ Majid Asadi-Shekaari
majidasadi@kmu.ac.ir

✉ Afshin Borhani Haghighi
neuro.ab@gmail.com

Sima Farpour
Sima.farpour@gmail.com

Hamid Reza Farpour
farporh@sums.ac.ir

[1] Neuroscience Research Center, Neuropharmacology Institute, Kerman University of Medical Sciences, Kerman, Iran

[2] Faculty of Medicine, Clinical Neurology Research Center, Shiraz University of Medical Sciences, Khalili Street, Shiraz, Iran

[3] Clinical Neurology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

[4] Faculty of Medicine, Bone and Joint Diseases Research Center, Department of Physical Medicine and Rehabilitation, Shiraz University of Medical Sciences, Emam Hossein Street, Shiraz, Iran

[5] Bone and Joint Diseases Research Center, Department of Physical Medicine and Rehabilitation, Shiraz University of Medical Sciences, Shiraz, Iran

[6] Shiraz Geriatrics Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

Hospital, Dr. Parisa Chamanpara,Dr. Nasrin Shokrpour, the Research Consultation Center (RCC) of Shiraz University of Medical Sciences, Shiraz, Iran, and Dr. Zahra Bagheri for their statistical and editorial assistance. The authors would also like to thank all the patients and their families/caregivers and head nurses and nurses who helped us to conduct this project.

Funding The work received support from Kerman Neuroscience Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran (No. 99000137).

References

1. Dziewas R, et al. European stroke organization and European society for swallowing disorders guideline for the diagnosis and treatment of post-stroke dysphagia. Eur Stroke J. 2021. https://doi.org/10.1177/23969873211039721.
2. Simons A, Hamdy S. The use of brain stimulation in dysphagia management. Dysphagia. 2017;32(2):209–15.
3. Cheng I, Sasegbon A, Hamdy S. Effects of neurostimulation on poststroke dysphagia: a synthesis of current evidence from randomized controlled trials. Neuromodulation. 2020. https://doi.org/10.1111/ner.13327.
4. Clavé P, Shaker R. Dysphagia: current reality and scope of the problem. Nat Rev Gastroenterol Hepatol. 2015;12(5):259–70.
5. Fairfield CA, Smithard DG. Assessment and management of dysphagia in acute stroke: an initial service review of international practice. Geriatrics. 2020;5(1):4.
6. Bath PM, Lee HS, Everton LF. Swallowing therapy for dysphagia in acute and subacute stroke. Cochrane Database Sys Rev. 2018. https://doi.org/10.1002/14651858.CD000323.pub3.
7. Geeganage C, et al. Interventions for dysphagia and nutritional support in acute and subacute stroke. Cochrane Database Sys Rev. 2012. https://doi.org/10.1002/14651858.CD000323.pub2.
8. Speyer R, et al. Effects of therapy in oropharyngeal dysphagia by speech and language therapists: a systematic review. Dysphagia. 2010;25(1):40–65.
9. Bonilha HS, et al. The one-year attributable cost of post-stroke dysphagia. Dysphagia. 2014;29(5):545–52.
10. Pisegna JM, et al. Effects of non-invasive brain stimulation on post-stroke dysphagia: a systematic review and meta-analysis of randomized controlled trials. Clin Neurophysiol. 2016;127(1):956–68.
11. Vasant DH, et al. Transcranial direct current stimulation reverses neurophysiological and behavioural effects of focal inhibition of human pharyngeal motor cortex on swallowing. J Physiol. 2014;592(4):695–709.
12. Yang SN, et al. Effectiveness of non-invasive brain stimulation in dysphagia subsequent to stroke: a systemic review and meta-analysis. Dysphagia. 2015;30(4):383–91.
13. Lefaucheur J-P. A comprehensive database of published tDCS clinical trials (2005–2016). Clin Neurophysiol. 2016;46(6):319–98.
14. Kumar S, et al. Noninvasive brain stimulation may improve stroke-related dysphagia: a pilot study. Stroke. 2011;42(4):1035–40.
15. Yang EJ, et al. Effects of transcranial direct current stimulation (tDCS) on post-stroke dysphagia. Restor Neurol Neurosci. 2012;30(4):303–11.
16. Ahn YH, et al. Effect of bihemispheric anodal transcranial direct current stimulation for dysphagia in chronic stroke patients: a randomized clinical trial. J Rehabil Med. 2017;49(1):30–5.
17. Suntrup-Krueger S, et al. Randomized trial of transcranial direct current stimulation for poststroke dysphagia. Ann Neurol. 2018;83(2):328–40.
18. Shigematsu T, Fujishima I, Ohno K. Transcranial direct current stimulation improves swallowing function in stroke patients. Neurorehabil Neural Repair. 2013;27(4):363–9.
19. Michou E, Hamdy S. Neurostimulation as an approach to dysphagia rehabilitation: current evidence. Curr Phys Med Rehabil Rep. 2013;1(4):257–66.
20. Wilmskoetter J, et al. Mapping acute lesion locations to physiological swallow impairments after stroke. NeuroImage Clin. 2019. https://doi.org/10.1016/j.nicl.2019.101685.
21. Ben-Shabat E, et al. The right supramarginal gyrus is important for proprioception in healthy and stroke-affected participants: a functional MRI study. Front Neurol. 2015;6:248.
22. Crary MA, Mann GDC, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. Arch Phys Med Rehabil. 2005;86(8):1516–20.
23. Mann G. MASA: the mann assessment of swallowing ability, vol. 1. Boston: Cengage Learning; 2002.
24. Fischer U, et al. NIHSS score and arteriographic findings in acute ischemic stroke. Stroke. 2005;36(10):2121–5.
25. Dehghani R, et al. Validity and reliability of the persian versions of national institute of health stroke scale and modified national institute of health stroke scale in hospitalized patients. Galen Med J. 2019;8:1188.
26. Koessler L, et al. Automated cortical projection of EEG sensors: anatomical correlation via the international 10–10 system. Neuroimage. 2009;46(1):64–72.
27. Teismann IK, et al. Cortical swallowing processing in early subacute stroke. BMC Neurol. 2011;11(1):1–13.
28. Acharya S, Shukla S. Mirror neurons: enigma of the metaphysical modular brain. J Nat Sci Biol Med. 2012;3(2):118.
29. Buccino G, et al. Neural circuits involved in the recognition of actions performed by nonconspecifics: an fMRI study. J Cogn Neurosci. 2004;16(1):114–26.
30. Suntrup-Krueger S, et al. The impact of lesion location on dysphagia incidence, pattern and complications in acute stroke. Part 2: oropharyngeal residue, swallow and cough response, and pneumonia. Eur j Neurol. 2017;24(6):867–74.
31. Cosentino G, et al. Anodal transcranial direct current stimulation and intermittent theta-burst stimulation improve deglutition and swallowing reproducibility in elderly patients with dysphagia. Neurogastroenterol Motil. 2020;32(5):e13791.
32. Solomons CD, Shanmugasundaram V. Transcranial direct current stimulation: a review of electrode characteristics and materials. Med Eng Phys. 2020;85:63–74.
33. Woods AJ, Bryant V, Sacchetti D, Gervits F, Hamilton R. Effects of electrode drift in transcranial direct current stimulation. Brain stimul. 2015;8(3):515–9.
34. ÁguidaFoerster F, LeilaFarnad A, WalterPaulus MA, Nitsche MF. Effects of electrode angle-orientation on the impact of transcranial direct current stimulation on motor cortex excitability. Brain Stimul. 2019;12(2):263–6.
35. Nasseri P, Nitsche MA, Ekhtiari H. A framework for categorizing electrode montages in transcranial direct current stimulation. Front Hum Neurosci. 2015. https://doi.org/10.3389/fnhum.2015.00054.
36. Hong DG, Yoo DH. A comparison of the swallowing function and quality of life by oral intake level in stroke patients with dysphagia. J Phys Ther Sci. 2017;29(9):1552–4.
37. Kim JY, et al. The mediating and moderating effects of meaning in life on the relationship between depression and quality of life in patients with dysphagia. J Clin Nurs. 2019;28(15–16):2782–9.