Changes in Experimental Pain Sensitivity from Using Home-Based Remotely Supervised Transcranial Direct Current Stimulation in Older Adults with Knee Osteoarthritis

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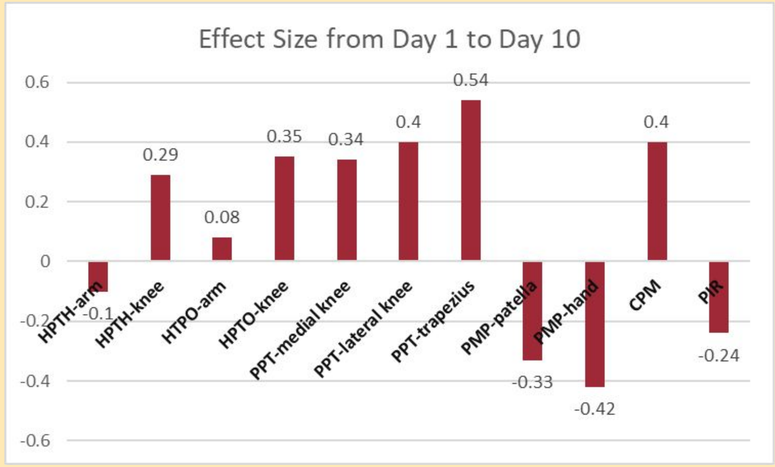
Introduction

- Osteoarthritis (OA): a degenerative disease where inflammation occurs in the joints. Inflammation causes swelling, affecting other joints and tissues connecting them. It is the most common disease of joints in adults worldwide. Due to the insufficient understanding of the mechanisms through which osteoarthritis develops and spreads, there is currently no known cure for the condition.
- Arthritis can negatively influence clinical and psychosocial factors leading to disability. More specifically, knee and hip OA is the 11th largest contributor to global disability.
- Those who suffer knee OA experience higher experimental pain sensitivities, lower heat pain thresholds, lower pain tolerances, and lower pressure pain thresholds (measurements taken in our study to determine improvement)
- In our experiment, we examine the impact of tDCS on adults who suffer from knee OA. Through the use of a home-based remotely supervised tCDS for 2 weeks, we will examine those QST measurements to prove improved responses to pain.

Methods

- tDCS (transcranial direct stimulation) used at home by participants throughout 10 sessions. This device applies a neuromodulatory effect on the body's central nervous system through a low amplitude direct electric current to the scalp (non-invasive and painless). tDCS was applied with a constant current intensity of 2 mA for 20 minutes every weekday for 2 weeks, resulting in 10 sessions.
- The effectiveness of tDCS can be examined by measuring pain sensitivity through qualitative sensory testing (QST).
- QST measurements used: heat pain threshold (HPTH) and tolerance (HPTO), pressure pain threshold (PPT), punctate mechanical pain (PMP), and conditioned pain modulation (CPM).



Measures tested graphed against its effect size from Day 1 vs Day 10, illustrating overall perceived pain differences from start to finish of the study.

Measure	Effect Linearity	Posterior Probability %
HPTH-arm	Linear	59.9
HPTH-knee	Linear	96.8
	Quadratic	93.1
HPTO-arm	Linear	90.2
	Quadratic	90.7
HPTO-knee	Linear	98.2
	Quadratic	95.6
PPT-medial knee	Linear	98.8
	Quadratic	94.1
PPT-lateral knee	Linear	>99.9
PPT-trapezius	Linear	>99.9
	Quadratic	99.5
PMP-patella	Linear	95.6
PMP-hand	Linear	99.5
CPM	Linear	96.4
PIR	Linear	76.6

This table represents the posterior probability percentage for each measure and whether they demonstrated linear or nonlinear results.

Results

We noted statistically significant differences from baseline to post-test for seven of the 11 measures:

- HPTO (heat pain tolerance)–knee
- PPT (pressure pain threshold)–medial knee
- PPT (pressure pain threshold)–lateral knee
- PPT (pressure pain threshold)–trapezius
- PMP (punctuate mechanical pain)–patella
- PMP (punctuate mechanical pain)–hand
- CPM (conditioned pain modulation)

All noted significant differences were in the direction of improved QST measurements. This means that they had increased pain tolerance and lower experienced punctuate pain. No subjects reported any adverse effects from the tDCS treatment.

Conclusion

The current study offered a preliminary indication that home-based remotely supervised transcranial direct current stimulation is an effective pain therapy option for older adults with knee osteoarthritis to alleviate the pain. This work adds to the expanding collection of research that supports noninvasive brain stimulation treatments carried out at home. These results need to be validated through larger-scale, randomized, double-blinded, controlled studies in the future.

References

Suchting, R., Kapoor, S., Mathis, K. B., & Ahn, H. (2020). Changes in experimental pain sensitivity from using home-based remotely supervised transcranial direct current stimulation in older adults with knee osteoarthritis. *Pain Medicine, 21*(11), 2676-2683. https://doi.org./10.1093/pm/pnaa268

Michael, J WP; Schlüter-Brust, K U; Eysel (2010) "*The epidemiology, etiology, diagnosis, and treatment of osteoarthritis of the knee*" Dtsch Arztebl Int.(107)9

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