Effects of transcranial pulse stimulation (TPS) on adults with symptoms of depression – a Pilot Randomized Controlled Trial

Teris Cheung[1*], Lok Yi Chiu[1], Tim Man Ho Li[2], Yuen Shan Ho[1], Georg Kranz[3], Kenneth Fong[3], Sau Fong Leung[1], Simon Ching Lam[4], Wing Fai Yeung[1], Joyce Lam[1], Kwan Hin Fong[1], Roland Beisteiner[5], Yu-Tao Xiang[6], Calvin Cheng[7]

[1] School of Nursing, the Hong Kong Polytechnic University, Hong Kong SAR, China
[2] Department of Psychiatry, the Chinese University of Hong Kong, Hong Kong SAR, China
[3] Department of Rehabilitation Sciences, the Hong Kong Polytechnic University, Hong Kong SAR, China
[4] School of Nursing, Tung Wah College, Hong Kong SAR, China
[5] Department of Neurology, Medical University of Vienna, Austria
[6] Unit of Psychiatry, Department of Public Health and Medicinal Administration, & Institute of Translational Medicine, Faculty of Health Sciences, University of Macau, Macao SAR, China
[7] Department of Psychiatry, University of Hong Kong, Hong Kong SAR, China

***Correspondence to: Dr. Teris Cheung, GH 518, School of Nursing, Hong Kong SAR, China. Email:** teris.cheung@polyu.edu.hk

Background

Transcranial pulse stimulation (TPS) is a recent development in non-invasive brain stimulations (NIBS) that has been proven to be effective in terms of significantly improving Alzheimer patients' cognition, memory, and executive functions. Nonetheless, there is, currently, no trial evaluating the efficacy of TPS on adults with major depression disorder (MDD) nationwide.

Objective

The primary objective of this study was to evaluate the effects of TPS on participants' depression severity scores among adults. The secondary objectives included examining the effects of TPS on participants' anhedonia symptoms, instrumental activities of daily living, cognition.

Design / Methods

In this single-blinded, randomized controlled trial, a 2-week TPS treatment comprising six 30 min TPS sessions were administered to participants. Participants were randomized into either the TPS group or the Waitlist Control(WC) group, stratified by gender and age according to a 1:1 ratio. Our primary outcome was evaluated by the Hamilton depression rating scale-17 (HDRS-17).

We recruited 30 participants that were aged between 18 and 54 years, predominantly female (73%), and ethnic Chinese. The Hong Kong Polytechnic University ethical approval reference # HSEARS20210608002. This trial is registered with Clin.Trials.gov, number NCT05006365.

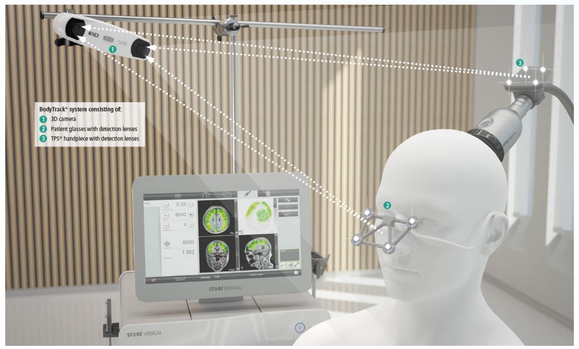

Figure 1. TPS system (image source: Storz Medical Group)

Results

There was a significant group x time interaction [F(1, 28) = 18.8, $p < 0.001$). Furthermore, when compared with the WC group, there was a significant reduction in the depressive symptom severity in the TPS group (mean difference =-6.60, $p = 0.02$, and Cohen's $d = -0.93$).

Table 1. Sociodemographic characteristics between the intervention group (IG) and the waitlist control (WC) group (n = 30)

	IG (n = 15)	WC (n = 15)	
	Mean (SD) / n (%)		p
Age	38.8 (15.0)	34.3 (16.5)	0.44
Gender			>.99
Male	4 (27)	4 (27)	
Female	11 (73)	11 (73)	
Living with family members	2.53 (1.19)	2.8 (1.47)	0.59
Education level			0.1
Elementary or below	1 (7)	1 (7)	
High school	0 (0)	4 (27)	
University or above	14 (93)	10 (67)	
Marital Status			0.5
Single	6 (40)	8 (53)	
In a relationship	3 (20)	1 (7)	
Married	5 (33)	6 (40)	
Divorced/separated	1 (7)	0 (0)	
Widowed	0 (0)	0 (0)	
Occupation			0.41
Administrative/clerical staff	1 (7)	0 (0)	
Managerial staff	1 (7)	0 (0)	
Casual worker	0 (0)	1 (7)	
Students (full-time)	5 (33)	6 (40)	
Housewife	0 (0)	2 (13)	
Licensed professionals	3 (20)	1 (7)	
Retirees	0 (0)	1 (7)	
Unemployed	5 (33)	4 (27)	
Income (HK$)			0.16
<20,000	4 (27)	8 (53)	
>20,000-49,999	4 (27)	5 (33)	
>50,000 -79,999	4 (27)	2 (13)	
≥80,000	3 (20)	0 (0)	
Chronic Illness			>.99
Yes	1 (7)	1 (7)	
No	14 (93)	14 (93)	
Psychiatric History (personal)			>.99
Yes	15 (100)	15 (100)	
No	0 (0)	0 (0)	
Duration of having major depressive disorder (in months)	98 (113)	48.4 (38.3)	0.12
Currently taking prescribed antidepressants			0.08
Yes	9 (60)	14 (93)	
No	6 (40)	1 (7)	
Duration of taking prescribed antidepressants (in months)	33.5 (48.5)	39.1 (34.8)	0.72

Table 2. Effects of the TPS intervention on the depression symptom score (HDRS-17) (primary outcome) between pre- and post- test (n=30)

Time points	Intervention (n = 15)	Control (n = 15)			
	Mean (SD)		Mean difference	p	d
Pre-test	25.73 (9.45)	21.60 (8.70)	4.13	.15	
Post-test	**13.20 (7.24)**	**19.80 (6.89)**	**-6.60**	**.02**	**-0.93**

Table 3. The differences in the secondary outcomes between pre-and post-test (n = 30)

Outcomes	Pre-test	Post-test	Mean difference	p	d
Cognition (HK-MoCA)	26.03 (3.74)	28.67 (1.97)	2.64	.003	**0.88**
Trail Making Test-A	11.22 (8.35)	8.31 (6.05)	-2.91	<.001	**-0.40**
Trail Making Test-B	35.88 (25.40)	33.73 (23.65)	-2.15	.07	**-0.09**
Daily Activities (IADL)	22.97 (5.42)	24.80 (3.46)	1.83	<.001	**0.40**
Anhedonia (SHAPS)	20.70 (8.65)	14.23 (7.78)	-6.47	<.001	**-0.79**
Digit Span - Forward	11.90 (2.40)	12.83 (1.91)	0.93	.003	**0.43**
Digit Span - Backward	8.03 (2.67)	10.17 (3.43)	2.14	<.001	**0.69**

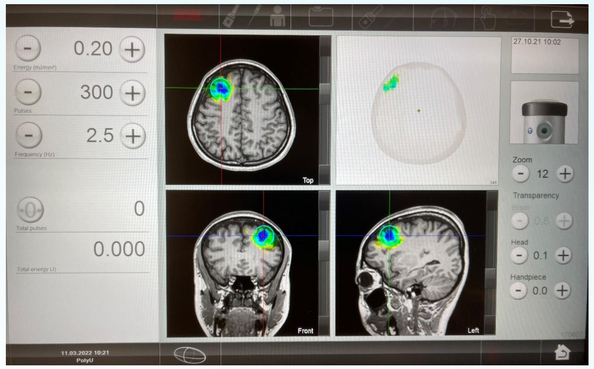

Figure 2. Subject's Structural MRI (T1 images) over the brain treatment region

Conclusion

The results showed a significant intervention effect; in addition, the effect was large and sustainable at the 3-month follow-up. TPS is the latest technological NIBS device that has been proven effective, safe, and sustainable for reducing depressive symptom severity in this pilot RCT. TPS may well be considered a top-on treatment option, especially for treatment-resistant patients and those who are seeking prompt recovery.

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Keywords

transcranial pulse stimulation, noninvasive brain stimulation, efficacy, major depressive disorder

Publication

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