

The intervention effects of the Panbrain EC2 on anxiety

1. introduction

Anxiety is a common emotional reaction that usually manifests as worry, tension, and fear about future threats or uncertainties.^[1] When anxiety is excessive and persistent, it can have a significant negative impact on an individual's emotional well-being. Transcranial direct current stimulation (tDCS), as a non-invasive neuromodulation technology, regulates the excitability of the cerebral cortex by applying constant microcurrent, and has been proven to be effective in alleviating individual anxiety symptoms.^[2] This study was conducted based on the Panbrain EC2 (Shenzhen Panbrain Technology Co., Ltd., using tDCS technology), aiming to evaluate the clinical effect of this device in relieving anxiety.

2. Experiment method

2.1. General information

This study recruited social groups, and after screening, 60 subjects were finally included, and the subjects were divided into stimulation group and control group using random grouping method, with 30 subjects in each group. There were no significant differences in basic characteristics such as age and gender between the two groups of subjects. See Table 1.

Table 1 Comparison of general information of the two groups of subjects

Group	n	Age (years, $\bar{x} \pm s$)	Gender (n)	
			M	F
Stimulation	30	36.47±12.14	12	18
Control	30	34.97±12.76	10	20
t/χ^2		0.467	0.287	
P		0.643	0.592	

Subject inclusion criteria: (1) In the past 2 months, most of the time showed excessive anxiety about many things or activities, and the score was ≥ 7 points as

assessed by a professional through the Hamilton Anxiety Scale; (2) No current or previous mental illness; (3) Not receiving any anti-anxiety treatment; (4) Age $\geq$ 18 years old; (5) Understand the trial process and sign the informed consent form.

Exclusion criteria: (1) History of alcohol or drug dependence; (2) Suffering from epilepsy or other systemic organic diseases; (3) Sensitivity to electrical stimulation; (4) Skin lesions or skull defects at the stimulation site; (5) Metal implants in the skull, electronic devices implanted in the body, etc.

Exit criteria: (1) Subjects had Poor compliance or voluntary withdrawal from the trial; (2) Subjects showed discomfort to tDCS treatment; (3) Subjects received other treatment intervention programs during the trial.

2.2. Intervention

The stimulation group used the Panbrain EC2 for tDCS treatment, and the stimulation site was the dorsolateral prefrontal cortex, which is the F3 and F4 areas in the 10-20 international standard system. The anode electrode is placed in the F3 area, and the cathode electrode is placed in the F4 area. The electrode is in full contact with the scalp through an electrode sleeve soaked in 0.9% sodium chloride solution. Each treatment lasted 15 minutes, once a day, 5 days a week, for a total of 4 weeks (20 sessions).

The operation of the control group was the same as that of the stimulation group, but no current stimulation was applied during the treatment process.

2.3. Evaluation indicators

Before the start of treatment and after the completion of 4 weeks of treatment, the subjects' anxiety level was assessed using the Generalized Anxiety Disorder 7-item scale (GAD-7) and the Hamilton Anxiety Scale (HAMA).

The GAD-7 scale can be used to screen anxiety symptoms and assess symptom severity.^[3, 4] It contains 7 items, each item scores 0 to 3 points, and the total score ranges from 0 to 21 points. Among them, 0 to 4 are classified as no anxiety, 5 to 9 are classified as mild anxiety, 10 to 14 are classified as moderate anxiety, and 15 to 21 are

classified as severe anxiety.

The HAMA scale contains 14 items, each item scores from 0 to 4 points, and the total score ranges from 0 to 56 points.^[5] A total score of ≥ 7 indicates possible anxiety symptoms; a score of ≥ 14 indicates anxiety; a score of ≥ 21 indicates significant anxiety; a score of ≥ 29 indicates severe anxiety. This scale is widely used in clinical practice and has become an important tool for assessing the severity of anxiety symptoms and the effectiveness of intervention treatments.

After the scale evaluation, the scores of GAD-7 and HAMA were converted to a percentage system, and the composite score was calculated based on the weight of GAD-7 accounting for 20% and HAMA accounting for 80%. The specific calculation method is as follows:

$$\text{Score} = \frac{\text{GAD} - 7}{21} \times 100 \times 20\% + \frac{\text{HAMA}}{56} \times 100 \times 80\%$$

2.4. Statistical Analysis

This experiment used SPSS 27.0 software to analyze data. Categorical data are expressed as counts (n) and χ^2 tested; Continuous data are expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$). The differences within the group before and after the intervention are using paired t test, and the differences between groups are using unpaired t test. $P < 0.05$ was considered to be statistically significant.

3. Results

Before treatment, there were no significant differences in GAD-7, HAMA scores and composite scores between the two groups ($P \geq 0.05$). After 4 weeks of treatment, the above-mentioned scores of subjects in both groups were significantly reduced ($P < 0.05$), and the scores of the stimulation group were significantly lower than those of the control group ($P < 0.05$). See Table 2-4.

Table 2 Comparison of GAD-7 scores between the two groups of subjects before and after treatment ($\bar{x} \pm s$)

Group	Before	After	<i>t</i>	<i>P</i>
Stimulation	7.00±1.84	4.43±1.41 ^{ab}	6.605	<0.001
Control	6.83±1.66	5.57±1.25 ^a	4.032	<0.001
<i>t</i>	0.368	-3.298		
<i>P</i>	0.714	0.002		

Note: Compared with before treatment, ^a*P*<0.05; compared with the control group, ^b*P*<0.05;

Table 3 Comparison of HAMA scores between the two groups of subjects before and after treatment ($\bar{x} \pm s$)

Group	Before	After	<i>t</i>	<i>P</i>
Stimulation	11.10±2.37	6.97±1.88 ^{ab}	7.878	<0.001
Control	10.77±2.33	9.17±1.80 ^a	3.413	0.002
<i>t</i>	0.550	-4.622		
<i>P</i>	0.585	<0.001		

Note: Compared with before treatment, ^a*P*<0.05; compared with the control group, ^b*P*<0.05;

Table 4 Comparison of composite scores between the two groups of subjects before and after treatment ($\bar{x} \pm s$)

Group	Before	After	<i>t</i>	<i>P</i>
Stimulation	22.52±4.90	14.17±3.76 ^{ab}	7.813	<0.001
Control	21.89±4.79	18.40±3.66 ^a	3.743	<0.001
<i>t</i>	0.508	-4.405		
<i>P</i>	0.613	<0.001		

Note: Compared with before treatment, ^a*P*<0.05; compared with the control group, ^b*P*<0.05;

4. Conclusion

This study shows through a randomized controlled trial that the Panbrain EC2

using tDCS technology can significantly reduce the severity of anxiety symptoms after 4 weeks (20 sessions). The results showed that the GAD-7 score of the stimulation group decreased by 36.67% ($P < 0.05$) with a responder rate of 86.67%; the HAMA score decreased by 37.24% ($P < 0.05$) with a responder rate of 90.00%; and the composite score decreased by 37.07% ($P < 0.05$) with a responder rate of 86.67%. In contrast, the GAD-7 score of the control group decreased by 18.54% ($P < 0.05$) with a responder rate of 73.33%; the HAMA score decreased by 14.86% ($P < 0.05$) with a responder rate of 70.00%; and the composite score decreased by 15.95% ($P < 0.05$) with a responder rate of 76.67%. Comparison between groups showed that the stimulation group's improvement in various indicators was significantly better than that of the control group, and the difference was statistically significant ($P < 0.05$). These findings suggest that the Panbrain EC2, as a non-invasive neuromodulation device, can provide a safe and feasible intervention option for patients with anxiety.

References

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Appendix A

Table A.1 General information and scores of the two groups of subjects

Group	Subject	Gender	Age	Before treatment			After treatment		
				GAD-7	HAMA	Composite score	GAD-7	HAMA	Composite score
stimulation group (1~30)	1	F	23	6	13	24.29	4	7	13.81
	2	F	36	10	14	29.52	5	6	13.33
	3	F	43	11	17	34.76	4	8	15.24
	4	M	49	5	9	17.62	3	5	10.00
	5	F	55	8	12	24.76	4	7	13.81
	6	M	37	6	10	20.00	2	4	7.62
	7	F	18	9	15	30.00	5	8	16.19
	8	M	27	7	10	20.95	6	11	21.43
	9	F	23	9	14	28.57	5	8	16.19
	10	F	64	6	9	18.57	4	6	12.38
	11	F	28	6	10	20.00	4	6	12.38
	12	M	45	5	8	16.19	6	7	15.71
	13	M	33	6	9	18.57	5	5	11.90
	14	M	47	8	13	26.19	4	6	12.38
	15	F	26	7	12	23.81	5	7	14.76
	16	M	19	7	11	22.38	4	7	13.81
	17	M	18	6	8	17.14	6	11	21.43
	18	F	42	10	16	32.38	4	7	13.81
	19	M	34	7	12	23.81	5	8	16.19
	20	F	33	4	10	18.10	3	6	11.43
	21	F	53	7	11	22.38	7	12	23.81
	22	F	39	5	10	19.05	3	5	10.00
	23	M	38	9	10	22.86	5	8	16.19
	24	F	55	5	10	19.05	4	7	13.81
	25	F	26	7	9	19.52	9	8	20.00

Continued Table A.1 General information and scores of the two groups of subjects

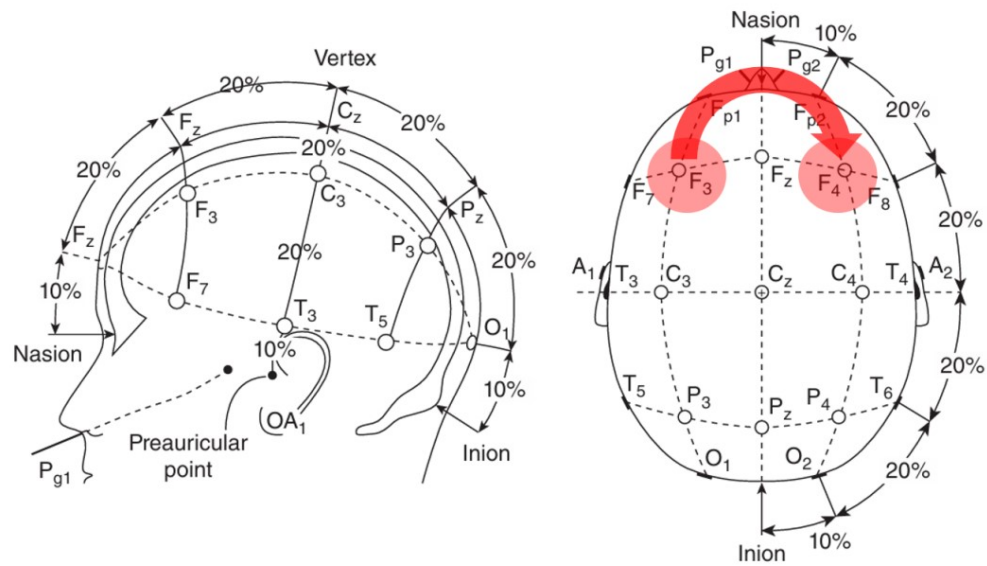
Group	Subject	Gender	Age	Before treatment			After treatment		
				GAD-7	HAMA	Composite score	GAD-7	HAMA	Composite score
stimulation group (1~30)	26	F	44	4	9	16.67	5	5	10.00
	27	M	46	7	11	22.38	8	8	15.24
	28	F	33	6	9	18.57	5	5	10.00
	29	M	38	7	9	19.52	6	6	12.38
	30	F	22	10	13	28.10	5	5	10.00
	31	F	22	7	12	23.81	5	8	16.19
	32	F	37	6	10	20.00	5	9	17.62
	33	F	45	4	10	18.10	4	7	13.81
	34	F	67	6	8	17.14	8	13	26.19
	35	F	28	9	14	28.57	6	8	17.14
control group (30~60)	36	F	38	5	9	17.62	5	9	17.62
	37	M	35	7	10	20.95	5	9	17.62
	38	F	18	9	15	30.00	7	11	22.38
	39	F	30	6	9	18.57	5	8	16.19
	40	F	18	5	8	16.19	4	7	13.81
	41	F	46	7	9	19.52	5	9	17.62
	42	M	25	4	7	13.81	4	9	16.67
	43	M	37	5	8	16.19	4	8	15.24
	44	F	29	6	10	20.00	7	10	20.95
	45	M	40	11	17	34.76	8	14	27.62
	46	M	28	7	11	22.38	5	8	16.19
	47	M	42	6	9	18.57	4	6	12.38
	48	F	45	6	10	20.00	7	12	23.81
	49	M	57	8	14	27.62	6	10	20.00
	50	M	33	8	13	26.19	6	9	18.57
	51	F	18	7	11	22.38	4	7	13.81

Continued Table A.1 General information and scores of the two groups of subjects

Group	Subject	Gender	Age	Before treatment			After treatment		
				GAD-7	HAMA	Composite score	GAD-7	HAMA	Composite score
control group (30~60)	52	F	26	7	11	22.38	6	8	17.14
	53	F	52	4	8	15.24	8	11	23.33
	54	F	23	7	11	22.38	5	9	17.62
	55	F	48	9	12	25.71	5	8	16.19
	56	M	37	8	12	24.76	6	10	20.00
	57	F	53	7	9	19.52	7	11	22.38
	58	F	18	7	11	22.38	5	9	17.62
	59	F	33	8	12	24.76	6	10	20.00
	60	M	21	9	13	27.14	5	8	16.19

Appendix B

Schematic diagram of intervention points based on the 10-20 international standard system



Appendix C Generalized Anxiety Disorder Scale (sample format)

Generalized anxiety disorder 7-item scale, GAD-7

No.: _____ Date of Completion: _____ Gender: ☐ M ☐ F Age: _____

In the past 2 weeks, how often have you been troubled by the following problems? (Mark your answer with " ✓ ")	Not at all	several days	Over half the days	Nearly every day
1. Feeling nervous, anxious or uneasy	0	1	2	3
2. Inability to stop or control worrying	0	1	2	3
3. Worrying too much about various things	0	1	2	3
4. Difficulty relaxing	0	1	2	3
5. Restless	0	1	2	3
6. Becoming easily annoyed or impatient	0	1	2	3
7. Feeling scared, as if something terrible is going to happen	0	1	2	3

The following information was compiled by the evaluator based on the
information provided by the subjects

Total score T ____ = ____ × 1 + ____ × 2 + ____ × 3

Evaluator: _____

Appendix D Hamilton Anxiety Rating Scale (sample format)

Hamilton anxiety scale, HAMA

No.: _____ Date of Completion: _____ Gender: ☐ M ☐ F Age: _____

The following information was completed by the evaluator based on an interview with the subject

project	Performance	score				
1. Anxious mood	Worry, feeling that the worst is about to happen, easily irritable.	0	1	2	3	4
2. Nervous	Tension, easy fatigue, inability to relax, emotional reactions, easy crying, shaking, and feeling uneasy.	0	1	2	3	4
3. Fear	Fear of the dark, strangers, being alone, animals, riding in cars or traveling, and crowded situations.	0	1	2	3	4
4. Insomnia	Difficulty falling asleep, waking up easily, not sleeping deeply, having many dreams, nightmares, night terrors, and feeling tired after waking up.	0	1	2	3	4
5. Intellectual	Or called memory and attention disorders. Inability to concentrate and poor memory.	0	1	2	3	4
6. Depressed mood	Loss of interest, lack of pleasure in previous hobbies, depression, early awakening, heavy days and light nights.	0	1	2	3	4
7. Somatic (muscular)	Muscle soreness, inflexibility, muscle twitching, limb twitching, teeth chattering, and voice trembling.	0	1	2	3	4
8. Somatic (muscular)	Blurred vision, chills and fever, weakness and tingling all over the body.	0	1	2	3	4
9. Cardiovascular symptoms	Tachycardia, palpitations, chest pain, pulsing feeling in blood vessels, feeling of fainting, and missing heartbeats.	0	1	2	3	4
10. Respiratory symptoms	Chest tightness, suffocation, sighing, difficulty breathing.	0	1	2	3	4
11. gastrointestinal symptoms	Difficulty swallowing, belching, indigestion (abdominal pain after eating, burning pain in the stomach, bloating, nausea, stomach fullness), bowel sounds, diarrhea, weight loss, constipation.	0	1	2	3	4
12. Genitourinary symptoms	Frequent urination, urgency to urinate, amenorrhea, frigidity, premature ejaculation, inability to have an erection, and impotence.	0	1	2	3	4
13. autonomic symptoms	Dry mouth, flushing, paleness, easy sweating, "goosebumps", tension headaches, and hair standing on end.	0	1	2	3	4

project	Performance	score				
14. Behavior at interviews	(1) General manifestations: nervousness, inability to relax, uneasiness, biting fingers, clenching fists, playing with handkerchiefs, facial muscle twitching, non-stop feet, trembling hands, frowning, stiff expression, high muscle tone, sighing breathing, and pale complexion; (2) Physiological manifestations: swallowing, hiccups, fast heart rate at rest, fast breathing (more than 20 times/min), hyperreflexia, tremor, pupil dilation, eyelid twitching, easy sweating, and exophthalmos.	0	1	2	3	4

Note: All items are scored on a 5-point scale from 0 to 4. The standards for each level are: "0" means no symptoms, "1" means mild, "2"

means moderate, "3" means severe, and "4" means extremely severe.

Total score T_____ = _____×1 + _____×2 + _____×3 _____×4

Evaluator:_____