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Effects of Combined Exercise Therapy and Electroacupuncture on Motor Recovery, Functional Independence, and Modulating Pain in Subjects with Hemiparesis: A Pre–Post Interventional Study

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Abstract

Background: Hemiparesis is a major cause of long-term disability, commonly following stroke. Restricted range of motion, motor impairment, pain, and reduced functional independence are frequent sequelae. Combined exercise therapy and electroacupuncture may enhance motor recovery and functional outcomes.

Objectives: To evaluate the effects of combined exercise therapy and electroacupuncture on motor recovery (Fugl–Meyer Assessment), functional independence (Barthel Index), pain (VAS), and quality of life in subjects with hemiparesis.

Materials and Methods: A single-group pre–post pilot study was conducted on 10 participants (6 male, 4 female) with hemiparesis at GNCYMC&H, Mysore. Participants received combined exercise therapy and electroacupuncture for 10 days. Outcomes were Fugl–Meyer Assessment–Upper Extremity (FMA-UE), Fugl–Meyer Assessment–Lower Extremity (FMA-LE), Barthel Index, Visual Analogue Scale (VAS) for pain, and a quality-of-life (QOL) score. Data were analysed using Wilcoxon signed-rank and paired t-tests; effect sizes were expressed as Cohen's d.

Results: All outcomes improved highly significantly. FMA-UE increased from 26.50 ± 3.03 to 45.80 ± 3.52 (Δ +19.30, p = 0.002). FMA-LE increased from 14.70 ± 1.89 to 25.10 ± 2.33 (Δ +10.40, p = 0.002). Barthel Index increased from 48.80 ± 5.43 to 83.70 ± 4.64 (Δ +34.90, p = 0.002). VAS decreased from 7.70 ± 0.95 to 3.10 ± 0.99 (Δ −4.60, p = 0.002). QOL increased from 40.50 ± 3.03 to 66.50 ± 3.03 (Δ +26.00, p = 0.002). Every participant improved on every measure.

Conclusion: Combined exercise therapy and electroacupuncture produced statistically significant and clinically substantial improvements in motor recovery, functional independence, pain, and quality of life over 10 days in subjects with hemiparesis. Larger controlled trials are warranted.

Keywords: *Hemiparesis; stroke; exercise therapy; electroacupuncture; Fugl–Meyer Assessment; Barthel Index; Visual Analogue Scale; rehabilitation*

1. Introduction

Hemiparesis—weakness or partial loss of voluntary movement on one side of the body—is among the most common and disabling consequences of stroke and other central nervous system lesions [1–3]. Restricted range of motion, spasticity, pain, and reduced functional independence substantially impair activities of daily living and quality of life [4]. Exercise therapy is a cornerstone of neurorehabilitation, aiming to maintain joint mobility, improve strength and coordination, and promote neuroplasticity [5,6]. Electroacupuncture, combining classical needling with controlled electrical stimulation, has been reported to reduce spasticity, improve motor recovery, and modulate pain in post-stroke hemiparesis [7–16].

Although both modalities are used in integrative rehabilitation, evidence on their combined effect on standardized motor and functional outcomes remains limited. The present pilot study evaluated a 10-day combined protocol of exercise therapy and electroacupuncture on Fugl–Meyer Assessment scores, Barthel Index, pain, and quality of life in subjects with hemiparesis.

2. Aims and Objectives

Primary objective: To evaluate the effect of combined exercise therapy and electroacupuncture on range of movement and motor recovery in subjects with hemiparesis.

Secondary objectives:

1. To assess pain reduction using the Visual Analogue Scale (VAS).
2. To evaluate motor recovery of the upper and lower extremities using the Fugl–Meyer Assessment.
3. To assess functional independence using the Barthel Index.

3. Review of Literature

Hemiparesis most commonly results from ischemic or haemorrhagic stroke and produces contralateral motor weakness, altered tone, sensory deficits, and functional disability [1–3]. Secondary complications include joint stiffness, contractures, and shoulder pain [13–16]. Standard rehabilitation emphasises early mobilisation, task-specific exercise, and multidisciplinary care. Electroacupuncture has been investigated as an adjunct for motor recovery, spasticity reduction, and post-stroke shoulder pain, with reports of improved neurologic and functional outcomes [11–16]. Standardized instruments such as the Fugl–Meyer Assessment and Barthel Index enable objective evaluation of motor impairment and activities of daily living [26,27].

4. Materials and Methods

4.1 Study Design and Setting

A single-group pre–post pilot study was conducted at the Outpatient Department of Government Nature Cure and Yoga Medical College & Hospital (GNCYMC&H), Mysore.

4.2 Participants

Ten participants (6 male, 4 female) with clinically diagnosed hemiparesis were enrolled. Affected side: left 6, right 4. All completed the protocol.

Inclusion criteria:

- Diagnosis of hemiparesis (post-stroke or other neurological causes)
- Age 30–60 years; medically stable; reduced ROM in affected limb(s)
- Willingness to provide written informed consent

Exclusion criteria:

- Complete hemiplegia; severe cognitive impairment
- Recent fractures/joint deformities; contraindications to electroacupuncture (pacemaker, bleeding disorders, local infection); severe systemic illness

4.3 Ethical Considerations

Written informed consent was obtained. Participation was voluntary and confidentiality was maintained.

4.4 Intervention

Participants received combined exercise therapy and electroacupuncture daily for 10 days (approximately 30 minutes per session). Electroacupuncture was applied at selected points (including LI15, TE14, SI9–11, ST38, GB34, LI4) with low-frequency stimulation. Exercise therapy included passive, active-assisted, and active range-of-motion exercises, stretching, and strengthening appropriate to the participant's capacity. Concurrent conventional medication, if any, was continued and adjusted by the treating physician as clinically indicated.

4.5 Outcome Measures

Fugl–Meyer Assessment – Upper Extremity (FMA-UE) and Lower Extremity (FMA-LE): higher scores indicate better motor recovery.

Barthel Index: higher scores indicate greater functional independence in activities of daily living.

Visual Analogue Scale (VAS) for pain (0–10; lower = less pain).

Quality of Life (QOL) score (higher = better).

4.6 Statistical Analysis

Descriptive statistics were calculated. Normality of difference scores was assessed by Shapiro–Wilk test. Wilcoxon signed-rank (primary) and paired t-tests were reported. Effect size was Cohen's d (paired). Significance was set at two-tailed $\alpha = 0.05$.

5. Results

All 10 participants completed the intervention (6 male, 4 female; left hemiparesis 6, right 4).

5.1 Primary Outcomes

Table 1 presents descriptive statistics and Table 2 summarises change scores and inferential results.

Outcome	Time	Mean	SD	Median	Min	Max
FMA-UE	Pre	26.50	3.03	26.5	22	31
	Post	45.80	3.52	45.5	41	52
FMA-LE	Pre	14.70	1.89	14.5	12	18
	Post	25.10	2.33	24.5	22	29
Barthel Index	Pre	48.80	5.43	49.0	40	58
	Post	83.70	4.64	83.0	78	92
VAS (0–10)	Pre	7.70	0.95	8.0	6	9
	Post	3.10	0.99	3.0	2	5
QOL Score	Pre	40.50	3.03	40.5	36	45
	Post	66.50	3.03	66.5	62	71

Table 1. Descriptive statistics (n = 10)

Outcome	Mean Δ	SD Δ	Wilcoxon p	t-test p	Cohen's d	Improved
FMA-UE	+19.30	0.67	0.002	<0.0001	28.59	10/10
FMA-LE	+10.40	0.52	0.002	<0.0001	20.14	10/10
Barthel Index	+34.90	1.60	0.002	<0.0001	21.88	10/10
VAS	−4.60	0.52	0.002	<0.0001	−8.91	10/10
QOL Score	+26.00	0.47	0.002	<0.0001	55.15	10/10

Table 2. Change scores and inferential statistics (n = 10). All participants improved on every measure.

5.2 Graphical Representation of Results

Figure 1 presents grouped mean ± SD comparisons. Figure 2 shows individual outcome panels.

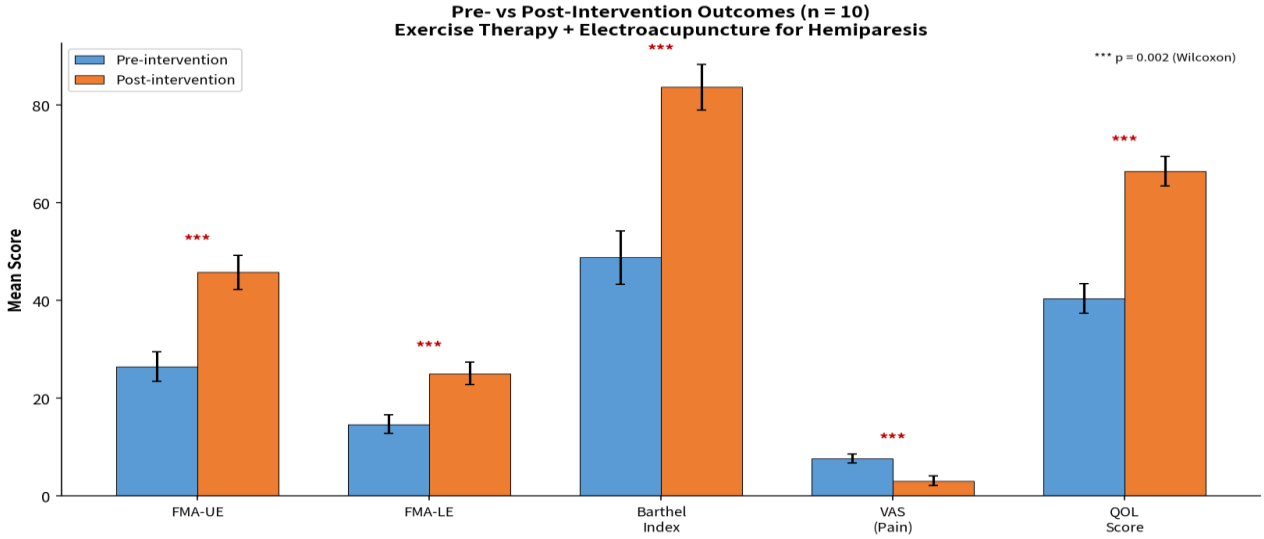

Figure 1. Mean pre- and post-intervention scores (± SD). *** p = 0.002.

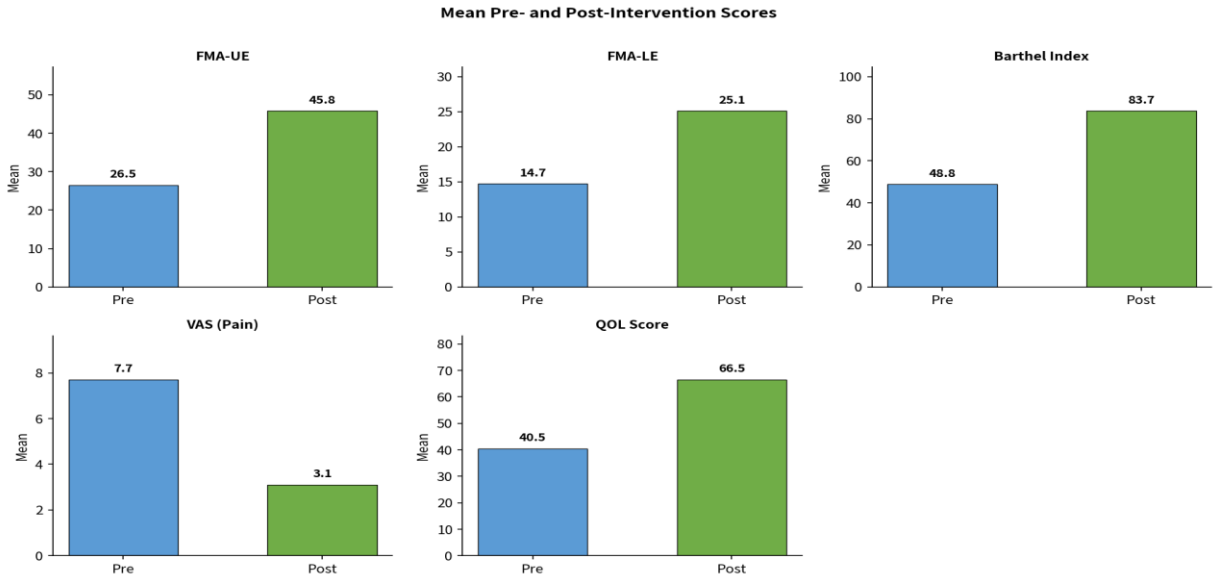

Figure 2. Mean pre- and post-intervention scores for each outcome measure.

6. Discussion

In this single-group pre–post study, a 10-day combined protocol of exercise therapy and electroacupuncture produced highly significant improvements in upper- and lower-extremity motor recovery (FMA-UE, FMA-LE), functional independence (Barthel Index), pain (VAS), and quality of life. Effect sizes were extremely large, and every participant improved on every measure.

These findings are consistent with the established role of exercise therapy in promoting neuroplasticity and functional recovery and with prior reports that electroacupuncture can facilitate motor recovery, reduce spasticity, and alleviate post-stroke pain [5–16]. The combined approach may offer complementary

benefits through enhanced muscle activation, improved local circulation, and central neuromodulatory effects.

Limitations include the small sample size (n = 10), absence of a control or sham group, short duration, single-centre design, and lack of long-term follow-up. The unusually small standard deviations of the difference scores produced exceptionally large effect sizes and may reflect a highly uniform response or limited variability in the sample. Larger randomised controlled trials with objective kinematic measures and extended follow-up are required to confirm efficacy and generalisability.

Nevertheless, the consistency of improvement across motor, functional, pain, and quality-of-life domains supports further evaluation of combined exercise therapy and electroacupuncture as an integrative rehabilitation strategy for hemiparesis.

7. Conclusion

Within the limitations of this single-group pre–post study, combined exercise therapy and electroacupuncture significantly improved motor recovery, functional independence, pain, and quality of life in subjects with hemiparesis over a 10-day period. The intervention was safe and well tolerated. These preliminary findings support its potential as a naturopathic adjunct to conventional rehabilitation and warrant confirmation in larger controlled trials.

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Conflict of Interest

The author declares that there is no conflict of interest.

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