



BRIEF REPORT

Laser Acupuncture and Auriculotherapy in Postural Instability—A Preliminary Report

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Abstract

The risk of falling is rather high among elderly people. Indexes obtained through the Romberg stabilometric test on a force platform have been suggested to be correlated with the risk of falling. This work aimed to test the effectiveness of auriculopuncture and ultralow-power laserpuncture versus placebo (sham stimulation) in improving postural control in an elderly population. Balance performance was measured on a force platform before and after both forms of stimulation. Main balance parameters pointed to an average short-term improvement of about 15% 1 hour after treatment and 5–10% after an interval of 3 days. However, a few participants showed a better than 30% improvement with the same parameters. Although the sample size does not allow reliable statistical analysis, the modifications are remarkable and some differences are observed between the two kinds of stimulation. Further testing with larger sized groups and including one further group using both stimulations is suggested. Although postural instability has to be defined as multi-factorial, it is often associated with balance dysfunctions that cannot be related to vestibular or central impairments but rather to proprioceptive deficits. A significant role may be ascribed to (even subliminal) nociceptive interferences with proprioceptive inputs and to a reduced capacity for updating cortical motor control models in the case of progressively declining locomotor capabilities. The explanation tentatively put forward to account for the results observed in the present preliminary study is that laser acupuncture and auriculopuncture stimulations reduce nociceptive interference and thus improve postural control.

1. Introduction

Falling in a domestic environment is the primary cause of osteoarticular trauma in the elderly population. Clinical statistics show that such accidents are often fatal (around 25% of elderly individuals with femur fracture are likely to die within 12 months

after the accident) and entail long and painful hospitalization (the Italian average is around 60 days) followed by a long and costly rehabilitation [1].

Together with increasing mean age and mean life expectancy, the problem is becoming more and more urgent. According to a credible British study [2], the statistical risk of being found dead at home

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after a fall for an over 65 is comparable that of being found dead after a stroke.

Falling in a domestic environment is a multifactorial event. The progressive functional decline and intrinsic frailty of the elderly may be aggravated by environmental conditions (inappropriate footwear, low light level, carpets and so on). Prevention strategies are effective if the persons at risk can be identified in time [3]. Postural control deficit is a primary factor [4] and 12 papers dealing with the very same subject based on the examination of 3628 falls [5] concur in indicating a significant percentage of falls linked to proprioceptive deficits. If added to falls due to dizziness and musculoskeletal pain [6], the total percentage exceeds 30%.

Acupuncture has been shown to improve postural control and has been used in the treatment of dizziness and vertigo [7–11]. Recently, a controlled randomized trial confirmed the effectiveness of acupuncture stimulation in improving balance, with the displacement area of the center of gravity decreasing in the experimental group but not in the control group [12]. According to the Ottawa Panel for Post-Stroke Rehabilitation [13], the available evidence provides support for surface acupuncture with electrical stimulation in subacute stroke and needle acupuncture with electrical stimulation in acute and subacute stroke for improving walking mobility, range of motion, and balance.

Previous tests using ultra low power laser (ULPL) stimulation, both following auriculopuncture [14–19] and acupuncture derived techniques, proved capable of modifying balance parameters. In the present work, the effectiveness of laser acupuncture and laser auriculopuncture in improving postural control is tested further. Being totally noninvasive, laser irradiation seems to be the most suitable kind of acupoint stimulation for the possible routine treatment of a wide range of elderly populations aimed at reducing the risk of falls. A further reason for choosing laser stimulation lies in its acknowledged antalgic action. Pain, as will be discussed below, must be considered one of the main causes of postural deficits and falls.

2. Materials and Methods

2.1. Sample population

The test was administered to 34 guests of two sheltered homes in the Lombardy region, Italy (mean data: age 85.38 years, height 157 cm, weight 59.7 kg). Guests with known central or vestibular pathologies were excluded. Pharmacological treatment was taken into consideration but was not used as a criterion for exclusion. Individuals were randomly

assigned to one of the following three groups, (1) auriculo: auriculopuncture with ULPL ($n=9$), (2) Biolite: acupuncture with ULPL ($n=9$), (3) placebo: sham auriculopuncture (laser switched off; $n=16$). The experimental study was performed within the frame of standard physiotherapeutic assistance provided at the two hospices. Musculoskeletal pain treatment following a conventional western medicine approach and/or acupuncture/acupressure, auriculotherapy, or manual medicine is currently provided for all the guests of the hospices. Individuals who received placebo treatment were later given one of the two treatments.

2.1.1. Balance test

All the balance tests were performed on the ARGO force platform (RGMD SpA, Genova, Italy). The device was chosen for its size (600 mm × 600 mm), comfort for the subjects, and its accuracy (COP coordinates are given with an accuracy of better than 0.1 mm) over the whole frequency range (up to 10 Hz). Sampling rate is 100 Hz.

2.1.2. Stimulation

BioliteLP020, a patented ULPL (RGMD SpA, Genova, Italy), was used. Biolite is a diode modulated laser using an unusually low mean power (0.03 mW) with a square wave modulation ($f=100$ Hz; duty cycle = 1%; peak power 3 mW). The emission is flashed by the operator and 20 half-second flashes are administered over the selected point. As a result, the average power is about half the nominal 0.03 mW and the single point energy treatment dose is about 0.3 mJ. Such a tiny dose, well below the levels proposed by Tunér and Hode [20], when administered on acupoints and through a particular emission mode, has proved capable of eliciting significant biological responses, as recently reviewed [21].

2.1.3. Bioactive stimulation points finder

An AgiscopDT (Sedatelec, Lyon, France) impedance-based acupoint detector was used to identify both auriculotherapy bioactive points and acupuncture points for Biolite stimulation.

2.2. Test protocol

All the participants received the test and treatment in their sheltered housing according to the following protocol: (1) baseline, initial balance test; (2) treatment within 15 minutes from the baseline test; (3) following test, balance test within 1 hour from baseline; (4) long term, balance test no earlier than 3 days after baseline.

2.2.1. Balance test

The balance test was performed with the individual standing relaxed (arms hanging down loosely), mouth closed (not tightly), feet parallel and in contact. The first recording was performed with eyes closed. Acquisition time was 45 seconds, and an adaptation time of 5 seconds was allowed and then discarded [22].

2.2.2. Auriculopuncture stimulation

Active points in the auricle were selected according to the Auricolo Terapia Posturale secondo Scoppa method [19,23] (Figure 1) and stimulated with 20 Biolite half-second flashes (0.3 mJ per point).

2.2.3. Biolite stimulation

The stimulation protocol was defined by the device producer in close cooperation with La Colletta Bioengineering Center (Genova University and Liguria Region Public Health Service) on the basis of acupunctural indications. Two points (BL60, Kun-Lun and KI3, Tai-Xi) were bilaterally stimulated with 20 Biolite half-second flashes (0.3 mJ/point) [24]. As will be discussed below, there is some evidence to indicate that back and lower limb pain affects motor and balance performance. The two points were selected as being of proven effectiveness in the treatment of back and lower limb pain (BL60) and dizziness (KI3) and as being devoid of known side effects. Placebo stimulation was identical to the auriculopuncture stimulation but with the Biolite device switched off.

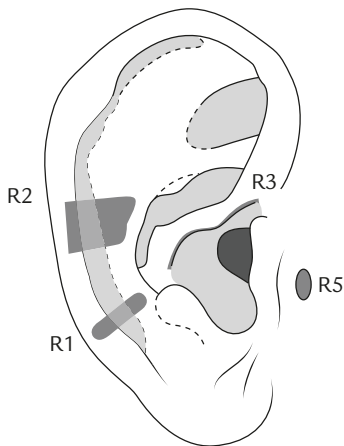


Figure 1 Auriculotherapy zones to be treated according to Auricolo Terapia Posturale secondo Scoppa technique. Image reproduced with permission from reference 19.

3. Results

Balance parameters gathered on the force platform were examined under “blind” conditions, as the analyzer did not know which group had received which treatment. Main balance parameters showed an average improvement of about 15% in the short term, 1 hour after treatment, and 5–10% at 3 days interval. As the test aimed to allow a preliminary investigation of the modifications, if any, produced by the stimulation, the main results are reported as the normalized (percent) modifications in the parameter values (Figure 3, Closed Eyes tests). A qualitative appraisal of the modifications is given in Figure 2 for both methods.

3.1. Baseline

Participants showed mild proprioceptive deficit and some of them also showed a deficit in the Open Eyes test, suggesting the likely presence of a central deficit.

		Romberg quotient		
Sway path	Sway area	Spatial distance	1/(Stay Time)	
1.41	1.93	1.55	1.67	

The values were computed as between the parameter read in the Closed Eyes test and the same reading in the Open Eyes test. The opposite was done for Stay Time (“the greater, the better”).

3.2. Following

It is worth stressing the temporary “worsening” of the main parameters both in the Closed and in the Open Eyes tests.

3.3. Long term

The beneficial effect is evident; particularly in the Closed Eyes test (thus confirming that the stimulation mostly affects the proprioceptive capabilities) for the two stimulated groups and more so in the Biolite group.

3.4. Comparison

Both the classical sway parameters (sway path and sway area normalized for test duration) and the structural parameters of sway density [25] (mean Stay Time on temporary centers of stability and mean spatial distance between temporary centers of stability) show the beneficial effect of “long term” stimulation (Figure 3, Closed Eyes). According to the reference mentioned [25] the Stay Time is

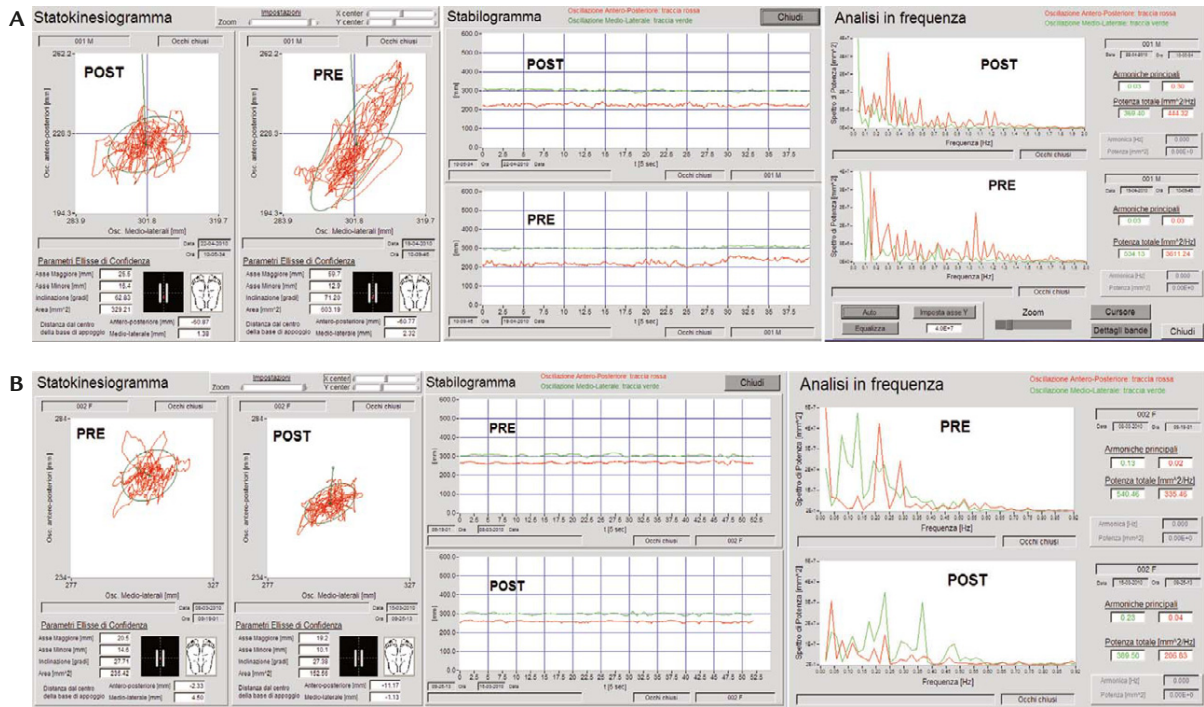


Figure 2 (A) Pre/post acupunctural stimulation (Biolite group). In addition to a morphological change displayed in the Statokinesigram. A high frequency harmonic has quite apparently been canceled. (B) Pre/post auriculopunctural stimulation (Auriculo group). In addition to a significant amplitude reduction observed in the Statokinesigram, it is quite apparent that low frequency oscillation harmonics (inverted pendulum natural frequencies) have been reduced, mainly on the anteroposterior plane.

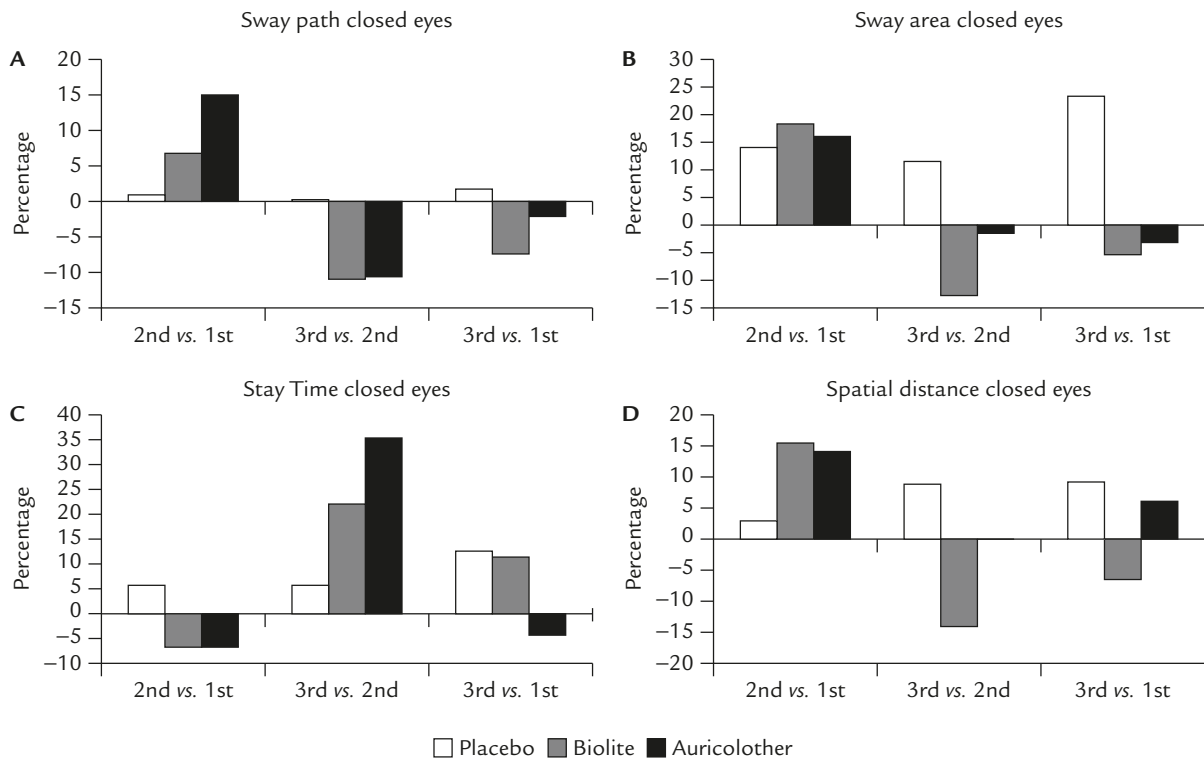


Figure 3 Closed eyes tests (normalized variations). The three measurements performed to the three groups (Placebo, Biolite, Auricolother) are referred to as 1st, 2nd and 3rd.

affected (reduced) by afferent (proprioceptive) deficit while the spatial distance between centers of stability is indicative of the overall neuromotor capability (for attaining a fresh balance condition). Therefore, an increase in mean Stay Time could be read as the effect of a reduction in proprioceptive interference and a reduction in mean spatial distance could be read as the effect of an improved control performance.

4. Discussion

To explain the laser action on postural performance observed in the present trial, the following hypothesis may tentatively be put forward. The ultralow-power laser stimulation, acting through the acupuncture pathways (as has recently been reviewed [21]), may have reduced the proprioceptive deficits through the inhibition of nociceptive afferents. Pain, possibly even below the conscious threshold, is known to affect postural control [26–34], presumably by interfering with normal proprioceptive inputs. Pain is in fact strongly correlated with the risk of fall, especially in the elderly [35,36].

The long term improvement of closed eyes parameters for the treated groups is consistent with such a hypothesis. The “worsening” in both the following test and in the open eyes tests could be explained in terms of a superior postural control model in which specific differentiated weight is attributed to the afferent proprioceptive signals processed in the sensorimotor integration area [37,38]. The apparent destabilization is in fact temporary and may be linked to the combined effects of a reduction in sensory interferences and a reorganization of the motor control model.

Beneficial effects produced by the Biolite acupuncture derived protocol seem to be slower to appear but more significant than those produced by auriculo stimulation. The difference seems to suggest the existence of different mechanisms underlying acupuncture and auriculotherapy.

5. Conclusions and Future Directions

The weaknesses of this preliminary study include the nonhomogeneous sample (which should be stratified), the fact that medical treatments were not taken into account, and, above all, the small sample size. Further analysis involving larger samples is needed. For three groups composed of equal numbers of subjects, power analysis suggests that to detect significant differences (confidence level: 95%, power: 0.80), the requisite number of participants should be 75 persons per group. Estimates of effect

size and standard deviation were made on the basis of the present and a previous unpublished study (Cervera Ch, Baratto M, Navarra S, Gallamini M, data not shown) in which daily variations in postural indexes (e.g., sway path, sway area) were analyzed in a sample of healthy subjects of different ages, and which showed that variations in the parameters were relatively independent of age and lay within the approximate range of $\pm 25\%$ (sway parameters) and $\pm 15\%$ (sway density). In a future trial it would also seem advisable to include a “combined stimulation group” and hopefully also a “motor rehabilitation group.”

If confirmed, the results reported in the present preliminary study may be deemed to give the following indications. It is possible to treat postural instability in the elderly through a noninvasive and safe method, with a combined auriculo-acupuncture stimulation protocol being the most effective. Additionally, controlled motor activity to enhance the reorganization of motor control models after treatment is likely needed to stabilize the beneficial effect of stimulation.

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