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Electrify Yourself

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Dear Readers of NOVN,

The effectiveness of visual restoration therapy in patients suffering from cerebral accidents remains a matter of debate. Although the *American Academy of Pediatrics*, the *American Association for Pediatric Ophthalmology and Strabismus and the American Academy of Ophthalmology* in 1998 and then in 2001 admonished against visual rehabilitative solutions aimed at improving the visual function (the so-called "visual training"), the proven plasticity of the cortical dynamics even in adult age opens up thrilling perspectives in the treatment of severe visual field losses due to central (i.e cerebral) origin.

Based on the working hypothesis that the functional and anatomical neural loss can be at least partly restored by stimulating impaired neuronal clusters or activating a silent cellular "reserve", a strand of research has investigated (and is currently evaluating) the usefulness of pharmacological neuro-enhancement (like the one allegedly promoted by citicoline) with questionable and at best transitory mild improvements. In turn, in the last years physical (viz non-pharmacological) approaches have been focused on the light stimulation of the visual field by repeatedly presenting localized stimuli at the borders of the blind region (see for example [1-8]. Such a procedure aims at improving the overall activity of the impaired neural substrate via indirect electrical stimulation, provided phototransduction is fully operative on the retina.

More recently a different (more direct) approach based on the application via electrodes of alternating electrical current to the visual cortex of the brain has been experimented.

About 30 years ago Bechtereva and associates were precursors of this approach since they implanted electrodes into the optic nerve during the surgical treatment in 45 severely visually impaired patients affected by lesions involving the optochiasmatic region. The electrode remained active for 2 or 3 weeks after the surgical intervention. The authors reported considerable improvement of the visual function in up to 75% subjects and partial recovery in cases of total blindness [9].

More recently a non-invasive approach has been developed in Germany and its effectiveness evaluated in a series of investigations carried out in some laboratories of this country.

Fedorov et al reported improvement of the visual field size (by 27% on average) in a sample of 874 patients affected by tumoral, inflammatory or traumatic optic nerve lesions with mild to profound visual field loss after sessions of low-intensity electrical stimulation [10].

Some years later, a 27 years-old male with optic nerve atrophy and nearly total loss of vision was administered transorbital alternating current stimulation. After ten sessions of 30-40 minutes, his detection ability and differential light sensibility were reported to be improved. The authors ascribed this functional gain to synaptic strengthening along the visual pathway [11].

In a subsequent placebo-controlled study [12] a sample of patients with optic nerve damage underwent ten sessions (5 days per week for 2 weeks, each session lasting between 10 to 20 minutes per eye) of transorbital cerebral stimulation (trains of squares and sinus pulses, frequency ranging from 5 to 30 Hz, current intensity below 500µA). After the electrical stimulation, the authors found improvement of the visual performance expressed as an index (namely detection ability; DA) in the affected region of the visual field, reduction of the mean differential light threshold, and isopteric enlargement. The improvement remained unchanged after 2 months of follow-up.

The same year transorbital alternating current stimulation (treatment period:10 days) applied to 446 patients suffering from optic nerve lesions proved to be effective in increasing the visual field size (by 7-9%) in up to 49% of the eyes, as well as visual acuity [13]. A subsequent German study confirmed this finding [14].

These results make the electric cerebral stimulation an interesting solution for visual restoration; however, its real potential in restoring visual function must be further probed. More extensive investigations are mandatory to shed light on the mechanisms responsible for the (supposedly) visual improvement. Experimental confirmation of the abovementioned encouraging results must be provided from other (independent) laboratories.

Preventing the creation of false expectations is a fundamental duty of the researchers who study novel procedures to improve the quality of life of people who suffer from severe visual disabilities, and of the physicians who propose new treatment strategies to their patients. Let's not forget it.

Carlo Aleci, Editor-in-Chief.

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