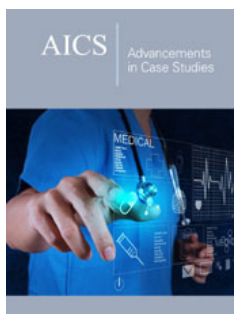


The Effects of Diamagnetic Therapy in a Peripheral Facial Paralysis: A Case Report

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Abstract

Peripheral facial paresis, or paralysis, is the most common acute mononeuropathy that affects the face. Also known as Bell's paralysis and it involves the VII cranial nerve on one side of the face. The clinical resolution is almost always spontaneous, in a few weeks, but the complete recovery usually occurs in about six months; rarely, the pathology continues with long symptoms for life or occurs more than once. Despite the cause is frequently unknown, the therapeutic choice includes corticosteroids or antiviral drugs in force of a possible inflammatory or viral origin. In addition to medical therapy, short electrical stimulation of the facial muscles, low-level facial lasers, facial exercises, and tape feedback have been proposed, but with conflicting results.

We are unaware of the use of Pulsed Electromagnetic Fields in the management of paralysis, although this type of biophysical stimulation has already proven to be effective in neurological diseases, both in the central and peripheral nervous contexts. Based on this rationale, an original technology that employs High-Intensity Magnetic Fields (Diamagnetic therapy) has been proposed as a therapeutic choice in facial palsy given the lengthy response after conventional rehabilitative treatments. The results of the treatment are very encouraging and give way to future applications, also extended to other diseases of the peripheral nervous system.

Keywords: Facial paralysis; Bell's paralysis; Pulsed electromagnetic fields; Diamagnetic therapy

Introduction

The incidence of peripheral facial paralysis is around 20 to 25 cases per 100.000 population annually and the age range that predominates in this pathology is between 15 to 45 years old people [1]. The cause can be idiopathic, infectious, traumatic, iatrogenic, or resulting from tumors or developmental abnormalities in the nerve, as part of isolate syndromes or traumatic birth injuries and early infections [2]. This condition affects the lower motor neuron tract on the face, specifically the cranial nerve VII, which has both motor and sensory components. Additionally, the sensory root of the facial nerve carries the parasympathetic innervation of some salivary, lacrimal and mucosa glands and the motor fibers supply the muscles of facial ex-expression, auricle and scalp [3]. The course of the facial nerve is one of the most complex compared to the other cranial nerves and comprises intracranial, infratemporal and extratemporal parts whose knowledge is crucial to locate and treating possible lesions by using biophysical stimulation of the nerve [4].

Bell's palsy is characterized by abrupt impaired facial expression due to unilateral facial weakness and involves all facial nerve branches, which directly implies a dry eye due

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to the impossibility of closing the eyelids, posterior auricular pain, numbness, altered taste and decrease tearing [5]. The onset generally occurs between 48 to 72 hours after the cause: infections, anatomic anomalies, inflammation, cold exposure, and ischemia [6]. The main current hypotheses on the pathophysiology of Bell's palsy are the reactivation of Herpes Simplex virus infection or other types of cell-mediated autoimmune inflammatory response. These episodes can be triggered by stress or an infection of other illnesses capable of triggering a reactive response against the myelin antigens of the facial nerve. In the pathogenesis, of the disease, inflammation edema, and swelling lead to nerve compression at the origin of the starting symptoms [7].

To define the presence of facial palsy a detailed examination of the patient's clinical history and a physical examination are recommended. The American Academy of Otolaryngology-Head and Neck Surgery does not recommend laboratory, electrodiagnostic or radio-logic testing or diagnostic imaging for the new onset of Bell's palsy. However, in presence of red flags or suspects of other pathology, is necessary to derogate from this rule and look for other causes of the disorder [8]. The common treatment includes the use of corticosteroids within 72h of facial paralysis onset, physiotherapy that includes heat therapy, electrostimulation, massage, mime therapy and biofeedback [5] also alternative therapies such as acupuncture, homeopathic or vitamins [9].

The prognosis of this condition is characterized by complete recovery in about 80% of the cases, 15% experience some permanent nerve damage, and 5% of them remain with sequelae [4]. Patients who have not gotten a recovery in the first 3 or 4 months after onset are more likely to have an incomplete facial function [10]. Despite the well-known impacts of electromagnetic fields in nervous tissues, few experiences report on the effects of the external stimulation of the facial nerve as a possible therapeutic choice. On these bases, we report the clinical case of a patient with facial palsy treated using an original technology based on the low frequency- high-intensity pulsed electromagnetic fields (Diamagnetic Therapy), as an add-on treatment.

Case Presentation

A female patient, 49 years old, suffering from an episode of peripheral facial paralysis because of a strong moment of stress in her work life, went to our observation at the Cell Regeneration Medical Organization in Bogotá-Colombia- to undergo rehabilitative and medical treatments.

The woman, within her recovery process, had been treated by professionals in neurology and physiotherapy, covering for approximately 4 months the standard procedures related to peripheral facial palsy (corticoids, mime therapy, acupuncture, biofeedback). Due to the slow functional recovery, we decided to treat the patient with an innovative technology based on the repulsive effects of the low frequency -high-intensity magnetic field (Diamagnetic Therapy), already experienced to accelerate the biological regenerative processes in an experimental and clinical

setting [11,12], besides the general well-known anti-inflammatory and modulatory effects of magnetic fields in nerves [13]. To evaluate the outcomes of the treatment, the Facial Nerve Grading System (FNGS) has been employed pre- and post-treatment [14] while the Visual Analogical Score was used for pain evaluation.

Methods

The preliminary clinical evaluation addressed the motor aspect of the disease. So, the ability to activate and move the facial muscles has been assessed and carried out before the first session of Diamagnetic treatment as follows (Table 1).

Table 1: Pain: According to VAS (Visual Analogic Score) 4/10.

Browse	Beginning of the movement - 5 points
Eyes	Slow closures with non-eyelid contact - 4 points
Naso Labial Fold (NLF)	The appearance of skin fold in the direction of the eye, below the inner part of the eyebrow - 5 points
Oral	A slight opening of the lip corner - 6 points
Secondary movements	Slight synkinesis and minimal contracture - 1 point
Score	21
Grade	V

Method of treatment

The Patient took 4 sessions, 1 per week, of diamagnetic therapy that includes high-intensity pulsed electromagnetic fields (2.2 Tesla), pulsed at low frequencies (7hz), named CTU Mega 20, provided by PERISO SA – Pazzallo (Switzerland) (Figure 1).



Figure 1: Diamagnetic Pump-CTU Mega 20 Device.

Protocol used for facial palsy

The treatment was divided into 3 phases:

- A. Phase Pain Control: 5 minutes neuropathic pain setting, using a mid-energy value due to the pain referred to in the frontal muscle (frontalis muscle occipitofrontalis): VAS 4/10 on a visual analog scale.
- B. Second phase Endogenous Bio-Stimulation: 5 minutes "nerve fast" over the facial nerve of the right hemiface.
- C. 5 minutes "nerve slow" over the facial nerve of the right hemi-face.
- D. 5 minutes "skeletal muscle" over all the right hemiface muscles.
- E. Third phase movements of liquids: 5 minutes intracellular and 5 minutes extracellular.

For a global time of 25 minutes treatment. The Diamagnetic treatment has been applied in the extracranial area at the emergence of the facial nerve. 50% of the treatment time was addressed to the correspondence of the geniculate nerve ganglion and the remaining part was to treat the ophthalmic, maxillary, and mandibular areas working in static and dynamic modes, with different times.

Results

Muscle movement evaluation: fourth session (FNCS score) (Table 2).

Table 2: Pain, after the fourth session 1/10 according to the VAS score.

Brow	In total symmetry, the wrinkles are in the extension of those not only on the healthy side: 2 points
Eyes	The marked force that results in the appearance of a vertical wrinkle between the eyebrows: 1 point
Naso Labial Folder	Wrinkles on the eyelids: 2 points
Oral	The slight asymmetry of the contour of the nasogenian fold: 2 points
Secondary movements	Lip fold appearance: 1 point
Score	8
Grade	II

Discussion

Facial nerve palsy causes a lack of facial expression and loss of functional capacities, resulting in movement difficulties, visual impairments and oral incompetence. These limitations have a big impact on social life and the patients affected may experience anxiety and depression, also as a consequence of a decreased quality of life [15]. Early diagnosis and treatment are mandatory, also considering that a delay can affect the long-term results. Both surgical and non-surgical treatments are commonly performed. However, in the case of Bell's palsy, the nerve is anatomically intact and before surgery, a period of observation is recommended. It is not clear how long

this period should be, but generally, a lack of improvements after 6 months of observation predicts no satisfactory long-term recovery [16]. A recent Cochrane systematic review confirms that there is no certainty on surgical intervention within three months [17] and up to 85% of patients with Bell's palsy treated with placebo report a complete recovery within 1 year. Those with remaining facial weakness, especially of eyelid muscles, could be candidates for surgery.

According to the American Academy of Neurology (AAN), in the case of Bell's palsy, it is recommended with a level A the use of cortico-steroids within 72 hours of onset. The addition of antiviral drugs does not offer significant benefits, but some studies could not rule out a possible effect and, for this reason, in general practice antivirals are often used [18]. Non-surgical treatments of facial palsy also include specific rehabilitative therapy. It consists of 5 main components: patient education, soft tissue mobilization, functional retraining concerning oral abilities, facial expression and synkinesis management [19]. The role of physical therapy like brief electrical stimulation of facial muscles, low-level facial laser, gross facial exercises and tape feedback are still controversial [20]. To our knowledge, no author has ever investigated the efficacy of electromagnetic field stimulation for facial palsy recovery. However, there is proof of evidence on the effects of magnetic fields once applied for the treatment of peripheral neurological pathologies in force of re-generative and anti-inflammatory effects [21,22]. Moreover, in the past transcranial magnetic stimulation (TMS) and peripheral stimulation of cranial nerves were investigated as methods of functional assessment of the rapid conducting corticobulbar and corticospinal projections in brainstem lesions [23] as well as the excitation of cortico-facial fibers at the brainstem level and the TMS at the posterolateral scalp to stimulate the nerve at the facial canal region or the labyrinthine segment of the nerve [24]. This approach derives from positive results by stimulating cranial nerves in the course of neuropsychiatric disorders, including the triggering of neuronal plasticity and potentiating synaptic transmission [25].

The technology we employed in our experience is quite different from other types of nervous stimulation. Specifically, we used a pulsed high-intensity low-frequency electromagnetic field (PEMF) delivered by the Diamagnetic Pump device (CTU Mega 20). This technology allows a treatment called diamagnetic therapy, which is safe for the patient thanks to the low frequency of the magnetic field (<50 Hz) and belongs to the non-ionizing radiation class. On the other hand, the high intensity (up to 2 Tesla) guarantees a diamagnetic effect on the treated tissues, consisting of a repulsive action (movement) of the water, solutes, ions and molecules, able to improve the electrochemical changes at the cell membrane level that is at the origin of the biological response in the treated tissues [11]. The intrinsic frequency of the magnetic field is 7500Hz, and the duration of the pulses is 5ms with a period of 1000ms, a wide bandwidth of the electromagnetic frequencies guarantees the possibility to treat selectively in the same session nerves, muscle and bone [26]. In the neurological field, the technology has been analyzed in a randomized double-blind sham-controlled trial which has shown that the non-ionizing LF-PEMFs induced by the CTU Mega 20 cause

an increase of more than 60% in corticospinal excitability in healthy subjects [27], also showing behavioral changes and qualitative improvements in a case series of rare-orphan diseases [28].

Given the above-mentioned prerogatives of Diamagnetic therapy, characterized also by the possibility to modulate the rise time of the Magnetic Pulse, the amplitude and the bandwidth of the electro-magnetic frequencies, it was possible to treat selectively, the ganglion, the muscles and nerve fibers both in static and dynamic mode. In this way, the symptoms, the clinical evidence and the changes reported during the treatment addressed the machine's setting. We started to modulate in order: the referred pain in the frontal region (VAS 4/10 at the beginning), the course of the facial nerve using selected frequencies for fast and slow nerve fibers, for muscles and to promote the extra and intracellular movement of liquids, ions and molecules. 50% of the treatment time was addressed to the correspondence of the geniculate nerve ganglion and the remaining part was to treat the ophthalmic, maxillary and mandibular areas working in static and dynamic mode, but not in the equivalent distribution of the time between the three branches of the facial nerve. This is due to the greater suffering of the mandibular branch. These positive effects would be related to the modulation of the inflammatory edema and the swelling that normally lead to nerve compression, given the repulsive effect on liquids induced by the high-intensity magnetic field [27], together with the selected stimulation of the nerve fibers.

We are aware of the weakness of a single case report without an equivalent case control but, as often happens, a single clinical report acts as a driving force for further studies with a suitable statistical sample and in a randomized and controlled form. Anyway, the results underline the fast efficacy of the treatment after four weekly sessions, as shown by the changes in the functional Facial Nerve Grading System (from Grade V to Grade II) and the fast recovery in pain (VAS 4/10 to 1/10). These last states a difference > of 2 points and, consequently, higher respect to the MCID (Minimally Clinically Important Difference).

Conclusion

Diamagnetic Therapy is a versatile ready-to-use technology that, according to the PEMF prerogatives allows, in an original way, effective and selected treatments in the different tissues including the nervous system. Further studies are necessary to valorize the results of our experience, and to exploit the therapy in other pathological conditions of the nerves. Moreover, this innovative technology may be tested for the release of heat from the low frequency high-intensity magnetic field, since heat may inactivate the heat shock gene Sirtuin 1 which is critical for neuroplasticity and neural stem cell regeneration [29,30], also considering that this is controversial with the absence of thermal effects observed, in terms of HSP90 expression, in different cell experimental settings employing Low-Frequency Magnetic Field (< 50Hz) [31].

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