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# DEEP OSCILLATION® THERAPY - CAN IT BE EFFECTIVE IN PATIENTS WITH COVID-19 AND POST - COVID SYNDROME

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**Abstract:** Treatment of patients with COVID-19, prevention of respiratory and other affected systems complications, prevention of multisystem damage and faster recovery possibilities and disease consequences overcoming is a particularly relevant topic today, when the number of people who have suffered from acute coronavirus infection is increasing. A tendency to shift the focus from acute manifestations to long-term morbidity and chronic involvement of various organs and systems is observed. In these subacute and chronic phases of illness, the application of physical modalities would be potentially effective. Traditionally, physical and rehabilitation medicine deals with patients with combined pathologies in order to reduce the duration of treatment and to speed up after-illness recovery. Deep Oscillation® therapy is a relatively new physical modality that is successfully applied to a number of diseases, including inflammatory pathologies of respiratory and musculoskeletal system, trauma, burns, fibrosis prevention, edema reduction, muscle relaxation etc. The purpose of this article is to make a review of the potential therapeutic effects of the Deep Oscillation® therapy application to patients suffering from COVID-19 and/or post-COVID-19 syndrome. Materials and methods: A review of the available literature was performed, including reports, articles, feedback letters regarding the application of Deep Oscillation® therapy. The search for scientific articles was conducted in the bibliographic database of Pub Med, Google Scholar, Elsevier. Results matching the following keywords were searched: Deep Oscillation® therapy, low-frequency and low-intensity electrostatic field, COVID-19, COVID-pneumonia, post-COVID-19 syndrome, long COVID, post-acute sequelae of SARS-CoV-2 infection, chronic COVID syndrome, diseases of the respiratory system, pneumonia, obstructive bronchitis, asthma, edema, lymphedema, musculoskeletal symptoms after COVID-19, chronic pain, myalgia, arthralgia, chronic back pain, fatigue. Results: The review made found evidence regarding the anti-inflammatory, anti-edematous, pain-reducing, and anti-fibrotic effects observed with the application of Deep Oscillation® in various diseases, including such of lungs. At this time, no research data were found regarding the application of Deep Oscillation® in patients with COVID-19 or after illness except for a brief communication in the form of a feedback letter regarding the therapy application in individual clinical cases of patients with COVID -19. Conclusion: The scientific studies carried out so far testify of established anti-inflammatory, -swelling and pain-reducing effects, fibrosis reduction possibilities, muscle spasm reduction, local microcirculation improvement and anti-lymphedematous effects of Deep Oscillation® application in various diseases, including lung diseases. These data suggest that a possible positive effect of the low-frequency electrostatic field can also be assumed in patients with COVID-19. Now, however, there are no clinical studies conducted about the Deep Oscillation® application effect in patients with COVID-19 and post COVID-19. Low-frequency electrostatic field therapy is probably an appropriate adjuvant therapy but cannot be recommended as a therapeutic modality in daily clinical practice in patients with COVID-19 due to the lack of reported therapeutic benefits in scientific reports. In the presence of convincing scientific evidence, this opinion is subject to correction. At the same time, it would be appropriate to determine the benefit of this therapy in post-COVID-19 recovery and persistent arthralgia and musculoskeletal symptoms.

Keywords: *Deep Oscillation® therapy, low-frequency and low-intensity electrostatic field, COVID-19, post-COVID-19 syndrome, post-COVID rehabilitation.*

*Field: Medical sciences and Health*

## INTRODUCTION

Treatment of patients with COVID-19 (Song et al. (2020); Jean et al. (2020); Elkhatib et al. (2022); Niknam et al. (2022)), prevention of respiratory and other affected systems complications, due to the multisystem damage (Barker-Davies et al. (2020); Zhang al.( 2020); Wang al. (2020); Shi et al. (2020)) and the possibilities for faster recovery (Asly & Hazim (2020)) and disease consequences overcoming is a particularly relevant topic today, when the number of people who have suffered from acute coronavirus infection is increasing. A tendency to shift the focus from acute manifestations to long-term morbidity and chronic involvement of various organs and systems is observed. (Lauwers et al. (2022)) In these subacute

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and chronic phases of the illness, the application of physical modalities would be potentially effective. Traditionally, physical and rehabilitation medicine deals with patients with combined pathologies in order to reduce the treatment duration and to speed up after-illness recovery. Deep Oscillation® therapy is a relatively new physical modality. It is based on the Johnsen-Rahbek effect, expressing the force of attraction between the contact materials as a function of the voltage applied between them. When an electric potential is applied between a metal surface and a semiconductor material in biological tissues, forces of electrostatic attraction and relaxation are created, and a soft-acting oscillation occurs in depth, which covers all tissues. (Locheva et al. (1019)) Deep Oscillation® therapy is a patented method, based on low-frequency variable electrostatic field. As a result of its application in depth of the treated area, a vibration of the affected area tissues occurs. (Zehtindjieva et al (2013); Kulikov A.G. et al. (2019)) According to the data from previous studies, the clinical effects include: analgesia in acute and chronic pain of different etiology (Jahr S. et al. (2008); Aliyev R. (2009); Fistetto G. et al. (2011); Hernández Tápanes. S. (2012); Hernández Tápanes S. et al. (2018): Kraft K. et al. (2013); Reinhold J. et al. (2014); O'Brien C.P. & Watson A. (2016); Vladeva E. et al. (2021)) anti-inflammatory effect; Boisnic S. & Branchet MC (2013)) primary or secondary lymphedema reduction (Mikhalchik E. et al. (2005); Jahr S. et al. (2008); Fistetto. G. et al. (2011). Teo I. et al. (2016)) prevention in the process of fibrous remodeling, fibrosis reduction, (Gao Y.C. et al. (2015); Hernandez. Solangel et al. (2018); Gasbarro V. et al. (2006)) muscle relaxation and fascial mobilization, range of motion improvement, (Jahr. S. et al. (2008); Hernández Tápanes. S. et al. (2012); Aliyev R. et al. (2008); Hinman MR. et al. (2013) Winkelmann Z.K. et al. (2018)) supporting the wound healing process, (Mikhalchik E. et al. (2005); Trybulsky. R. (2008); Reinhold J. et al. (2014)) accelerating recovery after exercise, decongestion, and functional improvement in obstructive pulmonary conditions (Reinhold J. (2017)).

The vibration generated in the tissues by the electrostatic field is of low frequency 5 to 250 Hz and with a small current amperage of 5–7 μA. The pulses are biphasic, in which no electrolysis is observed. The frequency of vibration also determines the physiological effect of Deep Oscillation® therapy (Kulikov A.G. et al. (2019)).

Deep Oscillation® therapy is administered through two main methods. The first uses a manual applicator (oscillating head). The second is performed by the therapist's hands in vinyl gloves, applying basic massage techniques. The patient and the therapist are under the influence of the electrostatic field and the main contraindications apply to both. Treatment duration is from 5 to 15 procedures, prescribed daily or every other day. The therapy can be combined with thermotherapy, cryotherapy, balneotherapy, other electro procedures and kinesitherapy. Several modalities are combined in one procedure depending on the phase of the disease.

Deep Oscillation® therapy is suitable for diseases of the musculoskeletal system of a traumatic, degenerative and inflammatory pattern (Kulchitskaya et al. (2019); Vakhova et al. (2022)), post bone fractures, in surgical practice (Kulchitskaya D.B. et al. (2020), during osteotomy, joint alloplastic, prevention of decubitus (Li A.A. et al. (2009); Khodyreva et al. (2012); Vladeva et al. (2021)) diseases of the peripheral nervous system - dorsopathies (Valeyev & Minenko (2010)) central nervous system - consequences of vascular and traumatic damage of brain and spinal cord, multiple sclerosis, migraine (Kulikov et al. (2019)), diseases of the cardiovascular system - hypertensive disease, chronic venous and lymphatic insufficiency, lymphedema (Abramovich et al. (2006)), diseases of the respiratory system: bronchial asthma, COPD, chronic bronchitis, pneumonia, cystic fibrosis. (Afanasyeva (2004); Yashkov et al. (2007)) Diseases of the digestive system (Timofeeva & Korchazhkina(2008)) in inflammatory ENT diseases - chronic sinusitis, laryngitis (Kulikov et al. (2019)), in kidney stone disease after extracorporeal lithotripsy, chronic prostatitis (Li A.L. & Li K.E. (2009)), in treatment of wounds and burns (Trubulski (2009); Kulikov et al. (2019)).

The advantages of the Deep Oscillation® therapy include the possibility of application, both in acute and chronic pain syndromes of musculoskeletal system, nervous system, in acute trauma and post-operative conditions, sports injuries and pain from muscle overstrain, effective prophylaxis against thrombotic conditions, shortens recovery period and reduces hospitalization time, accelerates lymphatic outflow, suitable for lymphatic drainage due to the precise adaptation to the tissue condition. Relaxing therapy for muscles with increased tone, comfortable and easy to apply therapy, without unpleasant sensations for the patient. Adverse reactions observed in Deep Oscillation® therapy application include: sharp pain sensations in the treatment area, increased sensitivity when urinating, signs of fatigue to exhaustion, increased local temperature and hypotonia.

The purpose of this article is to make a review of the potential therapeutic effects of the Deep Oscillation® therapy application to patients suffering from COVID-19 and/or post-COVID-19 syndrome.

## MATERIALS AND METHODS

A review of the available literature was performed, including reports, articles, feedback letters, randomized trials, testimonials, clinical trials, reports, guidelines, letters to the editor in English regarding the application of Deep Oscillation® therapy in various disabilities and in particular in diseases of the respiratory system. The search for scientific articles was conducted in the bibliographic database of PubMed, Google Scholar, Elsevier. Results matching the following keywords were searched: Deep Oscillation® therapy, low-frequency and low-intensity electrostatic field, COVID-19, COVID-pneumonia, post-COVID-19 syndrome, long COVID, post-acute sequelae of SARS-CoV-2 infection, chronic COVID syndrome, diseases of the respiratory system, pneumonia, obstructive bronchitis, asthma, edema, lymphedema, musculoskeletal symptoms after COVID-19, chronic pain, myalgia, arthralgia, chronic back pain, fatigue. The review examines the results meeting the above listed search criteria published in the period until October 30, 2022.

## RESULTS

The review made found evidence regarding the anti-inflammatory, anti-edematous, pain-reducing, and anti-fibrotic effects observed with the application of Deep Oscillation® in various diseases, including such of lungs. At this time, no research data were found regarding the application of Deep Oscillation® in patients with COVID-19 or after illness except for a brief communication in the form of a feedback letter regarding the therapy application in individual clinical cases of patients with COVID -19.

## DISCUSSIONS

Treating patients with COVID-19 was a real challenge at the beginning of the pandemic. Today, the problems related to faster recovery and return to pre-morbid activity of the patients, which are increasing worldwide, are coming to the fore. The question of the application of physical modalities in patients with and after COVID-19 is topical among Physical Medicine specialists. Although physical modalities including electrotherapy, light therapy, photo biomodulation are considered adjuvant therapy, they could provide a number of benefits in the treatment and rehabilitation of patients affected by COVID-19.

There are a few scientific publications describing the therapeutic effects of the Deep Oscillation® application in diseases, including the respiratory system (Kulikov et al., 2019). In a study on the effectiveness of the low-frequency electrostatic field in Chronic Obstructive Pulmonary Disease, the authors observed a positive effect, which was expressed in the optimization of central hemodynamics, bronchial patency improvement and disease progression slowing. In the studied patients, a decrease in the main clinical manifestations of the disease was observed, including cough, shortness of breath, sputum discharge, improvement of psycho-emotional tone and normalization of sleep. (Yashkov et al. (2007)). The application is carried out with special gloves, (80–100 Hz, 20 minutes, 20–30 Hz, intensity 60%), procedures are applied daily, 8-10 in a course) (Kulikov et al., 2019).

The low-frequency electrostatic field applied to patients with cystic fibrosis allows to increase the effectiveness of the complex therapy. A series of therapeutic effects have been reported in children with fibrocystic lung disease, in which improvement in clinical symptoms, drainage and evacuation function of the bronchi, improvement and increase in indicators of external respiration, saturation registered by pulse oximetry are observed. A specific methodology was developed according to Cherkashina and Nikitin, which includes a frequency of 40–80 Hz, and then without interruption with a frequency of 20–30 Hz on the chest - front, sides and back, and the duration of the procedure is dosed according to the age of the patient. The procedures are carried out daily, the course of treatment is 10-12 procedures (Kulikov et al., 2019).

Khan et al. (2015) reported good therapeutic effects achieved with the application of a low-frequency electrostatic field in children with bronchial asthma. They report a positive effect on the dynamics of the clinical symptoms of the disease, reduction in the frequency of asthmatic attacks, improvement in expectoration and normalization of auscultatory findings. The authors reported improvement in external breathing, respiratory excursion of the chest, and general physical condition. The impact is carried out according to the methodology with special vinyl gloves in the form of stroking the intercostal spaces of the front and back surface of the chest (100 Hz, when treating the front surface of the chest and successively 100 and 60Hz for the back surface, the duration depends on the age of the patient 8-12 minutes, daily,

10-12 in a course) (Khan et al., 2015).

In another study, Mikhalchik et al. (2005) reported the ability of a low-frequency electrostatic field to reduce both local lung inflammation and redox imbalance induced by quartz in the lungs of experimental animals. The authors observed a decrease in neutrophil content, protein level and glutathione peroxidase (GPx) activity in bronchoalveolar lavage fluid, as well as an increase in the concentration of the reduced form of glutathione (GSH) in lung tissue (Mikhalchik et al., 2005). According to Rahman & MacNee (2000) inflammatory lung diseases are characterized by chronic inflammation and oxidant/antioxidant imbalance, a major cause of cell damage. The development of an oxidant/antioxidant imbalance in lung inflammation can activate redox-sensitive transcription factors such as nuclear factor-KB and activator protein-1(AP-1), which regulate proinflammatory mediator genes and protective antioxidant genes (Rahman & MacNee (2000). At the same time, the low-frequency electrostatic field (applied through a device HIVAMAT®) does not affect the generalized oxidative stress in the blood and can be recommended for the treatment of acute lung inflammation of various origins in combination with conventional therapies (Mikhalchik et al., 2005).

Low-frequency electrostatic field therapy is applied to patients with mild and moderate forms of pneumonia in the absence of severe concomitant pathology and can be part of the complex treatment program (Afanasyeva, 2004). The methodology begins to be applied on the 2nd/3rd day after the disappearance of the symptoms of intoxication in patients with pneumonia and body temperature up to 37.4C° on the background of antibiotic therapy. The inclusion of this method in the program of complex treatment of pneumonia significantly reduces the time for the disappearance of clinical, radiological and laboratory indicators of inflammation, improves central hemodynamics and respiratory function of the lungs. The procedure is performed with the patient lying down, the main manual massage techniques are used, except for the vibrations at the frequency of 100 Hz, the intensity is 60%, the duration is 15-20 minutes, daily, 10-12 sessions (Kulikov et al., 2019).

Based on the available information from the conducted scientific studies regarding the anti-inflammatory, anti-edematous, pain-reducing, and anti-fibrotic effects observed post Deep Oscillation® application in various diseases, including of the lungs, it can be assumed that the low-frequency electrostatic field is probably effective in patients with Covid-19. To date, no data was found of scientific studies on this issue. The review of the literature regarding the physical factors' application in patients with coronavirus infection and in post-Covid patients during recovery phase reports of Deep Oscillation® application in individual clinical cases were found. Based on information from the clinical experience of Esposito F. & Braum S., Hospital Havelhöhe, Berlin, Germany and the reported three clinical cases (22.04.2020 to 30.05.2020) sharing their experience of Deep Oscillation® application in patients with COVID-19 pneumonia and pulmonary edema, information about the possible therapeutic effects of the method can be obtained. Side effects or patient's condition worsening are not reported. The benefits reported are as follows: activation or facilitation of mucolytic effect/expectoration, respiratory muscles relaxation, respiratory function, and general condition improvement (Feedback from Hospital Havelhöhe). The developed protocols recommended in patients with COVID-19 to be treated the thorax with variable frequency 40-80Hz, 20min., and 20-30Hz, 5 min., twice a day at 50% intensity; in patients with pneumonia, a treatment of the affected segments with a variable frequency of 40-80Hz, 10 min, while changing the position every 5min. at 50% intensity; in patients with cystic fibrosis - constant frequency 25Hz, 10min., 45Hz, 10 min., 100Hz, 10min., with 50% intensity, once or twice daily. The suggested therapeutic frequencies were developed based on previous experience with Deep Oscillation® therapy in patients with lung pathology: pneumonia, bronchial asthma, chronic obstructive pulmonary disease, (Yashkov et al. (2007); Khan et al. (2012); Verster J. (2014) Khan et al. (2015)) in which: mucolytic effect, expectoration is facilitated, interstitial drainage and pulmonary lymph activity increased, respiratory muscles relax, ventilation improves, adhesiolysis (reduction of fibrous adhesion in the lungs/chest wall).

## CONCLUSIONS

The scientific studies carried out so far testify of established anti-inflammatory, -swelling and pain-reducing effects, fibrosis reduction possibilities, muscle spasm reduction, local microcirculation improvement and anti-lymphedematous effects of Deep Oscillation® application in various diseases, including lung diseases. These data suggest that a possible positive effect of the low-frequency electrostatic field can also be assumed in patients with COVID-19. Now, however, there are no clinical studies conducted about the Deep Oscillation® application effect in patients with COVID-19 and post COVID-19. Low-frequency electrostatic field therapy is probably an appropriate adjuvant therapy but cannot be recommended as

a therapeutic modality in daily clinical practice in patients with COVID-19 due to the lack of reported therapeutic benefits in scientific reports. In the presence of convincing scientific evidence, this opinion is subject to correction. At the same time, it would be appropriate to determine the benefit of this therapy in post-COVID-19 recovery and persistent arthralgia and musculoskeletal symptoms.

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