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## APPLICATION OF DEEP OSCILLATION THERAPY IN PATIENTS WITH CERVICAL OSTEOCHONDROSIS: A PILOT STUDY

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**Abstract:** The aim of this clinical study is to evaluate the effect of the application of low-frequency electrostatic field /Deep Oscillation®/ in combination with Transcutaneous Electrical Nerve Stimulation /TENS/ and Kinesiotherapy, and to compare it to the effectiveness of a common physical therapy program applied to patients with cervical spondylosis. The short- and long-term effects of the applied therapy regarding the neck pain and the quality of life of the affected individuals are assessed. 60 patients with cervical spondylosis were included in the study, randomly divided into three equal groups. The patients were treated with different rehabilitation methods divided in three programs, for 10 days. Therapeutic group "A" received the combination of Deep Oscillation, TENS and Kinesiotherapy. The therapy of group "B" included Phonophoresis with non-steroidal anti-inflammatory gel /PP/, TENS and Kinesiotherapy, group "C" received therapy with placebo Deep Oscillation, TENS and Kinesiotherapy. The following parameters were used to monitor the treatment effect: static and dynamic pain assessed by VAS, and measuring the self-rated disability due to neck pain by NDI questionnaire. The assessment was carried out in three stages: on the 1st day (before the start of therapy), the 10th day (after the end of treatment) and the 45th day after the start of therapy. In the analysis of the obtained results regarding the VAS values at rest, it was found that after the end of the therapeutic course there was a statistically significant difference ( $F=8.028$ ;  $Sig.=0.001$ ), demonstrating the better results of group "A" compared to the other two monitored groups. The results from the other parameters used, considering the dynamic pain according to VAS and the disability due to neck pain evaluated by NDI test, are similar. This trend remains unchanged in time and is identical to the results of the next control carried out on the 45th day. The results of group "B" show improvement compared to group "C", despite the fact that the comparative analysis of the results of all the studied parameters does not show a statistically significant difference. The analysis found that the therapeutic approach consisting of these physical factors, including Deep Oscillation has a more pronounced analgesic effect and reduces functional disorders to a greater extent, compared to common physical therapy programs, applied to patients with cervical spondylosis. For a more precise assessment of the therapeutic effect of our proposed physiotherapy program including a low-frequency alternating electrostatic field, research needs to be expanded.

**Keywords:** deep oscillation, neck, pain, disability.

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**Summary:** The aim of this clinical study was to investigate the effect of low-frequency alternating electrostatic field /Deep Oscillation/ in combination with transcutaneous electrical nerve stimulation /TENS/ and kinesiotherapy /CT/ and to compare it with the effectiveness of routine physical therapy in patients with cervical osteochondrosis. The short- and long-term effects of the applied therapy on the neck pain and quality of life of the affected individuals were monitored. Sixty patients with cervical osteochondrosis were included in the study and randomly assigned to three equal groups.

Patients underwent treatment with three different rehabilitation programs for 10 days. The combination of Deep Oscillation /DO/, TENS and CT was applied to group "A". The therapy of group "B" included - phonophoresis with non-steroidal anti-inflammatory gel /FF/, TENS and CT, and group "C" - placebo Deep Oscillation, TENS and CT. The following parameters were used to monitor the effect of treatment: static and dynamic pain scores on the BAC, and quality of life assessment of neck pain using the NDI questionnaire at three time points: day 1 (before therapy initiation), day 10 (after treatment completion), and day 45 after therapy initiation. ANOVA test and Tukey's post hoc test (Tukey) were applied to statistically process the results. In the analysis of the obtained results concerning the values of BAC at rest, it was found that after the completion of the therapeutic course there was a statistically significant difference ( $F=8.028$ ;  $Sig.=0.001$ ) demonstrating the superiority of group „A" compared to the other two follow-up groups. The results of the other parameters used reporting dynamic pain on the BAC and quality of life in neck pain were similar. This trend is maintained when the results are reported at the next time point. Although, in the comparative analysis of the results of all parameters studied between group "B" and group "C", no statistically significant difference was reported, the results of group "B" had superiority. The performed analysis revealed that the therapeutic complex of physical factors including Deep Oscillation has a more pronounced analgesic effect and reduces functional disorders to a greater extent, compared to routine physical therapy applied to patients with cervical osteochondrosis. For a more precise evaluation of the therapeutic effect of our proposed physiotherapy program including low frequency alternating electrostatic field, research should be continued.

**Key words:** deep oscillation, neck, pain, quality of life

## 1. INTRODUCTION

Neck pain is the second most common musculoskeletal-related complaint of patients (Hoy et al., 2010). Each year, 10.4% to 21.3% of the world's population experiences neck pain (Côté et al., 2004; Croft et al., 2001; Feldman et al., 2002; Ståhl et al., 2004). One of the leading causes of neck pain is cervical osteochondrosis (Kuo & Tadi, 2021). Osteochondrosis represents degeneration of the intervertebral discs with concomitant changes in the vertebral bodies, such as osteosclerosis, Schmorl nodules, cysts and the presence of osteophytes of various sizes (Breitenseer et al., 2020). The alterations seen in the disease result in a change in the loading forces on the spine when performing its motor and support function. Together with this, the discs lose their sacred springing function and transfer the load to the facet joints and vertebral bodies. This type of pathology is generally age-related, but is increasingly seen in the younger population in the presence of certain encumbering factors (Jankovic et al., 2021; Scott & Kerr, 2006; Smith et al., 2011). 50% of people over the age of 40 have radiographic evidence of cervical osteochondrosis (Safiri et al., 2020). In addition to natural aging, other factors that contribute to the early debut of the disease include chronic overuse, prolonged standing in an awkward posture, spinal curvatures, immobilization, hormonal disorders, metabolic disorders, genetic factors, spinal trauma, spinal surgery, infections, etc. It is because of this that cervical osteochondrosis is more prevalent in occupations involving static and dynamic loading of the neck, such as computer, administrative and health care workers, municipal employees, and professional drivers, and the female sex is more affected than the male sex, with a prevalence of 27.2% in females versus 17.4% in males (Hoy et al., 2010). Multiple studies have shown that neck pain increases with advancing age and peaks in the 35-49 age group, and that it is increasingly associated with degenerative changes (Manchikanti et al., 2009). Neck pain impairs the work capacity and quality of life of affected individuals. Persistence and recurrence of symptoms from the disease do not have a favorable prognosis in inadequately treated patients. These factors concerning cervical osteochondrosis result in direct and indirect financial and societal costs of enormous magnitude (Clifford et al., 2014). Treatment is primarily conservative, which includes medical and/or physical therapy, and surgical for advanced degenerative process and difficult to respond symptomatology (Peng & DePalma, 2018). More and more patients are turning to physical medicine for treatment and prevention in this pathology, as they prefer not to be burdened with medications that have many side effects on the one hand, and on the other hand physical methods have proven their therapeutic capabilities in such pathology, as long as they are applied in time. This provoked our interest to investigate and evaluate the therapeutic effectiveness of a relatively new modality in physical practice, such as low-frequency impedance electrostatic field (Deep Oscillation), which has not been applied for therapy in this type of

pathology. This method is based on the Johnson-Rahbek effect and induces a low-intensity, low-frequency electrostatic field that has modulation capabilities. The therapy has trophic, antiinflammatory and antifibrotic effects. It has a positive effect on local haemodynamics and lymphodynamics, stimulates microcirculation and improves functional tissue regeneration, resulting in positive effects on pain sensations (Fistetto et al., 2011).

The aim of this study was to determine the effect of Deep Oscillation (DO), in combination with Transcutaneous Electrical Nerve Stimulation (TENS) and Kinesitherapy (KT), compared to conventional physical therapy represented by TENS, phonophoresis with non-steroidal anti-inflammatory gel (AF) and kinesitherapy.

## 2. MATERIALS AND METHODS

A randomized, prospective, controlled study was conducted at the Clinic of Physical and Rehabilitation Medicine and the Department of Rehabilitation at St. The study was carried out in a clinical trial. Varna. Patients were recruited on routine admission to the therapeutic unit. Their inclusion in the study was performed after signing an informed consent for the processing of their personal data and consent to participate in the study. Patient recruitment started after obtaining permission from KENI at MU-Varna. Patients had to meet the inclusion and exclusion criteria of the study and have a diagnosis of cervical osteochondrosis confirmed by imaging. After selection, patients were divided into three equal groups of 20. Participants were randomly assigned to three groups: group A, group B, or group C. All patients in all three groups were administered TENS with 80-140 Hz parameters for 15 minutes and a kinesiotherapy complex of exercises aimed at preserving and increasing the range of motion in the cervical spine in a 10-day therapeutic course. In group "A", a treatment with low frequency pulsed electrostatic field (Deep Oscillation) with parameters 160-180Hz with duration of 10 min was added, followed by 85 Hz with duration of 5 min. Patients in group "C" were given a "placebo" Deep Oscillation procedure. In group "B", ultrasound in the form of phonophoresis with NSAIDs was applied as an additional procedure. Static and dynamic pain was assessed by BAC to determine the treatment effect (BAC score is expressed in centimeters from 0 to 10, 0 = no pain, 10 = intolerable pain). Quality of life in neck pain was also assessed, as measured by the Neck Disability Index (NDI) questionnaire, which included 10 questions about neck pain and its impact on the patient's performance of activities of daily living. The patient's condition was assessed in all three treatment groups on day 1 before the start of the treatment course, on day 10 after the end of the treatment course and on day 45 after the start of the treatment course, respectively. Statistical methods were used to process the outcome data.

## 3. RESULTS

Sixty patients with cervical osteochondrosis between the ages of 18 and 55 participated in the study. Participants were from different social groups - students, workers, unemployed, athletes. Of the workers, there were representatives performing different types of work activity - static, dynamic and those doing heavy physical work. Patients were randomly assigned to three equal groups with equal number of participants. The mean age of the patients was 39.52 years. The male and female representatives were 42% and 58%, respectively. Patients aged less than 45 years were predominant as they constituted 68% and those above 45 years were 32%. At the time of treatment, no side effects were observed on the part of the patients.

For the purpose of the study, the following parameters were monitored: pain at rest measured by the application of the Visual Analogue Scale (VAS), pain on movement - dynamic pain measured by the VAS. Quality of life in neck pain was assessed using the Neck Disability Index (NDI) questionnaire.

When the results were reported, all three follow-up groups showed a decrease in static pain as measured by VAS. In order to compare all the follow-up groups against each other, a statistical test for analysis of variance applied to analyze the difference between the means of more than two groups, ANOVA, was used. Due to the randomization of the groups, there was no statistically significant difference for the value of the three indicators, between the three groups at the beginning of the study (group "A"- group "B", group "B"- group "C" and group "A"- group "C")(F=0.608, Sig.=0.548; F=0.778, Sig.=0.464; F=2.598, Sig.=0.083).

After the completion of the treatment course on day 10, a statistically significant difference (F=8.028; Sig.=0.001) was found regarding the value of the static pain indicator in the comparison made between the three

groups. Tukey's post-hoc test was used, which showed that the arithmetic mean of the BAC for static pain for group "A" (M=2.060) was statistically significant when compared with the arithmetic means of both group "B" (M=2.83) and group "C" (M=3.315). In the comparisons made between the arithmetic mean of BAC between group "B" (M=2.83) and group "C" (M=3,315) no statistically significant difference was found.

The results of the study proved that the application of the complex methodology of Deep Oscillation, TENS and kinesitherapy is more effective than the classical approach in terms of the possibility of reducing pain complaints. On day 45 of the treatment, there was also a statistically significant difference (F=12.976; Sig.<0.000) regarding the value of the BAC index at rest in group "A" (M=1.365), when compared with group "C" (M=3.115), and between group "A" (M=1.365) with group "B" (M=2.245). Although the arithmetic mean of the BAC at rest for group "B" (M=2,245) was not statistically significantly different relative to group "C" (M=3,115), their comparison showed a greater improvement in static pain for group "B" relative to group "C" (Fig. 1).

**Fig. 1. Static pain in the neck**

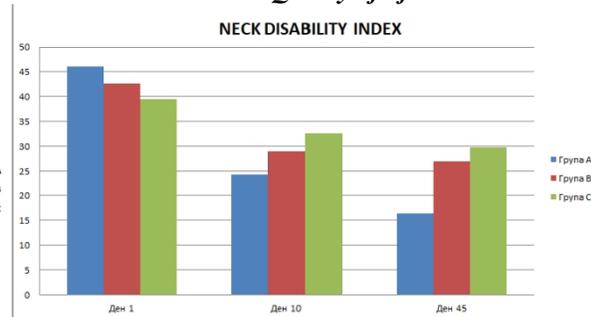


Considering the other two indicators, dynamic pain assessed by the VAS and the quality of life questionnaire for neck pain (NDI), similar results were reported at all three time points. (Figs. 2 and 3) The other two therapeutic approaches applied to group "B" and "C" both showed improvement, but the results obtained by the treatment method applied to group "A" outperformed them. (Sig.< 0.05)

**Fig. 2. Dynamic pain Fig**



**. 3. Quality of life**



#### 4. DISCUSSION

In our randomized trial, the therapeutic efficacy of three complexes of physical factors was investigated in patients with cervical osteochondrosis.

The results obtained in group „B" are similar to the results of Yesil et al. who also conducted therapy with TENS and CT aimed at influencing pain symptomatology in the neck (Yesil et al., 2017). Regarding changes related to improved quality of life in patients with neck pain treated with ultrasound therapy, CT and TENS, our results are similar to those obtained in the study conducted by Yilmaz et al. in 2020 (Yilmaz et al., 2020).

In our study, we applied a complex methodology, including three physical factors DO, TENS and CT, and the obtained results show that Deep Oscillation builds on and complements the therapeutic effect of the proven in practice combination of TENS and CT, and even outperforms the other complex methodology including phonophoresis, TENS and CT. The results obtained from our study demonstrate a better impact on all monitored parameters in group "A", both at the end of the therapeutic course and on the 45th day after the start of therapy. This leads to the conclusion that our proposed methodology including Deep Oscillation, TENS and CT has a better effect in terms of reduction of pain complaints and improvement of quality of life in cervical spine pain due to cervical osteochondrosis.

## 5. CONCLUSION

In our study, we found therapeutic efficacy in all three treatment groups. However, the best results in terms of change in quality of life, static and dynamic pain in patients with cervical osteochondrosis were achieved with the complex methodology including Deep Oscillation. For a more precise evaluation of the therapeutic effect of our proposed physiotherapy program including low frequency alternating electrostatic field, research should be continued with inclusion of a larger number of patients.

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