

Combining targeted IASTM applications and neuromuscular exercises can correct forward head posture and improve functionality of patients with mechanical neck pain: a randomized control study

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Abstract

Background The purpose of this study was to evaluate the short- and long-term effects of the combined application of instrument-assisted soft tissue mobilization (IASTM) techniques, and neuromuscular exercises of the cervical and thoracic area on the improvement of the functionality of patients with mechanical neck pain and accompanying forward head posture (FHP). **Methods** Twenty patients with neck pain and FHP were randomized and received eight treatment sessions of either targeted IASTM in combination with neuromuscular exercises (Group A), or classical massage and the same set of exercises (Group B). The cervical vertebral angle, cervical range of motion (ROM) and strength, and pain and disability were measured throughout the treatment period and in the two and four week post-treatment period. **Results** The combined application of IASTM and neuromuscular exercise (Group A) contributed to a significant improvement in FHP and disability. Both interventions improved cervical ROM and strength in the short term. Pain was also improved for both groups in both short and long term. **Conclusions** Combining IASTM and exercises for the cervical and thoracic area can induce positive postural adaptations and improve the neck pain patient's functional status. Registration number ISRCTN54231174

Background

Cervical pain syndrome is a pathological manifestation with a high epidemiological incidence rate [1,2] resulting from many aetiological factors. These include muscle strains or ligament sprains and pathological adaptations of the cervical soft-tissues, arthropathies, disc pathologies and poor posture [3]. Of the above aetiological factors, postural pathological adaptations of the human body have been particularly associated with the creation of stress and pain conditions in the cervical region. Epidemiological studies have shown that poor posture and poor neck control occur almost from puberty, with forward head posture (FHP) and rounded shoulders recorded as the most common orthostatic deviations of the neck and shoulder zone [4,5].

Several treatment techniques and methods are used to rehabilitate pathologies of the cervical and thoracic spine, including manual therapy, massage, stretching, soft-tissue techniques and therapeutic exercise[5,6]. Manual therapy includes hands-on therapy techniques, such as soft tissue mobilization and massage techniques, as well as techniques using therapeutic equipment, such as stainless steel tools that allow clinical therapists to identify and treat soft tissue dysfunctions [7,8]. Therapeutic exercise in the form of neuromuscular retraining is also one of the most important therapeutic interventions for the treatment of cervical pain, as it can improve the mobility of structures, increase muscle strength and tensile strength of ligaments and prevent tendon injuries [9,10].

Despite the above positive physical adaptations observed after the application of soft tissue techniques and therapeutic exercise, there is so far no research that has evaluated the effort to correct the overall posture of the human body (cervical, thoracic and lumbar spine) using these two therapeutic approaches. This scientific deficit is particularly important considering that pathological posture syndromes, such as the FHP, are accompanied or caused by other pathological adjustments of the body, such as rounded shoulders, chest kyphosis, and anterior pelvis shift[11,12].

In the context of this above research deficit, the main objective of this research is the comparative evaluation of the short- and long-term effects of a possible postural correction of the body in patients with cervical syndrome and co-existing pathological physical adaptations. In particular, the main objective of this research was to assess the possible positive effect of the combined application of soft tissue techniques of the cervical and thoracic spine and of a therapeutic exercise program for the neuromuscular strengthening of specific anatomical areas in the biomechanical correction of the body and in the improvement of the functionality of patients with mechanical neck pain syndrome and accompanying FHP.

Methods

Participants

The research sample consisted of 20 female adult patients, aged 43–65 years, weighing 51–73 kg with a height of 1.56–1.75 m, with a diagnosis of mechanical neck pain syndrome and accompanying pathological adjustments of the body, such as the FHP. All patients were informed of the objectives of the research, the days of measurements and therapies, and subsequently signed written consent of voluntary participation in the measurements. The study adhered to CONSORT guidelines and was approved by the Institutional Review Board approval of the Physical Therapy department at the University of Patras. Based on the desired power level of 0.80 for both bivariate comparisons and repeated measure ANOVA, and by using the G-power software [13], the sample size was estimated to be 18. The inclusion criteria included patients with a diagnosis of mechanical neck syndrome from a medical orthopedic doctor and pain symptoms lasting over three months (including headaches) accompanied by the FHP at an angle of $<50^\circ$. The exclusion criteria consisted of patients with little or no anterior head projection ($<50\text{o}$) and patients with minor neck injuries, intervertebral disc hernias, spondylolisthesis, accompanying neurological, musculoskeletal and mental problems, and patients under medication.

The patients were randomly divided into two groups using an online random generator(<https://www.randomizer.org/>), receiving either targeted IASTM Techniques and neuromuscular exercises (Group A, N=10), or the same exercise prescription accompanied with classical massage (Group B-control, N=10). Randomization and evaluation of the interventions were done by experienced physical therapists (members of the Laboratory of

Human Evaluation and Rehabilitation of the University of Patras) who were blind to the study scope. The variables evaluated in this study were the FHP, cervical ROM and strength, and pain and disability [14]. A photographic lens of the mobile iPhone X was used for the photographic evaluation of the FHP, and the IMAGE J computational program was used for the assessment of the cervical vertebral angle (CVA). Cervical ROM and strength were assessed with an inclinometer (Baseline inclinometer © bubble inclinometer), and the MicroFET2 dynamometer, respectively. The VAS scale was used for subjective pain assessment, and the neck disability index (NDI) questionnaire was used to record patient's functional status. A total of eight treatment sessions were performed on all patients, two each week. FHP, ROM, and cervical strength were evaluated before and after each session, while the functionality of the cervical spine through the NDI questionnaire was evaluated five times (before the 1st, 4th, and the 8th treatment sessions and at two and four weeks post-treatment). The therapeutic sessions and evaluations of the participants were carried out in the Laboratory of Human Evaluation and Rehabilitation of the University of Patras.

Therapeutic Interventions

Participants in Group A received soft tissue techniques in the form of the ERGON IASTM technique [15] in targeted cervical and thoracic spine areas with the aim of the myofascial release of shortened structures. Participants in Group B, for the same purpose, received a classical massage in the same area. Subsequently, participants in both groups underwent specialized neuromuscular exercises to correct the FHP. The duration of each treatment session was 50 min for both research groups. At the beginning of the procedure, the therapist performed a warm-up massage for both groups. In Group A, the massage lasted 10 min and was followed by the IASTM application for another 10 min, while in Group B, the massage lasted 20 minutes. Thus, the overall soft tissue interventions for both groups lasted 20 min.

The IASTM techniques were performed for 10 min on the anatomical structures of the cervical area, the thorax (back and front) and the shoulder girdle. Particular attention was paid to the treatment of local adhesions and myofascial restrictions. The massage techniques were applied in the same treatment areas as those in Group A and Group B.

Immediately after the application of the soft tissue techniques, four selected neuromuscular retraining exercises were applied to both groups. The first exercise included the strengthening of the deep neck flexors with a combination of neck curl with a chin tuck position in the supine position using the Chattanooga Stabilizer Pressure biofeedback (figure 1) [16]. The second exercise included cervical rotation strengthening through the contraction of the deep flexors at the same time as the rotating muscles (figure 2). The third exercise was aimed at strengthening the cervical lateral flexion and rotation and was performed from a sitting position (figure 3). For this exercise, the participants first performed a chin tuck and head pushing against the palm with their chin tucked (in all directions), and then the neck lateral flexion on the diagonal with chin tuck (left and right). Finally, the fourth exercise was aimed at correcting the forward position of the shoulder blades [17]; thus assisting the correct biomechanical posture of the chest by activating the trapezius and rhomboid muscles from the prone position through horizontal abduction of the shoulder blades (figure 4). All exercises were performed for 10 repetitions and 3 sets while the instructions were given for performing the exercises on the other days of the week for the entire eight weeks that the intervention lasted [18].

Statistical analysis

To compare the effectiveness of intervention programs, as well as to investigate their effects over time, the Repeated Measures ANOVA method (RM-ANOVA) was used with the one-variable approach. For statistical analysis of the data, the statistical software SPSS-25 was used. The minimum value of the statistical significance level, the p-value, in all statistical tests was set at 5%.

Results

The participants' functional data before and after therapeutic interventions are displayed in Table 1.

The results showed significant improvement in the mean FHP in sitting, which was higher in Group A that received IASTM and corrective exercises compared to Group B, which received massage and the same exercises. This improvement for Group A was maintained both in two ($p = 0.397$) and four weeks ($p = 0.080$) post-treatment. In Group A there was a statistically significant improvement in the FHP in the upright position immediately after the last treatment ($p = 0.0005$), which was not maintained two ($p = 0.01$) and four weeks ($p = 0.004$) post-treatment.

In both research groups, a statistically significant increase in the mean range of cervical flexion and extension ROM was found immediately after the last treatment ($p = 0.002$ and $p = 0.0005$, respectively). Furthermore, in both groups, there was maintenance of the average value after two ($p = 0.151$ and $p = 1,000$, respectively) and four weeks ($p = 0.064$ and $p = 1,000$, respectively). Cervical flexion strength was also increased immediately after the last treatment ($p = 0.017$) in Group A when compared to Group B. While there was no maintenance of this improvement after two weeks ($p = 0.019$), after four weeks there was a restoration of its level immediately after the last treatment ($p = 0.000$). In all other strength evaluations, no different behavior was observed statistically, depending on the type of therapeutic intervention.

A statistically significant decrease in the mean value of the VAS pain scale was observed in both groups immediately after the last treatment ($p = 0.0005$), which was also maintained in both groups after two ($p = 0.0005$) and four weeks ($p = 0.008$), respectively. NDI was improved with statistical significance in Group A compared to Group B after the 8th treatment session (Group A mean NDI score=11.8, Group B mean NDI score =22, $Z = -2.864$, $p = 0.004$) and at two (Group A mean NDI score=9.8, Group B mean NDI score =22,2, $Z = 3.467$, $p = 0.001$) and four weeks (Group A mean NDI score=6,2, Group B mean NDI score =23,2, $Z = -3.804$, $p = 0.0005$, $p = 0.001$) post treatment (figure 5).

Discussion

IASTM application in targeted areas of the body combined with neuromuscular corrective exercises improved the FHP, ROM strength, and functionality of women with painful cervical syndrome, to a greater extent compared to a similar program containing classical massage techniques instead of IASTM. The improvement of the FHP is very important and innovative finding as it highlights the possibility of correcting pathological postural adjustments through IASTM techniques in targeted areas and neuromuscular retraining exercises. In other words, it seems that targeted myofascial techniques that enhance the sliding of the fascia and reduce myofascial hardness are more effective than a classical massage to create conditions for myofascial tissue release and form the basis for creating positive postural adjustments when combined with specialized neuromuscular retraining exercises. The above finding is partly supported by the results of Kim et al.[19], who also showed a short-term improvement in the FHP when examining the effects of soft tissue techniques and strengthening exercises on the suboccipital muscles.

The cervical ROM and strength of most cervical movements appears to have been positively affected by both therapeutic interventions without significant differences between them. ROM improvement had a short-term appearance in most cervical movements, and this finding is consistent with many studies that have evaluated the short-term effect of IASTM techniques on the flexibility of central and peripheral joints, reporting the effectiveness of similar techniques in ROM short-term improvement. Strength adaptations were slightly different as the strength of the cervical flexion improved significantly immediately after the last treatment in the group A that received combined IASTM soft tissue techniques and neuromuscular exercises, and declined two weeks after the last treatment. However, four weeks after the completion of the main treatment, there was a return of cervical flexion strength at the levels of its initial improvement. The above findings on positive strength adjustments after targeted strength training programs were strongly supported by many studies that concluded that four to six-week strength training programs can lead to muscle hypertrophy and increased strength in specific muscle groups [20,21]. It can also be assumed that the improvement in the anterior displacement of the head observed in these patients contributed to the formation of positions of better biomechanical function and mechanical advantage of the cervical muscles that contribute to cervical flexion leading to long-term improvement in strength production. Based on the fact that force is transmitted through the connective tissue in and around the muscle and in non-muscular connective tissues [22], it can be assumed that the soft-tissue techniques with special equipment enhanced myodynamic adaptations by improving the sliding of the fascia and improving the mobility of the connective tissue in general. Maintaining strength improvement after the completion of the main intervention and for a period of four weeks can be explained by the fact that patients, after completing their basic treatment lasting four weeks, continued neuromuscular retraining exercises at home. The findings of this study confirm older findings that have shown a short-term improvement in function and the FHP through systematic and targeted strengthening of neck muscles [23]. On the contrary, Wright, et al., [24] reported that strengthening the neck muscles does not improve the FHP and the functionality of the specific anatomical area. However, this study did not combine soft tissue and strengthening techniques and, the strengthening program lasted only one month.

Both therapeutic interventions significantly reduced patient pain immediately after the last treatment, and this improvement was maintained and strengthened after two and four weeks from the end of the last treatment, without significant differences between groups. The above results are in agreement with findings from other studies on the short-term improvement of pain symptoms with myofascial release programs and therapeutic exercise programs in myofascial painful syndromes [25,26]. The maintenance of low levels of pain observed in this study cannot be compared with similar studies as there are no corresponding studies that have the methodological design of the present study, nor any similar studies that have evaluated the overall functional capacity and disability of patients in the long term. However, it can be assumed that the improvement of the FHP, as well as of the functional capacity as expressed by the improvement of the ROM and strength observed in the study patients and in combination with home-based exercise, is directly related to the reduction of pain symptoms in patients with mechanical neck pain. The above theoretical conclusion is reinforced by the findings of Yip et al [27], who stated that forward head posture is one of the factors relating to neck pain and disabilities in patients with neck pain.

Patient disability was also improved in both intervention groups in the course of the research. However, this improvement was statistically more significant in the group A that received the IASTM therapy. In particular, although patients in both groups started with the same levels of cervical disability, the mean cervical disability level of group A was significantly lower than that of group B that received classical massage both in the short and long term. This significant functional adaptation cannot be supported or confirmed by similar findings because no studies have systematically evaluated the improvement in the FHP and functional status of patients with cervical pain. This significant reduction in patient disability can be attributed to the biomechanical correction of the FHP that was greater in Group A and to the better myodynamic adaptations observed in this group.

The findings of this study should be evaluated under the weight of its limitations. Specifically, the patients evaluated in the present study were not recruited by random sampling but were a convenience sample from the same geographical area (Attica-Greece). Also, although the participants showed a relative homogeneity in their basic physiological characteristics, there was no homogeneity and reference to the pathology that led to cervical pain. Thus, the study included as many patients with cervical mechanical pain. It is well known, however, that mechanical pain is the result of multifactorial etiology and of many different pathologies that can range from cervical muscle strain to facets and ligament restrictions. Additionally, there were differences in patients' physical conditions, as some of the patients had never been practiced before.

Conclusions

IASTM techniques, combined with neuromuscular retraining exercises based on a holistic model of treatment of the human body, can significantly reduce pain and improve the corresponding function of patients with cervical pain opposed to the application of the same exercises and simple massage. These results need to be supported with future studies that implement larger samples that also target lumbar postural dysfunctions.

Abbreviations

IASTM: Instrument-assisted soft tissue mobilization

FHP: Forward head posture

ROM: Range of motion

NDI: Neck disability index

CVA: Cervical vertebral angle

Declarations

Ethics approval and consent to participate

The trial is conducted according to the principles of the Declaration of Helsinki. The trial was approved by the Ethics Committee of Physical Therapy Dept -University of Patras (29-10/11/2019). The trial is registered in the ISRCTN Registry <https://doi.org/10.1186/ISRCTN54231174> (No: 54231174). Participants provide informed consent prior to commencing the trial.

Consent for publication

Not applicable. The manuscript does not contain patient information or details.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

All authors contributed to study concept and design. KM was responsible for conducting the data acquisition. PA, EB and ET were responsible for data preparation. KF was responsible for writing the first draft of the manuscript. EB and ET were significant manuscript revisers. All authors have approved the submitted version of the manuscript. KF is the guarantor.

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Tables

Table 1. Mean values for FHP and cervical pain, ROM, strength and disability before and after therapeutic interventions in patients with mechanical neck pain (N=20).

Variables	Treatment	1 st Treatment	4 th Treatment	8 th Treatment	2 weeks post-treatment	4 weeks post-treatment						
Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B			
Forward head position (deg)	CVA in sitting	Before	41,4	42,4	43,7	43,7	46,4	44,6	49,2	44,2	48,6	43,5
After	45,7	43,4	47,3	45,0	49,9	46,0						
CVA in standing	Before	46,9	47,0	48,7	47,2	50,8	48,7	52,6	48,5	52,0	47,1	
After	50,3	48,0	52,1	48,9	54,1	50,5						
Pain	VAS scale	Before	6,1	4,0	3,1	2,8	0,4	1,5	0,4	2,0	0,6	2,5
After	3,6	3,4	1,6	1,9	0,2	0,9						
Cervical range of motion (deg)	Flexion	Before	58,7	54,5	64,2	54,4	69,7	58,2	70,2	55,8	69,0	55,3
After	64,7	58,1	70,1	61,4	71,4	62,9						
extension	Before	54,5	53,0	59,6	57,2	63,5	61,1	65,2	61,5	65,4	60,4	
After	60,6	52,9	68,7	61,4	67,5	59,5						
Lateral flexion (right)	Before	42,8	36,0	49,7	40,0	55,0	46,2	58,1	45,1	58,5	43,0	
After	46,5	43,6	56,2	43,8	62,3	49,4						
Lateral flexion (left)	Before	43,0	37,0	48,3	41,8	57,3	47,0	57,1	46,4	58,4	46,7	
After	47,8	44,5	56,5	45,5	64,6	51,7						
Rotation (right)	Before	62,5	61,5	73,4	62,3	75,2	65,1	80,3	66,4	75,6	63,2	
After	76,0	57,8	78,5	66,1	83,0	70,4						
rotation (left)	Before	64,5	62,4	70,5	64,6	76,6	66,3	79,9	69,3	79,0	64,0	
After	76,5	61,9	78,8	68,6	84,0	67,8						
Strength (kgr)	Flexion	Before	24,8	16,4	26,3	18,2	33,3	27,0	34,5	27,7	37,1	28,0
After	30,0	19,7	32,1	22,2	40,3	29,2						
Extension	Before	83,6	77,6	95,1	89,6	109,1	99,3	108,0	99,7	111,3	95,0	
After	90,4	76,5	103,0	92,2	127,1	104,1						
Lateral flexion (right)	Before	35,1	30,4	42,1	35,5	44,0	48,3	48,0	46,9	51,0	47,1	
After	44,3	30,3	45,3	38,9	50,3	55,8						
Lateral flexion (left)	Before	39,3	29,5	39,7	35,1	47,7	47,1	47,7	43,6	50,8	43,4	
After	46,3	32,6	46,5	41,7	54,0	52,6						
Disability	Neck disability Index	before	31,4	29	18,6	25	11,8	23	9,8	22,2	6,2	23,2

Figures



Figure 1

Strengthening of the deep neck flexors with a combination of neck curl with a chin tuck



Figure 1

Strengthening of the deep neck flexors with a combination of neck curl with a chin tuck



Figure 2

Cervical rotation strengthening through the contraction of the deep flexors at the same time as the rotating muscles



Figure 2

Cervical rotation strengthening through the contraction of the deep flexors at the same time as the rotating muscles



Figure 3

Cervical lateral flexion strengthening through the contraction of the deep flexors at the same time as the lateral flexors muscles



Figure 3

Cervical lateral flexion strengthening through the contraction of the deep flexors at the same time as the lateral flexors muscles

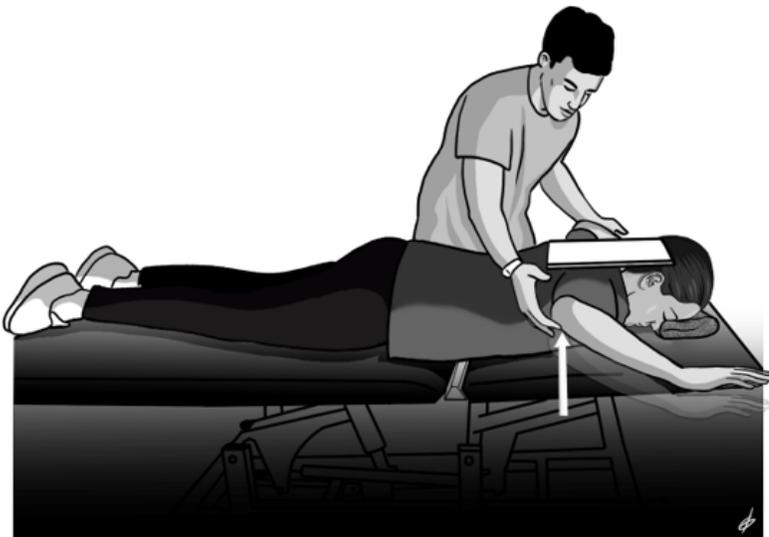


Figure 4

Strengthening of the trapezius and rhomboid muscles from the prone position through horizontal abduction of the shoulder blades

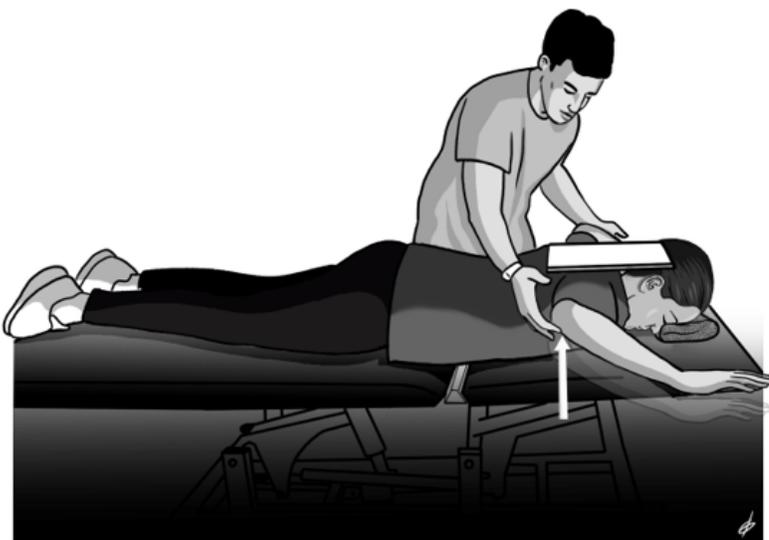


Figure 4

Strengthening of the trapezius and rhomboid muscles from the prone position through horizontal abduction of the shoulder blades

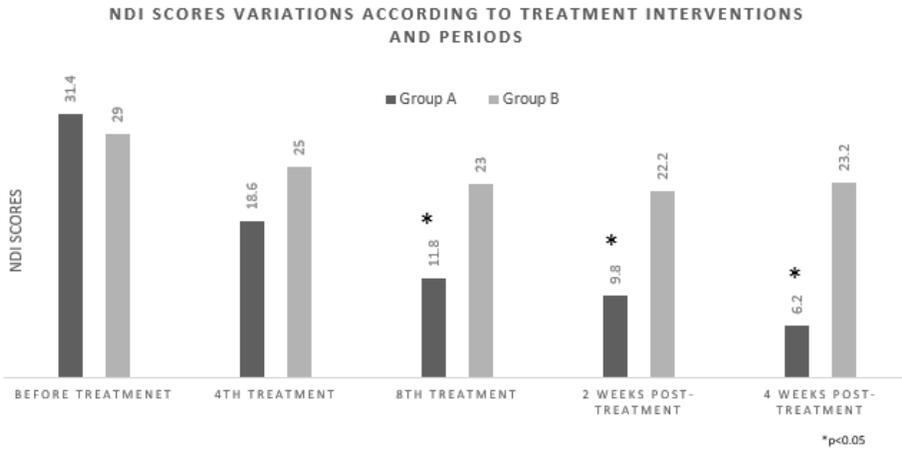


Figure 5

NDI scores variations according to treatment interventions and periods

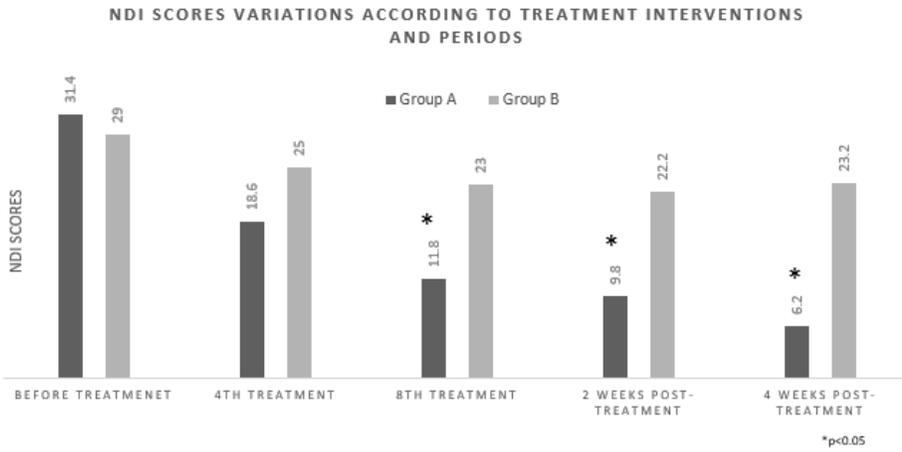


Figure 5

NDI scores variations according to treatment interventions and periods

Supplementary Files

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- [CONSORT2010ChecklistBMC.doc](#)
- [CONSORT2010ChecklistBMC.doc](#)