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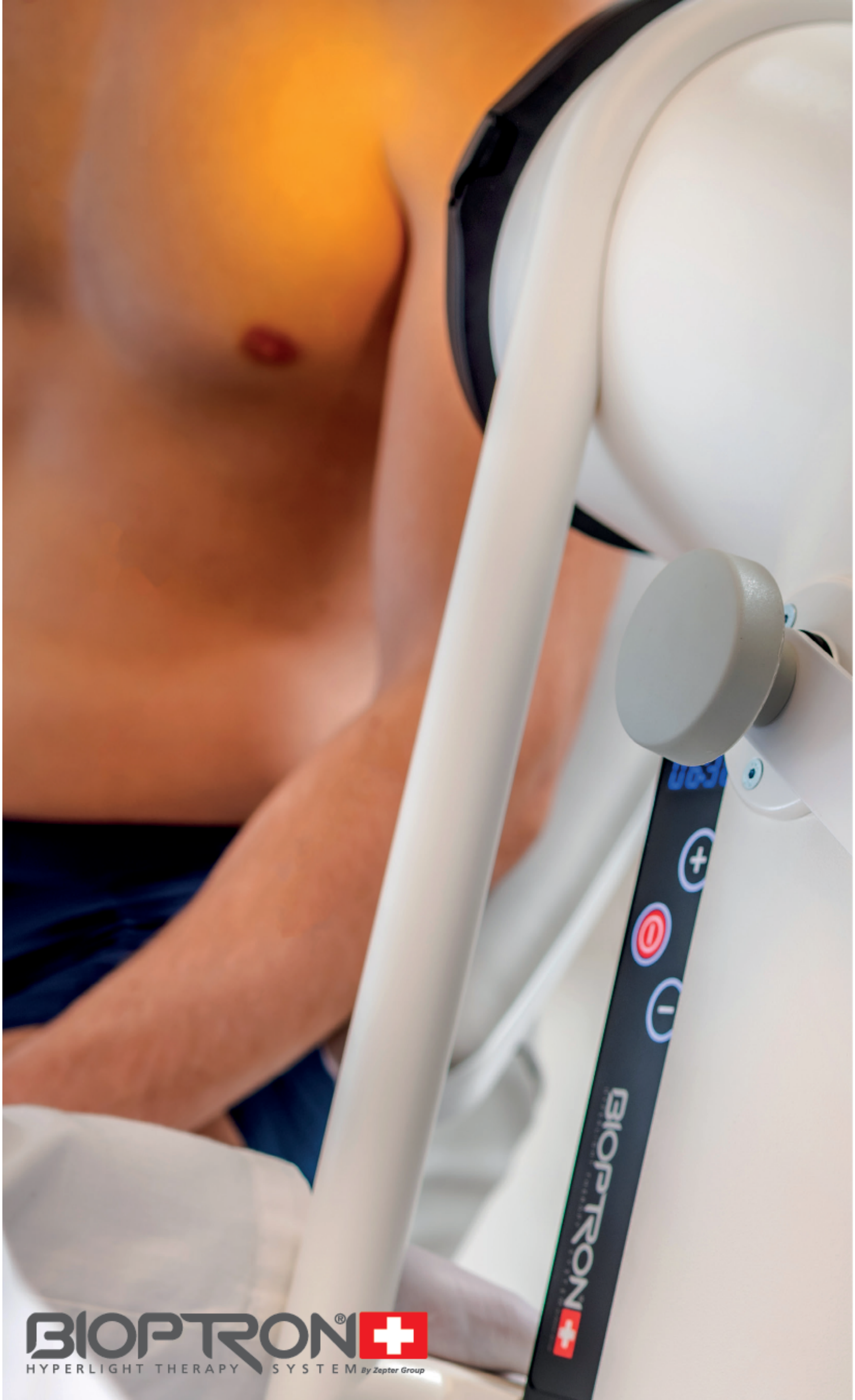

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Pełna oferta:

The effectiveness of rehabilitation by exercising central stability of the cervical spine in cognitive phase in patients with neck pain (pilot study)

Ocena skuteczności ćwiczeń centralnej stabilizacji w fazie kognitywnej odcinka szyjnego u pacjentów z zespołami bólowymi (badanie pilotażowe)

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Abstract

Introduction. In present times, vast majority of patients with back ailments complain about pain in cervical spine area. The use of exercises based on biofeedback as well as patient's full engagement and focus are designed to restore sufficient control to deep stabilizers of the cervical spine, where vestibular system plays a crucial role. The following method is appropriate for patients who experience different types of pain since it will not inflict further damage or exacerbate existing degeneration in that segment.

Purpose of the study. The purpose of this study is to analyze how central stabilization exercises influence stability of the neck in cognitive phase and whether they minimize neck pain, correct and restore overall motor control to effectively improve everyday physical activity and activities of daily living.

Measures and test methods. The subject of this research were patients with neck pain syndrome. The group of participants took part in a three-week program, which involved exercising central stability of the neck. The test measures were: Numeric Rating Scale (NRS), measures of neck mobility, Neck Disability Index, repositioning to neutral spot, as well as The Dartmouth Coop Functional and Health Status Measures for Adults. The patients were examined before and after completing the program.

Results. The study has shown that neck pain decreased by 1.7 points in 80% of the respondents. It has been observed that after the program patients had experienced increased neck mobility by 1 centimeter on average in all ranges of motion. They have also reported improved everyday physical activity and greater physical fitness.

Conclusions. Exercising central stability of the cervical spine in cognitive phase are beneficial for: restoring motor control, relieving neck pain, increasing range of motion of the head, and improving everyday physical activity.

Key words:

central stability, cervical spine, cognitive

Streszczenie

Wstęp. Jedną z przyczyn dolegliwości bólowych okolicy szyjnej kręgosłupa jest zaburzenie centralnej stabilizacji. Wykorzystanie ćwiczeń opierających się na biofeedbacku mają na celu przywrócenie prawidłowej kontroli głębokich stabilizatorów mięśniowych odcinka szyjnego.

Celem pracy była ocena wpływu zastosowanych ćwiczeń centralnej stabilizacji odcinka szyjnego w fazie kognitywnej.

Materiał i metody. Badanie zostało przeprowadzone na grupie 10 pacjentów z zespołem bólowym odcinka szyjnego kręgosłupa. Osoby brały udział w 3-tygodniowych ćwiczeniach centralnej stabilizacji odcinka szyjnego. Narzędziami oceny były: skala numeryczna NRS, pomiary ruchomość odcinka szyjnego, Neck Disability Index, test repozycji do miejsca neutralnego oraz skalę The Dartmouth Coop Functional and Health Status Measures for Adults.

Wyniki. Intensywność bólu uległa obniżeniu średnio o 1,7 punktu u 80% respondentów.

U pacjentów stwierdzono poprawę ruchomości odcinka szyjnego we wszystkich zakresach ruchu średnio o około 1 centymetr. Zakres aktywności codziennej i sprawności fizycznej poprawił się.

Wnioski. Ćwiczenia centralnej stabilizacji odcinka szyjnego kręgosłupa w fazie kognitywnej mają korzystny wpływ na: odbudowę kontroli motorycznej, zmniejszenie dolegliwości bólowych tej okolicy, zwiększenie zakresu ruchu głowy oraz poprawę aktywności ruchowej u badanych.

Słowa kluczowe:

centralna stabilizacja, odcinek szyjny, kognitywna

Introduction

Back pain syndromes are one of the most common civilization problems. It is estimated that, during the lifetime, 70% of the population experiences pain in the cervical spine [1]. Patients with cervical ailments usually have symptoms related to neck pain, shoulder pain, stiffness, cervical migraine, disc disease or muscle contracture, often called cervical torticollis. These symptoms most often occur due to various reasons, including cold, structural, muscular, myofascial or inflammatory causes [2, 3, 4].

By analyzing the possible types of pain, it can be concluded that the mechanisms, from which complaints arise are usually diverse and often overlap on each other. Regardless of the occurring pain mechanism, the problem of neuromuscular-ligamentous-bone control loss may be encountered. When such a defect in the control system occurs, it causes a change in the normal physiological motor pattern, and thus a change in the order of recruitment of individual muscle groups [5]. The cervical part, as one of the most mobile sections of the spine, must have an efficient structure of coordination and accuracy of movements, especially towards the stimuli it receives from the outside [6].

A properly functioning system that stabilizes the spine according to Panjabi, consists of three systems, which are: passive, active and nervous control system. The passive control system includes the vertebral bodies of the spine, intervertebral discs, spine joints, ligaments and joint capsules. The active control system consists of comprise muscles and tendons. Nervous control is possible thanks to many integrated elements of the CNS [7].

The active muscular system consists of superficial muscles, including: the sternocleidomastoid, trapezius and levator scapula. Among the deeper muscles, rectus capitis lateralis, rectus capitis anterior, longissimus cervicis and longissimus capitis deserve special attention. It should be remembered that these are selected structures that also perform other functions among other deep muscles. Deep cervical muscles play a much more important role in integrating the received stimuli and performing more precise movements than the superficial muscles. This is evidenced by the content of nerve spindles in individual muscles. The example is longissimus capitis muscle where the number of nerve spindles per gram of muscle is 48.6. It is twice more nerve spindle as the multifidus muscle in the C_5-C_7 segment, which has 24.3 spindles per gram of muscle [9]. It can therefore be concluded that the longissimus capitis will perceive stimuli of a much lower intensity, which is associated with more precise and accurate movements. Another aspect that deserves mentioning is the activation of the lateral rectus capitis during exercise. Structurally, this muscle has a direct connection with the visual system, which has a significant impact on motor coordination and perceiving external stimuli [8, 9]. Important attention should also be paid to the character of the muscle fibers located in individual muscles. Deeply located muscles have a higher proportion of tonic-type fibers, prepared for continuous loads, while superficial muscles usually have a greater proportion of phase-type muscle fibers. [10]. When the correct motor activity and recruitment of individual muscle groups is disrupted, in the longer course of such changes, the fibers in the muscles are rebuilt and change their character. These changes usually occur in only one direction - from tonic to phase fibers. Thus, they disrupt the proper functioning of these muscles. As a result of these processes, the enduring character of muscles resistant to constant stress changes to muscles incapable of prolonged effort, i.e. common problems associated with overload syndrome [10]. Another important element is the nervous system, specifically vestibular system. As a prioprioreceptive system, its main role is to control movements with linear and angular accelerations, information about the position of the body in space and the gravity forces affecting the entire system of the body. Its role is also to inform the CNS about the position of the head in relation to the neck and the rest of the body and the surrounding space. It is also important to maintain proper muscle tone, that is, to trigger appropriate body reflexes, to maintain the correct body posture or to coordinate the work of the eye system [11]. In order to properly rebuild the motor function in patients, a common model of motor improvement in the human body presented in 1969 by Fitts and Posner was used. This model consists of 3 phases: cognitive (cognitive), association (associative) and autonomous (automatic). The first of these models was used to restore the correct motor activity of the deep cervical muscles. This model is characterized by conscious concentration of attention on a given problem and deliberate execution of movement, paying attention to feedback. In this phase, the patient is instructed on how the correct movement should look like and in what sequence it should be performed. At this stage, mistakes often occur, which the person conducting the therapy must pay attention to and show them to the patient so that they can learn correct motor skills from the very beginning. In the association phase, the consciousness is reduced. All movement begins to be based on the principle of continuity of the performance of a given task. At this stage, the number of errors is smaller, the patient shapes the accuracy of the movement. In the automatic stage, a motor activity takes place that has been performed many times and the patient has gained some experience. The motor activity that is performed by the patient takes place without the participation of consciousness. These stages have very thin boundaries and the patient's transition between the phases is not immediately noticeable [12].

Material and methods

The pilot study was carried out in a group of 10 patients - 6 women and 4 men with cervical spine pain syndrome, undergoing rehabilitation at the University Clinical Hospital. WAM – Central Veterans Hospital in Łódź at the Orthopedic and Post-traumatic Rehabilitation Clinic. The examined patients were aged 44 to 64. Patients were qualified for the study on the basis of the current occurrence of pain in the cervical region. Other qualifying criteria were: the lack of ordered physical and kinesiotherapeutic procedures in the cervical region, and the lack of any contraindications from the treatment team nor the patient himself. Before starting the study, the patient was informed about the possible risks and consequences as well as benefits of participating in the research and exercises. In order to evaluate the results, patients were subjected to clinical evaluation, using selected research tools, before starting the therapy and after its completion. Patients qualified for the experiment performed exercises under the supervision of a therapist for a period of 3 weeks. The exercises used the biofeedback phenomenon in order to show the exercising person the correct exercise of the movement. A stabilizer was used as an element of biofeedback. It is a position control device through the feedback shown on the gauge indicator. Decreasing the pressure of the body on the chamber causes a decrease in pressure, while increasing pressure leads to an increase in pressure. The patient is lying with his back on the couch, one arm along the body, in the other hand the pressure indicator from the stabilizer. A towel is placed under the head in order to relax as much as possible in the cervical complex. The stabilizer pressure chamber was placed at the level of the C_2-C_3 spinous processes. The patient's task was to relax the temporomandibular joint by placing the tip of the tongue on the roof of the hard palate and allowing it to fall freely, thus obtaining a neutral position of the joint. The next step was to inflate the stabilizer’s chambers until the indicator reached 20 mmHg. When starting the exercise, the patient performed a gentle retraction of the head so that the index showed 22 mmHg, inhaled deeply through his nose along with the lifting of his eyes towards the cranial direction, and then, exhaling with his mouth, directed his eyes in the caudal direction, which was one repetition. The entire exercise was performed at one continuous pace with the desired pressure being maintained constantly throughout the series. The patient performed 8 repetitions in 2 series. During the interval between the series, the subject ceased to make a slight retraction movement, returning to the starting pressure of 20 mmHg.

The following tests and scales were used to assess the effectiveness of the study: Numerical Rating Scale (NRS), neutral reposition test, measurement of the cervical range of movement according to Zembaty, NECK DISABILITY INDEX scale and The Dartmouth coop functional and health status measures for adults. The numerical scale describes the pain experienced by the patient in the cervical region in a numerical range from 0 to 10, where 0 is no pain at all and 10 is difficult to imagine. The range of motion in the cervical region was investigated for the flexion (forward bend), extension (backward bend), lateral (side-to-side) flexion and head twist movements for both left and right sides. Measurements were made according to the assumptions of Andrzej Zembaty. In the neutral reposition test, the patient in a sitting position with a laser pointer placed on the head, at a distance of 1.5 m from the wall on which a specially prepared shield was attached – left and right rotation of the patient's head with a nod and return to the starting point, 3 times with eyes closed. Test ma na celu zbadanie koordynacji ruchowej oraz czucia kinestetycznego. The test is designed to test motor coordination and kinesthetic feeling. The Dartmouth coop functional and health status measures for adults international scale determines the patient's general health based on 9 subscales assessing: physical activity, emotional state, daily activity, social activity, pain, health status change assessment, general health assessment, social support and quality of life assessment. On each of the 9 subscales to choose, there are 5 answers with a description and presentation using an intuitive picture. The Neck Disability Index scale is an index describing disability caused by pain in the cervical spine and consists of 10 questions. Questions regard the most frequent activities performed during the day, such as work, concentration, trouble sleeping or the intensity of pain in the cervical region.

All data were statistically analyzed. Quantitative variables were characterized by basic descriptive measures - mean and standard deviation (SD), the lowest and highest value (min-max), median and interquartile range (Q25-Q75). Abbreviations used in the tables: SD-standard deviation, MIN-minimum, MAX-maximum, Q25-first quartile, Q75-third quartile. All data were analyzed for statistical significance using the student's t-test. The results at $p < 0.05$ were considered statistically significant.

Results

The subjects showed a mean decrease in pain after the therapy at the level of 1.7 points (Table 1). The difference between the mean level of pain before and after the therapy is statistically significant ($p = 0.0117$).

Table 1. Results of NRS – Numerical Rating Scale

Variable	Descriptive measures	Before treatment	After treatment	P level
Pain	Mean value	4.4	2.7	0.0108
	±SD	1.11	1.26	
	MIN	3	1	
	MAX	6	5	
	Median	4.5	2.5	
	Q25	3	2	
	Q75	5	4	

In the measurements of the range of motion, the improvement in two results was statistically significant: the forward bend and the backward bend (tables 2, 3).

Table 2. Movement changes in the forward and backward bend

Variable	Descriptive measures	Before treatment	After treatment	P level
Forward bend	Mean value	3.5	4.9	0.0001
	±SD	1.5	1.13	
	MIN	1	3	
	MAX	6	7	
	Median	3.5	5	
	Q25	2	4	
	Q75	5	6	

Table 3. Movement changes in the backward bend

Variable	Descriptive measures	Before treatment	After treatment	P level
Backward bend	Mean value	4.6	5.7	0.0067
	±SD	1.2	1.27	
	MIN	3	3	
	MAX	6	8	
	Median	5	6	
	Q25	3	5	
	Q75	6	6	

The forward bend improved on average in the patients by 1.4 cm, while the backward bend improved by 1.1cm.
In the remaining measurements, such as bend to the right and left sides, rotation to the left and to the right, the changes were statistically insignificant (Table 4)

Tabela 4. Zmiany zakresu ruchu – dane nieistotne statystycznie
Table 4. Changes in the range of motion – data not statistically significant

Zmienna Variable	Miary opisowe Descriptive measures	Przed leczeniem Before treatment	Po leczeniu After treatment	Poziom p P level
Lateral bend to the right	Mean value	3.4	3.9	0.2443
	±SD	1.28	1.51	
	MIN	1	2	
	MAX	5	6	
	Median	3	4	
	Q25	3	2	
	Q75	5	5	
Lateral bend to the	Mean value	3.8	4.4	0.2172
	±SD	1.4	1.9	
	MIN	1	1	
	MAX	6	7	
	Median	4	4,5	
	Q25	3	3	
	Q75	5	6	
Rotation to the left	Mean value	6	6.5	0.0957
	±SD	1.7	1.0	
	MIN	4	5	
	MAX	8	8	
	Median	6	6.5	
	Q25	4	6	
	Q75	8	7	
Rotation to the right	Mean value	5.9	6.4	0.4269
	±SD	2.2	1.5	
	MIN	1	0	
	MAX	9	9	
	Median	6	6	
	Q25	5	5	
	Q75	8	8	

In the neutral reposition test, both the right and left side of the patients improved. The mean improvement in patients was one circle on the test dial, i.e. by 1o on average (Fig. 1, Fig. 2).

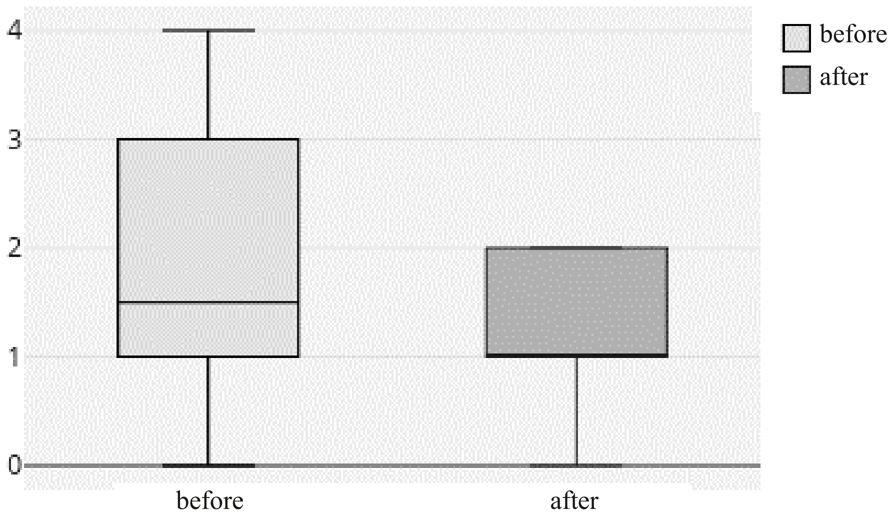

Fig. 1. The right side reposition test

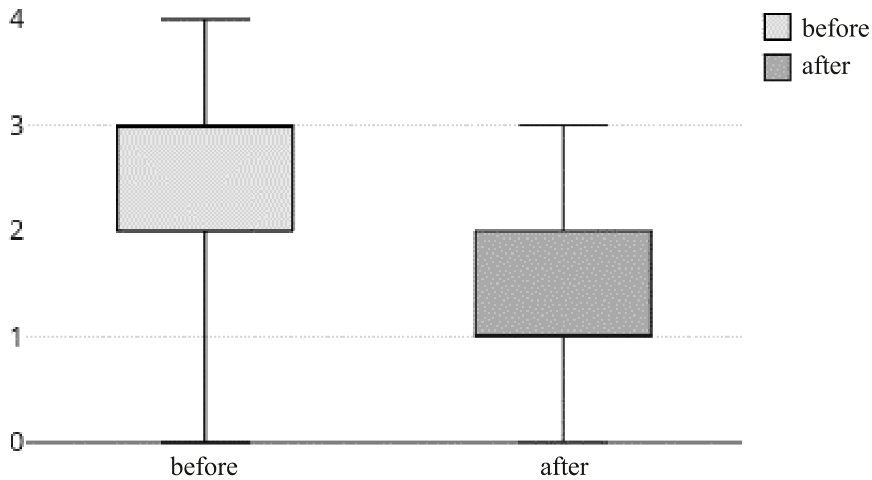

Fig. 2. The left side reposition test

In the international scale of The Dartmouth Coop Functional and Health Status Measures for Adults, statistically significant results can be noted in terms of feelings, daily activity, pain, changes in health and quality of life. However, the results in the field of physical condition, social activity, general health and social support turned out to be statistically insignificant. From the point of view of the conducted research, particular attention should be paid to changes in points assessing daily activity, pain and quality of life (Table 5, Table 6).

Table 5. Data statistically significant in the COOP questionnaire

Variable	Descriptive measures	Before treatment	After treatment	P level
Emotions	Mean value	2.5	2.1	0.036787
	±SD	0.5	0.7	
	MIN	2	1	
	MAX	3	3 kbl	
	Median	2.5	2	
	Q25	2	2	
	Q75	3	3	
Daily activity	Mean value	2.4	1.9	0.014956
	±SD	1.113552873	0.7	
	MIN	1	1	
	MAX	4	3	
	Median	2.5	2	
	Q25	1	1	
	Q75	3	2	
Pain	Mean value	2.9	2.1	0.010708
	±SD	1.044030651	0.830662386	
	MIN	2	1	
	MAX	5	4	
	Median	2.5	2	
	Q25	2	2	
	Q75	4	2	
Health changes	Mean value	2.4	2.4	0.005121
	±SD	0.489897949	0.4	
	MIN	2	1	
	MAX	3	2	
	Median	2	2	
	Q25	2	2	
	Q75	3	2	
Quality of life	Mean value	2.3	1.7	0.023856
	±SD	0.458257569	0.458257569	
	MIN	2	1	
	MAX	3	2	
	Median	2	2	
	Q25	2	1	
	Q75	3	2	

Table 6. Data not statistically significant in the COOP questionnaire

Variable	Descriptive measures	Before treatment	After treatment	P level
Physical fitness	Mean value	2.4	2.3	0.343436
	±SD	1.113552873	1.1	
	MIN	1	1	
	MAX	5	5	
	Median	2	2	
	Q25	2	2	
	Q75	3	3	
Social activity	Mean value	2	1.7	0.081126189
	±SD	0.894427191	0.640312424	
	MIN	1	1	
	MAX	4	3	
	Median	2	2	
	Q25	1	1	
	Q75	2	2	
Overall health	Mean value	2.9	2.7	0.167850656
	±SD	0.7	0.640312424	
	MIN	2	2	
	MAX	4	4	
	Median	3	3	
	Q25	2	2	
	Q75	3	3	
Social support	Mean value	1.5	1.5	1
	±SD	0.5	0.5	
	MIN	1	1	
	MAX	2	2	
	Median	1.5	1.5	
	Q25	1	1	
	Q75	2	2	

In the Neck Disability Index Scale, as an indicator of disability caused by pain in the cervical spine, there was also a statistically significant improvement related to the exercises performed by the patients (Table 7).

Table 7. Neck Disability Index

Variable	Descriptive measures	Before treatment	After treatment	P level
Neck disability Index	Mean value	8.3	6.6	0.000668
	±SD	5.48	5.33	
	MIN	2	1	
	MAX	19	18	
	Median	7.5	6	
	Q25	4	2	
	Q75	10	8	

Discussion

Taking into account the epidemiology of pain in the neck area lasting more than six months, which accounts for 34% of the population among women and 14% among men [14, 15], headaches of cervical origin, which accounts for 40% to 80% % of all headaches, including from 2% to 17% difficult to define [15, 16, 17] and having regard to the mechanism of whiplash associated disorders, which are clinical symptoms after motion accidents involving stress on the cervical spine lasting more than three months, and every tenth clinical case that develops extreme pain [18, 19, 20, 21], any exercise program targeting specific muscle structures for the atlanto-occipital junction deserves to be incorporated into an rehabilitation program. Especially that the local muscles in the area of the atlanto-axial junction present a very large number of muscle spindles and are connected with the vision and balance system [22, 23]. Frequent atrophy of the rectus capitis muscle pathohistologically leads to a change in the fibers from type I to type II, leading to a faster fatigue [24, 25] as well as deterioration of proprioceptive sensation and imbalance [26, 27]. Over time, atrophy may lead to functional and structural syndromes with stress on internal carotid vertebral arteries as carotidinia, IX-XII cranial nerve palsy, Honter's syndrome [28].

Conclusions

In a significant number of patients participating in the study, a reduction in cervical pain was observed, which may be the basis to confirm the effectiveness of the therapy. The improvement in daily activity and quality of life was highly assessed among patients and statistically significant. A positive result was noted in increasing the range of motion in the cervical complex, which allows patients to move their head freely. The performed exercises in the proven Fitts and Posner model [29, 30] had a positive effect on the restoration of motor control and the restoration of correct movement patterns along with the appropriate recruitment of individual muscle groups. The reconstruction of the correct movement pattern in the cervical section may also translate into the effects of therapy in other body segments, such as the lumbar spine [13]. Based on the presented results of the pilot study, it can be concluded that the applied exercises can be an effective form of therapy in patients with cervical pain syndrome.

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