ORIGINAL RESEARCH PAPER

EFFECT OF VITAMINS, MINERAL SUBSTANCES AND MANUAL MANIPULATIONS OF VERTEBRAL SEGMENTS C0-C3 AND C6-TH3 ON FUNCTIONAL STATE OF CERVICAL AND CERVICO THOROCAL PARTS OF BODY

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Abstract

According to literature sources it is known that the functional state of the cervical and cervico thorocal parts significantly affect the functioning of many systems of the body. To normalize the functional state of the neck, the pectoral muscles of the neck and joints, there are different therapy methods from pharmaceutical to even neuroreflectory applied. In this research we evaluated one pharmaceutical therapy (the therapy of mineral substances and vitamins) and one neuroreflectory therapy (the manipulation of joints) and their effect on the functional state of the cervical and cervico thorocal parts.

Key words: *Functionally weak muscle, neural regulation, mineral and vitamin disturbances, manual manipulations, functional state of the neck muscle.*

Introduction

In the practice of physiotherapy we often come across the situations when athletes performing movements do not do it in optimal routine. Assisting muscles are involved in the realisation of the movement, not forming an optimal stereotype of the movement. It is known from the literature that in such situations it is mostly found out that the muscles agonists in the realisation process of the movement operate only in the routine of phasic contraction. In the practice of applied kinesiology (AK) it has been empirically stated that, having neural regulation disturbance, as well as mineral or vitamin insufficiency the muscle cannot use the routine of

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tonic contraction. Such muscle neural regulation state in AK is called as a functionally weak muscle.

It is known from the literature that the reasons for muscle functional weakness can be as follows: in muscles themselves, in the segmental, CNS subcortical and cortical levels (*Васильева,* 1998). In AK practice it has been stated, if the source of the problem is irritated for a short time, muscle neural regulation is normalized for a while, letting it contract in tonic routine.

One of the reasons of formation of functionally weak muscles can be functional changes in the segmental level. The neck level significantly affects the functioning of many systems of the body *(Kaprelia, Vourazanisa, Strimpakosa***,** 2008). We provoked these functional changes in the segmental level in the cervico thoracal part.

Another reason of functionally weak muscles is insufficiency of mineral substances and vitamins. Insufficiency can make muscle neural regulation disturbance which in turn may cause decreased muscle tone (*Frost R.,* 2002).

The aim of the research was to find out changes of the cervical and cervico thorocal parts under the influence of vitamins, mineral substances and manual manipulations of the spinal segments C0-C3 and C6-Th3.

Matherial and methods

40 participants aged 20 – 25 with problems on the cervical and cervico thorocal parts such as neck flexion, head retroflexion, shoulder protraction participated in this research. Participants are divided into two groups (20 in each). For Group A applied joint manipulation, but for Group B applied pharmaceutical therapy.

The following methods were used in the research:

1. *Applied kinesiology (AK) tests.* We used AK tests for testing the neck flexor muscles, *m.scalenus, m.sternocleidomastoideus* and the upper part of *m. trapezius* for their functional weakness (*Ramšak, Gerz*, 2001; *Frost*, 2002).

Description of AK tests: The neck flexor sitting test: the patient maximally flexes the head and fixes this position (chin to chest). The stabilising hand is behind with the forearm resting over the thoracic spine and the flat hand behind the head. Light contact is made over the forehead. Test vector is in an arc in the direction of extension. The patient pushes futher into flexion.

M. Scalenii test: these muscles can be tested while sitting in flexion and at about 10 degree rotation away from the testing side. Ideally the examiner applies pressure with the ulnar edge of the hand on the middle of the patient`s forehead in the direction of extension.

M. Sternocleidomastoideus sitting test: the patient holds the head forward and maximally rotates it. The stabilising hand supports the head with a flat contact and the forearm rests over the thoracic spine. The testing hand makes contact on the side of the head above the temporo-mandibular joint. Test vector is in an arc dorsally, in the direction of extension. The patient pushes anteriorly, further into flexion.

M. Trapezius – upper division sitting test: the patient lifts the shoulder and drops the head towards the shoulder, with a small degree rotation to the opposite side. From this position the patient is asked to bring the head and shoulder further together, while the examiner tries to pull the head and shoulder away from each other.

2. Determination of mineral substance and vitamin deficiencies with AK tests.

If during testing with AK tests (*Galeja, Paeglitis*, 2013) of the deep neck flexor muscles, *m. scalenii, m.sternocleidomastodeus* and *m.trapezius* (the upper part) we stated neural regulation disturbance, then the subject repeated this test with specific vitamin or mineral substance contact with the body. If during the test with some vitamin or mineral substance contact with the body we could not find any disturbances of neural regulation, we marked this substance as vital to the body (*Walther,* 2000; *Ramšak, Gerz*, 2001; *Frost,* 2002).

The following mineral substances Zn, Se, Cu, Fe, Cr, Mg, Mn and the vitamins A, B_3, B_6, C, D, E, Q_{10} were used in this research. Participants taking only those substances which normalized the neural regulation.

The subjects used the mineral substances and vitamins necessary for the organism in accordance with the producer recommendations - three weeks daily intake dose.

3. *Goniomethry*. It was used to evaluate the range of motions (ROM). The involved pectoral muscles can influence the range of motions in the segment C0-C1 which ensures the head antiflexion and retroflexion and in the segment C1-Th3 which ensures head-to-neck flexion, extension, rotation and lateroflexion. (*Левит, Захсе, Яндла,*1993)**.**

In measuring we used fixed standardised initial state of the head and neck – in the frontal plane the line which connects the *procesus mastoideus* (mounds behind the ear) forms angle of 90 degrees regarding to the central axis of the body, but in the sagital plane on the vertical axis of the body there is the ear aperture, shoulder centre line and trochanter (*Васильева,* 1995; *Васильева,* 1998; *Kendall, McCreary, Provance, Rodgers,Romani,* 2005).

Description of the standardized tests:

Antiflexion of the head

The subject is lying on his or her back and the head is over the edge of the couch (the level of the spine vertebra Th1 is on the edge of the couch). In the rest state the head leans on the examiner`s hand. The head and neck are in standartized initial state. The examiner makes the subject's head antiflexion in movement until feeling the end state (fig. 1).

Figure 1. The standardized tests: Antiflexion of the head

Retroflexion of the head

The subject is lying on his/her back and the head is over the edge of the couch (the level of the spine vertebra Th1 is on the edge of the couch). In the rest state the head leans on the examiner`s hand, the head and neck are in standartized initial state. The examiner makes the subject's head retroflexion in movement until feeling the end state (fig. 2).

Figure 2. The standardized tests: Retroflexion of the head

Head-to-neck flexion

The subject is sitting with his back straight. In the rest state the head and neck are in standartized initial state. The examiner makes the subject's head-to-neck flexion in movement until feeling the end state (fig. 3).

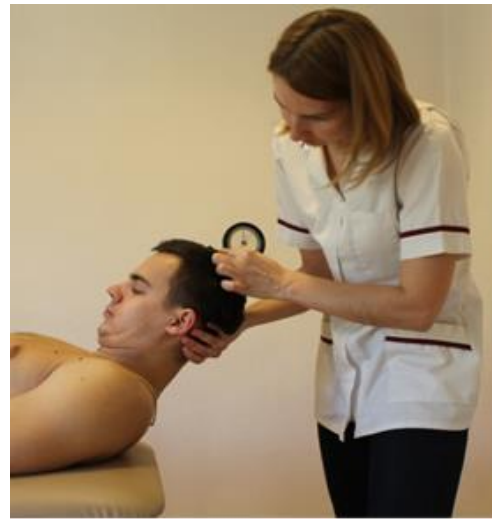

Figure 3. The standardized tests: Head-to-neck flexion

Head-to-neck extension

The subject is sitting with his back straight. In the rest state the head and neck are in standartized initial state. The examiner makes the subject's head-to-neck extension in movement until feeling the end state (fig. 4).

Figure 4. The standardized tests: Head-to-neck extension

Head-to-neck rotation

The subject is sitting with his back straight. In the rest state the head and neck are in standartized initial state. The examiner makes the subject's head-to-neck rotation (to the right and to the left) in movement until feeling the end state (fig. 5).

Figure 5. The standardized tests: Head-to-neck rotation

Head-to-neck lateroflexion

The subject is sitting with his back straight. In the rest state the head and neck are in standartized initial state. The examiner makes the subject's head-to-neck lateroflexion (to the right and to the left) in movement until feeling the end state (fig. 6).

Figure 6. The standardized tests: Head-to-neck lateroflexion

In all cervical and cervico thorocal movement tests: The goniometer plumb axis is placed perpendicularly to the horizontal plane and the goniometer indicator is adjusted on 0^0 mark. In the end of the measurment the value of ROM (range of motions) in degrees showed by the goniometer is read.

4. *The methods of mathematical statistics.* In order to detect changes we applied mathematical statistical program SPSS. To compare the results of each group before and after therapy we applied paired samples *t*-test. To compare therapies in the research we applied independent samples *t*-test.

Results

Assessing the cervical and cervico thorocal frequency of the neural regulation disturbances (NRD) after the procession of the obtained results of AK tests by the methods of mathematical statistics, we stated that NRD are in the neck deep flexor muscles, *m.scalenii*, *m.sternocleidomastodideus* and *m.trapezius* (the upper part).

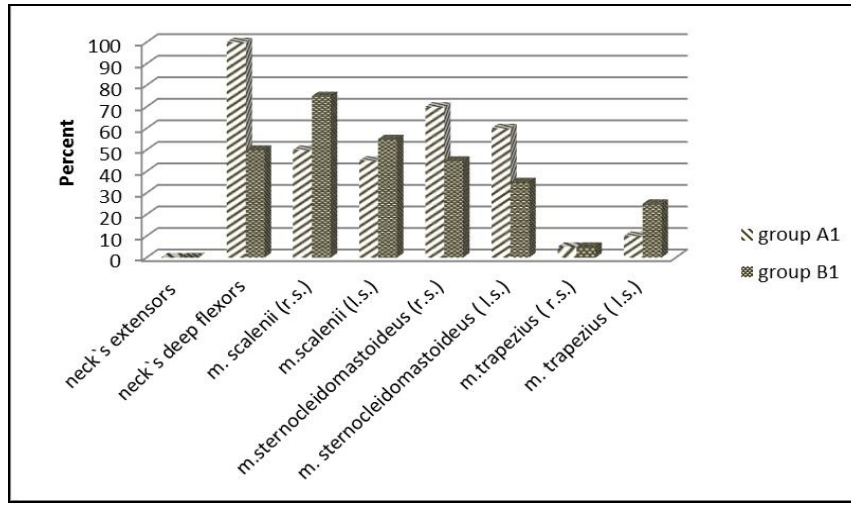

Figure 7. Neural regulation disturbances (%) of the cervical and cervico thorocal muscles

In the diagram (fig. 7.) we can see that during the tests of the neck extensor muscles NRD were not stated.

NRD in the cervical deep flexor muscles in group A were stated for 100% of the participants of this group and in group B for 50% of the participants (fig. 1).

Assessing *m.scalenii* in group A, NRD were stated for 50% of the participants in the right muscle and 45% of the participants in the left muscle. In group B NRD were stated for 75% of the participants in the right muscle and 55% of participants in the left muscle (fig. 7).

In *m.sternocleidomastoideus* measurment results, we stated NRD in the right side muscle of the body for 70% of the participants and in the left side muscle for 60% of the participants in group A. In group B NRD were stated for 45% of the participants in right side muscle of the body and 35% of the participants in the left side muscle (fig. 7).

Analysing *m.trapezius* (the upper part) measurment results we stated that NRD for 5% of the participants in right side muscle of the body and for 10% of the participants in the left side in group A. In group B NRD were established for 5% of the participants in the right side muscle and for 25% of the participants in the left side muscle (fig. 7).

Using goniomethry we assessed ROM in the head antiflexion, head retroflexion, head-to-neck flexion, head-to-neck extension, head-to-neck rotation and lateroflexion, we measured ROM while the neck and neck part of the chest were in the neutral state – after standartized conditions of the model.

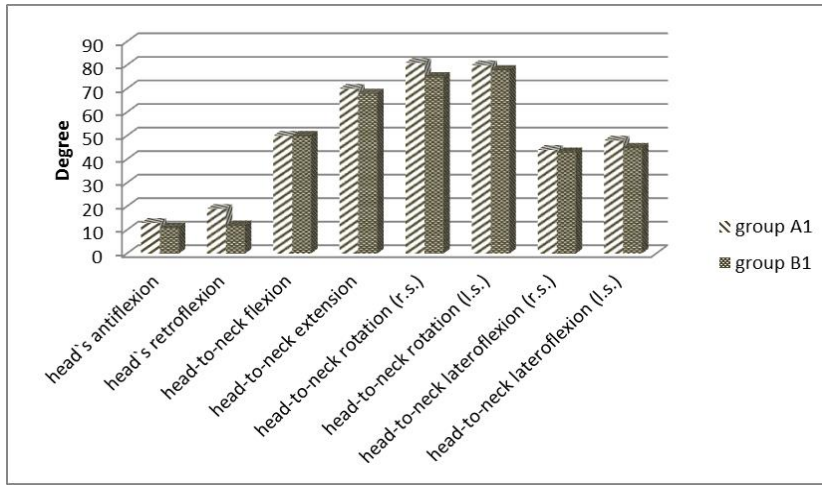

Figure 8. Cervical and cervico thorocal range of motions (ROM)

We can see in the diagram (fig. 8) that in the test of the head antiflexion the average value is 13 ± 1^0 for group A and the average value 11 ± 0.8^0 for group B. In the head retroflexion the average value is 19 ± 1.2^0 for group A and the average value 15 ± 0.9^0 for group B.

Analysing the results of the head-to-neck flexion ROM we stated that the average value of the movement dimension to the right was 50 ± 2^0 for group A and the average value 50 ± 1.9^0 for group B (fig. 8).

The average value of the head-to-neck extension ROM was 70 ± 2.3^0 for group A and the average value 68 ± 2.7^0 for group B (fig. 8).

Processing the data obtained in the head-to-neck rotation measurment we stated that the average value of the dimension of ROM to the right was 81 ± 1.4^0 and 80 ± 2^0 to the left for group A. In group B the average value to the right was 75 ± 1.6^0 and 78 ± 1.5^0 to the left (fig. 8).

In the head-to-neck lateroflexion after the obtained results we stated that the average value of the head-to-neck ROM lateroflexion was 44 ± 1.3^0 to the right and 48 ± 0.7^0 to the left for group A. The average value of the same indicator was 43 ± 0.9^0 to the right and 45 ± 1.1^0 to the left for group B (fig. 8).

Analysing the obtained results of the cervical and cervico thorocal neural regulation disturbances after the spine C0-C1 and C7-Th3 vertebrae manipulations and use of vitamins or mineral substances we stated that in both groups (A and B) there were changes of the neural regulation disturbances in the neck and neck part of the chest after the application of therapies, except the neck extensor muscles.

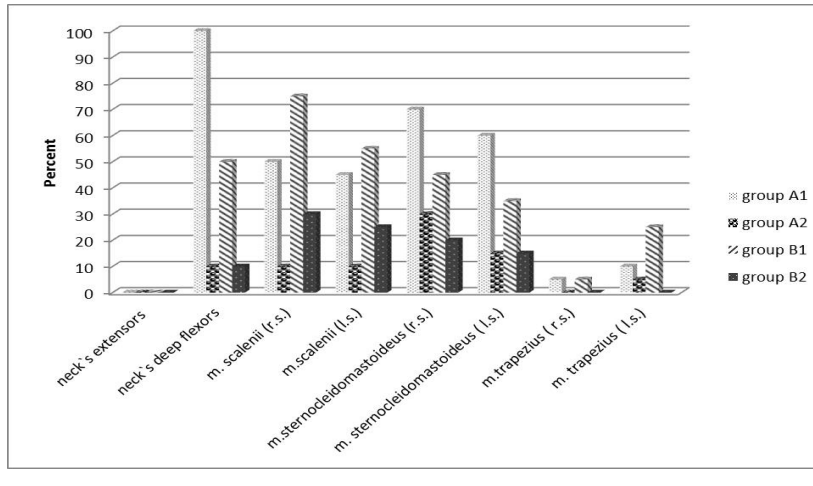

Figure 9. Neural regulation disturbances for the neck muscles (%) before and after the spinal segment C0-C3 and C6-Th3 manipulations and use of vitamins and mineral substances

Processing the data obtained in the extensor muscle tests we stated (fig. 9.) that in group A after the spinal segment C0-C1 and C7-Th3

manipulations and in group B after the use of vitamins and mineral substances, there were not any changes, because NRD was not stated.

NRD for group A in the neck deep flexor muscles after the spinal segment C0-C3 and C6-Th3 manipulations were stated for 10% of the participants. NRD for group B in the neck deep flexor muscles after the use of vitamins and mineral substances were detected for 10% of the participants (fig. 9).

After the spinal segment C0-C3 and C6-Th3 manipulations *m. scalenii* NRD in group A were stated for 10% of the participants on the right and left sides of the body. But in group B after the use of vitamins and mineral substances in *m. scalenii* on the right side of the body we stated NRD for 30% of the participants and on the left side of the body for 25% of the participants (fig. 9).

Processing results of *m. sternocleidomastoideus* in group A after the spinal segment C0-C3 and C6-Th3 manipulations NRD were stated for 30% of the participants in the right side of the body muscle and 15% of the participants in the left side of the body muscle. In group B after the use of vitamins and mineral substances in *m. sternocleidomastoideus* on the right side of the body NRD were stated for 20% of the participants and 15% on the left side of the body (fig. 9).

We evaluated the credibility of result changes with McNemar test and stated that the obtained result changes before and after the spinal segment C0-C3 and C6-Th3 manipulations were statistically significant ($a \leq 0,05$).

Processing the results of *m. trapezius* (the upper part) after the spinal segment C0-C3 and C6-Th3 manipulations, we stated NRD in 5% of the participants on the left side of the body muscle, but we did not stated it on the the right side of the body. We evaluated the credibility of result changes with McNemar test and stated that the obtained result changes before and after the spinal segment C0-C3 and C6-Th3 manipulations were not statistically significant ($a \geq 0,05$).

However, in group B after the use of vitamins and mineral substances in *m. trapezius* (the upper part) NRD were not stated.

We evaluated the credibility of result changes with McNemar test and stated that the obtained result changes before and after the spine C0-C3 and C6-Th3 manipulations were statistically significant ($a \leq 0,05$).

In the assessment of ROM of the cervical and cervico thorocal parts after the spinal segment C0-C3 and C6-Th3 manipulations, use of vitamins and mineral substances, we repeated the tests of the head antiflexion,

retroflexion, head-to-neck flexion, extension, head-to-neck rotation and lateroflexion.

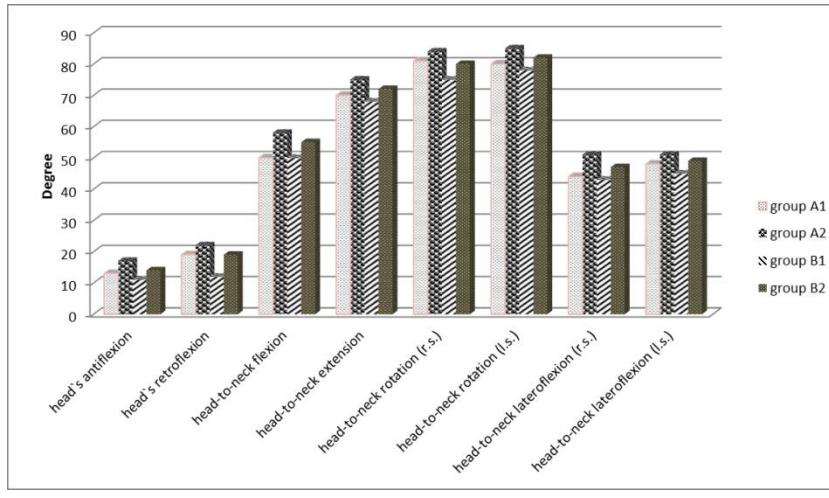

Figure 10. ROM of the cervical and cervico thoracal part of the chest before and after the spinal segment C0-C3 and C6-Th3 manipulations and use of vitamins and mineral substances

In the diagram (fig. 10) we can see that during the ROM test we stated that the average value was 17 ± 0.9^0 for group A and the average value 14 ± 0.8^0 for group B. In the ROM test for the head retroflexion we stated that the average value was 22 ± 0.9^0 for group A and 19 ± 0.8^0 for group B (fig. 10).

In the test of movement dimension for the head-to-neck flexion we stated that the average value was 58 ± 1.4^0 for group A 55 ± 1.8^0 for group B. In the test of movement dimension for the head-to-neck extension we stated that the average value was 75 ± 2.3^0 for group A and 72 ± 2.5^0 for group B (fig. 10).

In the test of movement dimension for the head-to-neck rotation we stated that the average value to the right was 84 ± 13^0 but to the left 85 ± 1.2^0 for group A. In group B the average value was 80 ± 1.4^0 to the right and 82 ± 1.3^0 to the left (fig. 10).

Analysing the changes of movement dimension in the head-to-neck lateroflexion after obtained results we stated that in group A the average value of the head-to-neck lateroflexion to the right was 51 ± 1.2^0 and to the left it was 51 ± 0.8^0. The average value of group B to the right was 47 ± 1^0 and to the left 49 ± 0.8^0 (fig. 10).

We evaluated the credibility of the results changes with Student`s T-criterion test and groups of model thereby we stated that the obtained result changes before and after the spine C0-C3 and C6-Th3 vertebrae manipulations and use of vitamins and mineral substances were statistically significant ($a \leq 0.05$).

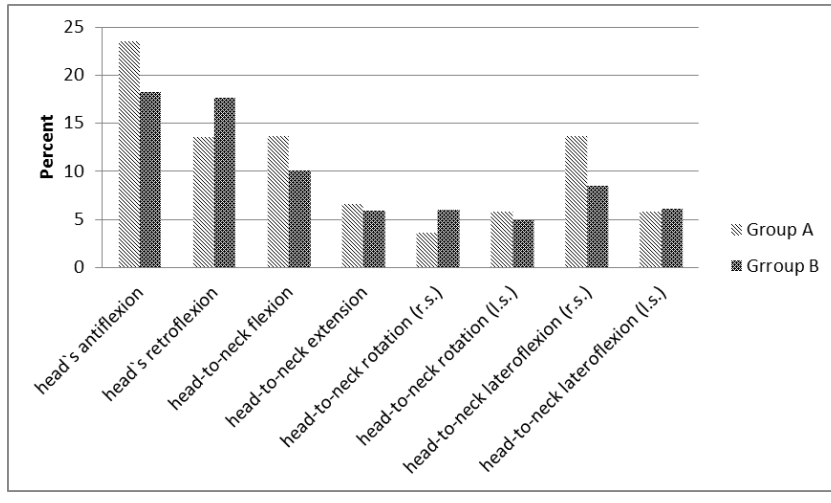

Figure 11. ROM of the cervico and cervico thoracal scaled values (%) after the spinal segment C0-C3 and C6-Th3 manipulations and use of vitamins and mineral substances

In the test of the head antiflexion ROM in group A has increased by 4^0. Assessing the percentage scaled value of the changes it is 23.5% from the average value. In group B it has increased by 3^0. Assessing the percentage scaled value of these changes it makes 18.2% from the average value. Comparing these percentage scaled values we can see that the changes caused by manipulations are by 5.3% more than after the use of vitamins and mineral substances (fig. 11).

In the test of the head retroflexion ROM in group A has increased by 3^0. Assessing the percentage scaled value of these changes it makes 13.6% from the average value. In group B it has increased by 3^0. Assessing the percentage scaled value of these changes it makes 17.6% from the average value. Comparing these percentage scaled values we can see that changes caused by the use of vitamins and mineral substances are by 4% more than after manipulations (fig. 11).

In the test of ROM of the head-to-neck flexion in group A has increased by 8^0. Assessing the percentage scaled value of these changes it makes 13.7% from the average value. In group B it has increased by 6^0.

Assessing the percentage scaled value of these changes it makes 10.1% from the average value. Comparing these percentage scaled values we can see that the changes caused by manipulations are by 3.6% more than after the use of vitamins and mineral substances (fig. 11).

ROM of the head-to-neck extension movement in group A has increased by 5^0. Assessing the percentage scaled value of these changes it makes 6.6% from the average value. In group B it has increased by 4^0. Assessing the percentage scaled value of these changes it makes 5.9% from the average value. Comparing these percentage scaled values we can see that the changes caused by manipulations are by 0.7% more than after the use of vitamins and mineral substances (fig. 11).

ROM of the head-to-neck rotation movement to the right in group A has increased by 3^0. Assessing the percentage scaled value of these changes it makes 3.6% from the average value. In group B it has increased by 6^0. Assessing the percentage scaled value of these changes it makes 2.4% from the average value. Comparing these percentage scaled values we can see that the changes caused by the use of vitamins and mineral substances are by 0.7% more than after manipulations (fig. 11).

ROM of the head-to-neck rotation movement to the left in group A has increased by 5^0. Assessing the percentage scaled value of these changes it makes 5.8% from the average value. In group B it has increased by 4^0. Assessing the percentage scaled value of these changes it makes 4.9% from the average value. Comparing these percentage scaled values we can see that the changes caused by the use of vitamins and mineral substances are by 0.9% more than after manipulations (fig. 11).

ROM of the head-to-neck lateroflexion movement to the right in group A has increased by 7^0. Assessing the percentage scaled value of these changes it makes 13.7% from the average value. In group B it has increased by 4^0. Assessing the percentage scaled value of these changes it makes 8.5% from the average value. Comparing these percentage scaled values we can see that the changes caused by manipulations are by 5.2% more than after the use of vitamins and mineral substances (fig. 11).

ROM of the head-to-neck lateroflexion movement to the left in group A has increased by 3^0. Assessing the percentage scaled value of these changes it makes 5.8% from the average value. In group B it has increased by 3^0. Assessing the percentage scaled value of these changes it makes 6.1% from the average value. Comparing these percentage scaled values we can see that the changes caused by the use of vitamins and mineral substances are by 0.3% more than after manipulations (fig. 11).

Discussion

Analysing the obtained results and assessing the functional state of the segments after AK tests we can see that in both groups we could state NRD for the researched muscles. Assessing the causes of these NRD with vitamins and mineral substances used in this study, we stated that the muscle functional weakness is connected to the disbalance of vitamins and mineral substances in the organism. In literature NRD caused by defficite of minerals and vitamins in different muscles are described by Walther D.S (*Walther,* 2000). At the same time testing the cervical and cervico thoracal part segment mobility we can see that practically in all ROM lack of movement was observed. To restore movement in the segments and decrease NRD we used manipulations on C0-C3 and C6-Th3 spinal segments as described by Levit K. (Левит, et al., 1993) in group A and 3 week long therapy of using vitamins and mineral substances in group B. After the application of these therapies we can see that in both groups A and B the cervical segment mobility has increased statistically significantly (a ≤0,05). NRD in the muscles of group B have similarly decreased statistically significantly. We should point out that that in group A due to manipulations there is statistically significant decrease of NRD in the neck deep flexor muscles, *m.scalenii*, *m.sternocleidomastoideus*, but in *m.trapezius* (the upper part) NRD practically did not change which we can explained by the fact that in these muscles initially NRD were for only two people.

To evaluate the effect of two different therapies on the cervical and cervico thoracal part of the chest mobility we assessed relative changes caused by these therapies as percentage scaled values. Comparing these results we can see that despite the fact that both therapies gave statistically significant changes, the effect of manipulations to mobility is greater than the therapy of using vitamins and mineral substances.

Conclusions

1. Results of the research approve information mentioned in the literature sources that both therapies increase joint mobility and decrease NRD. Results of the research demonstrate statistically significant (a ≤0.05).

2. Comparing therapies used in the research we got that manual therapy method provides a more significant impact on the neck segment mobility as using vitamins and mineral substances.

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