Abstract

The favoring causes leading to the appearance of hyperlordosis in female gymnasts are represented by a physical development that is improper for the demands of professional sports, which leads to a series of symptoms manifested through muscular imbalances in the anterior pelvic-femoral, posterior lumbar-pelvic and pelvic femoral regions, and in the abdominal muscles. This study aims to emphasize the effectiveness of physical therapy means that are applied early on in the treatment of the symptoms of lumbar spine deviation, aiming to improve joint mobility, strengthen injured muscles, and harmonize the physiological curves of the spine. Aiming to obtain conclusive results, we chose to study a group of 10 professional female gymnasts, who were identified to suffer from compensating lumbar hyperlordosis in the initial assessment. The applicative intervention consisted in the application of iso-stretching and therapeutic physical exercises using the Klein ball, over the course of approximately 7 months. From the analysis of the results, we observed that the implementation of postural reeducation programs with strict observance of age particularities, has beneficial effects in stabilizing posture and movements, leading to a static symmetrical ability without compensating and faulty movements, positively influencing the harmonious physical development of female gymnasts, as well as the functioning ability of the whole body.

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Keywords: compensating lordosis, female gymnasts, reeducation programs;

1. Introduction

The favouring causes leading to the appearance of hyperlordosis in female gymnasts are represented by a physical development that is improper for the demands of professional sports, which leads to a series of
symptoms manifested through muscular imbalances in the anterior pelvic-femoral, posterior lumbar-pelvic and pelvic femoral regions, and in the abdominal muscles. (Manole, Manole and Dobrescu, 2007).

The treatment of compensating hyperlordosis is done according to the treatment of the deviation that caused it (anteversion of the pelvis). The evolution and prognosis of the compensating hyperlordosis, just as in every compensating deviations of the spine, depend on the effectiveness of the treatment for the primary deviation. (Antonescu, Obrașcu and Ovezea, 1993). There are, however, cases in which, after fixating the primary curvature, the compensating lordosis continues its development, becoming more serious. (Duma, 1997). The author of the iso-stretching method is Bernard Rodendo, former physical therapist of France’s track and field team. He discovered the importance of the deep paravertebral muscle system in ensuring the balance of the body after many training courses with one of his teachers, Roger Perrin, who actually encouraged him to do deeper studies. Iso-stretching comes from the juxtaposition of the two terms defining the method: Iso, short for isometrics, clarifying the type of contraction that is used (isometric contraction of the antagonist muscles that neutralize the joint movement) and stretching, referring to the stretching of the muscles and ligaments (Redonto, 2003).

2. Material and methods

Purpose. This paper tries to bring its contribution to the existing considerations regarding the importance of postural reeducation for improving the symptoms caused by compensating hyperlordosis in female gymnasts. The applicative intervention of the research consisted in conducting an observational study, which comprised proposed and planned means and methods, the recorded data allowing us to observe the effects and tendencies regarding the application of the constructed programs and the recorded results.

After identifying the premises, we elaborated the hypothesis stating that presumably, the early and individualized applicative intervention, through the use of the most effective means and methods of rehabilitation for female gymnasts, contributes to the improvement of the symptoms caused by the compensating hyperlordosis and maintaining an adequate postural control.

The research methods we used were: the theoretical documentation method, the observation, the inquiry, the measurement and assessment, the statistical-mathematical method and graphical representation method.

The selected means were applied respecting the methodical demands for conducting an exertion session, age particularities, and material conditions. Thus, the study was conducted on a group of 10 subjects (female gymnasts), aged between 6 and 8, who were diagnosed with compensating hyperlordosis, during the somatoscopic examination.

The research was conducted in the “Vasile Alecsandri” University of Bacău gymnasium, over the course of approximately 5 months, consisting in the implementation of therapeutic physical exercises using the Klein ball and iso-stretching. Aiming to ensure a good environment that would stimulate the active participation of each child, we used also several tools, such as batons, and small medicinal balls of 1 kg.

Exploration and evaluation methods: Throughout the course of this study, a series of tests were conducted to obtain relevant data related to the subjects’ level of development, and to assess the initial and final functional levels. The tests were conducted before and after the application of the therapeutic physical exercises programs.

The general physical examination. Our attention was focused on the somatoscopic examination (constitution, nutrition state, physiognomy, skin color, body attitude, psychological and nervous reactiveness), anthropometric examination, and morphologic examination. These information helped creating a picture of the general functionality of the child’s body, and spotting the deviations of the spine.

The examination by touching of the lumbar-pelvic-femoral muscle tissue gave us information regarding the trophicity of those muscles, and their strength, observing their performances; in regards to muscle sensitivity and strength, we identified the painful areas in the observed muscles, and the differences that can appear between the agonist and antagonist muscles (hypotonia and hypertonia). The real cause of a muscle pain can be right there in the muscle, but most of the time is found at an osteoarticular level, in the nervous system, or internal organs; it can be joined by other problems such as: infiltrations, hypertonia, hematomas, etc.

Tonus. Outside the individual variations, from one region to another, from one day to the next, being
considered within normal range, one can distinguish: hypertonias, with various etiologies, especially nervous that often coincide with cutaneous and subcutaneous pains; indurations, which appear frequently in certain muscles, in sciatic, cervical-brachial, crural neuralgias; the gluteus medius, the quadriceps, the paravertebral muscles, are the most frequent to be affected; fibroses, when touched the muscle feeling very hard, with total or partial lost elasticity, painful if associated with an inflammatory state, or a contracture; other problems such as: hematomas, inflammatory states (myosites), aponeurosis, muscle rupture, etc. (Mărză Dănilă, 2002).

As methods of assessment and measurement, the following tests were used:

“Lumbar arrow” test – this is a simple test that allows us to spot the lumbar hyperlordosis values. The arrow of the lumbar curvature is determined by measuring the distance between the centimeter rope pressed on the subject and the lumbar spine. The normal sagittal morphological type is quantified for the value of 3 cm. (Fig. 1)

Shirado test – this test examines the trunk flexors, in this case the abdominal muscles, and is performed with the subject lying down on her back, her thighs and knees bended at a 90° angle, arms near her body. The subject raises her shoulders, maintaining this position for as long as possible in isometrics. The optimal time of maintaining the position is of 2 minutes (Balint, 2007). (Fig. 2)

Schöber sign: a point is marked, at the middle distance between the posterior-upper iliac spines. Then we measure, cranially, a distance of 10 cm, the subject being in the standing position. In the maximum flexion of the trunk, with extended knees, this distance becomes normal at 14.5-15 cm. If from the L₅ spine apophysis we measure upwards a distance of 15 cm, it will grow to 21 cm during the maximum flexion of the trunk. (Fig. 3,4)
The contents of the physical therapy intervention:
The general treatment goals were to:

- improve the suppleness, thus the joint mobility;
- rebalance the muscle strength;
- harmonize the physiological curvature in the lumbar spine;
- educate and reeducate the posture, the body alignment and its segments;
- improve the body image and scheme;
- correct and redress the abnormal body postures;

The physical therapy intervention. Postural control represents the coordination of the whole system of body processes, thus the therapeutic physical exercises and the iso-stretching envisaged the improvement of global postural dysfunctions, in three stages.

To achieve the set goals we used the following means of global postural reeducation: iso-stretching and proprioceptive physical exercises, using the Klein ball and other tools.

![Figure 5 - Iso-stretching for the psoas muscle](image1)
![Figure 6 - Iso-stretching for the right femoral muscle](image2)

![Figure 7, 8 - Active iso-stretching](image3)

In the first stage we applied the iso-stretching with manual resistance, to increase the flexibility of the psoas and right anterior muscles, physical exercises for improving the abdominal muscle strength and posturing on the Klein ball for correcting the deficient position of the lumbar spine. Iso-stretching is a method that needs attention, concentration in maintaining the correct postures, respiratory control and intense muscle work. (Fig. 5,6)

The second stage envisaged the use of iso-stretching, the isometric contractions of the antagonist muscles neutralizing the joint movement, facilitating the increase of flexibility in the thoracolumbar and lumbosacral
muscles. Concentric isotonic contractions were applied to improve the strength in the gluteus muscles, and the hamstrings, while the Klein ball posturing helped improve the proprioception. (see Fig. 7,8, 9)

![Concentric isotonic contraction for the hamstrings and the buttocks](image)

Figure 9  Concentric isotonic contraction for the hamstrings and the buttocks

The third stage focused on correcting the posture and the lumbar deviation through specific exercises and Klein ball posturing, in the sitting position. (see Fig. 10, 11)

![Postures on the Klein ball](image)

Figure 10, 11 – Postures on the Klein ball

3. Results and discussions

The data recorded with the help of the assessment tests have been grouped, and calculated. The calculated indices presented in the table highlighted a series of aspects regarding the subjects.

After analyzing the group of subjects, one can observe an improvement during the final examination, for all the three tests. In regards to the tests “Lumbar arrow” and Schober, the final results were reduced from 5.21 cm. to 4.21 cm, and from 16.83 cm. to 15.92 cm., respectively, which proves that the compensating hyperlordosis has diminished its development, through the correction of the muscular imbalances, installed in this situation as a result of the overwork of agonist muscles in the detriment of the antagonist ones.
Two of the gymnasts, M.S and S.O. (Table 1) presented in the initial testing, a lordotic curvature with the highest values of 6.5 and 6.6 cm., respectively, which had repercussions on the whole studied functional ensemble, causing significant differences between the hypertonic muscles in the anterior (right anterior and psoas) and posterior lumbar-pelvic regions (erector spine, interspinales and supraspinatus, serratus anterior, quadratus lumborum), and the hypotonic ones the pelvic-femoral posterior region muscles (the inferior lumbosacral muscles, the gluteus muscles, and the hamstrings) and abdominal muscles.

<table>
<thead>
<tr>
<th>No.</th>
<th>Initials</th>
<th>Lumbar arrow</th>
<th>Schober test</th>
<th>Shirado test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N.M.</td>
<td>5 cm 4.8 cm</td>
<td>17 cm 16.3 cm</td>
<td>14 sec. 30 sec.</td>
</tr>
<tr>
<td>2</td>
<td>M.S.</td>
<td>6.5 cm 5.5 cm</td>
<td>18.5 cm 17 cm</td>
<td>18 sec. 34 sec.</td>
</tr>
<tr>
<td>3</td>
<td>K.E.</td>
<td>5 cm 4 cm</td>
<td>17.5 cm 16.4 cm</td>
<td>13 sec. 35 sec.</td>
</tr>
<tr>
<td>4</td>
<td>M.V.</td>
<td>6 cm 5 cm</td>
<td>17.5 cm 16.5 cm</td>
<td>18 sec. 40 sec.</td>
</tr>
<tr>
<td>5</td>
<td>F.A.</td>
<td>5 cm 3.8 cm</td>
<td>17 cm 16 cm</td>
<td>15 sec. 36 sec.</td>
</tr>
<tr>
<td>6</td>
<td>P.I.</td>
<td>4 cm 3.5 cm</td>
<td>15.5 cm 15 cm</td>
<td>16 sec. 35 sec.</td>
</tr>
<tr>
<td>7</td>
<td>M.A</td>
<td>5.5 cm 4 cm</td>
<td>16 cm 15 cm</td>
<td>20 sec. 30 sec.</td>
</tr>
<tr>
<td>8</td>
<td>S.O</td>
<td>6.6 cm 5.5 cm</td>
<td>16.5 cm 16 cm</td>
<td>22 sec. 35 sec.</td>
</tr>
<tr>
<td>9</td>
<td>R.A</td>
<td>4.5 cm 3 cm</td>
<td>17.3 cm 16 cm</td>
<td>17 sec. 33 sec.</td>
</tr>
<tr>
<td>10</td>
<td>V.P</td>
<td>4 cm 3 cm</td>
<td>15.5 cm 15 cm</td>
<td>25 sec. 40 sec.</td>
</tr>
<tr>
<td></td>
<td>Arithmetical mean</td>
<td>5.21 cm 4.21 cm</td>
<td>16.83 cm 15.92 cm</td>
<td>17.8 sec. 34.8 sec.</td>
</tr>
</tbody>
</table>

After the intervention, using the means mentioned above, one can observe that the values have reduced by approximately 1 cm. for each of the subjects, meaning that the Iso-stretching method and the proprioception on the Klein ball are beneficial when applied at a young age for correcting the muscle deficit. Also, three of the subjects (P.I., R.A., V.P.) recorded approximately normal values at the final testing, in the specific tests “Lumbar Arrow” and Schober, their deviation being almost completely corrected.

Through these beneficial results, concretized by objective testing, the deficiency of the lumbar spine and of the whole muscle groups was completely improved in a shorter amount of time than for the other subjects in the experimental group.

The stretching and the analytically directed contractions have improved the muscle activity that plays a role in the harmonization of the physiological lumbar curvature, while the proprioceptive Klein ball training facilitated the strengthening of the deepest stabilizing muscles of the spine.

The results for the Shirado test – 17.8 sec. in the initial testing, and 34.8 sec in the final one – shows that the assurance of an optimal joint stability allows an adequate neuromuscular control that helps maintaining a correct body posture. The muscle imbalances installed in the lumbar-pelvic-femoral complex that remain untreated, as a result of practicing professional gymnastics, can lead to a large number of pathologies with various etiologies and manifestations. (Fig. 12)
4. Conclusions

Following the research, one can see that the symptoms caused by the studied deviation were reduced, due to the corrections of the muscle unbalances, and the pains caused by the lumbar paravertebral muscle contractures were diminished after the hypertonic muscles were elasticized.

The results recorded for the first parameter show that the hyperlordosis was diminished, recording a decrease of 1 cm in average, during the final testing of the target group.

Also, the isometric contractions administered through the motor content of the applicative intervention influenced the global motor control of the investigated subjects, recording a difference of 0.71 cm at the end of the study.

The final values in the Shirado test show an improvement of the abdominal strength with 17 sec. in average, influencing the postural control and the installment of a correct body posture.

According to the results pointed out during this study, the implementation of an individualized, but static program is beneficial for the female gymnasts during their growth period, demanding the spine with ample and repetitive movements, thus confirming the hypothesis.

The means used during the rehabilitation program helped to correct and redress the abnormal postures, but the systematic practice of professional gymnastics at an early age will keep leading to muscle imbalances that can become very serious in time.

References