The effect of aikido exercises on shaping spinal curvatures in the sagittal plane

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Summary

Introduction. Selected aikido exercises, actively affecting the muscles responsible for pelvic alignment were applied in the experiment. Such exercises may affect formation of spinal curvatures in children by connecting the pelvis and the vertebral column in the kinematic chain. The aim of the presented study was to determine the effect of the applied aikido exercises on α, β and γ angles of the sagittal plane and on anteversion of the pelvis in children.

Material and methods. The sample comprised 211 boys, pupils of elementary schools, from forms 1-4, aged 7-10 years. They were divided into three studied groups. The experimental group consisted of 68 children participating in aikido classes. The remaining two groups were control groups. The first one comprised 68 children. They did not attend any corrective gymnastics classes. They only participated in their physical education classes at school. The second control group comprised 75 children attending traditional corrective gymnastics classes. The measurements and body posture analysis were performed using Śliwa's approaches of. Posturometer S was used for the measurements.

Results. During the experiment which was conducted within the school year, no significant differences were found between the studied groups in α, β and γ curvature angles in the sagittal plane. In the experimental group a significant reduction of pelvic anteversion angle was found. No significant changes were noted in this angle values in the remaining groups.

Conclusions. Aikido exercises resulted in reduction of pelvic anteversion angle. The applied exercises affected pelvic muscles, resulting in changes in its alignment. No effect of aikido exercises on α, β and γ spinal curvature angles was found in the sagittal plane.

Introduction

Conventional corrective-compensatory gymnastics often includes sets of exercises affecting the vertebral column in children, however, exercises activating the muscles responsible for a correct alignment of the pelvis are rarely applied [1]. The pelvis and the vertebral column are links of the biokinematic chain where changes in one link entail changes in the neighbouring links. Incorrect alignment of the pelvis can be the reason of lateral curvature of the spine a [2,3]. Similar changes in pelvic anteversion angle entail changes in the size of lumbar lordosis and affect the remaining spinal curvatures in the sagittal plane [4]. During the experiment, selected aikido exercises, actively affecting the muscles responsible for pelvic alignment, were applied.

Exercises applied in martial arts competitors may be interesting in the aspect of self-defence and can be applied to compensate and correct postural deformities. Since they are not considered to be a form of treatment, they can be easily accepted by children [5]. The aim of the study presented in this paper was to determine the effect of the applied aikido exercises on alpha, beta and gamma angles of the spinal curvature in the sagittal plane and on the anteversion angle of the pelvis in children.

Material and methods

The sample comprised boys with first degree scoliosis according to Gruca. Besides, the boys with the risk of scoliosis due to the oblique alignment of the pelvis in the frontal plane were qualified for the study. Prior to the experiment, all the subjects participated in corrective gymnastics classes.

211 boys, pupils of primary schools from forms 1-4 participated in the experiment. They were divided into three groups. The experimental group consisted of 68 children. There were two control groups. The first one consisted of 68 children. They participated only in physical education classes at school. The second group consisted of 75 children attending traditional corrective gymnastics classes. The experimental group participated in sessions which were held three times a week within one school year. These were extracurricular activities in the afternoon hours and the children actively participated in the exercises within about 60 minutes. The experimental group and the first control group consisted of primary school chil-
Children from Konin and Koło. The second control group comprised children from the towns: Wałbrzych, Rzepin and Twardogóra, whose results were obtained from screening. Children from all groups lived in towns, mostly in blocks of flats. In order to facilitate interpretation of the results, it was accepted that the studied groups would be called as follows: Group 1 – the experimental group, Group 2 – the first control group and Group 3 – the second control group. The mean age was 8 years and 8 months in Group 1, 8 years and 11 months in group 2 and 8 years and 4 months in Group 3. The measurements and body posture analysis were carried out according to Sliwa approach [6]. The first part of the study included physical examination involving determination of the location of the apices of spinous processes from C7 cervical process to L5 lumbar process. Next, using Posturometer-S, the location of the designated anthropometric points in three-dimensional space was determined. This way the angles of spinal curvature inclination in the sagittal plane were determined:

- alpha angle ($\alpha$) – inclination of the upper thoracic segment;
- beta angle ($\beta$) – inclination of the thoracolumbar segment.
- gamma angle ($\gamma$) – inclination of the sacrolumbar segment.

Using Posturometer- S the angle of pelvic anteversion was also measured between the symphysis point and the intersection of the line connecting posterior iliac crests with the central posterior body line. The measurements were taken three times in the school year in Groups 1 and 2. The measurements were first conducted in September (b1), next at the beginning of March (b2) and next in June (b3), at the end of the school year. In group 3 which participated in traditional corrective gymnastics classes the measurements were taken twice with a 10-month interval. In Groups 1 and 3 the first measurements were taken prior to aikido classes. The next measurements were taken some time after the subjects started attending the classes. Group 3 did not undergo measurements of pelvic anteversion angle. In Group 2, all the measurements were taken in children who did not participate in any corrective gymnastics classes. All the measurements were taken in afternoon hours.

For the analysis of the studied sample, statistical methods were applied using Statistica 6.1 Pl software. The following statistical tests were applied: F- Snedecor test (w ANOVA) and Student- t test for independent variables.

Results

Variance analysis showed that the between-group differences in alpha angle values of spinal curvatures were insignificant in each measurement. Analysis of the changes in alpha angle values did not show any statistically significant changes (Figures 1,2,3) in the results of subsequent measurements taken in each group. No significant changes in gamma angle values were noted in Groups 1 and 2 either. Group 3 is the only exception with a statistically significant increase in this angle values in measurement 3 at the level $p < 0.05$. It was concluded that the type of group affected the values of pelvic anteversion angle in measurements 2 and 3 at the level $p < 0.01$. Statistically significant differences were noted between measurements 1 and 3 at the level $p < 0.01$. Subsequent measurements in Group 1 revealed a decrease in the mean values of this angle while in Group 2 an increase in the corresponding values was noted.

Discussion

Analysing the results obtained in the reported experiment, we should consider the fact that the experimental group was...
exposed to the effect of selected aikido exercises so that their effect on spinal curvature formation and pelvic anteversion angle, both in the sagittal and the frontal plane was determined. The papers on this issue by Mroczkowski and Jaskolski report that the exercises applied in the studied sample have contributed to the decrease in the lateral curvature of the spine and pelvic asymmetry in the frontal plane [5,8]. Moreover, these exercises have contributed to the increase in hip joint rotation angle in the frontal plane (unpublished materials) [9].

The results reported in this paper show that the applied aikido exercises have not resulted in changes in spinal curvatures in the sagittal plane. Conversely, these exercises have contributed to changes in pelvic anteversion angle. In our study an increase in this angle was noted in the experimental group.

**Figure 2.** Changes in beta angle of the spinal curvature in subsequent measurements taken separately for each group

**Figure 3.** Changes in gamma angle of the spinal curvature in subsequent measurements taken separately for each group
while in the control group this value decreased. It is worth noting, however, that the changes in this angle values were insignificant in both groups. The decrease in pelvic anteversion in the experimental group may result from the fact that in the applied aikido exercises, the subjects often rise after falling engaging the gluteus maximus muscle and ischiocrural muscles. Strengthening of these muscles may result in reduction of pelvic anteversion [7]. There is a well-known statement that changes in pelvic anteversion angles entail changes in lumbar lordosis size and affect the size of the remaining spinal curvatures in the sagittal plane. The obtained changes in pelvic anteversion angle were slight, as the results indicated, therefore they did not cause any changes in spinal curvatures in the sagittal plane. We cannot, however, exclude the potential changes in a long-term experiment. In selected aikido exercises, applied in the experimental group, emphasis was placed on the exercises affecting pelvic muscles and contributing to the increase in hip joint mobility. The author believes that the exercises allowing movements while kneeling, the so called shikko exercises which are necessary to perform aikido techniques while seated, are essential. Walking in shikko exercises requires active engagement of pelvic muscles and hip joint mobility and it is sometimes called “samurai walking” [10]. The changes in pelvic anteversion obtained in the reported experiment indicate that the applied exercises affected the group of muscles responsible for pelvic alignment. This is also confirmed by the reduced asymmetry of pelvic alignment in the frontal plane which has already been reported by Mroczkowski and Jaskolski [8] in the same experimental group.

We can conclude that the literature on the topic lacks descriptions of exercise sets recommended for children for improvement of pelvic alignment. The biomechanical analysis indicates that such exercises would be important for a correct formation of spinal curvatures in children achieved by connecting the pelvis and the vertebral column in the biokinematic chain where changes in one link entail changes in the neighbouring links [1,11].

In order to adapt aikido-specific exercises for sessions with children, the elements of games for children based on combat sports and martial arts were applied [12]. The exercises not only contributed to the formation of a correct body posture, but also were of some functional importance. Martial arts often develop the skills of safe falling, increasing safety of movements in children in case of an unexpected loss of balance. The ability of safe falling can be learned even by people after amputation of lower limbs [13]. This ability [14-19] allows avoiding injuries of the vertebral column during accidental falls. Majoch [20] believes that part of the scoliosis cases which are believed to be idiopathic may be due to an accidental severe fall, e.g. on a concrete panel. According to this author, most cases of idiopathic scoliosis are due to injuries of the vertebral column and dorsal muscles. During falling, the large body parts, particularly spinal muscles, are in contact with the floor. The muscles are exposed to various stress forces from the floor. The mechanical stress affects the vertebral column and its different vertebrae. The author believes that this can cause some activation of the muscles responsible for the correct alignment of vertebrae. This, in turn, may be the factor stimulating a correct development of the vertebral column.

Many authors emphasize the beneficial effect of martial arts on health. Exercises which are the elements of martial arts are increasingly used as forms of different therapies [8,11,21,22,23]. Often the proposed approaches to movement
in traditional corrective gymnastics are poorly adjusted to motor requirements of a child. Children maintain isolated positions too long when performing sets of exercises, e.g. in a lying position [5]. A child needs a greater freedom of movements. This can be obtained by the solutions used in judo or aikido. Instead of lying on one mattress a child exercises with a partner, moving freely on a mat. The partner is a natural “training device”. Such classes are not regarded as a form of treatment, therefore children readily participated in them during the reported experiment.

Conclusions

1. No effect of aikido exercises on alpha, beta and gamma angles of spinal curvatures was found in the sagittal plane.
2. Aikido exercises contributed to reduction of pelvic anteverision angle.
3. The applied aikido exercises actively affected pelvic muscles, resulting in some changes in pelvic alignment.

References


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