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Influence of aikido exercises on mobility of hip joints in children

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Abstract

Background and Study Aim. From biomechanical point of view adequate action on muscles responsible for mobility of hip joints can bring about changes in muscles affecting position of pelvis. Pelvis, on the other hand, as a link in a biokinematic chain can cause changes in the position of spine, especially in its lumbar section. The purpose of the present article was the knowledge about the effect of the selected aikido exercises on the angle of hip joint rotation in the transverse plane.

Material and Methods. The experiment involved 107 boys from 7 to 10 years of age, pupils of the 1st-4th grade of primary school. They were divided into two groups, namely the experimental E one and control C0. The E group consisted of 66 pupils and C0 of 41 boys. The research groups comprised boys exhibiting scoliosis of first degree according to Gruca, as well as boys with threatening scoliosis due to a slanting pelvis position in frontal plane.

The measurements of hip joint mobility in the transverse plane were taken with Posturometre- S. The angle of internal and external rotation was determined. In the C0 group there were children who had never participated in any corrective gymnastics classes, but only attended sports classes prescribed by the curriculum. The children from the control E group performed the selected aikido exercises. The measurements were taken three times during the school year.

Results. In the experimental group the increases of internal and external rotation of hip joints were bigger than in the control group. The results of the total angle of rotation in the left and right hip joint obtained in the third test differed statistically between the groups. A statistical difference between the groups concerning the results obtained for the angle of internal rotation in the left hip joint was also found in the second and third test.

Conclusions. Aikido exercises applied increased the range of the angle of rotation of hip joints in the transverse plane.

Key words: hip joint • scoliosis • pelvis • aikido • martial arts

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Prepared the manuscript and secured the funding.

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Introduction

Numerous articles on aikido [1-3] support the statement, that aikido exercises increase mobility of hip joints. However, the articles available do not provide any data illustrated by empirical investigations with the use of adequate diagnostic methods in order to justify this statement. From biomechanical point of view adequate action on muscles responsible for mobility of hip joints can bring about changes in muscles affecting position of pelvis. Pelvis, on the other hand, as a link in a biokinematic chain can cause changes in the position of spine, especially in its lumbar section and thus bring about changes in spinal curvatures. Slanting pelvis position in transverse plane can create a force rotating vertebra as well as cause asymmetric femoral bone load [4,5]. In case of a child this can lead to an incorrect bone growth. Some researchers reported [6-9] that aikido offers stretching exercises that may prevent formation of lateral spinal curvatures. It is very often that progression of scoliosis comes together with restricted mobility of hip joints.

The purpose of the present article was the knowledge about the effect of the selected aikido exercises on the angle of hip joint rotation in the transverse plane.

Material and Methods

The experiment involved 107 boys from 7 to 10 years of age, pupils of the 1st-4th grade of primary school. They were divided into two groups, namely the experimental E one and control C0. The E group consisted of 66 pupils and C0 of 41 boys. The boys came from primary schools in Konin and Koło. In the C0 group there were children who had never participated in any corrective gymnastics classes, but only attended sports classes prescribed by the curriculum. The children from the control E group performed the selected aikido exercises. Aikido classes were conducted three times a week outside the regular curriculum in the afternoon. Children actively participated in the classes for about 60 minutes. The research groups comprised boys exhibiting scoliosis of first degree according to Gruca, as well as boys with threatening scoliosis due to a slanting pelvis position in frontal plane. The experiment participants were members of the experimental groups E and C0 referred to in the papers by Mroczkowski and Jaskólski [7,8].

Research organization and methods

The assessment of the angle of lateral spinal curvature and the asymmetry of pelvis position in the frontal plane was made following Śliwa method [10] with the use of Posturometer- S device determining location of anthropometrical body points in three-dimensional space, similarly to Ortelius 800 [11]. This method as well as the organization of the measurements aiming at assessing a degree of lateral spinal curvature and pelvis position asymmetry in the frontal plane have already been elaborated by Mroczkowski and Jaskólski [7,8]. The present paper describes measuring of hip joint mobility in the transverse plane with the use of Posturometer S. The angle of internal and external rotation was determined. The examination was carried out following the generally accepted rules of measurement [12-14]. The person examined was lying face down on the floor with the lower limb bent at 90 ° in a knee joint. The pelvis during examination was immobile and controlled by the person taking measurement. The measurements were taken three times during the school year 2002/2003. The first was conducted in September, the second in the beginning of March and the third one in the end of June. The children of the two groups had never attended any corrective gymnastics classes. All the examinations were carried out in morning hours.

Method of exercises

The method of exercises applied did not differ from the ones referred to in previous papers [7,8]. Using the same set of exercises it was examined what influence they had on the angle of lateral spinal curvature, the value of the asymmetry of pelvis position and additionally in this paper on the changes in hip joint rotation. The selected aikido exercises were employed, which to a great extent comprised both stretching as well as bending-rotation exercises. The exercises focused much on walking on knees which is often referred to as “Samurai walk”; [1]. The exercises offered during the experiment were of a play and game character in order to adapt the activity to the needs of a child. These forms are used not only in aikido but in other martial arts as well [15,16]. The important part of the training was the initial phase, the so called warm-up. This phase included numerous stretching-relaxation exercises, which, however, were not very intensive, aiming at, for example, doing the splits.

Results

In order to analyze the research material methods of mathematical statistics were used including the programme Statistica 6.1. The following statistical tests were applied: test F Snedecora (in ANOVA), test Student test for dependent variables. The following abbreviations were used for the values measured c1, c2,…, c6.

The abbreviations used in the table mean:
c1 – total angle of rotation in the left hip joint
c2 – angle of external rotation in the left hip joint
c3 – angle of internal rotation in the left hip joint
c4 – total angle of rotation in the right hip joint
c5 - angle of external rotation in the right hip joint
c6 - angle of internal rotation in the right hip joint

Table 1. The value of t-Student test for the differences between test 1 and test 2 and test 1 and test 3 means the difference of the average, whereas SDR stands for standard deviation for the difference, t means the value of t-Student statistics and p is probability.

Quality	Group E				Group C0			
	r	SDR	t	p	r	SDR	t	p
c1								
2	−6.80	10.85	−5.0937	0.0000	−3.13	5.32	−3.3226	0.0023
3	−8.39	11.89	−5.7351	0.0000	−3.94	7.08	−3.1461	0.0036
c2								
2	−0.59	8.89	−0.5401	0.5910	1.13	4.28	1.4874	0.1470
3	−1.12	8.14	−1.1193	0.2672	0.69	5.37	0.7238	0.4746
c3								
2	−6.52	7.53	−7.0282	0.0000	−4.34	4.71	−5.2188	0.0000
3	−7.61	8.22	−7.5140	0.0000	−4.81	5.99	−4.5477	0.0001
c4								
2	−6.80	11.33	−4.8785	0.0000	−4.69	8.51	−3.1160	0.0039
3	−9.80	12.39	−6.4290	0.0000	−4.97	9.06	−3.1034	0.0041
c5								
2	−3.76	6.59	−4.6312	0.0000	−0.94	5.41	−0.9811	0.3342
3	−3.58	6.99	−4.1544	0.0001	0.34	6.40	0.3039	0.7632
c6								
2	−2.85	10.09	−2.2944	0.0250	−3.88	7.56	−2.8997	0.0068
3	−5.44	11.47	−3.8543	0.0003	−5.44	9.33	−3.2960	0.0025

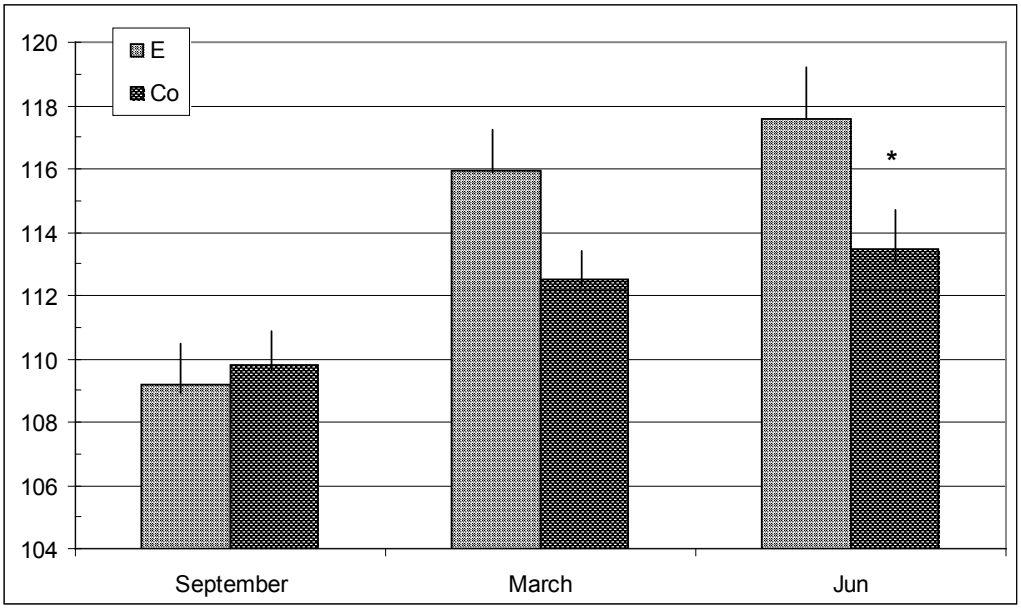

Figure 1. Change of the total angle of rotation (c1) in the left hip joint in successive tests for each group separately. (The differentiation between the groups was marked - * for $p < 0.05$, ** for $p<0.01$)

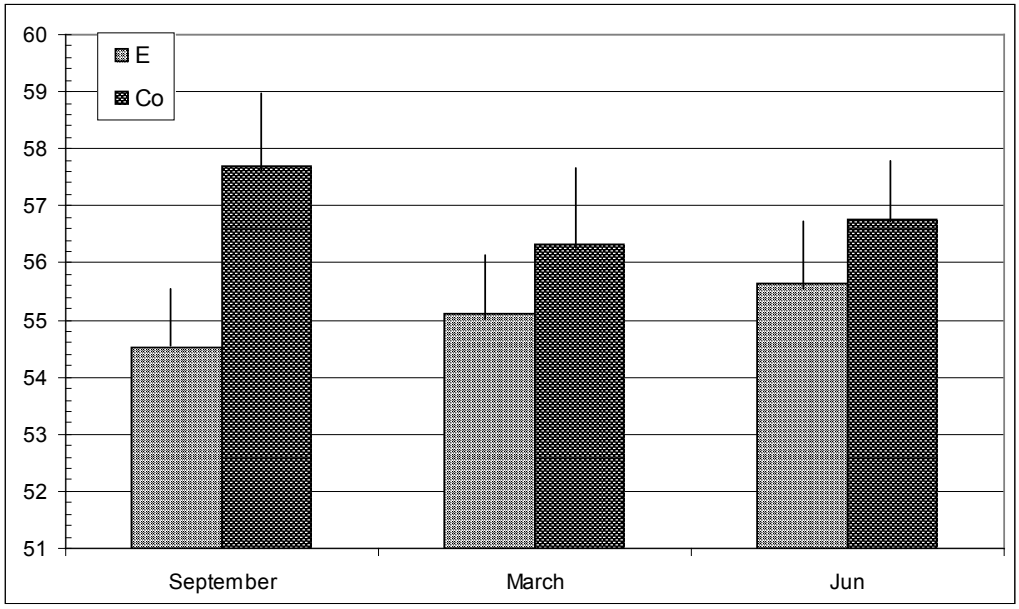

Figure 2. Change of the angle of external rotation (c2) in the left hip joint in successive tests for each group separately.

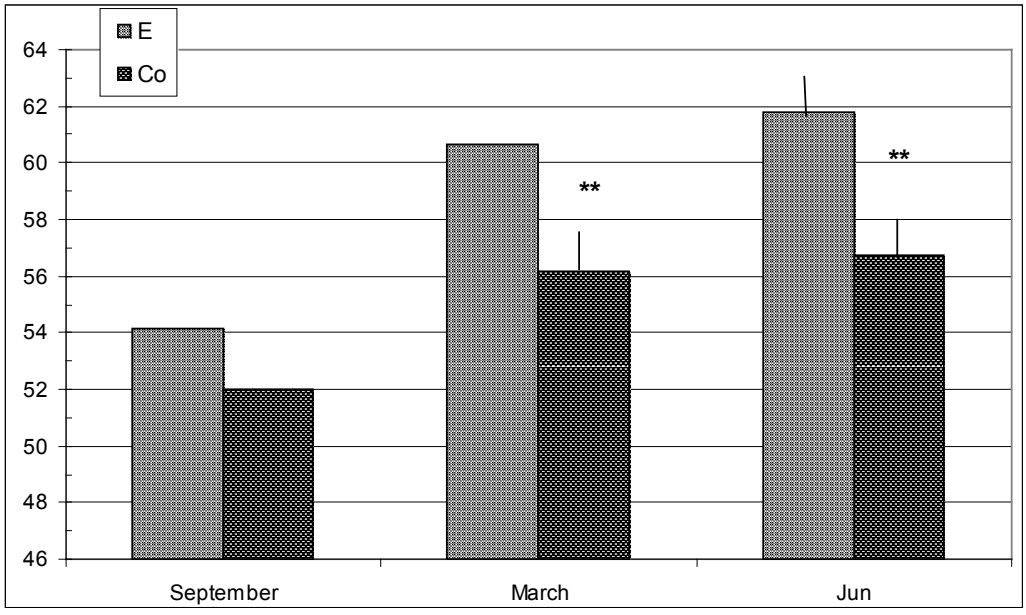

Figure 3. Change of the angle of internal rotation (c3) in the left hip joint in successive tests for each group separately. (The differentiation between the groups was marked - * for $p < 0.05$, ** for $p<0.01$)

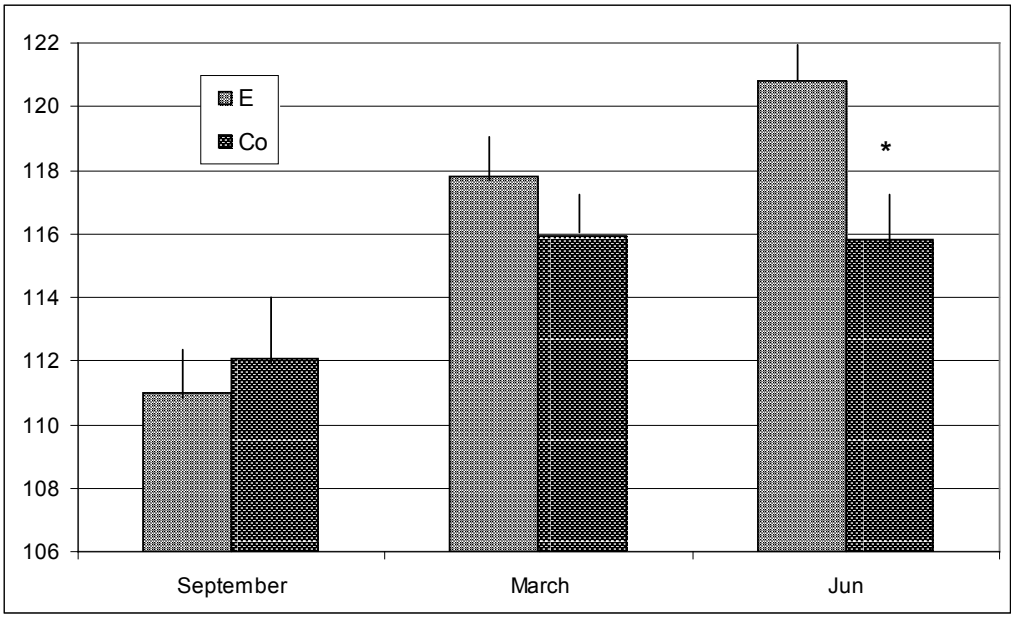

Figure 4. Change of the total angle of rotation (c4) in the right hip joint in successive tests for each group separately. (The differentiation between the groups was marked - * for $p < 0.05$, ** for $p<0.01$)

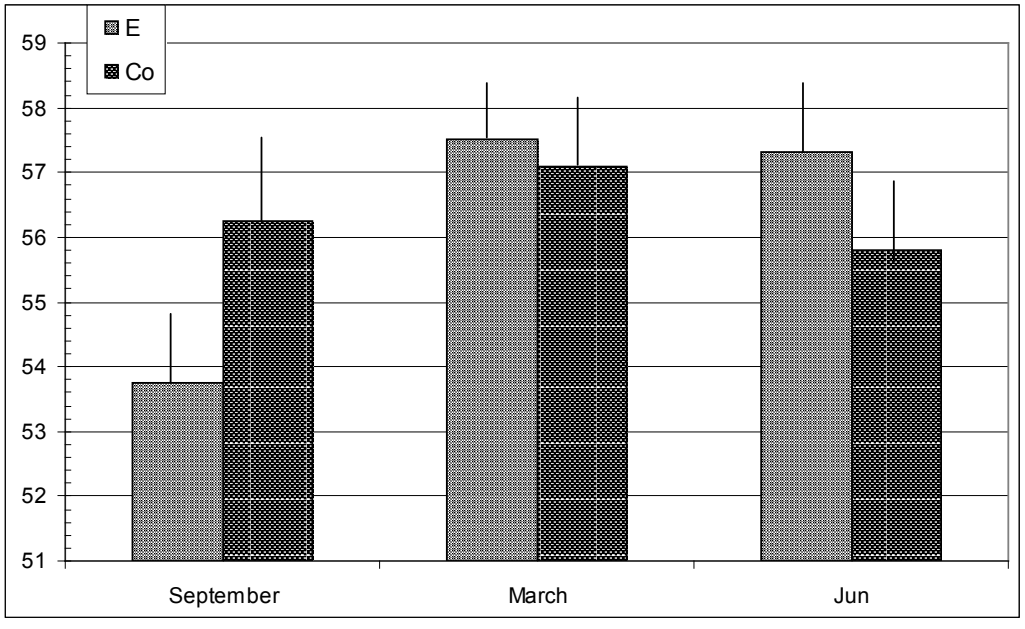

Figure 5. Change of the angle of external rotation (c5) in the right hip joint in successive tests for each group separately.

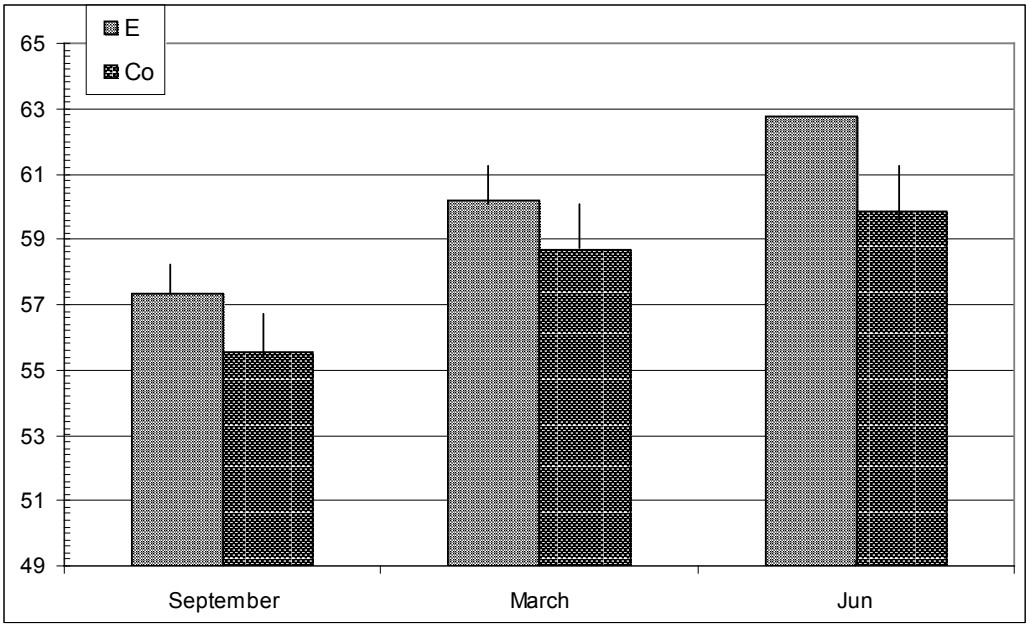

Figure 6. Change of the total angle of rotation (c6) in the right hip joint in successive tests for each group separately.

Statistical results show that for the total angle of rotation in the left hip joint (figure 1) there is a diversity in the significance in successive tests applied to group E and C0, however with a greater significance in group E (the smallest p value – table 1). The analysis of the variance showed a diversity in the significance between the groups only with respect to test 3 ($p<0,05$). No significant differences between the tests carried out in particular groups were found while examining the angle of external rotation in the left hip joint (c2). The type of the group did not influence the value of this feature. However, in group E (figure 2) an increasing tendency of the average value of this angle was noted. Analysis of the changes in the value of internal rotation angle (c3) showed significant statistical differences in both groups. In group E there was a bigger increase in the average value of this angle in comparison with the C0 group (figure 3). Analysis of the variance showed that type of the group had an influence on the value of this feature in test 2 and 3. Analysis of changes in the value of the total angle of rotation in the right hip joint (c4) showed significant differences between the results of tests applied to group E and C0, with a bigger significance in group E. In the test 3 the value of this quality differed significantly in group E and C0. The group type had an influence on the value of this quality in test 3. For the angle of external rotation (figure 5) the type of the group did not effect the value of this quality. Statistical analysis showed in successive tests significant increase in the angle value only in group E (table 1). For the angle of internal rotation (figure 6) the type of the group did not effect the value of this quality as well. A significant statistical increase in this angle value was obtained for both groups in test 2 and 3.

Discussion

Occurrence of restrictions of the mobility of hip joints along with the progression of scoliosis has already been analyzed by many researchers. The restriction of mobility concerning hip joint rotation in the transverse plane [17] is frequently found, the same as asymmetry concerning internal and external rotation of this joint [18]. Karski and et al claim that the main reason for the occurrence of idiopathic scoliosis are the progressing contractures of hip joints including abduction contracture [19]. Cole et al [20] in their research claimed that there was a relationship between the range of internal and external rotation of hip joints and the Cobb angle of scoliosis. The research carried out and referred to in this paper, according to its author, does not allow to conclude about the existence of such a relationship. This is because the analysis concerned boys with a small angle of lateral spinal curvature or just with an asymmetry in pelvis position in the frontal plane.

The exercises applied to the experimental group resulted in a much bigger increase of the angle of rotation of hip joints in the transverse plane than in a control group. The increase of the hip joint mobility was most probably affected by changes occurring in muscles that act on this joint. This may entail some changes in pelvis position. The research material used

for the experiment referred to in this paper is the material used for describing a part of the research results obtained. Analyzing the results obtained Mroczkowski and Jaskólski [7.8] came to the conclusion that by applying the selected aikido exercises it is possible to decrease the angle of lateral spinal curvature as well as to correct pelvis position in the frontal plane. It may be assumed that the exercises applied actively affect the muscles responsible for mobility of hip joints and through a biomechanical chain can influence position of pelvis as a base for correct development of a child's spine.

In the experimental group there was a bigger increase of the angle of rotation in hip joints in the cross section than in the control group.

A bigger increase of the angle of internal rotation than of external rotation of hip joint was observed in the experimental group.

In the control group C0 the increase in the angle of rotation was observed only in case of internal rotation of the hip joint.

Conclusions

Aikido exercises applied increased the range of the angle of rotation of hip joints in the transverse plane.

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