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THE INFLUENCE OF THE COMPREHENSIVE TREATMENT PROCEDURE ON BALANCED POSTURE IN PATIENTS WITH LUMBOSACRAL SPINE AILMENTS

WPŁYW KOMPLEKSOWEGO POSTĘPOWANIA LECZNICZEGO NA POSTAWĘ RÓWNOWAŻNĄ PACJENTÓW Z DOLEGLIWOŚCIAMI BÓLOWYMI KRĘGOSŁUPA W ODCINKU LĘDŹWIOWO-KRZYŻOWYM

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Summary

Introduction. The series of changes in biomechanics of spine and patient's balanced posture is observed when the symptoms associated with lumbosacral spine's ailments occur. As a result of involuntary and unconscious taking the weight off the "affected" side, there is a shift of the center of gravity onto the unaffected side which, in turn, is a reason for intensification of existing ailments or occurrence of new ones.

The aim of this thesis is to assess the balanced posture in patients with lumbosacral spine ailments before and after rehabilitation.

Materials and methods. The study was conducted on the group of 33 patients suffering with lumbosacral spine ailments aged 60-70. The assessment of balanced posture was prepared by means of the TecnoBody PK 252 platform during patients' stay in 21 Military Health Resort Rehabilitation Hospital in Busko Zdrój. Every patient underwent a comprehensive 21-days treatment consisting of the application of kinesiotherapy, physical therapy and balne otherapy.

Results. The comprehensive health resort rehabilitation treatment influenced the improvement of balanced posture parameters i.e. standard deviation forwards-backwards, standard deviation right-left, area of ellipse, perimeter and average speed of postural sways in patients aged suffering from lumbosacral spine ailments.

Conclusions:

1. The comprehensive health resort and rehabilitation treatment in 21 Military Health Resort Rehabilitation Hospital influenced the improvement of balanced posture parameters in patients aged 60-70 suffering from lumbosacral spine ailments.

2. Significant differences occur as far as the assessment of balanced posture is concerned in patients aged 60-70 suffering from lumbosacral spine ailments with open and closed eyes. The differences are noticeable both before and after the treatment.

S t r e s z c z e n i e

W s t ę p . W momencie wystąpienia objawów klinicznych związanych z dolegliwościami bólowymi odcinka lędźwiowo krzyżowego obserwuje się szereg zMarta Hałas et al.mian w biomechanice kręgosłupa oraz postawie równoważnej pacjenta. W wyniku mimowolnego i nieświadomego odciążenia strony „zajętej" dochodzi do przemieszczenia środka ciężkości w stronę niezajętą, co z kolei jest powodem nasilania istniejących dolegliwości lub powodem wystąpienia nowych.

C e l e m p r a c y jest ocena postawy równoważnej pacjentów z dolegliwościami bólowymi kręgosłupa w odcinku lędźwiowo-krzyżowym przed i po postępowaniu rehabilitacyjnym.

M a t e r i a ł i m e t o d y . Badania przeprowadzono na grupie 33 osób z dolegliwościami bólowymi kręgosłupa w odcinku lędźwiowo-krzyżowym w wieku 60-70 lat. Oceny postawy równoważnej dokonano na platformie TecnoBody PK 252 w trakcie pobytu w 21 Wojskowym Szpitalu w Busku Zdroju. U każdego pacjenta zastosowane zostało kompleksowe 21 dniowe postępowanie lecznicze polegające na stosowaniu kinezyterapii, fizykoterapii oraz balneologii. Oceny postawy równoważnej dokonano przed rozpoczęciem terapii i bezpośrednio po jej zakończeniu.

W y n i k i . Kompleksowe leczenie uzdrowiskowo-rehabilitacyjne wpłynęło na poprawę parametrów postawy równoważnej tj: odchylenie standardowe przód-tył, odchylenie standardowe prawa-lewa, pole elipsy, perymetr oraz średnia prędkość wychyleń posturalnych u pacjentów w wieku 60-70 lat z dolegliwościami bólowymi kręgosłupa w odcinku lędźwiowo-krzyżowym.

W n i o s k i :

1. Kompleksowe leczenie uzdrowiskowo-rehabilitacyjnego w 21 WSzUR, ma wpływ na poprawę parametrów opisujących postawę równoważną u pacjentów w wieku 60-70 lat z pacjentów z dolegliwościami bólowymi kręgosłupa w odcinku lędźwiowo-krzyżowym.
2. Występują istotne różnice w ocenie postawy równoważnej pacjentów z dolegliwościami bólowymi kręgosłupa w odcinku lędźwiowo-krzyżowym w wieku 60-70 lat z oczami otwartymi i oczami zamkniętymi. Zarówno przed rozpoczęciem leczenia, jak i po zakończonym leczeniu.

Key words: spinal ailments, balanced posture, stabilometric platform
Słowa kluczowe: dolegliwości bólowe kręgosłupa, postawa równoważna, platforma stabilometryczna

INTRODUCTION

Lumbosacral spine pain syndromes constitute a serious therapeutic problem caused by a huge number of patients of very diverse age, who very often require long-lasting clinical ambulatory and sanatorium treatment [1,2]. A series of changes in biomechanics of spine and patient's balanced posture are observed when the symptoms associated with lumbosacral spine ailments occur. As a result of involuntary and unconscious taking the weight off the "affected" side, there is a shift of the center of gravity onto the unaffected side which, in turn, is a reason for intensification of existing ailments or occurrence of new ones. Examination by means of stabilometric platform enables to obtain modern and objective assessment of the comprehensive treatment effects concerning balanced posture in patients suffering from lumbosacral spine pain syndrome [3, 4, 5].

As far as neurophysiology is concerned, wrong posture habit is the most important aspect in balance disorders. A disorder of one part of the body causes changes in another. This is so called spontaneous compensation which constitutes the basis of pathological afference [6]. A kind of sway range of the body from the vertical posture can be observed during calm, loose standing and that swinging is said to be the indicator of balance maintenance control system. It appears in every person; thus, it is necessary [7,8]. Maintenance of balance both static and dynamic (especially being in move) depends on the proper functioning of so called postural control system which keeps the center of pressure (COP) within the weight-bearing area [9,10,11]. The system is able to counteract external force causing postural destabilization. Central processing and coordination on the basis of both optical information, from vestibule and proprioceptors of skin, ligaments muscles are two main functions of the feedback system. As a result of this integration, an order is sent through the central nervous system to the musculoskeletal system; thus, its aim is to enhance the center of gravity by the change of body position [12, 13].

Impairment of postural control system i.e. central and peripheral nervous system, sensory system and musculoskeletal system is more observable with age. The occurrence of symptoms associated with spinal ailments can cause even more serious stability disorders in aged people [14].

MATERIALS AND METHODS

The study was conducted on the group of 33 patients suffering from lumbosacral spine pains aged 60-70, 22 (67%) of whom were women and 11 (33%) were men. The assessment of balanced posture was

prepared during patients' stay in 21 Military Health Resort Rehabilitation Hospital in Busko Zdrój. Every patient underwent a comprehensive treatment consisting of the application of kinesiotherapy, physical therapy and balneotherapy. The examination was conducted on TecnoBody PK 252 platform. Stability in quiet standing position was assessed in each patient in two 30 seconds trials with open and closed eyes.

The examination was repeated after 21 days. In order to analyze the changes thoroughly, the examination was conducted in every group in the variants below:

Variant 1: concerns the patient's reaction during the examination with open eyes before the therapy and the examination with closed eyes before the therapy;
Variant 2: concerns the changes that occurred between the examination with open eyes before the therapy and the examination with open eyes after the therapy;
Variant 3: concerns the changes that occurred between the examination with closed eyes before the therapy and the examination with closed eyes after the therapy;
Variant 4: concerns the patient's reaction during the examination with open eyes after the therapy and the examination with closed eyes after the therapy;

The following variables were taken into account in the examination:
N – size of research sample,
PX – average C.o.P.X (lateral)
PY – average C.o.P.Y (forwards-backwards)
FB – standard deviation F-B (forwards-backwards)
ML – standard deviation M-L (right-left)
SFB – average speed of postural sways F-B (mm/s)
SML – average speed of postural sways M-L (mm/s)
P – perimeter – track length (mm)
PE - area of ellipse - area plotted during examinations
The obtained results were subjected to statistical analysis by means of STATISTICA program and Microsoft Office Excel.

RESULTS

Tables below present the obtained results of the examination conducted on the stabilometric platform in four variants.

Analyzing the interaction between the results of the parameters obtained during the examination of patients with open eyes and then with closed eyes before the therapy, the statistically significant difference occurred when it comes to the following variables: FB - standard deviation F-B (forwards-backwards), SFB - average speed of postural sways F-B (mm/s), SML - average speed of postural sways M-L (mm/s), P - perimeter - track length (mm), PE - area of ellipse - area plotted during examinations.

Tab. I. *Comparison of the results of examination in patients with open eyes before the therapy and the examination in patients with closed eyes before the therapy*
Tab. I. *Porównanie wyników badań pacjentów uzyskanych przed leczeniem z otwartymi oczami, a badaniem pacjentów przed leczeniem z zamkniętymi oczami*

	N	p
PX & PX1	33	0.116956
PY & PY1	33	0.587633
FB & FB1	33	0.000125
ML & ML1	33	0.125106
SFB & SFB1	33	0.000005
SML & SML1	33	0.002235
P & P1	33	0.000010
PE & PE1	33	0.003133

Tab. II. *Comparison of the variables in which statistically significant differences occurred*
Tab. II. *Porównanie zmiennych, w których występują istotne różnice statystyczne*

	Mean	Standard Deviation		Mean	Standard Deviation
FB	9.273	2.577	FB1	11.879	3.533
SFB	19.212	3.879	SFB1	28.364	9.165
SML	7.485	3.327	SML1	9.939	6.077
P	578.061	123.298	P1	827.576	265.567
PE	716.939	633.1127	PE1	1008.061	806.1089

The most significant difference concerned average speed of postural sways SFB and perimeter, where means before the therapy in patients with open eyes were 19.212 mm/s and 578.061 mm respectively, and before the therapy in patients with closed eyes these indicators increased significantly and were 28.364 mm/s and 827.576 mm respectively.

It proves that there is a faster reaction of the balance system when the eyes are open than in case of closed eyes. Noticeable differences concern average speed of postural sways SML and area of ellipse i.e. before the therapy in patients with open eyes the results were 7.485 mm/s and 716.939 mm^2, respectively, and before the therapy in patients with closed eyes - 9.939 mm/s and 1008.061 mm^2, respectively. Higher parameter associated with the area o ellipse with closed eyes indicates that a patient needs more space to do the

test than in case of open eyes. More precise differences are presented in table III. The values of these indicators increased similarly to the other two.

Tab. III. *Comparison of the results of examination in patients with open eyes before the therapy and the examination in patients with open eyes after the therapy*

Tab. III. *Porównanie wyników badań pacjentów uzyskanych przed leczeniem z otwartymi oczami, a badaniem pacjentów po leczeniu z otwartymi oczami*

	N	p
PX & PX2	33	0.729395
PY & PY2	33	0.057051
FB & FB2	33	0.002137
ML & ML2	33	0.004550
SFB & SFB2	33	0.169731
SML & SML2	33	0.098093
P & P2	33	0.091314
PE & PE2	33	0.000195

When it comes to the interaction between the results obtained during the examination of patients with open eyes before the therapy and the examination of patients with open eyes after the therapy, a significant difference occurred when it comes to the following variables: FB - standard deviation F-B (forwards-backwards), ML - standard deviation M-L (right-left), PE - area of ellipse - area plotted during examinations.

Tab. IV. *Comparison of the variables in which statistically significant differences occurred*

Tab. IV. *Porównanie zmiennych, w których występują istotne różnice statystyczne*

	Mean	Standard Deviation		Mean	Standard Deviation
FB	9.273	2.577	FB2	7.788	2.132
ML	4.030	2.568	ML2	2.636	0.822
PE	716.939	633.113	PE2	388.030	173.425

In the first examination, the patients with open eyes held their position not satisfactorily enough in the area of ellipse the value of which was 716.939 mm^2, whereas after the therapy the mean of that area was 388.03 mm^2. The area was reduced almost by half which proves that after the therapy, patients need less space to hold their balance in test with open eyes. Also standard deviation of FB (forwards-backwards) decreased from 9.237 to 7.788 and of ML (right-left) from 4.03 mm to 2.636 mm which proves the improvement of balanced posture control.

Tab.V. *Comparison of the results of examination in patients with closed eyes before the therapy and the examination in patients with closed eyes after the therapy*

Tab. V. *Porównanie wyników badań pacjentów uzyskanych przed leczeniem z zamkniętymi oczami, a badaniem pacjentów po leczeniu z zamkniętymi oczami*

Analyzing the interaction between the results obtained during the examination of patients with closed eyes before the therapy and the examination of patients with closed eyes after the therapy, a significant difference occurred between almost all examined parameters that is: FB - standard deviation F-B (forwards-backwards),
ML - standard deviation M-L (right-left), SFB - average speed of postural sways F-B (mm/s), SML - average speed of postural sways M-L (mm/s), P - perimeter - track length (mm), PE - area of ellipse - area plotted during examinations.

Tab. VI. *Comparison of the variables in which statistically significant differences occurred*

Tab. VI. *Porównanie zmiennych, w których występują istotne różnice statystyczne*

	Mean	Standard Deviation		Mean	Standard Deviation
FB1	11.879	3.533	FB3	9.424	3.545
ML1	4.364	2.447	ML3	3.394	1.456
SFB1	28.364	9.165	SFB3	25.303	7.892
SML1	9.939	6.077	SML3	7.667	3.416
P1	827.576	265.5671	P3	696.515	242.6850
PE1	1008.061	806.1089	PE3	593.212	335.1283

As it is shown in table VI, all parameters in which significant changes are observed decreased. As far as the area of ellipse is concerned this change is almost doubled since in first examination the mean was 1008.061 mm^2 and after the therapy it was 593.212 mm^2. The value decrease is observed in FB standard deviations mean which before the therapy in patients with closed eyes was 11.879 mm and after the therapy it was reduced to 9.424 mm. It is definitely the proof of better postural control and better muscle-motor stabilization.

Tab. VII. *Comparison of the results of examination in patients with open eyes after the therapy and the examination in patients with closed eyes after the therapy*

Tab. VII. *Porównanie wyników badań pacjentów uzyskanych po leczeniu z otwartymi oczami, a badaniem pacjentów po leczeniu z zamkniętymi oczami*

	N	p
PX2 & PX3	33	0.127401
PY2 & PY3	33	0.781264
FB2 & FB3	33	0.002064
ML2 & ML3	33	0.000953
SFB2 & SFB3	33	0.000021
SML2 & SML3	33	0.002030
P2 & P3	33	0.000033
PE2 & PE3	33	0.000446

Similarly to the previous variant, the analysis of the changes between parameters' values obtained from the examination of patients with open and closed eyes after the therapy proved that almost all variables changed significantly: FB - standard deviation F-B (forwards-backwards), ML - standard deviation M-L (right-left), SFB - average speed of postural sways F-B (mm/s), SML - average speed of postural sways M-L (mm/s), P - perimeter - track length (mm), PE - area of ellipse - area plotted during examinations

Tab. VIII. *Comparison of the variables in which statistically significant differences occurred*

Tab. VIII. *Porównanie zmiennych, w których występują istotne różnice statystyczne*

	Mean	Standard Deviation		Mean	Standard Deviation
FB2	7.788	2.132	FB3	9.424	3.545
ML2	2.636	0.822	ML3	3.394	1.456
SFB2	18.273	4.274	SFB3	25.303	7.892
SML2	5.939	2.030	SML3	7.667	3.416
P2	528.212	91.4282	P3	696.515	242.6850
PE2	388.030	173.4246	PE3	593.212	335.1283

After the therapy, there are still some differences in open/closed eyes examinations but they concern 6 parameters. Before the therapy, in open/closed eyes examinations these differences concerned 5 variables. However, after the analysis it can be inferred that differences between these examinations are significantly less remarkable after the therapy than before it. Parameters in open/closed eyes examination both after and before the therapy increased. The most remarkable difference can be observed in the area of ellipse i.e. with open eyes the mean was 388.03 mm^2 and with closed eyes - 593.212 mm^2. The track length (P) also slightly increased, i.e. with open eyes it was 528.212 mm and with closed eyes - 696.515 mm. Precise parameter are placed in table VIII.

DISCUSSION

According to the conducted research, it is proved that significant differences occur when it comes to the assessment of balanced posture in patients aged 60-70 with open and closed eyes. Both before and after the therapy these differences occurred. In the examination before the therapy the area of ellipse (PE) in patients with open eyes compared to those with closed eyes increased from 716.939 mm^2 to 1008.061 mm^2; thus, the difference was 261.122 mm^2, i.e. 40.61%.

In the examination after the therapy those parameters decreased by half but yet, PE with open eyes was 388.03 mm^2 and with closed eyes 539.212 mm^2, which gives the difference of 52.88 %, i.e. 205.182 mm^2. The increase of the area of ellipse in examination with open eyes versus closed eyes proves that visual control serves a significant role in the maintenance of balanced posture.

Decreased area of ellipse is the evidence of better postural control. The values of PE were lower after the therapy, which is also a proof of enhanced proprioception. Further analysis of the group during the examination with open versus closed eyes, before and after the therapy, showed that at the beginning of the therapy there were following percentage differences: for SFB - average velocity of postural excursions 47.64% whereas the perimeter, which is the track length covered by the center of gravity, during the test was prolonged by 43.16%.

According to conducted research, it is proved that a significant difference between the variables occurred, as far as the interaction between the results obtained before the therapy in patients with open eyes and after the therapy in patients with open eyes is concerned. The area of ellipse is the parameter that changed significantly during the examination of patients with open eyes both before and after the therapy. The more limited this area is, the better muscular stability and proprioception are. This parameter decreased by 45.88% i.e. 328.909 mm^2. In the final test the mean of the area of ellipse was 388.03 mm^2. The other parameters, i.e. FB - standard deviation (forwards-

backwards) and ML - standard deviation (right-left) also changed in this test. The FB variable decreased by 16.01% and ML one by 34.59%. The reduction of these average deviations signifies the improvement of balanced posture after the therapy. The area of ellipse was reduced after the therapy which was also the case in the examinations with open and closed eyes. Standard deviations FB (forwards-backwards) and ML (right-left) decreased after the therapy which was the case in the final examinations with open and closed eyes.

A significant difference of SML (average speed of postural sways right-left) in final examination with closed eyes occurred and was as high as 22.86%. The acceleration of balance system's reaction proves the appropriate function of comprehensive treatment. Furthermore, there were differences in the group concerning two other variables: SFB -average speed of postural sways forwards-backwards and perimeter (P - the track length). These variables decreased in the final examination with closed eyes by 10.79% and by 15.84, respectively.

Both clinical data and examinations results showed that active lifestyle, good physical condition, performance of physical exercises increasing body mass and muscular strength support better postural control. Therefore, the ability to maintain balance is increased, the perception of stimuli, including visual ones is improved, reaction time is shortened and proper muscle tension is easily produced [15]. To sum up, it can be inferred that health resort treatment perfectly combines three basic forms: prevention, treatment and rehabilitation. Available treatments are applied here complementarily and comprehensively, most important of which are those using natural resources of the particular region or area. Comprehensive rehabilitation is of a great therapeutic importance by strengthening the muscular corset, increasing the mobility of the spine by improving the blood perfusion to all of its joints, relaxing the reflexively contracted muscles, relieving the pain and restoring a proper body posture. The rehabilitation also prevents the fixing of motor stereotypes [16].

CONCLUSIONS

1. The comprehensive health resort and rehabilitation treatment in 21 Military Health Resort Rehabilitation Hospital influenced the improvement of balanced posture parameters in patients aged 60-70 suffering from lumbosacral spine ailments.

2. Significant differences occur as far as the assessment of balanced posture is concerned in patients aged 60-70 suffering from lumbosacral spine ailments with open and closed eyes. The differences are visible both before and after the treatment.

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