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Zmiany wskaźnika stabilności oraz kontrolowanej równowagi u pacjentów po przebytej alloplastyce stawu biodrowego we wczesnym okresie pooperacyjnym

The Evolution of Index of Stability and Controlled Balance in Patients After Alloplastic Surgery of the Hip Joint in the Early Postoperative Period

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Streszczenie

Wstęp. Zmiany zwyrodnieniowe stawu biodrowego stanowią jedną z najczęstszych przyczyn dolegliwości bólowych u pacjentów w średnim i starszym wieku. Ponadto dochodzi do spadku aktywności oraz obniżenia jakości życia w sferze psychicznej, społecznej i fizycznej.

Cel pracy. W niniejszej pracy podjęto próbę analizy zmian wskaźnika stabilności posturalnej statycznej u pacjentów po zabiegu alloplastyki stawu biodrowego. Celem pracy jest ocena zmian środka ciężkości ciała pacjentów poddanych temu zabiegowi.

Materiał i metody. Badania zostały przeprowadzone w SPSZOZ Szpitalu Miejskim w Elblągu, na Oddziale Chirurgii Urazowej i Ortopedycznej. Do badań stabilograficznych wykorzystano platformę balansową BIODEX.

Badanie było przeprowadzone dwukrotnie, po raz pierwszy przed wykonaniem zabiegu alloplastyki, drugi raz w ostatni dzień pobytu pacjenta na oddziale (najczęściej była to 6-7 doba). Badanie polegało na zrealizowaniu przez badanych stania w sposób naturalny w pozycji pionowej na całych stopach z otwartymi oczami. Badanie składało się z 3 prób, każda trwała 20 sekund. Objętych badaniem było 85 osób.

Wnioski. 1. We wszystkich pomiarach, tj. wyniku ogólnym, we wskaźniku A/P i M/L, procentowym czasie obciążenia poszczególnych stref oraz kwadrantów nie odnotowano różnic pomiędzy wskaźnikami przed zabiegiem i po zabiegu operacyjnym. Badani podobnie funkcjonowali w czasie badania przed zabiegiem operacyjnym jak i po zabiegu. 2. Przed operacją gorszy wynik ogólny osiągnęli mężczyźni niż kobiety. Osoby z koksartrozą lewostronną osiągnęły gorszy wynik we wskaźniku M/L niż osoby z kosartrozą prawostronną co świadczy o większej asymetryczności miednicy w płaszczyźnie M/L u osób z lewostronną koksartrozą.
3. Po operacji gorszy ogólny wynik uzyskały kobiety niż mężczyźni. Kobiety również uzyskały gorsze wyniki we wskaźnikach A/P i M/L niż mężczyźni. 4. Przed operacją jak i po operacji ogólny gorszy wynik osiągnęły osoby niższe niż osoby wyższe. Po operacji gorsze wyniki uzyskały osoby z niższym wzrostem we wskaźniku A/P i M/L. 5. Po operacji zmieniła się wartość wskaźnika M/L na nieistotny statystycznie co sugeruje, że poprawiło się ustawienie miednicy w płaszczyźnie czołowej po operacji u badanych.
6. Osoby z wyższym wzrostem mają mniejsze odchylenia od środka ciężkości ciała po zabiegu operacyjnym. 7. Analiza wykazała iż wraz ze wzrostem wieku badanych wzrasta wskaźnik procentowy czasu w strefie C co świadczy o znacznym odchyleniu od osi ciała.

Słowa kluczowe:
Zmiany zwyrodnieniowe stawu biodrowego, wskaźnik stabilności, alloplastyka stawu biodrowego

Abstract

Background.Degenerative disorders of the hip joint are one of the most common causes of pain in patients in middle and old ages. In addition to pain, there occurs reduced activity and quality of life in the areas of psychology, social relations and physical fitness.

Aim of the study. In this work we have made an attempt to analyze the evolution of static postural stability in patients after the alloplastic hip joint surgery. The aim of the study was to evaluate the change of the center of gravity of the body in patients after the treatment.

Material and methods. The research has been carried out in SPSZOZ Municipal Hospital in Elblag, in the Department of Trauma and Orthopedic Surgery. For the stabilographic examinations we used the BIODEX balance platform.

The examinations were carried out twice, fist time before the alloplastic procedure, and second time on the last of the patient's stay in hospital (usually it would be 6th-7th day). The examination involved the patients standing naturally in vertical position, on the whole feet and with open eyes. There were 3 attempts, each lasting 20 seconds. In the study participated 85 persons.

Results. 1. In all the measurements, ie. in the overall result, the indicators A/P and M/L, percentage of time with the load on the particular zones and quadrants, there were no significant differences between the indicators before and after the surgical treatment. The study participants similarly functioned during the tests both, before and after the surgical procedure. 2. Before the surgery worse overall result obtained men than women. Persons with left side coxarthrosis obtained worse result in the indicator M/L than persons with right side coxarthrosis, which indicate greater asymmetry of the pelvis, in M/L plane, in patients with left side coxarthrosis. 3. After the surgery worse overall result obtained women than men. Women also obtained worse results in terms A/P and M/L indicators, than men. 4. Both, before and after the surgery, the overall worse results were obtained by shorter patients, in comparison to those who were taller. After the surgery, worse results obtained shorter persons in the A/P and M/L indicators.
5. After the surgery value of the indicator M/L changed to statistically insignificant, which suggests, that after the surgery position of pelvis improved in the frontal plane, in the examined patients,. 6. After the surgery, the taller persons have smaller deviations from their center of gravity. 7. The analysis showed, that along with the growing age of the patients, also grows the indicator of the percentage of time in zone C, which indicates a significant deviation from the axis of the body.

Key words:
degenerative disorders of the hip joint, index of stability, alloplastic surgery of the hip joint

Introduction

Degenerative disorders of the hip joint are one of the most common causes of pain in patients in middle and old ages. In addition to pain, there occurs reduced activity and quality of life in the areas of psychology, social relations and physical fitness [1].

Degenerative hip joint disorders (coxarthrosis) are the disease due to premature wear and degeneration of tissues forming the joint. In the course of disease the articular cartilage is being destroyed, and this results in irritation of nerve endings in the uncovered subchondral bone layer. At the bones epiphyses osteophytes are being formed. The most common symptom of the hip joint degeneration is pain in the inguinal and gluteal regions, which radiates in the anteromedial side of a thigh toward a knee. The pain sensation increases with the development of changes in the joint. In the first phase of disease, pain occurs when walking and during a significant physical effort, and subsides during the periods of rest. With the disease development, the pain occurs also at rest. Gradually there is a reduction of mobility in the diseased joint. In the beginning, the decreased range of motion applies to internal rotation, then subsequently to abduction and adduction. In the advanced stage of the disease, restricted range of motion occurs in all planes of the joint [2].

Change in the patients posture becomes apparent, it is caused by the pain and by the limited range of motion. Typical symptom is the foot placement on the side with the disorder, the toes are pointing outside. Patients tend to adopt antalgic posture - flexion, adduction and external rotation, which in turn may cause generating of compensating patterns - anteversion of pelvis, increased range of motion in the sacro-iliac and hip joints, on the healthy side. It also occurs, that joint stabilizing structures are stretched, in order to ensure smooth locomotion, which causes a knee contracture in flexion and external rotation. This may result in degenerative changes in the knee joint [3]. In advanced stage of the disease, noticeable becomes an inefficient pathological gait, which makes it necessary to use the walking aids such as canes, crutches or walkers. In bilateral coxarthrosis a duck gait occurs.

With the ever-increasing incidence rate of the disease, today we have no medications which would effectively slow down its development. In the advanced cases of degenerative changes in hip and knee joints, among the currently available methods of treatment the most effective is endoprosthesis implantation in the damaged joint [4].

Balance in the Lower Extremities Disorders

Control of proper posture and maintaining it continuously is a complex process, involving the central nervous system, and visual and muscular systems. Diseases or progressing process of aging worsens the balance control efficiency, which may lead to weakening of stability and consequently to falls, and those in turn may cause severe injuries and deterioration in quality of life (fear of the next fall, chronic pain, loss of physical fitness) [5].

Full control of the body, after such major procedure as the alloplastic hip joint surgery, is important in order to avoid the possible fall and any related complications.

Aim of the Study

In this work we have made an attempt to analyze the evolution of static postural stability in patients after the alloplastic hip joint surgery. The aim of the study was to evaluate the change of the center of gravity of the body in patients after the treatment. The following research questions were formulated:

1. Does the alloplastic hip surgery significantly affect indicators of balance in the early postoperative period, in comparison with the preoperative period?
2. Do the gender, hip side, patient's height and age influence in a significant way indicators of the level of balance before the treatment?
3. Do the gender, hip side, patient's height and age influence in a significant way indicators of the level of balance after the treatment?

In addition, stabilographic platform can be used, aside from the balance examination, for the body balance exercises. Such exercise is carried out by the proper balancing of the body. The indicator on the screen, which shows the changes of the center of pressure position, must reach certain points. This exercise is to improve the visual - motor coordination. In addition, the measuring set allows to determine the uniformity of load distribution between the left and right lower extremities. Exercises on the platform help the patient to evenly distribute the load between both extremities. Possible use of the platform for balance exercises, and the achieved results, will be discussed in detail in the next publication.

Research Materials and Methods

The research has been carried out in SPSZOZ Municipal Hospital in Elblag, in the Department of Trauma and Orthopedic Surgery. For the stabilographic examinations we used the BIODEX balance platform.

The examinations were carried out twice, fist time before the alloplastic procedure, and second time on the last of the patient's stay in hospital (usually it would be 6th-7th day). The examination involved the patients standing naturally in vertical position, on the whole feet and with open eyes. There were 3 attempts, each lasting 20 seconds. In the study participated 85 persons.

Postural stability test examines the ability of a patient to maintain the center of balance. Score of a patient in this test depends on the number of deviations from the center, which means the less points means better result and vice versa.

In the interpretation of the stability test results, we can point out:

1. General stability index: reflects deviation of the platform from horizontal plane, and is expressed in degrees. High value of the stability index indicates, that the patient has made many movements, which means, that he or she has problems with balance. Difference between right and left lower extremities can be determined.

2. Stability Indicator A/P: reflects the variations of the position of the platform for movements in the sagittal plane, and is expressed in degrees
3. Medial/lateral stability index M/L: reflects the variations of the position of the platform for movements in the frontal plane, and is expressed in degrees.
4. Percentage of time in a zone/quadrant: these values represent the percentage of the entire test time, during which a patient remained in a given zone/quadrant.
The target zones A, B, C, D are equal to the degree of the tilt of the platform. They are determined by the concentric circles, with their center at the center of the platform, as described below:
• Zone A: from zero to five degrees deviation in relation to horizontal plane
• Zone B: 6–10 degrees deviation in relation to horizontal plane
• Zone C: 11–15 degrees deviation in relation to horizontal plane
• Zone D: 16-20 degrees deviation in relation to horizontal plane
Quadrants represent four quarters of the test graph between the axis X and Y, as described below (Fig. 1).

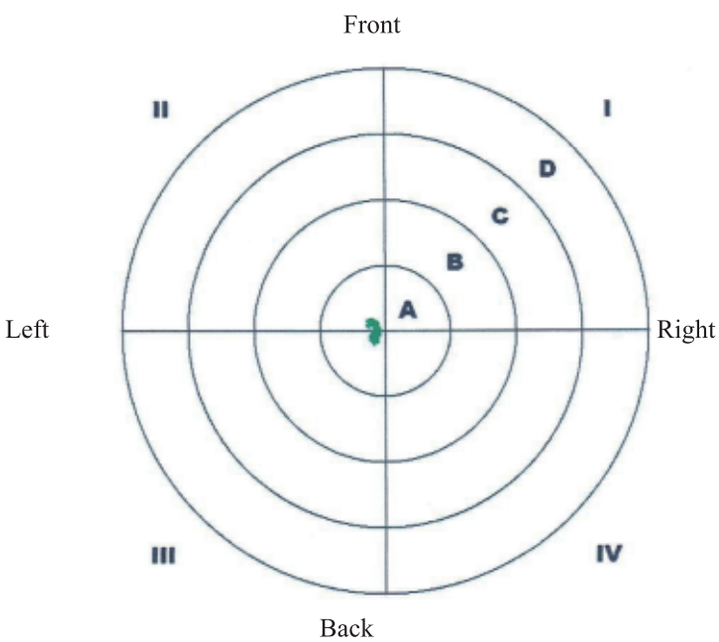

Fig. 1. Test graph

For the “both feet protocol”:
• Quadrant 1 = front right
• Quadrant 2 = front left
• Quadrant 3 = back left
• Quadrant 4 = back right
All statistical calculations were performed using the statistical package IBM SPSS 22 and the Excel 2010 spreadsheet.
Quantitative variables have been characterized using the arithmetic mean, standard deviation, minimum and maximum values. While qualitative variables have been

presented using counts and percentages. The significance of differences between the two groups was examined with the Mann Whitney U test. In the case of the model of two related variables, we used the Wilcoxon matched pairs test. In order to establish links between the force and direction between variables, a correlation analysis was applied, through calculation of the Spearman correlation coefficients. For all the calculations the level of significance was set at $p < 0.05$.

Characteristics of the Study Participants

In the study participated 85 patients. The youngest tested patient was Min = 21 years old, and the oldest Max = 80 years old, mean age was M = 64.16, with a standard deviation of SD = 10.65.

Table 1. Characteristics of the Study Participants

Descriptive statistics	N	Min	Max	M	SD
Age	85	21	80	64.16	10.65
General information			**N=85**		**%**
Gender					
Woman			48		56.5
Man			37		43.5
Height					
151-165			44		51.8
166-186			41		48.2
Hip					
Right			36		42.4
Left			49		57.6

Research Results

In order to verify the first issue of the research (first research question) a non-parametric Wilcoxon matched pairs test was used. The analysis showed no relationship between the variables. In all the measurements, ie. in the overall result, the stability indicators A/P, M/L, percentage of time with the load on the particular zones and quadrants, there were no significant differences between the indicators before and after the treatment:

- The overall result: $Z = 0.21$; $p = 0.832$. No statistically significant differences (Fig. 2, 3).
- Indicator A/P: $Z = 0.39$; $p = 0.695$. No statistically significant differences (Fig. 4, 5).
- Indicator M/L: $Z = 0.61$; $p = 0.541$. No statistically significant differences (Fig. 6, 7).
- Load time percentage in zone A: $Z = 1.04$; $p = 0.297$. No statistically significant differences (Fig. 8, 9).
- Load time percentage in zone B: $Z = 0.84$; $p = 0.398$. No statistically significant differences (Fig. 10, 11).
- Load time percentage in zone C: $Z = 0.36$; $p = 0.717$. No statistically significant differences (Fig. 12, 13).

• Load time percentage in zone D: Z = 1.46; p = 0.144. No statistically significant differences (Fig. 14, 15).
• Load time percentage in quadrant I: Z = 0.87; p = 0.385. No statistically significant differences (Fig. 16, 17).
• Load time percentage in quadrant II: Z = 0.52; p = 0.604. No statistically significant differences (Fig. 18, 19).
• Load time percentage in quadrant III: Z = 0.58; p = 0.561. No statistically significant differences (graphs 20, 21.) (Fig. 2, 3.)
• Load time percentage in quadrant IV: Z = 0.20; p = 0.842. No statistically significant differences (Fig. 22, 23.)

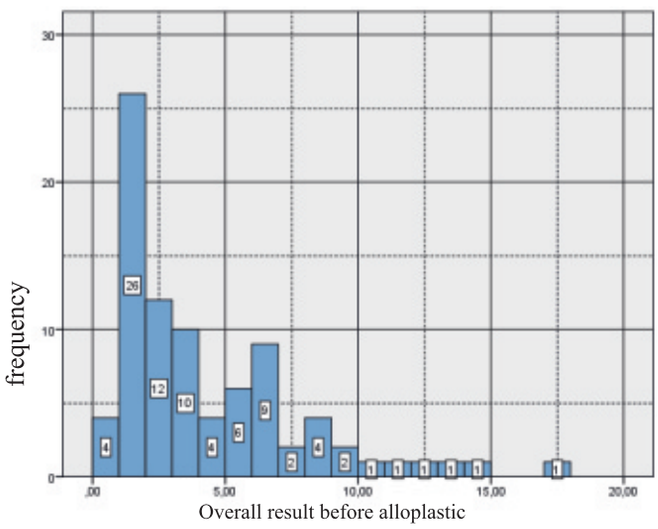

Fig. 2. Overall result obtained in patients before alloplastic hip joint surgery

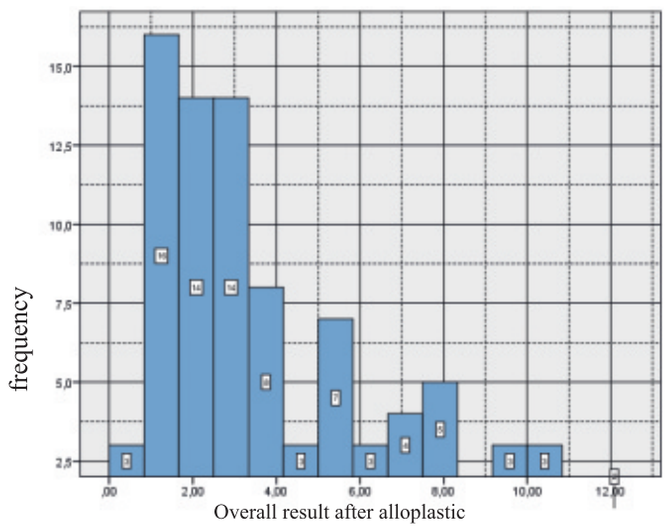

Fig. 3. Overall result obtained in patients after alloplastic hip joint surgery

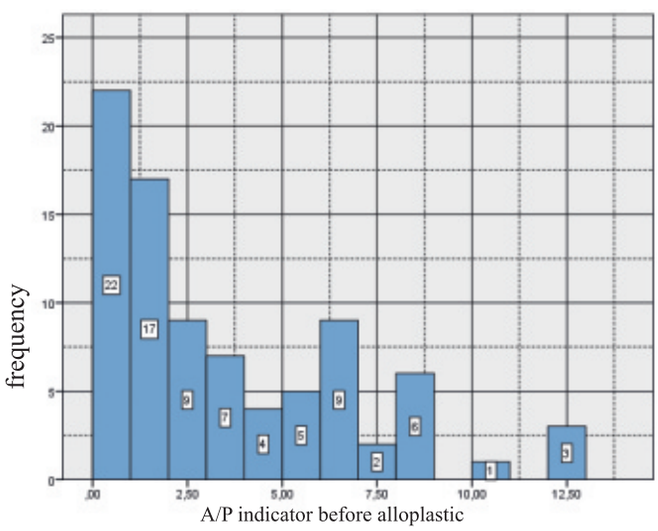

Fig. 4. Value of indicator A/P obtained in patients before alloplastic hip joint surgery

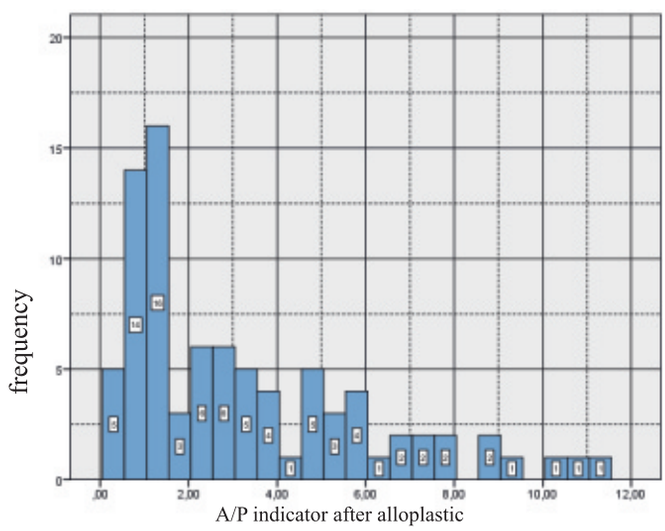

Fig. 5. Value of indicator A/P obtained in patients after alloplastic hip joint surgery

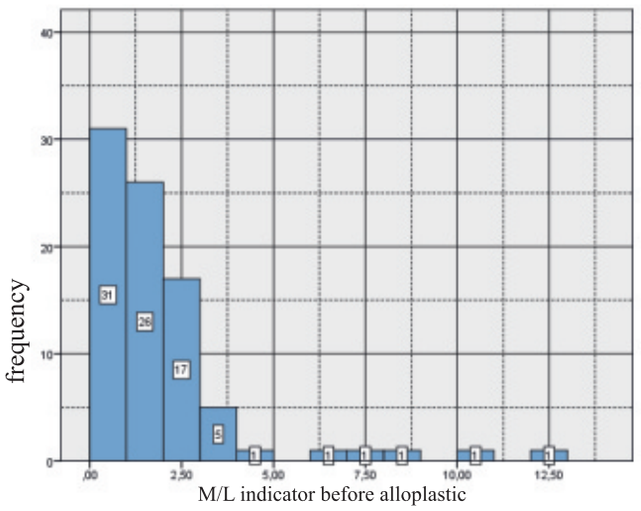

Fig. 6. Value of indicator M/L obtained in patients before alloplastic hip joint surgery

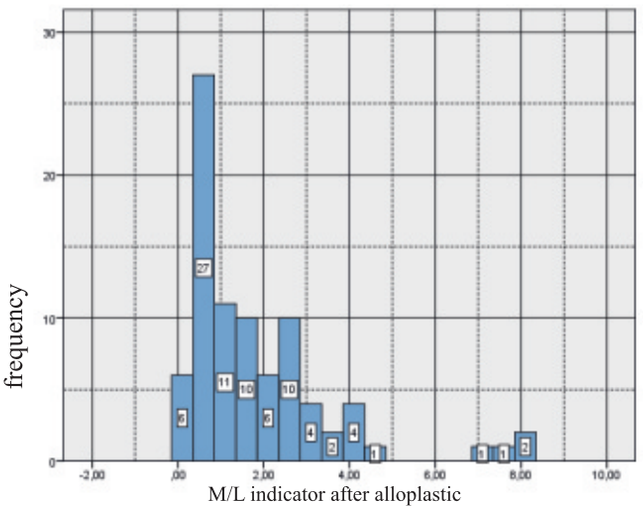

Fig. 7. Value of indicator M/L obtained in patients after alloplastic hip joint surgery

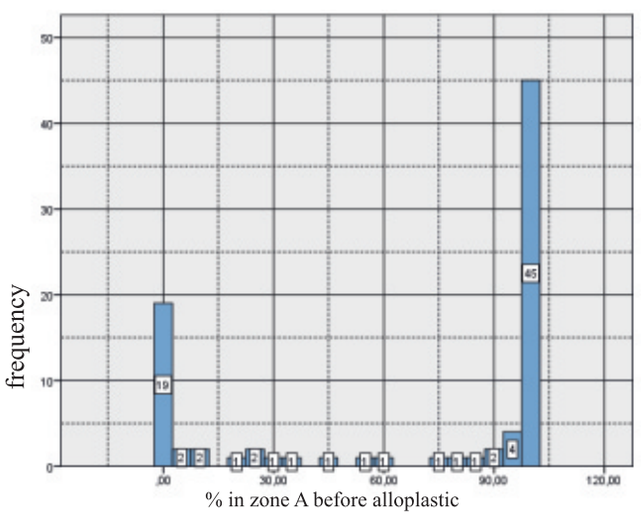

Fig. 8. Percentage of time for the load placed in zone A obtained in patients before alloplastic hip joint surgery

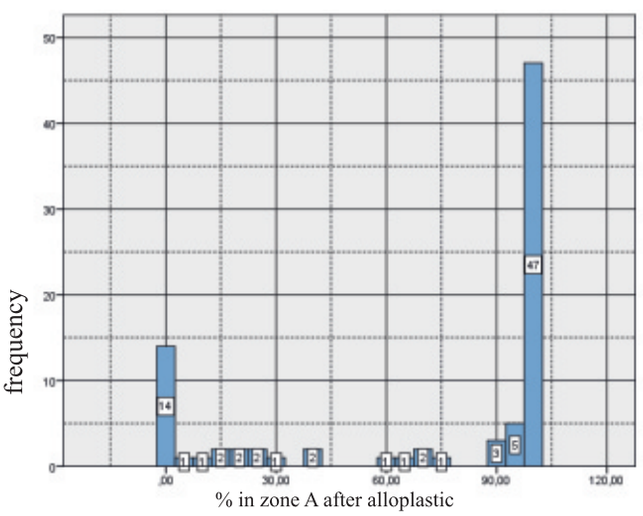

Fig. 9. Percentage of time for the load placed in zone A obtained in patients after alloplastic hip joint surgery

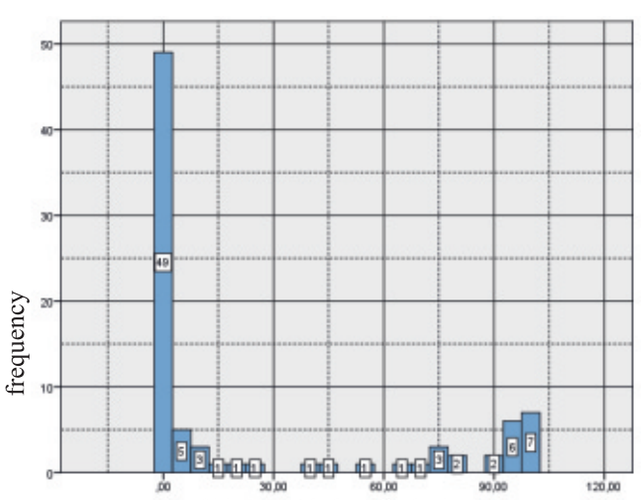

Fig. 10. Percentage of time for the load placed in zone B obtained in patients before alloplastic hip joint surgery

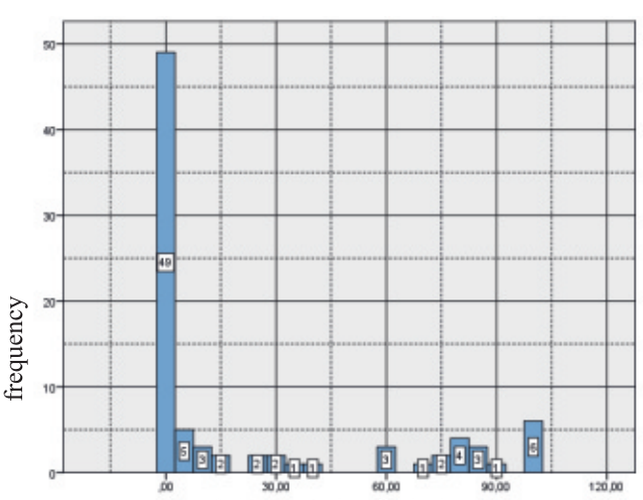

Fig. 11. Percentage of time for the load placed in zone B obtained in patients after alloplastic hip joint surgery

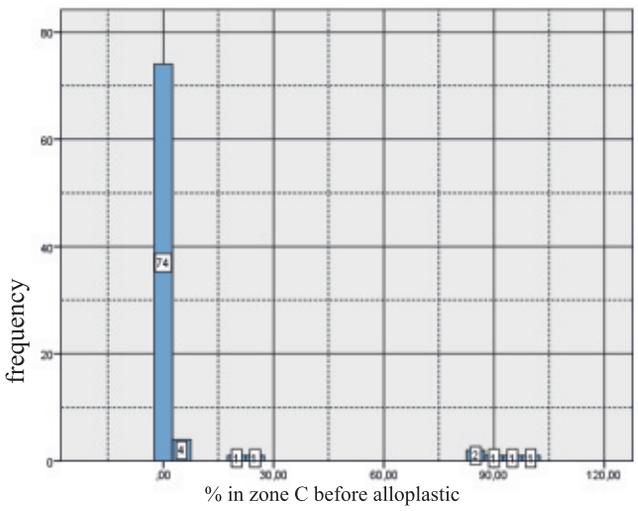

Fig. 12. Percentage of time for the load placed in zone C obtained in patients before alloplastic hip joint surgery

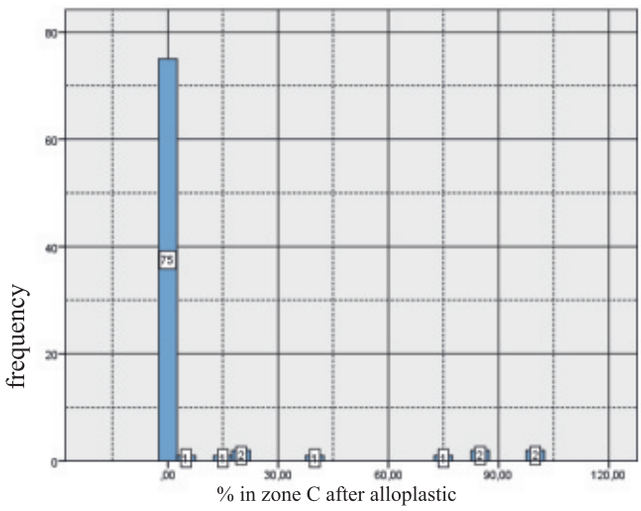

Fig. 13. Percentage of time for the load placed in zone C obtained in patients after alloplastic hip joint surgery

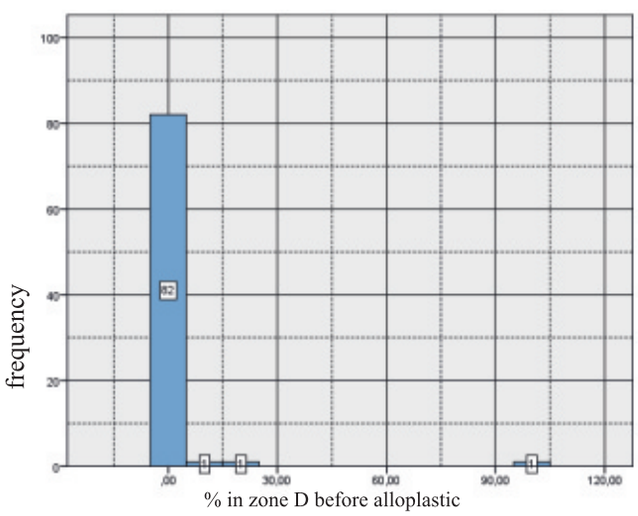

Fig. 14. Percentage of time for the load placed in zone D obtained in patients before alloplastic hip joint surgery

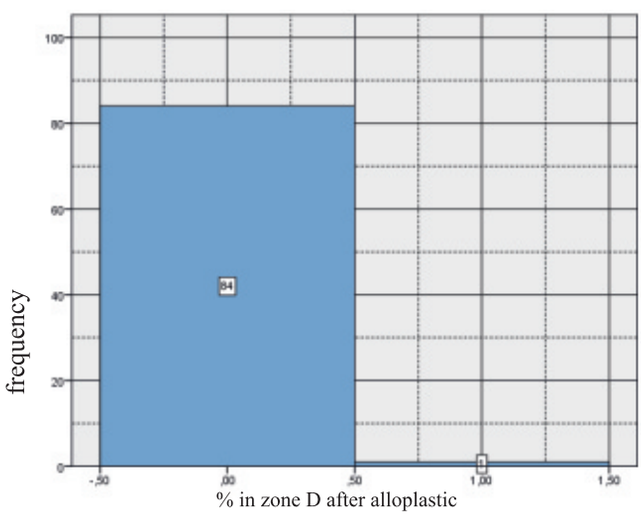

Fig. 15. Percentage of time for the load placed in zone D obtained in patients after alloplastic hip joint surgery

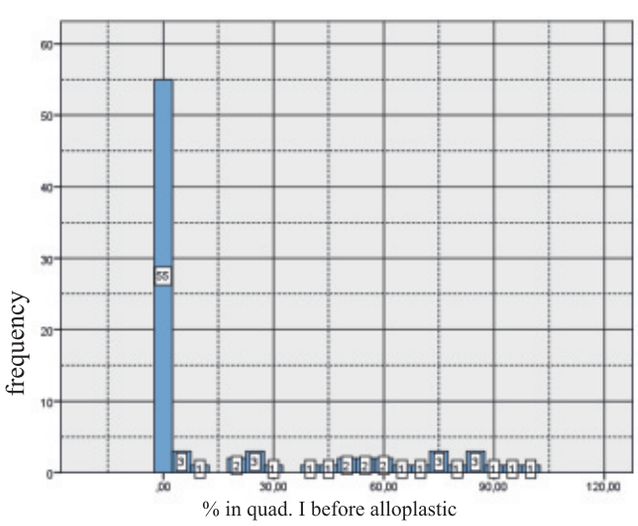

Fig. 16. Percentage of time for the load placed in quadrant I obtained in patients before alloplastic hip joint surgery

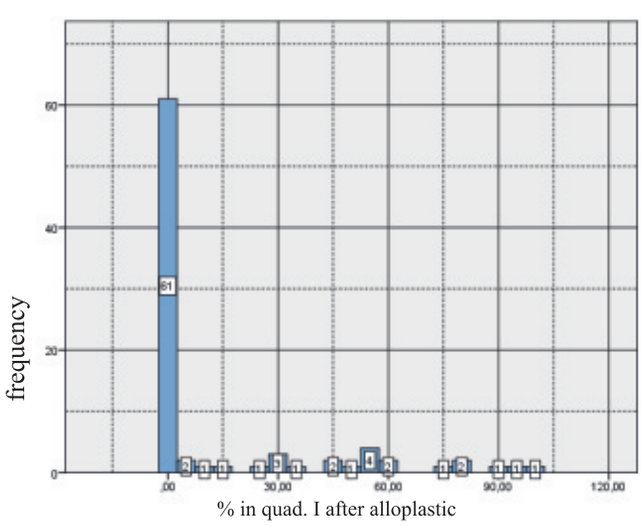

Fig. 17. Percentage of time for the load placed in quadrant I obtained in patients after alloplastic hip joint surgery

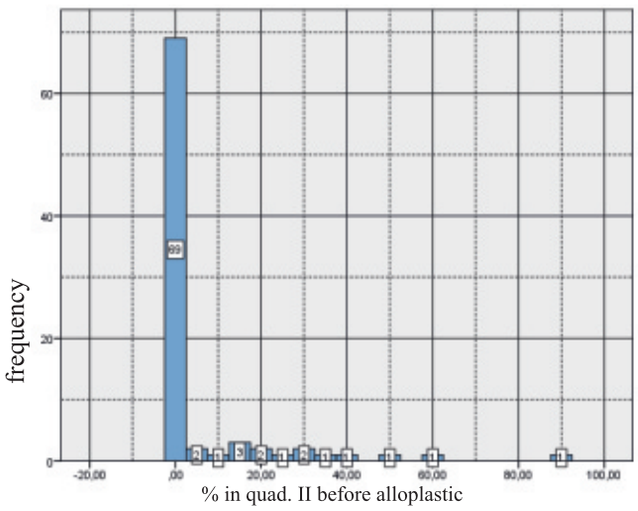

Fig. 18. Percentage of time for the load placed in quadrant II obtained in patients before alloplastic hip joint surgery

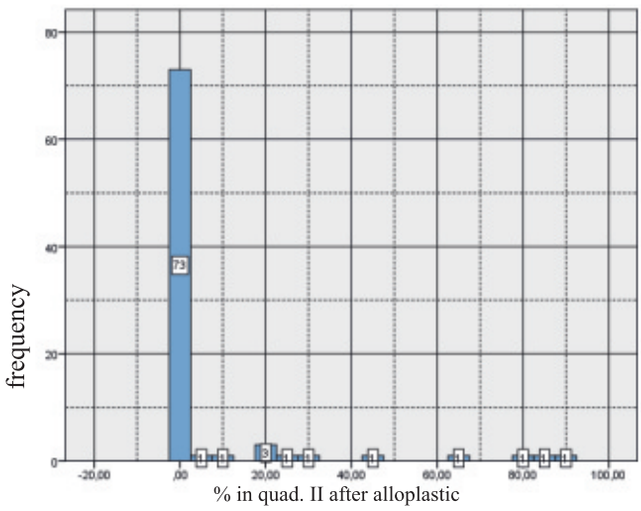

Fig. 19. Percentage of time for the load placed in quadrant II obtained in patients after alloplastic hip joint surgery

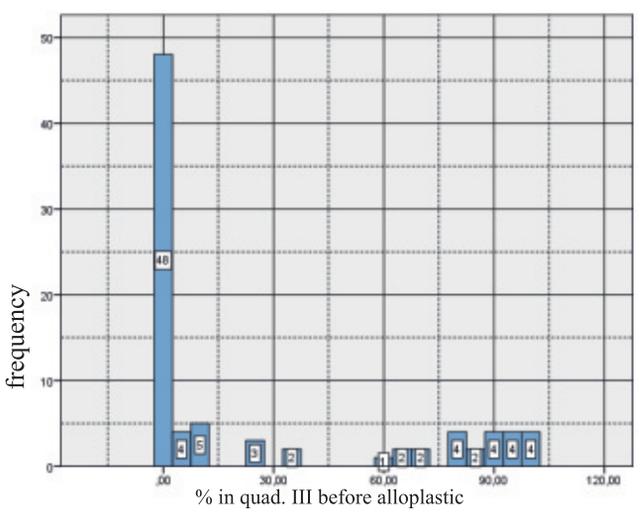

Fig. 20. Percentage of time for the load placed in quadrant III obtained in patients before alloplastic hip joint surgery

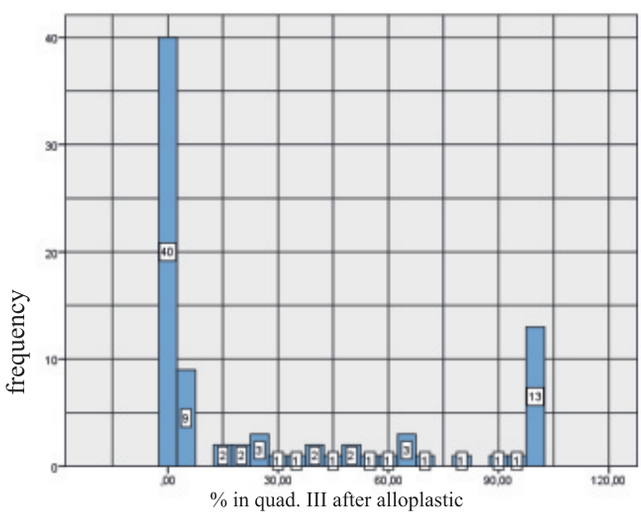

Fig. 21. Percentage of time for the load placed in quadrant III obtained in patients after alloplastic hip joint surgery

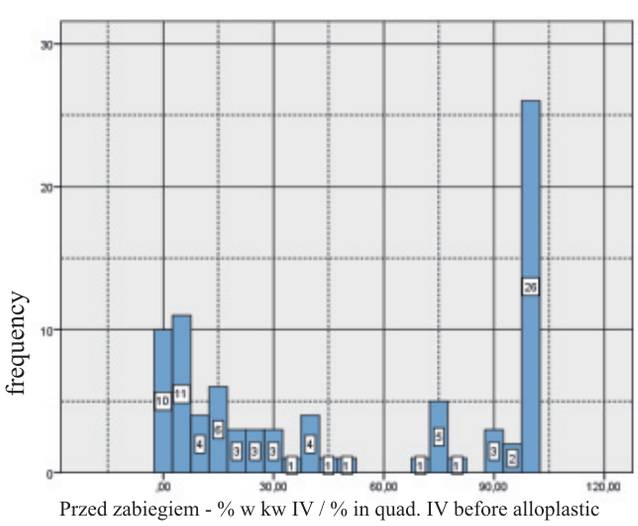

Fig. 22. Percentage of time for the load placed in quadrant IV obtained in patients before alloplastic hip joint surgery

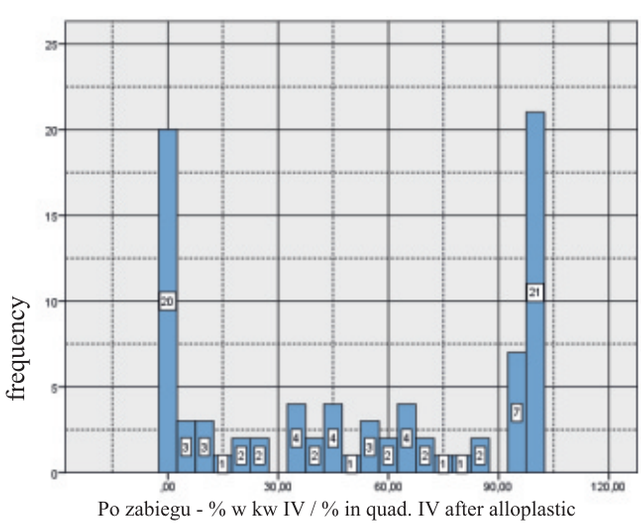

Fig. 23. Percentage of time for the load placed in quadrant IV obtained in patients after alloplastic hip joint surgery

Table 2. Correlations of indicators before and after the procedure

Correlations of indicators before and after the procedure	N	rHO	p
Overall result	85	0.44	**0.000**
A/P	85	0.39	**0.000**
M/L	85	0.32	**0.003**
% time percentage in zone A	85	0.39	**0.000**
% time percentage in zone B	85	0.19	0.083
% time percentage in zone C	85	0.48	**0.000**
% time percentage in zone D	85	-0.21	0.850
% time percentage in quadrant I	85	0.19	0.086
% time percentage in quadrant II	85	0.07	0.504
% time percentage in quadrant III	85	0.26	**0.018**
% time percentage in quadrant IV	85	0.29	**0.006**

The results of the measurements were related to each other, this means that the examined patients were functioning similarly before the surgery and after.
Do the gender, hip side, patient's height and age influence in a significant way indicators of the level of balance before the treatment?

In order to verify this research issue for the variables of gender, hip side and height there was applied the Mann Whitney U test, while for the variable of age it was the Spearman correlation test.

Gender

Table 3. Gender vs Indicators before the procedure

Gender vs indicators	Gender	N	M	SD	Z	p
Overall result	woman	48	**2.21**	3.92	2.81	**0.005**
	man	37	**3.00**	2.47		
A/P	**woman**	48	**4.53**	3.65	2.92	**0.004**
	man	37	**2.15**	1.82		
M/L	woman	48	1.94	2.14	1.09	0.277
	man	37	1.66	2.04		
% time percentage in zone A	woman	48	**52.81**	45.72	2.89	**0.004**
	man	37	**83.70**	34.21		
% time percentage in zone B	**woman**	48	**36.42**	42.48	2.60	**0.009**
	man	37	**12.92**	29.60		
% time percentage in zone C	woman	48	8.06	24.35	1.59	0.113
	man	37	3.38	16.80		
% time percentage in zone D	woman	48	2.71	14.66	1.54	0.124
	man	37	0.00	0.00		
% time percentage in quadrant I	woman	48	20.13	32.47	0.21	0.834
	man	37	16.43	27.84		
% time percentage in quadrant II	woman	48	4.69	13.08	0.11	0.916
	man	37	6.59	17.27		
% time percentage in quadrant III	woman	48	21.02	36.01	1.54	0.123
	man	37	32.08	39.67		
% time percentage in quadrant IV	woman	48	54.17	43.17	1.09	0.275
	man	37	44.89	39.50		

The analysis showed significant differences between the measurements before the treatment. The statistically significant higher indicators of the level of balance had women than men, in the stability indicator A/P $Z = 2.92$; $p < 0.05$ and % of time in zone B $Z = 2.60$; $p < 0.05$. In contrast, men had higher indicators than women in the overall result $Z = 2.81$; $p < 0.05$ and % of time in zone A $Z = 2.89$; $p < 0.05$. Please note that the higher the indicator value, the worse the result. In the overall result women were better than men, while in the A/P indicator men were better. In other measurements, there were found no statistically significant differences $p > 0.05$.

Hip

Table 4. Hip vs indicators before the procedure

Hip vs indicators	Hip	N	M	SD	Z	p
Overall result	right left	36 49	3.76 4.61	2.97 3.87	0.93	0.350
A/P	right left	36 49	3.10 3.78	2.77 3.49	0.53	0.593
M/L	right **left**	36 49	**1.51** **2.04**	1.75 2.30	1.98	**0.048**
% time percentage in zone A	right left	36 49	69.78 63.67	44.01 43.71	0.56	0.576
% time percentage in zone B	right left	36 49	26.72 25.80	40.86 38.03	0.01	0.992
% time percentage in zone C	right left	36 49	3.50 7.88	15.06 25.06	0.18	0.854
% time percentage in zone D	right left	36 49	0.00 2.65	0.00 14.51	1.50	0.133
% time percentage in quadrant I	right left	36 49	18.11 18.82	30.13 30.94	0.15	0.884
% time percentage in quadrant II	right left	36 49	6.72 4.63	15.45 14.73	1.03	0.301
% time percentage in quadrant III	right left	36 49	32.50 20.94	39.93 35.82	1.71	0.088
% time percentage in quadrant IV	right left	36 49	42.67 55.61	40.77 41.80	1.40	0.163

Statistically significant higher values defining the stability indicator M/L had the patients before the surgery on left hip than those before the surgery on right hip $Z = 1.98$; $p < 0.05$. In other measurements, there were found no statistically significant differences $p > 0.05$.

Higher indicator value means worse result, which in turn means that patients with the left hand side coxarthrosis had more asymmetric pelvis in the frontal plane, than patients with the right-hand side coxarthrosis.

Height

Table 5. Height vs Indicators before the procedure

Height vs indicators	Height	N	M	SD	Z	p
Overall result	**151-165 cm**	44	**5.27**	4.00	2.61	**0.009**
	166-186 cm	41	**3.15**	2.55		
A/P	**151-165 cm**	44	**4.58**	3.69	2.83	**0.005**
	166-186 cm	41	**2.33**	2.07		
M/L	151-165 cm	44	1.98	2.22	0.97	0.333
	166-186 cm	41	1.64	1.95		
% time percentage in zone A	151-165 cm	44	**53.23**	45.67	2.44	**0.015**
	166-186 cm	41	**80.24**	37.11		
% time percentage in zone B	**151-165 cm**	44	**35.02**	41.86	1.94	**0.050**
	166-186 cm	41	**16.71**	33.70		
% time percentage in zone C	**151-165 cm**	44	**8.80**	25.32	1.94	**0.050**
	166-186 cm	41	**3.05**	15.97		
% time percentage in zone D	151-165 cm	44	2.95	15.30	1.69	0.091
	166-186 cm	41	0.00	0.00		
% time percentage in quadrant I	151-165 cm	44	18.16	31.67	0.59	0.553
	166-186 cm	41	18.90	29.41		
% time percentage in quadrant II	151-165 cm	44	3.64	10.42	1.01	0.312
	166-186 cm	41	7.54	18.62		
% time percentage in quadrant III	151-165 cm	44	21.77	36.35	1.74	0.083
	166-186 cm	41	30.20	39.32		
% time percentage in quadrant IV	151-165 cm	44	56.43	42.88	1.45	0.147
	166-186 cm	41	43.37	39.64		

The analysis showed significant differences between the measurements before the treatment. Statistically significant higher values defining the level of balance had shorter patients than those taller in the overall result $Z = 2.61$; $p < 0.05$, in the stability indicator A/P $Z = 2.83$; $p < 0.05$, % of time in zone B $Z = 1.94$; $p = 0.05$ and % of time in zone C $Z = 1.94$; $p = 0.05$, while the taller patients had higher indicators of % of time in zone A than shorter patients $Z = 2.44$; $p < 0.05$. In other measurements, there were found no statistically significant differences $p > 0.05$.

Shorter persons obtained worse results than taller persons. Shorter persons obtained worse results also for stability indicator in the plane A/P than taller persons. The taller patients in 80.24% placed the load in zone A (shorter patients in 53.23%). Time of placing the load in zone B was dominated by shorter persons (35.02%) in comparison to taller persons (16.71%.)

Age

The analysis showed no relationship between the variables. The age of patients does not affect the level of indicators determining the level of balance before the treatment.

Do the gender, hip side, patient's height and age influence in a significant way indicators of the level of balance after the treatment?

In order to verify this research issue for the variables of gender, hip side and height there was applied the Mann Whitney U test, while for the variable of age it was the Spearman correlation test

Table 6. Correlations of indicators before the procedure vs age

Correlations of indicators before procedure vs age	N	rHO	p
Overall result	85	0.10	0.386
A/P	85	0.07	0.537
M/L	85	0.11	0.322
% time percentage in zone A	85	-0.06	0.604
% time percentage in zone B	85	0.06	0.576
% time percentage in zone C	85	0.19	0.081
% time percentage in zone D	85	-0.01	0.892
% time percentage in quadrant I	85	0.01	0.958
% time percentage in quadrant II	85	-0.02	0.875
% time percentage in quadrant III	85	0.02	0.823
% time percentage in quadrant IV	85	-0.09	0.430

Gender

Table 7 Gender vs gender after surgery

Gender vs indicators	Gender	N	M	SD	Z	p
Overall result	**woman**	48	**4.93**	3.33	2.65	**0.008**
	man	37	**2.92**	1.79		
A/P	**woman**	48	**4.08**	3.23	2.23	**0.026**
	man	37	**2.23**	1.47		
M/L	**woman**	48	**2.13**	1.85	2.35	**0.019**
	man	37	**1.44**	1.51		
% time percentage in zone A	woman	48	**59.23**	44.60	2.40	**0.016**
	man	37	**86.08**	30.45		
% time percentage in zone B	woman	48	29.33	37.49	1.73	0.084
	man	37	13.78	30.25		
% time percentage in zone C	**woman**	48	**11.44**	28.06	2.33	**0.020**
	man	37	**0.11**	0.46		
% time percentage in zone D	woman	48	0.00	0.00	1.14	0.255
	man	37	0.03	0.16		
% time percentage in quadrant I	woman	48	12.81	24.75	0.47	0.640
	man	37	15.62	28.95		
% time percentage in quadrant II	woman	48	4.44	14.88	0.64	0.523
	man	37	7.81	21.87		
% time percentage in quadrant III	woman	48	32.88	41.81	0.53	0.597
	man	37	22.97	32.90		
% time percentage in quadrant IV	woman	48	49.88	41.92	0.31	0.758
	man	37	53.59	38.93		

The analysis showed significant differences between the measurements after the treatment. Statistically significant higher values defining the level of balance had women than men in the overall result $Z = 2.65$; $p < 0.05$, in stability

indicator A/P Z = 2.23; $p < 0.05$, in stability indicator M/L Z = 2.35; $p < 0.05$, % of time in zone C Z = 2.89; $p < 0.05$, while the % of time in zone A higher level of the indicator had men than women Z = 2.40; $p < 0.05$. In other measurements, there were found no statistically significant differences $p > 0.05$.
After the surgery worse overall result had women (4.93) than men (2.92). Worse results women had also in terms of indicators A/P and M/L, in comparison with men.
Time percentage of placing load in zone A was greater for men (86.08%), than for women (59.23%). While in women there was definitely larger time percentage of load placed in zone C (11.44%) than in men (0.11%).

Hip

Table 8. Hip left right vs indicators after the procedure

Hip vs indicators	Hip	N	M	SD	Z	p
Overall result	right left	36 49	3.91 4.16	2.64 3.15	0.05	0.961
A/P	right left	36 49	3.17 3.35	2.57 2.92	0.12	0.904
M/L	right left	36 49	1.67 1.94	1.62 1.82	0.90	0.369
% time percentage in zone A	right left	36 49	71.44 70.53	41.80 41.02	0.26	0.793
% time percentage in zone B	right left	36 49	25.47 20.43	39.01 32.36	0.36	0.720
% time percentage in zone C	right left	36 49	3.06 9.04	14.69 25.58	1.53	0.127
% time percentage in zone D	right left	36 49	0.03 0.00	0.17 0.00	1.17	0.243
% time percentage in quadrant I	right left	36 49	10.53 16.61	24.33 28.06	0.87	0.384
% time percentage in quadrant II	right left	36 49	9.78 3.06	22.56 13.77	0.99	0.322
% time percentage in quadrant III	**right** left	36 49	**48.06** **14.24**	41.37 28.70	4.13	**0.000**
% time percentage in quadrant IV	right **left**	36 49	**31.64** **66.08**	37.10 36.70	4.16	**0.000**

Statistically significant higher values determining balance level for time % in quadrant III had patients after the surgery on right hip than those after the surgery on left hip Z = 4.13; $p < 0.001$, while higher indicators of time % in quadrant IV had patients after the surgery on left hip, than those after the surgery on right hip Z = 4.16; $p < 0.001$. In other measurements, there were found no statistically significant differences $p > 0.05$.
These results may indicate the involuntary, reflexive taking off the load of the extremity after surgery. The patients after the right side extremity alloplastic surgery placed the load for a higher percentage of time on quadrant III, while those after the left side alloplastic surgery placed the load longer on quadrant IV.

Height

Table 9 Height vs indicators after surgery

Height vs indicators	Height	N	M	SD	Z	p
Overall result	**151-165 cm**	44	**5.04**	3.35	2.81	**0.005**
	166-186 cm	41	**3.00**	1.93		
A/P	**151-165 cm**	44	**4.12**	3.26	2.09	**0.037**
	166-186 cm	41	**2.36**	1.72		
M/L	**151-165 cm**	44	**2.26**	1.90	2.87	**0.004**
	166-186 cm	41	**1.36**	1.42		
% time percentage in zone A	151-165 cm	44	**59.59**	44.32	1.99	**0.046**
	166-186 cm	41	**83.07**	33.82		
% time percentage in zone B	151-165 cm	44	27.93	36.11	1.16	0.246
	166-186 cm	41	16.80	33.67		
% time percentage in zone C	**151-165 cm**	44	**12.48**	29.11	2.68	**0.007**
	166-186 cm	41	**0.10**	0.44		
% time percentage in zone D	151-165 cm	44	0.00	0.00	1.04	0.300
	166-186 cm	41	0.02	0.16		
% time percentage in quadrant I	151-165 cm	44	14.45	26.78	0.44	0.662
	166-186 cm	41	13.59	26.58		
% time percentage in quadrant II	151-165 cm	44	2.14	6.74	1.37	0.170
	166-186 cm	41	9.95	24.80		
% time percentage in quadrant III	151-165 cm	44	33.09	42.21	0.16	0.870
	166-186 cm	41	23.71	33.42		
% time percentage in quadrant IV	151-165 cm	44	50.32	41.74	0.08	0.936
	166-186 cm	41	52.76	39.50		

The analysis showed significant differences between the measurements after the treatment. Statistically significant higher values defining the level of balance had shorter patients than those taller in the overall result $Z = 2.81$; $p < 0.05$, in the stability indicator A/P $Z = 2.09$; $p < 0.05$, in the stability indicator M/L $Z = 2.87$; $p < 0.05$m and % of time in zone C $Z = 2.68$; $p < 0.05$, while the taller patients had higher indicators of % of time in zone A than shorter patients $Z = 1.99$; $p < 0.05$. In other measurements, there were found no statistically significant differences $p > 0.05$.
Shorter persons obtained worse result (5.04) than taller persons (3.00). The shorter persons also had worse results than the taller ones in the indicators A/P and M/L. Taller persons placed more load on zone A (83.07%) than those shorter (59.59%). Time percentage of placing load in zone C was far greater for the shorter patients (12.48%), than for the taller ones (0.10%). The results show, that the taller patients more easily maintain their balance and less deviate from their center of gravity, after the surgery.

Age
The analysis showed, that along with the growing age of the patients, also grows the indicator of the % of time in zone C $rHO = 0.22$, $p < 0.05$. In other measurements, there was found no statistically significant relation $p > 0.05$. The below graph shows the statistical dispersion for the below dependency.

Table 10. Correlations of indicators after the procedure vs age

Correlations of indicators before procedure vs age	N	rHO	p
Overall result	85	0.13	0.233
A/P	85	0.17	0.111
M/L	85	0.03	0.781
% time percentage in zone A	85	-0.16	0.152
% time percentage in zone B	85	0.15	0.174
% time percentage in zone C	85	0.22	**0.048**
% time percentage in zone D	85	0.18	0.091
% time percentage in quadrant I	85	-0.16	0.132
% time percentage in quadrant II	85	0.07	0.501
% time percentage in quadrant III	85	0.11	0.310
% time percentage in quadrant IV	85	0.03	0.775

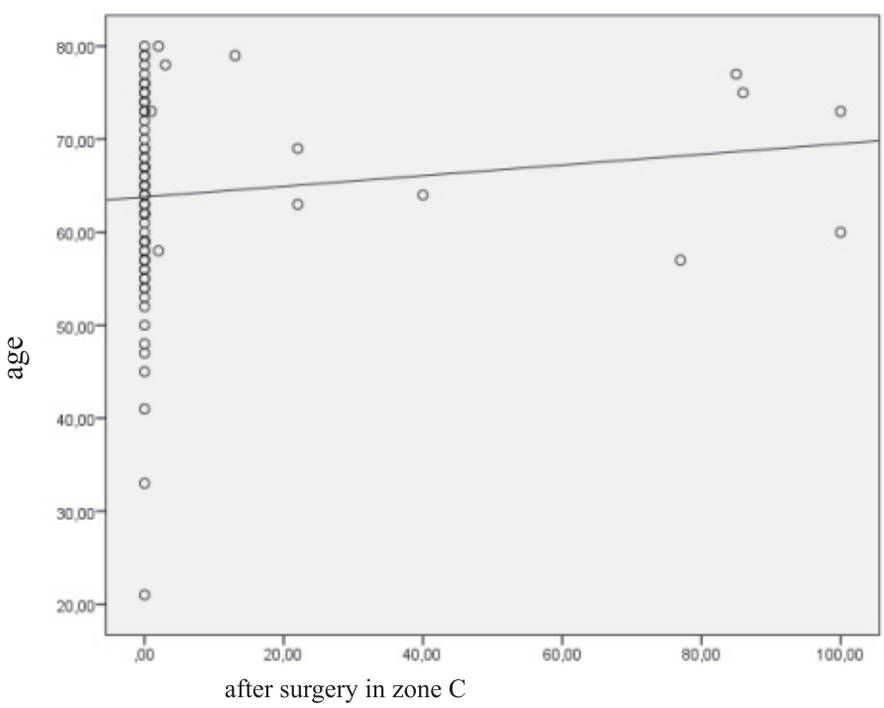

Fig. 24 Graph of statistical dispersion for the indicator % of time in zone C after surgery

Discussion

Tests of balance allow for an objective evaluation of evolution taking place after the alloplastic hip surgery. Compensating mechanisms, which are generated in the course of a degenerative disease are so strongly established, that the patients in the early period after surgery are no able to change them. Examined patients functioned in a similar way both, before and after the procedure. In all the measurements, ie. in the overall result, the indicators A/P and M/L, percentage of time with the load on the particular zones and quadrants, there were no significant differences between the indicators before and after the surgical treatment. The introduction of balance training on the balance platform may allow to improve

the early results after the alloplastic surgery, which suggests, that the exercises make sense. Evaluation of the results after alloplastic hip joint surgery may be done with the use of the platform stabilographic platform. Pethe-Kania assessed the effectiveness of early rehabilitation after alloplastic hip joint surgery with the use of the platform [6]. The author indicates that the static stabilography constitutes an objective method of assessment of the status of the patient after the alloplastic hip joint procedure. Pethe-Kania also points out, that before the rehabilitation process, usually less load was being placed on the extremity with the artificial hip joint. Similar results have been obtained on the Biodex platform. The patients after the right side extremity alloplastic surgery placed the load for a higher percentage of time on quadrant III, while those after the left side alloplastic surgery placed the load longer on quadrant IV. These results may indicate the involuntary, reflexive taking off the load of the extremity after surgery. Further Pethe-Kania indicates, that only rehabilitation has the most significant impact on the placing of increased load on the lower extremity with artificial hip joint [6] Michalska W. et al., also show the beneficial impact (approximately 10%) of rehabilitation on the improvement of balance, in the examination with open eyes, in patients after the alloplastic hip joint surgery [5].

When analyzing the indicators A/P and M/L, we can see that after the surgery, poorer results obtained women than men. Time percentage of placing load in zone A was greater for men (86.08%), than for women (59.23%). While in women there was definitely larger time percentage of load placed in zone C (11.44%) than in men (0.11%). Results clearly indicate, that women decidedly stronger escape from their balance center, which means, that they will require prolonged rehabilitation work toward stabilization of the structure: hip joint-pelvis-trunk. The obtained results give the overall picture of static stability. The results obtained for dynamic stability, seem to stress even more the disadvantaged situation of women. This topic is certainly important for the future research. Both, before and after the surgery, the overall worse results were obtained by shorter patients, in comparison to those who were taller. After the surgery, shorter persons obtained worse results in indicators A/P and M/L, which shows that taller people have smaller deviations from their center of gravity. This may indicate, that taller persons have better stability of the structure: hip-pelvis-trunk, and tend to tilt less in the sagittal and frontal planes. We must remember, that patients who during tests showed significantly longer times of placing load in zones B and C are more susceptible to falls. Especially for these patients, recommended would be proper training of balance and stabilization, in order to reduce their risk of falling. Any fall, for those patients, may result in chronic disability.

Persons with the left side coxarthrosis obtained worse results in the indicator M/L, than persons with the right-side coxarthrosis. Such findings demonstrate greater asymmetry of pelvis in the M/L plane, in persons with the left side coxarthrosis which suggests, that those persons should be especially thoroughly prepared for the surgery, in the area of rehabilitation (eliminating contractures, attempt to eliminate incorrect compensations).

In literature, there are no reports on early results of using the Biodex balance platform after the alloplastic hip joint surgery. Going throughout the publications one may find information about using the balance platform by athletes. We must also realize, that the results obtained may be affected by such factors as: previous diseases,

medications taken and certain individual motor characteristics. From observations of patients in the course of the research, it can be concluded, that of crucial importance is the individual approach.
Balance platform is a great research tool. It also provides a training tool, and its impact on the balance in patients after the alloplastic surgery will be the subject of further study.

Conclusions

1. In all the measurements, ie. in the overall result, the indicators A/P and M/L, percentage of time with the load on the particular zones and quadrants, there were no significant differences between the indicators before and after the surgical treatment. The study participants similarly functioned during the tests both, before and after the surgical procedure.
2. Before the surgery worse overall result obtained men than women. Persons with left side coxarthrosis obtained worse result in the indicator M/L than persons with right side coxarthrosis, which indicate greater asymmetry of the pelvis, in M/L plane, in patients with left side coxarthrosis.
3. After the surgery worse overall result obtained women than men. Women also obtained worse results in terms A/P and M/L indicators, than men.
4. Both, before and after the surgery, the overall worse results were obtained by shorter patients, in comparison to those who were taller. After the surgery, worse results obtained shorter persons in the A/P and M/L indicators.
5. After the surgery value of the indicator M/L changed to statistically insignificant, which suggests, that after the surgery position of pelvis improved in the frontal plane, in the examined patients,.
6. After the surgery, the taller persons have smaller deviations from their center of gravity.
7. The analysis showed, that along with the growing age of the patients, also grows the indicator of the percentage of time in zone C, which indicates a significant deviation from the axis of the body.

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Piśmiennictwo/ References

1. Brzosko M: Reumatologia kliniczna. Wydawnictwo Pomorskiego Uniwersytetu Medycznego, Szczecin 2010, 234-240
2. Demczyszak I., Wrzosek Z., Żukowska U. i wsp.: Ocena efektów usprawniania chorych po endoprotezoplastyce stawu biodrowego, Kwart. Ortop. 2012, 2, 169-175
3. Augustyniuk K., Wypyska M., Jurczak A.: Ocena występowania ograniczeń aktywności fizycznej w przebiegu leczenia bólu. Family Medicine & Primary Care Review, 2011, 13 (4): 678-682.
4. Kokoszka P., Markuszewski J., Jabłecka A. i wsp.: Co farmaceuta powinien wiedzieć na temat endoprotezoplastyki stawu biodrowego i kolanowego?; Farmacja Współczesna 2010; 3: 147-152
5. Michalska W., Szewereda K., Michnik R. i wsp.: Analiza zmian wybranych parametrów w badaniach stabilograficznych u pacjentów ze schorzeniami w obrębie kończyny dolnej przed i po rehabilitacji; Aktualne problemy biomechaniki, 2007;1: 145-152
6. Pethe-Kania K. Kidoń Z., Kania D.: Nowoczesna metoda oceny wyników rehabilitacji chorych po endoprotezoplastyce stawu biodrowego; Rehabilitacja w Praktyce, 2007;4: 41-44