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POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

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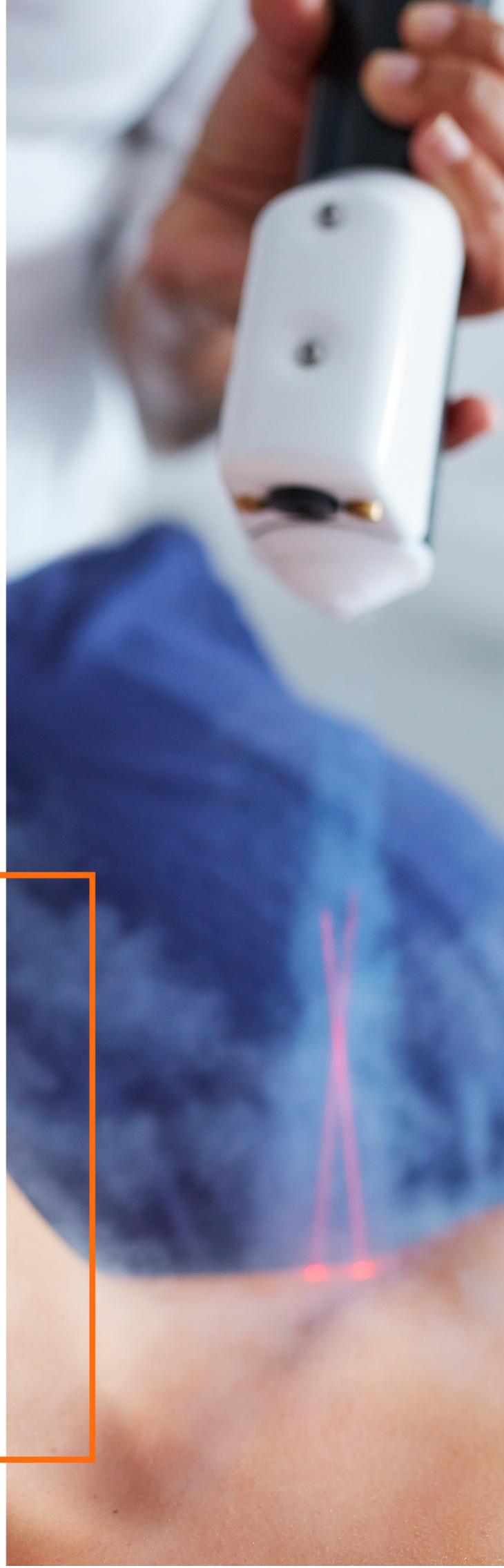

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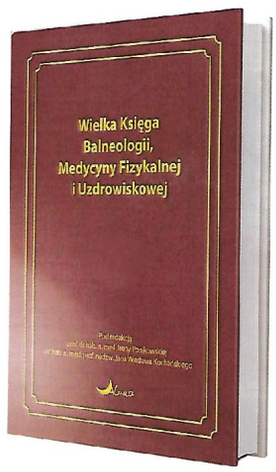

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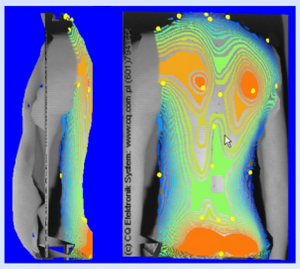

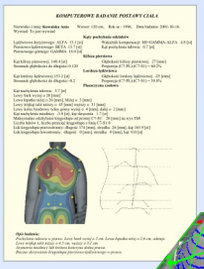

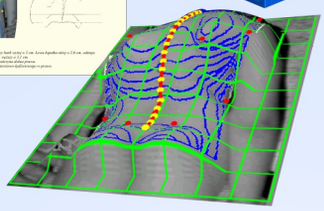

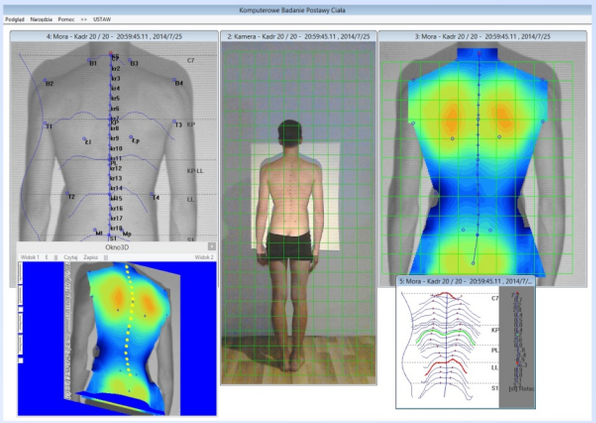

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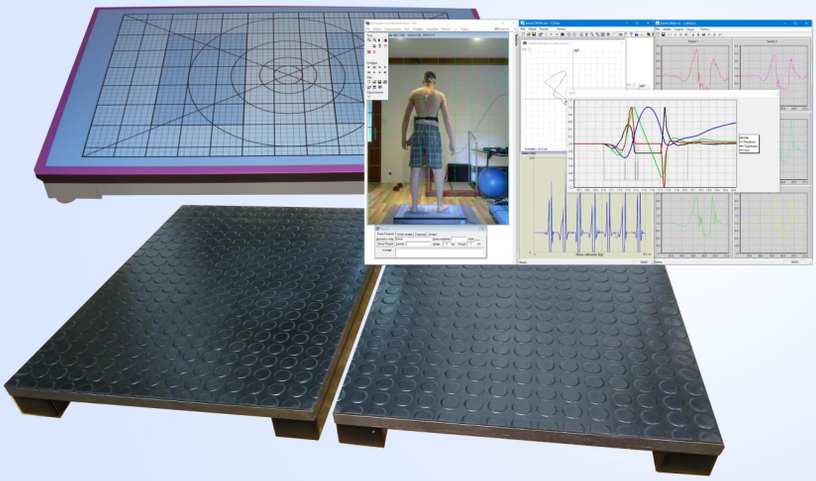

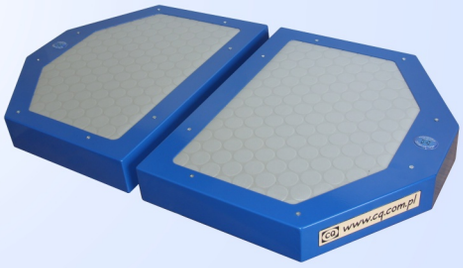

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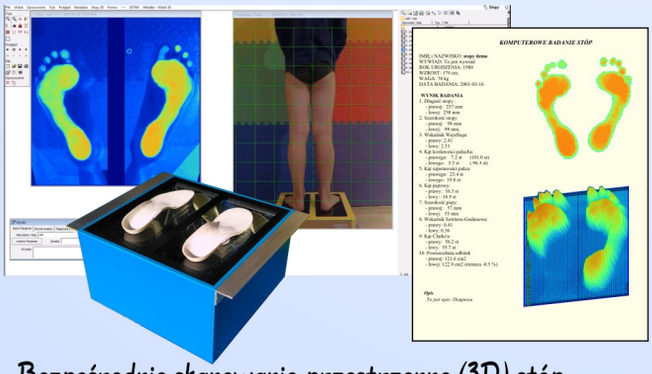

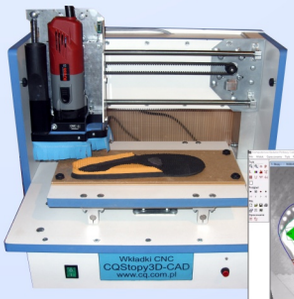

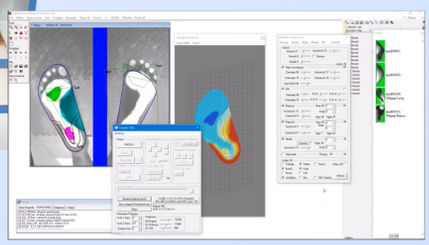

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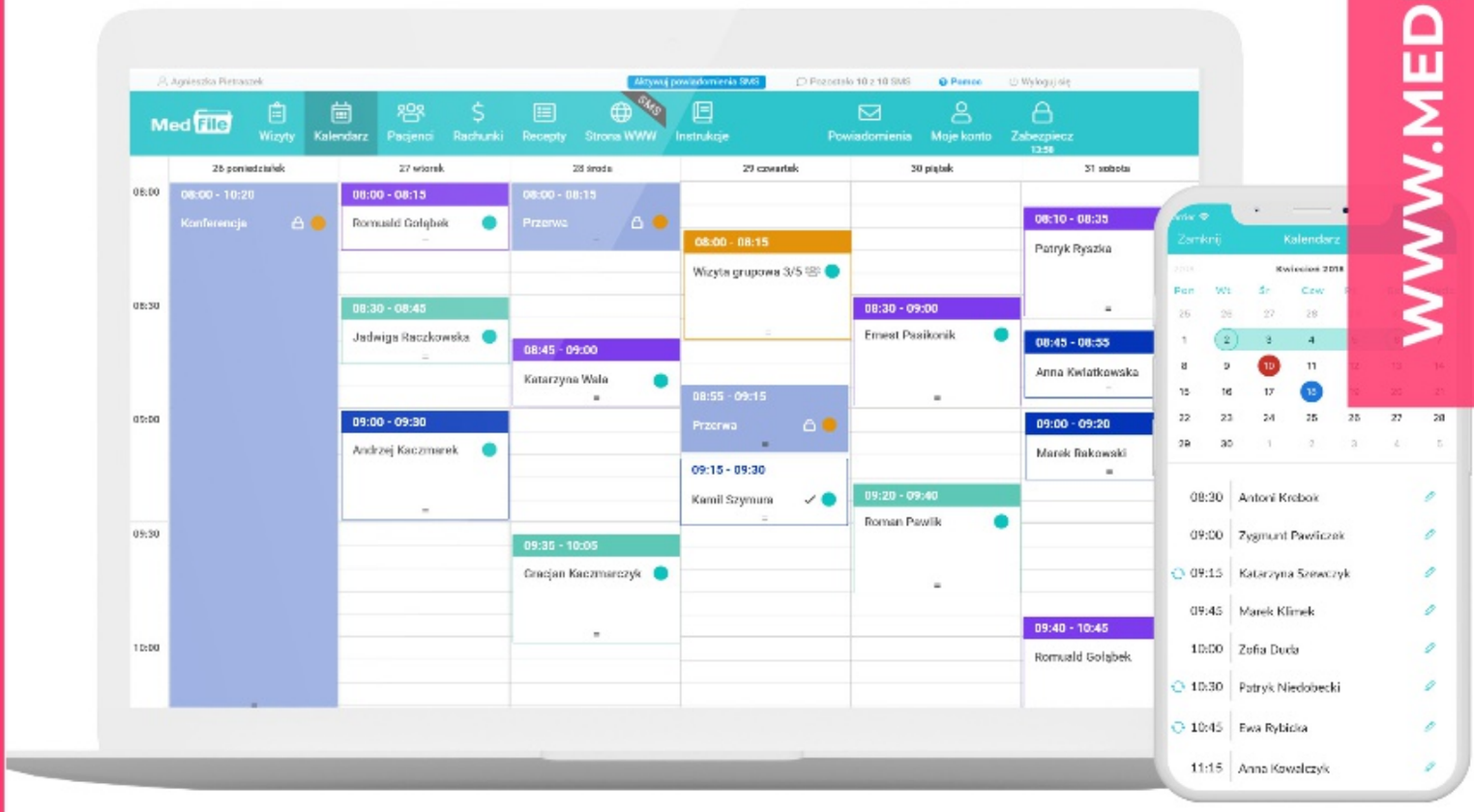

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Główne czynniki powodujące występowanie dysplazji stawów biodrowych u niemowląt na podstawie analizy dokumentacji medycznej noworodków przebywających w oddziale neonatologicznym Szpitala Wojewódzkiego w Tychach w roku 2017

The main factors determining the occurrence of developmental dysplasia of the hip in infants based on the analysis of medical history of newborns staying in the neonatal ward of the Szpital Wojewódzki in Tychy in 2017

根据 2017 年蒂黑省立医院新生儿科中住院的新生儿医疗文献分析所得，导致婴儿髋关节发育不全的主要因素

Magdalena Kiecoń[1(A,B,C,D,E,F)], Jarosław Madowicz[1(A,D,E)], Paulina Głowacka[2(A,D,E)], Renata Szczepaniak[2,3(E,F)]

[1]Wojewódzki Szpital Specjalistyczny Megrez Sp. z o.o. w Tychach / Provincial Specialist Hospital Megrez Sp. z o.o. in Tychy, Poland
[2]Akademia WSB w Dąbrowie Górniczej / WSB University in Dąbrowa Górnicza, Poland
[3]Pabianickie Centrum Rehabilitacji, PCM Sp. z o.o. / Rehabilitation Centre in Pabianice, PCM Sp. z o.o., Pabianice, Poland

Streszczenie

Cel pracy. Zbadanie częstotliwości występowania dysplazji stawów biodrowych u noworodków oraz wyróżnienie głównych czynników powodujących jej występowanie.
Materiał i metodyka. Badaniu poddano dokumentację medyczną w postaci historii choroby 1591 pacjentów oddziału neonatologicznego Wojewódzkiego Szpitala Specjalistycznego Megrez Sp. z o.o. w Tychach.
Wyniki. Częstotliwość występowania DDH była większa wśród dziewczynek niż wśród chłopców, a przeważała w stawach prawych. Badanie nie wykryło istotnych zależności pomiędzy występowaniem DDH a rodzajem porodu, tygodniem ciąży, mnogością ciąży i masą urodzeniową noworodków. Istotną statystycznie zależność wykryto natomiast między występowaniem stawów niedojrzałych fizjologicznie a masą urodzeniową noworodków.
Wnioski. 1. Częstotliwość występowania DDH wśród noworodków przebywających w oddziale neonatologicznym Szpitala Wojewódzkiego w Tychach w roku 2017 wynosiła 2,7% i była mniejsza niż podaje to literatura. 2. Występowanie DDH było częstsze wśród dziewczynek niż wśród chłopców. 3. DDH występowała częściej w sposób statystycznie istotny w stawie prawym. 4. Stwierdzono istotną zależność pomiędzy występowaniem zmian typu IIa wg skali Grafa a masą urodzeniową noworodka. 5. Nie stwierdzono istotnych zależności między występowaniem DDH a rodzajem porodu, tygodniem ciąży, mnogością ciąży i masą urodzeniową noworodków.

Słowa kluczowe:
DDH, dysplazja stawów biodrowych, pediatria, noworodki, staw biodrowy

Abstract

Aim. To investigate the frequency of occurrence of Developmental Dysplasia of the Hip in newborns and to distinguish the main factors causing its occurrence.
Material and methods. The research included medical documentation in the form of the medical history of 1591 patients in the neonatological ward of the Provincial Specialist Hospital of Megrez Sp. z o.o. in Tychy.
Results. The incidence of DDH was higher among girls than among boys, and predominantly in the right joints. The study did not detect any significant relationship between the occurrence of DDH and the type of delivery, week of pregnancy, multiplicity of pregnancy and birth weight of newborns. However, a statistically significant relationship was detected between the occurrence of physiologically immature joints and the birth weight of newborns.
Conclusions. 1. The frequency of occurrence of DDH among newborns staying in the neonatal ward of the Provincial Hospital in Tychy in 2017 was 2.7% and was lower than the literature gives. 2. The occurrence of DDH was more frequent among girls than among boys. 3. DDH occurred more frequently in a statistically significant way in the right joint. 4. A significant relationship was found between the occurrence of type IIa variations according to the Graf scale and the birth weight of the newborn. 5. There were no significant relationships between the occurrence of DDH and the type of delivery, week of pregnancy, multiplicity of pregnancy and birth weight of newborns.

Key words:

摘要

研究目的。检查新生儿髋关节发育不全的频率，并区分导致其出现的主要因素。
材料及方法。针对位于蒂黑省立专科医院 Megrez Sp. z o.o. 新生儿科中 1591 名病患的病历进行研究。
结果。女孩出现髋关节发育不全的频率比男孩高，普遍出现在右关节。研究中未发现髋关节发育不良的出现率与分娩的类型、孕周、孕期及新生儿出生体重间的显著相关性。然而，发现生理学上关节的发育不全和新生儿出生体重间具统计学上的显著相关性。
结果。1. 2017 年在蒂黑省立医院新生儿科住院的新生儿中髋关节发育不全的发生率为 2.7%，低于文献记录。2. 女孩出现髋关节发育不全的机率高于男孩。3. 髋关节发育不全出现于右关节的几率在统计学上显然较高。4. 确认在根据格拉夫量表的 IIa 型变异出现及新生儿体重之间存在显著相关性。5. 髋关节发育不良与分娩的类型、孕周、孕期及新生儿出生体重间未发现显著相关性。

关键词：
DDH、髋关节发育不全、儿科、新生儿、髋关节

Intoduction

Hip dysplasia (DDH) is one of the most common defects of the motor organ in newborns, especially among Caucasian children [1]. Its occurrence is six times higher in girls than in boys [2]. In 2012, the occurrence of hip dysplasia ranged from 4-6% [2, 3]. DDH is a pathology in the construction of the hip joint, which occurs between the femoral head and the acetabulum of the hip. These changes affect twice the left hip [1]. Among the main abnormalities in the hip joint can be distinguished, among others: abnormalities in acetabulum construction (too steep structure, flattening, shifting towards the front), too much flaccidity within the hip joint ligaments or incorrect twisting of the proximal femur [4].

Currently, the exact cause of DDH formation among infants is unknown. However, there are several factors that may influence its development, without any leading factor being clearly identified among them. The most common of these are: female sex, genetic burden of hip dysplasia, pelvic position, intrauterine tightness [5]. The occurrence of DDH may also be affected by additional congenital malformations, deformities within the musculoskeletal system and incorrect care of infants by both parents and medical staff. Failure to pay attention to the proper care of infants (proper way of carrying a child, changing, lifting or laying it in a crib) may result in the development or deepening of DDH and other injuries of the musculoskeletal system [7].

However, diagnosis of DDH in the fetus is currently not possible. The first diagnostic test is carried out only after the birth of the child. The most commonly performed test that detects hip dysplasia is ultrasound examination using the Graf method. This method evaluates the frontal cross-section of the hip joint, obtained from an ultrasound examination, in terms of the shape of the bone ceiling, the shape of the cartilage ceiling and the shape of the acetabular bone edge; additionally, it evaluates the alpha angle (inclination angle of the bone roof) and the beta angle (concerning the position of the cartilage part of the acetabulum roof) [1, 5]. The analysis of these results allows for the classification of hip joints in particular categories:

- Ia, b – normal hip,
- IIa – hip immature physiological syndrome, at risk of dysplasia,
- IIb – dysplastic joint,
- IIc – unstable joint, with large dysplasia without decentralization of the femoral head in the acetabulum,
- D – unstable joint, with large dysplasia with decentralized femoral head,
- III a, b – joint sublimated,
- IV – dislocated joint [5].

In addition to the ultrasound examination, there are many clinical tests that can confirm the occurrence of hip dysplasia among children, including: Ortolani test, Barlow maneuver, skin fold irregularity, restriction of hip joint motion, pumping test, bulge of the greater trochanter area, shortening lower limb, delayed start of walking. The symptoms of DDH in older children can be further distinguished: Trendelenburg's test, Duchenne's test, waddling gait or enlargement of the lumbar lordosis [8].

Aim

The aim of the study was to investigate the frequency of occurrence of DDH in newborns and to distinguish the main factors causing its occurrence.

Material and methodology

The retrospective examination was subjected to medical documentation in the form of medical history of 1591 patients (3182 hip joints) residing in the neonatological ward of Wojewódzki Szpital Specjalistycznego Megrez Sp. z o.o. in Tychy in 2017. Records in the medical documentation were supplemented with records of the medical statistics programs of the Hospital, including the ICD-10 and ICD-9. In order to determine the degree of abnormalities in the hip joints the Graf method was used in the ultrasound examination. The analysis included the gender of the child, dysplastic hip joint (right or left), multiplicity of pregnancy, delivery week, delivery method, occurrence of congenital defects within the motor organ associated with DDH.

Research questions:

1. Among which sex hip dysplasia was more common?
2. In which hip pathological changes in the construction of the joint occurred more often (right or left)?
3. Can the DDH be influenced by factors such as: multiplicity of pregnancy, length of pregnancy, newborn weight, type of labor?
4. Have there been additional congenital malformations accompanying hip dysplasia (such as: flat-lopsided feet, clubfoot feet, torticollis)?

In order to check the dependence of the occurrence of DDH in comparison with individual factors that may influence its development, the chi-square statistical formula was used. If any of the expected numbers was equal to or less than 5, a chi-square test with the Yates correction was used. The chi-square values obtained were compared with the critical values from the Chi-square test distribution table.

Results

1. Frequency of occurrence of DDH

Among 3182 hip joints tested type IIa was diagnosed in 676 hip joints. Type IIc was detected in 41 joints. In turn, type IIIa was recorded in 10 hip joints. The study did not detect other types of abnormalities in the construction of the hip joints. The type IIc and IIIa changes were accepted for the DDH study, while the physiologically immature joints (type IIa) were considered to be at risk of developing dysplasia. Detailed data is presented in Table 1.

2. Gender of the child

In the period under examination 1591 children were born, including 761 girls and 830 boys. Defect. In the ultrasound examination, out of 1591 DDH children in 46 girls and 5 boys were detected. Type IIa was detected among 419 girls and 257 boys. The Chi-square independence test confirmed a significant relationship between the occurrence of DDH and the child's gender. Detailed data is presented in Table 2 and 8.

Table 1. Frequency of occurrence of DDH

Ultrasound examination Graf method	Amount	%
IIa	676	21.2
IIc	41	1.3
IIIa	10	0.3
Correct joints	2455	77.2
Total	3182	100

Table 2. Abnormalities in the construction of the hip joints in comparison with the child's gender

	Girls		Boys	
	Amount	%	Amount	%
DDH (IIc + IIIa)	46	3.02	5	0.30
IIa	419	27.53	257	15.48
Correct joints	1057	69.45	1398	84.22
Total	1522	100	1660	100

3. Frequency of irregularities in the construction of the hip joints in the left and right joint

Type IIa was detected in 300 left hip joints, while in 376 right joints. Dysplasia of the hip joints concerned 18 left and 33 right joints. The chi-square independence test pointed to the existence of a significant relationship between the occurrence of hip dysplasia in individual joints. Detailed data is presented in Table 3 and 8.

Table 3. Abnormalities in the construction of the hip joints in the left and right joint

	Left joint		Right joint	
	Amount	%	Amount	%
DDH (IIc + IIIa)	18	1.13	33	2.08
IIa	300	18.86	376	23.63
Correct joints	1273	80.01	1182	74.29
Total	1591	100	1591	100

4. Type of labor

In the examined period of time, 1563 births were received. At natural delivery, DDH occurred in 22 hips, and type IIa was detected 242 times. At the cesarean section, DDH was detected in 21 joints, while type IIa in 203 joints. Among the births with the use of a vacuum extractor (VE) or obstetric forceps, type IIa were annotated in 7 joints, while dysplastic joints were not detected. Chi-square independence tests indicated that there is no significant

relationship between the type of delivery and the occurrence of changes in the construction of the hip joints. Detailed data are presented in Table 4 and 8

Table 4. Abnormalities in the construction of the hip joints in comparison with the type of delivery

	Regular labor		Caesarean section		VE + obstetric forceps	
	Amount	%	Amount	%	Amount	%
DDH (IIc + IIIa)	22	2.74	21	2.88	0	0
IIa	242	30.14	203	27.77	7	24.14
Correct joints	539	67.12	507	69.35	22	75.86
Total	803	100	731	100	29	100

5. Length of pregnancy

The study included 125 newborns born before 37 weeks of pregnancy, 1455 newborns born at regular time and 11 children born after 42 weeks of pregnancy. Among the children born prematurely there were 4 cases of DDH, while 39 cases of DDH were detected in newborns born at regular time. There were no pathologies in the construction of the hip joints among infants from late pregnancies. Chi-square independence tests did not confirm the existence of a significant relationship between the occurrence of DDH and the length of pregnancy, but confirmed a significant relationship between the occurrence of type IIa. Detailed data is presented in Table 5 and 8.

Table 5. Abnormalities in the construction of the hip joints in comparison with the length of pregnancy

	Premature labor		Correct time labor		Delayed labor	
	Amount	%	Amount	%	Amount	%
DDH (IIc + IIIa)	4	3.20	39	2.68	0	0.00
IIa	87	69.60	550	37.80	0	0.00
Correct joints	34	27.20	866	59.52	11	100.00
Total	125	100	1455	100	11	100

6. Newborn's weight

DDH was detected in 37 newborns' joints with regular birth weight and in 3 joints of newborns' with more than 4000 g. Type IIa was detected in 414 newborns' joints with regular weight and 27 newborns' joints with a weight above 4000 g. In newborns weighing less than 2,500 g no DDH or type IIa was detected. Chi-square independence tests did not confirm the existence of a significant relationship between the occurrence of DDH and child's weight. However, significant results were obtained in the type IIa analysis. Detailed data is presented in Table 6 and 8.

Table 6. Abnormalities in the construction of the hip joints in comparison with the birth weight of newborns

	Weight below 2500 g		Correct weight		Weight above 4000 g	
	Amount	%	Amount	%	Amount	%
DDH (IIc + IIIa)	0	0.00	37	2.42	3	5.36
IIa	0	0.00	414	27.11	27	48.21
Correct joints	8	100.00	1076	70.46	26	46.43
Total	8	100	1527	100	56	100

7. Multiplicity of pregnancy

The study included 28 twin pregnancies, 1563 single pregnancies and no multiple pregnancy (more than 2 children). Among single pregnancy DDHs were detected in 43 hip joints, whereas in twin pregnancies only in one joint. Type IIa was detected in 445 newborns' joints from single pregnancy and 5 from twin pregnancy. Chi-square independence tests did not confirm the existence of a significant relationship between the occurrence of DDH and type IIa and the multiplicity of pregnancy. Detailed data is presented in Table 7 and 8.

Table 7. The occurrence of irregularities in the construction of hip joints in comparison with the multiplicity of pregnancy

	Single pregnancy		Twin pregnancy	
	Amount	%	Amount	%
DDH (IIc + IIIa)	43	2.80	1	3.57
IIa	445	28.99	5	17.86
Correct joints	1047	68.21	22	78.57
Total	1535	100	28	100

Table 8. Results of independence tests

	Graf method	Severity level	χ^2 calculated	χ^2 theoretical	Severity level
Gender	DDH	p = 0.05	37.27	3.8415	significant correlation
	IIa	p = 0.05	68.88	3.8415	significant correlation
Type of joint (L/R)	DDH	p = 0.05	4.48	3.8415	significant correlation
	IIa	p = 0.05	10.85	3.8415	significant correlation
Type of labor	DDH	p = 0.05	0.706	5.9915	irrelevant correlation
	IIa	p = 0.05	1.373	5.9915	irrelevant correlation
Length of pregnancy	DDH	p = 0.05	0.22	5.9915	irrelevant correlation
	IIa	p = 0.05	54.92	5.9915	significant correlation
Newborn weight	DDH	p = 0.05	14.18	5.9915	irrelevant correlation
	IIa	p = 0.05	14.05	5.9915	significant correlation
Multiplicity of pregnancy	DDH	p = 0.05	0.041	5.9915	irrelevant correlation
	IIa	p = 0.05	1.47	5.9915	irrelevant correlation

8. Occurrence of additional congenital defects and deformities within the musculoskeletal system

There were no cases of newborns with additional congenital malformations of the musculoskeletal system and hip dysplasia in the study.

Discussion

1. Frequency of occurrence of DDH

Among the group of 1591 newborns (3182 hip joints), 494 of them had pathological changes in the construction of the hip joints. DDH occurred among 43 newborns. It follows that the frequency of dysplasia among newborns was 2.7%. The low level of occurrence of DDH in the studies carried out in this work is interesting – almost twice as low as in the literature [2,3]. It is possible that this is due to the range of the study, which was local rather than nationwide. It is possible that a larger-scale study would show a higher occurrence of DDH. On the other hand, it is also possible that the tendency of developing hip dysplasia in Poland diminishes. In order to confirm or reject the tendency, similar research should be carried out in other locations throughout the country.

2. Gender of the child

Analysis of the results showed that dysplastic changes in hip joints occurred in 3.02% of girls' joints and 0.3% of boys' joints. The ratio of dysplasia in the hip joints in girls and boys was therefore 10: 1. The same applies to the frequency of type IIa changes. As many as 419 joints affected by this change occurred among girls and only 257 among boys. The obtained result differs from the results presented in the literature, where the ratio of 6: 1 [1] or 4-8: 1 [5] is given, but still indicates a more frequent occurrence of changes in the construction of hip joints in girls than in boys. It cannot be ruled out that the higher occurrence of DDH among girls is influenced by the accumulating effect of maternal and child hormones (estrogens, relaxin) [6, 9], which have a relaxing effect on ligamentous structures and can contribute to an increased probability of joint dislocation.

3. Frequency of irregularities in the construction of the hip joints in the left and right joint

Analyzing the collected results concerning the occurrence of abnormalities in the left and right joints, it can be clearly seen that DDH is more likely to affect the right joints (2.08% of joints) than the left joints (1.13% of joints). Similarly, change IIa occurred in 23.63% of right joints and only 18.86% of left joints. These results differ from the results presented in the literature [1,3,5, 10] where the higher occurrence of DDH in the left joint is given, which may be related to the position taken by the child in the mother's womb. This position forces left hip joint to be set in a slight adduction, which may affect its stretching and increase instability in the future [9,10]. Data from the

medical records analyzed in this study did not provide the possibility of a more detailed analysis of the causes of a more frequent, statistically significant occurrence of dysplasia in the right hip joints. Perhaps it is worth continuing the research in the future to verify differences in the frequency of dysplasia in left and right hip joints and to identify its causes.

4. Type of labor

During the study, the occurrence of DDH in relation to the type of delivery (natural labor, caesarean section, delivery using VE or obstetric forceps) was also analyzed. 803 births took place naturally, 731 by caesarean section, and only 29 with the use of VE or obstetric forceps. Hip dysplasia occurred in 2.74% of natural births, 2.88% of deliveries through caesarean section. There was no DDH in labor with VE or obstetric forceps. Type IIa occurred in 30.14% of natural deliveries, in 27.77% of deliveries by caesarean section and in 24.14% of labor using VE or obstetric forceps. It can be concluded that changes in the construction of hip joints of newborns arise in the period preceding the delivery.

5. Length of pregnancy

In 2017 at the Provincial Hospital in Tychy 125 newborns born before 37 weeks of pregnancy, 1455 children born on regular time (between 38 and 42 weeks of pregnancy) and 11 newborns born after 42 weeks of pregnancy were observed. Among premature infants 4 cases of DDH were reported, while 39 cases were born with newborns born at regular time. However, no pathologies were observed in the construction of hip joints among infants born after the 42nd week of pregnancy. The incidence of DDH among newborns born before regular time was therefore 3.2%, whereas in normal-born newborns it was 2.68%. Similar percentages indicate no difference in the frequency of changes. The lack of significant correlation is also confirmed by the Chi-square independence test. On the other hand, the relationship between the occurrence of physiologically immature hip joints (type IIa) appears interesting, with the frequency of their occurrence among newborns from early births as high as 69.6% (1.85 times more frequently), with only about 37,8% regular time births. The Chi-square independence test confirmed a significant relationship between the occurrence of physiologically immature hip joints (IIa) in relation to the time of labor. Perhaps premature labor contributes to the development of small disturbances in the development of the hip joints.

6. Newborn's weight

Among children with normal birth weight the occurrence of DDH was only 2.42%, while in newborns with a weight above 4000 g it was 5.36%. The frequency of the occurrence of physiologically immature hip joints in newborns with regular birth weight was 27.11% and in newborns with birth

weight over 4000 g 48.2%. The analysis of data on the occurrence of DDH in relation to the birth weight of the newborn showed that the birth weight of the newborn over 4000 g does not contribute significantly to the development of DDH. This differs from the data in the literature [2, 3, 4], where one of the mentioned factors contributing to the development of DDH is the large mass of the newborn.

7. Multiple pregnancy

The analysis of the frequency of hip dysplasia versus the multiplicity of pregnancy showed that occurrence of DDH was slightly higher in newborns with twin pregnancy. The occurrence of DDH among newborns of single pregnancies was 2.80%, while of the twin pregnancy was 3.57%. According to the literature [5], more frequent occurrence of DDH in newborns with twin pregnancy may result from a reduced amount of space in the mother's uterus, by which the child is forced to take a damaging position for its hip joints.

The higher number of physiologically immature joints among newborns of single pregnancy (28.99%) in relation to twin pregnancy (17.86%) also seems to be interesting. Despite the clear percentage differences suggesting more frequent changes in the construction of the hip joints in twin pregnancies, chi-square independence tests did not confirm differences. On the basis of the test results, there is no correlation between the occurrence of changes in the construction of joints and the multiplicity of pregnancy.

8. Occurrence of congenital defects and deformities

There is an 8-20% probability associated with the occurrence of DDH in the case of torticollis, 25% risk in the case of flat-valgus and 1-10% risk of it occurring in clubfoot [6]. The frequency of congenital deformities with DDH may be associated with an unfavorable position taken by the child in the mother's womb. In the analysis of the relationship between the occurrence of DDH and congenital abnormalities no correlation were demonstrated. The study did not detect newborns with additional congenital malformations and DDH. In 6 newborns there were deformations in the feet (in 4 newborns flat-valgus feet were detected, while 2 in clubfoot), however, no DDH occurred, only the physiologically immature hip joints (type IIa). Too low occurrence of additional congenital defects in the test material simultaneously as DDH causes that the frequency of hip dysplasia in combination with additional congenital malformations cannot be analyzed.

Conclusions

1. Occurrence of DDH was 2.7%.
2. The occurrence of hip dysplasia was more frequent among girls than among boys.
3. Hip dysplasia occurred more frequently in a statistically significant way in the right joint.

4. There was a significant relationship between the occurrence of type IIa and the birth weight of the newborn over 4000 g.
5. There were no significant relationships between the occurrence of DDH and the type of labor, week of pregnancy, multiplicity of pregnancy and regular birth weight of newborns.

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