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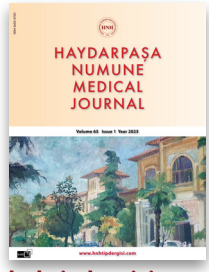

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ORIGINAL ARTICLE

Evaluation of Risk Factors for Developmental Dysplasia of the Hip

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Abstract

Introduction: While various risk factors and changes in the incidence of developmental dysplasia of the hip (DDH) over the last few decades have been discussed, the exact cause of DDH is currently unknown. This study aimed to determine the incidence and risk factors of DDH using hip ultrasonography (Graf method). The relationship between ultrasonographic findings and risk factors for DDH was prospectively evaluated.

Methods: A total of 339 patients, 211 females (62.24%) and 128 males (37.76%), were prospectively studied. In all patients, risk factors for DDH—such as female sex, breech presentation, being the first female baby, type of birth, oligohydramnios, high birth weight, and multiparity—were recorded in their medical files. All patients underwent hip ultrasound between the fourth and sixth weeks, performed by the same radiologist. The relationship between dysplastic hips and risk factors was determined using the Graf method.

Results: Breech presentation was observed in 39 cases (11.5%), oligohydramnios in 6 cases (1.8%), multiple pregnancy in 9 cases (2.7%), a history of being the first female baby in 107 cases (31.6%), high birth weight in 38 cases (11.2%), cesarean section in 150 babies (44.2%), a positive family history of DDH in 7 babies (2.1%), and torticollis in 1 baby (0.3%). Type 1a and 1b hips were detected in 304 babies (89.6%), type 2a hips in 31 cases (9.1%), type 2b and 2c hips in 2 cases (0.5%), and type 3 hips in 2 cases (0.5%). A significant association was found between DDH and female sex, as well as high birth weight ($p<0.05$).

Discussion and Conclusion: The etiology of DDH remains unclear, although many risk factors have been identified. This study demonstrated that DDH can occur in babies without any known risk factors. Therefore, we recommend routine hip ultrasonography for all newborns between Weeks 4 and 6.

Keywords: Graf method; hip dysplasia; hip ultrasonography; newborn.

Developmental dysplasia of the hip (DDH) is a spectrum of anatomical disorders of the hip that may be congenital or develop in infancy or childhood. DDH occurs when an overly lax hip capsule fails to maintain the continuity of the femoral head within the acetabulum[1]. DDH can develop during the prenatal, natal, and postnatal periods[2]. DDH incidence rates vary widely by gender, age group, race, and even geographical region within the same country[2,3]. The general incidence in all newborns is considered 0.5%–1.5%[2–4]. In Europe, this rate is around 1%–2%,[5] while studies conducted in Türkiye observed a 0.2%–21% rate[6–10]. In the literature, the lowest rate reported is 0.2/1,000, and the highest rate is 47.2/1,000 in the presence of various risk factors[3,6]. Several factors play a role in the etiology of DDH, particularly mechanical structural (connective tissue laxity and capsular and acetabular structures, such as the labrum, pulvinar, ligamentum teres, and transverse acetabular ligament), genetic (racial characteristics and gender), and mechanical environmental factors (oligohydramniosis, breech birth, first birth, and postnatal position)[3,4,11].

The most appropriate diagnosis and treatment period for DDH is the neonatal period. Although physical examination of the hips in this period is considered the gold standard for DDH diagnosis, the inadequacy of clinical evaluation and the possibility of different interpretations by examiners, as well as the inability of standard radiological examinations

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to clearly evaluate the hip joint, especially in the first three months, necessitated the search for a new early diagnosis and screening method[12].

Ultrasonography is a readily performed, radiation-free, and cost-effective radiographic examination of cartilage and soft tissues. The Graf classification categorizes DDH cases into five types, from a normal hip to a dislocated hip, by describing and measuring specific angles in sonographic examination[13,14].

If DDH is left untreated, it progresses to a more severe stage, which may require complex surgical interventions in some patients. In other cases, it may develop into a condition that is difficult or impossible to treat[14,15]. The aim of this study is to determine DDH incidence in neonates born at our hospital and to assess the occurrence ratio in infants with and without risk factors.

Materials and Methods

This prospective study was conducted to examine patients for the development of DDH and associated risk factors. The study involved 339 neonatal babies, comprising 211 girls (62.24%) and 128 boys (37.76%), who were born at the Gynecology and Obstetrics Clinic of Umraniye Research and Training Hospital and referred to the neonatal control clinic between May and November 2012, attending postnatal days 3 and 7. The newborns were examined in detail, and DDH risk factors were noted from their medical records and anamnesis taken from the family. The following factors were evaluated as potential risks: female gender, type of birth, firstborn female baby, breech position, positive family history for DDH, oligohydramnios, multiple pregnancy, torticollis, and high birth weight. (Table 1) (Fig. 1) Patients with congenital anomalies such as neural tube defects, neuromuscular diseases, and genetic syndromes were excluded from the study. All newborns underwent hip ultrasonography between the fourth and sixth weeks, and the results were classified according to the Graf method.

The ultrasound was performed by the same radiologist using a 7.5 MHz linear probe ultrasound machine and a specially prepared table. The appropriate position suggested by Graf (baby in the lateral decubitus position, with the hip and knee semiflexed at 15°–20° internal rotation) was applied first to the right hip and then to the left hip. Standard lines were drawn according to the Graf method, alpha and beta angles were measured, and typing was done according to the Graf method. According to the Graf classification, type 1a and 1b hips were evaluated as normal, and the families were informed that there was no need for rechecking. Type 2a hips were followed up as "immature hips." A repeat hip USG appointment was planned to be performed in the third month. Type 1 hips in the second follow-up were excluded from further follow-up[13].

Types 2b and 2c and type D hips were considered "dysplastic hips" and types 3 and 4 hips, "dislocated hips"[13]. The families were informed and referred to the Orthopedics and Traumatology Clinic of our hospital.

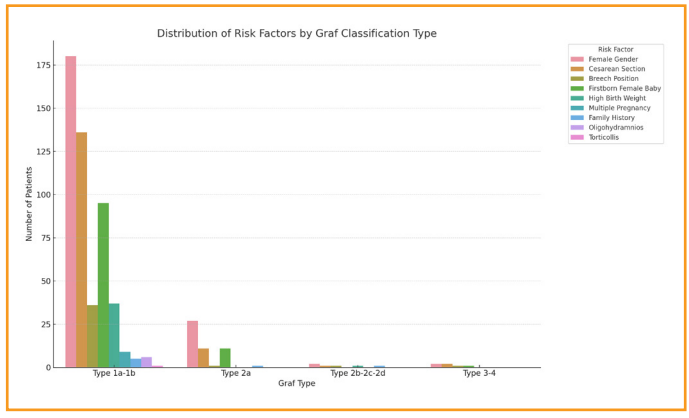

Figure 1. Distribution of selected risk factors by Graf classification type. Female gender and cesarean delivery were predominantly observed among dysplastic and dislocated hips (Graf type ≥ 2b).

Table 1. Classification of patients according to risk factors and Graf type

Risk Factor	Graf Type				All patient	p
	Type 1a-1b	Type 2a	Type 2b-2c-2d	Type 3-4		
Female Gender, n (%)	180 (59.2)	27 (87.1)	2 (100)	2 (100)	211 (62.2)	0.002
Cesarean Section, n (%)	136 (44.7)	11(35.5)	1 (50)	2 (100)	150 (44.2)	0.231
Breech Position, n (%)	36 (11.8)	1 (3.2)	1 (50)	1 (50)	39 (11.5)	0.092
Firstborn female baby, n (%)	95 (31.3)	11(35.5)	0 (0)	1 (50)	107 (31.6)	0.564
High Birth Weight, n (%)	37 (12.2)	0 (0)	1 (50)	0 (0)	38 (11.2)	0.019
Multiple Pregnancy, n (%)	9 (3)	0 (0)	0 (0)	0 (0)	9 (2.7)	0.575
Family History, n (%)	5 (1.6)	1 (3.2)	1 (50)	0 (0)	7 (2.1)	0.134
Oligohidramnios, n (%)	6 (2)	0 (0)	0 (0)	0 (0)	6 (1.8)	0.724
Torticollis, n (%)	1 (0.3)	0 (0)	0 (0)	0 (0)	1 (0.3)	0.975

Ethical Considerations

The ethics approval for this study was obtained from the Clinical Research Ethics Committee of the University of Health Sciences, Umraniye Research and Training Hospital, with decision number 16968 on 23/10/2012. This study was conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

While evaluating the findings obtained in the study, the Statistical Package for Social Sciences program version 17.0 was used for statistical analysis. In addition to using descriptive statistical methods, such as frequencies, bar charts, and pie charts, Pearson's chi-square test was used to compare qualitative data. However, for variables with expected frequencies <5 in any cell of the contingency tables, Fisher's exact test was applied in accordance with statistical guidelines. The results were evaluated at the 95% confidence interval, and the significance level was $p<0.05$.

Results

Our study involved a total of 339 newborn babies, 211 (62.24%) of whom were girls and 128 (37.76%) of whom were boys. Type 1a and 1b hip was detected in 304 infants (89.6%), type 2a hip in 31 cases (9.1%), type 2b–2c–D hip in 2 cases (0.5%), and type 3 hip in 2 cases (0.5%).

Thirty-nine cases (11.5%) were born in the breech position, 6 (1.8%) had oligohydramnios, 9 (2.7%) were multiple pregnancies, 107 (31.6%) were firstborn female babies, and 38 (11.2%) had a high birth weight. Cesarean section was performed for 150 babies (44.2%), a DDH-positive family history was present in 7 babies (2.1%), and torticollis was observed in 1 baby (0.3%).

Out of the babies with immature hips (type 2a), 87.1% were girls, and 12.9% were boys. All babies with type 2b–2c–D, as well as type 3 and 4, hips were girls. The statistical analysis revealed a significant difference between hip type and gender ($p<0.05$).

Among the babies with type 2a hips, 11 (35.5%) were delivered via cesarean section, while 20 (64.5%) were delivered vaginally. For babies with type 2b–2c–D hips, one (50%) was delivered via cesarean section. All babies with type 3 and 4 hips were delivered via cesarean section. The statistical analysis did not reveal any significant difference between hip type and the mode of delivery ($p>0.05$).

None of the babies with type 2b–2c–D hips were the first female babies. While one (50%) of the babies with type 3 and 4 hips was the first female baby, the other (50%) was not. There was no statistically significant difference between hip type and being the first female baby ($p>0.05$).

None of the babies with type 2a hips had a history of high birth weight, while 1 (50%) of the babies with type 2b–2c–D hips had a history of high birth weight. None of the babies with type 3 or 4 hips had a history of high birth weight. There was a statistically significant difference between hip type and having had a high birth weight ($p<0.05$).

Breech presentation was observed in one (3.2%) of the babies with type 2a hips and one (50%) of the babies with type 2b–2c–D hips. While breech presentation was observed in one (50%) of the babies with type 3 and 4 hips, it was not observed in the other (50%). There was no statistically significant difference between hip type and breech presentation ($p>0.05$).

None of the babies with type 2b–2c–D or type 3 and 4 hips were multiple pregnancies. There was no statistically significant difference between hip type and multiple pregnancy ($p>0.05$).

One baby (3.2%) with type 2a hip had a family history. For babies with type 2b–2c–D hips, one had a family history (50%), and the other did not (50%). None of the babies with type 3 or 4 hips had a family history. There was no statistically significant difference between hip type and a DDH-positive family history ($p>0.05$).

Torticollis was not observed in any of the babies with type 2a, type 2b–2c–D, or type 3 and 4 hips. There was no statistically significant difference between hip type and the presence of torticollis ($p>0.05$).

Oligohydramnios was not observed in any of the babies with type 2a, type 2b–2c–D, or type 3 and 4 hips. There was no statistically significant difference between hip type and the presence of oligohydramnios ($p>0.05$). To better illustrate the association between individual risk factors and DDH, an additional table has been provided (Table 2).

Table 2. Distribution of DDH (Graf Type 2b and higher) according to the presence of selected risk factors

Risk Factor	Total Cases (n)	Cases with DDH (Type ≥ 2b) (n)	Percentage with DDH (%)
Female Gender	211	4	1.9
Cesarean Section	150	3	2.0
Breech Position	39	2	5.1
Firstborn Female Baby	107	1	0.9
High Birth Weight	38	1	2.6
Multiple Pregnancy	9	0	0
Family History	7	1	14.3
Oligohydramnios	6	0	0
Torticollis	1	0	0

Discussion

DDH is considered the most common congenital defect among all congenital anomalies. It is present in approximately 7 of 1,000 newborns, but the rate varies depending on genetic factors, family history, and race[2,3]. In Türkiye, there were many studies related to the incidence of DDH. The incidence rate varies between 0.2% and 21%; thus, it may depend on the screening method, definition of DDH, and population[6–10]. But a true incidence rate based on ultrasonographic evaluation of all newborn hips is unavailable. In our study, we determined a DDH incidence of 1.3%, which is consistent with the findings of the above-mentioned studies.

The etiopathogenesis of DDH is multifactorial, involving a combination of mechanical, structural, environmental, and genetic factors. Several studies have indicated a significant increase in the likelihood of hip dysplasia and immaturity in the presence of risk factors, with a higher probability in cases with an increasing number of risk parameters within risk groups[4,8,9,14]. According to another study, risk factors are poor predictors of DDH; female gender alone, without other known risk factors, accounts for 75% of DDH cases[11]. In our study, we found the DDH incidence in infants with risk factors to be 7.8%. The variation in results among studies may be attributed to the referral of high-risk cases to centers with higher incidences, as observed by Ömeroğlu et al.[7]

The literature suggests that DDH is four to six times more common in females than in males, attributed to ligament laxity resulting from maternal and fetal hormones[15,16]. In our study, the DDH incidence rate was 1.3% in all patients, which increased to 1.9% in female babies.

Studies considering the mode of delivery as a risk factor for DDH have reported conflicting results[17,18]. Abu Hassan et al.[19] suggested that normal delivery of babies in the breech position and cesarean section for babies in the vertex position increase DDH risk. In contrast to the literature, our study found no statistically significant difference between DDH and cesarean section.

Breech presentation is considered another risk factor. A study from the United Kingdom reported a 2% prevalence of DDH in girls born in the breech position[20]. However, in the present study, we did not observe an increased risk in babies born with breech presentation. Birth weight has demonstrated inconsistent associations with DDH in previous studies[2,3,21]. In our study, we found high birth weight to be a significant risk factor for DDH. In summary, we identified having a female baby and a high birth weight as risk factors for DDH in our study.

Some studies have primarily reported data from orthopedic clinics, often including infants with risk factors and pathological examination findings. This may not accurately reflect the true DDH incidence or the risks of a multifactorial pathology. The limited number of cases in our study may have affected the accuracy of our results. Therefore, we believe that further research involving a larger number of healthy infants followed up in neonatal clinics is needed to better understand the risks associated with DDH.

In the context of the National Newborn Hip Screening Program in Türkiye,[22] family physicians working in Family Health Centers play a crucial role in the early identification and referral of infants at risk for developmental dysplasia of the hip. As the first point of contact in the healthcare system, they are responsible for performing initial postnatal assessments, identifying risk factors, and directing newborns in risk groups to appropriate imaging services such as ultrasonographic evaluation. Moreover, they contribute to parental education and the coordination of follow-up procedures, ensuring the timely detection and management of DDH.

Conclusion

In Türkiye, the National Newborn Hip Screening Program was revised under the Ministry of Health's 2019 directive (Circular No. 2019/13), which recommends targeted ultrasonographic screening for infants identified as being in risk groups[22]. Although our study supports the usefulness of ultrasonography in detecting DDH even in infants without classical risk factors, we acknowledge the importance of adhering to national screening protocols. Therefore, while our findings highlight the potential benefits of universal screening, we recommend that all newborns with identified risk factors undergo hip ultrasound between the fourth and sixth weeks, as stipulated by the updated national guidelines.

Ethics Committee Approval: The study was approved by University of Health Sciences, Umraniye Research and Training Hospital Ethics Committee (No: 16968, Date: 23.10.2012).

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Conflict of Interest: The authors declare that there is no conflict of interest.

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