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The effect of premature birth on developmental hip dysplasia: A screening study with ultrasonography

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Abstract

Developmental dysplasia of the hip (DDH) is an important problem in pediatric orthopedics and can lead to permanent deformities if not diagnosed early. In this study, we examined the effect of prematurity on the development of DDH and concluded that prematurity is not a risk factor for DDH. During 2021 ultrasonography scans, no significant association was found between prematurity and developmental dysplasia of the hip. The babies in the study were divided into two main groups as term and preterm, and preterm babies were also divided into advanced, intermediate, and borderline preterm subgroups. Ultrasonographic evaluations showed no significant difference in hip development between the two groups. When compared with the literature, the findings obtained in our study suggest that prematurity has no significant effect on the development of DDH. These results highlight the importance of focusing on other established risk factors such as family history, breech presentation, and female sex in DDH screening protocols.

Keywords: Developmental hip dysplasia, premature birth, ultrasonography, early diagnosis, pediatric orthopedics

Introduction

Developmental hip dysplasia (DDH) is one of the most common problems in pediatric orthopedics. DDH is a developmental disorder of the hips that occurs in different ways and at different ages. During embryonic development, certain hip structures are typically normal, but they may deteriorate over time due to various factors. The common cause in all cases of DDH is the excessive features of the capsules of the hip joints and the resulting failure to hold the femoral head in the acetabulum [1]. The incidence of DDH in Türkiye is estimated to be approximately 5-15 per 1000 live births (0.5-1.5%) [2].

In 96% of babies diagnosed and successfully treated during the neonatal period, anatomically and radiologically normal hip development can be achieved. When the child reaches walking age, the possibility of conservative treatment disappears. When all these are taken into consideration, it becomes clear how important early diagnosis and treatment are. In a study conducted in our country, it was determined that the number of late diagnoses and follow-up losses for DDH increased during the COVID-19 period. The study emphasized that special precautions should be taken to prevent future morbidities and reduce surgical interventions [3].

Whether prematurity (early birth) is a risk factor is still a matter of debate. The definition of DDH in premature infants has not been clearly defined. While Sezer et al. [4], Doğruel et al. [5], Timmler et al. [6], Sionek et al. [7] could not find a significant relationship between DDH and prematurity, Orak et al. argued

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that prematurity positively affects hip development in the postnatal period [8]. Since different results have been found in various studies, its relationship with DDH is not clear. The aim of this study is to contribute to the literature on this subject.

Material and Methods

In our study, newborns (0-6 months) who applied to the Orthopedics and Traumatology outpatient clinic of our university hospital between January 2021 and December 2021 were screened for DDH with physical examination and ultrasonography and recorded. Maternal age, infant birth weight, family history, examination findings, week of birth and accompanying anomalies were analyzed retrospectively in patient records.

Torticollis, plagiocephaly, metatarsus adductus, breech presentation and other deformities (Spina bifida, vertical talus, pes equinovarus, infantile scoliosis, congenital dislocation of the shoulder or knee, radioulnar synostosis, congenital defects of the upper and lower extremities, Infants with diseases that increase the risk of DDH or associated diseases such as pyloric stenosis, patent ductus arteriosus, urinary and gastrointestinal tract malformations) were not included in our study. Only infants without any risk factor except prematurity were selected for our study.

Between January 2021 and December 2021, 430 infants and 860 hips were examined and the results were recorded. One borderline preterm infant was excluded from the study because he/she did not attend the follow-up

Preterm babies are called advanced preterm (between 22 and 32 weeks), middle preterm (between 32 weeks + 1 day and 36 weeks + 7 days), borderline preterm (between 37 weeks + 1 day and 37 weeks + 7 days) and term at 38 weeks and above [9]. Our babies are divided into two main groups as term and preterm. Preterm babies are divided into three subgroups: advanced preterm, middle preterm and borderline preterm.

Term babies were ultrasonographically examined in the first 6-8 weeks after birth and preterm babies were ultrasonographically examined at 40 weeks of gestation. Hip ultrasonography was evaluated and classified according to Graf. According to the ultrasonographic value of the α angle, which is an indicator of bone structure and the main determinant of hip type, infants with an α angle of ≥60° were group 1 (mature), infants with an α angle between 50° and 59° were group 2 (immature), and infants with an angle of ≤49° were group 3 (pathological) [10].

Hip development of term and preterm infants was statistically compared in terms of DDH. They were then compared with the hips of term infants in three subgroups.

Ultrasonography was performed in the orthopedic outpatient clinic of our hospital using a 5-7.5 mHz linear probe ultrasonography device and a special table prepared for the lateral ducubit position. After the standard plan was obtained, the screen image was frozen and the alpha and beta angles were measured and recorded.

This study was approved by the Non-Interventional Research Ethics Committee of Fırat University with the decision dated July 6, 2022, and protocol number 9607. It was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki by the World Medical Association for medical research involving human subjects.

Statistical analysis was performed using IBM SPSS for Windows Version 22.0 software (licensed from University of California, Davis, USA). Descriptive statistical methods (frequency mean, standard deviation) were used for data analysis. Chi-square test was used to compare the score differences between the groups. P<0.05 was accepted as the statistical significance criterion.

Results

In this study, 430 newborn babies aged 0-6 months who applied to the Orthopedics and Traumatology outpatient clinic of our university hospital between January and December 2021 were screened for DDH by ultrasonography. A total of 860 hips were evaluated and the babies were divided into two main groups: term and preterm.The number of term babies was 249 (57.9%) and preterm babies was 181 (42.1%). Preterm infants were further divided into three subgroups as advanced preterm (n=25, 13.8%), middle preterm (n=72, 39.8%) and borderline preterm (n=84, 46.4%) (Table 1).

Table 1. Distribution of term and preterm babies- distribution of advanced, moderate and borderline premature babies

		Number	Rate (%)
All babies	**Term**	249	57.9
	Preterm	181	42.1
	Total	430	100.0
Preterm babies	**Advanced preterm**	25	13.8
	Middle preterm	72	39.8
	Borderline preterm	84	46.4
	Total	181	100.0

According to the screening results, 454 of 498 term hips were found to be mature hips (91.2%), 36 immature hips (7.2%) and 8 pathologic hips (1.6%). In preterm infants, a total of 360 hips were examined and 333 were evaluated as mature hips (92.5%), 23 as immature hips (6.4%) and 4 as pathologic hips (1.1%) (Table 2). No statistically significant difference was found between term and preterm babies in terms of DDH frequency.

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Table 2. Comparison of alpha structures of term and premature babies

		Total hip number			Total hip	p
		Mature hip	Immature hip	Pathological hip		
Term	**Number**	454	36	8	498	0.729
	Rate %	91.2%	7.2%	1.6%	100.0%	
Preterm	**Number**	333	23	4	360	
	Rate %	92.5%	6.4%	1.1%	100.0%	
Total	**Number**	787	59	12	858	
	Rate %	91.7%	6.9%	1.4%	100.0%	

A total of 50 hips were examined in advanced preterm infants and 47 were classified as mature hips (94%) and 3 as immature hips (6%). No pathologic hips were observed in advanced preterm infants (Table 3).

Table 3. Comparison of term and advanced preterm babies according to alpha value

		Total hip number			Total hip	p
		Mature hip	Immature hip	Pathological hip		
Term	**Number**	454	36	8	498	0.433
	Rate %	91.2%	7.2%	1.6%	100.0%	
Advan-ced pre-term	**Number**	47	3	0	50	
	Rate %	94.0%	6.0%	0.0%	100.0%	
Total	**Number**	501	39	8	548	
	Rate %	91.4%	7.1%	1.5%	100.0%	

In middle preterm infants, 144 hips were examined and 135 were classified as mature hips (93.8%) and 9 as immature hips (6.3%). No pathologic hips were observed in this group (Table 4). In borderline preterm infants, 166 hips were evaluated, 151 were classified as mature hips (91%), 11 as immature hips (6.6%) and 4 as pathologic hips (2.4%) (Table 5).

Table 4. Comparison of term and mid-preterm babies according to alpha value

		Total hip number			Total hip	p
		Mature hip	Immature hip	Pathological hip		
Term	**Number**	454	36	8	498	0.116
	Rate %	91.2%	7.2%	1.6%	100.0%	
Mid- preterm	**Number**	135	9	0	144	
	Rate %	93.8%	6.3%	0.0%	100.0%	
Total	**Number**	589	45	8	642	
	Rate %	91.7%	7.0%	1.2%	100.0%	

Table 5. Comparison of term and borderline-preterm babies according to alpha value

		Total hip number			Total hip	p
		Mature hip	Immature hip	Pathological hip		
Term	**Number**	454	36	8	498	0.786
	Rate %	91.2%	7.2%	1.6%	100.0%	
Borderline preterm	**Number**	151	11	4	166	
	Rate %	91.0%	6.6%	2.4%	100.0%	
Total	**Number**	605	47	12	664	
	Rate %	91.1%	7.1%	1.8%	100.0%	

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No statistically significant difference was found between the hip types of term and preterm babies. Especially in the comparisons between subgroups of preterm infants (advanced preterm, middle preterm, borderline preterm) and term infants, no statistically significant difference was detected in terms of developmental hip dysplasia.

Discussion

DDH is one of the most common problems in pediatric orthopedics. DDH is a disorder of hip development and is seen in different forms at different ages. The structures that form the normal hip joint during embryogenesis undergo structural deterioration over time for various reasons. In all cases, the primary etiology is excessive laxity (looseness) of the hip joint capsule, resulting in the femoral head not being retained in the acetabulum [1]. Anatomically and radiologically normal hip development can be achieved in 96% of infants diagnosed and successfully treated in the neonatal period. Once the child reaches the walking stage, conservative treatment is no longer possible. Given all these factors, the significance of early diagnosis and treatment in newborns becomes clear.

It is difficult to give clear figures for the incidence of DDH, but a review of large study series has shown that the incidence of DDH varies between 0.41% and 16.8% in clinical screening and between 4.4% and 51.8% in ultrasonographic screening [11]. According to two studies conducted in our country, the prevalence of DDH is between 1.34% and 1.49% [12,13]. In our study, 860 hips of 430 patients were examined by us according to their alpha angles. Of these patients, 91.7% had mature hips ($\alpha \geq 60$), 6.9% had immature hips ($50 \leq \alpha \leq 59$) and 1.4% had pathologic hips ($\alpha \leq 49$). Our results were similar to the literature.

Ultrasonography is the most frequently employed radiologic imaging technique for diagnosis and follow-up of DDH and dysplasias that could not be detected by early physical examination or conventional radiography have been detected by ultrasonography [14-18]. Hip ultrasonography can be performed in infants between 0-6 months. Diagnosis of infants older than six months is primarily based on anteroposterior radiographs [19]. Appropriate hip ultrasound is the gold standard for the diagnosis and follow-up of DDH [20]. Ultrasonographic examination of all patients in our study was performed by us in our clinic.

Whether prematurity (preterm birth) is a risk factor is still a matter of debate. Sezer et al. investigated gestational age and birth weight as potential risk factors in premature infants. A total of 421 infants and 842 hips were evaluated using ultrasonography and classified according to Graf. The findings showed that prematurity had no effect on DDH, independent of the presence of maternal risk factors [4].Similarly, Doğruel et al. evaluated low birth weight (<2,500 g) and prematurity (<37 weeks gestational age) as risk factors for DDH. Although 7 of 262 premature infants and 6 of 253 low birth weight infants had Graf type 2b or more severe DDH findings, no significant correlation was observed between prematurity, low birth weight, and DDH [5]. Studies by Timmler et al. [6] and Sionek et al. [7] also found no significant association between prematurity and DDH. Tuncay et al. [21], on the other hand, found no statistical difference between preterm and term infants in a study in which they aimed to emphasize the importance of prematurity and that prematurity caused inconsistency in hip typing. Burkhart et al. [22] reviewed articles published between January 1, 2000 and February 1, 2022, that evaluated the relationship between prematurity and DDH, and 11 studies were included in the analysis. A total of 8720 patients were included. Gestational age was defined as 23 to 36 weeks for preterm infants and ≥37 weeks for term births. Pooled analysis of available data showed no significant difference in DDH between preterm and term births. In a meta-analysis of 15 studies by Ghaseminejad-Raeini et al. [23], 759 newborns were screened. The DDH rate was found to be 2% in preterm infants and 1.9% in term infants, but no significant difference was found in the frequency of DDH between preterm and term infants.

On the other hand, Orak et al. suggested that prematurity positively affects hip development in the postnatal period [8]. Lange et al. [24] found that preterm infants had a reduced risk of DDH compared to term infants. Additionally, they observed that the incidence of mature hips was two times higher in preterm infants than in term infants.A study conducted in Central Europe involving 283 preterm and 377 term infants assessed by ultrasonography found that Prematurity is not a risk factor for DDH, but in fact offers a defensive effect for hip development [25]. Additionally, a meta-analysis by Xingguang Chen et al. [26] also concluded that prematurity serves as a protective factor against DDH.

Duramaz et al. [27] ultrasonographically examined 788 hips of 394 premature infants and found that the incidence of DDH was higher in preterm infants compared to term infants. The biggest difference of our study was that we analyzed preterm babies by dividing them into subgroups.

In our study, preterm infants were divided into three groups as advanced preterm, middle preterm and borderline preterm and these groups were compared with term infants. As a result, no statistically significant difference was found in the probability of DDH between preterm and term infants. Subgroup comparisons were then made between preterm and term infants. No difference was found in the probability of DDH between extremely preterm and term infants, while the probability remained similar between middle preterm and term infants. Finally, when borderline preterm infants were compared with term infants, no significant difference was observed in the probability of DDH. These results suggest that preterm birth does not increase the incidence of DDH and prematurity is not a risk factor for DDH in our study.

Limitations and Strengths of the Study

The strengths of the study encompass the utilization of a large sample size, sensitive screening with ultrasonography and

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a clear examination of the impact of prematurity. In addition, a more focused analysis was conducted by examining only the impact of prematurity. Limitations include the fact that it was a single-center study, making it difficult to generalize the findings. The retrospective nature of the article sample may lead to data incompleteness and errors, and may create difficulties in determining causal relationships.

Conclusion

In the current study, preterm birth was found to have no effect on developmental hip dysplasia. Preterm babies were compared among themselves as advanced preterm, moderate preterm and borderline preterm, no significant difference was found. It seems that the treatment of DDH cases, most of which show normal development with early diagnosis and treatment, is independent of a risk factor such as prematurity.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This study was approved by the Non-Interventional Research Ethics Committee of Fırat University with the decision dated July 6, 2022, and protocol number 9607.

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