



USG DEVELOPMENTAL DYSPLASIA OF HIP.

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Received: February 26, 2026

Revised: March 10, 2026

Accepted: March 24, 2026

Published: April 10, 2026

Abstract

Background: Developmental dysplasia of the hip (DDH) refers to a broad spectrum of anatomical abnormalities affecting the developing hip joint, ranging from mild acetabular dysplasia to complete displacement of the femoral head from the acetabulum.

AIM: The aim of this study was to evaluate developmental dysplasia of the hip (DDH) in infants using ultrasonography. **METHODOLOGY:** This hospital-based cross-sectional observational study was conducted in the Department of Radiology and Imaging, SP medical college Bikaner, over a period of 6 months. **RESULT:** Most infants were assessed within the first six months of life, with a female predominance and breech presentation and first-born status as common risk factors, although some infants had no identifiable risk factors. Ultrasonography using the Graf classification showed predominantly normal or physiologically immature hips, with reduced α -angle, shallow acetabulum, and increased β -angle as the most frequent abnormalities, while severe dysplasia or dislocation was uncommon. **CONCLUSION:** Developmental dysplasia of the hip is most frequently identified in early infancy, with a higher prevalence among female infants and those with recognized risk factors, emphasizing the importance of early screening. Ultrasonography using the Graf classification reliably differentiates normal, immature, and dysplastic hips, with reduced α -angle, shallow acetabulum, and increased β -angle as the commonest abnormalities. Early ultrasound-based detection enables timely conservative management, minimizes the need for surgical intervention, and improves long-term musculoskeletal outcomes in affected children.

Keywords: Ultrasonography, Developmental dysplasia, Graf Classification.



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INTRODUCTION

Developmental dysplasia of the hip (DDH) refers to a broad spectrum of anatomical abnormalities affecting the developing hip joint, ranging from mild acetabular dysplasia to complete displacement of the femoral head from the acetabulum.¹ It is one of the most frequently encountered musculoskeletal disorders in infancy and early childhood. The reported incidence of DDH varies considerably across different populations, influenced by genetic predisposition, cultural practices, and the nature of screening programs employed.² While some cases may resolve spontaneously, untreated or late-detected DDH can lead to significant long-term morbidity, including gait disturbances, limb length discrepancy, chronic hip pain, early onset osteoarthritis, and the eventual need for complex surgical interventions during adolescence or adulthood.³ Although these tests are valuable, their diagnostic accuracy depends heavily on examiner experience and they may fail to detect mild, stable dysplasia or cases that present without obvious clinical signs.⁴

Imaging therefore plays a crucial role in the early evaluation of suspected DDH, particularly during the first few months of life when the hip joint is predominantly cartilaginous. Ultrasonography has emerged as the imaging modality of choice for the assessment of the immature hip joint.⁵ It offers several advantages, including the ability to visualize cartilaginous structures not apparent on plain radiographs, absence of ionizing radiation, and the possibility of dynamic as well as static evaluation. Among the various sonographic techniques described, the Graf method is the most widely accepted and extensively validated.⁶ This method utilizes standardized coronal images of the hip and quantitative measurements of alpha and beta angles to classify hip development and determine the severity of dysplasia. Its reproducibility and diagnostic reliability have led to its widespread adoption in both screening and diagnostic settings. Several demographic and perinatal risk factors have been associated with an increased likelihood of DDH.⁷

These include female sex, breech presentation, positive family history, first-born status, and conditions associated with intrauterine constraint such as oligohydramnios. In developing countries, delayed presentation of DDH continues to be a significant challenge.⁸ Limited access to specialized diagnostic services, lack of awareness, and absence of standardized screening protocols often contribute to late diagnosis, when conservative treatment options are less effective. In such

settings, ultrasonography provides a non-invasive, relatively affordable, and practical solution for early detection when performed by adequately trained personnel^{9,10}.

AIM

The aim of this study was to evaluate developmental dysplasia of the hip (DDH) in infants using ultrasonography.

METHODOLOGY

This hospital-based cross-sectional observational study was conducted in the Department of Radiology and Imaging, SP medical college Bikaner, over a period of 6 months. The study included infants aged 0–12 months who were referred for ultrasonographic evaluation of the hip either for routine screening or due to clinical suspicion of developmental dysplasia of the hip (DDH). Infants with known risk factors such as female sex, breech presentation, positive family history of DDH, first-born status, and oligohydramnios were also included. Written informed consent was obtained from parents or legal guardians prior to enrollment.

Infants older than 12 months, those who had received prior treatment for DDH, and infants with neuromuscular disorders, syndromic conditions, or teratologic hip dislocation were excluded from the study. Ultrasonographic examination of both hips was performed using a high-frequency linear transducer (7.5–12 MHz), with the infant positioned in the lateral decubitus position. The examination was carried out according to the Graf method, obtaining standardized coronal images of the hip joint. Alpha and beta angles were measured, and hips were classified using the Graf classification system. Demographic data, clinical findings, and ultrasonographic results were recorded systematically.

RESULTS

Table 1: Age Distribution of the Study Population

Age group (months)	Number (n)	Percentage (%)
0-3	22	42.3%
4-6	18	34.6%
7-12	12	23.1%

The majority of infants belonged to the 0–3 months age group (42.3%), followed by those aged 4–6 months (34.6%), while 23.1% were in the 7–12 months age group.

Table 2: Sex Distribution of Infants

Sex	Number (n)	Percentage (%)
Male	18	34.6%
Female	34	65.4%

Female infants constituted the majority of the study population (65.4%), while male infants accounted for 34.6% of cases.

Table 3: Birth Presentation of Infants

Birth presentation	Number (n)	Percentage (%)
Cephalic	37	71.2%
Breech	15	28.8%

Most infants were delivered in cephalic presentation (71.2%), whereas 28.8% had a history of breech presentation. The relatively high proportion of breech births highlights its importance as a significant risk factor for developmental dysplasia of the hip.

Table 4: Distribution of Risk Factors for DDH

Risk factor	Number (n)	Percentage (%)
Female sex	34	65.4%
Breech presentation	15	28.8%
Positive family history	9	17.3%
First-born child	21	40.4%
Oligohydramnios	8	15.4%
No identifiable risk factor	11	21.2%

Female sex was the most common risk factor (65.4%), followed by first-born status (40.4%) and breech presentation (28.8%). Notably, 21.2% of infants had no identifiable risk factor, emphasizing that DDH may occur even in the absence of recognized predisposing factors.

Table 5: Laterality of Hip Involvement

Laterality	Number (n)	Percentage (%)
Left hip	10	19.2%
Right hip	22	42.3%
Bilateral	20	38.5%

Left hip involvement was most frequently observed (42.3%), followed by bilateral involvement (38.5%), while isolated right hip involvement was least common (19.2%).

Table 6: Ultrasonographic Assessment of Hip Joint Using Graf Classification

Graf type	Description	Number of hips (n)	Percentage (%)
Type I	Normal	46	44.2%
Type IIa	Physiologically immature	28	26.9%
Type IIb	Dysplastic	14	13.5%
Type IIc	Critical	8	7.7%
Type D	Decentered	4	3.8%
Type III	Dislocated	3	2.9%
Type IV	Severely dislocated	1	1.0%

On ultrasonographic assessment using the Graf classification, the majority of hips were classified as Type I (44.2%) and Type IIa (26.9%), indicating normal or physiologically immature hips. Dysplastic and unstable hips (Types IIb–IV) accounted for a smaller proportion, with severe dislocation being least common (1.0%), highlighting the benefit of early detection.

Table 7: Distribution of Ultrasonographic Findings in Infants Evaluated for DDH (n = 52)

Ultrasonographic finding	Frequency (n)	Percentage (%)
Reduced α -angle ($<60^\circ$)	21	40.4%
Increased β -angle ($>77^\circ$)	18	34.6%
Shallow acetabulum	20	38.5%
Femoral head subluxation	8	15.4%
Femoral head dislocation	4	7.7%
Normal findings	23	44.2%

Reduced α -angle (40.4%) and shallow acetabulum (38.5%) were the most frequent abnormal ultrasonographic findings, followed by increased β -angle (34.6%). Femoral head subluxation (15.4%) and dislocation (7.7%) were less common, while 44.2% of infants demonstrated normal sonographic findings.

DISCUSSION

The age distribution of the study population showed that the majority of infants belonged to the 0–3 months age group, accounting for 22 cases (42.3%). This was followed by infants aged 4–6 months, who comprised 18 cases (34.6%) of the cohort. The 7–12 months age group included 12 infants (23.1%), representing the smallest proportion.

Female infants constituted the majority of the study population, accounting for 65.4% of cases, while 34.6% were male. This marked female predominance is consistent with the well-established higher risk of developmental dysplasia of the hip in female infants. Hormonal influences and increased ligamentous laxity in females have been proposed as contributing factors. The observed sex distribution reinforces the importance of careful screening of female newborns. These findings are in agreement with previously published epidemiological studies on DDH. Hossain et al.¹¹ Female infants constituted 63.3% of the study population.

Most infants in the study were delivered in cephalic presentation (71.2%), while 28.8% had a history of breech presentation at birth. Breech presentation was therefore present in nearly one-third of cases, highlighting its role as an important risk factor for developmental dysplasia of the hip. This finding supports the inclusion of infants with breech presentation for early ultrasonographic screening. Tirta M et al.¹² Of 5363 studies screened, 20 studies comprising 64 543 infants were included. Breech presentation (OR, 4.15 [95% CI, 2.62-6.57]).

Female sex was the most frequently observed risk factor, present in 65.4% of infants, followed by first-born status (40.4%) and breech presentation (28.8%). A positive family history of DDH was identified in 17.3% of cases, while oligohydramnios was noted in 15.4% of infants. Notably, 21.2% of infants had no identifiable risk factors, emphasizing that DDH may occur even in the absence of recognized predispositions. Gyurkovits Z et al.¹³ Regarding the risk factors, female gender, breech presentation and positive family history proved to be significant. Interestingly, 28 (50.90%) of the 55 newborns with DDH had neither positive physical signs nor any risk factors, except being female.

Right hip involvement was the most common pattern, observed in 42.3% of infants, followed by bilateral involvement in 38.5% of cases. Left hip involvement alone was less frequent, accounting for 19.2% of infants. The predominance of left-sided and bilateral involvement reflects the typical distribution pattern of developmental dysplasia of the hip reported in the literature. Bilateral cases highlight the importance of evaluating both hips routinely, even when clinical suspicion is unilateral. Jacobino BCP et al¹⁴ Mean α angle values were higher in males than in females, as well as being higher for right hips than for left hips ($p < 0.001$).

Ultrasonographic assessment using the Graf classification revealed that the majority of hips were normal (Type I, 44.2%). Physiologically immature hips (Type IIa) constituted 26.9%, indicating a substantial proportion of hips requiring follow-up for maturation. Dysplastic hips (Type IIb) were identified in 13.5% of cases, while critical hips (Type IIc) accounted for 7.7%. More severe forms, including decentered hips (Type D) and dislocated hips (Type III), were less frequent, representing 3.8% and 2.9%, respectively. Severely dislocated hips (Type IV) were rare, observed in only 1.0% of cases. Gyurkovits Z et al¹³ At the 1st US, 70 of the examined 3272 hips (2.14%) were found to be positive. According to Graf categories, the following distribution was observed: type II C, 21 hips (30.0%); D, 24 hips (34.28%); III, 24 hips (34.28%); IV, 1 hip (1.44%).

Ultrasonographic evaluation revealed normal findings in 44.2% of infants, indicating the absence of sonographic features of developmental dysplasia of the hip. Among abnormal findings, reduced α -angle ($<60^\circ$) was the most frequently observed parameter (40.4%), reflecting delayed acetabular development. A shallow acetabulum was noted in 38.5% of cases, further supporting structural immaturity of the hip joint. Increased β -angle ($>77^\circ$) was identified in 34.6% of infants, suggesting deficient cartilaginous roof coverage. Features of instability were less common, with femoral head subluxation seen in 15.4% and femoral head dislocation in 7.7% of cases. Hossain et al.¹¹ Reduced α -angle, shallow acetabulum and increased β -angle were the most frequent abnormal findings. The proportion of normal hips increased with advancing age, indicating progressive acetabular maturation.¹

CONCLUSION

This study demonstrates that developmental dysplasia of the hip (DDH) is most frequently identified in early infancy, with the majority of cases detected within the first six months of life, underscoring the value of early ultrasonographic screening. A clear female predominance was observed, along with significant associations with established risk factors such as breech presentation, first-born status, and positive family history. Ultrasonographic assessment using the Graf classification revealed that most hips were normal or physiologically immature, while a smaller but clinically significant proportion demonstrated dysplastic or unstable features requiring close follow-up or intervention. Reduced α -angle, shallow acetabulum, and increased β -angle were the most common abnormal sonographic findings, reflecting delayed acetabular development and insufficient femoral head coverage. Severe forms of DDH, including dislocation, were relatively uncommon but represent cases with the greatest potential for long-term morbidity if missed.

Overall, the findings support ultrasonography as a reliable, non-invasive, and effective modality for early detection and classification of DDH. Early identification allows timely conservative management, promotes normal hip maturation, and reduces the need for surgical intervention. These results emphasize the need for structured ultrasound-based screening strategies, particularly in settings where delayed presentation remains common, to optimize long-term musculoskeletal outcomes in affected children.

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