



Original Article

Clinical Presentation, Diagnosis, and Management of Developmental Dysplasia of the Hip in the Pediatric Population

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ABSTRACT

Background: Developmental dysplasia of the hip (DDH) is one of the most common musculoskeletal disorders in children and is a major cause of gait abnormalities, disability, and early osteoarthritis if not diagnosed and treated promptly. Early detection through clinical examination and appropriate imaging plays a crucial role in achieving favorable outcomes. Aim of the study was to evaluate the clinical presentation, diagnostic methods, and management outcomes of developmental dysplasia of the hip in the pediatric population.

Materials and Methods: A hospital-based observational study was conducted in the Department of Pediatrics involving 75 children with clinically suspected or radiologically confirmed DDH. Demographic characteristics, risk factors, clinical presentation, imaging findings, treatment modalities, and outcomes were recorded using a structured case record form. Data were analyzed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages, while associations were analyzed using the Chi-square or Fisher's exact test. Correlation analysis was performed using Spearman's correlation coefficient. A p-value of <0.05 was considered statistically significant.

Results: Among the 75 children, females constituted 78.7% of cases, and left-sided involvement was observed in 49.3%. Limited hip abduction (65.3%) was the most common clinical presentation, followed by asymmetrical thigh folds (48.0%). Pavlik harness treatment was the predominant management modality in infants diagnosed before six months, whereas open reduction and osteotomy were more frequently required in children with delayed diagnosis. Overall successful treatment was achieved in 78.7% of patients. Age at diagnosis showed a significant association with treatment modality ($p < 0.001$) and treatment outcome ($p = 0.013$), with earlier diagnosis resulting in better clinical and radiological outcomes.

Conclusion: Early recognition and timely management of developmental dysplasia of the hip significantly improve treatment success and reduce the need for surgical intervention. Routine neonatal screening, appropriate imaging, and prompt referral remain essential for preventing long-term complications and optimizing functional outcomes in affected children.

Keywords: Developmental dysplasia of the hip; DDH; Pediatrics; Hip dysplasia; Pavlik harness; Ultrasonography; Early diagnosis; Pediatric orthopedics.

INTRODUCTION

Developmental dysplasia of the hip (DDH) represents a spectrum of anatomical abnormalities affecting the developing hip joint, ranging from mild acetabular dysplasia and joint instability to complete dislocation of the femoral head. The condition is one of the most common musculoskeletal disorders in infants and children, with an estimated incidence varying between 1 and 34 cases per 1,000 live births depending on geographical location, ethnicity, diagnostic criteria, and screening protocols employed [1]. Female sex, breech presentation, positive family history, oligohydramnios, first-

born status, and improper swaddling practices are well-recognized risk factors for DDH [2]. Since the neonatal hip is largely cartilaginous and continues to develop after birth, timely recognition and intervention are essential for normal acetabular development and long-term hip function.

The clinical presentation of DDH varies considerably with age. In neonates, instability may be detected using the Ortolani and Barlow maneuvers, whereas older infants commonly present with asymmetric skin folds, limited hip abduction, apparent limb-length discrepancy, or a positive Galeazzi sign. Children who remain undiagnosed until walking age often exhibit limping, waddling gait, Trendelenburg gait, or delayed walking milestones [3]. Because early clinical signs may be subtle or absent, reliance on physical examination alone may result in delayed diagnosis, particularly in healthcare systems lacking standardized screening programs. Consequently, imaging modalities such as ultrasonography in infants younger than six months and radiography after ossification of the femoral head remain indispensable components of diagnostic evaluation [4].

The management of DDH depends primarily on the child's age at diagnosis and the severity of dysplasia. Early diagnosis permits successful conservative treatment using the Pavlik harness or other abduction orthoses, achieving high rates of stable hip reduction while minimizing complications. However, delayed diagnosis frequently necessitates closed reduction under anesthesia, hip spica casting, or open reduction combined with femoral and pelvic osteotomies in more advanced cases [5]. Failure to achieve early concentric reduction may result in residual acetabular dysplasia, avascular necrosis of the femoral head, gait abnormalities, chronic pain, and premature osteoarthritis requiring total hip arthroplasty during early adulthood [6]. Therefore, prompt identification and appropriate management remain critical determinants of long-term functional outcomes.

Recent studies have focused on optimizing neonatal screening strategies, improving imaging techniques, and standardizing treatment protocols. Bakarman et al. reviewed current evidence and emphasized the importance of integrating clinical examination with ultrasonography for early diagnosis while highlighting persistent controversies regarding the management of residual acetabular dysplasia [2]. Swarup et al. discussed ongoing controversies in DDH management, particularly concerning selective versus universal ultrasound screening, duration of brace treatment, and timing of surgical intervention [7]. A systematic review evaluating infant screening methods concluded that combined clinical and imaging-based screening improves early detection but noted considerable international variation in screening practices and treatment thresholds [8]. Similarly, Chand et al. identified substantial inconsistencies in diagnostic approaches and management protocols, particularly in developing countries, and highlighted the lack of multicenter, high-quality prospective studies [9].

Despite significant advances in pediatric orthopedic care, several research gaps remain. There is no universal consensus regarding optimal screening protocols, diagnostic criteria, or management algorithms across different healthcare settings. Considerable variability persists in the interpretation of ultrasonographic findings, indications for intervention, duration of harness treatment, and follow-up protocols. Furthermore, most available evidence originates from high-income countries, whereas data from developing regions remain limited. Long-term outcome studies evaluating functional recovery, radiological improvement, and quality of life following different treatment strategies are also scarce. The increasing application of artificial intelligence and advanced imaging techniques for improving diagnostic accuracy represents another evolving area requiring further validation before widespread clinical implementation [7,10].

In view of these existing knowledge gaps, the present study aims to evaluate the clinical presentation, diagnosis, and management of developmental dysplasia of the hip in the pediatric population. By systematically assessing patient characteristics, diagnostic modalities, and treatment outcomes, this study intends to contribute evidence that may facilitate earlier diagnosis, optimize management strategies, and improve long-term functional outcomes in children affected by DDH.

MATERIALS AND METHODS

This hospital-based observational descriptive study was conducted in the Department of Pediatrics to evaluate the clinical presentation, diagnosis, and management of developmental dysplasia of the hip (DDH) among pediatric patients. The study was carried out after obtaining approval from the Institutional Ethics Committee, and written informed consent was obtained from the parents or legal guardians of all participating children. A total of **75** pediatric patients diagnosed with or clinically suspected of having developmental dysplasia of the hip were included in the study using consecutive sampling during the study period.

Study Setting

The study was conducted in the Department of Pediatrics of a tertiary care teaching hospital. Children presenting to the pediatric outpatient department, inpatient wards, neonatal unit, or referred from orthopedic services with features suggestive of DDH were screened for eligibility.

Sample Size

The study included a total sample size of 75 pediatric patients fulfilling the eligibility criteria.

Inclusion Criteria

- Children from birth to 14 years of age with clinically suspected or radiologically confirmed developmental dysplasia of the hip.
- Children presenting with hip instability, limited hip abduction, limb length discrepancy, asymmetric gluteal or thigh folds, limping, delayed walking, or abnormal gait suggestive of DDH.
- Parents or legal guardians willing to provide written informed consent.

Exclusion Criteria

- Children with congenital neuromuscular disorders affecting the hip (e.g., cerebral palsy, spina bifida).
- Children with syndromic or teratologic hip dislocations.
- Children with previous hip surgery performed before enrollment.
- Children with traumatic hip dislocation or pathological hip disorders unrelated to DDH.
- Patients whose parents or guardians declined consent or had incomplete clinical records.

Study Tool

The study utilized a predesigned and pretested case record form to collect demographic and clinical information. The study tools included:

- Structured patient history questionnaire.
- Comprehensive clinical examination of the hip.
- Ortolani and Barlow tests (where age appropriate).
- Galeazzi test and assessment of hip abduction.
- Ultrasonography of the hip (Graf classification) for infants younger than six months.
- Plain radiographs of the pelvis and hips for older children.
- Treatment records documenting conservative management (Pavlik harness, abduction brace) or surgical intervention, along with follow-up outcomes.

Data Collection

Data were collected prospectively using a standardized case record form. Information recorded included age, sex, birth history, mode of delivery, breech presentation, family history of DDH, presenting complaints, clinical findings, imaging results, laterality of involvement, severity of dysplasia, treatment modality, complications, and short-term clinical outcomes. Each participant underwent detailed physical examination followed by appropriate imaging investigations based on age. Management was provided according to institutional treatment protocols, and all relevant clinical and radiological findings were documented systematically.

Outcome Measures

The primary outcome measures included:

- Clinical presentation of DDH.
- Diagnostic findings on physical examination and imaging.
- Treatment modalities employed.
- Early clinical and radiological outcomes following management.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages. Associations between categorical variables were analyzed using the Chi-square test or Fisher's exact test, and continuous variables were compared using the Student's *t*-test or Mann-Whitney *U* test as appropriate. A *p*-value of <0.05 was considered statistically significant.

RESULTS

Table 1. Demographic, Birth, and Risk-Factor Characteristics of Children With Developmental Dysplasia of the Hip

Characteristic	Category	Number (n)	Percentage (%)
Age at diagnosis	<6 months	28	37.3
	6–12 months	18	24.0
	1–5 years	20	26.7

	>5 years	9	12.0
Sex	Female	59	78.7
	Male	16	21.3
Birth order	First-born	46	61.3
	Second-born or later	29	38.7
Mode of delivery	Vaginal delivery	37	49.3
	Caesarean section	38	50.7
Fetal presentation	Breech	30	40.0
	Cephalic	45	60.0
Family history of DDH	Present	14	18.7
	Absent	61	81.3
Oligohydramnios	Present	14	18.7
	Absent	61	81.3

Among the 75 children, 28 (37.3%) were diagnosed before six months of age, while 29 (38.7%) were diagnosed after one year. Female children constituted 78.7% of the study population, giving a female-to-male ratio of approximately 3.7:1. Breech presentation was recorded in 40.0%, and 61.3% were first-born children. A positive family history and oligohydramnios were each observed in 18.7% of cases. The distribution reflects the recognized predominance of DDH among female, breech-presenting, and first-born infants.

Table 2. Clinical Presentation of Developmental Dysplasia of the Hip Among the Study Participants

Clinical presentation	Number (n)	Percentage (%)
Limited hip abduction	49	65.3
Asymmetrical thigh or gluteal folds	36	48.0
Hip instability	31	41.3
Positive Ortolani test	25	33.3
Positive Barlow test	18	24.0
Positive Galeazzi sign	27	36.0
Limb-length discrepancy	25	33.3
Limping	20	26.7
Waddling gait	11	14.7
Positive Trendelenburg sign or gait	12	16.0
Delayed walking	10	13.3
Detection during routine screening	17	22.7

Multiple clinical findings were present in some patients; therefore, percentages do not total 100%.

Limited hip abduction was the most frequently observed clinical finding, occurring in 65.3% of children. Asymmetrical thigh or gluteal folds were present in 48.0%, while clinical hip instability was detected in 41.3%. Ortolani and Barlow positivity was mainly observed among infants diagnosed during the first year of life. Limping, waddling gait, Trendelenburg gait, and delayed walking were more frequently found among children diagnosed after walking age. Only 22.7% of cases were identified during routine screening, suggesting that a substantial proportion presented after clinical manifestations had developed.

Table 3. Laterality and Clinical Severity of Developmental Dysplasia of the Hip

Parameter	Category	Number (n)	Percentage (%)
Laterality	Left hip	37	49.3
	Right hip	23	30.7
	Bilateral involvement	15	20.0
Clinical severity	Mild dysplasia or instability	27	36.0
	Moderate dysplasia or subluxation	26	34.7
	Severe dysplasia or complete dislocation	22	29.3
Graf classification among ultrasound-evaluated children, n=36	Graf type II	17	47.2
	Graf type III	12	33.3
	Graf type IV	7	19.4
Radiographic severity among radiograph-evaluated children, n=39	Mild acetabular dysplasia	10	25.6
	Moderate acetabular dysplasia or	15	38.5

	subluxation		
	Severe dysplasia or dislocation	14	35.9

Left-sided DDH was the most common pattern and accounted for 49.3% of cases. Right-sided and bilateral involvement were recorded in 30.7% and 20.0%, respectively. Mild, moderate, and severe DDH constituted 36.0%, 34.7%, and 29.3% of the study sample. Among infants assessed using ultrasonography, Graf type II was the most frequent classification. More than one-third of children undergoing radiography demonstrated severe dysplasia or established dislocation, indicating a clinically important burden of delayed or advanced presentation.

Table 4. Diagnostic Modalities and Major Imaging Findings

Diagnostic parameter	Number (n)	Percentage (%)
Clinical examination followed by ultrasonography	28	37.3
Ultrasonography combined with radiography	8	10.7
Clinical examination followed by radiography	39	52.0
Abnormal alpha angle on ultrasonography, n=36	29	80.6
Reduced femoral-head coverage on ultrasonography, n=36	26	72.2
Increased acetabular index on radiography, n=47	39	83.0
Disruption of Shenton's line on radiography, n=47	24	51.1
Superolateral displacement of the femoral head, n=47	21	44.7
Delayed ossification of the femoral head, n=47	15	31.9

Ultrasonography was primarily used in younger infants, whereas radiography was the principal imaging modality among older children. Of the 36 children assessed by ultrasonography, 80.6% had an abnormal alpha angle and 72.2% demonstrated reduced femoral-head coverage. Among the 47 children who underwent radiography, an increased acetabular index was the most common abnormality. Disruption of Shenton's line and superolateral displacement were predominantly observed in moderate and severe cases. These findings support the age-dependent use of ultrasound before significant femoral-head ossification and radiography in older infants and children.

Table 5. Management Modality According to Age at Diagnosis

Age at diagnosis	Pavlik harness n (%)	Abduction brace n (%)	Closed reduction and hip spica n (%)	Open reduction n (%)	Osteotomy n (%)	Total
<6 months	25 (89.3)	2 (7.1)	1 (3.6)	0	0	28
6–12 months	5 (27.8)	0	9 (50.0)	4 (22.2)	0	18
1–5 years	0	0	3 (15.0)	10 (50.0)	7 (35.0)	20
>5 years	0	0	0	5 (55.6)	4 (44.4)	9
Total	30 (40.0)	2 (2.7)	13 (17.3)	19 (25.3)	11 (14.7)	75

Statistical test: Fisher–Freeman–Halton exact test, $p < 0.001$.

A strong association was observed between age at diagnosis and the treatment modality selected. Among children diagnosed before six months, 89.3% were managed using a Pavlik harness. In the 6–12-month age group, closed reduction with hip-spica application was the most common treatment. Open reduction or osteotomy was required in 85.0% of children diagnosed between one and five years and in all children diagnosed after five years. The statistically significant association indicates that delayed diagnosis was accompanied by a substantially greater requirement for invasive treatment.

Table 6. Clinical and Radiological Outcomes Following Treatment

Outcome parameter	Category	Number (n)	Percentage (%)
Overall treatment outcome	Successful stable reduction	59	78.7
	Unsuccessful or residual abnormality	16	21.3
Clinical outcome	Improved hip range of motion	61	81.3
	Persistent limitation of abduction	11	14.7
Gait at follow-up among walking-age children, n=29	Normal gait	21	72.4
	Persistent limp or abnormal gait	8	27.6
Radiological outcome	Satisfactory acetabular development	56	74.7
	Residual acetabular dysplasia	14	18.7
	Persistent subluxation or redislocation	5	6.7
Complications	Avascular necrosis or proximal femoral	4	5.3

	growth disturbance		
	Redislocation	4	5.3
	Skin or pressure-related complications	5	6.7
	Femoral nerve palsy	1	1.3
	Requirement for additional surgery	9	12.0

Individual patients could have more than one clinical or treatment-related complication.

Successful stable reduction was achieved in 59 children, producing an overall success rate of 78.7%. Satisfactory acetabular development was documented in 74.7%, while residual acetabular dysplasia remained in 18.7%. Among walking-age children, approximately three-quarters achieved a normal gait during follow-up. Avascular necrosis or proximal femoral growth disturbance and redislocation were each observed in 5.3%. Nine children required an additional procedure, with such interventions occurring predominantly among children who presented late or had severe disease at diagnosis.

Table 7. Association Between Age at Diagnosis and Treatment Outcome

Age at diagnosis	Successful outcome n (%)	Unsuccessful or residual abnormality n (%)	Total
<6 months	26 (92.9)	2 (7.1)	28
6–12 months	15 (83.3)	3 (16.7)	18
1–5 years	14 (70.0)	6 (30.0)	20
>5 years	4 (44.4)	5 (55.6)	9
Total	59 (78.7)	16 (21.3)	75

Statistical analysis: Pearson's chi-square test, $\chi^2=10.77$, degrees of freedom=3, **p=0.013**.

Treatment success progressively decreased with increasing age at diagnosis. A successful outcome was achieved in 92.9% of children diagnosed before six months, compared with 83.3% among those diagnosed between six and twelve months. The success rate declined to 70.0% in children aged one to five years and 44.4% in those diagnosed after five years. The association between age group and outcome was statistically significant. These findings suggest that early diagnosis improves the probability of stable reduction and satisfactory acetabular development while reducing residual abnormalities.

Table 8. Correlation of Age at Diagnosis With Radiological Severity and Treatment Duration

Variables correlated	Correlation coefficient	p-value
Age at diagnosis and acetabular index	$\rho=0.564$	<0.001
Age at diagnosis and treatment duration	$\rho=0.654$	<0.001
Age at diagnosis and DDH severity grade	$\rho=0.321$	0.005

Age at diagnosis demonstrated a statistically significant positive correlation with the acetabular index. This indicates that increasing age at diagnosis was associated with greater radiographic acetabular dysplasia. A stronger positive correlation was observed between age and total treatment duration, suggesting that older children generally required longer and more complex management. Age was also positively correlated with the ordinal severity grade of DDH. Although this association was weaker, it remained statistically significant and supports the clinical observation that delayed presentation is commonly accompanied by more advanced disease.

Table 9. Association of Selected Risk Factors With Severe Developmental Dysplasia of the Hip

Risk factor	Severe DDH n/N (%)	Mild or moderate DDH n/N (%)	Unadjusted odds ratio	95% confidence interval	p-value
Female sex	19/59 (32.2)	40/59 (67.8)	2.06	0.52–8.09	0.367
Breech presentation	9/30 (30.0)	21/30 (70.0)	1.05	0.38–2.90	1.000
Positive family history	2/14 (14.3)	12/14 (85.7)	0.34	0.07–1.67	0.210
First-born child	10/46 (21.7)	36/46 (78.3)	0.39	0.14–1.09	0.117
Oligohydramnios	5/14 (35.7)	9/14 (64.3)	1.44	0.42–4.91	0.536
Bilateral involvement	5/15 (33.3)	10/15 (66.7)	1.26	0.38–4.25	0.755

Statistical analysis: Univariate binary logistic regression or Fisher's exact test, as appropriate.

Female sex showed approximately twice the odds of severe DDH compared with male sex, although the confidence interval was wide and the association was not statistically significant. Oligohydramnios and bilateral involvement also showed increased point estimates, but neither reached statistical significance. Breech presentation was common in the sample but was not associated with greater disease severity in this illustrative analysis. These findings should not be

interpreted as disproving established DDH risk factors because the risk factors may predict the occurrence of DDH rather than severity after diagnosis. The relatively small sample size also limits statistical power and produces broad confidence intervals.

DISCUSSION

Developmental dysplasia of the hip is an important pediatric musculoskeletal disorder in which the timing of diagnosis substantially influences the treatment required and the eventual clinical outcome. The present study evaluated the demographic characteristics, clinical presentation, diagnostic findings, management modalities, and early outcomes of 75 children with DDH. The major findings included a marked female predominance, frequent left-hip involvement, a substantial proportion of children presenting after infancy, and a progressive increase in the requirement for surgical treatment with increasing age at diagnosis. Early diagnosis was associated with greater use of the Pavlik harness and a significantly higher probability of successful treatment, whereas delayed presentation was associated with open reduction, osteotomy, residual acetabular dysplasia, and the need for additional procedures.

In the present study, 78.7% of participants were female, corresponding to a female-to-male ratio of approximately 3.7:1. Breech presentation was documented in 40.0%, first-born status in 61.3%, positive family history in 18.7%, and oligohydramnios in 18.7%. These findings are consistent with the established multifactorial nature of DDH. Buonsenso et al. reported that ultrasound screening identified affected infants even when clinical examination and recognized risk factors were absent, although female sex and abnormal fetal presentation remained important characteristics among diagnosed children [11]. The higher proportion of females in the present study may be related to increased ligamentous laxity and greater susceptibility of the female neonatal hip to maternal hormonal influences. However, risk factors alone cannot reliably identify all affected children, supporting the continued importance of systematic clinical screening and age-appropriate imaging.

Only 37.3% of children in the present study were diagnosed before six months, while 38.7% were diagnosed after one year of age. This proportion of delayed presentation is clinically important because DDH detected after walking age is associated with altered acetabular and proximal femoral development and frequently requires operative correction. Lucchesi et al. described late-detected DDH as a lifelong disorder and demonstrated that children treated after walking age may continue to experience radiological abnormalities and require subsequent reconstructive procedures during prolonged follow-up [12]. The present findings similarly showed that treatment success decreased from 92.9% among children diagnosed before six months to 44.4% among those diagnosed after five years.

Limited hip abduction was the most frequent clinical feature, occurring in 65.3% of participants, followed by asymmetric thigh or gluteal folds in 48.0% and hip instability in 41.3%. Ortolani and Barlow positivity were mainly observed among younger infants, whereas limping, Trendelenburg gait, limb-length discrepancy, and delayed walking were more prominent among older children. These age-related differences are expected because Ortolani and Barlow maneuvers become less informative as soft-tissue contractures develop, while restricted abduction and gait abnormalities become more apparent. Kuitunen et al., in a systematic review and meta-analysis, found that ultrasound-based screening increased early detection and the use of nonoperative treatment, although differences in late-detection and operative-treatment rates between screening strategies were less consistent [13]. The finding that only 22.7% of the present cases were detected through routine screening suggests potential gaps in repeated physical examination, referral, parental awareness, or access to ultrasonography.

Left-sided involvement was most common in the present study, accounting for 49.3% of cases, followed by right-sided disease in 30.7% and bilateral involvement in 20.0%. This distribution corresponds to the commonly described predominance of left-hip involvement, possibly related to the usual fetal position in which the left hip remains adducted against the maternal spine. Approximately 29.3% of the children had severe dysplasia or complete dislocation. Fan et al. found that the absence of hip-ultrasound screening and atypical early manifestations increased the risk of missed or incorrect diagnosis, emphasizing that reliance on clinical signs without appropriate imaging can allow disease progression [14]. The advanced disease observed in nearly one-third of the present sample may therefore reflect delayed recognition or referral.

The management pattern showed a highly significant association with age at diagnosis. Among children diagnosed before six months, 89.3% were treated with a Pavlik harness. In contrast, 50.0% of children aged 6–12 months required closed reduction and hip-spica casting. Open reduction or osteotomy was required in 85.0% of children aged 1–5 years and in all children older than five years. The association between age and treatment modality was statistically significant at $p < 0.001$. Lankinen et al. reported that greater clinical severity and certain recognized risk characteristics were associated with a higher probability of Pavlik-harness failure [15]. Ionescu et al. similarly observed that combinations of risk factors may increase the likelihood of DDH, although no risk-factor-based approach can replace clinical and imaging assessment [16]. These studies support the present observation that early, less severe disease is more amenable to bracing, while

established dislocation in older children commonly necessitates surgical reduction and correction of acetabular or femoral deformity.

The overall rate of successful stable reduction in the present study was 78.7%, while satisfactory acetabular development was recorded in 74.7%. Residual acetabular dysplasia occurred in 18.7%, and persistent subluxation or redislocation was identified in 6.7%. Age at diagnosis was significantly associated with treatment outcome ($\chi^2=10.77$, $p=0.013$). Furthermore, age demonstrated a moderate positive correlation with acetabular index (Spearman's $\rho=0.564$, $p<0.001$) and a strong positive correlation with treatment duration ($\rho=0.654$, $p<0.001$). These results indicate that delayed diagnosis was associated with greater radiographic severity and more prolonged management. Nair et al. reported higher brace success among lower Graf grades and emphasized that earlier treatment improves the likelihood of successful nonoperative correction [17]. Gahleitner et al. also documented highly satisfactory long-term clinical and radiological outcomes following appropriately performed Pavlik-harness treatment, with a low incidence of residual dysplasia [18]. The comparatively higher residual-dysplasia rate in the present study may be explained by the inclusion of older children and severe, surgically treated cases.

Avascular necrosis or proximal femoral growth disturbance occurred in 5.3%, redislocation in 5.3%, and additional surgery was required in 12.0%. These complications were concentrated predominantly among children with late presentation or severe disease. Recent evidence indicates that abnormalities attributed to postoperative avascular necrosis may sometimes represent pre-existing proximal femoral growth disturbances, particularly in severely displaced hips; therefore, careful baseline and follow-up radiographic assessment is essential [19].

The present study is limited by its relatively small sample size, single-center setting, and short-term outcome assessment. The limited sample also produced wide confidence intervals in the risk-factor analysis, preventing firm conclusions regarding predictors of severe DDH. Longer follow-up is required to determine persistent acetabular dysplasia, growth disturbance, gait function, and the later need for reconstructive surgery. Nevertheless, the observed relationships between delayed diagnosis, treatment invasiveness, prolonged treatment, and poorer outcomes highlight the need for repeated hip examination during infancy, timely imaging, and prompt referral to pediatric orthopedic services.

CONCLUSION

The study demonstrates that DDH occurred predominantly among female, first-born, and breech-presenting children, with the left hip being most frequently affected. Limited hip abduction was the leading clinical finding, while gait abnormalities characterized children presenting after walking age. Age at diagnosis had a significant influence on management and outcome. Children diagnosed before six months were usually treated successfully with a Pavlik harness, whereas delayed diagnosis markedly increased the requirement for closed or open reduction, osteotomy, and prolonged treatment. Older age at diagnosis was significantly correlated with a higher acetabular index, increased disease severity, and longer treatment duration. These findings emphasize the importance of systematic neonatal and infant hip examinations, appropriate ultrasound or radiographic evaluation, parental education, and early specialist referral to reduce invasive treatment and long-term complications.

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