

Delay in Presentation of Developmental Dysplasia of the Hip (DDH): Average Age at Diagnosis vs Functional and Structural Outcomes

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Abstract: Developmental Dysplasia of the Hip (DDH) represents a spectrum of hip abnormalities that, if undiagnosed or diagnosed late, can result in long-term structural deformities and functional disability. Early detection is critical for optimizing outcomes, but in many developing regions, including Pakistan, delayed presentation remains common. This study aimed to assess the average age at diagnosis of DDH and to evaluate its impact on functional and structural outcomes. **Methods:** This observational cross-sectional study was conducted at the Department of Paediatric Orthopaedics, Benazir Bhutto Hospital, Rawalpindi, Pakistan, from June 2024 to July 2025. Eighty patients aged 6 months to 4 years diagnosed with unilateral or bilateral DDH were included through non-probability consecutive sampling. Clinical evaluation included gait analysis and range of motion, while radiographic assessment utilized the Tönnis classification for dislocation severity and Severin grading for postoperative radiological outcomes. Functional outcomes were assessed using the McKay Clinical Criteria. Data were analyzed using SPSS version 26.0, with $p < 0.05$ considered statistically significant. **Results:** The mean age at Diagnosis was 24.6 ± 8.3 months. Females predominated (77.5%) with a left-side predominance (46.3%). A total of 67.5% of patients presented after 12 months of age. Functional outcomes (McKay score) were significantly better in early-diagnosed cases (<12 months), with 76.9% achieving excellent-to-good outcomes compared with 38.9% in late presenters ($p < 0.05$). Structural results were also superior among early presenters, with 69.2% achieving Severin Grade I–II compared with 29.6% in the delayed group ($p < 0.01$). Late diagnosis was associated with greater dislocation severity: 63.0% of late presenters had Tönnis Grade III–IV dislocations, compared with 26.9% of early presenters ($p < 0.01$). **Conclusion:** Delayed diagnosis of DDH is strongly associated with increased structural deformity and poorer functional outcomes. Early detection—ideally before 12 months of age—significantly enhances prognosis. Implementing nationwide neonatal screening programs and raising parental awareness can reduce diagnostic delays and improve long-term musculoskeletal health outcomes in the Pakistani population.

Keywords: Developmental Dysplasia of the Hip; Late Diagnosis; Functional Outcomes; Structural Outcomes; McKay Clinical Criteria; Severin Grading; Tönnis Classification

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Introduction

Developmental Dysplasia of the Hip (DDH) is a prevalent congenital anomaly characterized by suboptimal development of the hip joint, ranging from mild acetabular dysplasia to complete femoral head dislocation. The incidence rates of DDH vary globally, with estimates reported as high as 28.5 per 1,000 live births in certain populations, indicating a significant public health concern in both developed and developing countries (1). The consequences of undiagnosed or late-presented DDH can include chronic hip pain, osteoarthritis, and functional impairments affecting mobility and quality of life (2,3).

The timing of diagnosis is crucial, as treatment outcomes are closely correlated with the age at which intervention begins. The literature consistently demonstrates that delays in the recognition and treatment of DDH result in poorer functional and structural outcomes, reinforcing the need for timely screening protocols (2,3). For example, late presentations are particularly challenging in developing countries where medical resources may be limited, resulting in missed opportunities for early intervention (4). The role of comprehensive screening, including clinical assessments and ultrasound evaluations, is essential for identifying at-risk infants and improving early diagnosis (5).

Furthermore, cultural practices and awareness significantly influence the effectiveness of DDH screening. Many families may prioritize traditional

practices over clinical evaluations, increasing the risk of missed diagnoses (6). In regions where awareness of the condition is low, the likelihood of children presenting at an older age with advanced hip dysplasia and associated complications increases (7). Addressing these disparities through community education and enhanced access to healthcare resources is vital for improving outcomes.

In the context of Pakistan, the situation is particularly concerning due to socio-economic factors and varying levels of access to healthcare. Findings indicate that disparities exist in the epidemiological data regarding DDH prevalence in Pakistani populations, with a considerable percentage of children presenting late for Diagnosis, leading to avoidable complications (8,9). As healthcare professionals advocate for improved screening practices, the establishment of standardized protocols tailored to local contexts can significantly enhance early detection rates and treatment outcomes for DDH within the Pakistani population.

Thus, timely diagnosis and intervention for DDH are paramount to preventing long-term disabilities. Awareness initiatives alongside enhanced screening practices can yield significant benefits in improving functional outcomes for affected infants, particularly within resource-limited settings such as Pakistan.

Methodology

This observational cross-sectional study was conducted at the Department of Paediatric Orthopaedics, Benazir Bhutto Hospital, Rawalpindi, Pakistan, from June 2024 to July 2025. The study population included patients aged 6 months to 4 years diagnosed with unilateral or bilateral developmental dysplasia of the hip (DDH) based on clinical and radiological findings. A total of 80 patients were enrolled using a non-probability consecutive sampling technique. Diagnosis was established through detailed clinical evaluation, including limb-length assessment, range of motion, and gait observation, supplemented by radiographic assessment. Radiographs of the pelvis (anteroposterior and frog-leg lateral views) were analyzed for acetabular index and femoral head positioning. The Tönnis classification was used to determine the degree of dislocation, while the Severin grading system assessed radiological outcomes post-intervention. Functional assessment was performed using the McKay Clinical Criteria at final follow-up. Patients with neuromuscular disorders, post-traumatic hip deformities, or previous hip surgeries were excluded. Interventions included closed or open reduction, depending on age and reducibility. All patients were followed for at least 6 months post-treatment to evaluate structural and functional outcomes.

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Associations between diagnostic delay and outcomes were assessed using the chi-square test; $p < 0.05$ was considered statistically significant. Ethical approval was obtained from the institutional review board, and informed consent was taken from parents or guardians before inclusion.

Results

A total of 80 patients diagnosed with developmental dysplasia of the hip (DDH) were included in the study. According to international demographic reporting standards, the mean age at diagnosis was 24.6 ± 8.3 months (range 6–48 months). The cohort included 18 (22.5%) males and 62 (77.5%) females, yielding a female-to-male Ratio of 3.4:1. The left hip was more frequently affected (46.3%) than the right (40.0%), while 13.7% had bilateral involvement. Most cases (67.5%) presented after 12 months of age, indicating a delay in diagnosis. Table 1 shows that the majority of patients were female and presented after 12 months of age, with limping as the most common presenting complaint. (Table 1)

Table 1. Demographic Characteristics of Patients (n = 80)

Variable	Frequency (n)	Percentage (%)
Age (months): <12	26	32.5
≥12	54	67.5
Gender: Male	18	22.5
Female	62	77.5
Side affected: Right	32	40.0
Left	37	46.3
Bilateral	11	13.7
Mode of presentation: Limping	31	38.7
Limited abduction	24	30.0
Leg length discrepancy	17	21.3
Hip pain	8	10.0

Functional assessment using the McKay Clinical Score showed significantly better outcomes in early-diagnosed cases (<12 months) than in those diagnosed later (≥12 months). Among early presenters,

76.9% had excellent to good functional results, whereas only 38.9% of late presenters achieved comparable outcomes ($p < 0.05$). (Table 2)

Table 2. Functional Outcome According to McKay Clinical Criteria

Functional Outcome	Early Diagnosis (<12 months) n=26	Late Diagnosis (≥12 months) n=54	Total (n=80)	p-value
Excellent	12 (46.2%)	9 (16.7%)	21 (26.3%)	<0.05
Good	8 (30.7%)	12 (22.2%)	20 (25.0%)	
Fair	4 (15.4%)	18 (33.3%)	22 (27.5%)	
Poor	2 (7.7%)	15 (27.8%)	17 (21.3%)	

Radiological evaluation using the Severin grading system showed that early-treated cases had significantly fewer residual deformities than those diagnosed late. The proportion of hips achieving Severin Grade

I–II (anatomically normal or near-normal) was 69.2% in early-diagnosed versus 29.6% in late-diagnosed patients ($p < 0.01$). (Table 3)

Table 3. Structural Outcomes According to Severin Radiological Grading

Severin Grade	Early Diagnosis (<12 months) n=26	Late Diagnosis (≥12 months) n=54	p-value
I–II (Excellent/Good)	18 (69.2%)	16 (29.6%)	<0.01
III–IV (Fair/Poor)	8 (30.8%)	38 (70.4%)	

The Tönnis classification further confirmed that delayed presentation was associated with more severe hip dislocation. Grade III–IV

dislocations were observed in 63.0% of late-diagnosed cases compared to 26.9% in early-diagnosed cases ($p < 0.01$). (Table 4)

Table 4. Comparison of the Severity of Dislocation According to Tönnis Classification

Tönnis Grade	Early Diagnosis (<12 months) n=26	Late Diagnosis (≥12 months) n=54	p-value
I–II	19 (73.1%)	20 (37.0%)	<0.01
III–IV	7 (26.9%)	34 (63.0%)	

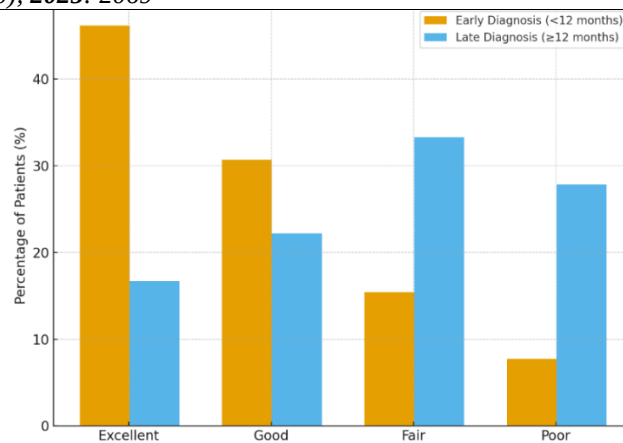


Figure 1 Inverse relationship between the age at Diagnosis and the proportion of favorable outcomes.

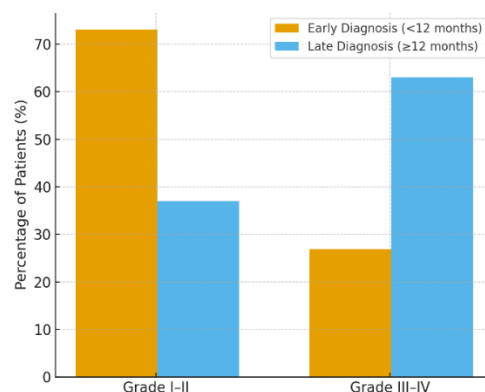


Figure 2 Distribution of structural severity across early- and late-diagnosed groups.

Discussion

In a study of developmental dysplasia of the hip (DDH), we analyzed data from 80 patients, revealing significant insights into the demographics and functional outcomes associated with the timing of diagnosis. The mean age at diagnosis was 24.6 ± 8.3 months, with most patients (67.5%) presenting after 12 months of age. This high percentage of late diagnoses mirrors findings from Ellsworth et al., who noted trends in older cohorts of DDH patients, indicating that advanced age at presentation leads to poorer outcomes Ellsworth et al. (10).

Our results, indicating that most patients with DDH presented after 12 months, support a growing body of literature affirming that delays in diagnosis significantly affect functional outcomes. Morello et al. highlighted similar challenges in late-presenting cohorts and emphasized the necessity for improved screening protocols to prevent adverse long-term effects (11). The gender distribution in our cohort aligns with established trends, with DDH exhibiting a higher prevalence in females, corroborated by a recent systematic review reporting a female-to-male ratio of approximately 3:1, consistent with our findings of 3.4:1 (12).

Table 1 of our study reveals that limping was the most common presenting complaint (38.7%), followed by limited abduction and leg length discrepancy. This pattern was also recognized in studies; for instance, Ho et al. noted that children often display gait abnormalities, such as limping, during weight-bearing activities, signaling undiagnosed DDH (12). These presentations are crucial indicators, yet they usually lead to late diagnosis if screening is not initiated early in life.

The disparity in functional outcomes by diagnosis timing is shown in Table 2. Notably, the McKay Clinical Score showed that early diagnosis (<12 months) was associated with 76.9% of patients achieving excellent to good outcomes, compared with only 38.9% in the late diagnosis category ($p < 0.05$). Similarly, Kumar et al. substantiated that early treatment significantly mitigates the risks of long-term complications in

DDH, reinforcing the findings of our study (13). The significant difference in outcomes underscores the critical importance of timing, as evidenced by previous studies demonstrating that late intervention correlates with poorer functional results and a greater need for surgical correction.

In our analysis of structural outcomes (Table 3), using the Severin grading system, we noted that early-treated cases resulted in 69.2% attaining grades I–II, indicating near-normal anatomy, compared to only 29.6% in late-diagnosed cases ($p < 0.01$). This finding aligns with literature suggesting that late presentation correlates with increased residual deformities and a higher incidence of osteoarthritis in adult life (14). The concerns surrounding late diagnosis have prompted discussions in the orthopaedic community, including proper follow-up strategies for populations identified with high-risk factors, as discussed by Zhang et al. (15).

Furthermore, our results reflected a significant correlation between the timing of diagnosis and dislocation severity, as highlighted in Table 4. The Tönnis classification indicated that 63.0% of late-presenting cases exhibited grade III–IV dislocations, underscoring a critical aspect of delayed diagnosis that could necessitate more extensive surgical intervention later in life. This aligns with findings by Pan et al., who noted that severe dislocations can result in increased complications and poorer overall outcomes when intervention is delayed (16). The consensus in contemporary research emphasizes the need for advances in screening practices to reduce late presentation, especially in regions with limited healthcare resources.

Thus, this study highlights the pressing need for improved awareness and screening for DDH, particularly in the context of the Pakistani population, where cultural factors may impede timely medical consultations. The delayed diagnosis frequently observed in our cohort reflects a critical gap that requires immediate attention through education and enhanced healthcare access. Given the demographic challenges, investing in

community awareness programs and integrating standardized screening protocols could significantly improve early detection and, ultimately, patient outcomes in this vulnerable population.

Conclusion

Delayed presentation of developmental dysplasia of the hip remains a significant challenge in Pakistan, where most cases are diagnosed after the first year of life. This delay contributes to more severe dislocations and suboptimal functional recovery, as evidenced by lower McKay and Severin scores among late presenters. Early screening, parental education, and standardized neonatal examination protocols are essential to ensure prompt Diagnosis and timely management, thereby preventing lifelong disability and improving quality of life for affected children.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-MMS-033-24)

Consent for publication

Approved

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The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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