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Original Research Article

Diagnostic Accuracy of Ortolani and Barlow Maneuvers in the Diagnosis of Developmental Dysplasia of the Hip Joint in Infants, Taking Alpha Angle on Ultrasound as a Gold Standard

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Abstract: *Developmental dysplasia of the hip is a frequent cause of preventable disability if not detected early. Ortolani and Barlow maneuvers are widely used bedside screening tests, but their accuracy varies across settings.* ***Objective:*** *To determine the diagnostic accuracy of the Ortolani and Barlow maneuvers in the diagnosis of developmental dysplasia of the hip joint in infants, taking the alpha angle on ultrasound as a gold standard.* ***Methods:*** *This cross-sectional validation study was conducted on a sample of 172 infants aged 1-16 weeks, who were suspected of DDH based on risk factors such as breech presentation, family history, or in utero restriction. The researcher performed the Ortolani and Barlow maneuvers. All infants underwent a hip ultrasound conducted by an experienced radiologist who was blinded to the clinical examination. Diagnostic accuracy of the Ortolani and Barlow maneuvers was determined, along with sensitivity, specificity, positive predictive value (PPV), and and negative predictive value (NPV), by constructing a 2x2 contingency table.* ***Results:*** *The mean age of the infants in this study was 8.03 ± 4.53 weeks, with male gender 96 (55.8%). DDH on hip ultrasound was positive in 98 infants (57.0%), while 77 (44.8%) had positive results on the Ortolani and Barlow maneuvers. The diagnostic accuracy of Ortolani and Barlow maneuvers was 64.53%, with a sensitivity of 58.16% and a specificity of 72.97%.* ***Conclusion:*** *Ortolani and Barlow manoeuvres exhibited a modest diagnostic accuracy of 64.53%, with sensitivity of 58.16% and specificity of 72.97%, using the alpha angle on ultrasound as the gold standard.*

Keywords: Developmental dysplasia of the hip, Ortolani manoeuvre, Barlow manoeuvre, diagnostic accuracy, hip ultrasound, alpha angle

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Introduction

Developmental dysplasia of the hip (DDH) includes a range of hip defects present from birth, ranging from mild joint instability to structural malformations of the acetabulum or femoral head and complete dislocation. Early screening, along with timely intervention, plays a critical role in enhancing long-term musculoskeletal function and overall quality of life in affected children (1-3). Due to the delayed diagnosis, management becomes significantly more challenging, often requiring extensive surgical procedures because of increased technical complexity and resulting in less favorable functional outcomes. Hip dysplasia can progress to chronic pain if not treated; however, the restricted mobility and early onset osteoarthritis commonly culminate in the need for total hip replacement in adulthood (5,6).

A child's age primarily determines treatment technique at diagnosis and the degree of hip involvement. Infants who are recognized early respond well to conservative management, which aims to achieve stable concentric reduction of the hip joint and is associated with excellent long-term results. Cases recognized after the child has initiated walking frequently necessitate more invasive reconstructive operations and carry an advanced risk of difficulties as well as long-term morbidity. Clinical assessment is a foundation for identifying DDH, particularly among infants with documented risk factors such as breech presentation and conditions that lead to intrauterine constraint and large-for-gestational-age. Barlow and Ortolani tests are generally used to measure hip stability and recognize dislocation. These maneuvers demonstrate high diagnostic accuracy, with reported sensitivity ranging from 87% to 97% and specificity between 98% and 99% (9). Additional clinical signs, including hip asymmetry, may raise suspicion for DDH; however, it is essential to note that such asymmetry can also be observed in a substantial percentage of healthy infants. Galeazzi's sign, which evaluates knee height discrepancy, serves as another valuable clinical indicator. Ultrasonography is the preferred diagnostic modality among infants due to its safety and ability to visualize cartilaginous structures (10-12).

Clinical screening with the Ortolani and Barlow maneuvers remains the primary technique for early recognition of hip instability in newborns and young infants. The diagnostic reliability of these maneuvers is highly operator-dependent and may vary with the examiner's experience and the infant's age. Evaluating the diagnostic accuracy of the Ortolani and Barlow maneuvers by comparing clinical findings with ultrasound-derived alpha angle measurements as the gold standard is essential to determine their sensitivity, specificity, and clinical utility, and to guide effective screening strategies for the appropriate diagnosis and management of DDH.

Methodology

This cross-sectional validation study was conducted from 11 January 2025 to 11 May 2025 in the Department of Paediatrics at Khyber Teaching Hospital, Peshawar. Ethical approval was obtained from the hospital prior to data collection. A non-probability consecutive sampling technique was used. Sample size was calculated using the sensitivity and specificity calculator, keeping a 95% confidence level, 55% prevalence of DDH3, 57.1% sensitivity of Ortolani and Barlow (10% absolute precision), and 95% specificity (5% absolute precision) of Ortolani and Barlow in the diagnosis of DDH, taking ultrasound as the gold standard. (13) Sample size was 172 patients.

Infants aged between 1 and 16 weeks of either gender, with suspected DDH, were included. Infants having a history of breech presentation, previous family history of DDH, and in utero movement restriction, including large for gestational age infants, oligohydramnios, and multiple gestations, were taken as suspected cases of developing DDH. Patients

with neurological disease and bone fractures were excluded from the study. Informed consent was obtained from the patients' parents or guardians, and the study's benefits and objectives were clearly communicated to them.

After enrollment, the patients' baseline demographics were recorded. The researcher performed the Ortolani and Barlow maneuvers, with the infant in the supine position, the hip was flexed at 90°, and in neutral rotation. This maneuver aimed to reduce the dislocated hip by holding the hip with the thumb on the inner aspect and the index and ring fingers on the greater trochanter. While applying anterior force on the greater trochanter, the hip was gently abducted. The researcher felt a jerk or clunk if the hip was dislocated. For the Barlow maneuver, the researcher employed the same initial position as the Ortolani maneuver; force was applied posteriorly to the trochanter, and the hip was adducted. A clunk or jerk was felt if the hip can be dislocated. All subjects underwent pelvic sonography. An ultrasound screening examination using linear 5 and 7.5 MHz probes was performed on all the infants. The presence of an alpha angle less than 43 degrees on ultrasound was labelled as developmental dysplasia of the hip. The examination was done by a radiologist who had more than five years of post-fellowship experience and was blinded to both the Ortolani-Barlow maneuver results and to any risk factors presented. The diagnostic accuracy of the Ortolani-Barlow maneuver was calculated as the proportion of patients accurately diagnosed by the Ortolani and Barlow maneuvers as having DDH, confirmed by ultrasound of the hip.

Data were entered and analysed using SPSS 25. Mean ± standard deviation was calculated for age and symptom duration. Gender, presence of risk factors, and diagnostic outcomes from clinical and ultrasonographic examinations were presented as frequencies and percentages. Diagnostic accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were calculated for Ortolani and Barlow using hip ultrasound as the gold standard by constructing a 2x2 table. Effect modifiers such as age, gender, and symptom duration were stratified to assess diagnostic accuracy.

Results

The study included 172 infants. The mean age of the infants was 8.03 ± 4.534 weeks. The average duration of symptoms before presentation was 3.19 ± 1.342 days.

Regarding gender distribution, male infants were 96 (55.8%) (Figure 1).

Clinical examination using the Ortolani and Barlow maneuvers diagnosed 77 (44.8%) infants as positive for developmental dysplasia of the hip, and 95 infants (55.2%) were negative. Hip ultrasound confirmed the diagnosis in 98 infants (57.0%), and it was negative in 74 cases (43.0%) (Table 1).

Breech presentation was noted in 91 infants (52.9%), the most common risk factor, followed by large for gestational age in 28 cases (16.3%) (Table 2).

The sensitivity of the Ortolani and Barlow manoeuvres was 58.16%. The specificity was 72.97%. The positive predictive value was 74.03%, and the negative predictive value was 56.84%. The diagnostic accuracy of the clinical examination was 64.53% (Table 3). Table 4 presents the stratification of age, gender, and symptom duration by diagnostic accuracy.

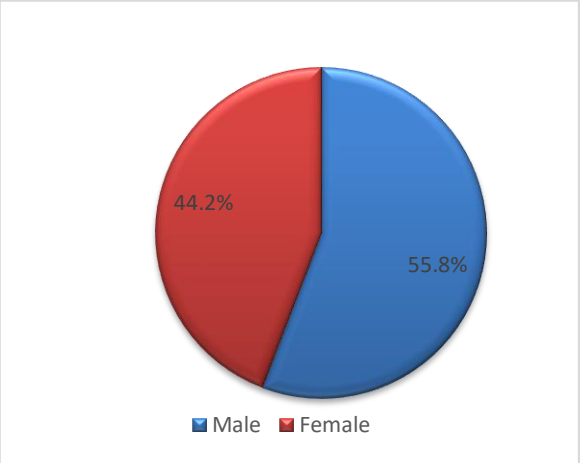

Figure 1: Gender distribution

Table 1: DDH diagnosis

DDH diagnosis		Frequency	Percentage
DDH on Ortolani and Barlow maneuvers	Positive	77	44.8
	Negative	95	55.2
DDH on hip ultrasound	Positive	98	57.0
	Negative	74	43.0

Table 2: Risk factors

Risk factors	Frequency	Percent
Breech presentation	91	52.9
Family history	27	15.7
Large for gestational age	28	16.3
Multiple gestations	8	4.7
Oligohydramnios	18	10.5
Total	172	100.0

Table 3: Diagnostic accuracy of DDH on Ortolani and Barlow maneuvers

		DDH on hip ultrasound		Total	Diagnostic accuracy
		Positive	Negative		
DDH on Ortolani and Barlow maneuvers	Positive	(TP) 57	(FP) 20	77	Sensitivity: 58.16% Specificity: 72.97% PPV: 74.03% NPV: 56.84% Diagnostic accuracy: 64.53%
		58.2%	27.0%	44.8%	
	Negative	(FN) 41	(TN) 54	95	
		41.8%	73.0%	55.2%	
Total		98	74	172	
		100.0%	100.0%	100.0%	

Table 4: Stratification of Diagnostic accuracy of DDH on Ortolani and Barlow maneuvers with age, gender, and duration of symptoms

Variable	Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
Age (Weeks)					
1 to 8	54.90%	69.77%	68.29%	56.60%	61.70%
> 8	61.70%	77.42%	80.56%	57.14%	67.95%
Gender					
Male	62.00%	73.91%	72.09%	64.15%	67.71%
Female	54.17%	71.43%	76.47%	47.62%	60.53%
Duration of symptoms (Weeks)					
1 to 3	54.90%	69.77%	68.29%	56.60%	61.70%
> 3	61.70%	77.42%	80.56%	57.14%	67.95%

Discussion

Studies on developmental dysplasia of the hip underscore the complex interplay among diagnostic methodologies, risk factors, and screening standards. Historically, clinical examinations, especially the Ortolani and Barlow manoeuvres, formed the foundation of neonatal hip screening. Studies indicate variable sensitivity, often below 60%, and a noticeable dependence on examiner expertise, which can lead to both missed diagnoses and needless interventions. (13) Graf in 1980 introduced ultrasonography as a transformative tool, providing objective anatomical assessment through standardised measurement of the alpha and beta angles. (14) This technique has been widely adopted in many countries, where its implementation in universal screening programmes has been associated with a significant reduction in late-presenting cases and the need for complex surgical procedures. (15)

Risk factor profiling remains a critical point for understanding DDH aetiology and refining screening protocols. A consistent association is observed with female sex, breech presentation, and a positive family history. (15) The mechanical constraints of breech positioning in utero and potential genetic predispositions involving ligamentous laxity are frequently cited pathogenic mechanisms. (17) Other factors, such as oligohydramnios, first-born status, and certain postnatal practices like restrictive swaddling, have also been considered as risk factors for DDH.(19) Studies have shown that prematurity is not strongly correlated with DDH.(18)

Static ultrasound using the Graf method is the most well-established technique; recent advancements have explored integrating artificial intelligence to automate measurements and assess scan quality, thereby improving standardisation and accessibility. (20) However, the efficacy of any imaging modality remains dependent on obtaining high-quality standardised views, a task that requires training.

The demographic profile of the patients in the present study showed a mean age of around 8 weeks, with a slight majority of males. The distribution of recognised risk factors within the sample is informative. Breech presentation was present in 52.9% infants, reinforcing its status as a significant risk indicator. Large-for-gestational-age was observed in 16.3% of cases; a positive family history was reported in 15.7% of cases, supporting a genetic factor; 10.5% had oligohydramnios; and 4.7% were multiple-gestation cases.

The Ortolani and Barlow manoeuvres demonstrated a sensitivity of 58.16% and specificity of 72.97%. The diagnostic accuracy was 64.53%. These results are consistent with previous studies reporting a modest sensitivity for these manoeuvres. (13) The observed specificity was higher than the sensitivity, indicating that a positive clinical test is a reliable indicator of pathology. Still, a negative test fails to rule out DDH in a concerning number of infants.

These results contribute to the literature by providing localised data on the performance of clinical examination. The results validate the claim that reliance solely on Ortolani and Barlow manoeuvres, even within a population where risk factors are assessed, will miss a high proportion of DDH cases.

Conclusion

In conclusion, the study showed that the Ortolani and Barlow manoeuvres demonstrated modest diagnostic accuracy (64.53%), with sensitivity of 58.16% and specificity of 72.97%, using the alpha angle on ultrasound as the gold standard. It is suggested that Ortolani and Barlow manoeuvres can be helpful in low-resource settings where ultrasonography is not available.

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.

Consent for publication
Approved

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Not applicable

Conflict of interest

The authors declared no conflict of interest.

Author Contribution

FR (TMO/PGR)
Data Collection, Data Analysis, Literature Search and Manuscript Drafting
SK (Asst/Assoc/Prof PROF)
Critical Input and Final Approval of Draft

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

References

1. Harsanyi S, Zamborsky R, Krajciova L, Kokavec M, Danisovic L. Developmental dysplasia of the hip: a review of etiopathogenesis, risk factors, and genetic aspects. Medicina (Kaunas). 2020;56(4):153. https://doi.org/10.3390/medicina56040153
2. Bakarman K, Alsiddiky AM, Zamzam M, Alzain KO, Alhuzaimi FS, Rafiq Z, et al. Developmental dysplasia of the hip (DDH): etiology, diagnosis, and management. Cureus. 2023;15(8):e43207. https://doi.org/10.7759/cureus.43207
3. Nicholson A, Dunne K, Taaffe S, Sheikh Y, Murphy J. Developmental dysplasia of the hip in infants and children. BMJ. 2023;383:e074507. https://doi.org/10.1136/bmj-2023-074507
4. Goiano ED, Akkari M, Pupin JP, Santili C. The epidemiology of developmental dysplasia of the hip in males. Acta Ortop Bras. 2020;28(1):26-30. https://doi.org/10.1590/1413-785220202801215936

5. Xiao H, Tang Y, Su Y. Risk factors of developmental dysplasia of the hip in a single clinical center. Sci Rep. 2022;12(1):19461. https://doi.org/10.1038/s41598-022-24025-8
6. Alassaf N. Treatment of developmental dysplasia of the hip (DDH) between the ages of 18 and 24 months. Eur J Orthop Surg Traumatol. 2020;30(4):637-641. https://doi.org/10.1007/s00590-019-02626-4
7. Pavone V, de Cristo C, Vescio A, Lucenti L, Sapienza M, Sessa G, et al. Dynamic and static splinting for treatment of developmental dysplasia of the hip: a systematic review. Children (Basel). 2021;8(2):104. https://doi.org/10.3390/children8020104
8. de Witte PB, van Bergen CJA, de Geest BL, Willeboordse F, van Linge JH, den Hartog YM, et al. Treatment of decentered developmental dysplasia of the hip under the age of 1 year: an evidence-based clinical practice guideline (Part 2). EFORT Open Rev. 2022;7(8):542-553. https://doi.org/10.1530/EOR-21-0126
9. Patel H; Canadian Task Force on Preventive Health Care. Preventive health care, 2001 update: screening and management of developmental dysplasia of the hip in newborns. CMAJ. 2001;164(12):1669-1677.
10. Noordin S, Umer M, Hafeez K, Nawaz H. Developmental dysplasia of the hip. Orthop Rev (Pavia). 2010;2(2):e19. https://doi.org/10.4081/or.2010.e19
11. Nemeth BA, Narotam V. Developmental dysplasia of the hip. Pediatr Rev. 2012;33(12):553-561. https://doi.org/10.1542/pir.33-12-553
12. Guarniero R. Dysplasia of hip development: update. Rev Bras Ortop. 2010;45(2):116-121. https://doi.org/10.1016/S2255-4971(15)30279-2
13. Kremli MK, Khoshhal KI, Zamzam M, Zamzani M, Badr AA, Taha WS. Evaluation of clinical signs and tests of congenital dysplasia of the hip. Ann Saudi Med. 2002;22(1-2):102-104. https://doi.org/10.5144/0256-4947.2002.102
14. Graf R. The diagnosis of congenital hip-joint dislocation by the ultrasonic compound treatment. Arch Orthop Trauma Surg. 1980;97(2):117-133. https://doi.org/10.1007/BF00450934
15. Sioutis S, Kolovos S, Altsitzioglou P, Karampikas V, Koulalis D, Mavrogenis AF. Hip sonography for developmental dysplasia of the hip: the Graf method. Acta Orthop Traumatol Hell. 2022;73(4):336-346.
16. Almutairi FF. Incidence and characteristics of developmental dysplasia of the hip in a Saudi population: a comprehensive retrospective analysis. Medicine (Baltimore). 2024;103(6):e36872. https://doi.org/10.1097/MD.0000000000036872
17. Loder RT, Skopelja EN. The epidemiology and demographics of hip dysplasia. ISRN Orthop. 2011;2011:238607. https://doi.org/10.5402/2011/238607
18. Burkhart RJ, McNassor R, Acuna AJ, Kamath AF. Is prematurity a risk factor for developmental dysplasia of the hip? A systematic review and meta-analysis. J Pediatr Orthop B. 2023;32(4):305-311. https://doi.org/10.1097/BPB.0000000000001100
19. Manoukian D, Rehm A. Oligohydramnios: should it be considered a risk factor for developmental dysplasia of the hip? J Pediatr Orthop B. 2019;28(5):442-445. https://doi.org/10.1097/BPB.0000000000000638
20. Hareendranathan AR, Chahal B, Ghasseminia S, Zonoobi D, Jaremko JL. Impact of scan quality on AI assessment of hip dysplasia ultrasound. J Ultrasound. 2022;25:145-153. https://doi.org/10.1007/s40477-021-00574-9