Retrospective Multicenter Analysis of the Accuracy of Clinical Examination by Community Physicians in Diagnosing Developmental Dysplasia of the Hip

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Objectives To determine among general practitioners (GPs) the most common clinical findings that raised concern for developmental dysplasia of the hip (DDH) and necessitated an orthopedic outpatient referral. In addition, we assessed the sensitivity and specificity of the most common of these clinical findings.

Study design We performed a multicenter retrospective review of all referrals by GPs to local orthopedic outpatient departments for DDH over a 12-month period. All patients had undergone pelvic radiographs, and the acetabular index (AI) was measured. The AI was used as a reference test to assess the accuracy of the clinical examination in diagnosing DDH. Sensitivity and specificity of each clinical sign was calculated.

Results Twenty-six of 174 (14.9%) referred patients were diagnosed with DDH, defined as an AI score > 30. The most common indication for referral, per the GP letter was asymmetrical skin folds (97 patients, 45.8%), followed by hip click (42 patients, 19.8%), and limb shortening (34 patients, 16%). Sensitivities and specificities, respectively, among findings were asymmetric skin folds 46.2% (95% CI 26.6%-66.6%) and 42.6% (95% CI 34.5%-51.0%), hip click 23.1% (95% CI 9.0%-43.6%) and 75.7% (95% CI 67.9%-82.3%), limb shortening 30.8% (95% CI 14.3%-51.8%) and 82.4% (75.3%-88.2%), and reduced abduction 19.2% (95% CI 6.6%-39.4%) and 91.9% (95% CI 86.3%-95.7%). Using logistic regression analysis, no clinical sign was found to be a statistically significant indicator of an abnormal AI.

Conclusions Clinical examination by GPs does not reliably detect radiographically-defined DDH. None of the clinical findings by the GP showed an acceptable level of sensitivity. Absence of reduced abduction and limb shortening are relevant negatives given the high level of specificity of these signs *(J Pediatr 2017;181:163-6).*

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Developmental dysplasia of the hip (DDH) is the most common musculoskeletal disorder in infancy and varies in severity, ranging from neonatal hip instability with or without associated acetabular dysplasia to irreducible dislocation.[1,2] The reported incidence of DDH is 1.5-2.5 per 1000 live births.[3] Failure to diagnose DDH and treat in infancy can result in significant long-term disability and has been shown to account for 29% of total hip replacements in people under the age of 60 years.[4]

Hip screening in newborns consists of a clinical examination plus the Ortolani and Barlow tests before discharge from the neonatal unit. The use of ultrasonography in neonatal hip screening has increased, but its application is limited in some regions to those infants with established risk factors such as family history, first born status, breech presentation, and female sex.[5]

Children who are not identified at the neonatal clinical examination are often diagnosed by general practitioners (GPs) in the community. Effective clinical examination by the GP and appropriate referral to a pediatric orthopedic consultant is crucial to prevent late diagnosis of DDH, which will ultimately lead to a more complicated course of treatment, often surgical. These findings on GP examination often vary, with "clicky hips," asymmetric skin folds, and reduced abduction being the more common.[6,7]

The most common indications for referral by a GP to a pediatric orthopedic outpatient clinic for DDH have not yet been explored. Furthermore, the sensitivity and specificity of the findings on clinical examination in the community has not been addressed, based on the presence of dysplasia on a plain radiograph. The primary objective of this study was to determine the most common clinical findings of DDH in general practice that necessitated an orthopedic outpatient referral. In addition, we aimed to calculate the sensitivity and specificity of the most common of these clinical findings by GPs.

Methods

We performed a multicenter retrospective review of all referrals by GPs to local orthopedic outpatient departments over a 12-month period from July 2014 to July

AI	Acetabular index	GPs	General practitioners
DDH	Developmental dysplasia of the hip		

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Table I. Sensitivity and specificity of each sign

	Sensitivity (95% CI)	Specificity (95% CI)	Positive predictive value (95% CI)	Negative predictive value (95% CI)
Asymmetrical skin folds	46.2% (26.6-66.2)	42.6% (34.5-51.0)	12.4% (6.6-20.6)	81.8% (71.4-89.7)
Limb shortening	30.8% (14.3-51.8)	82.4% (75.3-88.2)	23.5% (10.7-41.2)	87.1% (80.4-92.2)
Reduced abduction	19.2% (6.6-39.4)	91.9% (86.3-95.7)	29.4% (10.3-56.0)	86.6% (80.3-91.5)
Hip click	23.1% (9.0-43.6)	75.7% (67.9-82.3)	14.3% (5.4-28.5)	84.8% (77.6-90.5)
Hip clunk	3.9% (0.1-19.6)	99.3% (96.3-100)	50% (1.3-98.7)	85.5% (79.3-90.4)
Limp	7.7% (1.0-25.1)	98.0% (94.2-99.6)	40.0% (5.3-85.3)	85.8% (79.6-90.7)
Hip laxity	0% (0.0-97.5)	99.3% (96.3-100)	0.0% (0.0-97.5)	85.0% (78.8-89.9)
External rotation	7.7% (1.0-25.1)	96.6% (92.3-99.3)	28.6% (3.7-71.0)	85.6% (79.4-90.6)
Nonweight bearing	0.0% (0.0-13.2)	97.3% (93.2-99.3)	0.0% (0.0-60.2)	84.7% (78.4-89.8)

2015. All referrals in this 12-month period of patients < 36 months of age were included in the study. We included patients presenting to an orthopedic department for the first time with suspicion for DDH. Exclusion criteria were patients seen previously for DDH, those screened already with ultrasound, patients with genetic abnormalities or neurologic conditions, and any referral that did not specify clinical finding. Every patient had anteroposterior pelvic radiographs with a view to measure their acetabular index (AI).

The AI was used as reference to assess the accuracy of the clinical examination in diagnosing DDH.[8] The acetabular roof angle has been shown to be a reliable measure of dysplasia, with an AI > 30° consistent with DDH.[9-11] Satisfactory intra- and interobserver reliability in measuring AI also has been demonstrated.[12]

Two of the senior authors measured the AI independently of each other. They were blinded to the presenting complaint as per the GP letter. These 2 individuals took the measurements on 2 separate occasions. The average of the 2 measurements was taken. If an AI measurement differed by more than 2 degrees, which is outside the interobserver reliability, then the measurements were repeated.[12] If the difference remained, the measurement was excluded from the study. Any AI > 30° was considered to be a diagnosis of DDH. We did not consider the grades of the dysplasia as this determination was beyond the scope of our study.

Data were compiled with a Microsoft Excel spreadsheet (Microsoft, Redmond, Washington) and analyzed using Stata v 13 software (StataCorp, College Station, Texas). Sensitivity and specificity of each clinical sign were calculated. Negative and positive predictive values were also tabulated. Simple logistic regression analysis was used to calculate the OR for each clinical sign. It was assumed that the observed differences were statistically significant if the probability of chance occurrence was < 0.05. The Standards for Reporting of Diagnostic Accuracy statement was used as a guideline for the study.[13]

Results

Patients (n = 174; 105 female [60.3%]) were referred to our 2 tertiary referral centers over the 12-month period. There were no referrals with a clinical concern for bilateral hip dysplasia. The majority of patients (86.1%) were aged less than 1 year. The overall mean age at referral was 6.3 months (median 4, SD 6.3 months, range 0.5-38). Three percent of referrals were in patients > 24 months of age. Overall, 148 (86.1%) had an AI < 30 degrees. Therefore, 26 (14.9%) patients had a radiologic diagnosis of DDH (20 female and 6 male). The mean age of those with abnormal AI was 6.1 months (median 4, SD 6.1, range 1.5-28.) and the age of those referred with normal AIs was 6.3 months (median 4, SD 6.4, range 0.5-38). Although those with abnormal AIs tended to be younger, this was not found to be statistically significant (2-sample Kolmogorov-Smirnov test, $P = .770$). No radiographs were excluded, as all measurements were within accepted interobserver reliability for AI measurement. The average time from GP referral to radiograph was 15 days.

There was a total of 212 positive signs among the 174 patients. The most common indication for referral as per the GP letter was asymmetrical skin folds (97 patients, 45.8%). Hip click accounted for 19.8% (42 patients) of referrals, limb shortening was responsible for 16% (34 patients), and reduced abduction for 8% (17 patients) (**Figure**; available at www.jpeds.com).

The finding of asymmetric skin folds had a sensitivity of 46.2% (95% CI 26.6%-66.6%) and a specificity of 42.6% (95% CI 34.5%-51.0%). Hip click was found to have a sensitivity of 23.1% (95% CI 9.0%-43.6%) and a specificity of 75.7% (95% CI 67.9%-82.3%), and limb shortening had a sensitivity of 30.8% (95% CI 14.3%-51.8%) and a specificity of 82.4% (75.3%-88.2%). Reduced abduction had a sensitivity of 19.2% (95% CI 6.6%-39.4%) and a specificity of 91.9% (95% CI 86.3%-95.7%; **Table I**). **Table II** demonstrates the distributions of AI across the patient population. Using logistic

Table II. Values for AI angles

		Mean	Median	Minimum	Maximum	SD
Overall	LAIA	23.3	23	8.5	52.3	5.8
	RAIA	22.6	22.5	12	44.2	5.3
	Average	23	22.6	12.7	38.7	4.7
Normal AI	LAIA	22	22	8.5	29.9	4.3
	RAIA	21.5	21.5	12	29.8	4.1
	Average	21.7	22	12.7	29	3.7
Abnormal AI	LAIA	31.6	30.6	16.2	52.3	7.1
	RAIA	29.2	30.2	14.5	44.2	6.5
	Average	30.2	30	23.4	38.7	3.3

LAIA, left AI angle; *RAIA*, right AI angle.