

## The Hamstring Stretch Sign. A Reliable Clinical Test for the Detection of Congenital Dislocation and Dysplasia of the Hip

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**Objective:** Introducing a reliable clinical test for detection of Congenital Dislocation and Dysplasia of the Hip (CDH).

**Design:** Clinical examination of cases suspected of having Congenital Dislocation of the Hip was performed by a senior and junior staff member in the clinic.

**Setting:** The clinical tests used were the Ortolani-Barlow test, limitation of hip abduction in flexion, and the Hamstring stretch sign.

**Subjects:** All patients referred to the Pediatric Orthopedic Clinic at King Khalid University Hospital suspected of having CDH during a one year period.

**Main Outcome and Measures:** Results of the tests were analysed with regards to sensitivity, specificity and predictive value, after confirming or excluding the presence of CDH using Ultrasound for new born or x-rays for older children.

**Results:** One hundred and eighty hips in 90 patients were examined. In 64 hips (below 6 months of age) the sensitivity of the new sign was 70% compared to 64% for the Ortolani-Barlow test. In 116 hips (above 6 months of age) the sensitivity of the new sign was 98% compared to 88% for limitation of hips abduction in flexion. The overall sensitivity of the new sign (test) was 86% in hands of junior staff and 89% in the hands of senior staff.

**Interpretation:** The new sign is as good as Ortolani-Barlow sign in detecting CDH below the age of 6 months and as good as the limitation of hip abduction in flexion for those above 6 months of age.

**Conclusion:** The Hamstring stretch sign is a good supplementary test in the screening for CDH in children.

*Bahrain Med Bull 1999;21(4): 118 - 21.*

Congenital dislocation and dysplasia of the hip is a common problem encountered in medical practice in Saudi Arabia. Pediatricians usually screen all newborns for this problem, yet many cases present late after the child starts walking with limping<sup>1-5</sup>. Different diagnostic modalities have been suggested and practiced

in order to decrease the number of missed cases. These range from the performance of special clinical bed side examination of neonates, ultrasonographic screening or x-ray for suspected cases and those at risk<sup>6-8</sup>. No matter how good a test is, the human factor plays a major role in detecting or missing cases.

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Ludloff (1913) stated that when the hip in a normal child is fully flexed and abducted, the knee cannot be fully extended because of tightness of the hamstring muscles. When the hip is dislocated the knee can be extended fully. This sign was mentioned in the literature under his name<sup>9</sup>. However, this sign has been forgotten and was not established as a routine test in the clinical examination of suspected CDH cases.

Based on Ludloff's comment we introduced a modified test under the name of "Hamstring Stretch Sign", which in our experience proved to be a reliable sign in clinical detection of CDH.

### The Basis of the Hamstring Stretch Sign

The posterior femoral muscles, the biceps femoris, semi tendinosus, and semimembranosus, often grouped familiarly as the "Hamstring muscles", span the hip and knee joints, integrating extension at the former with flexion at the latter. They arise from the posterior aspect of the ischial tuberosity and are inserted into the head of the fibula and upper medial part of the tibia.

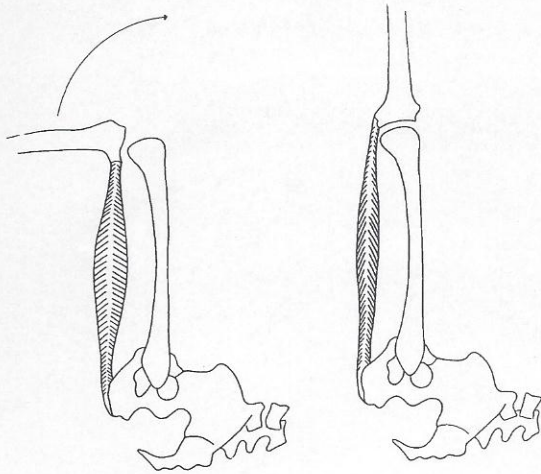


Figure 1. Hamstring tension is maximum when the hip is flexed and the knee is fully extended

When the hip is flexed 90° with the knee fully extended, the hamstrings become stretched maximally with increased tension that can be felt (Fig 1). In CDH the distance between the origin and insertion of the hamstrings is shortened, thus extension of the knee does not stretch the muscles maximally when the hip is flexed. The expected feeling of increased muscle tension is lost.

The hip should not be abducted during the test as was described by Ludloff, to avoid the tension of the

medial hamstring (Gracillis muscle) which can give a false negative result.

### METHODS

Patients included in this study were those referred to the Pediatric Orthopedic Outpatient Clinic at King Khalid University Hospital with the suspicion of having CDH during the period between January 1995 to January 1996.

All patients were examined by the first author and one of the junior staff. Patients with systemic or neurological problems were excluded. A thorough clinical examination of the hips was performed including Ortholani-Barlow test and testing for limited hip abduction in flexion which are the most reliable clinical tests for detection of CDH below and above 6 months of age respectively<sup>10-12</sup> together with the Hamstring Stretch test.

The "Hamstring Stretch sign" was performed with the patient in the supine position and the hip in neutral abduction and rotation. The hip and knee were both flexed to 90 degrees. Then passive extension of the knee was performed using the index finger behind the tendo-achilles of the child while the other hand stabilized the knee (Fig 2). A hip was considered normal when there was a feeling of muscle tension resisting full extension of the knee. Those in whom full knee extension was achieved with no muscle tension were labeled as having a positive test for CDH.



Figure 2. Performing the hamstring stretch sign

The diagnosis of CDH was confirmed or excluded afterwards with ultrasonograms of the hips for newborns (27 patients) or x-rays for older children (63 patients).

All the data collected from results of the hamstrings stretch test, Ortholani-Barlow test and the test for limited hip abduction in flexion were processed on a PC using Microsoft Excel 5.

Table 1. Results of hamstring stretch sign compared with Ortolani-Barlow and limitation of hip abduction in flexion signs in different age groups

Age	Sign	True	True	False	False	Sensitivity	Specificity	Predictive
		positive	Negative	Positive	Negative	%	%	Value (%)
Below 6 months	Hamstring stretch sign	21	29	5	9	70	83	81
	Ortolani-Barlow sign	22	30	0	12	64	100	100
Above 6 months	Hamstring stretch sign	61	47	7	1	98	87	90
	Limitation of hip abduction in flexion sign	53	48	8	7	88	86	87

Table 2. Overall result of hamstring stretch sign in the hands of two different examiners

Examiners	True	True	False	False	Sensitivity	Specificity	Predictive
	positive	Negative	Positive	Negative	%	%	Value (%)
Senior staff	82	76	12	10	89	86	87
Junior staff	68	60	11	11	86	85	86

The sensitivity was calculated for the true positive values, specificity for the true negative values and the predictive values for the ratio of the true positive to the sum of true and false positives, as follows:

$$\text{Sensitivity} = \frac{\text{True +ve}}{\text{all CDH cases (True +ve + False -ve)}} \times 100$$

$$\text{Specificity} = \frac{\text{True -ve}}{\text{all normal cases (True -ve + False +ve)}} \times 100$$

$$\text{Predictive value} = \frac{\text{True +ve}}{(\text{True +ve} + \text{False +ve})} \times 100$$

**RESULTS**

A total of 180 hips were examined in 90 patients. The age of the patients ranged from 2 weeks to 5 years and 4 months (average 12.6 months). Fig 3 shows the age distribution of all patients.

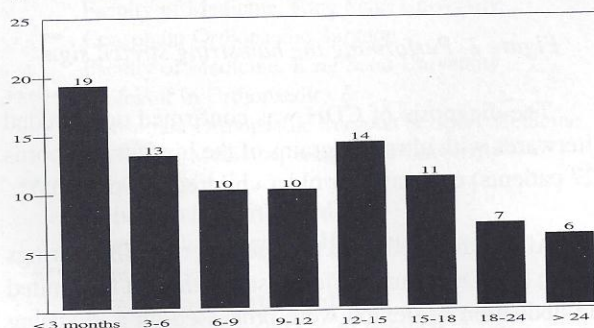


Figure 3. Age distribution of all patients in the study

Nineteen (21%) patients were confirmed to have bilateral CDH, 54 (60%) patients had unilateral CDH and 17 (19%) patients had normal hips.

The patients were divided into two groups, one group included patients younger than 6 months and the other included patients older than 6 months. The results of hamstring stretch test were compared with those of Ortolani-Barlow test in patients below the age of 6 months and with those tested for limited hip abduction in flexion in patients above the age of 6 months as shown in Table 1.

Table 2 shows the overall results of hamstring stretch sign when performed by the senior staff compared to that of the junior.

**DISCUSSION**

Screening for CDH inspite of the considerable experience over a period of more than 30 years has not been a total success<sup>13</sup>. Despite the screening campaigns for early detection of CDH, some cases continue to be diagnosed late, long after a satisfactory outcome can be guaranteed<sup>14</sup>. A dislocated or dislocatable hip is not always apparent during the initial newborn screening examination, and repeated clinical examinations throughout the first year of life are necessary in order to clearly establish the presence or absence of this disorder<sup>15</sup>.

The two well described routine clinical screening tests for CDH are the Ortolani-Barlow test for the new

newborn<sup>16</sup>, and testing for limited hip abduction in flexion for older children<sup>10-12</sup>. Despite early optimism, the former is in fact certainly not a simple test and requires a great deal of detailed training. The sensitivity and specificity of these tests vary in the literature. One of the best published data showed that the Barlow test has a sensitivity of 66% and a specificity of 98%<sup>11,17</sup>. It has been documented in more than one study that the magnitude of forces applied in order to perform an Ortolani-Barlow test, specially in inexperienced hands, could be enough to produce harmful effects on the hip<sup>18,19</sup>.

The hamstring stretch sign is thought to be an easily performed and harmless test. Although its sensitivity in the newborn (70%) is comparable to that of Ortolani-Barlow test (65%), however its specificity (85%) is not as good as that of Ortolani-Barlow test (100%) in the same age group. In children above 6 months of age the sensitivity and specificity of the hamstring stretch sign increased beyond that of the test for limitation of hip abduction in flexion. Hamstring stretch sign is still reliable in cases who have mild to moderate ligamentous laxity. In severe ligamentous laxity with a full picture of Ehler Danlos syndrome the test is not applicable and such cases were excluded from our study.

In our study we proved that the hamstring stretch sign is not only a sensitive and specific test for detection of CDH especially after the age of 6 months but is also an easily reproducible test which gives similar results in the hands of different examiners irrespective of their experience.

## CONCLUSION

**The Hamstring stretch sign is believed to be a harmless reproducible clinical test for detection of CDH which is easily taught and performed. It is a reliable test specially after 6 months of age. Its high sensitivity and specificity can establish it as a good supplementary test in the screening for CDH in children.**

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