

# Use of Limited Hip Abduction as a Predictor for Developmental Dysplasia of the Hip

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## Abstract

**Background:** Developmental dysplasia of the hip (DDH) includes multiple abnormalities. Females are more susceptible for DDH. The clinical examination is used for diagnosis, but its sensitivity is generally low. Ultrasound (US) examination identifies DDH in infants younger than 6 months of age. Because of its accessibility and the lack of exposure to radiation, the clinical applications of US in the diagnosis of DDH have expanded, making it the gold standard test for DDH. **Objective:** This study aimed to measure sensitivity and specificity of limited hip abduction (LHA) as a screening test for the detection of DDH. **Materials and Methods:** A cross-sectional study including 60 infants were brought to the Al-Wasity Teaching Hospital, Baghdad and Al-Rusafa Health Directorate, Ministry of Health and Environment, Baghdad, Iraq, within the period from January 2020 to October 2020. They were referred by other physicians and clinics or their parents suspected that they have abnormal hip. We excluded infants with associated congenital abnormality such as arthrogryposis or spina bifida. The diagnosis was made by clinical and US examination. The clinical examination included identification of LHA. Data regarding age and gender were recorded and were statistically analyzed. Frequencies and means were used to express data, and the  $\chi^2$  goodness of fit test and Student's *t*-test were used as appropriate to detect significance of difference between frequencies and means. **Results:** The sensitivity and specificity of unilateral and bilateral LHA were 51.35%, 95.18% and 27.03%, 63.86%, respectively. **Conclusion:** Unilateral LHA was more sensitive and specific than bilateral.

**Keywords:** Abduction, developmental dysplasia, hip

## INTRODUCTION

Developmental dysplasia of the hip (DDH) includes a wide range of abnormalities in the hip. These abnormalities are neonatal instability; acetabular dysplasia; hip subluxation; and true dislocation of the hip.<sup>[1-3]</sup> Instability means looseness or laxity within the acetabulum.<sup>[4]</sup> Dysplasia refers to some morphological changes in the acetabulum, proximal femur, or both, but articular surfaces are concentric in contact.<sup>[5]</sup> Subluxation means that there is contact between both articular surfaces, but not concentrically. In a true dislocation, there is no contact between the articular surfaces of the proximal femur and acetabulum.<sup>[5]</sup> Differentiation between these entities is important, because there are differences in its clinical course, treatment, and prognosis. When a child with DDH is presented, it is necessary to decide whether the hip is concentrically reduced. Popular terms such as “congenital dislocation of the hip” or “congenital dysplasia of the

hip” are currently used less often because they do not include the developmental aspect of the dysplasia, which is important from a medicolegal point of view.<sup>[6]</sup>

Causes of DDH include variable proposed factors and theories. The hormonal theory claims that a misbalance between estrogens and progesterone plays a role in DDH, in which it has been demonstrated experimentally that estrogens are protective against dislocation, whereas higher concentrations of progesterone can facilitate dislocation.<sup>[7]</sup> However, no relationship between DDH and serum concentration of beta-estradiol and relaxin has been demonstrated.<sup>[8-10]</sup>

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The mechanical theory claims that persistent mechanical stimulation can provoke a deformity, especially during the periods of high growth. The human fetus accomplishes these criteria, because of its plasticity and rapid rate of growth. Any circumstance that exposes the fetus to increased deforming forces is considered suitable for producing a DDH. Some of the risk factors based on the mechanical theory are mechanical restriction before birth (e.g., multiple pregnancies and oligohydramnios)<sup>[11]</sup> and breech presentation<sup>[7]</sup> after birth (swaddling, with the hips in an extended and adducted position).<sup>[12]</sup>

The left hip is more commonly affected than the right, because most of the non-breech newborns have this hip against the mother's spine, which limit the abduction of that hip.<sup>[6]</sup> Females and infants with a positive family history of DDH are more susceptible for DDH.<sup>[13]</sup> Other risk factors include ethnic background, co-existing lower limb, or musculoskeletal deformities.

The physical examination is the first step of DDH diagnosis. The 2000 AAP clinical practice guideline gave a detailed description of the examination, including observing for limb length discrepancy, asymmetric thigh or gluteal folds, and limited hip abduction (LHA) or asymmetric abduction, as well as performing Barlow and Ortolani tests.<sup>[14]</sup> The sensitivity of clinical examination is generally low in different studies<sup>[15-17]</sup>; however, unilateral LHA (uni. LHA) was found to be more sensitive than bilateral LHA (bi. LHA).<sup>[18,19]</sup>

Ultrasound (US) examination is a better choice to identify DDH in infants younger than 6 months of age, and it can diagnose more subtle forms of the disorder when clinical exam yields equivocal result.<sup>[20]</sup> It was established to identify the appropriate maturation of the hip joints in the newborn and to prevent DDH and was invented by Graf in 1980. The hip types according to Graf's type classification are: type I, normal hip; type II, dysplastic hip; type III, subluxed hip; and type IV, luxated hip.<sup>[21]</sup> Because of its accessibility and the lack of exposure to radiation, the clinical applications of US in the diagnosis of DDH have expanded, making it the gold standard test that allows the assessment of coxofemoral joints qualitatively and quantitatively in newborns and infants.<sup>[22]</sup>

## MATERIALS AND METHODS

This is a cross-sectional study. We enrolled a total of 60 infants (120 hips) who were brought to the Al-Wasity Teaching Hospital, Baghdad and Al-Rusafa Health Directorate, Ministry of Health and Environment, Baghdad, Iraq, within the period from January 2020 to October 2020. These infants were referred by other physicians and clinics because they had abnormal hip on clinical examination or their parents suspected that they have hip abnormality. Infants who had any associated congenital abnormality such as arthrogryposis or spina bifida were excluded from this study.

The diagnosis of DDH was confirmed by clinical and US examinations. The clinical examination included identification of the presence of LHA by examining the baby in supine position, hips in 90° of flexion so that both thighs are held vertically parallel to each other, hip abduction was determined from the initial position where the thighs are spread simultaneously, abduction was considered restricted if it did not exceed 60°. U.S. examination was done in a private clinic because it was not available in the hospital.

## Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients' verbal and analytical approval before the sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local Ethics Committee according to the document number 112 (including the number and the date in 4/1/2020) to get this approval.

## Statistical analysis

Data regarding age, gender, and medical and surgical history of infants were taken from parents. Data were entered into a computer and were statistically analyzed using the computer software Statistical Package for Social Sciences version 25 (SPSS 25). Categorical variables were expressed as frequencies and percentages, whereas continuous variables were expressed as means and standard deviations. The  $\chi^2$  goodness of fit test was used to detect significance of difference between frequencies of categorical variables, whereas Student's *t*-test was used to detect significance of difference between the means of the two groups. In all statistical tests, the level of significance used was 0.05.

## RESULTS

There were a total of 60 infants (120 hips). Of these 120 hips, 56 (46.7%) hips belonged to males and 64 (53.3%) belonged to females and there was no statistically difference between them ( $P = 0.47$ ). Mean age  $\pm$  SD was  $45.7 \pm 31.1$  days. These results are shown in Table 1.

Of the 120 hips, clinical examination revealed that 63 (52.5%) hips were LHA-positive (pos.) (23 uni. and 40 bi.) and 57 (47.5%) hips were LHA-negative (neg.). US examination revealed that 37 (30.8%) hips were DDH-pos. and 83 (69.2%) hips were DDH-neg. These results are shown in Table 2.

Of the DDH-pos. hips (37 hips), 10 (27.0%) hips belonged to males and 27 (73.0%) belonged to females, and there was a statistically significant difference between them ( $P = 0.005$ ), whereas of the DDH-neg. hips (83 hips), 46 (55.4%) hips belonged to males and 37 (44.6%) belonged to females, and there was no statistically significant difference between them ( $P = 0.32$ ).

**Table1: Gender (frequency and percentage) and age (mean  $\pm$  SD) for all hips**

| Clinical examination result |     |          |          | US result and Graf type |        |        |
|-----------------------------|-----|----------|----------|-------------------------|--------|--------|
| LHA pos.                    |     | LHA neg. | DDH neg. | DDH pos.                |        |        |
| Uni.                        | Bi. |          | Graf 1   | Graf 2                  | Graf 3 | Graf 4 |
| 23                          | 40  | 57       | 83       | 6                       | 14     | 17     |
| Total                       |     | 120      |          | 120                     |        |        |

**Table 2: Clinical examination results and US results with Graf's type for hips**

| Clinical examination result |     |          |          | US result and Graf type |        |        |
|-----------------------------|-----|----------|----------|-------------------------|--------|--------|
| LHA-pos.                    |     | LHA-neg. | DDH-neg. | DDH-pos.                |        |        |
| Uni.                        | Bi. |          | Graf 1   | Graf 2                  | Graf 3 | Graf 4 |
| 23                          | 40  | 57       | 83       | 6                       | 14     | 17     |
| Total                       |     | 120      |          | 120                     |        |        |

**Table 3: Gender and age mean  $\pm$  SD for hips by US result**

|                            |        | US result                 |                              |
|----------------------------|--------|---------------------------|------------------------------|
|                            |        | DDH-pos.                  | DDH-neg.                     |
| Gender                     | Male   | 10                        | 46                           |
|                            | Female | 27                        | 37                           |
|                            |        | $P = 0.005$ (significant) | $P = 0.32$ (not significant) |
| Age (mean $\pm$ SD) (days) |        | 55.5 $\pm$ 28.5           |                              |
|                            |        | $P = 0.02$ (significant)  |                              |

**Table 4: Frequencies of hips by clinical examination results and US results**

| Clinical examination | US                                  |                                                             | Total                                                       |
|----------------------|-------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
|                      | DDH-pos.                            | DDH-neg.                                                    |                                                             |
| Uni. LHA             | 19 hips (19 infants $\times$ 1 hip) | 4 hip (4 infants $\times$ 1 hip)                            | 23 hips (23 infants)                                        |
| Bi. LHA              | 10 hips (5 infants $\times$ 2 hips) | 30 hips (15 infants $\times$ 2 hips)                        | 40 hips (20 infants)                                        |
| LHA neg.             | 8 hips (4 infants $\times$ 2 hips)  | 49 hips [(13 infants $\times$ 2 hips= 26) + 23 contr. hips] | 57 hips [(17 infants $\times$ 2 hips= 34) + 23 contr. hips] |
| Total                | 37 hips                             | 83 hips                                                     | 120 hips                                                    |

The mean age  $\pm$  SD for the DDH-pos. hips was  $55.5 \pm 28.5$  days, whereas for the DDH-neg. hips, it was  $41.4 \pm 31.4$  days, and there was a statistically significant difference between them ( $P = 0.02$ ). These results are shown in Table 3.

We compared clinical examination results with US examination results to calculate sensitivity, specificity, positive predictive value, and negative predictive value for clinical examination as a screening test for DDH. First, we compared the LHA-pos. (uni. and bi.) and LHA-neg. hips with the DDH-pos. and DDH-neg. hips. Sensitivity, specificity, positive predictive value, and negative predictive value were 78.38%, 59.04%, 48.33%, and 85.96%, respectively.

When taking uni. LHA into consideration, i.e., comparing uni. LHA and non-uni. LHA (bi. LHA and LHA-neg.) hips with DDH-pos. and DDH-neg. hips, sensitivity,

specificity, positive predictive value, and negative predictive value were 51.35%, 95.18%, 82.61%, and 81.44%, respectively.

When taking bi. LHA into consideration, i.e., comparing bi. LHA hips and non-bi. LHA hips (uni. LHA and LHA-neg.) with DDH-pos. and DDH-neg. hips, sensitivity, specificity, positive predictive value, and negative predictive value were 27.03%, 63.86%, 25.00%, and 88.33%, respectively. Table 4 shows frequencies for hips by different categories of clinical examination results and US results that were used for these calculations.

## DISCUSSION

The current study showed that there was no significant difference between the number of males and females in the total sample (i.e., regardless of the presence or absence of DDH).

Clinical examination showed that 52.5% of hips were LHA-pos., whereas US examination showed that 30.8% hips were DDH-pos., i.e., there was a discrepancy between findings of clinical examination and US, with more hips with positive findings on clinical examination than those on US. This result is similar to results of other worldwide studies.<sup>[23,24]</sup> However, the current study showed notably higher percent of LHA-pos. hips (52.5%) compared with the mentioned studies, and this is probably due to the fact that the study was conducted in a national specialized center which receive cases referred from many other hospitals and private clinics from all provinces of Iraq, which means that a high prevalence of DDH cases would be expected to be found among the referred cases.

When taking the presence of DDH into consideration, the current study showed that among DDH-pos. hips there was a statistically significant difference between frequencies of male and female infants, i.e., there was a tendency of DDH to happen in female infants. This result is consistent with the results of many other studies worldwide.<sup>[23,25]</sup>

The current study showed that the mean age for the DDH-pos. hips was 55.5 days, whereas for the DDH-neg. hips, it was 41.4 days, and there was a statistically significant difference between them. The mean age of infants according to the DDH status was more or less different in some other worldwide studies; however, there was a significant difference between the mean age in DDH-pos. and DDH-neg. infants in these studies, i.e., a result similar to the result obtained in the current study.<sup>[17,18,24]</sup>

The current study showed that comparison of the LHA-pos. and LHA-neg. hips with the DDH-pos. and DDH-neg. hips yielded a sensitivity, specificity, positive predictive value, and negative predictive value of 78.38%, 59.04%, 48.33%, and 85.96%, respectively. This result is more or less close to the results by Čustović *et al.*,<sup>[16]</sup> which detected a sensitivity of 26.5%, a specificity of 88.5%, a positive predictive value of 40.3%, and a negative predictive value of 80.4%, by Dogruel *et al.*,<sup>[25]</sup> which detected a sensitivity of 97% and a specificity of 13.68%, and by Sulaiman *et al.*,<sup>[26]</sup> which detected a sensitivity of 67% and a specificity of 96%.

Comparison of uni. LHA and non-uni. LHA hips with the DDH-pos. and DDH-neg. hips yielded a sensitivity, specificity, positive predictive value, and negative predictive value of 51.35%, 95.18%, 82.61%, and 81.44%, respectively, and comparison of bi. LHA hips and non-bi. LHA hips with DDH-pos. and DDH-neg. hips yielded a sensitivity, specificity, positive predictive value, and negative predictive value of 27.03%, 63.86%, 25.00%, and 88.33%, respectively. These results are more or less close to the results of Senaran *et al.*,<sup>[18]</sup> which showed that uni.

LHA yielded a sensitivity of 41.8%, specificity of 98%, positive predictive value of 69.2%, and negative predictive value of 94.2%, whereas bi. LHA yielded a sensitivity of 30.2%, a specificity of 65.0%, a positive predictive value of 8.1%, and negative predictive value of 90.1%, and to the results of Jari *et al.*,<sup>[19]</sup> which showed that uni. LHA yielded a sensitivity of 70% and a specificity of 90%, and of Choudry *et al.*,<sup>[24]</sup> which showed that uni. LHA yielded a sensitivity of 14.4%, specificity of 99.3%, positive predictive value of 40%, and negative predictive value of 97.3%, whereas bi. LHA yielded a sensitivity of 2.2%, specificity of 41.1%, positive predictive value of 0.3% and negative predictive value of 81.8%. The reason for these variabilities between the results of these studies themselves, on the one side, and variabilities between the results of these studies and the results of our study, on the other side, is that there is a variation in sample size, sampling techniques, infants' age, interobserver variation in clinical and US examination, and the use of different ultrasound devices in different studies. For example, the success rate and benefits of clinical examination increase when examining an infant less frequently and gently.<sup>[17]</sup> Also, irritable infants can make examination difficult or cause inaccuracy in recording results of examination.<sup>[24]</sup>

## CONCLUSION

- 1- US is more valid and accurate in the diagnosis of DDH compared with clinical examination.
- 2- Female infants are more prone to DDH than male infants.
- 3- Clinical examination of hips is of little sensitivity and specificity as a screening test for the diagnosis of DDH; however, uni. LHA is more sensitive and specific than bi. LHA for screening of DDH.

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## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Moraleda L, Albiñana J, Salcedo M, Gonzalez-Moran G. [Dysplasia in the development of the hip]. *Rev Esp Cir Ortop Traumatol* 2013;57:67-77.
2. Dezateux C, Rosendahl K. Developmental dysplasia of the hip. *Lancet* 2007;369:1541-52.
3. Dunn PM. The anatomy and pathology of congenital dislocation of the hip. *Clin Orthop Relat Res* 1976:23-7.

4. Schwend RM, Shaw BA, Segal LS. Evaluation and treatment of developmental hip dysplasia in the newborn and infant. *Pediatr Clin North Am* 2014;61:1095-107.
5. Ponseti IV. Morphology of the acetabulum in congenital dislocation of the hip. Gross, histological and roentgenographic studies. *J Bone Joint Surg Am* 1978;60:586-99.
6. Kotlarsky P, Haber R, Bialik V, Eidelman M. Developmental dysplasia of the hip: What has changed in the last 20 years? *World J Orthop* 2015;6:886-901.
7. Yamamuro T, Hama H, Takeda T, Shikata J, Sanada H. Biomechanical and hormonal factors in the etiology of congenital dislocation of the hip joint. *Int Orthop* 1977;1:231-6.
8. Andersson JE, Vogel I, Uldbjerg N. Serum 17 beta-estradiol in newborn and neonatal hip instability. *J Pediatr Orthop* 2002;22:88-91.
9. Vogel I, Andersson JE, Uldbjerg N. Serum relaxin in the newborn is not a marker of neonatal hip instability. *J Pediatr Orthop* 1998;18:535-7.
10. Forst J, Forst C, Forst R, Heller KD. Pathogenetic relevance of the pregnancy hormone relaxin to inborn hip instability. *Arch Orthop Trauma Surg* 1997;116:209-12.
11. Clarke NM, Reading IC, Corbin C, Taylor CC, Bochmann T. Twenty years experience of selective secondary ultrasound screening for congenital dislocation of the hip. *Arch Dis Child* 2012;97:423-9.
12. Shaw BA, Segal LS, Section on Orthopaedics. Evaluation and referral for developmental dysplasia of the hip in infants. *Pediatrics* 2016;138:e20163107.
13. Ortiz-Neira CL, Paolucci EO, Donnon T. A meta-analysis of common risk factors associated with the diagnosis of developmental dysplasia of the hip in newborns. *Eur J Radiol* 2012;81:e344-51.
14. American Academy of Pediatrics. Clinical practice guideline: Early detection of developmental dysplasia of the hip. Committee on Quality Improvement, Subcommittee on Developmental Dysplasia of the Hip. *Pediatrics* 2000;105:896-905.
15. Choudry QA, Paton RW. Neonatal screening and selective sonographic imaging in the diagnosis of developmental dysplasia of the hip. *Bone Joint J* 2018;100-B:806-10.
16. Čustović S, Šadić S, Vujadinović A, Hrustić A, Jašarević M, Čustović A, *et al.* The predictive value of the clinical sign of limited hip abduction for developmental dysplasia of the hip (DDH). *Med Glas (Zenica)* 2018;15:174-8.
17. Omeroğlu H, Koparal S. The role of clinical examination and risk factors in the diagnosis of developmental dysplasia of the hip: A prospective study in 188 referred young infants. *Arch Orthop Trauma Surg* 2001;121:7-11.
18. Senaran H, Ozdemir HM, Oğün TC, Kapıcıoğlu MI. Value of limited hip abduction in developmental dysplasia of the hip. *Pediatr Int* 2004;46:456-8.
19. Jari S, Paton RW, Srinivasan MS. Unilateral limitation of abduction of the hip. A valuable clinical sign for DDH? *J Bone Joint Surg Br* 2002;84:104-7.
20. Harding MG, Harcke HT, Bowen JR, Guille JT, Glutting J. Management of dislocated hips with Pavlik harness treatment and ultrasound monitoring. *J Pediatr Orthop* 1997;17:189-98.
21. Graf R, Mohajer M, Plattner F. Hip sonography update. Quality-management, catastrophes—Tips and tricks. *Med Ultrason* 2013;15:299-303.
22. Mureşan S, Mărginean MO, Voidăzan S, Vlăsa I, Sintean I. Musculoskeletal ultrasound: A useful tool for diagnosis of hip developmental dysplasia: One single-center experience. *Medicine (Baltimore)* 2019;98:e14081.
23. Buonsenso D, Curatola A, Lazzareschi I, Panza G, Morello R, Marrocco R, *et al.* Developmental dysplasia of the hip: Real world data from a retrospective analysis to evaluate the effectiveness of universal screening. *J Ultrasound* 2021;24:403-10.
24. Choudry Q, Goyal R, Paton RW. Is limitation of hip abduction a useful clinical sign in the diagnosis of developmental dysplasia of the hip? *Arch Dis Child* 2013;98:862-6.
25. Dogruel H, Atalar H, Yavuz OY, Sayli U. Clinical examination versus ultrasonography in detecting developmental dysplasia of the hip. *Int Orthop* 2008;32:415-9.
26. Sulaiman A, Yusof Z, Munajat I, Lee N, Zaki N. Developmental dysplasia of hip screening using Ortolani and Barlow testing on breech delivered neonates. *Malays Orthop J* 2011;5:13-6.