

## The predictive value of the clinical sign of limited hip abduction for developmental dysplasia of the hip (DDH)

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### ABSTRACT

**Aim** To assess the relationship between the clinical sign of limited hip abduction and developmental dysplasia of the hip (DDH).

**Methods** A research was conducted on 450 newborns at the Neonatal Unit at the Clinic of Gynaecology and Obstetrics and the Orthopaedics and Traumatology Clinic of the University Clinical Centre, Tuzla, between 30<sup>th</sup> August 2011 and 30<sup>th</sup> April 2012. Clinical (degree of hip abduction) and ultrasound examination of all newborns' hips were performed using the Graf method on their first day of life.

**Results** Clinical sign of limited hip abduction showed significant predictive value for DDH. There were 67 (14.7%) newborns with the clinical sign of limited hip abduction, of which 26 (5.7%) were on the left hip, 11 (2.4%) on the right hip and 30 (6.6%) on both hips. Limited hip abduction had a positive predictive value (PPV) of 40.3% and a negative predictive value (NPV) of 80.4% for DDH.

**Conclusion** Limited hip abduction, especially unilateral, is a useful and important clinical sign of DDH. Doctors, who perform the first examination of the child after birth, would have to pay attention to this clinical sign. Newborns with this clinical sign would have to go to an ultrasound examination of the hips for further diagnosis.

**Key words:** predictive value, limited hip abduction, developmental dysplasia of the hip (DDH)

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## INTRODUCTION

Developmental dysplasia of the hip is a challenging condition that represents a state of deformity and slow development of the hip joint in early childhood (1,2). The term “developmental dysplasia of the hip” (DDH) describes a whole range of deformities involving the growing hip, including frank dislocation, subluxation and instability, and dysplasia of the femoral head and acetabulum. This term replaced the previously accepted “congenital dysplasia of the hip”, which did not describe the developmental aspect of the disorder (3-5).

This deformity of the hip joint can be observed as a progressive illness where secondary structural changes will emerge in and around the joint tissue if a normal relation between the joint bodies is not established (6). Early diagnosis and treatment of DDH is critical, to provide the best possible functional outcome (7).

Developmental dysplasia of the hip is the most common deformity of the bone-joint system. The incidence of this deformity is different in different countries, according to the data given by various authors, varying from two to 50 or even more per 1,000 births (3, 7-10). This type of hip dysplasia occurs six times more frequently in girls. The defect can be diagnosed in over 40% of all cases and it occurs more often on the left than on the right hip.

The cause of this development dysplasia is still not determined. Developmental dysplasia of the hip represents a dynamical process which occurs as a result of a series of exogenous and endogenous factors, both physiological and mechanical, which have the same effect on the mother and child during pregnancy and after birth (11). It is considered to have multifactorial etiology in the occurrence of developmental dysplasia of the hip (12).

Developmental dysplasia of the hip (DDH) is a common and preventable cause of childhood disability and forms a large portion of paediatric orthopaedic practice. It is generally agreed that late diagnosis (often referred to as a diagnosis after three months) leads to a higher chance of requiring surgery and a higher risk of long-term complications (13). The criteria for defining cases of developmental dysplasia of the hip diagnosed later in life are uneven. If DDH is recognized

early, the treatment is less invasive, and long-term effects are minimized (7,14).

The aim of this study was to assess a relation between limited hip abduction (unilateral and bilateral) and the developmental dysplasia of the hip (DDH). Bosnia and Herzegovina does not have an accepted screening programme for DDH. This study would help doctors, who clinically examine newborns for the first time, to make a selection of children with DDH who will later be directed to further diagnostics.

## PATIENTS AND METHODS

### Study design and patients

The research was conducted in 450 newborns at the Neonatal Unit at the Clinic of Gynaecology and Obstetrics and the Orthopaedics and Traumatology Clinic of the University Clinical Centre Tuzla, Bosnia and Herzegovina, from 30<sup>th</sup> August 2011 to 30<sup>th</sup> April 2012. During this period, 2678 babies were born. The survey included newborns born at 37 to 42 weeks of gestation. A clinical and ultrasound hip examination was conducted on all newborns on the day of birth. The examination was done on the predetermined three days of the week.

All medical examinations were done by an orthopaedic surgeon. To examine all children at the same age, the examination was done on the day of birth.

Research protocol was approved by the Ethics Committee of the University Clinical Centre Tuzla, Bosnia and Herzegovina.

### Methods

The diagnosis of developmental dysplasia of the hip was determined at the Neonatal Unit by clinical and ultrasound hip examination. Through the clinical examination, possible limited hip abduction, whether unilateral or bilateral, was recorded. The clinical examination starts from the child's so-called initial position. The child lies on the back, facing the doctor, with the hips in 90 degrees flexion, so that both thighs are held vertically, parallel to each other. This diagnostic procedure, which allows us to determine the stability of the hip joint, includes an estimation of the extent of the hip abduction. Hip abduction was determined from the initial position where the thighs are spread simultaneously, without

changing the initial flexion in the hips. Abduction was considered restricted if it did not exceed 45 degrees in newborns or 60 degrees in infants, unilaterally or bilaterally.

Ultrasound examinations were performed using a TOSHIBA SSA-240A (Kobe, Japan) apparatus with a 5MHz linear probe. Graf's ultrasound method was used (15). The hips were sorted according to Graf's classification: a normal hip was classified as type I (Ia, Ib), a dysplastic hip as type II (IIa+, IIa-, IIb, IIc/g/d), a subluxed hip as type III (IIIa, IIIb) and a luxated hip as type IV (15).

**Statistical analysis**

All variables were tested for normal distribution using the Kolmogorov-Smirnov test and presented with baseline characteristics. Student's t-test was used for comparison of arithmetic means with the application of the paired sample t-test where appropriate. A  $\chi^2$  test was used to compare frequencies between groups, with McNemar's test used for paired samples. The diagnostic accuracy was calculated using the usual measures of sensitivity, specificity and positive and negative predictive values, using a 2x2 table and Bayesian analysis. Univariate logistic regression was used to evaluate the predictive value of each variable of interest, via calculation of the odds ratio. All tests were performed with a statistical confidence level of 95% (p<0.05).

**RESULTS**

The overall sample included 450 examinees, 205 (45.6%) males and 245 (54.4%) females. A total of 450 examinees (900 hips) underwent an ultrasound examination at birth. A total of 780 (86.6%) hips had a normal ultrasound report, while 120 (13.4%) were found to fall into one of the DDH categories. The prevalence of DDH was 13.4 %.

The sonographic report showed that type Ia was found in 507 (56.3%) hips, transient form type Ib was found in 273 (30.3%) and immature type IIa+ was found in 92 (10.2%) hips. There were 22 (2.4%) hips with an unstable-critical IIg sonographic report. There were four (0.4%) decentred hips of type IID and 2 (0.2%) decentred hips of type IIIa. None (0%) of the hips was found to be sonographic type IV (luxated). There was no statistically significant difference in the appearance

of the developmental dysplasia of the hip between the right and left sides (p=0.48) (Table 1).

**Table 1. Distribution of sonographic values in the hips of newborns in the overall sample during the first examination**

Classification according to Graf	No (%) of newborns		
	Left hip	Right hip	Total
Ia	253 (56.2)	254 (56.4)	507 (56.3)
Ib	146 (32.4)	127 (28.2)	273 (30.3)
IIa+	39 (8.7)	53 (11.8)	92 (10.2)
IID	2 (0.4)	2 (0.4)	4 (0.4)
IIg(c)	9 (2.0)	13 (2.9)	22 (2.4)
IIIa	1 (0.2)	1 (0.2)	2 (0.2)
IV	0	0	0

Of the total number of 450 newborns examined at birth, 26 (5.7%) had limited left hip abduction, 11 (2.4%) had limited right hip abduction and 30 (6.6%) had bilateral limited hip abduction.

In the overall sample (n= 450), 67 (14.9%) newborns had limited hip abduction, and of these, 27 had developmental displacement of the hip while 40 did not have this deformity. In the overall sample there were 75 newborns who had one of the types of developmental hip dysplasia, and of these, 27 (26.5%) had limited hip abduction. If we consider the overall number of newborns included in the survey, 308 did not have DDH, and of these, 40 (11.5%) had this clinical sign (Table 2). The positive predictive value for this clinical sign was 40.3%, while the negative predictive value was 80.4%, i.e. out of 10 newborns with this clinical sign, four of them will have one of the types of developmental hip dysplasia, and out of 10 newborns who do not have this clinical sign, eight will have no DDH.

**Table 2. Prevalence of developmental hip dysplasia considering limited hip abduction with the measures of diagnostic accuracy**

	No (%) of newborns with developmental displacement of the hip		Total
	Without deformity	With deformity	
<b>Limited abduction</b>			
positive	308 (88.5)	75 (73.5)	383 (85.1)
negative	40 (11.5)	27 (26.5)	67 (14.9)
<b>Total</b>	348 (100)	102 (100)	450 (100)

Sensitivity = 26.5%; Specificity = 88.5%; Positive predictive value = 40.3%; Negative predictive value = 80.4%

The univariate analysis showed that limited hip abduction in newborns has a significant correlation with the presence of DDH (OR=2.842; CI95% 1.546-5.224) (p=0.001). Of 67 newborns with limited hip abduction, 30 had bilateral limited hip abduction and 37 had unilateral limited hip abduction. Of 30 newborns with bilateral li-

limited hip abduction, five (16%) had some type of DDH. Of 37 newborns with unilateral limited hip abduction, 25 (67%) had some type of DDH. Unilateral limited hip abduction was a more pathognomonic clinical sign for developmental hip dysplasia than bilateral hip abduction.

## DISCUSSION

Developmental dysplasia of the hip, as one of the most common malformations of the locomotor system, is a significant health issue (16). No other disorder gives such good results through treatment as developmental dysplasia of the hip if it is detected and treated on time. Primary prevention for developmental dysplasia of the hip is impossible to conduct since the primary cause of this disorder is not known (1). Nowadays it is possible to conduct secondary prevention based on very early diagnosis achieved through the screening (7). It is of great importance to recognize newborns at risk of DDH. If DDH is recognized early, treatment is less invasive, and long-term effects are minimized (10). Late detection causes increased treatment complexity and a sevenfold increase in the short-term costs of treatment, compared to early detection and successful management in Pavlik harness (17).

This study has shown a significant predictive value of unilateral limited hip abduction for DDH. The diagnostic accuracy of limited hip abduction, taking into account the sensitivity, specificity and predictive value, is 74.44%. Later cases of dysplasia, subluxation and luxation (in the second and third month after birth) are found within cases of undiagnosed primary contracture of the hip and within cases of malposition syndrome (plagiocephaly, torticollis, thoracic 'C' scoliosis,

oblique Vaisman pelvis and foot deformities), which is another reason why a child should be examined in the sixth week of life (18). This study has shown that 16% of newborns with bilateral limited hip abduction and 67% with unilateral limited hip abduction had one of the types of DDH. Unilateral limited hip abduction was five times more pathognomonic clinical sign for developmental hip dysplasia than bilateral hip abduction. Jari et al. (19) showed the significance of unilateral limited hip indicating obligatory detailed diagnostics, while bilateral limited hip abduction is considered to be a less reliable clinical sign. Some of the studies showed unreliability of the clinical examination in diagnosing DDH (20,21). Unilateral limitation of hip abduction is a time-dependent and useful clinical sign in the diagnosis of pathological DDH (22,23). Primary prevention for the developmental dysplasia of the hip is impossible to conduct for the reason of not knowing the primary cause for the appearance of this disorder. Today it is possible to conduct secondary prevention, which is based on a very early diagnosis set through the screening (24).

In conclusion, limited hip abduction (especially unilateral) is a useful and important clinical sign of DDH. Doctors who perform the first examination of the child after birth would have to pay attention to this clinical sign. Newborns with this clinical sign would have to undergo an ultrasound examination of the hips for further diagnosis.

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## TRANSPARENCY DECLARATION

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