CLINICAL STUDY

# Developmental dysplasia of the hip Prevention and real incidence

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**Abstract**

***Objective:*** **The controversy over the incidence of developmental dysplasia of the hip (DDH) stems mainly from an ambiguity of criteria for defining a genuinely pathologic neonatal hip. The aim of this study was to identify those neonatal hips which, if left untreated, would develop any kind of dysplasia and, therefore, are to be included in the determination of DDH incidence.**
***Methods:*** **Clinical and ultrasonographic examinations for DDH were performed on 4356 neonatal hips. Newborns with skeletal deformities, neurologic/muscular disorders, and neural tube defects were excluded. Hips that featured any type of sonographic pathology were reexamined at 2 or 6 weeks, depending on the severity of the findings. Only hips in which the initial pathology was not improved or had deteriorated were treated; all others were examined periodically until the age of 12 months.**
***Results:*** **Sonographic screening of 4356 hips detected 301 instances of deviation from normal, indicating a sonographic DDH incidence of 69.5 per 1000. However, only 21 hips remained abnormal and required treatment, indicating a true DDH incidence of 4.8 per 1000 hips. All the others evolved into normal hips, and no additional instances of DDH were found on follow-up throughout the 12 months.**
***Conclusions:*** **These findings enables us to distinguish two categories of neonatal hip pathology: one that eventually develops into a normal hip (essentially sonographic DDH); and another that will deteriorate into a hip with some kind of dysplasia, including full dislocation (true DDH). This approach seems to allow for a better-founded definition of DDH, for an appropriate determination of its incidence, for decision-making regarding treatment, and for assessment of the cost-effectiveness of screening programs for the early detection of DDH *(Tab. 2, Ref. 15)*. Full Text (Free, PDF) *www.bmj.sk*.**
**Key words: developmental dysplasia of the hip, incidence, neonatal screening, sonography.**

The definition of developmental dysplasia of the hip (DDH), formerly termed congenital dislocation of the hip (CDH), is a complex and controversial issue. Determining the incidence of DDH based on an uncertain definition is confusing, and the data in the literature on the subject vary widely, mainly as a consequence of the diversity in inclusion and exclusion criteria and in the protocols used by various authors. The discrepancy between the multiple reports on the incidence of DDH has more to do, according to Hering (1) with "how the disorder is defined than with a true population variance." This is also supported by Dunn et al (2), Palmen (3) and Tonnis (4).

Routine clinical screening for DDH in neonates and infants, as instituted by Ortolani (5) followed by others, and particularly the subsequent introduction of sonographic methods by Graf et al (6), Harcke et al (7), Suzuki et al (8), and Terjesen et al (9) for neonatal screening were a major advance towards a more precise neonatal diagnosis. However, they led to overdiagnosis of hip pathology in newborn infants and failed to resolve the problem of DDH incidence. Moreover, despite the long experience with clinical screening accrued for more than 20 to 30 years, the problem of coxarthrosis attributable to hip dysplasia remained unresolved.

On the premise that a combination of appropriately performed neonatal clinical and sonographic screening makes it possible to

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**Tab. 1. Newborns and ultrasound pathology in screening of DDH at the 1st Univ. Department of Orthopaedics, Comenius University Bratislava, in the years 2000–2003.**

| Year | Newborns | Hips | Normal findings | Stable hips with ultrasound pathology | Unstable hips with ultrasound pathology |
|---|---|---|---|---|---|
| 2000 | 512 | 1024 | 969 (94.62%) | 48 (4.6%) | 7 (0.68%) |
| 2001 | 623 | 1246 | 1183 (94.94%) | 53 (4,25%) | 10 (0.8%) |
| 2002 | 598 | 1196 | 1099 (91.88%) | 88 (7.36%) | 9 (0,75%) |
| 2003 | 403 | 806 | 771 (95.65%) | 30 (3,72%) | 5 (0.62%) |

**Tab. 2. Newborns and ultrasound pathology in screening of DDH at the Univ. Department of Pediatric Orthopaedics, Comenius uUniversity Bratislava in the years 2004–2005.**

| Year | Newborns | Hips | Normal findings | Stable hips with ultrasound pathology | Unstable hips with ultrasound pathology | Real hip pathology |
|---|---|---|---|---|---|---|
| 2004 | 1056 | 2112 | 1991 | 102 (4.8%) | 19 (0.9%) | 10 (0.47%) |
| 2005 | 1122 | 2244 | 2064 | 157 (7%) | 23 (1%) | 11 (0.49%) |
| Total | 2178 | 4356 | 4055 (93%) | 259 (6%) | 42 (0.95) | 21 (0.48%) |

detect virtually all pathologic hips, a major question that arises is whether all these apparently pathologic hips should be taken into account in the determination of incidence of DDH, or only those hips which, if left untreated, will evolve into any kind of hip dysplasia (eg, dysplasia, subluxation, luxation). An answer to this question can be derived from the ingenious observation of Barlow (10) who found that 88 % of unstable hips in his series eventually became normal without treatment. Recently, we suggested performing combined clinical-sonographic screening of all neonates, and we proposed a program for identification of those hips that do not need to be treated, thus sparing their overtreatment. This can be achieved by withholding initiation of treatment of neonatally pathologic hips, while observing them sonographically and clinically during the first weeks of life. Those hips that show no improvement are treated, whereas those that do improve are observed periodically until the age of 1 year. Based on this algorithm and on Barlow's (10) observations, and in agreement with ideas put forward by Aronson et al (11), Grill and Muller (12), and Taylor and Clarke (13), we can make a clear distinction between two categories of pathologic hips: one category of neonatal, essentially sonographic DDH, and another which, if left untreated, deteriorates into a hip with any kind of dysplasia (including subluxation and full dislocation), namely, true DDH. In this light, we propose that only this latter category of hips should be considered for the assessment of the true incidence of DDH. This concept constitutes the thrust of the present study.

## Methods

Combined clinical-sonographic neonatal screening for DDH was introduced at the 1st Univ. Department of Orthopaedics, Comenius University, Bratislava in Bratislava by the first author (M.K.) after a study stay in AKH Stolzalpe, headed by R. Graf in 1994, and in Rambam Medical Center, Haifa, Israel, headed by the senior author V.B. in 1995. The distribution of the ultrasound pathology during the screening of DDH at the 1st Univ. Department of Orthopaedics, Comenius University, Bratislava, in the years 2000–2003 is showsn in Table 1. After the resettlement of this institution to another building of the city hospital, the screening of DDH was performed by radiologists, and the continuity of the screening was lost. After the establishment of the University Department of Pediatric Orthopaedics, University Hospital, Bratislava in 2004 we continued with the „orthopaedically based" screening and prevention of DDH. At this department clinical and ultrasonographic examinations for DDH were performed on 4356 neonatal hips during the years 2004 and 2005 (Tab. 2). Newborns with skeletal deformities, neurologic/muscular disorders, and neural tube defects were excluded. Grading of the sonographic findings was conducted according to Graf's (6) classification. Hips that featured any type of sonographic pathology were reexamined at 2 or 6 weeks, depending on the severity of the findings. Only hips in which the initial pathology was not improved or had deteriorated were treated; all others were examined periodically until the age of 12 months.

## Results

Combined clinical – sonographic neonatal screening for DDH performed at the University Department of Pediatric Orhopaedics, University Hospital in Bratislava in 2004–2005 on 4356 hips showed normal findings in 4055 hips (93 %). In 301 hips we

detected morphological deviations (259 stable hips with ultrasound pathology from IIa to IV) and dynamic pathology (42 unstable hips with ultrasound pathology IIa–IV according to Graf). These results are indicating a sonographic DDH incidence of 69.5 per 1000. However, only 21 hips remained abnormal and required treatment, indicating a true DDH incidence of 4.8 per 1000 hips.

On the other hand, remaining 280 hips primarilly considered as pathological were carefully followed but were not treated, and they were found to be clinically, sonographically, and radiologically normal by the age of 1 year. In other words, 280 of 301 (93 %) either stable or unstable hips, with or without initial sonographic indication of pathology, were spared unnecessary overtreatment.

**Discussion**

Accounting for 75 % of all congenital defects, DDH, formerly termed CDH, is believed to be the most common defect in the newborn infant. DDH seems to be the most discussed subject in the pediatric orthopaedic literature dealing with the musculoskeletal system and, as ably stated by R. Salter (14, 15), "Congenital dislocation of the hip represents one of the most important and challenging congenital abnormalities of the musculoskeletal system." Searching for data on the true incidence of the condition, we found wide discrepancies between reports that were published during different periods of time. We believe that the first step toward the determination of the true incidence of DDH is to clarify the terminology and the definition of the condition.

Three periods are discernible from the literature dealing with the incidence of CDH and DDH: the first is the period before the introduction of routine screening programs for neonatal detection of DDH (1920s to 1950s); the second is the period of exclusively clinical neonatal screening (1950s to 1980s); and the third is the period that followed the introduction of sonographic techniques for neonatal screening (1980s onward).

The discrepancies between the data on the incidence of CDH obtained by various authors during the first period, before the introduction of screening programs for the neonatal detection of DDH, are explained mainly by the diversity of diagnostic methods for DDH detection, different age at the time of diagnosis, variable inclusion or exclusion criteria, and the different numbers of infants and populations included in the studies. The skills, experience, and conceptual approach of the examiner also influenced the reported incidence rates during this period (11). The published data were obtained by such different means that they are practically not comparable, and are more or less of historical value only. In this period, the incidence of CDH was estimated as 0 to 200 per 1000 children, or even 400 per 1000, as quoted by Tonnis.4

The second period began after the introduction of routine clinical neonatal screening, when the data on the incidence of DDH were based mainly on clinical findings denoting neonatal hip instability. This overall approach led to some degree of overdiagnosis and overtreatment. The same confounding factors as noted above were further complicated by the efforts of some authors to add late-diagnosed hip dysplasias and dislocations to the neonatal incidence. In this period, many spuriously pathologic hips were treated despite the fact that, if left untreated, they would have progressed to normal, although the inability to predict which hips would need treatment justified the tendency to overtreat. The tendency to treat all unstable and late-diagnosed hips contributed to overtreatment and engendered further confusion in calculating the incidence of DDH (CDH). On the other hand, when calculating the incidence of DDH, the authors did not include clinically silent hips, whose pathology was not discovered by clinical examination but that subsequently developed into early coxarthrosis. Recent reports based on ~30 years of experience with clinical neonatal screening reinforce the doubts and criticisms concerning different clinical screening programs, from which the true incidence rate of DDH cannot be determined. A further difficulty was introduced by diverse authors who variably defined CDH (DDH) either as established dysplasia, subluxation and full dislocation, radiologically proven dislocation, or any neonatally unstable hip. The incidence of DDH for white or mixed populations during this period was calculated as 0.41 to 168.6 per 1000, which is not essentially different from the estimated incidence during the first period but is, in our opinion, still greaterhigher than the true incidence.

The third period is the current stage, where ultrasonography is used in neonatal screening for DDH. Consequently, sonographic and clinical findings do not always correlate, which may add to the confusion even when Graf's6 rules are strictly applied. We must therefore be aware of the fact that a true incidence of DDH is not equal to a neonatal (clinical, sonographic, or clinical followed by sonographic) incidence.

Our finding of a sonographic incidence of 69.5 per 1000 is relatively low, mainly because of our high threshold for designating hips as bearing a pathology that would rate as type IIa. Our data are close to those published by Grill and Muller (12).

From our study, and we believe that the situation is similar worldwide, it emerges that the true incidence of DDH is actually low. The present study focuses only on the problem of the true incidence of DDH and, therefore, the girl:boy ratio, side prevalence, risk factors, seasonal variations, ethnic incidence, and correlation between the clinical and sonographic findings are not assessed here.

**Conclusion**

The diversities in size of the population samples and in the interpretation of the clinical findings, which may vary from clicking hips through mild instability to full unstable dislocation, are some of the reasons for data variability. The acumen, thoroughness, skills, and experience of the examiner and the diagnostic criteria used and the time of diagnosis play an important role in the determination of the reliability and accuracy of the data. The reporting of affected children rather than affected hips can also have a slanting influence on the results, because only some infants have a bilateral problem; thus, statistics that are based on

hip pathology rather than on affected children tend to be more accurate. Our results indicate true incidence rates that are relatively low (5 per 1000 hips), resembling those reported in the prescreening period when DDH (or CDH at that time) was empirically estimated. We believe that our proposed algorithm, when implemented adequately, is a framework that provides the true or real incidence of DDH and can prevent, (or at least reduce to a minimum), the evolution of late- or very-late-diagnosed hip dysplasia leading into early coxarthrosis, subluxation, or dislocation.

Establishment of a valid definition of DDH and an understanding of its nature will allow the elaboration of adequate guidelines for treatment and a more precise determination of the true incidence of the condition. Finally, information thus derived would serve as a basis for the estimation of the cost-effectiveness and the value of screening programs in various countries and populations.

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