

Diagnosis and treatment of developmental dysplasia of the hip in the Netherlands: national questionnaire of paediatric orthopaedic surgeons on current practice in children less than 1 year old

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Abstract

Purpose There is no consensus in the literature regarding the diagnosis and treatment of developmental dysplasia of the hip (DDH). We designed a national questionnaire to assess the various opinions and current practice of paediatric orthopaedic surgeons in the Netherlands regarding the diagnosis and treatment of DDH in children less than 1 year old.

Methods The questionnaire was sent to all members of the Dutch Paediatric Orthopaedic Society (DPOS). It discusses different methods and criteria used in the diagnosis of DDH, the use of different therapies and the use of different imaging techniques to evaluate the result of treatment.

Results With 38 responders, the overall response rate to the survey was 67%. Most surgeons use clinical, radiographic and/or ultrasound examination for the diagnosis. The starting point of treatment is usually on the mild part of the DDH spectrum. The Pavlik harness is most popular in the treatment of dislocated hips, whereas in dysplastic hips, most surgeons use a rigid splint. The duration of treatment has a wide range and evaluation of the effect of treatment is predominantly done by radiography.

Conclusions The diagnosis and treatment of DDH in the Netherlands has as much diversity as the literature has recommendations about this subject. The lack of consensus on many aspects of DDH diagnosis and treatment should form the basis for a discussion among Dutch paediatric orthopaedic surgeons. Using the available evidence, it

should be possible to formulate a more uniform protocol for the diagnosis and treatment of DDH.

Keywords Developmental dysplasia of the hip · Current practice · Diagnosis · Treatment

Introduction

In developmental dysplasia of the hip (DDH), the acetabular dysplasia is characterised by an immature, shallow acetabulum, which can be combined with subluxation or dislocation of the femoral head. In the Netherlands, in the current screening protocol, the incidence of DDH in the first months of life is estimated at 3.7% and the incidence of hip dislocation at 0.4% [1].

As part of the programme for child health surveillance, screening for DDH in the Netherlands is selective: a selection of infants are referred for visualisation of the hip joint. This selection is done by the child healthcare centres. These are publicly financed centres for the health surveillance and care for all infants and children, where they receive healthcare checks and vaccinations. Hip screening is part of this general screening programme. The first standardised physical examination of all infants is performed at 4 weeks of age by a child health MD. During the first year of life, the hips are also clinically assessed at 3 months and 6 months. The clinical hip signs sought are leg length differences using the Galeazzi test and limited hip abduction in flexion.

In the Netherlands, hip screening is selective in the sense that only the following infants are referred for visualisation of the hip at the age of 3–5 months: infants with the risk factors: breech position in the last trimester, positive family history, other congenital deformation and/

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or the positive clinical signs: leg length differences and/or limited abduction. The selective screening in our country shows that the positive predictive test of indication for referral is 16% and the negative predictive test is 99% [1].

There are different ideas and theories on the nomenclature and natural history of DDH [2]. Not only are there differing recommendations in the literature about the diagnosis and treatment [3], but there is also limited information as to how current practice is performed. The goal of this study was to assess the theory and practice of the management of DDH in the Netherlands and, thereby, identify points of agreement/disagreement in the diagnosis and treatment of DDH in children less than 1 year old.

Methods

The questionnaire was distributed to all 57 members of the Dutch Paediatric Orthopaedic Society (DPOS). Most orthopaedic surgeons treating children in the Netherlands (population 16.6 million) are members of this society. The questionnaire was sent by e-mail. All non-responders were sent a reminder by post.

The questionnaire focussed on diagnosis and treatment. It was semi-structured: it consisted of multiple-choice questions and open fields for additional remarks.

For diagnostic aspects, we questioned which clinical test they used and if they used radiographs and/or ultrasound and what criteria they use on these imaging techniques. Because most surgeons use more than one test, they were asked to rank a top 3 of diagnostic tests. We inquired whether they based their diagnosis only on radiographs and/or ultrasound or on a combination of imaging and clinical examination results. They were asked the threshold value of treatment of the acetabular index and the Graf classification.

Regarding treatment, we separated the treatment of dysplasia and dislocation. We asked what therapy they would use for starting the treatment of dysplasia and dislocated hips and what would be used as the second option. As the duration of treatment depends on whether the hip measurements normalise, we asked what would be the maximum duration of the first-choice treatment if it was not successful. The use of traction and the type and minimum age for open reduction were assessed. Finally, we assessed the method of evaluating the treatment.

Results

The Dutch paediatric orthopaedic surgeons are general orthopaedic surgeons who have an interest in paediatrics. Another recent Dutch questionnaire has shown that more

than half of the members of the DPOS treat children 75% or more of their time. All of these surgeons will treat DDH [4].

We have distributed a total of 57 questionnaires; the overall response rate was 38 (67%). Of the responders, 14 (37%) were employed at an academic hospital and 24 (63%) at general hospitals. The median duration of practice of the surgeons was 12 years (mean 12.9, range 1–32 years).

We shall discuss the different answers to the questionnaire by subject.

Diagnosis

Clinical examination

As it was possible to answer with more than one diagnostic test, the Barlow and Ortolani tests were used by, respectively, 62 and 65% of the surgeons, and 49% of them used both tests. The abduction test was used by 100% of the surgeons. The Galeazzi test was used by 76% of them [5].

Radiography

Eighty-six percent of the surgeons used the acetabular index according to Tönnis [6], 51% used the Shenton–Menard line, 41% used the Perkins quadrants, 38% used the medial joint space, 16% used the migration percentage and 14% used the centre–edge angle [5].

Ultrasonography

Graf's classification was used by 78% of the surgeons [7, 8]. Twenty-two percent of the surgeons used the percentage of femoral head coverage by the acetabulum to diagnose DDH [9].

Making the diagnosis

Because most surgeons use more than one diagnostic criteria, they were asked to rank the tests. One-third thought that the acetabular index was most important, for one-third this was the abduction test and for one-fifth the Graf classification.

In final decision-making, 81% of the surgeons based their diagnosis on a combination of both imaging and clinical examination results versus 19% who based their diagnosis on imaging results and used clinical examination for screening purposes only.

The indication to treat depended on the Graf type, acetabular index and age of the infant.

If surgeons based their diagnosis on the acetabular index, most often (41%), treatment was started from 25°

Table 1 Start of treatment in the Graf classification depending on the age of the infant

Age of the infant	1A	1B	2A	2B	2C	2D	3A	Total
0–3 months		1 (6%)	2 (12%)		7 (41%)	3 (18%)	4 (23%)	17
3–6 months				16 (70%)	4 (17%)	3 (13%)		23
6–12 months		2 (9%)		16 (73%)	1 (5%)	3 (13%)		22

Table 2 First choice of therapy for dysplasia and dislocation depending on the age of the infant

Therapies	Dysplasia <6 months	Dysplasia 6–12 months	Dislocation <6 months	Dislocation 6–12 months
Pavlik harness	14 (40%)	10 (29%)	32 (86%)	19 (52%)
Rigid splint	21 (60%)	25 (71%)		
Closed reduction			5 (14%)	9 (24%)
Traction				9 (24%)
Total	35	35	37	37

(range 24–30°) for infants aged 3–6 months. Indications to treat infants aged 6–12 months ranged from 27 to 34°, with a peak (36%) at 30°.

If based on the Graf classification, the majority would treat 2B from the age of 3 months (Table 1).

Treatment

Pavlik bracing is the usual technique for dislocation in infants under 6 months of age. In older children, dislocation is treated in half of the cases by closed reduction. Traction in those cases is used by half of the orthopaedic surgeons. In the treatment of dysplastic hips, rigid splints are used more often than the Pavlik harness (Table 2).

The maximum duration of treatment varied considerably. In dysplasia, bracing was continued longer, as the child was older at the time of detection. For dislocation of the hip, the duration of bracing was not influenced by the age of the child (Table 3).

If the Pavlik harness as the first choice of therapy for a dislocated hip failed, half of the surgeons would start traction followed by closed reduction. One-third would use closed reduction without traction. A minority would try a rigid splint before starting closed reduction.

Pre-reduction traction was used by 54% of the surgeons in the course of treating a dislocated hip for infants aged less than 6 months with a median duration of 3 weeks (range 1–6). Infants aged between 6 and 12 months were

treated by 58% of the surgeons with pre-reduction traction for 4 weeks (range 2–8).

The minimum age at which closed reduction would be performed ranged from 2 to 9 months (median 4). Open reduction would be performed from 3 to 12 months (median 6).

Seventy-three percent of the surgeons only used the anterior-lateral approach in open reduction, whereas 27% used the medial approach. The minimum age for the medial approach was 3.5 months (range 3–4) and for the anterior-lateral approach, it was 6 months (range 3–12).

Most surgeons use radiography to evaluate conservative treatment (Table 4). In closed and open reduction, some surgeons used more than one imaging technique.

Discussion

This survey shows that Dutch orthopaedic surgeons do not agree on the diagnosis and treatment of DDH.

Not only is diagnosis variable, but there is also substantial variability in the method, timing and duration of the treatment of DDH. Personal conviction, tradition and the lack of evidence-based studies [10] play a large role in the uncertainty on how to treat DDH.

Regarding diagnosis, fundamental to the variability of making a diagnosis of DDH is the uncertainty at which point the DDH spectrum becomes pathological in the sense that treatment or no treatment will increase the likelihood

Table 3 The median and range of maximum duration in months for the first-choice therapy

Therapies	Dysplasia <6 months	Dysplasia 6–12 months	Dislocation <6 months	Dislocation 6–12 months
Pavlik harness	2 (0.75–6)	3.5 (2–6)	1.5 (0.5–3)	1 (1–3)
Rigid splint	3 (1–12)	6 (2–18)		
Traction				1 (0.5–2)

Table 4 Evaluation of treatment

	Therapies	US	Radiography	CT/MRI	Arthrography	Total
	Pavlik harness	12 (35%)	22 (65%)			34
	Rigid splint	7 (20%)	27 (80%)			34
<i>US</i> ultrasonography, <i>CT</i> computed tomography, <i>MRI</i> magnetic resonance imaging	Traction	4 (17%)	16 (66%)		4 (17%)	24
	Plaster cast	8 (23%)	24 (68%)	3 (9%)		35

of an adverse outcome. This likelihood is clear for subluxation and dislocation. However, in the last several decades, the focus in the literature on the diagnosis of DDH has shifted from clinical criteria to imaging criteria, and it is unclear which anatomical changes in the infant hip will lead to an increased risk of degeneration. The anatomical form changes during growth, which adds to the uncertainty as to whether treatment is necessary. There is no gold standard for the diagnosis of a part of the DDH spectrum [3], which is reflected in the outcome of this survey. Often, diagnosis is still based on a combination of clinical examination and imaging. Each surgeon has his or her own criteria and personal conviction in attributing value to each test.

The literature is clear on the superiority of ultrasonography (US) in comparison to radiography in portraying the anatomical features of the young infant hip which are important in the diagnosis of DDH [11]. In the opinion of a group of orthopaedic surgeons in the UK, however, there is still uncertainty about the relevance and accuracy of US [12]. This uncertainty is also shown in the response of the Dutch orthopaedic surgeons to this study: only one-fifth consider US to be diagnostically the most valuable.

In general, infants are older when referred by the Dutch screening programme than in other countries. For instance, in the UK, the physical examination of a newborn is performed in the first weeks of life [13]. This increased age at the time of referral in the Netherlands also increases the extent of the bony anatomy visible with radiography compared to infants in the first weeks of life [14]. The relevance of radiography may be larger in the Netherlands than in other western countries and may explain why the majority (86%) of the surgeons use the acetabular index as a relevant factor and that one-third consider it to be the most valuable test.

The choice for radiography might be interpreted as out of date, but it has been shown that there is a good correlation between dislocation on radiography and US results, as well as for normal hips [12].

Regarding treatment, although there is no evidence on the optimal treatment of DDH, an accepted sequence in infants younger than 6 months of age is to start treatment using the Pavlik harness, if this fails closed reduction, and if this fails open reduction is performed [15].

In spite of the absence of evidence guiding decisions on timing duration and/or the role of other treatment

modalities (traction, night bracing etc.) in textbooks, often, arbitrary choices in this uncertainty are made and algorithms for DDH treatment using the above given sequence are given [16, 17]. One could say that, in the Netherlands, multiple algorithms are in use.

Bracing phase

In the Netherlands, there is general agreement that dislocated hips should be reduced early and preferably closed, usually with a Pavlik harness. Our study shows that the Pavlik harness is less often used when the infant is older at the time of detection in both concentric and non-concentric hips. This practice is supported by a study [18] which, among other factors influencing the results, found that an older age at the time of initiation leads to decreasing results of bracing. The effect of Pavlik bracing is debatable in Graf 4 hips: according to some, it should not be used in these [19] or, if used, has a substantial avascular necrosis (AVN) rate [20], which is reflected in the questionnaire results.

Asked what would be the maximum duration of treatment of bracing, our results show a great variability, especially in the treatment of concentric hips using a rigid splint. The goal of treatment in concentric hips is to stabilise the hip joint and facilitate endochondral ossification. It is logical to assume that the chance of reaching this goal increases with the duration of treatment, but to what extent this is true remains unclear.

Closed reduction phase and the use of traction

If reduction using the Pavlik harness failed, closed reduction would be performed, and in just over half of the surgeons preceded by traction. Although the use of traction is debatable [21], it has numerous followers in the Netherlands.

Evaluation of the effect of treatment is predominantly done using radiography (and/or arthrography/CT MRI), conforming to current international practice [22]. The US evaluation of closed/open reduction of non-concentric hips in a spica cast is used by a minority [23].

Limitations

Our response rate of 67% is reasonable, as a response rate of over 70% limits bias [24].

Although this is a questionnaire of the members of the DPOS, the number of active Dutch paediatric orthopaedic surgeons who are not a member of this society is very small.

A limitation is that this questionnaire does not deal with the end criteria of treatment and the amount of AVN seen because choices had to be made to present an overview of DDH diagnosis and treatment. We partially compensated these shortcomings by encouraging the surgeons to use the open fields below the questions for personal comments.

When discussing operative treatment, a serious limitation of this, as any, questionnaire becomes evident. It asked what surgeons would do, not what they did. This is particularly relevant for surgeons in general hospitals since, because of the anaesthetist's protocol, infants less than 12 months old can only be operated on in specialised hospitals. The availability of US is also limited: not all hospitals have trained skeletal US radiologists.

Conclusion

The diagnosis and treatment of developmental dysplasia of the hip (DDH) in the Netherlands has as much diversity as the literature has recommendations about this subject. The lack of consensus on many aspects of DDH diagnosis and treatment should form the basis for a discussion among Dutch paediatric orthopaedic surgeons. Using the available evidence, it should be possible to formulate a more uniform protocol for the diagnosis and treatment of DDH.

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