

Experiences in diagnosis and treatment of hip dislocation and dysplasia in populations screened by the ultrasound method of Graf

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Summary

Ultrasound investigation of the hip according to Graf is performed, whenever possible, as a routine screening test for hip dysplasia and dislocation in neonates. However, in spite of screening, hip dysplasia and/or dislocation is identified in a number of children after the third month of life only. The present study presents an analysis of reasons and causes. Between August 1999 and July 2001 children aged between six months and five years were documented, in whom the diagnosis of hip dysplasia or dislocation was made, despite normal ultrasound findings at primary investigation and who required non operative or operative treatment by a specialist surgeon working in Switzerland in paediatric orthopaedics. The study included 26 children (17 girls / 9 boys). Hip dysplasia and/or dislocation was diagnosed between the age of 6 days and 41 months. Twelve children had to be excluded from the sample (n = 26), four were infants who had basic neurological disorders or multiple anomalies and there were eight children from

abroad whose original documentation could not be obtained.

Analysis of the remaining 14 children showed that 43% were misdiagnosed (n = 6) and a treatment error occurred in 36% (n = 5) of cases. One child presented with a teratogenic hip dislocation. In two other infants with normal primary ultrasound findings, hip dysplasia was identified radiographically once the child started to walk.

Delayed diagnosis can be the result of technical errors or misinterpretation. The six patients meeting the criteria of misinterpretation can be expressed as a rate of 0.04% of all births. However, even if the disorder is correctly diagnosed, its identification and treatment may be inadequate or fail to produce the desired results. This was the case for five of the children, that is, for a rate of 0.03% of births.

Key words: missed hip dysplasia; hip dislocation; ultrasound; delay

Introduction

The Graf ultrasound hip screening procedure [3, 4] was introduced in Switzerland in the early eighties. Today, approximately 80% of all neonates in German-speaking Switzerland are screened according to this method [6, 9]. The screening rate is clearly lower in the French-speaking areas. The Graf hip screening procedure, which is performed for the first time when the infant is 6–8 weeks old, aims at the early identification of hip dysplasia and hip dislocation in order to administer adequate treatment according to the degree of severity (for stable dysplastic hips: abduction splinting; for unstable hips: closed reduction, hip-leg plaster cast; for dislocated hips: overhead extension, closed re-

duction, hip-leg plaster cast) [2, 10]. Reports in the literature have confirmed that more rapid healing with less invasive treatment methods is achieved if treatment can commence as early as possible [5, 11, 14]. Despite all efforts cases repeatedly occur in which there has been delayed or missed diagnosis of hip dysplasia and dislocation (IV congenital disorders 183) or which have required further paediatric-orthopaedic treatment despite timely sonographic investigation. The causes behind this phenomenon are analysed in this study, which was initiated by the Swiss Group of Paediatric Orthopaedic Surgeons (SGPO).

Materials and Methods

Children between six months and five years of age who required orthopaedic treatment in the period between 31. 7. 1999 to 1. 8. 2001 were documented.

The following data were recorded:

- Initials of the first and last names
- Date and place of birth (in Switzerland or abroad)
- Additional general diseases
- Time of the first ultrasound investigation, findings and original sonographic documentation
- Date of diagnosis of hip dysplasia or dislocation
- Date when treatment was performed

Population statistics: These were ascertained or calculated from data accessible on the internet (<http://www.statistik.admin.ch/stat>). Resident population 7.2 Mio. in the year 2000.

Births from August 1999 to July 2001: Rounded: 150'000.

Sonographic quality standards and assessment criteria according to Graf's method [3-5] and the treatment protocol.

The cases (n = 26) were collated from the following

hospitals: Cantonal Hospital for Orthopaedics Aarau 1 case; Balgrist University Hospital, Orthopaedics 2 cases; University Hospital Bern, Orthopaedics 1 case; Orthopädie CHUV Lausanne 2 cases, Cantonal Hospital St. Gallen, Orthopaedics 1 case, Schulthess Clinic Zürich 3 cases, UKBB Basel 16 cases.

Canton of origin of the patients: Aargau 2 children, Basel 4 children, Bern 1 child, Biel 1 child, Grisons 1 child, Lausanne 2 children, St. Gallen 1 child, Tessin 4 children, Zürich 3 children. From abroad: Germany 3 children, England 1 child, Croatia 1 child, Kosovo 2 children.

Additional diagnoses such as neurological disorders, arthrogryposis or multiple anomalies were observed in 1 child from Basel, 1 child from the Grisons, 1 child from St. Gallen, 1 child from the Valais, 1 child from Germany and one from England.

Twenty-six children were recorded of which 17 were girls and 9 were boys. After exclusion of the children from abroad, the children with neurological disorders and one case without sonographic images, the documentation for the remaining 14 children was further evaluated.

Results

Six neonates (43%) had been incorrectly diagnosed. In five cases the alpha and beta angles had been measured and the sonography was assessed as normal even though the femoral head was poorly covered or not even situated within the acetabulum. In one case, sectional images that did not meet the quality standards of the Graf ultrasound method were measured and diagnosed to be normal (Fig. 1). The total number of incorrect diagnoses came to seven since both hip joints were wrongly diagnosed in one child.

A treatment error occurred in five neonates (36%). In two of these cases an attempt was made to treat Graf Types III and IV hip dislocations by

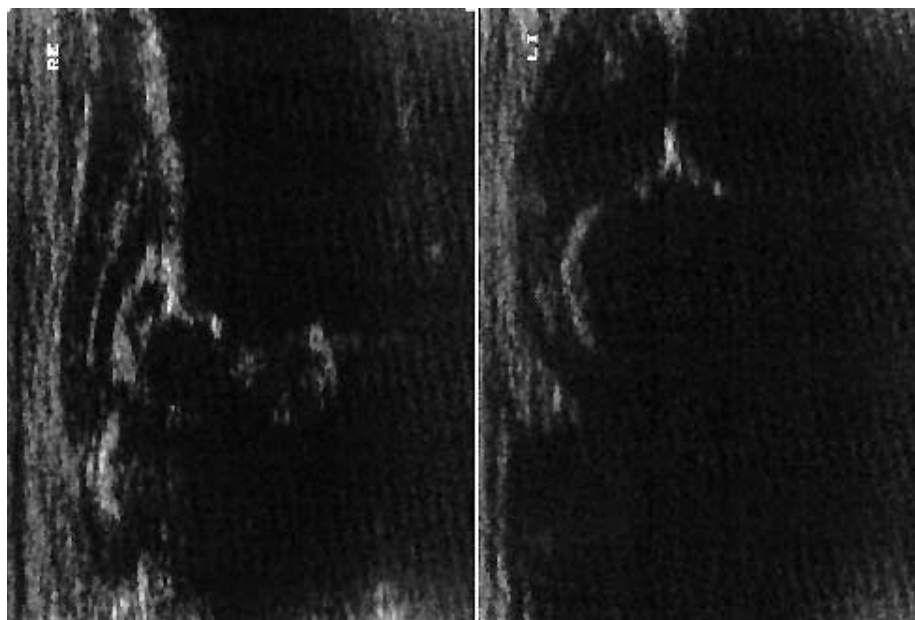
means of a Pavlik bandage and/or abduction orthosis, which is not in keeping with the treatment guidelines recommended by Prof. Graf. In one case, the parents of the child refused to consent to prompt corrective treatment. In two cases, open reduction had to be performed to deal with a reduction obstacle despite correct initial treatment.

In another case where there was congenital dislocation of both hips (= teratogenic hip dislocation) a repeat dislocation occurred during the course of healing despite correct open hip reduction.

Two children with primary abnormal ultrasounds (Graf Typ IIIa and IV) appeared to have

Figure 1

Example of a diagnostic error. Sonographic hip screening of a two-day-old girl (K.S.). The images do not conform to the quality criteria set by Graf in terms of image size and do not show the required landmarks. Nevertheless, an evaluation was carried out and the hip joint categorised and documented as a Graf Type Ib. Closer examination of the sonogram reveals that the right femoral head is not visibly resting in the acetabulum – the left side is showing a very rare case of capsular laxity. Due to this laxity the femoral head frequently pops out and in under a primarily rather well ossified acetabulum. This leads to intra-articular effusion and capsular distension (as showing on the sonogram) with recurrent luxations which secondarily will damage the acetabular roof growth plate. For correct diagnosis a stress test should be carried out.



achieved healing under correct treatment on ultrasound, however, the radiographs after the infant started to walk revealed dysplastic hip joints that required further assessment and treatment (pelvic and femoral osteotomy).

The consequence for our children ($n = 14$) in whom hip dysplasia and/or dislocation was diagnosed late was operative intervention in 79% of

cases (11/14) at an average age of 1 year 5 months (range, 6 months–3 years and 3 months). In four cases open reduction was necessary since the hips could not be reduced using a closed procedure; in 21% (3/14) non operative treatments (hip-leg plaster, harness) were adequate and produced sonographic evidence of healing after an average application period of four months.

Discussion

Although ultrasound screening of the hip is performed whenever possible, a number of children with hip dysplasia or dislocation are identified after the third month of life and need orthopaedic treatments. In the following study reasons and causes are analysed.

Depending on the country and the region an initial ultrasound investigation is performed in the period between birth and the third month of life. More recent specialist literature considers screening of neonates as early as possible to be ideal [1–3, 7, 11, 12]. In Switzerland, procedures with regard to ultrasound screening of the hip vary considerably. The screening rate in German-speaking Switzerland is around 80% and in Suisse romande around 60%. Thus, for a birth rate of 11% of the population [Swiss statistics, <http://www.statistik.admin.ch/stat>] this means that approximately 50,000 primary ultrasound screening procedures are performed. For a hip dysplasia and dislocation rate of around 1–5% [2, 9–11] screening should yield 500–2,500 early diagnoses. This figure includes less than 1% (fewer than 500 cases) of hip dislocation, ie, teratologic hip dislocations or dislocations due to a basic neurological disorder, an arthrogryposis or multiple anomalies.

If the sonographic diagnosis can be made at the right time and adequate treatment is initiated (for stable dysplastic hips: abduction splinting; for unstable hips: closed reduction, hip-leg plaster cast; for dislocated hips: overhead extension, closed reduction, hip-leg plaster cast), then hip dysplasia and dislocation should only be diagnosed in children aged 4 months to 5 years who have been resistant to treatment or who have not been screened.

The reason for delayed diagnosis of hip dysplasia or dislocation as identified in this case series in Switzerland was an *error of diagnosis or treatment* in the majority of cases ($n = 11$, 69%). In one child with a teratogenic hip dislocation, there had been neither an error of diagnosis nor of treatment; the dislocation of the hip proved to be resistant to treatment. In two children it was unclear why the apparently normal hip position after correct treatment seen on ultrasound could not be confirmed by the control radiographs at the age of 1½ years. This phenomenon correlates with our own experience even though it is seldom described in the lit-

erature [8]. Because of these findings we conclude that all children with hip dislocation or dysplasia should be followed up until the end of growth.

Technical errors of sonography were identified in six children (seven hip joints). In one case the device could not be set to the standard plane of section (Fig. 1). For six hip joints the measured angle was incorrectly evaluated as I a or I b. In these cases ultrasonography showed a poorly covered femoral head or a dislocated hip. Although this is a technical failure rate of well below 1% of all screening procedures (approximately 50,000 ultrasound investigation per year in Switzerland), it is necessary to aim for improvement. On the one hand, the quality of the ultrasound investigation could be improved by including a dynamic test. This has been emphasised by Graf in addition to ultrasonography in risky hips (type 2c) or in new-born babies with morphologically “normal”-looking acetabula, when there has been a suspicion of capsular laxity. Static images of joints, as for all imaging techniques, can produce incorrect results since the image may, by chance, be taken at the exact moment when the joint happens to be in a normal position. The tendency to dislocation seen in a dynamic investigation would modify the interpretation of the incorrect images and lead to an appropriate treatment (Fig. 1). On the other hand, the clinical examination is essential and has to be done first. If any irregularities in the case history or at the clinical examination are noticed, the ultrasound procedure must be regarded as investigative and not as a screening test. Furthermore, normal ultrasound findings in perfectly performed (STATE OF THE ART 2003) ultrasound procedures should not lead to a false sense of security. At every routine check-up, the hip has to be examined clinically and if any abnormality is identified, the result must be re-investigated by ultrasound or later with x-ray since there is a risk of secondary acetabular dysplasia.

According to statistical data one to five cases of hip dysplasia and dislocation will be identified for every 100 sonograms. The rate of type III and IV hips according to Graf is even lower [2, 9–12]. In order to counteract this effect and to maintain a high sonographic standard, refresher courses for operation of hip ultrasonography (re-certification, certificate of proficiency FMH) are essential. In

addition, the formation of regional interest groups with reciprocal supervision could lead to improvement.

With reference to the *technical errors* attempts had been made in two children to treat an unstable, dislocated hip by means of an abductor splint. The reason for this seems to be the diversity of opinion regarding the type of treatment. According to Graf's treatment protocol an unstable hip should be treated by closed reduction followed by hip-leg retention cast. Treatment with abductor splint was indicated for three children but the treatment was either not commenced due to poor communication among the treating surgeons or delayed due to lack of consent from the family. Thus the aim of maturation of the hip joint within the first five months of life was not achieved. Though the number of cases may be few, the situation must still be regarded as unacceptable.

On the basis of the results presented here and a study of the relevant literature, we conclude that ultrasound screening is worthwhile. This includes investigation of all neonatal hips with ultrasound within the first six weeks of life. A dynamic investigation must be included. A normal sonographic finding (STATE OF THE ART 2003 ultrasound)

in the first six weeks of life however does not exclude the possibility that pathology of the hip may develop. Therefore, supplementary clinical examination is imperative. Both methods of investigation, ie, clinical and sonographic, are susceptible to some degree of failure. Combining the two methods contributes to reducing the failure rate: The clinical examination did indeed reveal decentralised hips which had been overlooked or inadequately treated. A clinical examination should be performed at every routine assessment of a neonate and should be repeated. If the family history is positive or an abnormal clinical result is obtained, then the ultrasound investigation is to be regarded as investigative, serving the purpose of clarification, and is no longer a screening method.

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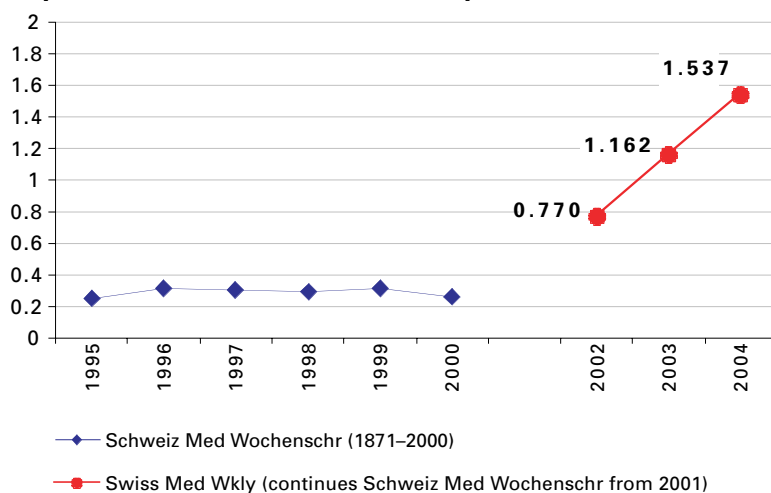
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