The significance of at-risk factors in ultrasound surveillance of developmental dysplasia of the hip

A TEN-YEAR PROSPECTIVE STUDY

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Of the 34,723 infants born between 1 June 1992 and 31 May 2002, the hips of 2,578 with clinical instability or at-risk factors for developmental dysplasia of the hip were imaged by ultrasound.

Instability of the hip was present in 77 patients, of whom only 24 (31.2%) had an associated risk factor. From the ‘at-risk’ groups, the overall risk of type-III dysplasia, instability and irreducibility was 1:15 when family history, 1:27 when breech delivery and 1:33 when foot deformity were considered as risk factors. Of those hips which were ultrasonographically stable, 88 had type-III dysplasia.

A national programme of selective ultrasound screening of at-risk factors for the diagnosis of hip dislocation or instability alone cannot be recommended because of its low predictive value (1:88). However, the incidence of type-III dysplasia and hip dislocation or dislocatability in the groups with clinical instability, family history, breech position and possibly postural foot deformity as risk factors could justify a programme of selective ultrasound imaging.

In the spectrum of developmental dysplasia of the hip (DDH), severe dysplasia or irreducible dislocation with early degenerative changes may require total hip replacement in early adulthood.1 The incidence of asymptomatic hip dysplasia is unknown although Tonnis2 estimated it to be between 1% and 8%.

In the UK, clinical guidelines for screening were developed in 1969 and updated in 1986.3 The clinical tests (Ortolani and Barlow) are 100% specific, but have a sensitivity of only 60% at best.4 Sensitivity further decreases if the primary screening personnel are inexperienced.5 Clinical screening programmes have been shown to decrease slightly the incidence of surgery for late DDH.6,7 Ultrasound screening programmes use either a universal or a selective technique. The latter assesses ‘at-risk’ factors. Recent reports have shown a lack of strong evidence to advocate screening for the diagnosis and/or treatment of dysplasia of the hip.8–11

We undertook a prospective ten-year study to quantify the relationship between at-risk factors or neonatal instability and the presence of dislocation or Graf type-III dysplasia.12,13

Patients and Methods

Between 1 June 1992 and 31 May 2002, we undertook a prospective programme of ultrasound screening for DDH. The Paediatric Department referred all newborn infants with suspected instability or a recognised at-risk factor to the Paediatric Orthopaedic Clinic. A small number of neonates or infants with potential instability, risk factors or unilateral limitation of hip abduction were referred by general practitioners. The at-risk factors were those identified as the most important in the United Kingdom’s guidelines,3 i.e. family history, breech delivery, postural or structural deformities of the foot, torticollis and oligohydramnios. The senior author (RWP) examined all the hips clinically using the Barlow and Ortolani tests and ultrasonographically by Harcke’s dynamic14,15 and Graf’s static morphological methods.12,13 A simplified Graf classification was used. A Graf angle of over 60° was classified as normal, of 43° to 60° as type II, and below 43° and stable as type III. A dislocatable or dislocated hip was classified as type IV.

Neonates with clinical suspicion of instability were assessed within two weeks. Those with at-risk factors but clinically stable hips were assessed usually between eight and nine weeks after birth.

Statistical analysis. We calculated and compared the exact confidence intervals (CI) for instability and irreducibility of the hip, with or without at-risk factors, using Fisher’s exact test.
Results
Over the ten-year period, there were 34 723 live births in the area of study. Of these infants, 2578 (7.4%) were assessed by ultrasound imaging; 452 (1.3%) were referred for potential clinical instability or clunky or clicky hips (13 per thousand live births). A further 2126 (6.1%) were referred for at-risk factors alone. The rate of instability diagnosed ultrasonographically was 2.2 per 1000 live births.

At-risk factors included breech delivery (1336), family history (220), foot abnormality (427) and oligohydramnios (157). Fourteen patients had two risk factors; oligohydramnios and either a family history or a foot abnormality. Instability (reducible displacement of the articulating bones leading to a separation of joint surfaces) was present in 77 infants, in four of whom the hip was subluxable (partial dislocation in that there was some contact between joint surfaces) (2.1 per thousand live births). Of these 77 infants 24 (31.2%) had an associated at-risk factor, 20 had one risk factor and four had two. Instability was treated by a Wheaton Pavlik harness.

During the period of study, there were 21 irreducible dislocations in 19 infants, a rate of 0.55 per thousand live births. Four of these hips had presented initially as clinical instability, splintage failed and they required open reduction. Of the 19 patients, 11 had been diagnosed at less than one year of age and eight between the ages of one and two years. No patient presented after two years of age.

In those hips referred as being potentially clinically unstable, the rate of detection of dislocation was 1:8.5 (95% CI 6.6 to 11.2). In the at-risk group, the rate was 1:88 (95% CI 59.7 to 138.0). Diagnosis by ultrasound was significantly more likely to detect a dislocation in the clinically unstable than in the at-risk group (p < 0.0001).

There were 88 type-III hips, excluding those with ultrasonographically proven instability, 48 with risk factors and 40 without. This represents a risk of type-III dysplasia of 1:11 if referred as a potentially unstable hip and of 1:44 if referred as having an at-risk factor. The overall rate of type-III dysplasia was 2.53 per thousand live births, approximately four times the rate of irreducible dislocation.

On subdividing the at-risk groups family history had a risk of 1:45 of instability or irreducibility and of 1:22 of type-III dysplasia, breech presentation a risk of instability or irreducibility of 1:70 and of type-III dysplasia of 1:43 and foot deformity a risk of instability or irreducibility of 1:71 and of type-III dysplasia of 1:61. The combined overall risk of type-III dysplasia and instability or irreducibility was 1:15 in the family history group, of 1:27 in the breech group and of 1:33 in the foot abnormality group (Table I).

Discussion
The United Kingdom's recommendations of 1986 indicated that 60% of dislocations were associated with at-risk factors, including breech delivery, family history, congenital postural deformities, Caesarean section, oligohydramnios and intra-uterine growth retardation. In a previous prospective five-year at-risk study, only 31% of dislocations were associated with at-risk factors and our findings corroborate this. In our study, 31.2% of cases had at-risk factors, confirming that most unstable hips were not referred from such groups, but from clinical screening programmes.

The rate of Caesarean section has greatly increased since the United Kingdom's guidelines were published in 1969 and is of the order of 22%. This mode of delivery cannot currently be considered as an at-risk factor on its own, however a recent Irish study has suggested emergency Caesarean section may be a risk factor.

Referrals of oligohydramnios as a risk-factor increased during the ten-year period from approximately one to two per year at the beginning to 58 in the last year of the study (Table II). Of the 166 cases in which oligohydramnios was the sole risk factor, there was no case of irreducible dislocation or type-III dysplasia. The most likely explanation is the striking increase in referrals due to a change of practice in which oligohydramnios is now diagnosed by ultrasound rather than by clinical examination. The latter is much less likely to diagnose the condition. We do not feel that oligohydramnios should be a risk-factor unless it is diagnosed clinically or is associated with syndromes such as arthrogryposis.

The incidence of postural foot abnormalities in the population may be an underestimate because of inaccuracy in diagnosis. The definition of such deformities is vague and subjective. The annual referral rate varies widely between 20 and 77 cases, and diagnosis usually depends on the clinical examination by inexperienced paediatric trainees.

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Number</th>
<th>Dislocation and type-3 dysplasia</th>
<th>Rate per 1000</th>
<th>Number needed to detect one patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breech</td>
<td>1336</td>
<td>50</td>
<td>37</td>
<td>27.0</td>
</tr>
<tr>
<td>Family history</td>
<td>220</td>
<td>15</td>
<td>68</td>
<td>14.7</td>
</tr>
<tr>
<td>Foot deformity</td>
<td>427</td>
<td>13</td>
<td>30</td>
<td>32.0</td>
</tr>
<tr>
<td>Oligohydramnios</td>
<td>157</td>
<td>NA*</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

* NA, not available

Table II. Increase in the number of referrals

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>First year</th>
<th>Final year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breech</td>
<td>117</td>
<td>140</td>
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<tr>
<td>Family history</td>
<td>17</td>
<td>35</td>
</tr>
<tr>
<td>Foot deformity</td>
<td>36</td>
<td>77</td>
</tr>
<tr>
<td>Oligohydramnios</td>
<td>0</td>
<td>58</td>
</tr>
</tbody>
</table>

On subdividing the at-risk groups family history had a risk of 1:45 of instability or irreducibility and of 1:22 of type-III dysplasia, breech presentation a risk of instability or irreducibility of 1:70 and of type-III dysplasia of 1:43 and foot deformity a risk of instability or irreducibility of 1:71 and of type-III dysplasia of 1:61. The combined overall risk of type-III dysplasia and instability or irreducibility was 1:15 in the family history group, of 1:27 in the breech group and of 1:33 in the foot abnormality group (Table I).
However, since the risk of significant hip pathology was of the order of 1:33, this factor may still be important.

The increased incidence of cases with a strong family history is predictable. If previous siblings had been treated during the study period there was increased awareness by family members and medical professionals.

Breech presentation as a risk factor had a fairly constant rate of referral.

From current literature it would seem that the most significant of the at-risk factors are family history and breech delivery. Before the use of ultrasound screening, children older than two years of age occasionally presented with irreducible dislocation. Because of the high profile of the ultrasound programme among general practitioners, midwives, health visitors and paediatricians, this no longer occurs and may be an additional unforeseen benefit.

Ultrasound screening has virtually abolished the need for diagnostic arthrograms, reduced the number of dislocations presenting very late and decreased the rate of surgical intervention in comparison with previous clinical screening methods (0.55 per 1000 compared with 1.2 per 1000). This decrease in surgical intervention corroborates the results of previous studies. Universal diagnostic ultrasound at birth has not been generally advocated. Such an approach could lead to a prohibitively expensive screening programme and to high rates of splintage, without a significant decrease in surgery. There would possibly be problems in encouraging more than 85% to 90% of the targeted population to attend, even with support of the law. Screening all at-risk factors cannot be advocated since the overall incidence of irreducible dislocation in our series is not significantly decreased compared with that of the best clinical screening programmes.

There are significant numbers of type-III dysplasia and instability in the probable clinical instability and at-risk groups (4.7 per 1000 live births, 6.4% of those screened). Since instability and type-III dysplasia have the potential to progress to irreducible dislocation or persistent dysplasia, it may be reasonable to screen these groups selectively.

The incidence of significant dysplasia in the adult is unknown. The largest study available showed that 7.6% of all hip replacements were undertaken for dysplasia and 1% for dislocation. Weinstein has suggested that the percentage of adults requiring a hip replacement secondary to dysplasia is of the order of 1%. If hip instability and type-III dysplasia can be treated successfully by abduction splintage, elective ultrasound imaging of groups with risk factors of clinical hip instability, family history, breech and foot deformity is reasonable. Unfortunately, there is no definitive research to confirm that abduction splints or harnesses work, although there is limited evidence to suggest that splintage may be useful.

We therefore advocate limited ultrasound screening for hips presenting with risk factors of clinical instability, family history, breech presentation and possibly postural foot deformities.

### Supplementary Material

A further opinion by Mr John Fixsen is available with the electronic version of this article on our website at www.jbjs.org.uk

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

### References


