EARLY DIAGNOSIS OF CONGENITAL DISLOCATION OF THE HIP

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In this prospective study, 3550 neonates were examined shortly after birth by a team of orthopaedic surgeons. They diagnosed 775 unstable or dislocated hips in 656 babies; there were two teratological dislocations. Treatment was first with a Frejka pillow and, if this failed to give a normal hip, a Pavlik harness at three months.

Early clinical examination did not identify 21 infants who were found to have subluxation or dislocation of the hip at the three-month review. The number of missed cases declined during the study, however, reflecting the increasing experience of the examiners. One case of avascular necrosis occurred in the group treated from birth and one in the late-diagnosed group. Open reduction was necessary only in the two teratological dislocations.

Experienced examiners are needed for accurate clinical diagnosis; and treatment should be started before the baby is discharged from the maternity ward.

The diagnosis and treatment of congenital dislocation of the hip (CDH) have always intrigued physicians. Physical examination is still the mainstay of diagnosis despite the routine use of radiography and the recent introduction of ultrasonography. The early work of Roser (1879), Le Damany (1912), Ortolani (1948), Janěk (1951), Coleman (1956), Palmen (1961) and Barlow (1962) suggested that diligent clinical examination of all new-born babies would result in the virtual elimination of CDH, but subsequent studies have cast serious doubt on the efficiency of these screening programmes (Cyvin 1977; Place, Parkin and Finton 1978; Frankenburg 1981; Catford, Bennet and Wilkinson 1982; Davies and Walker 1984; Leck 1986; Morriisy and Cowie 1987; Moore 1989).

To resolve this dilemma, it is necessary to follow prospectively a cohort of new-born babies in a relatively closed community. Although several such studies have been organised, in most the babies were not routinely re-examined by a specialist, but instead by a general practitioner, a paediatrician or a midwife. The studies also differed in that the primary examiner was in some an orthopaedic surgeon, in some a paediatrician and in others a specially trained physiotherapist.

In our five-year prospective study, we examined all new-born babies in Brno, a city with a population of about half a million people.

PATIENTS AND METHODS

During the period from 1984 to 1989 a team of five paediatric orthopaedic surgeons examined 3550 new-born babies in the first week after birth (Fig. 1). All the infants had been born in hospitals in Brno.

The techniques of examination were those described by Ortolani (1948), Palmen (1961) and Barlow (1962) and each baby was examined by all three methods. Each hip was designated as normal (stable), lax, subluxatable, dislocatable (reducible) or dislocated (irreducible). A lax hip was one in which the provocation manoeuvre caused a negligible slip of the femoral head (1 to 2 mm). Clicks were not recorded as they are known to have no clinical significance.

The infants with stable or lax hips at the first examination were re-examined at six weeks and again at three months, at which time radiographs were taken. These re-examinations were performed at three out-patient orthopaedic centres in Brno by the same group of...
orthopaedic surgeons and any cases of dislocation or subluxation diagnosed at this late stage were referred for treatment to the Children's Hospital. When the radiographic diagnosis of acetabular dysplasia was made, the child was treated and followed up at the same out-patient centre. All radiographs were reviewed by two of the authors (JP and MS).

All clinically unstable or dislocated hips at birth were immediately splinted with a Frejka pillow. They were checked weekly and once they were clinically stable, at two- to three-week intervals. This treatment was continued for three months after which the Pavlik harness was used. All children had anteroposterior radiographs at three months of age to assess the centring of the femoral head and the quality of the roof of the acetabulum.

The babies were classified into four groups depending on the outcome of treatment:

**Group 1.** Normal hips on clinical examination. The radiograph showed normally centred hips, an acetabular angle of 28° or less and a well-developed acetabular roof.

**Group 2.** Normal hips on clinical examination. Radiologically, they were abnormal with an acetabular angle greater than 28° or with a distinct lateral defect of the bony roof, giving the picture of acetabular dysplasia.

**Group 3.** Established subluxation.

**Group 4.** Established dislocation.

If the hip was not normal by three months of age (groups 2, 3 and 4), treatment was continued, in groups 2 and 3, almost exclusively with the Pavlik harness. For established dislocation (group 4), overhead traction, arthrography and plaster-cast immobilisation or open reduction were used.

Although ultrasonography has been in use in our hospital since 1985, the results of this examination were not allowed to alter the protocol of this prospective study, which was based throughout on clinical and radiographic examinations.

All treated babies were radiographed at one year of age for evidence of avascular necrosis of the femoral head using the criteria of Salter, Kostuik and Dallas (1969) and Kalamchi and MacEwen (1980).

**RESULTS**

Among the 35 550 babies examined in the first week of life there were 775 abnormal hips in 197 boys and 459 girls. The right hip was involved in 207 cases and the left in 568 (Fig. 2). The abnormality was bilateral in 119 babies. The time (days after birth) at which infants were
found to have unstable or dislocated hips is shown in Figure 3. There was no statistical difference between the birth weights of affected babies compared with matched control normal babies ($t$ statistic = -3.17).

The methods of delivery of the affected babies are shown in Figure 4. The distribution of the various presentations was compared with that of the matched control group using the chi-square test. There was a significant difference between the two groups ($p < 0.01$). Hip instability or dislocation was associated with breech presentation in 70 cases and with Caesarean section in 71, as against 11 and 52 respectively in the control group. Of the affected babies 51% were first born, 36.3% second and 12.7% third born or more. This distribution was not significantly different from that of the control group. There were no cases of monozygotic or dizygotic twins with CDH in our study. All the affected babies were Caucasians, although the Caucasian to Gypsy ratio in the population of Brno is about 20:1. Musculoskeletal abnormalities associated with CDH included congenital metatarsus varus (39 babies, 5.9%) and calcaneovalgus (13 babies, 1.9%). The occurrence of both of these deformities was higher than in the control group.

Most treated hips were normal by the age of three months (Fig. 5). The ages at which complete clinical and radiological normality were achieved in the treated group are given in Figure 6.

In the five-year study, there were two cases of teratological dislocation and one of bilateral hip instability thought to be due to cerebral palsy.

Almost all the treated babies had been radiographed at one year of age to determine the incidence of avascular necrosis of the femoral head. The radiographs were missing in 16 cases but treatment had been uncomplicated in all of them; the two children with teratological dislocations were excluded. There was one case of avascular necrosis in the 775 hips with typical dislocation instability.

In those babies with clinically normal hips, the three-month radiographs showed acetabular dysplasia in 327 (0.9%). Almost all of them have been treated at the out-patient centres and none has been referred to our hospital either for failed treatment or avascular necrosis.

In 21 children (0.6 per 1000) the diagnosis of dislocation or subluxation was not made until the age of three months. They were treated with the Pavlik harness, one of them requiring overhead traction and plaster-cast
imobilisation. One developed avascular necrosis. The prevalence of late-diagnosed cases diminished throughout the period of the study, probably reflecting the increasing clinical experience of the examiners.

DISCUSSION

Sensitivity and specificity of early clinical examination. There has been much controversy about who should undertake screening programmes for CDH. Screening has occasionally been performed by specially trained physiotherapists or nurses (Bernard et al 1987; Bower et al 1989) and it is believed that an orthopaedic surgeon is usually a more capable examiner than a paediatrician (Macnicol 1990). Marco Ortolani, a son of Marino Ortolani, who devoted his life to the popularisation of his technique of examination but never published a statistical analysis of his results, stated that “We still trust our fingers because during 50 years of screening in more than 8000 hips up to date, we have never missed cases” (Ortolani and Gerardi 1988). Generally, the most reliable results have been obtained when screening has been performed by skilled examiners (Somerville 1987).

The published studies have varied greatly in the number of babies examined; primary screening programmes reported by orthopaedic surgeons have usually been less extensive than those by paediatricians. Studies of less than 15 000 babies are probably too small to detect the incidence of teratological or irreducible dislocation, and conclusions derived from the experience of smaller series may be over-optimistic (Tredwell and Davis 1989). Our two teratological dislocations were found during the last year of our five-year study.

The sensitivity of our clinical examinations can be expressed in the following ways. If only late-diagnosed subluxations and dislocations are classified as false-negative cases, the sensitivity of the clinical examination is 96.9%. If the acetabular dysplasias are also counted as false-negative cases the sensitivity is only 65.3%.

The specificity is very difficult to determine. The incidence of neonatal instability was 18.4 per 1000 in our study compared with 10 to 30 per 1000 for subluxations and dislocations in the same population before early diagnosis had been introduced. These figures are based on routine radiographs, performed during the last three decades in Czechoslovakia. It seems therefore that there were probably very few false-positive diagnoses in our treated group.
Acetabular dysplasia is a doubtful clinical entity. Recently, Burger et al (1990) claimed to have found a rate of acetabular dysplasia of 30 per 1000 in babies with a negative Barlow’s test but many of these cases are probably due to over-diagnosis of the radiographs (Vizkelety 1988). The present view is that acetabular dysplasia alone seldom necessitates treatment (Catterall 1984; Seringe 1988).

**Indications for treatment.** The indications for treatment have also varied between authors. Some treated only the dislocations and merely observed the unstable hips (Barlow 1962, 1968; Smaill 1968; Lauritzen 1971; Gardiner and Dunn 1990). Others postponed treatment until two to three weeks of age (MacKenzie 1972; Bjerkreim 1974; Clarke, personal communication 1991). At our centre treatment was instituted for all unstable or dislocated hips at the time of diagnosis. We think that early treatment prevents the secondary changes which can occur not only in the dislocated but also in the unstable hip. Selective treatment may be a reasonable alternative if clinical re-examination also includes an ultrasound examination.

**The abduction devices.** The most popular devices for early treatment are the von Rosen splint, the Frejka pillow, the Pavlik harness and their common modifications. Scandinavian authors (Heikkillä and Ryöppy 1984; Hansson 1988) have reported less good results with the Frejka pillow than with the von Rosen splint. Disappointing results with the Frejka pillow were also described by Ilfeld and Makin (1977) and Gregosiewicz and Wośko (1988). In the latter study, however, a modified Frejka pillow was used and treatment was often long delayed. We used the Frejka pillow for the first four or five weeks and then changed to a Pavlik harness if the initial treatment had failed. The Pavlik harness proved very effective in all reducible subluxations or dislocations that were resistant to the primary treatment. For the irreducible dislocation, the treatment of choice is head traction, arthrography and open reduction.

**Incidence of avascular necrosis.** The incidence of avascular necrosis of the femoral head in most series is less than 1% of babies treated early (von Rosen 1962; Mitchell 1972; Williamson 1972; Tredwell and Davis 1989). Higher rates were reported by Felländer, Gladnikoff and Jacobsson (1970) using the von Rosen splint (12%) and by Gregersen (1969) who used plaster casts (3.4%). Lauritzen (1971) reported 1.8%, Smith (1984) 3%, and Burger et al (1990) 3%. Even if the hip is easily reducible, rigid immobilisation may cause avascular necrosis and a soft abduction device like the Frejka pillow should be used. Tredwell and Davis (1989) came to the same conclusion.

**Failure of early treatment.** Despite accurate diagnosis shortly after birth, early treatment can still fail (Wilkinson 1972; Almby, Hjelmstedt and Lönnerholm 1979), usually because of a primary impediment to reduction. In larger series an incidence of open reduction of about one case per 5000 neonates has been reported (MacKenzie 1972; Mitchell 1972; Williamson 1972; Almby et al 1979) although in Fredensborg’s study (1976) no case required open reduction. We found that conservative treatment with simple splinting in abduction could be used safely for irreducible dislocations soon after birth. If the hip is, however, completely dislocated, high-riding and with limited abduction (that is a teratological dislocation), it may be better to postpone treatment than to hold the femoral heads in an abnormal position by the abduction device.

**Conclusion.** Clinical examination by a skilled examiner is a valuable method of diagnosing CDH in new-born children. In many centres in Europe ultrasound screening of babies has become routine and we have also introduced the method at our hospital. We have become aware of the danger of over-diagnosis with this new technique, and believe that clinical examination should still be the first step.

Early treatment should consist of gentle abduction with a soft device, and we obtained good results with the Frejka pillow and the Pavlik harness.

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**REFERENCES**


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