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Congenital Dislocation of the Hip Joint in Norway

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CONGENITAL DISLOCATION OF THE HIP JOINT IN NORWAY

I. Late-diagnosis CDH

by

Ingjald Bjerkreim

The prospects for an early diagnosis and treatment of congenital dislocation of the hip joint (CDH) aroused an increasing optimism during the last decade. Andrén (1961 b) stated that there is hardly any excuse for not recognizing a congenital dislocation of the hip and not offering an effective treatment from birth. Schottstaedt (1965), referring to the Swedish works of Palmén (1961) and von Rosen (1962), concluded that 'from Scandinavian reports fixation in abduction is apparently all that is necessary; in Scandinavia, since all children with a questionable hip problem during the first few weeks of life have been so treated, congenital dislocation in older children has disappeared.'

In newborns the diagnostic procedure is assumed to be very simple, requiring no special skill. Also the interpretation of the Ortolani test has by some been supposed to be simple (Brit.med. J. 1967). In Norway, however, a late diagnosis of CDH appears to occur frequently. The disease is still a problem in orthopaedic surgery. In Rogaland, a county in southwest Norway with a yearly birthrate of about 5,000, Bjerkreim (1967) found the incidence of late-diagnosis CDH to be 3.5 per 1,000 live births during the period 1961 to 1965. Most of the newborns had been given a routine hip examination by the Ortolani procedure. Mean age at diagnosis was 13 months.

The purpose of the present paper is to estimate the number of cases of late-diagnosis CDH in a larger part of Norway and to compare the clinical and epidemiological characteristics of these cases with series investigated before hip examination of newborns was common.

TERMINOLOGY

The term congenital dislocation of the hip joint covers, in this investigation, luxation, subluxation, and dysplasia without displacement. These conditions are regarded as different degrees of severity of the disorder (Hilgenreiner 1925). The subdivisions have become generally adopted (Wiberg 1939, Hart 1949, Hass 1951). The classification generally provided distinguishable groups of the hip disorder, but transitional conditions are found ranging from a slight dysplasia of the acetabulum to a high luxation, and the two hips of one patient may show different degrees of involvement (Figure 1 a-d).

1. Luxation. The femoral head has completely lost contact with the acetabulum. There usually is a serious maldevelopment of all the components of the hip joint.

2. Subluxation. The femoral head is out of position but has retained some contact with the acetabulum. Also in this condition the development of all parts of the joint is defective, but usually the structures are better retained than in luxation.

3. Dysplasia without displacement of the femoral head. There is a delayed or defective development of the various components of the joint, which in radiographs is characterized by a sloping acetabular roof, with an indistinctly marked lateral margin, and a small epiphysis of the femoral head as the most important findings. The changes are considerably less than in luxation and subluxation. In the present study dysplasia refers to this group.

Late-diagnosis CDH denotes detection after 1 month of age. In earlier literature the term early diagnosis usually denoted detection during the first year of life. In this study the term neonatal or early-diagnosis CDH is used when the condition was diagnosed in the first month of life.

MATERIAL AND METHODS

Eight hundred and fifteen patients with late-diagnosis CDH treated at Sophies Minde Orthopaedic Hospital (SMOH) during the eleven-year period from 1960 to 1970 were evaluated. In addition, eight patients born in 1969 or earlier and admitted during the first half of 1971 (until the research was concluded)

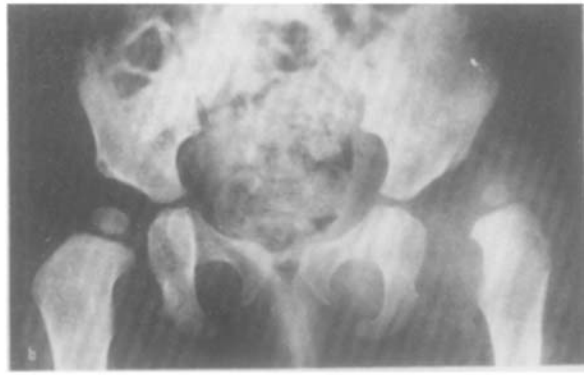

Figure 1. Different degrees of hip malformation.
a. High luxation of both hips.
b. Luxation of left and dysplasia of right hip.
c. Subluxation of right hip.
d. Dysplasia of right hip.

were included in order to complete the investigation of the incidence up to 1969. Of the total number, 24 cases were excluded because, judged by re-examination of X-rays, the diagnosis was equivocal, leaving 799 for further investigation.

Patients with CDH as part of a general developmental failure such as arthrogryphosis, meningomyelocele, cerebral palsy, and severe malformations were not studied.

The investigation is based on hospital records and X-rays. Information on birth presentation was supplemented by questionnaires or interviews. Information from the mother regarding foetal presentation was taken to be reliable, since the mothers know very well that cephalic presentation is usual and leads to safer delivery. The borderline between the dysplastic and the normal hip may be difficult to pinpoint in X-rays of young infants. The angle of the acetabulum varies with age, and there is a wide range in the normal distribution (Caffey et al. 1956, Harris et al. 1960, Tönnis & Brunken 1968). Additionally, it depends on the inclination of the pelvis and on a symmetrical adjustment (Kleinberg & Lieberman 1936, Palmén 1961, Stanisavljevic 1962, Matles 1965).

The age of the child at the first admission to hospital is taken as the age at diagnosis because these patients are admitted within a week or two after hip disorder is suspected.

An estimation of the total number of late-diagnosis CDH cases treated in the whole country in the years 1967 and 1968 was made by questionnaires to all hospitals treating such patients.

The collected data were processed in a CD 3300 computer at the University of Oslo. Differences were tested by the chi-square method. Differences between means were tested by Fisher's test for equality of variances. P denotes the probability of obtaining, by pure chance, differences as large as, or even larger than, the observed differences. P-values below 0.05 were regarded as significant.

RESULTS

(1) Annual survey

The number of new, late-detected patients treated annually in SMOH increased

from 53 in 1960 to 104 in 1965 (Table 1). In more recent years the frequency has been somewhat reduced. On an average, 73 new cases were treated yearly. There was a distinct drop in the number of patients with luxated hips in 1969 and 1970.

Table 1. Patients with late-diagnosis CDH treated at SMOH. Number by year of first admission and degree of hip deformity.

Degree of hip deformity	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971[1]	Total No.	Per cent
Luxation	46	51	40	42	33	41	37	38	41	26	23	2	420	52.6
Subluxation	4	8	13	8	17	33	17	17	24	27	21	4	193	24.2
Dysplasia	3	5	12	19	24	30	12	18	23	20	18	2	186	23.3
Total	53	64	65	69	74	104	66	73	88	73	62	8	799	100.0

[1] Incomplete.

In the entire country 130 and 136 new cases were treated in the years 1967 and 1968, respectively.

In Table 2 the patients are listed according to year of birth. The table shows a distinct increase of late-detected cases up to a peak of 92 patients in 1964. This increase in total number is due to inclusion of more patients with lesser degrees of malformation, i.e. subluxation and dysplasia. The number of patients with luxation varies little in the years from 1959 to 1966. Later there has been a distinct decrease.

(2) Age distribution

The number of patients with late-detected hip disorder who started to receive treatment before the age of four months or between four and six months increased in the beginning of the 1960s and has been fairly constant since 1964 (Table 3). The number of cases in the older age groups is also fairly constant throughout the whole period, although there has been a slight decrease during the last years.

Table 2. Late-diagnosis CDH treated at SMOH.
Number of patients by year of birth and degree of hip deformity.

Degree of hip deformity	1957[1]	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969[2]	1970[2]	Total
Luxation	24	29	35	39	43	25	41	37	39	40	27	25	13	3	420
Subluxation	5	6	4	12	5	9	13	25	22	19	21	21	20	11	193
Dysplasia	0	0	2	7	7	16	18	30	21	15	20	23	15	12	186
Total	29	35	41	58	55	50	72	92	82	74	68	69	48	26	799

[1] 1957 and earlier.

[2] Incomplete.

Table 3. Age distribution of patients with late-diagnosis CDH.
Number in different age groups by year of birth.
Figures inside zig-zag lines are comparable.

Age at start of treatment	1957[1]	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Total
1- 3 months	0	0	2	2	5	2	9	17	15	9	8	15	15	11	110
4- 5 months	0	0	1	1	3	7	11	20	21	20	15	18	16	8	141
6-11 months	0	2	6	13	13	13	15	22	12	18	23	19	10	7	173
1 year	12	22	20	31	26	22	31	27	26	21	18	15	7	0	278
2 years	4	7	6	8	5	4	4	4	6	6	4	2	0	0	60
3 years	2	2	3	1	3	2	0	1	1	0	0	0	0	0	15
4-6 years	8	1	3	0	0	0	1	1	1	0	0	0	0	0	15
7-9 years	3	1	0	2	0	0	1	0	0	0	0	0	0	0	7
Total	29	35	41	58	55	50	72	92	82	74	68	69	48	26	799
Mean age in months				20.0	15.4	14.6	13.9	10.7	11.5	10.7	9.8	8.2	6.3		

[1] 1957 and earlier.

The mean age at beginning of treatment was reduced from 20.0 months in 1960 to 8.2 months in 1968 (Table 3). The large decrease from 1963 to 1964 can be explained by the increase in the number of patients below six months of age.

The degree of hip deformity varies greatly according to the age at which treatment was started (Figure 2). In the age group below four months about 19 per cent had luxation, whereas this figure for the three-year-olds was about 86 per cent.

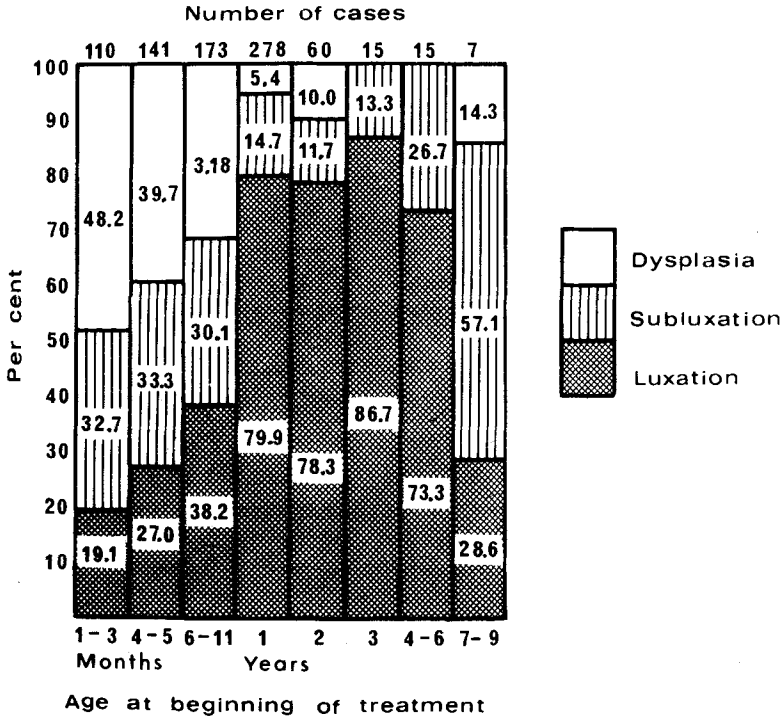

Figure 2. Degree of hip deformity by age at beginning of treatment.

(3) Sex ratio

The material consists of 689 girls (86.2 per cent) and 110 boys (13.8 per cent). The sex ratio differs significantly among the three X-ray groups (Table 4). Girls had luxation more frequently than the boys, 54.4 and 40.9 per cent, respectively, and there were relatively more boys in the subluxation and dysplasia groups.

Table 4. Sex by degree of hip deformity in CDH patients

Degree of hip deformity	Girls		Boys		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Luxation	375	54.4	45	40.9	420	52.6
Subluxation	159	23.1	34	30.9	193	24.2
Dysplasia	155	22.5	31	28.2	186	23.3
Total	689	100.0	110	100.0	799	100.1
	Percentage distribution by sex					
Luxation	89.3		10.7		100.0	
Subluxation	82.4		17.6		100.0	
Dysplasia	83.3		16.7		100.0	
Total	86.2		13.8		100.0	

$X^2 = 7.02$, with 2 d.f.; P = 0.03.

Mean age at start of treatment for girls was significantly lower than for boys (Table 5). However, when treatment started before two years of age the difference was only 0.2 months.

Table 5. Sex by age at start of treatment in patients with CDH

Age of start of treatment	Girls No.	Boys No.	Per cent girls
1-3 months	101	9	91.8
4-5 months	121	20	85.8
6-11 months	149	24	86.1
1 year	240	38	86.3
2 years	49	11	81.7
3 years	12	3	80.0
4-6 years	12	3	80.0
7-9 years	5	2	71.4
Total	689	110	86.2
Mean age in months	13.5	16.3	(P=0.047)
Mean age for cases starting treatment before 2 years of age	10.2	10.4	

(4) Side affected

In 48.2 per cent both hips were affected, in 29.8 per cent the left hip only, and in 22.0 per cent the right hip only (Table 6). The differences among sexes shown in the table as a whole are not greater than could be accounted for by chance alone. However, girls had the left hip affected significantly more often than the right hip ($P < 0.001$), whereas among boys no difference in affected side was found. Bilateral affection occurred somewhat more often in girls than in boys, but this difference is not significant.

Table 6. Affected side by sex in patients with CDH

Affected side	Girls		Boys		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Right only	144	20.9	32	29.1	176	22.0
Left only	208	30.2	30	27.3	238	29.8
Both	337	48.9	48	43.6	385	48.2
Total	689	100.0	110	100.0	799	100.0

$X^2 = 3.71$, with 2 d.f.; $P = 0.16$.

Patients with luxation had bilateral involvement in 56.0 per cent of the cases (Table 7). In the subluxation and the dysplasia groups bilateral af-

Table 7. Degree of hip deformity by affected side in patients with CDH

Affected side	Luxation		Subluxation		Dysplasia		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Right only	76	18.1	50	25.9	50	26.9	176	22.0
Left only	109	26.0	51	26.4	78	41.9	238	29.8
Both	325	56.0	92	47.7	58	31.2	385	48.2
Total	420	100.1	193	100.0	186	100.0	799	100.0

$X^2 = 34.71$, with 4 d.f.; $P = 0.0000$.

fection were observed in 47.7 and 31.2 per cent, respectively. Left side had luxation somewhat more often than the right, but the difference is not significant. Patients with both hips affected started to receive treatment at a later age than those with unilateral affection (Table 8).

Table 8. Affected side by age at start of treatment in patients with CDH

Age at start of treatment	Right side		Left side		Both sides		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
1- 3 months	23	13.1	33	13.9	54	14.0	110	13.8
4- 5 months	37	21.1	46	19.3	58	15.1	141	17.6
6-11 months	44	25.0	72	30.3	57	14.8	173	21.7
1 year	56	31.8	69	29.0	153	39.7	278	34.8
2 years	9	5.1	9	3.8	42	10.9	60	7.5
3 years	1	0.6	4	1.7	10	2.6	15	1.9
4-6 years	4	2.3	4	1.7	7	1.8	15	1.9
7-9 years	2	1.1	1	0.4	4	1.0	7	0.9
Total	176	100.0	238	100.1	385	99.9	799	100.0
Mean age in months	12.8		11.9		15.6		13.9 (P=0.002)	

(5) Birth presentation

Information on presentation at birth is missing in only 19 out of 799 cases. A cephalic presentation occurred in 89.0 per cent of the children, 8.3 per cent had breech presentation, and 2.7 per cent were delivered by Caesarean section. No sex difference was observed.

First-born patients were more often delivered by the breech (Table 9). The difference of birth rank 1 versus ranks 2 and over is significant ($0.02 < P < 0.05$). No significant variation was found in the degree of hip deformity according to birth presentation ($X^2 = 2.79$, with 4 d.f.; $P = 0.59$). Cases with right-sided affection were more often delivered by breech or by Caesarean section than those with left-sided or bilateral affection (Table 10). However, the difference in the proportion of breech presentation between patients with right- and left-sided hip disorder is not significant ($X^2 = 2.66$; $P > 0.05$). Breech-presentation infants were not more frequently bilaterally affected than the others.

Table 9. Frequency of breech delivery by sex and birth rank in CDH patients

Birth rank	Sex	All cases No.	Breech delivery No.	Breech delivery Per cent
1	Female	268	28	10.5
	Male	36	5	13.9
2 and over	Female	401	27	6.7
	Male	72	4	5.6
Sum	Female	669	55	8.2
	Male	108	9	8.3
Insufficient information	Female	20	1	
	Male	2		
Total	Female	689	56	
	Male	110	9	

Table 10. Birth presentation by affected side in CDH patients

Birth presentation	Right side No.	Right side Per cent	Left side No.	Left side Per cent	Both sides No.	Both sides Per cent	Total No.	Total Per cent
Cephalic	142	82.6	211	91.3	341	90.5	694	89.0
Breech	20	11.6	15	6.5	30	8.0	65	8.3
Caesarean section	10	5.8	5	2.2	6	1.6	21	2.7
Sum	172	100.0	231	100.0	377	100.1	780	100.0
Unknown	4		7		8		19	
Total	176		238		385		799	

$X^2 = 12.44$, with 4 d.f., $P = 0.014$.

DISCUSSION

The present investigation shows that in SMOH on an average about 70 new, late-detected patients with CDH were treated annually during the eleven-year period 1960 to 1970. In the entire country about 130 new cases were treated

yearly in 1967 and 1968. This number corresponds to an annual incidence of late-diagnosis CDH of about two per thousand live births in Norway. The Ortolani test came into use in Norway in 1953 (Walther & Moe 1954), and the incidence of cases diagnosed neonatally has been extremely high, more than six per thousand in most regions (Bjerkreim 1974 d). In spite of this, a fairly constant and large number of CDH cases was diagnosed after the neonatal period.

This problem is not restricted to Norway: Owen (1968), Jansen & Reimann (1970), and Lloyd-Roberts (1971), among others, have drawn attention to this phenomenon. Recent figures published from Ireland and Scotland by Williamson (1972) and MacKenzie (1972), respectively, correspond fairly well to ours. Thus, detection of CDH at birth is not possible in all cases. The observed reduction of luxations in SMOH since 1967 (Table 2) may be due to several factors: the opening of two new departments of orthopaedics (Tromsø in 1967, Kristiansand in 1968) reduced the number of patients admitted to SMOH by an average of seven cases yearly; the 1969 group was not complete when the investigation was concluded in the middle of 1971; and a reduced mean age at diagnosis may also in part explain the reduction of patients with luxation.

In late-diagnosis CDH a considerable reduction in mean age at start of treatment was found - a decrease from twenty to about eight months during the years 1960 to 1968. The most obvious reason for this is a more thorough investigation of the hip joints at the infant welfare clinics (Bjerkreim 1974 b).

A distinct increase in the degree of hip joint deformity correlated with the age at which treatment was started (Figure 2). To some extent the variation is due to different reasons for diagnosis in children under one year and children aged one to four years (Bjerkreim 1974 b), most of the latter cases being detected owing to limping caused by luxated hips. However, infants below one year also show a distinct variation in hip deformities according to age ($P < 0.01$). The figures thus show clearly that the severity of hip malformation increases with the age at start of treatment, except for the oldest groups. In these the percentage of cases of subluxation or dysplasia without displacement is naturally somewhat increased, since the luxated hips are diagnosed at an earlier age because of the associated limping that brought the patients to examination.

The association between age at start of treatment and degree of hip deformity does not necessarily support the formerly accepted theory that a dysplasia of the hip joint is the primary cause, and luxation its sequela (Lorenz 1920, Hilgenreiner 1935, Hart 1949, Hass 1951). The observation may equally well be in accordance with the most prevailing opinion of today, that abnormal joint laxity and dislocation are the primary state, and that other pathological changes, such as slanting of the acetabular roof, are secondary (Howorth 1947, Massie 1956, Andrén & von Rosen 1958, Sommerville 1962, Salter 1966). However, the association between age and degree of hip joint deformity seems to indicate that when the relationship between the head of the femur and the acetabulum is abnormal, whatever the cause, displacement in many cases increases gradually. This is in agreement with most reports, e.g. Putti (1933), Hart (1952), Sommerville (1953), Coleman (1956, 1965), Palmén (1961), and Stracker (1961). Medalie et al. (1966), however, concluded that age at diagnosis did not appear to be associated with the type of hip anomaly; and, in contrast, Barlow (1962) and Rabin et al. (1965) suggested that dysplasia is a stage in the spontaneous recovery of a previous dislocation.

The great predominance of female patients with CDH in the present material is in close agreement with previous investigations (Isigkeit 1928, Poli 1937, Severin 1941, Alvik 1960). Girls also, significantly more often than boys, had the most serious degree of hip deformity. Scaglietti (1932) and Medalie et al. (1966) found a similar, but not so distinct, difference. The observation that in the milder degrees of malformation there are relatively more boys is also in accordance with Faber (1937), who found the female to male ratio to be 1.74 : 1 when dysplasia without dislocation was included.

The reason for the lower mean age for girls is probably that the milder degrees of hip deformity, more frequently occurring in boys, are less likely to be detected in the first years of life. Girls were somewhat more often bilaterally affected than boys. Scaglietti (1932), Poli (1937), Muller & Seddon (1953), and Medalie et al. (1966) reported a similar difference in incidence of bilateral dislocations among sexes, but Record & Edwards (1958) found a somewhat higher incidence of bilateral affections among boys.

The left side was affected more often than the right in the present material. The reason for this is obscure; possibly the position of the foetus

in utero is of significance (Medalie et al. 1966). The distribution by side is fairly similar to that in most other publications, e.g. Lorenz (1920), Isigkeit (1928), and Platou (1953). The percentage of bilateral affections, however, varies greatly: Alvik (1960) found 67, whereas Medalie et al. (1966) reported 21.9. Bilateral affections were frequent also in the lesser degrees of hip deformity in the present material (Table 7). In contrast, Scaglietti (1932) found 10.6 and Poli (1937) only 2.6 per cent bilateral subluxations, whereas Medalie et al. (1966) found 14.5 per cent in the subluxation and dysplasia group. The difference in the frequency of bilateral affections may dysplasia group. The difference in the frequency of bilateral affections may depend on the evaluation of dysplasia without displacement, since in many cases of luxation or subluxation on one side there are various degrees of dysplasia in the other hip. The number of cases of subluxation and dysplasia will naturally increase with the degree of diagnostic accuracy, as will the number of bilateral affections. The generelly accepted reason for the higher mean age in patients with both hips affected is that these cases often have symmetrical findings and are thus more difficult to detect. Patients detected at the child welfare clinics had unilateral affection significantly more often than other patients (Bjerkreim 1974 b).

The population frequency of breech deliveries in Norway was 3.4 per cent in 1966 (Central Bureau of Statistics of Norway, 1968). Breech presentations in the present series were about two and a half times that in the general population ($P < 0.001$) but relatively low, 8.3 per cent, as compared with most other series, e.g. Isigkeit (1928), Carter & Wilkinson (1964), and Wynne-Davies (1970). No difference between sexes was observed, in contrast to the findings of most authors (Record & Edwards 1958, Andrén 1961 a, Robinson 1968, Woolf et al. 1968).

Breech presentation was in this material associated with birth rank 1. The same observation was made by Robinson (1968), who in the control group found no correlation between breech presentation and birth rank. However, estimated from data reported by Bjerkedal (1973), breech presentation is significantly more frequent among firstborn babies in the Norwegian population. The high percentage of breech deliveries among males of birth ranks 2 and over reported by Record & Edwards (1958) could not be confirmed.

The frequency of Caesarean section in the present series was about the same as in the general population. This was also found by Record & Edwards

(1958) and by Robinson (1968). Thus it seems that Caesarean section does not influence the incidence of CDH. Patients with affection of only the right hip had significantly more often had complicated deliveries, i.e. breech presentation or Caesaren section. No explanation for this has been found so far, and other studies have made different observations. Thus, Robinson (1968) found no difference in affected side as a result of complicated deliveries. Sinios (1963), by contrast, found that, in 90 neonatal cases, the left side was affected more often in breech-born than in cephalic-born babies.

Although, there are small differences, the present material of late-diagnosis CDH is similar to earlier published series of late cases regarding sex ratio, frequency of breech presentation, and distribution by affected side. The investigation confirms the figures from Rogaland (Bjerkreim 1967) and shows that late-diagnosis CDH still is frequent in Norway. Because the incidence of neonatal CDH also is high, this situation raises several questions, which will be evaluated in subsequent papers.

SUMMARY

Patients with late-diagnosis CDH treated at Sophies Minde Orthopaedic Hospital were evaluated. On an average about 70 new cases were treated annually in the years 1960 to 1970. The number did not decrease with the years. About half of the patients presented with luxation, one fourth with subluxation, and one fourth with dysplasia. The age at start of treatment decreased from 20 months in 1960 to about 8 months in 1968. Association was found between age and degree of hip deformity. Of the total material of 799 patients, 86.2 per cent were girls, 8.3 per cent had breech presentation, both hips were affected in about 50 per cent, the left only in 30 per cent, and the right only in 20 per cent. The distribution by sex, birth presentation, and side affected is similar to earlier published series. Girls had luxation significantly more often than boys, and girls had affection of the left hip significantly more often than of the right. Treatment started later in cases of bilateral hip disorder and later in boys than in girls. Breech presentation was associated with birth rank 1, like in the general population. It was concluded that late-diagnosis CDH is still frequent in Norway and that the problem of detecting CDH at birth has been greatly simplified.

ACKNOWLEDGEMENTS

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From Sophies Minde Ortopaedic Hospital, University of Oslo, Norway

CONGENITAL DISLOCATION OF THE HIP JOINT IN NORWAY

II. Detection of late cases

by

Ingjald Bjerkreim

Recently it was reported (Bjerkreim 1974 a) that about 70 new, late-detected cases of CDH were treated annually in Sophies Minde Orthopaedic Hospital (SMOH) in the period 1960 to 1970. The incidence of late cases was about two per thousand live births in five counties in southeast Norway (Bjerkreim 1974 d).

There may be several explanations for the high prevalence of late cases: primarily, the hips may not have been examined in the neonatal period. Secondly, the examination may have 'failed' because the malformation was not present at birth (postulated by Walker, 1971). Thirdly, the test itself may have failed as indicated by Williamson (1972). A fourth reason, which most authors seem to support, is inadequate technique, lack of experience, or reduced alertnes of the examiner (Owen 1968, Lloyd-Roberts 1971, James 1972).

The purpose of the present investigation is to evaluate the reasons why late-diagnosis CDH still occurs with a high frequency in Norway. A further purpose is to analyse clinical signs in late cases to decide if it is possible to reduce age at diagnosis in cases not detected or not detectable at birth.

MATERIAL AND METHODS

The material consists of 799 cases of late-diagnosis CDH. The terminology and statistical methods have been described previously (Bjerkreim 1974 a).

Hospital records were supplemented by questionnaires or interviews, to obtain information on where the child was born (hospital, maternity home, at home), whether the hips were examined at birth, whether the child was given a routine clinical examination, and how the hip disorder was discovered. Information has also been collected from obstetric units concerning when hip examination of newborns started to be done routinely. Patients born after this time and patients whose mother knew that the hips had been checked were regarded as examined.

The investigation of physical signs in late-diagnosis CDH includes only patients who started to receive treatment at SMOH, a total of 716. Information concerning the clinical signs on first admission to hospital was obtained from the records. Observations were registered on abduction of the hips, limb length, asymmetry of skin folds in thigh, groin, or nates region, instability of the hip joint, Trendelenburg sign, and the reduction sign.

The abduction test was carried out with the patient's hips and knees in about 90 degrees of flexion (Figure 1). Abduction of less than 55 degrees has

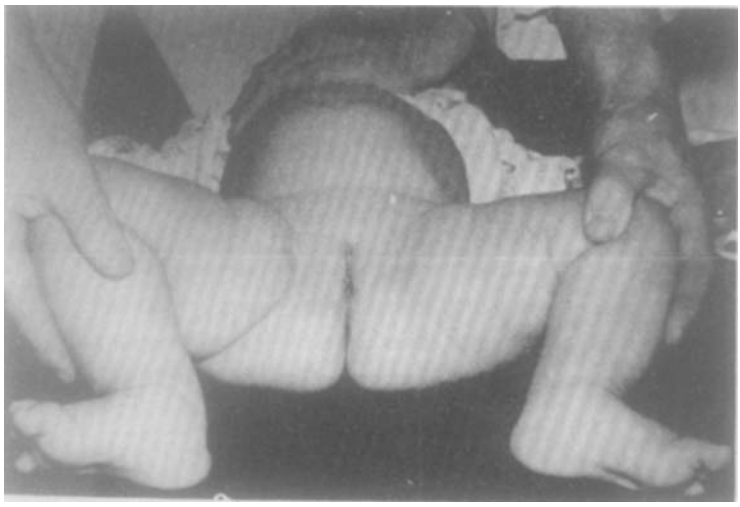

Figure 1. The abduction test is carried out with the infant's hips and knees in about 90 degrees of flexion.

been classified as pathological, around 60 degrees as doubtful, and more than 65 degrees as normal. All asymmetrical abduction, however, has been registered as pathological.

RESULTS

A. Routine examinations before diagnosis

(1) Hip examination at birth

In the present material, 613 (76.7 per cent) of the patients were examined at birth, according to the criteria mentioned (Table 1). There was no informa-

Table 1. Hip examination at birth by year of birth in CDH patients

Year of birth	Examined		Not examined		Unknown		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
1957[1]	3	10.3	24	82.8	2	6.9	29	100.0
1958	15	42.9	14	40.0	6	17.1	35	100.0
1959	20	48.8	9	22.0	12	29.3	41	100.1
1960	30	51.7	20	34.5	8	13.8	58	100.0
1961	38	69.1	10	18.2	7	12.7	55	100.0
1962	31	62.0	9	18.0	10	20.0	50	100.0
1963	56	77.8	8	11.0	8	11.1	72	100.0
1964	81	88.0	2	2.2	9	9.8	92	100.0
1965	68	82.9	5	6.1	9	11.0	82	100.0
1966	68	91.9	0		6	8.1	74	100.0
1967	63	92.6	2	2.9	3	4.4	68	99.9
1968	68	98.6	0		1	1.4	69	100.0
1969	46	95.8	0		2	4.2	48	100.0
1970	26	100.0	0		0		26	100.0
Total	613	76.7	103	12.9	83	10.4	799	100.0

[1] 1957 and earlier.

tion about 83 (10.4 per cent), and 103 (12.9 per cent) were not examined. The percentage of those examined increased from about 50 in 1960 to close to 100 in 1968. In 18 patients the hips were examined with particular care, often repeatedly, because a close relative suffered from CDH (Figure 2).

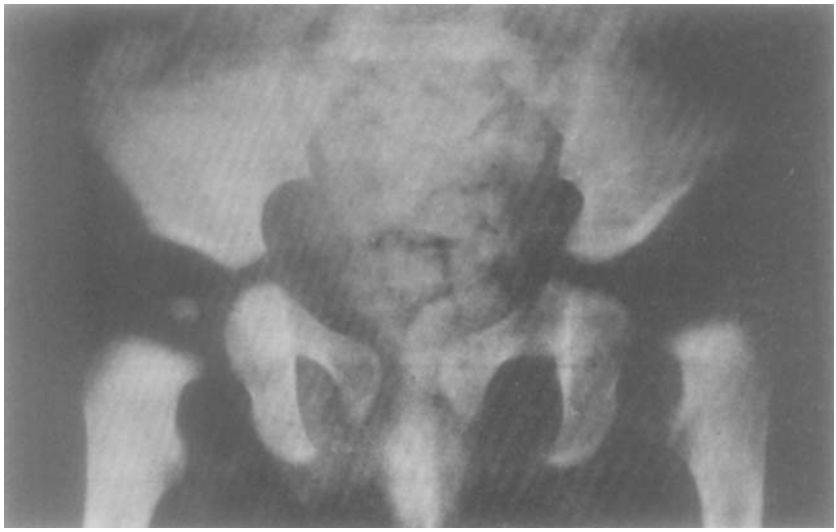

Figure 2. Girl, 4 months old, with luxation of left hip. She was examined particularly carefully at birth because an older sister suffered from congenital dislocation of the hip. The dislocation test was negative. On re-examination at 4 months, owing to the family history, a limitation in abduction was found on the left side.

Of the patients, 641 were born in hospitals, 122 in maternity homes, and 33 at home (Table 2). Of the patients born in hospitals, 87.7 per cent were examined at birth, compared with 41.0 per cent of those born in maternity homes. Only one of the home-born patients was examined at birth. In the four counties Akershus, Oppland, Hedmark, and Buskerud 16 per cent of patients with late-detected hip disorders and 8 per cent of those with neonatal disorders were born in maternity homes, as compared to about 13 per cent of the total number of children in these four counties.

Table 2. Hip examination at birth by place of birth in CDH patients

Hip examination	Hospital		Maternity home		At home		Unknown		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Examined	562	87.7	50	41.0	1	3.0	0		613	76.7
Not examined	30	4.7	41	33.6	32	97.0	0		103	12.9
Unknown	49	7.6	31	25.4	0		3	100.0	83	10.4
Total	641	100.0	122	100.0	33	100.0	3	100.0	799	100.0

(2) Routine infant examination

Of the total number of patients, 91.1 per cent had attended child health clinics or practitioners at regular intervals. The percentage increased from about 75 in the years before 1960 to 96 in the years 1965 to 1970.

B. Reason for diagnosis

The reasons for diagnosis have been divided into five groups (Tables 3 - 5).

Table 3. Reason for diagnosis by age at start of treatment in CDH patients

Age group	Limping or asymmetry observed by the family		Routine infant examination		Incidental examination		Familial occurrence		Uncertain dislocation test at birth		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
1- 3 months	4	0.9	79	29.7	9	18.4	12	27.9	6	42.9	110	13.8
4- 5 months	18	4.2	91	34.2	15	30.6	12	27.9	5	35.7	141	17.6
6-11 months	53	12.4	90	33.8	13	26.6	15	34.9	2	14.3	173	21.7
1 year	261	61.1	6	2.3	7	14.3	3	7.0	1	7.1	278	34.8
2 years	57	13.3	0		2	4.1	1	2.3	0		60	7.5
3 years	15	3.5	0		0		0		0		15	1.9
4-6 years	14	3.3	0		1	2.0	0		0		15	1.9
7-9 years	5	1.2	0		2	4.1	0		0		7	0.9
Total	427	99.9	266	100.0	49	100.0	48	100.0	14	100.0	799	100.1

Table 4. Reason for diagnosis by degree of hip deformity in CDH patients

Degree of hip deformity	Limping or asymmetry observed by the family		Routine infant examination		Incidental examination		Familial occurrence		Uncertain dislocation test at birth		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Luxation	319	74.7	70	26.3	16	32.7	11	25.6	4	28.6	420	52.6
Subluxation	67	15.7	83	31.2	23	46.9	17	39.5	3	21.4	193	24.2
Dysplasia	41	9.6	113	42.5	10	20.4	15	34.9	7	50.0	186	23.3
Total	427	100.0	266	100.0	49	100.0	43	100.0	14	100.0	799	100.0

$X^2 = 202.20$, with 8 d.f.; $P = 0.0000$.

Table 5. Reason for diagnosis by affected side in CDH patients

Affected side	Limping or asymmetry observed by the family		Routine infant examination		Incidental examination		Familial occurrence		Uncertain dislocation test at birth		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Right only	92	21.5	67	25.2	10	20.4	7	16.3	0		176	22.0
Left only	112	26.2	96	36.1	16	32.7	10	23.3	4	28.6	238	29.8
Both	223	52.2	103	38.7	23	46.9	26	60.5	10	71.4	385	48.2
Total	427	99.9	266	100.0	49	100.0	43	100.1	14	100.0	799	100.0

$X^2 = 20.48$, with 8 d.f.; $P = 0.009$.

(1) Limping or asymmetry observed by the family

This group consists of 427 patients (53.4 per cent of all). The percentage has, however, decreased considerably during the last decade, from 75.9 in 1960 to 36.2 in 1968 (Figure 3). Most of these cases were detected after the child had started to walk (Table 3). As many as 74.7 per cent presented with luxation (Table 4). In 52.2 per cent the affection was bilateral (Table 5). Of all patients detected by the family, 86.5 per cent had attended child welfare clinics at regular intervals.

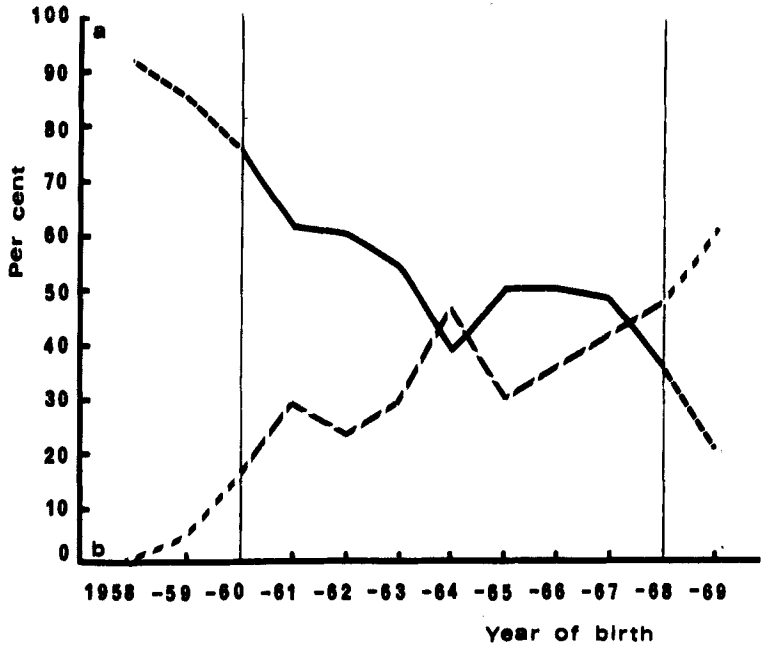

Figure 3. Reason for diagnosis by year of birth.
a = the percentage detected by the family;
b = the percentage detected at the child welfare clinics.

(2) Routine infant examination

This group consists og 266 patients (33.3 per cent). The proportion of patients diagnosed at the child welfare clinics increased from 15.5 per cent in 1960 to 47.8 per cent in 1968 (Figure 3). For 1969 and 1970 the proportion was still higher. For these years, however, more cases are likely to be detected by the family after the end of this investigation. In most of the cases found by routine infant examinations, treatment was started at below six months of age (Table 3) but in 96 cases, 36.1 per cent at six months or older.

Children in this diagnostic group most frequently had the less serious degrees of hip deformity (Table 4). Only 26.3 per cent presented with luxation. Cases detected at the welfare clinic had bilateral affection significantly less frequently than those in other diagnostic groups (Table 5).

(3) Incidental examination

A relatively high number, 49 (6.1 per cent), of the cases were discovered in connection with examination for other diseases. In 22 cases an orthopaedic surgeon was consulted because of deformities of feet, most frequently some sort of flat foot or talipes equinovarus (Figures 4 and 5).

Figure 4. Boy, 26 months old, with subluxated hip on right side. He was admitted to the outpatient department owing to a severe pes planovalgus. The dislocation test was negative at birth, and he had been examined repeatedly at the child welfare clinic. He had an extreme joint laxity but no restricted hip abduction.

Six children had other musculoskeletal anomalies. In another five patients X-ray examination of the urinary tract led to diagnosis (Figure 6). Sixteen patients were found to be affected while being examined for other disorders.

Most of the patients discovered incidentally started treatment before one year of age, but three were more than four years (Table 3). In this group 32.7 per cent presented with luxation (Table 4). Bilateral affections were observed in 46.9 per cent (Table 5).

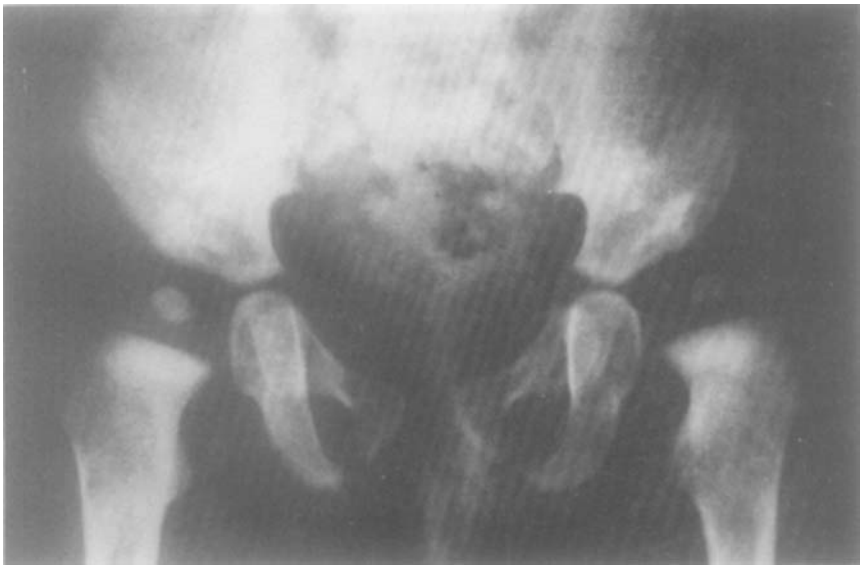

Figure 5. Girl, 4 months old. Subluxation of left hip and dysplasia without displacement of right hip. The dislocation test was negative in the maternity unit and at the orthopaedic clinic, where she was treated for a bilateral talipes equinovarus from the second day. The abduction test was positive at 4 months.

(4) Familial occurrence

A positive family history resulted in hip examination in 43 children, or 5.4 per cent (Figure 2). As in other cases discovered early, the percentage of luxations was low: 25.6 (Table 4). The proportion of bilateral affections was relatively high: 60.5 per cent (Table 5).

(5) Uncertain dislocation test at birth

This group includes fourteen cases. Because of an equivocal dislocation test (Ortolani test) at birth, these patients were checked clinically or by X-ray at the age of four to six months, irrespective of clinical signs. All but one were detected before one year of age (Table 3). Half of the patients

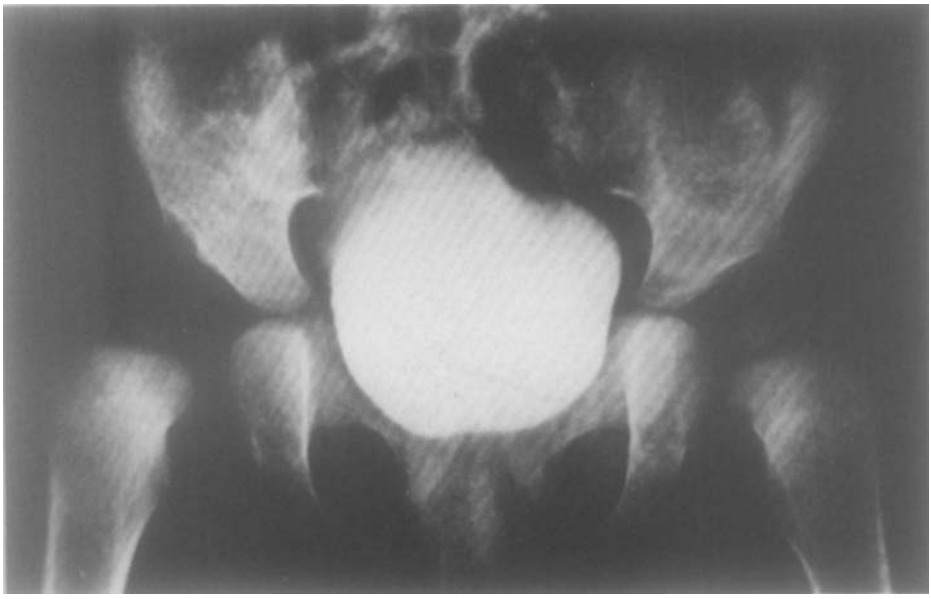

Figure 6. Girl, 22 months old. She presented with subluxation of different degrees in the two hips. The malformations were detected incidentally at urography. The dislocation test was negative at brith, and she had been checked regularly at infant control examination. On admission, the abduction test was positive.

presented with dysplasia without displacement (Table 4), and most of them had bilateral affections (Table 5).

C. Physical signs in late cases

Often only one or two clinical findings were registered in the records. Abduction of the hip joints was most frequently recorded. The result of the test was not given in 10.9 per cent of the patients. In 28.5 per cent, information regarding the limb length was missing. Information concerning skin folds was lacking in 50 per cent of the patients and information on other clinical signs in an even larger proportion.

(1) Restricted abduction

Abduction was found to be limited in 88.1 per cent of the recorded examinations (Table 6). Positive abduction tests were frequently found in all age

Table 6. Abduction test by age at start of treatment in CDH patients

Abduction test	1-3 months		4-5 months		6-11 months		1 year		2 years		3 years		4-6 years		7-9 years		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Positive	77	86.5	115	89.9	129	90.8	173	87.4	42	85.7	13	92.9	10	83.3	3	50.0	562	88.1
Uncertain positive	5	5.6	4	3.1	8	5.6	9	4.5	3	6.1	0		1	8.3	0		30	4.7
Negative	7	7.9	9	7.0	5	3.5	16	8.1	4	8.2	1	7.1	1	8.3	3	50.0	46	7.2
Sum	89		128		142		198		49		14		12		6		638	
Unknown	11		4		16		38		6		0		2		1		78	
Total	100		132		158		236		55		14		14		7		716	

$X^2 = 22.15$, with 14 d.f.; $P = 0.08$.

groups, and, except for the oldest group, the test was positive in about 85 per cent or more. Patients with luxation of the hip most often had limitation of abduction (Table 7). The test was positive in 92.5 per cent of pa-

Table 7. Abduction test by degree of hip deformity in patients with CDH

Abduction test	Luxation		Subluxation		Dysplasia		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Positive	296	96.7	128	77.1	138	83.1	562	88.1
Uncertain positive	4	1.3	15	9.0	11	6.6	30	4.7
Negative	6	2.0	23	13.9	17	10.2	46	7.2
Sum	306	100.0	166	100.0	166	99.9	638	100.0
Unknown	55		8		15		78	
Total	361		174		181		716	

$X^2 = 44.75$, with 4 d.f.; $P = 0.0000$.

tients in whom the disorder had been discovered at infant welfare clinics - the largest of all diagnostic groups (Table 8). In unilateral affections the abduction test was positive in about 90 per cent and in bilateral affections in about 86 per cent. The difference is not significant.

Table 8. Abduction test by reason for diagnosis in CDH patients

Abduction test	Limping or asymmetry observed by the family		Routine infant examination		Incidental examination		Familial occurrence		Uncertain dislocation test at birth		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Positive	287	89.1	210	92.5	32	78.0	26	72.2	7	58.3	562	88.1
Uncertain positive	14	4.3	8	3.5	4	9.8	3	8.3	1	8.3	30	4.7
Negative	21	6.5	9	4.0	5	12.2	7	19.4	4	33.3	46	7.2
Sum	322	99.9	227	100.0	41	100.0	36	99.9	12	99.9	638	100.0
Unknown	52		16		4		5		1		78	
Total	374		243		45		41		13		716	

$X^2 = 31.35$, with 8 d.f.; $P = 0.0001$.

In 46 patients no restricted abduction was observed. According to X-rays, six of these patients had luxation, twentythree subluxation, and seventeen dysplasia. Of the six patients with luxation, one presented with a reduction jerk; in two others the unrestricted abduction could be explained by abnormal joint laxity. Of the other cases, seventeen were discovered by the family because of unusual gait, limping, or asymmetry of the lower limbs. Nine were detected at infant welfare clinics, and six because of familial occurrence. Four were found incidentally (two by urography and two at treatment for talipes equinovarus) and four because of a doubtful dislocation test at birth.

(2) Shortening of the limb

Limb shortening was observed in 70.5 per cent of the patients with recordings on this sign; in 26.8 per cent no shortening was found (Table 9).

Table 9. Shortening of limb by degree of hip deformity in patients with CDH

Limb length	Luxation		Subluxation		Dysplasia		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Shortening	250	88.3	60	51.7	51	45.1	361	70.5
Uncertain shortening	2	0.7	8	6.9	4	3.5	14	2.7
No shortening	31	11.0	48	41.4	58	51.3	137	26.8
Sum	283	100.0	116	100.0	113	99.9	512	100.0
Unknown	79		57		68		204	
Total	362		173		181		716	

$X^2 = 101.94$, with 4 d.f.; $P = 0.0000$.

A positive sign occurred most frequently when the hips were luxated. However, as many as 51 cases of dysplasia without displacement have been registered as having limb shortening. There was significantly less frequent difference in limb length in patients with bilateral CDH ($P < 0.01$).

Table 10. Asymmetry of skin folds by degree of hip deformity in patients with CDH

Skin folds	Luxation		Subluxation		Dysplasia		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Asymmetry	138	83.1	67	68.4	69	72.6	274	76.3
No asymmetry	28	16.9	31	31.6	26	27.4	85	23.7
Sum	166	100.0	98	100.0	95	100.0	359	100.0
Unknown	196		75		86		357	
Total	362		173		181		716	

$X^2 = 8.41$, with 2 d.f.; $P = 0.015$.

(3) Asymmetry of skin folds

Asymmetry was found in 76.3 per cent of cases with information on this sign (Table 10). The sign was observed most frequently in patients with luxation, but patients with the lesser degrees of hip deformity also often

presented with asymmetrical skin creases. Patients with one hip affected had asymmetry significantly more frequently than those with both hips affected ($P < 0.001$).

(4) Instability of the hip joint

This test was positive in 44.7 per cent and negative in 48.8 per cent of the patients recorded (Table 11). Instability occurred most frequently in luxated hips.

Table 11. Instability of hip joint by degree of hip deformity in patients with CDH

Instability test	Luxation		Subluxation		Dysplasia		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Positive	111	70.3	11	15.9	8	12.5	130	44.7
Uncertain positive	4	2.5	5	7.2	10	15.6	19	6.5
Negative	43	27.2	53	76.8	46	71.9	142	48.8
Sum	158	100.0	69	99.9	64	100.0	291	100.0
Unknown	204		104		117		425	
Total	362		173		181		716	

$X^2 = 95.92$, with 4 d.f.; $P = 0.0000$.

(5) Trendelenburg sign

The result of this test was recorded in only 97 patients, one of whom was below one year of age. Luxation was present in 91.5 per cent of the patients with a positive test, and the rest had subluxation.

(6) Reduction sign

A positive reduction sign was observed in thirty-seven patients, thirteen of whom were 1 year and one, 2 years old. In most cases this sign was discovered on performance of the abduction test (Figure 7). Resistance to abduction or even no resistance at all was noticed when the reduction jerk was felt. The reduction sign was found on both sides in five patients. The X-rays revealed thirty-nine luxations, one subluxation, and two dysplasias.

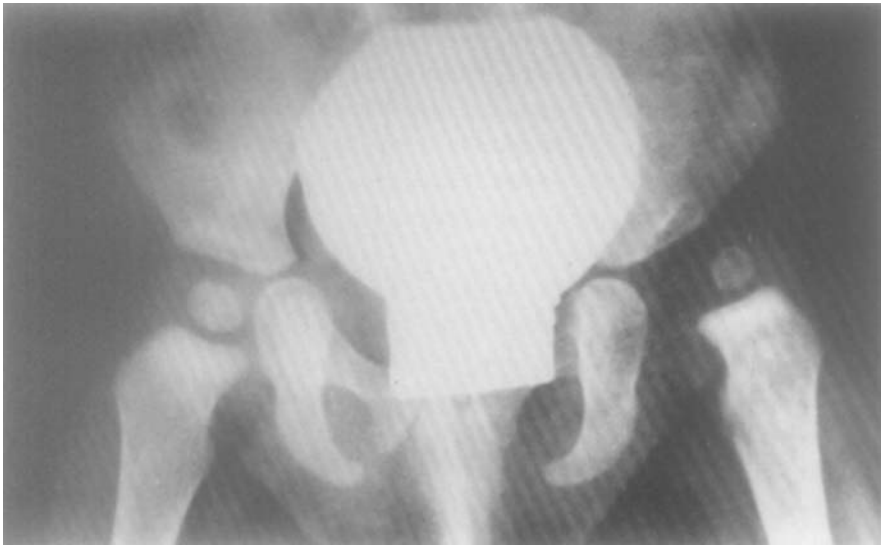

Figure 7. Girl, 8 months old. Luxation present in left hip. On abduction, a reduction jerk was found.

DISCUSSION

The present investigation shows that about 77 per cent of all late-diagnosis CDH patients had their hips examined at birth. This percentage rose from about 50 in 1960 to close to 100 per cent in 1968. Since January 1967 a new scheme of medical registration of birth has been used in Norway, in which congenital malformations, including a positive Ortolani test, are recorded. Thus, although information is missing in some of the cases, it is reasonable to assume that the hips of all children born in 1967 or later have been examined at birth. The present study indicates that examination of the hips of newborns in small maternity units has not been done as carefully as in hospitals. In Rogaland (Bjerkreim 1967) a considerable difference was found; the incidence of late-diagnosis CDH of children born in maternity homes was two and a half times greater than that of children born in hospitals.

The reduction in the frequency of late-diagnosis CDH has not been as successful in Norway as that reported from other countries (Palmén 1961. von Rosen 1962, Finlay et al. 1967). In 1959, about 66 per cent of all children in Sweden were born in obstetric units where hips were examined, and in 1963 the percentage was 99 (Palmén 1970). The present figures are not directly comparable to the Swedish, but they indicate that we have had a less well established examination of newborns than that organized by Palmén in Sweden, where late dislocations were reduced by about 80 per cent from the years before 1953 to 1966. However, the present material includes 184 patients born in hospitals in the city of Oslo. The hips of all but one had been examined at birth by experienced paediatricians. Thus, these babies were checked optimally, and still the incidence of late-diagnosis CDH was about 2 per 1,000 live births in Oslo (Bjerkreim 1974 d). The reason for the different incidences of late-detected cases in Sweden and Norway is therefore still obscure.

Most authors discussing neonatal CDH report 'missed' cases, varying from 0.1 to 0.7 per 1,000 live births (Medbø 1961, Njå 1962, Smaill 1968, James & Sevastikoglou 1970, Mitchell 1972). Williamson (1972), in Ireland, and MacKenzie (1972), in Scotland, reported a frequency of late cases at the level of the previously estimated incidence of CDH, 0.6 to 1.1 per 1,000 live births, even though the regions had a well-organized examination of newborns.

When radiograms are normal at birth in clinically suspected cases, these patients are sometime left untreated (Palmén 1970). This was the reason for delayed diagnosis in only two patients in the present study (Figure 8 a and b). Palmén also found excess of prematures among late cases and suggested that these are often insufficiently examined owing to their general condition. We have also found an excess of prematures in late-diagnosis CDH (Bjerkreim & van der Hagen 1974). However, prematurity accounted for only a small proportion (4.9 per cent) of the late cases. Sinios (1963) found that five of six patients with 'missed' hip disorder had club foot, and he was of the opinion that the changed biomechanical condition, owing to the plaster cast, might have led to the hip joint deformity. Also in the present material were concomitant anomalies frequent (Bjerkreim & van der Hagen 1974). However, the suggested mechanism can be the cause of the hip disorder in only a small proportion of the total number of late-dianosis CDH patients.

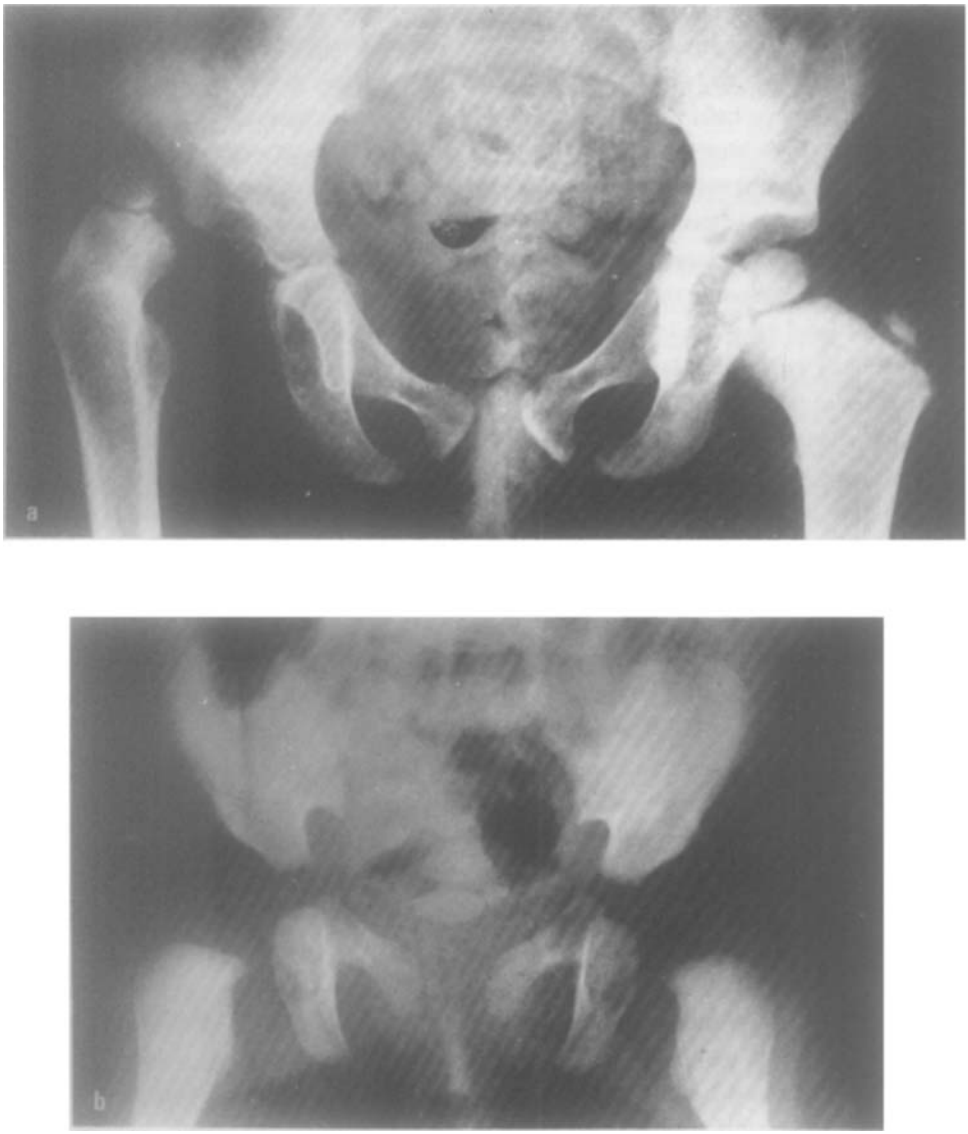

Figure 8. Girl, $2\frac{1}{2}$ years old. She presented with a high dislocation of the right hip (a). An X-ray shortly after birth (b) was interpreted as normal, and she received no treatment.

Strang (1960), by consecutive examinations of the hips of 4, 500 infants below one year of age, found that only three out of nine dislocations were diagnosed at the first routine examination. Ryder et al. (1962) studied the hips of 1,000 normal infants clinically and by X-ray examination. Two children whose hips were normal at birth had subluxation at six months of age. Ramstad (1964) found that as much as 6.5 per cent of the newborns were suspected of having unstable hips, and none of these were given immediate treatment. Nevertheless, only ten of seventeen who later presented with CDH belonged to the group with unstable hips at birth.

At least 18 of the late-diagnosed patients in the present series were examined with particular care, often repeatedly at birth because of a family history of CDH. Adams (1965) reported a single similar case. In addition, the material includes three patients admitted for club foot whose hips were examined in the obstetric unit and by an orthopaedic surgeon during the first two days of life without detection of any hip instability. Recently we have also seen two cases of talipes calcaneovalgus with a similar course. Sinios (1963), Corkery (1971), and Walker (1971) reported similar cases of foot deformities. In the present series 96 of the 266 cases detected at the child welfare clinics came to treatment after six months of age. Some of the patients had been checked at regular intervals by doctors with great experience in hip examination, but no suspicious signs were observed at the first examinations. From observations of the present material and from the reports of other authors it therefore seems likely that, in a large proportion of patients who later present with CDH, no detectable signs of hip disorder exist at birth. Observations indicate that the deformity, at least in some cases, may develop later in the first year. Besides, it cannot be excluded that a forceful hip examination at birth may have led to late sequelae in some cases (Bjerkreim 1967, Finlay et al. 1967).

The most important clinical sign in late-diagnosis CDH is a limitation in abduction, which was found in 88 per cent of all patients examined. In addition, five per cent had tests that were characterized as doubtful. Nearly all patients with luxation have restricted abduction, but also in the lesser degrees of hip deformity is limitation of abduction frequently found. The higher proportion of positive abduction tests in cases detected at the child welfare clinics is probably due to the use of this test as a screening procedure in these clinics.

Restricted abduction in CDH was described by Joachimstahl (1909). Later the importance of this sign has been stressed by several authors, e.g. Hilgenreiner (1925), Chapple (1935), and Hart (1950). Although almost invariably normal at birth (Harris et al. 1960, Palmén 1961), the abduction becomes restricted during the first few weeks or months in most cases of CDH (von Haberler 1944, Klopfer 1950, Harris et al. 1960, Coleman 1965).

Restricted abduction is not a pathognomonic sign of CDH. It occurs in diseases affecting the central nervous system, Calvé-Legg-Perthes disease, coxa vara, and inflammatory conditions in or near the hip joint. Apparent or real, it may be present in the moulded baby syndrome (Lloyd-Roberts & Pilcher 1965) and in congenital abduction contracture of the hip (Tachdjian 1967). If a baby maintains a one-sided recumbent position for some weeks or months, this may lead to head moulding as well as asymmetrical abduction of the hips. Further, unequal or restricted abduction may be present in normal hips (Harris et al. 1960, Ryder et al. 1962, Sharrard 1971). Finally, voluntary stiffening of an anxious and worried child may give a false positive sign and necessitate repeated examinations.

Limb shortening was the second most important sign, found in half of all 716 patients. It was surprising that many patients with dysplasia without displacement had a difference in limb length. However, patients with unilateral dysplasia usually hold the affected limb in a adduction or less abducted than the other limb. Thus, the apparent shortening may have been taken for a real difference in limb length.

Only half of the records contained information on skin creases. The value of asymmetrical skin folds as a sign of CDH is a matter of dispute, since asymmetry is also observed frequently in children without dysplastic hips (Harris et al. 1960, Palmén 1961, Ryder et al. 1962). However, asymmetrical skin folds, when distinct, are often noticed by parents and should arouse a suspicion of hip-joint deformity.

Manipulations to disclose instability in the hip joints were not carried out to any great extent in the present material. The presence of instability or telescoping is often difficult to determine in lesser degrees of CDH, and doubt will lead to repreated examinations. In normal as well as in dysplastic and subluxated hips, provocation of instability is an attempt to produce a traumatic dislocation and should be regarded as undesirable unless performed

with great care. The Trendelenburg test requires a standing position and is therefore of little diagnostic value in the first year of life.

A reduction jerk was observed in 37 patients. The presence of this sign in late-diagnosed cases is of great importance. The contracture of the adductor muscles of the hip, however, in most cases prevents reduction, and force should be avoided in a hip with restricted abduction.

The present investigation shows that more than 90 per cent of the patients with late-detected disorders had attended a child welfare clinic at regular intervals. In spite of this, most of them were detected by the family. Throughout this period, however, there has been a distinct change, in that more patients are diagnosed at the child welfare clinics (Figure 3). In 14 cases the mother drew attention to the fact that she had noticed asymmetry or restricted movements of the lower limbs when she handled the child and, in some cases, limping (Figure 9). Such information should not be neglected and should lead to a careful examination. Mitchell (1970) stressed this problem in bilateral dislocations.

Figure 9. Girl, 15 months old. Luxation present in both hips. The mother had observed asymmetry at 3 months, but no hip disorder was found on clinical examination at that time. Later the malformation was detected owing to limping.

As for diagnosis of late cases, it is of significance that a positive abduction test usually develops at an early age. Detection is often possible, or suspicion may be aroused by mere observation of the child. The affected limb is held in less abduction than the normal. Asymmetry of thigh and gluteal skin creases and difference in limb length should also be looked for. Another clinical sign, not investigated in the present series, is an increase in the adduction on the affected side in CDH (Jones 1965). It corresponds to the limitation of abduction, and the test is probably best carried out with the patient in the prone position (Figure 10 a and b).

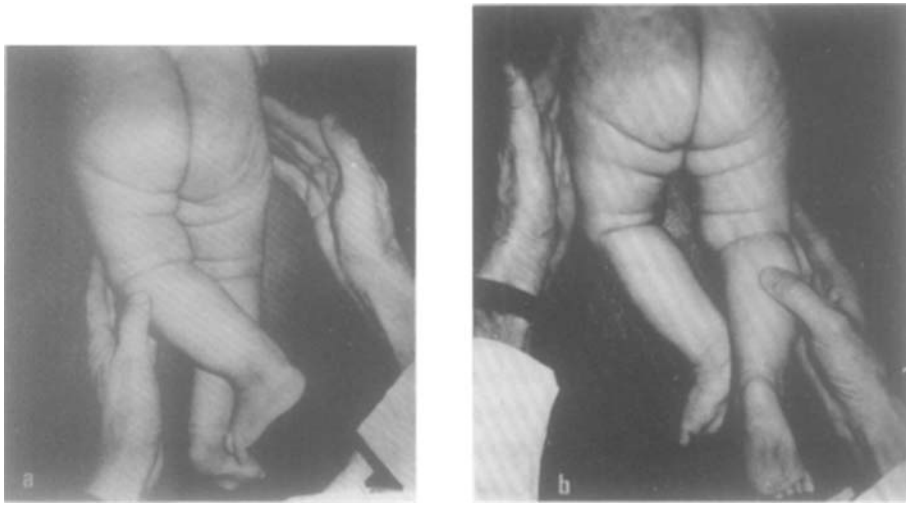

Figure 10. Increased adduction in the affected left hip (a).
Physiological 'abduction contraction' in the normal right hip (b).

Because a certain number of cases are not detected or not detectable at birth, re-examinations at regular intervals during the first year are imperative in order to discover these 'missed' cases as early as possible. This view has been stressed by many authors (Coleman 1956, Strang 1960, Bull-Hansen 1962 , Ilfeld 1962, Bjerkreim 1967, Salter 1967, Hiertonn & James 1968, Owen 1968, Walker 1971) but is still neglected. Berglund (1956) recommended X-rays of all infants at four months, but this is impossible to carry out practi-

cally in our country. Besides, the potential harmful effects of radiological examinations must be taken into consideration. Familial occurrence and concomitant anomalies are frequent in CDH (Bjerkreim & van der Hagen 1974). Therefore, children with a family history of CDH and those with malformations need a careful clinical examination, as do those who had a breech presentation. In a few cases no clinical signs are present; it may therefore be reasonable to recommend X-ray examination, at about four months of age, of the hips of a selected group of children at risk: those with affected first-degree relatives and those with congenital foot deformities.

In Norway, close to 100 per cent of all infants attend welfare clinics. This means that we have an established organization and, besides, a simple, fairly safe test suitable for screening - the abduction test. We should expect nearly all cases 'missed' at birth to be detected in the first six months of life if re-examination of the hips at two, four, and six months becomes a routine procedure in every infant welfare clinic.

SUMMARY

To evaluate the reasons why late-diagnosis CDH still exists in a high frequency in Norway and to evaluate the possibilities of reducing the age at diagnosis in late-diagnosed cases, 799 patients were studied. The hips of 77 per cent of the patients had been examined at birth. Several cases were repeatedly examined after birth because of a family history of CDH or because of foot deformities, and some were regularly checked during the first five to six months of life without any suspicious signs of hip disorder at the first examinations. Thus, the investigation indicates that in many patients who later presented with CDH no clinical signs of the hip disorder existed at birth.

More than half of the patients were detected by the family, although 90 per cent of all had attended child health clinics at regular intervals. However, the percentage of patients diagnosed at the child welfare clinics increased from 15.5 in 1960 to 47.8 in 1968. A limitation in abduction of the hip joints was found in 88 per cent of all patients. The abduction test became positive at an early age and was frequently found in all degrees of hip deformity. The great majority of late cases are detectable in the first few

months, and screening examinations have to be continued at regular intervals in the first year of life. Children at risk need particular attention in infancy as well as in the newborn period.

ACKNOWLEDGEMENTS

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CONGENITAL DISLOCATION OF THE HIP JOINT IN NORWAY

III. Neonatal CDH

by

Ingjald Bjerkreim

In Norway the reported incidence of congenital dislocation of the hip joint (CDH) detected at birth varies from 1.6 per 1,000 live births (Kåss 1961) to 15 per 1,000 (Medbø 1961). The diagnosis is mainly based on a positive instability test. A wide variation in the incidence of CDH in newborns is reported by different authors from other countries and even by the same author from the same district at different times. In Sweden, James & Sevastikoglou (1970) found 20 per 1,000 live births, whereas Jacobsson (1970) reported 2. In Malmø the incidence was 1.3 per 1,000 in 1956; 9 years later ut had increased to 12.9 (von Rosen 1970).

The incidence of neonatal CDH in Norway of five to eight per 1,000 live births (Harlem 1961, Torp 1961, Njå 1962, Bjerkedal et al. 1971) seems to be in accordance with comparable studies in Sweden, Great Britain, and New Zealand (Palmén 1961, Finlay et al. 1967, Smaill 1968). This is four to seven times higher than that previously found, 1.2 per 1,000, when the diagnosis of CDH was made at walking age (Getz 1955). This difference may be due to several factors:

1. A spontaneous healing or stabilization of unstable hips in newborns (Le Damany & Saiget 1910) has been confirmed by several authors, e.g. Barlow (1962).

2. The reported incidence of CDH at walking age does not include the lesser degrees of hip deformity, which may lead to disabling osteoarthrosis in adult life (Putti 1933, Wiberg 1939, Lloyd-Roberts 1955, Jakobsen 1957).

3. An overdiagnosing of the hip disorder may occur in newborns. The wide variation of the incidence of neonatal CDH at different centres may depend on the examiner's experience and method and on differences in terminology and criteria for diagnosis. The increased incidence with experience (Finlay et al. 1967, Phillips 1968, von Rosen 1970), however, indicates that underdiagnosing may also occur.

Despite the high incidence of neonatal CDH reported in Norway, there has been no reduction of late-detected cases (Bjerkreim 1974 a, d). The purpose of the present investigation is to evaluate the reliability of the Ortolani test (the dislocation test) in diagnosing CDH at birth.

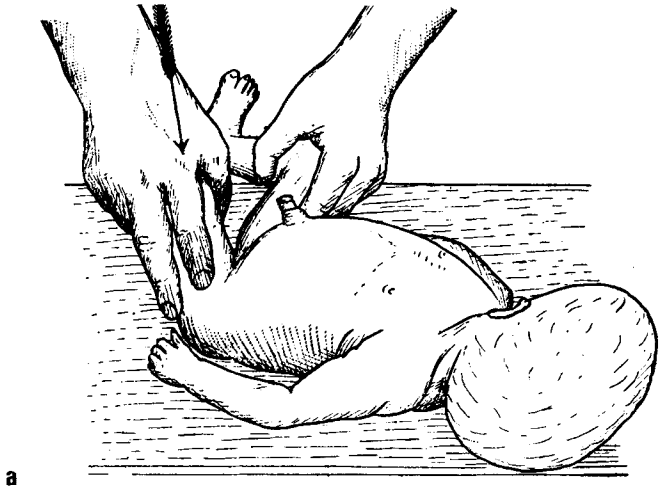
MATERIAL AND METHOD

Thirteen hundred and forty-six children were treated for neonatal CDH in Sophies Minde Orthopaedic Hospital (SMOH) during the period 1960 to 1969. Of the total number of patients, 163 had uncertain clinical signs of CDH when examined in the obstetric units and negative or uncertain signs if examined at SMOH in the neonatal period. These cases were treated because of a slight suspicion. The group showed no district differences from the general population regarding sex ratio and birth presentation and invariably had normal development of the hips. This group was excluded, leaving 1,183 patients for further analysis.

The patients were mostly referred from obstetric units in Oslo and surrounding counties for immediate treatment. The results of the hip examination both in the obstetric unit and in the orthopaedic clinic were available in most cases. In the later part of the period patients at the most distant institutions had treatment started locally. At about four months of age these patients made their first visit to SMOH's outpatient department, where the later follow-up examinations were made. Furthermore, the material includes patients admitted to SMOH for supplementary treatment and, finally, a few patients who, while receiving treatment elsewhere, moved to the district covered by SMOH.

Sources for information, criteria for inclusion in the study, as well as terminology and statistical methods have been described previously (Bjerk-

reim 1974 a). The investigation has been concentrated on the following factors: (1) diagnostic groups; (2) sex ratio; (3) side affected; (4) birth presentation; (5) age at beginning of treatment, and (6) result of the primary treatment.



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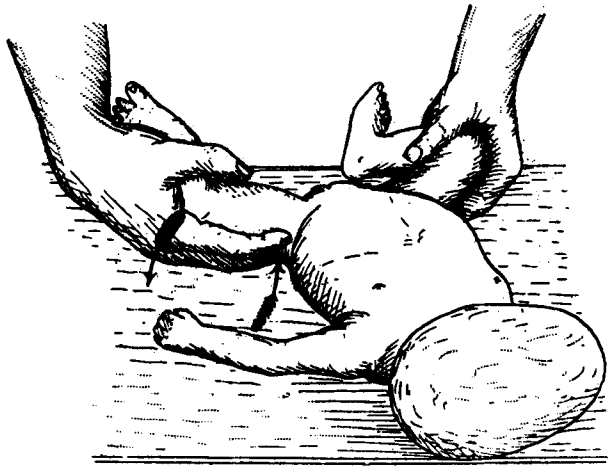


b

Figure 1. Examination of newborns' hips to disclose instability (a and b). From Le Damany & Saiget (1910).

Newborns were examined by the Ortolani test as it was originally described by Le Damany & Saiget in 1910 (Figure 1 a and b). This is a luxation provocation test. To include abduction of the hip joints, the term dislocation test is preferable. The modifications of Coleman (1956), Palmén (1957), or Barlow (1962) were used only occasionally.

When the jerk of entry was present, the test was scored as positive. Often a 'click' - a short, dry, sharp sound or a dry crunching or crepitation - is noticed on examination of the hips. This click is quite different from the jerk phenomenon, which one can feel, and often see and hear, when the femoral head is moved over the rim of the acetabulum into the socket. The click is not a sign of CDH, and the anatomical basis is not clear. Sometimes one has a feeling of a slight sliding movement or telescoping in the hip joint. Such observations have been registered as an uncertain sign of CDH (Stracker 1961, Finlay et al. 1967). An objective classification of the clinical state of unstable hips is difficult (Thieme et al. 1968). In the present study patients with a dislocation test termed 'distinctly' or 'definitely' positive and those with a test termed simply positive have been grouped separately.

The abduction capacity of the hip joints is easily observed when performing the dislocation test. Restricted abduction is rare in newborns with CDH (Coleman 1956, Harris et al. 1960). In manifest luxations at birth, however, limitation of abduction may be present and the jerk sign negative (Lloyd-Roberts & Swann 1966). In the present material nine newborns referred for restricted abduction are included among those with a positive dislocation test.

Radiological examination in newborns has been done only exceptionally because X-rays of hips of newborns may be equivocal (Laurenson 1959) and even give false negative results (Palmén 1970).

The standard treatment has been the abduction pillow (Frejka 1941) for a period of six to eight months from 1960 to 1966 and for about four months from 1966 on. Mothers have been trained in the use of the pillow before discharge from the obstetric units, and the babies have attended the first check-up at three to four months of age in the outpatient department of SMOH. Further follow-up examinations have usually taken place at six to ten months of age, at twelve to sixteen months, at two years, at three years, and at older age, depending on clinical and radiographical findings.

The first radiogram was performed at about four months of age. Evaluation of the femoral anteversion has been part of the follow-up examinations. In walking children, an inward rotation of the hip joints of 75 degrees or more in the prone position (Alvik 1962), combined with radiographical signs of increased femoral anteversion, was considered pathological. The early results of the primary treatment were studied in patients who started treatment at SMOH or in the obstetric units in collaboration with this hospital - a total of 1,121 cases.

RESULTS

(1) Diagnostic groups

The patients were classified into six diagnostic groups (Table 1).

Table 1. Diagnostic groups by sex in neonatal CDH patients

Sex	Distinctly positive		Positive		Positive/ negative		Mixed		Locally treated		Referred		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Girls	255	81.0	195	81.9	245	77.8	66	71.0	129	72.1	35	81.4	925	78.2
Boys	60	19.0	43	18.1	70	22.2	27	29.0	50	27.9	8	18.6	258	21.8
Total	315	100.0	238	100.0	315	100.0	93	100.0	179	100.0	43	100.0	1,183	100.0

$X^2 = 10.44$, with 5 d.f.; $P = 0.06$.

Group A (distinctly positive). In this group, consisting of 315 patients (26.6 per cent), a positive dislocation test was found in the obstetric units and in SMOH. The tests were recorded as distinctly positive in both institutions in 118 cases and in one institution in 197 cases.

Group B (positive). This group consists of 238 patients (20.1 per cent). These cases were recorded as having a positive dislocation test in both institutions.

Group C (positive/negative) includes 315 patients (26.6 per cent) who had a positive dislocation test in the obstetric units and a negative (248 cases) or an uncertain test (67 cases) at SMOH.

Group D (mixed) consists of 93 patients (7.9 per cent) whose clinical findings were not sufficiently recorded in one of the institutions. The group includes 22 cases that had uncertain positive tests in the obstetric units but positive tests at SMOH, as well as one uncertain case that later showed radiographical signs of dysplasia.

Group E (locally treated) consists of 179 patients (15.1 per cent) who started treatment at the obstetric units in co-operation with SMOH. A comparison between obstetric unit and orthopaedic clinic results could not be made for this group.

Group F (referred) includes 43 patients (3.6 per cent) referred to SMOH for evaluation of supplementary treatment.

(2) Sex ratio

The material consists of 925 girls, 78.2 per cent, and 258 boys, 21.8 per cent (Table 1). Patients who had a positive dislocation test in both institutions and patients referred for supplementary treatment have a smaller proportion of boys than the others ($P < 0.01$). The differences in Table 1 as a whole, however, are not statistically significant.

(3) Side affected

Bilateral instability was found in 39.7 per cent of the cases, left-sided only in 40.4 per cent, and right-sided only in 19.9 per cent (Table 2). There is

Table 2. Affected side by sex in neonatal CDH patients

Affected side	Girls		Boys		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Right only	180	20.0	48	19.5	228	19.9
Left only	358	39.8	105	42.7	463	40.4
Both	361	40.2	93	37.8	454	39.7
Sum	899	100.0	246	100.0	1,145	100.0
Unknown	26		12		38	
Total	925		258		1,183	

$X^2 = 0.69$, with 2 d.f.; $P = 0.71$.

no significant difference in affected side according to sex. Children with a distinctly positive dislocation test were most frequently bilaterally affected (Table 3).

Table 3. Affected side by diagnostic groups in neonatal CDH patients

Affected side	Distinctly positive		Positive		Positive/ negative		Mixed		Locally treated		Referred		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Right only	43	13.7	39	16.4	84	27.6	15	16.9	39	24.2	8	21.1	228	19.9
Left only	97	30.8	89	37.4	142	46.7	38	42.7	85	52.8	12	31.6	463	40.4
Both	175	55.6	110	46.2	78	25.7	36	40.4	37	23.0	18	47.4	454	39.7
Sum	315	100.1	238	100.0	304	100.0	89	100.0	161	100.0	38	100.1	1,145	100.0
Unknown	0		0		11		4		18		5		38	
Total	315		238		315		93		179		43		1,183	

$X^2 = 85.97$, with 10 d.f.; $P = 0.0000$.

(4) Birth presentation

A cephalic presentation occurred in 81.5 per cent of the neonatal cases, 15.7 per cent had breech presentation, and 2.8 per cent were delivered by Caesarean section. There was no significant sex difference. First-born patients more often had breech presentation than those of ranks 2 and over (Table 4, $P < 0.001$). Breech presentation occurred most frequently in the distinctly positive group (Table 5). The difference between this group and the positive/negative group is significant ($P < 0.01$). Patients with breech presentation had bilateral affection significantly more frequently than the others ($P < 0.01$).

(5) Age at start of treatment

Since 1964 treatment generally has been started during the first few days of life. The mean age at start of treatment at SMOH has sunk from seven to three days (Table 6). Mean age at start of treatment was 4.5 days for patients with a positive dislocation test in both institutions and 5.4 days for

Table 4. Frequency of breech delivery by sex and birth rank in neonatal CDH patients

Birth rank	Sex	All cases No.	Breech delivery No.	Breech delivery Per cent
1	Female	425	84	19.8
	Male	127	27	21.3
2 and over	Female	484	55	11.4
	Male	124	16	12.9
Sum	Female	909	139	15.3
	Male	251	43	17.1
Insufficient information	Female	16	0	
	Male	7	1	
Total	Female	925	139	
	Male	258	44	

Table 5. Birth presentation by diagnostic groups in neonatal CDH

Birth presentation	Distinctly positive		Positive		Positive/ negative		Mixed		Locally treated		Referred		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Cephalic	236	75.4	198	83.2	260	83.6	75	82.4	151	86.8	33	78.6	953	81.5
Breech	67	21.4	36	15.1	40	12.7	15	16.5	17	9.8	8	19.0	183	15.7
Caesarean section	10	3.2	4	1.7	11	3.5	1	1.1	6	3.4	1	2.4	33	2.8
Sum	313	100.0	238	100.0	311	100.0	91	100.0	174	100.0	42	100.0	1,169	100.0
Unknown	2		0		4		2		5		1		14	
Total	315		238		315		93		179		43		1,183	

$X^2 = 17.78$, with 10 d.f.; $P = 0.06$.

patients with a change from a positive to a negative test. The difference in mean age is significant ($P = 0.0003$).

Table 6. Mean age in davs at start of treatment by year of birth in neonatal CDH patients

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Total
Mean age	7.0	7.1	6.9	7.2	5.3	4.3	3.5	3.3	3.1	3.1	5.1
S.D.	3.72	3.90	3.00	4.44	3.31	3.00	3.56	2.92	3.39	2.24	3.78

P = 0.0000.

(6) Result of the primary treatment

Twenty patients (1.8 per cent) have not had regular follow-up examinations and could not be traced (Table 7).

Table 7. The course after the primary treatment by diagnostic groups in neonatal CDH patients

The course	Distinctly positive		Positive		Positive/ negative		Mixed		Locally treated		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Normal	119	37.8	110	46.2	159	50.5	46	49.5	100	62.5	534	47.6
Increased femoral anteversion	44	14.0	22	9.2	43	13.7	11	11.8	15	9.4	135	12.0
Remaining dysplasia	52	16.5	25	10.5	38	12.1	8	8.6	16	10.0	139	12.4
Plaster cast only	52	16.5	46	19.3	52	16.5	11	11.8	14	8.8	175	15.6
Rotation osteotomy	37	11.7	26	10.9	17	5.4	7	7.5	7	4.4	94	8.4
Reduction	8	2.5	5	2.1	1	0.3	6	6.5	4	2.5	24	2.1
Unknown course	3	1.0	4	1.7	5	1.6	4	4.3	4	2.5	20	1.8
Total	315	100.0	238	99.9	315	100.1	93	100.0	160	100.1	1,121	99.9

$\chi^2 = 64.57$, with 24 d.f.; P = 0.0000.

Of the total number, 808 (72.0 per cent) received no treatment beyond Frejka pillow. On follow-up examinations, 534 (47.6 per cent) presented with entirely normal clinical and radiographical findings. Abnormal clinical and/or radiographical signs were found in 274 patients (24.4 per cent)

who had not had any supplementary treatment. In 135 of these cases, increased femoral anteversion was the only abnormal finding (Figure 2 a and b). In another 139 cases dysplastic signs were present in the hip joints (Figure 3 a and b). In the latter group some also had increased femoral anteversion.

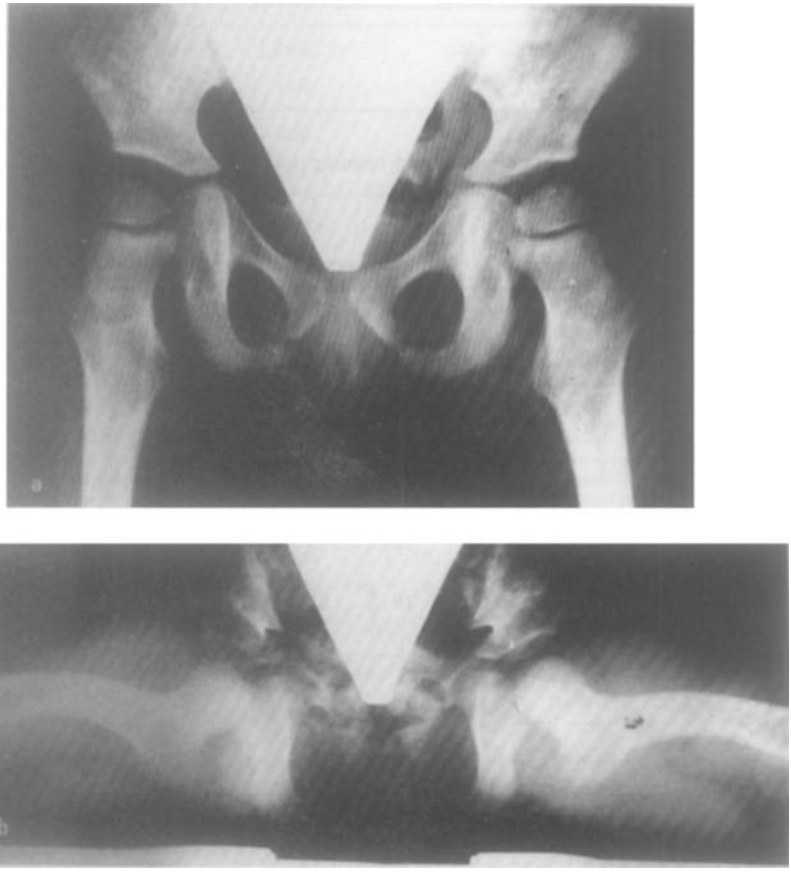
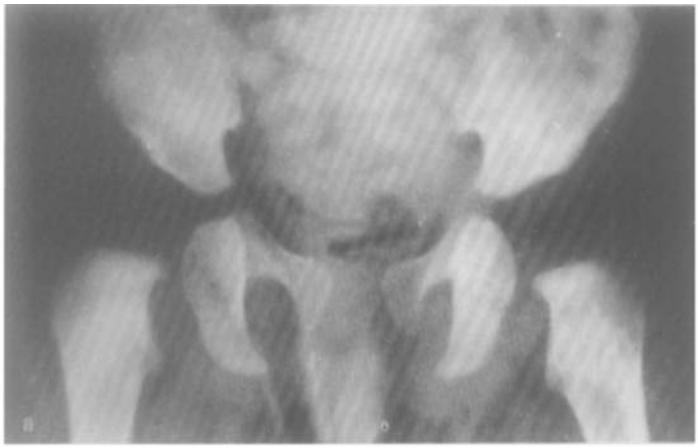


Figure 2. Girl aged 27 months. The dislocation test was positive in left hip at birth. She used the Frejka pillow for 4 months, and no additional treatment was given. Increased femoral anteversion is present (a and b) - 63 degrees on the right side and 59 degrees on the left. Inward rotation 85 degrees and outward 20 degrees on both sides.

Figure 3. Girl with distinctly positive dislocation test in both hips at birth. The Frejka pillow was used for 4 months, and no additional treatment was given. At age 2 years (a) and 3 years (b) dysplasia is still present on the left side.



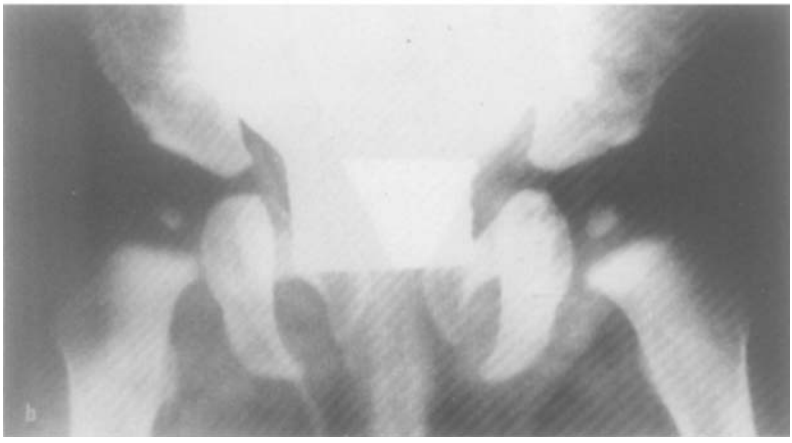
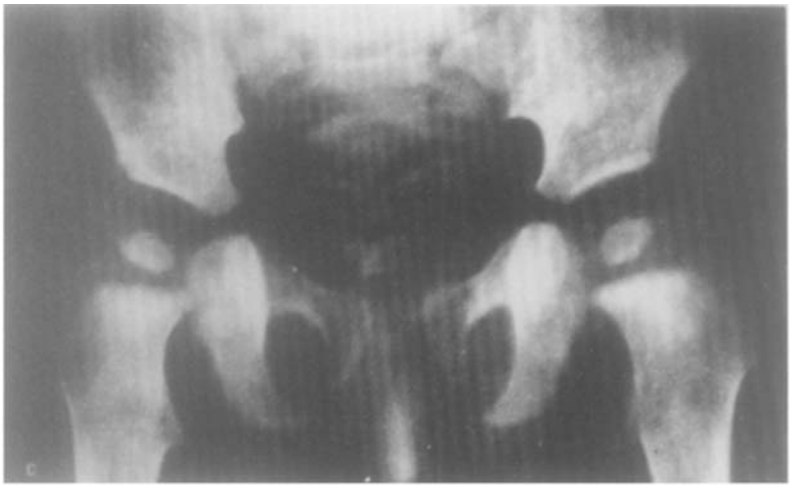
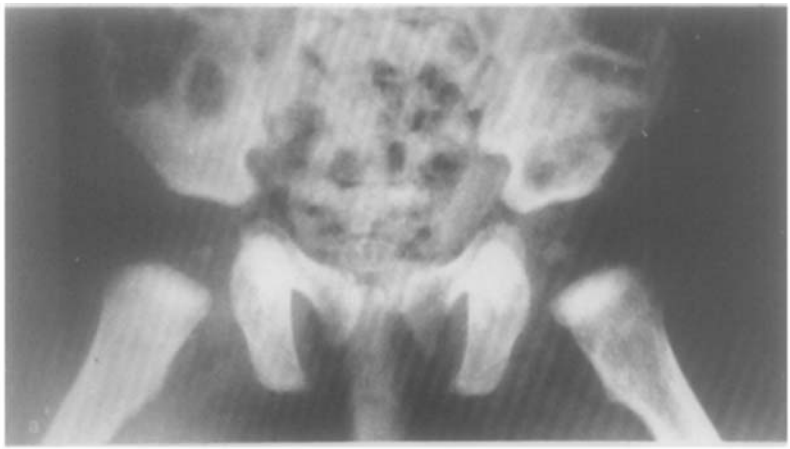


Figure 4. Girl with positive dislocation test in both hips at birth. When referred to SMOH at 10 days of age the test was negative. Treated by the Frejka pillow and plaster cast. X-rays show right-sided dysplasia, at 3 months (a), at 7 months (b), and at 10 months (c) and normal hips at 7 years (d).



Because of persisting dysplasia or subluxation of the hips, 175 patients (15.6 per cent) had a plaster hip-spica as the only additional treatment (Figure 4 a-d). In 94 patients (8.4 per cent) rotation osteotomy was performed; most of these patients had been treated by plaster casts earlier because of persisting hip joint maldevelopment (Figure 5 a-e).

Reduction of the hip joint was needed in 24 patients, 2.1 per cent of all. Open reduction was done in 12 (Figure 6 a-e), and 12 were reduced by skin traction (Figure 7 a and b). Failure of the initial reduction occurred in 5



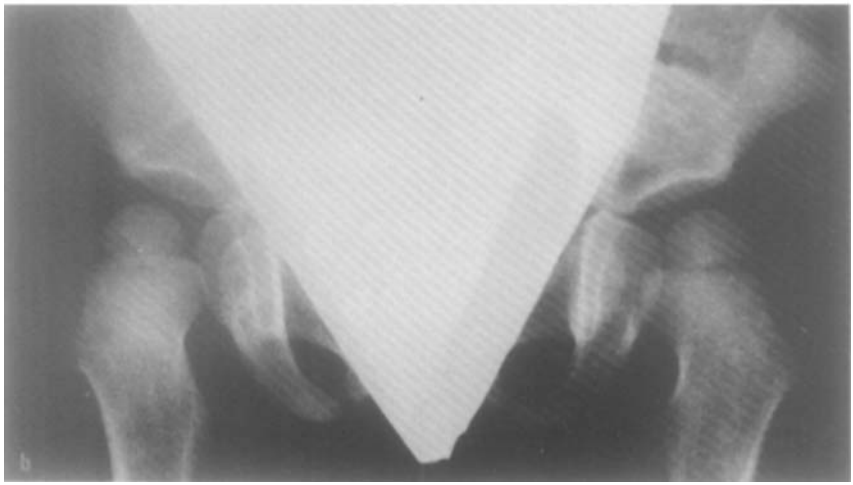
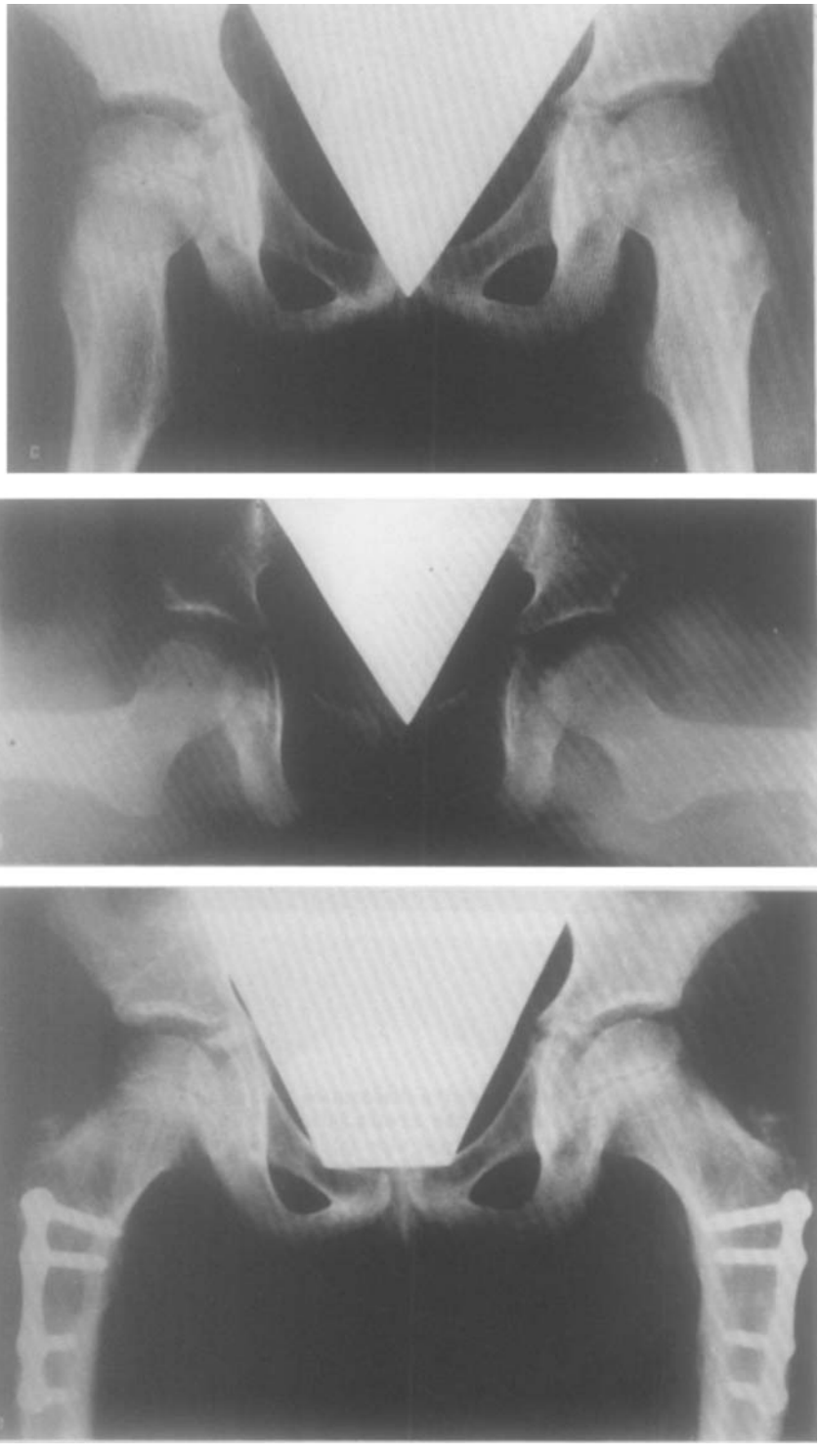


Figure 5. Girl with a positive dislocation test in both hips at birth. The Frejka pillow was used for 6 months. X-rays at 4 months (a) and at 20 months (b). Owing to persistant dysplasia, a plaster cast was applied to avoid weight bearing for half a year. X-rays at 4 years and 4 months (c and d) show increased femoral anteversion - 72 degrees on the right side and 66 degrees on the left. Hip rotation was symmetrical - inward 80 degrees and outward 10 degrees in the prone position. Subtrochanteric osteotomies were done; the right side was derotated 60 degrees and left side 50 degrees. X-ray 1 year after the operations (e) shows normal hips and healed osteotomies.



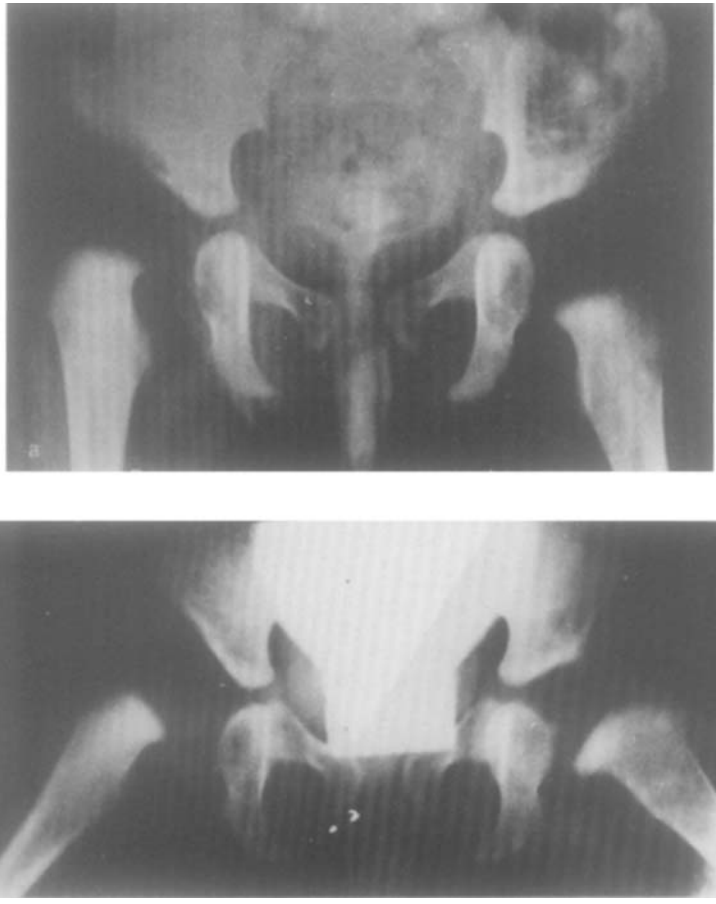
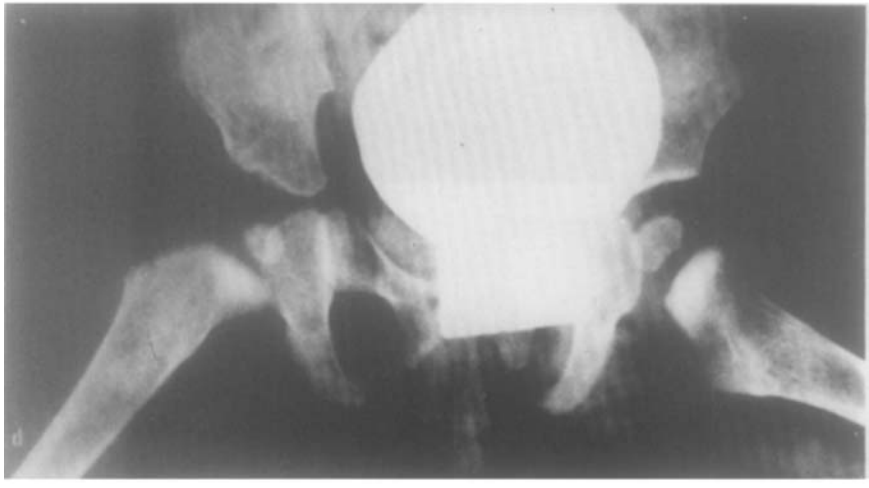
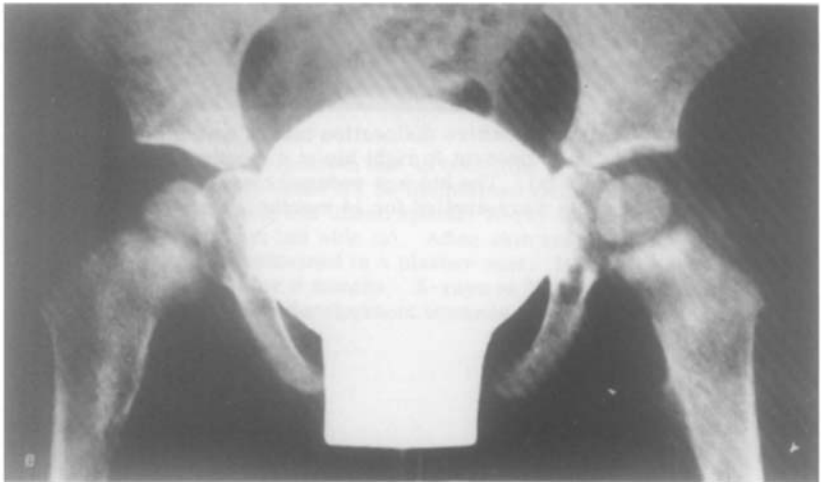


Figure 6. Girl with a distinctly positive dislocation test in both hips at birth and treated initially with the Frejka pillow. X-ray at 3 months of age shows dislocation on the right side (a). Reduction by skin traction failed (b), and the hip was reduced operatively at 5 months, followed by plaster casts for 15 months. X-rays at 6 months (c), at 10 months (d), and at 20 months (e) show development to normal hips.





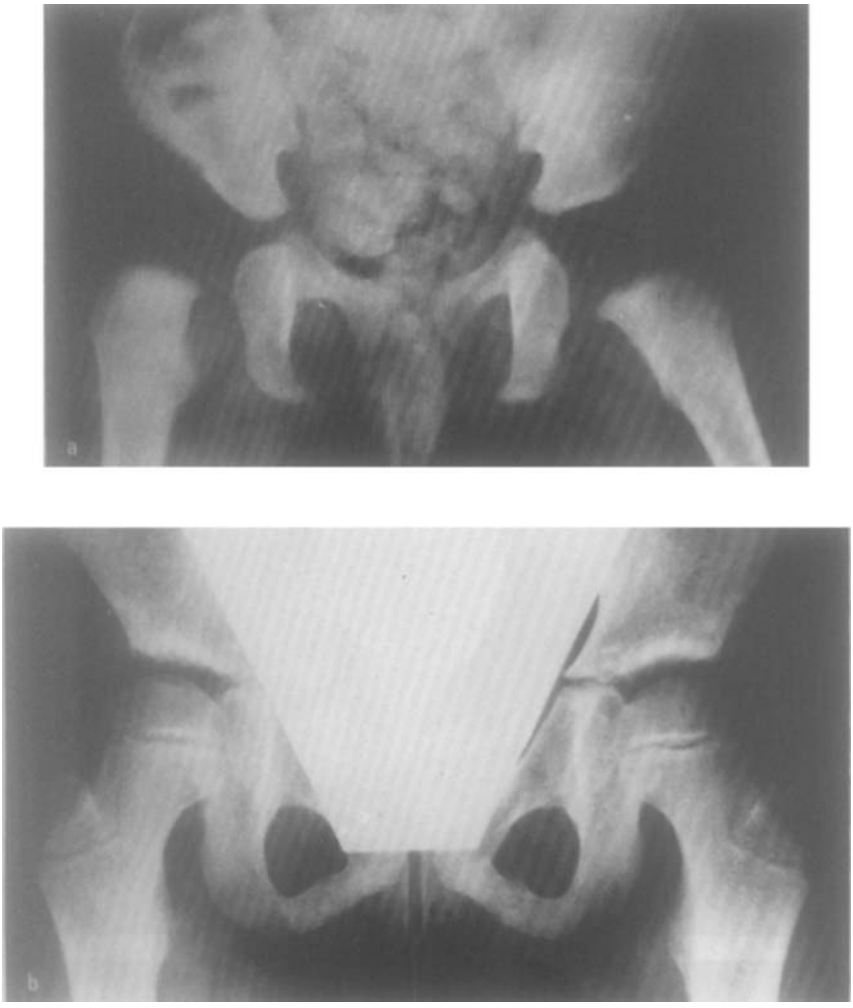


Figure 7. Girl with distinctly positive dislocation test in both hips at birth. Luxation is present in right hip at 4 months, despite pillow treatment (a). The hip was reduced by skin traction, and plaster casts were applied for 14 months. Normal hips at 7 years (b).

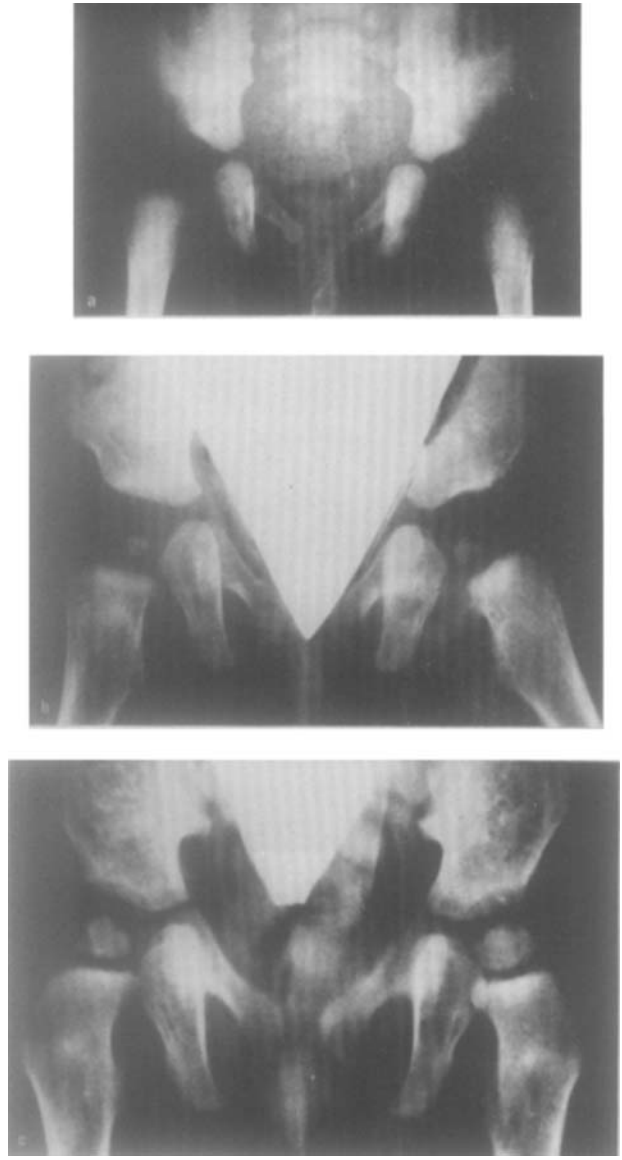


Figure 8. Girl with positive dislocation test in both hips at birth. Reduction of left hip could not be maintained either with the Frejka pillow or with von Rosen splint. X-ray at 14 days, shows dislocation on left side (a). After skin traction, reduction could be maintained in a plaster cast. Immobilisation was continued for 9 months. X-rays at 7 months (b) and at 17 months (c) show development towards normal.

(Figure 8 a-c), failure to maintain reduction in 17 (Figures 6 and 7), and the pillow treatment was interrupted in two cases (Figure 9). Of the 24 reduced cases, 13 needed rotation osteotomy later on.

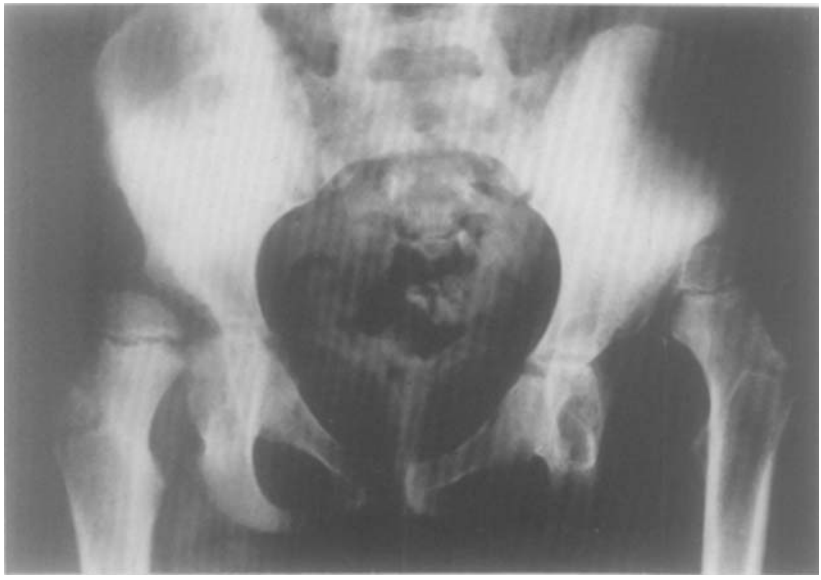


Figure 9. Girl with positive dislocation test in both hips. Pillow treatment was discontinued by parents. At 5 years a high luxation is present in left hip and a subluxation in the right.

For the different diagnostic groups, a striking difference is observed in the course after the primary treatment (Table 7). Only 37.8 per cent of patients with a distinctly positive dislocation test had an entirely normal course, whereas the percentage was 50.5 in the group of patients with hips that stabilized before treatment and 62.5 for those starting treatment in the obstetric units. The course after primary treatment was different for the two sexes (Table 8): 56.2 per cent of the girls had pathological signs on X-ray in contrast to 30.6 per cent of the boys.

Table 8. The course after the primary treatment by sex in neonatal CDH patients

The course	Girls		Boys		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Normal	370	42.2	164	66.9	534	47.6
Increased femoral anteversion	116	13.2	19	7.8	135	12.0
Remaining dysplasia	121	13.8	18	7.3	139	12.4
Plaster cast only	153	17.5	22	9.0	175	15.6
Rotation osteotomy	84	9.6	10	4.1	94	8.4
Reduction	18	2.1	6	2.4	24	2.1
Unknown course	14	1.6	6	2.4	20	1.8
Total	876	100.0	245	99.9	1,121	99.9

$X^2 = 52.44$, with 6 d.f.; $P = 0.0000$.

DISCUSSION

The sex distribution of 3.6 times more affected girls is in accordance with that found by other investigators (Palmén 1961, Weissman & Salama 1966, Finlay et al. 1967). The percentage of affected boys, however, in neonatal CDH varies considerably. Njå (1962) found 16.5 per cent, whereas MacKenzie (1972) found 37 per cent, in Norway and Scotland, respectively. Compared with the late-diagnosis CDH (Bjerkreim 1974 a), the proportion of boys is significantly higher in the present neonatal series ($P < 0.001$).

Boys had an entirely normal course after primary treatment significantly more frequently than girls (Table 8). This suggests that boys are less severely affected than girls. The same observation was made in the late-detected series (Bjerkreim 1974 a) and by Faber (1937). Further, a family study (Bjerkreim & van der Hagen 1974) showed that the sex ratio of affected second-degree relatives, who all belong to an age group with no neonatal hip examination, was similar to that of all CDH probans (late-

diagnosis and neonatal). Thus, if the neonatal group, as generally assumed, includes cases that would have healed spontaneously and cases that would have developed towards the lesser degrees of CDH (Coleman 1956, Palmén 1961), a higher percentage of boys among early than among late cases should be expected. The higher percentage of boys in the clinically less reliable groups in the present material (Table 1) could also suggest that some over-diagnosing has taken place.

The distribution by side affected in the present series (Table 2) corresponds fairly well with that of comparable investigations in that bilateral affections are frequent and left side is affected considerably more often than the right (Palmén 1961, Njå 1962, Finlay et al. 1967, Phillips 1968, Mac-Kenzie 1972). The proportion of bilateral affections is about 9 per cent lower than in the series of late cases (Bjerkreim 1974 a). The difference, which is significant ($P < 0.001$), may be owing to different diagnostic criteria in the two groups or to the fact that most severely affected patients most often have bilateral affections.

The high incidence of breech presentation (15.7 per cent) is in agreement with other neonatal series, which show a variation of from 11.4 (Palmén 1961) to 25 per cent (Njå 1962, Andrén 1962). Breech presentation was associated with birth rank 1, as found among late-detected cases (Bjerkreim 1974 a) and by Robinson (1968). The same association exists in the Norwegian population (Bjerkedal 1973).

A distinct difference in the frequency of breech delivery was found between the neonatal cases and the late-diagnosis CDH patients - 15.7 and 8.3 per cent, respectively ($P < 0.001$). This could mean that breech-presentation infants are examined more thoroughly at birth. However, of the patients who had a distinctly positive dislocation test at birth, 21.4 per cent were breech born, whereas the percentage was 12.7 in the group of patients whose hips stabilized before treatment ($P < 0.01$). Thus, it seems as though breech presentation gives a more distinct dislocation test, and these cases are probably more readily detected at birth. Breech presentation was also associated with bilateral affection in the neonatal group but not in the late-diagnosis CDH group. Therefore, breech presentation itself may be a more important aetiological factor in neonatal cases than in late-diagnosis CDH. Wynne-Davies (1970) found no difference in the frequency of breech presentation in

the two groups. The series, however, are not comparable, since the greater part of her late-diagnosis CDH cases were probably born before hip examination of newborns became widespread.

Investigation of the incidence (Bjerkreim 1974 d) showed that Oslo had the highest incidence of neonatal cases and that at the same time, this county had the lowest percentage of affected boys (19.2) and few cases in the clinically less obvious groups. Also, nearly all the newborns from Oslo were examined by experienced paediatricians. Thus, although over-diagnosing may exist in some other counties, underdiagnosing of unstable hips is probably also a problem if we assume that the real incidence of CDH is about the same in the different counties in southeast Norway.

Hip examination in the obstetric units usually takes place during the first two days of life (Njå 1962). The spontaneous stabilization frequently found in unstable hips is probably the reason for the change from a positive to a negative dislocation test in about 24 per cent of the cases, during the time span until examination at SMOH. These cases were also treated. The survey of the results of early treatment shows that about 25 per cent of the total number of neonatal cases received treatment in addition to the pillow. Another 25 per cent, at follow-up examinations, presented with stigmas of residual dysplasia of the hip joint, including increased femoral anteversion, signs that in most cases normalized during the further course without supplementary treatment.

There is no general agreement about the indications for additional treatment. Radiographical - and, in many cases, clinical - signs, judged as pathological according to generally accepted criteria, were present in about 50 per cent of all neonatal cases subsequent to the initial diagnosis and treatment. Several authors (Palmén 1961, Weissman & Salama 1966, Felländer et al. 1970, Mitchell 1970) have made similar observations, even though the final result of early treatment is normal hips in 90 per cent or more in most neonatal series.

It is not likely that the pillow treatment is harmful to the hip joints. The position assumed is considered favourable for the hip joints (Ponseti 1966) and is the same as often used for treatment of manifest dislocations after reduction. Further, the pillow allows some movement of the hip joints.

The group that normalized after pillow treatment may include some false positives. However, 38 per cent of those with a distinct dislocation test belong to this half, and, besides, only 50 per cent of the cases that stabilized before treatment presented entirely normal X-rays on subsequent examinations. This observation shows that, although some hips have stabilized during the first week of life, they are not completely cured. Matles (1966) made the same observation in four of six cases. The laxity of the hip joint capsule, which generally is believed to be the anatomical basis for the snapping sign in newborns, ceases during the first week (Andrén 1962), and the dislocation test consequently becomes negative in many cases. This, however, need not necessarily lead to an entirely concentric relationship between the femoral head and the acetabulum, a position that is essential for a subsequent normal development of the hip joint. At birth it is not possible to distinguish between unstable hips that will heal completely with or without treatment and those that will not. The course may depend on genetic and environmental factors as well as on the degree of instability. At birth these hips are all dislocated or dislocatable owing to a laxity of the soft tissue of the hip joint, by which these hips differ from the normal. It is therefore reasonable to regard all as pathological. However, caution is essential. Even normal hips may subluxate if force is applied when newborns' hips are examined.

Several observations clearly show the aetiological relationship between unstable hips at birth and late-diagnosis CDH. For one, a reduction of late dislocations has been observed in most centres after detection and treatment at birth (Palmén 1961, von Rosen 1962, Mitchell 1972). Also, although X-rays are often negative in newborns with unstable hips, Coleman (1956) found that radiograms were corroborative in 70 per cent, and those hips that showed the greatest instability had the highest acetabular angle values. Further, refusal or interruption of early treatment leads to subluxation and luxation in a high percentage (von Haberler 1944, Klopfer 1950, MacKenzie 1972). In the present neonatal series 2.1 per cent had luxation or subluxation of the hip owing to failure of pillow treatment.

The wide variation in the incidence of unstable hips may indicate that the performance and the interpretation of the dislocation test are difficult and that experience is necessary. Although some overdiagnosing has taken place,

this study suggests that, when an experienced doctor finds a positive dislocation test at birth, the child has a congenital dislocation of the hip joint.

SUMMARY

To evaluate the reliability of the dislocation test in diagnosing CDH at birth, 1,183 neonatal cases were studied. In this series 21.8 per cent were boys, 15.7 per cent had breech presentation, both hips were unstable in about 40 per cent of the patients, the left side only in 40 per cent, and the right side only in 20 per cent. The distribution by sex, birth presentation, and side affected is similar to that in most comparable studies. The percentage of boys is significantly higher than in the series of late-diagnosis CDH. The reason for this may be that the neonatal group includes a higher proportion of cases of the lesser degrees of hip deformity, and boys are generally less severely affected than girls. Breech presentation is significantly more frequent in the neonatal group than in the late-diagnosis CDH group. Breech-presentation infants more often had a distinctly positive dislocation test and were therefore probably more readily detected at birth. The difference in the proportion of breech presentation suggests an aetiological difference between neonatal and late-diagnosis CDH.

Half of the patients with neonatal CDH presented residual radiographical signs at follow-up examinations. About one fourth of all cases received treatment in addition to the Frejka pillow, including 2.1 per cent that needed reduction by skin traction or by operation. Unstable hips that stabilized during the first few days of life were not always completely cured. It was concluded that the dislocation test, which also includes hip abduction, is reliable in diagnosing CDH at birth.

ACKNOWLEDGEMENTS

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CONGENITAL DISLOCATION OF THE HIP JOINT IN NORWAY

IV. The incidence in southeast Norway

by

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The incidence of CDH diagnosed after walking age is, according to Getz (1955), 1.2 per 1,000 live births in Norway. He observed a variation in different counties of from 0.5 in Oppland to 2.4 per 1,000 in Finnmark, where a large proportion of the population is Lapp. It is reasonable to interpret the figures as underestimated values because mainly patients with luxation or distinct subluxation were registered. Severin (1956) reported an incidence of 0.9 per 1,000 in Sweden. Laurent (1953) found 0.6 per 1,000 in the Finnish population, and Record & Edwards (1958) found 0.65 per 1,000 in Birmingham, England.

Recent investigations (Bjerkreim 1974 a, c) have suggested that the incidence of CDH in Norway is higher than that reported by Getz. The purpose of the present investigation is to calculate the total incidence of CDH in Norway. Oslo and four surrounding counties (Figure 1, No. 2 to 6) were selected. The paediatric service in this region is supposed to be of good quality.

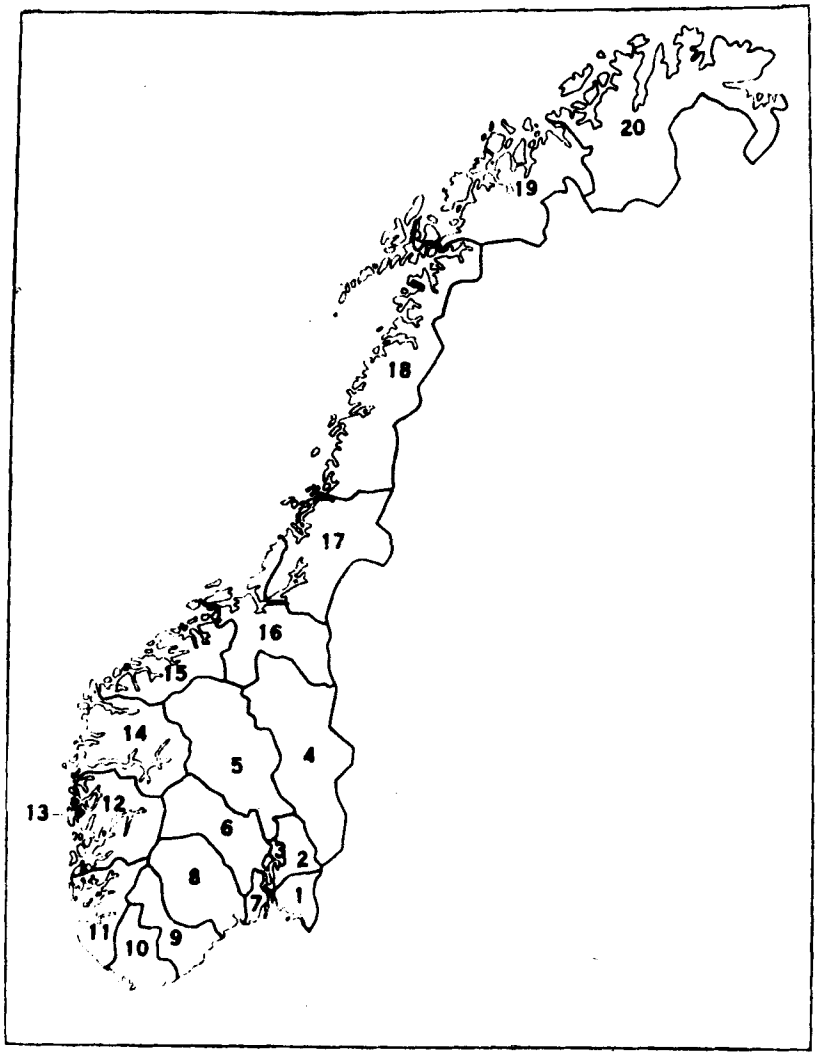

Figure 1. The five counties investigated are:
Akershus (2), Oslo (3), Hedmark (4), Oppland (5),and Buskerud (6).

MATERIAL AND METHODS

In the present investigation 620 patients from the late-diagnosis series and 1,032 patients from the neonatal series of CDH (Bjerkreim 1974 a, c), born in the years 1960 to 1969, were studied. Two late-diagnosis cases and 319 neonatal cases treated outside Sophies Minde Orthopaedic Hospital were also included. The total material thus consists of 1,973 patients. The terminology has been described previously (Bjerkreim 1974 a).

The patients were recorded according to the mother's county of residence. Information about the total number of live births in the different counties and years was obtained from the Central Bureau of Statistics of Norway.

RESULTS

The incidence of CDH in the years 1960 to 1969 is given in Table 1. We expect that additional late cases, at least in infants born in 1969, will be detected after this investigation was finished, in the middle of 1971. The incidence of luxations varied between 1 and 0.7 per 1,000 live births, with no decline in tendency until 1968. From 1962 to 1964 a distinct increase occurred in the number of cases of milder degrees of hip deformity, and the total incidence of late cases reached 3 per 1,000 in 1964. In 1968 it was still 2.2 and constituted nearly one quarter of the total number of CDH cases. Thus, with an increase in neonatal cases of from 4.4 per 1,000 in 1960 to 7.1 in 1968, there was not a corresponding decrease in the number of late-detected cases.

A survey of the incidence in the five different counties is given in Tables 2-6.

In Oslo, hip examination of newborns had been done routinely in every maternity unit before 1960. The annual incidence of neonatal CDH has been high and relatively constant throughout the period, with an average of 9.4 per 1,000 live births. The average incidence of late-diagnosis CDH was 2.1 per 1,000; of these, 0.5 per 1,000 were luxations. The mean total incidence of CDH in Oslo has been 11.4 per 1,000 during the decade.

In Akershus, hip examination of newborns has been done routinely during the whole period, except for in some small units. The number of CDH cases

Table 1. The incidence of CDH (number per 1,000 live births) in five counties in southeast Norway

Year	Neonatal		Late-diagnosis CDH								Total incidence of CDH	
			Luxation		Subluxation		Dysplasia		Sum			
	CDH No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000
1960	84	4.43	19	1.00	6	0.32	4	0.21	29	1.53	113	5.96
1961	101	5.30	17	0.89	2	0.10	5	0.26	24	1.26	125	6.56
1962	106	5.54	15	0.78	5	0.26	10	0.52	30	1.57	136	7.11
1963	118	6.09	16	0.83	7	0.36	15	0.77	38	1.96	156	8.05
1964	138	6.75	18	0.88	17	0.83	27	1.32	62	3.03	200	9.78
1965	160	7.68	15	0.72	14	0.67	19	0.91	48	2.30	208	9.98
1966	149	7.10	22	1.05	11	0.52	12	0.57	45	2.15	194	9.25
1967	163	7.97	18	0.88	15	0.73	16	0.78	49	2.40	212	10.37
1968	150	7.09	15	0.71	14	0.66	18	0.85	47	2.22	197	9.31
1969	182	8.45	7	0.33	14	0.65	13	0.60	34	1.58	216	10.03
Total	1,351	6.69	162	0.80	105	0.52	139	0.69	406	2.01	1,757	8.70
1965-1969	804	7.66	77	0.73	68	0.65	78	0.74	223	2.12	1,027	9.79

Table 2. The incidence of CDH in Oslo (3)

Year	Neonatal		Late-diagnosis CDH								Total incidence of CDH	
			Luxation		Subluxation		Dysplasia		Sum			
	CDH No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000
1960	47	7.18	3	0.46	3	0.46	3	0.46	9	1.38	56	8.56
1961	57	8.67	4	0.61	0		1	0.15	5	0.76	62	9.43
1962	58	8.89	2	0.31	1	0.15	4	0.61	7	1.07	65	9.97
1963	57	8.85	2	0.31	1	0.16	9	1.40	12	1.86	69	10.71
1964	56	8.20	4	0.59	9	1.32	12	1.76	25	3.66	81	11.86
1965	64	9.18	4	0.57	6	0.86	7	1.00	17	2.44	81	11.62
1966	72	10.44	3	0.43	7	1.01	4	0.58	14	2.03	86	12.47
1967	82	12.31	5	0.75	6	0.90	8	1.20	19	2.85	101	15.16
1968	66	9.28	5	0.70	7	0.98	6	0.84	18	2.53	84	11.81
1969	74	10.50	2	0.28	6	0.85	6	0.85	14	1.99	88	12.48
Total	633	9.36	34	0.50	46	0.68	60	0.89	140	2.07	773	11.43

Table 3. The incidence of CDH in Akershus (2)

Year	Neonatal CDH		Late-diagnosis CDH								Total incidence of CDH	
			Luxation		Subluxation		Dysplasia		Sum			
	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000
1960	23	5.20	3	0.68	1	0.23	0		4	0.90	27	6.10
1961	31	6.84	3	0.66	1	0.22	3	0.66	7	1.54	38	8.38
1962	30	6.39	5	1.06	2	0.43	1	0.21	8	1.70	38	8.09
1963	36	7.27	4	0.81	2	0.40	2	0.40	8	1.62	44	8.89
1964	37	7.00	5	0.95	2	0.38	7	1.33	14	2.65	51	9.65
1965	33	6.03	4	0.73	5	0.91	3	0.55	12	2.19	45	8.22
)66	37	6.69	8	1.45	1	0.18	2	0.36	11	1.99	48	8.68
967	26	4.76	3	0.55	4	0.73	3	0.55	10	1.83	36	6.59
1968	39	6.82	2	0.35	4	0.70	1	0.17	7	1.22	46	8.04
1969	48	8.09	0		3	0.51	1	0.17	4	0.67	52	8.76
Total	340	6.54	37	0.71	25	0.48	23	0.44	85	1.63	425	8.17

Table 4. The incidence of CDH in Hedmark (4)

Year	Neonatal CDH		Late-diagnosis CDH								Total incidence of CDH	
			Luxation		Subluxation		Dysplasia		Sum			
	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000
1960	8	2.98	5	1.86	1	0.37	0		6	2.23	14	5.21
1961	11	4.01	4	1.46	1	0.36	0		5	1.82	16	5.84
1962	9	3.27	3	1.09	1	0.36	3	1.09	7	2.54	16	5.81
1963	13	4.93	4	1.52	3	1.14	0		7	2.66	20	7.59
1964	21	7.69	3	1.10	3	1.10	1	0.37	7	2.56	28	10.26
1965	18	6.75	1	0.38	0		1	0.38	2	0.75	20	7.50
1966	13	4.73	2	0.73	0		3	1.09	5	1.82	18	6.55
1967	20	7.69	6	2.31	2	0.77	0		8	3.07	28	10.76
1968	18	7.15	4	1.59	0		3	1.19	7	2.78	25	9.94
1969	35	13.05	3	1.12	1	0.37	3	1.12	7	2.61	42	15.66
Total	166	6.20	35	1.31	12	0.45	14	0.52	61	2.28	227	8.48

Table 5. The incidence of CDH in Oppland (5)

Year	Neonatal		Late-diagnosis CDH								Total incidence of CDH	
			Luxation		Subluxation		Dysplasia		Sum			
	CDH No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000
1960	1	0.37	5	1.84	1	0.37	1	0.37	7	2.57	8	2.94
1961	0		3	1.15	0		0		3	1.15	3	1.15
1962	2	0.77	2	0.77	0		1	0.39	3	1.16	5	1.93
1963	6	2.20	1	0.37	0		0		1	0.37	7	2.56
1964	5	1.87	4	1.49	1	0.37	0		5	1.87	10	3.73
1965	9	3.31	3	1.10	2	0.74	3	1.10	8	2.94	17	6.25
1966	4	1.43	3	1.08	1	0.36	1	0.36	5	1.79	9	3.23
1967	20	7.33	1	0.37	0		0		1	0.37	21	7.70
1968	17	6.32	2	0.74	0		1	0.37	3	1.12	20	7.44
1969	13	4.66	1	0.36	0		1	0.36	2	0.72	15	5.37
Total	77	2.85	25	0.92	5	0.18	8	0.30	38	1.40	115	4.25

Table 6. The incidence of CDH in Buskerud (6)

Year	Neonatal		Late-diagnosis CDH								Total incidence of CDH	
			Luxation		Subluxation		Dysplasia		Sum			
	CDH No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000	No.	Per 1,000
1960	5	1.93	3	1.16	0		0		3	1.16	8	3.10
1961	2	0.77	3	1.15	0		1	0.38	4	1.54	6	2.31
1962	7	2.74	3	1.18	1	0.39	1	0.39	5	1.96	12	4.70
1963	6	2.30	5	1.92	1	0.38	4	1.53	10	3.83	16	6.13
1964	19	6.47	2	0.68	2	0.68	7	2.38	11	3.75	30	10.22
1965	36	11.96	3	1.00	1	0.33	5	1.66	9	2.99	45	14.96
1966	23	7.62	6	1.99	2	0.66	2	0.66	10	3.31	33	10.94
1967	15	5.01	3	1.00	3	1.00	5	1.67	11	3.68	26	8.69
1968	10	3.21	2	0.64	3	0.96	7	2.25	12	3.85	22	7.06
1969	12	3.91	1	0.33	4	1.30	2	0.65	7	2.28	19	6.19
Total	135	4.74	31	1.09	17	0.60	34	1.19	82	2.88	217	7.62

has been fairly constant throughout the ten years, but somewhat lower than in Oslo (Table 3). On an average, 6.5 per 1,000 live births started to receive treatment in the neonatal period and 1.6 per 1.000 later. The incidence of late luxations was 0.7 per 1,000. From 1967 on, however, there has been a distinct decrease.

In Hedmark, the incidence of neonatal CDH increased in the first years, as more of the obstetric units started to perform hip examination of newborns (Table 4). From 1964 onwards the average annual incidence was 7.8 per 1,000. The incidence of late luxations has been higher than in Oslo and Akershus.

In Oppland, although hip examination of newborns occasionally was done before 1960, it was not until 1963 and 1967, respectively, that the two obstetric clinics started to perform hip examinations regularly. Thus, the incidence of neonatal CDH in the first three years was, on an average, 0.4 per 1,000; in the next four years, 2.2; and in the last three years, 6.1 per 1,000 (Table 5). The incidence of all types of CDH, except late luxations, has been low.

In Buskerud, regular hip examination of newborns had been done in all obstetric units from 1964, and the incidence rose from 1.9 in the first four years to 6.4 per 1,000 in the next six years (Table 6). Total late cases, however, also increased from 2.1 to 3.3 per 1,000 in these two periods, whereas the number of luxations was 1.4 and 0.9 per 1,000, respectively.

For the other counties of Norway, the material does not give sufficient information, since CDH cases treated in regional hospitals are not included. The available figures, which mainly include patients with the most serious degrees of hip malformation, are listed in Table 7. The incidence varies from 0.7 to 2.1 per 1,000 live births.

DISCUSSION

The incidence of late-diagnosis CDH has been high in all the counties investigated. Some variation in incidence was observed in the different counties. However, screening among newborns and among infants in the first year of

Table 7. Incidence of late-diagnosis CDH in some counties outside the Oslo region. Only cases treated in SMOH are included

County	1960 - 1964 No. of cases	Per 1,000	1965 - 1969 No. of cases	Per 1,000
1 Østfold	17 (9-3-5)[1]	1.03	14 (5-5-4)[1]	0.80
9 Aust-Agder	7 (7-0-0)	1.14	8 (6-1-1)	1.29
10 Vest-Agder	18 (13-3-2)	1.74	9 (7-2-0)	2.06[2]
14 Sogn og Fjordane	8 (7-0-1)	0.89	9 (3-5-1)	1.05
15 Møre og Romsdal	15 (9-5-1)	0.75	14 (10-3-1)	0.68
18 Nordland	29 (23-4-2)	1.26	26 (15-8-3)	1.10
19 Troms[3]	19 (15-4-0)	1.45		
20 Finnmark	10 (5-2-3)	1.20	11 (9-1-1)	1.22

[1] Figures in parentheses denote luxation, subluxation, and dysplasia.

[2] Only 1965 and 1966 are included because a new orthopaedic clinic was started in this county in 1968.

[3] New orthopaedic clinic in 1967.

life has lead to an increased incidence, and differences in carrying out the screening are probably the main reason for the regional variation during the period investigated. Another reason for the higher incidence of CDH in Oslo may be the higher incidence of first-born babies in urban districts. Breech presentation is associated with CDH and with birth rank 1, in the general population (Bjerkedal 1973) as well as in CDH cases (Bjerkreim 1974 a, c).

Getz (1955) also found a somewhat lower frequency of CDH in Oppland than in the other counties investigated. However, the incidence of luxations alone, in the years 1960 to 1966, inclusive, was 1.1 per 1,000, i.e. more than double that found by Getz and about the same as in other counties. Concerning late cases of luxated hips, Oslo had the lowest incidence during the years 1960 to 1969, with an average of 0.5 per 1,000 live births, as compared to 0.7 in Akershus, 1.3 in Hedmark, 0.9 in Oppland, and 1.1 in Buskerud. In many of the other counties of Norway the incidence of late-diagnosis CDH has also been high even though hip examination of newborns started before 1960 (Medbø 1961, Torp 1961, Ramstad 1964).

One reason for the lower incidence of luxations in Oslo is possibly that all babies in this city were born in hospitals and examined by experienced paediatricians. This was also the case for an increasing proportion of babies in other regions, but the examinations were not carried out as thoroughly for all babies in the last decade as in Oslo. However, many cases of milder degrees of late-diagnosis CDH were found in Oslo as well as in other counties in this region. These cases increased from 1962 to 1964 as hip examination started to be performed at more of the child welfare clinics. The number of subluxations and dysplasias is assumed to be highest where preventive medical care is best developed, since a great proportion of these cases probably would have passed undiagnosed through childhood if they had not been detected at a routin examination. An early detection of cases of the lesser degrees of hip disorder will probably also in some cases prevent worsening of the hip deformity and thus reduce the incidence of luxations (Bjerkreim 1974 a).

The figures from the Oslo region during the last five-year period are considered the most reliable for calculation of the incidence of CDH in Norway, since this region has had the best diagnostic possibilities and since Oslo has a large contingency of inhabitants originating from all over the country. Using these figures (Table 1), the incidence of neonatal CDH in Norway is about 8 per 1,000 live births, based on the dislocation test, which has been found reliable (Bjerkreim 1974 c). The incidence of late-diagnosis CDH is about 2 per 1,000, of which about 0.7 per 1,000 are cases of luxated hips. Thus, the total incidence of CDH in Norway is calculated to about 1 per cent.

This incidence is considerably higher than the generally accepted incidence of CDH, although they are not directly comparable. A difference in age at and method of diagnosis can possibly explain most of the great difference in the incidence found today and that found earlier. The fact that many counties have a frequency of patients with luxated hips of 1 per 1,000 or even more, in addition to all cases detected at birth, means that the previous estimates are not valid today. A real increase in the incidence of CDH is unlikely but difficult to exclude. Another problem is whether the routinely performed hip examination of newborns may damage the hip joint in some cases. Most athors, like Sinios (1963), seem to believe that the examination

is safe. However, repeated and vigorous examinations may be harmful to the hip joint and may lead to an increase in neonatal cases and to late sequelae in other cases (Bjerkreim 1967, Finlay et al. 1967).

Some smaller, regional investigations in Norway have shown a considerably higher incidence of CDH than that found by Getz. Bjerkreim (1962), in the county of Nord-Trøndelag, found that 14 of 3,226 children born in the years 1954 to 1958, or 4.3 per 1,000, were admitted for late-diagnosis CDH. Ramstad (1964) gave a frequency of 5.7 per 1,000 for Nordland in the years 1958 to 1962. In Rogaland, Bjerkreim (1967) found the incidence of late-diagnosis CDH to be 3.2 per 1,000 for the years 1950 to 1954. These regional studies probably give a more correct picture of the frequency of CDH among young children in Norway at a time when no treatment of newborns was performed.

Besides luxations and severe subluxations, the present study of late-diagnosis and neonatal CDH includes many cases of minor degrees of hip deformity. Without treatment these milder malformations could have taken different courses. Spontaneous healing is described in neonatal CDH (Le Damany & Saiget 1910, Barlow 1962) as well as in late-diagnosis cases (Putti 1929, Hart 1949, Iino 1960, Rabin et al. 1965). Further, many cases would have had no symptoms until a complicating osteoarthrosis of the hip joint developed in adulthood. The correlation between coxarthrosis and CDH is found to be high, ranging from 20 to 60 per cent (Putti 1933, Wiberg 1939, Gade 1947, Lloyd-Roberts 1955, Jakobsen 1957). The incidence of osteoarthrosis of the hip joint in Norway is not known. In Sweden, Danielsson (1966) found an incidence of about 1 per cent in the age group 55 to 59 years. It thus seems reasonable to assume that before screening of newborns was started, up to 0.5 per cent of the population had, in childhood, a silent hip deformity that later developed into osteoarthrosis. By adding these cases to the incidence of CDH diagnosed in childhood, it appears that the present total incidence of 1 per cent is not unduly high.

The high incidence of late-diagnosis CDH in Norway, as compared to that registered in Sweden (Palmén 1961 and 1970, von Rosen 1962), is surprising. James & Sevastikoglou (1970) from Uppsala, Sweden, reported a high incidence of neonatal cases and 0.34 'missed' typical dislocations per 1,000. However, in addition they had cases of lesser degrees of hip deformity,

and the total incidence of treated, late cases reached 1.9 per 1,000. Thus, classification and registration may account for some of the differences in incidence of late-diagnosis CDH in Sweden and Norway. Based on screening in the first year of life, Medalie et al. (1966) from Jerusalem, reported an incidence of 9.8 per 1,000, equal to that currently found.

In conclusion, the present investigation has shown that CDH is frequent in Norway. About 1 per cent of the population is affected. The increase of neonatally diagnosed CDH has not led to a corresponding decrease in the incidence of late-diagnosis CDH. However, a comparison with some regional studies suggests that a careful hip examination in newborns has reduced the frequency of late-diagnosis CDH from a range of 4 per 1,000 to 2 per 1,000 live births. Besides, detection and treatment of CDH at birth as well as treatment of the lesser degrees of late-diagnosis CDH probably will prevent osteoarthrosis of the hip joint in many cases.

SUMMARY

The incidence of CDH was estimated in five counties in southeast Norway on the basis of 1,973 neonatal and late-diagnosis CDH patients treated in this region in the years 1960 to 1970. Neonatal CDH increased from 4.4 per 1,000 in 1960 to 8.5 in 1969. The frequency of late-diagnosis CDH patients with luxation decreased from 1 per 1,000 in 1960 to 0.7 in 1968. However, the incidence of all late-diagnosis CDH patients increased owing to inclusion of more cases of the lesser degrees of hip deformity, the incidence being 2.2 per thousand in 1968. Figures from other counties suggested that the incidence of CDH is high all over Norway.

The total incidence of CDH in southeast Norway was calculated to be 1 per cent in the years 1965 to 1969 - 0.8 per cent neonatal CDH and 0.2 per cent late-diagnosis CDH. This is about eight times the previously accepted incidence, when the diagnosis was made at walking age. Differences in age at and method of diagnosis can possibly explain most of this great difference. The incidence currently found includes cases of the lesser degrees of hip deformity, some of which could have healed spontaneously or been free from symptoms until osteoarthrosis of the hip developed in adulthood.

It was concluded that the incidence of CDH is high in Norway. Late-diagnosis CDH has not decreased corresponding to the increase of neonatal CDH.

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