

THE RESULTS OF EARLY TREATMENT OF TYPICAL CONGENITAL DISLOCATION OF THE HIP IN MALMÖ

NIS FREDENSBORG, MALMÖ, SWEDEN

From the Department of Orthopaedic Surgery, Malmö General Hospital (University of Lund), Malmö

The late results of early treatment of congenital dislocation of the hip in the von Rosen splint have been recorded in a follow-up study of 111 children with an average age of ten years (range eight to sixteen). The clinical diagnosis had been made within two days of birth and in most cases confirmed by radiological examination. Splintage was in all cases begun within the first few days and maintained for an average period of ten weeks. Two cases of failure of the initial treatment were encountered but had good final results. The follow-up study included a radiological examination in which were recorded the general configuration of the joint, the CE-angle described by Wiberg, the presence or absence of an os acetabuli and the roundness of the femoral head. The findings were compared with those in a control group of 222 normal children. All the treated hips developed normally except for a single case of minor dysplasia and a single case of slight enlargement of the femoral head and neck following appearances suggestive of avascular necrosis at the age of two years.

It has long been established that in the city of Malmö almost every case of congenital dislocation of the hip can be diagnosed at the time of birth (von Rosen 1962). Similar success in early diagnosis has been reported by Barlow (1966), by Finlay, Maudsley and Busfield (1967) and by Mitchell (1972). Thus the results from Malmö are not exceptional, as claimed in an editorial in *The Lancet* (1974); indeed they seem to be a common experience.

Recent reports, however, have questioned both the possibility of early diagnosis (Wynne-Davies 1970) and its benefits (Williamson 1972; Bjerkreim 1974). Moreover, opinions on the results of treatment are at variance. Weissman and Salama (1966 and 1969) found that a considerable number of the children treated either in a von Rosen splint or with a pillow of the Freika variety still had dislocated hips at three months, and Williamson maintained that early treatment did not always prevent dislocation. Bjerkreim found that after the use of a Freika pillow 30 per cent of the patients needed further treatment.

The aim of the present study was to investigate whether or not normal development of unstable hips can be expected when treatment on the lines advocated by von Rosen is begun within the first few days of life.

MATERIAL

During the years 1956 to 1964 30,280 live births were recorded in Malmö, 99.5 per cent of them in the maternity ward of the General Hospital. All the infants were examined by a trained paediatrician, at first once or twice a week but later daily, so that the interval from birth to examination did not exceed two

days. This was repeated at the time of discharge from the maternity ward. The hips were tested by the method described by Ortolani (1937), and in all but a few cases the diagnosis was confirmed radiologically according to the method of Andrén (Andrén and von Rosen 1958). From 1959

TABLE I
CONGENITAL DISLOCATION OF THE HIP IN MALMÖ
FROM 1956 TO 1964

	Number	Incidence per thousand
Live births	30,280	
Dislocation diagnosed	121	4.00
Missed cases	2	0.07

TABLE II
DISTRIBUTION OF 111 CASES ACCORDING TO SEX AND SIDE

	Unilateral		Bilateral*			Totals
	Left	Right	Left > right	Right > left	Equal	
Girls	21	14	26	13	19	93
Boys	8	1	4	4	1	18
Totals	29	15	30	17	20	111

* Bilateral cases are grouped according to the side showing the greater instability.

onwards the signs of pelvic instability were also considered (Andrén 1960 and 1961). In most instances the radiological examination was by Dr Andrén himself. The diagnosis was therefore based on both clinical and radiological findings. It must be concluded that in nearly all the cases comprised in the present study the hip was either dislocatable or was found

Dr Nis Fredensborg, Department of Orthopaedic Surgery, Malmö General Hospital, Malmö, Sweden.

to be pathologically unstable on at least one occasion, namely, at the time of radiological examination. In a few cases with incomplete radiological records the diagnosis was based on clinical examination by two experienced physicians and was therefore probably correct.

In the present study the initial radiographs have served as valuable retrospective confirmation of the diagnosis. It is therefore not possible to argue that a substantial number of these children were normal. The overall incidence of congenital dislocation is shown in Table I.

surgeon every two or three weeks until the splint was removed. The mothers were not allowed to remove the splints; the children were bathed once a week in the outpatient department by an experienced nurse.

The period of splintage varied between two and twenty weeks, with an average of ten weeks. At first the duration was three months, but in late 1959 and early 1960 a trial of shorter periods was made. One girl was splinted for only two weeks and redislocated. Subsequently the three months policy was resumed, except for a short period in 1963 when



FIG. 1

Case 1—A radiograph taken at the age of 11.



FIG. 2



FIG. 3

Case 2. Figure 2—A radiograph taken at 1 year showing subluxation of the left hip. Figure 3—A radiograph of the same patient taken at the age of 8, showing normal development of the hip.

Among 119 cases diagnosed early and treated in a von Rosen splint there was one of arthrogyriposis, one of meningomyelocele, one of Bonnevie-Ullrichs syndrome and one of cerebral palsy. Another child died later of cardiac failure and three had emigrated, leaving 111 typical cases for follow-up examination. These were distributed as shown in Table II.

With few exceptions the children were seen in the Department of Orthopaedic Surgery within one week of birth and put in the splint. Thereafter they were seen by the

some further experiments with shorter fixation were undertaken, this time without failure. After splintage had been discontinued the children were usually seen at six and twelve months and at three, five and seven years; radiographs were taken at the same intervals.

The initial treatment gave two failures.

Case 1—This was the girl already mentioned, a bilateral case. The left hip redislocated after only two weeks of splintage. This failure was discovered after another two weeks, when a plaster cast in the Lorenz first position was applied and maintained for ten months owing to persistent instability.

Puberty was early but the development of both hips at eleven years was normal (Fig. 1).

Case 2—In this girl, originally a bilateral case with more instability on the left side, the initial treatment in a von Rosen splint for eight weeks was uneventful. At seven months the acetabulum was thought to be rather steep on the left side and at one year subluxation was visible (Fig. 2). She was treated in a larger model of the splint for three months and went on to show normal hips at the age of eight (Fig. 3).

METHOD OF ASSESSMENT

Clinical examination—This was undertaken within an age range of eight to sixteen years, the average being ten years. The factors recorded were the walking age, hip symptoms, gluteal insufficiency and range of movement.

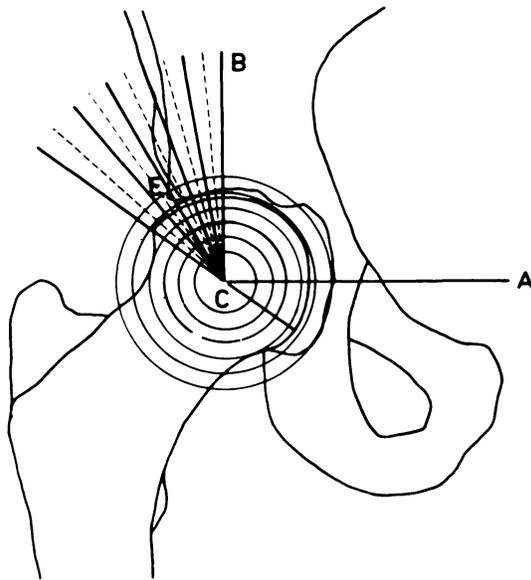


FIG. 4
To show how the CE-angle is measured.

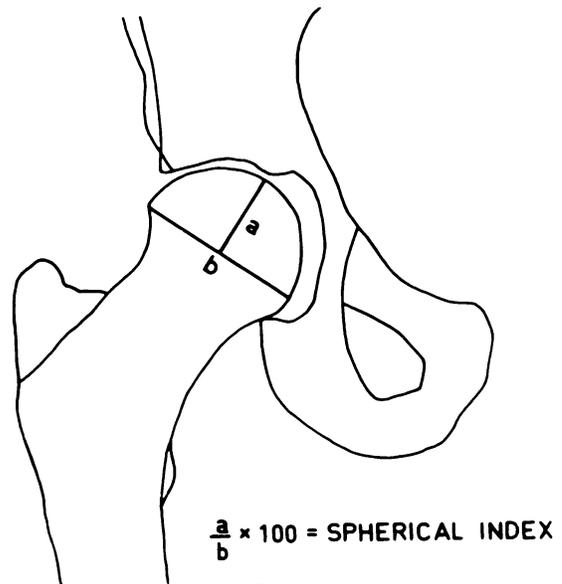


FIG. 5
To show how the spherical index is calculated.

Radiological examination—This was usually made at the time of follow-up. In a few cases films taken one year sooner were used, but in no case was the child then younger than eight. The antero-posterior film of the pelvis was taken with the hips in full inward rotation. In all but twenty-seven cases a film was also taken in the so-called Lauenstein position, with the hips in flexion, abduction and outward rotation. The focal distance used was 125 centimetres.

The general configuration of the hips was noted. The CE-angle of Wiberg (1939) was measured (Fig. 4) and the presence or absence of an os acetabuli was noted. In order to express the roundness of the femoral head a *spherical index* was designed, giving as a percentage the relationship of maximum width to maximum height of the head (Fig. 5). The earlier films were reviewed with regard not only to the signs of dislocation at birth, but also to the transverse diameters of the capital epiphyses when these first became visible.

For the purpose of comparison, films of 222 children with a similar age and sex distribution were studied in the same manner; all had been radiographed after 1950 for reasons such as trauma or transient pain in the hip. The rotational position of these hips could not be established in retrospect.

RESULTS

Clinical features

Walking age—The average was 13.1 ± 2.2 months. This may be compared with the average walking age of normal children from Stockholm found by Hindley and his colleagues in 1966, which was 12.5 ± 1.2 months. There would appear to be a significant delay of two weeks ($0.01 > P > 0.001$). The information concerning these control children, however, was obtained in a longitudinal study, not retrospectively as in this review.

Hip symptoms—No child complained, and in no instance was there any disability connected with daily life or sport.

Gluteal insufficiency—No case was recorded.

Movement—As measured by goniometer, this was in all cases within the range of normal (American Academy of Orthopaedic Surgeons 1965).

Radiological examination

General configuration—This was normal in all but two cases (see later).

CE-angle—The CE-angles compared with the controls were of identical distribution (Fig. 6), indicating normal development of the acetabulum. In relation to age, however, there was a difference. The girls in the series appeared to have a slightly lesser angle at an early age and later the same or even a greater angle, that is, an acetabulum less steep.

Spherical index—The spherical indices were the same as in the controls (Fig. 7), indicating normal development of the femoral head. The index increased significantly with age ($P < 0.001$) indicating that the capital epiphyses are somewhat flatter in young children. Skeletal development in this respect was identical in affected girls and in controls.

In unilateral cases there was no side-to-side difference of the CE-angle or of the spherical index between the stable and the once unstable hip. These anthropological measurements indicate that the affected children had developed normal hips with a deep acetabulum and a round femoral head.

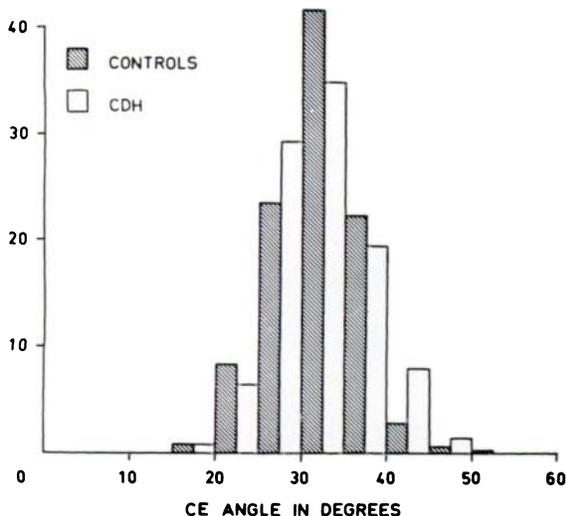


FIG. 6

A histogram showing how the CE-angles in 222 affected hips compared with 444 controls.

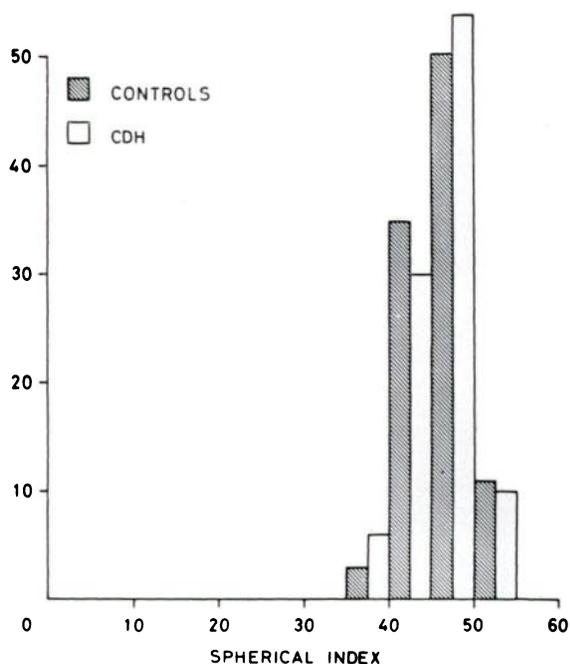


FIG. 7

The spherical index in 222 affected hips compared with 444 controls.

Os acetabuli—This was present in five of the affected children and five of the controls. The difference was not significant ($P > 0.2$).

Capital epiphyses—In unilateral cases the epiphysis on the affected side was significantly smaller (Table III), and again in the less stable hip in bilateral cases with a

side-to-side difference (Table IV). There was no right-left difference in bilateral cases with equal stability (Table V).

Deviating cases

Case 3—A girl with dislocation of the left hip was initially treated without complication and at first showed normal development of the joint. By the age of ten, however, the hip showed a minor degree of dysplasia (Fig. 8). Nevertheless the CE-angle was within the lower normal limit of 15 degrees (Wiberg 1953) and the femoral head was not displaced.

TABLE III

UNILATERAL CASES: SIDE DIFFERENCE IN DIAMETER (MILLIMETRES) BETWEEN THE CAPITAL EPIPHYSES (dislocated minus stable)

	Left minus right	Right minus left
Number	29	15
Average	-1.00	-0.87
S.D.	1.46	1.19
	$P < 0.001$	$0.02 > P > 0.01$

TABLE IV

BILATERAL CASES WITH UNEQUAL INSTABILITY: SIDE DIFFERENCE IN DIAMETER (MILLIMETRES) BETWEEN THE CAPITAL EPIPHYSES (less stable minus more stable)

Number	47
Average	-0.64
S.D.	1.52
	$0.01 > P > 0.001$

TABLE V

BILATERAL CASES WITH EQUAL INSTABILITY: SIDE DIFFERENCE IN DIAMETER (MILLIMETRES) BETWEEN THE CAPITAL EPIPHYSES (right minus left)

Number	20
Average	-0.05
S.D.	1.32
	$P > 0.5$

Case 4—This girl was originally treated for bilateral dislocation without complication. A radiograph at the age of one year, however, disclosed a small cyst on the right side and an appearance of avascular necrosis was noted at two years (Fig. 9). At follow-up at eight years of age the hip was normal except that the right femoral head and neck were slightly larger than the left (Fig. 10).

DISCUSSION

The differences in opinion about the early treatment of congenital dislocation of the hip are hard to explain. Reports of a high incidence of complete or partial failure are surprising when compared with the good series that

have been recorded. It is true that the time of observation in many cases has been fairly limited; some workers have based their judgement of failure and success on radio-

treatment was ever really reduced in the first place. No doubt the firm regimen instituted by von Rosen has been a great advantage; only experienced hospital staff were



FIG. 8

Case 3—A radiograph taken at the age of 10 showing a steep acetabulum on the left side.

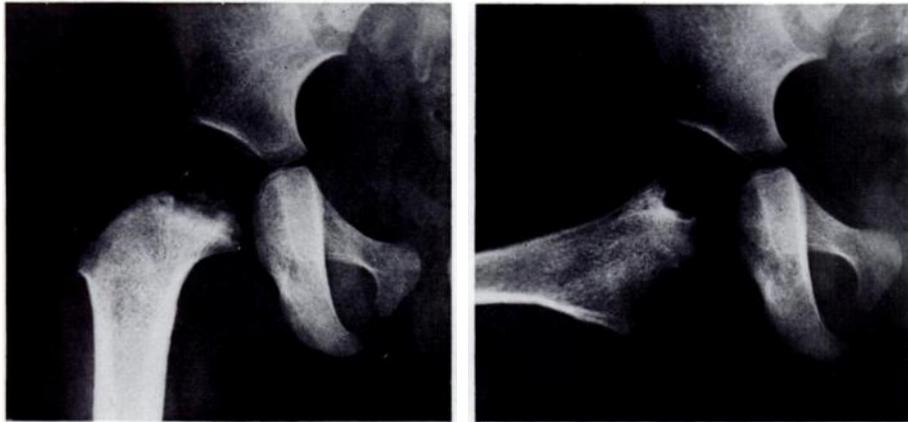


FIG. 9

Case 4—Antero-posterior and lateral radiographs of the right hip at 1 year.



FIG. 10

Case 4—A radiograph taken at 8 years.

graphs taken in much younger children than those reviewed here. Nevertheless, it seems unlikely to us that a hip found to be dislocated after three months of

allowed to remove the splint or to reapply it. This must be an insurance against redislocation during the first weeks of treatment.



FIG. 11

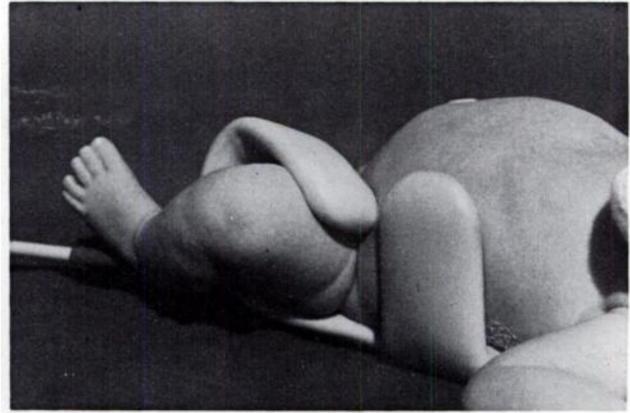


FIG. 12

Figure 11—A child asleep in a von Rosen splint properly applied. The resting position is 90 degrees of flexion and 60 to 70 degrees of abduction. The sole of the left foot is about to be stroked with a pencil. Figure 12—A closer view of the same child with the lower limb now withdrawn. Note the range of movement of the hip that occurred.

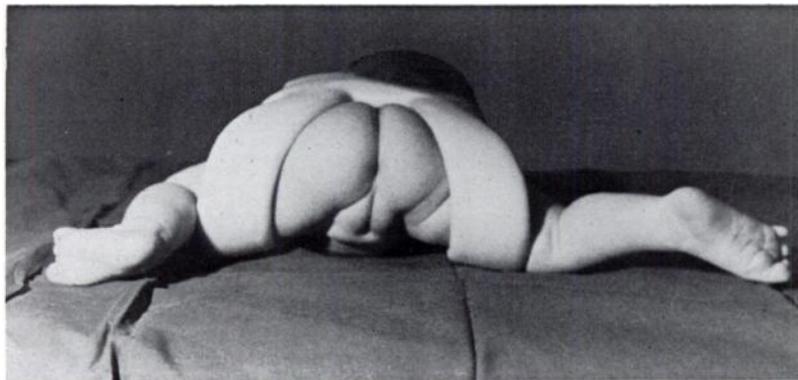


FIG. 13

Another photograph of the same child. The prone position is permitted and aids the toilet.

A dangerously high complication rate in early treatment has also been reported. Felländer, Gladnikoff and Jacobsson (1970) described osseous changes in the acetabulum and in the femoral epiphysis in 40 per cent of their cases, all treated as newborns in a modified von Rosen splint with rigid fixation. Mitchell (1972) described two cases of transient deformity of the hip after splint fixation, possibly due to avascular necrosis. Mears (1974) has suggested that avascular necrosis is such a common and harmful complication of treatment that the newborn child should not be subjected to it but rather operated on. In a recent editorial (*Lancet* 1974) a warning is issued against splintage for congenital dislocation based on records of avascular necrosis following treatment in plaster casts. If only children splinted within the first few days of life are considered, the first report of a case of avascular necrosis in its usual sense, or at least of a radiological finding consistent with early avascular necrosis, is in fact the single case in this series. We therefore maintain that avascular necrosis need be only a rare and benign complication of treatment begun in the newborn, a point of view shared by other investigators (Ponseti 1966).

Those who believe that rigid fixation of the hip of a young child is harmful may well be right. In the von

Rosen splint a certain amount of movement is allowed, whereas in modifications with straps this range may be considerably limited. The position of the child in the splint may also be of importance, as we have noticed in some papers describing attempts with the von Rosen treatment that the splint was not applied properly (Figs. 11 to 13). It must therefore be suspected that some failures with redislocation or subluxation are due to poor positioning.

The duration of treatment varied considerably in the present study. It has been suggested that six weeks are enough (Emnéus and Undeland 1970) and also that only dislocated hips require treatment (Barlow 1966), or dislocatable but not unstable hips (Finlay *et al.* 1967). Because treatment has caused no harm to the development of the hip joint in this series we continue to treat every suspect child for three months, irrespective of the degree of instability.

It is a common experience in follow-up studies of congenital dislocation of the hip that the functional results are better than the anatomical (Severin 1941). Consequently the absolutely normal clinical follow-up that was found might have been expected.

The appearance of an os acetabuli at an early age is supposed to be due to accelerated growth in a formerly dysplastic hip some years after reduction (Wiberg 1944

and 1953). In the present study all hips were reduced at birth and thereafter, with one exception, have developed normally. The two patients with missed dislocation, who are excluded from this report, had both developed an os acetabuli by the age of ten years. As a matter of interest, four missed cases have now been discovered among the 58,759 live births in Malmö from 1956 to 1972 inclusive and will be discussed in detail elsewhere (Fredensborg 1976). Suffice it to say that in none of these four children

can the failure in early diagnosis be explained by a study of the case history.

Radiologically the hip joints of 109 out of 111 children at the time of late follow-up were indistinguishable from normal. Only one child had a slightly dysplastic acetabulum, and another had a slightly large femoral head and neck. All of these children will no doubt be kept under observation at regular intervals, well into adult life.

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REFERENCES

- American Academy of Orthopaedic Surgeons** (1965) *Joint Motion. Method of Measuring and Recording*. Edinburgh and London: E. & S. Livingstone Ltd.
- Andrén, L.** (1960) Instability of the pubic symphysis and congenital dislocation of the hip in newborns. *Acta radiologica*, **54**, 123-128.
- Andrén, L.** (1961) Aetiology and diagnosis of congenital dislocation of the hip in newborns. *Der Radiologe*, **1**, 89-94.
- Andrén, L., and von Rosen, S.** (1958) The diagnosis of dislocation of the hip in newborns and the primary results of immediate treatment. *Acta radiologica*, **49**, 89-95.
- Barlow, T. G.** (1966) Early diagnosis and treatment of congenital dislocation of the hip in the newborn. *Proceedings of the Royal Society of Medicine*, **59**, 1103-1106.
- Bjerkreim, I.** (1974) Congenital dislocation of the hip joint in Norway. *Acta orthopaedica Scandinavica*, Supplement 157.
- Emnéus, H., and Undeland, K.** (1970) Två olika mönster för behandling av congenital höftledsluxation. *Opuscula medica*, **15**, 357-360.
- Felländer, M., Gladnikoff, H., and Jacobsson, E.** (1970) Instability of the hip in the newborn. *Acta orthopaedica Scandinavica*, Supplement **130**, 36-54.
- Finlay, H. V. L., Maudsley, R. H., and Busfield, P. I.** (1967) Dislocatable hip and dislocated hip in the newborn infant. *British Medical Journal*, **4**, 377-381.
- Fredensborg, N.** (1976) The effect of early diagnosis of congenital dislocation of the hip. *Acta Paediatrica Scandinavica*, **65**, 323-328.
- Hindley, C. B., Fillionat, A. M., Klackenberg, G., Nicolet-Meister, D., and Sand, E. A.** (1966) Differences in age of walking in five European longitudinal samples. *Human Biology*, **38**, 364-379.
- Lancet** (1974) Editorial, Iatrogenic hip disease. *Lancet*, **2**, 266-267.
- Mears, D. C.** (1974) Treatment of congenital dislocation of the hip. *Lancet*, **2**, 780.
- Mitchell, G. P.** (1972) Problems in the early diagnosis and management of congenital dislocation of the hip. *Journal of Bone and Joint Surgery*, **54-B**, 4-12.
- Ortolani, M.** (1937) Un segno poco noto e sua importanza per la diagnosi precoce di prelussazione congenita dell'anca. *Pediatria*, **45**, 129-136.
- Ponseti, I. V.** (1966) Non-surgical treatment of congenital dislocation of the hip. *Journal of Bone and Joint Surgery*, **48-A**, 1392-1403.
- Rosen, S. von** (1962) Diagnosis and treatment of congenital dislocation of the hip joint in the new-born. *Journal of Bone and Joint Surgery*, **44-B**, 284-291.
- Severin, E.** (1941) Contribution to the knowledge of congenital dislocation of the hip joint. Late results of closed reduction and arthrographic studies of recent cases. *Acta chirurgica Scandinavica*, Supplement 63.
- Weissman, S. L., and Salama, R.** (1966) Treatment of congenital dislocation of the hip in the newborn infant. *Journal of Bone and Joint Surgery*, **48-A**, 1319-1327.
- Weissman, S. L., and Salama, R.** (1969) Treatment of congenital dislocation of the hip in the newborn infant. *Journal of Bone and Joint Surgery*, **51-A**, 601-603.
- Wiberg, G.** (1939) Studies on dysplastic acetabula and congenital subluxation of the hip joint with special reference to the complication of osteoarthritis. *Acta chirurgica Scandinavica*, Supplement 58.
- Wiberg, G.** (1944) Pfannendachplastik bei Dysplasia acetabuli, Subluxatio and Luxatio coxae unter besonderer Berücksichtigung der Entwicklung des oberen Pfannenrandes. *Archiv für orthopädische und Unfall-Chirurgie*, **43**, 314-369.
- Wiberg, G.** (1953) Shelf operation in congenital dysplasia of the acetabulum and in subluxation and dislocation of the hip. *Journal of Bone and Joint Surgery*, **35-A**, 65-80.
- Williamson, J.** (1972) Difficulties of early diagnosis and treatment of congenital dislocation of the hip in Northern Ireland. *Journal of Bone and Joint Surgery*, **54-B**, 13-17.
- Wynne-Davies, R.** (1970) Acetabular dysplasia and familial joint laxity: two etiological factors in congenital dislocation of the hip. *Journal of Bone and Joint Surgery*, **52-B**, 704-716.