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Frejka pillow and Becker device for congenital dislocation of the hip: Prospective 6-year study of 104 late-diagnosed cases

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Frejka pillow and Becker device for congenital dislocation of the hip

Prospective 6-year study of 104 late-diagnosed cases

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During the period 1974–1986, 107 consecutive 1–9 month-old children with late-diagnosed congenital dislocation of the hip (CDH) were treated with a Frejka pillow primarily, followed by a Becker device. Treatment was initially successful in 96 cases with 2 not reduced, 4 failed stabilization, 4 persisting dysplasia, and 1 avascular necrosis. No correlation was found between age at the time of diagnosis or the severity of the dislocation and the duration or the result of treatment.

In those initially successful, 14 percent had slight dysplasia 6 months later. The last follow-up, at the mean age of 7 years, excluding the 11 children needing supplementary treatment, showed that 84 percent had normal hips on radiography, based on measurements of the acetabular angles and the center-edge angles. The clinical findings were normal.

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For late-diagnosed CDH, the most common treatment method is skin traction for reduction and plaster of Paris for stabilization (von Krämer 1975, Visser 1984). In the outpatient treatment for CDH in children under 1 year of age, the Pavlik harness has probably become the most commonly used method. While it seems to be simple, safe and successful, serious iatrogenic complications like avascular necrosis are still reported (Pavlik 1957, Ramsey and Lasser 1976, Johnson et al. 1981, Tönnis 1982, Grill et al. 1988) and the simplicity of the Pavlik harness has been disputed (Mubarak et al. 1981). The results of a recent study (Lempicki et al. 1990) demonstrated the Frejka pillow to be an alternative in outpatient treatment for CDH.

In 1974, a study of late-diagnosed CDH was started by one of us (JDB) to evaluate an outpatient reduction treatment in which the Frejka (1941) pillow, and the Becker (1969) device were used in turn. Based on good initial short-term results, this treatment was continued. We describe both short-term and late results of this treatment and attempt to assess whether the age at diagnosis or severity of dislocation was correlated with either duration or outcome of treatment.

Patients and methods

During the period 1974–1986, 107 consecutive children (age 1–9 months) were treated for congenital dislocation of one or both hips. None of them participated in our earlier-reported neonatal screening (Burger et al. 1990), and most were referred to our outpatient clinic when signs of CDH were found (hip instability, restricted abduction, leg length inequality, asymmetrical gluteal folds). Sometimes, a positive family history was the only reason for referral.

At the first visit to our outpatient clinic, the source, reason and age, as well as the family history (CDH in relatives up to the fourth degree) and the position in utero during the last quarter of pregnancy (cephalic or breech), were registered (Figure 1). A physical examination was performed with separate attention to hip instability, pathologic abduction (asymmetric and/or abduction below 60°), leg length inequality and asymmetric gluteal folds (regarded as pathological when other signs were present). On a frontal radiograph, Hilgenreiner's line was drawn at the inferior margin of the acetabular roof. Perkins' line was drawn from the most lateral point of the acetabular roof perpendicular to Hilgenreiner's line. The intersection of these lines, dividing the hip joint into quadrants, was used in a crude classification of normal and 3 grades of dislocation (Figure 2). Acetabular dysplasia was evaluated by the acetabular angle of Hilgenreiner, and categorized according to Tönnis (1987), subdividing angles above mean + 1SD and those above mean + 2SD. Avascular necrosis was classified according to Kalamchi and MacEwen (1980) in 4 severity ratings.

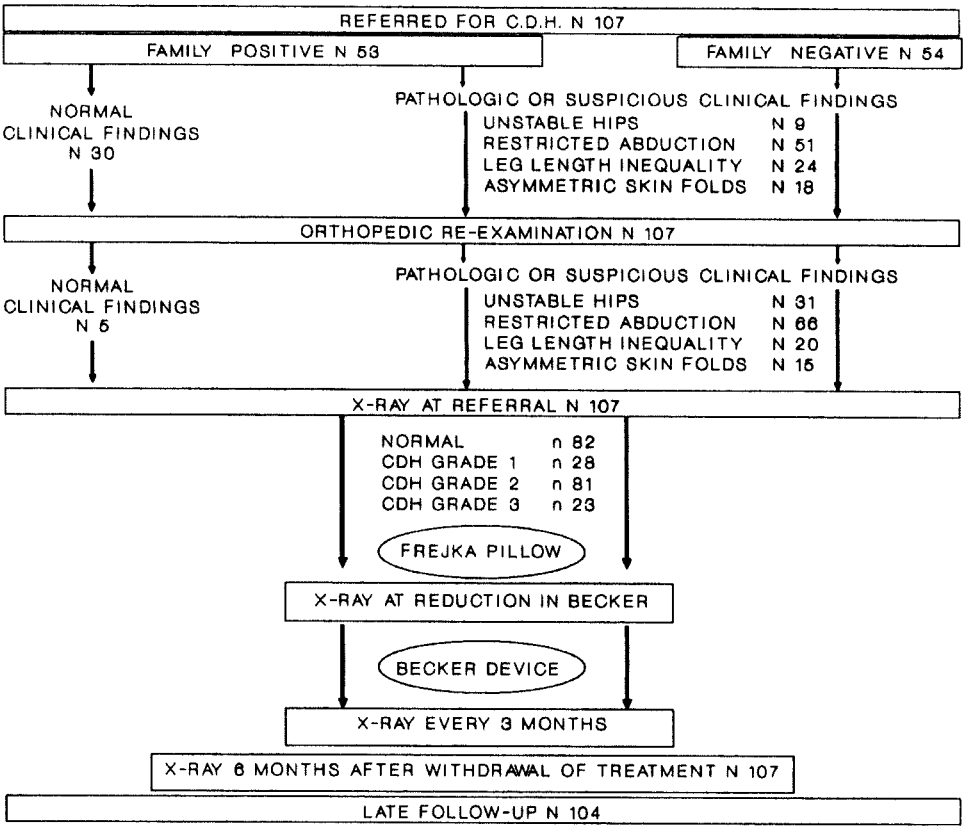

Figure 1. Schematic representation of protocol used for the study. N patient characteristics, n hip characteristics.

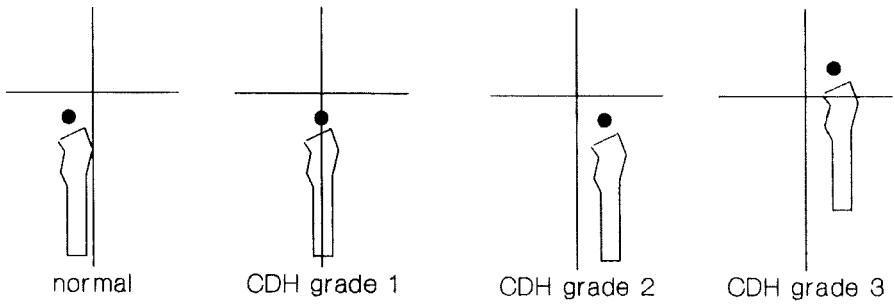

Figure 2. Crude classification of normal and 3 grades of dislocation.
Normal: the proximal femoral metaphysis is in the lower medial quadrant.
Grade 1: (subluxation) > 50 percent of the proximal femoral metaphysis is lateral to Perkins' line.
Grade 2: (dislocation) the proximal femoral metaphysis is in the lower lateral quadrant.
Grade 3: (high dislocation) the proximal femoral metaphysis is in the upper lateral quadrant.

The diagnosis

77 (72 percent) of the referrals were made from the national infant health care program: 49 by the infant health care physician and 28 by the family doctor. On the other hand, CDH was not diagnosed initially in 30 children. Of these, 25 were diagnosed by the pediatrician when the child was hospitalized for other reasons, while in 5 children the dislocation was discovered by the parents and referral took place at their insistence.

Included in Figure 1 are the main reasons for referral as well as the findings on re-examination at our

Table 1. Risk factors for CDH and severity of dislocation at diagnosis

Age in months at diagnosis	1–2	3–4	5–6	7–9	Total
Number of children	14	25	58	10	107
Family positive	9	12	27	5	53
Breech:head	3:11	2:23	6:52	1:9	11:96
Girls:boys	13:1	24:1	52:6	9:1	98:9
Number of hips	28	50	116	20	214
CDH Grade 1	2	5	18	3	28
CDH Grade 2	16	21	39	5	81
CDH Grade 3	0	5	14	4	23

Figure 3. Radiographic findings at diagnosis and radiographic results of treatment in a breech-delivered boy with negative family history who was referred at the age of 6 months.

Grade 3 dislocation at diagnosis (age 6 months).

Concentric reduction in Becker device (age 8 months).

Result 6 months after withdrawal of treatment (age 17 months).

Result at late follow-up (age 8 years).

outpatient clinic. In 30 children, a positive family history was the only reason for referral, although only 5 of these remained clinically normal after being re-examined by the orthopedist. Only 9 children had been referred with the diagnosis of an unstable hip, while the specialist examination revealed this condition in 31 children.

In 65 children the diagnosis was made before the age of 6 months. 92 percent of the children were girls, 53 had a positive family history, and 10 percent were in the breech position in utero (Table 1).

A shift to more severe Grade 3 dislocations was seen when the diagnosis was made later (Table 1) (P 0.04, Fisher's exact test). Nevertheless, a strong correlation between age and severity of dislocation was not observed (Pearson correlation coefficient 0.25; P 0.007). In 97 of the 214 dislocated hips, the acetabular roof angles were categorized above the mean + 2SD, according to the Tönnis (1987) criteria (Table 2). A strong correlation between age at the time of diagnosis and acetabular angle minus Tönnis' mean value, was not found (Pearson correlation coefficient 0.24; P 0.01).

Treatment started with the Frejka pillow to obtain gentle reduction. The control visits were scheduled once every two weeks. When a clinical reduction was assumed (i.e., stabilization of the hip, equalization of leg length and normalization of abduction), a plastic abduction splint (Becker 1969) was employed, and a radiograph of the hips was obtained in the device to confirm a concentric reduction. If reduction was not obtained, radiographs were taken monthly. After concentric reduction, control visits were scheduled every 3 months for physical examination and a radiograph. Treatment was discontinued when the acetabular roof angles were normal (Figure 3).

Table 2. Age, number of hips and mean acetabular roof angles with *SD* at diagnosis and follow-up

Group	1		2		3		4		Total	
At diagnosis										
Age in months	1–2		3–4		5–6		7–9		1–9	
Normal	10		19		45		8		82	
AC angle	27	*4.5*	28	*4.5*	23	*4.3*	23	*2.2*	25	*4.7*
Dysplasia >mean +SD	18		31		71		12		132	
AC angle	37	*4.2*	40	*5.3*	37	*4.9*	34	*5.2*	37	*5.1*
Dysplasia >mean +2SD	5		23		58		11		97	
AC angle	43	*1.3*	42	*3.8*	38	*4.1*	35	*5.2*	39	*4.7*
Short-term follow-up[a]										
Mean age in months	19	*6.9*	20	*7.5*	22	*6.4*	26	*8.0*	21	*7.0*
Dysplasia >mean +SD	1		4		13		1		19	
AC angle	29	*0*	24	*1.4*	25	*1.3*	25	*0*	25	*1.6*
Dysplasia >mean +2SD									0	
Late follow-up[a,b]										
Mean age in years	6.5	*2.5*	6.6	*2.6*	6.3	*2.5*	7.3	*2.5*	6.5	*2.6*
Dysplasia >mean +SD	4		2		15		1		22	
AC angle	21	*3.3*	22	*5.7*	21	*3.9*	23	*0*	21	*3.7*
Dysplasia >mean +2SD	1		1		4				6	
AC angle	24	*0.0*	26	*0.0*	26	*0.5*			26	*0.8*
Late follow-up[a,c]										
Mean age in years	7.2	*2.2*	6.6	*2.2*	6.8	*2.3*	7.7	*2.2*	6.9	*2.3*
Normal	19		36		78		17		150	
CE angle	29	*4.0*	26	*3.8*	26	*3.9*	28	*3.0*	27	*3.8*
Dysplasia	1		2		10		1		14	
CE angle	13	*0*	17	*2.8*	20	*3.8*	19	*0.0*	19	*3.8*

[a]Initial failures excluded.
[b]Age 3–14 years
[c]Age 4–14 years.

A short-term follow-up was performed 6 months after withdrawal of treatment. Between January 1989 and January 1990, all children received an invitation for a clinical and radiographic examination, approved by the ethics committee, to check the late results of treatment. The acetabular angles of Hilgenreiner were measured. In children over 4 years of age, the center-edge angles were measured (Wiberg 1939). The cut-off values of normal were chosen above 20° (age 4–8 years) and above 25° (8–18 years). Treatment was regarded as a failure if supplementary treatment was needed initially or because of relapse of dysplasia, and also if avascular necrosis developed.

Non-parametric data were analyzed with chi-square and Fischer's exact tests. Student's *t*-test was used to assess all radiographic data. Pearson's correlation coefficient was used to assess a possible correlation between the age at diagnosis or severity of dislocation with either duration or outcome of treatment. A significance level of 0.05 was used.

Results

Treatment and initial results

In all children, a Frejka pillow was used and was accepted without problems during the period of reduction. Initially, a very small pillow was needed in 4 patients with less than 50° of abduction. These pillows could be replaced by a larger pillow after 2 weeks. Installation of the Becker device never imposed more than 75° of abduction; nevertheless, a spontaneous maximum abduction (90°) was often seen. In all but the above-mentioned 4 patients, reduction was clinically assumed within 2 weeks, and therefore the Becker device was employed. In 60 children reduction was confirmed on the second radiograph; the average period until concentric reduction was 1.7 months. The treatment was initially successful in 96 patients (90 percent; Table 3) with an average time needed for normalization of the acetabular angle of 10 months. There was no correlation between the age at diagnosis and the duration of treatment needed for either reduction or normalization of the acetabular angles.

Table 3. Initial and short-term results of outpatient treatment in children with CDH

Group	1	2	3	4	Total
Number of children	14	25	58	10	107
Failed reduction	0	1	1	0	2
Failed stabilization	0	2	2	0	4
Dysplasia > mean+2SD[a]	0	0	3	1	4
Avascular necrosis	0	1	0	0	1
Initial success	14	21	52	9	96
Short-term success[b]	13	18	44	8	83

[a] Acetabular angle > mean values + 2 SD (Tönnis 1987).
[b] 6 months after withdrawal of treatment, initial failures excluded.

Table 4. Late follow-up after outpatient treatment for CDH

Group	1	2	3	4	Total
Number of children	12	21	50	10	93
Success[a]	9	20	40	9	78
Number of children	10	19	44	9	82
Success[b]	9	17	36	8	70

[a] Based on acetabular roof angle measurements, initial failures excluded.
[b] Based on center-edge angle measurements, initial failures excluded.

Follow-up of 96 patients with initially successful treatment

The short-term follow-up, 6 months after withdrawal of treatment, showed no re-dislocations. Hip characteristics using acetabular angles showed no differences between the age groups. Relapse of dysplasia was seen in 13 patients, giving an average short-term success rate of 86 percent (Table 3). Because the acetabular angles were within mean + 2SD (Table 2), no treatment was started.

For the late follow-up the response was 97 percent (n 93). Their average age was 6.5 years. They had no complaints and clinical examination was normal. 15 patients (28 hips), had residual dysplasia, and a deterioration of acetabular angles was seen in 5 patients (6 hips; Table 2). The late follow-up success rate with regard to acetabular angles was 84 percent (Table 2).

Treatment failures

Treatment was considered as a failure in 11 children (Table 3). In 2 children, open reduction was performed after failed closed reduction, because of an infolded labrum. In 4 patients, major instability persisted after successful reduction with the Frejka pillow. In these cases, the Becker device was insufficient, and immobilization with plaster of Paris was needed. Severe dysplasia with coxa valga antetorta was seen in 4 children and a rotational femoral osteotomy was performed at the age of 3 years. Grade III necrosis was seen in 1 patient who started treatment at the age of 3 months. Of the 11 patients with initial treatment failure, 6 patients had normal hips at late follow-up, after adequate supplementary treatment. In 5 children residual dysplasia was found, of these, 2 children (3 hips) had acetabular angles above mean + 2SD.

Discussion

Diagnosis and risk factors

The majority of our late-diagnosed cases of CDH were detected by the national infant health care program. At referral, clinical examination by the orthopedic surgeon revealed pathologic findings more frequently, indicating that the infant health care diagnosis was not as reliable as one might hope. An analysis of classic risk factors confirms their importance. The percentage of positive family histories was remarkably high, and the breech position was more common than in the general population. We think that radiographic or sonographic follow-up of these children is justified, even when the clinical examination is normal.

Corresponding to the results of Lempecki et al. (1990), a significant change in severity of the dislocation with age was found. It should be noted, however, that a detailed evaluation, requiring exact measurements on lateral and/or proximal displacement of the proximal femur (Terjesen et al. 1989), was not performed in our study. Nevertheless, our study showed that the percentage of Grade 3 dislocations increased, whereas the percentage of Grade 2 dislocations decreased with age.

Acetabular angles below mean + 2SD (Tönnis 1976) could be regarded as normal because one third of normal children have angles between 1SD and 2SD. However, it was assumed by Tönnis (1976) that it was better to include cases with angles between 1SD and 2SD for treatment because some of them became pathological. The increased frequency and deterioration of dysplasia seen in our study, supports the assumption that some hips with angles between 1SD and 2SD are at risk and perhaps should be treated.

Treatment

The combined Frejka-Becker treatment approximated the ideal device criteria (Johnson et al. 1981). In most patients, the Frejka pillow allowed gentle reduction and the Becker device maintained a concentric reduction. Both devices are simple in design and application, they permit mobility, and are inexpensive.

For outpatient treatment with the Pavlik harness, other studies report a success rate of 80–92 percent and femoral head necrosis in 0–7 percent (Pavlik 1957, Ramsey and Lasser 1976, Johnson et al. 1981, Mubarak et al. 1981, Tönnis 1982, Grill et al. 1988). Visser (1984) found in children whose treatment (traction/plaster of Paris) was started within the first 2 years of life a success rate of 93 percent and necrosis in 5 percent. Our results with the combined Frejka-Becker treatment correspond to the results of a recent follow-up study of outpatient treatment with the Frejka pillow (Lempicki et al. 1990), where an initial success rate of 90 percent was found and 5 percent permanent sequelae of necrosis. Thus the Frejka-Becker treatment was able to compete with the other methods with respect to both the initial success rate and the avoidance of avascular necrosis. The 2-failed closed reductions could be explained by an infolded labrum, but no cause was found for the failed stabilizations.

Since relapse of dysplasia at follow-up was also regarded as a treatment failure in our study, the primary success rate dropped to 86 percent. Unfortunately, other follow-up studies do not include exact specifications concerning acetabular angles and center-edge angles; nevertheless, they claim a healing rate of 80 percent (Grill et al. 1988), and a 95 percent normal or almost normal radiographic appearance in cases evaluated late (Lempicki et al. 1990). It should be noted that 6 percent (Grill et al. 1988) and 5 percent (Lempicki et al. 1990) of the hips required operation. Problems, like remaining adductor contracture, transient femoral-nerve palsy or poor compliance of the parents, as described in the study on pitfalls of the Pavlik harness by Mubarak et al. (1981), were not observed in our study.

The reduction treatment principle of the Frejka pillow probably differs from that of the Pavlik harness. To bring the axis of the femoral metaphysis towards the triradiate cartilage, the Pavlik harness induces a gentle increase of hip flexion, whereas the Frejka pillow induces both gentle flexion and abduction. The elasticity of the pillow serves as a built-in control mechanism, giving the desired flexion and abduction, without using force against the restrictions in motion of the hip. This elasticity replaces the strap adjustment needed in the Pavlik harness and the gradually increasing abduction used in the traction treatment.

We think that treatment of late diagnosed CDH is a 3 stage process. Following gentle reduction and stabilization, the third stage will lead to resolution of the acetabular dysplasia. Without concentric reduction, which should be confirmed by radiography in the Becker device, and stabilization, the recovery from dysplasia is not possible. To reduce the risk of a relapse, this third stage should not end until a normal acetabulum is obtained. A deterioration of both dislocation and dysplasia was expected when the diagnosis was made later but, surprisingly, this was not confirmed. On the other hand, this explained why duration of treatment did not increase when the diagnosis was made later.

In relapse of dysplasia, seen after initially successful treatment, it is uncertain whether an expectative treatment strategy is justified, since deterioration of dysplasia may occur. On the other hand, residual dysplasia was observed in some patients who received additional treatment with a rotational femoral osteotomy. Recent MR studies (Bos et al. 1991) indicate that, in some of these cases of dysplasia, a sufficient cartilaginous acetabular coverage is visualized; this might predict the possibility of spontaneous recovery.

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Good results after treatment with the Frejka pillow for hip dysplasia in newborns: a 3-year to 6-year follow-up study.

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Abstract

Because there is no consensus with regard to the efficiency of the Frejka pillow in the treatment of hip joint dysplasia in newborns, the aim of the present study was to evaluate our results with this device. During the 3-year period 1988 to 1990, the Frejka pillow was used in 108 newborns with clinically unstable hips verified by ultrasonography. There were three treatment failures (2.8%), defined as infants who needed additional treatment with an abduction splint or hip-spica cast. Avascular necrosis of the femoral head occurred in one patient (0.9%). At an age of 3 years to 6 years, 85 of the children attended a follow-up examination. An intoeing gait was observed in 17% and slightly reduced hip mobility in 20% of the patients. Compared with normal children, the patients had somewhat lower coverage of the femoral head by radiography, indicated by a lower centre-edge angle and a higher migration percentage, but the coverage was within the normal range in all cases. The mean anteversion angle was larger than that of normal children but only three patients had abnormally high anteversion angles. In conclusion, the results with the Frejka pillow were good, with few treatment failures and complications, and it is the most simple abduction device for the parents to handle. More rigid devices like the von Rosen splint seem to involve a slightly lower failure rate, but a higher risk of avascular necrosis. Therefore, we recommend the Frejka pillow when treatment is started within a few days of birth.

Comment in

- Good results after treatment with the Frejka pillow for hip dysplasia in newborn infants: a 3-year to 6-year follow-up study. [J Pediatr Orthop B. 2005]