The von Rosen splint compared with the Frejka pillow

A study of 408 neonatally unstable hips

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101 children in Tromsö, Norway, treated with the Frejka pillow for 4.5 months because of neonatal hip instability (NHI) were compared with 307 children in Malmö, Sweden, treated with the von Rosen splint for 3 months. The pelvic radiographs, taken when the treatment was terminated, were assessed by the acetabular index (AI) and the cases of failure were evaluated. The AI showed no difference between the two groups. The Frejka group had 4 patients who received further treatment because of remaining acetabular dysplasia and/or subluxation while the von Rosen group had none. The difference in risk of failure might partly be explained by different criteria for failure.

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Submitted 91-06-22. Accepted 92-04-09

The optimal treatment of neonatal hip instability (NHI) is still being debated. The advocates of the von Rosen splint claim that children treated with the splint for 3 months, as recommended in Malmö, develop hips that do not differ from normal controls at the age of 8–16 years (Fredensborg 1976). The advocates of the Frejka pillow claim that this treatment needs less supervision and is easier to handle. The von Rosen splint, for instance, must be removed and replaced only by an experienced nurse at the hospital, whereas the child with a Frejka pillow can be nursed at home (Hansson 1988). This practical reason is thus considered more important than the increased risk of failure when using the Frejka pillow (Hansson 1988). Also the risk of avascular necrosis of the femoral head when the von Rosen splint is not properly applied has to be considered (Mitchell 1972).

The aim of this study was to compare the outcome of two treatments, for two groups of children with neonatal hip instability diagnosed by the same screening method.

Patients and methods

In Malmö, Sweden, all newborn babies were screened for NHI according to Ortolani and Barlow (Palmén 1984) and 1.5 percent were treated in a von Rosen splint for 3 months. The hip joints were checked with an antero-posterior (AP) radiograph at the age of 3 months and 1 year.

In Tromsö, Norway, the neonatal screening for NHI was similar to that in Malmö and 1.8 percent of the children were treated with a Frejka pillow for 4.5 months. The primary radiographs were obtained at 4.5 months and further radiographs were obtained only in cases of doubt, usually at the age of 1 year.

In Malmö, 307 children consecutively treated for NHI over the period 1980–1984 were included in the study and the data were recorded prospectively. Dr. L. Danielsson, Head of Pediatric Orthopedics in Malmö, organized the treatment and the follow-up in Malmö and made all measurements.

In Tromsö, 89 children consecutively treated for NHI over the period 1983–1985, plus 12 children born in 1982 treated for NHI, were included in the study. The records and radiographs were analyzed retrospectively. 8 of the 101 radiographs could not be traced because of emigration, 2 were excluded because the quality of the radiographs was unacceptably low and 10 radiographs were obtained at the age of 5.5 months or later. The reason for postponing the examination in these cases was in most cases low parent compliance and in a few cases long distance or bad weather (Tromsö is the northernmost university hospital in the world). However, according to the records these 10 radiographs were all classified as normal.

The acetabular index (AI) was measured according to Lusted and Keats (1972). Adequate centering was

checked by measuring the foramen ovale according to Tönnis (1976) The interobserver error was evaluated by measuring 40 pelvic radiographs, 20 from Tromsö and 20 from Malmö—of children aged 3–12 months. The mean value of the AI was 21.4 ± 5.4 degrees when measured by L.D. and 22.0 ± 4.8 degrees when measured by T.H. The mean difference was thus 0.6 degrees ($P < 0.05$) and the 95 percent confidence interval was –5.2 degrees to +4.0 degrees (range –7 degrees to +4 degrees) (Bland and Altman 1986). The 307 radiographs from Malmö were measured by L.D. and the 81 from Tromsö by T.H.

Statistical methods used were the chi-square test and analysis of variance (ANOVA) for the comparison of the values of the Frejka pillow group with the mean 3 months' and 12 months' values of the von Rosen group.

Results

In Malmö none of the 307 children treated with the von Rosen splint needed any supplementary treatment and there was no failure of the treatment.

In Tromsö 4 girls among the 101 children treated with the Frejka pillow had supplementary treatment because of remaining acetabular dysplasia or subluxation diagnosed later ($P < 0.01$). All these girls developed normal hips.

Case 1

A girl born in breech presentation with a positive Ortolani test in the right hip. At the end of treatment, at the age of 4.5 months there was symmetric abduction of both hips and the acetabular index was 19 degrees bilaterally. The ossification of the right caput measured 6 mm and on the left side 4 mm. In a check-up at the age of 10 months a 0.5 cm shortening of the right leg was found, the abduction was 80 degrees bilaterally. The radiogram showed subluxation of the right hip. After traction and treatment in plaster the girl developed normal hips.

Case 2

A girl born in vertex presentation delivered by Cesarean section. Because of crepitation in the left hip and hip dysplasia in the mother, the girl was treated with a Frejka pillow. At the end of treatment the clinical findings were normal, but because of steep acetabula (AI 28/29 degrees) she was treated in an abduction orthosis for some months and developed normal hips.

Case 3

A girl born in vertex presentation with a positive Ortolani sign in both hips. At the termination of the treatment at the age of 4.5 months the clinical findings were normal. The acetabular indexes were 31 and 34 degrees. At a follow-up at the age of 9 months the abduction was 90 degrees bilaterally. On the basis of radiographic findings, dysplasia was suspected and the girl was treated in an abduction orthosis and plaster until she was 1 year and 7 months old. Because of increased anteversion and coxa valga she was operated on bilaterally with femoral osteotomies. At the age of 3 years there was no sign of dysplasia of the hips.

Case 4

A girl born by Cesarean section because of breech presentation and prolonged labor. Ortolani's sign was positive in the left hip. After 4.5 months' treatment with the Frejka pillow the hips were stable and the

Table 1. Acetabular index in children treated with the von Rosen splint or the Frejka pillow. Mean *SD*

	Girls			Boys		
	N	Right	Left	N	Right	Left
von Rosen splint 3 months	209	21.2 *4.3*	22.7 *4.6*	98	19.8 *3.7*	21.6 *4.3*
Frejka pillow 4.5 months	59	20.8 *4.6*	22.1 *4.0*	22	19.7 *4.4*	19.9 *4.5*
von Rosen splint 12 months	209	20.2 *2.8*	21.1 *2.9*	98	19.5 *3.2*	19.9 *3.0*

Table 2. The 10 percent percentile with the highest acetabular index (AI) in the von Rosen splint group and the Frejka pillow group

AI	von Rosen splint 3 months	Frejka pillow 4.5 months	von Rosen splint 12 months
24			7
25			22
26			11
27		3	8
28		3	3
29	21	3	4
30	19	5	5
31	9	1	1
32			
33	2		
34		1	
35	5		
36	1		
37			
38	4		

abduction was 90 degrees in both hips. The acetabular indexes were 26 and 30 degrees. At the age of 1 year a radiograph was made because of increased external rotation of the left hip. The acetabular index was 31 and 30 degrees and the hips were believed to be dysplastic. After treatment in an orthosis for 6 months there were no signs of dysplasia of the hips.

There was no significant difference in the acetabular index between children treated in a von Rosen splint or a Frejka pillow. As shown in Table 1 the acetabular index was higher on the left side ($P < 0.0001$) and in girls ($P < 0.0001$). When studying the 10 percent highest AI in both groups (Table 2) there was no difference in favor of the von Rosen splint.

Discussion

The criteria for inclusion in this study were the same in Tromsö and in Malmö and similar proportions of newborn infants were treated. Thus the two groups were assumed to be comparable.

A main aim of the treatment of NHI is to secure the retention of the femoral head within the acetabulum and thereby to promote the normal development of the hip (Visser 1984). One possible explanation for the four failures in the Tromsö group could be that the Frejka pillow has to be removed when changing napkins and in children with extreme hip instability the hip may dislocate and not become reduced again when the pillow is replaced (Hansson 1988). However, in this retrospective study we cannot be sure that there was a subluxation or that the "dysplasia" needed treatment because radiological and clinical findings can be misleading (Bowyer et al. 1985).

Although there is agreement on the anatomical definition of dislocation, subluxation and dysplasia, there are no strict clinical or radiological criteria that can be used in a retrospective study (Palmén 1984, Visser 1984). There is also a strong likelihood of spontaneous normalization if only acetabular dysplasia is present (Pratt et al. 1982). Thus, the significantly higher rate of failures in the Frejka pillow group can at least partly be due to different criteria for failure and/or different indications for treatment. However, this study supports the opinion that the von Rosen splint is superior in this respect (Hansson 1980, 1988).

In the radiological assessment of acetabular dysplasia the AI index is the most helpful measurement up to the age of 8 years (Broughton et al. 1989). Although we found a systematic difference between the readings of L.D. and T.H. it was very small and would not alter the interpretation of our data, for instance, if the difference was added to the mean values of the von Rosen group. The confidence interval in our study was also slightly smaller than the intra- and inter-observer difference of Broughton et al. (1989).

Although AI is considered to be the most reliable radiographic variable when evaluating the hips in this age group (Broughton et al. 1989) one must be aware of the fact that a dislocated hip often has a high AI, but that there is also a biological variation.

Tönnis' (1976) definition of severe dysplasia is just a mathematical calculation in a normal population where those above 2 SD (2.5 percent) are recommended for treatment. For instance, at the age of 3–4 months the unacceptable value for the left hip in girls is 38.7 degrees and for the right hip in boys 32.4 degrees. Since we know that CDH is more common in girls and on the left side (Palmén 1984), it is not acceptable that 6.3 degrees higher values should be admissible for these cases. The progression of a value over a series of radiographs in the same child is much more valuable than a single measurement, and often a verbal description is more useful (Broughton et al. 1989).

Compared with Tönnis' (1976) normal values there was a remarkably low decrease in AI between 3 and 12 months. That is, the AI values in our series are lower compared to Tönnis' values at the age of 3 months. It is possible that the treatment with a von Rosen splint speeds up the development of the hip in those hips that would otherwise probably have had higher values than normal, since the children were selected because of NHI. The continued normalization of the most extreme values between 3 and 12 months, without further treatment, as shown in Table 2, indi-

cates that further treatment in abduction is not necessary as long as the hips are stable.

In this study the majority of hips would probably have become normal without any treatment at all, since about 1.5 percent of all newborn infants were treated and only about 0.1 percent would have devloped unmistakable CDH without screening and about 0.3 percent subluxation or dysplasia of the hip (Palmén 1984). This makes the 10 percent with the highest acetabular index interesting since some extreme values because of CDH could be present without any noticeable effect on the mean value and the standard deviation. In Table 2 some of the AI at 3 months would have been classified as severe dysplasia according to Tönnis (1976) and thus according to his recommendation would have required further treatment. However, as shown in Table 2 they were all normal at the age of 1 year.

Our study demonstrated that treatment with a Frejka pillow was sufficient for the development of a bony acetabulum in most cases. However, there appears to be a greater risk of failures because of redislocation when the Frejka pillow is chosen—maybe because the pillow has to be removed when changing napkins or perhaps because of too little fixation in hips that are very unstable. The risk of avascular necrosis is very small, if any, when the treatment with the von Rosen splint is started within the first days of life and given as recommended in Malmö. If, instead, the Frejka pillow is chosen for practical reasons one must be aware of the risk of later acetabular dysplasia and/or subluxation.

In conclusion, the von Rosen splint treatment and the Frejka pillow treatment for NHI gave similar results as concerns the development of the bony acetabulum. The difference in risk of failure can partly be explained by the different criteria for failure but, as in earlier studies, there was an increased risk of failure with the Frejka pillow.

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