Hip instability in myelomeningocele

158 patients followed for 15 years

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In 158 patients with myelomeningocele, the prevalence of hip dislocation at birth and subluxation or dislocation of unoperated on hips at 2 and 15 years of age were assessed. In neonates examined during the first 10 weeks of life, 10 percent of the hips were dislocated. In children with a thoracic or L1-2 neurologic level, the cumulative incidence of dislocated hips increased from 8 to 26 percent and subluxations from 33 to 45 percent. In children with L3 and L4 levels, one fourth of the hips had dislocations and nearly half subluxations. At L5 and the sacral motor level, dislocations did not occur, but one fifth of the hips had subluxations. Children with L3 or L4 neurologic levels had bilateral hip dislocation at an earlier age than those with higher levels of paralysis. There appears to be no risk of developing hip dislocation at neurologic levels below L4, and spasticity promotes hip dislocation above L3.

In patients with myelomeningocele, one or both hips may be dislocated at birth, but more frequently instability resulting in subluxation or dislocation develops gradually. There appears to be no elaborate analysis of long-term follow-up in nonoperated on patients. Our aim was to study the relationship between the neurologic level of paralysis and spasticity on the one hand and hip subluxation and dislocation on the other.

Patients and methods

The series consisted of 85 males and 73 females treated before 1985 at Karolinska Hospital in Stockholm or at the Medical Center Hospital in Örebro. Previous hip operations performed during the course of the disease to prevent or treat hip dislocations made us exclude 81 hips in 50 patients. In neonates the lack of a radiologic method permitting retrospective assessment of subluxation made us choose to record only unequivocal dislocations. Further evaluations of the hips were based on radiographs obtained at approximately 2 years of age and at a clinical and radiographic follow-up at the mean age of 15 (2–40) years. There were no reliable assessmentsof the neurologic level at 2 years of age useful for retrospective assessments. The definition of subluxation and dislocations given by Eklöf et al. (1988) using the percentage of migration was applied (Figure 1). The upper normal value of the percentage of migration is 16 in children < 4 years of age, 19 in children 4–8 years old, 22 in children 8–12 years old, and 24 in children above 12 years of age. Subluxation includes all the values between the upper normal value and 80 percent, which is defined as a dislocation in each age group (Cooperman et al. 1987).

The findings were correlated with the motor level of the lesion, neurologic deterioration, and spasticity of the legs. The motor level of deficit was defined as the lowest level at which the patient could perform an antigravity movement through the available range of joint mobility (Lindseth 1976).

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Results

Neonates. Four out of 92 neonates examined during the first 10 weeks of life had bilateral and 10 unilateral hip dislocation. Bilateral dislocation of the hips

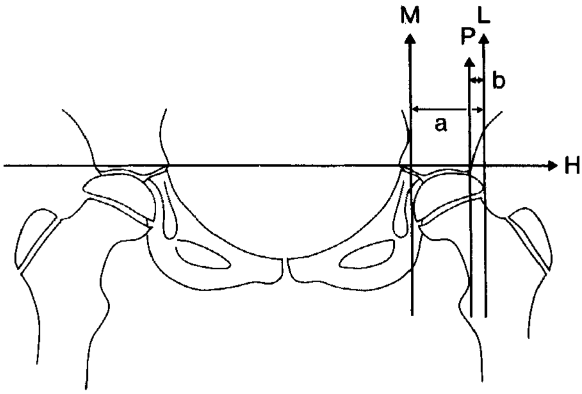

Figure 1. Determination of the percentage of migration of the hip (100b/a). H = Hilgenreiner's horizontal. P = Perkins' line. L = lateral and M = medial perpendicula to the horizontal H, tangential to the femoral head.

Table 1. Correlation between neurologic levels and dislocation at birth (n 18)

	Dislocated	
	Both hips	One hip
Thoracic	-	4
L1–L2	-	1
L3	2	2
L4	2	2
L5	-	1

Table 2. Correlation between neurologic levels, subluxation, and dislocation in hips (*n* 190) unoperated on at 2 years of age

Level	Number of hips	Normal	Subluxated Both hips	Subluxated One hip	Dislocated Both hips	Dislocated One hip
Thoracic	59	34	7	6	-	5
L1–L2	8	5	1	1	-	-
L3	35	12	6	4	3	1
L4	38	13	7	6	1	3
L5	22	19	-	2	-	1
Sacral	28	28	-	-	-	-

Table 3. Correlation between neurologic levels, subluxation, and dislocation in hips (n 235) unoperated on at follow-up

Level	Number of hips	Normal	Subluxated Both hips	Subluxated One hip	Dislocated Both hips	Dislocated One hip
Thoracic	44	13	3	14	2	7
L1–L2	5	1	-	2	-	2
L3	24	8	2	5	3	1
L4	46	17	7	5	4	2
L5	32	19	6	1	-	-
Sacral	84	75	2	5	-	-

Table 4. Correlation between neurologic levels and lower limb spasticity in patients with hip dislocation unoperated on at follow-up

Level	Number of hips	Spastic Both hips	Spastic One hip
Thoracic	11	2	3
L1–L3	2	-	2
L3	7	-	-
L4	10	-	-

was seen only with lesions at the L3 and L4 levels, whereas five unilateral dislocations were seen above L3 (Table 1).

Two years of age. Radiographs of the hips of 97 children (Table 2). Four hips operated on were omitted from this evaluation. One hundred and eleven hips were normal. Twenty-one children had bilateral and 19 unilateral subluxations. Bilateral dislocation was found in 4 and unilateral dislocation in 10 patients.

Follow-up. At follow-up, 133 out of 235 unoperated on hips in 127 patients were normal (Table 3). Twenty patients had bilateral and 32 unilateral subluxated hips. Bilateral dislocation was seen in 9 patients and a unilateral dislocation in 12. Dislocation was associated with spasticity below the lesion in 9 of 13 hips at the thoracic or L1–2 motor levels as compared with none of 17 hips at lower level motor deficits (Table 4). Data for all the patients in the study are shown in Table 5.

Table 5. Data for 158 patients with myelomeningocele showing the relation between neurologic level, hip subluxation, or dislocation in nonoperated on hips

A	B	C	D	E	F	G	H
1	Th	2	2	1	1	6	1
2	L5	2	2	1	1	6	6
3	L3	2	2	1	1	6	6
4	Ll-2	2	2	1	1	1	6
5	Ll-2	2	2	3	3	3	5
6	Th	2	4	1	4	3	4
7	L3	2	2	3	3	6	1
8	L4	2	4	1	4	1	4
9	Th	2	2	3	3	3	5
10	L5	2	2	1	1	3	3
11	S	-	-	-	-	1	1
12	Th	-	-	-	-	1	3
13	S	-	-	-	-	3	3
14	L5	2	2	1	1	1	1
15	L3	2	2	3	3	6	1
16	Th	2	2	1	1	3	3
17	L4	2	2	1	3	6	6
18	L4	2	2	1	1	1	1
19	L3	2	2	1	1	6	6
20	L5	2	2	1	1	1	1
21	S	2	2	1	1	3	1
22	Th	2	2	3	1	3	6
23	S	-	-	-	-	1	1
24	S	2	2	1	1	1	1
25	L3	2	2	3	1	6	6
26	L4	-	-	-	-	3	1
27	L3	2	2	1	3	3	6
28	S	-	-	-	-	3	3
29	Th	2	2	1	1	3	4
30	S	2	2	1	1	3	1
31	L4	2	2	1	1	3	1
32	Th	2	2	1	1	5	5
33	Th	2	2	1	1	5	1
34	L5	-	-	-	-	1	1
35	L3	-	-	4	4	6	6
36	L4	2	2	3	3	6	6
37	Th	4	2	4	1	6	6
38	S	-	-	-	-	1	1
39	L4	-	-	-	-	1	1
40	Th	2	2	3	3	1	6
41	L5	-	-	-	-	6	1
42	S	2	2	1	1	6	6
43	L3	2	2	1	1	1	3
44	Th	-	-	3	4	3	4
45	L4	2	2	3	3	3	3
46	Th	2	2	1	1	6	6
47	L3	2	2	3	3	3	3
48	S	2	2	1	1	1	1
49	L5	-	-	-	-	3	3
50	L5	-	-	-	-	3	3
51	S	-	-	-	-	1	1
52	L4	2	2	3	4	6	6
53	S	2	2	1	1	1	1
54	L4	2	2	3	3	3	3
55	L3	2	2	-	-	6	6
56	S	-	-	-	-	1	1
57	L4	-	-	-	-	3	3
58	S	-	-	-	-	1	1
59	L1-2	2	2	1	1	5	3
60	L4	2	4	3	6	4	6
61	L3	4	4	-	-	6	6
62	S	-	-	-	-	1	1
63	L4	2	2	3	3	6	6
64	Th	-	-	-	-	3	1
65	S	-	-	-	-	1	1
66	Th	2	2	3	3	6	6
67	L5	2	2	1	1	1	1
68	L1-2	4	2	3	1	6	6
69	S	2	2	1	1	1	1
70	L4	2	2	-	-	4	4
71	Th	-	-	6	1	6	3
72	L3	-	-	3	3	1	6
73	Th	2	2	1	1	1	1
74	Th	-	-	-	-	6	1
75	L3	2	4	3	6	6	6
76	S	-	-	1	1	1	1
77	L4	-	-	-	-	1	3
78	S	-	-	-	-	1	1
79	L5	-	-	3	1	3	1
80	S	-	-	-	-	1	1
81	S	-	-	-	-	1	1
82	S	2	2	1	1	1	1
83	S	-	.	-	-	1	1
84	S	-	-	-	-	1	1
85	L5	-	-	-	-	1	1
86	L4	-	-	-	-	1	6
87	Th	2	2	1	1	3	3
88	L4	4	4	4	4	6	6
89	S	-	-	-	-	1	1
90	L3	2	2	3	3	3	6
91	S	-	-	-	-	3	1
92	S	-	-	-	-	3	1
93	L4	2	2	3	3	3	3
94	L5	2	2	1	1	1	1
95	L3	-	-	-	-	4	4
96	Th	2	2	3	3	5	5
97	Th	2	2	1	1	-	-
98	L5	-	-	-	-	1	1
99	S	2	2	1	1	3	1
100	Th	2	2	1	3	6	6
101	S	-	-	-	-	3	1
102	S	-	-	-	-	1	1
103	L3	4	4	4	4	4	4
104	Th	2	4	3	4	3	6
105	L3	2	2	3	4	6	6
106	S	-	-	-	-	1	1
107	L4	2	2	3	1	6	6
108	L4	2	2	3	3	3	1
109	Th	2	2	1	1	1	3
110	L5	2	2	1	1	3	3
111	S	2	2	1	1	1	1
112	Th	2	2	3	3	6	6
113	S	-	2	-	-	1	1
114	L4	4	4	-	-	6	6
115	L4	2	2	1	1	6	6
116	S	-	-	-	-	1	1
117	L4	-	-	-	-	1	1
118	Th	2	2	3	3	6	6
119	L5	4	2	4	3	6	1
120	Th	2	2	1	1	1	1
121	L4	2	2	3	6	6	6
122	Th	2	2	1	1	-	-
123	S	2	2	1	1	1	3
124	Th	2	2	1	3	1	3
125	S	-	-	-	-	1	1
126	L4	2	2	1	1	3	3
127	S	-	-	-	-	1	1
128	S	-	-	-	-	1	1
129	S	-	-	-	-	1	1
130	L3	4	2	-	-	6	6
131	Th	-	-	-	-	3	6
132	L3	-	-	-	-	1	6
133	L3	-	-	-	-	1	1
134	S	2	2	1	1	1	1
135	L5	-	-	-	-	1	1
136	L4	-	-	-	-	1	1
137	L3	2	2	3	3	6	6
138	L3	2	2	1	1	3	3
139	L4	-	-	-	-	3	1
140	L3	-	-	-	-	3	1
141	L4	-	-	4	3	4	1
142	Th	2	2	3	3	3	3
143	L4	-	-	-	-	4	4
144	L1-2	-	-	-	-	6	6
145	Th	2	2	1	1	3	6
146	Th	4	2	4	1	5	3
147	L4	2	2	1	1	3	3
148	L4	-	-	-	-	1	1
149	L5	-	-	1	1	3	3
150	L4	-	-	-	-	1	3
151	Th	-	-	1	3	4	3
152	L3	2	2	1	1	3	4
153	S	-	-	-	-	1	1
154	S	-	-	-	-	1	1
155	S	-	-	1	1	1	1
156	L3	2	2	4	4	4	4
157	L5	2	2	1	1	3	3
158	L4	2	2	3	3	4	4

A Case
B Neurologic level
C Degree of lateral migration of the right hip at birth
D Degree of lateral migration of the left hip at birth
E Degree of migration of the right hip at 2 years of age
F Degree of migration of the left hip at 2 years of age
G Degree of migration of the right hip at follow-up
H Degree of migration of the left hip at follow-up (Median age 14.6 years)

C–H
1 Normal
2 Normal or subluxed
3 Subluxed
4 Dislocated
5 Dislocated and leg spasticity
6 Previously operated on hip

Discussion

Muscular imbalance caused by the underlying neurogenic abnormality complicates the treatment of patients with myelomeningocele (Lindseth 1976, Stark and Baker 1967). Gradually impaired coverage of the femoral heads is easily overlooked both clinically and radiographically.

The concept of subluxation has been rather vaguely defined (Carroll and Sharrard 1972, Stillwell and Menelaus 1983). The reintroduction of the migration percentage (Reimers 1980) and establishment of new standards of normal variations have facilitated the radiographic interpretation of the position of the femoral heads (Eklöf et al. 1988). As pointed out by Cooperman et al. (1987), a lateralization of the femoral head exceeding 80 percent implies dislocation. We have adopted this concept, because beyond this point more of the weight-bearing forces are directed laterally than upwards.

The preponderance of early dislocations in patients with motor deficits below the levels L1–L2 is mainly explained by strong, unopposed adductors and flexors of the hips, sometimes active already before birth. Unilateral subluxation or dislocation may develop later owing to a weaker influence of autonomous activity of an isolated cord segment below the lesion (Stark and Baker 1967), especially in patients with levels above L3.

Our 7 percent rate of hip dislocation at 2 years of age in patients with neurologic deficits above the L3 level differs markedly from the 45 percent incidence reported by Carroll and Sharrard (1972). Looking specifically at patients with L3–L4 motor deficits, they reported 53 percent of the hips to be dislocated as compared with only 15 percent in the present material. Furthermore, when compared with previous reports, our incidence of dislocated hips at follow-up was lower at most levels of motor deficit (Carroll and Sharrard 1972, Lindseth 1976). Differences in appreciation of muscular strength when defining each neurologic level may explain some of these discrepancies. Verbally defined hip instability may also prove difficult to interpret and is therefore apt to cause misinterpretations rendering comparisons difficult.

Lower-limb spasticity and hip dislocation proved to be associated only with thoracic and L1–L2 levels of motor deficit, which indicates that spasticity seems to promote hip dislocation (Table 4). Spasticity may also be an expression of a changing motor pattern and contribute to late dislocations as shown by Samuelsson et al. (1987). In agreement with other reports, we had no patients with dislocation and a sacral level lesion (Carroll and Sharrard 1972, Lindseth 1976). In addition, only 11 percent of the hips of patients belonging to this category were subluxated at follow-up.

Universal acceptance of criteria defining neurologic levels of motor deficit, subluxation and dislocation of the hips would facilitate future comparisons of treatment. The neurologic classification proposed by Lindseth (1976) together with conventional spinal radiographs facilitate a reasonably safe and early prediction of which hips will remain stable. Hips at risk should be followed by serial determinations of migration (Eklöf et al. 1988). However, as demonstrated in this series, far from all subluxated hips turn into manifest dislocations. An individual approach considering the influence of associated anomalies will probably prove most rewarding.

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