Osteotomy for femoral anteversion

A prospective 9-year study of 52 children

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Fifty-two children with increased femoral anteversion had bilateral derotational subtrochanteric osteotomies at a mean age of 7 years. They were followed prospectively until at least 15 years of age; the mean observation time was 9 years. They were a subset of 95 children whose 2-year results were reported in 1989. The mean increase of femoral anteversion after the osteotomy was 6° (0.7° per year) and of the neck-shaft angle 5°. The CE angle did not increase. Although we at present practice a more restrictive attitude towards operation of increased femoral anteversion, our study showed that a derotational osteotomy is effective in eliminating the intoeing gait and associated complaints, and the hip angles change only moderately during the remaining period of growth.

Very few studies exist regarding the long-term results of operative treatment for increased femoral anteversion (AV; Scholder 1979, Reikerås and Bjerkreim 1982). Gross recurrence (up to 40°) of the AV angle after a derotational osteotomy has been reported (Kleine 1961, Mittelmeier and Jäger 1969).

The aim of the present work was to analyze the development of the femoral neck angles, the hip rotation, and the intoeing gait during growth after a derotational osteotomy.

Patients and methods

The series comprised 52 patients (31 girls and 21 boys; Table 1). Bilateral subtrochanteric osteotomy, with plate fixation, was performed. These children were part of a series of 95 children treated operatively for increased femoral anteversion (Svenningsen et al. 1989b).

The mean age at operation was 7 (5–13) years, and at the last control 16 (15–18) years. The mean observation time was 9 (5–11) years. Nine children with neonatal hip instability had been treated with a Frejka pillow for 4 months. One girl in addition was treated with a hip spica for 3 months. In 1 patient, hip dysplasia was discovered at 4 months of age, and this girl was treated with a hip spica for 3 months. None of the children had known neuromuscular diseases.

The study was prospectively designed. The patients were examined in the same way preoperatively and postoperatively at 4 months, 1 year, 5 years; and the last examination was performed when the children had reached the age of at least 15 years. At this age, the growth plates of the proximal femur were closed in all the girls and almost closed in the boys. The clinical and the radiographic examinations were performed as previously described (Svenningsen et al. 1989a, b). All the children attended the follow-up examination.

Statistics. Nonparametric tests were performed using the Wilcoxon's two-sample test and the rank correlation test. *P*-values below 0.05 were considered significant.

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Results

Femoral anteversion. The AV angle increased ($P < 0.0001$) during the follow-up period of 9 years

Table 1. Observations in 52 children after osteotomy for femoral anteversion

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	X	Y
1	2	5	15	20	27	23	25	22	24	20	25	118	105	120	110	126	116	32	34	24	27	36	35
2	1	9	15	−9	−6	−15	−8	−23	−10	−23	−10	130	125	133	125	133	127	32	34	24	27	24	27
3	1	7	16	5	5	5	5	5	5	5	6	130	110	132	118	132	123	16	16	24	21	22	18
4	1	8	17	23	19	24	22	22	22	22	18	128	128	132	134	138	136	31	28	31	31	32	32
5	2	9	18	8	2	7	0	6	4	5	−2	135	135	136	136	137	139	24	21	23	24	27	29
6	2	9	18	−5	10	−5	10	2	13	−3	5	135	135	137	138	137	137	23	25	30	30	31	31
7	1	5	16	−4	0	0	4	9	7	19	10	126	126	138	140	133	133	23	25	30	30	31	31
8	2	5	15	9	−6	10	−6	14	−2	21	5	128	120	135	124	138	126	30	25	30	20	23	20
9	1	6	15	−12	−5	−15	−5	−5	6	−1	12	118	123	137	129	136	129	30	25	30	20	23	20
10	2	6	16	7	3	7	3	11	8	9	2	128	125	136	135	137	138	22	25	28	26	24	24
11	1	8	17	−10	10	−10	10	15	25	15	25	118	115	125	120	130	127	40	40	30	32	25	28
12	2	6	15	−6	−20	0	−10	1	−4	−2	−4	120	118	126	130	129	132	35	35	25	25	30	26
13	1	6	15	1	−2	2	0	2	0	−4	−4	132	130	128	128	127	132	25	22	24	26	30	30
14	2	6	15	18	6	17	7	25	15	20	16	115	120	122	124	124	128	30	26	30	30	26	30
15	2	7	15	20	−4	20	−4	19	−5	25	4	120	115	126	116	135	122	27	27	25	27	40	34
16	2	5	15	27	26	28	27	14	20	7	20	130	127	133	131	131	131	28	26	31	28	40	32
17	1	6	15	0	0	2	4	0	0	9	11	110	115	120	120	123	123	33	32	30	30	28	32
18	1	10	15	0	26	5	28	3	24	3	24	138	148	138	148	143	148	35	38	31	33	31	33
19	1	7	15	−20	−5	−17	−4	−14	0	−15	−5	125	125	131	134	135	137	20	20	18	18	17	22
20	2	5	15	0	0	3	3	12	12	14	14	120	120	122	120	129	125	35	35	30	34	30	30
21	1	10	15	7	7	7	4	6	3	6	3	135	135	130	134	132	132	40	40	38	38	38	38
22	1	6	15	2	−2	3	2	13	12	15	15	127	127	138	140	139	144	25	20	25	24	26	22
23	1	13	18	−13	3	−13	4	−10	6	−7	3	125	124	125	130	126	134	32	30	28	30	28	30
24	1	8	16	5	0	5	5	10	3	7	7	120	120	123	123	125	125	22	22	21	26	21	26
25	2	5	15	0	0	3	5	10	15	20	23	112	129	123	132	130	137	30	30	28	25	30	30
26	1	6	15	15	3	15	4	26	20	20	13	117	115	127	128	129	129	34	34	37	31	35	35
27	1	8	16	−12	5	−8	3	−7	1	−5	3	131	130	138	128	137	133	33	31	35	35	38	39
28	1	9	18	2	0	10	−2	8	3	3	1	128	130	138	131	140	131	37	40	33	34	31	26
29	1	6	15	0	3	4	6	14	12	10	10	116	116	124	124	125	125	36	36	35	36	35	35
30	1	7	15	−13	2	−12	5	0	20	1	14	130	135	133	138	139	140	28	26	38	28	36	30
31	1	5	15	4	2	6	3	5	11	13	10	118	120	130	129	131	126	25	30	27	25	25	32
32	2	5	15	0	5	5	7	8	17	13	15	120	123	123	120	126	126	16	18	22	28	25	30
33	1	6	15	−3	0	−2	5	−2	4	0	5	120	125	125	129	129	129	25	23	35	35	28	28
34	1	6	15	−5	−1	−5	−1	3	5	−4	−1	118	117	121	121	122	123	25	29	30	30	23	23
35	2	13	18	18	5	15	5	15	7	15	7	130	128	132	128	132	128	29	30	24	22	30	30
36	1	8	15	−1	3	2	5	−1	5	5	8	125	123	128	126	131	129	28	27	40	40	38	36
37	1	6	15	0	0	0	5	14	13	14	15	135	135	136	134	139	136	22	29	25	28	33	35
38	2	7	15	−7	10	−7	10	−4	11	−2	18	125	130	124	134	130	137	31	31	25	28	33	35
39	1	10	15	−3	−2	0	1	3	4	3	4	121	128	121	127	121	127	50	50	50	60	50	60
40	2	11	16	34	28	31	26	34	23	34	23	152	143	153	146	153	146	45	45	45	45	50	45
41	1	10	15	3	−5	0	10	10	−2	6	−4	127	125	135	129	135	129	32	30	22	25	22	25
42	2	6	15	0	0	5	5	12	17	14	17	130	130	136	138	144	139	21	21	17	20	17	23
43	2	6	15	13	10	15	10	29	21	31	21	127	123	139	130	135	130	30	30	30	21	30	30
44	1	8	15	0	0	−3	0	−2	3	6	6	126	123	132	127	135	130	35	35	37	37	35	35
45	2	8	16	0	6	−2	6	2	12	1	10	143	143	146	146	141	144	41	42	43	42	40	39
46	1	8	16	20	15	30	19	28	20	23	19	130	130	135	135	132	131	23	25	26	26	20	25
47	1	7	15	−2	−3	2	−1	3	0	3	0	118	120	125	130	125	130	35	37	34	34	35	35
48	1	10	15	4	6	8	13	13	14	13	14	128	129	129	134	129	134	42	42	31	36	31	36
49	2	10	15	1	4	5	10	5	9	5	9	137	137	145	145	145	145	40	43	32	36	32	36
50	2	5	15	0	0	2	1	12	10	12	14	105	120	117	130	118	130	31	28	34	34	33	38
51	1	5	15	2	−4	4	−2	11	7	14	14	124	117	120	123	122	125	33	34	35	34	36	36
52	2	5	16	10	18	11	16	20	22	22	23	110	115	120	123	122	125	34	30	34	27	34	30

A Case (the same case number as in Svenningsen et al. 1989b)
B Sex: 1 female, 2 males
C Age at operation (years)
D Age at the last control (years)
E AV angle right hip 4 months postoperatively
F AV angle left hip 4 months postoperatively
G AV angle right hip 1 year postoperatively
H AV angle left hip 1 year postoperatively
I AV angle right hip 5 years postoperatively
J AV angle left hip 5 years postoperatively
K AV angle right hip at the last follow-up
L AV angle left hip at the last follow-up
M CCD angle right hip 4 months postoperatively
N CCD angle left hip 4 months postoperatively
O CCD angle right hip 5 years postoperatively
P CCD angle left hip 5 years postoperatively
Q CCD angle right hip at the last follow-up
R CCD angle left hip at the last follow-up
S CE angle right hip preoperatively
T CE angle left hip preoperatively
U CE angle right hip 5 years postoperatively
V CE angle left hip 5 years postoperatively
X CE angle right hip at the last follow-up
Y CE angle left hip at the last follow-up

Table 2. The values for the AV angle, the CCD angle, and the CE angle (degrees) preoperatively and at the postoperative follow-up examinations in 104 hips. Mean (range)

	AV angle	CCD angle	CE angle
Preoperatively	47 (28–65)	135 (125–150)	30 (16–50)
Postoperatively			
4 months	3 (–20–34)	125 (105–152)	
1 year	4 (–17–31)	126 (105–151)	
5 years	9 (–23–34)	129 (110–153)	29 (17–60)
Last follow-up	9 (–23–34)	130 (116–153)	31 (17–60)

Table 3. The hip rotation (degrees) preoperatively and at the postoperative controls in 104 hips. Mean (range)

	Internal rotation	External rotation
Preoperatively	82 (70–90)	10 (0–45)
Postoperatively		
1 year	41 (20–60)	50 (30–75)
5 years	45 (20–70)	47 (30–70)
Last follow-up	45 (20–70)	48 (25–70)

Table 4. Signs and symptoms (number of patients) in 52 patients

	Preoperative	1 year	5 years	Last control
Intoeing gait	52	15	3	3
Stumbling	42	1	1	1
Reduced endurance	35	13	3	1
Thigh pains	10	0	0	0

(Table 2). The average increase was 6°: the range was, however, considerable (–20° to +25°). The mean yearly increase was 0.7° (–2.8° to +2.8°, SD 0.9). No sex difference was found. The increase of the AV angle was 9° in the group with known hip dysplasia (10 patients) and 5° in the "normal" group ($P = 0.056$).

No correlation was found between the increase of the AV angle postoperatively and the preoperative CE angle. A weak correlation was found between the increase of the AV angle and the increase of the CCD angle postoperatively ($r = 0.27$, $P < 0.0001$).

Seventeen femurs ended up with a postoperative retroversion (–20° to –2°). These hips showed little trend towards correction during growth, as the mean AV angle only increased from –9° to –7°. This correction did not, however, differ from the whole material. The children with a retroversion above –10° had a long-lasting, unsightly gait and limp.

The neck-shaft angle (CCD) increased ($P < 0.0001$) during the follow-up period from 125° to 130° (Table 2). The preoperative mean value of 135° was, however, not reached.

The CE-angle of Wiberg did not increase during the postoperative follow-up period (Table 2). The 16 hips with a preoperative CE angle below 25° were studied separately. In this group the mean CE angle increased but 2°, from 20° (16° to 24°) to 22° (17° to 30°) during the observation period.

Hip rotation (Table 3). The correlation between AV value and internal rotation at the last control was 0.25 ($P < 0.003$), and between AV value and external rotation – 0.32 ($P < 0.0001$).

*Signs and symptoms.*The intoeing gait persisted in only 3 children (Table 4). The intoeing was in all the cases unilateral, and the AV angle in these hips was respectively 14°, 20°, and 22°. The complaints possibly related to the increased femoral anteversion disappeared in all but 2 children.

Scar formation. Forty-four of the 52 operated on children had wide operation scars, but most of them did not consider this a problem. However, 4 girls were embarrassed by "ugly" scars.

Discussion

The mean increase of the AV angle of 6° during the 9-year follow-up period corresponds with Scholder (1979), who found that the AV angle seemed stable after an intertrochanteric osteotomy. The gross recurrence of the AV angle reported by Kleine (1961) and Mittelmeier and Jäger (1969) could not be confirmed. Reikerås and Bjerkreim (1982) found that the postoperative AV angle increased on an average 10° during 9 years following a subtrochanteric osteotomy. They therefore recommended overcorrection

of the derotation in order to normalize the AV angle during growth. Their study was retrospective, however, and they did not measure the immediate postoperative AV values radiographically. In our study, 17 hips had a postoperative retroversion ranging from –2° to –20°. These hips showed little trend towards correction during growth, and the children with retroversion above –10° had a long-lasting, unsightly gait and limp. This corresponds to the experience of Schulitz (1970). A postoperative retroversion should therefore be avoided, and we do not recommend overcorrection of the derotation.

A mean variation of 10° was achieved at operation, and the CCD angle increased on an average of 5° during follow-up. A more pronounced increase was found by Scholder (1979), who blamed the intertrochanteric osteotomy, and recommended that the osteotomy should be performed in the supracondylar region. The subtrochanteric level, as used in our study, involves less risk of damaging the apophyseal plate than the intertrochanteric one.

No increase in the CE angle during growth occurred. Thus, derotational osteotomy, when performed in this age group, does not seem to increase the acetabular coverage of the femoral head during growth. In long-term follow-up studies of congenital dislocation of the hip Harris (1976) and Koshimune (1985) stated that correction of the AV angle was not of major importance for maintaining acetabular growth, and Dürrschmidt (1982) found a negative effect of derotational varus osteotomy on the development of the acetabulum. In a previous study of the long-term results of nonoperated on children with an increased AV value (Svenningsen et al. 1989a), a substantial increase of the CE angle was found.

The derotational osteotomy was effective in eliminating the stumbling, reduced endurance, thigh pain, and the intoeing. Only 3 patients had an intoeing gait at the last follow-up examination.

A considerable number of complications after osteotomy for femoral anteversion were reported by Staheli et al. (1980) and Svenningsen et al. (1989b). Moreover, there is a trend towards spontaneous regression during growth of both the AV angle and the intoeing gait (Jani 1979, Svenningsen et al. 1989a). Consequently, we now have a more restrictive attitude towards operative treatment of this condition (Svenningsen et al. 1989b).

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