Regression of femoral anteversion

A prospective study of intoeing children

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To study the spontaneous regression of femoral anteversion, 30 children referred to the outpatient clinic for intoeing were followed until at least 15 years of age. The mean observation time was 9 (7–12) years, and all the children were examined three times during the growth period.

The mean radiographic angle at the first examination was 42°, at the second examination 36°, and at the last examination 28°. The mean decrease of the AV angle per year was 1.5°, with a considerable range (0.2–3.1°). The mean internal rotation of the hip decreased from 74° to 53° during the observation period, and the external rotation increased from 19° to 37°.

While all 30 children had an intoeing gait at the first examination, this disappeared in all but 5 children.

In children with an intoeing gait, Fabry et al. (1973) reported no significant regression of the increased femoral anteversion (AV) after the age of 8, whereas other studies found that the regression continued until adult age (Schwarzenbach 1971, Jani 1979). In order to investigate this controversy, we performed a prospective study in children with intoeing. The children were followed until at least 15 years of age.

Material and methods

The material comprised 30 children (60 hips) – 21 girls and 9 boys – who were admitted to our outpatient clinic because of intoeing gait during the period 1976–1980. These children were not operated on, but followed up. The indications for operative treatment of increased AV during this period were based on a combined evaluation of the degree of intoeing, the subjective complaints, the hip rotational profile, and radiographic measurements of the AV angles. Although we had no sharp distinction between those operated on and those not operated on, the patients of the present study had generally fewer complaints and somewhat lower AV than the operated on children, who are reported separately (Svenningsen et al. 1989).

None of the children had neuromuscular disease, and all the hips were normal by conventional radiography. The lowest CE angle of Wiberg was 23°.

The study was prospective, and the children were examined three times during growth. The mean observation time was 9 (7–12) years. The mean age at the first examination was 7 (4–10) years, at the second examination 10 (7–13) years, and at the third examination 16 (15–21) years. At the third examination the growth plates of the proximal femur were closed in all the girls and almost closed in the boys.

The same clinical and radiographic procedure was followed at each of the three examinations. All the children attended the follow-up examinations.

At the *clinical examination*, the children were asked for any complaints possibly related to the intoeing gait, such as stumbling, reduced endurance compared with children of the same age, and pain in the hip or thigh. An intoeing gait was noted when the child several times walked over the floor as naturally as possible.

Hip rotation was performed with the child lying prone with extended hips and the knees flexed to a right angle. The angles were measured with a goniometer with long arms. The pelvis was pressed firmly to the table while passively moving the lower leg through the permitted range, and no power was executed.

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For the *radiographic examination*, the biplanar method of Dunlap et al. (1953) as modified by Ripp-stein (1955) was used. The anteversion of the femoral neck (AV), the collum-shaft angle (CCD), and the CE angle were calculated.

To eliminate the interobserver error and to reduce the known sources of error by this method (Gross and Haike 1970, Reikerås et al. 1985), all the radiographic measurements were performed by the same individual (SS).

Statistics. Nonparametric tests were performed using the Wilcoxon two-sample (two tailed) test and the rank correlation test. *P*-values below 0.05 were regarded significant.

Results

Femoral anteversion (Table 1).The mean AV angle decreased markedly between the first and second examination, as well as between the second and last examination ($P < 0.0001$). In all the children the AV values decreased between the two first examinations, and this was also the case in all but 2 children between the second and the third examination. The mean reduction of the AV angle was 1.5° per year (SD 0.8, range 0.2–3.1).

In order to investigate whether there was a different pattern of regression of AV between those with the highest and the lowest initial AV, the total group was split into 2 subgroups, one half with AV values above and the other with AV values below the mean value at the first examination. A remarkable uniformity was found in the pattern of decrease of the two subgroups compared with the total group (Figure 1).

No sex difference was found either for the mean AV values at the three controls or for the mean reduction of anteversion per year.

According to Fabry et al. (1973) the upper normal limit (mean + 2 SD) of the AV angle for a 7-year-old child is 38°, and the upper limits at 10 and 16 years of age 34° and 31°, respectively. Forty-seven out of 60 hips had values above the upper normal limit at the first examination. The AV angle was within normal limits

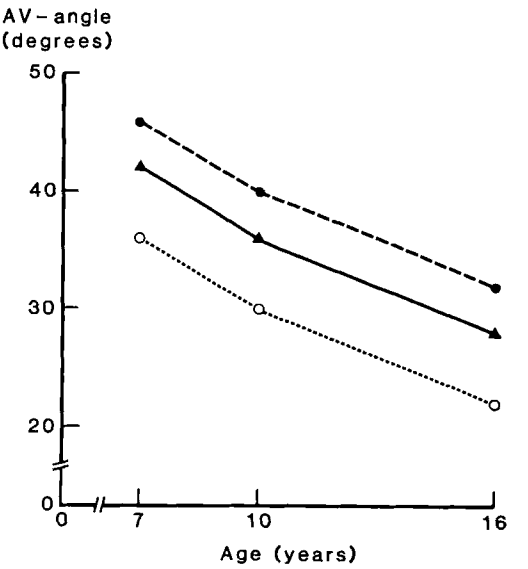

Figure 1. The regression of the AV angle during growth in the total group (▲—▲) and in the half with AV values above (●- - -●) and below (○ ··· ○) the mean value at the first examination.

in 8 of these hips at the second control, and in 11 additional hips at the last. Thus, spontaneous normalization occurred in 19 hips during growth.

Regarding *the collum-shaft angle*, no differences between the three examinations were found (Table 1). *The CE angle* increased between the first two examinations ($P < 0.01$) , as well as between the last two ($P < 0.01$; Table 1).

Internal rotation decreased between the first and the second examination ($P < 0.001$) and between the last two ($P < 0.01$, whereas external rotation increased at the same intervals ($P < 0.001$; Table 2).

The correlation between femoral anteversion and internal rotation of the hip was modest ($r = 0.50$, $P < 0.05$). The correlation was higher regarding external rotation and AV ($r = 0.66$; $P < 0.001$).

Intoeing gait. At the first examination, all 30 children had an intoeing gait. This was reduced to 19 children at the second examination; and at the last control,

Table 1. Degrees of femoral anteversion, center-edge angle, and collum-shaft angle during growth

Examination	Age (yr)		Femoral anteversion			Center-edge angle		Collum-shaft angle	
	mean	range	mean	*SD*	range	mean	*SD*	mean	*SD*
1	7	4–10	42	*5.5*	29–56	31	*5.3*	133	*5.5*
2	10	7–13	36	*6.3*	20–46	35	*6.5*	132	*4.5*
3	16	15–21	28	*8.4*	6–41	38	*6.0*	133	*5.2*

Table 2. Degrees of internal and external rotation of the hip at the first, second, and third examinations

Examination	Internal		External	
	mean	SD	mean	SD
1	74	6.8	19	7.2
2	60	7.2	27	7.8
3	53	8.5	37	5.9

only 5 children presented with a mild intoeing in one or both legs. The mean AV value for these 5 children was 30°, which did not differ from the AV angle of the total material (Table 1).

Complaints. At the first examination, 22 children had definite complaints possibly related to the intoeing gait, as stumbling, reduced endurance, and thigh pain. Such symptoms spontaneously vanished during growth in all but 3 children.

Discussion

We could not confirm the statement of Fabry et al. (1973) that no significant decrease in femoral anteversion occurs after 8 years of age in children with intoeing. Our results, on the contrary, accord with other authors (Schwarzenbach 1971, Jani 1979, Reikerås and Bjerkreim 1982), who found a steady decrease of femoral anteversion until completion of growth.

The mean yearly reduction of femoral anteversion in this intoeing group was 1.5°. The reduction was remarkably similar whether the AV value was above or below the mean value at the first examination. From the values for normal children (Shands and Steele 1958, Fabry et al. 1973), a yearly decrease of the AV value of 1.1° from 7 until 16 years can be calculated. Thus, the pattern of regression of femoral anteversion is approximately the same in children with increased femoral anteversion as in normal children.

The range of the yearly decrease of femoral anteversion in our study was considerable. It is therefore difficult to predict the end result for the individual child. Half the hips had AV angles above normal at the completion of growth. The significance of increased AV in adults is still not settled, but two recent studies indicate that this condition is a predisposing factor for coxarthrosis (Terjesen et al. 1982, Reikerås and Høiseth 1982).

The indications for operative treatment of increased AV are controversial, but most authors recommend a restrictive attitude (Jani 1979, Scholder 1979, Staheli et al. 1980, Salter 1983). Our study supports this view, as most children during growth became free of symptoms possibly related to increased anteversion, and the AV values decreased until completion of growth. Consequently, we recommend postponing any operation until 12–14 years of age. At this time, an indication for operation no longer exists in most children, whereas in those with persistent complaints and an AV above the normal limit, an operation could be considered. Based on the experience of the present study, this policy has been adopted at our institution.

Clinically, the pattern of hip rotation is often used to estimate the degree of anteversion. Hip rotation is, however, not only dependent on the degree of femoral anteversion, but also on the shape of the acetabulum, the hip capsule, and the muscles around the hip (Kleiger 1968, Anda et al. 1986). There was a modest correlation between AV and internal rotation, whereas the correlation between AV and external rotation was somewhat better. This accords with Staheli et al. (1968), Cyvin (1977), and Reikerås and Bjerkreim (1982). Therefore, caution should be taken in assessing the degree of femoral anteversion clinically, and external rotation seems to be a better predictive factor than internal rotation.

In conclusion, the natural development for children with intoeing is that this symptom will disappear with age in most cases. The femoral anteversion spontaneously regresses during growth, and the yearly decrease is the same as in normal children. However, because of the higher initial AV and the considerable individual differences in the yearly AV reduction, many of these children will still have increased femoral anteversion at the completion of growth.

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