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ORIGINAL STUDY

Retroversion of the contralateral adult acetabulum after previous Perthes' disease

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Retroversion of the adult acetabulum following a previous Legg-Calvé-Perthes disease (LCPD) is found in 30-40% of the patients. It is known that in LCPD there may also be morphologic changes in the non-affected controlateral acetabulum. We investigated the prevalence of retroversion of the contralateral acetabulum in a group of adult patients with a history of LCPD. We found this morphology in 11 out of 36 patients (31%). The aetiology and its relation to Perthes' disease are discussed.

Keywords : hip ; Legg-Calvé-Perthes ; retroversion ; acetabular version.

INTRODUCTION

It is known that there is a high percentage of morphological changes of the acetabulum in hips that were previously affected by Legg-Calve-Perthes Disease (LPCD). Acetabular dysplasia, in particular, is not uncommon. Retroversion of the acetabulum has been described as a type of acetabular dysplasia (*17*). Recently, the prevalence of retroversion of the acetabulum after LCPD was shown to be in the region of 30-40%. However, the prevalence of radiographic acetabular retroversion in the general population is around 5-6%, it is 16% in patients with "classic" acetabular dysplasia, and 20% among patients with idiopathic hip osteoarthritis (*9*). Since it is also known that in unilateral LCPD there may also be pathology in the so-called normal contralateral acetabulum (*11*), we investigated the prevalence of retroversion in the contralateral acetabulum.

PATIENTS AND METHODS

We reviewed 52 patients who visited the orthopaedic outpatient department of the AMC, Amsterdam between 1983 and 2001 for hip symptoms after having suffered a unilateral LCPD as a child. At this point both hips were investigated and radiological signs of morphological changes in both acetabula were analysed. Of the 52 patients, there were 36 with radiographs suitable for analysing the acetabular version of the non-affected hip. Excluded were all patients with radiographs on which a malrotation of the pelvis in the horizontal plane was seen, where the coccyx did not point to the middle of the symphysis and the obturator foramina did not appear symmetrical (*21*) and/or the distance between the symphysis and the middle of the sacrococcygeal joint was not in the range of 25-40 mm in men and 40-55 mm in women (*19*).

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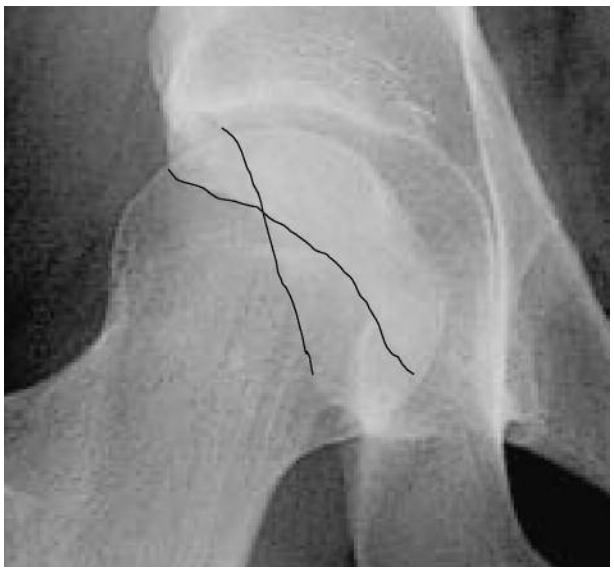

Fig. 1. — The crossover sign : the anterior wall crosses the posterior wall medially.

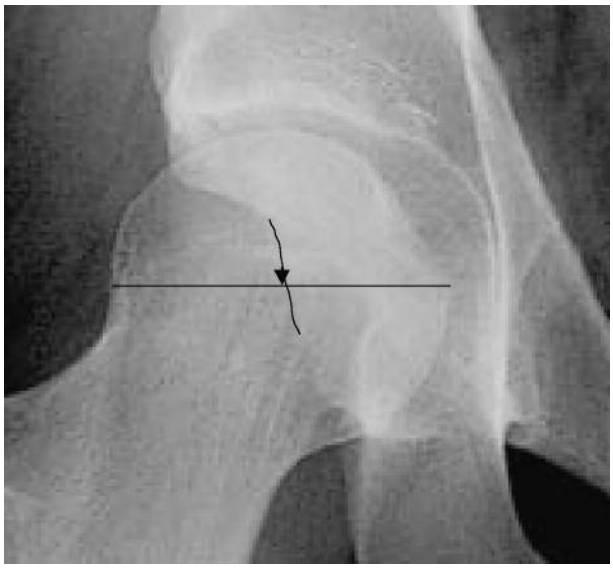

Fig. 2. — The posterior wall passes just medial to the middle of the femoral head : the posterior wall sign is (just) positive.

There were 29 males and 7 females. The age of the patients at the time of the last radiograph was 29 years (range : 17-63). The right hip had been affected by LCPD in 18 patients. Twenty seven patients had undergone previous surgery on the affected hip : intertrochanteric osteotomy in 22, total hip replacement in 4, acetabular osteotomy in one, and 9 patients had been treated conservatively.

Radiographic measurements included the centre-edge (CE) angle of Wiberg *(21)* and the version of the hip. To assess the latter, the presence of the cross-over sign and the posterior wall sign were analysed *(19)*. The anterior wall of the acetabulum is always more horizontal and extends towards the pubis. The posterior wall is more vertical and extends to the ischium, which is lateral to the pubis. In the normal anteverted acetabulum the anterior and posterior walls contact each other at the lateral edge of the sourcil and should not cross each other. Anterior over-coverage is suggested by any crossover of the anterior wall over a normal posterior wall, called the crossover sign (fig 1), True retroversion of the acetabulum should have posterior under-coverage along with this crossover sign. The more distally the crossover occurs the more significant is the anterior over- coverage.

The anterior wall covers the head to a lesser extent than the posterior wall, and the projection of the posterior wall typically passes through the centre of the head. If the posterior wall passes lateral to the centre of the head, the posterior coverage is considered to be excessive ; if it passes medial to the centre of the head, the posterior coverage is deficient, which is called the posterior wall sign (fig 2). To determine the version quantitatively, the template developed by Hefti was used *(12)*.

RESULTS

Eleven patients (31%) had a retroverted acetabulum of the non-affected hip on the standing anteroposterior pelvic radiograph. The mean retroversion was 9º (range : 5º-15º). In patients with a normal anteverted acetabulum the mean anteversion was 10º (range : 0º-20º). The mean CE angle in the non-affected hip was 33º (range : 18º-35º). In the eleven patients with a retroverted acetabulum the mean CE-angle was 38º (range : 18º-40º) compared with a mean CE-angle of 30º in the other patients with a normal anteverted acetabulum (range : 25º-35º). In all patients with a retroversion of the non-affected side, the affected side was either also retroverted or this was suspected, but not properly assessable (table I, fig 3).

DISCUSSION

The prevalence of retroversion of the acetabulum in the affected hip in LCPD is known to be 30-

Fig. 3. — Typical AP pelvic radiograph of one of the patients. Note the retroversion of the acetabulum on both sides : both the crossover sign and the posterior wall sign are clearly positive.

40% (*6,9,18*). Retroversion of the contralateral so-called normal hip in unilateral LCPD was not investigated until now. A few studies of the asymptomatic contralateral hip joint in LCPD were performed, especially on the femoral head. Katz found asymptomatic radiological changes of the contour of the contralateral femoral head in 20% of children with unilateral LCPD (*14*). Chivabongs *et al* considered that LCPD is often bilateral because of unmistakable radiological changes of both hips in the early stages (*3*). Harrison *et al* also found in 48 % of patients irregularities of the surface of the non-affected femoral head (*11*). By contrast, these changes were only present in 10% of a control group. They reported retarded bone age, abnormal bone loading and poor performance of the chondroblasts or osteoblasts (or both) as possible contributory causes. Kandzierski *et al* found flattening and irregularity of the unaffected epiphysis in 35% of patients with unilateral LCPD (*13*).

One of the morphological signs of LCPD is the bicompartimental acetabulum (*4*). Supposedly, this is caused by an imbalance of growth between the cartilage-covered lunate surface and the cartilage-devoid acetabular fossa. Whether this is caused by LCPD and can lead to rotation of the complete acetabulum and thus to retroversion is unknown.

The aetiology of the retroversion is not clear, especially whether the LCPD or the retroversion was first. In a recent study, retroversion in children was investigated in the affected hips. The authors did not find any acetabular retroversion early after the diagnosis and suggested a cause-and-effect relationship. However, they did see the final development of retroversion in 31% of cases. In their study the acetabular version was measured on the axial cut with the largest femoral head cross-section (*18*). Since the acetabular version especially consists of retroversion of the acetabular dome, the results of this study are difficult to interpret.

The mean age of our patients was 29 years, with a wide range. Therefore, it is hypothetically possible, that the morphologic features of the acetabulum had changed over the years. However, it has been stated that this is not usually the case (*9*). As mentioned before, we did not attempt to measure the acetabular version of the affected hip, maybe the retroversion was bilaterally present at birth. Reynolds *et al* state that retroversion is bilateral in 100% of the cases (*17*).

Whatever the reason for the existence of the retroversion, the question arises if there is a relationship between acetabular retroversion and LCPD. Avascular necrosis may appear in children in the presence of acetabular dysplasia, but is initiated by medical treatment, be it a plaster cast or splint, whereby the position of the leg in the splint, or the surgical treatment (open reduction of the femoral head) is often blamed for the necrosis (*2,10,16*). Avascular necrosis of the femoral head in adults is another separate entity and is also not well understood. Steroids and alcohol are known to be often involved, but the mechanism of necrosis is not known (*21*).

It is not known if an abnormal morphology of the acetabulum can lead to necrosis in the femoral head. However, the fact that a certain position in a hip spica can cause necrosis of the femoral head seems to indicate some sort of mechanical process. We have previously suggested that an existing morphological anomaly of the acetabulum may result in intermitted abnormal loading of the dorsal femoral head-neck junction and the local blood

Table I. — Signs of retroversion in the 36 affected and contralateral hips : 11 contralateral hips show retroversion

			Affected Hip		Contralateral Hip			
No	Sex	O*	Crossover sign	Posterior Wall sign	Crossover sign	Posterior Wall Sign	Version	CE
1	m	2	0	0	y	y	-5	41
2	m	1	y	0	y	Y	-15	25
3	f	1	n	n	n	n	25	40
4	m	1	n	0	n	n	15	30
5	m	1	y	0	y	y	-10	32
6	m	1	y	y	y	Y	-10	35
7	m	1	0	0	n	n	15	34
8	m	1	n	n	n	n	25	35
9	m	1	n	0	n	n	20	30
10	m	1	0	0	y	y	-5	34
11	f	1	y	0	n	n	25	38
12	f	1	n	0	n	n	25	32
13	m	1	n	0	n	n	20	40
14	m	2	0	0	n	n	20	28
15	m	0	y	0	n	y	0	35
16	m	0	0	0	n	n	5	38
17	m	0	y	0	y	y	-15	30
18	m	0	n	0	n	n	20	32
19	m	1	0	0	n	n	15	32
20	m	2	0	0	y	y	-5	40
21	m	1	0	0	n	n	25	36
22	f	0	y	0	y	y	-10	41
23	f	0	n	0	n	n	5	30
24	m	0	n	0	n	n	20	38
25	m	1	0	0	0	n	20	30
26	m	1	y	0	0	n	20	28
27	m	1	n	0	n	n	20	32
28	m	1	0	0	n	n	25	36
29	m	1	0	0	y	y	-5	40
30	m	1	n	0	n	n	20	32
31	m	1	y	0	y	Y	-15	30
32	f	1	n	0	n	n	20	34
33	m	2	0	0	n	n	20	32
34	m	3	n	0	n	y	10	38
35	f	0	y	0	y	y	-5	40
36	m	0	n	n	n	n	10	36

* O = Operation : 0 = no operation ; 1 = intertrochanteric osteotomy ; 2 = total hip replacement ; 3 = other.
y = yes ; n = no ; 0 = not properly assessable
Version and CE angle in degrees.

vessels, which may lead to insufficient blood supply (*7*). This may lead to asymptomatic contour irregularities of the epiphysis at one end of the spectrum and LCPD disease at the other end (*1,7,8, 11,15,20*). However, the relation and aetiology are difficult to explain. Dora *et al* found a retroverted acetabulum in 27% of patients who had a Salter or a triple pelvic osteotomy for congenital dislocation of the hip. This was not associated with a higher incidence of avascular necrosis (*5*).

The normal acetabulum is said to be anteverted by 20 degrees. The version of the acetabulum is

difficult to measure in any cross-sectional study, as it varies depending on the distance of the cut from the dome. A global estimate of the version is best noted on the AP view. Irrespective of which imaging technique is used, measuring of acetabular retroversion is susceptible to errors, especially on plain radiographs. Measuring degrees of version is not very precise and is not frequently practised (*12*). Since the contralateral hips in our study were all non-affected, non-symptomatic hips, we chose to measure the degree of version to get an impression of the amount of abnormality. On paediatric radiographs the morphology of the acetabulum is difficult to detect. In adults however, malrotation of the pelvis in the horizontal and sagittal plane will substantially alter many of the measured angles. There are no established parameters for determining the pelvic tilt on AP radiographs of the pelvis. We used the distance between the symphysis and the sacrococcygeal joint. Comparison of this distance with the average distance for men and women will help to detect measurement errors due to increased or decreased pelvic tilt (*11*). Although CT and MRI are the standard techniques when analysing pathomorphology, it is obvious that in our patients these were not available. Computed tomography scans will be helpful in determining acetabular version but are also not sufficient to describe acetabular version in the roof area (*5,11,17*). An analysis of the contralateral hip in children using MRI should give us more accurate data on pathomorphology, but may not be enough to give more insight in the aetiology of the necrosis. A dynamic analysis, like an MRI with the hip in different positions, or the investigation of the blood supply of the hip by laser probes is difficult, but should maybe be initiated.

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