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THE "TEAR-SHAPED PHENOMENON" IN CALVE-PERTHES' DISEASE

By

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The general opinion of Calvé-Perthes' disease (C-P) is that the disease primarily affects the caput femoris, so that possible changes in the acetabulum do not appear until later and then seem to be secondary, adaptive and arthrotic changes attributed to the deformation of the caput, which is the result of no or insufficient relief from weight-bearing in the active phases of the disease.

On studying the roentgen films of a number of patients with active C-P the author was surprised to almost constantly find clearly a relative increase in breadth of the so-called tear shape[1] on the affected side. The increase in breadth was seen in patients quite early and at more advanced stages. In patients with bilateral C-P, but in whom the disease arose at different times on each side, the tear shape was found to be broader on the side last attacked.

When investigating a number of handbooks and monographs (*Helbo, Schinz, Baensch* and *Friedl, Goff*) the phenomenon was not seen to be

[1] The tear shape, die Tränenfigur, described by *Köhler,* is an almost rectangular figure with a more or less vertical longitudinal axis which is plainly seen on the majority of ventrodorsal roentgen pictures of child pelves, taken in the common recumbent position and also with Lauenstein's projection. On the negative film it is bordered by a line of light which medially corresponds to the inner surface of the lesser pelvis, laterally to the floor of the acetabulum, above to the epiphysis cartilage, below to the foremost margin of the limbus. Thus it is evident that the tear shape does not represent any simple anatomic structure.

In the great majority of normal persons the tear shape is symmetrical on both sides. But it must be pointed out that when studying normal control pictures of 125 children aged from 4–12 years, photographed in the common recumbent position without waterpass, some increase in breadth was discovered on one of the sides in 24 cases—19 %.

Fig. 1 a.
K.R. 23/9-47. Left-sided tuberculous coxitis. Initial changes. The tear shape is wider on the healthy side. Ordinary recumbent position.

Fig. 1 b.
K.R. 18/2-53. Left-sided tuberculous coxitis. Late result. Ordinary recumbent position.

discussed anywhere, although the phenomenon was plainly observed on roentgen reproductions of the disease. In both *Goff*'s and *Helbo*'s publications roentgen pictures are shown intended to illustrate such early cases of unilateral C-P, that as yet nothing roentgenologically abnormal can be demonstrated. Even on these pictures (see *Helbo* p. 59), however, a clear increase in breadth of the tear shape is to be seen on the side where the disease later manifests itself roentgenologically through changes in the caput. Dr. *Helbo,* who has recently studied the literature of the C-P disease, has very kindly informed me that changes in the tear shape do not previously seem to have been discussed.

Jansen and *Perkins,* however, discussed in 1923–25 a partly related problem. *Jansen* thought that the cause of C-P was a congenital in-

congruency between the caput and the acetabulum in these patients, in that the arc of the acetabulum had a larger radius than the caput, which primarily was normal.

In addition to the ball-and-socket joint movements slipping thus occurred in the hip joint involving prolonged traumatisation of the caput. There could be two reasons for the greater radius of the acetabulum: the acetabulum could be too wide, which is mostly found in combination with so-called ischium varum[1]; the floor of the acetabulum could be too thick. *Jansen* thought that the roentgenological manifestation of the latter condition was too great a "length" of the cartilage which connects the acetabulum and the linea innominata. *Perkins* completely denied that any background of fact lay behind the conditions which he ascribed exclusively to projection faults. While in the instance of ischium varum the latter point seems to be quite clear from *Perkin*'s pictures the cartilage mentioned above cannot be judged from the reproductions owing to the primitive roentgenological technique of that time. One must in any case grant *Perkins* the point that this cartilage has but poor definition roentgenologically. Others, too, have thought that the C-P disease was due to acetabular changes, in particular that the disease was a consequence of slight congenital subluxations, but these theories have possessed little significance, and the general opinion now corresponds with that stated in the introduction.

The explanation of the increase in width of the tear shape may be sought in different causes: A) chance, B) projection faults, C) a genuine change of the very structures which form the figure.

A–: It has been already said that a relative increase in width of the tear shape was discovered on one side or the other in 19 % of the roentgen films taken of 125 child pelves presumed normal. On the other hand examination shows that the increase in width of the tear shape on the side affected was missing in only 2 out of 20 consecutive patients with unilateral C-P disease. Moreover in one of these 2 patients the diagnosis of unilateral C-P disease was perhaps doubtful. This is to say that a fortuitous discovery of increase in width on one side or the other in 19 % of the controls is opposed to 90 % correspondance between increase in width and the side affected in patients with unilateral C-P disease. This difference should be statistically reliable and seems to exclude chance playing any part in such an increase with C-P disease.

B–: Even if one begins from the fact that the structures forming the tear shape are quite uniform on either side, a roentgenological increase

[1] This is to say that the ramus superior ossis ischii has a more transverse course than normal.

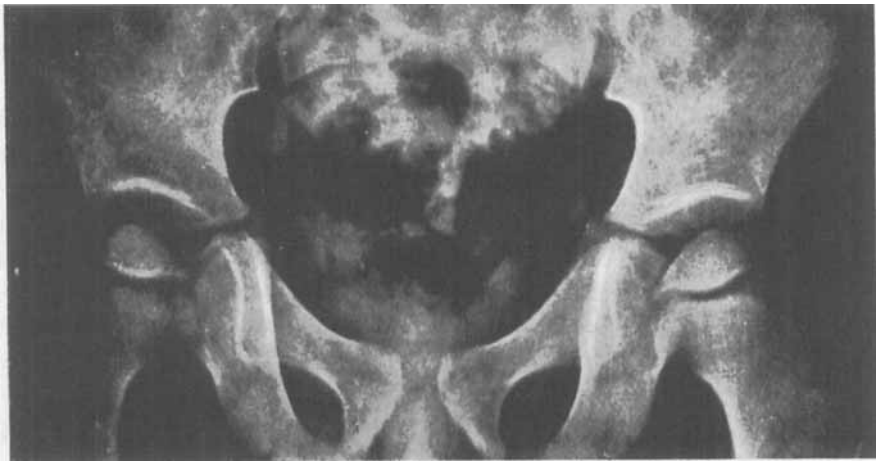

Fig. 2 a.
K.M. 24/6-54. C-P disease, right side. Initial changes in the caput. Definite increase in width of the tear shape. Ordinary recumbent position.

Fig. 2 b.
K.M. 24/8-55. Healing stage. Ordinary recumbent position.

in width can nevertheless be obtained on the one side, that is, if the X-rays do not pass through the pelvis sagittally. This can easily be shown by photographing normal children and rotating the pelvis round the body's longitudinal axis. *Ott,* who has repeated my experiments with tilting and alignment of the iliac spines, described below, thinks, however, that it may be stated that 5° side-tipping of the roentgen table is required in order to produce any difference between the 2 sides in normal people.

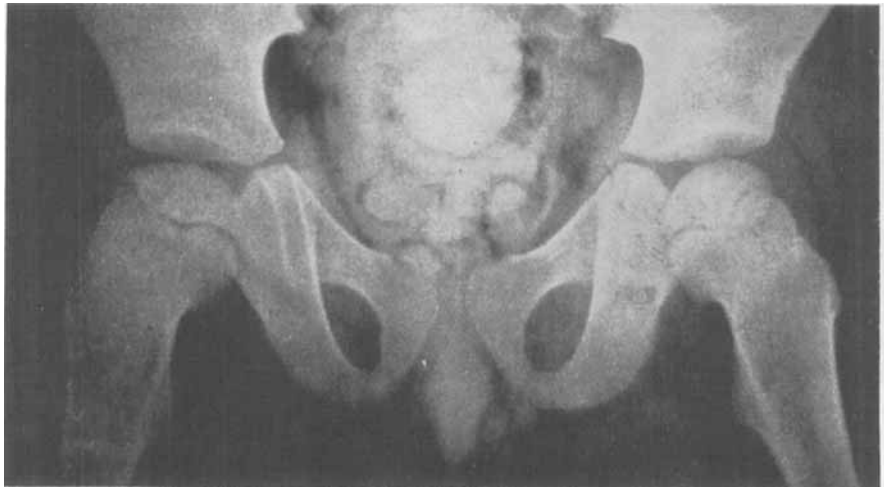

Fig. 2 c.
K.M. 24/8-55. Iliac spines aligned in the same horizontal plane using waterpass.

Possible reasons for the X-rays not passing sagittally through the pelvis: 1) the position of the roentgen table (not horizontal), 2) the placing of the roentgen apparatus (not vertically over the patient), 3) asymmetrical positioning of the patient, either owing to a) unilateral soft tissue changes of the pelvis (especially muscles), or b) osseous asymmetry of those parts of the pelvis which are not included in the tear shape.

1) and 2) can be excluded at once, since right-sided and left-sided cases were found among both the patients with C-P disease and the controls, although all lay with the head in the same direction.

3 a): Nates atrophy often seems to be quite pronounced on the affected side in such children. If, however, this nates atrophy were to be the cause of increase of width via an asymmetrical recumbent position one might expect the symptom to be common in other hip diseases also. An investigation into a number of children with early, tuberculous and unspecific coxitis showed however, that increase in width on the affected side certainly does occur in these patients, but with far from the same frequency nor, in the individual patient, with the same constancy even, after repeated X-rays. (Out of 15 children with tuberculous coxitis the increase in width was seen on the affected side in 5. At this time all had osseous destruction). In some of the coxitis cases (see fig. 1) the increase in width was seen on the healthy side.

Moreover it happens to be that in a relaxed recumbent position one rests only to a slight degree upon the buttocks, but mainly on the

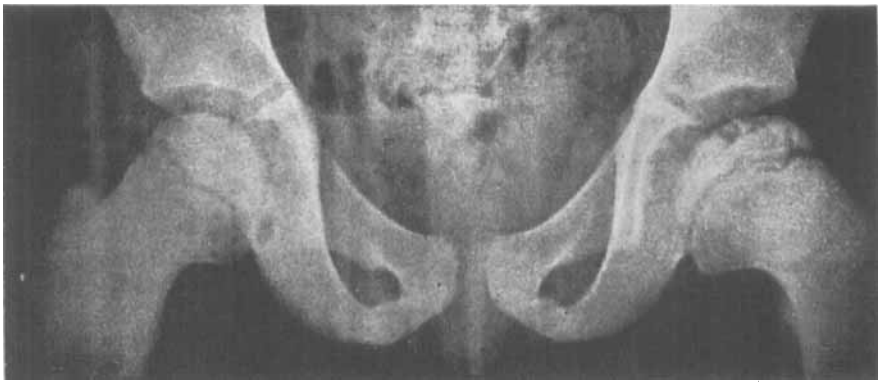

Fig. 3 a.
R.B. 24/8-55. C-P disease, left side. Healing stage. Ordinary recumbent position.

Fig. 3 b.
RB. 24/8-55. The iliac spines aligned in the same horizontal plane using waterpass.

osseous projections. In order to eliminate, finally, the possibility that the gluteal atrophy was important, 10 patients with unilateral C-P disease were examined for an incorrectly aligned pelvis, in a recumbent position, with the aid of a waterpass on the anterior iliac spines. It was shown that 7 spontaneously had the spines in the same plane, but that in 3 patients the affected side was tilted downwards in relation to the healthy side 1° (2 patients) and 2° (1 patient) respectively. The nates atrophy therefore does not seem to be the solution of the problem; this was further demonstrated by photographing 5 patients with unilateral C-P disease, first in the ordinary recumbent position and then with the spines in the same horizontal plane, of course with waterpass. There was no clear difference between the 2 classes of pictures (see figs. 2, 3 and 4).

Fig. 4 a.
J.D.C. 24/8-55. C-P disease, right side. Fragmentation stage.
Ordinary recumbent position.

Fig. 4 b.
J.D.C. 24/8-55. Iliac spines aligned in the same horizontal plane using waterpass.

3 b): On looking at the X-rays of these patients the impression is often gained of asymmetry between the 2 halves of the pelvis. But it is difficult to decide how far this asymmetry is due to projection faults or is genuine. The experiments discussed under 3)a, however, seem to some extent to argue against such a possible asymmetry affording the explanation required.

C): After studying points a) and b) much seems to indicate that genuine osseous changes may lie behind the phenomenon demonstrated. The quite small series of investigations described do not permit any definite conclusion to be formed how far these changes are localised to the tear shape itself, which however seems to be the most probable explanation, or whether, in spite of everything, they are due to projection errors following on asymmetry of other parts of the pelvis.

DISCUSSION

After the above report it appears to be a fact that the tear shape undergoes a relative increase in width on the affected side in patients with unilateral C-P disease. On the other hand it is not yet possible to decide definitely how far the phenomenon has a secondary role in relation to the partly unknown pathological changes which determine the development of C-P disease or whether a primary occurrence is involved, that is, a condition of pathogenetic significance. The very early appearance of the increase in width which, as stated before, can be substantiated, argues in favour of a primary factor. The mechanism behind the development of C-P disease would then approximate more closely to the previously submitted, but now generally discredited theories of subluxation. The object of this small article is merely to draw attention to the phenomenon. It would be desirable nevertheless if more detailed information could later be given concerning the problem on the basis of a considerably larger series.

Apart from any academic interest, the phenomenon demonstrated may perhaps have a certain importance in the early roentgen diagnosis of C-P disease.

SUMMARY

An earlier apparently disregarded roentgenological symptom of C-P disease is reported: The almost constant increase in width of the so-called tear shape on the side affected. A discussion follows of how far a pathogenetic factor or a projection phenomenon is involved.

RESUME

Description d'un symptôme radiographique qui paraît avoir passé inaperçu antérieurement dans la maladie de Calvé-Perthes: accroissement constant en largeur de ce que l'on appelle le trait lacrymal du côté malade.

Discussion sur la question de savoir s'il s'agit d'une réalité anatomopathologique ou d'un phénomène de projection.

ZUSAMMENFASSUNG

Ein früher anscheinend unbeachtetes Symptom beim m. C. P. wird beschrieben: Die nahezu konstante Breitenzunahme der sogenannten Tränenfigur auf der erkrankten Seite. Wieweit es sich dabei um eine pathologisch-anatomische Realität oder um eine Projektionserscheinung handeln kann, wird besprochen.

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