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ANTEVERSION DEFORMITY AND DEROTATION OSTEOTOMY IN CONGENITAL DISLOCATION OF THE HIP

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An anteversion deformity in congenital dislocation of the hip means a disproportion in direction between the neck and head of the femur on the one hand and the acetabulum on the other, so that the head does not reach the bottom of the socket in the normal position, but assumes an eccentric position.

The anteversion deformity is due not only to the anterior direction of the neck-head, but also to frontal or ventral rotation of the acetabulum. Both factors vary considerably, without any interdependence (*Laurent* 1953).

Sandifort Jr. (1836) appears to have been the first to point out an increased anteversion of the femoral neck in infants having congenital dislocation of the hip.

The extent of this anteversion has been determined *inter alios* by *Putti* (1937) who found it to range from 33°–84° in autopsies in children aged 1–6 years with congenital dislocation of the hip. Measurements during open reduction by *Farrell & Howorth* (1935) showed 63° and by *Laurent* (1953) 10°–80°, average 37°, in patients up to 3 years of age.

Radiological determinations of the anteversion of the femoral neck in children with congenital dislocation of the hip have been in the focus of interest ever since the studies of *Drehmann* (1908). Such methods have been described by *inter alios Dunlap, Shands, Hollister & Streit* (1953), *Ryder & Crane* (1953), and *Billing* (1954).

The variations in the frontal inclination of the acetabulum have been studied by *Putti* (1937) in autopsies on patients with congenital dislo-

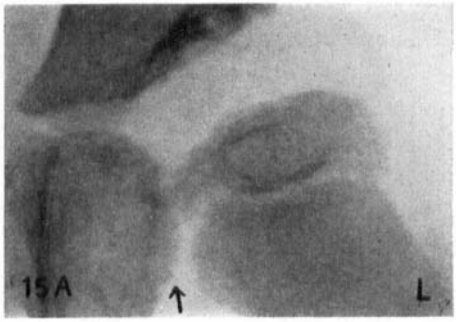

Figure 1a. Arthrogram taken when the cast was removed 5 months after the reduction. In spite of a position of abduction-internal rotation, there is a 4 mm contrast pool on the acetabular floor, indicating severe anteversion deformity. Derotation osteotomy was not done because of progressive muscular dystrophy.

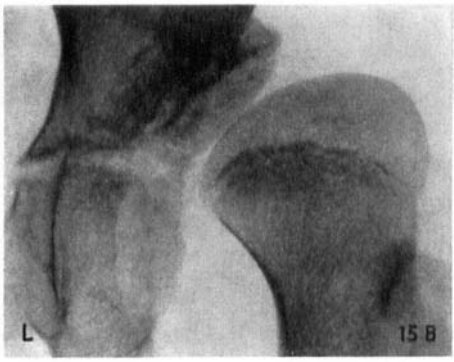

Figure 1b. 18 months after cast was removed. Outward displacement of the head-neck, incipient bony filling in of the bottom of the socket (arrow), and obliteration of the lateral limb of the U figure.

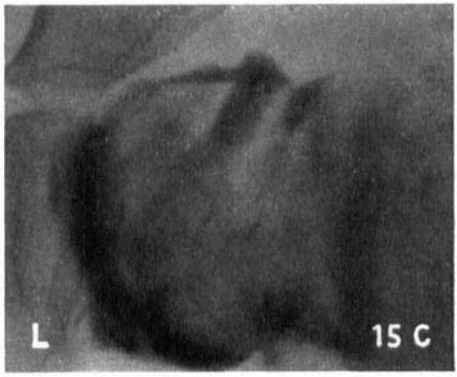

Figure 1c. 7½ years after removal of the cast: Massive bony filling in of the floor of the socket with flattening of the acetabulum as a result of severe subluxation. Acetabular roof fairly well-developed.

Figures 1a, 1b, and 1c. Bony filling in of the acetabular floor in anteversion deformity. Complete dislocation with isthmus treated, after unsatisfactory closed reduction, at the end of the 2nd year of life.

cation of the hip in the first 5–6 years of life. He found the anteversion to range from 35° to 54°. In measurements during open reductions on children aged 1–3 years *Laurent* (1953) found the variations to be from 15°–55° and demonstrated that the anteversion of the neck and the ventral rotation of the acetabulum varied independently of each other.

Since the two factors which determine the disproportion between the articulation of the femoral head with the acetabulum in congenital dislocation of the hip show the same, wide range, it serves no practical purpose to determine one of these factors accurately in degrees by means of complicated X-ray projections and mathematical calculations —at least while there is no radiographic method for assessing the anteversion of the acetabulum. On the other hand, the result of the interplay of these two factors may be assessed arthrographically with contrast medium in the joint.

The first radiological sign of a deficient adjustment of the femoral head, after closed reduction followed by plaster casts has been completed, is slight outward displacement with recurrence of the anteversion configuration and a widened joint space. At times, however, the latter may prove merely apparent, due to a reduced size of the ossification centre. Somewhat later there will be signs of incipient bone filling in the acetabular floor with widening or obliteration of the U figure. If the anteversion deformity remains uncorrected, this filling with bone will continue and become an important cause of the so-called shallow acetabulum (Figures 1 b and c).

ARTHROGRAPHIC ASSESSMENT OF THE ANTEVERSION DEFORMITY

An eccentric situation of the femoral head in the acetabulum, due to a disproportion in their directions so that the head does not contact the bottom of the socket, shows in the arthrogram a sickle-shaped pool of contrast medium when the exposure has been made with the hip extended and in a neutral position (Figure 2 a).

The pool will be diminished, and may even completely disappear, on films taken in internal rotation (Figure 2 b). The degree of internal rotation required to make the sickle-shaped contrast pool disappear gives a direct measure of the anteversion deformity and thus of the number of degrees required in derotation. If mild subluxation coexists, the arthrogram in internal rotation also shows the head and

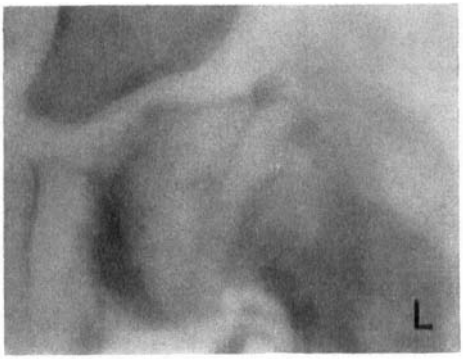

Fig. 2 a.

Fig. 2 b.

Figures 2a and 2b. Arthrogram showing typical anteversion configuration. B 63 433: Arthrogram (2a) in slight abduction and neutral rotation showing a pool of contrast medium, about 5 mm wide, between the femoral head and acetabulum. On internal rotation the pool disappears (2b). The pool is due to anteversion deformity which ought to be corrected.

glenoidal labrum to be lower in relation to the Y line than on a film taken in the normal anatomical position.

Therefore, arthrographic check-up following closed reduction should not be done until mobility in the hip joint has been re-established to the extent that the hip can be placed, without force, in the positions necessary for these projections.

There is arthrographic indication for derotation osteotomy when a sickle-shaped contrast pool, exceeding 2–3 mm in width at the acetabular floor, disappears entirely or partially upon internal rotation, or when the glenoidal labrum shows elevation, diminished upon internal rotation.

No other diagnostic method is of the same practical value in assessing the question of incongruence due to anteversion deformity and thus in deciding the indications for derotation osteotomy.

DEROTATION OSTEOTOMY

Schede's name was identified with the first derotation osteotomy (*Petersen* 1899), but this is not correct. *Schede* was an ardent adherent of correcting the anteversion deformity, it is true, but it was the Danish surgeon *Tscherning* (1894) who performed the first operation and, during the same stage, open reduction and subtrochanteric derotation osteotomy on a 12-year-old girl with unilateral dislocation of the hip. In this case the direction of the femoral neck was parallel to the long axis of the foot.

In *Lorenz'* (1895) opinion, the technical difficulties in fixing the proximal fragment were so great that he did not only advise against derotation osteotomy, but also felt that open reduction was contraindicated in the presence of severe anteversion deformity.

Leveuf, in 1941, believed that the anteversion factor caused a number of secondary subluxations, but in 1946 he felt that this was not correct (*Leveuf & Bertrand* 1946). *Bertrand & Guias* (1955) performed derotation on only 17 out of 551 treated cases.

Platou (1953) demonstrated that dislocated hips showing anteversion of 30° or more of the femoral neck at follow-up were subject to subluxation or re-dislocation in 87 per cent of the cases. He convincingly demonstrated the value of derotation osteotomy which was done if the anteversion deformity exceeded 35°.

This is not, however, *per se* any proof that the anteversion deformity induces dislocation or subluxation. But when considering also the increased stability and possible abolition of subluxation in internal rotation, it seems justified to attribute to the anteversion deformity a central role in the mechanism of dislocation.

It cannot be the true cause of congenital dislocation of the hip, because as mentioned below the anteversion deformity sometimes recurs after sufficient derotation. This indicates that the anteversion deformity is the result of deeper-lying, unknown forces in the dislocated hip.

Francillon (1955) corrects anteversion when it exceeds 30°—which it did in 75 per cent of his open and 50 per cent of his closed reductions.

Sommerville (1955) consistently does derotation on all complete dislocations, although he does admit that in certain cases the anteversion deformity will regress spontaneously. As a motive for this attitude he stresses that derotation increases stability, that the period

in plaster is shortened and mobilization of the hip may be started earlier.

In the present author's experience too, an anteversion deformity may spontaneously regress after reduction. However, while there is no means of predicting in which cases this will occur, derotation osteotomy should be carried out as soon as it has been demonstrated and before bone filling of the acetabular floor starts. In that event acetabuloplasty is very seldom indicated, as also pointed out by *Desorgher* (1955) and *Francillon* (1955).

At the Orthopaedic Hospital, Aarhus, derotation osteotomy is performed in all open reductions on hips showing an anteversion exceeding 30° and, if stability is poor, also less than 30°.

After closed reduction, it is endeavoured to decide, within one year, whether correction is to be done. This practice is on the whole in keeping with *Platou* (1953), *Francillon* (1955), *Sommerville* (1955), and *Müller* (1957).

PREVIOUS METHODS

Zahradnicek's (1934) osteotomy at the junction of the greater trochanter and femoral neck is wedge-shaped, with the object of correcting the anteversion of the head-neck as well as the valgus deformity. This procedure must be considered to jeopardize the vascularization of the head and neck.

Intertrochanteric osteotomy is theoretically the most correct procedure, partly because the lesser trochanter, with the psoas muscle attached, is included in the derotation—so that the externally rotating effect of this muscle will be more or less neutralized—and partly because this method is best suited for simultaneous correction of the valgus deformity.

Bernbeck (1954) has advocated a low and oblique intertrochanteric osteotomy which corrects both factors and *Francillon* (1950) an intertrochanteric transverse osteotomy in which the fixation is maintained by a compression apparatus which also serves to correct the valgus deformity. *Francillon* has performed about 100 intertrochanteric osteotomies without having observed structural changes in the femoral head, which might perhaps be feared *a priori*, and which some authors consider the main objection to this form of osteotomy.

Subtrochanteric osteotomy has been recommended by *Ponseti* (1944), *Platou* (1953), and *Somerville* (1953). This method is considerably less suited than the intertrochanteric method for correcting the valgus deformity. However, it possesses the advantage of entailing less risk of vascular disturbances, the internal fixation material is farther from the growth zones, and it is technically easier.

Diaphyseal osteotomy is used by *Langenskiöld* (1953) and his assistant *Laurent* (1953) combined with transposition of the psoas tendon to the lateral aspect of the femur. This tendon transposition was described independently by *Rohleder* (1947) and *Langenskiöld* (1953). It is a serious objection to this method that bone healing is slower and that it is unsuited to be done in the same stage as open reduction.

PRESENT METHOD

The derotation osteotomies at the Orthopaedic Hospital, Aarhus, are subtrochanteric, using a wire saw just distal to the lesser troochanter. A short vitallium plate with 4 holes is fixed distally to the bone, so that the wire saw is on a level with the middle of the plate. After a Steinmann pin has been driven into the greater trochanter from the lateral side, to act as a temporary guide pin and goniometer, the bone is sawn through and the proximal fragment rotated inward into a position of anteversion of 10°–15°. The plate is fixed with two screws to the greater trochanter, and the hip is kept in a plaster cast for 6 weeks. As a rule, the plate is not removed.

MATERIAL

A total of 147 patients under 5 years of age, representing 201 dislocated hips, were treated in the Orthopaedic Hospital, Aarhus, during the period 1947–1955. The therapeutic principles were on the lines advocated by *Leveuf, i.e.* arthrographic determination of the type of dislocation and checking of the quality of closed reduction before applying the plaster cast. If reduction was unsatisfactory arthrographically, open reduction was done without any preceding attempt at bandaging. The extent and development of the anteversion deformity were followed, and if necessary, correction by derotation osteotomy was done.

Out of these patients 145, representing 197 hips, are alive, and all have been seen in a follow-up study after 4–12 years.

Correction of anteversion deformity was done by subtrochanteric derotation osteotomy in 39 of the 201 cases treated according to the principles of *Leveuf* (19 per cent).

Derotation was used as a corrective procedure in 29 cases, in the same stage as the open reduction in 11 cases, and as a palliative procedure in 10.

In 2 instances the derotation osteotomy had to be repeated. In one of these cases the derotation had primarily been insufficient, *viz.* 50° of a 90° anteversion, and in the other case the anteversion deformity had recurred. This latter case is interesting, seeing that in the primary operation the derotation amounted to 50° of an 80° anteversion. Later, an additional 40° derotation was done. At follow-up, two years after the latter correction, there was again considerable anteversion deformity,

In another three cases the anteversion deformity had recurred, so that in 4 out of the 39 cases (10 per cent) there were recurrences.

The real need for operative correction of the anteversion deformity has not been fulfilled by the 39 derotation osteotomies. The minimum requirement may be estimated by investigating how many hips exhibited at follow-up the sequelae of an uncorrected anteversion deformity, in the form of bony filling of the bottom of the socket or major or minor obliteration of the U figure or exhibited typical anteversion configuration of the head-neck. Such sequelae were found in 35 cases.

Thus, 74 (39 + 35) of the 201 cases must be said to have required derotation osteotomy, *i.e.* a minimum requirement in the present series of almost 40 per cent. In practice, a larger percentage is required, since it is not possible to decide beforehand in which hips the deformity is going to be spontaneously corrected and in which cases active interference is needed.

SUMMARY

The author describes the anteversion deformity in congenital dislocation of the hip, stressing the importance of arthrography using contrast medium in deciding the indication for correcting derotation osteotomy.

Among 201 cases of congenital dislocation of the hip treated primarily during the first 5 years of life, 39 had derotation osteotomy. After follow-up periods which always exceeded 4 years the non-derotated cases were seen. This disclosed in another 35 definite radiological sequelae of uncorrected anteversion deformity.

Derotation osteotomy should be done in the presence of anteversion of 30° and over, and—if open reduction reveals instability—also if it is less than 30°.

RESUME

L'auteur décrit la déformité d'antéversion dans la dislocation congénitale de la hanche, soulignant l'importance de l'arthrographie utilisant on agent de contraste poor décider de l'indication d'une ostéotomie de correction de la dérotation.

Parmi 201 cas de dislocation congénitale de la hanche traités primairement durant les cinq premières années de la vie, 39 avaient subi l'ostéotomie de dérotation. Après une période d'observation qui a toujours dépassé 4 ans, les cas de non-dérotation ont été réexaminés. On constata dans 35 cas des sequelles radiologiques certaines d'une déformité d'antéversion non corrigée.

L'ostéotomie de dérotation doit être pratiquée en présence d'une antéversion de 30° et plus et—si la réduction ouverte révèle de l'instabilité – également si elle est inférieure à 30°.

ZUSAMMENFASSUNG

Der Verfasser beschreibt die Anteversionsdeformitet bei angeborener Hüftverrenkung und betont die Wichtigkeit der Arthrographie mit Kontrastmittel um die Anzeige für die korrigierende Derotationsosteotomie zu entscheiden.

Von 201 Fällen von angeborener Hüftverrenkung, die ursprünglich während der ersten 5 Lebensjahre behandelt worden waren, hatten 39 eine Derotationsosteotomie. Nach Beobachtugszeitspannen, die immer 4 Jahre überschritten, wurden die nicht derotierten Fälle gesehen.

Dies zeigte bei noch weiteren 35 Fällen röntgenologisch Folgezustände einer nicht korrigierten Anteversionsdeformitet auf.

Derotationsosteotomie sollte beim Vorhandensein einer Anteversion von 30° und mehr, und – wenn eine offene Einrenkung Instabilitet zeigt – auch bei weniger als 30° Anteversionwinkel ausgeführt werden.

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