ARTHROGRAPHY IN CONGENITAL DISPLACEMENT OF THE HIP

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In congenital dislocation of the hip the degree and type of displacement are important both in deciding treatment and in estimating the results of treatment.

Plain radiographs can demonstrate only the osseous relationships in the abnormal joint: they provide no information about the relative position of the cartilaginous head, the fibrocartilaginous labrum and the capsule. Arthrography, by defining the transradiant structures, enables a more accurate estimation to be made of the type and degree of displacement. If redislocation occurs, arthrography may help in determining the cause of failure and in planning further treatment.

When closed methods succeed in reducing a dislocation of the hip without interposition of soft tissues between the head and socket the result will clearly be different from that obtained when such interposition persists. Arthrography is helpful in making this differentiation. For these reasons arthrography was done on all displaced hips treated at the Princess Margaret Rose Orthopaedic Hospital from 1954 to 1961. More than 200 arthrographies were done, and the results are recorded in this paper.

METHODS

Arthrography was done soon after the child's admission and in the earlier years it was repeated after reduction had been achieved by gradual reduction on a frame. Every hip in which there was evidence of interposition of soft tissues was opened; in all these inversion of the limbus was found and in some cases there was also an interposed capsular fold. The inverted limbus was excised in every case. The capsular fold was excised when it appeared to be causing a definite obstruction and failed to free itself satisfactorily after incision of the capsule.

Technique of arthrography—When the anterior approach is used the displaced head is palpated just below the anterior superior iliac spine, and the fluid is injected close to the femoral head so as to flow into the joint.

In the superior approach, which is preferred, the fluid is injected directly into the joint from above (Fig. 1). Any fluid that escapes from the joint flows upwards and so does not obscure the arthrogram. A lumbar puncture needle with a short bevel is inserted half an inch behind the anterior superior iliac spine. It is pointed downwards and inwards toward the ilium and is advanced down the bone until the point makes contact with the roof of the acetabulum. With slight pressure the needle enters the joint. Sterile water is first injected; if the needle is in the joint the water flows freely. When the needle is correctly placed one to two millilitres of 35 per cent diodone are injected. The injection of too much fluid distends the joint, obscuring the free edge of the limbus or masking slight filling defects.
Radiographs are taken with the hip in neutral rotation, in full medial rotation and in full lateral rotation with abduction. Any slight irregularities of outline indicate an abnormality if they are shown in radiographs taken in two or more positions. The radiograph taken with the hip rotated medially shows the relations of the joint structures with anteversion corrected. The radiograph taken with the hip fully abducted and laterally rotated shows the joint in the best position for reduction; irregularities of outline indicate interposition of soft tissues even if the femoral head appears to lie in the socket.

![Fig. 2](image)

**Fig. 2**
Arthrography of both hips in a girl aged two years, showing the normal right hip and dislocation of the left hip (right). Note in the normal hip the smooth outline of the femoral head, the absence of pooling and the labrum outlined by the contrast material ("rose-thorn" appearance). In the left hip the outline of a capsular fold is seen in front of the inverted limbus.

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**Fig. 3**
Tracings of arthrographs showing degrees of displacement. **Fig. 4**—Primary instability. The bony roof is sloping but its cartilaginous component forms an adequate socket. There is no significant displacement of the femoral head. **Fig. 4**—Partial displacement (subluxation). The femoral head is displaced but lies in partial contact with the cartilaginous socket. The labrum is everted and there is no obstruction to reduction. **Fig. 5**—Complete displacement—"tight" dislocation. The femoral head has escaped from the socket and the limb is inverted and interposed posteriorly between the head and the socket. **Fig. 6**—Complete displacement—"loose" dislocation. There is more marked displacement of the femoral head and a capsular fold as well as the limbus is interposed between the head and the socket.

**Difficulties and complications**—Few difficulties have been encountered. If a stilette is retained during introduction the needle does not become blocked. The needle may enter the joint but become embedded in normal or abnormally interposed soft tissue within the joint. The obstruction to the free flow of sterile water will suggest that this has happened: the needle is then moved gently until free flow occurs. There was no case of joint irritation, stiffness or infection. In no case did avascular changes occur in the femoral head after arthrography in those patients subsequently treated by gradual reduction. Failure to produce a satisfactory radiograph in any hip showing an apparently typical displacement was attributed to faulty technique; in such cases subsequent attempts proved successful.
INTERPRETATION OF ARTHROGRAPHS

In the arthrograph of the normal hip the labrum is outlined by the passage of the contrast medium into the space between the capsule and the lateral surface of the labrum. The outline of the joint is smooth and there is no persistent pooling of the contrast medium nor any filling defect (Fig. 2).

Arthrographs and operation findings in abnormal hips suggest that there are three degrees of displacement: 1) primary instability (Fig. 3); 2) partial displacement (Fig. 4); 3) complete displacement. Complete displacement may occur either as a "tight" or as a "loose" dislocation (Figs. 5 and 6).
Primary instability—The term primary instability is preferred to the term predislocation because the latter suggests that the hip will subsequently dislocate. Many such hips develop normally without treatment while others only do so if they are kept in abduction for some time. Arthographs of such hips show well the effect of abduction. With the hips lying relaxed in lateral rotation the labrum is not well outlined because of the tendency of the femoral head to displace from the lax capsule. When the hips are abducted the femoral heads bed down in the socket and the outline of the labrum is clearly seen (Figs. 7 to 9).

Partial displacement—In partial displacement or true subluxation the femoral head lies in potential contact with the whole socket without any interposition of soft tissue. As the femoral head displaces the limbus is pushed upwards by it. When the femur is abducted the head slides back into the socket without any obstruction and the labrum comes down over it.

The arthograph taken with the hip in the neutral position may be difficult to interpret. With medial rotation or with lateral rotation and abduction the head is seen to return to normal relation with the acetabulum and the labrum is again well outlined (Figs. 10 and 11).

In dubious cases or when tight adductor muscles require stretching, arthrography should be repeated after reduction to confirm the diagnosis. Thus, plain radiographs may suggest that a hip is completely dislocated, yet arthrography may show that the labrum is evverted, not inverted to lie between the head and the socket. In such a case arthrography repeated after gradual reduction may show reposition of the head and of the labrum (Figs. 12 to 15).

Complete displacement—In complete displacement or dislocation the head escapes from the socket and the labrum becomes inverted to lie posteriorly between the head and the posterior wall of the socket. Arthrography shows the interposition of this limbus between the head and the socket.
The value of arthrography in diagnosis between partial and complete displacement. Figure 12—Radiograph of hips of a girl of seven months. Appearances suggest that there is actual dislocation of the right hip. Figure 13—Arthrography suggests that the labrum is everted (compare Fig. 4). Figure 14—Arthrography repeated after gradual reduction. The head has returned to normal position and the "rose-thorn" outline of the labrum is now well shown. Figure 15—Arthrography repeated after one year's treatment in abduction. The appearances are almost those of a normal hip.
Study of our arthrographs has suggested that there are two types of dislocation—"tight" and "loose" (Figs. 16 to 18).

"Tight" dislocation—In the "tight" dislocation the femoral head is not markedly displaced; without arthrography the condition could be mistaken for a partial displacement (Fig. 19). Arthrography, however, fails to show the outline of the labrum. Further, it may show a filling defect in the posterior superior part of the joint. This filling defect is produced by the inverted limbus lying directly behind the femoral head (Figs. 20 to 23). Pooling of contrast medium tends to increase with the degree of displacement.

"Loose" dislocation—In the "loose" dislocation the femoral head is markedly displaced and the diagnosis of dislocation with interposition of soft tissue is never in doubt (Fig. 24). Arthrography before reduction demonstrates the high position of the femoral head and an
appearance of constriction of the capsule between the head and the socket. This apparent constriction (the so-called hour-glass constriction) is caused by a fold of capsule which is inverted with the limbus. It appears to be the most obvious obstruction to replacement of the femoral head. The limbus still lies posteriorly at the back of the joint and sometimes produces a filling defect. Arthrography repeated after gradual reduction may show that the inverted capsular fold has disappeared; in other cases the fold remains. When the hip is put into lateral rotation and abduction the femoral head will push past even a large capsular fold to enter the joint, but it still lies in front of the inverted limbus (Figs. 25 to 28).

At operation it is possible to remove an obstructing capsular infold in mistake for an inverted limbus. Such a mistake may be the cause of the unexpected redislocations which sometimes occur after the supposed removal of a limbus.

“Tight” dislocation. Figure 19—Radiograph of hips of a girl of twenty-one months. Moderate displacement of left femoral head. Figure 20—Arthrograph with the hip in medial rotation suggests reduction, but there is a filling defect in the acetabular roof and pooling of the contrast medium. Figure 21—Arthrograph repeated after gradual reduction. The filling defect is again seen. Figure 22—Arthrography repeated after operation and excision of inverted limbus. Note the smooth acetabular roof. Figure 23—The excised limbus.

The two types of dislocation seem to be different and distinct entities. No instance of a tight dislocation developing into a loose dislocation has been seen. The tight dislocation is frequently seen in the child of three or four years, having gone undetected in earlier years because of the less noticeable degree of deformity and limp. The association of an inverted limbus with only moderate displacement of the femoral head might suggest that in the tight dislocation the head escapes from a moderately relaxed capsule only enough to allow inversion of the limbus. Subsequent tightening of the capsule and contraction of the hip muscles, attempting to hold the head in the joint, might maintain the head in what appears to be a position of subluxation.

In the loose dislocation greater capsular laxity may have allowed greater displacement of the femoral head. Either the advanced degree of displacement or the presence of a capsular infold would make it impossible for the head to be held in close proximity to the socket.
"Loose" dislocation. Figure 24—Arthrograph of left hip of a girl of eighteen months. Obvious dislocation with marked displacement of femoral head and capsular infolding. Figures 25 to 27—Arthrographic appearances after gradual reduction. Figure 25—Hip in medial rotation and abduction. Head not reduced, capsular fold still present. Figure 26—Half way to position of abduction and lateral rotation. The capsular fold is being pushed aside. Figure 27—In full abduction and lateral rotation. The head is in the socket but is in front of the inverted limbus. Figure 28—The excised limbus.

SUMMARY AND CONCLUSIONS

1. The technique of arthrography in congenital displacement of the hip is described. No complications have been encountered in a series of over 200 examinations. The interpretation of the arthrographs is discussed.
2. It is suggested that the abnormal hips may be classified in three degrees: 1) Primary instability; 2) partial displacement without interposition of soft tissue; 3) complete displacement with interposition of soft tissue between head and socket.
3. Two types of complete displacement or dislocation are recognised: 1) the "tight" dislocation; 2) the "loose" dislocation. In the latter there is marked displacement of the femoral head, and arthrography done before reduction demonstrates interposition of a fold of capsule lying in front of the inverted limbus.
4. Arthrography is of special help in making the diagnosis between partial displacement with eversion of the labrum and "tight" dislocation with an interposed limbus. It is helpful too in establishing the cause of failure of reduction.