THE DIAGNOSTIC VALUE OF TRACTION DURING RADIOGRAPHY IN DISEASES OF THE HIP

A PRELIMINARY REPORT

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A diastasis between the femoral head and the acetabulum can be achieved for a short while by the application of manual traction on the lower extremity. The intra-articular low-pressure area can be visualised radiographically and is known as a "vacuum phenomenon". The resulting arthrogram clearly outlines the shape, thickness and extent of the cartilage. In the presence of an effusion the diastasis occurs without a vacuum phenomenon. This simple, non-invasive and inoffensive method of traction radiography will not only show abnormalities of the cartilage but also demonstrate the presence or absence of an effusion of the hip.

Abnormalities in the shape, thickness and extent of the cartilage of a joint are not visible on a plain radiograph. Arthrography is essential to determine abnormalities. As in other joints, it is possible to create a diastasis in the hip by traction. The space thus created between the articular surfaces can be visualised during radiography and is known as the "vacuum phenomenon" (Fick 1910).

This phenomenon applied to the knee enabled the menisci and cartilage to be visualised (Felsenreich 1935; Evans 1940). Another interesting and useful aspect of the vacuum phenomenon was described by Rubin (1939) who demonstrated that a vacuum phenomenon did not occur in the presence of free fluid in a joint. Rubin did not, however, consider the hip in this context. More recently, changes in the thickness of the cartilage of the femoral head in osteoarthritis and Perthes' disease have been demonstrated using the vacuum phenomenon (Martel and Poznanski 1970).

In this preliminary report attention is drawn to our first experiences with traction during radiography of the hip as a diagnostic method of investigation in a number of orthopaedic and post-traumatic cases.

METHOD

The patient is placed supine on the table and with arms extended holds the handles positioned at the level of the pelvis. If required, somebody may hold the patient by the armpits as a means of counter-traction. The x-ray tube is centred on the femoral head. Manual traction is applied by the investigator who grips the patient's ankle.

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Simultaneously the hip is visualised under image intensification. When the maximum diastasis between femoral head and acetabulum has been achieved a radiograph is made. In the absence of an effusion a vacuum arthrogram will be the result (Fig. 1) and will show the shape, thickness and extent of the cartilage. Additional exposures in medial rotation, lateral rotation, flexion and axial views can be made. There is no age limit to this investigation. Even in the very young, with no epiphysal ossification, the shape of the femoral head and acetabulum will be visualised (Fig. 2). The occurrence of diastasis without vacuum indicates the presence of free fluid in the hip joint (see Figs 14 and 15).

Fig. 1

Vacuum arthrogram of a normal hip taken during traction (T). Cartilage of the femoral head (1), limbus articularis (2), ligamentum teres (3).

Fig. 2

Vacuum arthrogram of an infant, showing the femoral head and acetabulum outlined.

ILLUSTRATIVE CASE REPORTS

Case 1. A 25-year-old man with a known symptomatic osteochondritis dissecans of the right hip underwent plain radiography which did not indicate whether there was any loosening of the necrotic fragment (Fig. 3). Radiographs taken during traction in medial and lateral rotation showed a discontinuity of the cartilage over the necrotic fragment and the presence of a vacuum phenomenon under the fragment (Fig. 4). It was therefore concluded that this fragment was loose.

Case 2. A 17-year-old girl had pain in the left groin on walking. Plain radiography of the hip showed cystic changes in the femoral head and neck (Fig. 5). It was not clear whether there was a co-existing fracture in the femoral head; tomography had been inconclusive. A vacuum arthrogram in lateral rotation clearly showed a cartilaginous defect in the femoral head (Fig. 6). Viewed in medial rotation there was evidence that collapse of subchondral bone had occurred without discontinuity of the cartilaginous cover (Fig. 7).

Fig. 3

Fig. 4

Case 1. Figure 3—Osteochondritis dissecans of the femoral head. Figure 4—The radiograph taken during traction in medial rotation clearly outlines a vacuum beneath the necrotic fragment and discontinuity of the femoral cartilage.

Fig. 5

Fig. 6

Fig. 7

Case 2. Figure 5—Aneurysmal bone cyst in femoral head and neck. Figure 6—Anterolateral cartilaginous defect with vacuum arthrography in lateral rotation. Figure 7—Posterolateral subchondral collapse but continuity of cartilage, seen in medial rotation.

Case 3. A 42-year-old man with a posterior fracture-dislocation of the left hip had been treated operatively two years before. He complained of pain in the groin when walking. Radiographically there were no signs of segmental collapse but there appeared to be a slight diminution of the joint space (Fig. 8). During radiography with traction a large vacuum phenomenon appeared showing that the cartilage of the femoral head had disappeared (Fig. 9). This obviously was a suitable case for replacement arthroplasty.

Case 4. A three-month-old child with a left-sided congenital dislocation of the hip was examined by radiography with traction but a vacuum phenomenon could not be obtained (Fig. 10). Treatment consisted of traction and abduction splintage. Three months later a vacuum phenomenon could be demonstrated and readily visualised a relocated joint with satisfactory development of the acetabulum (Fig. 11).

Case 5. A 17-year-old girl with a painful left hip due to acetabular dysplasia was a suitable subject for acetabuloplasty, but it was not possible to determine the lateral edge of the acetabulum on plain radiography (Fig. 12). Under traction a vacuum phenomenon could be obtained and it was then easily possible to give the exact location for an acetabuloplasty to be performed (Fig. 13).

Case 6. A 15-year-old youth with pain in the right groin presented with a limping gait of one week's duration. On examination he exhibited a fixed flexion deformity of 35 degrees. He had no abdominal signs, no fever and had an erythrocyte sedimentation rate of three millimetres in the first hour. On plain radiography the right hip appeared normal. A vacuum phenomenon could be demonstrated during radiography with traction, indicating the absence of effusion. The fixed flexion deformity disappeared after a few days. The patient was discharged but one week later he returned as an outpatient and again

Fig. 8

Fig. 9

Case 3. Figure 8—Some loss of joint space after posterior fracture-dislocation; no signs of segmental collapse. Figure 9—Frank vacuum phenomenon; no cartilage covering the femoral head.

Fig. 10

Fig. 11

Case 4. Figure 10—Congenital dislocation of the left hip. No vacuum phenomenon obtainable on traction. Figure 11—Three months after treatment. Vacuum arthrogram outlines a congruous hip joint.

Fig. 12

Fig. 13

Case 5. Figure 12—Adolescent dysplasia of the hip. Figure 13—With radiography under traction the border between the dysplastic acetabulum and the capsule is clearly outlined. The cartilage in the weight-bearing area of the femoral head is thickened.

presented a fixed flexion deformity of the right hip, but this time it was accompanied by a tenderness in the right lower abdomen. An appendix abscess was diagnosed. Throughout, the presence of a vacuum phenomenon totally excluded any abnormality of the hip.

Case 7. A 34-year-old man presented with pain in the left hip and a limp. Clinical examination revealed a fixed flexion deformity and a limitation of medial rotation. His temperature was 37.9 degrees Celsius, and erythrocyte sedimentation rate 45 millimetres in the first hour. Plain radiography of the hip revealed no abnormalities (Fig. 14). Radiography under traction produced a frank diastasis without a vacuum phenomenon (Fig. 15). Consequently the joint was aspirated and 15 millilitres of

purulent material was evacuated. A direct stain demonstrated the presence of intracellular diplococci in this material. In conjunction with the aspiration a radiograph was made under traction and this now presented a vacuum phenomenon which showed the cartilage to be normal (Fig. 16).

DISCUSSION

Traction during radiography of the hip is a simple, non-invasive and non-offensive method of investigation. In most cases a diastasis can be achieved. This obviously depends on muscular development, muscle tone, laxity of the joint capsule and ligaments, age and sex. Certainly in

Fig. 14

Fig. 15

Fig. 16

Case 7. Figure 14—Plain radiography of subacute coxitis. Figure 15—Radiography with traction produces diastasis but no vacuum phenomenon, indicating an effusion of the joint. Figure 16—After needle aspiration a vacuum phenomenon on traction outlines intact cartilage.

children and adolescents and especially in girls it is easy to produce a vacuum phenomenon. In contrast, in advanced osteoarthritis diastasis is limited by capsular thickening and muscular spasm. However, by using muscle-relaxing agents (diazepam or propanidid) it is almost always possible to produce a diastasis.

This method has been used clinically to demonstrate diffuse changes in cartilage in osteoarthritis and Perthes' disease (Martel and Poznanski 1970). In our experience it also seems to be possible to demonstrate local changes in the cartilage of the femoral head. In the newborn the vacuum phenomenon demonstrates the shape of the non-ossified femoral head and acetabulum and therefore replaces a conventional arthrogram. In hip dysplasia the

extent of the lateral rim of the acetabulum can be visualised and, what is more, its behaviour can easily be monitored. In our experience it has not been possible to produce the vacuum phenomenon in congenital dislocation of the hip and therefore we were not able to comment on the limbus.

Of supreme value is the ability of radiography under traction to demonstrate the presence of free fluid in the hip at any time. It should therefore be obvious that aspiration of the joint is never indicated when a positive vacuum phenomenon can be elicited.

It is our opinion that in the case of doubtful symptomatology it is always advisable to perform radiography of the hip under traction.

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