A STUDY OF THE "CAPSULAR" SHADOW IN DISORDERS OF THE HIP IN CHILDREN

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Displacement and blurring of the soft-tissue shadows about the hip has been described in several conditions, particularly in transient synovitis. A study was made between such displacements and the posture commonly adopted by an "irritable hip". Examination of radiographs of normal hips, and of those in cases of transient synovitis and Perthes' disease showed that the appearance of "capsular swelling" is related to the position of lateral rotation and abduction. This was confirmed by anatomical dissections of the lateral plane, which appears to be an intermuscular plane lying anterior to the hip, and an explanation is given for the blurring which may accompany its lateral displacement. "Capsular swelling" appears to be a radiological artefact.

Bone changes are not seen in the radiographs of patients with transient synovitis, but several authors have drawn attention to the soft-tissue shadows about the hips, and the displacement and blurring of muscular and "capsular" shadows have been described. In radiographs of good quality three soft-tissue planes can usually be identified (Fig. 1). These represent fatty layers, which are transradiant. The outline of the medial border of the iliopsoas can be seen medial to the hip. There are intermuscular plane lying anterior to the hip joint and extending back to reach the lateral capsule (Fig. 2). He suggested that its lateral displacement might be explained by variations in radiological projection, or by differences in muscle thickness. He considered that the blurring of muscle planes, sometimes noted in transient synovitis, might be caused by inflammatory oedema.

We decided to investigate the effect of varying the position of the leg, for an important clinical feature of two planes lateral to the hip. The more lateral of these lies between gluteus medius and minimus. It is inconstant and variable, and is frequently absent. The medial plane is more important, for it lies just lateral to the femoral head, and is frequently believed to represent the capsule of the hip joint. Lateral displacement of this plane is frequently described in transient synovitis and in Perthes' disease as evidence of capsular thickening.

Reichmann (1967) rejected the view that this shadow indicated the capsule, and showed that it followed an inflammatory conditions of the hip is the characteristic posture adopted at rest. A position of flexion, abduction and lateral rotation allows the greatest relaxation of the joint capsule, and promotes the greatest comfort. Movement of the hip from this position causes pain and spasm of varying degree. It is clear, therefore, that slight asymmetry in the position of the legs can readily occur in antero-posterior radiographs, and it is possible that "capsular swelling" is the result of the position adopted by an irritable hip. We have examined the relationship

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between the position of the limb and those radiological signs which may be interpreted as evidence of capsular thickening.

METHODS OF INVESTIGATION

First, the relationship of the transradiant soft-tissue planes about the hip to the position of the leg was studied of pelvic irradiation. In all cases the hips were normal. The effect of flexion, rotation, abduction and adduction were studied alone, and in various combinations. The shadows lying lateral and medial to the hip were examined, with special reference to displacement and blurring.

It was found that significant movements of the soft-tissue shadows could be produced by altering the position of the leg. The shadow lying immediately lateral to the hip, which is believed to represent the joint capsule, showed the most significant changes. In lateral rotation this shadow is displaced laterally, and in medial rotation it shifts medially (Figs. 3 and 4). An additional feature noted in several of the hips was that lateral rotation produced blurring of the outline of this shadow, which became more clearly defined in medial rotation. It was found that abduction also caused lateral displacement and adduction medial displacement. The effect of flexion was not significant. It is clear, therefore, that the appearance of capsular distension can be produced by laterally rotating and abducting the limb.

In most instances the inner border of the iliopsoas could also be defined. Movements of this shadow occurred, but they were slight and variable. In general, it became more prominent in medial rotation and abduction. The obturator shadow lying along the inner brim of the pelvis was present in most cases, and no significant fluctuations were observed. It was also found that displacements of the shadows could be produced by asymmetrical projections of the pelvis.

TABLE I

<table>
<thead>
<tr>
<th>Displacement of lateral shadow</th>
<th>Position of hip</th>
<th>Number of cases</th>
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</tr>
<tr>
<td>Neutral</td>
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</tr>
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</table>

Transient synovitis—A retrospective study was made of the radiographs of patients treated for transient synovitis. In twenty-four hips the lateral shadows could be identified both at the time of the illness and at a variable interval after full clinical recovery. The relative position of the two limbs was noted. Abduction and adduction presented
Fig. 5a

Fig. 5b
Transient synovitis of right hip, of twelve hours' duration. The lateral shadow is displaced laterally on the affected side, which is laterally rotated.

Fig. 6a

Fig. 6b
Transient synovitis of right hip, of twenty-four hours' duration. The lateral shadow is displaced laterally on the affected side, which is abducted.

Fig. 7a

Fig. 7b
Perthes' disease of right hip. In the presence of lateral subluxation of the femur the lateral shadow can be seen to cross the line of the femoral head.
no problems, but the degree of rotation was more difficult to assess, and several criteria were used. In lateral rotation the following changes occurred: 1) the lesser trochanter became more prominent; 2) the greater trochanter lay behind the femoral neck; 3) the femoral neck was more vertically aligned. Conversely, in medial rotation the lesser trochanter was less prominent, the greater trochanter was shown in profile, and the femoral neck was more horizontal. A comparison was then made between the position of the two limbs, and of the lateral shadows. The results are shown in Table I. There was a close relationship between the lateral shadow and the position of the femur, lateral displacement being associated with lateral rotation and abduction (Figs. 5 and 6). In several instances a marked degree of lateral displacement was noted within twelve hours of the onset of symptoms. The same relationship was present in radiographs taken after clinical recovery, when comparison with the initial radiographs showed displacement of the soft-tissue shadows which bore the expected relationship to the position of the leg.

Perthes' disease — The radiographs of twelve patients with Perthes' disease were examined. The lateral shadow was displaced laterally in three and medially in one, and was unaffected in the remainder. Owing to structural changes in the upper end of the femur it was not possible to compare the degree of rotation with that in the normal hip. It was, however, possible to make a comparison with the radiographs of the same hip taken at different times, and in several instances changes were noted in the lateral shadows which bore the expected relationship to the position of the limb.

Two further features were noted. First, in the presence of coxa magna, and in hips with lateral subluxation of the femoral head, the lateral shadow could on occasion be observed to cross the outer border of the femoral head, showing that this shadow cannot represent the joint capsule (Fig. 7). Secondly, the addition and rotational realignment produced by upper femoral osteotomy often cause a marked displacement of the shadow.

ANATOMICAL STUDY

Ten normal hips of cadavers were dissected. The plane described by Reichmann (1967) was exposed. This plane passes medial to the tensor fasciae latae, between it and the rectus femoris, and extends back to lie lateral to the joint capsule. After a preliminary manipulation to overcome post-mortem stiffness it was possible to place the limb in any desired position. The position of the plane was found to bear the expected relationship to movements of the femur, with lateral shift on lateral rotation and abduction. This was confirmed in a further ten cases in which wire markers were inserted in the anterior plane before radiography. There are two obvious objections to this method of study. First, with the intermuscular gliding planes made adherent by post-mortem changes, the displacements noted might differ from normal. Secondly, the plane exposed by dissection was visible on radiographs, and could thus be interpreted as an artefact.

In three cases the opportunity was taken to expose the same plane in the course of upper femoral osteotomy for Perthes' disease. Preliminary radiographs had been taken in medial and lateral rotation to show changes in the soft-tissue shadows. Wire markers were then inserted as before, arthrography was performed, and further radiographs were taken in medial and lateral rotation. Although the radiographs were not of high quality, the markers were found to correspond both in their position and in the nature of their displacement with the lateral plane shown in pre-operative radiographs. An additional feature was noted in two patients: in medial rotation the markers lay in an antero-posterior plane, whereas in lateral rotation they lay more obliquely. This might explain the observation sometimes made that a blurring in definition of this shadow may be associated with its lateral displacement.

DISCUSSION

Various radiological features have been described in transient synovitis. Drey (1953) reported swelling of the gluteus minimus, psoas, and obturator internus. Hermel and Sklaroff (1954) noted swelling of the iliopsoas in some of their cases. The feature which has attracted the most attention, however, is the shadow lying immediately lateral to the hip, which has been generally thought to indicate the joint capsule. The lateral displacement of this shadow in transient synovitis has been described by several authors (Ferguson 1954, Hermel and Albert 1962, Adams 1963), and interpreted as evidence of capsular thickening.

Other authors have found the soft-tissue changes to be variable and unreliable (Rosenberg and Smith 1956; Arcomono, Stunkle, Barnett and Sackler 1963; Hardinge 1970). Several explanations have been given for the soft-tissue changes. Van deputte (1971) thought that apparent capsular bulging might be explained by increased muscular contraction, or by differences in radiological projection, and found the appearance of the soft-tissue outlines to be unreliable. Caffey (1967) suggested that variations in muscle bulk and oblique projections of the pelvis could explain asymmetries of the soft tissues in some instances. Spock (1959) noted variations in the capsular and muscular shadows with alterations in the position of the limb. He found a suspicion of abnormal soft-tissue outlines in 15 per cent of his cases, but the appearance was not specific. Valderrama (1963) also found variations in the muscle shadows in different positions of the femur, but believed that capsular swelling and blurring of the intermuscular septa were valuable radiological signs.

Most authors agree that the capsular outline can be identified lateral to the joint in standard radiographs.
This can no longer be accepted. Reichmann (1967) investigated the soft-tissue shadows by anatomical and radiological study, and found that the shadow hitherto thought to outline the capsule was an extensive intermuscular plane. Anteriorly, it lay between tensor fasciae latae and rectus femoris, and extended back to reach the extracapsular space. Tomography showed that the shadow was formed by the intermuscular part of this plane, which lies anterior to the hip, and that the capsule could not be seen. He considered that apparent capsular swelling might be due either to taking the radiographs in oblique projection or to differences in muscle thickness caused by hypertrophy or oedema secondary to the hip disorder.

The present investigation supports Reichmann's (1967) views regarding the nature of the soft-tissue shadows, but suggests a different explanation for the apparent capsular swelling. We have shown that marked displacement of the lateral soft-tissue shadows can be caused by alterations in the position of the limb. Moreover, the position of the limb normally adopted when the hip is irritable produces the type of soft-tissue displacements often described in transient synovitis.

We may then explain the fallacy in this way: the standard position for antero-posterior hip radiographs requires that the feet are in the vertical plane (Shanks and Kerley 1971). This is not, of course, the position of rest, which is one of lateral rotation, so that to reach the standard position the legs must be rotated medially about 30 degrees. A clinical feature common to those conditions in which soft-tissue changes are described is limitation of medial rotation. When, therefore, the appearance of capsular thickening is noted on one side, the bias would be expected in favour of the irritable hip. This was confirmed by the review of "capsular thickening" in transient synovitis. The operative radiographs in this study suggest an explanation for the blurring of the "capsular shadow" which has been sometimes described. The study of Perthes' disease, although less conclusive, suggests that a similar mechanism could be invoked to explain the apparent capsular swelling also described in that condition.

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REFERENCES