THE ACTION OF THE ILIOPSOAS MUSCLE IN THE NEWBORN

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The standard anatomical texts are unanimous that the primary action of the psoas muscle is flexion of the hip joint. At the same time it is usually credited with some secondary rotary action, although there is less agreement about the direction in which this rotation occurs. Basmajian (1958) reviewed the literature in relation to this long-standing controversy and found opinion to be almost equally divided as to whether the secondary action was one of medial or of lateral rotation at the hip. Most of the English texts favour medial rotation (Grant 1948, Gray 1949, Cunningham 1956, Last 1963). It is usually pointed out that although the posterior and medial location of the lesser trochanter might suggest that the pull of the muscle would result in lateral rotation, the axis of rotation of the femur passes through the head and the condyles of the bone and not along its long axis (Fig. 9) so that it lies medial to the insertion of the tendon. Shortening of the muscle must therefore give rise to medial rotation, although it is unlikely that such movement will be very powerful. Basmajian (1958) attempted to assess the functional role of the iliacus muscle by electromyography but he was unable consistently to associate electrical activity with rotation in either direction. On this basis he suggested that whatever the anatomical action of the muscle might be, it had no functional value as a rotator of the hip, and he proposed that the entire controversy be abandoned. This attitude is reflected in more recent editions of some of the above reference works (Gray 1962, Grant and Basmajian 1965).

It might seem that the argument has degenerated to the level of anatomical hair splitting, but clinical studies reveal that the rotary action of the muscle is of considerable functional significance. Thus, in pathological conditions in which the psoas is abnormally short the range of medial rotation is often improved after its division, and this may aid the reduction of a paralytic dislocation of the hip. Figure 1 shows such a dislocation resulting from spina bifida in which the leg lay in fixed lateral rotation. Division of the psoas enabled the leg to be put well into medial rotation and the dislocation was reduced (Fig. 2). This finding must be interpreted with caution because Somerville (1959) pointed out that when the hip is dislocated or when valgus of the neck is extreme the axis of rotation now runs along the shaft of the bone so that the action of the psoas becomes one of lateral rotation. However, improvement in

Fig. 1
Radiographs of the pelvis of a child with spina bifida and paralytic dislocation of the right hip. Figure 1—Before operation, with the hip held in the most medial rotation possible. Figure 2—After division of the psoas tendon there is a considerable increase in medial rotation possible, indicated here by the apparent increase in the neck-shaft angle. The hip is reduced.
the range of medial rotation after psoas division is commonly seen even when the hip is not dislocated (Figs. 3 and 4) and it is hard to escape the conclusion that the muscle is a true lateral rotator. This belief is further strengthened by the observation that during operative exposure of the psoas from the front the access to it is greatly facilitated by flexing and laterally rotating the thigh, which causes the lesser trochanter to present more anteriorly and slackens off the tendon. This was recommended by both Mustard (1959) and by Sharrard (1964) in describing their respective operations of psoas transplantation.

There is a conflict therefore between the evidence from anatomical and clinical studies. Because the clinical evidence is derived mostly from observations made during operations on very young children it is possible that the difference is attributable to anatomical peculiarities associated with their immaturity. It was decided therefore to investigate the action of the muscle in newborn children.

![Fig. 3](image1.png)  ![Fig. 4](image2.png)

**FIG. 3** Radiographs of a child with slight subluxation of the left hip who had spina bifida. Figure 3—Before operation the hip is held in the most medial rotation possible. Figure 4—Immediately after psoas division there is an increase in the amount of medial rotation possible and this is shown by an apparent increase in the neck-shaft angle.

**MATERIAL AND METHODS**

The entire pelvis and both femora with the associated muscles were obtained from sixteen infants who had died within the first eight weeks of life from causes thought to be unrelated to any musculo-skeletal pathology. One child was found on subsequent dissection to have bilateral congenital dislocation of the hip and was excluded, leaving a total of thirty hips for examination. The specimens were dissected in the fresh condition on the day of necropsy. The muscles were removed except for the psoas and iliacus and their conjoined tendon, but the capsule of the hip joint was not disturbed. With the resulting preparation it was possible to assess the action of the psoas by pulling it in its long axis, and by putting the hip into various positions while noting the tension in the muscle.

**RESULTS**

In all the specimens, when the psoas was pulled in the direction of the tendon the hip became flexed and laterally rotated (Fig. 5). Again, when the hip was medially rotated the muscle was tightened (Fig. 6) while in lateral rotation it became slack provided that the amount of flexion was unchanged. When the limb was abducted the lateral rotation action became very much more pronounced (Fig. 7). In this position medial rotation served to wind the tendon round the femur almost like a windlass, so that if the muscle was to contract in
this position very powerful lateral rotation would result. The position in which the psoas was most fully relaxed was in full abduction, flexion and lateral rotation—that is, in the so-called "frog" position (Fig. 8).

**DISCUSSION**

It is clear from the foregoing that the action of the ilioptoas muscle in the newborn infant is to flex and laterally rotate the hip. In the anatomical position with the thigh in line with the trunk this secondary rotary action is weak, but with the thigh abducted the ilioptoas becomes a powerful lateral rotator. It remains to attempt to reconcile these findings with the situation in the adult hip.

In considering the action of the psoas with the limb in the anatomical position it is easy to account for the difference between the adult and the neonatal state. In Figure 9 the axis of rotation of an adult femur has been constructed by joining the centre of the head with the
centre of the femoral condyles. This axis passes well medial to the lesser trochanter so that the psoas, which pulls the trochanter forward, must necessarily medially rotate the limb. In the case of the neonatal femur, however, when the axis of rotation is constructed in the same way it passes directly in front of the trochanter because of the very much shorter relative length of the femoral neck. Figure 7 shows that it is an oversimplification to represent diagrammatically the action of the psoas by drawing a line from its origin to its insertion as is commonly done. The tendon is not straight but winds in a spiral manner round the neck of the femur so that when it shortens it unrolls, as it were, the femur around the indicated axis of rotation. This is very much more obvious with the hip abducted as in Figure 7, for here the line of pull of the psoas is much altered in relation to the axis of rotation. This illustration together with Figure 8 also shows how the muscle can act as an abductor of the hip towards the extreme of this movement, a function which is very much better fulfilled by the iliacus portion of which the line of pull is farther away from the axis of movement; indeed in this position it enjoys a mechanical advantage at least as great as that of the gluteal abductors themselves.

Out of this confusion of anatomical facts it is desirable to attempt to discern some purposeful pattern in the construction of the iliopsoas muscle complex. It seems extraordinary on the face of it that a muscle should have an action in the newborn child which is reversed by the time it has reached maturity. Basmajian (1958) dismissed the problem by regarding the secondary rotary action as of such small account that it did not matter in which direction it operated, but this cannot apply to the abducted hip, and the role of the short psoas in maintaining fixed rotational deformity has been demonstrated (Figs. 1 and 2).

It is submitted that the confusion largely arises out of the fact that anatomical texts have concentrated, quite properly, on the action of the muscle with the limb in the anatomical position. Figure 7 shows that in the abducted position the conventional argument in favour of medial rotation breaks down even in the adult, because the line of pull of the muscle is so profoundly altered in relation to the axis of rotation. It is simpler, therefore, to regard the muscle as a flexor and lateral rotator, which accords with the posterior location of the lesser trochanter. It is true that when the limb is abducted this secondary action gradually wanes, and if the femoral neck is not short or valgus a position may be reached where the muscle has a theoretical medial rotary action. However, the mechanical advantage in this position is extremely poor and its functional effect as a medial rotator may be discounted. It is unfortunate that this position should correspond with the “anatomical” position which in all muscle actions are normally described, but this detail of anatomical convention should not be allowed to obscure the fact that the muscle is functionally a lateral rotator.

No apology is offered for reawakening this ancient controversy. The iliopsoas muscle plays a vital role in paralytic dislocation of the hip and is of considerable importance in congenital dislocation. It is important that the details of its action should be fully known.

A stable reduction of a paralytic dislocation of the hip can usually be achieved by putting the leg into one of two positions, abduction, flexion and lateral rotation, the so-called first position of Lorenz, or in abduction, extension and medial rotation. If the former position is
choked the psoas will be at its most slack, and while it will therefore provide no obstacle to reduction it will be offered the greatest opportunity to shorten. Sharrard (1964) pointed out the danger of maintaining a paralysed hip in this position for too long because the leg may rapidly become fixed in abduction. At first sight this seems difficult to explain because the gluteal abductors are also paralysed in this type of dislocation, but Figures 7 and 8 show how the iliacus could be responsible while the remainder of the shortened muscle holds the limb in flexion and lateral rotation.

Immobilisation in the extended medially rotated position on the other hand means that the psoas is tightened, so that if it should be abnormally short it may be impossible to get the thigh into enough extension and medial rotation to make reduction possible unless the psoas is divided as in the child illustrated in Figures 1 and 2. If the hip can be immobilised in this position without dividing the psoas it has less opportunity for shortening.

It should be made clear that, although the secondary actions of the iliopsoas muscle are of considerable significance in the mechanism of deformity it cannot be taken to mean that they are of functional significance in normal use. Because the muscle is capable of laterally rotating the abducted thigh does not imply that it is ever used for this purpose. The only information we have about normal function derives from electromyography (Basmajian 1958; Keagy, Brumlik and Bergan 1966), and this suggests that the muscle serves as a flexor only.

**SUMMARY**

1. Dissections of the newborn child revealed that the psoas muscle is a lateral rotator of the hip in all positions but that this secondary action is much stronger when the limb is abducted.
2. It has also been shown that the iliacus portion of the muscle can contribute to the completion of abduction movement.
3. An attempt has been made to reconcile these facts with the accepted concept of the action of the muscle in the adult.
4. The clinical significance is discussed.

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**REFERENCES**