ON THE USE OF THE LIGAMENTUM TERES OF THE HIP-JOINT.

By W. S. SAVORY, F.R.S., *Surgeon and Lecturer on Surgery, St Bartholomew's Hospital, late Professor of Comp. Anat. & Physiol., R.C.S.E.*

WHAT is the function of the Ligamentum Teres? Many authors who describe this structure are silent on the question, while of those who answer it the general conclusion is that it has, for its chief function, to limit adduction of the thigh, or when the thigh is fixed, to limit lateral movement of the pelvis on the femur—to prevent the pelvis from rolling toward the opposite side. Authors, of course, are not fully agreed in explanation of its use, and other less prominent functions are by many assigned to it, such as to limit rotation of the thigh; but the conclusion substantially arrived at is the one given above. I cannot, and need not, here quote from the several authors who are entitled to speak with authority on the subject, but neither in them nor elsewhere can I find any allusion to what appears to me to be the prime purpose of this ligament[1]. Its strength is very great; its attachments are remarkable; its situation is peculiar. I submit the following explanation of its use.

When the person is erect the ligament is vertical and tight. This statement, although generally accepted, has been challenged. I am satisfied of its accuracy. By removing the bottom of the acetabulum from the pelvis with a trephine the state of

[1] Since this paper has been in type I have learnt that Prof. Partridge in his lectures on anatomy at King's College was accustomed to compare the Ligamentum Teres, in its function, to the leathern straps by which the body of a carriage is suspended on C springs; and my attention has been called to the following passages published by Prof. Turner in 1857 (*Human Anatomy and Physiology*, Edinburgh): "In the interior of the joint (hip) is a strong band of fibres called the inter-articular or suspensory ligament. When a person is standing erect or with the body slightly bent, a portion of the weight of the trunk is borne directly by the heads of both thigh-bones, or of one thigh-bone, according as he stands upon one or both legs, owing to the direct pressure of the acetabulum upon the heads of those bones. Now as the end of this ligament, which is connected to the lower margin of the acetabulum, is much lower than the end connected to the thigh-bone, it of necessity suspends that portion of the weight of the body which is thrown upon it. The effect of this is to distribute over the head of the thigh-bone that weight which, supposing the suspensory ligament had not been present, would have been sustained by that portion merely which is in direct contact with the upper part of the acetabulum." (p. 42.)

the ligament may be demonstrated. But I think the discrepancy of observation is due to the fact that the degree of tension of the ligament is dependent on the line of direction of the femur. The ligament is moderately tight when a person stands evenly upon both legs. It is tighter when the femur is slightly flexed as it more usually is. But when resting upon one leg, inasmuch as the pelvis is then raised on that side, which of course affects the ligament in the same way as adduction of the femur would do, then the ligament becomes extremely tense. In other words, it becomes tightest when the hip-joint has to sustain the greatest weight.

When therefore the pelvis is borne down upon the femur, or when the femur is forced upwards—that is, when the pressure would be greatest between the upper part of the acetabulum and the opposite surface of the head of the femur—it is put directly on the stretch. More precisely, its great purpose is to prevent undue pressure between the upper portion of the acetabulum, just within the margin, and the corresponding part of the head of the femur. But for this ligament such undue pressure must inevitably occur. Suppose the Ligamentum Teres absent, and the person standing upright: owing to the obliquity of the acetabulum and the head of the femur—of the axis of the joint—pressure between the two could not be equally, or nearly equally, diffused over their opposing surfaces, but it would be concentrated on a spot in the upper part of the socket through which a line drawn down the body, through the joint into the leg, would pass. When the thigh is straight, when the femur is in a line with the body, as when one stands upright, then is the Ligamentum Teres in the same line too, and consequently any force which drives the femur and pelvis together must tell at once upon the ligament, and be directly checked by it.

Owing, therefore, to the shape and obliquity of the hip-joint, and the weight of the body, the Ligamentum Teres is necessary to prevent concentration of pressure at a particular point above it.

The line through which the weight or force acts between the upper part of the acetabulum and the opposed surface of the head of the femur forms, with the line of weight or force which passes through the Ligamentum Teres, an obtuse angle; and the

resultant of these forces is in a line which passes through the long axis of the head of the femur.

When the person is erect the body partly hangs upon the Ligamentum Teres.

I submit that this is the prime function of the Ligamentum Teres. Other purposes I do not deny, but would maintain that they only occasionally come into play, and are altogether subordinate to this one, which is especially called into action whenever the weight of the body is thrown upon one leg.

Now this view may be tested by the facts of comparative anatomy.

It has often been remarked that the Ligamentum Teres is apparently distributed among animals in a very arbitrary manner.

In most of the mammalia it is present, *e.g.* in ruminants, rodents, and terrestrial carnivora. In many other absent, *e.g.* in the elephant, sloth, seal, walrus, sea-otter, ornithorhynchus, and echidna.

It exists in animals with the utmost diversity of form and habits.

It is sometimes present in one animal, *e.g.* the chimpanzee, and absent in another very closely related to it, *e.g.* the ourang-outang[1].

Now is it possible to discern the conditions under which it is present or absent?

When the cavity of the acetabulum looks downward and the head of the femur upward, in other words, when the direction of the hip-joint is nearly vertical, and the weight of the body falls through the centre of the joint, then the Ligamentum Teres is absent, *e.g.* elephant.

When the acetabulum looks outward and the head of the femur is inclined inward, in other words, when the hip-joint is placed obliquely, so that there would otherwise be undue

[1] There is great difference in the degree to which the Ligamentum Teres is developed in Birds. In some it hardly appears, while in many it is very strong. The great depth of the groove in the head of the femur of the Ostrich shews the size it occasionally attains. In several birds in which I have dissected this ligament I have always found its pelvic attachment to be, not to the border of the acetabulum, but to the lower margin of the large foramen or foramina which exist at the bottom; this, so far as its action is concerned, comes to the same thing.

pressure at a particular part, then the Ligamentum Teres is present, *e.g.* horse.

The exceptions to this occur in those animals in whom, although it is an instrument of progression, the posterior extremity does but little in supporting the weight of the body, *e.g.* seals, and the ourang-outang.

These facts, that while the Ligamentum Teres is found in the chimpanzee and other monkeys, it is almost or entirely wanting in the ourang-outang, at first sight apparently so capricious, are very suggestive. It is easy, I think, to understand why it is generally present in monkeys, inasmuch as in them the hip is placed obliquely, and the posterior extremity can support the trunk. But the hip-joint is oblique also in the ourang-outang. The conformation of the foot, however, is the key to the explanation of its absence here. It is clear that in the ourang-outang the posterior extremity cannot be such an instrument of support to the trunk raised upon it, as in the chimpanzee, and consequently the Ligamentum Teres is not needed to counteract undue pressure at a particular point.

Again, it may be said that when an animal stands, in proportion as the long axis of the head of the femur approaches to a vertical line, so does the Ligamentum Teres become weak until it disappears. On the contrary, it is strongest where the head of the femur has a direction farthest from the vertical, and has to support the greatest weight.

In conclusion, I should like to call attention, without attempting to lay too much stress on it, to a specimen (2. 43) in the pathological series of the museum of St Bartholomew's Hospital, which is thus described in the catalogue.

"Two hip-joints from the same person. In each joint the Ligamentum Teres is completely wanting. The capsule of each is perfect and exhibited no appearance of disease. In the usual situation of the attachment of the Ligamentum Teres there is a deep depression in the head of the femur, and just above this the cartilage of each femur is slightly absorbed."

It may be observed that the cartilaginous shell on the head of the femur is naturally thickest on the upper and inner aspect.

The above Paper was read at a Meeting of the Cambridge Philosophical Society, in April, 1874.

In discussions which followed Professor Humphry, after expressing his obligation to Mr Savory for affording the opportunity of discussing the subject with him, observed that the suggestions made with reference to the function of the ligament by Mr Savory rested entirely upon the view that the ligament is tight in the erect posture. Professor Humphry was one of those who had challenged this view, of the accuracy of which Mr Savory had expressed himself to be satisfied. He referred to his work *On the Human Skeleton including the Joints*, in which he had stated as the result of careful observation that the ligament is not tense and cannot be rendered tense in the erect posture. He had lately reconsidered the question and re-examined the specimens, or some of them, upon which his statement had been based, as well as other recent specimens made for the purpose, and he was convinced that it was correct. In the first place, the dimple in the head of the femur for the ligament is more or less oblong or pear-shaped, and is directed from above downwards and backwards with such obliquity that the ligament can lie in it, as it must do when it is in a state of tension, only in the semiflexed position of the hip, the thigh being inclined from the vertical to an angle of about 45°. This can be seen in the dry bone, and still better in recent specimens in which the direction of the insertion of the fibres of the ligament are seen to correspond with this view. Secondly, the trephine hole through the bottom of the acetabulum shews clearly that it is at about this angle only, and when the thigh is adducted, that the ligament is really tense. In the erect posture, and by the erect posture he meant when the thigh descends vertically from the pelvis and the capsular ligament, more particularly the anterior part of it, is tight, neither adduction, nor rotation, nor any other movement will throw it into a state of full tension. If this is so, which the several specimens examined by the Professor proved to be the case, then it is quite certain that the body cannot hang upon the Ligamentum Teres when the person is erect, and the inferences based upon such a view fall to the ground.

When resting upon one leg the body is tilted a little over to that side so as to throw the line of gravity more directly over that limb, the opposite side of the pelvis is slightly raised, the movement being equivalent to that of *ab*duction of the limb upon which the weight is borne, and the Ligamentum Teres is not stretched, but is still more relaxed than in the erect posture. Even in the position of 'stand at ease,' when the weight is borne upon one limb and the opposite side of the pelvis is lowered, the other limb being placed upon the ground slightly flexed, the movement now being equivalent to that of *ad*duction of the weight-bearing limb, though the Ligamentum Teres is less relaxed than in the former position, and is also less relaxed than in the erect posture, still it is not tight; and the body is slung, not

upon the Ligamentum Teres, but upon the thick and strongly resisting upper portion of the anterior ligament of the hip. The use of the ligament the Professor believed to be, as he had stated in his work, to assist in bearing weight when the limb is placed upon the ground partially flexed and adducted, when the capsule of the hip is comparatively relaxed, and when, if the body be overweighted, dislocation is most likely to occur. In estimating, however, its value, even in this position, it must not be forgotten that several instances have occurred, some of which are noted in Meckel's *Archiv*, VI. 341, in which the ligament was wanting without its being known that any inconvenience had resulted from its absence. In dislocation, too, it must be severed, and it is highly improbable that it ever unites. It has been found indeed ununited. Still the loss of it does not appear to be much felt.

With regard to other mammals the ligament as stated in the paper is commonly absent when the lower limbs do not bear much weight, and also when they descend vertically from the pelvis. The Professor had, however, pointed out in the *Journal of Anatomy*, Vol. III. p. 312, that it is present in the Bats. In most mammals in which it exists the dimple or furrow or angular depression which it occupies in the head of the femur is oblique, as in Man, indicating its tension in them, as in him, to occur in the semiflexed position of the joint.

There were other points to which the Professor took exception, but the important one was this of the position of the joint in which the tension of the ligament takes place.

Mr Savory, in reply, remarked that he quite agreed with Professor Humphry that, if he were wrong as to the assumption of the tension of the ligament in the erect posture, his view fell to the ground, but he could not agree with the Professor as to what really is the erect posture. The skeletons in museums are commonly articulated wrong, and give too much inclination to the pelvis, and he thought Professor Humphry was in error on this point, and that if the ligament be examined in the strictly erect posture it will be found tight, or more nearly so than the Professor admitted. He added that by applying his view he had generally been able to judge from the direction of the limbs in well-articulated specimens of animals whether the ligament had been present during life or not. Still there were some exceptions, among the most notable of which was the difference between the ostrich and the emeu. In the former it is large, whereas in the emeu it is absent. Yet, though he had visited the latter animal in the Zoological Gardens, and examined its posture and movements with reference to this question, he had been unable to make out why it should thus differ from the ostrich.