Remarks on the anatomy of the knee-joint / by Holmes Coote.

REMARKS

ON THE

ANATOMY OF THE KNEE-JOINT.

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The thigh, which may be freely flexed upon the pelvis, as in the act of raising the knee, cannot be extended backwards beyond a perpendicular line drawn from the acetabulum through the long axis of the inferior extremity. The leg, on the other hand, cannot be extended beyond a similar line, but may be flexed to almost any extent upon the thigh. The movements in the one joint are precisely the opposite to those in the other. In the upright position the bones composing the knee-joint are held by the ligaments, as well as by the muscles, immoveably fixed, so that the limb may constitute a firm column of support to the weight of the trunk; but in the semiflexed position the tibia is capable of rotating to a limited extent upon the articulating extremity of the femur.

The number, direction, and points of attachment of the ligaments of the knee-joint have a direct relation to these three points: namely, the freedom of flexion; the firmness of the whole limb in its extended position; and the power of rotation, to a limited extent, when the leg is bent upon the thigh.

Flexion.—The prominent and horizontally elongated condyles of the femur have their articulating surfaces continued backwards to the shaft of the bone, that the shallow head of the tibia may freely move in the common flexion of the leg, as in the act of walking, running, &c. Most persons, and indeed all by practice, can, with a slight effort and with the assistance of the hand, make the extremity of the os calcis, or the heel, touch the buttock opposite the tuberosity of the ischium. If, in the dead subject, the mechanical obstruction offered to extreme flexion by the muscles of the calf of the leg, and by the hamstring muscles, be removed, the approximation of the heel and buttock is the more easy. It is therefore irrational to talk of any ligaments being concerned in checking a movement which the mechanical construction of the joint allows in its freest range. The only tension observed is in the fold of synovial membrane, and in a few stray ligamentous fibres, covering the anterior surface of the crucial ligaments; but the resistance thus offered is inconsiderable, and may be overcome without damage to the ligamentous structures of the knee.

Extension.—The leg cannot be extended beyond a straight line drawn perpendicularly through the long axis of the inferior extremity. In complete extension all the ligaments are tense; and an attempt to force the leg beyond this line would rupture, first, the ligamentum posticum Winslowii; secondly, the two lateral ligaments; and thirdly, the two crucial ligaments. In the living subject the resistance offered by the

flexor muscles of the leg inserted into the upper extremity of the tibia and the fibula must also be overcome. It is for the purpose of limiting extension that the semi-membranosus muscle sends a strong tendinous prolongation upwards from its tendon of insertion into the external condyle of the femur. The two lateral ligaments for the same purpose extend obliquely backwards, as well as downwards, from their respective origins to the heads of the tibia and fibula: from the shape of the condyles of the femur, extension separates more widely their fixed points, and thus renders them more tense. This remark refers especially to the external lateral ligament.

When the leg is semiflexed it may be rotated to a limited extent both inwards and outwards.—In this position the internal lateral ligament is nearly as tense as in the extended state of the joint; the shape of the internal condyle being such, that flexion does not cause any considerable approximation of its fixed points. Indeed, there is one position in which the ligament is rather stretched than otherwise, and the surfaces of the tibia and femur are pressed together more firmly than in others.

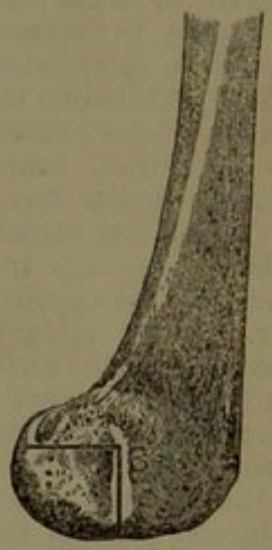
The external lateral ligament is relaxed.—In flexion, the fixed points of this ligament are approximated nearly a quarter of an inch. The external condyle of the femur is so shaped, that a line drawn from the point of attachment of the external lateral ligament to the surface of the bone measures more if drawn directly downwards in the line of the axis of the former, than if drawn at right angles to this line, from the same point in the direction backwards.

My friend Mr. Ingram has kindly measured several bones, to ascertain, at my request, the accuracy of this point, and the accompanying drawing illustrates the result of his examinations. Let it be understood, therefore, that the shape of the condyles has a direct influence upon the state of tension of the lateral ligaments. The circumference of the internal condyle of the femur is part of a circle; the point of attachment of the internal lateral ligament being in its centre: flexion influences, in a scarcely perceptible manner, the state of tension of the ligament. The external condyle of the femur is of elongated form: the external lateral ligament is attached much further back than the internal, and flexion brings its fixed point nearer the surface of the joint.

Internal condyle.

A. Attachment of internal lateral ligament.

External Condyle.



B. Attachment of external lateral ligament.

Therefore, in flexion, the internal articulating surface of the tibia, and the internal condyle of the femur, being held together, form a sort of pivot, around which the external articulating surface of the tibia moves in rotation.

The internal interarticular fibro-cartilage is of semilunar form.—It is attached to the head of the tibia by its two widely separated extremities, and to the internal lateral ligament at the midpoint of its circumference. It is, therefore, immoveable, and it corresponds with the other conditions of the inner half of the knee.

CORRIGENDA.

In the Engravings to Mr. Coote's paper, the condyle marked A is the *external* condyle; and the horizontal line behind A ought to be *shorter* than the vertical line. The condyle marked B is the *internal* condyle.

The external interarticular fibro-cartilage is circular, and attached to the bone only at that point where the two extremities meet. A pouch of synovial membrane intervenes between it and the external lateral ligament. It freely follows the external condyle of the femur in the movement of rotation.

The accident known as dislocation of the semilunar cartilage affects the external, and not the internal cartilage, as has been erroneously supposed.

The crucial ligaments have for their office the limitation of the rotatory movement. Rotate the foot outwards, the posterior crucial ligament is tense; rotate the foot inwards, the anterior crucial ligament is tense: but in this latter position both ligaments are tense, in consequence of their crossing in the middle of the joint.

The posterior crucial ligament is intimately connected at its tibial insertion with the posterior cornu of the moveable external semilunar cartilage, which requires to be held under the extremity of the femur. The anterior crucial ligament is not so intimately connected to either of the semilunar cartilages: its attachment is chiefly to the bone. A small transverse band connects the anterior parts of both these semilunar cartilages.

There are many muscles which rotate leg and foot inwards: all those muscles inserted into the inner surface of the head of the tibia, but more especially the semi-membranosus and the popliteus.

The muscles which rotate the leg and foot outwards are the biceps flexor cruris, which is inserted into the extremity of the fibula (the homotype of the olecranon), and the tensor vaginæ femoris, which is continued from the crista of the ileum downwards, by means of a strong fascia, to the head of the tibia. Dr. Palasciano, of Genoa, was the first, I believe, to point out the proper functions of the tensor vaginæ femoris. Let any one semiflex the leg, and then rotate the foot outwards, he will feel the strong ligamentous band on the outer part of the thigh, usually described as part of the fascia lata, become tense and relaxed with the movements of the limb. Dr. Palasciano justly remarks, that a dense fascia is not stretched over that part of a limb where the muscles are most powerful, otherwise it would be strong where it covers the adductors on the inner side of the thigh, and thin on the outer side of the limb, which is occupied only by the vastus externus muscle. He might have added to his description of the muscle, that it is part of the gluteus maximus, as it arises from the crista of the ileum over the gluteus medius, and is inserted into the anterior margin of that dense band of fascia which receives the greater part of the gluteus maximus. It is supplied also by nerves from the sacral plexus. The gluteus maximus pulls the pelvis backwards, and assists in the maintenance of the erect posture: the tensor vaginæ femoris rotates the leg when semiflexed; but, if both muscles act in concert, they pull upon a strong ligamentous stay, which binds the pelvis to the head of the tibia.

But little attention has been paid by anatomists to the mechanism for the rotation of the tibia upon the femur; and yet it is exclusively for this movement that, in place of the hinge-shaped joint instanced in the elbow, we find the flat broad surface of the articulating extremity of the tibia applied to the condyles of the femur.

Liability to displacement is overcome by an assemblage of ligaments, which, when examined in minutest detail, show in their great variety of form and attachments, the most perfect adaptation to the office which they have to perform.