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ON DISEASED CONDITIONS OF THE
 KNEE-JOINT

WHICH REQUIRE AMPUTATION OF THE LIMB, AND THOSE CONDITIONS WHICH ARE FAVOURABLE FOR EXCISION OF THE JOINT; WITH AN EXPLANATION OF THE RELATIVE ADVANTAGES OF BOTH OPERATIONS, AS FAR AS CAN BE ASCERTAINED BY CASES PROPERLY AUTHENTICATED.

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SECTION I.—GENERAL ANATOMY OF THE
 KNEE-JOINT.

The Knee-joint, the largest and most complicated articulation in the body, belongs to that class of joints termed *ginglymoid*. Its osseous structure is derived from the lower extremity of the femur, the upper extremity of the tibia, and the patella.

The Femur, at its lower extremity, terminates in the external and internal condyles, continuous with one another in front, but divided posteriorly by a depression called the intercondyloid fossa. Of the two condyles, the external presents the larger articular surface in front; but the internal extends below the external. If the condyles of the femur be placed flat on the tibia, it will be found that the shaft diverges about 15° from a line perpendicular to the tibia. It is to compensate for this oblique position of the shaft of the bone that the internal condyle is so much longer than the external. (Humphry, *On the Human Skeleton*, p. 475.) It is most necessary to bear this fact in mind when sawing the bone through, as one of the steps in excision of the joint. If the saw be carried at right angles to the shaft of the bone, the cut surface, when in contact with the tibia, must of necessity bow the knee outwards. In writing on the operation of excision of the knee, I shall again refer to this point. Each condyle possesses a large articular surface covered with cartilage, on either side of the fossa, for articulation with the tibia; whilst between these two surfaces, in front, lies the patellar articular surface, over which the patella plays. It is of some practical bearing to note that the external articular condyle is of the two the more prominent, as in diseased conditions of the joint the patella is frequently found attached to this surface. On each side of the condyles are rough surfaces for the attachment of the external and internal lateral ligaments; and on the side of the external condyle is also a smooth groove terminating in front in a depression, from which the popliteus muscle takes its rise. It is of importance to observe particularly the origin of this muscle, as in noticing certain pathological conditions of the joint we shall have again to refer to it.

Development. An ossific nucleus is not deposited in the lower extremity of this bone until the eighth

or ninth month of foetal life; and although this is the first of its epiphyses in which bone is deposited, yet it is the last to become united to the shaft, complete union not being accomplished before the twentieth year. (Humphry on *The Human Skeleton*, p. 476.) Barwell, in his work on *Diseases of the Joints*, p. 6, relates a strumous case in which union did not take place until the twenty-fourth year.

The Tibia. The head of the tibia presents two condyloid surfaces corresponding to the articular condyles of the femur. Between them rises the spine, and at its base, one in front and the other behind, are the depressions which give attachment to the crucial ligaments and semilunar cartilages of the joint. On the outer side of the head is an articular surface for the head of the fibula; and on the inner side, and somewhat behind, is a groove for the insertion of the tendon of the semi-membranosus muscle. In front is the anterior tuberosity, giving attachment to the ligamentum patellæ, and behind the rough popliteal line passing obliquely downwards and inwards from the outer tuberosity of the head, bounding the attachment of the popliteus muscle.

Development. There is a special nucleus for the head of the tibia which does not appear until some weeks after birth. This epiphysis includes the anterior tuberosity within its boundary, a point of considerable importance to the surgeon, although there is sometimes a special nucleus at this point. At the age of 20 years, this epiphysis is frequently not yet united to the shaft of the bone.

The Patella is a sesamoid bone developed in the tendon of the quadriceps extensor muscle. It is subcutaneous; its under surface being coated with cartilage for articulation with the patellar articular surface of the femur. It is attached by the ligamentum patellæ to the anterior tuberosity of the tibia. At birth this bone is cartilaginous, and an ossific deposit appears about the third year.

The Growth of the Bones. Before leaving the consideration of the bones entering into the formation of the knee-joint, it may be well to refer to the very important subject of their growth. It is well known that long bones grow longitudinally by successive additions to their extremities; an ossific nucleus being deposited in the epiphysal cartilage, the bony matter extends in all directions, stopping short, however, of the edge of the cartilage, and leaving two layers—one, the articular cartilage, between it and the joint, and the other, the epiphysal junction, between it and the shaft of the bone.

The further researches of Humphry, Ollier, and others, show, moreover, that the larger ends of the long bones, and those in which the epiphysal cartilages remain the longest, grow the most. Thus, at the lower end of the femur, where the epiphysal cartilage is the last to be united to the bone, the growth is most rapid and prolonged. Much, if not all, of the growth in length at the upper epiphysis is lost, owing to its extreme obliquity; it is, therefore, of great importance to preserve the longitudinal growth of this bone. In the case of the tibia, the longitudinal growth being at both epiphyses is all gain (Hodges on *Excision of Joints*, p. 157); but here, too, the most important growth is at the larger end, that in connection with the knee-joint. Ollier points out that, whereas removal of the epiphysal ends of the humerus and ulna at the elbow-joint interferes but little with the subsequent growth of the

limb, yet that the analogous proceeding at the knee-joint, removing, as it does, the two principal sources of longitudinal growth, must materially interfere with the after proportions of the limb. (Ollier, *Journal de Physiologie*, vol. iv, p. 87.)

The Muscles and Tendons in connection with the knee-joint, which are more or less involved either in morbid conditions or operative procedures, next require notice. Passing anteriorly to its insertion in the anterior tuberosity of the tibia is the tendon of the quadriceps extensor femoris, beneath which muscle is the subcrureus, extending from the lower part of the anterior surface of the femur to the synovial membrane of the knee-joint.

On the inner side, a little below the insertion of the quadriceps, is inserted the tendon of the sartorius, and beneath this the tendons of the gracilis and semitendinosus. The semimembranosus is inserted by three slips: one passing to the inner side of the tibia, one to the popliteal fascia, and one to the posterior ligament; and, with the semitendinosus, forms the inner ham-strings. The biceps femoris, forming the outer ham-string, passes to its insertion in the head of the fibula by two slips, between which passes the external lateral ligament, a bursa being interposed. Posteriorly, the gastrocnemius arises from the condyles of the femur. Under the inner head, separating it from the tendon of the semimembranosus, is a synovial sac, which sometimes communicates with the knee-joint. The plantaris takes its origin from above the external condyle and the posterior ligament of the knee-joint. The popliteus, as before remarked, arises from a depression in front of the popliteal groove on the external condyle within the capsule of the joint, and is in contact with the external semilunar cartilage.

Action of the Muscles. The quadriceps extensor extends the knee-joint; the ham-string muscles flex it. The inner ones with the popliteus act as rotators inward, especially in flexed conditions of the joint. The outer ham-string, the biceps, acts as an external rotator. The subcrureus is supposed, in extension of the joint, to pull up the synovial membrane, and prevent its being pressed between the patella and the femur.

The Ligaments of the knee-joint are the external, internal, and the posterior, or ligament of Winslow; this latter one being strengthened by slips from the tendons of the semimembranosus, the popliteus, and the heads of the gastrocnemius, and presenting a strong and firm partition between the joint and the popliteal vessels and nerves which lie upon it.

The ligamentum patellæ, although strictly the tendon of the quadriceps, may be considered one of the ligaments of the knee-joint. The attachment has been already noticed. Between it and the top of the tibia a bursa is found.

The crucial ligaments are within the joint. The anterior, arising from the depression in front of the spine of the tibia, passes backwards and upwards to be inserted into the inner and posterior part of the external condyle of the femur. The posterior, arising from the depression behind the spine of the tibia, passes forwards and upwards to be attached to the intercondyloid hollow and inner condyle of the femur.

The transverse ligament is a slight band of membrane connecting the interarticular fibro-cartilages of the knee-joint in front.

The capsular membrane is a fibrous tissue occupying the space between the ligaments. It is specially present between the sides of the patella and the femur, and covers the condyles of the femur beneath the gastrocnemius.

The Semilunar Cartilages are placed on the articular surface of the head of the tibia. They are surrounded by synovial membrane. The outer convex borders are thick, whilst the inner concave borders are bevelled down to a fine edge; the surface of the tibia within the borders being uncovered by them.

Articular Cartilage. The entire articular surfaces of the femur, tibia, and patella, are coated by a layer of cartilage varying in thickness from one-sixteenth to one-seventh of an inch. (*On the Thickness of Articular Cartilage.* P. Redfern, M.D.) As has been already noticed in considering the growth of bone, this cartilage is the layer of unossified cartilage which exists between the deposits of bone in the epiphysis and the joint. It is a tough elastic material, permeated neither by vessels, nerves, nor lymphatics. Exposed as it is to continual wear and tear at its free surface, there is special arrangement made for its repair. It is attached, or is rather continuous with the bone; but that portion of bone with which it is immediately in contact, the articular lamella, consists, according to Barwell, of a series of minute tubes running forward to the cartilage surface, through which passes the nutrient fluid from the bone to the deep surface of the cartilage. It is very doubtful as to whether the surface of articular cartilage is covered with any membrane. It is more than probable that the peculiar arrangement of the cartilage corpuscles has led some observers to the conclusion that the free surface of the cartilage was covered by epithelium. It has been pointed out that these corpuscles, as they approach the free surface, gradually change their position; from being perpendicular, they gradually assume a horizontal position, until, at the free surface of the cartilage, they form several layers of corpuscles placed horizontally one on another. (Barwell on *Diseases of the Joints*, p. 12.) By this arrangement, a continuous growth of cartilage takes place from the attached surface to compensate for the loss at the articular surface.

The Synovial Membrane of the knee-joint encloses the largest synovial cavity in the body. It forms a large sac beneath the quadriceps, and invests the entire circumference of the lower end of the femur. It is thence reflected on to the tendons of the gastrocnemius behind. A process invests the crucial ligaments, the upper and lower surfaces of the semilunar cartilages, and thence passes to the tibia. Another process passes down on the popliteus, and sometimes is blended with the fibular joint. It sends processes named "ligamenta alaria" between the tibia and patella; and another process, "ligamentum mucosum", through the joint to the front of the intercondyloid fossa. These processes lie on and enclose fat, which fills up the numerous interstices in the joints and forms a soft pad on which the synovial membrane rests. A variety of opinions has been expressed as to the prolongation of the synovial membrane over the articular cartilage. Barwell states that it is his conviction that the cartilage is not covered by this membrane, but that it is lost near its edge (Barwell, p. 14); whilst, on the other hand, Toynbee has

proved its existence in the foetus (*Philosophical Transactions*). Price states that he is convinced that more than once he has traced a prolongation over the cartilaginous surface; and that, in some diseased conditions of the articulation, it can be demonstrated. (Price, *On the Knee-joint*, p. 7.) Seeing, however, that the resemblance between cartilage structure and the structure of synovial membrane is very great, and that diseased conditions extend rapidly from the one to the other, I am inclined to coincide with Barwell's views upon this point, and to regard the synovial membrane, not as a closed sac, but as a simple tube terminating at either end at the edge of the articular cartilage. The loose arrangement of the membrane, and the plentiful deposit of soft fat and subsynovial tissue, seem especially to provide against the bruising and injury to which it would otherwise be subjected; and it appears to me that this arrangement would be materially interfered with if the synovial membrane were prolonged tightly over prominent portions of bone such as those found in the knee-joint.

The *Vascular Supply* to the joint is derived from an anastomotic branch of the superficial femoral, branches of the popliteal, and a recurrent branch of the anterior tibial artery.

The *Nervous Supply* is obtained principally from the internal popliteal nerves, and a small twig from the obturator nerves may be traced to the back of the joint.

[To be continued.]

DR. MACLAREN, of Blairgowrie, receives in his house victims of tipping, dipsomaniacs as they are called.

PRESENTATION TO DR. JONES, OF WASHINGTON, DURHAM. At the seventh anniversary of the Court North Biddick, of the ancient order of Foresters, held at Washington, on the 3rd inst., a silver tea and coffee service, snuff box, medal of the order, and address were presented to Frederick Denbigh Jones, M.D., Surgeon to the Court, by his numerous friends and brethren of the Court, in token of their great regard and esteem, and in appreciation of his private worth and professional abilities. The event was celebrated by a dinner, at which nearly one hundred gentlemen sat down, under the presidency of S. B. Coxon, Esq., head viewier of Usworth Colliery.

THE DARK RACES. The Supreme Court of Michigan has worried itself to discover what is a white man. It has been clearly established by the laws of several States, that a man may be a white man, and at the same time a black man. Everything depends upon the cartilage of the nose. "A certain peculiarity of the cartilage of the nose," says the scientific testimony taken before the Circuit Court of Wayne County, "is an infallible indication of African blood." A man, being ignorant that he was a negro, attempted to vote at a local election, and was arrested for violation of the laws. He brought numerous witnesses, who testified that, to the best of their knowledge, there was not a drop of negro blood in his body. But this availed not. A Dr. Pitcher examined his nose before the Court; and, from the conformation of his cartilage alone, he was pronounced to be but fifteen-sixteenths of a white man, the remaining sixteenth being pure African. The defendant appealed to the Supreme Court, and that intelligent body sustained the nose; and the man, we believe, was punished for voting contrary to law. (*New York Tribune*.)

Addresses and Papers

READ AT

THE THIRTY-FOURTH ANNUAL MEETING OF THE BRITISH MEDICAL ASSOCIATION.

[Held in CHESTER, AUGUST 7th, 8th, 9th, and 10th, 1866.]

THREE CASES OF COMPOUND DIS- LOCATION OF THE ASTRAGALUS, WITH REMOVAL OF THE BONES.

By T. T. GRIFFITH, Esq., Wrexham.

THE chief interest and value of the following cases, is that they illustrate and confirm the clear practical rules laid down by Mr. Turner, in his valuable monograph on "Dislocations of the Astragalus" published in the eleventh volume of the *Transactions* of our Association. The rules of practice there recommended are logical deductions from a thorough consideration of the subject in its anatomical, physiological, and pathological relations, and have received the sanction of the principal surgical authorities which have subsequently treated of this branch of local injuries; and I consider myself most fortunate in having read Mr. Turner's paper before meeting with a case of serious accident to the astragalus.

One important fact is that in compound complete dislocations of the bone, reduction may be considered impracticable from the almost immediate contraction of the muscles acting upon the os calcis and foot generally, bringing the tibia, fibula, and calcaneum into more or less close and firm contact, leaving no space for restoring the astragalus to its wedge-like position within the joint. Then follows, as a conclusion, the necessity for removing the bone at once, to prevent the constitutional and local disturbances so likely to arise from its presence as a foreign body, detached more or less from its vascular and vital connexions, and liable to a long process of caries and suppuration.

1. *Case of Complete and Compound Dislocation of the Astragalus forwards and outwards: Removal of the Bone: Death from Tetanus.* David Roberts, aged about 40, of spare habit and of nervous temperament, suddenly leaped from a horse which started. He alighted on his feet, stood for a moment, and then fell. On visiting him, I found the astragalus of the right foot completely dislocated forwards and partially outwards through an extensive wound reaching across the instep; it remained attached to the ankle only by a few ligamentous bands. Upon dividing these the bone was at once removed. There was neither fracture nor displacement of the tibia or fibula. It was at once apparent that reduction of the astragalus would have been impracticable, and here I felt the great value of the rules laid down by Mr. Turner deduced from sound physiological and pathological principles, as to the treatment such cases required. On examining the astragalus, I found that a small portion had been broken from its posterior and inner angle, and doubtless retained in the joint by ligamentous union. The same circumstance occurred in another case; but there the fracture was through its posterior and outer angle. In both cases I deemed it best to allow the broken off portion to remain,