

On Hey's 'internal derangement of the knee-joint' / by J.F. Knott.

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Publication/Creation

Dublin : Printed for the author by John Falconer, 1882.

Persistent URL

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ON
INTERNAL DERANGEMENT

J. F. KNOTT
M.D. AND NEW YORK

A P
New York the UNIVERSITY BOOK

Entered from the "Papers"

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ON HEY'S

124

INTERNAL DERANGEMENT OF THE KNEE-JOINT."

BY

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IRELAND.

A PAPER

Read before the UNIVERSITY BIOLOGICAL ASSOCIATION, May 11, 1882,
and

Reprinted from the "DUBLIN JOURNAL OF MEDICAL SCIENCE."

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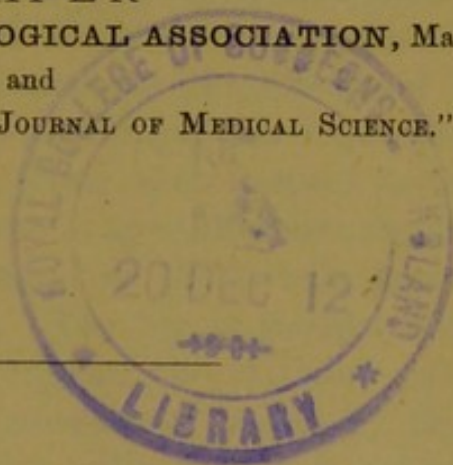
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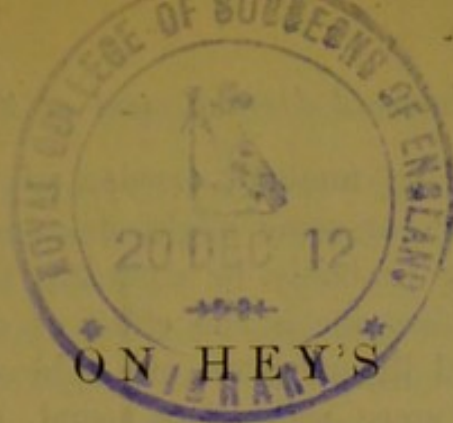
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THE HISTORY OF THE
CITY OF BOSTON
FROM THE FIRST SETTLEMENT
TO THE PRESENT TIME

By SAMUEL JOHNSON, LL.D.
OF THE UNIVERSITY OF OXFORD.
IN TWO VOLUMES.
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“INTERNAL DERANGEMENT OF THE KNEE-JOINT.”

IN the volume of “Practical Observations in Surgery,” published by Mr. Hey, of Leeds, is included a paper “On Internal Derangement of the Knee-joint,” which contains the original description of the very peculiar lesion to which the name of this distinguished surgeon has since been attached. It is given in the following words:—“This joint is not unfrequently affected with an internal derangement of its component parts, and that sometimes in consequence of *trifling* accidents. The disease is, indeed, now and then removed, as suddenly as it is produced, by the natural motions of the joint without surgical assistance; but it may remain for weeks or months, and will then become a serious misfortune, as it causes a considerable degree of lameness. . . . This disorder may happen with or without contusion. In the former the symptoms are equivocal till the effects of the contusion are removed. When no contusion has happened, or the effects of it are removed, the joint, with respect to its shape, appears to be uninjured. If there is any difference from its usual appearance, it is that the ligament of the patella appears more relaxed than in the sound limb. The leg is readily bent or extended by the hands of the surgeon, and without pain to the patient—at most, the degree of uneasiness caused by this flexion or extension is trifling. But the patient himself cannot freely bend, nor perfectly extend, the limb in walking; he is compelled to walk with an invariable and small degree of flexion. Though the patient is obliged to keep the leg thus stiff in walking, yet in sitting down the affected joint will move like the other.

“The complaint which I have described may be brought on, I apprehend, by any such alteration in the state of the joint as will prevent the condyles of the os femoris from moving truly in the hollow formed by the semilunar cartilages and articular depres-

sions of the tibia. An unequal tension of the lateral or cross ligaments of the joint, or some slight derangement of the semilunar cartilages may probably be sufficient to bring on the complaint. When the disorder is the effect of contusion, it is most likely that the lateral ligament on one side of the joint may be rendered somewhat more rigid than usual, and hereby prevent that equable motion of the condyles of the os femoris which is necessary for walking with firmness."

Such are the words of the earliest notice of this peculiar injury which we possess, and such is the uncertainty as to the accurate diagnosis in which the original describer has left his readers, and, so far as we can see, was obliged to remain himself. Sir Benjamin Brodie notices Hey's observations, and says that "the symptoms very much resemble those produced by a loose cartilage within the joint," but his views of the actual nature of the lesion seem even more indefinite than those of the latter writer, and he states further on, in reference to a case which occurred in his own practice, that "the facts which I am about to state are not very easy to be reconciled, either with this hypothesis or with that suggested by Mr. Hey." Many, at least, of the surgeons of the present day appear to have made up their minds to a very decided view of the state of things in Hey's internal derangement of the knee-joint; and, without much more conclusive evidence to go upon than that which was possessed by the distinguished surgeons whose names I have mentioned, unhesitatingly inform their readers or hearers, as the case may be, that the symptoms are due to a luxation of one of the semilunar fibro-cartilages, which are interposed between the cartilaginous surfaces in the femoro-tibial articulation. To examine the validity of the grounds for such a conclusion is my chief object in making this communication. To do so satisfactorily, it will be necessary to call attention to some of the more prominent features in the mechanism of the knee-joint, and to notice the connexion of the fibro-cartilages, which concern us so intimately in this lesion.

The upper end of the tibia presents an extensive surface, bearing two articular facets separated by a rough non-cartilaginous surface, which runs in an antero-posterior direction, and is chiefly destined for ligamentous attachment. Of these facets the internal is the larger, and of somewhat oval shape, with the long axis passing from before backwards; it is also somewhat more hollow than the other, although the amount of depression on either side is

but slight, and is still further diminished by the greater thickness of the articular cartilage in the central part. The outer facet approaches the circular form.

The inferior extremity of the femur is more extensive than the opposed articular surface of the tibia on which it rests. The deep intercondyloid notch separates the two condyles, of which the latter is prolonged downwards considerably further than the external—a disposition which determines the internal obliquity of the shaft of the femur, and the formation of an angle salient inwards on the inner aspect of the knee-joint.

It is obvious that the very shallow depressions on the upper end of the tibia can afford no security for the condyles of the femur during the various movements of the joint. The glenoid cavities for the reception of these articular prominences are, accordingly, almost solely formed by the semilunar cartilages. Each of the latter structures presents three surfaces—a superior, which is markedly concave; an inferior, nearly flat; and an external, forming the prominent rim, which is connected to the fibrous structures surrounding the joint. This rim is about five centimetres in depth; at the inside the cartilage thins down to an irregularly festooned edge. On examination of the mutual relation of these cartilages we find that the external forms almost a complete circle, while the internal forms a C-shaped curve, elongated from before backwards, and of which the extremities embrace those of the outer cartilage. These extremities (*cornua*) are extremely strong, and bind the cartilages with great firmness to the non-articular portions of the osseous surface, while the circumferential aspects of the cartilages are bound to the margin of the head of the tibia by the so-called coronary ligaments. The other surfaces are covered with synovial membrane, and glide smoothly—the upper on the cartilaginous surface of the corresponding femoral condyle, the lower on the head of the tibia. “The fore part of each is less fixed than the hinder, so that it may be free to follow up the condyles as the latter recedes from the front of the tibia in flexion, and be pressed back again into its place in extension” (Humphry). In the case of the external cartilage the posterior cornu has an accessory attachment to the femur, which accompanies the posterior crucial ligament (*cornu postici adhesio prima* of Weitbrecht, *ligamentum cruciatum tertium* of Robert). This femoral adhesion causes the cartilage to follow, in a limited degree, the movements of the lower end of the thigh bone; and its nearly circular outline, with

the greater looseness of its coronary attachments, and the fact that it does not, like the internal semilunar cartilage, adhere intimately to the corresponding lateral ligament of the joint—all combine to secure to the external cartilage a greater degree of mobility than is permitted to the internal.

The more obvious movements of the knee-joint are those of flexion and extension, characteristic of the ginglymus articulation, of which it forms an imperfect type. In addition to these, the knee possesses, when moderately flexed, a rotatory movement, which, as shown by the brothers Weber, may attain a range of 39 degrees. The vertical axis around which these movements take place passes through the head of the tibia at the *inner* side of the spine. The use of the greater mobility of the outer cartilage is obvious in this action, for if it were absolutely fixed to the head of the tibia, any considerable rotatory movement of the latter bone would throw the external femoral condyle out of its articular cavity.

Slight lateral movements of the *passive* variety may also be demonstrated in the knee-joint when the leg is semi-flexed. In this position, the ligaments being relaxed, external pressure will produce movement of the tibia to either side; the latter bone gliding, to a very limited extent, of course, upon the articular facets of the femoral condyles.

With regard to the more ordinary movements of the knee, an interesting anatomical fact has been demonstrated by Tillaux. This anatomist has pointed out that a vertical antero-posterior section through one of the condyles is not limited at the lower end by an arc of a circle, as formerly represented; the cartilaginous surface represents two arcs—one anterior, and the other posterior, belonging to circles of different radii, and separated by a portion of a very flattened ellipse. The mechanical result of this arrangement is that in flexion of the knee there is, at first, rotation around an anterior axis; towards the middle of the movement, a combination of rotation and gliding, which is, in turn, replaced by a purely rotatory movement towards the end of the act of flexion. The axis, around which the movements of flexion and extension take place, passes through the femoral condyles at the level of the attachment of the lateral ligaments of the joint.

A careful examination of the various observations of "internal derangement of the knee-joint" that have been placed on record will show that writers on the subject have included, under the

same denomination, two distinct varieties of surgical lesion—one, in which the displacement affected the semilunar cartilages only; the other, in which, besides the derangement of the cartilages, there is also a change in the normal relations of the femur and tibia, or, in other words, an incomplete dislocation of the leg.

Some cases of the former class were unaccompanied by any prominences or displacement visible externally, as occurred in some of the instances observed by Hey himself. A good example of "internal derangement" has also been recorded by Bonnet (de Lyon):—"A very active man, aged forty-five years, twisted his knee in making a movement of external rotation. I saw him two days after the accident; no physical derangement could be detected in the knee; there was merely a small amount of serous effusion into the synovial cavity. The patient could walk only with extreme pain, he suffered much, and could extend the leg upon the thigh but in a very incomplete manner. This disproportion between the impairment of motion, which was carried to an-extreme degree, and the inflammation, which was but slight, made me think that a luxation of the semilunar cartilages had probably taken place. I then flexed the knee as much as possible; this flexion was painful. Having done this a first time, I extended the leg, and flexed again. This manœuvre was followed by immediate relief; the patient was able to walk with less pain, and to extend the leg upon the thigh completely. The inflammation rapidly subsided."

Very valuable evidence with regard to the nature and mechanism of the injury was obtained by this writer from the results of experiments performed on the dead body. In the body of an adult male who had succumbed to a chronic malady, and whose articulations in consequence presented a considerable degree of relaxation, Bonnet found that by flexing the leg to form a right angle with the thigh, as the body lay in the prone position, and suddenly rotating the foot outwards, a peculiar snap was felt, after which the limb remained in the position of external rotation, with the leg flexed upon the thigh at an angle of about 45° . At the antero-internal aspect of the knee-joint a prominence could be felt corresponding to the inner tuberosity of the tibia; this prominence projected in front of the inner condyle of the femur; the head of the femur was carried backwards and inwards. The rotation of the leg, measured by the deviation of the foot, amounted to nearly a quarter of a circle. Upon extending the leg (for which a slight effort was

found necessary) the snapping sensation was again felt, and the normal relations of the articular surfaces were re-established. Subsequent dissection of the knee showed no displacement of the interarticular structures, and no appreciable laceration of either ligaments or muscles. In the next experiment he removed the patella, and, repeating the movements already described, he watched the effect on the interarticular structures. The snapping sensation was then found to be produced by the passage of the inner condyle of the femur behind the semilunar cartilage, which was, accordingly, pushed forwards on the internal glenoid cavity of the tibia, but without any laceration of the internal lateral or capsular ligament of the joint. On the outer side the condyle had undergone no considerable displacement; it was carried a little forwards from its normal position, but still lay in the glenoid cavity formed by the external semilunar cartilage. On extension of the limb, with a little effort, this peculiar luxation was at once reduced. The experiment was frequently repeated with a similar result.

Cases have been observed in the living body corresponding closely with the facts observed by Bonnet on the cadaver. But these cannot properly be regarded as luxations of the semilunar cartilage; they are incomplete rotatory dislocations of the leg itself. The possibility of the existence of a lesion of this kind cannot well be doubted, and the author of the present communication can add to the evidence already published on this subject a description of the accident as it has repeatedly occurred in his own person.

With regard to the other form of displacement, in which the semilunar cartilage alone is said to alter its position without the application of extreme violence, or the coexistence of extensive laceration of the other fibrous structures which enter into the formation of the joint—I look upon its occurrence, in the normal anatomical state of the parts, as a physical impossibility. Any anatomist who has taken the trouble to test the strength of the cornua which fix the cartilages to the head of the tibia, not to mention the accessory fastenings afforded by the coronary, jugal, and tertiary crucial bands, and the adhesions to the capsular and internal lateral ligaments, will have, I think, but small faith in the existence of a displacement engaging the semilunar cartilages only, and produced by a slight amount of external violence.

In many of these cases the history corresponds more or less

closely to the following type:—A slight amount of violence is applied to the foot on its inner side, when the knee-joint is flexed to a very slight degree; the ligaments about the knee in the somewhat relaxed condition which corresponds to this posture; and the muscles, as it were, thrown off their guard. A sudden acute pain is then felt in the joint at the inner side, and the patient is unable to move the leg, which remains fixed in a slightly flexed position, with a certain amount of abduction and external rotation. Sir Astley Cooper, whose description of the ætiology of this lesion agrees more closely with my experience than that of any other writer whom I have consulted on the subject, has observed it to occur most frequently when a person in walking strikes his toe, the foot being at the same time *everted*, against any projecting body, such as the fold of a carpet. He also met with the accident in a person who had suddenly turned in bed, when, the clothes not suffering the foot to turn with the body, the thigh-bone was believed to slip from the articular cavities formed by the semilunar fibro-cartilages.

No autopsy has, so far as I have been able to ascertain, demonstrated the actual displacement of one of the semilunar fibro-cartilages of the knee-joint, if we except a case noted by Beid, who discovered (accidentally) in a dead body that the anterior segment of the external cartilage was detached from the tibia, and displaced backwards and inwards. This portion appeared flattened and widened, as if the displacement were of old standing. No history could, however, be obtained.

Verneuil has seen most of the cases of supposed luxation of the fibro-cartilages occur in rheumatic subjects, and would explain the symptoms present by the changes within the joint produced by this disease. He mentions a case in which he took the opportunity of carefully examining the movements of the joint in a highly emaciated patient whom he was treating for some other disease. In this individual, extreme flexion of the knee caused a prominence to form on the outer side corresponding in position and form to the outer margin of the external semilunar fibro-cartilage. Palpation gave, at the same time, a sensation of crepitation, and the patient felt some pain in the corresponding part of the joint. He observes, in conclusion:—"I believe that in my case no luxation of the fibro-cartilage took place, for the mobility of this cartilage is a normal condition; accordingly, a new element must be added, which I believe to be synovitis."

It is observed by Panas (*Dict. de Méd. et de Chir. Prat.*) that all the cases of luxation of the semilunar cartilages belong to a period when the occurrence of loose cartilages in the interior of joints, and also the existence of arthritis deformans, had still remained unknown pathological facts, and he believes that all the recorded examples of the internal derangement of the knee-joint were but misunderstood cases of one or other of these conditions. In this hypothesis he merely corroborates that already enunciated by Velpeau and by Malgaigne. The latter eminent authority also points out that in the cases in which (as in those recorded by Bassius and Dequevauviller) an abnormal projection was present, and supposed to correspond to the margin of the displaced cartilage, it was found on more careful inquiry that this projection had existed before the occurrence of the injury. In a case observed by himself the projection had existed in a healthy limb, although to a somewhat less degree.

The fact that it may be confounded with a floating body within the joint was demonstrated in a case recorded by Gimelle. This surgeon detailed to the Académie de Médecine (*à propos* of an observation of luxation of the cartilages communicated by Londe) an account of a *similar* case which he had met with, in which the same diagnosis was made. The supposed luxation recurred frequently, and the repeated trouble led to a closer examination, disclosing the existence of a foreign body, which was afterwards extracted by Larrey.

The most probable cases of luxation of the cartilages which have been recorded are, perhaps, those of Lannelongue and Le Fort (communicated to the Société de Chirurgie in 1879). The former was one of a girl, aged eleven years, in previously good health, and apparently without any form of arthritic diathesis. Ten months before entering hospital she had suddenly, while walking with her mother and without any appreciable cause, experienced a sensation of crackling in the knee-joint. It was not accompanied by any sensation of pain, nor was progression at all impeded. The articular crepitus continued, and accompanied every movement of the joint. Two months later, walking became impeded; but it was not till eight months had elapsed after the original injury that pain was complained of, when it became so acute on any movement of the limb as to render walking nearly impossible.

Examination of the joint when at rest gave merely negative

results; nothing abnormal could be discovered by sight or touch; there was no displacement, and no pain on pressure. When the extended limb was gradually flexed, a crackling sound was perceived as soon as the flexion had attained an angle of about 20 degrees, and, at the same time, a projection formed on the outer aspect of the joint which could be seen and felt. When the limb was brought gradually back to the state of extension from the position of right-angled flexion—as soon as it had passed through an angle of 20 degrees in this direction, another *bruit* was heard louder than the first, with increased prominence of the tumour, after which complete extension (with subsidence of the swelling) followed without further opposition. The evidence of the hand and ear demonstrated that the bruit and the prominence corresponded to the interval between the outer condyle of the femur and the glenoid cavity of the tibia; while the displacement obvious to the eye on the outer side of the joint apparently implicated the external semilunar fibro-cartilage. This prominence formed a transverse ridge, occupying the line of the articulation in the depression on the outer side of the ligamentum patellæ; it was best marked in front, and gradually lost when traced backwards. When the finger was placed on the skin just before the formation of the swelling, it was found to be suddenly elevated with a peculiar vibratory sensation, which conveyed the idea of an elastic band. It was compared by Lannelongue to the elevation of the skin produced by the pulsation of a large artery. After the formation of the swelling it remained till the second bruit indicated the reduction of the displacement. On the inner side of the joint all was normal. The reduction alone was accompanied by marked pain. In this case Lannelongue considers that the only explanation of the phenomena which can be offered is that afforded by admitting the existence of a subluxation of the external semilunar fibro-cartilage. There was no evidence whatever of arthritis deformans; and he believes that the idea of a foreign body is out of the question, as the latter could not always persist in reproducing an identical deformity.

The case of Le Fort possesses a special interest, as it occurred in his own person. The first cause of the accident, as the sufferer himself observes, presents but few poetic details. The eminent surgeon occupied a position similar to that which the author of "Gulliver's Travels" leads us to infer was assumed by his hero when hidden between two leaves of Brobdingnagian sorrel. On

this occasion, the Professor, while resting on his feet with both hip and knee-joints strongly flexed, suddenly experienced a distinct sensation of displacement in the outer part of the right knee-joint. When he raised himself from this posture, the knee remained flexed, but a powerful muscular effort restored it to the extended position. This effort was accompanied by acute pain, and a loud crackling sensation, as if some displaced object had suddenly returned to its place. All pain instantly disappeared, and freedom of movement was completely restored. The lesion subsequently appeared on almost every occasion that the knee was forcibly flexed, so that this movement had to be studiously avoided.

These cases afford the best circumstantial evidence which can be produced of the occurrence of luxation of the semilunar cartilages of the knee-joint, from slight or indirect violence. An important case of injury of the knee-joint was communicated to the Pathological Society of Dublin by the late Professor R. W. Smith (Feb. 4, 1865), in which the cartilage appeared to have been displaced by a very unusual form of direct violence. It occurred in a boy of sixteen, who had been wounded in the knee by a hackle-pin, the sharp curved point of which penetrated the joint on the inner side, and close to the line of the long saphena vein. The boy fell backwards, and the hook tore its way out. Escape of synovial fluid was followed by very severe inflammation, which yielded completely to treatment. On recovery, a certain amount of stiffness of the joint remained, the limb tended to remain somewhat flexed, and a distinct projection was found in the position of the wound, which presented a curved outline, was somewhat elastic to the feel, and, manifestly, was not of an osseous nature. The diagnosis in this case was that the hook which penetrated the joint had fixed itself in the internal semilunar fibro-cartilage, and in tearing its way out had displaced this structure from its normal position. The possibility of a certain amount of displacement, accompanied by laceration, in such a case cannot, I think, be questioned. The evidence afforded by the other cases quoted, as well, indeed, as that derived from the less important examples which we have found recorded by various surgical authorities, is not so conclusive.

Sir Astley Cooper observes that "under extreme degrees of relaxation, or in cases in which there has been increased secretion into the joint, the ligaments become so much lengthened as to allow the cartilages to glide upon the surface of the tibia, and

particularly when pressure is made by the thigh bone upon the edge of the cartilage. The cartilages which receive the condyles of the os femoris are united to the tibia by ligaments, and when these ligaments become extremely relaxed and elongated the cartilages are easily pushed from their situations by the condyles of the os femoris, which are then brought into contact with the head of the tibia; and when the limb is attempted to be extended the semilunar cartilages prevent it." There can be, I think, no reasonable ground for refusing assent to these views, as in the case of extreme relaxation of the ligaments, which is supposed by this distinguished authority to exist, the parts of the semilunar cartilages between their cornua must be freely mobile; but the case of a previously healthy joint is a widely different one.

Before summarising my conclusions as to the state of things in the more typical forms of Hey's internal derangement of the knee-joint, I will relate the causes, symptoms, and treatment of the lesion as it has repeatedly occurred in my own person. It has always been the result of *very slight* and, in every instance, *indirect* violence. The violence has always been applied so as to produce a twist of the knee—either of the leg outwards, or femur inwards. The more common cause was striking the inside of the great toe against something when the knee was slightly flexed, and the parts about the joint as relaxed as possible—when, if I may be allowed to use the expression, the muscles were thrown off their guard. It has never occurred to me when the limb was in a decided state of active movement. It first occurred to me (when a boy) as I was sauntering slowly along a pasture-field in the country. I lightly struck the inner side of the point of my shoe against some elevation in the ground, and was instantly brought to a stand-still by pain of an agonising character developed in the interior of the right knee-joint and on the inner side. Besides the pain, I experienced the mingled sensations of fright and helplessness (as I was alone) to a degree which I have never forgotten. I soon reached the ground, by a movement combined of those of sitting and falling. The joint was slightly flexed, the leg slightly rotated outwards, and all power of voluntary movement of the limb below the knee entirely lost. As this occurred many years before the commencement of my anatomical and surgical experiences, I made no observations on the position of the bony prominences about the knee-joint. But I applied my hands to either side of the knee, and instinctively made as powerful pressure

as I could, with the hope of diminishing the pain. The continuance of the pressure caused the flexion of the joint to diminish, when suddenly I felt an exacerbation of the pain following by a loudly audible clucking sensation, conveyed both to hand and ear. This sound was followed by instantaneous and complete relief. No sequelæ followed. But the lesion frequently reappeared, from similar causes, and always yielded to the same treatment. It has also occurred when, in moving the right foot under a table, the inner side of the great toe has struck lightly against one of the legs. As in the other cases referred to, this has only occurred when the knee was already slightly flexed, and the surrounding structures much relaxed. The total number of my personal experiences of this lesion would amount, I believe, to at least a couple of dozen. Several of these occurred while I was a medical student. I have met with the accident twice since I became possessed of a surgical diploma. I early took an opportunity of informing myself of the probable nature of the "internal derangement" of the knee-joint, and was able on several occasions to examine my own joint with sufficient care while still *deranged*. Careful manipulation has convinced me that the internal semilunar cartilage has never, in my own case, been displaced from its tibial attachments. Two very slight prominences could be detected in every instance in which I made a careful examination—an internal, apparently formed by the projecting lower margin of the inner condyle of the femur; and an antero-external, found on the inner side of the ligamentum patellæ, and due, I believe, to a projection formed by the upper end of the tibia, and the semilunar cartilage still attached thereto.

Accordingly, my explanation of the nature of this lesion, which I look upon as a typical one of Hey's internal derangement of the knee-joint, is that by the combined twisting and lateral movement conveyed to the knee, at a moment when the ligaments are as lax as possible, the margin of the condyle is *jerked over* the edge of the internal semilunar fibro-cartilage. The immediate result is pressure of this structure, which is increased when the resulting pain brings about spasmodic contraction of the surrounding muscles. The leg undergoes in these injuries a rotatory movement which carries the tibia forwards and outwards. A similar rotation of the leg in the opposite direction, and an analogous displacement of the outer condyle occurs, I have no doubt, in case of the rarer variety of "derangement" which is located in the outer part of the joint.

The comparative infrequency of this latter is, I think, satisfactorily explained by the greater mobility of the outer cartilage, and the existence of a strong femoral attachment, which secures its adaptation to the varying positions of the outer condyle.

Such I believe to be the only form of displacement which can occur from slight or indirect violence in the otherwise anatomically normal knee-joint. The lesions which occur in pathological conditions I have not examined, as I do not think they should be included in this inquiry.^a

^a In the discussion on this paper it was remarked by Professor Bennett that a case of dislocation of one of the semilunar cartilages of the knee-joint was recorded by Mr. Bromfield some years *previous* to the appearance of Hey's well-known work. I have since found, on comparing dates, that the cases (two in number) of dislocation of the semilunar cartilages recorded by Bassius (*Obs. Anatomico-Chir.-Méd., Decad. II., Obs. V.*) saw the light before those of either of the latter observers. For reasons which must be obvious to my readers, I prefer to retain still the nomenclature of Hey, and even to credit him with the original description of the lesion which is the special subject of the above communication, in contradistinction to the questionable one of dislocation of a semilunar fibro-cartilage.

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