A Clinical Lecture

ON

SOME OF THE COMMON INJURIES OF THE KNEE-JOINT AND THEIR CONSEQUENCES.

DELIVERED AT GUY'S HOSPITAL.

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It would seem that the most common form of injury of the knee-joint is some damage to the internal semilunar fibro-cartilage. The semilunar cartilages form what one might call variable intermediaries between the tibia and femur, accommodating themselves to the altering mutual relationship of these articular surfaces to one another. They occupy a space that must necessarily be filled with some material, whether solid or liquid. If a cartilage is removed and there is no fluid present in the joint, a new growth of connective tissue spreads into the interval between the bones from the interior surface of the adjacent portion of the capsule. The function of the external fibro-cartilage is much more simple than that of the inner, since it is more circular and the fixation of the external tibio-femoral joint is much more secure than is that of the inner. The outer joint performs the function of a hinge up to a certain point, movement taking place on a transverse axis, while beyond that the movement between the bones is one of rotation on a vertical axis to permit of the further movement of the internal condyle around a transverse axis, and when complete the external femoro-tibial joint forms the fulcrum of a lever in a transverse plane. This movement of extension of the knee-joint is limited by the posterior ligament, by the anterior crucial ligament, and by both lateral ligaments, which are placed behind the transverse axis of rotation. This is particularly true of the internal lateral ligament, since it does not sustain a maximum strain till after the external lateral ligament, and consequently permits of a greater degree of relaxation also than the external. The fibro-cartilage is therefore evolved in order to fill what would otherwise be a varying vacuous cavity between the bones, and its extension into the joint is limited by the impact of the cartilaginous articular surfaces on one another. For this reason the firmer this bearing is and the more accurate the apposition of the articular surfaces the smaller is the area and bulk of the interarticular fibro-cartilages and their mobility is correspondingly less. Now the fit of a joint varies directly with the degree of development of the muscles which control that joint. In other words, the area of the articular surfaces which come into direct contact is great in the vigorous labourer, while it is small in the badly-nourished, inactive subject.

When the knee-joint is flexed the internal lateral ligament is relaxed and in a degree directly proportional to the flexion.

When also the foot is abducted the superjacent weight of the trunk is transmitted outside the centre of the joint, and there exists a tendency to the diminution of the external femoro-tibial angle and to the separation of the internal condyle of the femur from the corresponding aspect of the tibia, the external condylar joint forming the fulcrum around which movement takes place. This leads to an increase in the influence of the factors which are primarily responsible for the development of the internal interarticular fibro-cartilage and produces a tendency to the separation of the internal condylar surfaces and to the consequent displacement of this fibro-cartilage between the bones. The sudden removal of the superjacent pressure tending to reduce the external femoro-tibial angle permits of the articular surfaces regaining their normal relationship, and may result in the bruising of the inner portion of the inner fibro cartilaginous crescent, or even in its rupture from the internal lateral ligament and adjacent capsule should it not have had time to escape. This tendency to damage of the fibro-cartilage increases with the degree of flexion of the knee joint and diminishes

as the knee approaches the position of extension. The more secure the fit of the joint the greater must be the amount of force necessary to damage the fibro-cartilage, while in a loosely fitting joint the amount of force required to produce the same injury may be very slight. Any bruising of the free margin of the articular crescent results in its swelling and possibly, later, in its destruction. The portion most liable to damage is the back part of the middle third. In proportion as a segment of the free margin of the cartilage is destroyed so its total length is increased, and also its mobility or liability to injury. This is shown by Figs. 1, 2, and 3 (p. 538).

In proportion as the leg approaches a position of extension the greater is the force requisite to produce any displacement and consequent damage of the fibro cartilage, and the more severe is the strain sustained by the internal lateral ligament of the joint. This latter strain is felt most at the point of attachment of the upper extremity of the internal ligament, where it is most limited. When the knee-joint is in a position of extreme extension abduction of the articulation must be sufficiently forcible to rupture the internal lateral ligament before any separation of the internal condyle from the tibia can be effected by it. Therefore, besides the damage to the fibro-cartilage, there may be a certain amount of laceration and consequent inflammation of the upper part of the internal lateral ligament, varying chiefly with the degree of extension of the knee-joint. When the interarticular fibro-cartilage is torn away from its attachment to the capsule and internal lateral ligament, and is displaced between the condyles, it is not possible to extend the joint completely, as the back part of the fibro-cartilage intervenes between the articular surfaces of the tibia and femur.

The symptoms of damage to the internal fibro-cartilage vary considerably. In the milder form of injury there may be merely pain and tenderness along the anterior two-thirds of its length which exists only when the knee is bent, but the pain may be absent when the knee is retained in a position of extension. In the more severe forms the fibro-cartilage is very swollen and tender on pressure, and may form a distinct protrusion along its length.

There may be a varying amount of synovial effusion, and when the cartilage is still compressed between the articular surfaces or displaced from its marginal attachment it is not possible to extend the joint completely. If the cartilage is displaced an endeavour should be made to restore it to its normal position by forcibly separating the opposing surfaces of the internal condyle and of the corresponding surface of the tibia by flexing the knee, and at the same time abducting it, using the external condylar joint as a fulcrum. Should the surgeon be unsuccessful in freeing the displaced cartilage from its abnormal position, the sooner it is removed by an incision into the joint the better, as there is always a difficulty in extending the knee completely after it has been kept flexed for any length of time.

Apart from this condition, I believe that the best treatment for a damaged fibro-cartilage is efficient massage and exercises, commenced as soon as possible after the injury has been sustained. As long as the fibro-cartilage is painful and swollen, the patient should retain the limb in a position of extension when he gets about, which must at first be very little.

It is very important that any synovial effusion should be removed, and the muscles about the joint restored to their normal bulk and function as soon as possible, since impaired function means liability to recurrence of the trouble.

The patient should be instructed to avoid the attitude of flexion of the knee and abduction of the foot in which the cartilage was injured. The inner margins of the feet should be kept parallel during locomotion and the universally accepted attitude of turning the feet out discarded. One may assume that anything that is universally accepted as true is certain to be false. Perhaps nothing is more generally taught and accepted than that in walking the feet should include an angle between them open forward; the mother, the schoolmistress, the school-master, the dancing master, the drill sergeant, etc., all seem to conspire to preach this doctrine, which is obviously wrong and mechanically disadvantageous. If the individual wants to lace or button his boots, the foot should

be turned inwards or adducted and approached from internal to the knee. If the patient must kneel, he or she should do so on an adducted foot, and not on an abducted one. There are certain games—as tennis, golf, cricket, and football—in which the posture producing damage to the cartilage is constantly recurring. These games should be avoided in bad cases or the function of the knee-joint limited to a hinge movement by a suitable apparatus. Each succeeding squeeze tends to destroy an increasing quantity of the fibro-cartilage and so render it abnormally long and liable to injury. Later, after the cartilage has been completely divided, the anterior portion is sucked still further in between the bones, and is cut off from its attachment to the capsule. Finally it forms a tag which has only a small attachment to the tibia in front of its spine. This plays freely about in the joint, and may even be felt beneath the inner margin of the ligamentum patellae. When this stage is reached, its connexion with the internal fibro-cartilage may be readily missed, since a structure resembling the original fibrous wedge is then generally pretty well developed.

If the damage to the cartilage is repeated, the sooner it is removed the better. Surgeons differ as to the position and form of the incision necessary for its removal, some preferring a vertical, others a transverse, and others, again, a curved incision. Providing the fibro-cartilage is neatly removed, I do not think it matters much which incision is

Fig. 1 represents diagrammatically the upper surface of the right internal semilunar cartilage. In it I have attempted to represent as lines running along its length the resistances offered to its elongation, and consequently to its relaxation and outward displacement, and in smaller concentric crescents the manner in which these resistances are progressively obliterated when the cartilage is nipped between the bones and severely bruised and destroyed. The force opposing the excessive suction of the fibro cartilage between the bones is the resistance offered by the capsule and internal ligament and the structures uniting the fibro-cartilage to them.

employed, but the accurate and efficient suturing of divided capsular structures and the early restoration of the functions of the joint are important factors in treatment. Synovial effusion can be readily controlled by elastic pressure.

In children especially, and in patients of all ages in whom there is a tendency to the development of tubercle, owing usually to a lowering of the resisting power to its entry consequent on autointoxication from intestinal stasis, or possibly from the influence of such an organism as the influenza bacillus, it is very important that the joint should recover its normal character as soon as possible, so that it may not form a culture medium for the bacillus of tubercle.

Some years ago¹ I called attention to the fact that the large majority of cases of tuberculous infection of the knee-joint originate in the local depreciation of vitality consequent on damage to the internal fibro-cartilage. I had then on very many occasions satisfied myself as to the accuracy of this conclusion, and always took it into consideration when asked to treat cases of injury of the cartilage occurring in subjects likely to develop tubercle or already possessing some tuberculous focus in any other portion of the body.

It does not follow that the tuberculous organism should of necessity first obtain a foothold in the inflamed fibro-cartilage or in the synovial membrane or tissues immediately in relation with it whose vitality have been lowered through their share in the inflammation; but the effusion in the knee-joint itself, and the general inflammation of the synovial membrane of the articulation, which is secondary to the local inflammation of the fibro-cartilage,

may form the nidus in which these organisms can grow and thrive.

Therefore, contrary to the usual teaching, I concluded that tuberculous affection of the knee-joint was in adult life almost always consequent upon damage to the internal semilunar fibro-cartilage, and that in young life it frequently resulted from it either directly or indirectly. When the joint has become affected by tubercle the condition becomes one of great anxiety. In slight cases rest and tuberculin, with the most scrupulous attention to the gastro-intestinal drainage, are the most effective. The use of the tuberculin should be in the hands of an expert bacteriologist who is thoroughly familiar with the work. My experience of the treatment by tuberculin is that the failure is due in most cases to the practitioner and not to the principle. Believing as I do that tubercle rarely affects patients whose resisting power is not depreciated by intestinal autointoxication, I employ pure liquid paraffin as a vehicle to facilitate drainage, having completely discarded all drugs of a purgative character, and I have been most pleased with the result. Should the condition of the joint be such that it is not likely to improve under this treatment, I divide the ileum and put it directly into the rectum as low down as I can. I used to do it by means of a lateral anastomosis, as I believed it to be the most secure and safe method of establishing the junction, but now I invariably put it in direct into the side of the rectum. I do this as, however accurate the lateral anastomosis,

Fig. 2 represents a right internal fibro-cartilage which has been completely divided. Its posterior third retains its normal attachment, while the remains of its anterior two-thirds are shown as a tag attached by its extremity only to the tibia.

Fig. 3 represents the appearance presented by the right internal semilunar fibro-cartilage, whose anterior two-thirds have been separated from the capsule of the joint, and been displaced outwards beneath the internal condyle. The anterior extremity still retains its attachment to the tibia.

there is always a tendency to pouching of the ileum beyond the junction sufficient in certain cases to require an operation for its removal. The use of a soft rubber tube passed up through the anus, lower part of the rectum, and through a length of the ileum, serves to drain the small bowel and reduce the risk of the operation enormously. I have practically quite discarded such operations as erosions and excisions of joints for tubercle, and obtain far better results in every way by dissociating their cesspool. Should any surgeon care to see the results in apparently hopeless joint cases of the operation of short-circuiting the bowel I shall be very pleased to furnish him with the names and addresses of these patients. In these cases the rectum is generally very elongated and easy to deal with.

The other injuries about the knee-joint are rare as compared with those which I have described. They consist of bruising of a synovial fringe, or the removal of a portion of the articular cartilage with or without a part of the surface of the subjacent bone. The fringe of synovial membrane may be damaged by being squeezed or nipped between the articular surfaces or by a blow upon the knee. The symptoms may resemble very closely those of damage to the semilunar fibro-cartilage, and if the joint be explored during a period of quiescence it may be impossible to differentiate between these conditions. It is only by a careful study of the symptoms that any conclusion can be arrived at before operation. If the joint is opened during the acute stage the swollen and inflamed fringe can be readily recognized and dealt with. I have seen several cases of this condition in which the internal fibro-cartilage has been removed without affording the patient

any relief, which at once followed the removal of the bulky ligamentae alaria. Practically most, if not all, cases of this sort which have come under my observation have been regarded as damaged or displaced semilunar fibro-cartilages, and have been treated more or less actively. It is a mistake one is very liable to make. A portion of the articular cartilage may be removed from the joint in two different ways. One is by direct impact as in a fall upon the knee. In these cases a triangular piece of articular cartilage breaks off the subjacent bone and separates from the adjacent articular cartilage by a vertical fracture.

In flexion of the knee beyond a right angle there exist two considerable areas of the articular surfaces of the condyles of the femur below the patella and on either side of the ligament, which are covered merely by skin and by the capsule of the joint. In the position of kneeling with the knees separated by a moderate interval, the portion of the under surface of the internal condyle comes into immediate relationship with the ground. When kneeling on one knee the under surface of the external condyle comes into contact with the ground. In falling on one knee the same portion of the articular surface of the external condyle sustains much of the impact. If the force of the blow sustained is sufficiently great a portion of the articular cartilage is fractured and is displaced from its connexion with the femur. It moves about in the

Fig. 4.

joint and forms a loose body. If left for some time the sharp cut edges, both of the loose piece and the depression left by its removal, are gradually rubbed down, and I believe that after a time the loose body may be completely absorbed, and the place from which it escaped may be represented only by a slight concavity in the articular surface. I can best illustrate this by a case which I published in the BRITISH MEDICAL JOURNAL, December 2nd, 1893, page 1207:

E. P., aged 25, had a loose body in each knee-joint. The right knee-joint was opened, when a piece of articular cartilage (as illustrated in Fig. 4) was removed. It had evidently been very recently broken, since its edges were sharp and clearly defined. In the outer part of the under surface of the external condyle there was an area in this articular cartilage into which the separated piece fitted accurately. On opening the left knee-joint a piece of articular cartilage of about the same size was removed. This piece was completely altered in character, its edges being smoothed down like a flat stone in a brook. On the same area of external condyle as in the right knee a smooth depression in the articular cartilage was observed. Its edges were smoothed down, and its floor was covered with articular cartilage. In neither case was there any bone attached to the cartilage.

I have not invariably removed the piece of loose cartilage from the knee-joint when I felt that it was disappearing pretty rapidly and when it appeared to be doing very little or perhaps no harm. That these pieces of cartilage may absorb completely I have no doubt. If, however, they give trouble they can be readily removed if they can be felt. At the same time I have known of several cases in which a joint has been opened and the small movable foreign body has eluded the surgeon.

There is another group of cases showing similar symptoms, in which the loose body can be shown by the x rays if the rays are transmitted through its breadth, for

the reason that there is a thin scale of bone attached to the under surface of the articular plaque. The cartilaginous fragment differs in shape from that previously described, since it is not triangular but broadly square with thin edges.

In these there is never a history of impact on the knee, but a definite one of a twist or strain of the knee-joint. The fragment is generally found in the upper and outer part of the knee-joint. It presents all the appearances of being pressed off the bone, a portion of which frequently appears to come away with it.

Unfortunately, in the few cases on which I have operated for removal of the fragment an incision was made directly over it above and outside the patella, and I did not feel justified in enlarging the incision and exploring the knee-joint more thoroughly merely to determine the seat of damage in the femur or tibia. They all experienced pain or tenderness when pressure was made on the inner portion of the articular surface of the internal condyle where it articulates with the patella.

REFERENCE.

¹ The Surgery of the Internal Semilunar Fibro-cartilage, *Clinical Journal*, June 6th, 1900.

A Lecture

ON

INJURIES OF THE LOWER END OF THE HUMERUS.

DELIVERED AT GUY'S HOSPITAL.

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GENTLEMEN,—The study of injuries of the lower end of the humerus is naturally divisible into two classes: one which comprises injuries occurring in childhood before the lower epiphysis of the humerus is united to the diaphysis; and the other, including fractures in adults, of the lower end of the diaphysis—the common type of supracondylar fracture. This distinction is in reality largely an artificial one, for, as I shall attempt to show, a simple separation in children of the lower humeral epiphysis uncomplicated by any fracture is very rarely met with; in fact, the common injury to the lower end of the humerus in childhood is in many features similar to that of adult life. A true understanding of the injuries likely to affect the lower end of the humerus in childhood depends on an accurate knowledge of its ossification, and, as the diagrams in most anatomy books have been, until recently, inaccurate in respect to the relative amount which is formed by the lower epiphysis, I shall spend a few minutes talking about its development. My first diagram shows the lower end of the humerus entirely cartilaginous during the first year after birth, and the second diagram shows that certainly up to the fourth, and often well into the fifth, year of life the lower epiphysis consists of one cartilaginous mass, encircling a gradually increasing ossific nodule, known as the centre for the capitulum which may be seen during the second year.

In the next figure we come to the point on which former descriptions were inaccurate, for in them we were told that the whole lower end of the humerus is formed from the lower epiphysal centres; whereas we know recently, partly from anatomical work and partly from Poland's pathological researches upon the lower epiphysis of the humerus, that the diaphysal centre, beginning to grow in the eighth week of fetal life and forming the whole of the shaft, gives a downgrowth, which forms anteriorly and posteriorly a considerable finger-like process of bone, separating the internal epicondyle from the rest of the lower epiphysis. This hypophysis begins to extend towards the lower border soon after the fourth year, and definitely forms the lower non-articular margin just internal to the trochlea in the thirteenth year; so that after the thirteenth year a simple separation of the total lower epiphysis of the humerus is impossible, for any injury which dissolves the continuity of the bone at the level of the epiphysal line