Notes on Military Orthopaedics.

VI. DISABILITIES OF THE KNEE-JOINT.

BY

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EVERY kind of disability of the knee-joint may occur in military practice, from a simple sprain to the results of a severe wound.

An attempt will be made in this article to give a broad classification of these derangements and disabilities, with their diagnostic signs, and to indicate appropriate lines of treatment.

There are three common conditions which are not always as clearly distinguished by practitioners as they might be. They are, (1) simple sprain of the lateral ligament, usually the internal, (2) slipping of the semilunar cartilage, and (3) nipping of the infrapatellar pad of fat. All these injuries may be produced by a twist or fall, which at first does not seem serious; all are associated with effusion of fluid in the joint, and in all the patient complains of more or less recurring disability after the lesion, unless it has been recognized and treated in the first instance.

SPRAIN OF INTERNAL LATERAL LIGAMENT.

Sprain of the internal lateral ligament is distinguished by definite pain and tenderness on pressure over the attachments of the internal lateral ligament; the patient himself localizes the pain of which he complains to the inner side of the knee; definite pain and tenderness is not found anywhere else about the knee, and the movement of eversion and external rotation of the leg stretches the injured ligament and retards recovery.

The treatment indicated, therefore, is firm strapping round the knee in order to steady it, and a raising of the inner side of the heel to divert body weight to the outer side of the foot, and thus relieve the ligament from tension. It is hardly necessary to say this treatment is preceded by rest in bed, usually with the aid of a straight posterior splint. This is the initial treatment, but neglect of the after-treatment just mentioned renders the patient liable to recurring injuries of the ligament.

INTERNAL DERANGEMENTS OF THE KNEE.

A regular gradation of injuries is met with, from a slight strain of the attachments of the internal semilunar cartilage of varying degrees of gravity to fractures of the spines of the tibia with rupture of the crucial ligaments. The former is a condition scarcely distinguishable at first sight from a simple sprain; the latter is at once obvious as a grave disability. It has become very important in military surgery to be able to distinguish these conditions clearly from signs which can be determined by the surgeon rather than by symptoms described by the patient; as, in my experience, a considerable number of men who wish to avoid service have found that they can puzzle the medical officer by complaining of obscure pain and disability in the knee.

There are very many cases in which military surgeons have been led to operate upon a normal joint, expecting to find some abnormality of the semilunar cartilage. The cartilage is very frequently torn in its posterior portion, and before deciding at operation that it is not damaged it is necessary to dislodge it outwards. Hence the necessity for careful consideration of symptoms before deciding to operate; it must be realized that exploration, in the case of a cartilage, really involves its removal, otherwise a damage at the posterior part of the cartilage may be overlooked.

Mechanism of Certain Injuries.

Probably the best way in which to get a clear idea of the injuries which lead to error is to consider the mechanism of the various injuries, beginning with simple sprain and going on to real rupture or tear of the semilunar cartilage, and to compare them with bruising of the infrapatellar pad of fat, which is a lesion not always recognized or understood.

All these conditions may lead to a recurring chronic synovitis. Every case of recurring synovitis has a cause, and practically each is curable if the cause is recognized and receives appropriate treatment.

It has already been stated that simple sprain of the internal lateral ligament is marked by a specially tender spot over the attachments of the ligament and nowhere else.

Rupture of Internal Ligament and Damage of the Semilunar Cartilage.

If we remember the anatomical fact that the internal semilunar cartilage is closely connected round its convex margin with the deepest layers of the internal ligament and with the capsule of the knee-joint, we will understand why a severe twist of the knee, with the leg abducted, may rupture the ligament and drag the semilunar cartilage with it, straining or tearing the attachments of the anterior horn. At this stage the inner side of the knee-joint is, so to speak, opened out, and everything depends upon what happens when it closes again as soon as the distorting force ceases to act.

If the cartilage is caught in displacement between the bones the knee "locks" in the manner familiar to us all. The cartilage may be split, fractured transversely, rolled up, or completely torn from its attachments. A perusal of the literature of the subject, indeed, shows that every conceivable injury to the semilunar cartilage may take place, and such cases have often been fully described. Sometimes the cartilage slips back into position without being crushed or caught between the bones; there is then no locking of the joint, but, in every respect, the etiology of the lesion is the same with the exception of the actual injury to the cartilage, and the patient generally states that he felt something "slip" or "click" in the knee, but could quite easily straighten it immediately after the accident.

The history suggests the usual cartilage injury of textbooks but without locking; the knee becomes distended with fluid, and the patient refers his pain to the inner side. The physical signs are tenderness on pressure over the internal lateral ligament, and a specially tender spot to the inner side of the ligamentum patellae just over the border of the tibia, a symptom always strongly suggestive of an injury about the attachment of the anterior end of the internal semilunar cartilage.

The treatment of the condition when the knee cannot be fully extended without causing pain will be discussed later. If the knee can be fully extended without causing pain, the aim should be to ensure complete rest until the torn attachments have united. The knee should be kept absolutely straight on a back splint for at least ten days, the bandage being firmly applied over cotton-wool. After this the patient may begin to walk, and when he does so he should have a firm bandage over the knee to prevent effusion into it. Movements of the joint should be very limited the first day, and should gradually increase in range.

A common fault in treatment is to allow the patient up without a proper protective bandage on the knee, the result of which is effusion into the joint, and, what is more harmful, into the newly formed cicatrix about the anterior horn of the semilunar cartilage, thus stretching the newly formed scar and letting the end of the cartilage shift about. When this happens the patient is often put to bed for a week until the effusion has disappeared, but when he gets up again the effusion recurs, and so he goes on week after week, until finally the attachments of the anterior end of the cartilage become elongated and slack. The patient then complains that occasionally he feels a "give" in the knee, but it does not "lock." Some day a slight unusual twist may result in a real locking of the joint.

A joint such as this which has been the seat of a definite injury will generally fill up with synovial fluid when first used. Therefore the application of a pressure bandage should never be omitted. If the knee is carefully brought into use by graduated exercise, there should never be much effusion, and each day it should be less in amount; that is to say, there is no effusion in the morning, although by the end of the day it may have appeared, and each evening the amount is less than on the preceding one.

Thickened Cicatrix about the Semilunar Cartilage.

If the effusion does not become progressively less, either the patient is using the knee too much and moving it too roughly, or some injudicious masseur is moving it too roughly for him, or the surgeon has made a mistake in his diagnosis and there is some condition in the joint which requires further attention, and he should make a careful examination and reconsider his opinion of the case. When these cases have been the victims of defective after-treatment, repeated stretching and effusion about the anterior end of the semilunar cartilage gives rise to a thickened cicatrix, which is tender, and can sometimes even be felt by the surgeon moving under his finger as the knee is flexed and extended. This painful spot is situated at the diagnostic point, already described, on the front of the knee, well to the inner side of the ligamentum patellae. Sometimes this cicatricial thickening is so great that it is pinched between the bones when the knee is fully extended, and this causes sharp, well localized pain and tenderness.

Treatment in such cases depends upon the exact condition, and two types must be distinguished:

1. In cases in which the cicatrix is not pinched, but merely gives rise to a sense of insecurity as if something is moving or "clicking" inside the joint, a rigorous course of strict rest, followed by massage and carefully graduated exercises, may cure the condition in a month.
2. In cases in which the cicatricial mass gets definitely nipped, the condition has become similar to the type of displaced semilunar cartilage usually described, and if rest and careful exercise fail, an operation to remove the whole mass is indicated—the opportunity being taken to inspect the cartilage at the same time.

DISPLACED CARTILAGE WITH LOCKING.

It has long been recognized that definite "locking" of the knee-joint is a characteristic sign of displacement of the internal semilunar cartilage, as described in textbooks. This condition is a more severe variety of the injury just described; it differs from it in the fact that some portion of the cartilage is, for a time at least, caught between the bones and prevents full extension.

The treatment of this condition aims at the restoration of the power of extending the knee fully without pain.

If the displaced cartilage is fully reduced the knee can be fully extended, both actively and passively, without pain. If this cannot be done, the cartilage is not reduced. When the cartilage becomes disengaged the patient is aware of it—in fact, he is the most competent judge of the success or failure of the manipulation.

Treatment of the Initial Injury.

First complete reduction is necessary. This can usually be effected by manipulation without the use of force, and the routine I prefer involves the active assistance of the patient. The patient should lie on his back with the thigh flexed on the body and the leg on the thigh. When in this position the surgeon can manipulate the leg, and can sometimes feel a fullness over the site of the displaced cartilage.

The patient is then told that he will be given the word "One, two, three, kick!" On the word "kick" the patient extends the limb as suddenly as he can. At the same time the surgeon rotates the foot inwards and pulls, while pressure is placed upon the thigh. If the dislocated cartilage is reduced, the patient is almost certain to announce the fact, and the objective sign is that the knee can be completely extended without impediment. The knee, surrounded by wool, should be bandaged firmly, and fixed on a posterior knee splint. If the patient is not of a temperament likely to be helpful, an anaesthetic is advisable.

Our next effort is to secure the healing of the lesions in and about the cartilage, so that it may have a chance of adhering in its proper position. The patient should, therefore, wear the splint for about ten days, but can usually be allowed up in his room at the end of five days. After ten days he may walk with the knee bandaged, taking care not to bend the knee suddenly. Active flexion of the joint should be practised very gradually, and the quadriceps muscle should be massaged and exercised gently. If the progression is carefully made from gentle to stronger movements, the full range should be recovered

without the recurrence of any effusion in the joint in about three weeks. The majority of these cases, carefully and efficiently treated in the first instance, do not give any further trouble.

Where a successful reduction is not accomplished, and, in consequence, the patient is not able to extend the knee fully, an operation will probably be required.

Cases of Imperfect Reduction.

I see many cases two or three weeks or more after the accident, in which it is obvious that attempts at reduction have either not been made or have failed. The surgeon in charge of the case may have thought that he had got the knee fully extended, but passive extension still caused pain, localized over the anterior end of the cartilage; the knee filled with fluid when the patient walked, and, though comparatively free from pain after rest, it became tender after exercise. It is often possible, even after weeks of displacement, to reduce the cartilage in these cases by manipulation similar in kind but more forcible than that necessary in dealing with the original injury. This manipulation forces the displaced cartilage from its abnormal to its normal position, where it may become firmly and accurately fixed. This late reduction so often succeeds that it is always worth trying. If, after an attempt at reduction under anaesthesia, the cartilage still remains in a position in which it gives trouble, or if it remains loose and frequently gets nipped, operation is the only sure treatment; for the case now has become one of recurring dislocation of the semilunar cartilage with "locking" of the joint.

A word of warning may here be given about cases in which reduction is apparently complete, and the patient can get about with tolerable comfort, but complains that the knee-joint does not feel quite secure, although there is no evidence of the intrusion of any structure between the bones. These symptoms are often due to some minute adhesion within the joint which does not produce sufficient limitation of movement to be detected by the surgeon, but leaves the patient with the sense that he cannot use the joint without a feeling of restraint. Full movement of the joint, particularly in rotation, under gas anaesthesia, will often remove these symptoms, although the surgeon cannot always feel any definite adhesion give way during the manipulation.

OPERATION ON THE INTERNAL SEMILUNAR CARTILAGE.

It is needless to say that the knee should never be opened except under the most scrupulously aseptic conditions, and never in a hospital in which there are a large number of septic cases. Operations on cartilages, even at base hospitals at the front, should be discouraged. It is not a practice which can be recommended, as the environment is a

source of danger, no matter how experienced the surgeon.

The procedure which I prefer is the following: The leg is placed to hang over the end of a table at right angles to

FIG. 1.—Showing position of incision.

the thigh; the knee is wrapped in sterile gauze, soaked in biniodide solution; the incision is made through the gauze, and the edges of the gauze clipped over the skin edges to the superficial fascia. As the knife with which the skin is cut may become infected by *Staphylococcus albus*, a second clean knife should be used for all the deeper dissections. The incision need not be more than an inch or an inch and a half in length; it is made over the anterior end of the cartilage, sloping very slightly downwards and inwards—that is, nearly, but not quite, parallel to the upper edge of the tibia (Fig. 1). Great care should be taken never to allow

the incision to extend far enough to the inner side to cut any fibres of the internal lateral ligament; this is a fault which leads to weakness of the knee lasting for months or years, and is, unfortunately, still frequently to be met with in cases which have been operated on by the old large J-shaped incision described in textbooks. The joint being opened, a blunt hook can be slipped under the free margin of the cartilage, and by picking it up it can easily be seen whether the front part is intact, or torn, or has tags or projections producing disability. In removing the whole cartilage great care should be taken that no tags of cartilage are left projecting from the attachment to the coronary ligament, as these frequently give rise to continued symptoms, due to nipping or adhesions, and may necessitate a second operation. The condition of the fringes should be examined before closing the knee, and by retracting the patella the opposite front part of the cartilage can be inspected, if this be deemed necessary. No movement of the knee must be allowed after the incision has been made, as this may favour the entrance of air—a minute risk, but an avoidable one, and therefore one which the surgeon has no right to take. It is not until the stitching is complete and pads placed over the wound that the knee is straightened. Dressings are then applied, elastic pressure put on by bandaging over large pads of wool, and a simple posterior knee splint affixed to keep the knee straight. If the operation is performed with a tourniquet around the thigh—and this is advisable—no vessels need be tied; and if the elastic pressure is applied before the tourniquet is removed there need be no fear of bleeding into the joint. My experience of these operations now extends to over 2,000 cases, and I feel that I can speak with some authority.

After-Treatment.

In a straightforward case there is no reason why the patient should not get out of bed on to a couch on the third or fourth day. He should not, however, put his foot to the ground for the first week. The stitches are removed as usual about the tenth day and massage may be commenced, the patient being allowed gradually to bend his knee. Each day he exercises, bending and extending the knee more and more, until in about three weeks he should reach the full range of movement and walk with freedom. In my practice several professional footballers have resumed their game in six or eight weeks after the operation. There is no reason why in suitable cases men should not return to light duty about five weeks after the operation and, if properly exercised, be fit for full duty three weeks from that date. This, however, depends upon the patient being put through a course of carefully graduated movements and exercises through the whole period of his convalescence.

Surgeons who have been operating upon soldiers complain of the weakness in the knee which so often follows operation. This experience is common, but if the operation has been properly performed and the after-treatment by massage and exercise has been thorough, these disappointments will not occur. The surgeon should be assured that the thigh muscles are restored to their normal condition, and a patient should not be discharged from hospital until the thigh has attained its normal girth. We must also retain a critical attitude of mind, for some soldiers are keen to remain off duty, and the knee is often only an excuse.

RECURRENT EFFUSION INTO THE KNEE-JOINT.

Recurrent effusions into the knee-joint are often very puzzling. It is possible, however, to lay down a few rules for guidance.

I. After injury of the knee, effusion of fluid into the joint is very liable to occur, and if the patient is kept resting and not using the limb, the effusion will probably recur the first time he uses it. The patient is again put to bed, but when he gets up effusion reappears. The rational treatment in such cases is to bandage the knee firmly and let him walk, and in the evening there will be some effusion, which will disappear by morning. The knee should again be bandaged and the patient allowed to walk. In the evening there will be still effusion, but not so much as before. By following this routine the joint will gradually become accustomed to the increasing exercise, with a diminishing amount of effusion on each

day. This is the real test that a joint which has been injured is really recovering and is fit for gradually increasing exercise.

II. The second point is that recurring effusion which increases instead of diminishes under the above careful treatment is a sure indication that the joint is not fit for use, and localizing symptoms and signs should be searched for to find what the precise cause of disability is.

III. Recurring effusion, which is associated on each occasion with some slight mishap—a trifling strain, such as a twist of the knee, a feeling that something has slipped in the joint, or definitely localized pain—is rather an indication that there is some definite body loose in the joint which is occasionally getting nipped, though not retained long enough in one position to produce "locking." The surgeon should then decide whether it is an enlarged pad of fat, a loosened cartilage, or a loose "body," or a portion of the cartilage left after operation.

DISLOCATIONS OF THE EXTERNAL SEMILUNAR CARTILAGE.

The symptoms associated with accidents to the external semilunar cartilage are much less clearly defined than those associated with injury of the internal cartilage. One reason for this is that the external cartilage is not attached to the external lateral ligament of the joint, and there is no definite mechanism by which it is pulled out of place. "Locking" may occur, the pain being referred to the front or back portion of the outer part of the knee according as the anterior or posterior end of the cartilage is torn from its attachment or crumpled up. Cases occur in which both cartilages are displaced by one injury, suggesting that it is only a rather more severe accident than that usually associated with the displacement of the internal cartilage which damages the external one also, probably the mechanism being a lateral sliding of the condyle on the top of the tibia, squeezing the cartilage out of place and tearing its attachment.

RUPTURE OF CRUCIAL LIGAMENTS AND FRACTURE OF THE SPINE OF THE TIBIA.

In more severe accidents to the knee the displacement of the tibia on the femur may be sufficiently great to cause rupture, not only of lateral ligaments, but of the intrinsic ligaments of the joint. This may or may not amount to what may be described as complete dislocation. Experience of cases of dislocation of the knee-joint, in which of necessity all the ligaments have been torn, proves that with appropriate rest in a correct position an astonishingly good result can be obtained. When called on to treat a serious accident such as this, the practitioner's instinct is to get the limb straight and to keep it fixed for a long time. It is when the accident has been less than a complete dislocation that one is liable to think that less strict treatment may suffice. Consequently, cases are met with in which the patient suffers from abnormal mobility of the knee-joint, clearly indicating that one or both of the crucial ligaments have been ruptured or stretched. Bearing in mind the mechanism of the crucial ligaments, it is not difficult to make a diagnosis.

1. The anterior crucial ligament is tense when the knee is fully extended, and prevents the tibia from being displaced forwards on the femur.

2. The posterior crucial ligament is tense in complete flexion, and prevents the tibia from being displaced backwards on the femur.

3. Both ligaments check inward rotation of the tibia. Hence, if the tibia cannot be displaced forwards in the extended position, it may be assumed that the anterior crucial ligament is not completely torn; and if the tibia cannot be displaced backwards in full flexion, the posterior crucial ligament is presumably not ruptured. Abnormal mobility indicates elongation or rupture of the corresponding ligament. The history of an injury helps the surgeon to exclude cases in which prolonged distension of the joint with fluid has caused elongation of all the ligaments, as well as the conditions associated with diseases, such as Charcot's disease or locomotor ataxia. The treatment, when any such condition is diagnosed, is prolonged rest with the knee in extension, or fixed in plaster, or a Thomas caliper splint, in which the patient can walk, the object being to keep the joint immobilized for a time long enough to allow union of the torn ligaments or adaptive shortening of stretched tissue. The operation of stitching

the ligaments is absolutely futile as a mechanical procedure. Natural cicatricial tissue, allowed to mature without being stretched, is the only reliable means of repair.

Fracture of the Spine of the Tibia.

The mechanism of this accident appears to be the following. The knee is subjected to violent torsion, such as might produce a dislocation or rupture of the crucial ligaments; at the time when the force is applied the condyle of the femur grinds across the surface of the tibia, and the sharp intercondylar margin shears off the spine. In some cases avulsion of the spine occurs instead of rupture of the crucial ligaments. The displaced fragment of bone may be lodged in the front part of the knee-joint, and so prevent its full extension. Diagnosis is verified by *x*-ray examination.

Symptoms.—The most constant symptom is a somewhat rigid block to full extension, usually accompanied by pain behind the patella.

Treatment.—If the knee can be fully extended the displaced fragment of bone being presumably pushed back somewhere between the condyles, the knee should be fixed in this position for a long period to allow the torn structures to reunite. On the other hand, if the displaced fragment

FIG. 2.—Showing patella split. A, Femur; B, tibia; C, transverse ligament; D, anterior crucial ligament; E, posterior crucial ligament; F, cut halves of patella.

longitudinally (Fig. 2), but if the *x* rays show that the offending fragment of bone could be reached by an incision at the side of the patella, this is a less severe method of procedure. As I am largely responsible for the split patellar route in dealing with unusual derangements, I am anxious to emphasize that it is only needed in exceptional cases.

THICKENED RETRO-PATELLAR PADS OF FAT.

Almost any injury of the knee which is associated with increased vascularity or bruising may give rise to swelling of the pad of fat situated behind the patellar ligament. Consequently this fat is liable to be nipped in full extension of the knee. In ordinary civil life, this forms one of the varieties of the initial stage of a local monarticular rheumatoid arthritis. The condition, however, is in no sense rheumatic. The patient complains of pain and tenderness in the knee after walking, and especially when going up and down stairs, or when getting up suddenly from a chair after sitting for any length of time. The condition is maintained by the repeated small injuries which occur every time the knee is fully extended. The treatment, therefore, is obviously to prevent the patient from inflicting small bruises on the tender fat and its covering of synovial membrane. This can easily be done by putting a cork pad, half an inch thick, inside the boot under the heel, to prevent the complete extension of the knee during walking, and by fitting the knee with a cage support (Fig. 3), which allows full flexion but limits extension by about 30 degrees. Wearing this boot and cage splint the patient cannot fully extend the joint and in this way bruise the post-patellar fat. The swelling

gradually disappears, and after a few weeks full extension can be performed without pain. The diagnosis of this condition is easy. The patient complains of pain in the knee, or, more often, in the front of the knee, not at the inner side. Passive extension of the knee by the surgeon produces the pain, which is definitely localized just below and behind the patella. On palpation the thickening of the pad of fat may be felt; it is enlarged and tender, but there is no sepsitiveness over the internal cartilage or the internal lateral ligament. In some instances the retropatellar pad of fat may be bruised in common with injury to the semilunar cartilage. The full tender point of the internal lateral ligament, cartilage, and fatty pad will be found in such a case.

In all the injuries of the knee which I have been discussing wasting and weakening of the quadriceps muscle is a characteristic feature, and no treatment can be regarded as sufficient which does not provide for the restoration of the efficiency of this muscle during the stage of convalescence. This is particularly to be noted in the condition which is now under discussion, for some of the deep short fibres of the subcrureus muscle are inserted into the synovial membrane of the joint, and when they contract they draw up the synovial membrane and help to pull the pad of fat out of danger when the knee is extended. Neglect, therefore, of the quadriceps muscle will leave the patient peculiarly liable to a recurrence of the injury.

If the reader has appreciated the regular gradation of disorders of the knee already described, he should have little difficulty in applying and adapting the method of diagnosis and treatment to unusual types which occur as a result of injuries in military service. Even bullet wounds through the joint, which sometimes chip off fragments of bone, can be dealt with on lines similar to those indicated for fractures of the spine of the tibia. The whole question of septic arthritis in and about the joints, with resulting ankylosis, is a larger subject, which cannot be dealt with in the present article.

FIG. 3.—Cage support for knee.

FURTHER OBSERVATIONS ON THE TREATMENT OF GAS GANGRENE BY THE INTRAVENOUS INJECTION OF HYPOCHLOROUS ACID (EUSOL).

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(Report to the Medical Research Committee.)

In the BRITISH MEDICAL JOURNAL (1916, i, 83) we published a series of cases giving the results of treatment of the toxæmia of gas gangrene by the intravenous injection of hypochlorous acid. We have now had further experience of this method of treatment, and we submit the results which we have obtained.

CASE I.

Corpl. G. S. (Chart 1). Admitted January 28th, 1916, at 1.30 a.m., having received a bullet wound of the right forearm on the previous day. On being examined under chloroform at 9 a.m., the arm was found to be extensively infected with gas gangrene. This was spreading upwards along the brachial