

INJURIES AND DISPLACEMENTS OF THE SEMILUNAR CARTILAGES.

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The knee joint is very susceptible to injury, but because a knee is injured it does not necessarily follow that the semilunar cartilage is displaced or fractured.

Nature of Injury.

There are three main ways in which the knee is damaged:

Lateral strain, commonly caused by an abduction force, resulting in a tear or partial rupture of the femoral attachment of the internal lateral ligament. Much less commonly the knee is injured by an adduction force, tearing the external lateral ligament.

Rotation strain, caused by twisting of the knee. If weight is being borne on the flexed knee with the foot firmly anchored to the ground, the force of the injury in addition to stretching or tearing the coronary ligaments may cause a split or fracture of the semilunar cartilage. When no weight is borne, or if the foot be not held, the semilunar may escape. The modern football boot, with good studs to prevent slipping, often gives just that fixation which causes damage to the cartilages, whereas a rotation sprain whilst on a pair of skis, by allowing the foot to slip, more often causes tearing of the ligaments and allows the cartilage to escape.

Hyper-extension strain results in a tear or rupture of the anterior crucial ligament. This injury may be further complicated by an avulsion of the anterior superior spine of the tibia—in other words the bony attachment yields rather than the ligament.

A **severe crush** may result in a combination of these injuries. In the War we saw many such, but in civil practice the ruptured ligament and the torn cartilage are generally distinct and separate entities.

Mechanism of Derangement.

A displaced cartilage is always a torn cartilage. The line of cleavage is in the substance of the cartilage itself. The reason for this is that cartilage is avascular and so incapable of repair, except at the extreme periphery. Tears of the coronary ligament repair by fibrous tissue.

The injury then, which results in a damaged cartilage, in the first instance is usually a rotation sprain or twist, with the knee flexed and the weight transmitted. The semilunar cartilage, caught between the femur and tibia, is compressed and splits longitudinally by this direct compressing force. A clinical observation which supports this hypothesis, is the age incidence of patients with cartilage injury. With the exception of congenital variations in the external cartilage, which are met with and give rise to symptoms, injuries to the semilunars are rare in children and in adolescents. It seems likely that the elasticity of the cartilage at this age allows considerable compression without a fracture resulting. Under the age of seventeen or eighteen, in my experience, one commonly finds no lesion in exploring a knee in which the symptoms and the story suggest a cartilage derangement. One should wait for clear evidence of recurrent internal derangement, before operating on the knee joint of a boy still at school.

If the split is complete, the central portion may be displaced across the joint, giving rise to the so-called "bucket-handled" displacement. If the split is incomplete, the symptoms and physical signs will be those of a sprained knee, that is, there will be no "locking" of the joint, unless one end is torn off in addition.

With the tearing free of either the anterior or posterior end, we get the displaced tongue-like process passing across between the femur and tibia, interfering with joint movement and giving rise to the so-called "locking." (See Fig. I.)

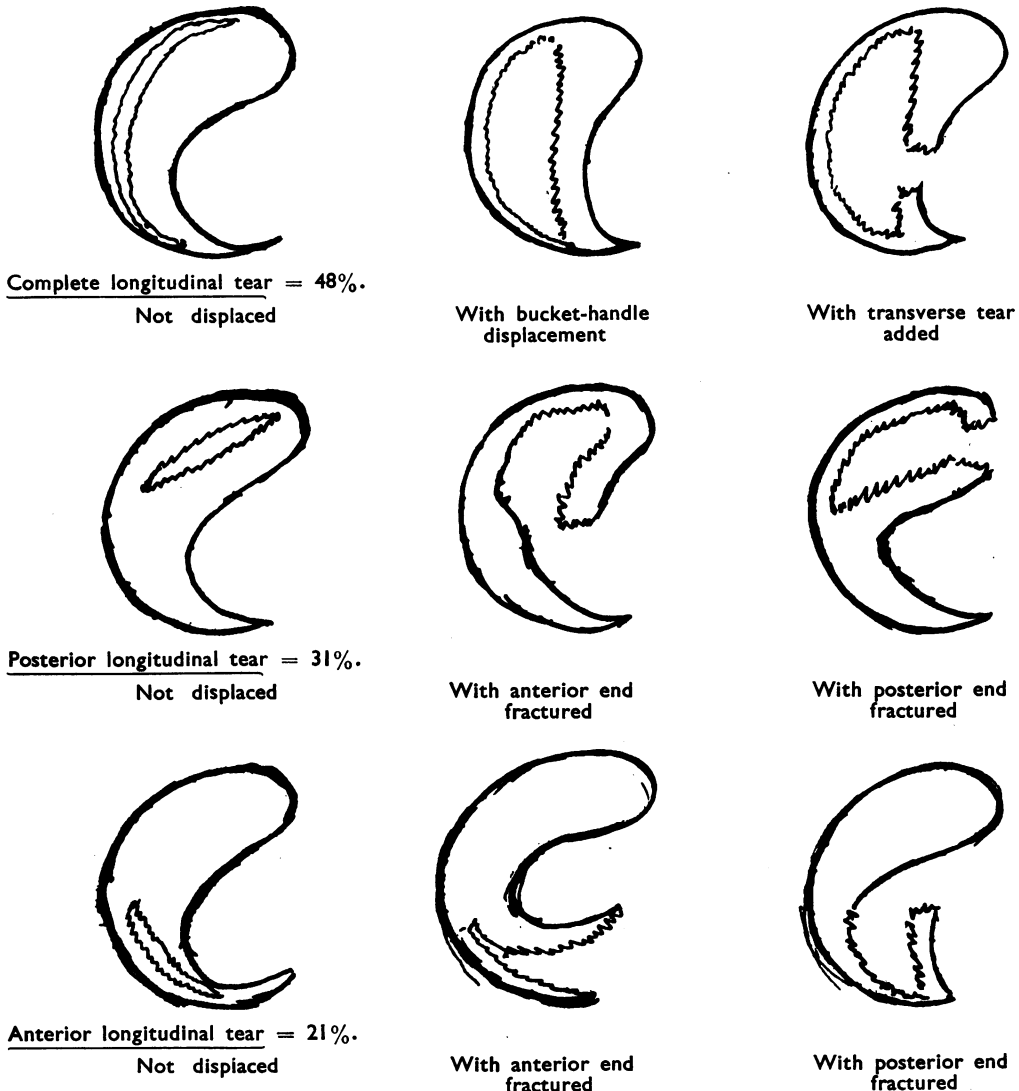


FIG. I.—Diagrammatic scheme to show the primary injury, a longitudinal tear, either complete or confined to posterior or anterior end of the cartilage—and displacement caused by further rupture at either end. Based on an analysis of 629 longitudinal tears or fractures of cartilage found at operation.

This conception of the mechanism of derangement explains the varying picture found at operation, when the torn cartilage is seen and removed, and also explains certain difficulties when assessing the value of points in the history of the patient's injury and subsequent happenings.

Some three years ago the writer analysed his own operation cases—and found that the relative frequency of injury of internal cartilage over the external cartilage was five to one (See Table I). The converse is true in children when the injury, which is rare, is generally a congenital lesion of the external. The relative frequency of the tear being limited to the posterior part of the cartilage is also noticeable, and this point is of great importance when we are considering the operative exposure, and deciding how to proceed when the anterior third or even half, which is the part seen on opening the joint, appears normal.

TABLE I.
Analysis of 629 cases operated on—1921-1934.

Type of Tear.	Internal Cartilage.	External Cartilage.	Total.	Percentage.
Complete	277	23	300	48
Posterior	143	52	195	31
Anterior	106	28	134	21
Total	526	103	629	

The semilunar cartilages have a twofold function. They tend to adapt the surfaces of the tibial tuberosities to fit the femoral condyles during movement, and they play an important part in the lubrication of the joint. It has been shown that if two gliding surfaces are not parallel to one another, but inclined at an angle, there is less friction. The semilunar cartilages insure this wedge-like action by virtue of their shape.

If the knee is opened after the cartilages have been removed, their place is taken to some extent by fibrous tissue, which sometimes conforms in shape very nearly to the periphery of the removed cartilage—an attempt by nature to make up the loss. In practice, it is the common experience that the removal of these cartilages does not handicap the majority of patients.

Diagnosis.

It is impossible to overstate the value of an accurate history—details of the accident and the after happenings. This takes time but is time well spent, and is an indispensable prelude to the clinical examination.

Primary Injury. The diagnosis of the primary injury is much more difficult than of a recurrent derangement, and we may well be in doubt as to whether we are dealing with a severe rotation sprain, or whether the cartilage is torn in

addition. Pain and tenderness on palpation over the jointline is suggestive and helpful. When we are uncertain it is wise to regard the injury as a sprain, treat it accordingly, and wait for a recurrence of symptoms, before advising operation.

If a knee previously uninjured as the result of an accident, and with a history of twist, becomes locked, that is, fails to extend fully to 180° , and if when manipulated is immediately restored to normal, perhaps with an audible snap, we may confidently diagnose an internal derangement—either a torn cartilage or a loose body. I would emphasize the value of the unlocking, that is restoration of the lame knee to normal by manipulation, rather than the story of locking. A strained knee will often fail to extend, being held semi-flexed by muscle spasm. Under anæsthesia such a knee straightens, but the spasm returns as the effect of the anæsthetic wears off. With a displaced cartilage when reduction is accomplished the knee remains straight, that is retains the power of extension to 180° .

Recurrent Displacement. There is little difficulty in arriving at a correct diagnosis of recurrent displacement when a patient states that his knee was injured and since that time has given way on some four or five definite occasions; that he fell because the knee gave way and not because he slipped; that the knee would not straighten and that he was assisted off the field limping, with the toe but not his heel on the ground; that someone pulled his leg straight, he felt something move, and was then able to straighten and bend the leg; and that the leg swelled the same evening. From such a history, the diagnosis of recurrent displacement of a torn cartilage is simple. In practice, it is only necessary to exclude a loose body.

Loose Body. A loose body gives a similar history and similar symptoms to that given of a torn and displaced semilunar cartilage. The X-ray examination is the deciding factor, unless the loose body can be felt by the patient or the surgeon. Frequency of locking with great ease of unlocking is suggestive of loose body. A radiogram should always be taken before finally arriving at a diagnosis of any injured joint.

Rotation Sprain of the Knee. This is the real and practical difficulty, and it may well be that it is impossible to be sure whether such sprain is complicated by a torn cartilage or not. The best thing to do is to treat the sprain, and await evidence of recurrence of the cartilage displacement, as otherwise many knees will be needlessly submitted to operation.

A lateral sprain can be diagnosed with certainty by the site of maximum tenderness on palpation, by pain on forced abduction, or more rarely adduction with the knee extended. There may be limitations of extension in a severe sprain.

In addition to the sprains affecting and chiefly confined to one or the other of the lateral ligaments, we sometimes see a more severe and generalized sprain of the joint, a rotation sprain. The knee injured by a fall when ski-ing is a good example of the severe sprain which may be mistaken for an internal derangement. The writer has opened several such knees under the impression that he was dealing with a torn cartilage.

A severe rotation strain without weight on the leg is liable to damage the attachments of the cartilages toward the front of the joint and about the fat pad—it produces an intra-articular lesion. There is pain, fluid in the joint, and movement is limited by spasm. The range is small. The knee will neither fully flex nor extend, but has perhaps some 30 to 40 degrees of movement through an intermediate arc. The joint line is tender on palpation, and there may be oedema localized over the internal lateral ligament which may be tender too.

Now, if one opens such a knee, the operative findings will vary according to the interval of time which has elapsed since the accident. In the early stages, the fluid is generally a mixture of blood and synovia. The anterior part of the cartilage appears thickened. There is thickening about the attachments of the anterior horn and maybe a swollen fat pad. In the later stages, there is thickening and fibrosis.

Under anæsthesia, knees of this type straighten and bend. The protective spasm is overcome, but, if a few weeks have elapsed since the accident, there is a feeling of spring, as if the full 180° extension were not quite maintained. Any forced manipulation makes the condition worse and operation is useless. The great factor in recovery is time, together with early rest and physical treatment. If the rest is complete—e.g. in a plaster cast—the inflammation will subside more quickly, but adhesions will form. The effusion and hæmorrhage into the loose cellular tissue and the fibrosis—in fact all the processes of repair—tend to cause limited movement. When these adhesions are put on the stretch, the patient at once experiences a feeling of weakness, pain, and insecurity. Early mobilization ends in disaster. The knees get stiffer and the spasm returns. Many patients are incapacitated for months, but they gradually improve with time. These are knees which may require forced manipulation later on and do not require operation for removal of cartilage.

Overuse Arthritis. By this is meant a knee joint which feels weak, swells, and may give way under strain, or more often feels insecure. Such knees are generally seen in patients from 35 to 50, who for some reason take more active exercise than is their usual habit. For example, a doctor takes his holiday and tries to play two, or it may be three, rounds of golf a day, with an occasional game of tennis. He gives his knee some slight and indefinite twist. It fills with fluid, and extension is painful and limited by a few degrees. The inner joint line is tender. He feels the knee will give way and he does not trust it. The radiogram may show some slight lipping but no gross change.

Support, building up of the quadriceps, and counter-irritation, together with a return to the normal and less active life, will usually be followed by a cessation of the symptoms.

Torn or Stretched Crucial Ligaments. These allow of hyperextension and give a feeling of weakness and insecurity, with recurrent attacks of synovitis, on any strain or overuse. Careful examination of the passive joint range in comparison with that of the sound side will clear up the diagnosis.

Avulsion fracture of tibial spine and fracture of the patella without separation must be borne in mind. The radiogram, which forms part of the routine clinical examination of every joint, will show the fracture.

Recurrent dislocation of the patella is more common than is generally supposed, and patients, generally girls in the late teens or early twenties, come complaining that the knee gives way, feels weak and is liable to synovitis.

Clinical examination will reveal the extra mobility of the patella, and the ease with which it can be pushed over the ridge on the outer femoral condyle. I have seen several such knees operated on for a cartilage derangement, and the true diagnosis not appreciated, until the patient was later re-examined because of a continuance of the symptoms.

Treatment.

When the diagnosis of the primary injury is in doubt, as at times it must be, it is wiser to wait than to advise operation. The knee should be treated symptomatically, then tried out with use and free-standing gymnastic work. If the knee holds up, well and good. If it gives way and exhibits the syndrome of a recurrent cartilage displacement, an operation should be performed. If it recovers up to a point, but then exhibits the syndrome of capsular adhesions—pain and limitation of movement on forced flexion with rotation—it should be mobilized.

If one can be reasonably sure that a cartilage is torn and displaced, it is safer and better to remove it. Treatment by manipulation is indicated if the disability is due to adhesions which are the results of sprain.

As has been stated, the difficulty lies in arriving at a certain diagnosis following the primary injury, and so we temporize. As we cannot see what has happened unless we look into the joint, it is obvious that any statistics as to the cures by manipulation must be fallacious. If the correct treatment of the primary injury, whether by rest, by manipulation or by operation, be a matter of opinion, there can be no doubt that operation is required for a recurring derangement. A knee which has been subjected to repeated internal trauma is likely to be the site of osteo-arthritis, and every experienced surgeon has seen the degenerative change following a history of repeated derangement. Again, the physical danger of the unstable joint, which may throw the patient down at any time and in any place, is a factor to be considered.

The Operation*. Certain details of the technique which the writer adopts will be briefly described. Operation is carried out with a tourniquet, and an oblique incision crossing the joint line, but avoiding the patellar branch of the internal saphenous nerve, suffices for opening the front of the joint and exposing the anterior half, or with a lax knee, two-thirds of the cartilage.

If a bucket-handle tear is met with the central portion is displaced, running backwards across the joint, removal of the displaced part, and of the peripheral part as far back as convenient, is the wisest course.

If the joint looks normal when opened, the anterior third or half of the cartilage must be freed and pulled upon, when if there is a posterior longitudinal split, the cartilage will be displaced across the joint. If the posterior part of the cartilage is not torn—in other words, if the cartilage is normal—it will not be displaced when pulled. Unless the surgeon is prepared to detach the normal front end, he will often fail to recognize the posterior longitudinal tear. This tear is common, occurring in 31 per cent. of the cases operated upon.

* For description of the operation in detail and of the posterior approach see *Journal of Bone and Joint Surgery* Vol. xvii, No. 3, July 1935.

If the posterior half has failed to pull across the joint and is to be regarded as normal, what should be the next step? The anterior part, already detached by the surgeon, must be removed and the fixed posterior part left.

We are faced by the alternative that either we have made a wrong diagnosis or that the lesion is a torn external semilunar cartilage with symptoms referred to the inner side. One cannot see the external cartilage from the inner incision, so that the knee must be explored from the outer side as well. If the outer cartilage is normal, it should be left *in situ*; there is no need to detach a part, as is done on the inner side, in order to be sure that there is no posterior longitudinal tear. The outer cartilage is always more mobile than the inner, and we must not delude ourselves that a normally attached cartilage is loose or hypermobile.

The amount of the cartilage which can be removed *via* the anterior incision varies considerably in individual patients. In some, only a bare two-thirds can be removed; in others four-fifths, or nearly the whole, can be detached. With few exceptions, and these in a lax type of knee, the whole cartilage cannot be removed *via* the anterior route, unless the internal lateral ligament is cut. In the writer's experience, the removal of this anterior part is all that is required in the majority of cases.

The posterior horn, if giving trouble and requiring removal, must be approached from the back and the postero-internal and the postero-external pouches are reached by separate incisions.

The wound is closed and a firm bandage applied for twelve hours—then this bandage is cut without disturbing the dressings. No splint is used.

Post-Operative Care. The writer regards the post-operative treatment as of the utmost importance. The patient is encouraged to put his quadriceps muscle into action on the day following operation—and if he can be persuaded to lift the leg from the bed so much the better. He should be able to do this at any rate by the third day, and on the sixth day electrical stimulation of the quadriceps by the method known as graduated contraction is practised in addition to the voluntary movement.

He gets up, with a small supporting bandage, on the tenth day, and his early efforts at walking are watched and assisted by the masseuse, who insists on symmetry of stride—balance and so forth—avoiding the tendency to limp.

No passive movement is required—movement is made by the patient's voluntary effort, but the masseuse assists with rotation of the knee during all degrees of flexion. Especially towards the end of the treatment period it is necessary that she should make sure that full outward and inward rotation is regained, to avoid the formation of adhesions about the attachment of the coronary ligaments.

The patient can usually accomplish reasonable walking on about the twelfth day and leaves hospital then, but attends for a further week or ten days for his electrical treatment and muscle training.

Some swelling of the joint is not uncommon in the early stages but may be disregarded. It is controlled by a small crepe bandage, which does not extend up the thigh beyond the limits of the joint.

Mild games—e.g. golf—may be resumed in four weeks, active games in six weeks—and in about six weeks the patient should usually have made a full recovery.

Manipulative Treatment. This has been so often described that it will be only referred to as the essential method of dealing with the effects of injury to the knee, when the lesion is caused by adhesions rather than by a torn cartilage. Again, it should be borne in mind that when we are in doubt about the accuracy of diagnosis and with a normal radiogram, manipulation is well worth a trial. Adhesions about the periphery of the cartilages, at the coronary attachments, will commonly follow a strain, unless the original injury has been treated by active movements or manipulation at an early stage. Such adhesions, when put on the stretch by a sudden twist during active movement, as in playing a game, give rise to a sudden feeling of pain and weakness, and mimic a true internal derangement.

If the manipulation is carried out under gas anæsthesia, the patient should, immediately on recovery from the anæsthetic, walk and put the joint through its full range several times.

The manipulation may be repeated with advantage, even with anæsthesia, if the result on the first attempt is not completely successful.