

children the surgeon can make the necessary manipulation himself without any aid.

Where in a young child, after a fall, the thigh is found bent forwards and shortened, and the child does not use it or move it, and the bent part is tender and swelled, but there is no crepitus, while the upper end of the bone moves with the lower end, there is an *incomplete fracture of the femur*.

The surgeon should remember that it is common to find the signs of effusion into the knee joint a few days after fracture of the femur, especially when the injury is in the lower third of the bone, and is the result of direct violence.

C. Injuries about the knee.—The special injuries that may be met with in this region are :

- Fracture of the lower end of the femur, of the upper end of the tibia, and of the patella.
- Dislocation of the tibia, of the fibula, of the patella, or of a semilunar cartilage.
- Sprain, rupture of lateral ligaments, or of ligamentum patellæ.

As the bones are so superficial, and their fracture and dislocation are attended with marked deformity, there is usually not much difficulty in distinguishing these various injuries. In cases where there is an alteration in the plane or in the axis of the limb about the knee joint, the surgeon must determine whether the displacement is at or near the articulation. For this purpose the head of the tibia must be carefully felt to ascertain whether the displacement is between the femur and tibia, or at a higher or a lower level. Being satisfied on this point, the surgeon should grasp each condyle of the femur and each tuberosity of the tibia separately, and attempt to move it on the rest of the bone; the same may be done with the head of the fibula on the outer side of the tibia. The patella may then be examined, its outline defined, and compared

with that on the other side; an attempt may also be made to obtain movement transversely and longitudinally; while failing that, firm pressure should be made all around its edge, and across its surface, any crepitus elicited being carefully noticed. The relations of the patella to the femoral condyles should be compared on the two sides, and the continuity of the patellar ligament traced from the patella to the tubercle of the tibia. Until the surgeon has satisfied himself that the patella and its ligament are entire he should not bend the knee joint, as fracture of the bone and rupture of the ligament may be seriously exaggerated in their effects by such a movement. Having in this way examined the bones and the patellar ligament, the surgeon should examine closely the interval between the tibia and the femur, to notice any difference between the two limbs, and then, grasping the leg, he should test the amount of lateral motion in the joint; of course he will observe the outline of any swelling of the soft parts.

The leg is displaced laterally.—This may be due either to dislocation of the tibia, or to separation of the lower epiphysis of the femur.

(1) If the femoral condyles be found continuous with the shaft of the bone, and immovable upon it, and the head of the tibia project to either side of the femur, the patella lying on the corresponding condyle instead of between the two, and the joint being nearly if not quite immovable, the injury is a *lateral dislocation of the tibia*. This form of dislocation is incomplete; it may occur to either side, and when the tibia is displaced outwards it is usually also rotated out, the foot being everted. Correction of the deformity is not attended with crepitus.

(2) If, however, both the femoral condyles be found resting upon the head of the tibia in their normal relation, but the lower end of the femur

be displaced to either side, movable, with soft crepitus, and if there be some amount of flexion and extension movement in the joint, there is a *separation of the lower epiphysis of the femur with lateral displacement*. This accident may occur at any time up to sixteen years of age.

The leg is displaced antero-posteriorly.

(a) If the femoral condyles with the patella lying between them project at the front of the knee, and the leg is lying at a posterior level, projecting backwards into the ham, the whole limb being shortened, and the measurement from the adductor tubercle to the tip of the internal malleolus is also shortened, there is a *dislocation of the tibia backwards*.

(b) If, however, the anterior projection be found above the condyles of the femur, higher up than or tilting forward the patella, and the condyles of the femur are situated immediately above and in contact with the head of the tibia, but a firm mass or bony projection is felt in the ham, and the measurement from the adductor tubercle to the internal malleolus is not shortened, although that from the iliac crest to the malleolus is shortened; and, further, if movement of the part elicit crepitus, there is a *supracondyloid fracture of the femur*. If the patient be under seventeen years of age, and the crepitus soft, it is a *diastasis*. In this injury the sharp lower end of the upper fragment may transfix the triceps muscle, or even the skin. If with these signs either condyle be found movable apart from the other, it would show that the injury was an *intercondyloid fracture*; there would then certainly be effusion of blood into the knee joint, distending the synovial cavity.

(c) If the anterior prominence be formed by the head of the tibia, and the back of the femoral condyles be felt projecting strongly in the ham, the joint being rigid, the entire limb, and the leg as measured from the

lower end of the femur, being shortened, and there being no crepitus, the injury is a *dislocation of the tibia forwards*. In these injuries the circulation in the popliteal vessels is very apt to be interfered with, and therefore in every case the surgeon must carefully observe the pulse in the tibial arteries, the state of the superficial veins, and whether a swelling rapidly forms in the ham.

The leg is not displaced.—The surgeon must first assure himself of the condition of the bones, and he should examine them in the following order: patella, femur, tibia, fibula.

(a) The patella should be found lying flat upon the femur between the two condyles, with its ligament passing straight down from it to the tubercle of the tibia, and when the knee joint is extended, and the quadriceps is relaxed, the bone can be moved laterally. It may be found lying on the side of either condyle of the femur, more frequently the outer, with its anterior surface directed outwards or inwards, and its articular surface resting on the femur, fixed in position, and having its ligament passing obliquely down to its insertion, and leaving the trochlea of the femur empty, and easily felt through the skin; in such a case the surgeon has no difficulty in diagnosing a *lateral dislocation of the patella*.

(b) The patella may be seen and felt very prominent in front of the knee, with one edge directed forwards and the other edge resting on the trochlea of the femur; what should be the anterior surface of the bone, that continuous with the front of the patella ligament, will be found directed outwards, while the articular surface will be directed inwards. This is a *dislocation of the patella on to its outer edge*.

(c) If, on feeling for the patella, the trochlea of the femur be felt, and the bone be found higher up the

thigh, movable both laterally and vertically, and if below the bone a gap in the firm patellar ligament be felt, the case is one of *rupture of the ligamentum patellæ with dislocation of the patella upwards*.

(d) If the bone be felt occupying too low a position, and its ligament be relaxed, while above the bone a depression in the quadriceps muscle be felt, there is a *rupture of the extensor muscle with dislocation of the patella downwards*. If some time have elapsed since the accident, there may be a swelling over the rupture in the muscle, preventing the surgeon feeling the gap in it. In either of the latter two cases the patient will have lost the power of extending the knee joint. The displacement of the patella can be verified by measurements between it and the iliac crest and the tibial tubercle.

(e) If on examining the bone a gap be seen or felt across it, a part of the bone being attached to the extensor muscle and a part to the patellar ligament, with mobility between the two parts; or if, without any such gap, on seizing the upper and lower parts of the patella in the two hands, one can be moved on the other with crepitus, there is a *transverse fracture of the patella*. The amount of separation between the fragments varies from nil to two inches or more; it should never be increased or made apparent by flexing the knee if the injury is recent, as this may lacerate the fibrous structures on the side of the bone, which are of great importance in preventing the displacement of the upper fragment. The amount of separation of the fragments is a measure of the laceration of the fibrous tissue over and on the sides of the bone. Quickly after the accident the joint will be swelled from effusion of blood into it. The patient will have lost the power of extending the knee.

(f) If on grasping the bone laterally a portion of

it be found to move on the rest with crepitus, or if, on pressing over the front of the bone, an irregularity of the bone be felt, and crepitus be elicited, or on pressing on the edge of the bone in some one spot crepitus be detected, a *vertical or oblique fracture of the patella* has occurred. In these cases, too, the joint becomes distended with blood, but the loss of power is not so great as in the former case, nor is there the obvious deformity sometimes met with in transverse fracture of the bone. When the surgeon has satisfied himself that there is no fracture of the patella, he may in his subsequent manipulations bend the knee joint.

Grasp each condyle of the femur separately, and try to move it from before back, or obliquely up and down on the shaft of the bone, and run the fingers over the bone to detect any projecting angle. Repeat this manipulation on the tuberosities of the tibia; notice any increase in width of the head of the tibia, and measure it with compasses, measuring also the length of the leg from the patella to either malleolus. Then feel for the head of the fibula, and, comparing it with the one on the uninjured side, notice if it be displaced forwards or backwards, be more movable than normal, or whether the tendon of the biceps attached to it is lost under the ilio-tibial band of fascia lata, or is too prominent at the back of the joint.

(g) If either condyle be movable on the rest of the bone, or the attempt to obtain movement elicit crepitus, there is a *fracture of a condyle of the femur*. The direction of the mobility as well as the detection of a projecting ridge or angle of the bone will enable the surgeon to determine the position and direction of the fracture, which may be transverse or oblique. The symptoms of the injury will be pain, bruising over the knee, loss of power to move the joint, and effusion into it.

(h) If either tuberosity of the tibia be movable

with crepitus, or the head of the bone be increased in width with slight shortening of the leg, and the part be painful, tender and swelled, a *fracture of the head of the tibia* is to be diagnosed. This is a rare and a severe accident. The upper epiphysis of the bone may separate in a child or adolescent. If there be much shortening of the leg from impaction of the shaft in the head, there will be found either a fracture or a dislocation upwards of the fibula. This injury is quickly followed by effusion into the knee joint.

(i) If the head of the fibula be found in front of its normal position, and the usual prominence of the biceps tendon be lost beneath the ilio-tibial band or fascia, there is a *dislocation of the head of the fibula forwards*. The signs may be reversed, and the head of the bone be found projecting at the back of the knee with the outer hamstring abnormally prominent in the ham; then a *dislocation of the head of the fibula backwards* is to be diagnosed.

When the surgeon has in this way examined all the bones of this region, and found them unbroken and not displaced, he must proceed to investigate the softer parts, and he must be especially careful to assure himself that there is no displacement of a semilunar cartilage or rupture of either lateral ligament of the joint, in cases which might be assumed to be simple sprains. To do this he should feel carefully on each side of the patellar ligament for any projection as of a displaced cartilage, also over the line of the joint between the femur and the tibia; and he should then estimate the amount of lateral movement possible in the joint.

(j) If, after some jerk, strain, or sudden movement of the joint, the patient complain of a sudden severe pain in the joint, and if he be unable to extend it or bend it completely, although passive movement short of extreme limits is free, and does not occasion

much pain, there is probably a *dislocation of a semilunar cartilage*.

If, now, there be a swelling felt on either side of the joint just over the line between the femur and tibia, corresponding to the cartilage in outline and feel, especially if there be a clear history of this swelling having appeared at the time of the accident, and if on manipulation it can be pressed into place with relief of pain and of the stiffness of the joint, this diagnosis is certain, and the displacement is to be described as *marginal* or *extra-articular*. If, however, there be no such swelling, but an interval be felt between the femur and tibia, and especially if to this be added the detection of a projection on the same side of the patellar ligament, and slight relaxation of the ligament, the diagnosis is confirmed, and the displacement is to be described as *central* or *intra-articular*. This injury is liable to be mistaken for the impaction of a loose body in the joint and *vice versa*. But attention to the following points will enable a diagnosis to be made. A semilunar cartilage is always *first* displaced by some sudden wrench of the joint, although subsequently it may slip out of place during any sudden or extreme movement of the joint. The impaction of a loose body between the articular surfaces is not dependent upon a wrench or sudden twist of the joint, but occurs during the customary movements. When dislocated, the semilunar cartilage may be felt projecting; the loose body, on the other hand, cannot be felt when impacted, but may be felt between the attacks of pain freely floating in the synovial cavity. In impaction of a loose body the joint is locked; in dislocation of a semilunar cartilage, the joint is capable of free passive motion. A cartilage may remain dislocated and cause lameness for a long period, or even permanently; the impaction of a loose body

between the bones is always an acute affection, and is corrected by some sudden active or passive movement; it may often recur, but is not a chronic or permanent condition.

(k) If, after a sudden wrench of the knee, there be found increased lateral movement of the tibia to one side, the surgeon may diagnose *rupture of the lateral ligament* on the opposite side of the joint; this diagnosis will be confirmed by finding the pain chiefly situated on that side, or by swelling and ecchymosis.

(l) If, after a wrench or strain of the joint, there be great pain, inability to move the joint, swelling assuming the form of the synovial cavity, and passive movement be found free but painful, and there be an absence of the signs of any of the injuries above mentioned, the case is to be diagnosed as a *sprain of the knee*.

D. Injuries of the leg.—The tibia for its whole length, and the fibula for some distance, are so subcutaneous that any deformity of the shafts of these bones is readily recognised, either by the eye or by the hand. Deformity is not marked unless both bones be fractured, but it may be so striking as to render the diagnosis certain. Where that is not the case, the surgeon should run his fingers carefully down the inner surface of the tibia, comparing the two bones, noticing any little unevenness, the position of chief pain, and particularly of marked tenderness; then grasping the leg above and below the most tender or painful part, he should attempt to obtain mobility and crepitus. A similar examination of the fibula should be made, and in addition it should be pressed in towards the tibia just below its head and above its malleolus, to observe whether this gives crepitus, or causes acute pain at a distance from the point compressed. The deformity, or the direction of mobility, will usually at

once make it clear in what direction the bones are broken.

(1) If there be marked deformity of the leg, with pain, swelling, loss of function, shortening of the distance between the tubercle of the tibia, and either malleolus, free mobility in the length of the leg, and crepitus, these signs clearly indicate a *fracture of the shafts of the tibia and fibula*. The most frequent deformity is the projection forwards of the lower end of the upper fragment of the tibia, with eversion of the foot and the lower part of the leg. Where this deformity exists a very careful examination of the ankle joint should be made, with a view of determining whether the lower fragment is fissured into the joint (the *V-shaped fracture* of Gosselin), in which case both the surgeon and the patient should be prepared for more or less ankylosis of the ankle. When it is certain the tibia is fractured, there is no justification for a prolonged or painful examination into the state of the fibula; that bone is certainly broken when the injury is the result of indirect violence, or when there is marked shortening, deformity, and ready mobility. When the surgeon is in doubt upon the point, the bone should be assumed to be broken; the fact will not alter the treatment, and the attempt to discover the full truth may seriously increase the laceration of the soft parts.

(2) Where there is no obvious deformity of the leg, with no shortening of the limb, and yet there are marked pain and tenderness over one part of the tibia, with swelling, and loss of power in the limb, and on manipulation crepitus is elicited, slight mobility being detected, but the line of the fibula unbroken, and this bone is not the seat of severe pain or tenderness, the surgeon should diagnose a *fracture of the shaft of the tibia*.

(3) If there be a severe fixed pain at a particular

spot on the outer side of the leg, increased by standing or attempting to walk, the surgeon should examine the fibula carefully. If he find that the painful part is very tender, and that when the fibula is compressed against the tibia by grasping the leg just below the knee or above the ankle, smart pain is caused at the same tender spot (not at the point pressed upon) the diagnosis of *fracture of the shaft of the fibula* may be made. This diagnosis will, of course, be confirmed if the finger detect any irregularity in the outline of the bone, or any crepitus on compressing the two bones, or if the surgeon notice a failure of the natural rebound of the fibula after its compression against the tibia.

(4) If there be no evidence of a complete fracture of the tibia, such as we have just mentioned, but the patient complain of a severe and fixed pain in the bone, and on careful examination the part where the tenderness is greatest is found not to be a spot, but a line running obliquely across or vertically down the bone, and if along this same line of tenderness a linear induration or swelling on the bone be subsequently detected, the surgeon may diagnose a *fissure of the tibia*. This injury is often very difficult to diagnose, and to distinguish from a bruise of the part.

(5) If, during some sudden exertion, the patient experience a severe pain in the calf, or behind the ankle, and lose power in his leg, and on examination the bones and joints are found uninjured, but above the heel there be ecchymosis and swelling, and a depression be felt where the prominent tendo Achillis should be, the surgeon will have no difficulty in diagnosing a *rupture of the tendo Achillis*. When with these symptoms this tendon is found entire, but all voluntary attempts to extend the ankle give great pain, while passive movement of the joint is free, and especially if the patient felt or heard any "snap" at

the time of the accident, a *rupture of the plantaris tendon* is to be recognised. Rupture of the tendo Achillis may be attended with a loud snap.

E. Injuries about the ankle.—Under this head are included a large group of injuries: fractures of the lower ends of the bones of the leg and of the astragalus; dislocations of the fibula, the ankle, the astragalus, and of the foot from the astragalus, together with displacement of the peronei or posterior tibial tendons and sprains of the ankle joint. The difficulty of diagnosis is increased by reason of the fact that a characteristic deformity (as of Pott's fracture) may be corrected before the surgeon sees the case, and by the great swelling which quickly ensues upon many of these injuries. The nature of the accident, the character and seat of the pain, and the degree to which the function of the part is lost, are facts valuable as suggestive of the nature of the injury. The cases group themselves naturally into those in which there is no obvious deformity, and those in which there is a striking deformity.

(1) **There is no obvious deformity of the ankle.**—Careful measurement should be taken of the length of the leg, and of the distance between the malleoli and the heel, and between the malleoli and the tubercles of the scaphoid, and of the fifth metatarsal bones respectively to show that there is no bony displacement, as a slight slipping of the part laterally or antero-posteriorly might otherwise escape detection. The seat of pain and tenderness should be carefully observed, and then each malleolus should be grasped, and an attempt made to move it independently. The part should then be seized and moved laterally, and be pressed up into the arch of the tibia, and moved freely.

(a) If in this examination either malleolus be found movable with crepitus, it will demonstrate the