SURGICAL PROCEDURES IN GENERAL PRACTICE

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FRACTURES OF THE SHAFTS OF THE TIBIA AND FIBULA

BY

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When considering the fracture of a long bone, the position and the nature of the break in continuity are frequently determined by the structure of the bone. A broken tibia often illustrates this relation between fracture and structure. The upper third of this bone is thick and prismatic, but the lower two-thirds becomes increasingly thinner until near the lower end, when some expansion again occurs to form an articular surface of the ankle. It is the lower slender part of the tibia that is most frequently broken, and here, too, is one of the well-known sites for non-union of a skeletal fracture. Furthermore, the whole length of the inner surface of the tibia lies immediately beneath the skin, and there is thus a greater liability for a fracture of this bone to become compound than is the case with most bones. Fractures of the bones of the leg may arise from direct or indirect violence, the severity and nature of which will decide whether one or both bones are broken and also the particular variety of fracture inflicted. Direct violence, such as that of a crushing force applied to the limb, usually produces a transverse fracture, and very often with comminution. On the other hand, indirect violence, such as occurs when falling from a height, as a rule causes severe twisting of the leg with the foot momentarily fixed on the ground. The fracture which follows such a torsion strain is either oblique or spiral in character. Comminution may occur with all varieties, and frequently there is a detached triangular piece present, the so-called "butterfly fragment." Again, the tibia, whether broken alone or in company with the fibula, is almost invariably severed in its lower two-thirds; if both bones suffer the fibula is fractured at a higher level than the tibia.

The more severe the injury the easier the diagnosis. A simple fissured fracture of the fibula may readily escape detection except by radiographic examination in two planes. Clinically there is local tenderness at the site of bone injury accompanied by some swelling due to extravasation of blood, and lateral pressure on the fibula either above or below is painful at the fracture. But a person with a broken fibula may be able to walk without great discomfort, and this fact is very disarming to the unwary. A fracture of the tibia, on the other hand, is at once disabling. There is local pain and swelling at the point of injury, and if the examining fingers follow the crest of the tibia from above downwards a sudden interruption is experienced at the fracture and the lower end of the upper segment can be felt. These signs are enough to diagnose a fracture without recourse to the eliciting of crepitus or of abnormal mobility at the break. The obtaining of the last two signs is inadvisable, for they can only be secured with pain to the patient and some risk of disturbing what may be a reasonably good alignment of the fragments. A fracture of both bones presents no difficulty of diagnosis: the grave disability, the angular deformity, and the great swelling of the parts are only too obvious.

Treatment

Once the clinical diagnosis of a fracture of one or both bones of the leg is made the protective treatment of the fracture should begin, without waiting for an x-ray examination. Neglect to protect the injured leg during transport from the scene of the accident may have irreparable consequences. Fractures of both bones in their fresh state may present the fragments in good anatomical alignment, but if left unprotected these may easily become so disturbed by the time they reach the x-ray table that their realignment may baffle the skill of the most experienced. It is important, therefore, that these fractures be protected on the spot; for this early splinting may well be the most important step of all, in spite of whatever procedure may follow. In a fracture of the fibula alone the uninjured tibia acts as an adequate splint. For a broken tibia the uninjured fibula is something of a protection, but it is safer to adopt the plan that is recommended where both bones are broken, which is as follows. The leg should be supported by an assistant, while the foot is then brought up to right angles with the leg and some traction applied. With the leg in this position, a padded box splint, with foot-piece, is bandaged to the limb. If only one side splint is available it should be applied to the outer side of the injured limb, and then both lower limbs should be tied together at the feet, ankles, mid-calf, knees, and thighs. Even if no splint is available the limb should be tied as indicated.

As soon as possible the radiographs should be taken in two planes, and the whole tibia and fibula examined to avoid missing any undetected fracture at some distance from the main injury. A skiagram alone will reveal the true nature of the fracture, and by indicating the disposition of the fragments will serve to point out what the right line of treatment should be.

Fracture of Fibula Alone

Fractures of the shaft of the fibula are rarely of great importance, for the body weight is transmitted almost entirely by way of the tibia. Sometimes, however, a fracture of the neck may be accompanied by injury to the external popliteal nerve, with consequent drop-foot paralysis; but as a rule the paralysis is only temporary, although it may take some months to recover. An absolute irreparable paralysis is excessively rare. Fracture of the lower end of the shaft may be part of a Pott's fracture and should be treated as such. With an intact tibia there is usually no gross displacement of the segments of a fractured fibular shaft. The fracture is best treated in a plaster-of-Paris cast. Stockinet is put on the limb, and the slightly inverted foot is held at a right-angle to the leg and manual traction exerted; by this means displacement of the fragments will be corrected. While the foot is thus held under traction the plaster is applied direct to the stockinet from the toes to just below the knee and without any wool or felt padding. A walking-iron, preferably with a rubber disk for comfort, is incorporated in the cast, taking care that the iron lies in the axis of the leg and is not tilted forward below the sole of the foot (Fig. 1). Lastly, the edges of the stockinet at each end are folded back and are fixed in the cast by the turns of the last

plaster roll. When the cast is dry and well set, walking may begin with the aid of a stick. The plaster may be removed in three to four weeks, for by then there is usually enough callus present to keep the segments immobile.

FIG. 1.—Plaster cast with walking-iron incorporated.

Fractures of Tibia Alone

A fracture of the tibia is completely disabling, and reduction should be attempted without delay. It is much easier to reduce displacement during the first few hours while the muscles are relaxed than it is after a day or two when the exudation has increased and the muscles are more resistant. The anaesthetic should be such as will produce complete relaxation of the limb. The knee is first held flexed at nearly a right-angle, and traction and counter-traction are employed, with lateral pressure on the fragments if necessary. Should this procedure fail, then deliberate angulation of the fragments with traction and counter-traction may succeed in bringing the ends together. If this occurs the leg is straightened, bringing the fragments into alignment. Care, however, must be taken to avoid thrusting the sharp end of a fragment through the skin. The result should be checked by the fluorescent screen, and if unsatisfactory the manipulation should be repeated. When good reduction has been obtained the limb should be encased in a plaster cast on stockinet from the toes to the groin, and a walking-iron incorporated; but it is a good precaution to make two or three longitudinal slits in the front of the cast so that it can be prised open a little if the patient complains of undue discomfort some days later. A radiograph in two planes should be taken as soon as the plaster is dry, and again a week later. In spite of every care the fragments sometimes change their position even in the cast, and this is due to the fact that with the absorption of the exudate and the diminution of the swelling the plaster does not grip the limb so well as when first applied.

There are three things in particular that must be watched: that there is no angulation at the fracture; that the articular surface of the tibia at the ankle is horizontal; and that the foot is at a right-angle to the leg. The avoidance of angulation is of more importance than end-to-end apposition, provided the axes of the tibia

and fibula are parallel. Permanent angulation or obliquity of the articular surface will mean future ankle strain, with a weak foot in a valgus or varus attitude, and a foot fixed in plantar flexion may lead to contraction of the tendo Achillis. If there is angulation of the fracture it must be corrected forthwith by removing the plaster, manipulating the leg, and applying a fresh cast. An alternative method is to remove a wedge from the cast on the side to which the angulation is pointing and continue the narrowing slit around on either side for two-thirds of the circumference of the cast. The angulation can then be corrected by approximating the edges of the gap left after the plaster wedge has been removed; but this should be checked by the x-ray screen. If the deformity is abolished fresh plaster should be applied to close the slit and bind the cast. The plaster should be kept on the limb for eight to ten weeks or even longer, according to the severity of the fracture. But before walking is permitted a radiograph should be taken to determine whether sufficient consolidation of the callus has occurred.

If the fracture resists manual reduction, or if there is a persistent separation of the segments in spite of all attempts to approximate them, then it is probable that muscle is interposed between the fragments or the intact fibula is obstructing reduction. In these circumstances it is best to explore the limb by open operation, reduce the fracture, and maintain the reduction securely with a metal plate. This procedure will be safer if the "no touch" technique be observed throughout.

Fractures of Tibia and Fibula

Fractures of both bones are more disabling and far more difficult to treat than the fracture of a single bone. They are usually the result of greater and longer-continuing violence, so that the displacement and comminution of the fractures and the injuries to the soft parts are more serious. The attitude of the leg is characteristic: there is anterior bowing at the fracture, due to the upward pull of the quadriceps on the upper fragment and the retraction of the lower fragment by the tendo Achillis. The treatment of these fractures will depend upon the amount of displacement, overlapping of the fragments, and whether there is any muscle interposed between the ends of the bones.

MANUAL REDUCTION AND FIXATION BY PLASTER CAST

In attempting manual reduction of fractures of both bones the same principles obtain as described for fracture of the tibia alone; also, checking by fluorescent screen and by subsequent radiographs must be followed in similar manner. If the reduction is satisfactory and the alignment of the fragments correct, a plaster cast, with incorporated walking-iron, should be applied to keep the bones fixed in position. There is, however, a greater liability to displacement of the fragments under the plaster than in the case of a patient with only a tibia broken. It also takes a week or ten days longer to get these patients walking in the plaster.

REDUCTION BY DISTRACTOR AND FIXATION BY PLASTER CAST

If the attempt at manual reduction fails, or if at the outset it is felt that the overlap or displacement is such that there is little prospect of success by manipulation alone, reduction by a distractor should be undertaken. There are a number of good distractors available for the reduction and fixation of these difficult fractures of long bones. With aseptic precautions a sterilized stainless-steel pin, 4 mm. thick, is passed through the tibia above

the fracture and another pin through the lower end of the tibia or through the posterior part of the os calcis. The pins are then connected to the appliance. Traction and counter-traction are made by screw adjustment, and, with

FIG. 2.—A leg with a severely comminuted fracture-dislocation of the lower third of the tibia and fibula. Cuendet's distractor is shown attached to pins transfixing the tibia and os calcis after reduction and fixation of the fragments.

FIG. 3.

FIG. 3.—Tracing of a radiograph of the case illustrated in Fig. 2, before treatment.

FIG. 4.

FIG. 4.—Tracing of a radiograph of the same case after reduction and fixation of the fragments by the distractor.

the aid of some manual adaptation of the fragments as well, a good anatomical reposition of the broken bones can be obtained in almost every case. The procedure is best carried out with the help of the x-ray screen, for by this means the right amount of distraction necessary can be accurately estimated. When correct reposition of

the segments has been obtained the apparatus alone will maintain the fixation (Figs. 2-4). To prevent infection occurring between skin and pin, it is a good precaution to smear bipp around the pin at its emergence from the limb and apply a strand of sterile gauze over the paste. A strip of thin felt is next applied to the outer side of the leg in the lower third, and this passes down over the external malleolus, under the heel, and upon the inner side to well beyond the internal malleolus; this felt gives protection to the bony prominence in the region of the ankle. The plaster is then applied direct to the skin and over the thin felt, from the toes to the upper part of the thigh, and when the cast is dry the distractor is removed, leaving the pins in the limb. At the end of ten days walking with crutches may begin, and later on sufficient aid will be derived from a walking-stick. Pins and plaster should be removed in eight weeks. If there is enough consolidation of the fracture, walking may be allowed without the cast; but if the union of the fracture is weak, or if there is pain, a fresh cast with walking-iron should be applied for another three or four weeks. The rate of consolidation depends upon the severity of comminution, the state of health, and the age of the patient.

Delayed union is apt to follow severe comminution, and particularly if loose devitalized fragments are present. In such cases firm union may not occur for four months or even longer, and demonstrable x-ray consolidation not for five to six months. Again, some may require the protection of a walking-calliper for a while after the plaster cast has been discarded; this particularly applies to the elderly heavy patient with a severe fracture in the lower third of the tibia. Angulation is apt to occur in this type of case even when clinically there is apparent consolidation and immobility of the fragments. Fractures in young children, on the other hand, usually heal soundly in six to eight weeks. All patients after discarding plaster casts should have physiotherapy treatment, directed to improve muscle tone and to get rid of knee and ankle stiffness.

SKELETAL TRACTION AND SPLINTING

Another method of treating fractures of both bones of the leg is by skeletal pin traction combined with a Thomas or Braun splint. A Kirschner wire is inserted through the posterior part of the os calcis and tightened and clamped in a stirrup. The wire can be inserted under local anaesthesia: about 2 c.cm. of a 2 per cent. solution of novocain is injected under the sterilized skin and down to the periosteum of the bone at the point of proposed entrance of the wire. The latter is then driven through the os calcis until the skin begins to bulge on the opposite side. A second injection is now made about the exit of the pin from the bone and afterwards the pin is pushed out through the skin. The limb is placed in a Thomas bed calliper, which is bent to an angle of 45 degrees at the knee and suspended from pulleys attached to an overhead frame; the stirrup is attached to a cord which passes over a pulley, at the foot of the bed, to a weight of 12 lb. or more, according to the amount of traction required to overcome the displacement of the fragments, as indicated by the radiographs. Good correction can be obtained by this method, but it is open to the objection that the patient is kept recumbent, the fracture is not sufficiently immobilized, and there is a tendency towards delayed union. The method is, however, of great value in compound fractures or where it is necessary to keep the state of the limb under observation for trophic or other reasons. In some cases where it is desirable to begin the treatment in a Thomas splint it may be possible, after two or three weeks, to incorporate the limb in a plaster cast.

Compound Fractures of Tibia and Fibula

Compound fractures are a special problem, and they vary from one or two punctures of the skin to complete destruction of the limb, for which amputation is the only remedy. Every compound fracture must be presumed to be potentially infected, and therefore protective inoculation ought to be instituted at once; 1,000 units of anti-tetanic serum (500 American units) should be given subcutaneously and 4,000 units of gas-gangrene antitoxin intramuscularly. The treatment of the wound will depend on the degree of damage to the soft tissues. Puncture wounds are best left alone and watched; if suppuration occurs free drainage should be provided. Where there are laceration and some devitalization of the part the soiled tissues and skin involved should be excised (*débridement*). If the skin edges can be brought together without tension this should be done; but if it is not possible the wound should be packed with pure flavine and gauze. Should the wound eventually suppurate flavine and glycerin with gauze packs had best be employed and the leg dressed daily. If there is good alignment of the fragments the limb might be encased in plaster from the toes to the groin and a generous window provided for dressing. If a cast is not possible, or if it is necessary to employ skeletal traction, the limb is best nursed on a Thomas splint. Many compound fractures do well under this treatment, although union of the fragments is delayed. A sinus, however, may persist for several months, the healing of which often follows the shedding of a superficial sequestrum. Very often compound fractures require some calliper protection during the early stages of walking.

Where amputation is inevitable it is best in the early case to amputate through the fracture and provide adequate drainage from the beginning. This procedure, rather than a higher amputation, diminishes the shock, and ultimate healing is often so satisfactory that a secondary amputation for limb-fitting is unnecessary.

In other cases a more conservative attitude may be justified, and by efficient drainage, antisepsis, and possibly administration of sulphanilamide, an unpromising limb may be saved. But if in spite of such treatment there is commencing retrogression with the limb red, swollen, and oedematous, a slowly ascending inflammation and a patient very ill, then amputation becomes a life-saving operation. Even in this type of case amputation at the fracture with very free drainage may be quite enough. But if not enough it very often suffices to tide a patient over a crisis, and a secondary amputation can be planned later with a good prospect of success.

The nineteenth annual report of the National Institute of Industrial Psychology (Aldwych House, W.C.2) records important work of both industrial and educational interest. It is to be hoped that the information the Institute has accumulated and the experience it has gained since its foundation shortly after the last war will be utilized to the full in the present emergency. The section of the report dealing with industrial investigations shows the wide variety of problem with which the investigators are accustomed to deal. Particularly good results are reported in simplifying methods of work and in devising training schemes for new employees. A large part of the Institute's work is concerned with vocational and educational guidance. There was a marked increase in the number of young men sent for testing and interviewing by firms employing or proposing to employ them and in the number of boys and girls dealt with in groups at their own schools. This advisory service is still available, and to meet the needs of school-leavers who have been evacuated the Institute is prepared to send members of its staff to schools in the country.

"THE APPOSABLE THUMB"**SIR WALTER LANGDON-BROWN'S LECTURE**

Under the title of "The Apposable Thumb" Sir Walter Langdon-Brown discoursed in his Thomas Vicary Lecture at the Royal College of Surgeons on November 30 on the history of craftsmanship in medicine and the rise of surgery to its proper place. The subject took him to the origin of schools of learning and universities, the separation of philosophy from handicraft (of which the separation of medicine from surgery was a phase) and the intellectual conflicts of the Middle Ages. The lecture was attended by the Presidents of the Royal Colleges of Physicians and of Surgeons and a distinguished company.

The lecturer began his history in almost the darkest of the dark ages, when Theodore of Tarsus arrived in England in 669. Although he was 66 years of age, he proved himself an active reformer and founded a school of learning at Canterbury, at which school our written literature in English may be said to have had its birth. A few years later the monastery at Jarrow associated with the Venerable Bede was consecrated. Jarrow must have been an oasis of civilization in those times. This in turn led Egbert to establish his cathedral school at York. Thus, if one went back far enough, Britain could claim to have planted the seed from which sprang the mediaeval universities. The very names of those universities affected one with a kind of nostalgia—Salerno, Bologna, Paris, Salamanca, Oxford, Padua. They were not founded, but just grew out of the sudden passionate desire for learning in the twelfth century, wandering scholars flocking hither and thither as the reputation of some teacher waxed and waned.

The word *universitas* originally signified not a *studium* or school but a guild formed for self-protection either by teachers or students. A university was and still remained an intangible thing. He sometimes wondered what would happen if a man arrived at Cambridge station and asked a taxi-driver to take him to the university. It would be like arriving at Victoria and asking to be driven to the British Constitution. The rise of Oxford was one of the results of the quarrel between Henry II and Thomas à Becket. As the clergy naturally sided with the archbishop the king ordained that no cleric should cross the Channel except by his permission and that clerics abroad should return or lose their livings. The result was that, exiled from Paris, they crowded in the little *studium* at Oxford. In 1209 the feud between town and gown ended in masters and students three thousand strong deserting Oxford for Cambridge and Reading, and when the quarrel was settled in favour of the university many of the migrants remained in Cambridge, though Reading had to wait until the present century to get its university.

The Ascendancy of Scholasticism

It was Hugh de Balsham, Bishop of Ely, who first took steps to introduce the collegiate system into universities, though for the beginning of the system one must go to Paris. By the middle of the thirteenth century the majority of middle-class students were living in halls under the control of masters. These halls largely disappeared or were absorbed by the colleges, though this absorption was more gradual at Oxford than at Cambridge. Hugh de Balsham founded Peterhouse at Cambridge in 1284, and between 1324 and 1352 seven new colleges at Cambridge came into existence. King's College was founded in 1441 and Queens' a few years later. "It is a strange madness," said Petrarch, "this desire ever to be sleeping in a strange bed," but now the wandering scholars were settling down.

The lecturer next traced the rise of authority in the Middle Ages and the ascendancy of scholasticism which kept control until the Renaissance. He asked what was the attraction of scholasticism to the human mind. It was an attempt to push reasoning by the apparatus of logic to