

be marked on the flat surface every half-inch from the edge, in order that the distance that the instrument has penetrated the bone may be known. A large handle is also of advantage, as it can be grasped more easily. The best width is half an inch. It is well to be provided with three osteotomes of the same width, but of different thickness, in order that, if the largest gets wedged, it may be withdrawn and replaced by the next smaller, to be again replaced by the third if it be found necessary. I also have an osteotome of the same shape, but only one quarter of an inch wide, for section of the fibula or any small bone.

Most of the osteotomes found in instrument-stores are not made properly. They have a bulge just above the cutting edge, like a post-mortem chisel. In some trials made upon the cadaver with such an instrument it was found that the bone was invariably splintered at right angles to the line of desired section, the fracture extending several inches above or below the instrument. This was due to the thickness of the chisel just above its cutting edge acting too much like a wedge. The force required to drive such an instrument into the bone is much greater than with one made with straighter lines.

An instrument properly made can be driven into the bone without turning from its direction.

The mallet should be made heavier than those sold in necrosis cases. In fact, a good-sized carpenter's mallet is the best. A sand pillow, about six by eight inches square and three quarters filled with sand, and covered over with rubber cloth, complete the special outfit.

The chisel for performing a cuneiform osteotomy is shaped much like a carpenter's; half an inch is sufficient for its width. It should taper down more than the common necrosis chisel, and the beveled portion should not be too large. It should have a temper similar to the osteotome.

Osteotomy is either linear or cuneiform. The former is performed through a small wound, just large enough to easily admit the osteotome. The latter must be done through an open wound, and is therefore not subcutaneous.

The limb in either case, if possible, should be rendered bloodless by the use of an Esmarch bandage or any other method, as, especially in cuneiform sections, it renders the operation much easier and does away with the constant use of the sponge.

In regard to the use of Listerism, I am clearly of the opinion that it affords no additional safety, and I have long since abandoned its use. The method of management of the wound will be given in detail farther on.

Simple Osteotomy.—The patient having been placed thoroughly under the influence of an anæsthetic, the limb rendered bloodless if that is possible, and the point of section decided upon, an incision is made with a sharp scalpel immediately down to the bone. Unless there are special reasons for so doing, the bone should not be reached by dissecting down to it, but a quick, clean cut should be made. The line of the incision should be parallel with the line of the fiber of the muscles through which the wound passes. As a rule, this is parallel with the long axis of the limb. The place of in-

cision should be so planned as to avoid any artery or vein. The length of the wound should be only sufficient to easily admit the osteotome. This instrument is then passed down upon the knife as a guide, and, when the former is well down upon the bone, the latter is withdrawn, and the osteotome is rotated so as to be at right angles with the long axis of the bone, and then driven in with pretty firm blows with the mallet. After each blow the instrument is moved in a direction at *right angles* to the long axis of the bone—that is, in the line of the axis of the instrument—in order to keep it from becoming wedged and to change the direction of the cut in the bone. It is also well, in bones of any width, to first divide the bone throughout its superficial surface, and then gradually to work from without inward through its width. Under *no circumstance* should the osteotome be used as a lever, as it will result in breaking the instrument. In some cases the bone may be divided in a fan-shaped manner by working in different directions from the point of first entrance. Divisions should be commenced with the largest osteotome, if the bone is of any size, as the femur or tibia, because after a time the instrument becomes wedged and is difficult to work. It can then be withdrawn and replaced by the next smaller, this to be again replaced by the third if necessary. Another reason is, that, by using the largest first, the cut is made more V-shaped. When the osteotome has penetrated the hard, compact, bony tissue in the external portion, it will be felt to work more rapidly. When the external portion on the opposite side of the bone is reached, it will

be detected by the resistance in cutting. Then, as Macewen remarks, the osteotome acts as a probe as well as cutting instrument.

During section the wound may be kept damp with carbolized water, but I do not think it essential, nor do I place my instruments in any antiseptic solution before using. When the bone has been nearly divided, the osteotome is removed and the section completed by fracturing the remaining portion, a sponge wet with carbolized water being first placed over the wound and held firmly in place to prevent the entrance of air. The bone should have been sufficiently severed to make the fracture easy without the use of much force. If, however, it can not be broken without the use of too much force, the osteotome is re-entered and further section made. After fracture, the sponge is firmly secured over the wound with a few turns of a bandage, and then the Esmarch bandage removed. The limb is then left while the same operation is performed upon the other side. In case only one limb is to be operated upon, it is well to let the parts remain at rest for a few moments until the circulation in the limb has been re-established. The hæmorrhage after an osteotomy is slight. I have never seen enough to cause any anxiety, although in a few cases there may be quite a free venous hæmorrhage if the sponge has been removed too soon. There is, moreover, more blood oozing from the wound when the section has been made near the epiphysis of the tibia or when the bone is superficial. In deep osteotomies the blood is effused among the muscles, and does not come out of the wound unless pressed

out. I have once divided an artery of some size, to which reference will be made in another place.

Management of the Wound.—On removing the sponge from over the wound, it will be found that the hæmorrhage has almost ceased, but that blood can be forced up from its deeper portions, or will continue to ooze if the bone be superficial. Macewen has advised that any piece of adipose or cellular tissue that may protrude from between the lips of the wound should be removed with a pair of curved scissors, as it will prove a source of irritation and prevent the closure of the wound by a blood-clot. Experience has proved that this is an important point, and, from the neglect of this, failure to obtain rapid closure of the wound is almost always due. Macewen dresses the wound on strict Listerian principles. I do not think that there is any gain thereby. The method that has gained excellent results is as follows: In deep wounds, after removing any piece of tissue from between the lips of the wound, it may be washed out with some carbolized water of the strength of 1 to 40, and, after the parts are well dried, a strip of adhesive plaster, about half the width of the length of the wound, and long enough to pass one quarter of the way around the limb, is applied, passing over the center of the wound, care being taken to bring the edges of the incision into perfect coaptation. The object in only partially covering the incision is that, if there is any undue accumulation of blood, it can find vent through the portions of the wound not covered by the plaster, and thus prevent tension of the parts. The limb about the point of operation is now dusted over with iodoform diluted

with subnitrate of bismuth, and over this is placed a small compress of cheese-cloth, two or three inches square and four or five layers thick. Or a compress of Lister's gauze may be used. If it is possible, a flannel bandage is applied from the extremity to some distance above the point of section, and over this a plaster-of-Paris bandage (we are considering osteotomies below the middle of the thigh). Before the plaster sets, the deformity should be corrected and held in the proper position until it has well hardened. I think it is well always to overcorrect a little, for, as the bandage becomes loose, there is a tendency to lose a little of the correction. It will be found that, by the addition of some sulphate of potash to the water in which the plaster-of-Paris bandages are soaked, they will harden much more rapidly.

The bandage on the following day will be found more or less stained with blood from the oozing that has taken place, but it is of no consequence, and needs no attention. On the third day a fenestra should be cut over the seat of the wound, the compress removed, and the wound examined. An easy way to remove a small window is to make two cuts with a saw, at right angles to the long axis of the bone and about two inches apart, through the plaster, and then to unite their extremities by cuts with a strong knife. The square piece can then be lifted out, the flannel bandage cut, and through this opening the compress removed and the wound examined. The adhesive plaster need not be removed. If there is any oozing from the cut, a fresh piece of compress should be applied, and the wound examined every day. If it is

dry, a little lint may be placed over it, and no further dressing is required.

The result from this way of managing wounds has been eminently successful. In all but exceptional cases the incision has been found united on the third day, being represented by a mere line. Macewen's method aims at union by means of an organized clot. Of this method he says:¹ "During the first twenty-four hours the dressings ought to be looked at, in order to detect any appearance of blood-stains. If a stain of blood shows itself, the dressings must be removed. If there is no blood-stain during the first forty-eight hours, it is unlikely that any will afterward appear. . . . The dressings are put on (strict Lister) in the operating-room, and not touched, unless blood appears, for a fortnight."

Again, on page 175, in speaking of the organization of a blood-clot, he says: "The ordinary course which a wound healing by blood-clot takes may be described as follows: The blood is effused between the lips of the wound, and forms a clot. During the first few days a layer of translucent, yellowish material is often effused from the surface of the clot. This, however, is not constant. During the first week the blood-clot remains soft and moist; then it becomes opaque round the margins, and by and by dries, the opacity and dryness gradually extending centripetally." Closing of a wound by a blood-clot takes ten or twelve days; by primary union, two or three days.

With care to remove everything that may protrude from between the lips of the wound, primary

¹ "Osteotomy," *loc. cit.*

union should be obtained in all cases. The simplicity with which the plan advocated in these pages can be carried out is in contrast to that of Macewen. Since adopting this method, I have performed over sixty linear osteotomies. In all but three cases the wound was united on the third day. Failure to obtain primary union was in two cases due to the fact that the wound was not properly cared for. In the third no reason can be assigned.

It is evident that the earlier the wound closes the less is the liability of any accident, and the closer will the reparative process in the bone follow the course of a simple fracture. I believe that the success of an osteotomy depends more upon the management of the small incision than upon any detail in the section of the bone, and that the neglect to remove any tissue that protrudes between the lips of the incision is the cause above all others of suppuration.

The temperature after an osteotomy seldom rises above 100° F., and in the majority of cases does not get above normal. In a few patients I have seen a temperature of 102° or 103° F. without any assignable cause, the wound pursuing a perfectly normal course. As a rule, however, a registration of the mercury above 100° after the third day demands a careful inspection of the wound, as it may denote suppuration. The temperature in children often rises rapidly, and has as sudden fall without any serious import. A temperature of 103° the day after an osteotomy in an excitable child has been met with, yet the wound, on inspection, appeared perfectly normal, and primary union was obtained. Again,

I have seen quite a large abscess in the soft parts, of which the thermometer gave not the slightest indication. So the thermometer is not an infallible guide as to the presence of pus.

The pain after an osteotomy is generally slight. I have seen a child, two hours after an osteotomy of both tibia, sitting up in bed and playing with her toys as though nothing had been done. But, as a rule, a small dose of some anodyne is required the first night.

The first dressing (plaster splint) can usually be left on until firm union has taken place and the patient is well enough to be up and about.

Cuneiform Osteotomy.—In anterior curvatures of the tibia, and in angular deformities of the long bones, a wedge of bone has often to be removed. For this purpose a *chisel*, and not an *osteotome*, is used, and the operation is through an open wound.

An Esmarch bandage having been applied, an incision is made parallel to the long axis of the limb, directly down to the bone at the point of greatest curvature, long enough to give plenty of room, which will be found, in the deepest portion of the wound, to be a little longer than the width of the wedge to be removed. If the bone is covered with much muscular tissue, the incision in the skin will have to be somewhat longer. The periosteum is divided in the same line as the incision in the soft parts, and is of the same length. Another short incision at right angles to the first at about its middle is often an advantage. The periosteum is then separated from the bone well down on either side. The exact size of the wedge to be removed should be accurately ascertained before beginning the operation.

A ready way is to take a narrow piece of lead and mold it to the curvature of the bone. This can be traced upon a piece of paper or card-board, and a line drawn parallel to it at a distance equal to the thickness of the bone. By cutting this out you have a pattern of the outline of the bone. Now cut this in two at the point of greatest curvature, and, by placing one piece over the other until the line of the upper border is straight, the amount that one overlaps the other will represent the size of the wedge to be removed.



FIG. 5.



FIG. 6.

Figs. 5 and 6 are reduced from the pattern of a case of anterior curvature of the tibia. Fig. 5 shows the amount of deformity, and the dotted lines in Fig. 6 the size of the wedge of bone to be removed, in order to correct the deformity.

In the beginning a much smaller wedge should be removed than is required, by cutting with the flat side of the chisel toward the part of the bone to be left. This can be increased by chips or shavings removed alternately from either side, and gradually increasing in depth. By keeping the chisel inside of the periosteum, there will be no danger of injuring

the soft parts on either side of the bone. The apex of the wedge should extend well into the compact tissue on the opposite side of the bone. When this point has been reached and the whole width of the bone included in the wedge, the section can be completed by driving an *osteotome* directly backward from the apex of the cuneiform section. If the V-shaped piece has been accurately calculated, the two opposite surfaces will come into apposition, and the deformity just corrected. During the operation, care should be taken to remove all the shavings of bone. A sponge wet with carbolized water is placed over the wound and the Esmarch bandage removed. The hæmorrhage from a cuneiform is much greater than that from a linear osteotomy. After the circulation has become re-established in the limb the sponge is removed, and any vessel that may cause trouble secured with carbolized gut. The edges of the periosteum are to be approximated with antiseptic ligatures. If the bone is subcutaneous, and if it is possible, a counter-opening should be made opposite the apex of the wedge, and carbolized horse-hair passed from this through the operation wound. The lips of the wound should then be brought into perfect coaptation with carbolized gut, the horse-hair being brought out at one corner. Over the line of incision iodoform is dusted, and then a small compress applied sufficient to cover the wound, and over this again a flannel bandage and plaster-of-Paris splint, if in a position where such a dressing is applicable. On the second day a fenestra is to be cut, the compress removed, and the horse-hair is taken out piece by piece. This is easily done without giving the

patient any pain. A fresh compress is applied, and over this a bandage to keep it in place.

The reason why a counter-opening is advocated is because in a certain class of cases, where the bone is superficial, on account of the increased amount of hæmorrhage there is liable to be too much tension of the skin, thus preventing primary union. Before I adopted this plan I invariably had suppuration, but since its adoption have secured primary union in every case.

In correcting after a cuneiform osteotomy great care should be taken that no portion of tissue gets between the ends of the bone. Should such an accident happen, suppuration will be sure to follow. I think that many cases of suppuration after this operation are due to this accident.

An argument has been frequently used against osteotomies, that in performing them compound fractures are produced, and as compound fractures are exceedingly dangerous, therefore osteotomies are exceedingly dangerous operations. In only one respect can an osteotomy be classed with a compound fracture, and that is that in both there is a communication between the ends of the bone and the air; but the bone is reached in the former by a clean-cut wound without any disturbance of the soft parts; in the latter the wound is a contused and lacerated one, caused either by the ends of the fractured bone, or by the violence causing the injury. The danger from a compound fracture is not the simple fact that there is a communication with the bone, but that the soft parts are torn and lacerated, and herein arises the danger. Osteotomy should be classed as simple fracture.